

Kingdom of Thailand

FY2016 Ex-Post Evaluation of Technical Cooperation Project

“Project on a Comprehensive Flood Management Plan for the Chao Phraya River Basin”

External Evaluator: Satoshi Nagashima, INTEM Consulting, Inc.

## **0. Summary**

This Project was conducted to support recovery from the flood damage in the Chao Phraya River basin which occurred in Thailand during 2011 and to take emergency measures to prevent subsequent flooding. As a consequence, the aim was to carry out a flood management project and feasibility studies based on the “Master Plan for Chao Phraya River basin”<sup>1</sup> developed in the Project and to implement comprehensive disaster prevention and reconstruction in cooperation with Japan’s grant aid projects at the same time.

Implementation of the Project is fully consistent with the policy and the needs of flood management in Thailand, and Japan's aid policy. In addition, although the content of the Project was partially modified during the implementation period, the logic of the project design and the outcomes were not affected. Therefore, the relevance of the Project is high.

Through the implementation of the Project, the Project Purpose which was “to carry out the emergency measures for flood prevention in the Chao Phraya River basin” has been achieved. In addition to this, achievements have been confirmed for the Overall Goal including: (1) projects and feasibility studies have been implemented based on the priorities laid out in the Master Plan; and (2) disaster prevention and reconstruction grant aid projects have been conducted. Therefore, the effectiveness and the impact is high.

The Outputs of the Project had been achieved as planned. Regarding the required Inputs for generating results, although the project was completed within the planned timeframe, the project budget exceeded the predicted expenditure. Therefore, the efficiency is fair.

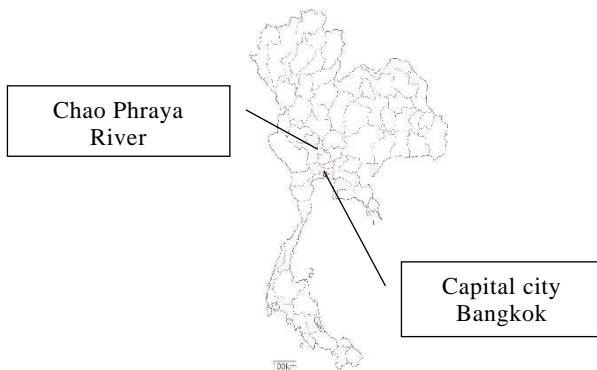
No problems were observed in regards to the policies and systems to manage flooding in Thailand or the organizational structures to sustain the results of the Project, and the technical and financial aspects of the implementing agencies. Therefore, the sustainability of the outcomes expressed by the Project is high.

In light of the above, the Project is evaluated to be highly satisfactory.

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<sup>1</sup> “Master Plan for Chao Phraya River Basin” is used to describe the formal name but “the Master Plan” is used in the other part of the report.

## 1. Project Description



Project Location(s)



The target of the Project, Chao Phraya River

### 1.1 Background

The Chao Phraya River flowing through Thailand has a poor flow regime downstream, and flooding has occurred frequently even in the past. The sediment containing nutrients transported by this flooding is very important for Thailand's agriculture. Therefore, in Thailand, natural flooding measures to mitigate damage have historically been repeated during the rainy season. This has not prevented flooding completely but has directed flows of flooding intentionally from areas upstream towards the right bank of the Chao Phraya River Basin downstream, where the central part of Bangkok and industrial parks are not located. In Japan, "The Study on Integrated Plans for Flood Mitigation in Chao Phraya River Basin" was conducted between 1995 and 1999 and a master plan for flood management was prepared to support flood management effectively.

However, due to the intermittent heavy rain from July 2011 which had randomly occurred once in fifty years, flooding started in the downstream area earlier than expected. Therefore, it was impossible to carry out flood management activities such as discharging water from the filled reservoirs and dams. This caused a massive flood spreading to the affected areas of 61 prefectures nationwide and caused major flood damage to areas including the capital city of Bangkok and Ayutthaya, where there are industrial clusters, and there were risk of similar floods taking place after 2012. From such a point of view, it was necessary to protect Bangkok, Ayutthaya area and an industrial park located on the east bank of the Chao Phraya River where there were many Japanese automobile production and electronics manufacturing companies. From great appreciation to Thailand for the assistance received during the Tohoku Earthquake, and to carry out disaster prevention utilizing lessons learnt from Japan's past earthquakes, preparation for floods that might occur in the future was necessary. For this reason, by applying JICA's fast-track system<sup>2</sup>, technical cooperation was implemented with the "Project on a

<sup>2</sup> The fast-track system is a system of JICA which certifies highly urgent projects as a fast-track project. The

Comprehensive Flood Management Plan for the Chao Phraya River Basin” which was aimed at emergency restoration/refurbishment of damaged facilities, construction of new facilities and examination of measures based on medium-long term perspectives.

## 1.2 Project Outline

Overall Goal <sup>3</sup>		<u>Utilization goals of the proposed plan</u> Projects or Feasibility Studies (hereinafter referred to as “F/S”) are conducted based on the priorities of the revised “Master Plan for the Chao Phraya River Basin”. Disaster prevention and reconstruction grant aids are implemented and infrastructures are constructed.
Project Purpose		Emergency measures are carried out for flood prevention in the Chao Phraya River Basin.
Output(s)	Output 1	<u>Component 1: Development of “Master Plan for the Chao Phraya River Basin”</u> Comprehensive flood management plan in the Chao Phraya River Basin is developed based on scientific and engineering evidence.
	Output 2	<u>Component 2: Outline design of disaster prevention and reconstruction grant aids</u> Outline designs are carried out for projects which need short-term measures.
	Output 3	<u>Component 3: Establishment of an emergency flood information system and planning of long-term operable flood management system</u> A flood data analysis system is established for the 2012 flood season and an action plan is formulated to develop a flood management system.
Total cost (Japanese Side)		2,692 million yen
Period of Cooperation		December 2011 – October 2013
Implementing Agency		National Economic and Social Development Board (hereinafter

conventional system is flexibly operated, using a simplified implementation procedure and the organizations involved cooperatively work together.

