第11章　プロジェクト評価

11.1　経済評価

11.1.1　評価の手法

(1)　総　論

経済評価を行う主な目的は、可能な限り費用便益分析を適用し国民経済の観点からマスタープランで提案されたプロジェクトに対する投資効率を検討することである。市場価格は、市場の歪みを取り除いて経済価格に変換されている（いわゆるシャドウプライス）。財やサービスの市場が存在しない場合は、機会費用の考え方を用いている。プロジェクトに対する投資効率の指標として経済的内部収益率（EIRR）が使われている。

(2)　前提条件

以下の前提条件に基づいて経済評価を行っている。必要に応じて前提条件を追加している。

(a)　事業実施ケースと事業未実施ケース

事業未実施ケースとは洪水対策が既存のシステムで実施されるケースを指す。事業実施ケースとはマスタープランで提案された事業が既存のシステムに対して導入されるケースである。

(b)　評価対象期間

評価の対象となる期間は、プロジェクトの準備段階から事業の全体終了の時期までを含む。本件では 2013 年から 2050 年（事業の開始から 38 年間）を評価対象期間としている。

(c)　標準変換係数（SCF）

変換係数とは、事業への投入ないし成果にかかる経済価格と市場価格の間の比率である。経済全体を対象として導出された場合に標準変換係数（SCF）あるいは平均変換係数という。国境価格が経済価格とみなされるため、SCF は国内価格で表示された財と国境価格で表示された財を共通の尺度で評価するために適用される。さらに、SERF は定義によりシャドウ・エクスチェン・ジレート係数（SERF：シャドウ・エクスチェン・ジレートと公定レートの比）の逆数である。タイ国の SCF は 1 と見積られる。

(d)　シャドウ賃金率係数

タイ国においては失業率が低いだけでなく低下傾向にあるため、非熟練労働者についてシャドウ賃金率と市場賃金率の比であるシャドウ賃金率（SWRF）は 1 と推定される。

(e)　価格水準

価格水準は 2012 年を基準とする。2012 年以前の価格データはインフレ率データを用いて 2012 年水準に調整する。

(f)　社会的割引率

本件経済評価において社会的割引率に 12%が採用される。

(3)　費　用

評価における費用については、事業実施ケースと事業未実施ケースを比較し、追加的に発生する費用を算入する。発生する費用は評価対象期間において各年のキャッシュフローの形で計算される。以下の項目が費用として検討される。

(a) 資本費用

資本費用には、施設や構造物の建設コスト及びコンサルティングサービスにかかる費用が含まれる。経済評価においては、物理的予備費は算入されるが、物価上昇分は算入されない。

(b) 維持管理費用

毎年の維持管理費用が算入される。物価上昇分は算入されない。

(c) 減価償却費

減価償却費はその時点で実際に支出されるものではないため、費用として算入しない。

(4) 便 益

評価における便益については、事業実施ケースと事業未実施ケースを比較し、追加的に発生する便益を算入する。発生する便益は評価対象期間において各年のキャッシュフローの形で計算される。洪水対策事業の便益としては、洪水によって引き起こされる被害の低減・緩和があげられる。

洪水の直接的被害としては、一般的に以下の式により計算される。

[当該地域の直接被害（Baht）] = [地域の面積（km^2）] × [潜在的被害額（Baht/km^2）] × [浸水深に対応した被害率]

潜在的被害額とは、その地域において浸水によって資産に被る被害の最大額である。被害率は浸水深（m）の関数として想定され、その関数を推定する。被害を引き起こす洪水の発生は確率事象であることから、計算される被害額は洪水の発生確率に基づく期待値（それぞれの被害額に、対応する洪水発生確率を乗じて総和を取ったもの）である。本調査では、5 つの異なる発生確率（2 年、10 年、30 年、50 年および 100 年確率）で洪水解析を実施する。なお、経済評価では、プロジェクト完了後においても考え得る洪水リスクを踏まえた評価を行う必要があるため、破堤を考慮した解析を実施する。

