

# Environmental Monitoring Report

---

Semi-annual Report  
July – December 2013

## VIE: Phuoc Hoa Water Resources Project

Prepared by Hydraulic Project Investment and Construction Management Board No. 9 and Institute of Coastal and Offshore Engineering for the Socialist Republic of Viet Nam and the Asian Development Bank.

**MINISTRY OF AGRICULTURE AND RURAL DEVELOPMENT  
VIETNAM ACADEMY FOR WATER RESOURCES  
INSTITUTE OF COASTAL AND OFFSHORE ENGINEERING**

658 Vo Van Kiet, Ward 1, District 5, Ho Chi Minh city  
Tel: 08-3923 1088 Fax: 08-3924 5269

-----+++++-----



**SIX-MONTHLY REPORT FOR  
ENVIRONMENTAL MONITORING**

*(July - December 2013)*

**PHUOC HOA WATER RESOURCES PROJECT  
ADB LOAN NUMBER: 2025 – VIE (SF)**

**PACKAGE OP4:**

**REGULATION, SUPERVISION AND SYNTHESIS FOR PACKAGES OF  
ENVIRONMENTAL MANAGEMENT**

**Ho Chi Minh City, March 2014**

**MINISTRY OF AGRICULTURE AND RURAL DEVELOPMENT  
VIETNAM ACADEMY FOR WATER RESOURCES  
INSTITUTE OF COASTAL AND OFFSHORE ENGINEERING**

658 Vo Van Kiet, Ward 1, District 5, Ho Chi Minh city

Tel: 08-3923 1088

Fax: 08-3924 5269

-----+++++-----



**SIX-MONTHLY REPORT FOR  
ENVIRONMENTAL MONITORING**

*(July - December 2013)*

**PHUOC HOA WATER RESOURCES PROJECT**

**ADB LOAN NUMBER: 2025 – VIE (SF)**

**PACKAGE OP4:**

**REGULATION, SUPERVISION AND SYNTHESIS FOR PACKAGES OF  
ENVIRONMENTAL MANAGEMENT**

**Institute of Coastal and Offshore Engineering**  
Director

**Hydraulic Project Investment and  
Construction Management Board  
No. 9**

**Ho Chi Minh City, March 2014**

## **CURRENCY EQUIVALENTS**

(as of 20 July 2012)

Currency Unit - Vietnam dong (VND)  
\$1.00 = VND 20,870

## **ABBREVIATIONS AND ACRONYMS**

ADB	Asian Development Bank
AFD	Agence Française de Développement
DARD	Department of Agriculture and Rural Development
DTPW	Department of Transport and Public Works
DOC	Department of Construction
DOF	Department of Finance-Pricing
DONRE	Department of Natural Resources and Environment
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
GIS	Geographical Information System
HCMC	Ho Chi Minh City
ICOE	Institute of Coastal and Offshore Engineering
ICMB9	Investment and Construction Management Board No.9
IDA	International Development Association (of the World Bank)
JBIC	Japan Bank for International Cooperation
MARD	Ministry of Agriculture and Rural Development
MONRE	Ministry of Natural Resources and Environment
PAF	Project Affected Families
PHWRP	Phuoc Hoa Water Resources Project “the Project”
RAP	Resettlement Action Plan
RFP	Request for Proposals
RPF	Resettlement Policy Framework
TOR	Terms of Reference
WB	World Bank



## NOTES

- The fiscal year (FY) of the Government of Vietnam and Ministry of Agriculture and Rural Development ends on 31 December. FY before a calendar year denotes the year in which the fiscal year ends, e.g., FY2011 ends on 31 December 2011.
- In this report, "\$" refers to US dollars.

This environmental monitoring report is a document of the borrower. The views expressed herein do not necessarily represent those of ADB's Board of Directors, Management, or staff, and may be preliminary in nature.

In preparing any country program or strategy, financing any project, or by making any designation of or reference to a particular territory or geographic area in this document, the Asian Development Bank does not intend to make any judgments as to the legal or other status of any territory or area.

## TABLE OF CONTENTS

<b>1.</b>	<b>Introduction.....</b>	<b>2</b>
1.1.	Phuoc Hoa Project Introduction .....	2
1.2.	Package OP4 Introduction .....	3
1.2.1.	<i>The Scope of Works of OP4 Package comprises:.....</i>	3
1.2.2.	<i>Specific Tasks of OP4 Package .....</i>	4
<b>2.</b>	<b>Activities of OP4, BVI and ICMB9 in the last six months 2013</b>	<b>5</b>
2.1.	Activities of OP4.....	5
2.2.	Activities of ICMB9.....	5
2.3.	Activities of BVI.....	6
<b>3.</b>	<b>Implementation of EMP packages in the last six months of 2013 .....</b>	<b>7</b>
3.1.	Package MT1.....	7
3.2.	Package MT2.....	8
3.3.	Package MT3.....	9
3.4.	Package MT4.....	10
3.5.	Package MT5:.....	11
3.6.	Package MT6:.....	12
3.7.	Package MT7.....	13
3.8.	Package MT8:.....	14
3.9.	Package MT9.....	14
3.10.	Package MT10.....	14
<b>4.</b>	<b>Management and operation at Phuoc Hoa headwork and Environment Protection works.....</b>	<b>15</b>
4.1.	Management and operation at Phuoc Hoa headwork .....	15
4.2.	Environmental Protection works .....	15
<b>5.</b>	<b>Environmental management program at construction sites .</b>	<b>17</b>
5.1.	Main construction activities at the sites .....	17
5.2.	Impacts to be caused by construction activities.....	18
5.3.	Environmental monitoring results at the sites .....	18
5.3.1.	<i>Air quality .....</i>	19
5.3.2.	<i>Domestic water .....</i>	20

5.3.3.	<i>Drinking water</i> .....	21
5.3.4.	<i>Surface water</i> .....	22
5.3.5.	<i>Waste water</i> .....	22
5.3.6.	<i>General conclusion of environmental status in sites</i> .....	23
<b>6.</b>	<b>Water Environment</b> .....	<b>24</b>
6.1.	Changes of the water flow and erosion status at riverbanks .....	24
6.1.1.	<i>Changes of the water flow</i> .....	24
6.1.2.	<i>The status of riverbanks erosion</i> .....	27
6.1.3.	<i>Variables of the vegetation along the Be riverbanks.</i> .....	27
6.2.	Changes of the water quality .....	27
6.2.1.	<i>Surface water quality</i> .....	28
6.2.2.	<i>Groundwater quality:</i> .....	39
6.2.3.	<i>Water quality of Duc Hoa irrigation area:</i> .....	41
6.2.4.	<i>Prediction of the water environment quality trend:</i> .....	42
<b>7.</b>	<b>Biodiversity</b> .....	<b>44</b>
7.1.	Aquatic biodiversity .....	44
7.1.1.	<i>Fishes and shrimps</i> .....	44
7.1.2.	<i>Phytoplankton</i> .....	45
7.1.3.	<i>Zooplankton</i> .....	47
7.1.4.	<i>Zoobenthos</i> .....	48
7.1.5.	<i>Fishery productivity in Be River</i> .....	49
7.2.	Terrestrial biodiversity of Lo Go – Xa Mat National Park (NP) .....	51
<b>8.</b>	<b>Soil condition</b> .....	<b>53</b>
8.1.	Soil .....	53
8.2.	Soil solution.....	54
<b>9.</b>	<b>Monitoring results of Administration House</b> .....	<b>55</b>
<b>10.</b>	<b>Environment Awareness</b> .....	<b>56</b>
<b>11.</b>	<b>Conclusions and Recommendations</b> .....	<b>58</b>
11.1.	Conclusions .....	58
11.1.1.	<i>The natural and social environments</i> .....	58
11.1.2.	<i>EMP packages</i> .....	58
11.1.3.	<i>Advantages, disadvantages and outstanding issues:</i> .....	59

11.2. Recommendations .....	60
11.2.1. <i>General recommendations for EMP packages</i> .....	60
11.2.2. <i>Recommendation for each EMP packages</i> .....	61

## LIST OF FIGURES AND TABLES

Figure 1: Average discharge at stations in the rainy season of years from 2010 to 2013 .....	25
Figure 2: Water discharge at Q4 station – in the upstream of Phuoc Hoa Dam .....	25
Figure 3: Water level at Q4 station – in the upstream of Phuoc Hoa Dam .....	26
Figure 4: TSS value of Be River, 2010-2013 .....	30
Figure 5: BOD <sub>5</sub> value of Be River, 2010-2013 .....	30
Figure 6: Total Nitrogen of Be River, 2010-2013 .....	30
Figure 7: pH value of Dong Nai river, 2010-2013 .....	33
Figure 8: Salinity of Dong Nai river, 2010-2013 .....	33
Figure 9: TSS value of Dong Nai river, 2010-2013 .....	33
Figure 10: Salinity value of Saigon River, 2010-2013 .....	35
Figure 11: TSS value of Saigon River, 2010-2013 .....	36
Figure 12: The pH value of Saigon River, 2010-2013 .....	37
Figure 13: Salinity value of Saigon River, 2010-2013 .....	38
Figure 14: The COD value of Saigon River, 2010-2013 .....	38
Figure 15: The TSS value on the transfer canal and the lake in 2013 .....	39
Figure 16: Variable of groundwater level in the dry season 2013 in project area (G10 and G15 locations were out of monitoring) .....	40
Figure 17: Percentage of fish species composition at all stations .....	44
Figure 18: Graph on variables of number of species fish in four years .....	44
Figure 19: Graph on variables of number of species fish at monitoring stations in October 2013 .....	44
Figure 20: Graph on species composition of phytoplankton at survey stations .....	45
Figure 21: Graph on densities of phytoplankton at survey stations .....	46
Figure 22: Variation of phytoplankton species composition in 2011-2013 .....	46
Figure 23: Variation of phytoplankton density in 2011-2013 .....	46
Figure 24: Structure of zooplankton species composition .....	47
Figure 25: Fluctuation of zooplankton densities at stations .....	47
Figure 26: Variation of number of species zooplankton in 2011-2013 .....	48

Figure 27: Variation of densities of zooplankton in 2011-2013 .....	48
Figure 28: Percentage of zoobenthos composition at all stations (by phyla) .....	49
Figure 29: Graph on Fluctuation of zoobenthos species composition at all stations .....	49
Figure 30: Variation of number of species zoobenthos in 2011-2013 .....	49
Figure 31: Variation of densities of zoobenthos in 2011-2013 .....	49
Table 1: Monitoring stages of water flow of package MT5 .....	12
Table 2: Total volume construction of PH4 package .....	17
Table 3: Total volume construction of PH4 package until 31/12/2013 .....	17
Table 4: Environmental monitoring locations in PH4 construction sites .....	18
Table 5: Monitoring results of dust concentration in PH4 construction sites – Quarter IV/2013 .....	19
Table 6: Monitoring results of noise in PH4 construction sites – Quarter IV/2013 .....	20
Table 7: Monitoring results of domestic water in PH4 construction sites – Quarter IV/2013 .....	21
Table 8: Monitoring results of drinking water in PH4 construction sites – Quarter IV/2013 .....	21
Table 9: Monitoring results of surface water in PH4 construction sites – Quarter IV/2013 .....	22
Table 10: Monitoring results of surface water in PH4 construction sites – Quarter IV/2013 .....	23
Table 11: Fisheries development situation in Binh Duong Province .....	49
Table 12: Fisheries development situation in Binh Phuoc province .....	50

## **FOREWORD**

Phuoc Hoa Water Resources Project (Project) consists of two parts: Part A – Support for Institutional and Integrated Development, and Part B – Construction of Water Resources Infrastructure. Currently, the project has implemented a series of components including construction of the Headwork's of Phuoc Hoa reservoir, Phuoc Hoa – Dau Tieng transfer canal, and Tan Bien irrigation Main Canal. These construction activities and their effect on the natural and hydrological conditions in the area have caused different negative and positive impacts to the environment. The aim of the Environmental Packages (Packages) is to collect environmental indicators regularly and other related issues, record and detect different impacts of the Project to the environment in order to adjust, overcome and mitigate any negative environmental impacts.

For the purpose of coordination, monitoring, and implementation of the EMP packages, this six-monthly progress report will summarize all activities and the implementation status of these Packages. The report will also orientate and guide in implementing the tasks of EMP packages as well as monitor and speed up the implementation progress of the tasks as in proposed schedules. In addition, the report also monitors the current situation in the project area and its vicinity, and develops the database for the environmental management programs of the Project. Meanwhile the report aims to ensure that project implementation can be made in compliance with the EMP and the Environmental Protection Law of Vietnam.

The six-monthly progress report is a basis for ICMB9 to upgrade their tasks of management and coordination and it also helps ADB and others to monitor the implementation status of the project as well as the concerned environmental changes.

## 1. Introduction

### 1.1. Phuoc Hoa Project Introduction

- (i) Phuoc Hoa Water Resources Project is funded jointly by the Asian Development Bank (ADB) and Agence Française de Développement (AFD) with a total amount in loans and Special Drawing Rights (SDR) equivalent to 217.27 million USD. The loans were agreed in 2 phases, for the 1st phase in 2003 and for the 2nd phase in 2011/2012. The closure dates are in 2014 and 2017 for ADB and AFD loans respectively.

All loans are summarized in the table below.

Loans	Amount (US\$ million)		Date		
			Approval	Signed	Effective
ADB loan	SDR 63.042 million equivalent to US\$ 90 million		27 November 2003	08 April 2004	23 August 2004
Two AFD loans	EUR 29.6 million equivalent to US\$ 2.270 million		20 November 2003	20 August 2004	20 August 2004
ADB loan supplemental	SDR 38.594 million equivalent to US\$ 60 million		27 May 2011	27 May 2011	30 September 2011
AFD loan supplemental	EUR 20 million equivalent to US\$ 25 million		25 May 2012	7 September 2012	7 September 2012
Total	217.27				

- (ii) The project objective is to provide additional water to Sai Gon River and Vai Co East River for agriculture development (with irrigation) and enhance current water sources supply in order to control salinity, domestic, municipal industrial water supply (DMI) to Ho Chi Minh City and neighbouring provinces. This project will use the approach of integrated development to increase agricultural production by enhancing effective and sustainable water resources management.
- (iii) The Project consists of two parts: Part A – Support for Institutional and Integrated Development, and Part B – Construction of Water Resources Infrastructure.
- (iv) The Project will support construction of the Phuoc Hoa barrage and transfer canal to convey water from the Be River to the existing Dau Tieng reservoir on the Saigon River. Under Phase 2, two new irrigation areas will be constructed: Tan Bien irrigation system in Tay Ninh Province; and Duc Hoa irrigation system in Long An Province. The ADB loans are financing the main infrastructure: Phuoc Hoa barrage, Phuoc Hoa – Dau Tieng transfer canal



and the 2 main irrigation canals as well as project management costs. The AFD loans are financing infrastructure development of tertiary canals for the irrigation systems and support for the on-farm and social development program (OSDP).

- (v) The executing agency (EA) is the Ministry of Agriculture and Rural Development (MARD), which originally provided overall management and coordination through its Central Project Office (CPO) based in Hanoi. In order to improve project management and coordination, from November 2006, MARD assigned the overall responsibility for project implementation to Investment and Construction Management Board No.9 (ICMB9) in Ho Chi Minh City (HCMC), and Departments of Agriculture and Rural Development (DARDs) of four provinces (Binh Duong, Binh Phuoc, Tay Ninh and Long An). ICMB9 provides an interface with the ADB and AFD, and is directly responsible for management and construction of the Phuoc Hoa Barrage, Phuoc Hoa – Dau Tieng transfer canal, and main canals for the two irrigation systems, and for transfer of infrastructure to Dau Tieng Irrigation management company (IMC) for management and operation. The role of ICMB9 is to provide overall management assistance and coordination, and to provide instruction to the DARDs and PPMBs with assistance of Black & Veatch International (BVI) Consultants.
- (vi) Project environmental management and Environmental Impact Assessment (EIA) study was prepared by Black & Veatch International (BVI) in September 2001 (BVI 2001a and approved by the Asian Development Bank (ADB) in March 2003 (ADB 2003a). In accordance with Vietnamese environmental law, a third EIA report (ENTEC 2007) was carried out in April 2005 by the Environmental Technology Centre (ENTEC), under contract (A41) to ICMB9 from 2005 - 2007. This EIA was revised and submitted to the Ministry of Natural Resources and Environment (MONRE) for approval in September 2007. MONRE approved the project EIA in early 2008.

As required by ADB, a follow-up Environmental Management Plan (EMP) for the Project was prepared by BVI in late 2006 – 2007 period (BVI 2007c). The EMP was approved by MARD and ADB in January 2008. The EMP documents provide details of the environmental management, monitoring and protection programmes.

## **1.2. Package OP4 Introduction**

### **1.2.1. *The Scope of Works of OP4 Package comprises:***

- Overall management, co-ordination, supervision and monitoring of the Phuoc Hoa Water Resource Project environmental and EMP implementation programmes;

- Supervision and monitoring of environmental programmes and EMP implementation consultants and contracts;
- Collection, storage and distribution of EMP monitoring data, technical reports and civil contracts or EMP techniques for project extension, providing the information of progress and budgets from EMP consultants and other Provincial sources, and presenting these data in accordance with an appropriate format;
- Carry out field surveys and keep contact with provincial governments and communities to inspect the environmental conditions in the project area and its vicinity as well as downstream areas in order to ensure that construction contracts, EMP and project activities are implemented in accordance with environmental laws, safeguards and signed agreements;
- Provide main information of the report and comments to ICMB9 regarding problems and solutions relating to the EMP implementation, EMP consultants' performance, environmental trends in the project area or within river basin of the project and environmental impacts from the project;
- Acting as a spokesman for the environmental aspect of the project and representing ICMB9 in general scope and official forums relating to ministerial, provincial levels and communities as well as media liaison;
- Provide six-monthly reports to ICMB9, MARD, ADB, AFD, MONRE, and local governments, PPCs in the project areas as well as organisations and individuals that are in charge of the above mentioned tasks. Environmental staffs, the environmental division of ICMB9, consultants and contractors must comply with environmental requirements of the Project.

#### *1.2.2. Specific Tasks of OP4 Package*

- Understanding the existing and proposed Phuoc Hoa water resources project environmental management programme;
- Management, supervision and monitoring the work of EMP implementation contractors and contracts;
- Supervision and monitoring of EMP implementation programmes and environmental compliance;
- Supervision and monitoring of environmental outputs, environmental trends and project environmental impacts;
- Ministerial, provincial and public liaison;
- Reporting and data distributing.

## 2. Activities of OP4, BVI and ICMB9 in the last six months 2013

### 2.1. Activities of OP4

Based on the TOR, and in order to implement the tasks of coordination and supervision of EMP packages, the OP4 consultant has carried out activities including meetings with EMP consultants, employer, donors, local authorities and others relating to relevant issues of the project as follows:

The list of meetings held by OP4

No.	Time	Participants	Contents
1	12/08/2013	Representatives of ICMB9, OP4, MT8 package, and Binh Duong, Binh Phuoc, and Long An Provinces.	The implementation of OP3 package.
2	21/10/2013	Representatives of ICMB9, OP4, BVI, and EMP packages	Checking up on the outstanding issues of each packages that were mentioned on the Aide Memories of ADB, and setting up the implementation plan for solving there issues mentioned.
3	26/10/2013	Representatives of OP4, and MT5 package	surveying, and assessing the execution of field monitoring.
4	14/11/2013	Representatives of ICMB9, OP4, BVI, and OP3 package	Inspection of the operation and management of the stations (Binh Duong, Dong Nai).
5	08/01/2014	Representatives of ICMB9, OP4, BVI, and EMP packages	A briefings meeting

In accordance with each package's TOR, the review and assessment results of implementation activities of EMP packages through progress reports have also been carried out frequently.

### 2.2. Activities of ICMB9

In the last six months of 2013, ICMB9 cooperated with BVI and OP4 consultants to carry out some main contents as follows:

- Overall management on the progress and implementation of EMP packages;
- Organization meetings with the relevant authorities in order to monitor supervise and speed up the progress as well as to solve outstanding issues of EMP packages.
- Worked with local authorities regarding the implementation of packages MT1, MT2, MT3, MT4, MT7, OP3;
- Inspected, speeded up the EMP packages to implement the aide memoir of

ADB on 26<sup>th</sup> October 2013.

- Cooperated with BVI to prepare the request proposal for MT9 package; extending the implementation time of MT7 and OP4 consulting contract.
- Inspected, evaluated and requested construction contractors to implement the Environmental Management Plan of the project seriously.

### **2.3. Activities of BVI**

The main activities of BVI consultant in the last six months of 2013 included:

- Supported ICMB9 in carrying out the management and implementation of EMP packages;
- Cooperated with OP4 Consultant to comment and assess the implementation results of EMP packages through their progress reports of consultants.
- Attended and organized meetings between the EMP consultants and local authorities.
- Cooperated with ICMB9 and relevant consultant units such as MT1, MT2, MT4, MT7, OP4, and others to implement works as indicated in the Aide-Memoir of ADB dated 26<sup>th</sup> October 2013.
- Supported ICMB9 in preparing the request documents for some EMP packages such as MT9, MT7, and OP4 (Extension).

### **3. Implementation of EMP packages in the last six months of 2013**

By this time, there is 11/14 packages were signed contract, these packages are implementing as follows:

#### **3.1. Package MT1**

Name of the package is '**Tan Bien National Park and Forest Protection program in Tay Ninh Province**'. The contract agreement of package was signed in September 2012, the implementing period of the package is 22 months since the date of signing of the contract. The consulting agency is '*Joint Venture Southern Sub - Institute of Forest Inventory and Planning and Institute for Water and Environment Research*'. The implementing results are presented as follows:

- **An assessment of the status of forests, monitoring of the residence and biodiversity of the National Park and Production Forest:**
  - o *An assessment of the status of forests;*
  - o *Monitoring the forest fauna and flora;*
  - o *Monitoring the impact of humans;*
- **Monitoring the level and quality of groundwater:**
  - o *Monitoring the groundwater level (6 wells);*
  - o *Monitoring the groundwater quality;*
  - o *Monitoring the surface water quality and the aquatic biodiversity;*
- **Defining the National Park and Production Forest boundaries:**
  - o *The consultant has finished the demarcation plan report of National Park, and has been accepted by ICMB9;*
  - o *The consultant has finished the demarcation plan report of Production Forest;*
- **Guidance on resettlement issues:**
  - o *The details of the status of resettlement issues, and proposal resettlement plan have been presented in the Interim Report of the package.*
- **Capacity building and raising awareness program:**
  - o *Organized the field trip to the Cat Tien National Park from 27/09/2013 to 29/09/2013;*
- **Buffer zone economic development Program:** *including 2 parts (i) 50,000 fruit trees plantation programme (ii) Drafting the economic development and the improvement of the life quality of communities in project area packages through the development of breeding and agriculture.*

- *The plan of 50,000 fruit trees plantation program has been accepted by ICMB9 on 25/09/2013, and this program has finished in December 2013.*
- *Drafting the economic development and the improvement of the life quality of communities in project area packages have been done.*

The Consultant is simultaneously implementing tasks following the proposed working plan. The implementation results are presented through the progress reports and suitable implementation approaches.

### **3.2. Package MT2**

Name of the package is '**Be River catchment protection study and Phuoc Hoa Reforestation and Forest Management**'. The contract agreement of package was signed in April 2010, the implementing period of the package is 40 months since the date of signing of the contract. The consulting agency is '*Infra – Thang Long Joint Stock Company*'.

Up to now, Task I '*Study on Be River catchment protection*' is considered finishing. Task II '*Supporting local government on implementing the forestation planning for the reservoir areas belong to Phuoc Hoa Project that were compensated*'. The implementing results are presented as follows:

- **IIA: Supporting District People's Committee to carry out land-use planning on the total compensated area surrounding Phuoc Hoa Reservoir from elevation +42.9 m to +44 m and submit to relevant authorities for appraisal:**
  - *Study on relevant regulations/guideline on land use plan, which has been done;*
  - *Study on local socio-economic development plan, which has been done;*
  - *Synthesis and update the land use status of the total compensated area from elevation +42.9 to +44 m, which has been done;*
  - *Community consultation on land use plan, which has been done approximate 50%;*
  - *Guidance local government on land use planning, which has been done approximate 60%;*
- **IIB: Protection Forest development planning on the total compensated area surrounding Phuoc Hoa Reservoir from elevation +42.9 m to +44 m:**
  - *Preparatory works for building protection forest development plan from elevation, which has been done approximate 40%;*
  - *Developing the detailed design of a five year reservoir edge reforestation and protection plan, which has been done approximate*

60%;

- **IIC: Developing detailed action plan for reforestation on semi-submerged area from elevation +42.9 to 44 m:**
  - To locate boundary and area, plan for cutting off the rubber trees as well as other trees, *which has been done approximate 50%*;
  - To develop suitable and applicable plan for allotment and exploitation of rubber trees, *which has been done approximate 50%*;

### **3.3. Package MT3**

Name of the package is '**Consultancy Services for Water Supply Stations for Lower Be River and Duc Hoa**'. The contract agreement of package was signed on 21 September 2011, the implementing period of the package is 26 months since the date of signing of the contract. The consulting agency is '*Thang Long Infrastructure Development Joint Stock Company*'.

Task 1 '**Understanding of the domestic water supply program for Be river basin and Duc Hoa area**' this task has been finished.

Task 2 '**Investigation, choice of location and technology, and preparation of cost estimate for water supply station in Be river basin**'

*The Domestic water supply system in Cay Truong Commune, Ben Cat District, Binh Duong Province, the following reports have been finished:*

- Feasibility Study;
- Design documents and drawings;
- Design cost estimate;
- Bidding documents;
- Choosing location for construction: the acquired land procedure has not been done yet. At present, ICMB9 works closely with local government to obtain a land use right certificate for construction of this stations.

Task 3 '**Investigation, choice of location and technology, and preparation of cost estimate for water supply station for Duc Hoa area**'

*The Domestic water supply system in Tan My Commune, Duc Hoa District, Long An Province, the following reports have not been finished yet:*

- Feasibility Study;
- Design documents and drawings;
- Design cost estimate;
- Bidding documents.

- Choosing location for construction: the same as the station in Binh Duong Province, through many times changings the location, the acquired land procedure has not been done yet. At present, ICMB9 works closely with local government to obtain a land use right certificate for construction of this stations.

### 3.4. Package MT4

Name of the package is '**Be River and Phuoc Hoa Fishery Management Programme**'. The contract agreement of package was signed in February 2010, the implementing period of the package is 50 months since the date of signing of the contract. The consulting agency is '*Research Institute for Agriculture 2 (RIA2)*'.

At present, the MT4 consultant completed the Inception report, and the annual reports of 2010, 2011, 2012, the first interim report, and the implementation result report in the first six months of 2013.

In the last six months of 2013, the consultant continued to implement the tasks as required. According to the TOR, package MT4 consists of 09 specific tasks. We, OP4 consultant, assessed the implementation status as follows:

Task I "***Understanding the proposed Be River and Phuoc Hoa fishery, Reservoir and Fish pass management program***": this task has been implemented early, the basic information was collected and analysed. Recently, the consultant has continued to update the statistic data of the fishery sector of Binh Duong and Binh Phuoc provinces in 2011 and 2012.

Task II "***Monitoring hydrology and environmental flows management***": This task has been done regularly and continuously. The main data was collected from the data of packages MT5 and MT6.

Task III "***Monitoring the fish pass construction***": During the reporting phase, the MT4 consultant supervised and monitored the construction of the fish pass. By this time, the construction of the fish pass was finished. In the last six months of 2013, the consultant conducted two field surveys respectively, the results shown that the discharges and the water level of the fish pass have not satisfied in some periods, which affected the migration of fishes. Some parts of the fish pass were collapsed seriously.

Task IV "***Establishment of Be River and Phuoc Hoa forest and fisheries association***": This is one of the key tasks of the package. On 9 December 2012, the consultant held a meeting with representatives of ICMB9, BVI, MT4, and Binh Phuoc Aquiculture Centre to discuss the establishment of Phuoc Hoa Fishery Resources Exploitation and Protection Association. On 15<sup>th</sup> May 2013, a meeting between Binh Phuoc Aquiculture Centre and MT4 Consultant was held. On 28<sup>th</sup> June 2013 a



meeting among representatives of ICMB9, MT4 and Binh Phuoc, Binh Duong DARD was conducted at Binh Phuoc Province People's Committees office. According to the report, these departments have worked with each commune and prepared personnel scheme, operational regulation, and these associations. At present, three fisheries associations were established, 01 in Binh Duong Province, and 02 in Binh Phuoc Province.

Task V "**Operation and Protection of Fish Pass**": Recently, the Consultant conducted 01 field trip to survey, and monitors the components of migratory fish species through the fish pass.

Task VI "**Phuoc Hoa Reservoir fishery management plan**": in the last six months of 2013, the Consultant conducted several field surveys together with fish pass surveys.

Task VII "**Social support and compensation for affected fishermen**": According to the MT4's report, land acquisition and compensation were implemented quite well.

Task VIII "**Management of Be River and lower Dong Nai fishery**": The main contents of this task are to prepare fishery management plans and action plans for Be - Dong Nai Rivers basin. Recently, main activities are defined as the collection of relevant documents/data and investigation.

Task IX "**Monitoring and evaluation of Be River fishery management program**": Consultant aimed to understand the fisheries management models of other provinces with a similar program so that the consultant will be able to apply these similar programs for the Be River basin in future.

MT4 package is going to end in 2014, however, according to the result of some field surveys of OP4 consultant, the fishing activities are still being occurred at the restricted areas of Phuoc Hoa dam that could cause unsustainable fishing and unsafely for the fishers. We request MT4, with the support from ICMB9, work closely with Dam owner and local authorities to prevent these activities above.

According to the TOR of the package, some remaining contents should be presented in the final report:

- A strategy and plan for overall Be River and lower Dong Nai fisheries management;
- The result report of surveying the breeding and fattening areas in Phuoc Hoa reservoir area;

### **3.5. Package MT5:**

Name of the package is '**Monitoring of water flow of Be, Sai Gon, Dong**

**Nai, and Vam Co Dong Rivers**'. The contract agreement of package was signed in September 2009, the implementing period of the package is 50 months since the date of signing of the contract. The consulting agency is '*Southern Institute of Water Resource Research*'.

Up to the end of December 2013, the consultant has monitored the water flow at nine stages. The details of these measurements are presented in Table 1. The monitoring activities have been made seriously and sufficiently. These monitoring activities were consistent with current governmental norms and regulations and complied with the requirements of the TOR.

**Table 1: Monitoring stages of water flow of package MT5**

No.	Date		No. monitoring stations	Monitoring stations	Notes
	From	To			
1	17/10/2009	22/10/2009	6	From Q1 to Q6	
2	20/04/2010	25/04/2010	6	From Q1 to Q6	
3	7/10/2010	12/10/2010	6	From Q1 to Q6	
4	20/04/2011	25/04/2011	6	From Q1 to Q6	
5	13/10/2011	18/10/2011	6	From Q1 to Q6	Monitoring station Q5 was moved to upstream with a distance of 1.0 km as proposed by BVI.
6	23/04/2012	28/04/2012	8	From Q1 to Q8	Provided 2 additional monitoring stations at the fish pass and downstream of the dam.
7	02/10/2012	07/10/2012	8	From Q1 to Q7	Q8 had not been monitored due to the water level in fish pass was too low.
8	22/04/2013	27/04/2013	10	From Q1 to Q10	Q9 is placed at the beginning (K0) and the end (K36+316) of PH-DT canal. Q11 and Q12 have not been monitored yet, because construction has been not completed.
9	26/10/2013	31/10/2013	8	From Q1 to Q8	Stations from Q9 to Q12 have not been monitored yet, because construction has been not completed.

### 3.6. Package MT6:

Name of the package is '**Consultancy services for environmental monitoring**'. The contract agreement of package was signed in November 2009, the implementing period of the package is 52 months since the date of signing of the contract. The consulting agency is '*Southern Institute of Water Resource planning*'.

At present, the consultant completed their Inception Reports and monitoring result reports in 2010, 2011 and 2012, and the monitoring result report in April from 2010 to 2013. The measurement and sampling activities at sites have been made as scheduled.

The implementation of water quality monitoring was conducted at 23 stations, sampling of aquatic biology were implemented at 11 stations. Groundwater was sampled at 15 stations. The details of each monitoring stages are showed as follows:

- Surface water was sampled at 23 stations in June and October.
- Surface water in Duc Hoa Irrigation Area was sampled at 12 stations in June and October.
- Groundwater was sampled at 15 stations in October.
- Aquatic biology was sampled at 11 stations in November.
- Acid sulfate soils was sampled at 6 stations, and 4 stations for Acid sulfate soil solution in Duc Hoa Irrigation Area in October.
- Groundwater in Duc Hoa Irrigation Area was sampled at 6 stations in October.
- Monitoring of operation of Management House.

According to TOR, 2013 is the last year of MT6 package, besides the periodic works, the consultant has to prepare a final report that summarizes whole implementation process of environmental monitoring from 2010 to 2013, and this report expects to finish at the end of February 2014.

### **3.7. Package MT7**

Name of the package is '**Consultancy services for environmental monitoring of construction contracts**'. The contract agreement of package was signed in October 2008, and was finished in October 2012. The implementing period of the package is 52 months since the date of signing of the contract. The consulting agency is '*Joint Venture of Institute for Water and Environment Research and Institute for Environment and Resource*'.

The implementation time of extension phase of the package is 11 months from 11/2013 to 9/2014. The results of the package in the last two months of 2013 as follows:

- Prepared and submitted the Inception report for environmental monitoring of PH4 construction package to ICMB9 and receipted the no objection letter.
- Organized meeting with ICMB9 and construction contractors in order to unify working procedure, information exchange, and carried out field survey to

access the environmental protection tasks of the construction contractors on 5/11/2013.

- Organized field survey with construction contractors to unify the position of environmental monitoring stations and the framework of reports on 22/11/2013.
- Implemented two sampling stages on 29/11/2013 and 27/12/2013.
- Implementing the environmental monitoring in worksite that comply the TOR (1 time per week).

The other tasks are under processing.

### **3.8. Package MT8:**

Name of the package is '**Building, buying, installing consultancy of salinity monitoring devices**'. The contract agreement of package was signed in June 2011. The consulting agency is '*Tan Tien Automatic Technology Corporation*'. At present, the Consultant continues to support the monitoring stations, particularly support the OP3 package in operating and managing the stations.

### **3.9. Package MT9**

Name of the package is '**Post evaluation of Environmental Impacts**'. BVI consultant has drafted the TOR and cost estimate of package MT9, and submitted to the investor. The investor has submitted to the donor (ADB) to review. Revision was made on the implementation schedule and resubmitted to ADB for approval .

### **3.10. Package MT10**

Name of the package is '**Capacity building, technology transfer, and awareness raising**'. The contract agreement of package was signed in November 2009, and was finished in October 2011, the implementing period of the package is 24 months since the date of signing of the contract. The consulting agency is '*Southern Institute of Water Resource Research*'.

Up to now, the tasks of package MT10 were finished. The effects of this package have been recorded and evaluated through the process of EMP packages implementation. These evaluations have been combined and performed more details in Section 9 "Environment Awareness" of this report.

#### **4. Management and operation at Phuoc Hoa headwork and Environment Protection works**

##### **4.1. Management and operation at Phuoc Hoa headwork**

###### **Management works:**

Shortly after taking over and putting to use the structure, the Dau Tieng – Phuoc Hoa IMC has established and assigned Phuoc Hoa Team to manage, operate, and protect the Phuoc Hoa Water Resource system, including the head works and vicinities, reservoir and inside reservoir, Phuoc Hoa – Dau Tieng transfer canal. Detecting and preventing unsafe behaviours for works such as stealing or damaging machineries and equipments; fishing in lake with dynamite; fishing in the fish pass; digging and vandalizing the canal banks; transgressing the work's protection areas. They are coordinating closely with local authorities to handle strictly the violations.

###### **Operation works:**

Phuoc Hoa Reservoir has been operated under “The temporary technical process of operating and maintaining the works” belong to Phuoc Hoa Project in accordance with Decision No.307/QĐ-BQL9 dated 23/05/2012, Letter No. 427/CV/BQL-TL9.3 dated 03/07/2012, and Decision No.1517 issued by Binh Phuoc Province People's Committee on “The temporary coordination regulation for multiple operation of irrigation reservoirs and hydropower on Be River such as Thac Mo, Can Don, Sok Phu Mieng, Phuoc Hoa”. The results show that the current operation is safe.

###### **Maintenance works:**

Pursuant to Decision No.487/QĐ/BNN-KH dated 21/02/2006 issued by MARD on the economic and technical norms in the management and exploitation of the irrigation systems of Dau Tieng – Phuoc Hoa IMC. And the consumption norm of material, fuel in machinery maintenance in order to supply materials (fuel, engine oil) to maintain the machinery of head works, opening and closing machines, backings.

##### **4.2. Environmental Protection works**

###### **Protecting and managing the submerged and reservoir areas:**

At present, the landmarks system for defining the reservoir area's protection boundary has not been set up, hence Phuoc Hoa – Dau Tieng IMC has no management plan, and protection works in these areas have many difficulties. Demarcated protected project of Phuoc Hoa Reservoir is in the proposal approval stage.

