

Environmental Monitoring Report

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VIE: Phuoc Hoa Water Resources Project

Prepared by Institute of Coastal and Offshore Engineering for the Hydraulic Project Investment and Construction Management Board No.9 - Ministry of Agriculture and Rural Development and the Asian Development Bank.

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 Francais de Developpement
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
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.

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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 series of components including construction activities of the Headworks, Phuoc Hoa – Dau Tieng transfer canal, Tan Bien irrigation canal ... that has caused different negative and positive impacts to the environment. The task for Environmental Packages (Packages) is to collect environmental indicators regularly and other related issues, record, detect and respond different impacts of the Project to environment in order to adjust, overcome and mitigate the environmental impacts.

For the purpose of coordination, monitoring, and implementation of EMP packages, the six monthly progress report will summarize all activities and implementation status of environmental packages. The report also orientate and guide in implementing tasks of EMP packages as well as monitor and speed up the implementation progress of the tasks as proposed schedule. In addition, the report also monitors current situation in the project area and its vicinity, and develop the database for environmental management programmes of project as well as to ensure that the implementation can be done in compliance with environmental management plan and Environmental Protection Law of Vietnam.

The six monthly progress report as a basis for ICMB9 to upgrade their tasks of management and coordination and it also helps ADB 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 funded by Asian Development Bank (ADB) with the Loan No. 2025 (SF) according to Special Draw Out Rights (SDR) equivalent to 90 million USD and 2 loans of Agency Française de Développement (AFD) with a total amount of 34 million USD. The ADB loan was approved on 27 November 2003, signed on 8 April 2004 and took efforts from 23 August 2004. The AFD loans were approved on 20 November 2003. 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) 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.
- (ii) The Project consists of two parts: Part A – Support for Institutional and Integrated Development, and Part B – Construction of Water Resources Infrastructure.
- (iii) 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. Two new irrigation areas will be constructed as: Tan Bien irrigation system in Tay Ninh province; and Duc Hoa irrigation system in Long An province. The ADB loan is financing to construct Phuoc Hoa barrage, transfer canal and main canals of three irrigation systems, 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).
- (iv) 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 June 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 transfer to Dau Tieng Irrigation management company (IMC) for management. 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) Consultant.

- (v) 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 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 from 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. Scope of Works

- 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 the 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 form;
- Carry out field surveys and 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

contractors, 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 consultant 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 report to ICMB9, MARD, ADB, AfD, MONRE and organizations, PPCs who participating in environmental condition of the project as well as relating to above duties. Responsibilities of the environmental staffs, ICMB9 environmental division, consultants and contractors must comply with environmental requirements and trends of the project based on the river basin.

1.2.2. Specific Tasks

- Understanding the existing and proposed Phuoc Hoa water resources project environmeantal management programme;
- Management, supervision and monitoring 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;
- Misnistrial, provincial and public liaison;
- Reporting and data distribution.

2. Activities of OP4, BVI and ICMB9 in the last six months 2011

2.1. Activities of OP4

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

- Participated in provincial workshops in Tay Ninh and Long An provinces which were organized by MT10 consultant on 4 and 26 August 2011.
- Worked with the representatives of ICMB9, ADB, BVI regarding the current

implementation, outstanding issues and forthcoming plans of EMP packages on 17 October 2011.

- Worked with representatives of the MT8 consultant regarding field survey plans to select proper locations for installing salinity monitoring stations on 25 November 2011.
- On 06/12/2011, the OP4 consultant and representatives of MT8 consultant had a meeting with the Meteorological and hydrology Centre in Binh Duong province regarding proposals of the installation of monitoring equipments at the Thu Dau Mot hydrology station.

In addition to aforementioned meetings, the OP4 consultant has also cooperated with relevant agencies to involve in field surveys in the project area and worked with local authorities. These activities are summarized in Table 1.

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

2.2. Activities of ICMB9

In the last six months of 2011, 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;
- Organized 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 MT8 and MT3.
- Inspected, evaluated and requested 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 2011 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 during the implementation.

- Supported ICMB9 in preparing the proposed documents for packages which are going to open the bidding such as MT1, MT9, etc.

Table 1: Summary of contents and implementation results

No.	Date	Coop erativ e units	Superviso n contents	Supervision results
1	18/10/2011	Repre sentati ves of ICMB 9, ADB, BVI, OP4, and MT7 packa ge contra ctor	<ul style="list-style-type: none"> - Inspect the implementation of EMP packages in Binh Duong Province. - Survey the current environmental status at some locations in project site. 	<ul style="list-style-type: none"> - As informed by the representative of Binh Duong PPMB, in the initial time of the project, some consultants (MT4, MT5) had contacted with them to provide information on the project implementation, but there have not been any information from these contractors during the execution. - Some residents who living near the project sites claimed that there was more dust and damaged road appeared. - For the installation of water supply station at An Linh Commune, recently the provincial government agreed with this investment. ICMB9 and MT3 consultant also worked with local authorities and recommended to build this station in Cay Truong Commune.
2	18/10/2011	Repre sentati ves of ICMB 9, ADB, BVI, OP4, and MT7	<ul style="list-style-type: none"> - Inspect the implementation of MT7 package in construction sites. - Survey the current environmental status in the construction sites of packages 1A and 1B. 	<ul style="list-style-type: none"> - Package 1A: as informed by the consultant, the workload has been completed nearly 99%, the construction roads are going to be finished. Serious environmental impacts have not been happened yet. - According to the survey, at the site of 1A, structures were completed; workers are planting grass and restoring the site condition. - At Package 1B: as informed by the site manager, structures are finishing and willing for handing over, and the contractor is improving infrastructures of the local people. - After inspecting along the transfer canal, there is a big volume of

		packa ge contra ctor		excavated soil that has not been levelled. This is caused by dust in sunny and more traffic conditions.
3	19/10/2011	Repre sentati ves of ICMB 9, ADB, BVI, OP4, and MT2 packa ge contra ctor	<ul style="list-style-type: none"> - Inspect the implementation of EMP packages in Binh Phuoc Province. - Inspect the implementation of MT7 package. 	<ul style="list-style-type: none"> - As informed by the representative Binh Phuoc PPMB, currently, they have not received the six monthly environmental reports of EMP packages implementation. - Currently, due to the elevation of canal embankment is higher than the existing ground level causing local flood to the area along the canal, and it also caused by the limited capacity of drainage structures. - Currently, the PPC has not received any information regarding an argument between local people and MT2 Consultant in developing the pilot forestation. - Provincial authority recommends that consultants should inform and coordinate with local governments during the implementation.
4	20/10/2011	Repre sentati ves of ICMB 9, ADB, BVI, OP4, and MT6 packa	<ul style="list-style-type: none"> - Work with the representatives of DONRE and DARD Tay Ninh Province. - Inspect the environmental status at some locations of PH3 package. 	<ul style="list-style-type: none"> - As informed by the representatives of Tay Ninh DONRE, they have not provided any information on the EMP implementation in their provincial area. Therefore, they recommended that EMP package consultants work with relevant departments in the coming time. - Local people claimed that the excavation activities of the contractor encroached their land area. Through the site inspection, it is found that this is only local situation and the area can be restored when construction completed. - Conducted a survey on the environmental condition at WQ22 point for sampling (Tra Cu) on the Vam Co Dong River, Tan My commune, Duc Hoa district, Long An province.

		ge contra ctor		
5	10/10/2011	MT6 packa ge	<ul style="list-style-type: none"> - Survey the Duc Hoa irrigation system area. - Supervise the alum soil monitoring at Duc Hoa irrigation system area, Long An. 	<ul style="list-style-type: none"> - As observed, soil in survey area is highly contaminated alum. - The survey carried out in accordance with current regulations and norms.

3. Implementation of EMP packages in the last six months 2011

3.1. Package MT2

The contract agreement of Package MT2 was signed in April 2010. The consultant has carried out office works and field surveys. Quarter III & IV reports in the last six months of 2011 were submitted.

According to the TOR, package MT2 consists of two specific tasks: Tasks I: study on the Be river catchment protection; Tasks II: Phuoc Hoa reservoir reforestation and forest management programme. Each main task consists of detailed tasks. Base on the implementation results in the last six months, the implementation of the package MT2 can be assessed as follows:

Task I-A '**Erosion risk survey, report and data collection**': this task has been implemented early. Its data and maps (scale 1:50.000) were collected and processed. Based on these data, the eroded risk areas primarily located by the consultant. In the last six months of 2011, the consultant conducted field surveys based on GIS data of the eroded risk area maps. The potential and trended erosion maps will be completed in the coming time.

Task I-B '**Field survey of risk erosion sites**': the consultant chose appropriate milestone on December 2011 when the dam was impounded for the inspection of collapsed status in downstream of Be riverbanks. The results are very valuable. It timely represented the collapsed status on the riverbanks due to the water level changes in the river flow. Therefore, it is proposed that consultant should plan a monitoring program to collect the Be River morphology changes after the Phuoc Hoa dam appeared.

Task I-C '**Catchment Protection Site Selection**': Forest GIS data are under preparation.

Task I-D '**Scoping and Awareness Workshop**': in the last two quarters, the consultant organized the meetings with local authorities and people regarding the erosion control in the semi-flooded area caused by the land re-encroaching.

Task I-E '**Follow-up Planning Meetings and Workshops**': as same as the Task I-D, the meetings and workshops were also held.

Task I-F '**Species, Planting Configuration and Management Options**': this task basically completed and a criteria set of forest trees is established, some following trees will be selected as *Hopea odorata*;

Lagerstroemia loudoni; Dipterocarpus alatus; Dalbergia tonkinensis; Pterocarpus macrocarpus, etc;

Task I-G '**Nurseries and Plant Material Supply Review**': to contact suppliers to be provided seedling for the plantation that was made in the previous period.

Task I-H '**Development of Catchment Protection Investment Plans**': this task has been implemented. Particularly, the consultant got trouble in choosing the pilot forestation locations.

Task I-I '**Development of Monitoring, Evaluation and Management Framework**': was carried out in the previous period. In the last six months, it was only considered to supplement and complete the anti-erosion and reforestation framework.

Task II-A '**Nurseries & Plant Material Supply**': the consultant determined scope and area for the reforestation, conducted an analysis on natural, socio-economic characteristics. The consultant also provided three proposed forestation options and confirmed that the first option is the most feasible option.

Task II-B '**Forest & Agro-forest Establishment**': is in process.

Task II-C '**Monitoring, Evaluation & Protective Management**': is in process.

Base on the consultant's report, in recent times, it has appeared a problem that local people re-encroached the project compensated land for reforestation to protect Phuoc Hoa reservoir catchment. To solve this problem, the consultant associated with employer to prepare and issue documents addressing to Binh Duong and Binh Phuoc PPCs, the letter requesting support from local authorities to prevent the semi-flooded area in the reservoir, however, its achievement has not been reached as expected.

For the coming solution, The consultant suggests to work directly with the People's committees of communes in the project area and request them to comply the responsibility in managing the right of way under the "Decision No. 245/1998/QĐ-TTg signed on 21/12/1998 by the Prime Minister in compliance with management responsibilities of governmental levels on forests and forest land".

Based on the implementation results and compared to the TOR, up to now, the consultant has implemented in accordant with the proposed schedule and requirements. During the implementation, the consultant has

actively collaborated with ICMB9 and local authorities, especially, worked with authorised agencies of Binh Duong and Binh Phuoc provinces to achieve the best results.

3.2. Package MT3

The contract agreement of Package MT3 was signed in September 2011 and the consultant has carried out some office works and field surveys, held some meetings with competent agencies and local authorities relating to the package as follows:

3.2.1. *The investment items review:*

Results of investment items have been made by the consultant as follows:

- In Binh Duong Province: based on the analysis and evaluation of the advantages and disadvantages in both Tam Lap, Cay Truong communes relating to actual status of the clean water use, water demand, quality and raw water source reservation. The consultant proposed to build a water treatment station in Cay Truong commune instead of An Linh commune as expected to supply clean water;
- In Long An Province: after working with local authorities such as DARD, Department of Irrigation, Center for Clean Water and Environmental Sanitation Long An Province, ... It is agreed that the location of water supply station will be located at Tan My commune, Duc Hoa district, Long An Province.

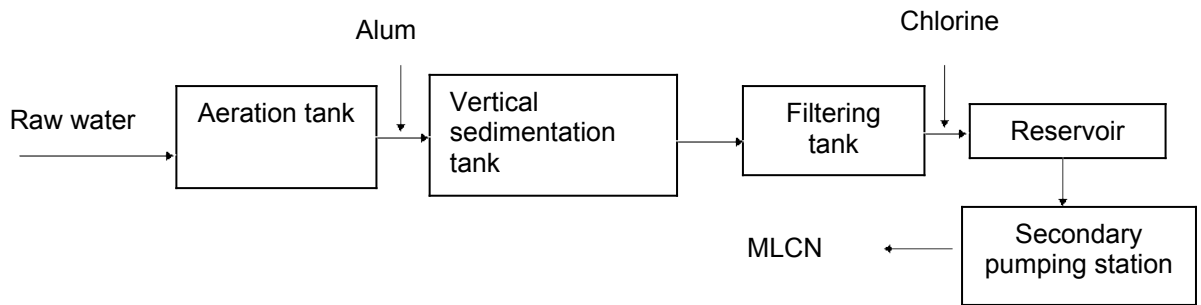
3.2.2. *Proposals for investment priorities of each phase:*

- Phase 1: Installing the clean water treatment station for the Be River basin;
- Phase 2: Installing the clean water treatment station in Duc Hoa area after the Duc Hoa irrigation canal system will be completed.

3.2.3. *Selection of technology, capacity, and cost estimate for the construction of the stations:*

❖ Water treatment station at Cay Truong commune, Ben Cat district, Binh Duong province:

- The capacity of this water supply station is 200 m³/day to distribute water for approximately of 500 households in the total of 1119 households at Cay Truong commune;
- it is primarily selected that the underground water treatment technology by artificial aeration combined with chemical supplying will be used;



- Construction cost of the clean water supply station is 2,717,696,000 VND (equivalent to \$130,000);
- The total cost of operation, maintenance, and management per year is 205,339,000 VND (equivalent to \$9,700).
- ❖ Water treatment station at Tan My commune, Duc Hoa district, Long An province:
 - The capacity of the water supply station is 50 m³/day;
 - it is primarily selected that the underground water treatment technology by artificial aeration combined with chemical supplying will be used (the same as Cay Truong commune);
 - The construction cost of the clean water supply station is 984,504,000 VND (equivalent to \$47,000);
 - The total cost of operation, maintenance, and management per year is 97,707,000 VND (equivalent to \$6,400).

In late months of 2011, the consultant has held the meetings with local authorities as follows:

- A meeting with Binh Duong DARD regarding the construction investment of water supply station in Phuoc Hoa dam - Be River was held on 21 October 2011;
- On 11 January 2012, a meeting with Tan My authorities regarding the investment of Water Supply Station for Tan My Commune, Duc Hoa District, Long An Province was held.
- On 10 February 2012, the consultant held a meeting with Cay Truong authorities in order to confirm the location for installing the Water Supply Station in Cay Truong Commune.

Based on the implementation results and compared to the TOR, up to now, the implementation activities have been made by the MT3 consultant is behind the proposed schedule. This delay was also caused by other reasons such as change of the water supply station locations, the

contact with local authorities in selecting the new location and waiting for comments from employer and donors. In summary, the volume and quality of works were done by the consultant that are met the requirements of the project.

3.3. Package MT4

The contract agreement of Package MT4 was signed in January 2010. At present, the MT4 consultant completed the Inception report, the first six monthly report of 2010, the implementation report of 2010, the first temporary report and the first six monthly report of 2011 were submitted.

Due to the MT4 consultant did not submitted their last six monthly report of 2011 yet, the specific contents of each task was not collected. However, based on the recent meeting results between OP4 Consultant and MT4 Consultant, the consultant carried out main activities such as supervision, selecting documents/data; working with local authorities; surveying the flooded areas/fish pass; finding procedures and law for establishment of Forestry – Fisheries Association/team; surveying the real conditions as basis for the development of management strategy and plan as well as development of fisheries in Phuoc Hoa reservoir and Be River.

In accordance the TOR, package MT4 consists of 9 specific tasks. We, OP4 consultant, primarily assessed the implementation status up to now as follows:

- ***“Understanding the proposed Be River and Phuoc Hoa fishery, Reservoir and Fish pass management programme”***: this task has early implemented, the basic information was collected and analysed. For this task, the statistic data of the fishery sector of the two provinces (Binh Duong and Binh Phuoc) are very important. Through these data, it can be recognised the changes on condition of aquaculture and fisheries. Therefore, new data will be needed to collect and update in next report.

- ***“Monitoring Hydrology and environmental flows management”***: has been done regularly and continuously. The hydrological data of flow was selected from observational results of package MT5. Similarly, the environmental flow was also selected from observational results of package MT6; the data of calculation results were fully integrated through the reporting periods. Based on selected data over the reporting periods, experts predicted the qualitative trend of aquatic organisms systems change. However, due to the monitoring data is so short, an exact conclusion on the potential changes could not be made.

- ***“Monitoring the fish pass construction”***: the main tasks of MT4

consultant is the supervision of the fish pass construction. Up to now, the construction was completed. As informed by the consultant, the fish pass was built in accordance with the original design. As expected by the fishery experts, the fish pass can only maintain 50% of existing crayfish and about 80% of existing fish sources.

- **“Establishment of Be River and Phuoc Hoa forest and fisheries association”**: this is one of the key tasks of the package. According to the consultant, after studying on the legal basis and discussing with local authorities of the project site, the association establishment would not be feasible. The consultant proposed to establish “The exploitation and protection of fisheries resources team” it is agreed by local authorities, local people, employer and donors. However, a specific structure has not been provided by the consultant (including function, obligation of the team, management, staffing, operation regulations; ...) of the proposed association. Therefore, it is suggested that the consultant must implement and finalize above tasks as soon as possible.

- **“Supervision and management of fish pass protection and operation”**: until now, the consultant has not provided a proper management, exploitation, and operation program for the fish pass, especially, the monitoring programme in order to evaluate the effect of these items.

- **“Establishment and implementation of Phuoc Hoa reservoir fishery management plan”**: the main content of this task is to provide guidance for the Association/ team to manage, exploit, plan, and conserve Phuoc Hoa Reservoir fisheries resources. It is very complicated to provide a proper guideline; it is needed to study carefully. Until now, the consultant has preliminarily outlined some contents for fishery management of Phuoc Hoa reservoir. It is suggested that the consultant should provide a specific management program and this program needed to be presented through workshops and meetings to have comments from experts and local authorities soon.

- **“Monitoring of Social support for affected fishermen”**: up to now, the consultant only collected some basic information on the project’s OSDP program in Binh Duong Province. In addition, the consultant informed that they could not approach other related information in Binh Phuoc Province. In addition, through the reports, it is found that the consultant has not reported any activities related to specific tasks out of the task of information collection. Therefore, it is considered that there are many shortcomings in this task, we suggest that the consultant need to

understand the OSDP program carefully and give specific actions in the coming time.

- ***“Establishment and implementation of Be River and lower Dong Nai fishery strategy”***: The main tasks are to prepare fishery management plans and action plans for Be and Dong Nai River basin. Until now, the main works were done those are data collection and training for aquatic resource protection and investigation, etc.

- ***“Monitoring and evaluation of Be River fishery management programme”***: is carrying out, study on the similar fisheries management model, which will be applied to Be River area in the future.

In general, there are still many outstanding works in package MT4. It is considered that the implementation progress of this package is quite slow by the late submission of the report of 2011. Therefore, we suggest that the MT4 should provide the detailed work plans in order to complete the contract successfully.

3.4. Package MT5:

Up to now, the MT5 consultant has implemented five survey stages included one survey in 2009, two surveys in 2010, and two surveys in this year and collected important data. The measurement and field survey were implemented seriously with sufficient contents in accordance with current norms and regulations to ensure the quality and meet TOR requirements.

Nevertheless, through surveys, up to now, the analysis and assessment parts of the 5th monitoring results report are still desultory and not provided an overall picture of hydrology regime change in space and time. Therefore, it is recommended that the consultant consider the mentioned limitations as well as implement next task timely, and ensure the quality and quantity.

3.5. Package MT6:

The contract agreement of package MT6 was signed in November 4th 2009, up to now, the MT6 consultant completed Inception Reports, monitoring reports in April, June, and August and October 2010 and submitted the survey report in 4/2011. The monitoring results in April (dry season) and October (rainy season) 2011 carried out timely.

Based on the TOR, most of the contents have been implemented such as understanding the existing monitoring network, proposal for the monitoring network during the construction stage, collect samples in the

field and analyse the surface water quality, underground water, and industrial pollution sources. These activities have been done well.

Recently, the consultant prepared a proposed table for new sampling locations for the operation phase including sampling locations for surface water quality, the hydrological monitoring locations in Phuoc Hoa Reservoir, and transfer canal, East and West canals of Dau Tieng Reservoir. However, the new monitoring locations system has not mentioned a biodiversity monitoring stations yet. Besides, the locations which proposed by the consultant need to be considered carefully by BVI and OP4 environmental specialist as well as agreed by the employer before implementing.

Besides mentioned achievements, based on the TOR, there are still some contents that have not been done well such as collecting the related documents/data from the institutes, schools, local agencies in project area. Among data need to be collected, the groundwater hydrology data are quite important, but have not been collected by the consultant. The consultant is not active in contacting and cooperating with local agencies and authorities. Therefore, the information of monitoring system and monitoring data from local agencies have not presented in reports of the package.

Therefore, as aforementioned disadvantages, We, OP4 Consultant proposed that the MT6 consultant must find out proper solution for the treatment and supplement missing contents/data/documents in the next report.

3.6. Package MT7:

The contract agreement of package MT7 was signed in October 18th 2008. Up to now, MT7 completed quarterly their reports such as report of Quarter IV/2008, four quarters in 2009, four quarters in 2010, and four quarters in 2011. The environmental monitoring results of Package MT7 is a basis for evaluating current condition and trend of environment change in the construction sites of the project, as well as some other issues related to social environment, labour safety.

According to TOR, package MT7 consists of six specific tasks, the implementation of each task during last six months of 2011 can be assessed as follows:

Task A ***“To Propose a structure of quarterly environmental monitoring report for contractors”***: was early completed before implementing other tasks.

Task B “**To Propose the Supervision and Environmental Monitoring Schedule**”: as same as Task A, this task was also completed early during the inception report period.

Task C “**Details of environmental Monitoring Programs for Contractors**”: there are five sub-tasks, and was fully implemented during quarters. However, except the Sub-task C3 “To verify the results of monitoring through field sampling and analysis independently” was not able to implement because the fact that all constructors did not taken samples and analyse environmental factors as the environmental management plan. For this problem, MT7 Consultant has many comments to the Contractors as well as the Employer but this has not been resolved.

Task D “**Environmental Monitoring implementation**”: there are seven sub-tasks, most of these tasks have been done well. Except sub-task D6 - environmental awareness assessment of contractors and providing necessary solutions. Through the reporting periods, the consultant has not provided necessary solutions to enhance the environmental awareness for contractors.

Task E “**Report preparation**”: the preparation and submission of reports have been done well although the progress is quite low. Although reports were done early (2008), there are still many mistakes. Furthermore, due to the self-monitoring of environmental factors of the construction contractors have not been implemented seriously. Therefore, most of the contents of the MT7 quarterly reports are independently monitored by themselves, the comparison of contents have not been done.

Task F “**Operation Phase**”: with following tasks “*Prior to completion of the construction works, the consultant shall advise ICMB9 and PPMBs on the implementation of EMP requirements in the operation phase.*” Although, the Phuoc Hoa dam is impounded and under operation, the consultant still has not proposed necessary contents and programmes yet. Therefore, we suggest that the MT7 consultant should complete these contents early and submit in the next first quarter report.

In general, most of TOR’s tasks have been implemented seriously. Up to now, the construction of project is going to finish. Serious environmental impacts have not been occurred, this is a good effort from the relevant units. However, there are still some outstanding issues as mentioned. It is suggested that the consultant should pay attention and resolve seriously.

3.7. Package MT8:

The contract agreement of package MT8 was signed contract June 30th 2011, up to reporting time, although the execution time has expired under the package's contract. However, the consultant has just implemented some of the contents such as purchasing of monitoring equipment, field survey, contacting with local authorities in getting the building permission of monitoring stations. Therefore, we can see the limited ability of consultant in implementing their missions, affecting to the objectives of the package that is salinity monitoring and other environmental indicators before and after the Be River was closed.

In addition, with the current implementation status, the remaining tasks of this package is hard to finish soon. This will influence significantly on the results of EMP. Therefore, we recommend that the consultant need to pay more attention to these current issues, prepare specific action plans, increase human resources in implementing and follow the consulting contract's requirements. Closely cooperate with employer, BVI and OP4 Consultant as well as local agencies during the implementation process.

3.8. Package MT10

The contract agreement of package MT10 was signed in November 2009, up to reporting time, the MT10 consultant completed the Inception report. In 2010, the consultant organized four workshops consisted of 2 workshops in Binh Phuoc Province in March (a community level workshop and a provincial level workshop), 2 workshops in Binh Duong Province in August (a community level workshop and a provincial level workshop).

In the last six months of 2011, the consultant also carried out 6 workshops consisted of 3 workshops at Tay Ninh Province in February, 3 workshops at Long An project in April. The workshops were organized as scheduled. And the consultant also submitted summary reports of 12 workshops which were held in 6 provinces in the project area and its vicinity, and they are considered satisfactory and in accordance with TOR.

In general, Package MT10's workshops were organized publicly, training, and high public awareness. At the end of each workshop, comments and recommendations from the delegates are discussed, many contents related to key issues such as environment; water management; alum soil using, forest protection and social security, etc) have been risen for discussion to present the interests and understanding of the

communities of the project site. Many questions were also answered by experts at the seminars under the public popular approach. This can be considered a propaganda important training channel in order to help improving the public awareness of environment issues in the project area.

4. Environmental management program at construction sites

4.1. Main construction activities at the sites

Up to December 2011, packages 1E and 1F were completed. Packages 1A, 1B, 1C, 1D, and Tan Bien are going to hand over. The construction packages of Duc Hoa main canal and Duc Hoa irrigation area are going to implement. In the last six months 2011, the main activities of construction packages mainly concentrate on finishing and preparing as-built documents to hand over.

Table 2: Construction workloads in Quarter IV/2011

No.	Packages	Construction quantity in quarter IV/2011
1	1A	Finishing construction and preparing as-built documents
2	1B	Finishing construction and preparing as-built documents
3	1C	Finishing construction and preparing as-built documents
4	1D	Finishing construction and preparing as-built documents
5	PH3	Finishing construction and preparing as-built documents

Sources: ICMB9

4.2. Impacts to be caused by construction activities

Unexploded Ordinance, Land Mines and Toxic Waste: According to the results reported from the contractor, up to now, the unexploded ordinance, land mines or toxic waste have not been found during excavation or site clearance.

Reinstatement of Temporary Working Areas: The contractors are carrying out the reinstatement of temporary working areas as indicated in the EIA Report, Technical Specifications and SEMP.

Work in public highway, inside and outside the sites: The contractors have complied with the National Standards in transporting materials on the public highway, avoid moving the construction equipment

through residential areas and managing temporary and permanent transportation.

Site drainage: in the beginning stage of the project construction, there were heavy rainfall causing local flood in some locations (foundation pits), however, all problems have been solved. Up to now, the flooding problems are no longer occurred.