<sup>3</sup> Since the Project was technical cooperation for development planning, the Overall Goal and Project Purpose were not set as in the case of ordinary technical cooperation. For this reason, it was interpreted that “utilization objective of the proposed plan” was the Overall Goal. The Project Purpose was set at the time of the ex-post evaluation by integrating all the outputs in order to secure the logic from the outputs to the impact.

	referred to as “NESDB”), Royal Irrigation Department (hereinafter referred to as “RID”, Department of Water Resources (hereinafter referred to as “DWR”)
Supporting Agency/ Organization in Japan	PASCO Corporation, Kokusai Kogyo Co., Ltd., Asia Air Survey Co., Ltd., CTI Engineering International Co., Ltd., Oriental Consultants Co., Ltd., Nippon Koei Co., Ltd., CTI Engineering Co., Ltd., Foundation of River and Basin Integrated Commutations, Public Works Research Institute, International Center for Water Hazard and Risk Management, University of Tokyo, Ministry of Land, Infrastructure, Transport and Tourism, Ministry of Economy, Trade and Industry, Japan Aerospace Exploration Agency
Related Projects	<p><b>【Technical Cooperation】</b></p> <p>The Study on Integrated Plan for Flood Mitigation in Chao Phraya River Basin (1995-1999)</p> <p>Flood management/Flood measures advisor/program coordination (dispatch of experts) (2012-2013)</p> <p>Integrated Study Project on Hydro-Meteorological Prediction and Adaptation to Climate Change in Thailand (IMPAC-T) (2009-2014)</p> <p>Follow up cooperation for Component 3 of “Project on a Comprehensive Flood Management Plan for the Chao Phraya River Basin” (2014-2015)</p> <p><b>【Grant Aid】</b></p> <p>The Flood Prevention Project of East Side of the Pasak River in Ayutthaya (2013)</p> <p>The Rehabilitation Project of the Outer Bangkok Ring Road (2013)</p> <p><b>【Other international organizations, aid organizations etc.】</b></p> <p>Dispatch of Emergency Rapid Assessment (Team) by ASEAN (2011)</p> <p>Dispatch of a team for Post Disaster Needs Assessment (PDNA) by World Bank and ADB (2011)</p> <p>JICA emergency aid (provision of goods, dispatch of expert team) (2011)</p>

## **2. Outline of the Evaluation Study**

### 2.1 External Evaluator

Satoshi Nagashima, INTEM Consulting, Inc.

### 2.2 Duration of Evaluation Study

This ex-post evaluation study was conducted with the following schedule.

Duration of the Study: July 2016 – December 2017

Duration of the Field Study: October 2, 2016 – October 15, 2016

January 9, 2017 – January 14, 2017

### 2.3 Constraints during the Evaluation Study

In the ordinary ex-post evaluation, comparison is made between ex-ante project evaluation and the situation at the time of ex-post evaluation in order to compare the plan with actual results. However, the Project is a fast track project with high urgency and detailed project contents were decided during implementation. Therefore, in the ex-post evaluation, the evaluation of efficiency was carried out based on the information of the project cost and the project period between the time of the consultant's contract for each component which can be confirmed within the plan retrospectively and according to the time of payment.

## **3. Results of the Evaluation (Overall Rating: A<sup>4</sup>)**

### 3.1 Relevance (Rating: ③<sup>5</sup>)

#### 3.1.1 Consistency with the Development Plan of Thailand

In response to the flood disaster in 2011, the Thailand government had tackled restoration and reconstruction for the flood damage and measures against floods<sup>6</sup> after 2012 such as launching Strategic Committee for Reconstruction and Future Development for reconstruction of the country and Strategic Committee for Water Resource Management (hereinafter referred to as “SCWRM”) for water resource management including measures against floods, etc. in November 2011 as an important issue of the nation.

According to interviews conducted at the implementing agencies, SCWRM did not exist at the time of the ex-post evaluation. The main body for measures against floods was handed over to the Single Command Authority (hereinafter referred to as “SCA”), which

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<sup>4</sup> A: Highly satisfactory, B: Satisfactory, C: Partially satisfactory, D: Unsatisfactory

<sup>5</sup> ③: High, ②: Fair, ①: Low

<sup>6</sup> In the current policies, the word of “flood management” is used. Therefore, in the ex-post evaluation, the words are separately used such as “measures against floods” for emergency restoration and reconstruction and “flood management” for measures with a long-term perspective.

was newly established in February 2012 by the former Yingluck regime, and this SCA also lost its function after the change of administration by the National Council for Peace and Order (hereinafter referred to as “NCPO”) in May 2014. At the time of the ex-post evaluation, under the current Prayuth regime that was established in 2014, it was a policy to conduct integrated water resource management by utilizing National Water Resources Committee (hereinafter referred to as “NWRC”), which was legislated for water resource management in 2007 but had not been utilized in the event of the emergency. The main objective was the implementation of *Strategic Plan on Thailand’s Water Resources Management* (hereinafter referred to as “SPTWRM” (2015 - 2036) enacted in 2015 for the purpose of the integrated water resource management such as drought, water quality, reforestation, etc. besides flood/disaster prevention. The new NWRC appointed by the NCPO has been based on the above, the organizational goal of the NWRC itself for the purpose of water resource management including flood management has not changed since the launch in 2007, and the development of policy was consistent even at the time of ex-post evaluation.

### 3.1.2 Consistency with the Development Needs of Thailand

A record-breaking heavy rain, which statistically occurs once in 50 years, had occurred in Thailand during the rainy season in 2011, and subsequent flood disaster was risked of occurring again after 2012. Therefore it was urgent to restore the damaged area in the short term and to formulate and implement a plan based on past recommendations in the mid- to long-term.

According to RID and DWR, which are the implementing agencies of the Project, serious flood damage of the same level has not occurred after 2011. Conversely, the damage of drought is greater in the past three years. Therefore measures against drought have been emphasized in the short term, and the priority of budget allocation for flood management is somewhat lower compared to 2011. Meanwhile, according to interview surveys conducted at the implementing agencies, drought and flooding have historically occurred in turn, and in January 2017, damage caused by unprecedented dry season flooding occurred in 12 prefectures in southern Thailand, and the implementing agencies continue activities for flood management. Therefore, there is no change in the perception that flood management is important in the medium-long term.

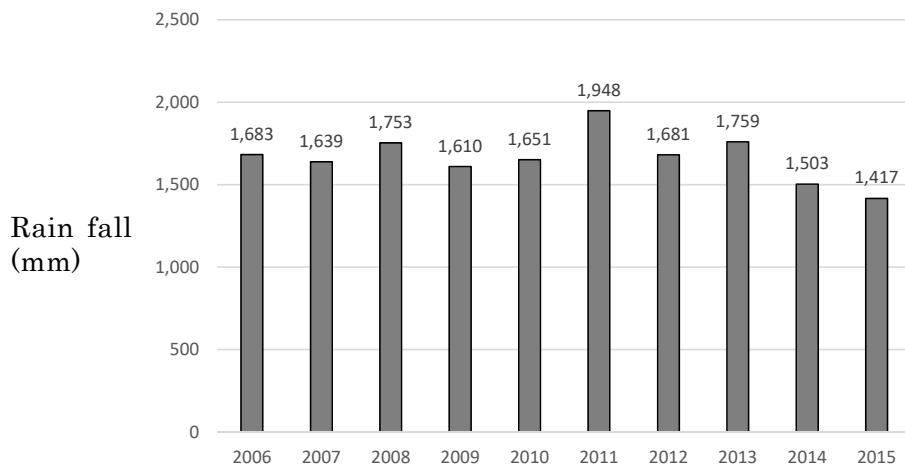


Figure 1 Average annual rain fall in Thailand in the last ten years (2006-2015)

Source: Material provided by RID

In addition, the Project was implemented utilizing the fast track system. Since the implementing agencies needed emergency assistance at the time of 2011, it was confirmed that JICA's response which was quicker than other donors was highly appreciated.