###### **Environmental protection works:**

In order to prevent illegal fishing status that affect fisheries resources, Phuoc Hoa – Dau Tieng IMC has coordinated with Phu Giao District's police and People's Committee (An Thai and Minh Thanh commune) to plug "No fishing" sign boards in the upstream and downstream area of Labyrinth spillway, in lake, dam's lower area, and the fish pass. It is however still the case not abides, especially at the bridge passing the Labyrinth spillway that obstructing the traffic.

Phuoc Hoa – Dau Tieng IMC sent the Phuoc Hoa Team to conduct statistical survey of factories, Processing Facilities in the basin, which are likely to cause pollution to Phuoc Hoa Lake in order to have suitable water resource protection solutions.

Phuoc Hoa – Dau Tieng transfer canal does not go through the resident areas much, hence the environmental status is quite good. In the long term, this canal however needs more suitable structure solution combine with the propaganda, and people's awareness rising of environmental protection. At present, Phuoc Hoa – Dau Tieng IMC has coordinated with local authorities to propagandize local people not discharge into the canal.

## 5. Environmental management program at construction sites

### 5.1. Main construction activities at the sites

Up to the end of June 2013, all construction packages (1A, 1B, 1C, 1D, PH3) were completed. At present, only PH4 package is under processing. This package consists of one main contractor and five subcontractors.

**Main contractor:** Joint Venture Taeyoung E&C and WASECO Company.

**Subcontractors:**

- K0+000 - K2+550: CC5 (Construction Company No.5);
- K2+550 - K10+200: BIDEKO (Binh Thuan Infrastructure Development Joint Stock Company);
- K10+200 - K12+770: CCI9 (Construction Company No.9);
- K12+770 - K14+020: Joint Venture TW and LILAMA 45.1 (LILAMA 45.1 is in charge of producing the siphon steel pipes);
- K14+020 - K17+680: BIDEKO.

**Table 2: Total volume construction of PH4 package**

No.	Categories	Unit	Total
1	Excavated soil	m <sup>3</sup>	700.350
2	Filling soil	m <sup>3</sup>	1.142.361
3	Filling sand	m <sup>3</sup>	180.450
4	PVC connection (channel reinforcement only)	m	111.985
5	Geotextile Fabric	m <sup>2</sup>	120.309
6	Concretes	m <sup>3</sup>	43.462
7	Steel and reinforcing steel	kg	4.552.472
	Where, Thay Cai siphon steel:	kg	2.949.915
	- Steel pile D 2,6 m, thickness 18 mm	kg	2.181.725
	- Steel pile D 2,6 m, thickness 22 mm	kg	768.190

Sources: ICMB9

**Table 3: Total volume construction of PH4 package until 31/12/2013**

No.	Categories	Unit	Total	30/12/2013
1	Excavated soil	m <sup>3</sup>	700.350	201.360
2	Filling soil	m <sup>3</sup>	1.142.361	101.200

No.	Categories	Unit	Total	30/12/2013
3	Filling sand	m <sup>3</sup>	180.450	30.000
4	PVC connection (channel reinforcement only)	m	111.985	
5	Geotextile Fabric	m <sup>2</sup>	120.309	49.100
6	Concretes	m <sup>3</sup>	43.462	1900
7	Steel and reinforcing steel	kg	4.552.472	70.000
	Where, Thay Cai siphon steel:	kg	2.949.915	0
	- Steel pile D 2,6 m, thickness 18 mm	kg	2.181.725	
	- Steel pile D 2,6 m, thickness 22 mm	kg	768.190	

Sources: ICMB9

## 5.2. Impacts to be caused by construction activities

The impacts of construction activities at work sites must be monitored, considered frequently during construction time as follows:

- Unexploded Ordinance, Land Mines and Toxic Waste;
- Reinstatement of Temporary Working Areas;
- Work in public highway, inside and outside the sites;
- Site drainage;
- Sanitation and site facilities;
- The protection of the surrounding landscape.

## 5.3. Environmental monitoring results at the sites

Monitoring positions (air, water quality) were defined by MT7 Consultant, which ensured to provide a general valuation about environment such as at the positions construction activities are taking place; gathering a large amount of workers; worker camp; nearest residential areas.

**Table 4: Environmental monitoring locations in PH4 construction sites**

No.	Constructors	Type	Code	Site	Coordinates	
					x	Y
1	Constructor CC5	Water	K0-WW1	Km0	682791	1226614
2			K0-DW1			
3			K0-PW1			
4	Constructor BIDEKO	Air	K2-A1	Km2	681875	1224567
5			K7-A2	Km7	680052	1220325



6			K8-A3	Km8	679819	1219453
7	Constructor TTP and VMC	Air	K11-A4	Km11	680922	1216061
8		Water	K11-WR4			
9	Constructor TW JV	Air	K11-A5	Km13	681145	1214222
10		Water	K11-WW5			
11			K11-WR5			
12	Constructor BIDECO	Air	K15-A6	Km15	681039	1212436

### 5.3.1. Air quality

#### a. Air

November and December are the dry months of year, very convenient for construction activities on the sites. The dry weather is however also convenient conditions for shedding dust in the air.

According to MT7's independence monitoring result, the dust concentration in Km2 position (where intersects with Road 2, Cu Chi District) is high ( $560 \mu\text{g}/\text{m}^3$ ), over nearly 02 times higher than the regulation. December is the last month of year, hence constructors accelerated the construction progress, amount of workers and traffic densities in the sites increased too much combining with dry weather condition that leads to dust concentration dispersal increased from 1.4 to 1.6 times, especially at Km7+550, Km11 and Km13 areas. Dust concentration at the remaining positions meet the regulation.

**Table 5: Monitoring results of dust concentration in PH4 construction sites – Quarter IV/2013**

No	Monitoring positions	Unit	Monitoring results in 2013		QCVN 05:2009/BTNMT
			November	December	
1	K2-A1	$\mu\text{g}/\text{m}^3$	<b>560</b>	190	300
2	K7-A2	$\mu\text{g}/\text{m}^3$	200	<b>430</b>	300
3	K8-A3	$\mu\text{g}/\text{m}^3$	100	200	300
4	K11-A4	$\mu\text{g}/\text{m}^3$	230	<b>420</b>	300
5	K13-A5	$\mu\text{g}/\text{m}^3$	100	<b>480</b>	300
6	K15-A6	$\mu\text{g}/\text{m}^3$	230	140	300

Sources: Monitoring result report of construction contracts in Quarter IV/2013 – MT7 package

#### b. Noise

Although construction quantity increased in comparison with the previous months, the density of traffic and workers also increased, but the noise still satisfies

the regulation. The highest value of noise is 66.5 dBA at Km7 in November, the lowest value is 56.7 dBA at Km13 in December.

**Table 6: Monitoring results of noise in PH4 construction sites – Quarter IV/2013**

No	Monitoring positions	Unit	Monitoring results in 2013		QCVN 05:2009/BTNMT
			November	December	
1	K2-A1	dBA	58.0	65.2	70
2	K7-A2	dBA	<b>66.5</b>	63.2	70
3	K8-A3	dBA	58.8	57.9	70
4	K11-A4	dBA	63.4	66.5	70
5	K13-A5	dBA	58.7	<b>56.7</b>	70
6	K15-A6	dBA	60.1	65.7	70

Sources: Monitoring result report of construction contracts in Quarter IV/2013 – MT7 package

General assessments:

In general, the monitoring period from November to December 2013, the air pollution status occurred in the low level, primarily dust pollution in several construction areas, due to the traffic density of material transport increased. The mitigation solutions for dust pollution by spraying water have no effect in these areas. Therefore, Constructors should raise the operation frequency of water spraying car to overcome the dust pollution.

**5.3.2. Domestic water**

The domestic water in construction packages is pumped from the groundwater in workers camp. The groundwater is pumped again from drilling wells at depths from 15 to 25 m. After pumping up, water is stored in tanks or drums. The domestic water uses for bathing, washing. Several workers camps use the domestic water to wash fresh food before being cooked. Observations with the naked eyes, the pumped water is quite transparent, not colour, not taste.

The analyzed results at the two different areas perform that all water samples are reached the standard for domestic water. However, the only samples in Km0 area (K0-PW1) contaminated microorganism, the cause of contamination is that the pumped water has been contained in drums but not be carefully shielded hence leads to pollution. To handle this situation, MT7 Consultant instructed the constructors to clean the tanks and requested to build the roof in the containing water areas.

**Table 7: Monitoring results of domestic water in PH4 construction sites – Quarter IV/2013**

No.	Indicators	Unit	K0-PW1		K15-PW6		Column I QCVN 02: 2009/BYT
			Nov	Dec	Nov	Dec	
1	pH	-	6.01	6.34	6.02	6.01	6 - 8.5
2	Total hardness	mgCaCO <sub>3</sub> /l	5	4	2	10	350
3	Total suspended Solid (TSS)	mg/L	KPH (<0.5)	1	KPH (<0.5)	1	-
4	Clorua, Cl <sup>-</sup>	mg/L	4	4	2	12	300
5	Nitrate, N-NO <sub>3</sub>	mg/L	KPH (<0.01)	0.04	KPH (<0.01)	0.06	-
6	Sulphate, SO <sub>4</sub> <sup>2-</sup>	mg/L	KPH (<1)	KPH (<1)	KPH (<1)	KPH (<1)	-
7	Mangan, Mn	mg/L	KPH (<0.02)	KPH (<0.02)	KPH (<0.02)	KPH (<0.02)	-
8	Total Fe	mg/L	KPH (<0.06)	0.06	KPH (<0.06)	0.06	0.5
9	E. Coli	CFU/100ml	<b>1.8 x 10<sup>1</sup></b>	<b>4.3 x 10<sup>1</sup></b>	KPH (<1)	5	0
10	Total Coliform	MPN/100ml	<b>1.2 x 10<sup>2</sup></b>	<b>6.7 x 10<sup>1</sup></b>	1	7	50
Note: KHP: not found; NA: not analyzed							

**5.3.3. Drinking water**

At the monitoring time, the drinking water in sites is purified bottled water (type 20 litres), several worksites use boiled water. In general, observed with the naked eye, the water is quite transparent, not colour, not taste.

**Table 8: Monitoring results of drinking water in PH4 construction sites – Quarter IV/2013**

No.	Indicators	Unit	K0-DR1		K15-DR6		QCVN 01:2009/BYT
			Nov	Dec	Nov	Dec	
1	pH	-	<b>5.83</b>	<b>6.33</b>	<b>5.43</b>	<b>5.75</b>	6.5 – 8.5
2	Colors	-	KPH (<2)	KPH (<2)	KPH (<2)	KPH (<2)	15
3	Total hardness	mgCaCO <sub>3</sub>	4	14	4	2	-
4	Temporary hardness	mgCaCO <sub>3</sub>	KPH (<0.2)	1	KPH (<0.2)	KPH (<0.2)	-
5	Clorua Cl <sup>-</sup>	mg/L	4	12	4	1	250
6	Total Fe	mg/L	KPH (<0.06)	KPH (<0.06)	KPH (<0.06)	KPH (<0.06)	0.3
7	Asen, As	mg/L	KPH (<0.001)	KPH (<0.001)	KPH (<0.001)	KPH (<0.001)	0.01
8	Total Coliform	MPN/100ml	<b>7,6 x 10<sup>3</sup></b>	<b>8,7 x 10</b>	KPH (<1)	KPH (<1)	0
Note: KHP: not found; NA: not analyzed							

Most of the local purified water production companies use the production technique is not guaranteed that leads to unstable quality. The analyzed results at K0-PW1 and K15-PW6 show the pH indicator was not guaranteed. In addition,

particularly at K0-PW1 position, the drinking water with Total Coliform indicator exceeds the regulations of the Ministry of Health. The cause is that during the using period, the water has not been contained in the hygienic equipments. If this polluted situation extends, it will affect the health of staffs and workers in sites, especially the digestive systems.

#### 5.3.4. Surface water

The surface water in project areas are primarily from Thay Cai canal, the other canals, ponds, paddy fields. Except the Thay Cai canal has great flow and good water circulation, the remaining canals have weak flow with the circulation of water flow is weak, easy to be polluted.

**Table 9: Monitoring results of surface water in PH4 construction sites – Quarter IV/2013**

No.	Indicators	Unit	K11-WR4		K13-WR5		Column B1, QCVN 08: 2008 BYT
			Nov	Dec	Nov	Dec	
1	pH	-	6.93	6.93	6.53	6.74	5.5 – 9
2	COD	mg/L	9	7	48	85	30
3	TSS	mg/L	7	7	22	46	50
4	Total Oil	mg/L	0.6	KPH	0.5	KPH	0.1
5	E.Coli	CFU/100ml	$1.2 \times 10^3$	$2.1 \times 10^3$	$1.6 \times 10^4$	$2.6 \times 10^3$	100
6	Total Coliform	MPN/100ml	$9.4 \times 10^3$	$3.3 \times 10^3$	$2.3 \times 10^5$	$4.3 \times 10^3$	7,500

The analyzed results show that the surface water samples in project areas are contaminated microorganism, the highest Total Coliform ( $2.3 \times 10^5$  MPN/100ml) was detected at K1-WR5 in December 2013. In addition, since the limit of the water flow, the water on several canals has sign of organic pollutants, COD indicator exceeds the regulation from 1.6 to 2.8 times, the highest value is 85 mg/L at K13-WR5 position in December 2013.

Oil pollution is also quite common for the surface water in construction sites, the monitoring areas have the oil concentration exceeded the regulation from 5 to 6 times.

#### 5.3.5. Waste water

Domestic wastewater mainly contains residues, suspended solids (SS), organic compounds (BOD/COD), nutrients (N, P) and micro-organisms. The amount of domestic wastewater generated in the sites is not large, but due to the density of workers gathering in the workers camp areas is too high. Furthermore, the drainage and hygiene conditions has not ensured, hence the influence of wastewater on the environment is too large.

**Table 10: Monitoring results of surface water in PH4 construction sites – Quarter IV/2013**

No.	Indicators	Unit	K0-WW1		K13-WW5		Column B QCVN 14: 2008/BYT
			Nov	Dec	Nov	Dec	
1	pH	-	6.41	6.86	6.31	6.56	5 – 9
2	COD	mg/L	49	16	63	83	-
3	TSS	mg/L	<b>154</b>	38	50	<b>127</b>	100
4	Total oil	mg/L	0.7	1.7	2.4	1.5	-
5	E.Coli	CFU/100ml	$2 \times 10^4$	$3 \times 10^3$	$1.5 \times 10^4$	$1.2 \times 10^4$	-
6	Total Coliform	MPN/100ml	<b><math>9.4 \times 10^5</math></b>	$4 \times 10^3$	<b><math>2.2 \times 10^4</math></b>	<b><math>2.3 \times 10^4</math></b>	5,000

The analysed results show that the wastewater samples at workers camps have TSS indicators higher than the regulation from 1.3 to 1.5 times. On the other hand, the microbial contamination is one of the components were polluted highly and commonly. At K0-WW1, Total Coliform concentration is  $9.4 \times 10^5$  MPN/100ml in November that highest value during the monitoring time. However, up to December, since the decline of the number of workers in the sites, the pollution of water reduced, and the other indicators reach the regulation. Similarly, the polluted situation occurred at K13-WW5 with the raising trend in December.

#### 5.3.6. General conclusion of environmental status in sites

The monitoring results of MT7 Consultant show that the constructors did not let any serious environmental problems happen. Nevertheless, since after a long time without the participation of the environmental monitoring consultants, several common environmental pollutions occurred in the worksites as follows.

- Dust pollution occurred in areas where the density of construction is high. The constructors has not paid attention more to mitigation solutions such as spraying water to keep moist; shielding the material transportations and the material yards, etc.
- The domestic water is polluted including the microbial contamination and the low pH indicator. Because the domestic water is pumped from the drilling wells, the containing equipments are not hygienic.
- The surface water is polluted by the amount of oil that using in operating machineries, the TSS concentration in the water is high due to the solid waste has not been managed well.

On the other hand, the constructors are lack of staffs, who are responsible for environmental management, hence the outstanding environment issues as mentioned above have not been controlled closely.

## 6. Water Environment

### 6.1. Changes of the water flow and erosion status at riverbanks

#### 6.1.1. Changes of the water flow

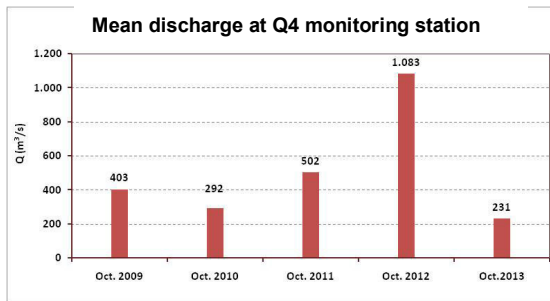
See the map of flow monitoring stations in attached appendix A.

#### General changes of the water flow:

During wet season, flow regime strongly depends on tidal regime, precipitation and especially release from upstream reservoirs. Observed data show that flow regime at each monitoring station is complicated and varies randomly (not follow a certain trend). With the large rainfall in the rainy season 2012, the upstream monitoring stations (Q1, Q2, Q5) in the river has large discharge and higher than that in the last five stages. There also a positive relationship between water flow in the rainy season this year and water flow in the dry season of the coming year.

The observed data of Phuoc Hoa Gauging Station (the downstream of dam) show the decline trend of the average water level of 2010 in comparison with 2009. The decline range of water level in the rainy season is greater than in the dry season, and this range is also greater than the calculated scenario for the operation period in the EIA report.





**Figure 1: Average discharge at stations in the rainy season of years from 2010 to 2013**

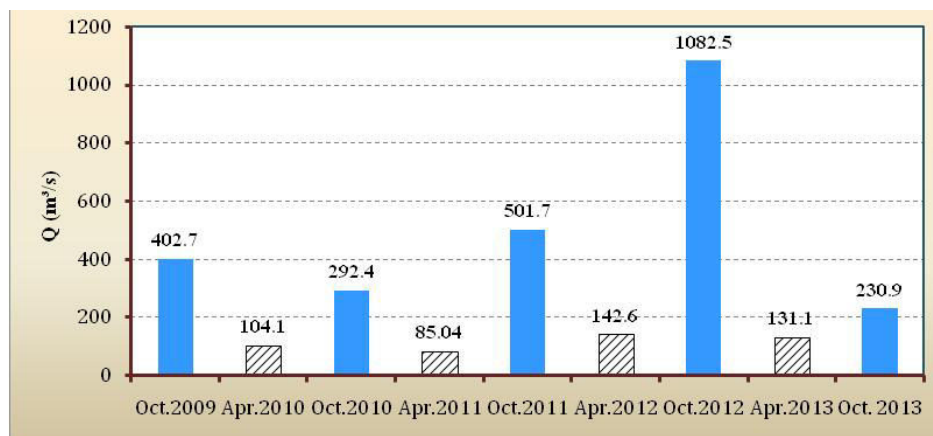
### **Changes of the water flow upstream and downstream Phuoc Hoa dam**

#### **i. Upstream:**

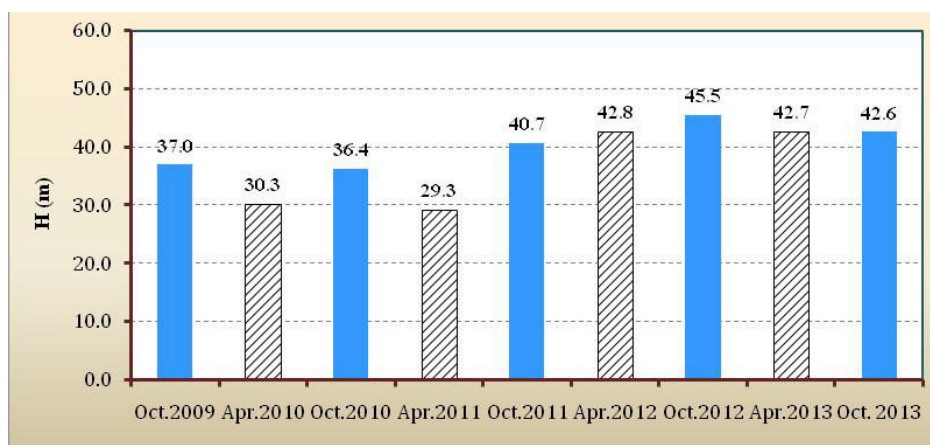
The monitoring results of the station Q4 (Nha Bich bridge) in the upstream area of the Phuoc Hoa dam in 2010, 2011, 2012, and 2013 show that:

- Before the impoundment time for Phuoc Hoa Dam (July 2010), if the water flow is decreased in comparison with the same period of the previous year, hence the water level is decreased (the measured results in 10/2009 and 10/2010, 4/2010 and 4/2011).
- Since the monitoring stage in the dry season of 2011, although the discharge in April 2012 was  $142.6 \text{ m}^3/s$  that was too much less than that in October 2011, was  $501.7 \text{ m}^3/s$ . However, at Q4 station, the water level in April 2012 was still higher than that in October 2011 of 2.1 m (+42.8 m in comparison with +40.7 m).
- The mean water level at Q4 station in October 2012 and April 2013 were higher than the top of Labyrinth spillway +42.5 m (the top of Labyrinth spillway of Phuoc Hoa Dam), and in October 2013 is 42.6 m.

The monitored results show that Phuoc Hoa Dam has made the water level in the upstream areas raise.



**Figure 2: Water discharge at Q4 station – in the upstream of Phuoc Hoa Dam**



**Figure 3: Water level at Q4 station – in the upstream of Phuoc Hoa Dam**

**ii. Downstream:**

Since 17<sup>th</sup> February 2013, Dau Tieng – Phuoc Hoa IMC has begun transferring water from Phuoc Hoa Reservoir to Dau Tieng Reservoir with the maximum discharge of 50 m<sup>3</sup>/s. The average discharge at the head of transfer canal is 43.7m<sup>3</sup>/s (from 22 to 27 April 2013). Since the beginning of February 2013, Dau Tieng Reservoir has to release water three times to push salinity to ensure the water quality for Tan Hiep Water supply Company. For this reason, the salinity intrusion on the Sai Gon River and Vam Co Dong River is negligible, thanks to the regression discharge from Dau Tieng.

At Dong Nai River basin, the monitored results show that the discharge was decreased compared to the same period of 2012 at stations namely Q7 (in the downstream of the Phuoc Hoa Dam), Q5 (in the downstream of the Be River), and Q2 (Dong Nai Bridge). Hence the transfer of water may impact certainly on the flow regime and salinity intrusion in the Dong Nai River. In order to have a precise conclusion about the impact of water transfer, we should have a sequence of continuous monitoring data of water quality and salinity.

**Preliminary forecast on the salinity intrusion possibility in the Sai Gon and Dong Nai Rivers:**

The monitoring results of 8 measured stages from October 2009 to April 2013 show that there is a close interrelationship between the volume and time of rainfall in the rainy season in the previous year and the dry season in the next year.

- In the dry season of 2011, the water flow from the upstream to the downstream areas was less than that in 2010, the level of salinity intrusion was therefore more serious in 2011.
- Up to the rainy season of 2011, the water flow was higher than in the years 2010, 2009. Therefore, the level of salinity intrusion in 2012 is less serious than in the previous 2 years.



- In 2012, the rainy season came and ended soon, it's mean that the dry season also ends soon. In addition, the flood season of 2012 was smaller than forecast, the water discharge came to the upstream reservoirs was small. In coordination with prolonged drought that will make salinity intrusion raises in the Sai Gon, Dong Nai, Vam Co Dong Rivers in the dry season of 2013. Salinity of Sai Gon River in the early of March 2013 was higher than the same period of the previous year 3 – 5 ‰. The salinity peak fell at the end of March, up to April several seasonal rains was appeared then the average salt content reduced slightly.

#### **6.1.2. *The status of riverbanks erosion***

As mentioned in the previous reports, there were 09 minor eroded locations. Up to now, these old erosions are stable and new erosion locations have not been found. The natural vegetation along both sides of the river was overgrown and stable. For downstream areas, there were 66 eroded locations noticed 4 days after the dam had been impounded due to slides caused by groundwater pressure. So far, these erosions have been stable and new erosions did not occur. Vegetation on both sides of the river is growing stably.

For the transfer canal, in the monitoring stage of April 2013, working team found serious collapsed location at Km36+800, the collapsed location extended over 50 meters length, and 2 – 3 meters deep into the riverbank that made the TSS content and organic matter in water, which discharged into Dau Tieng Reservoir, significantly increased and obstructed the flow.

#### **6.1.3. *Variables of the vegetation along the Be riverbanks.***

Regarding the surveying results of the MT2 package, along both sides of Be River consists of 2 kinds of vegetation: natural vegetation and artificial vegetation.

The natural vegetation mainly distributes on the left bank of Be River (viewed upstream to downstream), including 04 main types: Type 1: *Pure thorny bamboo forest*; Type 2: *Thorny bamboo forest mixed with broad-leaved species*; Type 3: *Sparse broad-leaved forest and shoot regenerating forest*; and Type 4: *Grass and shrubs*. The artificial vegetation includes rubber forest, cashews, orchards and short-term crops, which are mainly grow both sides of Be River (not on vacant land). All artificial vegetation as mentioned above were grown one species with one-layer, which is relatively uniform in size and coverage. The current coverage ranges 50 - 60%. Most types of planted vegetation typically distribute from the river inclined edges about 5 -10 m.

### **6.2. *Changes of the water quality***

See the sampling map for water quality in attached appendix A.

#### 6.2.1. Surface water quality

##### ❖ **Be River basin:**

There are 05 monitoring locations: Nha Bich (WQ01), Phuoc Hoa dam (WQ04), Phuoc Hoa Bridge (WQ05), Ma Da (WQ09), downstream of Be river (WQ10).

##### **Monitoring results in the last six months of 2013:**

- Value of pH was stable in the range from 6.68 – 7.34, there is no considerably difference among sampling periods.
- Salinity value was low, ranging from 0.2 to 0.3 g/l.
- TSS value in the last two sampling stages of year shown that it fluctuated from 60 to 262 mg/l, and higher than the level A2 (30 mg/l) of the regulation. Overall route, the high TSS value was defined at the beginning and end of the river. At the middle of route (Phuoc Hoa lake), the TSS concentration tended to decrease.
- The nutrient content was rather low, total nitrogen (T-N) in the range from 0.444 to 1.097 mg/l, total phosphorous (T-P) in the range from 0.089 to 0.437 mg/l. The trend of Nitrogen content changed from Nha Bich Bridge to Phuoc Hoa Bridge was not significant; it increased so much at areas after the junction with Ma Da Spring. Moreover, the Nitrogen content in the rainy season was higher than that in the dry season at the upper areas of Phuoc Hoa Bridge.
- Dissolved oxygen values (DO) at monitoring locations in Be River in April were greater than 4 mg/l. Up to October (the rainy season), the DO value was higher than with greater discharge.
- Organic content shown a weak increase towards the downstream. The COD values in the range from 1.60 to 4.24 mgO/l, BOD<sub>5</sub> in the range from 1.07 to 2.46 mg/l. The COD value in October was higher than in June, this indicated that the organic matter had an increasing trend in the dry season and in the beginning of the rainy season.
- The highest Fecal Coliform value was 24.000 MPN/100ml at Phuoc Hoa Bridge in June, while these value just reached 430 MPN/100ml in October and 40 MPN/100ml in April.

##### **Comparison with the standard QCVN 08:2008/BTNMT**

The water quality in Be River was quite good, equivalent to the water resource range **A1 – A2 under the standard QCVN 08:2008** (it is good for domestic water supply, aquatic conservation and other demands which need a lower water

quality). Expect the Fecal Coliform concentration exceeded the level B2 up to 2.4 times.

- The impact of Phuoc Hoa dam construction to TSS content only occurred clearly at the downstream area.
- DO values was suitable for protection of aquatic life according to the Standard QCVN 38:2008 and meet the level A1 of the standard QCVN 08:2008.
- COD values and BOD<sub>5</sub> values were equivalent to the level A1 and A2 of the standard QCVN 08:2008.
- Total oil and heavy metal contents were equivalent to normal values of metal that naturally occur in surface water.

**Comparison of monitoring results through the years:**

Assessment of yearly trend of Be River water quality in this report do not include springs such as Thon Spring (WQ02), Nuoc Trong (WQ03) and Giai Spring (WQ08), because these stations was not monitored continuously in 2012.

- The TSS content in 2013 was higher than the average of many years at WQ09 and WQ10, mainly because of the great increase of TSS in October 2013 compared with the same period of previous years. At stations from the downstream of dam towards Phuoc Hoa Bridge, TSS content was rather stable, not change much [Figure 4].
- COD and BOD values in 2013 did not have great difference in comparison with the years 2010 – 2012 at most of sampling positions. [Figure 5].
- The period from 2010 to 2013, the total nitrogen value did not have any significant change from the upstream of Be River towards Phuoc Hoa Dam (WQ01 – WQ04). At particular WQ05 position, the value was higher than that in the years 2010 – 2012, while the value in the upper of dam in 2013 was decreased in comparison with that in 2012, but still higher than that in 2010 - 2011.

*(See the results of the monitoring stage in April of years in the First Six-Monthly Report 2013 – Package OP4).*

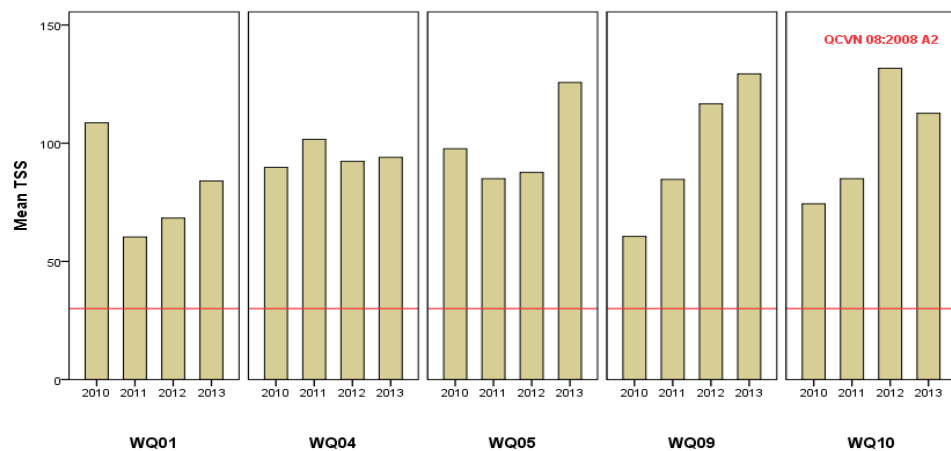


Figure 4: TSS value of Be River, 2010-2013

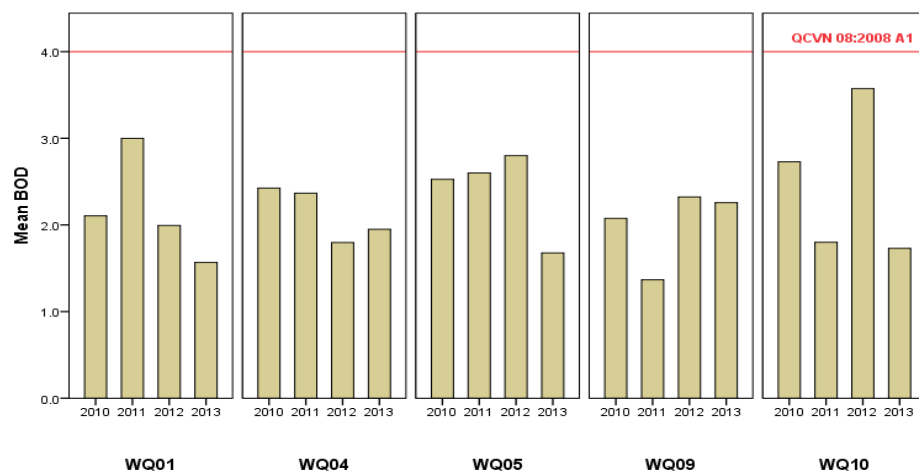


Figure 5: BOD<sub>5</sub> value of Be River, 2010-2013

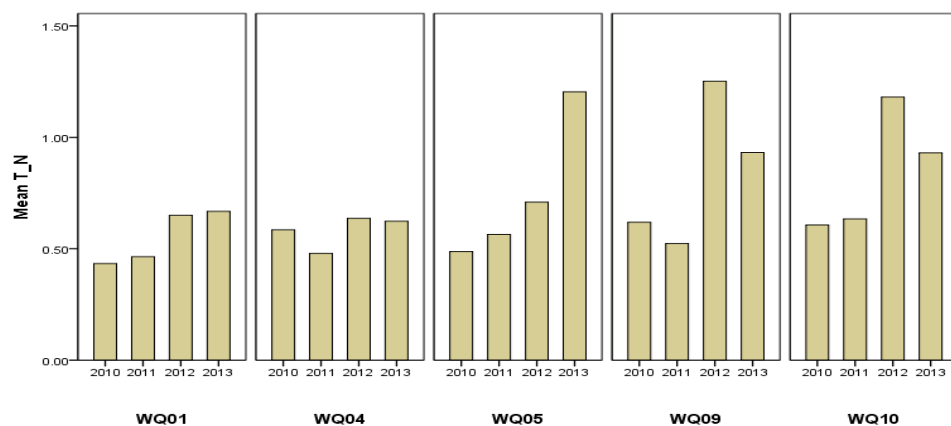


Figure 6: Total Nitrogen of Be River, 2010-2013

❖ **Dong Nai River:**

The monitoring stations in Dong Nai River are located in the downstream area of Tri An reservoir (WQ11), Bien Hoa City (WQ12), downstream area of Hoa An Bridge (WQ13), Nhon Trach area (WQ18) and before the junction with Sai Gon River at Nha Be district (WQ19).

### **Monitoring results in the last six months of 2013:**

- pH values were stable and fluctuated in range of 4.35 to 6.83 during the monitoring stages of the end of 2013. And they had no great difference among stations as well as among sampling period in 2013 concurrently.
- In the monitoring stage of October 2013, highest salinity values at Nha Be were 4 mg/l. In the rainy season (October), the salinity at most of stations were decreased, approximately 0.03 mg/l.
- In the last six months of year 2013, contents of nutrient, organic matters were low generally. T-N value was varied in the range from 0.72 to 1.89 mg/l, T-P value was varied in the range from 0.03 to 0.13 mg/l. The lower areas of Nhon Trach and Nha Be (WQ18, WQ19) had the nutrient content higher than of the upstream stations as Tri An and Hoa An (WQ11, WQ13) because they are affected by towns such as Bien Hoa, Nhon Trach, Ho Chi Minh City.
- Oxygen demand contents of Dong Nai River were low, met the level A2 of the standard QCVN 08:2008, with COD in the last six months of 2013 ranging from 2.28 to 9.08 mg/l, and BOD<sub>5</sub> ranging from 1.12 to 2.56 mg/l. Most DO values met the level A2 of the standard QCVN 08:2008. The lowest DO was 4.35 mg/l, occurred at Nha Be in the beginning of the rainy season (June).
- The amount of Fecal Coliform in the upstream area of the Dong Nai River was high and fluctuated from 0 to 24,000 MPN/100ml. The highest value was measured in Nhon Trach area 24,000 MPN/100ml in June 2013.
- The values of the monitoring stage in June and October 2012 shown that the Pb value was in the range from 0.001 to 0.009 mg/l, the Cd value from 0.000 to 0.003 mg/l, the Cu value from 0.002 to 0.014 mg/l, the Mn value from 0.012 to 0.079 mg/l. In general, the content of heavy metal measured at monitoring stations was low in comparison with the level A2 of the standard QCVN 08:2008.

### **Comparison with the standard QCVN 08:2008/BTNMT**

In general, the water quality of the upper Dong Nai River is good at monitoring stations equivalent to the Rank **A1 and A2 of the standard QCVN 08:2008**.

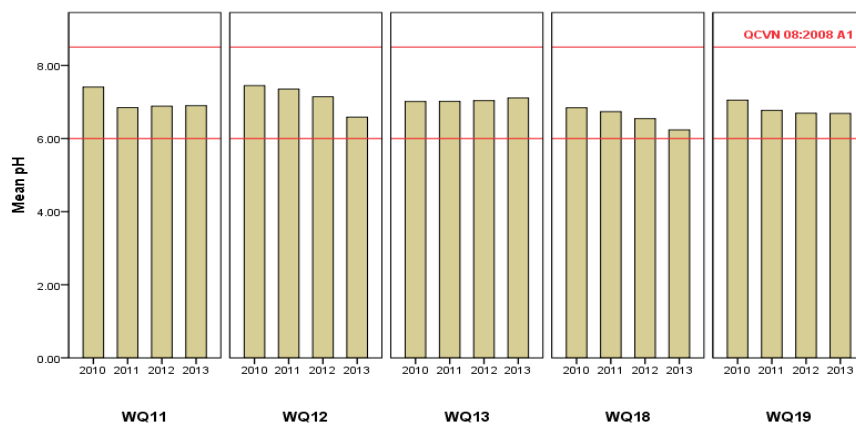
- The water resource in lower areas were influenced by salinity intrusion in the dry season which could not be used for domestic and irrigational purposes, and was contaminated micro organism. At monitoring periods in April 2012, there did not have any significant change in the Dong Nai River's water quality that could have been affected by the Phuoc Hoa reservoir.