Sanitation and site facilities: The contractors comply with the arrangement of worker camps, offices as indicated in drawings. Water supply systems were done and domestic water is enough for requirements of living. Solid waste at the packages are collected and disposed to the opening pits for the natural decomposability and these pits close to the offices or worker camps. Currently sanitation is going to do at the site as guidance of MT7 consultant. However, domestic wastewater and sewerage at the sites have not been treated and wasted directly into the environment. These problems should be paid attention in the coming phase of project at Duc Hoa irrigation system area.

The protection of the surrounding landscape: During the implementation, the contractors have complied with the approved construction layout. The project is not located in the National Parks or Nature Reserves. The contractors also avoid the influence of historical relics during the implementation.

4.3. Environmental monitoring results at the sites

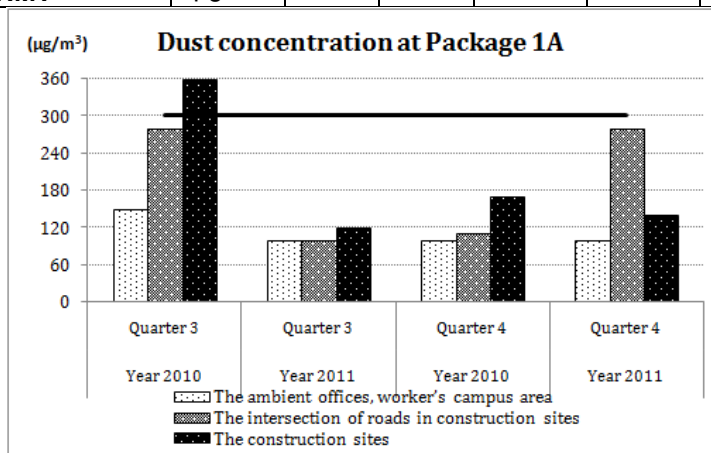
4.3.1. Air quality

❖ At the Headwork (Package 1A):

Based on the analysis results, it shows that dust concentration at the Package 1A in the last 6 months of 2011 is in the range of allowable limit of QCVN 05:2009/BTNMT. In comparison with the same period in 2010, most observed positions dust concentration value is equal or lower. Especially at the intersection roads in the construction sites, in the quarter IV of 2011, the dust concentration was high significantly (255% of the same period in 2010). The reason is that most of the roads in the project area completed and connected with the local transportation system. Thus, the transport of local people become more favourable, making the increasing of the traffic density, it means that air pollution levels rising again. Therefore, it is proposed that MT7 Consultant conducts surveys in order to identify the high polluted positions, cooperate with Constructors to increase watering until the project complete and hand over to local authorizes.

Table 3: Dust concentration at Package 1A

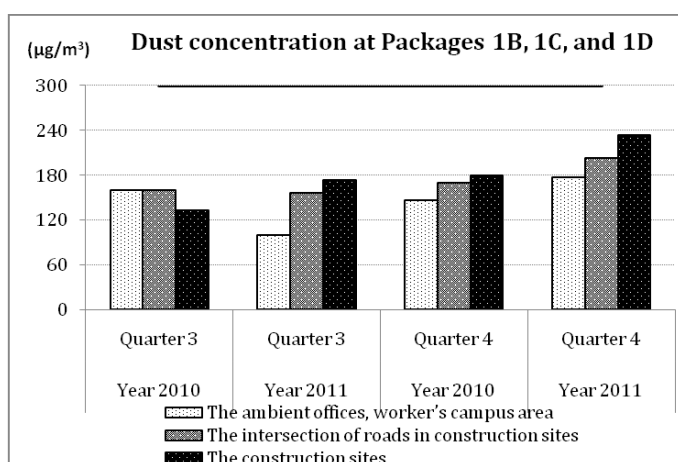
No.	Monitoring locations	Units	2010	2011	Rate (2)/(1)	2010	2011	Rate (4)/(3)
			Q.3 (1)	Q.3 (2)		Q.4 (3)	Q.4 (4)	
1	Offices, worker's campus areas	$\mu\text{g}/\text{m}^3$	150	100	67%	100	100	100%
2	The intersection of roads in construction sites	$\mu\text{g}/\text{m}^3$	280	100	36%	110	280	255%
3	The construction sites	$\mu\text{g}/\text{m}^3$	360	120	33%	170	140	82%
	QCVN 05:2009/BTNMT	$\mu\text{g}/\text{m}^3$	300	300		300	300	

**Figure 1: Graph of dust concentration at Package 1A**

❖ At the transfer canal construction sites (Packages 1B, 1C, 1D):

Table 4: Dust concentration of Packages 1B, 1C and 1D

No.	Monitoring positions	Units	2010	2011	Rate (2)/(1)	2010	2011	Rate (4)/(3)
			Q.3 (1)	Q.3 (2)		Q.4 (3)	Q.4 (4)	
1	Offices, worker's campus areas	$\mu\text{g}/\text{m}^3$	160	100	63%	147	177	120%
2	The intersection of roads in construction sites	$\mu\text{g}/\text{m}^3$	160	157	98%	170	203	120%
3	The construction sites	$\mu\text{g}/\text{m}^3$	133	173	130%	180	233	130%
	QCVN 05:2009/BTNMT	$\mu\text{g}/\text{m}^3$	300	300		300	300	

**Figure 2: Graph of dust concentration at Packages 1B, 1C, 1D**

Based on the analysis results, it shows that, along the construction

alignment of main canal No 1 from Phuoc Hoa to Dau Tieng reservoir, average dust concentrations at these packages 1B, 1C and 1D were lower than the permitted limit of QCVN 05:2008/BTNMT in the last 6 months of 2011. In general, the monitoring locations show that the air quality is good, have not been impacted by industrial and agricultural activities, etc. In comparison with the same previous time in 2011, dust concentration at the most monitoring locations were increased from 20% to 30%. As mentioned so far, the reason is most of roads in the project site completed and connected to the local traffic and makes the traffic density increasing and as well air pollution.

❖ At the Tan Bien irrigation area (Package PH3):

Table 5: Dust concentration at Packages PH3

No.	Monitoring positions	Units	2010	2011	Rate (2)/(1)	2010	2011	Rate (4)/(3)
			Q.3 (1)	Q.3 (2)		Q.4 (3)	Q.4 (4)	
1	Offices, worker's campus areas	$\mu\text{g}/\text{m}^3$	120	140	117%	140	100	71%
2	The intersection of roads in construction sites	$\mu\text{g}/\text{m}^3$	140	160	114%	240	140	58%
3	The construction sites	$\mu\text{g}/\text{m}^3$	140	140	100%	250	400	160%
	QCVN 05:2009/BTNMT	$\mu\text{g}/\text{m}^3$	300	300		300	300	

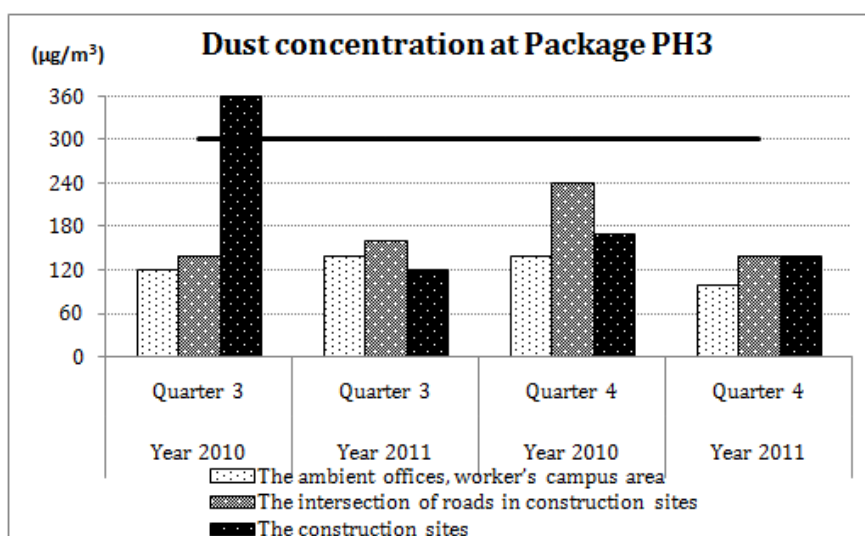


Figure 3: Graph of dust concentration of Packages PH3

In general, at Tan Bien irrigation area, in the last 6 months of 2011, the most monitored locations met the allowable limit of QCVN 05:2008/BTNMT. In the quarter IV, at construction sites, dust concentration was exceeded the permitted limit (exceeding 30%), and equivalent to 160% compared to the same previous time in 2010. The constructors need to conduct mitigation methods to reduce the air pollution at the construction sites.

4.3.2. Noise

The monitoring results show that all monitored locations have the noise in the range of permitted limit of QCVN 26:2010/BTNMT. The constructor maintains and does not make the noise pollution exceed the standard value at construction sites.

4.3.3. Domestic water

Domestic water plays an important role health of staffs and workers in construction sites. In the construction packages, the domestic water is supplied from underground water, the depth of well is from 25 to 50 m.

❖ At the headwork package (Package 1A):

Table 6: Monitoring parameters of domestic water of Package 1A in Quarter III& IV of the year 2011

No .	Monitoring locations	Units	2010	2011	Rate (2)/(1)	2010	2011	Rate (4)/(3)
			Q.3 (1)	Q.3 (2)		Q.4 (3)	Q.4 (4)	
1	Fe ^{Total}	mg/l	0.03	0.13	433%	0.18	0.06	33%
	QCVN 02:2009/BYT	mg/l	0.5	0.5		0.5	0.5	
2	E. Coli	MPN/100ml	33	4	12%	0	200	200%
	QCVN 02:2009/BYT	MPN/100ml	20	20		20	20	
3	Total Coliform	MPN/100ml	180	1	1%	52	3,900	7,500%
	QCVN 02:2009/BYT	MPN/100ml	150	150		150	150	

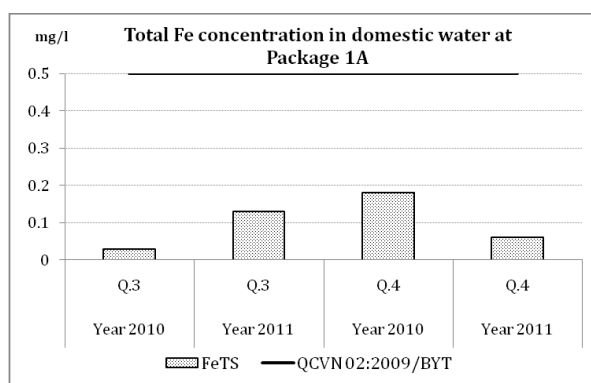


Figure 4: Graph of total Fe concentration in domestic water of Package 1A

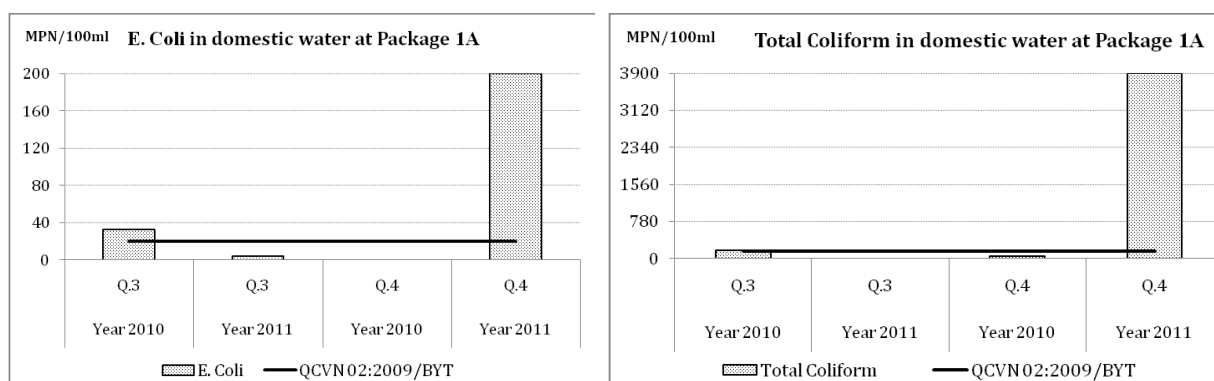


Figure 5: Graph of pollutant indicators in domestic water of package 1A

The monitoring results show that: at Package 1A, pH value in the domestic water does not reach the QCVN 02:2009/BYT. The other chemical factors are achieved the permitted standard. The microorganism pollution factor does not meet the permitted standard (E. coli: 200 CFU/100ml; Coliform: 3900 MPN/100ml). The micro-organism pollution level of domestic water at package 1A in the quarter IV/2011 reached an alarming level (increased 26 times in comparison with the permitted limit, and increased many times in comparison with the same period in 2010). Contaminating micro-organism in the water of the bid packages may result from groundwater at depths ranges from 20 m to 50 m infected with bacteria, and tanks are not cleaned regularly, pipe leakage, etc., also are major causes. Due to the construction works in these packages is completed, MT7 consultant needs to learn from these experiences, and propose appropriate solutions for the next phase to be used for Duc Hoa irrigation area.

❖ At the transfer canal sites (Packages 1B, 1C, 1D):

In comparison with the same period in 2010 and the situation of pollution at Package 1A, the drinking water pollution status at the transfer canal (packages 1B, 1C, 1D) have been improved remarkably, and most of them met the permitted of QCVN 02:2009/BYT standard for the domestic water quality.

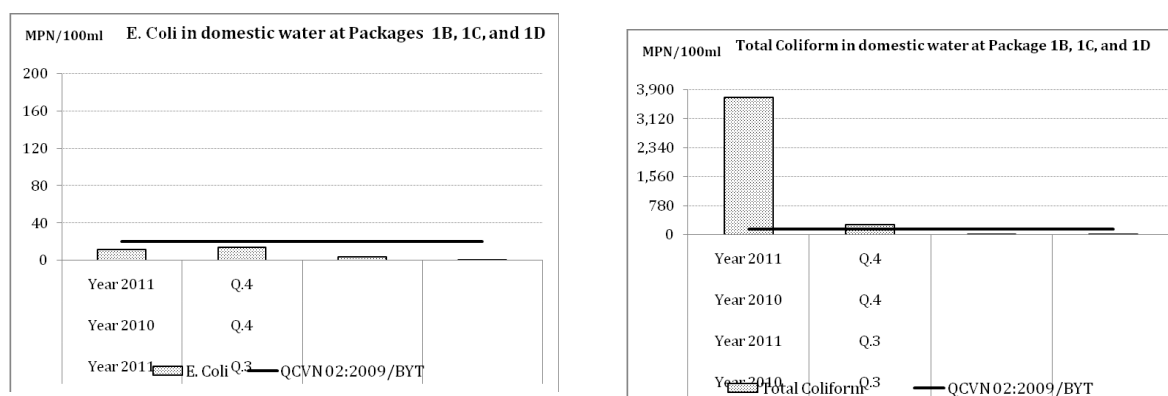
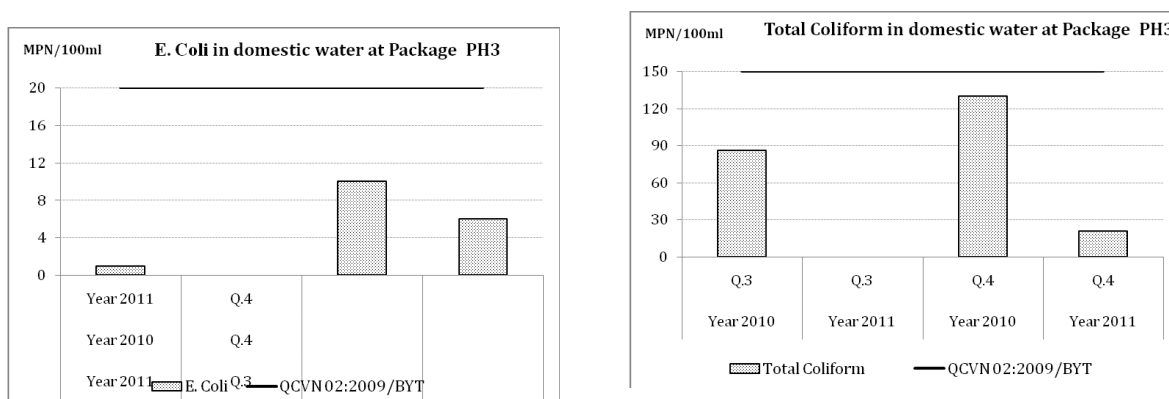


Figure 6: Graph of microorganism pollution in domestic water of packages 1B, 1C, and 1D❖ At the Tan Bien irrigation (Package PH3):

As the same case as the transfer canal construction packages, the condition of domestic water quality at Tan Bien irrigation area have been improved considerably, and most of them met the permitted QCVN 02:2009/BYT standard for the domestic water quality.

**Figure 7: Graph of microorganism pollution in domestic water of package PH3****4.3.4. Drinking water**

During the survey period, boiled and filtered water was used for drinking at construction packages.

The physical and chemical factors met the permitted standard. The state of microorganism contaminant has been improved compared to previous times, however, the two packages 1B (Quarter III: 140 CFU/100ml, Quarter IV: 20 CFU/100ml) and 1C (Quarter III: 3 CFU/100ml, Quarter IV: 27 CFU/100ml) did not meet the regulation.

Table 7: Monitoring parameters of drinking water at packages in quarter IV/2011

No .	Parameters	Units	1A	1B	1C	1D	PH3	QCVN 01:2009/ BYT
1	pH	-	7.09	7.89	5.62	6.04	7.41	6.5 - 8.5
2	Colour	Pt - Co	(< 2)	10	(< 2)	(< 2)	2	15
3	Total hardness	mgCaCO ₃ /l	8	144	(< 0.2)	(< 0.2)	12	300
4	Temporary hardness	mgCaCO ₃ /l	1	140	(< 0.2)	(< 0.2)	1	-
5	Clorua (Cl ⁻)	mg/l	3	3	2	2	15	250
6	Total Fe	mg/l	0.21	(< 0.06)	(< 0.06)	(< 0.06)	(< 0.06)	0.3
7	Asen (As)	mg/l	(< 0.001)	(< 0.001)	(< 0.001)	(< 0.001)	(< 0.001)	0.01
8	Total Coliform	CFU/100ml	(< 1)	20	27	(< 1)	(< 1)	0

(Source: IWER on 16 - 18 /11/2011)

4.3.5. Surface water

Most of packages (except: PH3), physical and chemical factors (pH, COD, total Suspended Substances, Oil, and Total Fe) met the QCVN 08:2008/BTNMT standard. Particularly, at Tan Bien irrigation area (package PH3), the value of COD, total Fe, and E.Coli exceeded the QCVN 08:2008/BTNMT standard. Constructors and the employer need to pay more attention to the surface water quality in Tan Bien irrigation area.

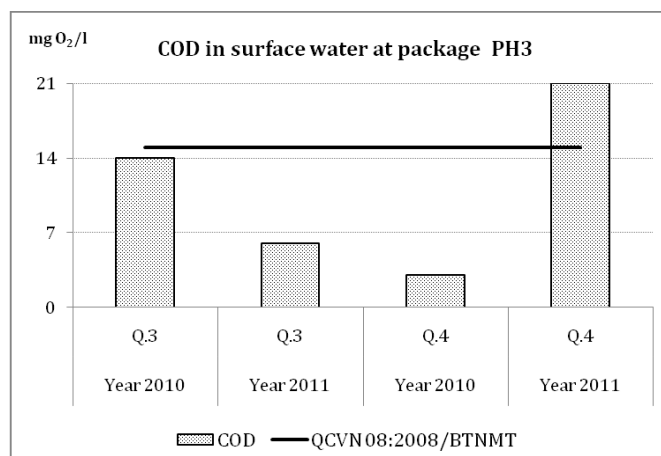


Figure 8: Graph of COD in surface water of package PH3

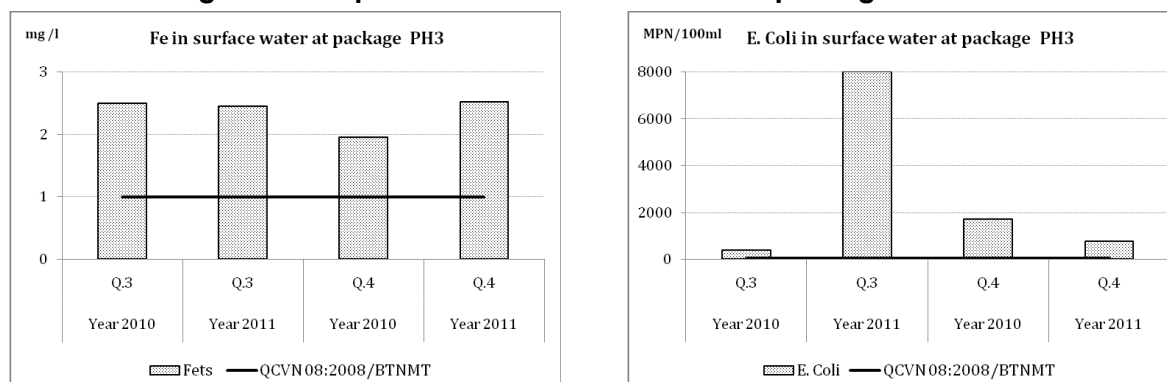


Figure 9: Graph of Total Fe and E.Coli in surface water of package PH3

4.3.6. Wastewater (domestic and worksites)

In general, in the last six months of 2011, the polluted level of domestic wastewater was not reduced in comparison with previous monitoring quarter. And the total criteria of Coliforms is much higher than the regulations. Wastewater could be a cause of infectious diseases for people living in lower areas due to using fisheries and domestic water. Therefore, MT7 Consultant need to consider, analysis the causes and propose remedies and limitations, especially, in next phase of the project.

For construction site wastewater, except the value of total Coliform at package PH3 (9,000 MPN/100ml) that did not meet the regulation, the remaining physical and chemical indicators met the regulations. The polluted level is trending downward in comparison with the same previous

time of 2010.

Table 8: Domestic wastewater quality of packages in Quarter IV/2011

No.	Indicators	Units	Results					Column B, QCVN 14:2008/BTNMT
			1A	1B	1C	1D	PH3	
1	pH	-	5.91	6.79	6.2	4.49	4.62	5 - 9
2	COD	mgO ₂ /l	216	187	35	35	470	100
3	TSS	mg/l	37	44	45	4	112	100
4	Total Oil	mg/l	0.6	0.7	(< 0,5)	(< 0,5)	17.4	10 - 20
5	Total Coliforms	MPN/10 0ml	9.3 x 10 ⁷	7.5 x 10 ⁴	9 x 10 ⁶	4.6 x 10 ⁸	1.1 x 10 ⁸	5,000

(Source: IWER, on 16 - 18 /11/2011)

Table 9: Construction sites wastewater quality of packages in Quarter IV/2011

No .	Indicators	Units	Results					Column B QCVN 24:2009/BTNMT
			1A	1B	1C	1D	PH3	
1	pH	-	6.68	7.7	5	6.23	6.4	5.5 - 9
2	COD	mgO ₂ /l	2	52	2	4	12	100
3	TSS	mg/l	4	12	16	5	54	100
4	Total Oil	mg/l	(< 0.5)	(< 0.5)	(< 0.5)	(< 0.5)	(< 0.5)	5 - 20
5	Total Coliforms	MPN/10 0ml	270	460	240	1,100	9,000	5,000

(Source: IWER, on 16 - 18 /11/2011)

4.3.7. Conclusion of the monitoring results at construction sites:

❖ The air quality and noise:

In the last six months of 2011, the monitoring results of noise level at all packages met regulations. Dust concentration at most of monitoring positions met the allowable regulation. Only the case of package PH3, the dust concentration exceeded the regulation in the Quarter IV. However, this case is not so serious.

These shown that the air pollution is mostly dust, dust arising from the sites clearance and the traffic of local people. The contractors have applied the dust control measurements, and the most effective solution is water injection.

Although dust in the air fluctuates constantly, sometimes it exceeds the regulation, but is not too serious. This has not affected to the local people living around the project. It is recommended that contractor uses proper solution so that the dust concentration in package PH3 can meet stipulated environmental norms.

❖ The drinking water quality:

The drinking water at the packages is provided by local companies with a manual and unclosed process. Therefore, the water quality is unstable, especially the hygienic activities section and water is usually infected with bacteria. On the other hand, the water tank is not cleaned, thus the water is infected with bacteria.

It is recommended that contractor must apply two solutions: (i) boiling the drinking water; (ii) if using the filter water, contractor should purchase good quality water for their workers.

❖ The surface water:

In general, the hauling of materials is not affected to water quality. Some causes could affect to water quality such as dust, soil sand, cement, and asphalt ... falling down the road or to be swept to streams causing polluted water. The consultant should pay attention to the surface water in the Tan Bien Irrigation Area (package PH3).

❖ The wastewater (domestic and worksites):

Domestic wastewater discharged from the kitchens, the bathrooms. It usually has the level of organic, micro-organism, total oil pollutant at the places, where gathering a large amounts of employees, workers, and untreated wastewater higher than the other packages. The reasons, which caused the increase of micro-organism pollutants in Quarter IV/2011, were probable that the site huts must be removed to return the construction site plan, thus workers gather around office areas. Therefore, some proposals was made such as filtering sediment tanks and the disinfected tank by chlorine for domestic wastewater before discharging into the environment. MT7 consultant need to consider carefully and cooperate with constructors to choose effective and feasible methods.

The pollution level of construction site wastewater of packages were caused by leaking waste oil from cooling water of construction machinery, equipments, the water from mixing chemical tanks, the water from batching plant; the stagnant rain water contained organic matter; mineral from soil, stone layers; from food waste of activities of worker; organic residues at the construction work. Up to quarter IV/2011, the activities of construction packages nearly finished. Main works were finishing activities for handing over, thus the pollution level of wastewater was trending downward remarkably.

5. Water Environment

5.1. The changes of the water flow and erosion status at riverbanks

5.1.1. The changes of water flow

General situation:

Base on the observed data on hydrological factors of Package MT5 showed that in rainy season the three stations Q2 (Dong Nai River), Q6 (Ben Luc River), Q3 (Ben Than) where the water flow is two directions. The other stations (such as Q1, Q4, Q5) the water just flows from upstream to downstream.

The velocity of water flow was monitored at monitoring stations in October 2011 was higher than the same monitoring period of 2010. The main reason was the rainfall in 2011 higher than 2010. In additional, in 2011, there were many flush flood from the upstream of rivers (Cambodia) then the water flow came to reservoirs (such as Tri An, Thac Mo, Srock Phu Mieng) which was increased than 2009 and 2010.

The changes of the water flow in the upstream of Phuoc Hoa dam

Up to now, the assessment of water flow changes for Phuoc Hoa dam upstream based on the monitored data at station Q4 (Nha Bich Bridge) since 2009. In pre-project period, SIWRR measured the water flow of rivers from 2003 to 2008. However, except the station Q2 (Dong Nai Bridge), the other stations are not identical to the existing stations. In addition, Srock Phu Mieng hydropower in the upstream of Phuoc Hoa Reservoir impounded in January 8th 2006, the water flow has changed compared with the previous natural water flow.