### 3.1.3 Consistency with Japan's ODA Policy

In response to flood damage in 2011 in Thailand, in October of the same year, a draft proposal of the Japanese Prime Minister was compiled. In the proposal, plans were given to conduct assistance for; (1) showing the great appreciation of Japan in respect to donations of more than two billion Japanese yen and many emergency supplies from Thailand when Japan was struck by the Tohoku Earthquake, (2) making international contributions to measures against disaster and towards disaster prevention based on lessons learned from the Tohoku Earthquake, (3) supporting Japanese companies which have expanded in Thailand, because it had the largest industrial cluster of Japanese companies in Southeast Asia. The industrial park in Ayutthaya where Japanese companies for automobile production and electronic manufacturing are located was damaged by the flood. This is also due to an anticipated global impact of these interrupted supply chains and predicted affect of damage to the center of Bangkok, and (4) eventually supporting the Thailand economy and ASEAN economy in general.

In line with the support plan, the Project was consistent with Japan's assistance policy of Thailand since the master plan based on lessons learned from Japan would be revised and at the same time, outline designs of the flood countermeasure facility would be also conducted to support Japanese companies expanding in Thailand.

#### 3.1.4 Appropriateness of the Project Plan and Approach

In the Project, the fast track system was utilized and it was started only two months after October 2011 when the flood became serious. Due to the urgency of the Project, the Project was started without carrying out a sufficient preliminary survey. For that reason, “Implementation of pilot projects for emergency restoration and improvement and emergency flood control measures” (hereinafter referred to as “old Component 3”) was changed to “Establishment of emergency flood information system and planning of long-term operable flood management system” (hereinafter referred to as “new Component 3”) after the start of the Project.

According to the contracted consultant, the objective of the old Component 3 was to implement emergency restoration/improvement, flood control measures and implementation of the pilot projects for industrial clusters and important areas such as Bangkok. However, in consultation with the Thailand side at the start of the survey of the Project in December 2011, Thailand had already prepared an emergency flood control project that was anticipated to be completed in time for the the flood period of 2012 and it was also found out that the part of the construction had been already started. The government of Thailand desired that the construction would be completed in 2013. If the Project implemented the construction work, it would be difficult to meet the demands of the Thailand side if normal bidding procedures were included in the design. Therefore, the old Component 3 was excluded from the Project.

On the other hand, according to interviews at the implementing agencies, there was no systematic, single database or alarm system in Thailand at the time of the flood damage. The water level data of rivers etc. which was reported by the ministries and agencies was not consistent or became old. Therefore, in the process of revising the Master Plan, the necessity became clear to improve the flood management and flood forecasting system, and the new Component 3 was added. Regarding the establishment of the flood forecasting system, it was also one of the recommendations of the revised Master Plan which was parallelly conducted in the Project. In addition, after the Project was completed, a goal expected to be achieved by the proposed plan is that “Floods are appropriately controlled in the upper, middle and downstream, and there is no unexpected flood damage if the same scale of rain as 2011 occurs”. The system established by the Project was also utilized in the flood that occurred in the Chao Phraya River in 2014 to mitigate the damage caused. It is recognized by related organizations that the system is one of the important tools for properly controlling flooding. Therefore, through establishing the system the possibility became high to also achieve higher objectives such as controlling the floods appropriately in the upper, middle and downstream and to avoid unexpected flood damage if the same scale of rain as 2011 occurs.



From the above, it was appropriate that the Component 3 was changed during the Project since there is no problem in the logic of the project design and the expressed outcomes due to the change of the Component 3 after the start of the Project.

Regarding the consistency of the Project with development policy, there is a policy to conduct the integrated water resource management including flood management by NWRC which was legislated in 2007, and there is no change in its purpose at the time of the completion of the Project. Regarding the consistency with development needs, there is no change in perception that flood management is still important in the medium to long term. The Project was consistent with Japan's Thailand assistance policy. In addition, although the project plan was partially changed during the Project, there was no change in the approach and the logic, and it was an appropriate modification.

For the reasons above, the Project was highly relevant to the country's development plan and development needs, as well as Japan's ODA policy. Therefore, the relevance is high.

### 3.2 Effectiveness and Impact<sup>7</sup> (Rating: ③)

#### 3.2.1 Effectiveness

##### 3.2.1.1 Achievement of Project Purpose

In order to implement emergency measures to prevent flooding in the Chao Phraya River Basin (Project Purpose), it was necessary to formulate the Master Plan based on scientific and engineering evidence and detailed data (Output 1). In addition, it was necessary to conduct outline design for the restoration/improvement of the facilities necessary for flood management as measures for emergency while the Master Plan would be formulated, (Output 2). Further, it was necessary to establish a flood management system to solve the problem to be able to carry out flood management appropriately in the Chao Phraya River Basin in anticipation of further floods of the same level as 2011 (Output 3). In the Project, emergency measures necessary for flood prevention in the Chao Phraya River Basin and medium-long term measures were appropriately implemented due to achievement of these outputs. From the above, the Project achieved the purpose.

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<sup>7</sup> Sub-rating for Effectiveness is to be put with consideration of Impact.