- The amount of Fecal Coliform was equivalent to the standard QCVN 39:2011 for irrigational purpose. At Nhon Trach, the amount of Fecal coliform of 3 sampling period were over the standard, the highest value is 24,000 MPN/100ml in June 2013. At Nha Be, the amount of Fecal Coliform was over the standard QCVN39:2011 in June and October. The amount of Fecal Coliform at Nha Be in April was low due to inhibition of salinity to Coliform growth.

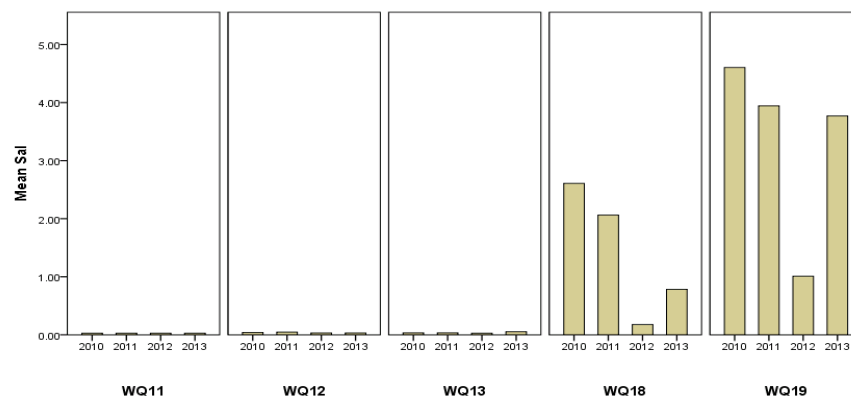
**Comparison of monitoring results through the years:**

- The monitoring results in 2013 performed that the pH value of Dong Nai River tended to decrease in comparison with the years 2010-2012 at most of sampling locations [Figure 7] .
- Salinity had no great change in the upper areas from Tri An to Hoa An. However, in the lower areas of Dong Nai River, at Nhon Trach and Nha Be stations that were impacted by salinity intrusion and tidal regime, the salinity value tended to increase in comparison with the same period of 2012 [Figure 8].
- TSS and COD concentration in 2013 tended to increase slightly in comparison with 2012. However, COD concentration was still lower than that in 2010, especially at the lower area of Dong Nai, where going through Bien Hoa area. This result was consistent with the results were observed by The Monitoring and Technical Environment Centre of Dong Nai Province announced in 2013.
- The NO<sub>3</sub>-N and PO<sub>4</sub>-P content tended to increase, while DO content tended to decline (at WWQ12, Tan Mai).
- The PO<sub>4</sub>-P content at most stations did not change significantly among years, except 0.02 mg/l increased at Nhon Trach (WQ18) in 2012 in comparison with the year 2011.

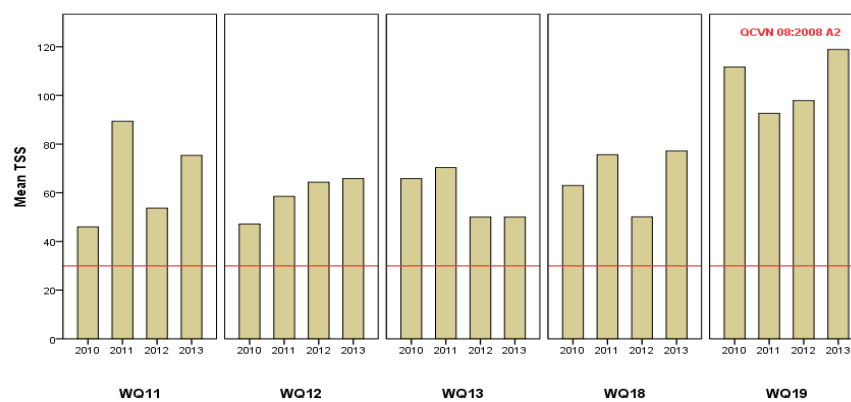
*(See the results of the monitoring stage in April of years in the First Six-Monthly Report 2013 – Package OP4).*



**Figure 7: pH value of Dong Nai river, 2010-2013**



**Figure 8: Salinity of Dong Nai river, 2010-2013**



**Figure 9: TSS value of Dong Nai river, 2010-2013**

❖ **Sai Gon River:**

Monitoring stations in Sai Gon River located at the Ben Than water treatment plant in Cu Chi district (WQ14), the confluence with Thi Tinh River (WQ15), Dau Tieng Township in Binh Duong Province (WQ16) and downstream of Sai Gon River in Tan Thuan (WQ17).

**Monitoring results in the last six months of 2013:**

- In the two monitoring stages in the end of 2013, pH value was stable and

fluctuated between 5.9 and 7.0 at all monitoring locations; the impact of acid sulphate soils on Sai Gon River was not significant. The pH value at Tan Thuan (6.99) was higher than the other upper locations due to tidal impact.

- In the last six months of 2013, salinity fluctuated from 0.03 to 0.25 g/l, at the confluence of Sai Gon and Dong Nai River (WQ19) and at Tan Thuan position (WQ17), this area is affected by tide causing salinity intrusion in the dry season, hence they affects the domestic water supply and irrigation. The highest salinity measured at Tan Thuan (WQ17) was 0.25 g/l in October 2013.
- TSS content fluctuated from 43 – 108 mg/l in Sai Gon River; the highest value was measured at Ben Than. At Ben Than location, the turbidity was highest causing by sand exploitation, construction material transportation along the river from An Nhon Tay to Ben Than.
- Total Nitrogen value fluctuated from 0.64 to 5.57 mg/l, and total Phosphorus value fluctuated from 0.05 to 0.56 mg/l in the two monitoring stages in the end of 2013. At Ben Cui (WQ16), nutrient parameters such as total Nitrogen, total Phosphorus were low. The measured highest value of total Nitrogen was 5.57 mg/l at Tan Thuan (WQ17) in October, and the measured highest value of total Phosphorus was 0.56 mg/l at Tan Thuan again in October 2013.
- Highest value of COD, BOD occurred in October at Tan Thuan, average value of COD was 11.28 mg/l, and BOD was 3.26 mg/l.
- Amount of Fecal Coliform in Sai Gon River was fluctuated so much, from 0 to 930 MPN/100ml, the highest at the confluence of Thi Tinh River, the amount of micro organism increased due to the impacts of residential areas.
- The heavy metal concentration of 03 stations that receive waste sources such as WQ14, WQ15 and WQ17 were very low in the last six months of 2013.

#### **Comparison with the standard QCVN 08:2008/BTNMT**

Water resource in the Saigon River where from Thi Tinh to Cu Chi was quite good in 2013 and similar to the rank **A2 under the standard QCVN 08:2008**, it is good for domestic water supply, aquatic conservation and other demands which need a lower water quality.

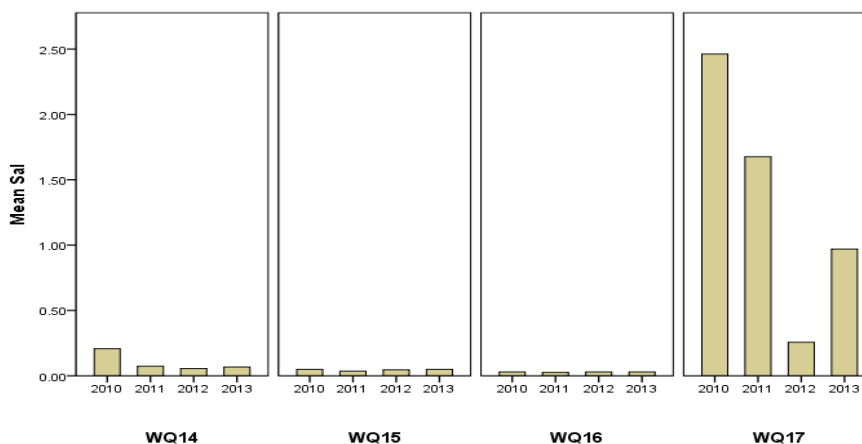
As mentioned in the previous reports, the monitoring values of Sai Gon River in the last six months of 2013 show that the water quality was impacted by waste sources from towns, industrial parks, agricultural zones, especially in the lower areas. The results from monitoring networks of Nation and the General Department of Water Resources also find the degradation of water quality of Sai Gon River in period 2001-2013.



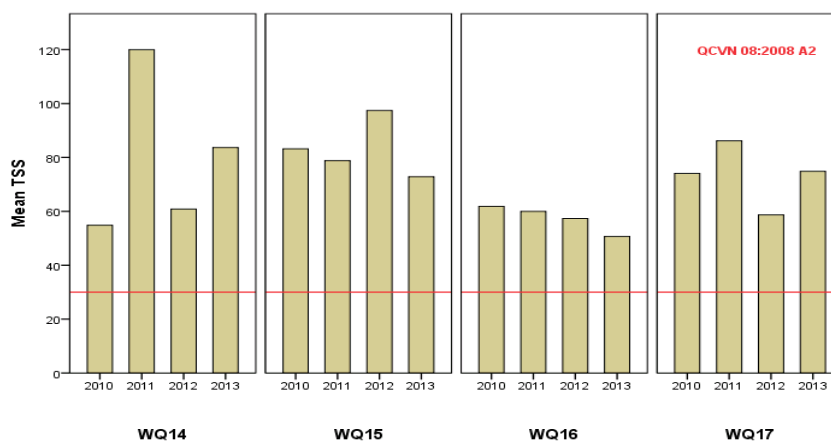
### Comparison of monitoring results through the years

- pH value was stable and not significant difference to the years 2010 and 2013.
- In the lower area of Saigon River, the highest salinity value was 3 g/l at WQ17 (Tan Thuan) in 2013 that higher than 2012, but lower than that in the same periods of years 2010 – 2011 [Figure 10].
- Water quality was significantly improved in comparison with the same period of last years in the upper area of Saigon River from Dau Tieng (WQ14) towards Ben Cui (WQ16). Based on the fact data provided, the salinity of 2013 tended to decrease considerably in comparison with the years 2011 – 2012.
- The water quality has not been improved in the lower area of Saigon River from Thu Dau Mot to Ho Chi Minh City, and tended to increase pollutant in comparison with the last years inversely.

The water transfer in the first year of Phuoc Hoa Water Resources Project shown the first sign of water quality improvement for the lower area. According to DARD of Tay Ninh and Long An Province, confronted with situation of serious drought that occur at most of areas in whole country in the dry season of 2013, the water supplement to Dau Tieng Reservoir from Phuoc Hoa has improved the drought condition for thousand hectares of paddy field and vegetable garden.



**Figure 10: Salinity value of Saigon River, 2010-2013**



**Figure 11: TSS value of Saigon River, 2010-2013**

*(See more results of the monitoring stage in April of years in the First Six-Monthly Report 2013 – Package OP4).*

#### **Vam Co Dong River:**

Monitoring stations in Vam Co Dong River located at Ben Da in Chau Thanh district, Tay Ninh province (WQ21), Tra Cu in Duc Hoa district, Long An province (WQ22), Ben Luc in Long An province, at the junction with Xang canal (WQ23).

#### **Monitoring results in the last six months of 2013:**

- During the monitoring stage, the pH value in Vam Co Dong River varied according to space and time, fluctuated from 5.62 to 6.71. The pH value was high and stable at WQ21 (fluctuated from 6.47 to 6.71), and decreased gradually towards the downstream. At WQ22 and WQ23 locations, the pH value fluctuated so much among times of year, it was lowest in June, because this month is the end of the dry season and the beginning of the rainy season.
- The salinity intrusion in Vam Co Dong River was not substantial and fluctuating from 0.03 to 0.12 g/l in June and October 2013, the highest salinity measured in Kanh Xang was 0.12 g/l, and Tra Cu was 0.11 g/l.
- TSS value was quite low; the highest value measured with 102 mg/l at Ben Luc (WQ23) in October 2013, and the lowest value at Duc Hoa (WQ22) was 64 mg/l. The TSS value increased a little big at areas in October.
- The total Nitrogen value in October (0.87 mg/l) was lower than that in June 2013 at Ben Luc. The change trend of total Nitrogen in Vam Co Dong in the last six month of 2013 was high in the dry season and strongly reduced when flood comes.
- The content of organic matter was quite stable in October, COD value fluctuated from 3.26 to 6.36 mg/l, and BOD<sub>5</sub> value also fluctuated from 2.21 to

2.50 mg/l. COD value was highest at Ben Luc (WQ23) about 6.36 mg/l, and BOD<sub>5</sub> value was highest at Hao Duoc about 2.5 mg/l.

- The amount of Fecal Coliform in the last six months of 2013 fluctuated quite large from 43 to 93,000 MPN/100ml, the amount of Fecal Coliform was high in October, particularly at Tra Cu (WQ22) it was up to 93,000 MPN/100ml.

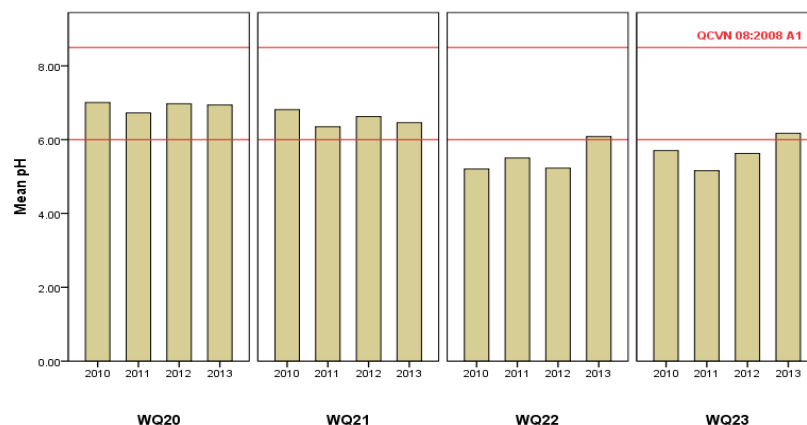
Water resource in the Vam Co Dong River was quite good in 2013 and similar to the rank **A2 under the standard QCVN 08:2008**, it is good for domestic water supply, aquatic conservation and other demands, which need a lower water quality. However, where the river going through Duc Hoa, Long An the pollutants tended to decrease.

### Comparison of monitoring results through the years

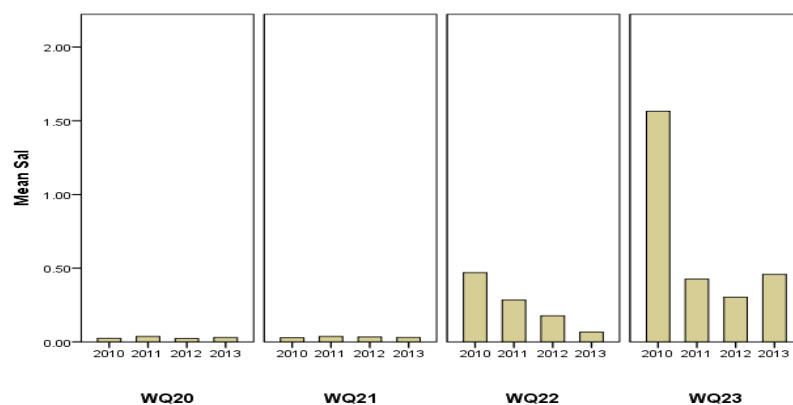
- Comparison between monitoring results of 2013 with the years 2010-2012 they were not shown a obvious trend. The pH value of 2013 at WQ22 and WQ23 were generally improved in comparison with the pH value of years 2010 – 2012 [Figure 12].
- The lower area of Vam Co Dong River (the section from Tra Cu to Ben Luc), the salinity was declined gradually in the years 2010 – 2013 [Figure 13].
- The content of nutrients and organic matter were not shown the similar trends between the observation positions on the Vam Co Dong River over time.
- There was no relationship between the water quality in Vam Co Dong River and the activities of building Phuoc Hoa dam in 2010-2013 periods.

Since the construction of Duc Hoa canal has not finished, it should be continued to monitor the water quality change in this area until the construction finishes.

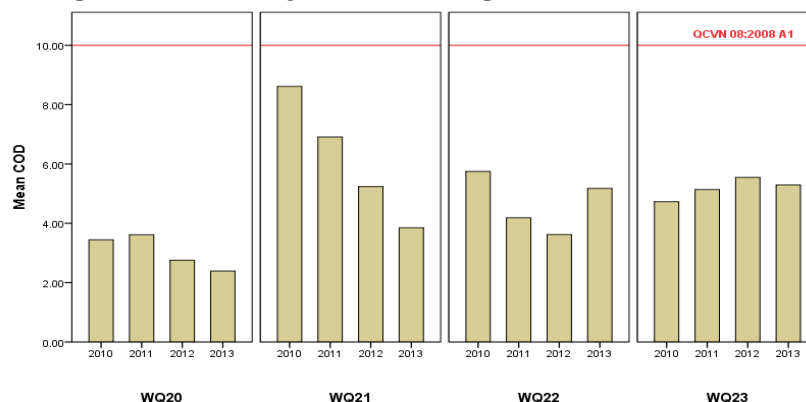
(See the results of the monitoring stage in April of years in the First Six-Monthly Report 2013 – Package OP4).



**Figure 12: The pH value of Saigon River, 2010-2013**



**Figure 13: Salinity value of Saigon River, 2010-2013**



**Figure 14: The COD value of Saigon River, 2010-2013**

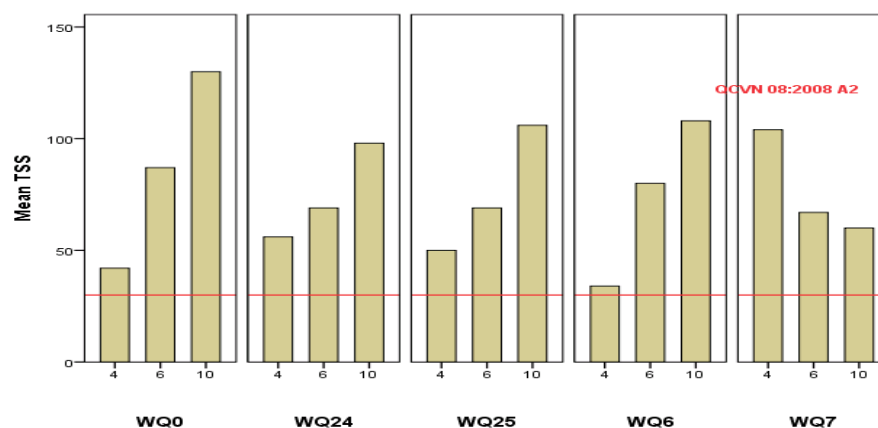
❖ **Phuoc Hoa – Dau Tieng Transfer Canal, Duc Hoa and Tan Bien main Canals:**

From April 2012, the MT6 package implement additional monitoring activities at 5 more surface water stations. It includes 02 stations at beginning and ending of Phuoc Hoa-Dau Tieng Water Transfer Canal (WQ25, WQ26), 01 station on Tan Bien Canal (WQ06), and 01 station on Duc Hoa Canal (WQ26).

**Phuoc Hoa – Dau Tieng Transfer Canal:**

In general, the water quality of Phuoc Hoa – Dau Tieng transfer canal and in lake was rather good. The pH value fluctuated from 6.8 to 7.3. The nutrient and organic contents was low and lower than the level A1 of the standard QCVN 08:2008/BTNMT. The content of heavy metal was low and lower than the detection limit, similarly the detection of microorganism contents was low.

In October, the TSS value in lake was 130 mg/l, higher than 3 times in compared with the value of April, and decreased to 108 mg/l after slowing into the transfer canal, and 60 mg/l at the end of the canal (Km 38+800).



**Figure 15: The TSS value on the transfer canal and the lake in 2013**  
**West Canal and Tan Bien Canal:**

In rainy season, the pH value in Tan Bien canal was 6.26, the TSS content was 106 mg/l. The content of organic matters such as COD and BOD were lower than the level B1 of the standard QCVN 08:2008/BTNMT. However, the value of DO was rather low, and the nutrient content was lower than the value of the surrounding areas, where the total nitrogen was 0.814 mg/l, NO<sub>3</sub> was 0.398 mg/l. The water quality of Tan Bien canal is however equal to the level B1 of the standard QCVN 08:2008/BTNMT that suitable for agricultural water supplies.

#### 6.2.2. Groundwater quality:

The groundwater is monitored at drilling wells or digging wells depended on characteristics and actual situation of wells in project area. The six wells in Binh Phuoc Province were measured including GW1, 2, 3, 4, 7 and 8; the three wells in Binh Duong Province were measured including GW5, 6 and 9; the three wells in Tay Ninh province were measured including GW10, 11 and 12. In addition, the three wells the National Lo Go – Xa Mat Forest were measured in including GW13, 14 and 15.

#### **Monitoring results in April 2013:**

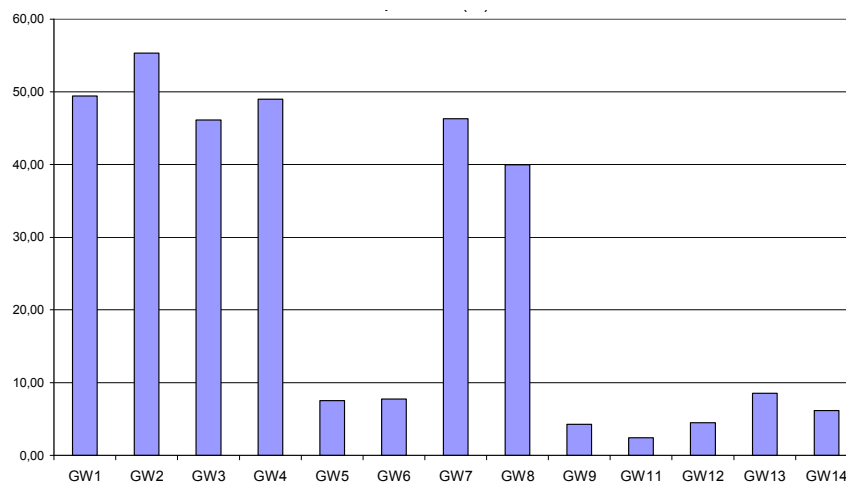
##### Water level:

According to EIA report, the practise of raising water level in the upper of reservoir will impacts actively on the raising of groundwater level in the dry season from 2 to 4 m, it depends on the distant to the reservoir. For the lower area of reservoir towards the junction of Be River and Dong Nai River, the groundwater level in dry season will decrease from 1 to 2 m.

However, the monitoring results shown that the groundwater level in the upper area of reservoir in Nha Bich and Hieu Cam commune increased in comparison with the same period of years 2010 – 2011, but the level of increase was insignificant, in range of 5 – 20 cm, it almost did not increase in comparison with year 2012. In the lower area of reservoir in Hieu Liem commune, the groundwater

level in the dry season of years 2012 – 2013 had no significant change. The other areas of Binh Duong, Tay Ninh Province and Lo Go – Xa mat National park had no change of groundwater level. The fluctuation of groundwater level above was too low, and equivalent to the fluctuation of rainfall in this area from the previous rainy season.

We have not detected any significant and obvious changes from the Phuoc Hoa Reservoir. For the upper and lower areas of the reservoir, the water level should be continuing measured in order to monitor the groundwater level behaviour. For the Duc Hoa and Tan Bien irrigation areas, the construction work has not finished and we have not found any negative impacts from Phuoc Hoa project on the groundwater behaviour.



**Figure 16: Variable of groundwater level in the dry season 2013 in project area (G10 and G15 locations were out of monitoring)**

Water quality:

- In Binh Duong, Binh Phuoc and Tay Ninh regions, the pH value was low and *did not met the standard QCVN 09:2008/BTNMT* (pH <5.5). Particularly, they met the standard QCVN 09:2008/BTNMT at GW1, GW6, GW10, and GW11.
- Content of nutrient was rather low. The PO<sub>4</sub> content fluctuated in range of 0.005 – 0.624 mg/l, highest value was measured at GW10 in Tay Ninh Province. The NO<sub>2</sub> content was low as well, less than 0.091 mg/l that lower than the standard QCVN 09:2008/BTNMT.
- The Fe content fluctuated in the range of 0.15 to 3.41 mg/l, lower than the standard QCVN 09:2008 (Fe < 5mg/l).
- The Mangan content fluctuated in the range of 0.057 to 0.109 mg/l, less than the standard QCVN 09:2008/BTNMT (Mn < 0.5 mg/l). In Binh Duong, Tay Ninh regions, the mangan content in rainy season is higher than that in the dry season, Xa Mat and Binh Phuoc regions have otherwise trend.

- Content of heavy metal namely Pb, Cd, Cu were less than the detection limit.
- Most wells were not contaminated by Fecal coliform, except the five wells namely GW04, GW05, GW06, GW10, GW14, and GW15 with the Fecal coliform fluctuated in range of 930 MPN/100 ml.

**In comparison with the standard QCVN 09:2008/BTNMT:**

Monitoring results show that most of chemical and physical compositions were stable through the years and these results are *consistent with the groundwater standard QCVN 09:2008/BTNMT* for evaluating the groundwater quality, it is oriented toward many using purposes, except the low value of pH and micro organic contaminated at some locations.

**Comparison of monitoring results through the years:**

- The monitoring results in the dry season in the period from 2010 to 2013 shown that the groundwater quality did not present obvious trend.
- The pH value at wells in the lower of Phuoc Hoa Reservoir in Binh Duong and Binh Phuoc areas had no significant change in the 2010 to 2013 period. The pH value at the wells in Tay Ninh and Lo Go – Xa Mat areas tended to decrease slightly from 2010 to 2013.
- In 2013, content of nutrients at wells in Binh Duong, Binh Phuoc and Tay Ninh areas had higher value compared to 2011 and 2012, but less than the value of 2010 at GW13, 14, 15.
- Total Fe content in the dry season of 2013 was higher than in 2012 at all wells. Total heavy metal content such as Mn, Cd, As, and Hg were less than the detection limit. There were no significant changes compared to the previous years.
- The other chemical and physical compositions had no clear difference in 2010 – 2012 periods.

In general, there were some changes of the chemical and physical compositions in years. However, these changes were not affected by the construction activities of the Phuoc Hoa dam.

**6.2.3. Water quality of Duc Hoa irrigation area:**

Monitoring results of surface water quality parameters in Duc Hoa – Long An compared to the Class B1 of the standard QCVN 08:2008/BTNMT are as follows:

- The pH value of monitored water samples varied from 2.46 to 5.87. Comparison of these values with the standard QCVN 08:2008/BTNMT shown that most of these samples did not meet the standard.

- The  $\text{NO}_3^-$  content in ground water samples varied from 1.62 to 15.34 mg/l. The  $\text{NO}_3^-$  content of 3 samples among 12 monitored samples was higher than the class B1 of the standard QCVN 09:2008/BTNMT from 1.0 to 1.5 times.
- Total nitrogen content in monitored samples varied from 6.73 to 27.53 ppm. Total phosphorus content in monitored samples changed from 0.01 to 3.34 ppm.
- Total Fe content found at monitored locations fluctuated from 1.16 to 5.86 mg/l. In comparison with the standard QCVN 08:2008/BTNMT, it shows that most of the samples exceeded the standard from 1 to 3.5 times.
- $\text{Al}^{3+}$  content that was found at monitoring locations varied from 0.45 to 5.47 mg/l. There was significant change of  $\text{Al}^{3+}$  content among monitored locations. Although there is no standard of the  $\text{Al}^{3+}$  content for the comparison of the groundwater, but the Aluminum is toxic to human health. Therefore, it should be continually considered the change of content in the domestic water.

#### 6.2.4. *Prediction of the water environment quality trend:*

Some preliminary predictions of water quality in the project area are based on monitoring results of 2010 – 2013 periods.

- Water quality of Be River is rather good, for this area is not highly populated, production activities have not developed yet, and streams discharge into Be River with the water quality is rather good. In future, industrial and domestic wastewater maybe will make negative impacts on water quality of Be River and Phuoc Hoa Reservoir (*especially the status of building the toilets along the lakeshore, and discharge directly the wastewater into the lake, and the status of deposition*) , if we do not have any restricted solutions.
- Water quality of Dong Nai River is rather good, especially the area after Tri An Dam. However, at Bien Hoa City, the reach of Bien Hoa River has being impacted by socio-economic activities. The variable trend of water quality of Dong Nai River will be complicated due to the impacts of wastewater from towns and industrial parks in this area, especially after Hoa An Bridge. The lower areas continued to be salt intruded and complicated due to the effects of the extreme weather phenomenas (*drought, sea level rise, climate change, etc*) and socio-economic development activities.
- Water quality of Sai Gon River is not only affected by nature conditions (*acidification, salinity intrusion in the lower areas*), but also by human activities (*alkaline cleaning activities, domestic wastewater, industrial wastewater*) from the largest city of the entire nation in term of population size and economic development. The predictions of water quality of Sai Gon River



in the reach flowing through Ho Chi Minh City will tend to decline due to the development of the city increasingly, in which the concern is that the expendable orientation of the city, while the current spontaneous residential areas have no suitable infrastructure, no guarantees for the environmental protection.

- Water quality of Vam Co Dong River is not only affected by nature conditions, but also by human activities. Especially, it is impacted by acid sulphate soils in the upstream and salinity intrusion in the downstream. The developing trend of production activities in the upstream of this river (belong to Long An Province) can make the water quality to be worse.
- Groundwater quality has averaged; it is predicted that impacts on groundwater caused by project activities are very low.
- Duc Hoa irrigation area (Long An) has not been finished yet, hence we can not give any specific statements about the impacts of project upon environment and production activities of this region. However, the impacts of project in the irrigation area is able to increase in the rainy season in 2014, due to Phuoc Hoa construction activities are happening, as it rains, the rain water will sweep away toxins in the acid sulphate soils, oil, mud and sand into the canal systems.

In recent years, the climate factors have great changes, it is probably due to the impacts of climate change and socio-economic development activities, hence the recognition of Phuoc Hoa Project impacts on this area will be very difficult. Besides the monitored data of the project, we need more in-depth study on environmental variables in order to recognize obviously the effects and the other negative impacts of the project.

## 7. Biodiversity

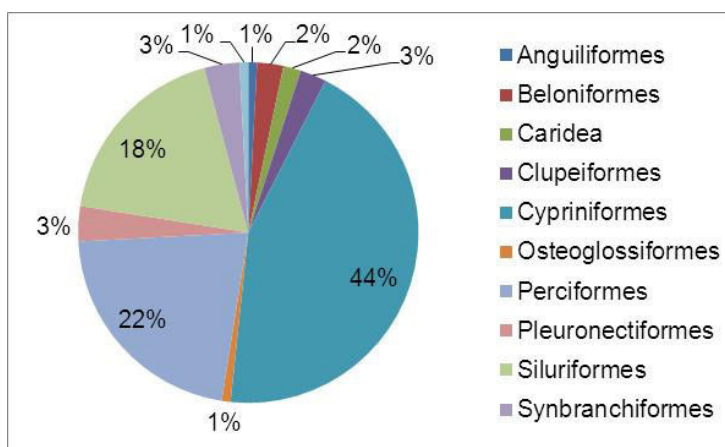
### 7.1. Aquatic biodiversity

Assessment the Aquatic biodiversity in the last six months of year based on the results of the monitoring stage in November of 2013 of Package MT6.

#### 7.1.1. Fishes and shrimps

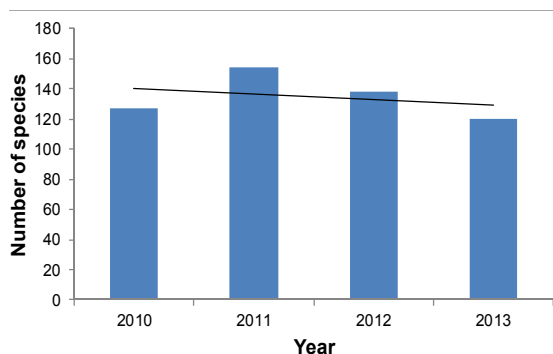
Total of 120 species fish and shrimp were identified at eleven surveyed stations belong to 11 orders, 31 families, and one specie of Riceland river prawn (*Macrobrachium mirabile*) and one specie of Giant river prawn (*Macrobrachium rosenbergii*). The abundant of species composition at stations was rather high showed in species level, families level and order level.

There are 31 families in 11 orders, in there the dominating orders are *Cypriniformes* with 53 species (44.17%), *Perciformes* with 26 species (21.67%), next is *Siluriformes* with 22 species (18.33%).

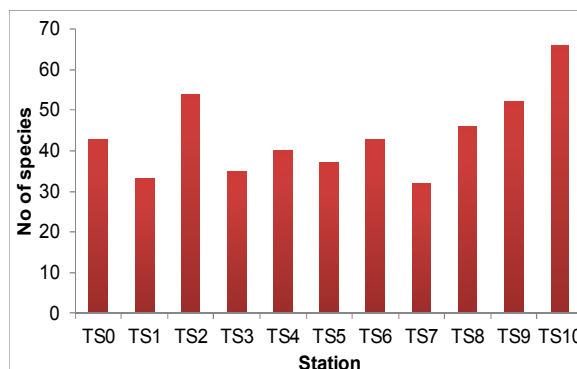


**Figure 17: Percentage of fish species composition at all stations**

In contrast, there are four orders with only one species (0.83%) such as *Anguiliformes*, *Osteoglossiformes* và *Tetraodontiformes*. The remaining orders were varied from 2 to 4 species (1.67% – 3.33%).



**Figure 18: Graph on variables of number of species fish in four years**



**Figure 19: Graph on variables of number of species fish at monitoring stations in October 2013**

Figure 18 indicated that there were slightly variables of the number of species fish through the years. The number of species was 154 in 2011, until 2013,

the remaining species was 120 species that also less than the number of species in 2012 was 07 species. This trend should be continued to monitor in order to define the change trend and the causes obviously.

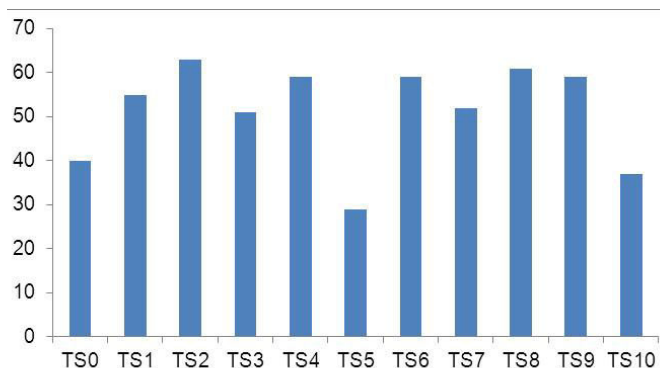
In total of 164 species of fishes and shrimp, there are ten species in The Red List of Vietnam at VU level (Vulnerable), they need to be protected such as *Cirrhinus microlepis* at TS3 (reservoir area), and at TS10 (Xa Mat River), *Hemibagrus filamentus* at TS1 (above reservoir area) and TS6 (end of Be River), *Anguilla marmorata* at TS0 (above reservoir area), *Albulichthys albuloides*, *Probarbus jullieni*, *Chitala ornata*, *Channa limbata*, *Bagarius bagarius*, *Mytus wyckoides*, *Wallago micropogon* at TS0, TS1, TS2 and TS3 stations (Vietnam Red Book 2007).

#### 7.1.2. Phytoplankton

The monitoring results at 11 stations show that the species composition of Phytoplankton was focused on 6 phylums, 115 species. In there, the phylum *Bacillariophyta* with the highest species composition that accounts for 33.91% (39 species), next is the phylum *Chlorophyta* accounts for 33.04% (38 species), the phylum *Cyanophyta* accounts for 16.52% (19 species), the phylum *Euglenophyta* accounts for 12.17% (14 species), the remaining algae phyla account for 3% of the total species. The dominant species of the algae phylum are classified by the following rank:

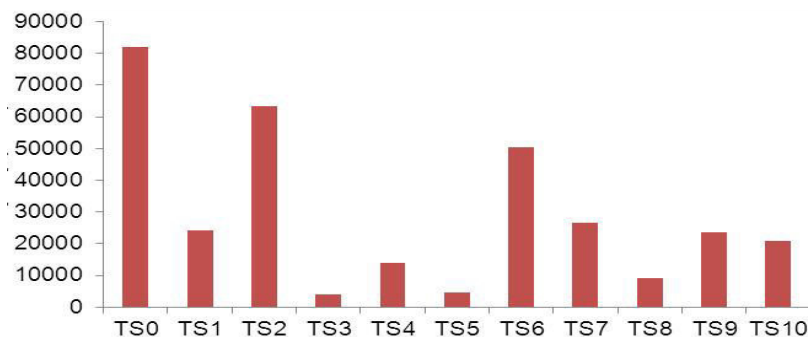
- The phylum *Bacillariophyta*: 39 species (33.91%)
- The phylum *Chlorophyta*: 38 species (33.04%)
- The phylum *Cyanophyta*: 19 species (16.52%)
- The phylum *Euglenophyta*: 14 species (12.17%)
- The phylum *Dinnophyta*: 03 species (2.61%)
- Th phylum *Chrysophyta*: 02 species (1.74%)

Figure 26 shows the fluctuation of species composition of phytoplankton at survey stations. The highest species composition found at TS2 was 63 species (54.8%), at TS8 was 61 species (53%) the lowest found at TS5 was 29 species (25.2%).