The observed data of the mean water level (H), and discharge (Q) in the dry season 2011 were lower than 2010. Conversely, the rainy season in 2011, H and Q at Q4 station is remarkably higher than 2010, can be explained as follows:

In the dry season 2011: because of the reduction of precipitation in 2010 then the water came to Srock Phu Mieng and Can Don were declined compared with 2010. Thus, in order to maintain the water supply for the whole dry season, the run-off water from these reservoirs have been reduced compared with 2010;

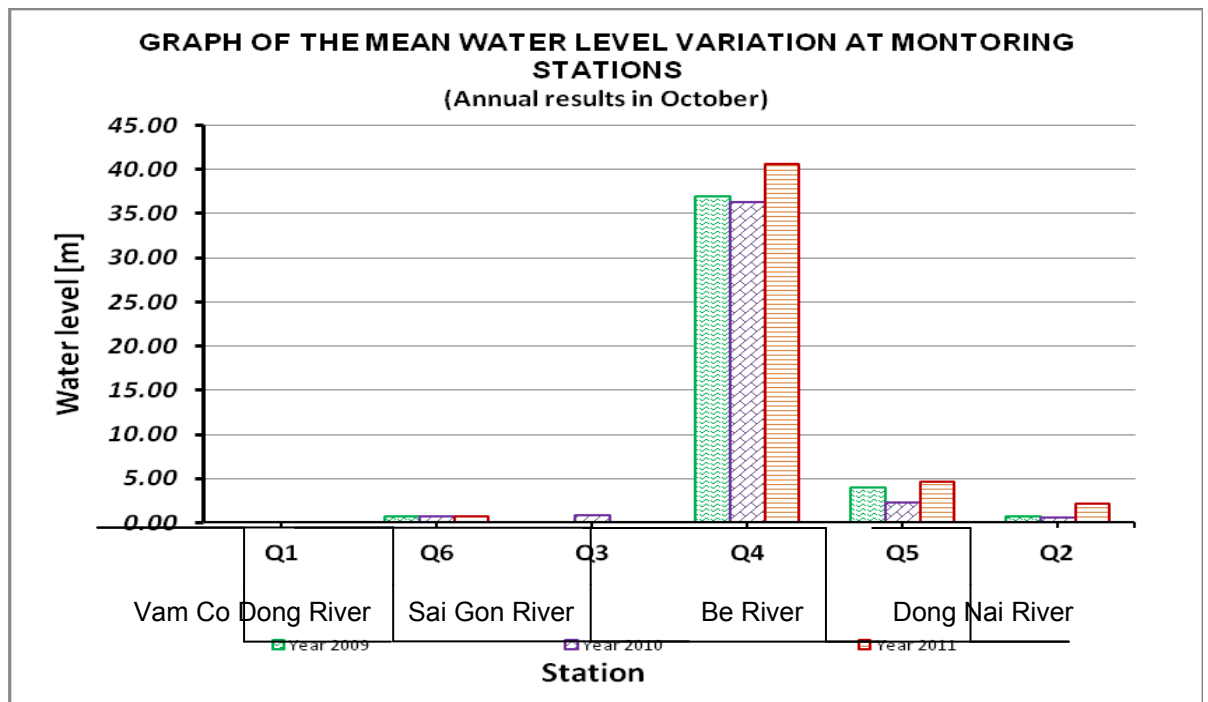


Figure 10: Graph of the mean water level at monitoring stations (Annual results in October)

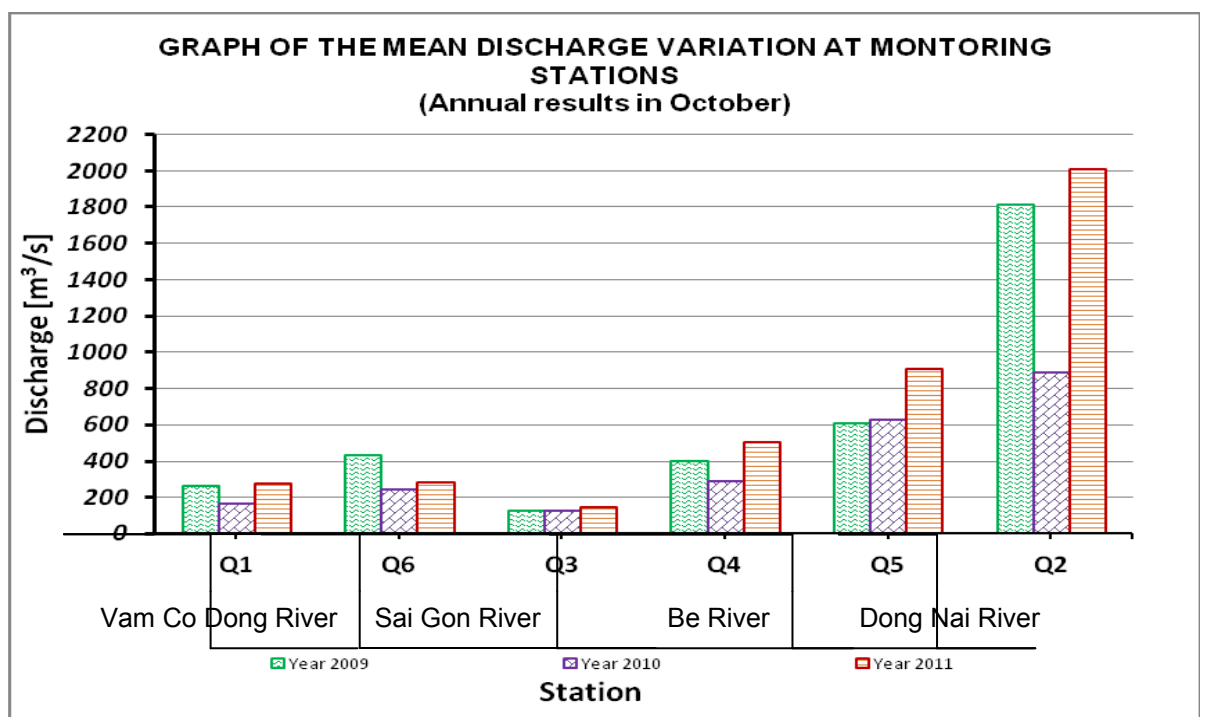


Figure 11: Graph of the mean discharge at monitoring stations (Annual results in October)

In rainy season 2011: there was the existing extreme flood upstream, thus, the water discharge came to reservoirs were increased, so that these reservoirs must drain the water out. The water discharge flows to downstream; beside the normal discharge for operation, a remarkable amount of water has been spilled to ensure safety.

The variation of the water flow downstream of Phuoc Hoa dam

and vicinity:

Up to October 2011, Phuoc Hoa reservoir had been impounded, the Phuoc Hoa – Dau Tieng transfer canal has not completed. Hence, the positive and adverse impacts of Phuoc Hoa project on the water flow downstream and vicinity area if any will be obviously seen at Q5 monitoring station (downstream of Be River, near the confluence between Be and Dong Nai Rivers).

Observed data at Q5 show that mean discharge during monitoring period in October 2011 was 1.5 times higher than those 2010. If not consider the cross section change at Q5 due to shifting gauging station to new location. We can conclude that Phuoc Hoa dam has no impacts on the water flow of Be River downstream of the dam.

At the other monitoring stations in vicinity, in general the water flow in the dry season of 2011 is lower than those of 2010. Especially, at Q2 station on Dong Nai River, the average discharge in April 2011 was just only 20% of the flow in 2010. However, up to the last October, because of the enhancement of rainfall, release and water flow from upstream then the mean monitoring discharge in October 2011 was higher than in 2010.

Up to October 2011, due to Phuoc Hoa – Dau Tieng transfer channel was not completed. Therefore, we can temporally conclude that the practise of Phuoc Hoa constructions have not influenced the upstream and downstream water flow regime of dam.

5.1.2. *The situation of the erosion at riverbanks*

To identify the potential erosion locations along downstream Be River, in addition, to evaluate the situation of riverside landslide downstream as close to the dam. MT2 consultant has conducted field surveys at the beginning of December of 2011, the scope of surveying from the toe of Phuoc Hoa dam to Hieu Liem – Dong Nai with total length is 50 km, in there focusing on 15 km from the dam toe to downstream, because this river has many curved sections.

Observed results show that the natural winding morphology of river creates the phenomenon of one side is eroded, one side is deposited. On the erosion side, the riverside is nearly vertical with angle from 15° to 30°, with vegetation such as grass, brushwood, bamboo hemp, and La Nga bamboo. The soil composition on the erosion side includes heavy clay layer at the water contact side, the over layer is covered by a new alluvial soil layer that created by falling down of above layer. On the deposition side, the riverbank slopes gentler from 50o to 60o, acidic alluvial soil, and

grey ferralic with coverage vegetation above, and people grow short-day crops such as corn, and breeding grass. Root systems of these plants are very weak, unable to link with soils and the risk of soil erosion on a large scale when the water level suddenly changes is big. Within 15 km of the survey, 66 landslides with length from 20 to 350 m and depth from 5 to 15 m, a number of deep erosion on people arable land.



Figure 12: Typical collapsed locations along the downstream of Be Riverbanks

All collapsed locations appeared after Phuoc Hoa Reservoir had impounded. Hence, it is primarily concluded that the collapses in Be River banks were caused by the sharp subsidence of water level versus the existing level. When the water level is subsided, water content in soil layers along the river is reduced as well, leading to changes of adhesiveness of soil particles. Consequently, soil mass riverside (at the bend of river or the reaches with vertical slope) slide down that caused the riversides collapse.

5.2. The changes of water quality

5.2.1. Surface water quality

❖ Be River basin:

Monitoring results of 2011:

- The value of pH is stable, ranges from 5.8 to 7.2, and there were no

significant difference in April, July, and October.

- The value of EC is quite low and equivalent to the salinity which does not exceed 0.03 g/l.
- The TSS value in October is higher than that in April and July, which is suitable with seasonal change.
- The organic content is trending higher in the upstream area and gradually decreasing to downstream area, these could be caused by two reasons as follows: (i) flow of streams to the Be River, which directly received bad quality wastewater sources from industrial and residential zones. The Be River basin has collected wastewater level (residential and production zones) in the downstream is higher than upstream area; (ii) in the case of downstream area, due to the interference with Dong Nai River. Hence the water at the end of Be river downstream area can be partially cleaned by diluted and increased self-cleaning ability.
- The value of total oil ranges from 0.01 to 0.03 mg/l, and is in the permitted limit, column A of QCVN-08.
- The content of heavy metals such as copper (Cu), lead (Pb) and cadmium (Cd) is quite low.
- Highest coliform number is not over 2500 MPN/100 ml (the permitted limit, column A1 of QCVN-08).

In comparison with QCVN 08:2008/BTNMT:

The water quality of Be River is fairly good equivalent to A1 and A2 column of QCVN-08 (using good for domestic water supply, aquatic fauna and flora conservation, and other reasons with lower water quality requirements). Impact on the Phuoc Hoa construction process, the TSS concentration is just temporary in construction sites.

Comparison of monitoring results through the years:

According to statistic data, the most analyzed indicators had no great difference in the annual mean value in 2010 and 2011 such as pH, EC.

In October 2010, the value of TSS was higher than those in 2011 at WQ01 and the three stations in upper Phuoc Hoa dam such as WQ05, 09, 10. Although the difference of absolute value of the above indicators is not too much, they are suitable with the Phuoc Hoa Reservoir construction process.

In comparison with monitoring results in April 2010 and 2011, in

March 2003 at Hieu Liem port (WQ10) in lower Be River close to the confluence of Dong Nai River shows that there are no great differences in the absolute value of most measuring indicators in this time

Table 10: Comparison of monitoring data in April 2010, 2011 and before project implementation

No.	Monitoring indicators	3/2003	4/2010	4/2011	QCVN - 08 A2
1	TSS (mg/l)	44	55	78	30
2	PO ₄ ³⁻ (mg/l)	0,018	0,04	0.054	0.2
3	NO ₃ ⁻ (mg/l)	0.4	0.04	0.36	5
4	DO (mg/l)	6	6.2	6.25	5
5	COD (mg/l)	7	2.5	1.95	15

Source: EIA report, Southern Institute for Water Resources research, 9/2007.

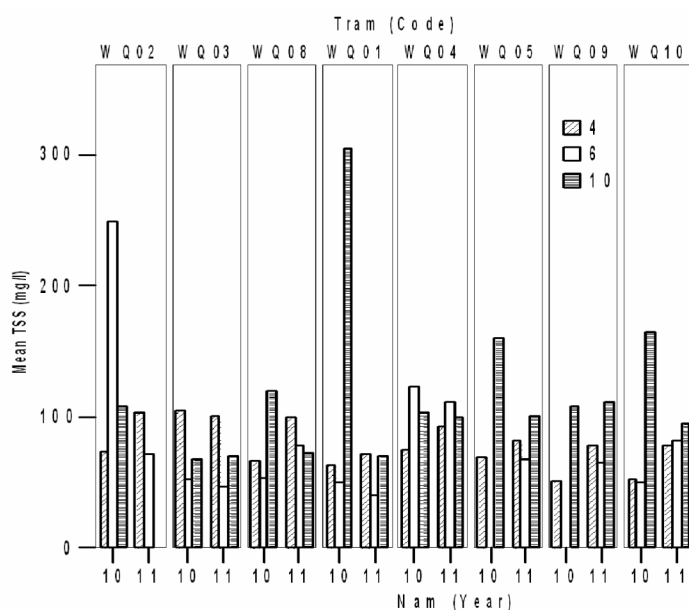


Figure 13: Comparison of TSS in Be River between 2010-2011

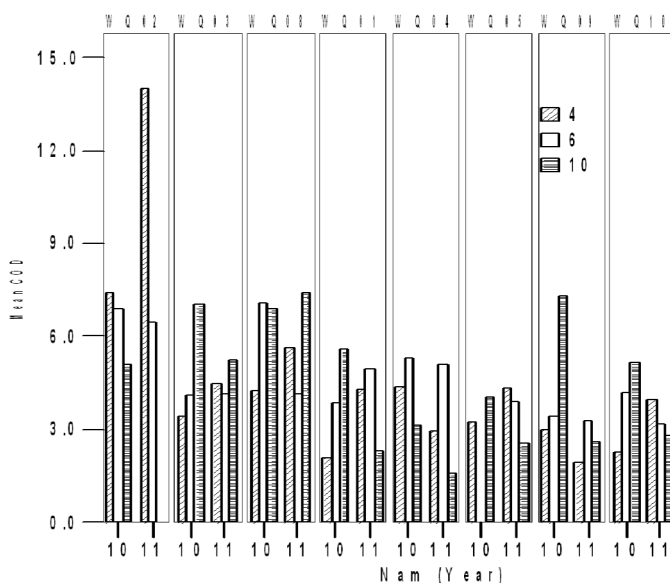


Figure 14: Comparison of COD at Be River in 2010-2011

Levels, trends and causes of pollution:

The water quality of Be River is rather good, most of monitoring indicators (pH, NO₃⁻, COD, BOD, and heavy metals) are reached the column A1, A2 of QCVN08:2008/BTNMT, due to the population of this region is sparse, the production activities have not yet developed. In 2010 and 2011, the civil works of Phuoc Hoa project were not impacted considerably on the Be River's water quality. The Be River's water resource is satisfactory for the water use purpose, the aquatic organism protection, and irrigation.

On the other hand, the discharge flows directly into Be River from streams with low quality, because they receive the domestic and industrial wastewater. These streams will affect the water quality of Phuoc Hoa Reservoir, especially in the initial phase of impoundment.

In the future, the industrial and domestic wastewater will affect negatively on the water quality of Be River and Phuoc Hoa Reservoir, if wastewater quality control solutions will not be applied. The Phuoc Hoa impoundment causes the decomposed vegetation in flooded area, it may be not impacted on the lower Be River's water quality, but affected on the Phuoc Hoa Reservoir's water quality in the initial phase.

❖ Dong Nai River basin:

Results of 2011:

- At monitoring stations, the values of pH are stable and fluctuate from 6-7.5, and no great difference among monitoring stations and monitoring period in year.
- In upstream area of Dong Nai River, the EC values are quite low, equivalent to salinity of 0.05 g/l, in the downstream from Nhon Trach (WQ18) to Nha Be (WQ19) where there is strong impact of salinity intrusion, especially in the beginning of dry season. In April 2011, salinity values in spring tide at Nhon Trach and Nha Be are 6.27 and 9.83 g/l, respectively.
- Nutrient and organic contents are low with COD from 1 – 5 mg/l, BOD₅ from 1-4 mg/l. The lowest DO value monitored in dry season at Tri An reservoir was of 3 mg/l.
- Coliform value in upstream of Dong Nai River is rather low – 4500 MPN/100ml. At Nhon Trach, the highest coliform value is 24.000 MPN/100ml recorded in October 2011.

In comparison with QCVN 08:2008/BTNMT:

In general, the water quality of upper Dong Nai River is good at monitoring stations equivalent to A1 and A2 column of QCVN-08. The

water quality infected by salinity in the downstream area is unsuitable for domestic and agricultural water use.

In 2011, the Dong Nai River's water quality there is no sign of any significant changes affected by the Phuoc Hoa civil works.

Comparison of monitoring results through the years:

There are no significant differences of pH, main ions in Dong Nai River at monitoring periods in 2010 and 2011.

The value of TSS at Tri An and Bien Hoa areas in 2010 are lower than those in 2011. However, contrary to this trend, in downstream from Hoa An to Nha Be, the TSS in 2011 is higher than those in 2010 [Figure 15].

At two lower monitoring stations (WQ18, 19), the salinity in the 2011 dry season is higher than those in 2010. This phenomenon is caused by the weather 2010 with low rainfall which decreased water flow of Dong Nai River in the beginning of 2011 in combination with spring tide and sea water level rise, making high salinity in 2011.

Nutrient content in 2011 is higher than that in 2010 at the same monitoring period over all monitoring stations, especially the downstream area from Bien Hoa to Nha Be. While, organic contents in 2010 are higher than those in 2011 over all monitoring stations in Dong Nai River [Figure 16].

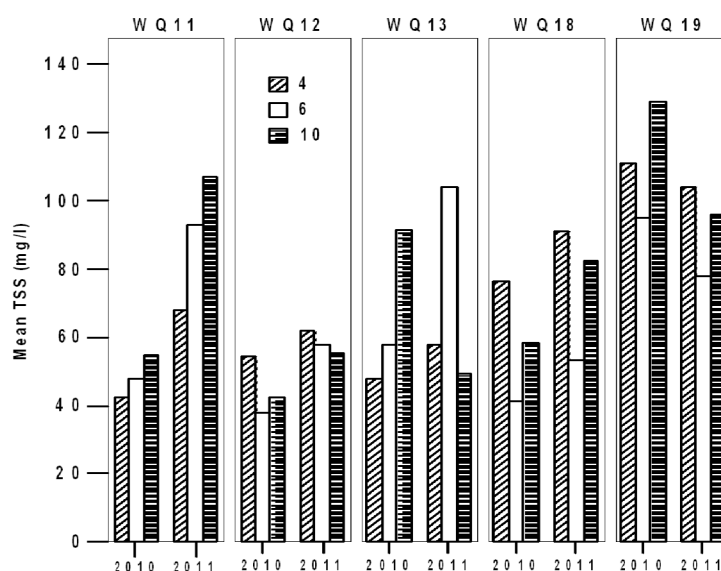
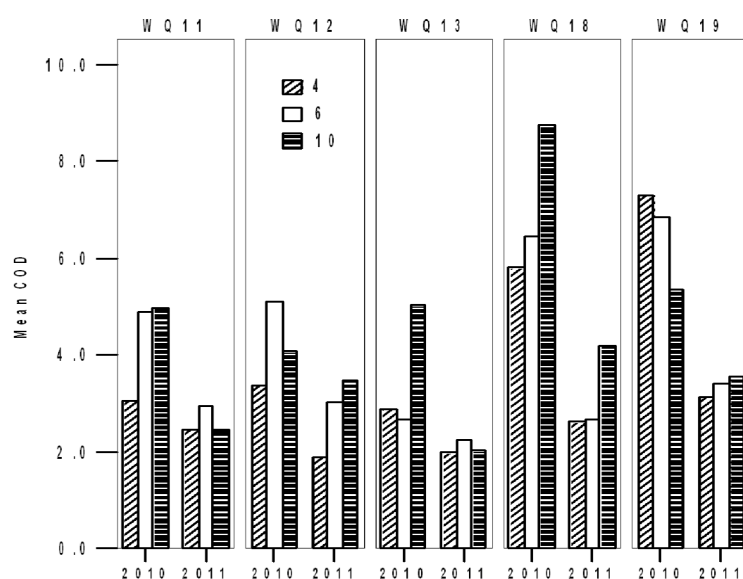


Figure 15: Comparison of TSS of Dong Nai River in 2010-2011

Table 11: Comparison of monitoring data in April 2010, 2011 and before project implementation

No.	Monitoring indicators	3/2003	4/2010	4/2011	QCVN - 08 A2
1	TSS (mg/l)	61	56	69	30
2	PO ₄ ³⁻ (mg/l)	0.016	0.03	0.032	0.2
3	NO ₃ ⁻ (mg/l)	0.01	0.09	0,593	5
4	DO (mg/l)	5	5.2	5.46	5
5	COD (mg/l)	12	3	2	15

Source: EIA report, Southern Institute for Water Resources Research, 9/2007.

**Figure 16: Comparison of COD at Dong Nai River in 2010-2011**

Levels, trends and causes of pollution:

Similar to the monitoring stage in 2010 and 2011, all monitoring parameters (pH, NO₃⁻, COD, BOD, heavy metal) conform to columns A2 and B1 of QCVN 08:2008 Standard (for domestic water supply, aquatic organism protection, respectively). Exceptional cases are Tan Mai, Ong Keo getting bacteria polluted because they are affected by untreated domestic wastewater.

The changes of some monitoring parameters in Dong Nai River in 2010 & 2011 are also in accordance with those obtained by monitoring networks in this area carried out by national programme or water resources sector.

The monitoring results of package MT6 have not discovered any relation between construction activities of the Phuoc Hoa project with those changes of water quality in Dong Nai River in 2010 and 2011.

❖ Sai Gon River basin:

Results of 2011:

- At monitoring stations the water has rather stable pH value from 6 - 7.5, and acid sulphate soil impact on Sai Gon River has been significantly improved.
- The section of Sai Gon River crossing Ho Chi Minh City is strongly influenced by tide which cause salinity intrusion in the dry season affect to the water supply for domestic and irrigation purposes in April 2011 with saline level approximately 5 g/l (WQ17) at Tan Thuan.
- The value of TSS in the rainy season fluctuates from 80 – 300 mg/l, and is usually highest value at Ben Than and exceeds the permitted value of QCVN 08:2008/BTNMT.
- The Coliform is also very much different among sampling stations and monitoring times with highest value of 24000 MPN/100ml recorded in July 2011 at QW15.
- The heavy metal content is low at all monitoring stations, the Cd content fluctuates the range of 0.001 – 0.003 mg/l, Pb from 0.001- 0.009 mg/l, and Cu from 0.001-0.014mg/l.

In comparison with QCVN 08:2008/BTNMT:

According to the results from national monitoring networks and general water resources department monitoring networks found that the water quality in Sai Gon River in the period of 2001 and 2011 was trending downward. The water value at stations WQ15 and WQ16 is equivalent to the rank B1 under the QCVN-2008, meet requirements for irrigation. Water sources at WQ14 and WQ17 is equivalent to the rank B2 under the QCVN-2008, meet requirements for navigation.

Comparison of monitoring results through the years:

The infected alum status in Sai Gon River in 2011 was significantly improved in comparison with 2010.

The TSS content at WQ14 in October 2011 is two times higher than that of 2010 while there is also difference among other monitoring stations but not significant.

There is no significant difference on organic matter and nutrient at monitoring stations WQ15 and WQ16 during monitoring times of 2010 and 2011, except the WQ14 and WQ17, the organic and nutrient values in 2011 are higher than those in 2010.

The comparison of monitoring results in the years 2010 and 2011, within the scope of environment monitoring of Phuoc Hoa project that is in

accordance with the evaluation of water quality changes in Sai Gon River which was done by the national monitoring networks and the general water resources department monitoring networks. Monitoring results of package MT6 proves that construction activities of Phuoc Hoa reservoir and dam have not affected to the degradation of water quality in Sai Gon River.

Table 12: Comparison of monitoring data in April 2010, 2011 and before project implementation

No.	Monitoring indicators	3/2003	4/2010	4/2011	QCVN - 08 A2
1	TSS (mg/l)	72	51	62	30
2	PO ₄ ³⁻ (mg/l)	0.003	0.05	0.04	0.2
3	NO ₃ ⁻ (mg/l)	0.6	0.9	0.825	5
4	DO (mg/l)	5	4.5	5.12	5
5	COD (mg/l)	5	6.15	4.6	15

Source: EIA report, Southern Institute for Water Resources Research, 9/2007.

Levels, trends and causes of pollution:

The monitoring results in Sai Gon River in 2011 show that the water quality was affected by the urban, industrial, agricultural waste resources, especially the lower areas are effect by Ho Chi Minh City, Binh Duong Province that caused organic and microorganism pollutions. The monitoring results of MT6 show that the Phuoc Hoa Reservoir civil works have not affected to the decline of the water quality in Sai Gon River.

Sai Gon, Thi Tinh, Nha Be River were affected by alum at stations of Ben Cui (Sai Gon river) and Ong Co bridge (junction with Thi Tinh River) in early months of rainy season. Stations as Ben Than, Tan Thuan on Sai Gon River, Binh Khanh on Nha Be River are affected by wastewater from Ho Chi Minh City with a low polluted level. The downstream areas of Sai Gon River are affected by salinity intrusion in dry season as well.

Sai Gon River is being seriously affected by natural phenomenon (alum, salinity intrusion) as well as human activities (domestic, industrial, and productive wastewater) of a largest city of country on the aspect of population size as well as economy. It is predicted that the water quality of Sai Gon section crossing Ho Chi Minh city will be trending downward due to the development of the city while the environmental protection activities, especially, polluted water resources status has not been significantly improved.

❖ Vam Co Dong River basin:

Results of 2011:

- The pH values in Vam Co Dong River from Tra Cu to Ben Luc area are quite

low (<4). In the dry season (April), and the middle of the rainy season, pH increases up to 6.0 - 7.0.

- The salinity intrusion impacts on Vam Co Dong River is insignificant with the highest salinity values is 0.8 and 1.1 g/l at Duc Hoa and Ben Luc, respectively.
- The TSS content is rather low with the highest value of 108 mg/l recorded at Ben Da (WQ21) in April 2011.
- As the same with nutrient, the organic content in rainy season, in October 2011 is rather stable with COD fluctuates from 5.5 to 6.0 mg/l, and BOD5 fluctuates from 2.0 to 2.5 mg/l. The highest COD value is 9 mg/l and, BOD5 is 5.5 mg/l are recorded at Ben Da (WQ21) in April and July 2011.
- The coliform is rather low with the highest value is 4300 MPN/100 ml.
- Although the pH values are low at the beginning of the rainy season, the contents of iron (Fe) and aluminums (Al) are quite low with Fe content from 0.11 mg/l to 2.33 mg/l and Al from 0.01 mg/l to 0.3 mg/l.
- The monitoring results are also familiar with those recorded by monitoring networks which done by local agencies and general water resources department.

In comparison with QCVN 08:2008/BTNMT:

The water quality in Vam Co Dong River is quite good, equivalent to rank A1 – A2 under the QCVN-08, except pH indicator.

Because of the acid sulphate soil effect from areas belong to Long An and Tay Ninh province, at Tra Cu (WQ22), Kenh Sang (WQ22), the pH values are lower than 5.2 (rank B1 under the QCVN-08, the water supply for irrigation).

Comparison of monitoring results through the years:

The comparison between 2010 and 2011 shows that there were no significant difference on pH, salinity, and main ions .