Table 1 Major outputs of the Project

Project Purpose	Emergency measures are carried out for flood prevention in Chao Phraya River Basin.	
Outputs	Indicator	Major achievements
Output 1: Component 1: Development of <i>Master Plan for the Chao Phraya River Basin</i>	Component 1-1: Preparation of detailed topographic map of the Chao Phraya River Basin by airborne laser measurement	The survey began in February 2012 and the detailed topographic map of the Chao Phraya River basin by airborne laser measurement was created. In August 2012, the final report on airborne laser measurement survey work was submitted.
	Component 1-2: Revision of “the Chao Phraya River Basin Master Plan”	The survey began in December 2011 and the <i>Chao Phraya River Basin Master Plan</i> was revised based on scientific and engineering evidence collected in the Project
Output 2: Component 2: Outline design of disaster prevention and reconstruction grant aids	Component 2-1: Outline design of grant aid for construction of flood gates (Han Tra, Kra Mang) in Ayutthaya district	In December 2011, a preparatory survey related to this matters was started and the outline design was completed in August 2012. As the output of the works, <i>Preparatory Survey Report on the Flood Prevention Project of East Side of the Pasak River in Ayutthaya (Detail Design)</i> was prepared.
	Component 2-2: Outline design of grant aid for rehabilitation (raising) in the outer Bangkok Ring Road (National Highway No.9)	In February 2012, a preparatory survey related to this matters was started and the outline design was completed in August 2012. As the output of the works, <i>Preparatory Survey Report on the Rehabilitation Project of the Outer Bangkok Ring Road</i> ” was created.
Output 3: (New Compornet 3) Establishment of emergency flood information system and planning of long-term operable flood management system		In July 2012, the survey related to this matters was started. Establishment of the flood management system of the Chao Phraya River and the planning of the flood management system that can be operated for a long term were carried out, and the final report was submitted in October 2013.



Photo 1 and 2 Flood management system supported by the Project (left) and the server (right)

### 3.2.2 Impact

According to interview surveys conducted at the implementing agencies at the time of the ex-post evaluation, detailed topographic maps conducted by airborne laser measurement as well as the Master Plan of Chao Phraya River Basin (Output 1 of the Project) are fully utilized by the implementing agencies and have led to flood management activities such as conducting F/S by RID. In addition, based on the outline

designs of the two grant aid projects, which are the outcomes of Output 2, the main projects (construction etc.) were carried out. Based on the above, the outcomes of the Project are contributing to achieve the Overall Goal, that is, the utilization goals of the proposed plan, (1) the projects are implemented or F/S is implemented based on the priority order of the revised Master Plan reconsidered, (2) disaster prevention and reconstruction grant aid is implemented, and it contributes to the development of these infrastructures. In addition, the flood management system, which is the outcome of Output 3, has contributed to mitigate subsequent flood damage.

### 3.2.2.1 Achievement of Overall Goal

The status of achievement of the set indicators for the Overall Goal of the Project is shown in Table 2 below.

Table 2 Achievement of Overall Goal

Overall Goal	Indicator	Actual								
Projects or F/S are conducted based on the priority of revised “Master Plan for the Chao Phraya River Basin”.  Disaster prevention and reconstruction grant aids are implemented and the infrastructures are constructed.	(1) (Corrected indicator) Thailand government takes measures to allocate budget to implement projects or F/S based on formulated “the Chao Phraya River Basin Master Plan” and on over 80% of the recommended priority projects	According to interview surveys at the implementing agencies, the responses on the indicator (1) were as follows. Among the five recommendations of the Master Plan, the projects has been implemented or F/S has already been implemented or are in progress excluding the outer-ring road diversion channel. Regarding the outline ring road diversion channel, RID has jointly submitted a request for implementation of F/S to JICA in July 2016 in collaboration with the Department of Highway (hereinafter referred to as “DOH”), and the survey has been started since January 2017. Thus, projects or F/S have been carried out or measures have been taken for the budget allocation by the implementing agencies for at least 80% of the recommendations. Therefore the indicator has been achieved.								
		<table border="1"> <thead> <tr> <th>Priority projects</th> <th>Status of implementation</th> </tr> </thead> <tbody> <tr> <td>Effective operation of existing dam</td> <td>The Electricity Generating Authority of Thailand (hereinafter referred to as "EGAT"), which manages the dam, has operated the dam in accordance with the recommendation<sup>8</sup> of the Master Plan since 2012. No additional budget is needed to implement this recommendation.</td> </tr> <tr> <td>Outer-ring road diversion channel</td> <td>In collaboration with the DOH, RID requested JICA to implement F/S of the outer-ring road and the diversion channel (in 2016). For this reason, the Thailand government has not allocated the budget.</td> </tr> <tr> <td>River improvement</td> <td>By RID, approximately 50 million baht was budgeted for the F/S of the renovation of the Tha Chin River and the Western Chao Phraya River, and approximately 50 million baht was secured for F/S on the improvement of the</td> </tr> </tbody> </table>	Priority projects	Status of implementation	Effective operation of existing dam	The Electricity Generating Authority of Thailand (hereinafter referred to as "EGAT"), which manages the dam, has operated the dam in accordance with the recommendation <sup>8</sup> of the Master Plan since 2012. No additional budget is needed to implement this recommendation.	Outer-ring road diversion channel	In collaboration with the DOH, RID requested JICA to implement F/S of the outer-ring road and the diversion channel (in 2016). For this reason, the Thailand government has not allocated the budget.	River improvement	By RID, approximately 50 million baht was budgeted for the F/S of the renovation of the Tha Chin River and the Western Chao Phraya River, and approximately 50 million baht was secured for F/S on the improvement of the
		Priority projects	Status of implementation							
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		Outer-ring road diversion channel	In collaboration with the DOH, RID requested JICA to implement F/S of the outer-ring road and the diversion channel (in 2016). For this reason, the Thailand government has not allocated the budget.							
River improvement	By RID, approximately 50 million baht was budgeted for the F/S of the renovation of the Tha Chin River and the Western Chao Phraya River, and approximately 50 million baht was secured for F/S on the improvement of the									
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Outer-ring road diversion channel	In collaboration with the DOH, RID requested JICA to implement F/S of the outer-ring road and the diversion channel (in 2016). For this reason, the Thailand government has not allocated the budget.									
River improvement	By RID, approximately 50 million baht was budgeted for the F/S of the renovation of the Tha Chin River and the Western Chao Phraya River, and approximately 50 million baht was secured for F/S on the improvement of the									

<sup>8</sup> Recommendations in the Master Plan are: (1) to release the inflow amount according to the “target curve” of the suggested water storage volume and maintain the reservoir level, (2) to release the suggested maximum release amount (210 m<sup>3</sup>/s for Pumipon Dam, 190 m<sup>3</sup>/s for Sirikit Dam) during the flood season (from August to October). In addition, when the water storage volume falls below the “target curve”, the inflow amount is further stored, (3) to release based on the dry season water distribution plan during the dry season (from November to April), and so on.