**Figure 20: Graph on species composition of phytoplankton at survey stations**

Almost of species at survey stations was fresh water species, they are good food for fishes and shrimps. Especially, there were no any toxic species such as *Pseudonitzschia spp.* and *Dinophysis caudata*.



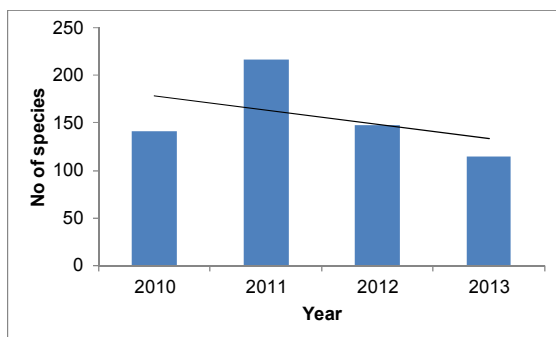
**Figure 21: Graph on densities of phytoplankton at survey stations**

The highest density of phytoplankton at TS0 station was 81,905 cells/litter (25.4%), after that TS2 station was 63,195 cells/litter (19.6%) In contrast, the four stations TS3, TS5, TS8 and TS4 were the lowest density with the number of cells in turn 3,990 cells/litter (with 1.2%), 4,475 cells/litter (with 1.4%), 9,085 cells/litter (with 2.8%) and 14,075 cells/litter (with 4.4%).

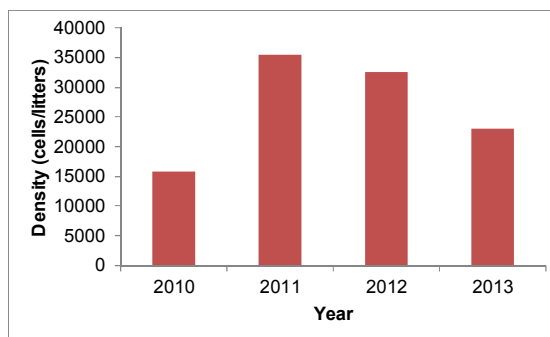
#### The monitoring results from 2010 to 2013:

In four years of the survey, the species composition of phytoplankton included 270 species. The monitored species belong to six phyla in following order:

- Phylum *Bacillariophyta*: 100 species with 37.04%
- Phylum *Chlorophyta*: 95 species with 35.19%
- Phylum *Cyanophyta*: 38 species with 14.07%
- Phylum *Euglenophyta*: 29 species with 10.74%
- Phylum *Dinophyta*: 06 species with 2.22%
- Phylum *Chrysophyta*: 02 species with 0.74%



**Figure 22: Variation of phytoplankton species composition in 2011-2013**



**Figure 23: Variation of phytoplankton density in 2011-2013**

The highest species composition is in 2011 with 217 species and the lowest

is in 2013 with 115 species. Variation of phytoplankton species composition shows a decreasing trend throughout four years. Similar with variation of species number, there is variation of density of phytoplankton in four years. The highest variation of density is in 2011 with average of 35,472 (cells/litter), the lowest is in 2010 with average of 15,752 (cells/litter). Density of phytoplankton has a decreasing trend from 2011 to 2013.

### 7.1.3. Zooplankton

There was 41 species of zooplankton belong to 5 phyla at 11 surveyed station. Phylum *Arthropoda* was the highest number of species that contains 29 species (occupy 70.73%), within sub-class *Cladocera* contains 10 species (occupy 24.39%) with some of common species by *Bosmina longirostris*, *Bosminopsis deitersi*, *Ceriodaphnia rigaudi*, etc, and sub-class *Copepoda* contains 12 species (occupy 36.59%) with some of common species by *Mesocyclops leuckarti*, *Microcyclops varicans*, *Thermocyclops hyalinus*, etc, sub-class *Ostracoda* contains 2 species (occupy 4.88%), sub-class *Decapoda* contains 1 species (occupy 2.44%). Next is phylum *Aschelminthes* including sub-class *Rotatoria* contains 6 species (occupy 14.63%). Next is phylum *Protozoa* contains 3 species (occupy 7.32%). *Mollusca* larval contains 2 species (occupy 4.88%). *Polychaeta* larval belongs to phylum *Annelida* contains 1 species (occupy 2.44%).

The species composition of zooplankton at surveyed stations fluctuated slightly. Similarly, the density of zooplankton at surveyed stations were varied slightly as well. The highest density was at TS2 with 24,000 cell/m<sup>3</sup> (occupy 19.43%), and the lowest density was at the two stations TS0 and TS8 with 5,000 cell/m<sup>3</sup> (occupy 4.05%).

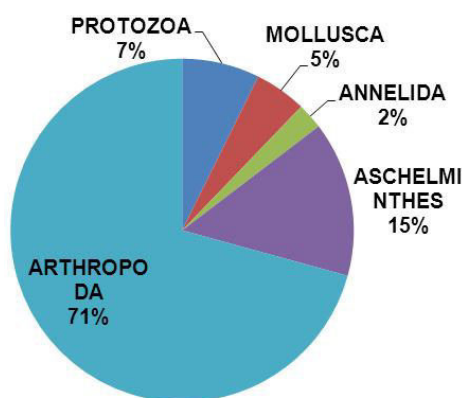


Figure 24: Structure of zooplankton species composition

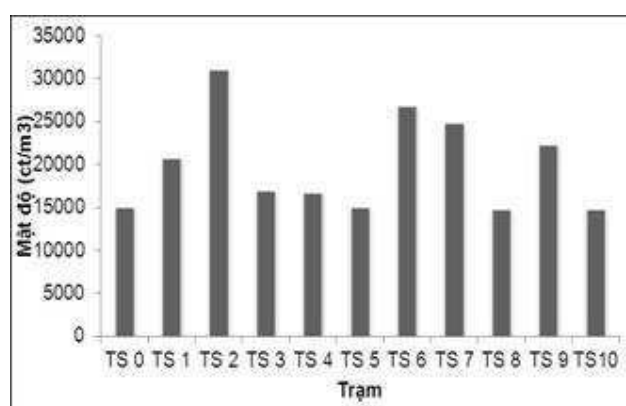
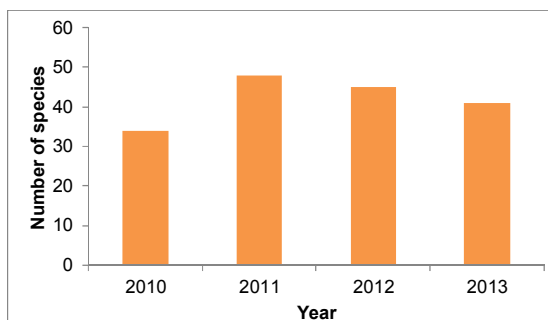


Figure 25: Fluctuation of zooplankton densities at stations

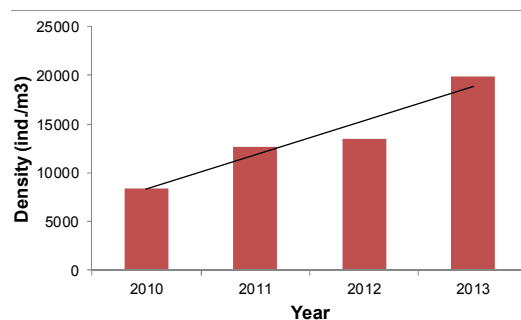
### The monitoring results from 2010 to 2013:

The four-year survey at 11 monitoring stations shows that there were 52 species of zooplankton belonging to 5 phyla in following order:

- Phylum *Protozoa*: 3 species with 5.77%
- Phylum *Annelida*: 1 species with 1.92%
- Phylum *Mollusca*: 2 species with 3.85%
- Phylum *Aschelminthes*: 11 species with 21.15%
- Phylum *Arthropoda*: 35 species with 67.31%



**Figure 26: Variation of number of species zooplankton in 2011-2013**



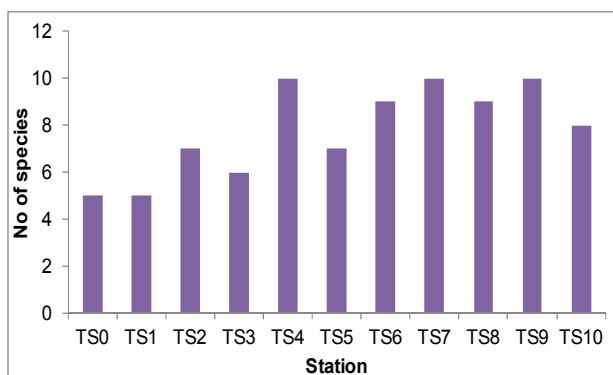
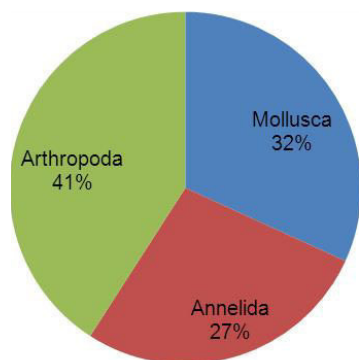
**Figure 27: Variation of densities of zooplankton in 2011-2013**

. The highest number of species was found in 2011 with 48 species, next was 2012 year with 45 species and the lowest was in 2010 with 34 species. Variation of number of species zooplankton shows a trend of decrease from 2011 to 2013.

For the density of zooplankton, there was lightly increase variation of densities of zooplankton in four years. In which, average density of zooplankton in 2010 was 8,432 individual/m<sup>3</sup>, in 2011 average density was 12,659 individual/m<sup>3</sup> and 2012 average density was 13,500 individual/m<sup>3</sup> and the last, year 2013 average density was 19,886 individual/m<sup>3</sup>.

#### 7.1.4. Zoobenthos

The species composition of zoobenthos found at 11 surveyed stations contains 22 species belong to 6 classes, 3 phyla. Phylum *Arthropoda* was the highest number of species with 9 species (occupy 40.91%), next is phylum *Mollusca* contains 7 species (occupy 31.82%), and phylum *Annelida* was the lowest number of species with 6 species (occupy 27.27%).



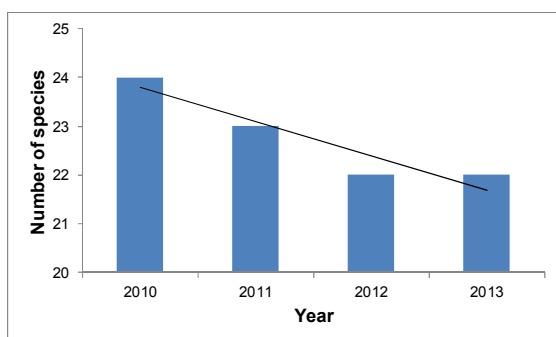
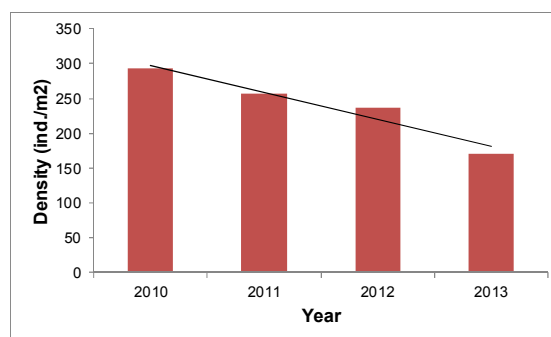
**Figure 28: Percentage of zoobenthos composition at all stations (by phyla)****Figure 29: Graph on Fluctuation of zoobenthos species composition at all stations**

Fluctuation of zoobenthos species composition at all stations with the number did not exceed 10 species. The highest species composition was at TS4, TS7 and TS9 stations contained 10 species (occupy 45.45%), next is the two stations TS6, TS9 contained 9 species (40.91%). The species composition of remaining station was fluctuated from 6 to 8 species (occupy 27.27 to 36.36 % the total of species).

#### **The monitoring results from 2010 to 2013:**

The monitoring results show that there were differences of species number zoobenthos in four years with the decreasing trend. The highest was 24 species in 2010, next was 23 species in 2011 year and the lowest was 22 species in 2013.

For the density of Zoobenthos, there was slightly fluctuation and with decreasing trend in four years. The highest average density was 292 individual/m<sup>2</sup> in 2010 year, and these densities were regular decrease in 2011, 2012 and the lowest density was 170 individual/m<sup>2</sup> in 2013 year.

**Figure 30: Variation of number of species zoobenthos in 2011-2013****Figure 31: Variation of densities of zoobenthos in 2011-2013**

#### **7.1.5. Fishery productivity in Be River**

##### **❖ Binh Duong Province:**

Based on the data of DARD of Binh Duong Province in 2012 show that, aquaculture productivity in 2012 was nearly 20 times higher than that in 2003 (302 tons) and increased approximately 35 times compared to 1996 (189 tons). In recent times, the increase of aquaculture productivity is rather high [Table 9].

**Table 11: Fisheries development situation in Binh Duong Province**

No.	Indicators	Unit	2007	2008	2009	2010	2011	2012
1	Aquaculture							
	- Area	Ha	469	495	517	398	420	415
	- Productivity	Ton	4059	4559	4906	5381	6616	-

2	Fishing	Ton	518	468	536	280	264	250
3	Total output	Ton	4577	5027	5442	5661	6880	7200

Source: Binh Duong DARD

Currently, the Economic Division of DARD is managing fisheries activities in Binh Duong Province. At district level, the management unit is the district Economic Division and the Commune People's Committee directly manages households.

❖ Binh Phuoc Province:

Based on the annual report of the Binh Phuoc DARD, the total fisheries productivity in the whole province has increased over the years for both fishing and aquaculture sectors until 2009 [Table 10]. Total fisheries production was 643 tons and aquaculture productivity 7,078 tons in 2009. Since 2010, however, fishing and aquaculture productivity have decreased. Up to 2012, the fishing productivity was 377 ton, and the aquaculture productivity was 4,637 ton in the whole province.

The statistics shown that between 2007 and 2009 the area of fish cultivation increased by 9%; the aquaculture output rose by 17%; Fisheries output rose nearly 16%, but the productivity of later years has decreased gradually. Fishing in pond and cage are the main types. In 2011, there were 126 cages, a decrease 2010 with 133 cages.

In the whole province, there are 07 clubs "**Aquaculture Extension Club**" that helps farmer households develop their aquaculture careers. For aquaculture section, there are 05 teams "**Team of Capture Fisheries and Resource Protection**". The member votes the management board. In order to help the teams operating well, contribute to protect the fisheries resources, the aquaculture department participates in regular activities, opening training courses on technical introduction, propagandizing the law for aquatic resource protection, and help them with the breeder to renew the resources.

**Table 12: Fisheries development situation in Binh Phuoc province**

No.		Unit	2007	2008	2009	2010	2011	2012
1	Aquaculture							
	- Area	Ha	2118	2229	2496	2295	2113	2065
	- Productivity	Ton	5269	6102	7078	6393	6052	4637
2	Fishing	Ton	488	559	643	412	357	377
3	Total output	Ton	5757	6661	7721	6926	6409	5014

Source: Binh Phuoc DARD

It is not similar to Binh Duong Province: the Fisheries Division – Binh Phuoc DARD takes the responsibility to manage fisheries activities, support technologies to fishermen and plays a role as an advisory unit for the DARD on the fishery aspect in the whole provincial area. The fishing activities are managed by the Commune People's Committees.



**Status of fishery resources in the Phuoc Hoa reservoir and downstream of the dam:** Due to the fact that Phuoc Hoa reservoir is a reservoir with the open ecosystem, the species composition in the reservoir and along Be river did not changed too much. In the temporary report, the consultant presented surveyed species and updated the survey data of package MT6 by seasons that were presented in the six-monthly report and previous annual reports.

Based on the newest data provided by MT6, total of 120 species fish and shrimp were identified at eleven surveyed stations belong to 11 orders, 31 families, and one specie of Riceland river prawn (*Macrobrachium mirabile*) and one specie of Giant river prawn (*Macrobrachium rosenbergii*) (see Item 6.1.1 in this report).

**The situation of fisheries and aquaculture sectors in upstream reservoir and reservoir areas:**

Fishing sector: At present, the local government has not yet conducted an inventory of the numbers of fishery households and the fishing output in the reservoir. Based on the survey results, the consultant MT4 found that many fisherman came from other provinces. These fisherman used many types of fishing gear such as fishing nets, fishing rods, fishing spears and even electrical tackles. This problem has not been addressed by the local government. These fisherman even caught fishes in the fish pass (this information was given by the local people).

After the Fisheries Associations were established with the support of local authorities, relevant agencies such as Aquatic Centers, Agriculture Department have provided training, propaganda for aquatic resource protection, promulgating the regulation for team members. The exploitation and protection of fisheries resources of Phuoc Hoa and Be River is performed under co-management model. However, the government agencies have not prevented the exploitation activities in the fish pass timely. In addition, fishing by electric shocks has not been prevented yet.

Aquaculture sector: At present, there are 02 fishing cages in Tan Thanh Communes along the Be river. In Binh Phuoc Province, some households living in the semi-flooded area are digging fishponds spontaneously (Hamlet 2, Minh Thanh Commune).

## **7.2. Terrestrial biodiversity of Lo Go – Xa Mat National Park (NP)**

Based on the implementation results of package MT1, the terrestrial biodiversity has been mentioned, the mentioned results in MT1 report were the retrospective results of previous studies and the implementation results of package MT1 as follows:

The Birdlife Organization in 2000 reported that NP had many race species with large number of individuals. Institute of Tropical Biology in 2001 reported that

have 29 species in which included some important species such as black-shanked douc langur (voọc chà vá chân đen), silver langur (voọc bạc), pig-tailed monkey (khỉ đuôi lợn), etc. There are 149 species of birds (estimated there are 162 to 173 species) in which there are 3 rare species: *Lophura diardi* (gà lôi hồng tía), *Leptotilos javanicus* (già đẫy Java), *Ciconia episcopus* (hạc cổ trắng). About amphibians, there are 23 species, in which mainly contain *Ichthyophis bannanicus* (ếch giun) and *Michryla picta* (nhái bầu); there are 56 species of reptiles including lizards.

The results of investigating 10 monitoring routes and interviewing 6 hunters for common fauna that frequently appear in Lo Go – Xa Mat National Park as follows:

There are 33 species of birds was identified preliminary. The most appearance species are *Anthracoseros* (cao cát), *Copsychus* (chích chòe), *Phasianidae* (gà rừng), *Dicrurus paradiseus* (chèu bẻo cò đuôi chẻ), *Streptopelia chinensis tigrina* (cu gáy), *Lophura* (gà lôi). In addition, there are *Fringillidae* (se sẻ), *Accipiter trivirgatus* (ó), *Pycnonotus jocosus* (chào mào), *Megalaima lineata* (cu rốc), *Podargidae* (đớp muỗi), *Polyplectron germaini* (gà tiền mặt đỏ), *Parus major* (khướu bạc má), *Anas platyrhynchos* (le le), *Sturnidae* (sáo nghệ), *Oriolidae* (vàng anh), *Falconidae* (bù cắt), *Dicaeidae* (chim sâu), *Pharacrocoraxniger* (công cọc), *Strigidae* (cú mèo), *Treron* (cu xanh), *Gracupica nigricollis* (cường), *Francolinus pintadeanus* (đà đà), *Ardeidae* (diệc), *Accipiter bicolor* (diều hâu), *Muscicapidae* (đớp ruồi), *Buceros bicornis* (hồng hoàng), *Gracula religiosa* (nhông), *Coraciiformes* (sa sả).

About animals, preliminarily identified some species such as wild pig (lợn rừng), *Macaca fascicularis* (khỉ đuôi dài), *Tragulidae* (cheo cheo), *Viverricula indica* (chồn hương), *Sciuridae* (sóc), *Viverra megaspila* (chồn mướp), *Felis silvestris* (mèo rừng), *Hylopetes spadiceus* (sóc bay), *Pholidota* (trút), *Mustelidae* (chồn đen), *Martes flavigula* (chồn vàng), *Nycticebus coucang* (cu li), *Macaca nemestrina* (khỉ đuôi lợn), *Hystricidae* (nhím),...About Reptiles and Amphibians there are snake, *Gecko gecko* (tắc kè), *Varanidae* (kỳ đà), *Daboia russelii* (Rắn hổ bươm), *Pteranodon* (thằn lằn bay), etc.

## **8. Soil condition**

Assessment of the monitoring results was made in the Duc Hoa irrigation area in 2013. In this period, the monitoring activities have been done in October. The results were presented as follows:

### **8.1. Soil**

- The  $\text{pH}_{\text{H}_2\text{O}}$  value at monitoring locations in this period varied from 3.43 to 4.78. The  $\text{pH}_{\text{H}_2\text{O}}$  value at most of monitoring locations met the standard TCVN 7377:2004 Soil quality - pH indicator value in the land of Vietnam. The  $\text{pH}_{\text{KCl}}$  value at most of monitoring locations fluctuated from 2.47 to 3.76. Within total 6 monitoring locations, the strongest acidity was measured at S6 station, the level of acidity at S3 station was less than the other locations. The difference of pH values measured in soil depth at each monitoring location is not much.
- Most of soil samples had the organic contents in range from high to very high. The total organic carbon content of soils varied from 0.34% to 7.03%, most of them met the standard TCVN 7376:2004 Soil quality – Carbon content indicator value in the land of Vietnam.
- Total Nitrogen content in monitored samples in October 2013 varied from 0% to 0.46%, especially Total Nitrogen content was not detected at some locations, while this value was too high at some other locations, exceeding the allowable limit of the standard TCVN 7373:2004 Soil quality – Nitrogen content indicator value in the land of Vietnam (S5 and S6 positions).
- Soil at project areas appeared with the poor level of total Phosphorous or not detected, all monitored results (October 2013) met the allowable limit of the standard TCVN 7374:2004 Soil quality – Phosphorous content indicator value in the land of Vietnam. The highest value of total Phosphorous was appeared in the top soil layer of the monitoring station S51 with 0.248%.

#### **Comparison of the monitoring results from 2010 to 2013:**

- The monitoring results of 2013 show that the  $\text{pH}_{\text{H}_2\text{O}}$  value tends to increase slightly, but less significant than the results in the 2010-2012 period at overall monitoring locations.
- The nutrient contents in the dry season of 2013 were less than that from 2010 to 2012 at S1, S2, S3, S4, and S4 locations, but they still met the standard TCVN 7373-2004; the value at S5 and S6 locations was no change in compared with the 2010-2012 period, and exceeded the standard TCVN 7373-2004.

- For the total Fe content, there was no significant change between the monitoring results of the dry season in 2013 and the 2010-2012 periods.

In general, the monitoring results indicate that the construction activities of the transfer canal have not affected the acidity in the project areas yet.

## **8.2. Soil solution**

In the monitoring stage, the soil solution in monitored areas contained a high acidic content. The pH value of most soil samples was less than 4 (except SW21 position) and varied from 3.33 to 4.56.

Total Nitrogen content in the soil solution varied from 17.63 to 42.59 ppm. Total Phosphorous content in soil solution varied from 0.87 ppm to 2.94 ppm.

$\text{SO}_4^{2-}$  concentration in the soil solution at monitored locations varied from 214.65 ppm to 286.23 ppm, the lowest value appeared at SW12 and the highest value appeared at SW11.

These monitoring results are similar to the soil testing results in this areas, it shows that the veneer soil in Duc Hoa irrigation area has the properties of actual acid sulphate soils with the high toxins and poor nutrition. Because one of major tasks of Duc Hoa canal is improved the soil quality by water resources for agricultural section. Nevertheless, up to October 2013, the soils in this region have not been improved due to the Duc Hoa construction has not finished yet.

## **9. Monitoring results of Administration House**

As mentioned in the previous reports, the monitoring results have no significant differences. There are about 15 staffs of company working at Administration House frequently. Groundwater is using for domestic purpose and the wastewater has been collected into storage containers, deposition tanks and then being penetrated into ground. Domestic solid wastes with mainly organic wastes and a small amount have been gathered for drying and burning. The traffic density acrossing dam area is rather low, hence air is fresh and unpolluted.

- Waste water has been collected and flowed into the septic tank and seepage, the tank was constructed following the technical design and located away from the dam about 150 m, There are about 6-10 workers working in the Administration House, so wastewater is negligible.
- For the Air quality: the Administration House located far away from residential areas, traffic density is too low, mostly motorbikes. At all monitoring locations, the air quality met the standard QCVN 05:2008/BTNMT, noise was measured with value 25 dBA, temperature is 30°C, and humidity is 70 %, equivalent to the air, temperature and humidity in this area at the same time.

The Administration House are complied with environmental hygiene requirements, and they do not cause any negative impacts on ambient air quality, as well as surface water and groundwater in this area.

## **10. Environment Awareness**

In 2013, the EMP packages have conducted with a series of tasks, which contributed to enhance the environmental awareness of communities, management agencies, and the bit packages (the constructors).

Package MT1, the capacity building and raising awareness program for the National Park management board and relevant agencies was held in May 2013. The program has helped management staffs and local people comprehending more about the Tan Bien Irrigation Project, the important role of the National Park's preservation, land clearance, compensation and resettlement of the project, and the other issues relating to the environmental protection. Also in the scope of works, MT1 Consultant organized on tours to Cat Tien National Park.

Package MT2, the consulting workshop on Land use planning, land allocation, and protective forest in the Phuoc Hoa Reservoir that was held in March 2014. The workshop has helped staffs and local people comprehending more about the important role of the protective forests of reservoir and the water resource protection, aquiculture development, preventing erosion and deposition that help prolong the life of the lake.

Package MT7, after signing the extension contract, they have conducted the significant tasks, including meeting with the constructors, conducting field surveys and consulting the communities in the surrounding areas. Thereby officials explained and advised the technical solutions to help the environmental managers has more experience as well as greater awareness of environmental protection the sites.

In the last phase, Package MT10 belongs to EMP packages of Phuoc Hoa Project is conducted with major objectives as follows: (i) Raising stakeholder's and manager's understanding of fundamental concepts and background science of environmental, water resources and natural resources management, as needed within the project development sites, surrounding areas and effected river basins in order to protect the environmental, water and natural resources; (ii) Enhancing the awareness of Project and EMP stakeholder's and manager's of: the potential environmental impacts of the project, content and function of the EMP framework and monitoring sub-programs applied to address impacts; and the role of the involvement of project managers, contractors, state agencies and the local community in implementation of the Project and in protection of local and regional environment, water and natural resources.

Nevertheless, throughout these workshops and also community contacts in the process of implementing project could make sure that the present environmental awareness of local communities are still low. It is difficult to change the habit of life and production of local people, which had been shaped for a long time by few

training workshops.

In addition, only a small part of local people and managers have opportunity to access and know the major information of the project, so that the propagation is still limited and has not the effective results in the community, the role of local authorities has not performed well. Therefore, right places, where were organized the training workshops, local people still have activities that harm the environment and the project (*that was mentioned in the previous reports*). These are the encroachment of the local people on the land that was acquired for the forestation to protect the Phuoc Hoa Reservoir catchments, many people living around the reservoir area built toilets inside the reservoir, fishing in the reservoir by forbidden tackles using electrical shock, and even fishing right the fish pass, etc. For the constructors, although the project has official provisions for environment protection and consequently receipt the reminders and warnings from supervisors, however some constructors has not executed right the environment protection engagements that cause environment pollution and adverse effect on local people.

Overall, it can be concluded that the practices of enhancing propagation, education, training to raise the local communities' and manager's awareness of environment protection are very essential, even when the project put into operation. On the other hand, it needs to pay attention to reasonable and practical sanctions, policy mechanism, and social support programs, etc.

## **11. Conclusions and Recommendations**

### **11.1. Conclusions**

#### *11.1.1. The natural and social environments*

The monitoring results of the EMP packages show that the water quality at monitoring stations in Be, Dong Nai, Sai Gon Rivers was rather good, it is suitable for aquatic conservation and irrigation water supply. However, the lower areas and estuaries of Dong Nai, Vam Co Dong and Sai Gon Rivers are affected by salinity intrusion in the dry season, the increase in the organic matter and micro organism contaminations, hence create negative impacts on domestic and agricultural water supply. Degree of salinity intrusion effect in the dry season of 2013 was significantly declined compared to the same period of the previous years.

The practice of transferring water from Phuoc Hoa Reservoir to Dau Tieng Reservoir in the dry season of 2013 has contributed significantly to irrigation water supply, environmental water improvement, salinity intrusion reduction in the lower areas of Sai Gon River in the reach from the downstream of Dau Tieng Reservoir to Thu Dau Mot City, but the water quality has no sign of improvement from Thu Dau Mot City towards Ho Chi Minh City.

In recent period, natural environment has no sign of negative impacts of the project. However, the end of transfer canal was collapsed seriously, the collapsed area extends over 50 meters length, and 2 – 3 meters deep into the riverbank, made the TSS content and organic matter in water, which discharged into Dau Tieng Reservoir, increased significantly (these issues have been indicated in the first six-monthly report 2013).

Based on the monitoring results and the information that was provided by EMP packages and ICMB9, social issues related to the environment have not occurred in the project area. The problems of land occupation in the semi-flooded area have a suitable solution.

#### *11.1.2. EMP packages*

Package MT1: Based on the implementation results in comparison with the TOR of the consultancy contract, MT1 consultant has implemented the contract in accordance with required schedule and proposed workloads.

Package MT2: MT2 consultant has implemented the contract in accordance with required schedule and proposed workloads. Up to now, Task I was completed, Task II will be updated to be suitable for the actual situations that carry out “Land use planning and protective forestation for revocation areas (from +42.9 m to +44 m)”. The land use planning reports was prepared by the Consultant, the consulting workshops have also been arranged in localities in quarter I/2014.



**Package MT3:** Based on the implementation results in comparison with the TOR of the consultancy contract, up to now, the implementation of this package is behind schedule. In addition, MT3 consultant lacks active in contacting with local governments to complete a land use right certificate for construction of this stations.

**Package MT4:** over 92% of total work volume of the package has been finished; one of the most important task is established the Fisheries Associations has been finished so far. The consultant is preparing the final report.

**Package MT5:** The consultant implemented their works timely, but the submission of reports is still delayed, needs to be improved. The consultant is preparing the final report.

**Package MT6:** in the last six months of 2013, the consultant implemented well the requirements as indicated in the consulting contract. However, the last six-monthly monitoring report of 2013 was not submitted timely. The consultant is preparing the final report.

**Package MT7:** the consultant implemented well the requirements as indicated in the consulting contract. The consultant is preparing the first quarter report.

**Package MT8:** this package was finished. Up to now, Consultant unit continues to support the investor in supplying information, operation instruction, and equipment maintenance for monitoring stations.

**Package MT9:** At present, this package has not been conducted as planned; hence, the remaining time to implement the package is very limited. The delay of implementing the package will affect the overall assessment of the EMP packages.

**Package OP3:** Based on the implementing results and compared with the TOR, by this time, the consultant conducts their tasks as planned. However, this package is also experiencing several disadvantages in getting the support from the equipment providers.

#### *11.1.3. Advantages, disadvantages and outstanding issues:*

##### ***Advantages:***

The implementation of all EMP packages is consistent with the requirements of the proposed schedule and contents. These results have the following advantages:

- Selected consultants are capable and have experiences in implementing the tasks of the package.
- Enthusiastic support from local authorities, agencies, and local people.

- Cooperation, sharing, and support among EMP consultants.
- Coordination and timely supports from ICMB9, BVI in all cases to assist consultant in implementing their works.

***Disadvantages:***

In the last half of 2013, besides the above-mentioned advantages, the EMP tasks had certain difficulties as follows:

- For EMP packages, only 11 out of 14 packages are under the implementation but the workload is still quite big. In addition, each package implements different missions at different times. Therefore, the coordination between these packages is very difficult.
- The area of Phuoc Hoa reservoir is quite large and located in different provinces. Therefore, it was very hard to find out the problems after the reservoir has been impounded. Some typical unexpected problems were mentioned in the previous reports.
- Some generated issues in the implementing process of EMP packages need cooperation, indicator notions of Employer, Sponsor, and also local agencies, therefore impact on the implementing progress of project (MT2, MT3, MT4).
- Several consultants (MT3, MT4) have confused and lacked active in cooperating with local agencies in the implementing process.

***Outstanding issues:***

The outstanding issues, which indicated in previous reports, have been solved by consultants. However, there are still some outstanding issues as follows:

- Submission of progress reports to Employer and supervision consultant on the implementation status of packages is still slow. This affects the data collection of the OP4 consultant. In addition, the consultants did not provide fully 03 sets of reports including hardcopy and CD Rom.
- After having comments from OP4 and BVI consultants, the revision and resubmission of reports to the Employer have not been made promptly.
- During the implementation, the consultants did not inform the detailed working programs to the local government, the Employer and the supervision consultant.

## **11.2. Recommendations**

### ***11.2.1. General recommendations for EMP packages***

- Relevant agencies should resolve outstanding issues as mentioned in this report immediately.

- The consultants must comply with the deadline for the submission of reports as required in the TOR. The consultant should also summarise EMP packages implementation results in the middle and the end of the year.
- The consultants need to provide the detailed working plans to the local government during the implementation.
- For packages MT4, MT5 and MT6: the 6-monthly progress reports must be submitted before 15/02/2014.
- The consultants should submit the inception report with three full sets (hard copy and CD Rom).

In addition, as mentioned in Section 9 of this report. Training workshops on enhancing environmental awareness and raising environmental management capacity are very essential. These activities direct to the agencies, which receive, manage and operate the project (Dau Tieng – Phuoc Hoa IMC, provincial exploitation and management agencies, etc), and local authorities. Therefore, recommend the Sponsor, the Employer consider organizing these above-mentioned activities as soon as possible.

#### *11.2.2. Recommendation for each EMP packages*

- ✓ For package MT1: continues to implement next activities on the basis of the TOR.
- ✓ For package MT2: completing land use planning for the semi – flooded areas consistent with the Vietnam regulations, satisfy the purposes of project environment protection.
- ✓ For package MT3: complete the procedure for handing over land use for bumping station in Binh Duong and Long An. .
- ✓ For package MT4: the consultant should complete the final report positively.
- ✓ For packages MT5: the consultant should complete the final report positively.
- ✓ For package MT6: the consultant should complete the final report positively.
- ✓ For package MT7: Strengthen inspection and monitoring the sites, support the constructors solve the current environmental issues.
- ✓ For package MT8: continues to support the investor in supplying information, operation instruction, and equipment maintenance for monitoring stations.

- ✓ For package MT9: this package should be carried out early to have enough time to implement the requested tasks and completed before 30/09/2014.

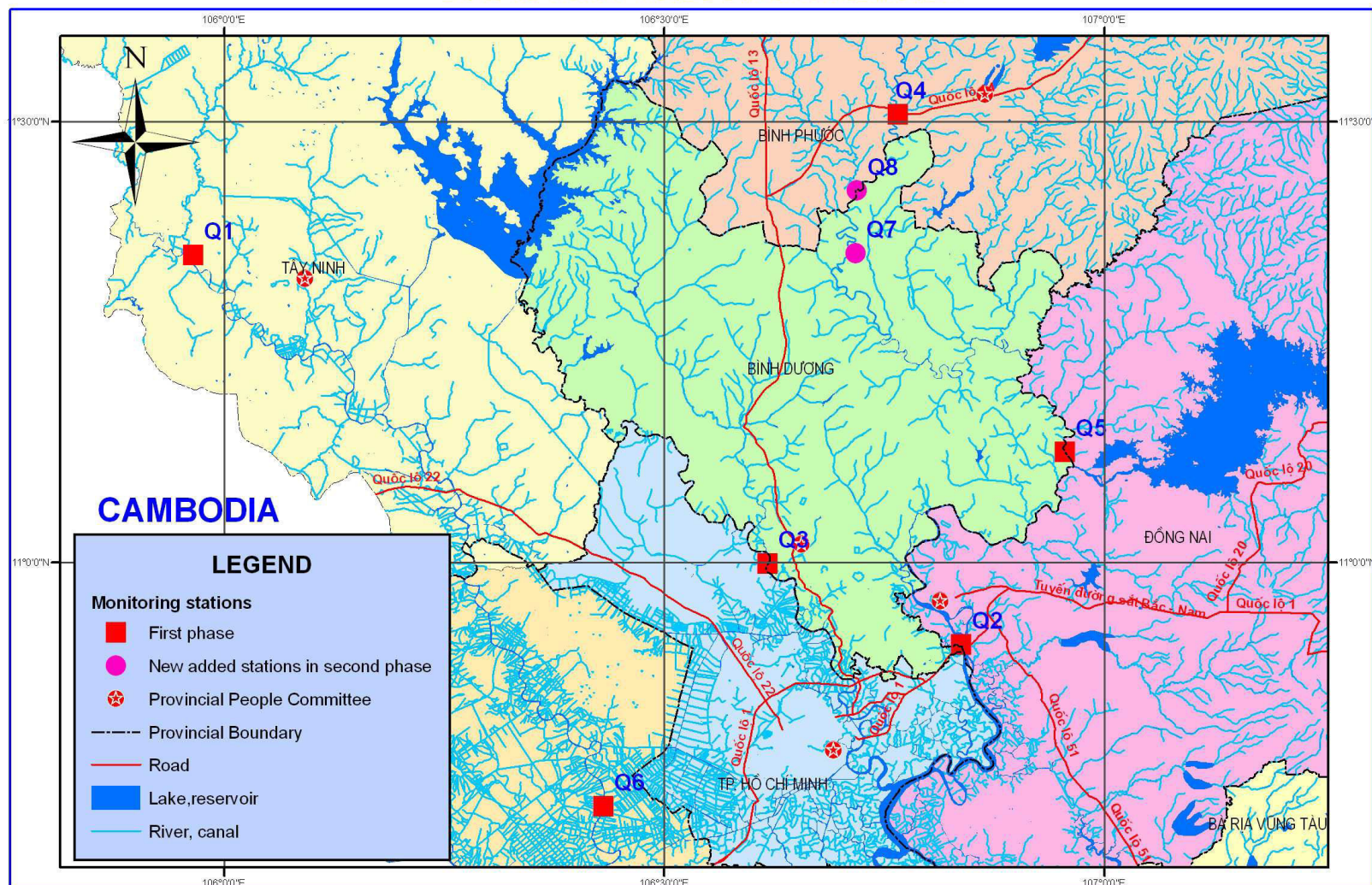
## REFERENCES

1. Detailed environmental impact assessment report of Phuoc Hoa Project, *Investment and Construction Management Board No.9 (ICMB9)*, 2007.
2. Inception report (updated) - Package MT2, *Thang Long Infrastructure Development Joint Stock Company*, 2013.
3. Report of hydrological survey in October 2013 - Package MT5, *Southern Institute of Water Resources Research (SIWRR)*, 2014.
4. Report of monitoring results in August, October 2013 - Package MT6, *Southern Institute of Water Resources Planning*, 2014.
5. Report of Binh Duong DARD in 2012 and orientation for 2013, Binh Phuoc DARD in 2011.
6. Report of Plan and Implementation situation in 2011, plan and budget statement in 2012, Binh Phuoc DARD, 2011.
7. Report of Implementation of 50,000 fruit tree plantation programme in buffer zone of Lo Go – Xa Mat National Park and Buffer Zone Economic Development Programme of Lo Go – Xa Mat National Park, *Joint Venture Southern Sub- Institute of Forest Inventory and Planning and Institute for Water and Environment Research*.
8. The brief report of the EMP packages, 2014.