In April 2011, the TSS content at Tra Cu is two times higher than that of 2010, while there was no difference at other monitoring stations. There are no significant changes of nutrient content between the two monitoring years.

Although the total oil content in Vam Co Dong River is not high, the monitoring data indicate that the oil content gradually decreased approximately 50% in 2011 in comparison with 2010 at all monitoring stations [Figure 18].

The comparison of monitoring results in April 2010 & 2011 and March 2003 at WQ23 station of Vam Co Dong River at the Xang Lon canal [Table] shows that there was no significant difference on absolute values of most monitoring parameters between these period, the parameters of PO_4^{3-} , NO_3^- , and COD have values higher than those in March 2003.

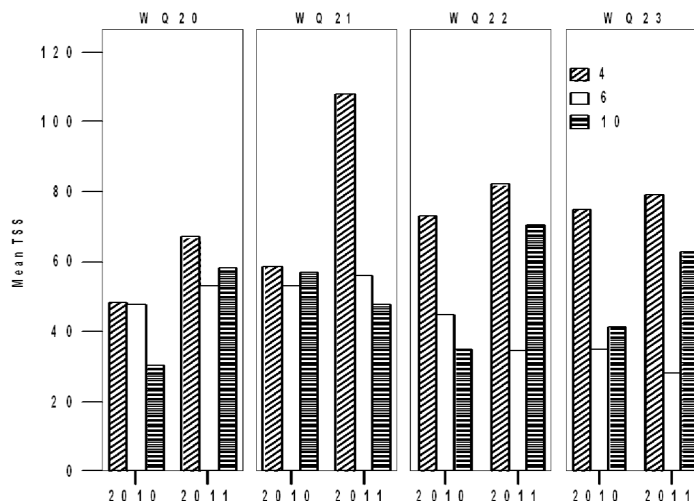


Figure 17: Comparison of TSS at Vam Co Dong River in 2010 – 2011

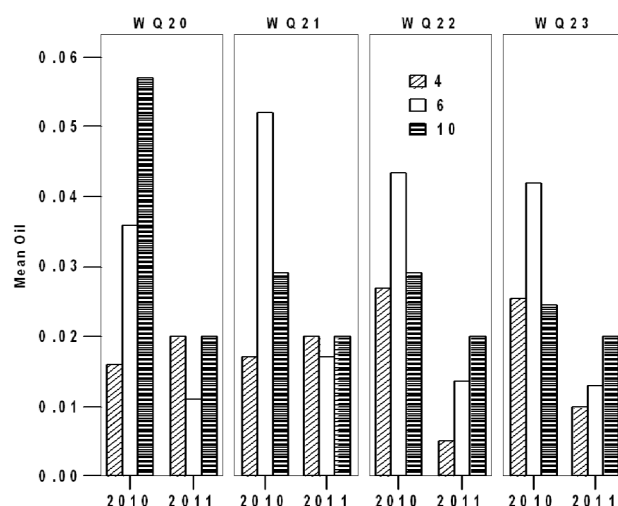


Figure 18: Comparison of total oil of Vam Co Dong River in 2010 – 2011

Table 13: Comparison of monitoring data in April 2010, 2011 and before project implementation

No.	Monitoring indicators	3/2003	4/2010	4/2011	QCVN - 08 A2
1	TSS (mg/l)	164	70	72	30
2	PO_4^{3-} (mg/l)	0.002	0.03	0.012	0.2
3	NO_3^- (mg/l)	0.4	0.7	0.78	5
4	DO (mg/l)	6	4.5	4.2	5
5	COD (mg/l)	8	6	6.7	15

Source: EIA report, Southern Institute for Water Resources research, 9/2007.

Levels, trends and causes of pollution:

In early months of rainy season, the water sources were affected

by acid sulphate soil causing difficulties in using domestic and agricultural water. In the dry season, the downstream areas were affected by salinity intrusion and the area from Go Dau to Ben Luc where affected by wastes discharged from Go Gau and Ben Luc industrial parks which increase the polluted organic risk and decrease water use capacity, which is naturally limited in Vam Co Dong River.

Aforementioned issues indicate that the water quality of Cam Co Dong river is not only affected by natural impacts such as alum, salinity intrusion but also affected by waste sources discharge from industrial zones which were strongly increasing in recent years in Long An, Tay Ninh provinces. The development trend of production activities in the downstream of Long An could cause the water quality going bad.

It found that there was no relation between water quality changes in Vam Co Dong River and construction activities Phuoc Hoa reservoir in the periods of 2010-2011.

5.2.2. Groundwater quality:

Results of 2011:

- Monitoring results on ground water level indicate that there is a significant difference between dry and rainy seasons over all ground water monitoring wells. The difference between dry and rainy seasons in 2011 is 1.5 – 4.0 m in Binh Duong province, 1.2 – 4.5 m in Binh Phuoc, 1.0 – 2.0 m in Tay Ninh and 1.0 – 2.5 m in Lo Go-Xa Mat National Park.
- Assessment of chemical composition of ground water in 2011 shows that in Binh Duong, Binh Phuoc and Lo Go-Xa Mat areas, the ground water contains a low value of pH (< 5.5), and does not meet the requirements under the QCVN-09. In Tay Ninh province, the ground water contains the pH value ranging from 6.5 to 7.0. The nitrite (NO₂-) content is quite low at most wells over 4 monitoring locations with the highest value of 0.182 mg/l in Binh Phuoc province in October 2011.
- Iron content ranges from 0.01-3.1 mg/l and does not meet the permitted limit under the QCVN-09. The Manganese (Mn) content is less than 0.2 mg/l and its content in the dry season is higher than that in the rainy season at all monitoring locations. The heavy metal content is often smaller many times than those in QCVN-09 and insignificant changed among monitoring times.
- Most of wells in Binh Phuoc province are infected by Faecal Coliform with the

highest value of 24000 MPN/100 ml.

In comparison with QCVN 08:2008/BTNMT:

Most of physical and chemical compositions of ground water meet the QCVN-09 regulations, except some wells are infected by ated Faecal Coliform, high Fe, and Mn content.

These results are also familiar with the evaluation report on monitoring trends of ground water in Binh Phuoc province.

Comparison of monitoring results through the years:

In comparison with avarage value of ground water level shows that the ground water level in 2011 was higher than that of 2010 over all monitored areas of the project. This absolutely suitable with weather situation in the years of 2010 and 2011. In 2011, the rainy season came early with the annual average rainfall that is higher than 2010, which increases the ground water level in 2011.

For the ground water quality, in comparison with 2010, the monitoring results of 2011 has no significant change. There were only changes of Al_3^+ and SO_4^{2-} contents compared to those in 2010:

Al_3^+ content did not appear at some monitored locations in 2011. While, it appeared over all monitored locations in 2010.

SO_4^{2+} content did not appear at some monitored locations in 2011, or appeared with a small content in comparison with 2010 (from 0 to 61.23 mg/l in 2011 compared with from 39.5 to 88.1 mg/l in 2010).

Some physical-chemistry compositions and water level were changed in 2010 and 2011 which is confirmed that not affected by the construction activites of Phuoc Hoa dam.

Table 14: Comparison of monitoring data in October 2010, 2011 and before project implementation

No.	Monitoring indicators	9/2005	10/2010	10/2011	QCVN-09
1	pH	6.3	6.0	6.3	5.5 – 8.5
2	NO_3^- (mg/l)	10	0.04	0.05	15
3	T-Fe	1.0	5.3	1.0	5
4	Mn	0.2	0.1	0.05	0.5
5	Faecal Coliform	0	0	90	0

Source: EIA report, Southern Institute for Water Resources Science, 9/2007.

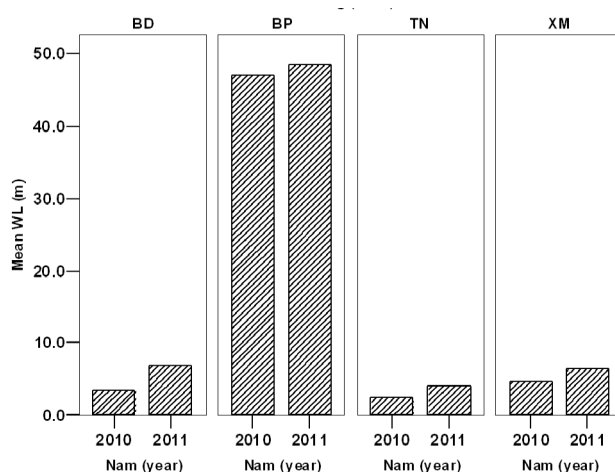


Figure 19: Comparison of groundwater level in 2010 – 2011

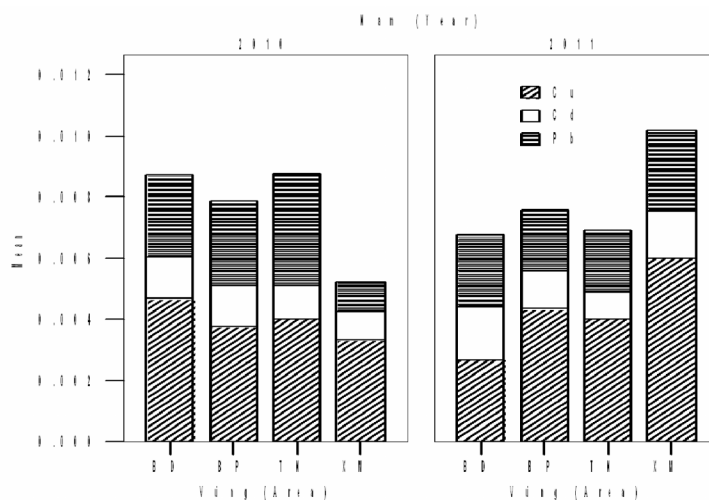


Figure 20: Comparison of heavy metals for groundwater in 2010 – 2011

Levels, trends and causes of pollution:

The monitoring results shows that the ground water level at construction sites usually changes by seasons, especially at the places where the aquifers are exposed. In the dry season, the ground water level tends to decrease from the beginning of season and get minimum level in end months of dry season. In the rainy season, the aquifers collect water from rainfall and the ground water level tends to increase and get maximum level at the end of rainy season. In recent years, the ground water level at construction sites usually reaches minimum level at late April and early May; and the ground water usually reaches maximum level at late October and early November.

Water level of all monitored wells in 2010 was lower than 2011. Some monitored wells could be located near residential areas, which locally contaminated in the dry season because water reached minimum level and domestic wastewater infiltrated into the groundwater source.

Phuoc Hoa dam construction is going to complete and the reservoir

has not been impounded. Therefore, there is not any basis for an assessment of the project affecting to the ground water. The ground water quality is medium, the impact of construction activities to ground water is impossible.

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

Monitoring results of surface water parameters of Duc Hoa –Long An irrigation area compared to the range B1 of the QCVN 08:2008/BTNMT as follows :

- The pH values of monitored water samples range from 2.78 to 7.20, some samples have pH values lower than the permitted value of the norm QCVN 08/BTNMT. It shows that the water was infected by alum.
- The NO_3^- content ranges from 0 to 16.47 mg/l; many monitored samples contain the NO_3^- content higher 1.7 to 2.5 times in comparison with the environmental norm.
- Total nitrogen content ranges from 0.15 to 31.13 mg/l; Total phosphorus content ranged from 0 to 3.16 mg/l
- Total Fe content ranges from 0.15 to 6.57 mg/l; many water samples have value exceeded 1.0 to 3.0 times in comparison with the norm.
- Al^{3+} content varies from 0.03 to 5.17 mg/l; SO_4^{2-} content ranges from 1.56 to 86.2 mg/l.

Monitoring results of groundwater quality parameters in Duc Hoa Irrigation area, Long An province in 2011 was compared to the QCVN 09:2008/BTNMT as follows:

- pH value of the groundwater samples ranged from 5.2 to 7.8; all six groundwater samples meet the requirement of the QCVN 09:2008/BTNMT. Some samples were slightly infected by alum.
- NO_3^- content ranges from 0.14 to 2.34 mg/l; all samples are met the groundwater quality standard.
- Total Nitrogen content ranges from 0.98 to 11.56 mg/l; total phosphorus content ranges from 0 to 2.16 mg/l;
- Fe content ranges from 0.03 to 5.62 mg/l; this meets the requirements of the QCVN 09:2008/BTNMT.
- SO_4^{2-} content ranges from 0 to 61.23 mg/l, all samples met the standard of ground water.

Comparison of monitoring results through the years:

In comparison with 2010, monitoring results of surface water in 2011 has no significant changes:

- Total Fe content is twice higher than 2010 at some monitored locations (3.12 mg/l in 2010 compared to 6.57 mg/l in 2011).
- Al_3^+ content declined in 2011 in comparison with 2010 (86.2 mg/l in 2010 compared to 6.57 mg/l in 2011).

In comparison with 2010, monitoring results of groundwater in 2011 has no significant changes. There are only some small changes in the contents of Al^{3+} and SO_4^{2-} in comparison with 2010.

- Al_3^+ content did not appear at some monitored locations in 2011. While it appeared over all monitored locations in 2010.
- SO_4^{2+} content did not appear at some monitored locations in 2011, or appeared with a small content compared to the year 2010 (from 0 to 61.23 mg/l in 2011 compared to the year 2010 from 39.5 to 88.1 mg/l).

Level, trends and causes of pollution:

It is difficult to predict how the project affect to the alum infected irrigation area in Long An because there is only monitoring data in 2010 and 2011 and there are no information of production activities in this area.

6. Biodiversity

6.1. Aquatic biodiversity

6.1.1. Fishes and shrimps

A total of 164 species of fishes and shrimps belong to 13 orders, 37 families have been found at 11 monitoring stations. Among them, the family of Carp (*Cyprinidae*) is the most diverse with 60 species and occupying 36.59% in total. The Striped catfish (*Bagridae*) with 14 species account for 8.54% in total. The other families have been found average from 1 to 7 species and occupying 0.6 – 4.27% in total species.

The fish species composition in Phuoc Hoa irrigation systems are diverse and abundant that specific to the different catchments, it can be divided into 2 major groups including brackish water group in the river outfall area and freshwater fish group. Most of freshwater fish groups were

recorded at all monitoring stations. especially, there are 10 rare fish species appeared in the Red book of Viet Nam, in range VU (Vulnerable) and need to protect such as *Cirrhinus microlepis*, *Hemibagrus filamentus*, *Anguilla marmorata*, *Albulichthys albuloides*, *Probarbus jullieni*, *Chitala ornata*, *Channa limbata*, *Bagarius bagarius*, *Mytus wyckoides*, *Wallago micropogon* (Vietnam's Red book, 2007). In total of species, 5 exotic fish species were founded including *Colosoma brachypomum*, *Hypophthalmichthys nobilis*, *Cyprinus carpio*, *Cichla ocellaris*, *Oreochromis niloticus* and other 56 high-value species. These exotic fish species will strongly interact to the fish and shrimp sources because they have high output and fast proliferation.

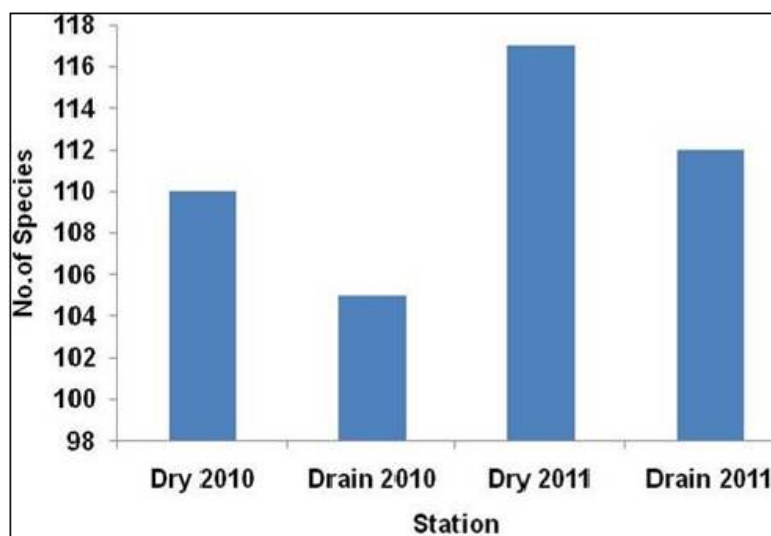


Figure 21: Graph of number of fish seasonal changes

In the above graphs, the number of species were changed by seasons between 2010 and 2011. The trend of the changes in species composition and number of fish species were increased in dry season and decreased in rainy season. However, the change is not much from 105 to 117 species. In short, the number of fish species in 2011 increased in comparison with 2010.

The number of species and density plankton were increased in comparison with 2010, it is a feed source for number of fishes. In the upstream area of Phuoc Hoa irrigation systems, the water quality is good; it is a good condition for growth and development of fishes. In the downstream is the transition area of freshwater and brackish water so that interference in fish species composition.

6.1.2. Phytoplankton

Over the four surveys, there 261 were alga species recorded. Species composition focuses on 6 phyla and ranks following order:

- The phylum Bacillariophyta: 96 species; 36.78% in total;
- The phylum Chlorophyta: 92 species; 35.25% in total;
- The phylum Cyanophyta: 36 species; 13.79% in total;
- The phylum Euglenophyta: 28 species; 10.73% in total;
- The phylum Dinnophyta: 6 species; 2.30% in total;
- The phylum Chrysophyta: 3 special; 1.15% in total.

The number of alga species determined in 2011 were increased in comparison with in 2010, corresponding to 178 species and 149 species. Generally, the species composition and number of species of phytoplankton in the project area are diverse and abundant. Among them, most of species of phylum siliceous algae are freshwater species such as *Gyrosigma*, *Melosira*, *Surirella*, etc.

The group Cyanophyte contains most of the harmful algae and usually concentrate in aquatic and rich nutrition environment. When they live in good conditions, they will rapidly increase the number of cells, and then their density rises. Thus, the number of cyanophyte had been highly dominant (36 species) mainly downstream. It is a signal of the pollution.

The phylum Chlorophyta is the most abundant of the kingdom of algae. They are a rich nutrition specy and the resources for supplying primary feed for zooplankton. Therefore, they play the important role in food chain of aquatic ecosystem. The present of both number of species and density Chlorophyta are increased the food source for fish.

The appearence of Dinnophyta and Chrysophyta (only from 3 to 6 species) is negligible and its role increased the biodiversity of the phytoplankton system.

Similar to the qualitative result, quantitative result shows that the average density of algae in 2011 is slightly higher than in 2010 with 22,018 cells/L and 15,753cells/L respectively . On the other hand, the density of algae in rainy season is higher than in the dry season with 29,867 cells/L and 7,904 cells/L respectively.

With the recent growth of urbanization , especially in the basins of Phuoc Hoa irrigation systems caused increasing the amount of wastewater. It is an good condition for agae species in developing quantity and density. It is considered that downstream Be and Dong Nai rivers corresponding to streams that had been contaminated with density and the number of phytoplankton species higher than other locations .

6.1.3. Zooplankton

The monitoring results of zooplankton at 11 stations showed that there are over 51 zooplankton species of 5 phylums. Arthropoda phylum is the most dominant number and species. This implement that the shrimp and crab species in the project site is fairly abundant and diversified, including:

- The phylum Protozoa: 3 species; 5.88% in total;
- The phylum Annelida: 1 species; 1.96% in total;
- The phylum Mollusca: 2 species; 3.92% in total ;
- The phylum Aschelminthes: 11 species; 21.57% in total;
- The phylum Arthropoda: 34 species; 66.67% in total.

The average number of zooplankton increased 12 species in 2011 in comparison with 2010 with 9 species. The number of species in rainy season usually increases in all monitoring stations compared to other seasons. The density of zooplankton were changed significantly in monitoring stations in monitoring periods. The average density in 2011 is higher than in 2010, corresponding to 12,659 individual/m³ with 8,432 individual/m³.

In the survey of 2011, the number of phytoplankton species increased in comparison with 2010. Therefore, the food source for zooplankton is abundant and some fish species increased. According to the water quality report, it shows that in the rainy season, quantities of nutrients increase and this is a good condition for mobile phytoplankton development. However, water quality-monitoring needs to carry out frequently and annually to manage phytoplankton species growth.

6.1.4. Zoobenthos

24 zoobenthos species belonging to 6 class of 3 phylum were found in the survey of 2011. Among them, *Arthropoda* class has the highest number with 11 species, while two remain phylums are Mollusca 7 species, *Annelida* 6 species. The class Crustacea *has the highest number of 7* belong to phylum Arthropoda (29,17%), then the class *Gastropoda belong to phylum Mollusca* and Oligochaeta class belong to phylum *Annelida* has 4 species(17%), then the class *Bivalvia* class has 3 species and *Polychaeta* class has 2 species (13%) of the total species.

The number of zoobenthos species in 2011 is similar to the year 2010. Zoobenthos density in 2011 has decreased but it is not different in comparison with 2010, 257 individual/m² compared to 292 individual/m². In

comparison with the plankton, the zoobenthos was not significantly changed□

6.1.5. Fishery productivity in Be River

❖ Binh Duong province:

Based on the data of DARD of Binh Duong province in 2010, the fishery productivity increased twice in comparison with 2003 (235 tons) and increased 4 times in comparison with 1996 (152 tons). In Tan Uyen district fish was caught on Dong Nai River and Da Ban Reservoir (55%); In Thuan An district fishery productivity was caught on Sai Gon river (14%). In Phu Giao and Ben Cat districts fishery productivity was caught in Be and Thi Tinh rivers (11%), in Dau Tieng district, fishery productivity was caught in Dau Tieng and Can Nom reservoirs (4-5%).

Table 15: Fisheries development situation of Binh Duong province

No.	Indicators	Units	2007	2008	2009
1	Aquaculture				
	- Area	Ha	469	495	517
	- Production	Ton	4059	4559	4906
2	Fishing	Ton	518	468	536
3	Total production	Ton	4577	5027	5442

Source: Binh Duong DARD

Currently, fisheries activities are under the management of Economic Division- Binh Duong province DARD. At district level, the management unit is the district Economic Division and household is managed by commune People's Committee.

❖ Binh Phuoc province:

According to data of fishery surveys of Binh Phuoc Statistics Department, there were 586 households with 772 labours (2009) who fishing in Thac Mo reservoir and upstream Be River of Phuoc Long district.

Base on the assessment of governmental agencies, it is shown that the period from 2006 to 2010, aquaculture areas increased of 12%, aquaculture productivities increased of 16%; fishing productivities increased of 15%.

Table 16: Fisheries development situation of Binh Phuoc province

No.	Indicators	Units	2007	2008	2009
1	Aquaculture				
	- Area	Ha	2118	2229	2496
	- Production	Ton	5269	6102	7078
2	Fishing	Ton	488	559	643
3	Total production	Ton	5757	6661	7721

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, supports technologies to fisherman and plays a role as an advisory unit for the DARD. The management of household activities is Commune People's Committees.

6.1.6. Conclusion of aquatic life

The composition of plankton is abundant at eleven survey sites that indicated 261 species phytoplankton, 51 species zooplankton, and 24 species zoobenthos.

Number of species and amount of aquatic organism density in 2011 are higher than 2010.

The composition of fish and shrimp species is 164 fish species 37 families and 2 shrimp species. Especially, 10 fish species were found in the list of endangered and rare species, 5 alien fish species, and 56 high economic value fish species. In addition, giant shrimp exists in some sites will be able to develop and exploit. There is no significant change of fish species in the survey times.

6.2. Terrestrial biodiversity

Recently, packages MT1 and MT2 have contents related to terrestrial biodiversity. However, package MT1 has not implemented yet. While package MT2 task in TOR, it has observed vegetation in Phuoc Hoa Reservoir catchments, the monitoring data used in designing forestation protection program.

Based on the previous reports of MT2, there have not had any significant changes of vegetation in the Phuoc Hoa reservoir basin.

Information of fauna will be updated based on the implementation results of package MT1 in the coming time.

7. Soil condition

7.1. Assessment of monitoring results of Duc Hoa irrigation are in 2011:

7.1.1. Acid sulphate soil

Similar to previous years, in 2011, soil condition in the observed areas is very acid. pH_{H_2O} values at monitoring sites in 2011 ranged from 3.13 to 4.47. pH_{KCl} at monitoring sites in 2011 ranged from 2.55 to 3.95.

Since there is acid sulphate soil areas, $\text{pH}_{\text{H}_2\text{O}}$ values at monitoring sites from 3a, the number of the soil samples was appeared a high or quite high organic content. Organic carbon content of soils ranged from 0.25% to 7.45%. Most of the monitoring areas, the total N content is low. Total N content in soil varies from 0% to 0.519%. Total P content is low.

Total Fe content in the soil at the monitored locations varied from 846 to 2469 ppm. Al^{3+} content in soil ranged from 146 to 863 ppm. SO_4^{2-} content in the soil at monitored locations ranged from 0 to 0.56%.

7.1.2. Soil solution

In 2011, soil solution in monitored areas contains a high acidic content, pH ranged from 2.5 to 3.12. Total N content in the soil solution ranged from 10.23 to 89.60 ppm. Total P content in soil solution ranged from 0.35 ppm to 9.65 ppm.

Total Fe content ranged from 6,34 đến 9,86 ppm. Value Al^{3+} in soil solution ranged from 24 to 221 ppm. And SO_4^{2-} content in the soil solution ranged from 156 to 342 ppm at monitored locations.

7.2. Comparison of monitoring results through the years:

In comparison with 2010, the monitoring results of acid sulphate soil in 2011 changed negligibly with some small changes: (i) Total P content in soil was appeared in most of samples; and (ii) SO_4^{2-} content was not appeared some locations, these are S21 and S63 monitored in April 2011.

In comparison with 2010, the monitoring results of soil water have some changes: (i) Total N content at some locations was increased suddenly compared to 2010 (23.82 ppm in 2010 compared with 89.6 ppm in 2011); (ii) total P content appeared in all samples. In 2010, total P content only appeared in deep layers at both two monitored locations in November 2010.

The remaining monitoring indicators have not been significantly changed.

7.3. Levels, trends and causes of pollution:

It is difficult to predict how the project affect to the alum infected irrigation area in Long An because there is only monitoring data in 2010 and 2011 and there are no information of production activities in this area.

8. Environment Awareness

8.1. Environment Awareness of contractors

Recently, the environment awareness of most contractors have been improved significantly, all tasks of EMP have been implemented fully except sampling collection for analysing at worksites as mentioned above. In the last six months, all contractors submitted their SEMP reports.

The workload of construction packages is completed, clearing for completion stage is going to carry out hurriedly, comply with the technical regulations, until now no serious environmental problems occurred. Some contractors support local people in the areas to upgrade some rural roads. It shows that the contractors' awareness about natural environment protection is high.

8.2. Environment Awareness of resident's community

During the project implementation, we can see the environment awareness of local communities in the project area and vicinity is very different.

Most local communities have begun to aware well about the environment after receiving the sufficient information of project and the relevant environment information in some workshops of packages MT2, MT4, especially package MT10. However, only a small part of local people and authorities have opportunity to access and know the major information of the project, through the environmental training courses, so that the propagation is still limited and has not the effective results in the community.

Therefore, currently package MT2 reflects the reoccupation of project acquired land in Phuoc Hoa Reservoir catchments protection that causes obstructing and affecting to the forestation implementation in the coming time and increasing basin erosion. This is one of insufficient environment awareness.

The propaganda and training help to enhance the communities' awareness is difficult to carry out with people participation in each region. Besides, the implementation of the propaganda training content for officials and authorities has not been considered, so the effectiveness of these activities is very limited.