			Eastern Chao Phraya River (in 2015).
		Ayutthaya bypass channel	By RID, about 60 million baht of budget for F/S on the project was secured (in 2012).
		Flood forecasting	The RID maintains and manages the flood management system established in the Component 3. There is no need for an additional budget for this.
	(2) (Corrected indicator) Project implementation or F/S will be implemented by the Thailand government for the formulated <i>Chao Phraya River Basin Master Plan</i> and over 60% of the recommended priority projects.	According to interview surveys at the implementing agencies, the responses on the indicator (2) were as follows. Thus, projects or F/S have been carried out for at least 80% of the recommendations. Therefore the indicator has been achieved.	
		Priority projects	Status of implementation
		Effective operation of existing dam	EGAT has been managing the dam in accordance with the recommendation of the Master Plan since 2012. The implementing agency of the Project (RID) itself is responsible for providing information on water demand, and it is not involved in the operation of the dam. However, it is possible to provide more detailed and accurate data than before by utilizing detailed topographic map and flood management system obtained through the outcome of the Project. Therefore, the cooperative relationship between RID and EGAT became closer than before the Project.
		Outer-ring road diversion channel	In collaboration with DOH, RID has requested JICA to implement the F/S of the outer-ring road and the diversion channel. Information collection and confirmation survey has started since January 2017.
		River improvement	By RID, the Tha Chin River improvement and the F/S of the canal network of the Western Chao Phraya River are underway (October 2015-March 2017 (planned)). In addition, the F/S on improvement of the eastern Chao Phraya River and the diversion channel are underway (October 2015-April 2017 (planned)).
		Ayutthaya bypass channel	F/S on this project has been implemented by RID (April 2012-October 2013). RID is applying a budget request for implementation for detail design in the fiscal year 2017.
		Flood forecasting	RID currently operates the flood management system developed by Component 3 of the Project and the public release site (floodinfo.rid.go.th) is also utilized. DWR also utilizes flood forecasting utilizing the model developed in the Project for policy decision. Data collected from twelve relevant departments and agencies including RID and DWR are shared by National Hydrology and Climate Data Center (hereinafter referred to as "NHC") in Hydro and Agro Informatics Institutes affiliated with Ministry of Science and Technology, and has been utilized for disaster information conducted by the Department of Disaster Prevention and Mitigation. In the past, NHC did not function sufficiently, but it became functional due to the impact of the Project. Regarding flood related information, the main source of information is RID, which enables

			more accurate information to be provided by the flood model and flood management system developed in the Project and it contributes to mitigate flood damage.																												
(3) (Additional indicator) Grant aid projects are implemented based on the contents of the outline design implemented in the Project.		Based on the outline design implemented in the Project, grant aid projects "The Flood Prevention Project of East Side of the Pasak River in Ayutthaya" and "The Rehabilitation Project of the Outer Bangkok Ring Road" were implemented, and it was completed in September 2015 and April 2015 respectively. Therefore, the indicator has been achieved.																													
(4) (Additional indicator) The stakeholders' satisfaction level of the proposed plans become four or more out of five levels for each Component 1 to 3.		A questionnaire survey <sup>9</sup> was conducted for staff involved in direct activities at the time of implementation of the Project. The results are as follows. For staff involved in direct activities, the satisfaction level of the quality of the proposed plan was more than four out of five levels for all components, and the indicator has been achieved.																													
			<table border="1"> <thead> <tr> <th></th> <th>Satisfaction level of the quality of the proposed plan (five levels<sup>10</sup>)</th> <th>Number of respondent</th> </tr> </thead> <tbody> <tr> <td>NESDB</td> <td>5</td> <td>1</td> </tr> <tr> <td rowspan="4">RID</td> <td>Component 1-1</td> <td>5</td> </tr> <tr> <td>Component 1-2</td> <td>5</td> </tr> <tr> <td>Component 2-1</td> <td>5</td> </tr> <tr> <td>New Component 3</td> <td>4</td> </tr> <tr> <td rowspan="3">DWR</td> <td>Component 1-2</td> <td>4</td> </tr> <tr> <td>New Component 3</td> <td>4~5</td> </tr> <tr> <td>Component 3</td> <td>3</td> </tr> <tr> <td>DOH</td> <td>Component 2-2</td> <td>5</td> </tr> <tr> <td></td> <td></td> <td>2</td> </tr> </tbody> </table>		Satisfaction level of the quality of the proposed plan (five levels <sup>10</sup> )	Number of respondent	NESDB	5	1	RID	Component 1-1	5	Component 1-2	5	Component 2-1	5	New Component 3	4	DWR	Component 1-2	4	New Component 3	4~5	Component 3	3	DOH	Component 2-2	5			2
	Satisfaction level of the quality of the proposed plan (five levels <sup>10</sup> )	Number of respondent																													
NESDB	5	1																													
RID	Component 1-1	5																													
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	Component 3	3																													
DOH	Component 2-2	5																													
		2																													

Note: Contents of each component are as Table 1.

From the above, the Overall Goal has been achieved.

### 3.2.2.2 Other Positive and Negative Impacts

#### (1) Impact on the natural environment

It was confirmed from the implementing agencies that there was no impact on the natural environment through the activities of the Project.

#### (2) Resident relocation and land acquisition

It was confirmed from the implementing agencies that the Project did not include activities requiring resident relocation and land acquisition.

#### (3) Other indirect effects

In the Project, in terms of the goals expected to be achieved by the proposed plan after

<sup>9</sup> Survey was conducted based on questionnaires for staff of related organizations such as NESDB (one person), RID (eight persons), DWR (four persons), DOH (two persons), and all respondents provided the responses.

<sup>10</sup> Five levels represent very fair, fair, moderate, bad and very bad

the completion of the cooperation, two of these goals were “Floods are appropriately controlled in the upper, middle and downstream, and there is no unexpected flood damage if the same scale of rain as 2011 occurs” and “In the industrial cluster along the Chao Phraya River, comprehensive damage from rain of the same level as 2011 will be mitigated”.

As shown in Figure 1, Thailand has not had the same level or higher rainfall after 2011, and drought rather than flooding is a serious concern at the time of ex-post evaluation. Therefore, it is difficult to judge whether overall damages will be mitigated or not when rain of the same level as 2011 occurs. However, according to interviews conducted at the implementing agencies, the recommendations of the Master Plan are fully utilized. In addition, as a result of the outcomes, it was confirmed that mitigation of the damage was seen in the flood that had occurred in the Chao Phraya River during 2014. Therefore, it is deemed highly possible to achieve these goals for the future as well.

Through the implementation of the Project, the Project Purpose “Emergency measures are carried out for flood prevention in Chao Phraya River Basin” was completed . In addition to this, the achievement of the Overall Goal such as conducting projects or F/S base on the priority of the revised Master Plan has also been confirmed, as well as implementing disaster prevention and reconstruction grant aid projects. Therefore, the effectiveness and the impact of the Project are high.

### 3.3 Efficiency (Rating: ②)

#### 3.3.1 Inputs

In the Project, following inputs were carried out.