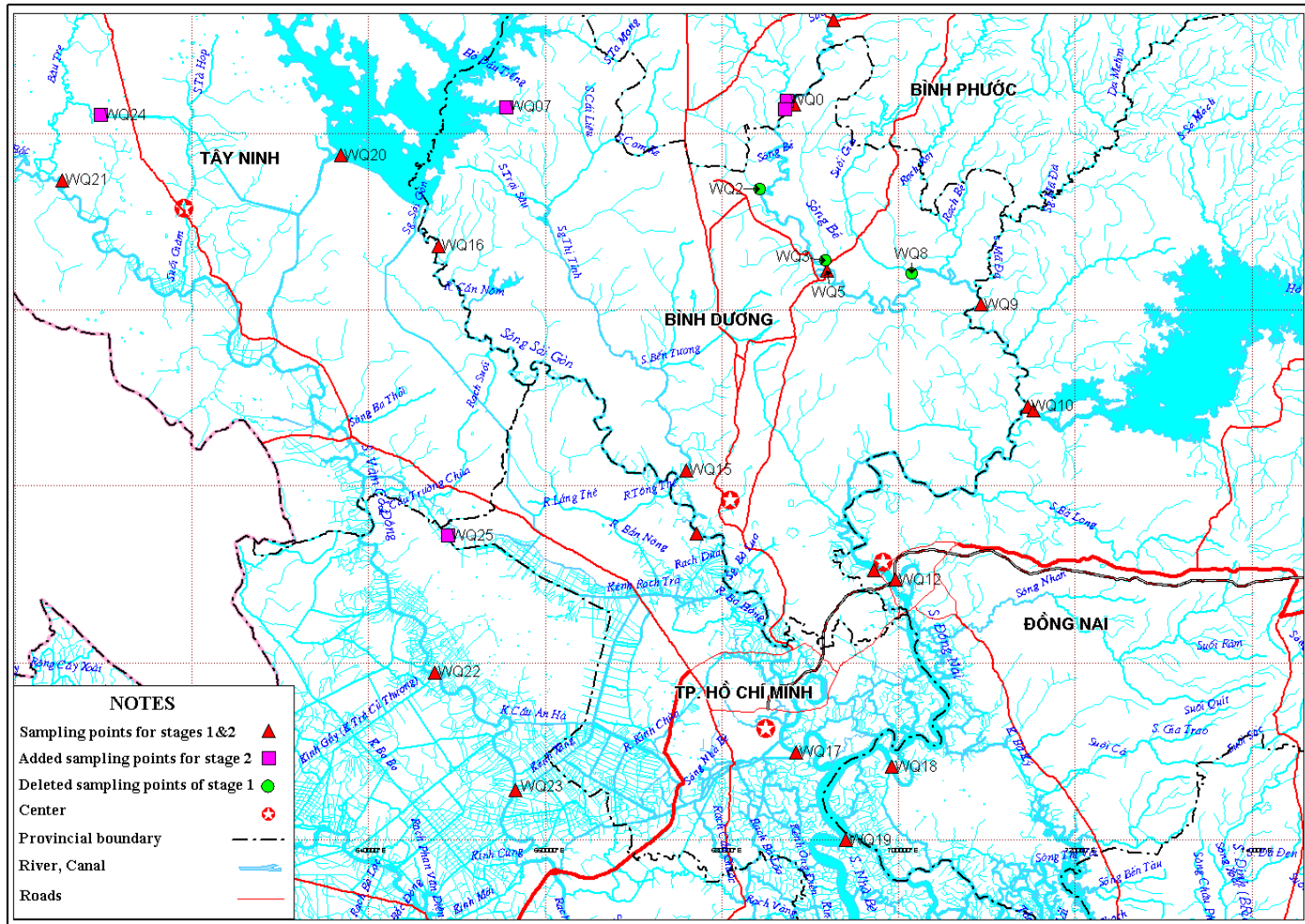
## **APPENDIX A**

### **MONITORING STATION SCHEME - PACKAGES MT5 & MT6**

# PHUOC HOA WATER RESOURCES PROJECT MAP OF FLOW MONITORING STATIONS

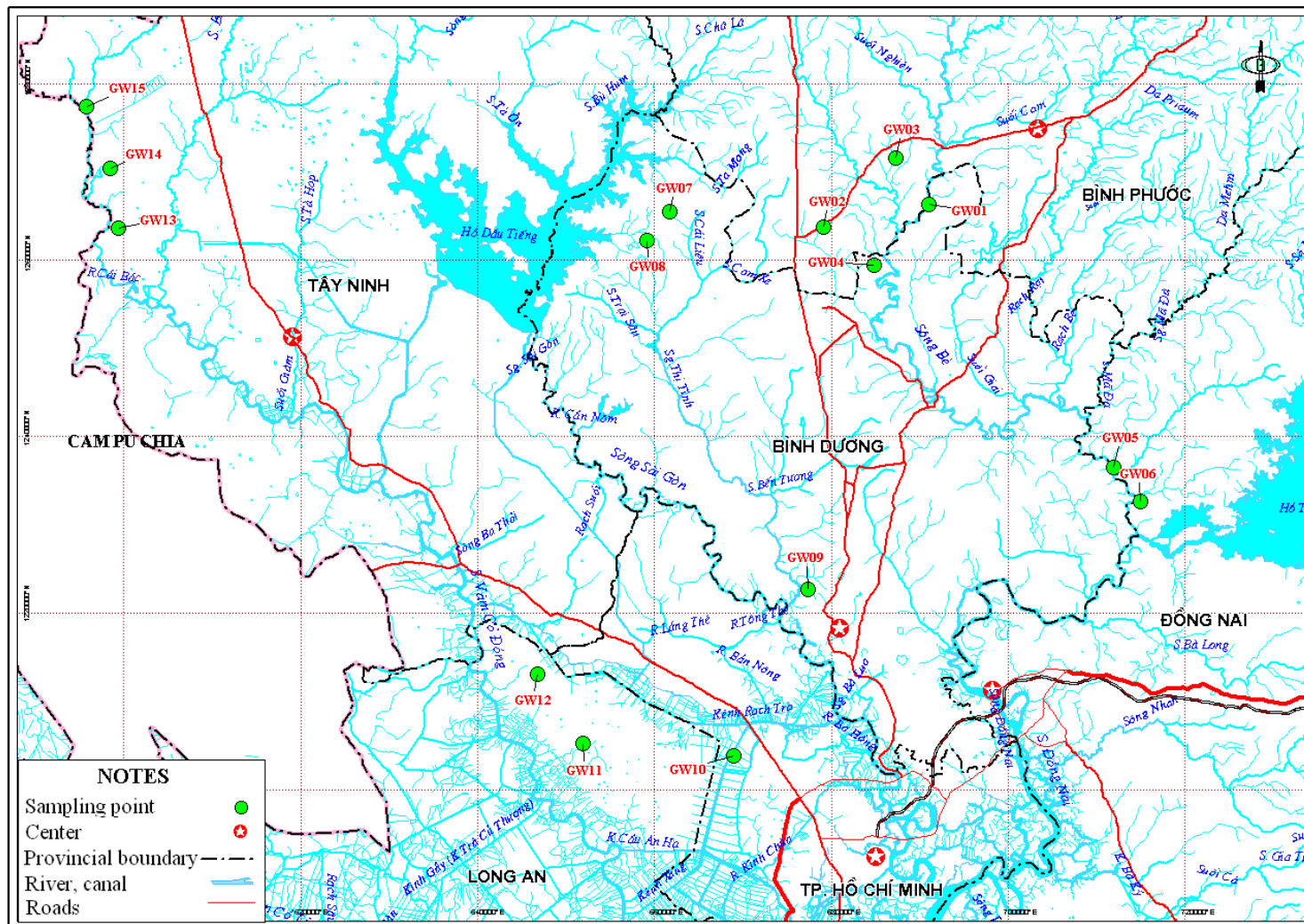


**PHUOC HOA WATER RESOURCES PROJECT  
SAMPLING MAP FOR SURFACE WATER MONITORING**

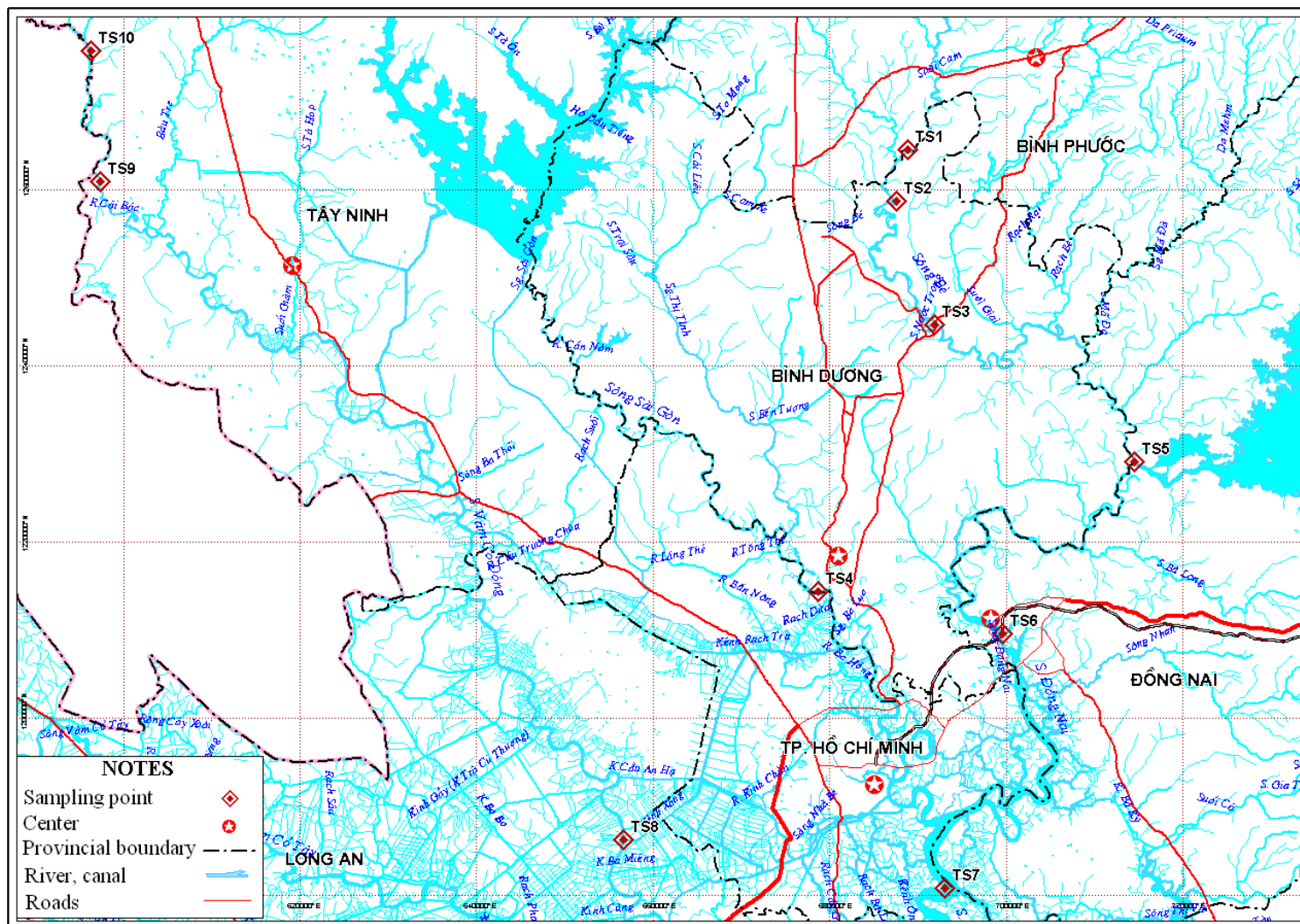




**PHUOC HOA WATER RESOURCES PROJECT  
SAMPLING MAP FOR GROUND WATER MONITORING**



**PHUOC HOA WATER RESOURCES PROJECT  
SAMPLING MAP FOR AQUATIC BIOLOGY MONITORING**



**NOTES**

- Sampling point
- Center
- Provincial boundary
- River, canal
- Roads

## APPENDIX B

### OBSERVED WATER LEVEL & DISCHARGE – MT5 PACKAGE

#### 1. Station: Q1 (Vam Co Dong River)

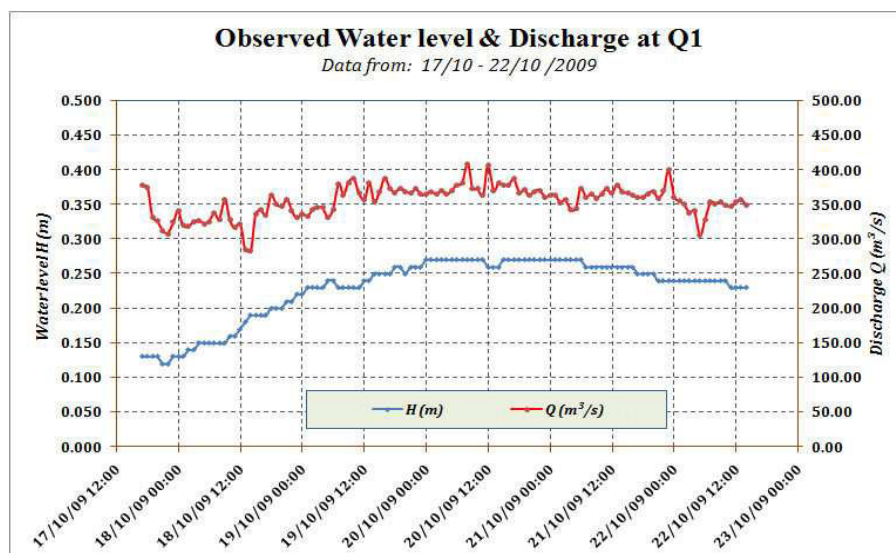


Figure 1: Observed Water level and Discharge at Q1 (October 2009)

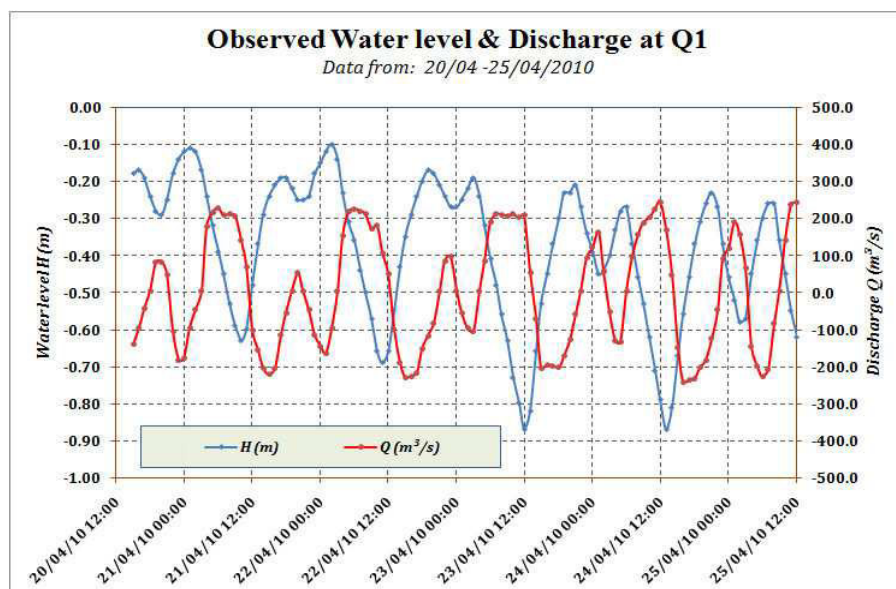


Figure 2: Observed Water level and Discharge at Q1 (April 2010)



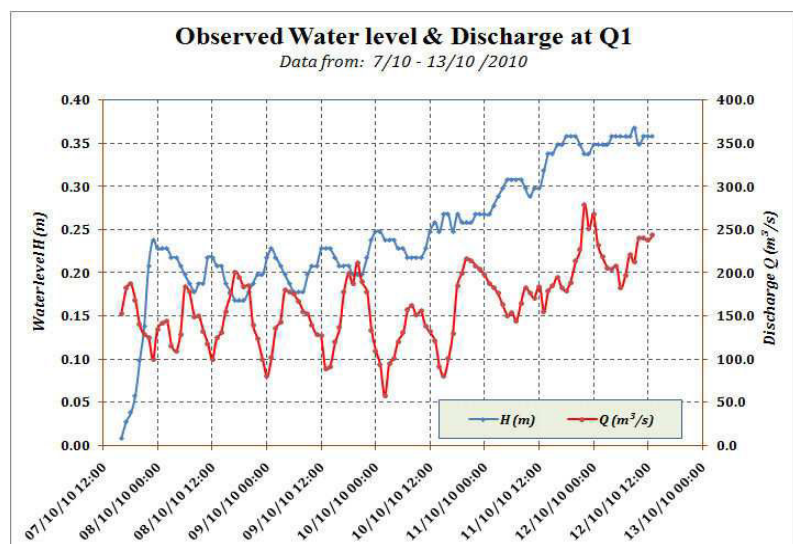


Figure 3: Observed Water level and Discharge at Q1 (October 2010)

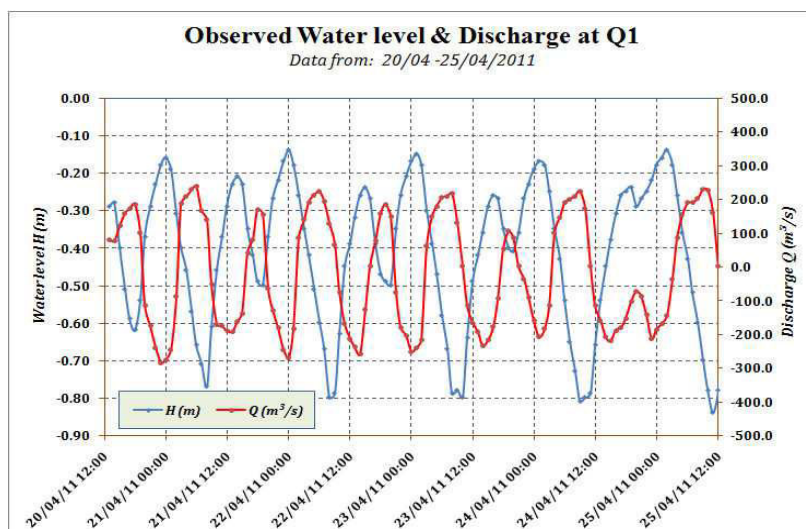


Figure 4: Observed Water level and Discharge at Q1 (April 2011)

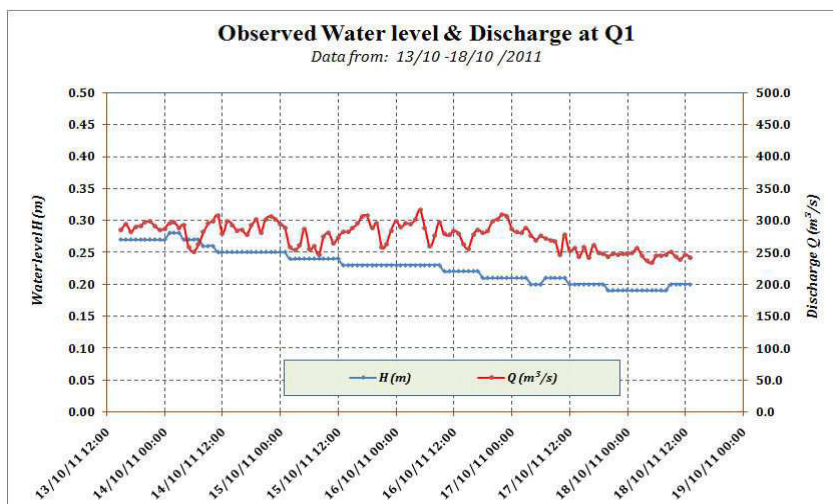


Figure 5: Observed Water level and Discharge at Q1 (October 2011)

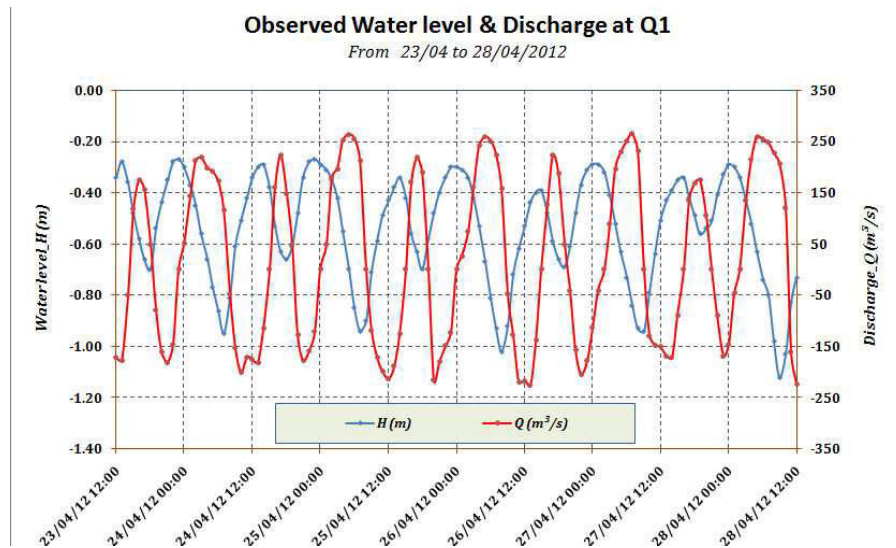


Figure 6: Observed Water level and Discharge at Q1 (April 2012)

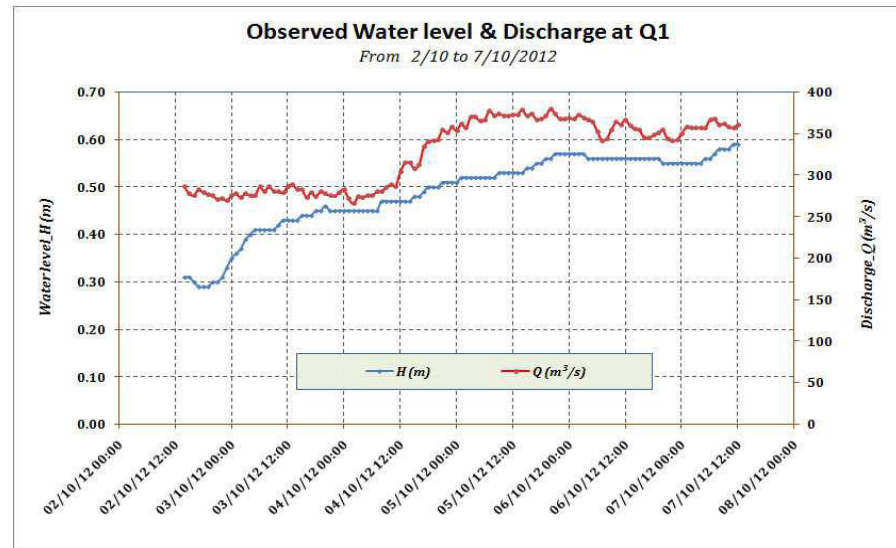


Figure 7: Observed Water level and Discharge at Q1 (October 2012)

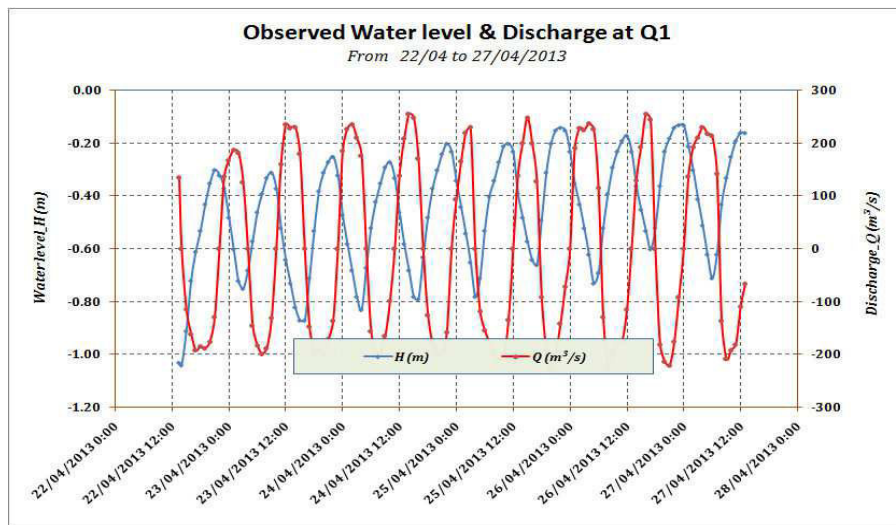


Figure 8: Observed Water level and Discharge at Q1 (April 2013)

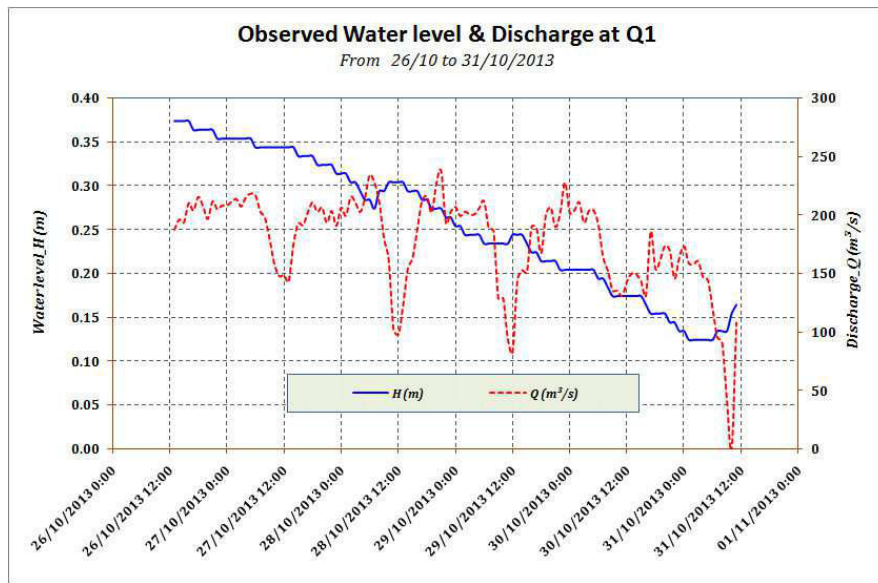


Figure 9: Observed Water level and Discharge at Q1 (October 2013)

## 2. Station: Q2 (Dong Nai River)

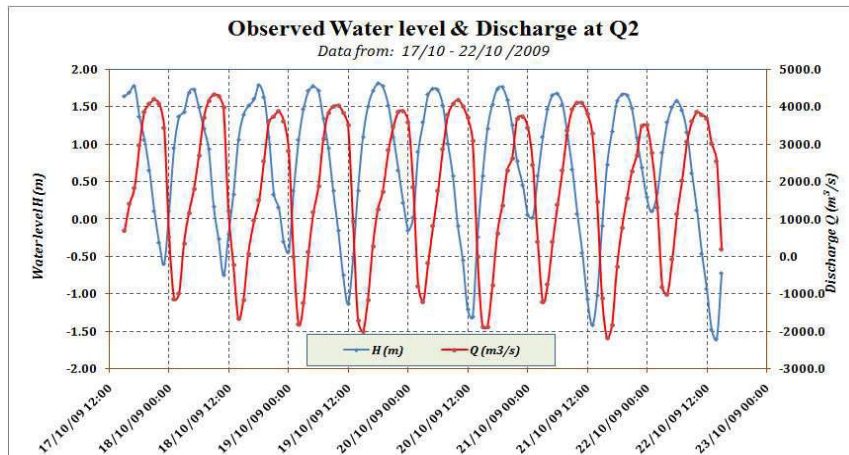


Figure 10: Observed Water level and Discharge at Q2 (October 2009)

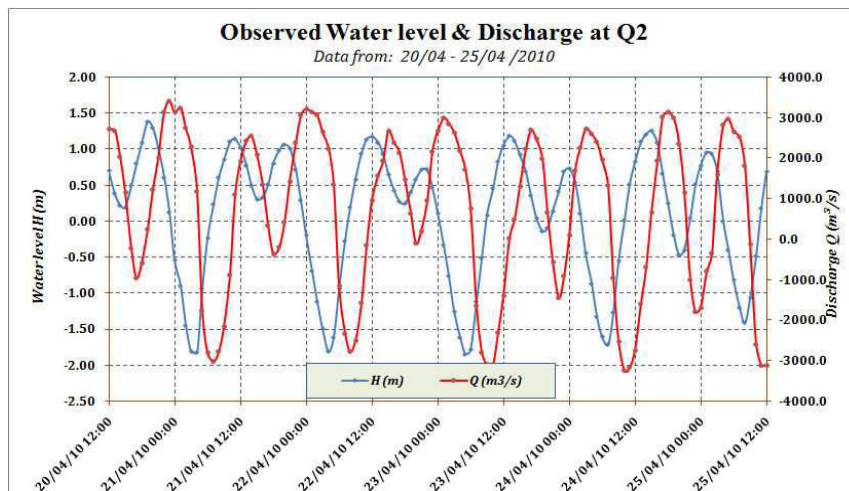


Figure 11: Observed Water level and Discharge at Q2 (April 2010)



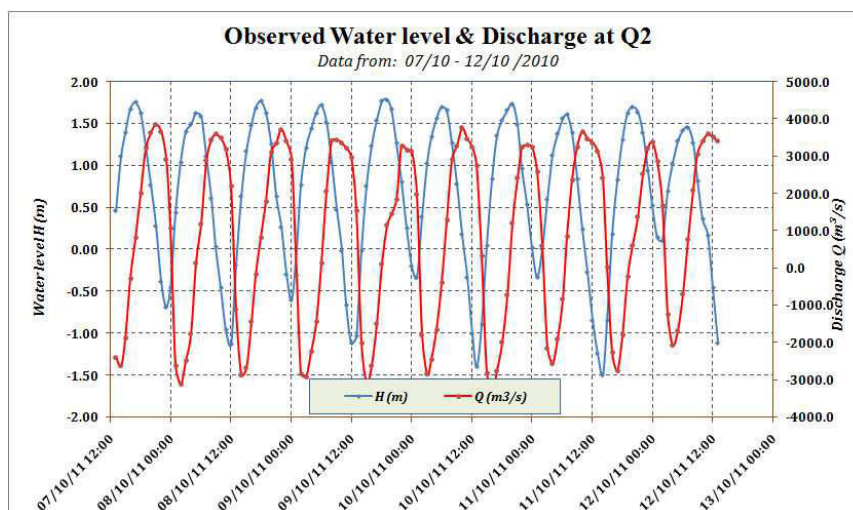


Figure 12: Observed Water level and Discharge at Q2 (October 2010)

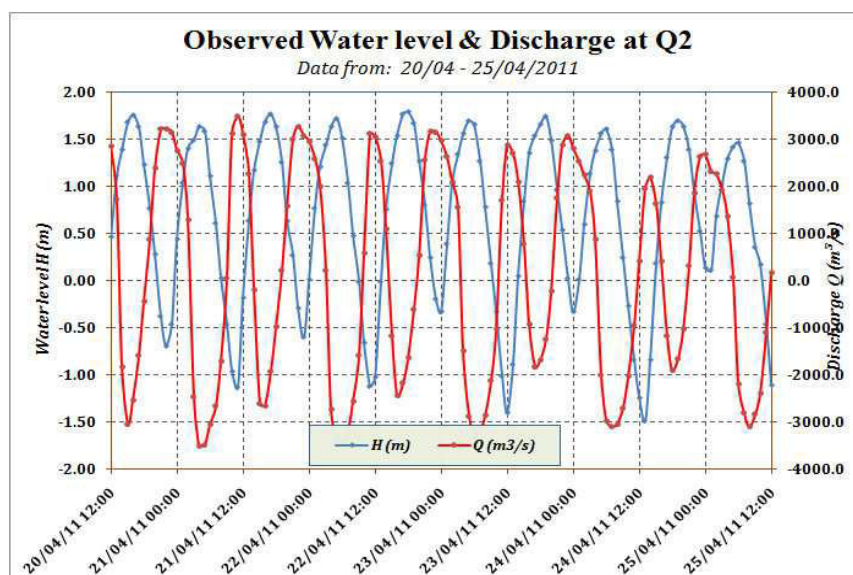


Figure 13: Observed Water level and Discharge at Q2 (April 2011)

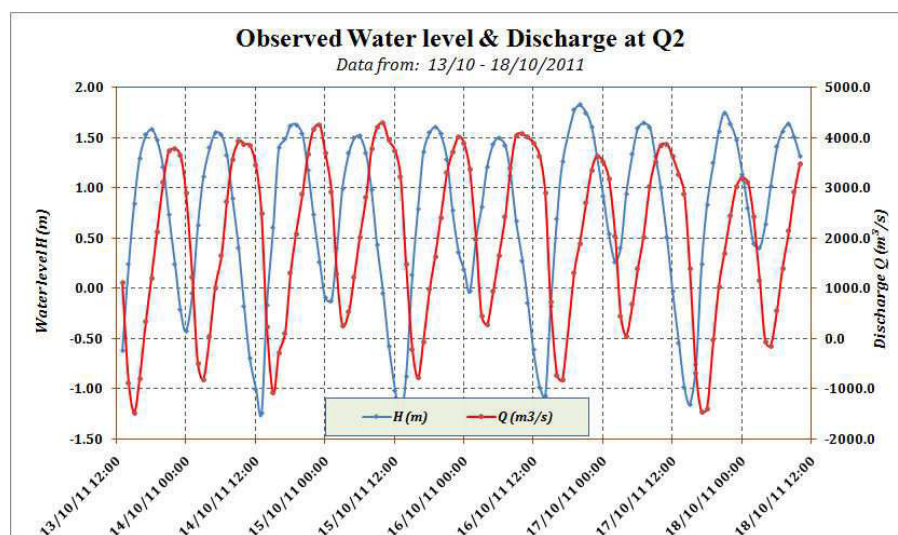


Figure 14: Observed Water level and Discharge at Q2 (October 2011)



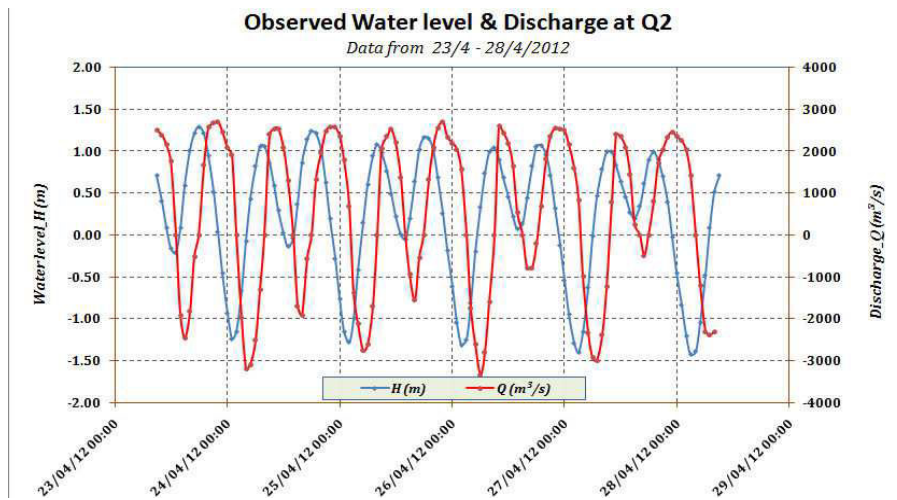


Figure 15: Observed Water level and Discharge at Q2 (April 2012)