In order to be aware from local people to the project as well as environmental issues adequately, it is important to provide information of the project regularly, it can inform the implementation process of project through meetings in each hamlet or ward. In the other hand, leaflets can be designed to propagate the contents to public. By such way, the necessary

contents could come to the individual citizens.

9. Conclusions and Recommendations

9.1. Conclusions

9.1.1. The natural and social environment

Up to now, there are no problems of negative impacts to the project area, except some local impacts in construction sites. Since Phuoc Hoa Reservoir has stored water, but Phuoc Hoa – Dau Tieng transfer canal has not operated yet. However, as mentioned in the previous reports, (as EIA detail Report), the water quality of the river catchments in the project area has become worse, the polluted level is increasing, particularly in some large urban areas of Bien Hoa and Ho Chi Minh City.

In the last six months of 2011, the hydrologic regime was complex, and exceeded the experts' predictions. The discharge in the dry season (April) is low, but increases in some last months of the year, due to the increasing of the mean rainfall and the upstream flow is big as shown in the monitoring results of discharge and water level in package MT5.

Through field survey results, it is found that EMP package reports, and ICMB9 the project has not occurred any social issues recently. As mentioned in the previous MT2 reports, the encroachment of the compensated area in the semi-flooded area of the local people presented in MT2 report that impacted to the Phuoc Hoa Reservoir protection responsibility.

9.1.2. EMP packages

Package MT2: These issues of this package that should be considered is to carry out the pilot forestation and Phuoc Hoa Reservoir's protective forestation, to build up the potential erosion map for the further protection basin. It is needed to have necessary warning of erosion to local authorities of Be river downstream Phuoc Hoa dam to mitigate the lowest damages caused by erosion. Erosion positions, forecast areas, effective alternatives need to be identified.

Package MT3: some contents have been implemented as follows: (i) To review investment items; (ii) Propose of investment priority levels; (iii) capacity selection, production line and construction estimate cost of the stations. The works' content of the package has been initially implemented later than planned, but its progress meets the TOR requirements.

Package MT4: In the implementation process, the consortium of package MT4 was not contacted and worked with other EMP packages to collect the significant monitored data which leads to the late report submission and it affects the overall progress of the environmental management program EMP.

Package MT5: the consultant was implemented their work based on the project schedule and work plan, but the editing and submission of reports is still slow.

Package MT6: In the first six months of 2011, the MT6 consultant was implemented all tasks, met the contents consultant contract, and proposal requirements. Nevertheless, the monitoring results report in last six months 2011 was submitted too late.

Package MT8: It can see that the implementation progress of the consultant is limited, affected the package objectives that are to monitor the variation of salinity and other environmental indicators before and after the Be River restored the water.

Package MT10: the consultant submitted their report through 12 workshops that were organized at 6 provinces in the project site and the vicinity. They are assessed satisfactory and suitable to TOR.

9.1.3. *Advantages, disadvantages, problems:*

Advantages:

The implementation of all EMP packages are within the proposed contents and schedule except package MT8 is behind the schedule, but there have not any serious environment problems occurred. This results due to some advantages as follows:

- Selected consultants are capable and have experiences in implementing contents of package.
- Good support from local authorities, agencies, and local people.
- Cooperation, share, and support of EMP consultant each other .
- Coordination and supports timely from ICMB9 in all cases to assist consultant in implementing their works.

Disadvantages:

As mentioned in the previous reports, in the last half of 2011, besides the above advantages, the EMP tasks were faced to some certain difficulties as follows:

- For construction packages: Contractors do not have any staffs, which had the

environment management background but pluralities. Therefore, the commitment complying and environmental contents implementation related to the protection have not really well yet, there have been many outstanding issues were not solved yet (mentioned below).

- With EMP packages: at present, there are only 9/14 packages are under the implementation but the workloads are still quite big. In addition, each package implements different missions in different times. Therefore, the coordination among these packages is also very difficult.

Problems:

Some problems had mentioned in the previous reports that were solved by the consultants. However, there are still some outstanding issues as follows:

- The submission of progress reports and providing the information packages implementation activities to the Employer and supervision consultant is late that affecting to the data and information selection of the OP4 consultant. In addition, the consultants have not complied with the engagement that submitting the inception report with three completed sets (hard copy), and CD Rom.
- After receiving comments from OP4 and BVI consultants, the revision and resubmission of reports were not even carried out promptly.
- The implementation reports of the contractors were mentioned statistics and general assessment, they were not analysed deeply to clarify the reasons.
- Many packages have carried out field surveys and worked with local authorities, but the information on contents and work plan have not been provided to the employer and supervision consultant
- During implementing their works in the provinces, the consultants were not informed to local authorities the work plans and implementation process.

9.2. Recommendations

9.2.1. General recommendations for EMP packages

- The EMP package consultants must comply with the commitment of the submission of inception report with three full sets (hard copy and CD Rom).
- Relevant agencies should immediately resolve outstanding issues as mentioned in this report.
- The EMP package consultants should be initiative in delivering and sharing the data with other agencies.
- The deadline for the submission of reports must be complied within the TOR,

summarise the EMP packages implementation results in the middle and the end of the year.

- It is needed to assess, analyse the current environmental issues based on the monitoring data from packages.
- It is needed to contact, provide the contents and working plans to local authorities in the project area before implementing.
- For the packages MT2, MT7: the quarterly reports should be submitted after 10 days from the completion time of each quarter (For example, the implementation results report of quarter I/2012 must be submitted before 10/4/2012).
- For package MT3: the feasibility study report should be submitted before 30/5/2012 according to the proposed plan.
- For the packages MT4, MT5, MT6: the six monthly reports should be submitted after 10 days from the completion time of each quarter. (For example, the first six monthly report of 2012 must be submitted before 10/6/2012).

9.2.2. *Recommendation for each EMP packages*

- ✓ For package MT2: Out of the remaining contents of package MT2 as mentioned in Item 1.2.1, the consultant should have a detailed plan for pilot forestation, cooperate with local authorities and the Employer in providing mitigation solutions to limit the encroachment of compensated land, establish the GIS database and Erosion map for Phuoc Hoa reservoir catchment.
- ✓ For packages MT3: Continuously implement the next tasks that closely follow the TOR. The MT3 consultant should inform working plans to the Employer, supervision consultant during the implementation, especially when working with local authorities.
- ✓ For package MT4: continue to supervise the fish pass construction, always play a role as a technical consultant during the implementation process, and report the specific situation to the Employer, BVI and OP4. Actively carry out the community support program as assigned. To overcome the late submission of reports, to take the initiative in data collection from EMP packages and to contact to work with local authorities.
- ✓ For packages MT5: To prepare necessary contents for the next survey in April 2012, continue to collect data and documents as package's

requirements, and pay more attention to the submission of implementation result reports. Continuously update the information of the operation regime of Phuoc Hoa Reservoir in conveying water through the Phuoc Hoa – Dau Tieng transfer canal and this information should be provided in next report. Especially, analysis result reports are very important to provide an overall picture of the hydrological changes, identify positive and negative impacts not only in the project area, but also in the vicinities. In addition, meteorological experts need to assess the situation, forecast the change process, set up a warning mechanism, and support in developing mitigation solutions relating to the water environment.

- ✓ For package MT6: In the coming time, there are some works that have been operated especially transfer canal that causes effects and changes on the natural environment in this site. It is recommended that the consultant continuously update and provide the significant monitoring data in order to report promptly the trend of environmental changes in the project area, and to propose the monitoring locations in the next phase based on the experiences from the similar projects to have a monitoring network and program with the ability to cover the whole project area.
- ✓ For package MT6: It is suggested that the consultant continue updating data, enhancing the supervision and field survey on the issues of Sanitation and site facilities, Reinstatement of Temporary Working Areas, Disposal of water and waste products, etc, and supporting the consultant to implement the packages.
- ✓ For package MT8: it is recommended to pay attention to outstanding issues, prepare a detailed work plan, strengthen the human resources for the implementation, and implement closely to consulting contract's requirements. To closely cooperate with the Employer, BVI and OP4 as well as local authorities during the implementation. To complete and submit the Inception reports, field survey reports and meeting results with local authorities regarding the establishment of monitoring stations on 1 May 2012.

At present, in the whole project area, there have not been any environmental incident occurred and negative impacts caused by Phuoc Hoa dam construction activities. The current major solutions is to continue supervising and monitoring effectively in order to prevent and inform initial signs of environmental incidents as fast as possible for timely solutions.

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APPENDIX A

OBSERVED WATER LEVEL & DISCHARGE – MT5 PACKAGE

Station: Q1 (Vam Co Dong River)

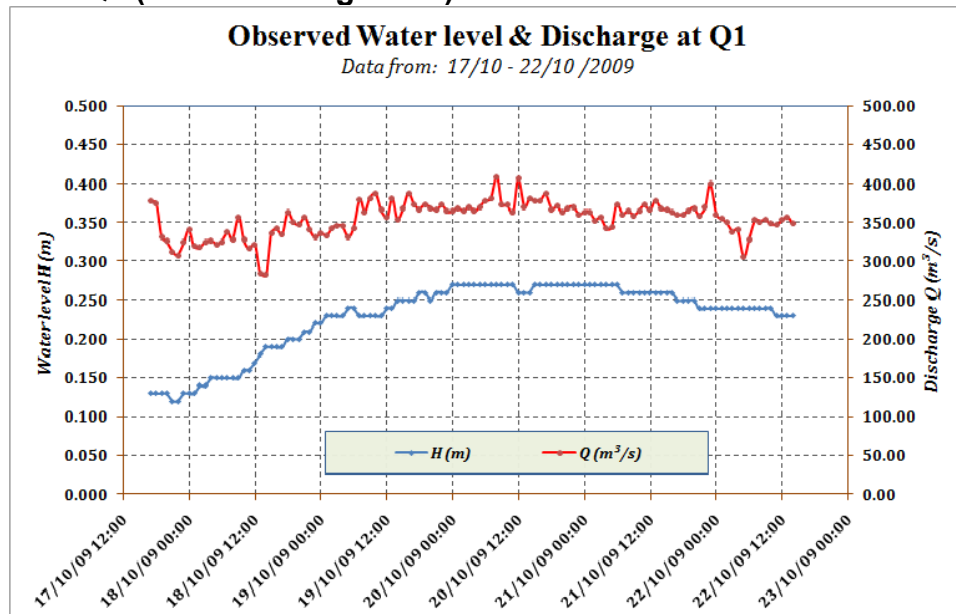


Figure 22: Observed Water level and Discharge at Q1 (October 2009)

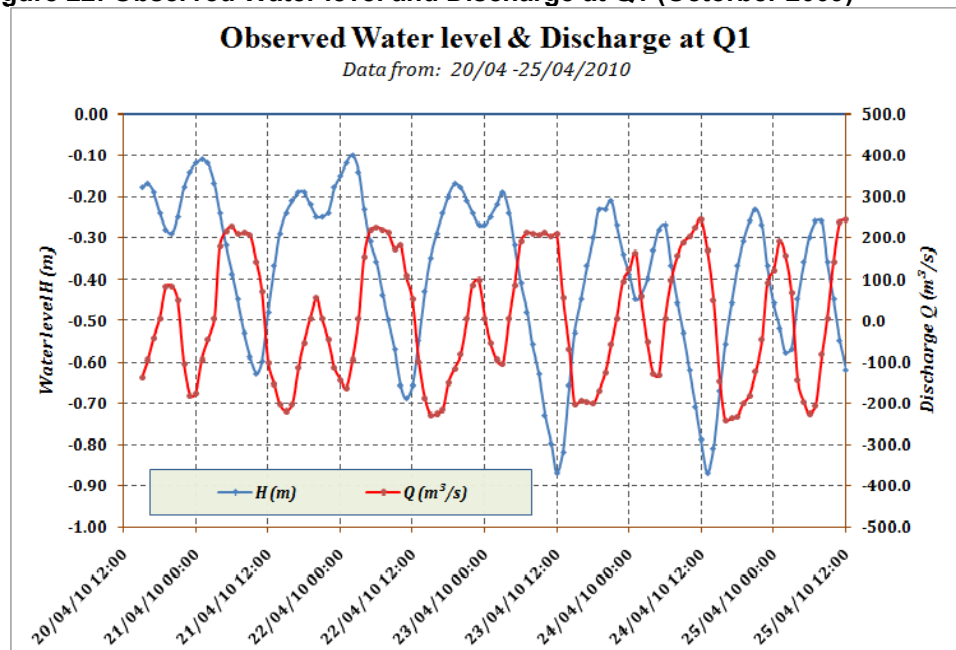


Figure 23: Observed Water level and Discharge at Q1 (April 2010)

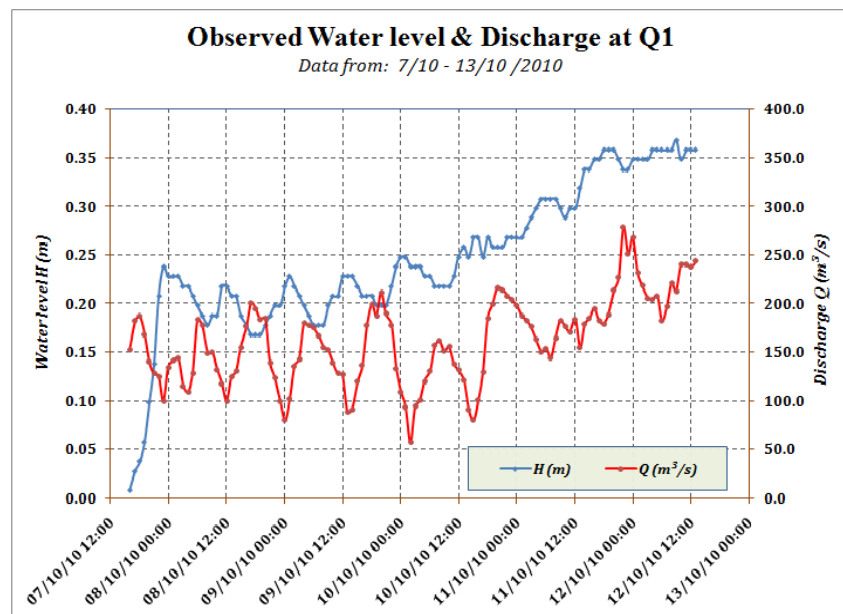


Figure 24: Observed Water level and Discharge at Q1 (October 2010)

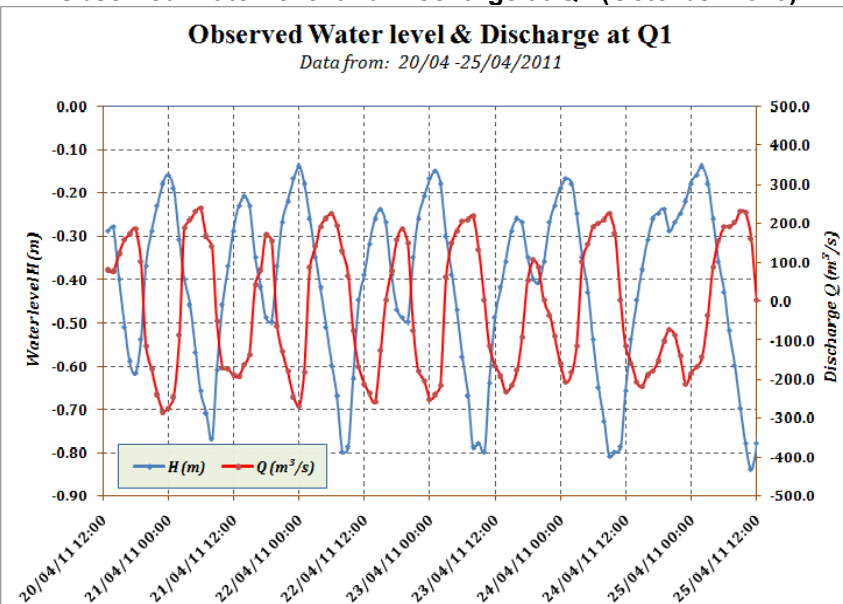


Figure 25: Observed Water level and Discharge at Q1 (April 2011)

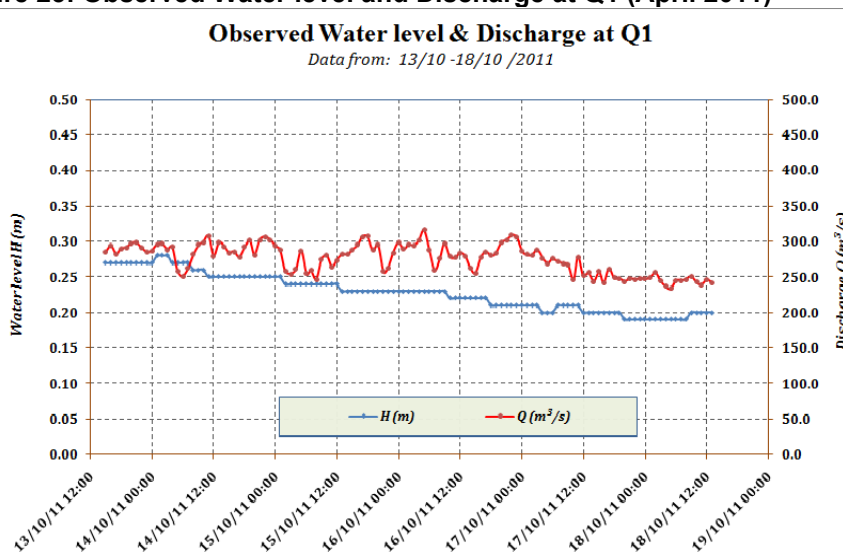


Figure 26: Observed Water level and Discharge at Q1 (October 2011)

Station: Q2 (Dong Nai River)

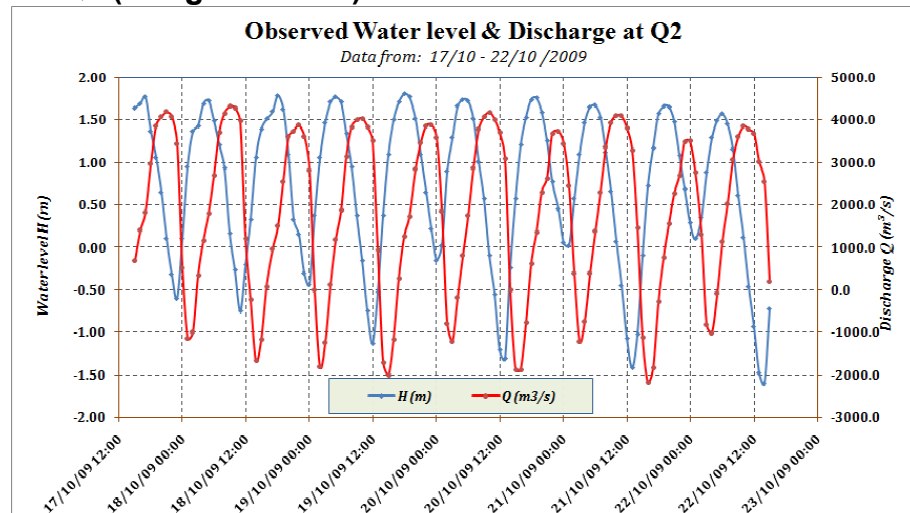


Figure 27: Observed Water level and Discharge at Q2 (October 2009)

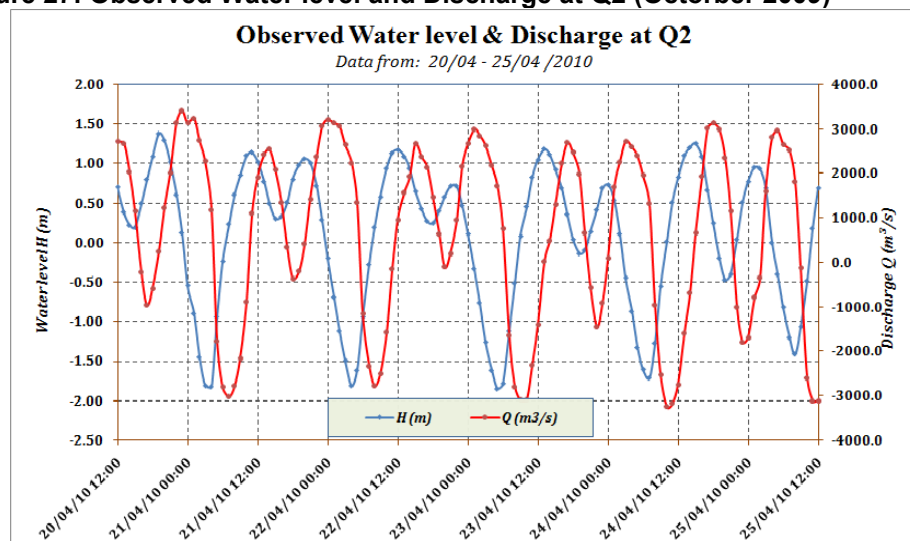


Figure 28: Observed Water level and Discharge at Q2 (April 2010)

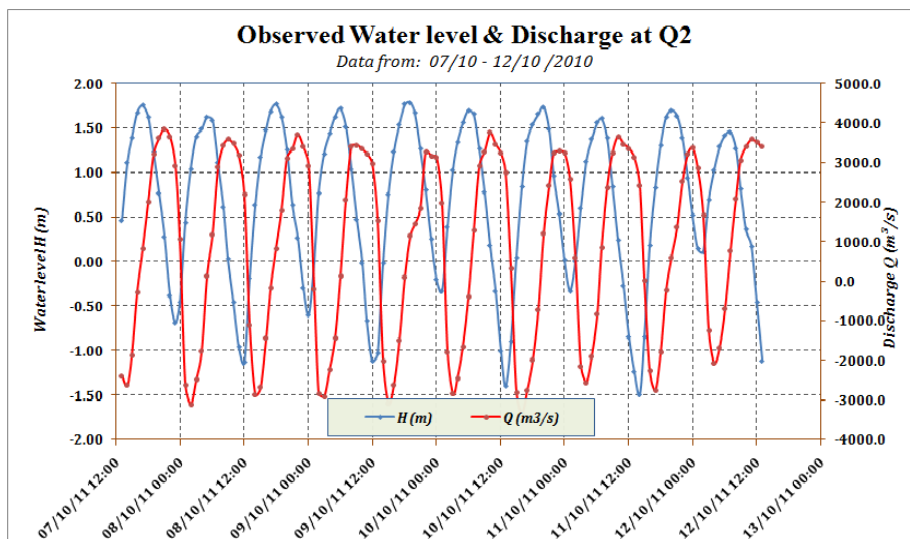


Figure 29: Observed Water level and Discharge at Q2 (October 2010)

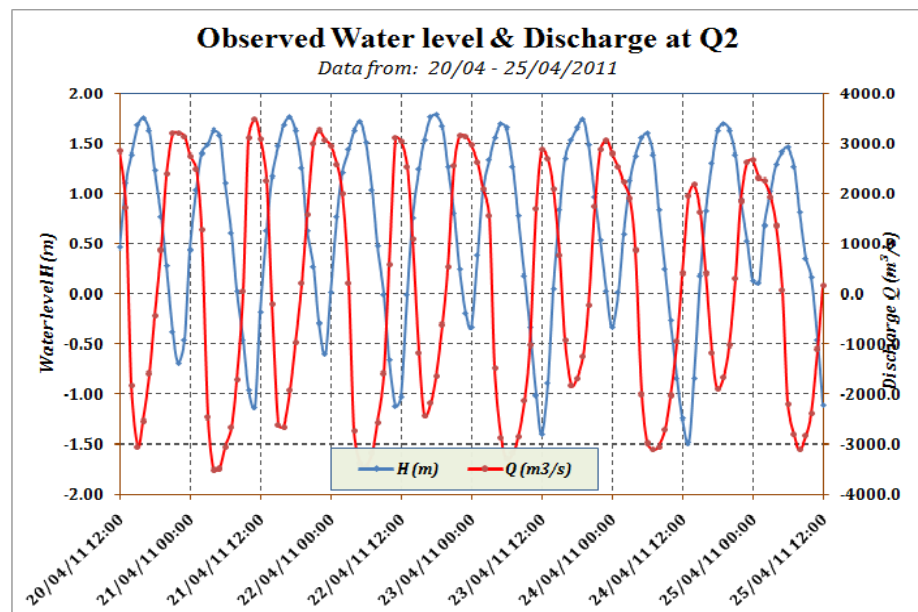


Figure 30: Observed Water level and Discharge at Q2 (April 2011)

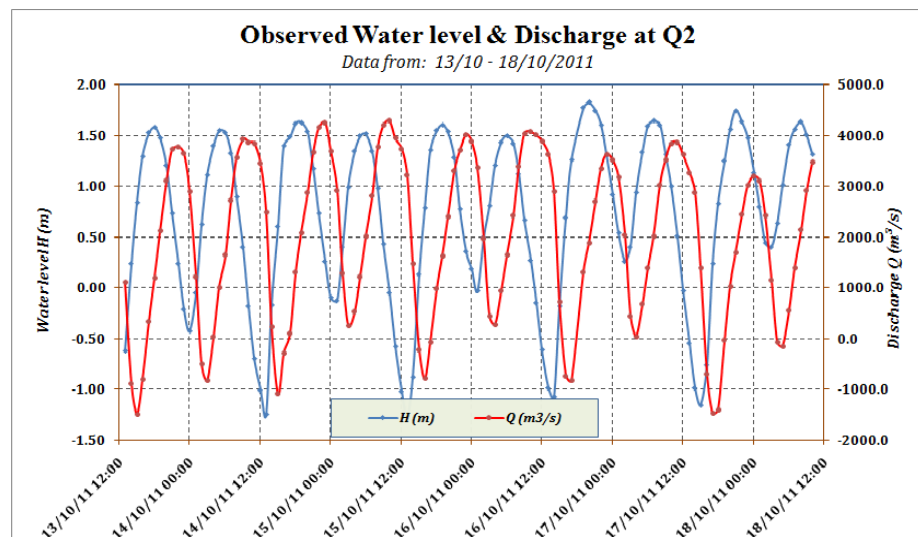


Figure 31: Observed Water level and Discharge at Q2 (October 2011)

Station: Q3 (Sai Gon River)

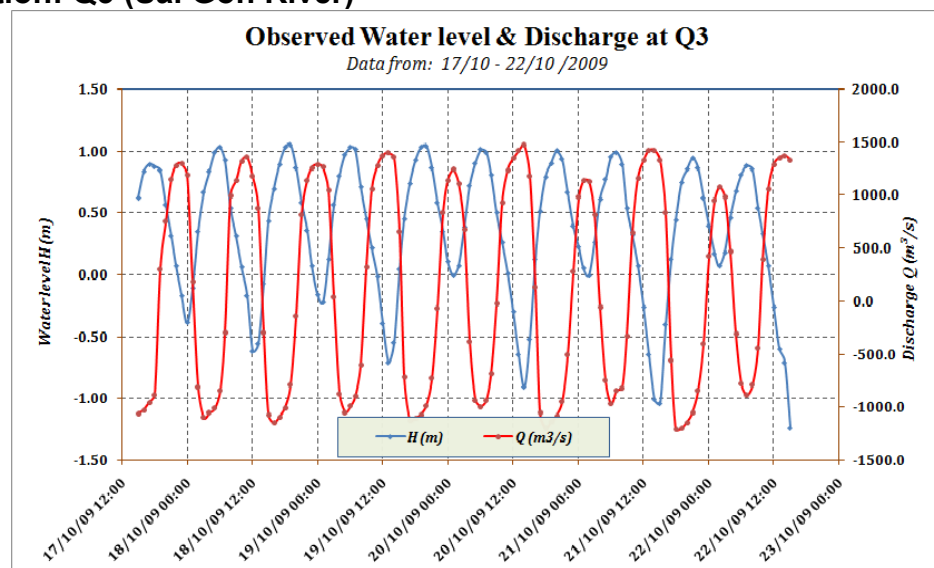


Figure 32: Observed Water level and Discharge at Q3 (Octorber 2009)