<b>Inputs</b>	<b>Plan (At the time of contract)</b>	<b>Actual (At the time of completion)</b>
(1) Experts	Sixty two (62) Short-Term	Eighty six (86) Short-Term
(2) Trainees received	Ten (10) persons	Ten (10) persons
(3) Equipment	No information on the plan	GPS, digital cameras, GIS, PCs, photo copy machines, CAD, server storage equipment, hard disk for data storage (However, the prices are unknown)
(4) Overseas project enhancing expense	No information on the plan	Approximately 28 million yen
Japanese Side Total Project Cost	Total 2,395 million yen	Total 2,692 million yen
Thailand Side Total Project Cost	No information on the plan	1. Assignment of counterparts Steering Committee 20 persons, counterparts 26 persons 2. Provision of land and facilities project office, electricity and water fare 3. Salary of counterparts

Source: Result of questionnaire survey

##### 3.3.1.1 Elements of Inputs

At the time of contract (planning), dispatch of 62 short-term experts were planned together with all the Components. However, at the time of completion of the Project, 86 short-term experts were dispatched. This was mainly due to the fact that the number of Japanese staff was increased since Japanese side implemented the outline design of the grant aid projects for Components 2-1 and 2-2 though it was originally expected to utilize local consultants in Thailand. Regarding the acceptance of trainees, it was as planned. With regard to equipment provision, overseas project enhancing expenses, and project costs borne by Thailand, there was no information at the time of planning. Therefore, it is difficult to compare between the plan and the actual results. For the project cost on the Japanese side, it is analyzed in the next section.

### 3.3.1.2 Project Cost

In this ex-post evaluation, it was decided to compare on JICA's overseas project enhancing expense and the amount and performance of consultant's contract. As a result, as shown in Table 3 below, the actual project cost was increased by 112% compared with planned project cost.

Table 3 Comparison of the project cost between the plan and the actual

Unit: million yen

	Plan (at the time of contract)	Actual	Result of comparison
Component 1-1	1,400	1,397	99%
Component 1-2	436	471	108%
Component 2-1 and 2-2	202	370	183%
Old Component 3	64	20	31%
New Component 3	265	406	153%
Sub-total	2,367	2,664	112%
Overseas project enhancing expenses <sup>11</sup>	28	28	-
Total	2,395	2,692	112%

Source: Questionnaire survey, material provided by JICA

The reasons for the difference between the plan (at the time of contract) and the actual result are as follows.

- (1) For Component 1, expenses increased due to recalculation of analysis data based on the maps created by airborne laser measurement and holding seminars.
- (2) With regard to Component 2, relatively simple river facility projects such as a levee were initially assumed, and it was a precondition to utilize local consultants for the detail design. However, as a result of the field survey and consultation with the Thailand side, the detailed design of the new flood gate project and the national highway raising project would be implemented in the Project, and the number of personnel was increased.
- (3) In the initial stage of new Component 3, formulation of an implementation plan for establishing a flood management system was proposed. However, a complete version of the flood management system was established as a result. For this reason, the

<sup>11</sup> For overseas project enhancing expenses, the same amount was added for the Plan and Actual and then compared.



period of implementation was extended for 8 months.<sup>12</sup>

From the above, the project cost was higher than planned. However, (1)-(3) were necessary inputs for the Project.

### 3.3.1.3 Project Period

In the ex-post evaluation, the actual implementation period was compared with the planned implementation period in the consultant's contract.

Table 4 Comparison of Project period between the plan and the actual

Plan (At the time of contract)	Actual	Result of comparison
December 2011 – October 2013	December 2011 – October 2013	100%

Source: Result of questionnaire survey

As explained in 3.3.1.2, the survey period was extended for eight months for the new Component 3 (until October 2013). However, as the entire project was planned to be completed by October 2013, the project period as a whole for the Project was completed in accordance with the initial contracted schedule.

From the above, the project period proceeded as planned.

As a result, although the project period was within the plan, the project cost exceeded the plan. Therefore, efficiency of the Project is fair.

## 3.4 Sustainability (Rating: ③)

### 3.4.1 Related Policy and Institutional Aspects for the Sustainability of Project Effects

In order to sustain the effect expressed in the Project, flood management was continuously recognized as an important policy, and it was necessary for the implementing agencies to carry out activities for that.

According to interview surveys at the implementing agencies at the time of the ex-post evaluation, as described in the relevance section, there is a policy to conduct the integrated water management by utilizing NWRC. The secretariat of the NWRC is DWR. Procedures are in the process of being approved by the National Water Act by parliament so that the authority of the DWR will be strengthened. However, the timing of the enactment of the bill is undecided<sup>13</sup>.

<sup>12</sup> In the component, it was planned to prepare a basic plan of the flood management system at first, to organize the activities and construction period necessary for establishment of the system (by each implementing agency), and to develop the prototype of the system.

<sup>13</sup> According to the interview survey at the DWR in the first field survey, there was information that this bill

In addition, according to interviews conducted at the implementing agencies, SPTWRM which was formulated in 2015 aims not only to contribute to flood management but also to integrated water resource management. SPTWRM consists of (1) water management for domestic use, (2) building water security for the production sector (agriculture and industry), (3) flood management, (4) water quality management, (5) upstream forest rehabilitation and soil erosion prevention, and (6) administrative management, and the flood management is one of the important strategies.

Thus, at the time of the ex-post evaluation, policies and strategies for the integrated water resource management, including flood management by utilizing NWRC in the medium to long term, had been set up and the policy sustainability is secured.

#### 3.4.2 Organizational Aspects for the Sustainability of Project Effects

In order to sustain the effects developed in the Project, it was necessary to establish an appropriate implementation system on the overall flood management and the responsible organization of each component of the Project. At the time of the ex-post evaluation, the following are the implementation system for flood management as a whole and for each component.

##### (1) Implementation system of flood management as a whole

According to interviews conducted at the implementing agencies, at the time of ex-post evaluation, NWRC is used for managing the water resources including flood management in Thailand. Under the Prime Minister who is the chairperson, the lower committee contains all Ministries concerning the water resource management as the members, and it aims to establish a system to manage the water resources in a unified manner under the Prime Minister. The organization chart of NWRC is shown in Figure 2.

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is expected to be approved by the parliament in January 2017. However, when the situation was confirmed in the interview at the second field survey, the bill was remanded once due to the instruction by the Prime Minister, and it was the stage of submitting the revised proposal to the Cabinet. Therefore, the timing of enactment of the bill is undecided.