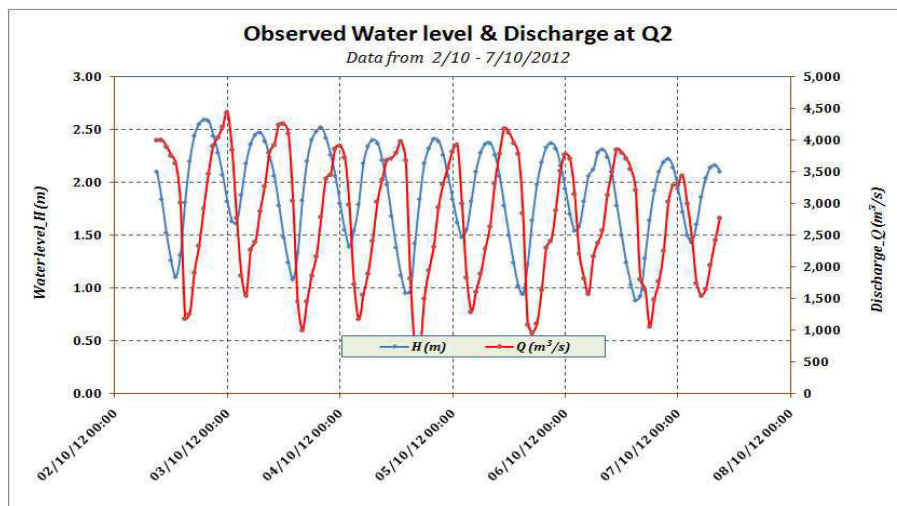


Figure 16: Observed Water level and Discharge at Q2 (October 2012)

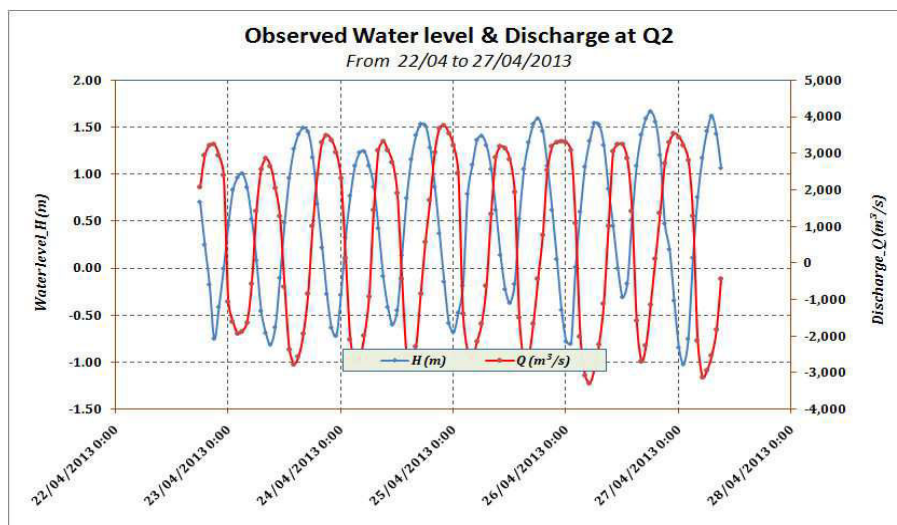


Figure 17: Observed Water level and Discharge at Q2 (April 2013)

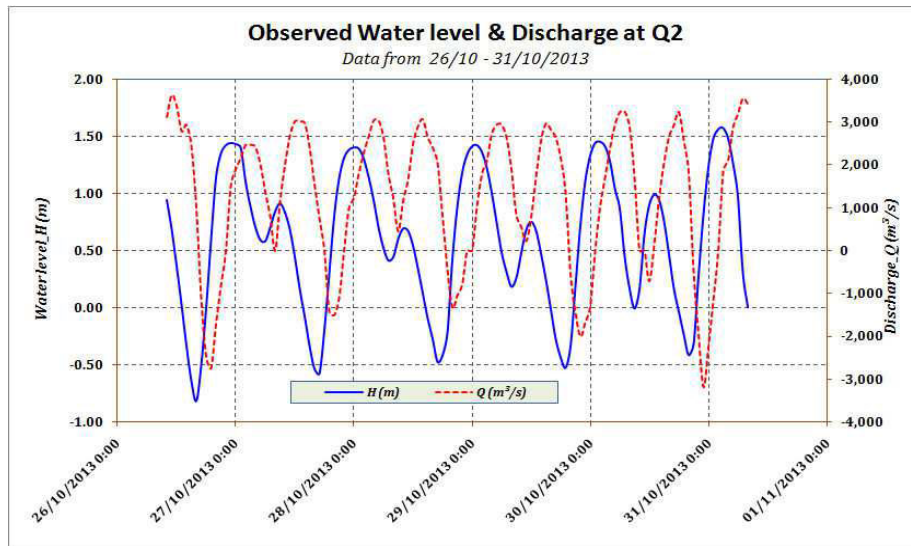


Figure 18: Observed Water level and Discharge at Q2 (October 2013)

### 3. Station: Q3 (Sai Gon River)

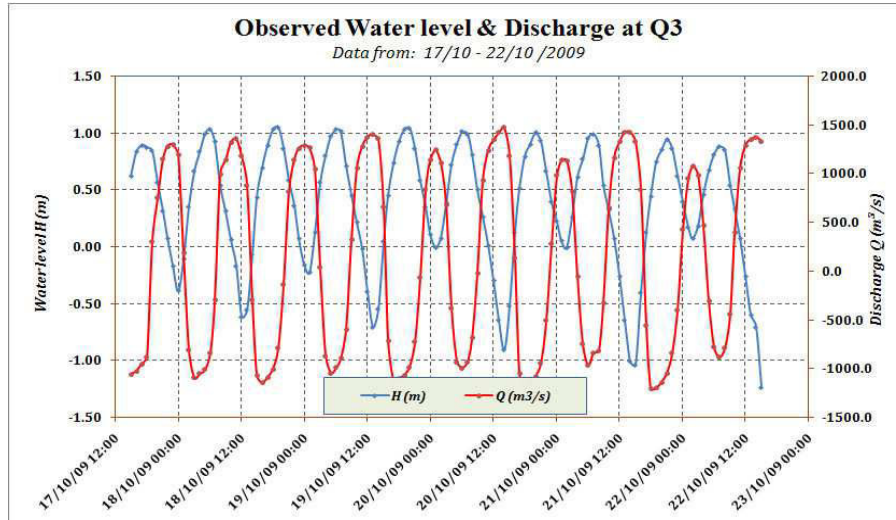


Figure 19: Observed Water level and Discharge at Q3 (October 2009)

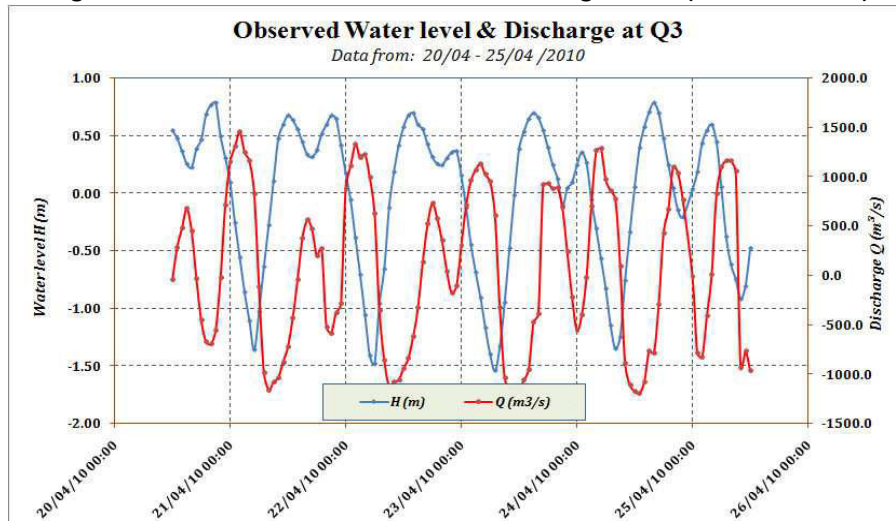


Figure 20: Observed Water level and Discharge at Q3 (April 2010)

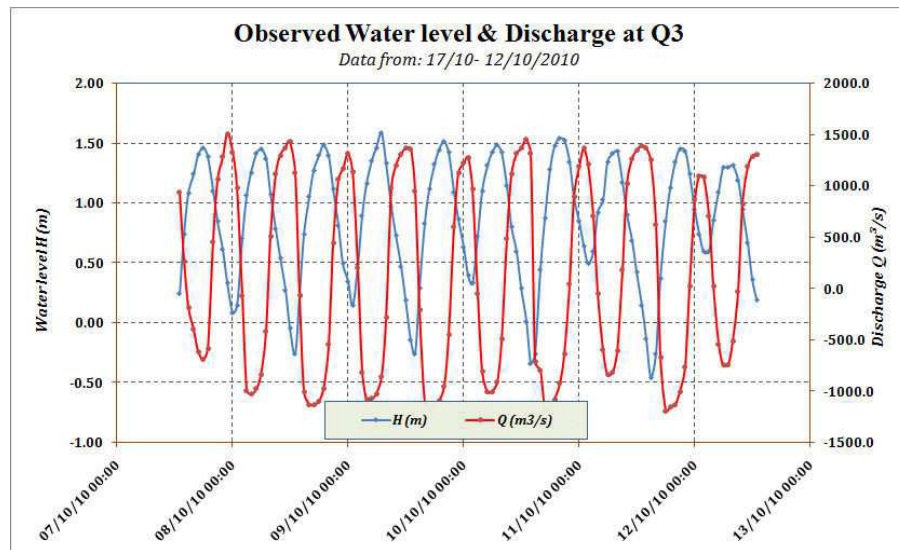


Figure 21: Observed Water level and Discharge at Q3 (October 2010)

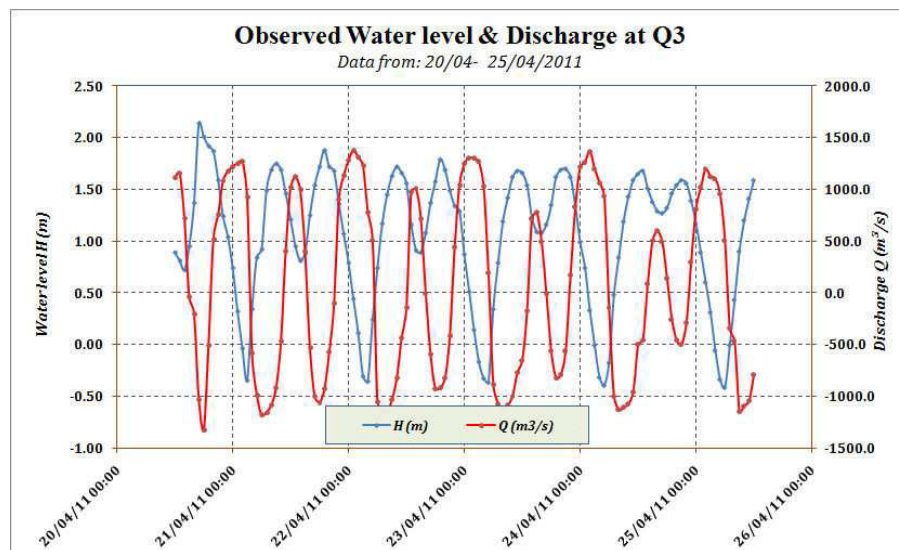


Figure 22: Observed Water level and Discharge at Q3 (April 2011)

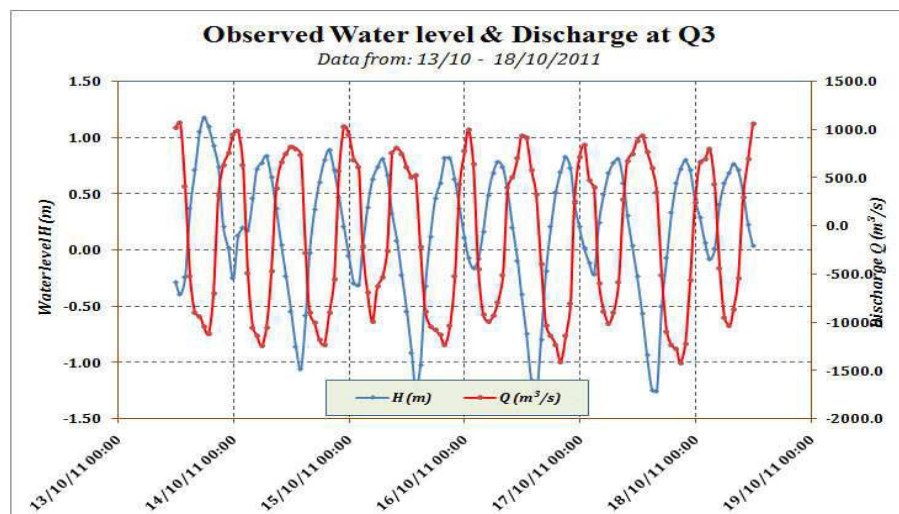
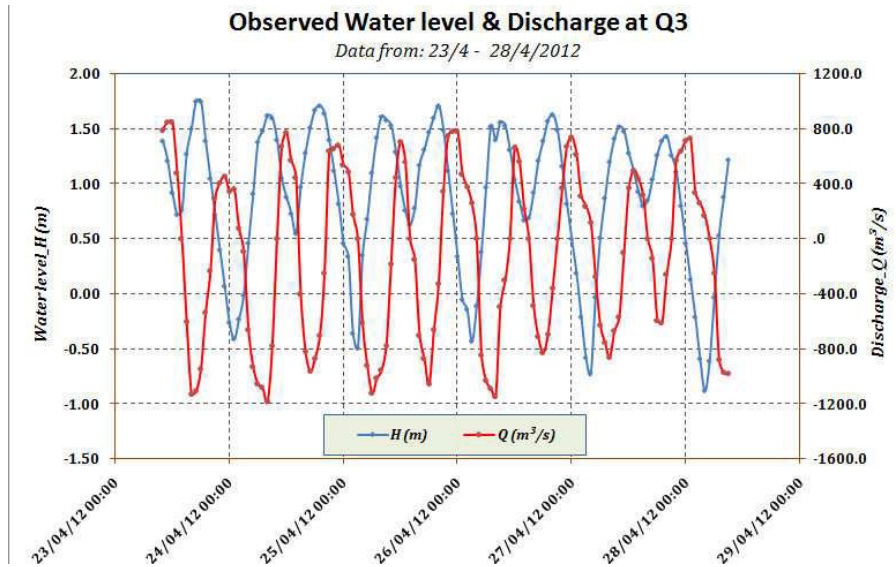
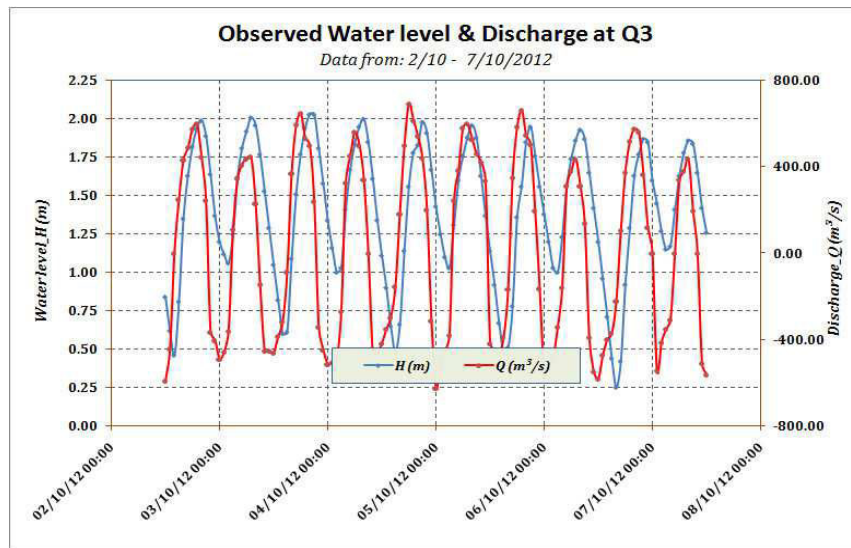


Figure 23: Observed Water level and Discharge at Q3 (October 2011)

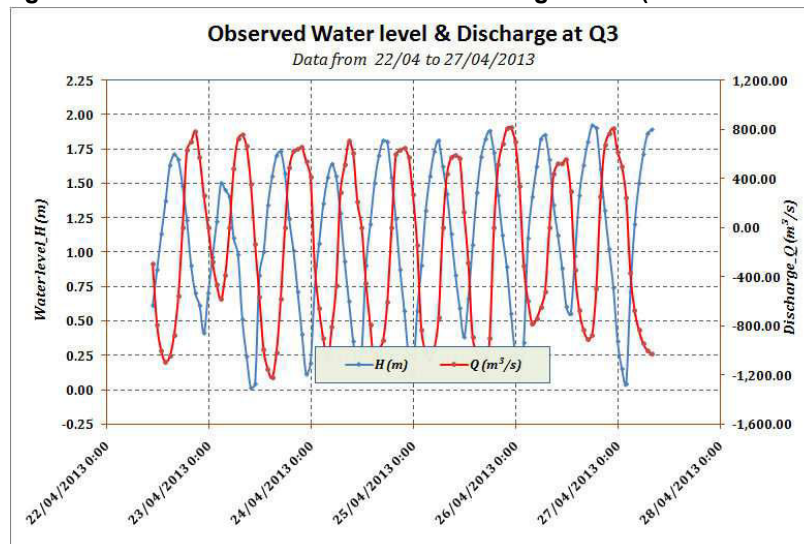




**Figure 24: Observed Water level and Discharge at Q3 (April 2012)**



**Figure 25: Observed Water level and Discharge at Q3 (October 2012)**



**Figure 26: Observed Water level and Discharge at Q3 (April 2013)**

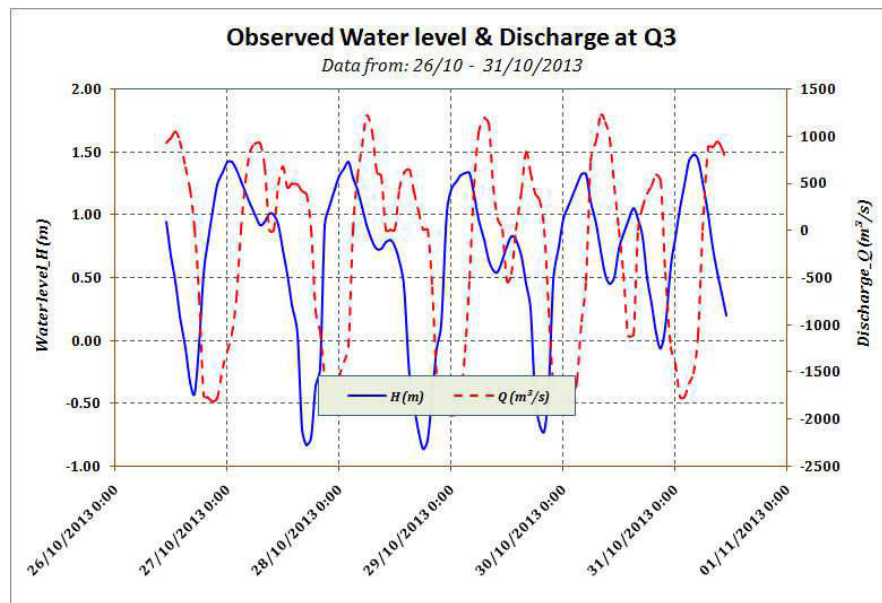


Figure 27: Observed Water level and Discharge at Q3 (October 2013)

#### 4. Station: Q4 (Be River)

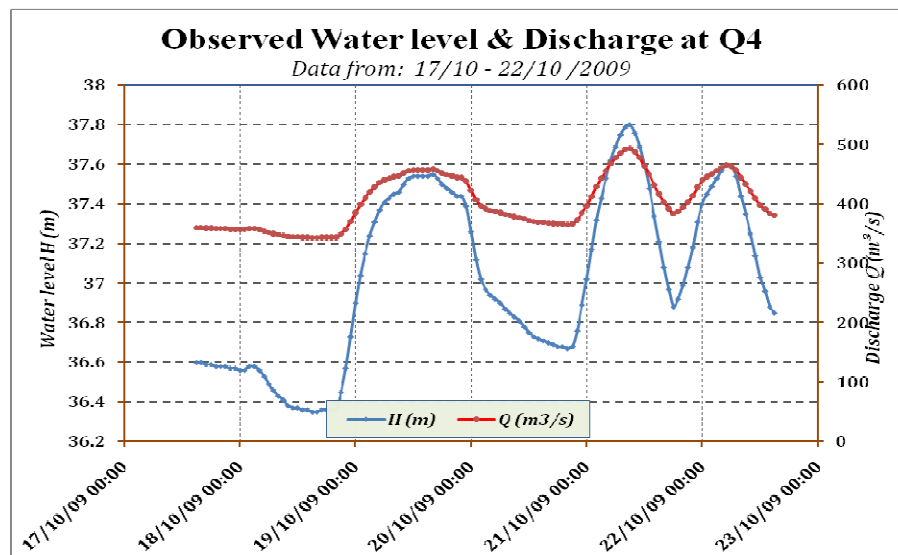


Figure 28: Observed Water level and Discharge at Q4 (October 2009)

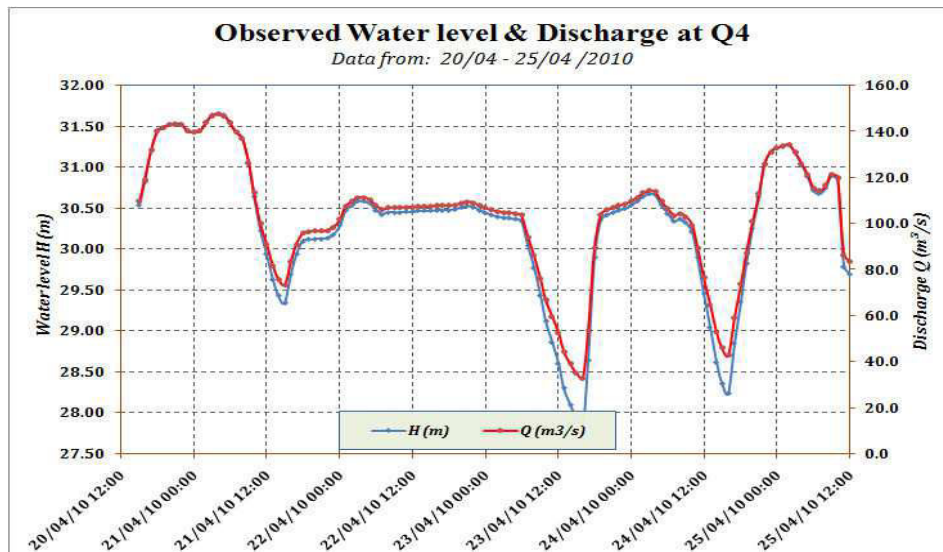


Figure 29: Observed Water level and Discharge at Q4 (April 2010)

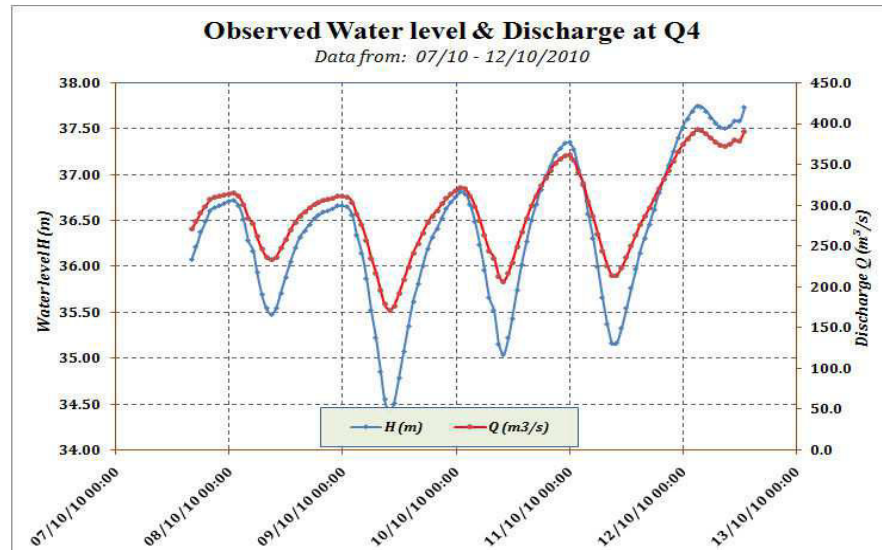


Figure 30: Observed Water level and Discharge at Q4 (October 2010)

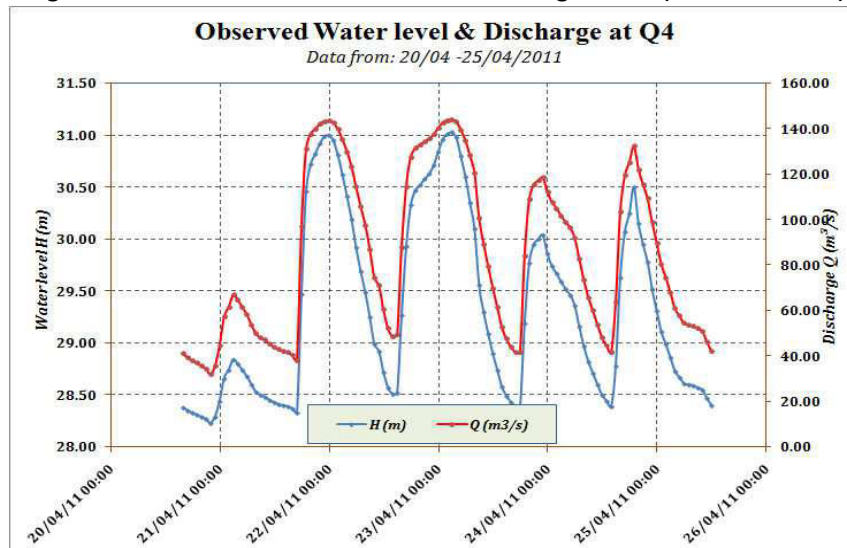


Figure 31: Observed Water level and Discharge at Q4 (April 2011)

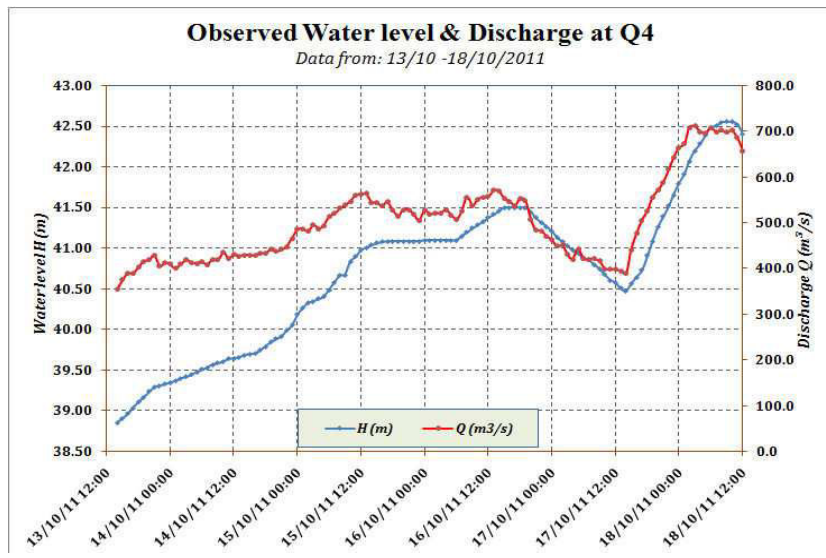


Figure 32: Observed Water level and Discharge at Q4 (October 2011)

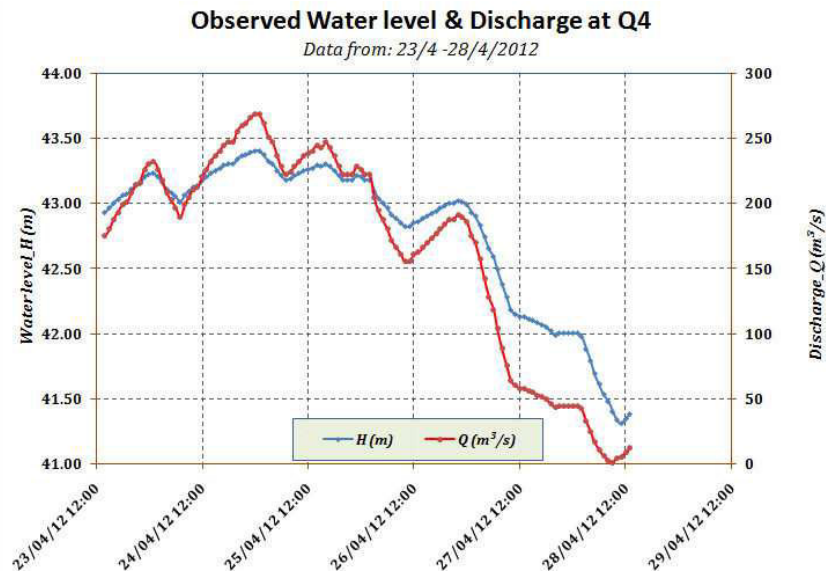


Figure 33: Observed Water level and Discharge at Q4 (April 2012)

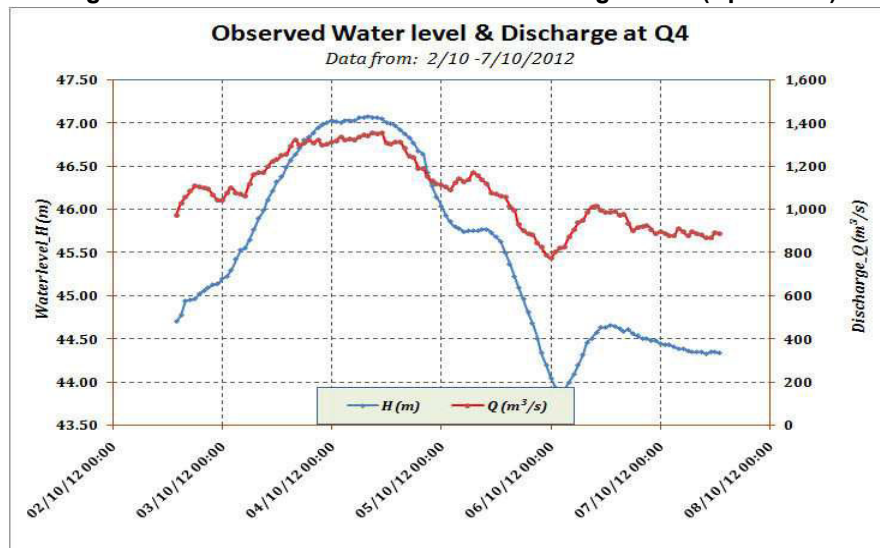


Figure 34: Observed Water level and Discharge at Q4 (October 2012)



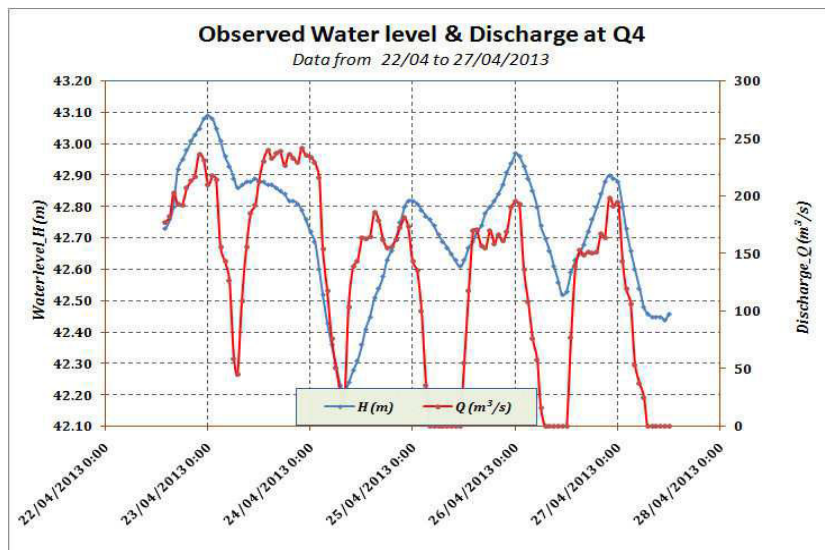


Figure 35: Observed Water level and Discharge at Q4 (April 2012)

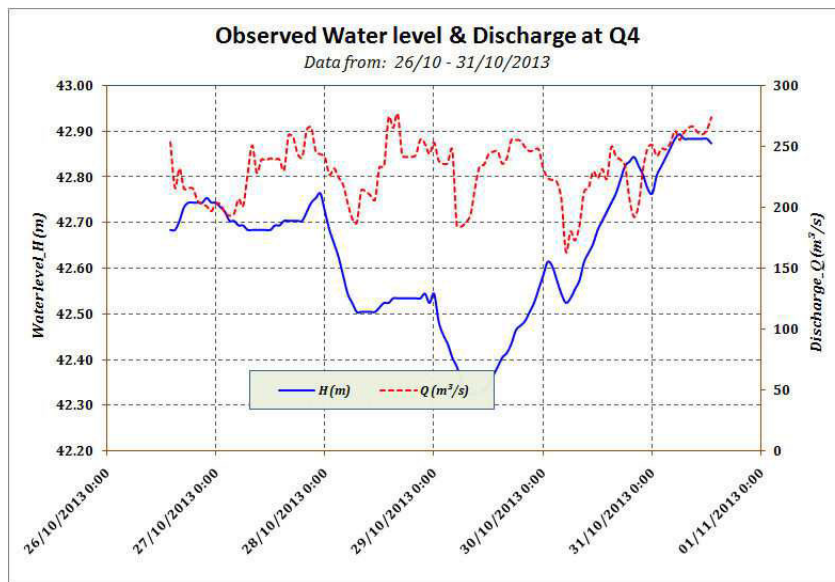


Figure 36: Observed Water level and Discharge at Q4 (October 2012)



## 5. Station: Q5 (Be River)

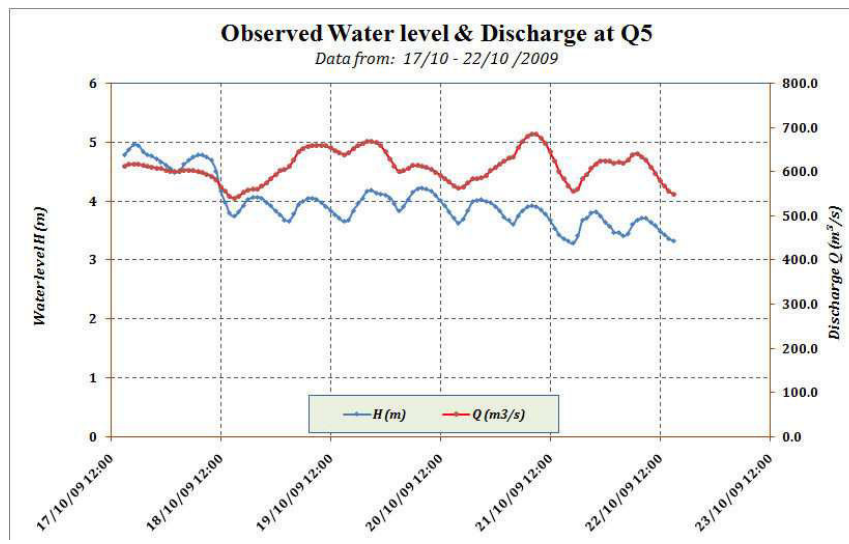


Figure 37: Observed Water level and Discharge at Q5 (October 2009)

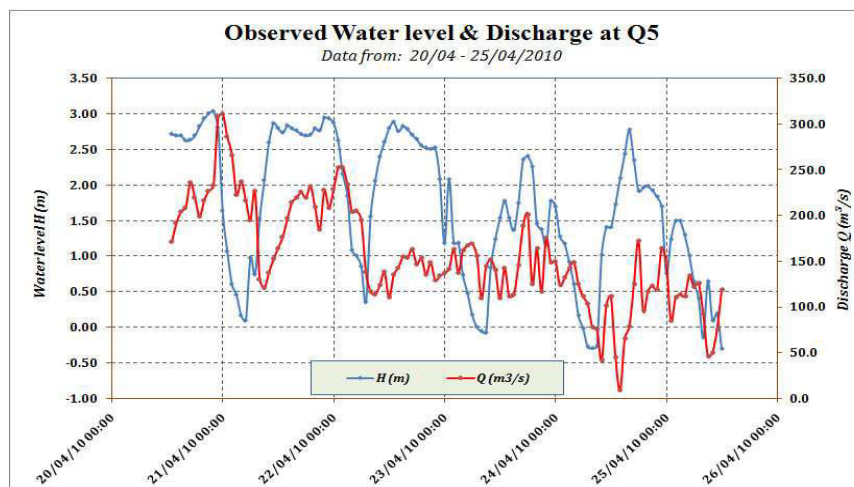


Figure 38: Observed Water level and Discharge at Q5 (April 2010)