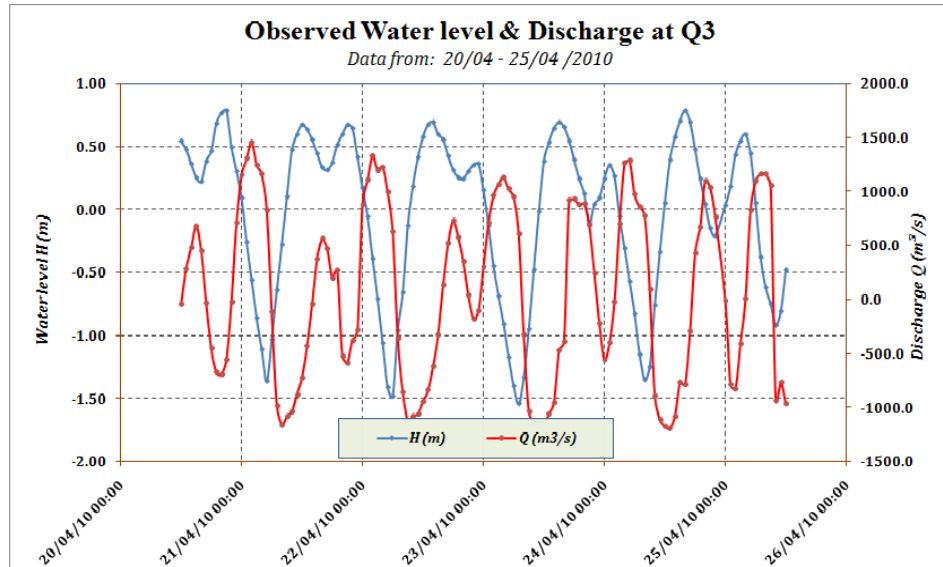


Figure 33: Observed Water level and Discharge at Q3 (April 2010)

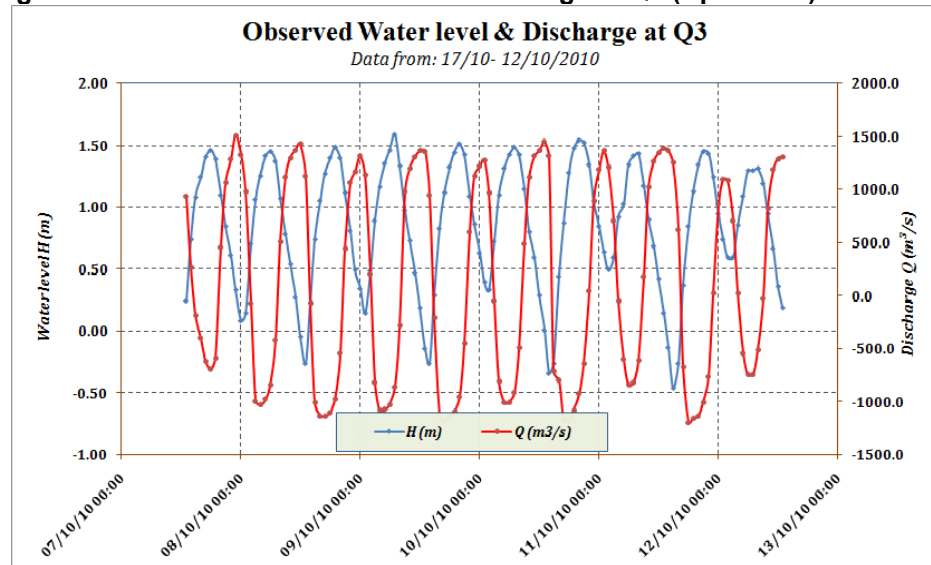


Figure 34: Observed Water level and Discharge at Q3 (October 2010)

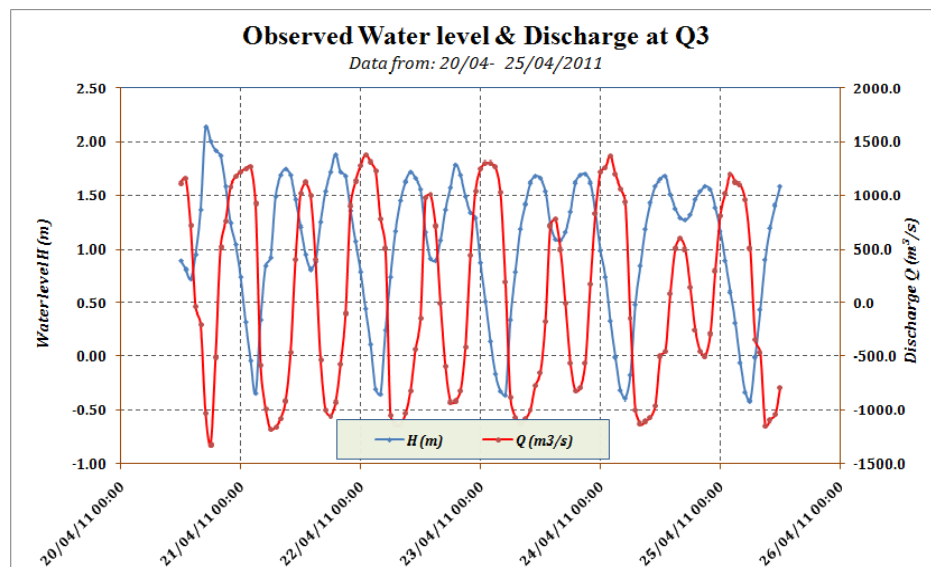


Figure 35: Observed Water level and Discharge at Q3 (April 2011)

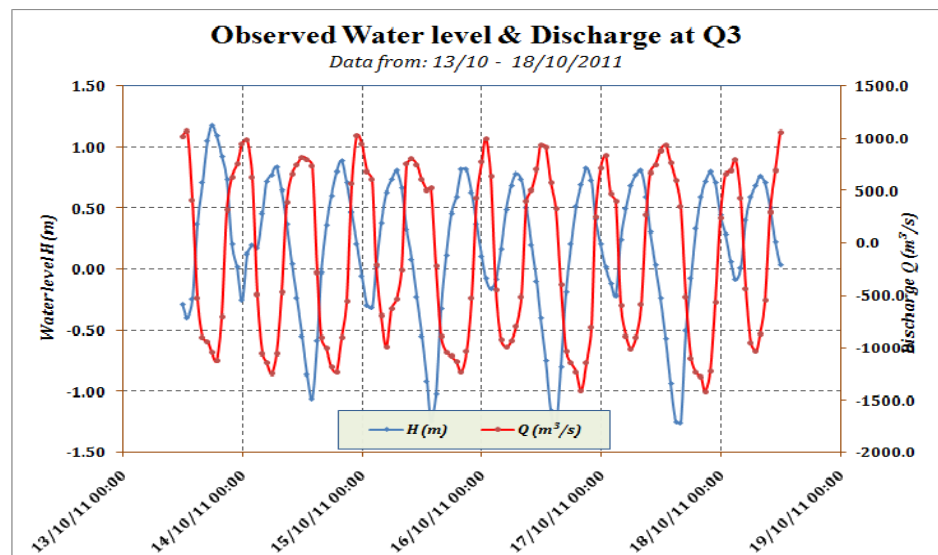


Figure 36: Observed Water level and Discharge at Q3 (October 2011)

Station: Q4 (Be River)

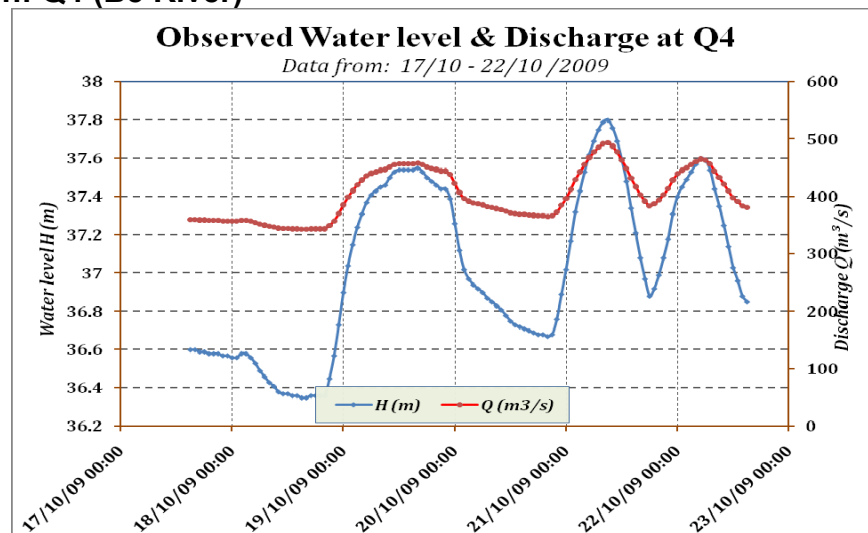


Figure 37: Observed Water level and Discharge at Q4 (October 2009)

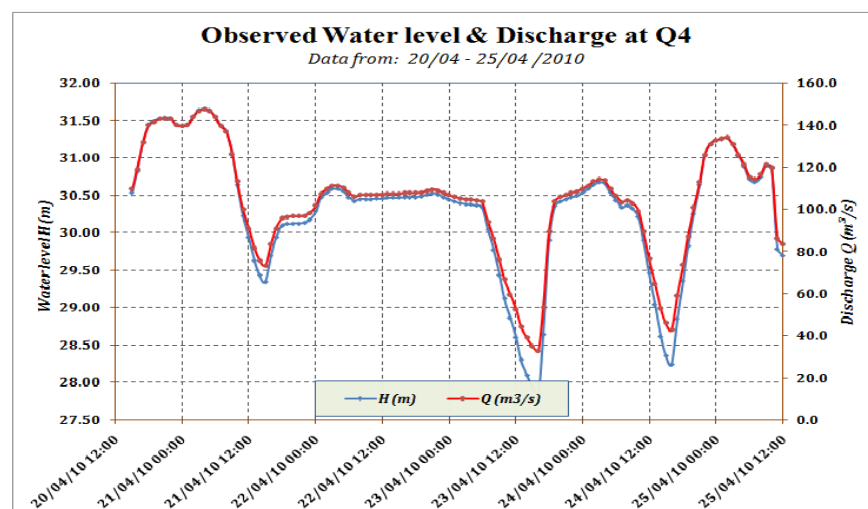


Figure 38: Observed Water level and Discharge at Q4 (April 2010)

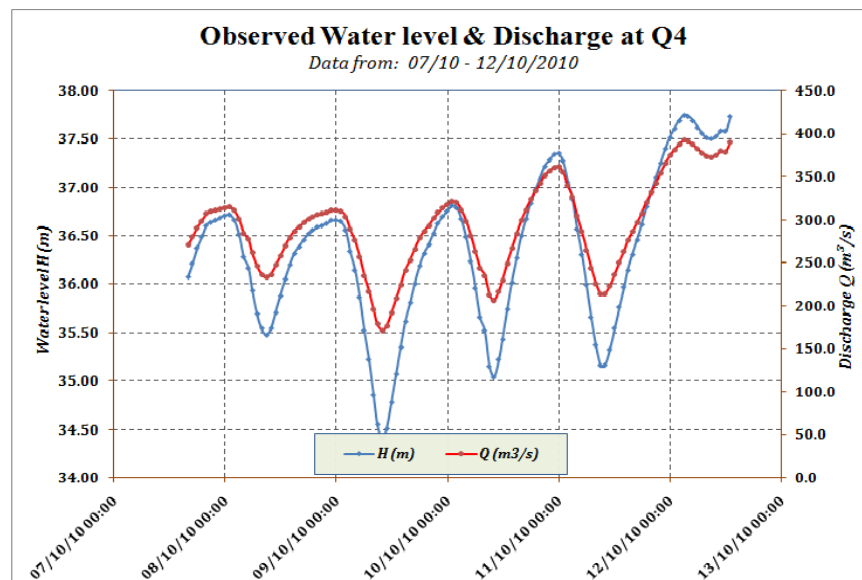


Figure 39: Observed Water level and Discharge at Q4 (October 2010)

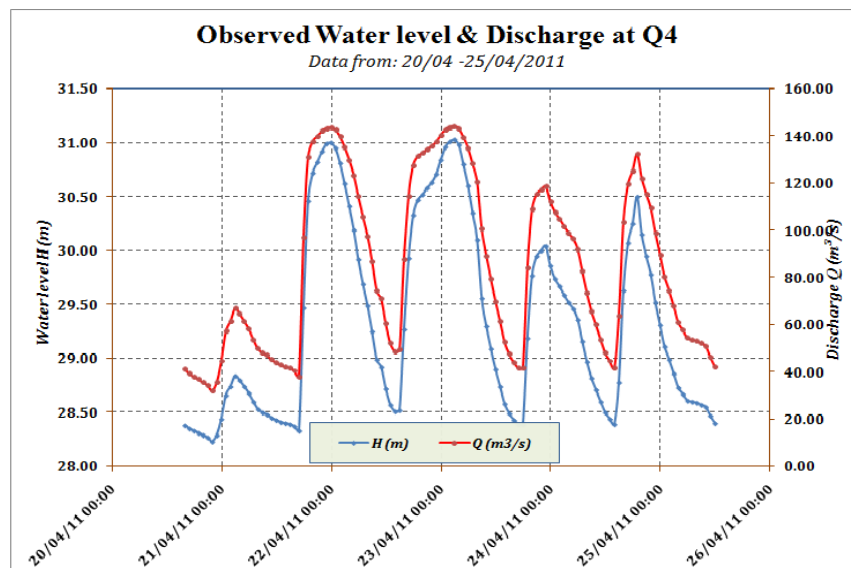


Figure 40: Observed Water level and Discharge at Q4 (April 2011)

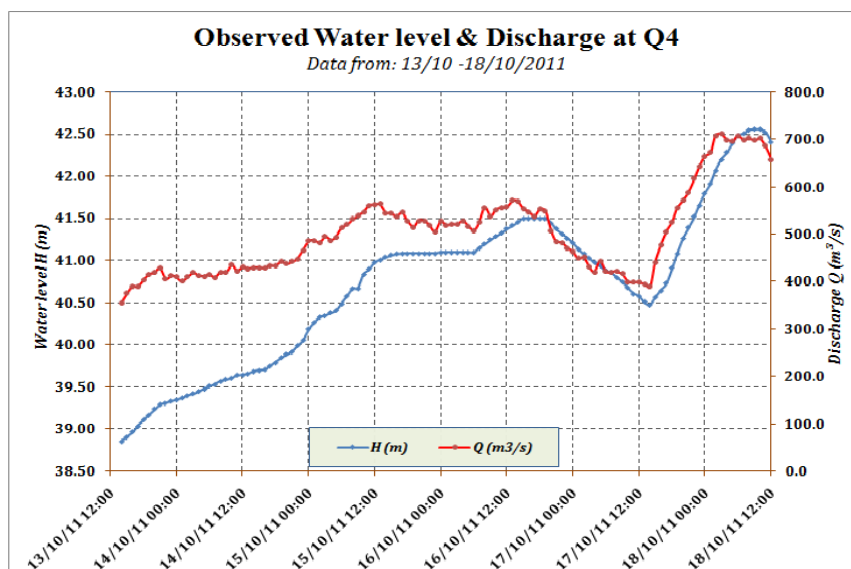


Figure 41: Observed Water level and Discharge at Q4 (October 2011)

Station: Q5 (Be River)

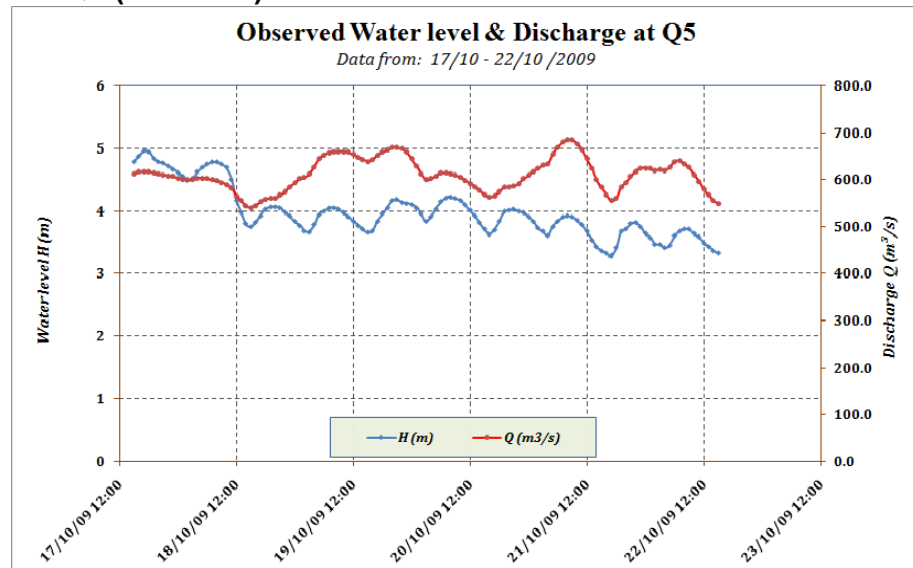


Figure 42: Observed Water level and Discharge at Q5 (October 2009)

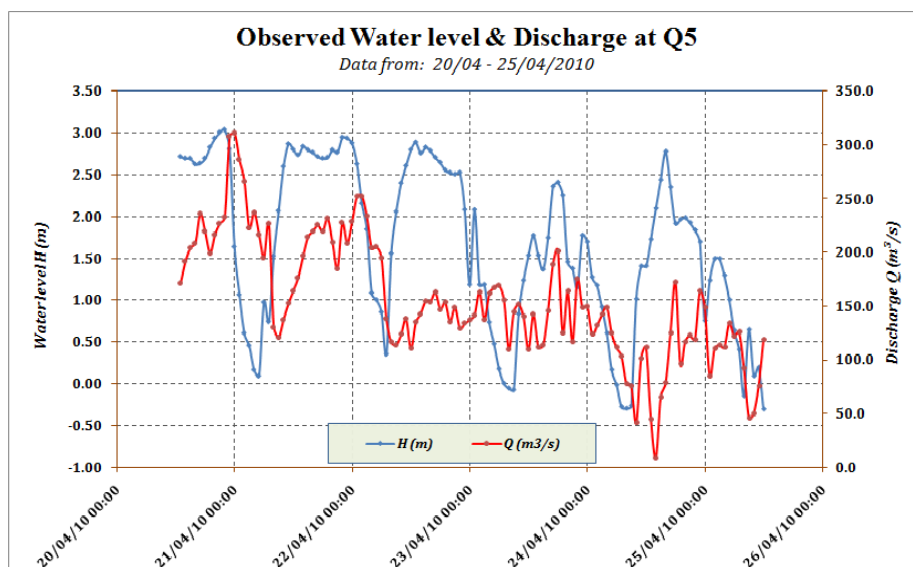


Figure 43: Observed Water level and Discharge at Q5 (April 2010)

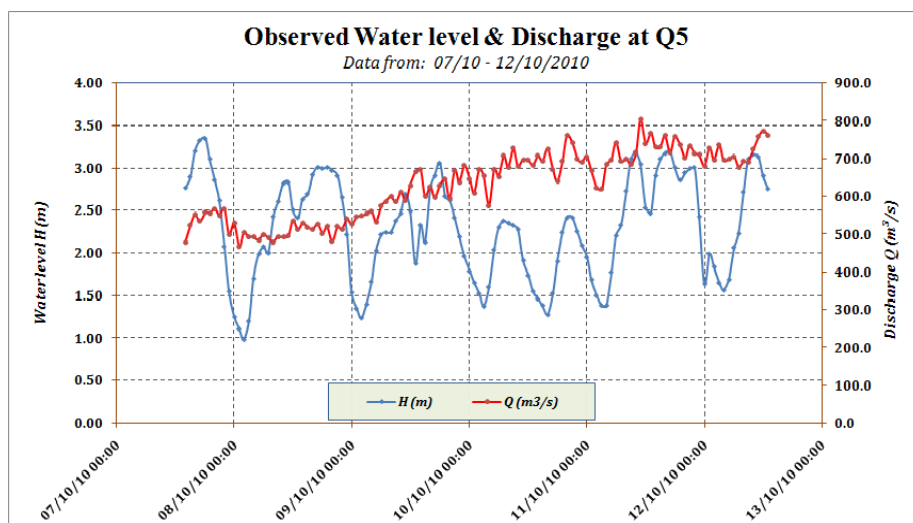


Figure 44: Observed Water level and Discharge at Q5 (October 2010)

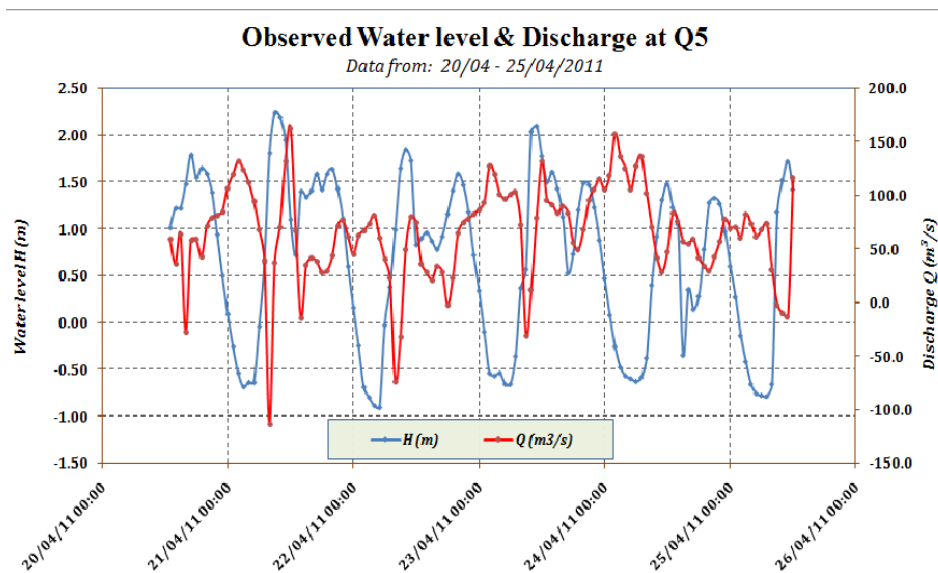


Figure 45: Observed Water level and Discharge at Q5 (April 2011)

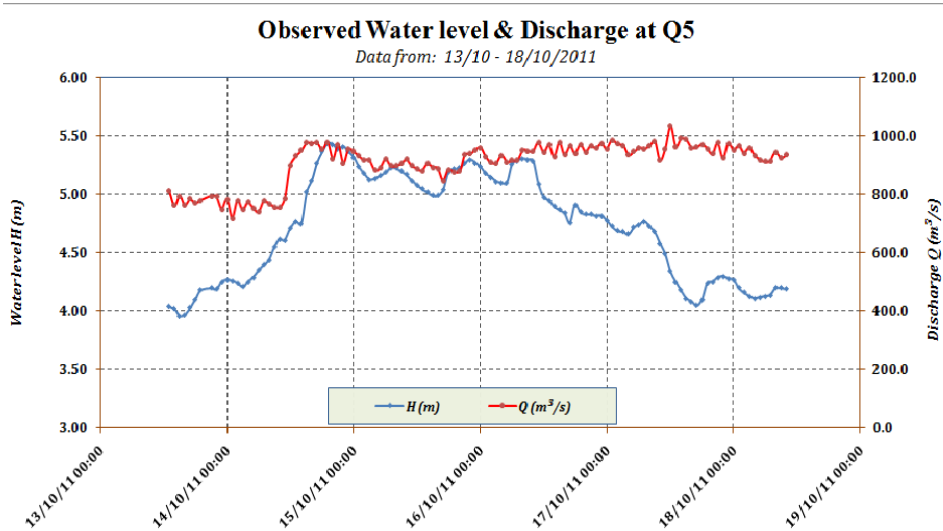


Figure 46: Observed Water level and Discharge at Q5 (October 2011)

Station: Q6 (Vam Co Dong River)

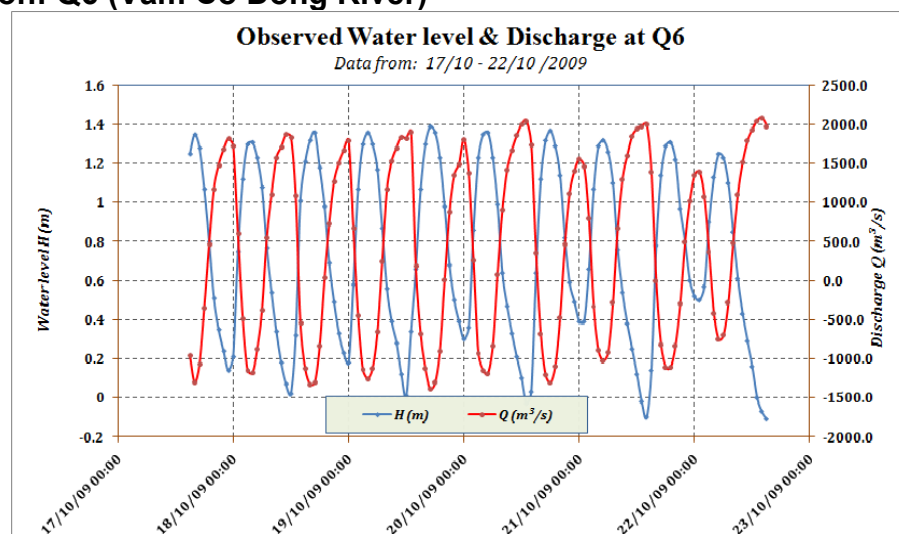


Figure 47: Observed Water level and Discharge at Q6 (October 2009)

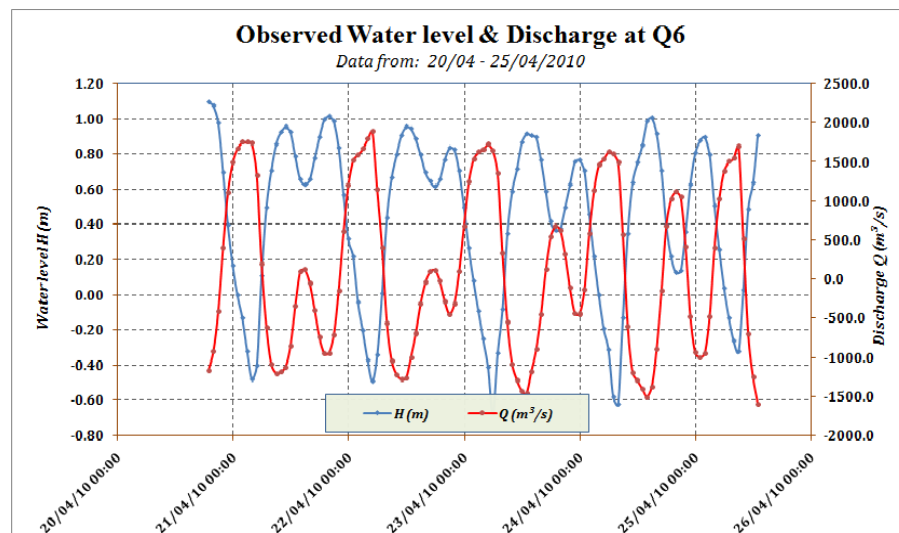


Figure 48: Observed Water level and Discharge at Q5 (April 2010)