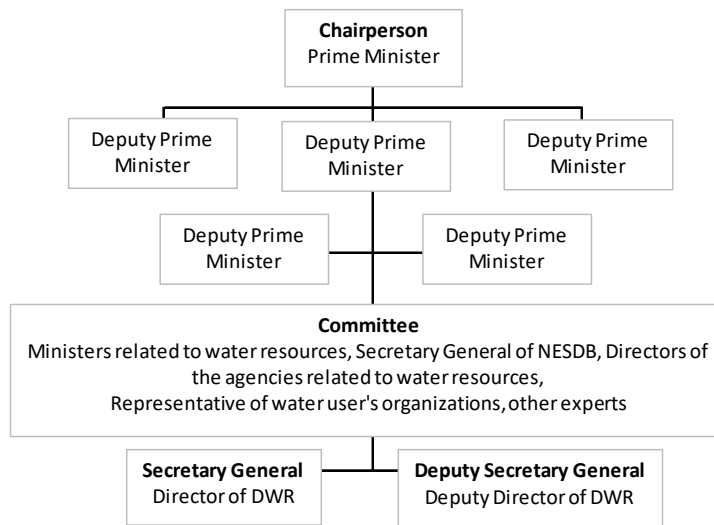


Figure 2 Organization chart of current NWRC

Source: Interview survey results at implementing agencies

The NWRC is chaired by the Prime Minister, and the committee composed of relevant ministries and experts is formed under it. In addition, the secretariat is DWR. The current organizational structure is to be reorganized again for efficient organizational management after the *National Water Act* is enforced<sup>14</sup>.

According to interviews conducted at the implementing agencies, the main responsibilities of NWRC are: (1) to drive SPTWRM for concrete and efficient outcome, (2) to recommend the water resources management policy or plan that are necessary to proceed to the cabinet in order to carry out SPTWRM to achieve its objective, (3) to prepare overall water resources management and action plan of the country under SPTWRM in normal and crisis situation, and to propose overall plans for the cabinet to endorse so that the government sectors and agencies can carry out the plans, (4) to formulate rules and conditions for appropriate water resources control and allocation to related organizations with the requirement of consumption, agriculture, industry, ecosystem, water transportation, hydropower and other related areas, (5) to consider and review plans, action plans and projects of the government sectors or relevant agencies including water resource management, development plan and action plan at river basin levels to be in line with SPTWRM and the national economic and social development plans as well as policy and environmental quality management plan to be the guidance for the integrated water resources management budget plan, (6) to supervise, monitor, review, evaluate and advises the government sectors and agencies as well as the river basin committee to carry

<sup>14</sup> According to the interview survey at DWR, it is requesting Khon Kaen University to examine the draft of the reorganization.

out SPTWRM, the water resources development and management plan, water resources management action plan and integrated water resources management budget plan. In addition, to propose to the Prime Minister to command or control to take some course of action for the highest benefit of water resources management, (7) to appoint a subcommittee or working group to assist when the task is required, (8) to provide recommendations to adjust the law, rules and regulations or other related regulations for the benefits of water resources management of the country as well as the international water resources management, and (9) to perform any other tasks assigned by the cabinet or the Prime Minister. The meeting is held approximately once a month.

## (2) Implementation system for each component

Regarding the implementation system for each component at the time of the ex-post evaluation, the substantive works excluding Component 2-2 (Renovation (raising) of the Eastern Outer Ring Road (National Highway No.9) are conducted by RID, and Component 2-2 is carried out by DOH. RID, DWR, and DOH have sufficient organizational structures to utilize the results of the Project as follows.

### 1) Implementation system of RID

According to the interview survey at RID, all relevant results have been utilized and sustained by RID after the completion of the Project. The departments which mainly follow up the Project are the Bureau of Project Management, the Bureau of Engineering Topographical and Geotechnical Surveys, the Bureau of Engineering and Architectural Design, the Bureau of Water Management and Hydrology and the Regional Irrigation Offices.

RID is conducting major activities concerning the water resources development, the water management and prevention against the water-related disasters. The total number of permanent staff in whole of RID is 24,897 in the central and local areas together, and it is 225,167 if temporary staff members are included.

### 2) Implementation system of DWR

According to the interview survey at DWR, DWR utilized the Master Plan at the time of SPTWRM formulation and has utilized the outcome of the new Component 3 after the completion of the Project. The department which mainly utilizes the outcome of the Project is the Water Crisis Prevention Center in DWR. The role is to analyze disaster areas, propose disaster prevention guidelines and develop alarm systems, etc.

DWR is developing policies on water resource management at domestic and international levels, enhancing the capacity of water management organizations and

networks, maintaining and rehabilitating and developing water resources to maintain efficiency and ecosystems and wetlands; standardization of knowledge base, information systems, and integrated water resource management; and development of alarm system and others. The total number of permanent staff in DWR is 647 in the central level and 1,707 in the regional offices, and the total is 2,354.

### 3) Implementation system of DOH

The number of staff at DOH is 15,410 in total in the central and regional offices. DOH is in charge of overall road administration such as planning, maintenance, operation and maintenance of Thailand's main arterial roads, and plays a central role in the maintenance of major arterial roads.

#### 3.4.3 Technical Aspects for the Sustainability of Project Effects

Based on the outcomes of the Project, it was necessary that the implementing agencies for each component have sustained the technologies to implement the proposed plans or F/S and to manage the equipment provided. At the time of ex-post evaluation, the technical level of the implementing agencies was as follows.

##### (1) RID and DWR

According to the interview survey at RID, 14 out of 16 persons to whom technologies were directly transferred in the Project, except for two who retired, are still in service, and the transferred technologies have been maintained in RID.

In addition, according to the interview survey at DWR, the four persons to whom technologies were directly transferred through the Project are still in service, and the transferred technologies have been retained in DWR.

According to an interview survey at RID, the detailed topographic map obtained from the airborne laser measurement of Component 1-1 is still effectively used. Regarding the revised Master Plan of Component 1-2, whenever RID proposes projects related to flood management, they always refer to the Master Plan, and they have independently carried out or are in progress of implementation of F/S for each of the two recommendations of the Master Plan. In addition, although the flood management system of the new Component 3 had been always used for the water management but had limited opportunities for utilization on the flood management at the time of drought in the past three years, the model developed in the Project allows accurate flood prediction up to seven days later and the gap of abilities that was missing so far has been filled and it became possible to conduct accurate flood prediction. The system was fully utilized by RID and DWR during the flood at the Chao Phraya River which occurred in 2014.

Thus, RID and DWR are considered to have a sufficient technological level to utilize the transferred technologies. In addition, five members from RID and four from DWR participated in training in Japan on the new Component 3 and capacities on disaster prevention knowledge were strengthened. In addition, follow-up cooperation on further utilization of flood management system were carried out and it strengthened technologies related to the utilization of the flood management system further.

## (2) DOH

Three of whom the technologies had been directly transferred by the Project are still in service, and the transferred technologies are retained in DOH.

DOH is carrying out planning and management of all highways including the Project without problems and the technical level is high.