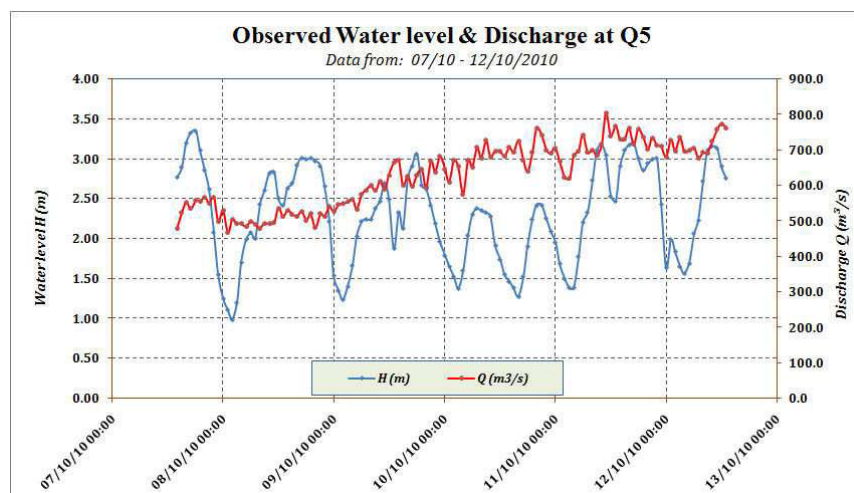


Figure 39: Observed Water level and Discharge at Q5 (October 2010)

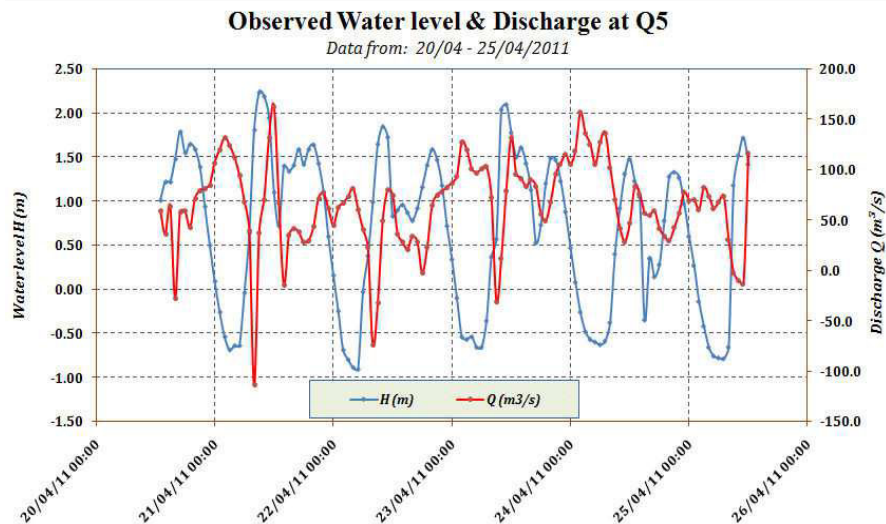


Figure 40: Observed Water level and Discharge at Q5 (April 2011)

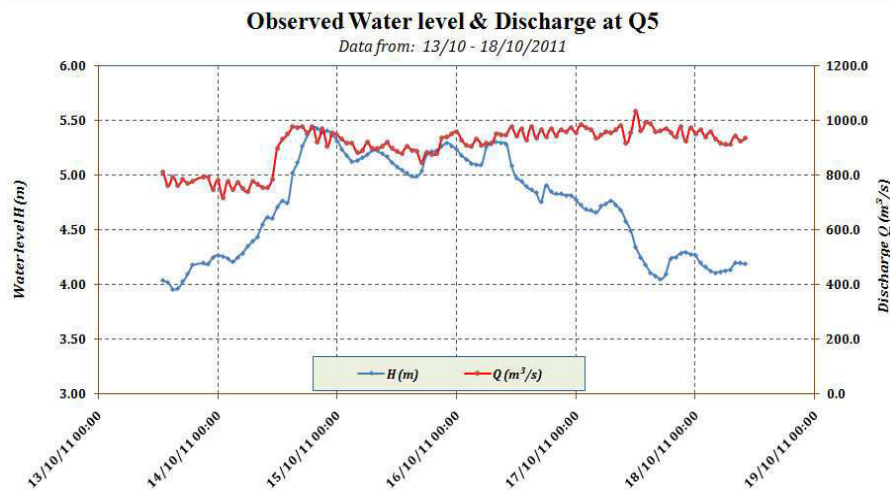


Figure 41: Observed Water level and Discharge at Q5 (October 2011)

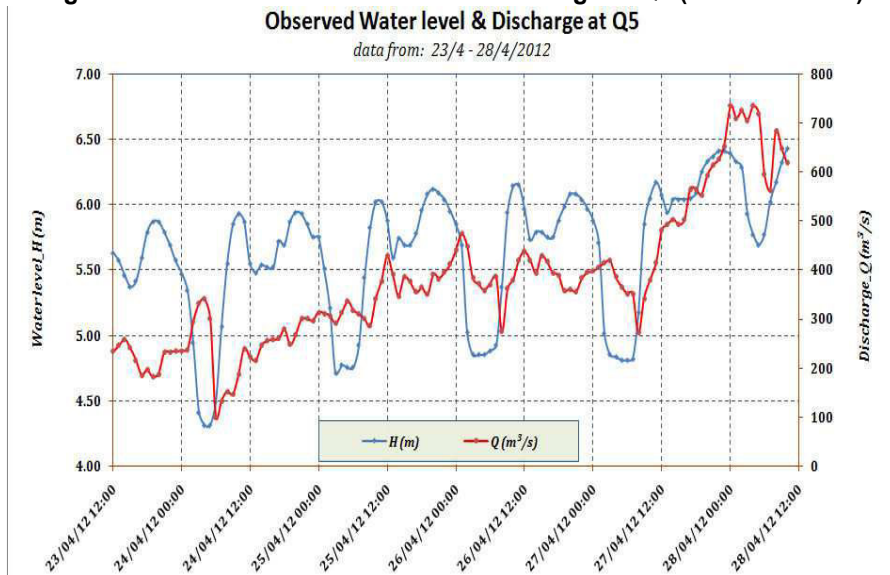
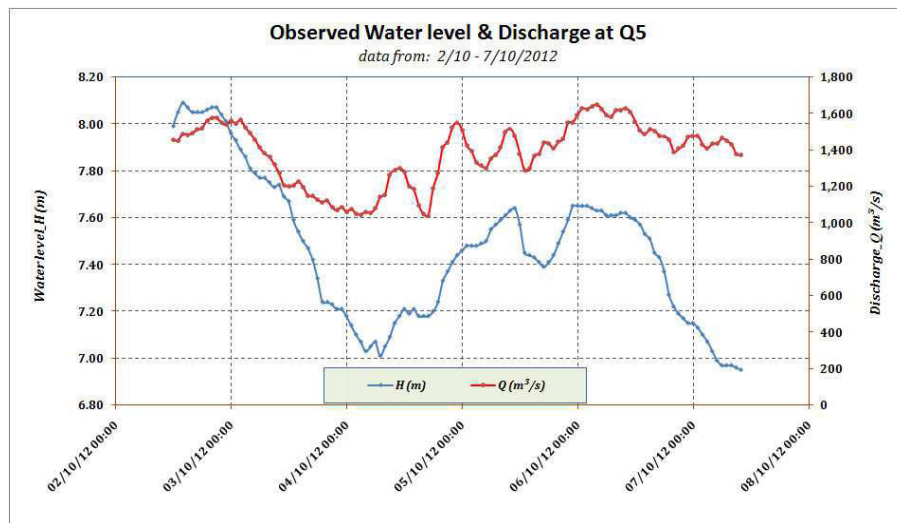
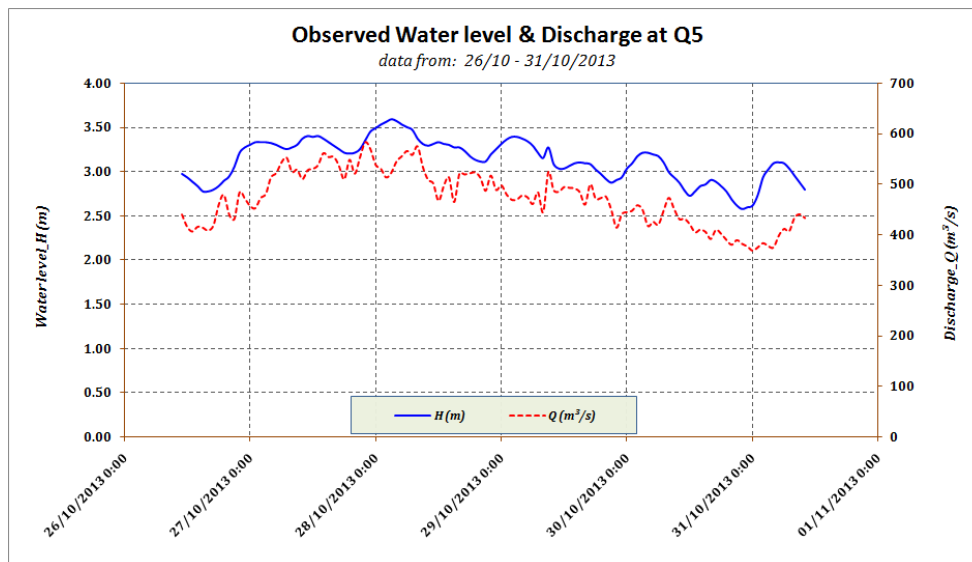


Figure 42: Observed Water level and Discharge at Q5 (April 2012)



**Figure 43: Observed Water level and Discharge at Q5 (October 2012)**



**Figure 44: Observed Water level and Discharge at Q5 (October 2013)**

## 6. Station: Q6 (Vam Co Dong River)

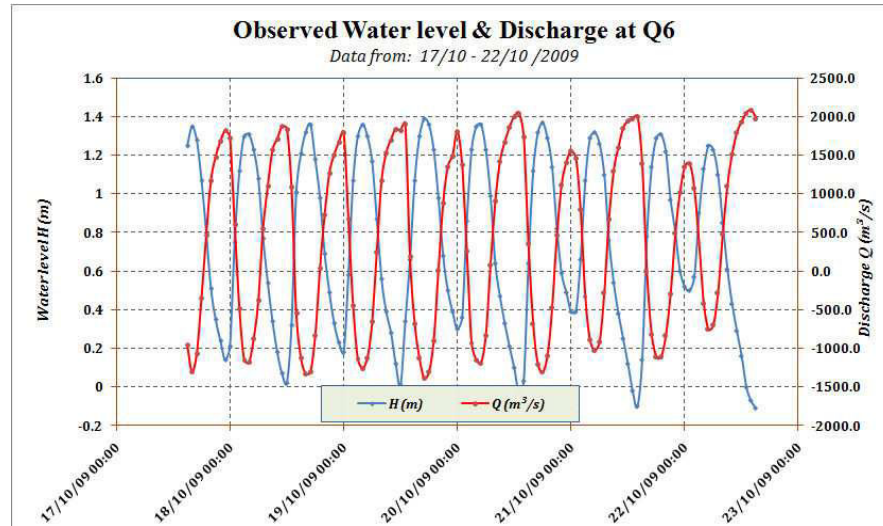


Figure 45: Observed Water level and Discharge at Q6 (October 2009)

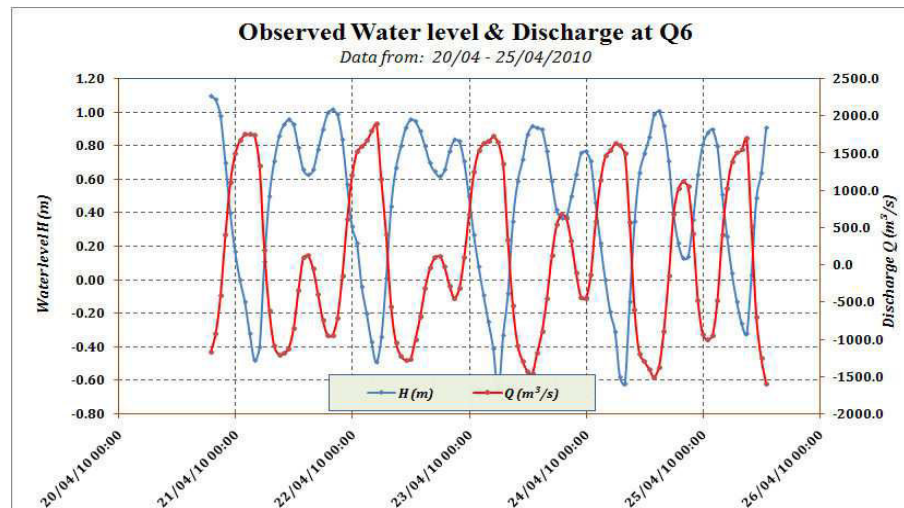


Figure 46: Observed Water level and Discharge at Q6 (April 2010)

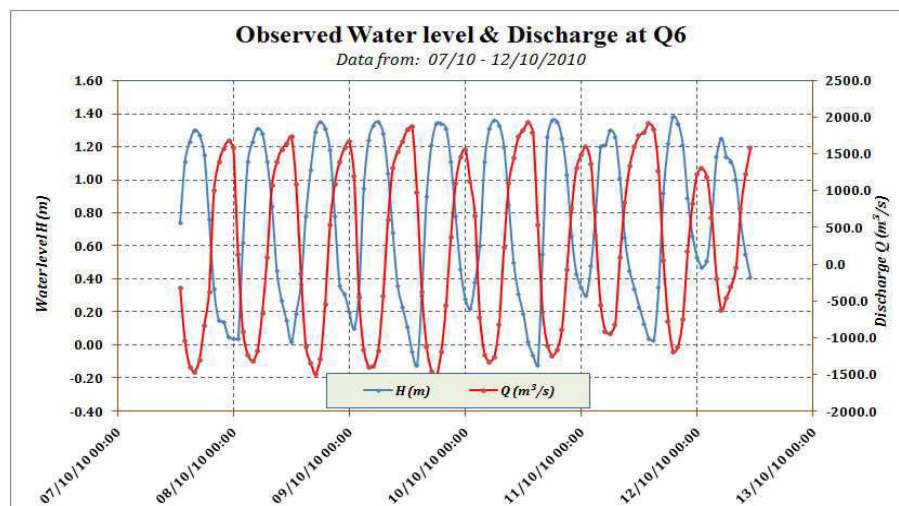


Figure 47: Observed Water level and Discharge at Q6 (October 2010)



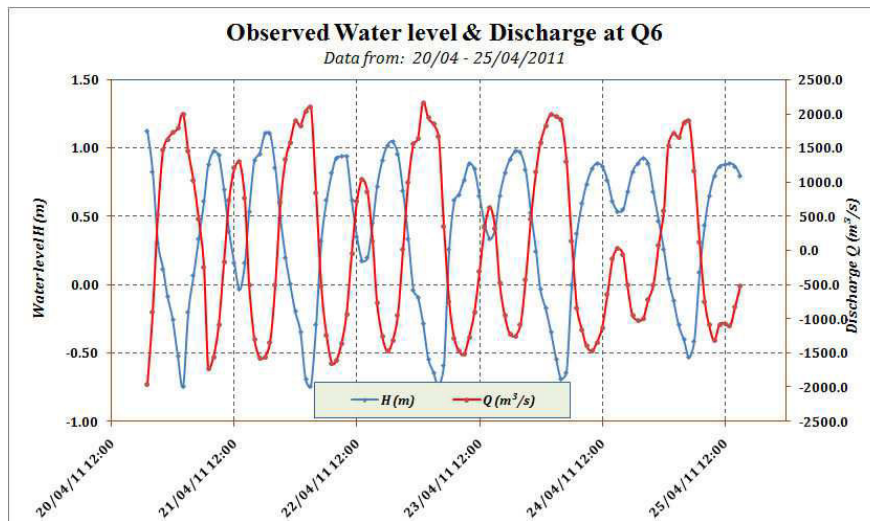


Figure 48: Observed Water level and Discharge at Q6 (April 2011)

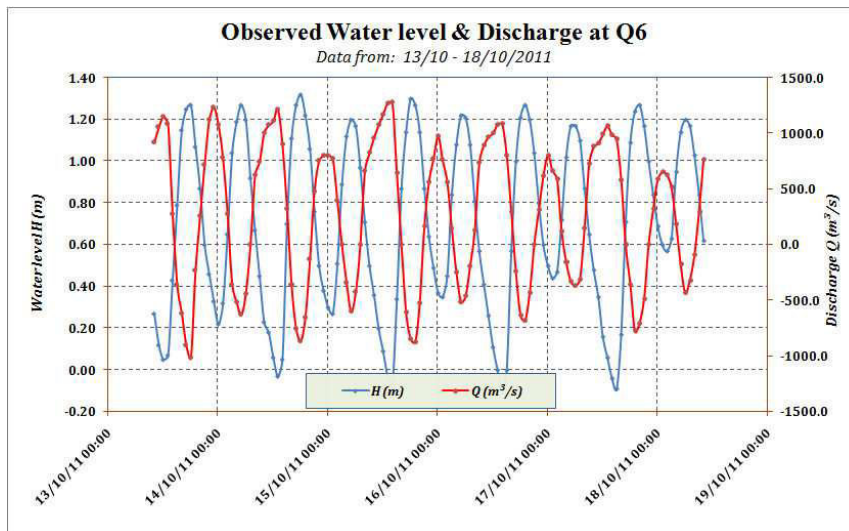


Figure 49: Observed Water level and Discharge at Q6 (October 2011)

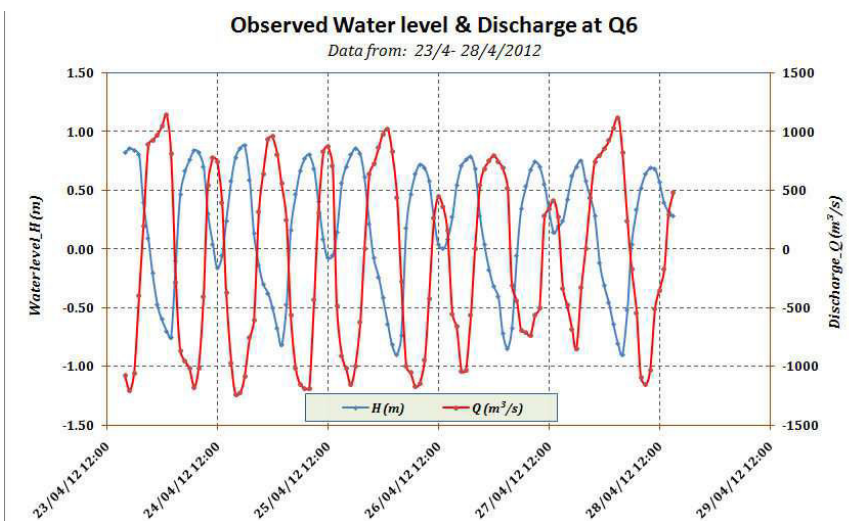


Figure 50: Observed Water level and Discharge at Q6 (April 2012)

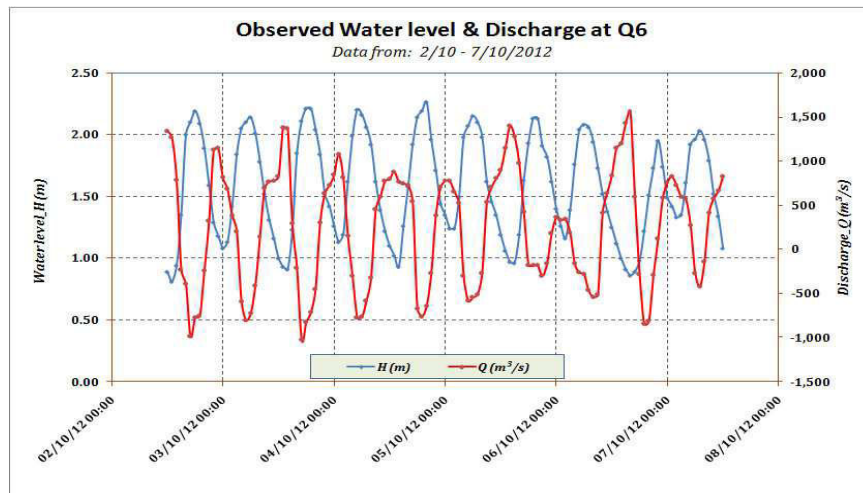


Figure 51: Observed Water level and Discharge at Q6 (October 2012)

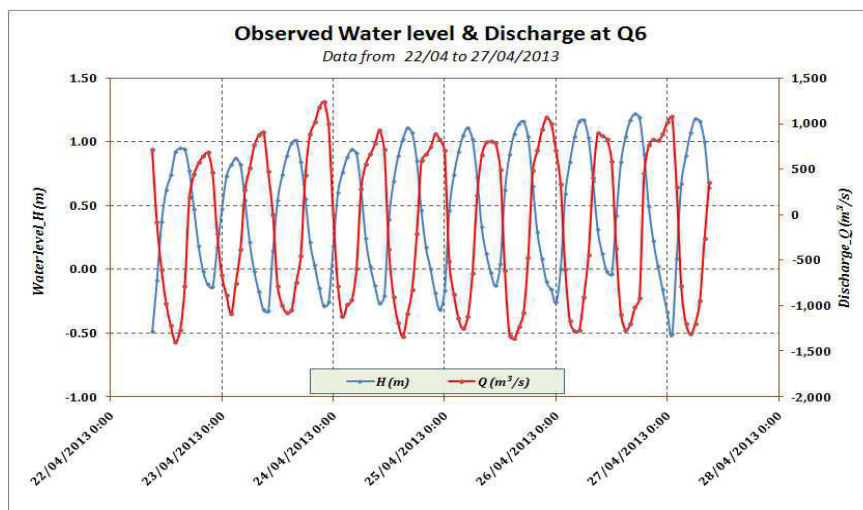


Figure 52: Observed Water level and Discharge at Q6 (April 2013)

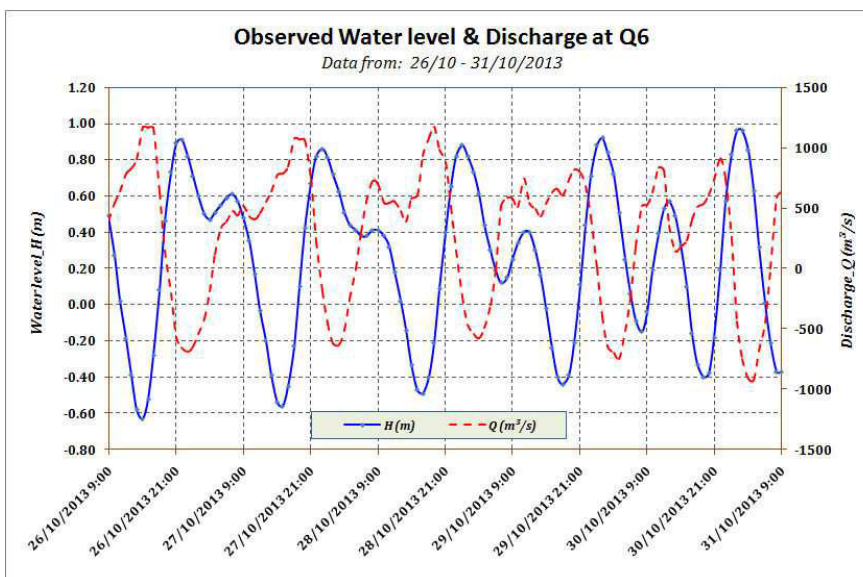


Figure 53: Observed Water level and Discharge at Q6 (October 2013)

## 7. Station: Q7 (An Linh-An Long Bridge)

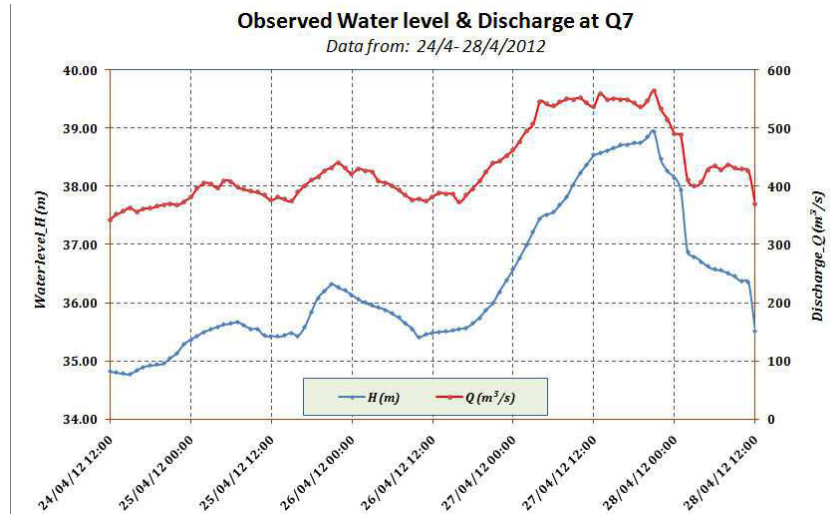


Figure 54: Observed Water level and Discharge at Q7 (April 2012)

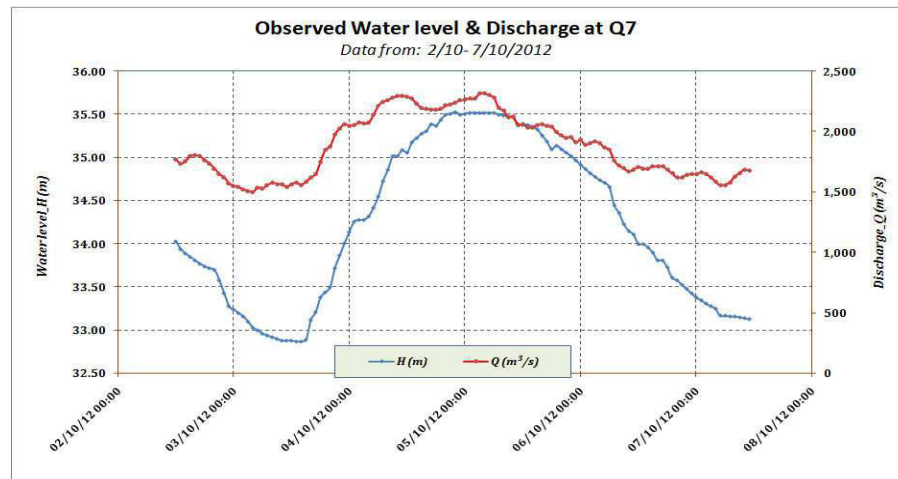


Figure 55: Observed Water level and Discharge at Q7 (October 2012)

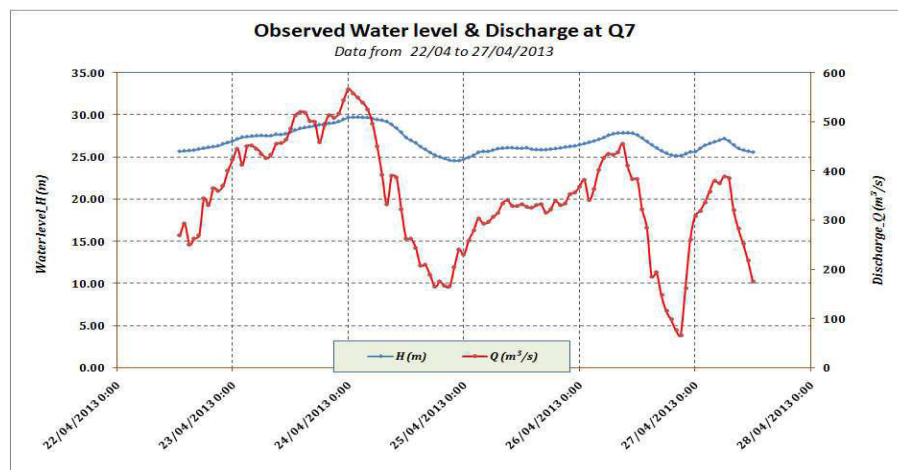


Figure 56: Observed Water level and Discharge at Q7 (April 2013)

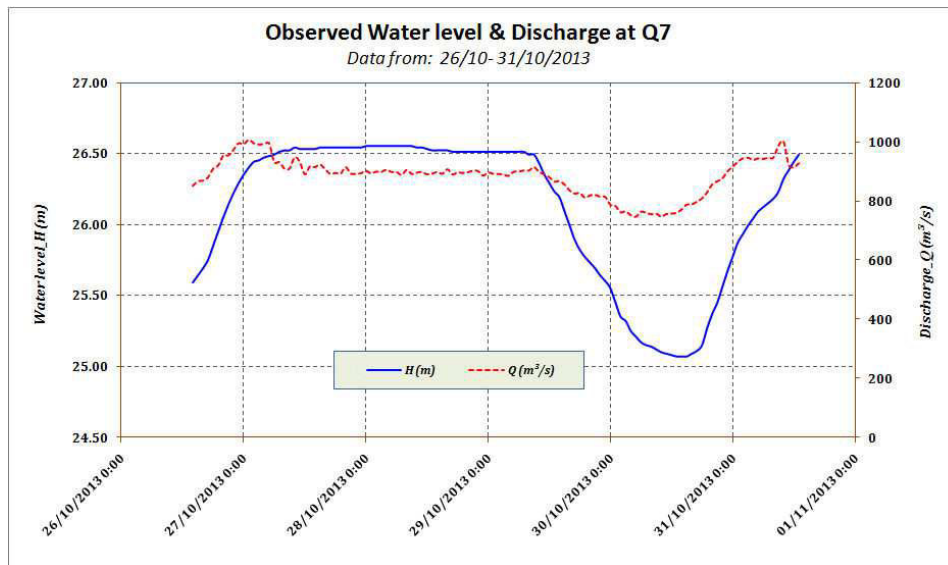


Figure 57: Observed Water level and Discharge at Q7 (October 2013)

## 8. Station: Q8 (The fish path)

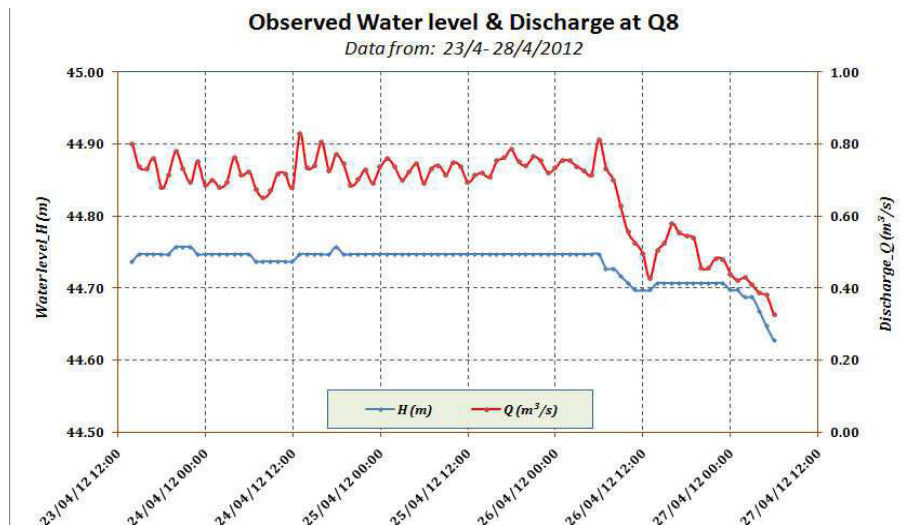


Figure 58: Observed Water level and Discharge at Q8 (April 2012)

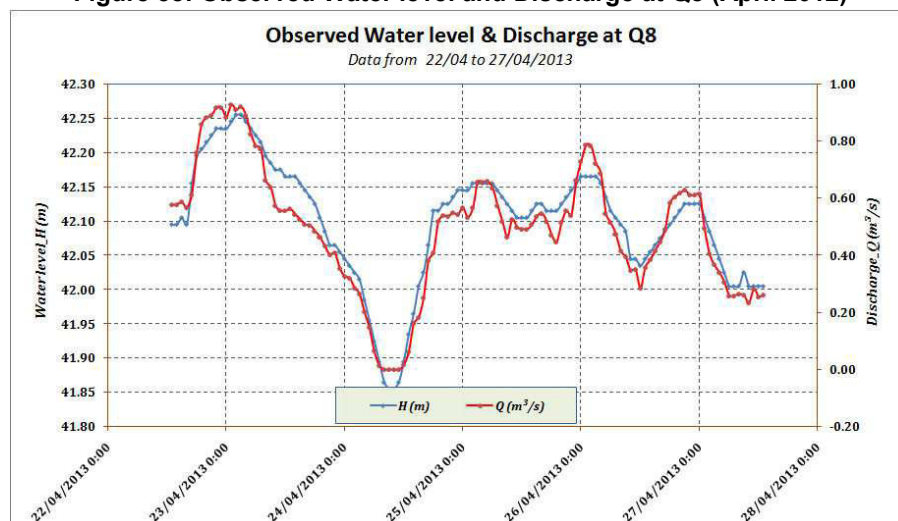


Figure 59: Observed Water level and Discharge at Q8 (April 2013)



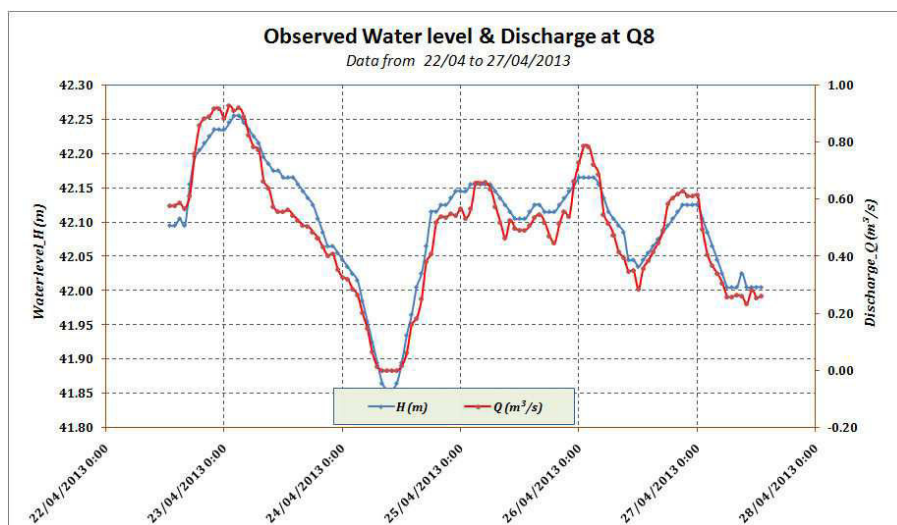


Figure 60: Observed Water level and Discharge at Q8 (October 2013)

## 9. Station: Q9

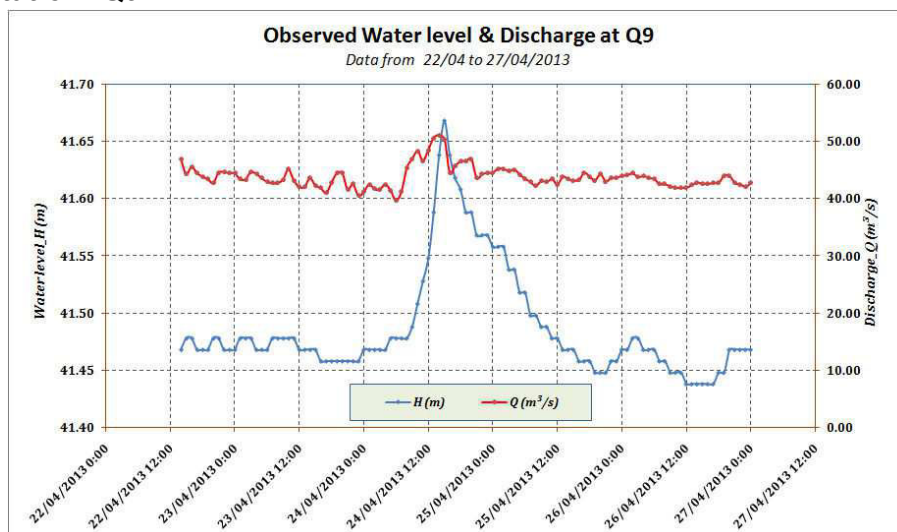


Figure 61: Observed Water level and Discharge at Q9 (April 2013)