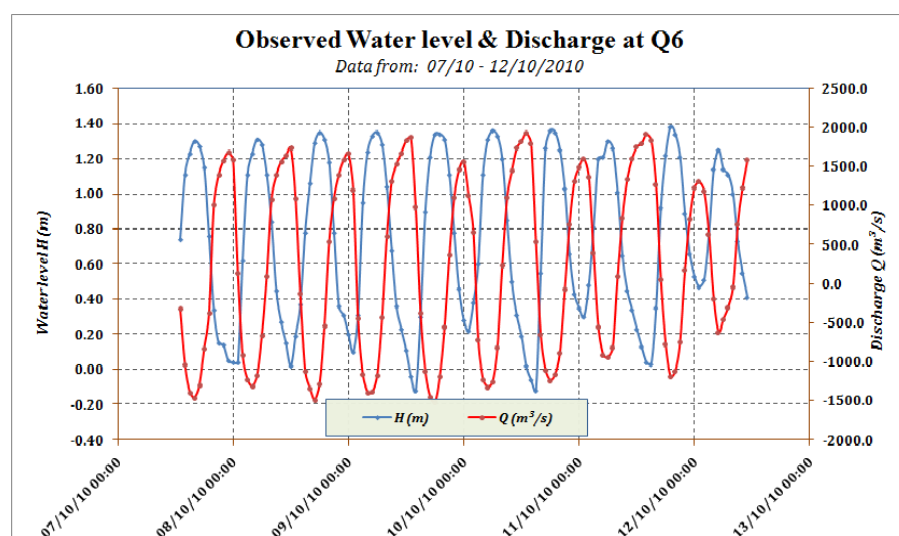


Figure 49: Observed Water level and Discharge at Q5 (October 2010)

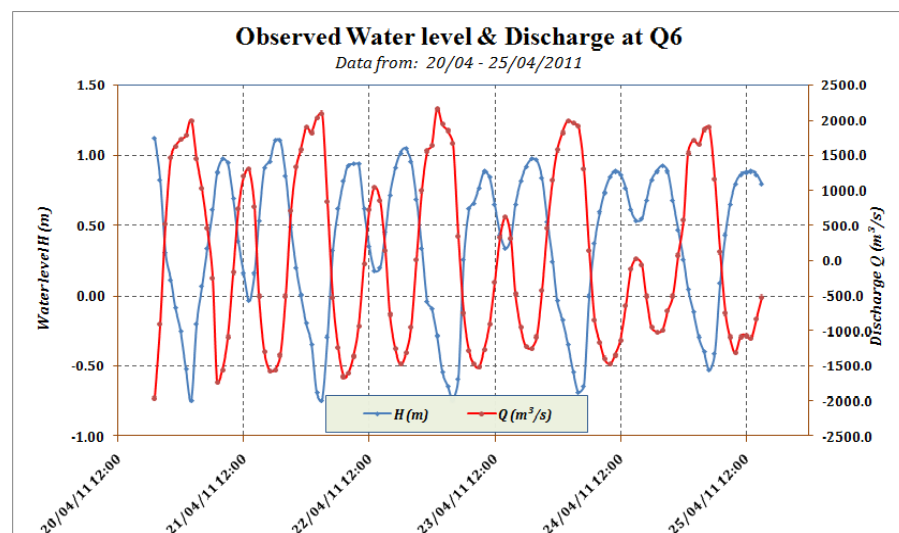


Figure 50: Observed Water level and Discharge at Q5 (April 2011)

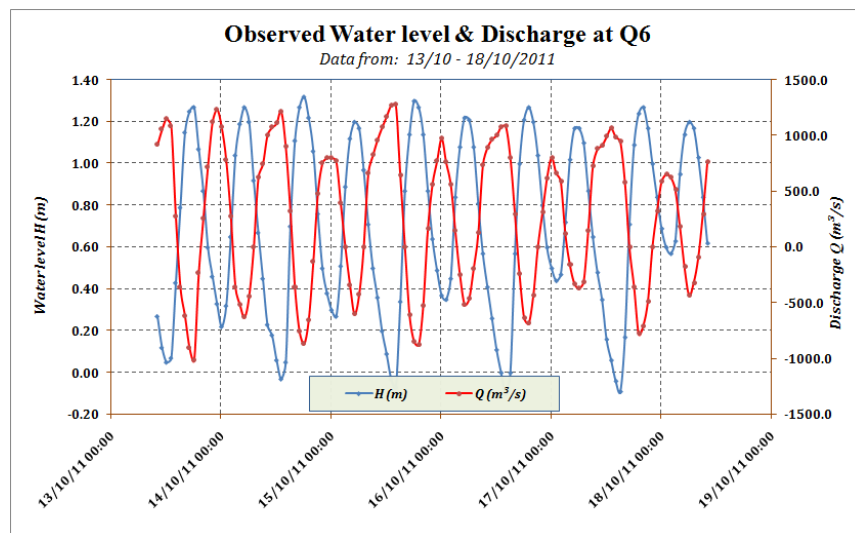


Figure 51: Observed Water level and Discharge at Q5 (October 2011)