### 3.4.4 Financial Aspects for the Sustainability of Project Effects

Based on the outcomes of the Project, it was necessary to maintain financial strength by the implementing agencies in charge of each component to implement the proposed projects or F/S, and to operate and maintain the equipment provided. The financial situation of the implementing agencies at the time of ex-post evaluation is as follows.

#### (1) RID

The transition of RID's budget over the past seven years is as Table 5 below.

Table 5 Transition of RID's budget over the past seven years

Unit: million baht

Year	2010	2011	2012	2013	2014	2015	2016
Personnel expense	6,633	6,195	6,438	6,708	6,382	6,537	6,722
Operation expense	1,263	1,326	1,300	1,392	1,392	1,490	1,381
Investment expense	16,314	32,419	35,042	27,200	31,711	34,854	38,449
Subsidy	1	1	1	1	1	1	1
Others	173	174	138	193	159	165	115
Total amount	24,384	40,115	42,919	35,494	39,645	43,047	46,668

Source: Materials provided by RID

Since the emergency projects on flood countermeasures were implemented ahead of schedule in FY 2011 and FY 2012, the budget was temporarily reduced in 2013. However, it recovered to the pre-flood level in 2014 and the budget has been following an increasing trend after that. Within the budget, investment expenses to be used for construction and survey expenses have also increased in recent years. In addition, RID has allocated budget

to implement F/S of the project proposed in the Project and it has completed or is being implemented. Therefore, RID has the financial strength necessary to maintain the outcome of the Project and to maintain and manage the equipment of the new Component 3.

(2) DWR

The transition of DWR's budget over the past five years is as Table 6 below.

Table 6 Transition of DWR's budget over the past seven years

Unit: million baht

Year	2012	2013	2014	2015	2016
Personnel expense	674	700	745	698	739
Operation expense	152	152	152	152	142
Investment expense	5,955	8,724	7,909	6,239	6,573
Subsidy	17	19	20	23	26
Others	1,066	343	265	481	644
Total amount	7,864	9,938	9,091	7,593	8,124

Source: Materials provided by DWR

DWR also has revenues through mid-year budgets, loans, etc. The DWR budget has been stable between about 7,600 to 9,900 million baht. Investment expenses are the highest, and there is much room for expenditures for projects and others. In addition, although not shown in Table 6, the budget has increased by five to six times considering that the budget at the time of 2005 which was about 1,500 million baht, and it is considered that its importance has also increased as an agency.

Since RID mainly follows up the activities of the Project and DWR is in charge of the policy aspects of the water resources management as the secretariat of the NWRC, many budgets are not necessary for the sustainability of the project activities. Therefore, the current financial situation is a sufficient financial level to utilize the outcomes of the Project.

(3) DOH

The transition of DOH's budget over the past five years is as Table 7 below.

Table 7 Transition of DOH's budget over the past seven years

Unit: million baht

Year	2012	2013	2014	2015	2016
Personnel expense	4,463	4,844	4,643	4,648	4,793
Operation expense	675	736	717	725	700
Investment expense	45,140	46,988	46,972	54,597	71,479
Subsidy	10	13	15	8	8
Others	134	386	412	356	530
Total amount	50,422	52,967	52,759	60,334	77,510

Source: Materials provided by Department Highway

The annual budget of DOH has been increasing in the past five years. Investment expenses including operation and maintenance expenses are allocated in excess of 40 billion baht, and it reached at 70 billion baht in 2016. Therefore DOH has high financial strength for operation and maintenance of the highways. Since they operate on all the highways without problems, there is no problem in the financial situation in terms of sustaining the project effects.

In this way, the sustainability of policy and institutional aspects have been secured by utilization of NWRC and formulation of SPTWRM. Regarding the structure of the implementing agencies, the integrated water resource management system using NWRC has been established in Thailand. Even in the implementation system of the institution responsible for the implementation of concrete activities of the Project, RID and DOH have mainly been in charge of the activities and DWR takes advantage of utilizing the outcomes. There are no problems with the technical capabilities and financial situations of RID, DWR and DOH.

Based on the above, no major problems have been observed in the policy background and the organizational, technical, financial aspects. Therefore, sustainability of the project effects is high.

#### **4. Conclusion, Lessons Learned and Recommendations**

##### 4.1 Conclusion

This Project was conducted to support recovery from the flood damage in the Chao Phraya River basin which occurred in Thailand during 2011 and to take emergency measures to prevent subsequent flooding. As a consequence, the aim was to carry out a flood management project and feasibility studies based on the "Master Plan for Chao Phraya River basin" developed in the Project and to implement comprehensive disaster



prevention and reconstruction in cooperation with Japan's grant aid projects at the same time.

Implementation of the Project is fully consistent with the policy and the needs of flood management in Thailand, and Japan's aid policy. In addition, although the content of the Project was partially modified during the implementation period, the logic of the project design and the outcomes were not affected. Therefore, the relevance of the Project is high.

Through the implementation of the Project, the Project Purpose which was "to carry out the emergency measures for flood prevention in the Chao Phraya River basin" has been achieved. In addition to this, achievements have been confirmed for the Overall Goal including: (1) projects and feasibility studies have been implemented based on the priorities laid out in the Master Plan; and (2) disaster prevention and reconstruction grant aid projects have been conducted. Therefore, the effectiveness and the impact is high.

The Outputs of the Project had been achieved as planned. Regarding the required Inputs for generating results, although the project was completed within the planned timeframe, the project budget exceeded the predicted expenditure. Therefore, the efficiency is fair.

No problems were observed in regards to the policies and systems to manage flooding in Thailand or the organizational structures to sustain the results of the Project, and the technical and financial aspects of the implementing agencies. Therefore, the sustainability of the outcomes expressed by the Project is high.

In light of the above, the Project is evaluated to be highly satisfactory.

## 4.2 Recommendations

### 4.2.1 Recommendations to the Implementing Agency

None

### 4.2.2 Recommendations to JICA

None

## 4.3 Lessons Learned

### (1) Creating outcomes in line with technologies

Based on scientific and engineering evidence, the Master Plans etc., which are the outcomes of the Project, were created to express maximum results at low cost. The results were highly appreciated by counterparts of the implementing agencies that were direct beneficiaries. However, there was a period when the flood management was led by politicians, and the results of the Project were not sufficiently utilized and a flood management without emphasis on scientific and engineering evidence had been promoted

(as they could appeal their results). After that, the administration was changed. The initiative for flood management was handed back to the working-level again and the outcomes of the Project were again recognized and it led to the high evaluation results in the ex-post evaluation. As a result of consistent activities based on scientific and engineering evidence, the project outcomes have been utilized in the long-term.