## 10. Station: Q10

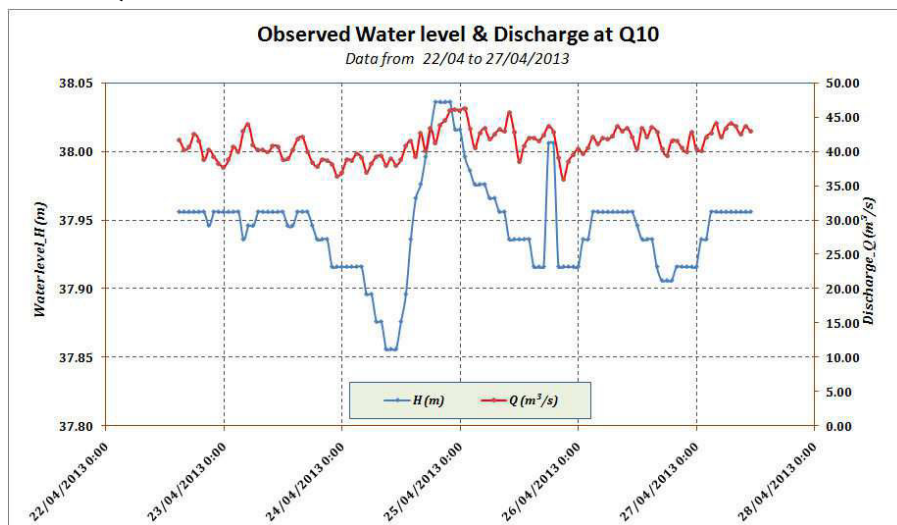


Figure 62: Observed Water level and Discharge at Q10 (April 2013)

## APPENDIX C

### SURFACE WATER QUALITY – MT6 PACKAGE

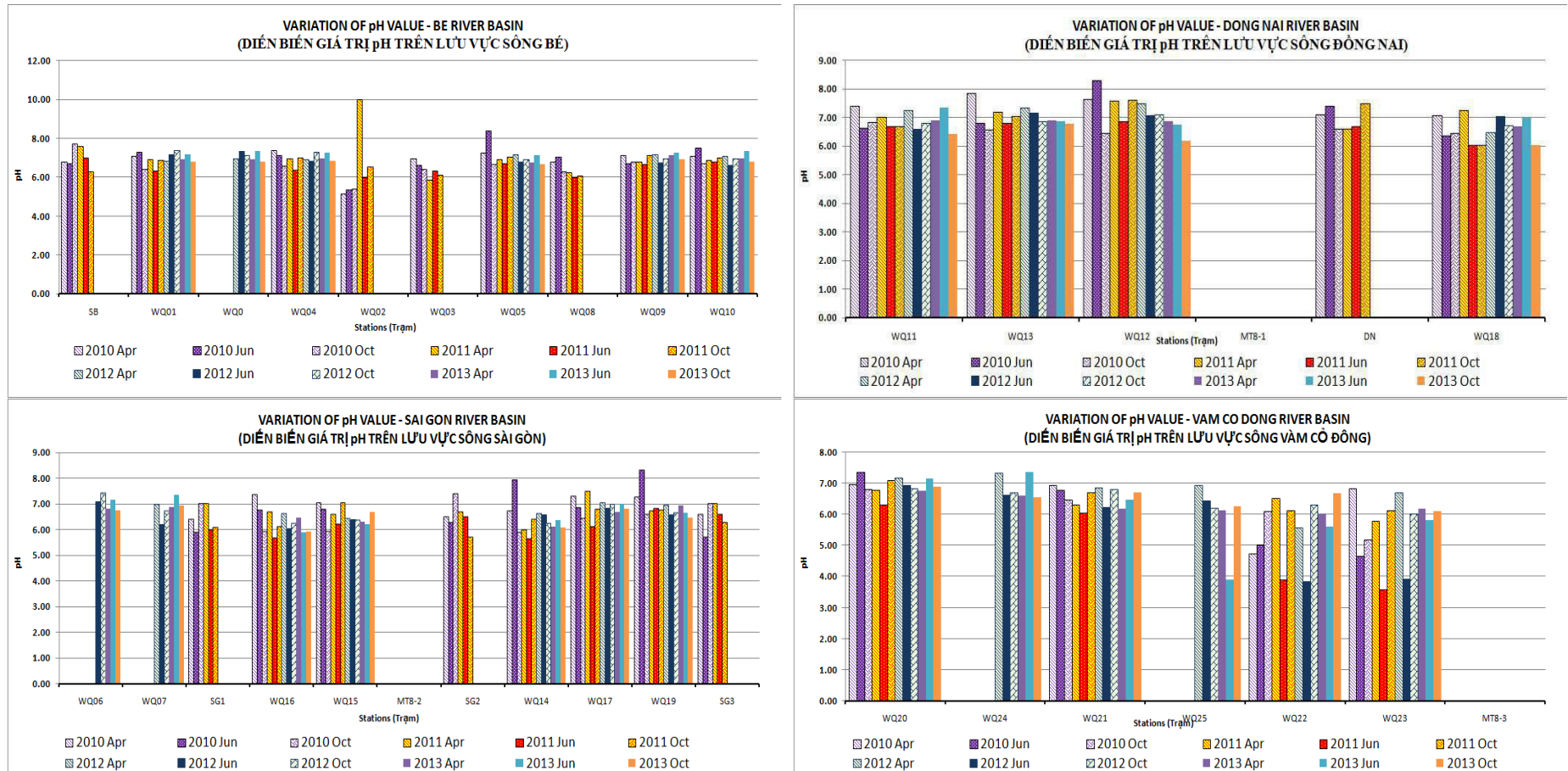


Figure 1: Graph of pH value at rivers in project area

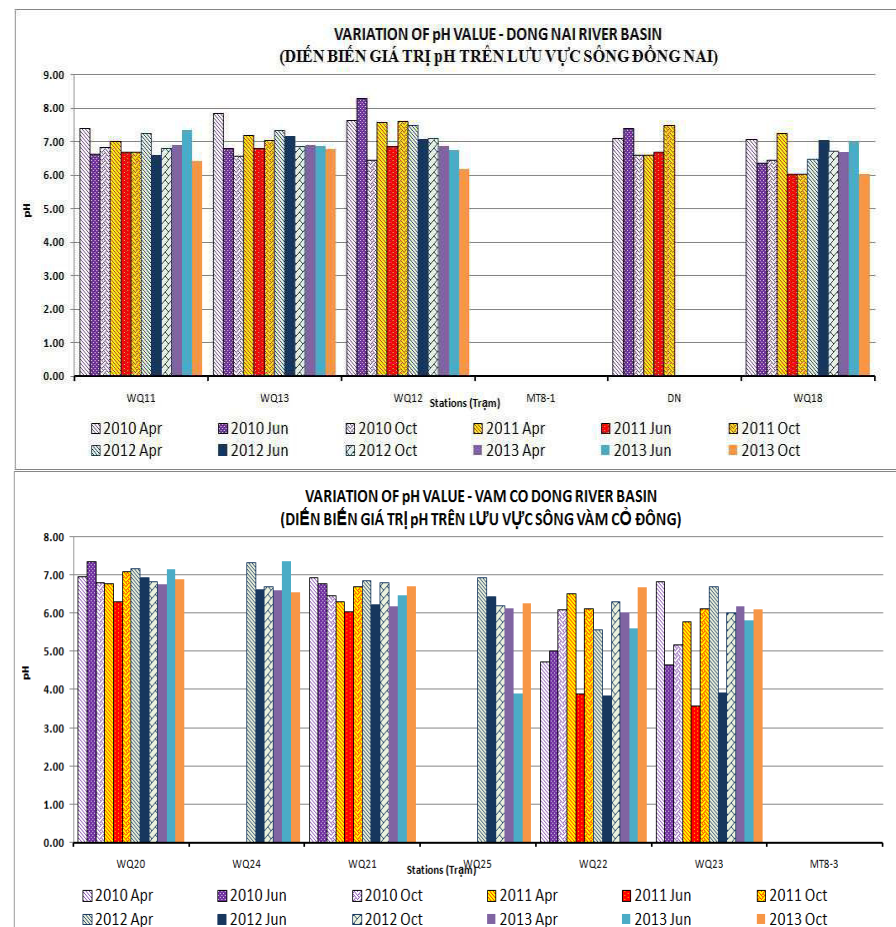
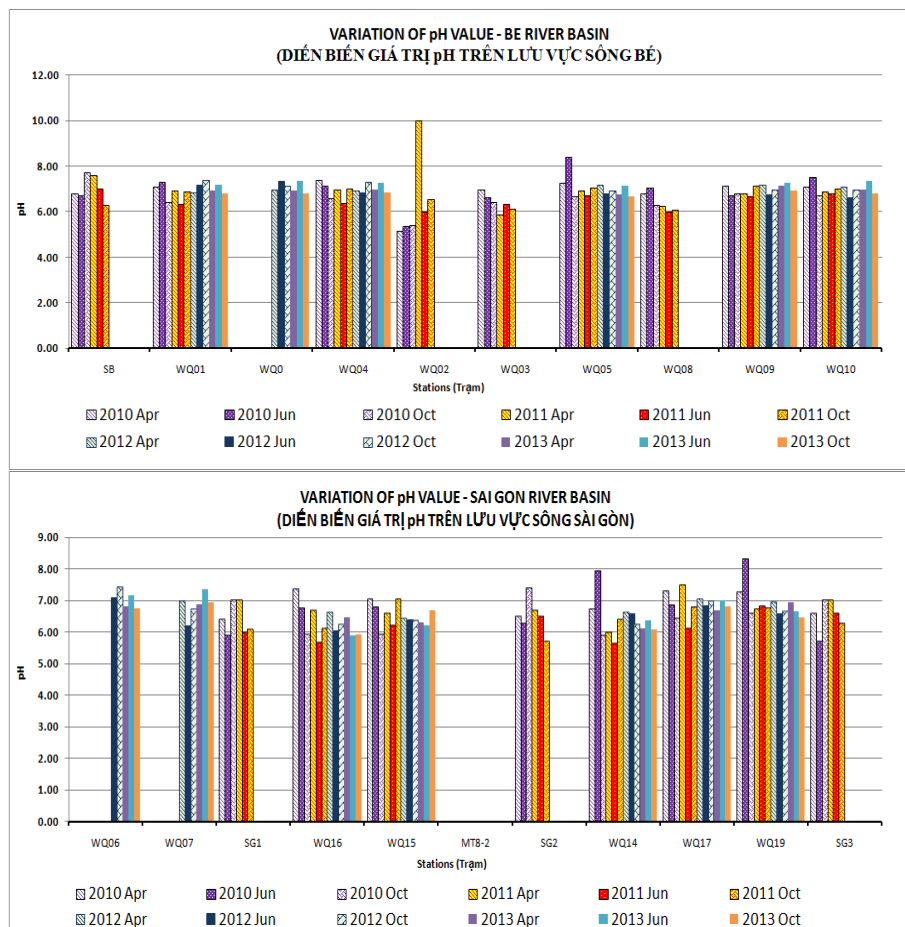


Figure 2: Graph of turbidity value at rivers in project area

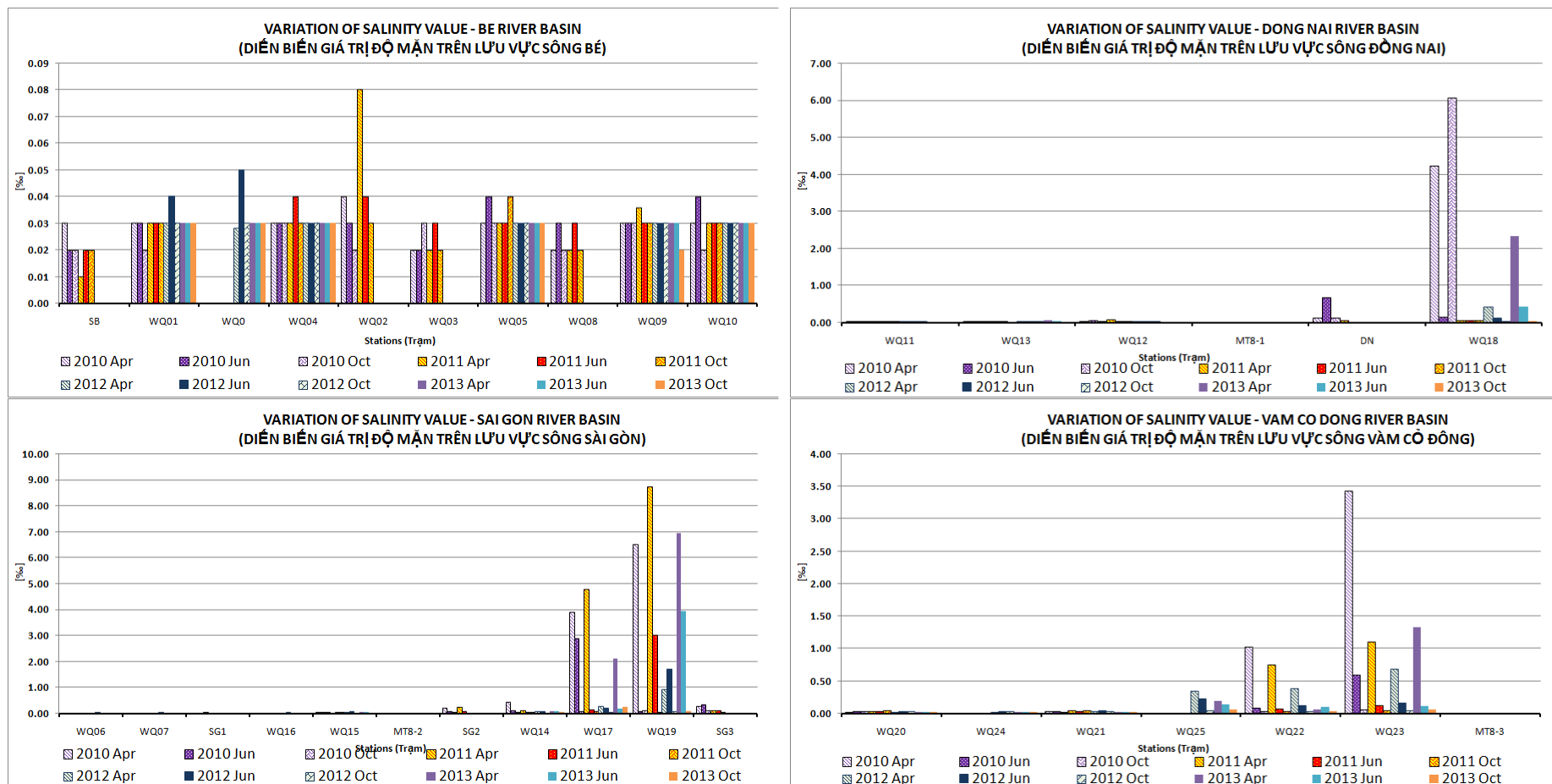


Figure 3: Graph of salinity value at rivers in project area

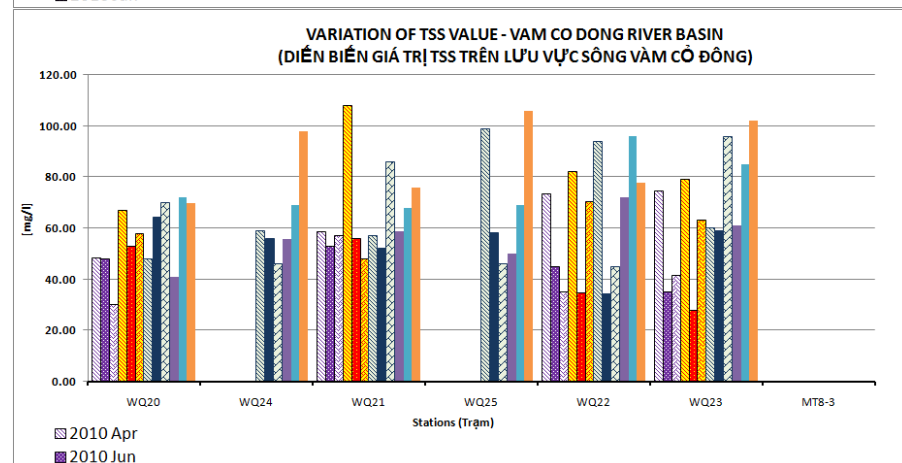
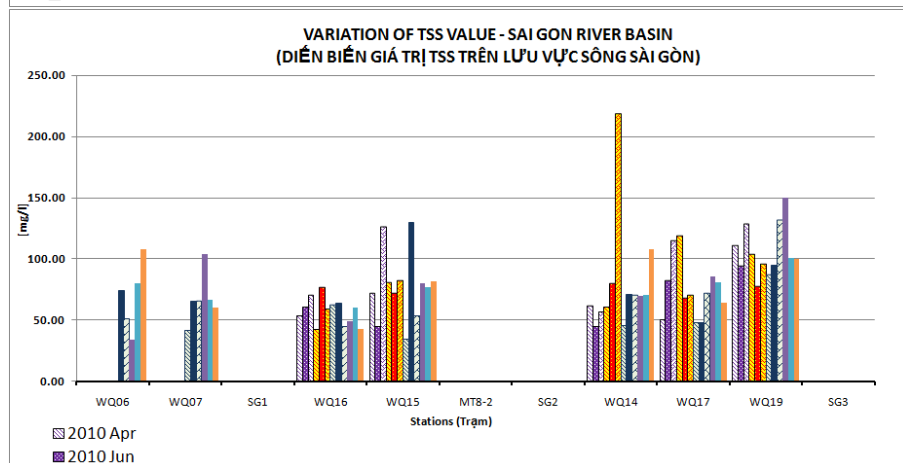
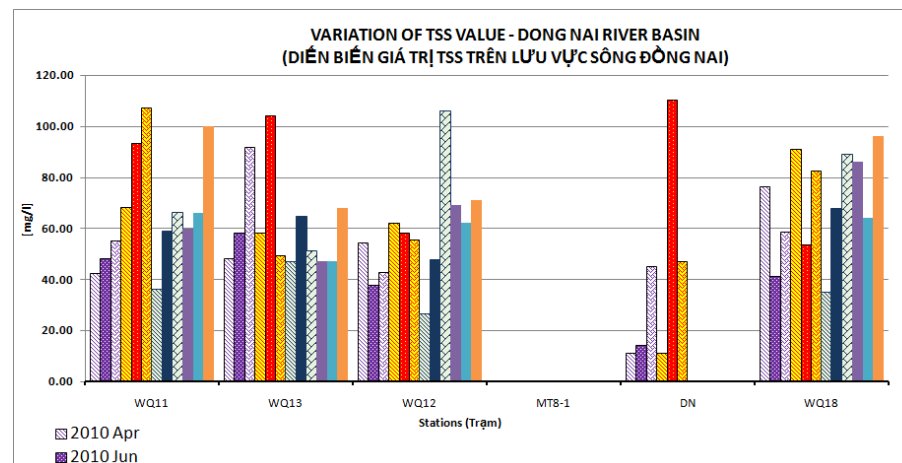
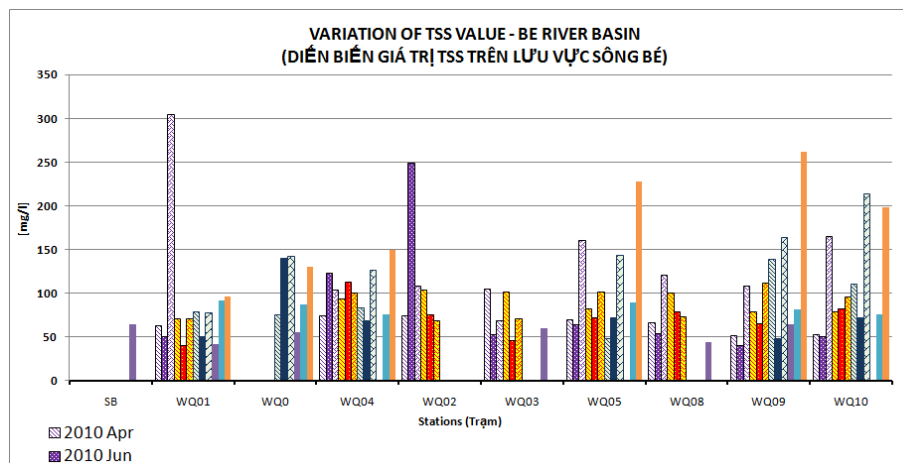


Figure 4: Graph of TSS value at rivers in project area



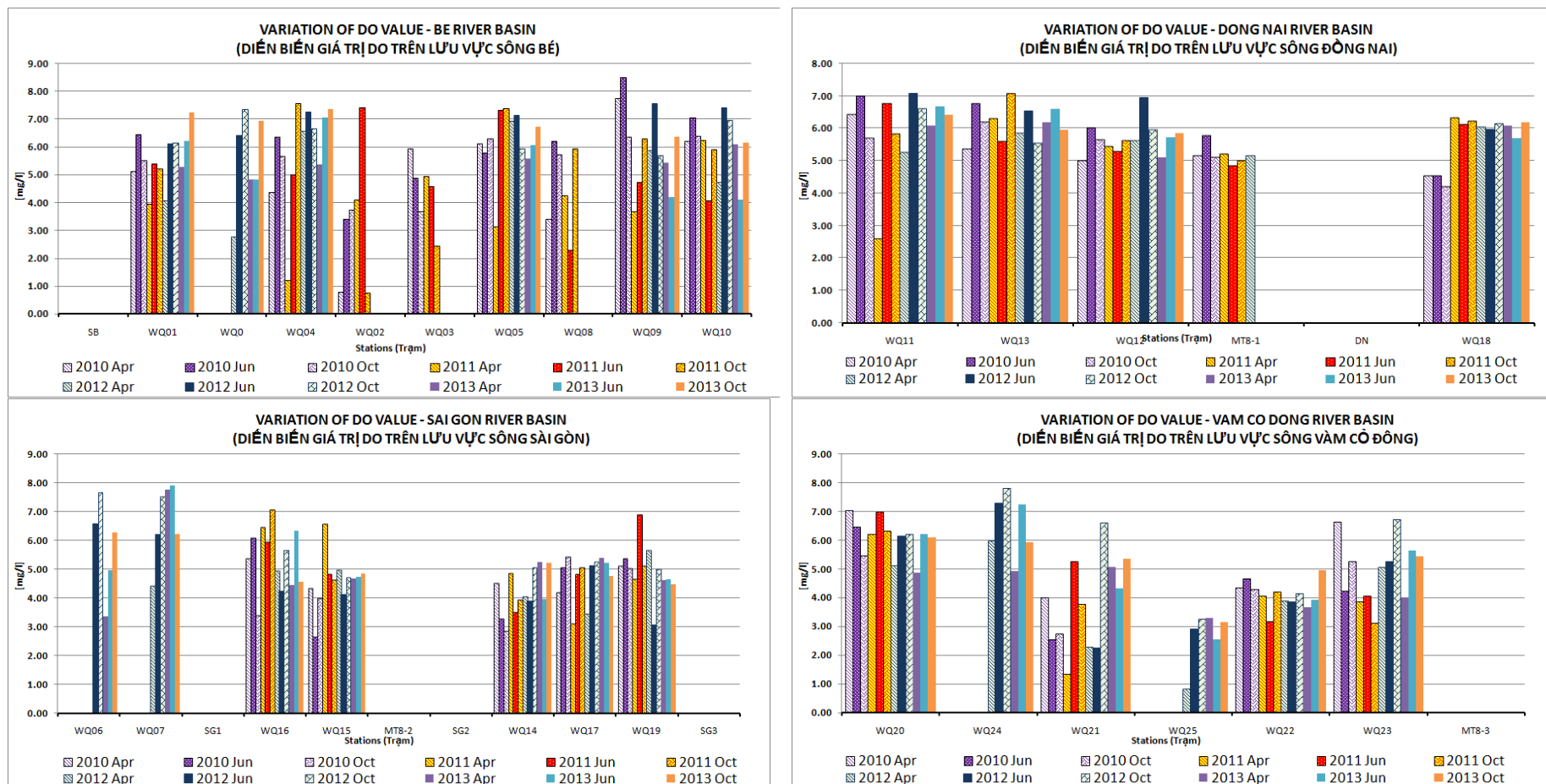


Figure 5: Graph of DO value at rivers in project area

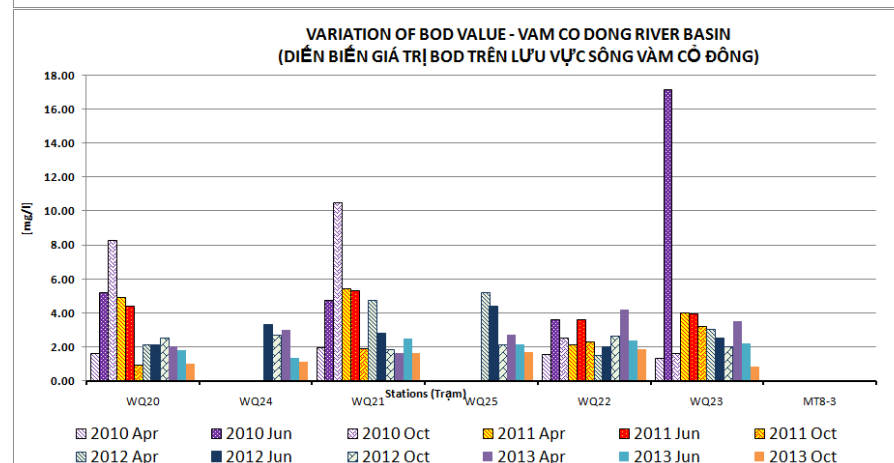
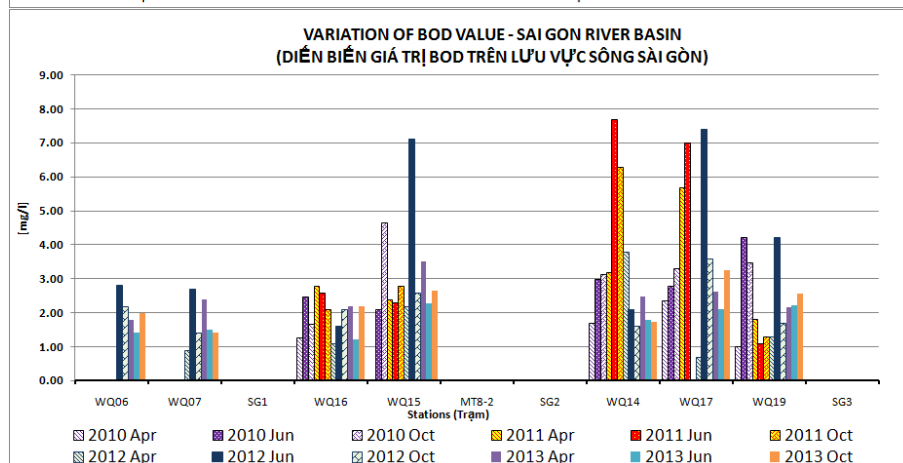
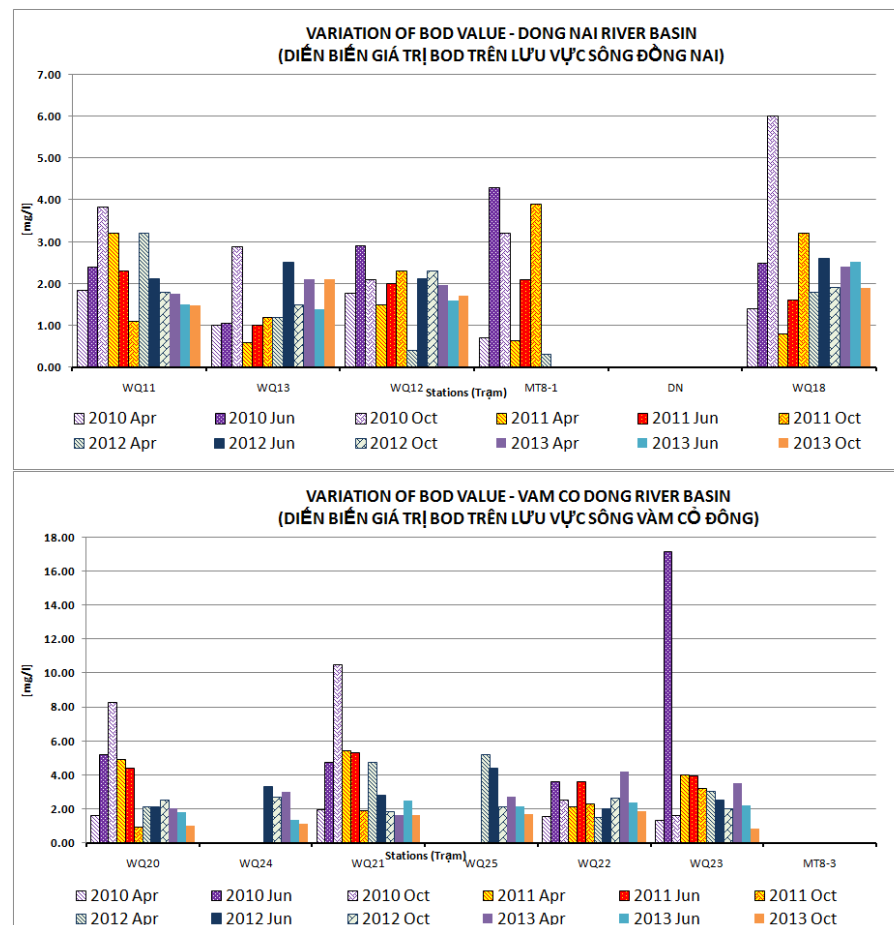
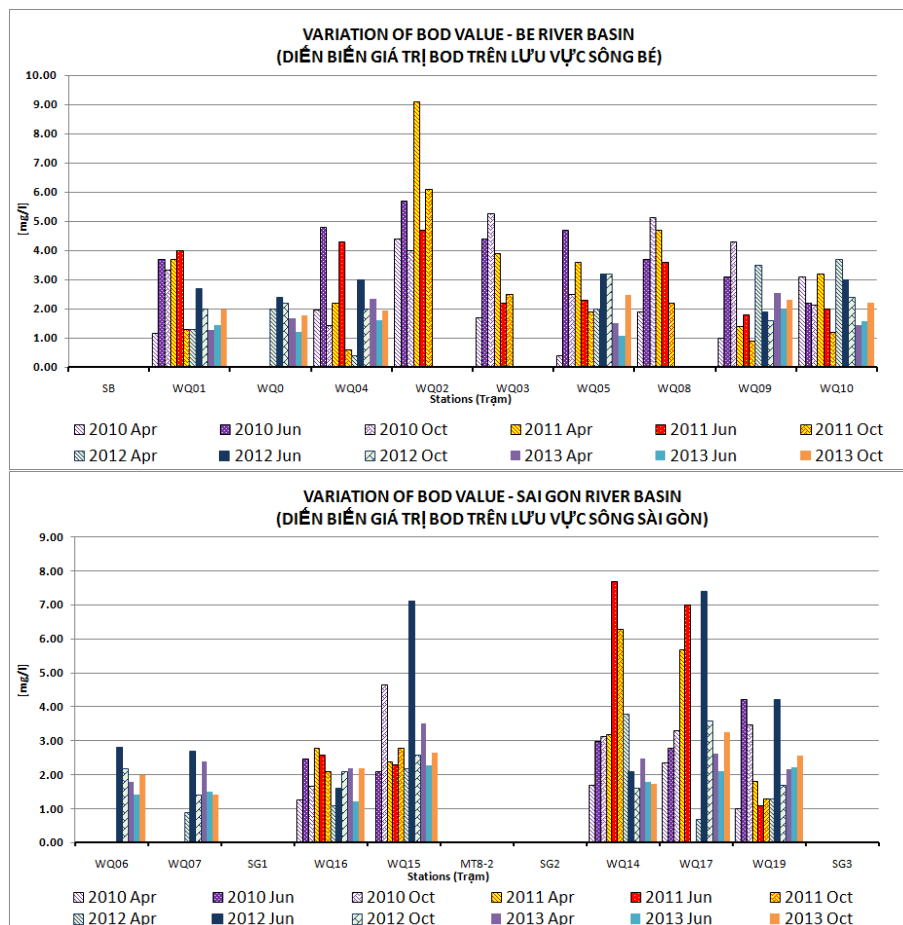


Figure 6: Graph of BOD value at rivers in project area

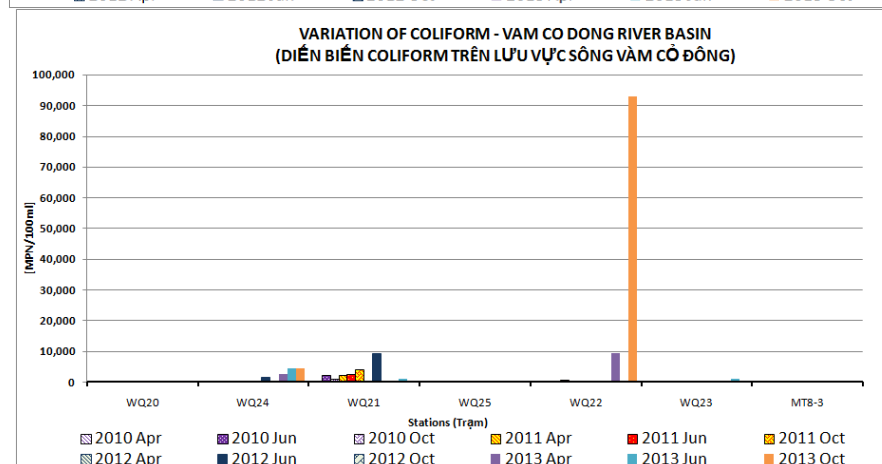
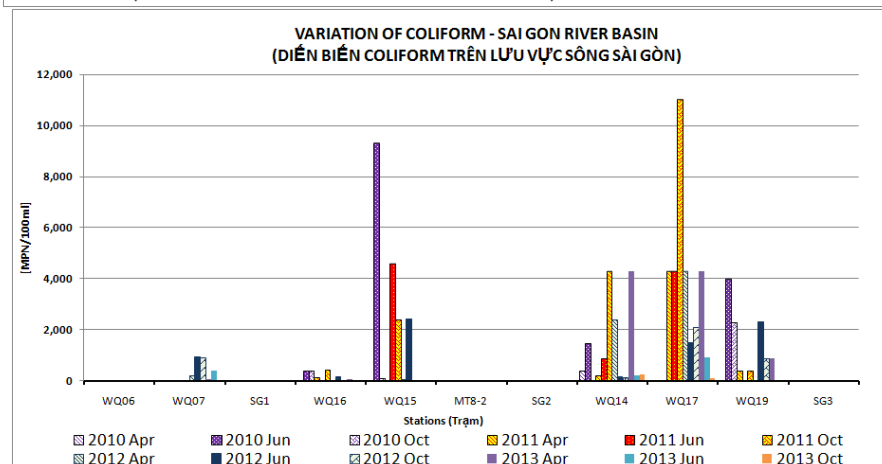
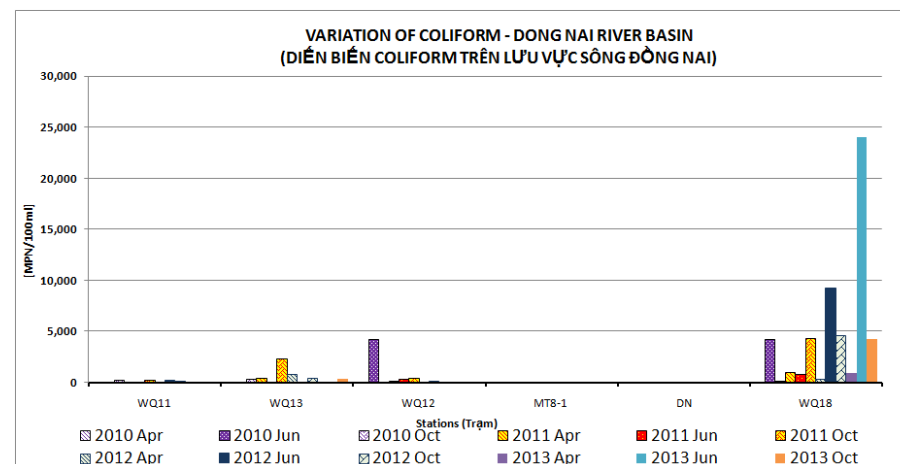
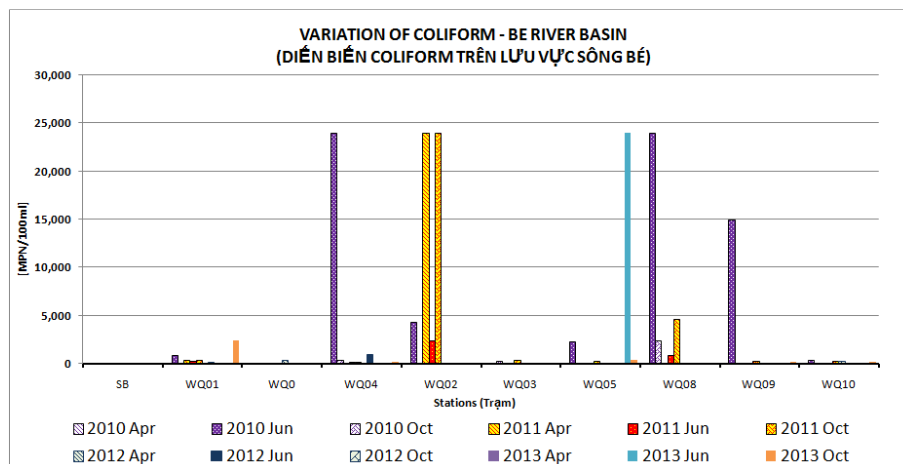


Figure 7: Graph of Coliform at rivers in project area