APPENDIX B

SURFACE WATER QUALITY – MT6 PACKAGE

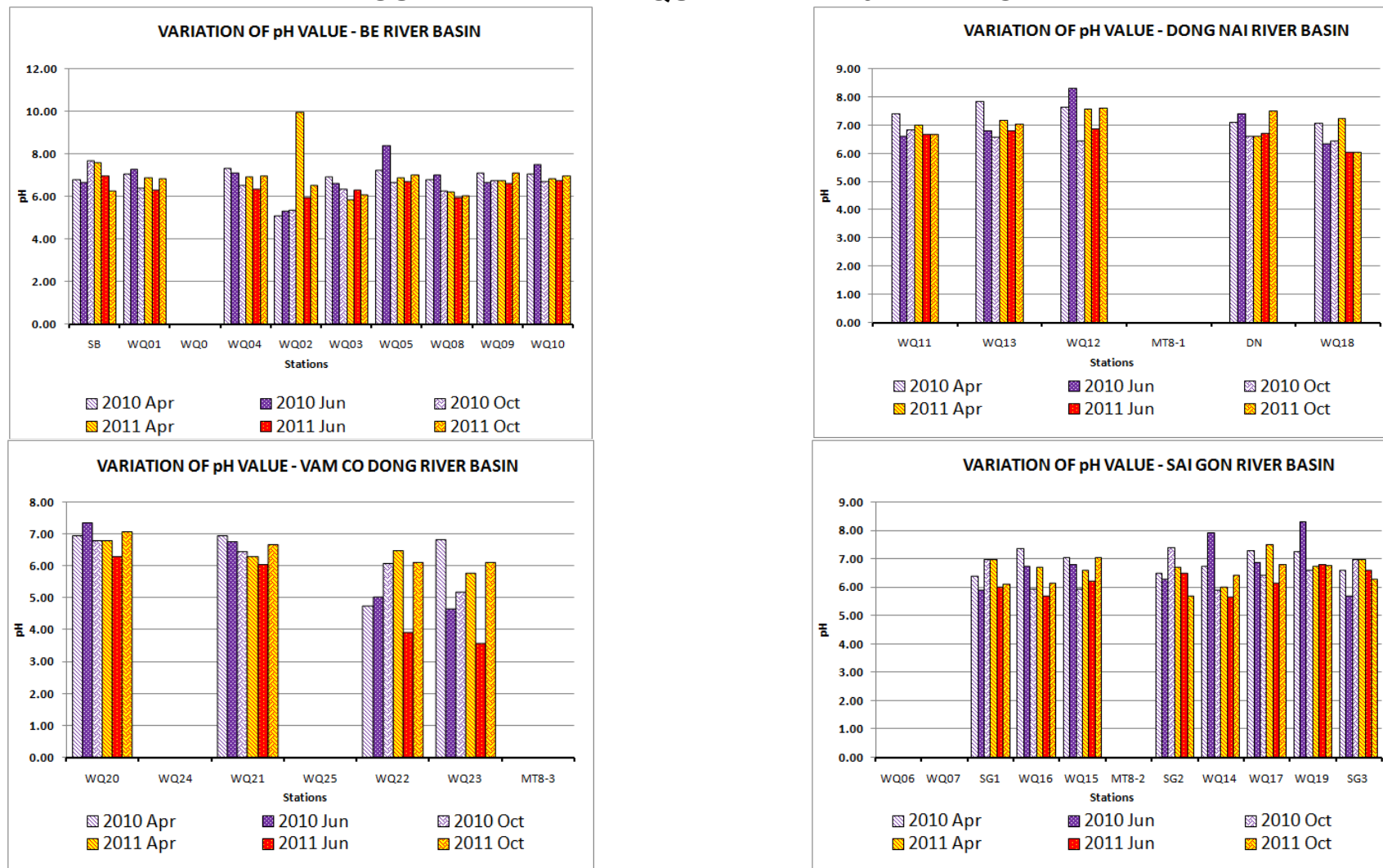


Figure 52: Graph of pH value at rivers in project area



Figure 53: Graph of turbidity value at rivers in project area

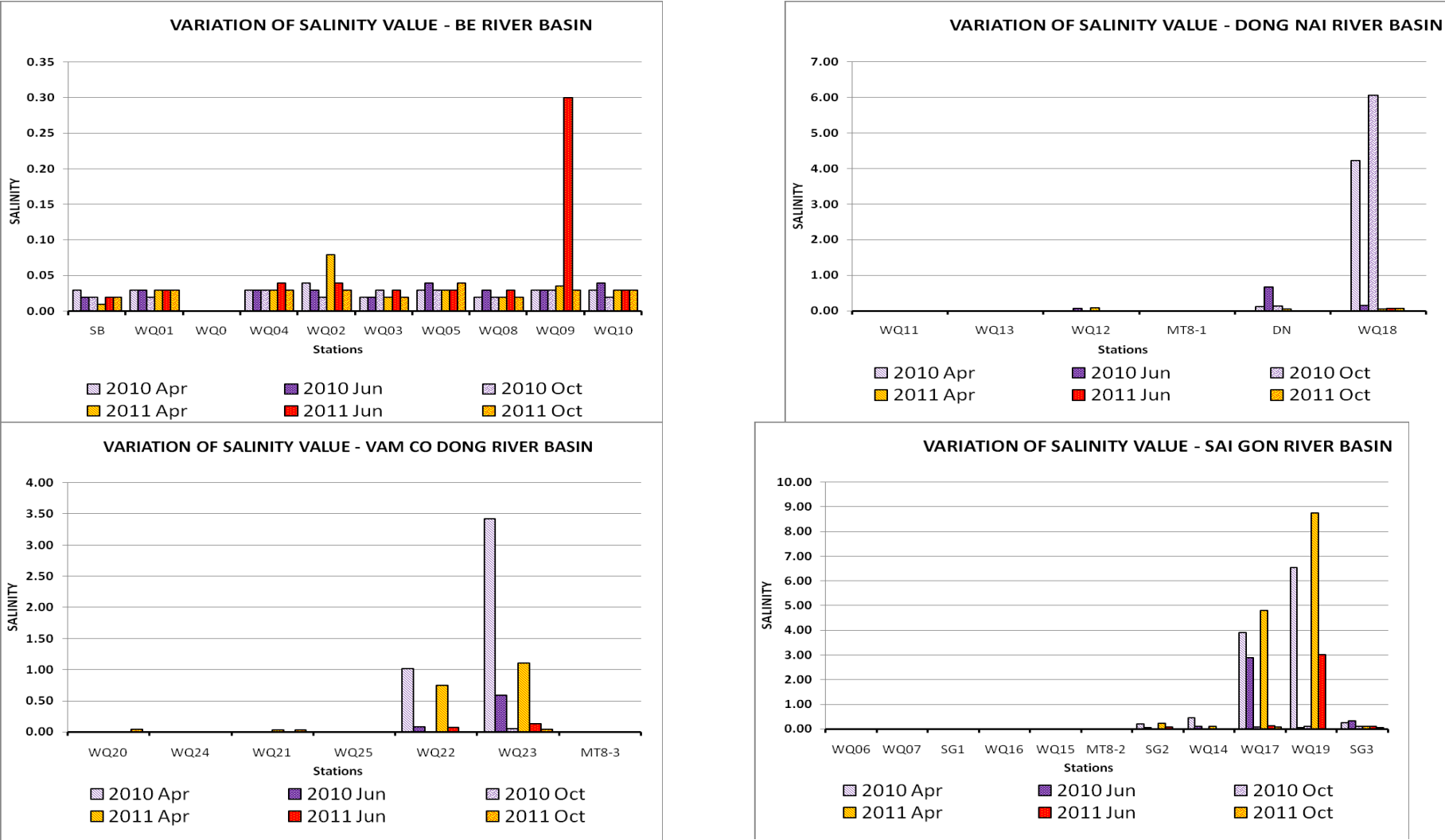


Figure 54: Graph of salinity value at rivers in project area

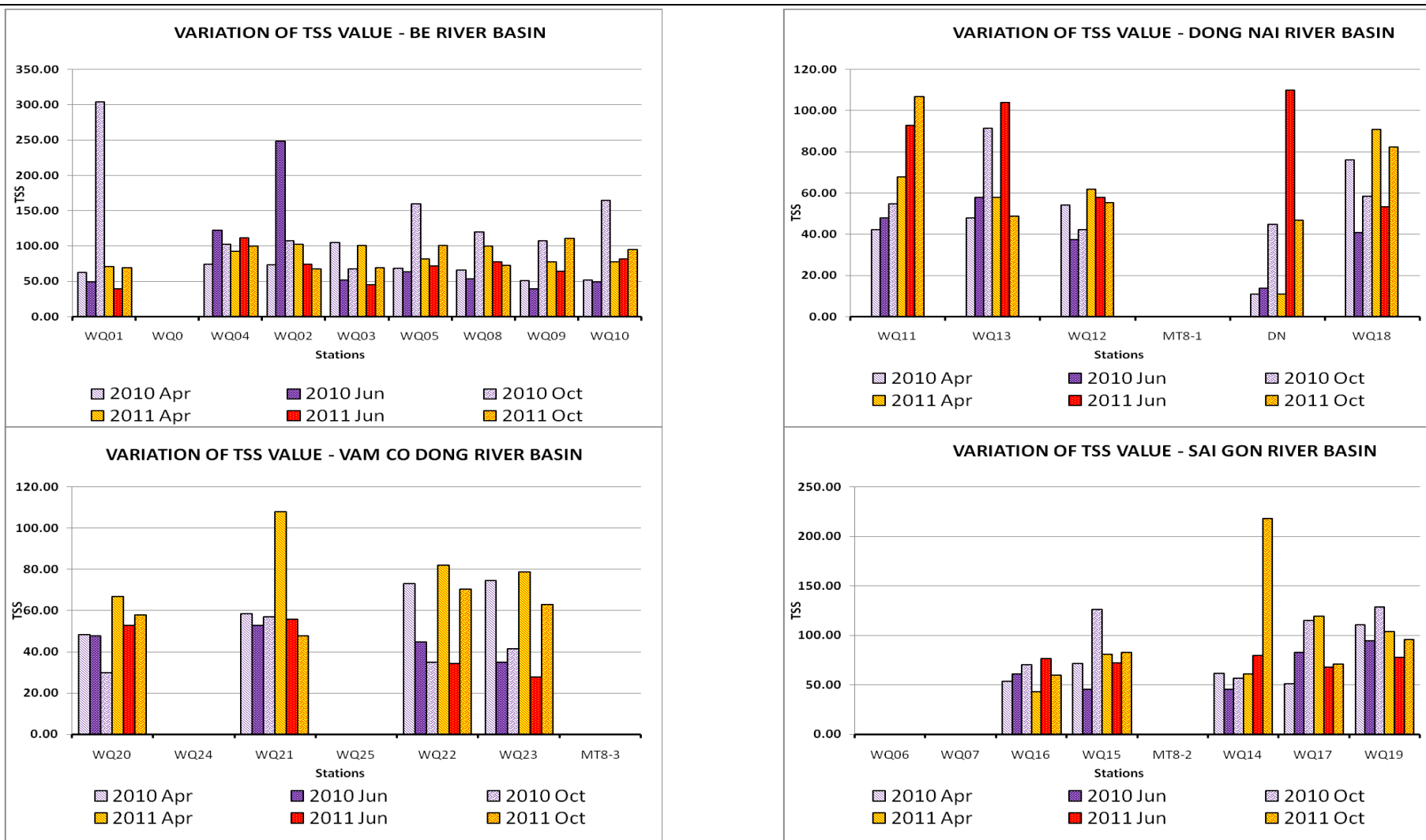


Figure 55: Graph of TSS value at rivers in project area

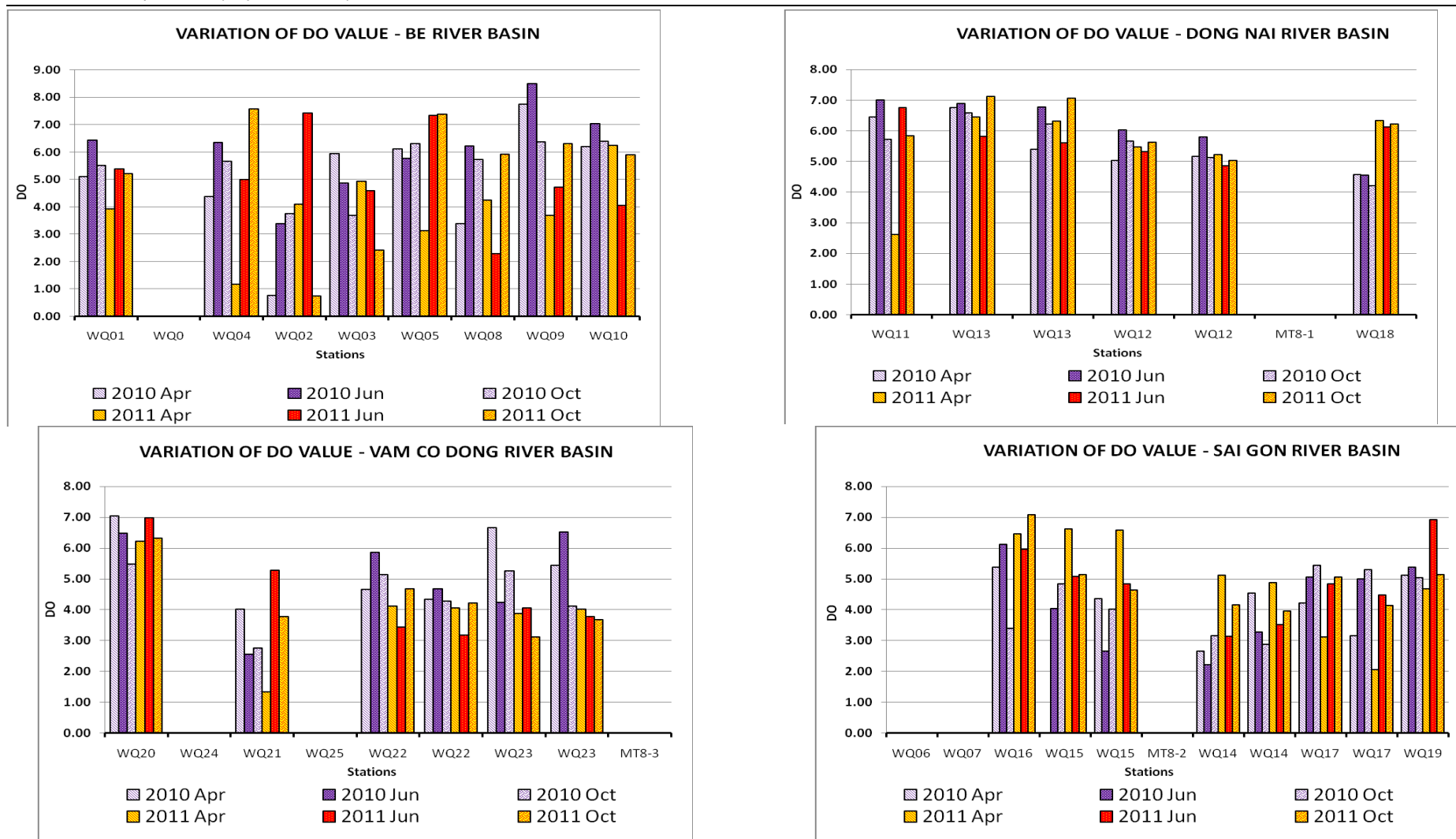


Figure 56: Graph of DO value at rivers in project area

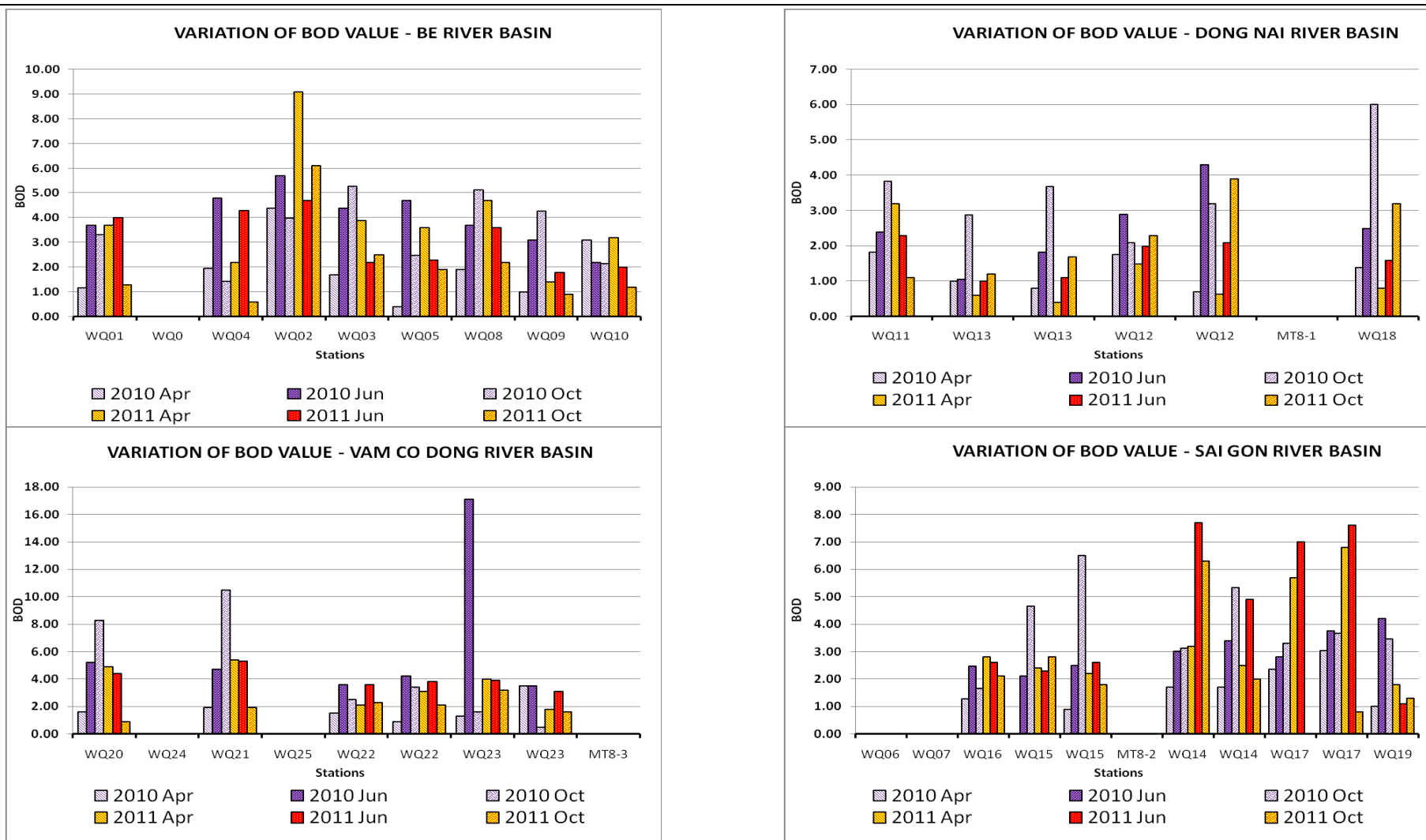


Figure 57: Graph of BOD value at rivers in project area

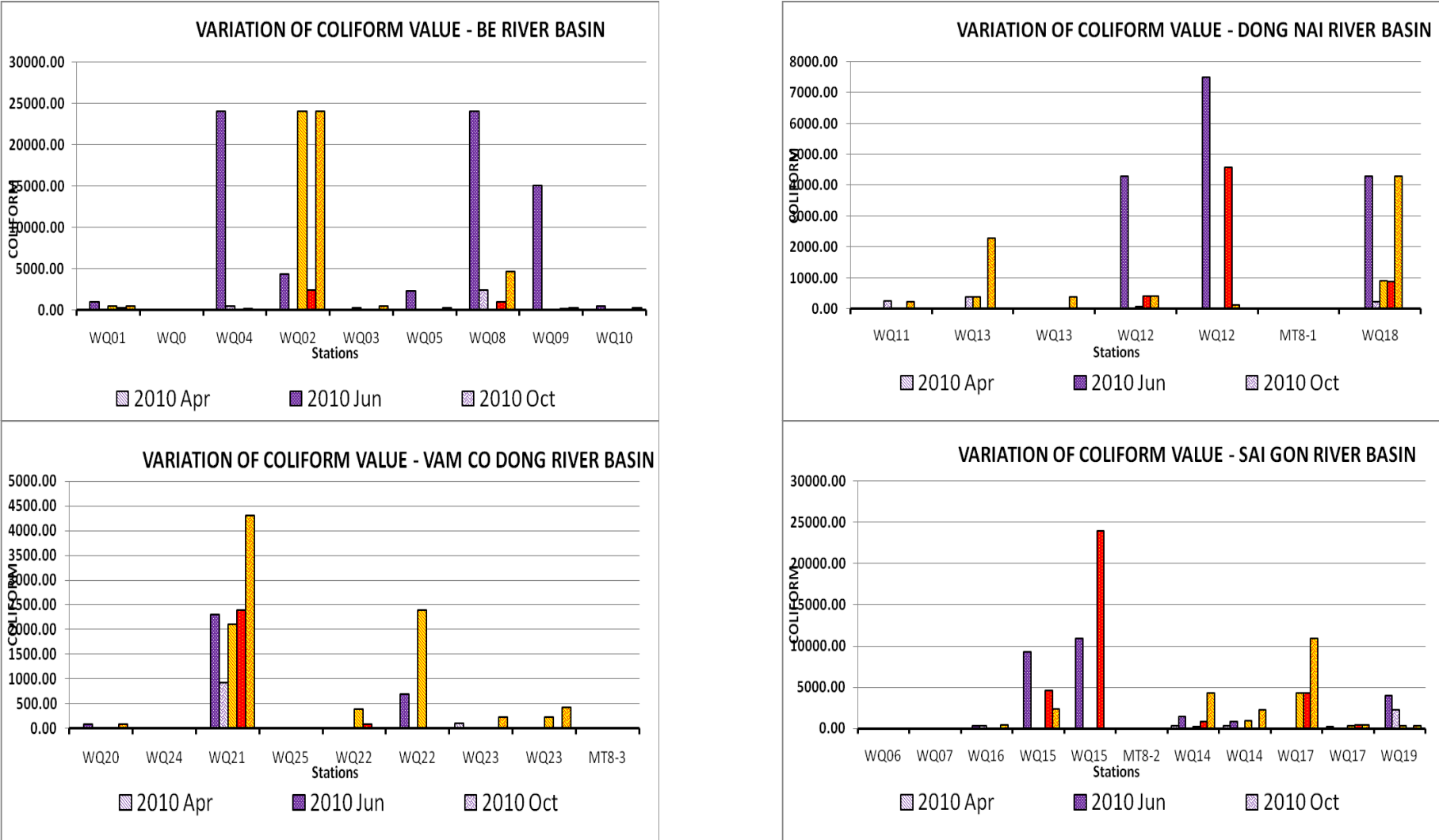


Figure 58: Graph of Coliform at rivers in project area

APPENDIX C

AIR QUALITY – MT7 PACKAGE

Construction package 1A

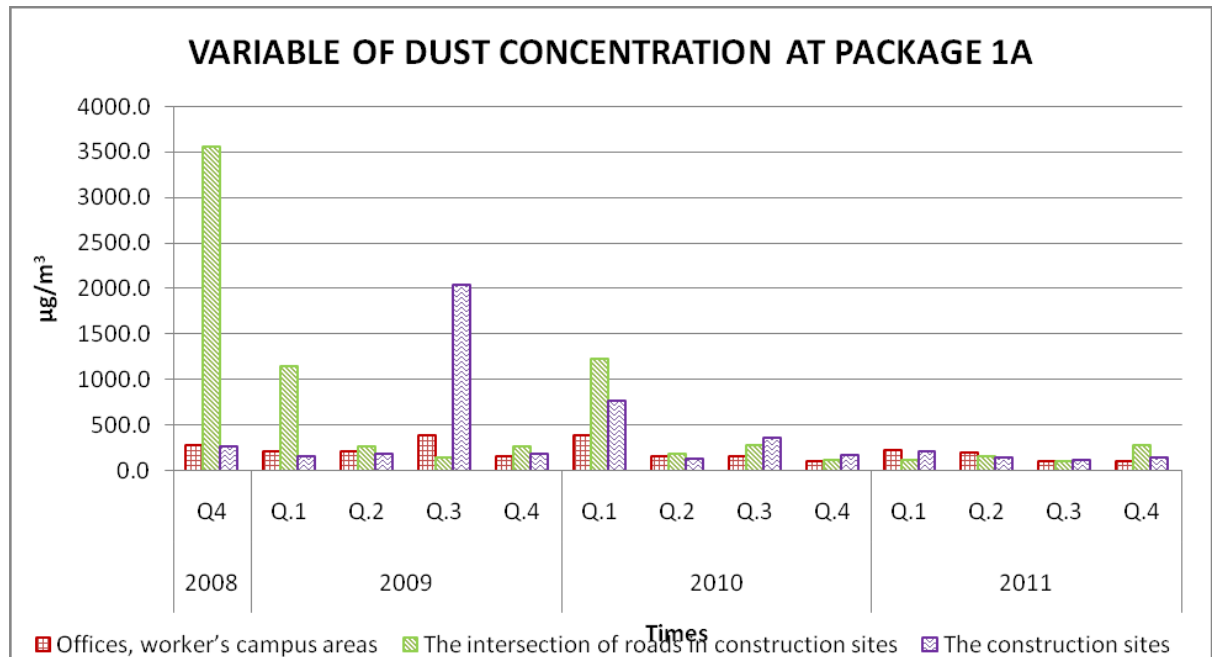


Figure 59: Graph of variable of dust concentration at Package 1A

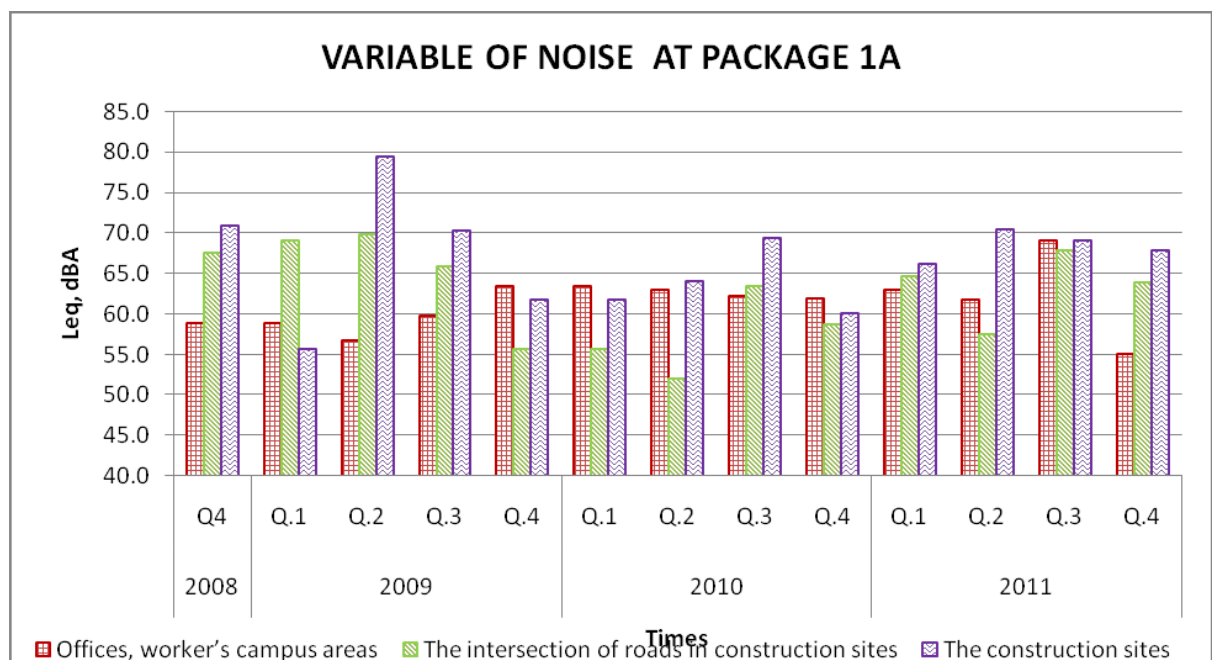


Figure 60: Graph of variable of noise at Package 1A

Construction package 1B

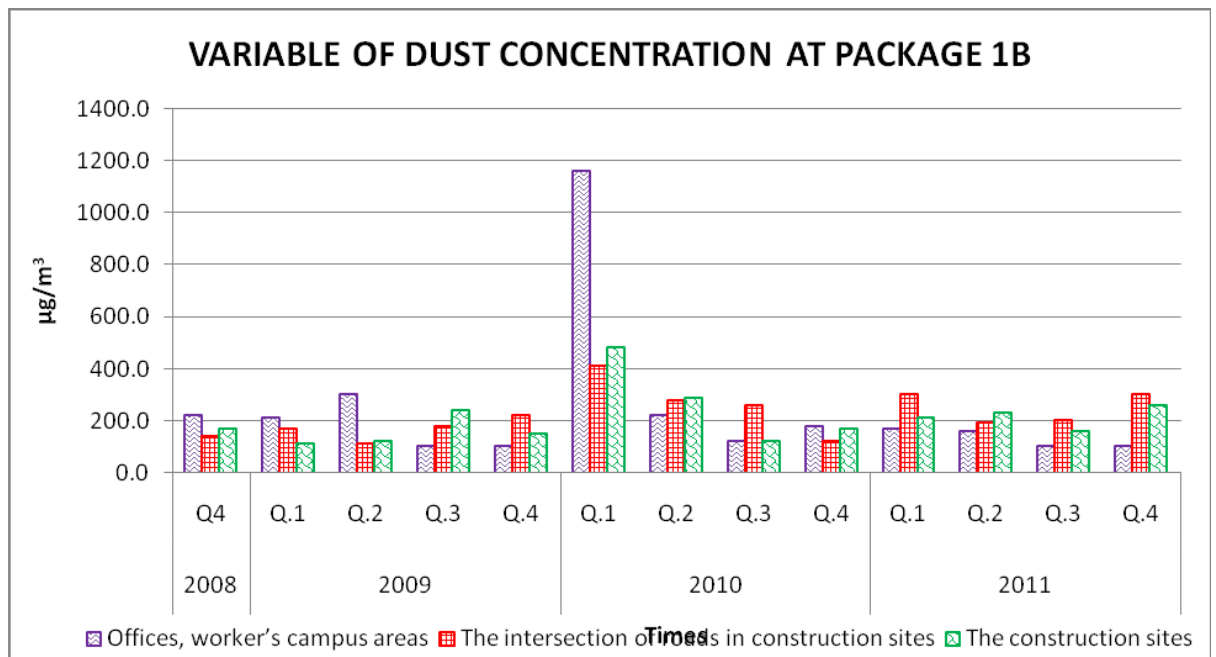


Figure 61: Graph of variable of dust concentration at Package 1B

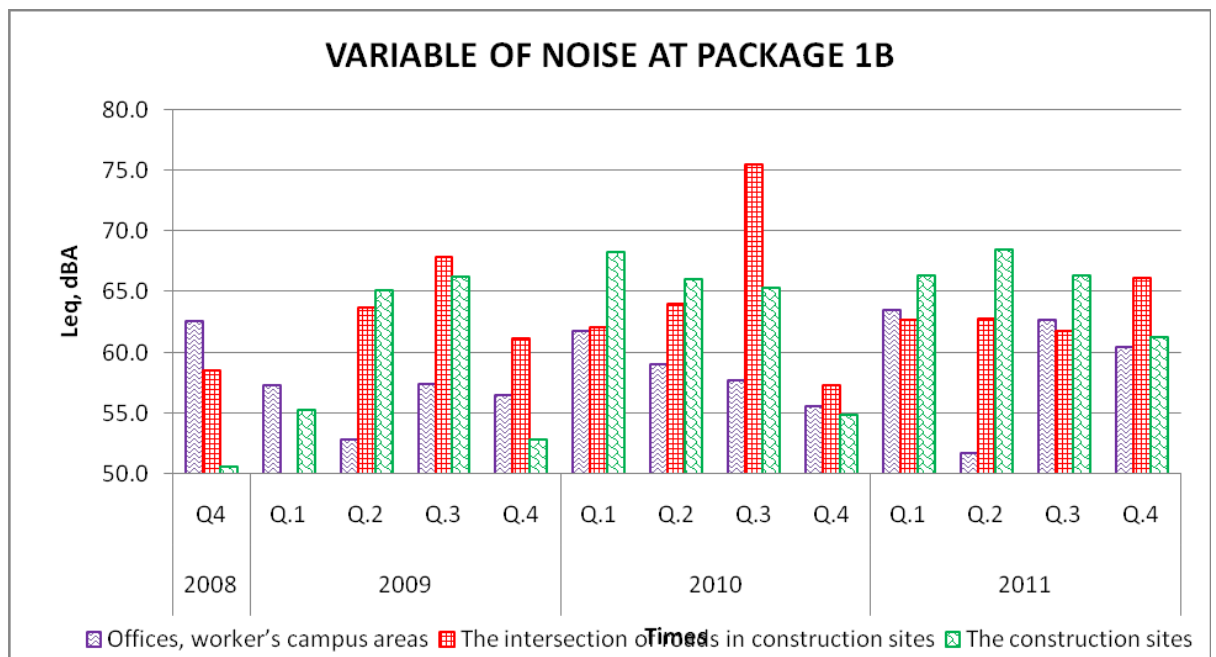


Figure 62: Graph of variable of noise at Package 1B

Construction package 1C

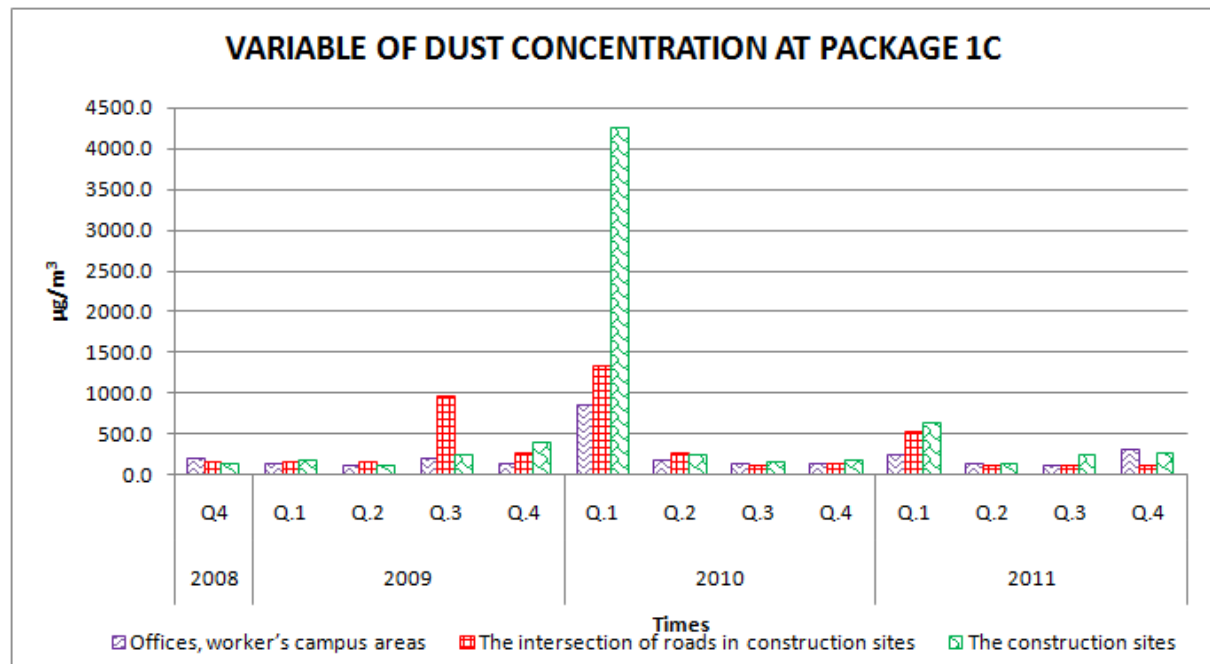


Figure 63: Graph of variable of dust concentration at Package 1C

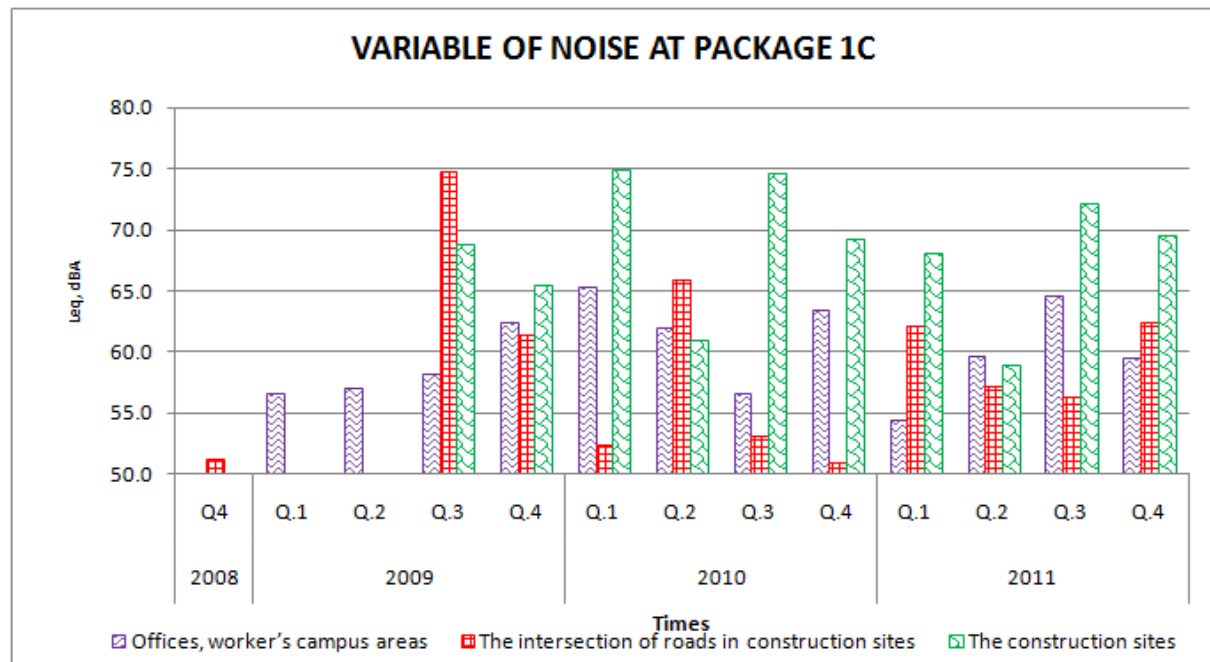


Figure 64: Graph of variable of noise at Package 1C

Construction package 1D

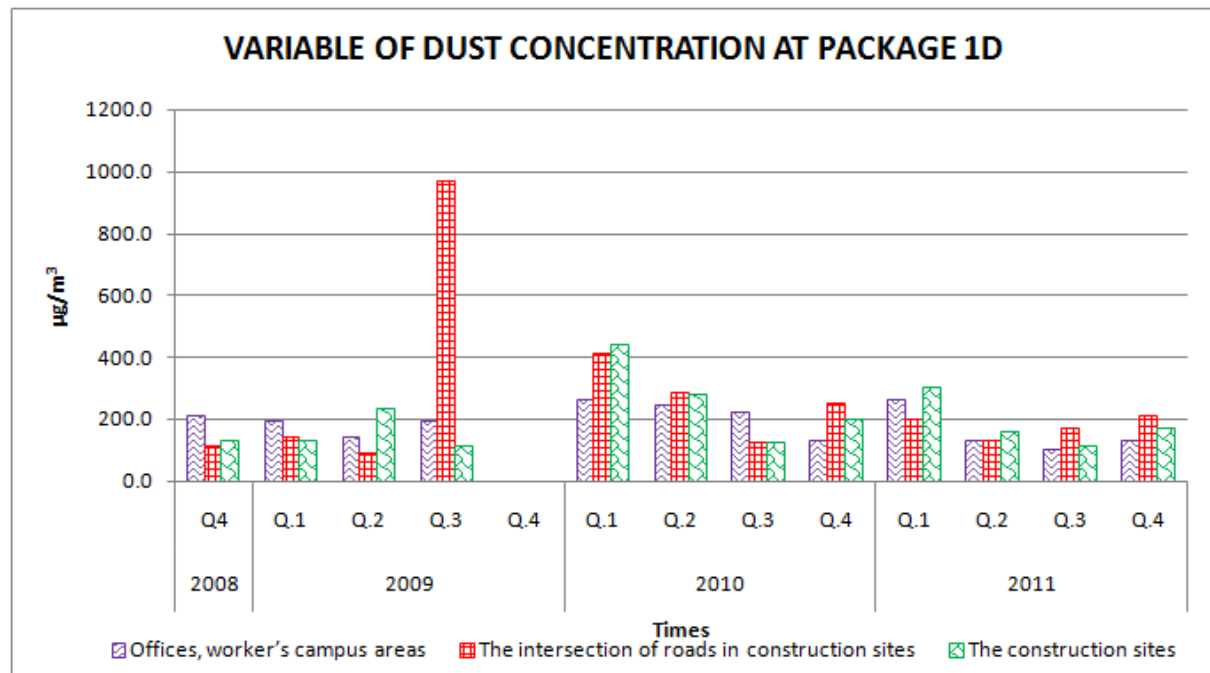


Figure 65: Graph of variable of dust concentration at Package 1D

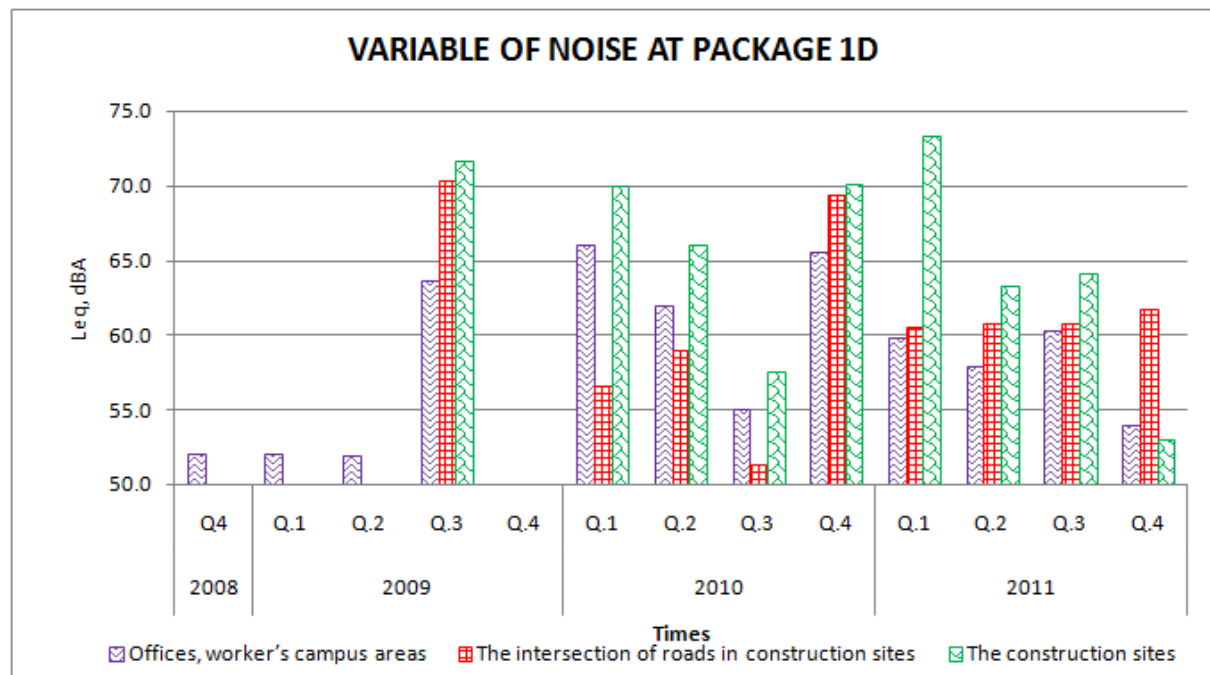


Figure 66: Graph of variable of noise at Package 1D

Construction package PH3

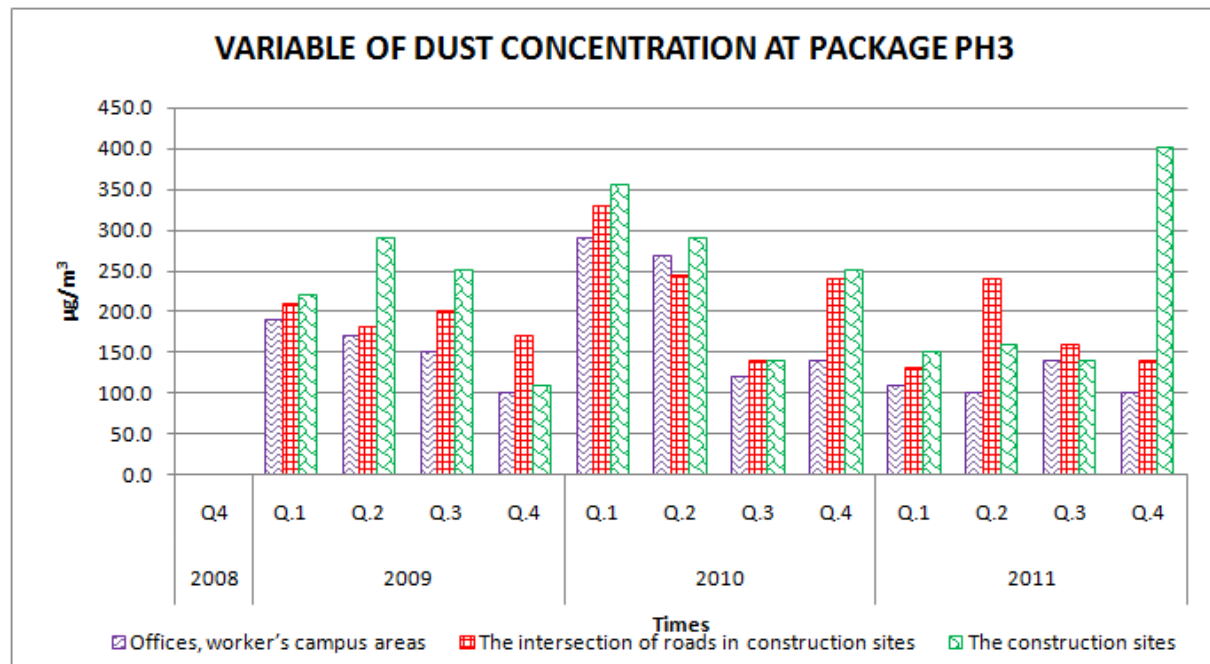


Figure 67: Graph of variable of dust concentration at Package PH3

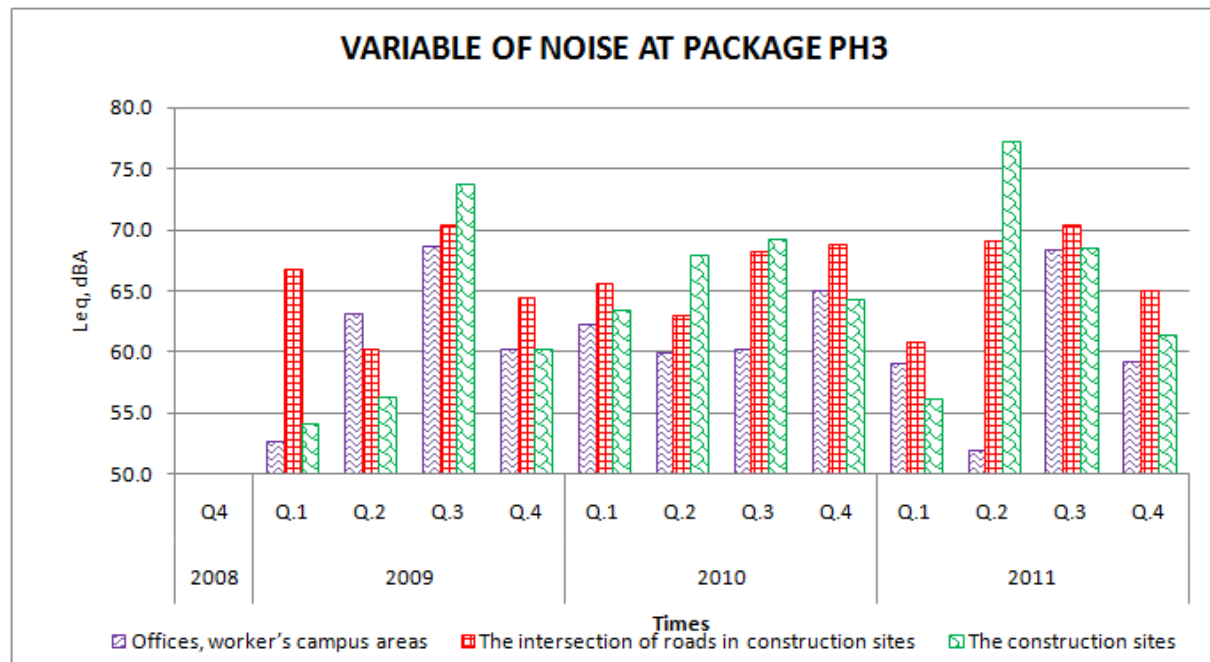


Figure 68: Graph of variable of noise at Package PH3