想定される破堤地点は、以下の条件に従って選定した。

i) 経済重要地域に直接的な被害を与える河川はチャオプラヤ川とパサック川であることから、チャオプラヤ川とパサック川を対象に破堤を考慮する。
ii) 2011 年洪水では、比高差の大きい区間に破堤箇所が集中したこと（第 2 章 2.1.4 河川水系を参照）、また河川水位が高い状態が長く続くほど浸透破壊による破堤リスクは増大することから、河岸と堤防の比高が 2m を超え、かつ、チャオプラヤ川については河川水位が DHWL を、パサック川については左右堤防高の平均から 50cm 引いた高さを、30 日以上超える箇所を破堤地点とした。

洪水確率規模別の浸水図および想定した破堤箇所は、サポーティングレポート（Sector P : Economic Evaluation）に記載した。

間接被害について、その見積り方法は被害のカテゴリーごとに異なる。見積りの方法は後のセクションにおいて実際に計算する際に説明を行う。

11.2 マスタープランの経済評価

11.2.1 評価の手法

(1) タイ国経済の将来展望

日本で有数の商業銀行である三菱東京 UFJ 銀行では、タイ国経済の中期的見通しを 2013 年 1 月に発表している。これによれば、2022 年までのタイ国の経済成長シナリオは以下のとおりである。

(a)　2012 年～2014 年: 平均成長率は 4.5%～4.9%の見込みである。

2012 年の成長率は、2011 年の落ち込みからの反発で 5%台の半ばに上昇していたはずであるが、2013 年は 2012 年の急成長からのリバウンドにより再び低下するであろう。ただし、洪水対策のための政府投資とともにアセアン経済共同体（AEC）設立の期待から海外直接投資の増加により成長率は堅調に推移する模様である。他方で、2012 年～2013 年に実施された最低賃金の大幅な引き揚げが消費を拡大させ、成長率を下支えするであろう。

(b)　2015 年～2018 年: 平均成長率は 4%台の半ばになる見込みである。

タイ国は、AEC 設立による利点を生かすことによってアセアンの生産センターとしての役割を強化することになるであろう。消費の拡大とアセアン域内輸出の増加によって成長率は次第に上昇し、2018 年までには 5%台に達している模様である。

(c)　2019 年～2022 年: 平均成長率は 4.0%～4.4%になる見込みである。

タイ国は人口オーナスの時期に入り、また中国経済が安定期に移行することの効果が発現することから、成長率は次第に低下して行くであろう。タイ国の労働コストが上昇するため、付加価値の低い製品の生産は CLM 諸国（カンボジア、ラオス、ミャンマー）にシフトして行くであろう。輸出は依然として成長の駆動力であるが、その依存度は低下して行く模様である。他方で、都市化が進展し、かつ一人当たり DGP が 8,000 米ドルに達するため、サービスなどの成熟産業関連の消費が拡大することにより成長率を引き上げる作用が働くであろう。

【参考】
英国の経済予測会社である Oxford Economics では、2012 年 5 月 24 日付の“County Economic Forecast”において以下のようなタイ国経済の予測を行っている。同社では洪水からの回復後の数年間について三菱東京 UFJ 銀行が行ったものよりも高い成長率を予測している。

Year	2011	2012	2013	2014	2015	2016
GDP Growth (%)	0.1	5.3	6.5	5.6	5.4	4.9

Source: Oxford Economics, "Country Economic Forecast," May 24, 2012.

(2)　洪水被害に関するアンケート調査結果の解析

(a)　製造業

2011 年洪水による経済被害を調べるために、洪水被害に遭った 7 工業団地の工場を対象にアンケート調査を実施し（2012 年 8 月～10 月）、その結果を用いて解析を行った。解析結果及び評価は以下のとおりとなった。

(i)　浸水深と資産被害率との関係（全産業）

アンケート調査から得られた結果のうち、解析に適したデータを用いて、床上浸水深と固定･在庫資産を含む資産被害率との関係を調べた。被害率が同一浸水深で広くばらつくため、2 変数間での統計的有意差は見いだせなかった。このことは、決定係数（R^2）が固定資産で 0.0042、在庫資産で 0.015 であったことからも裏付けされる。

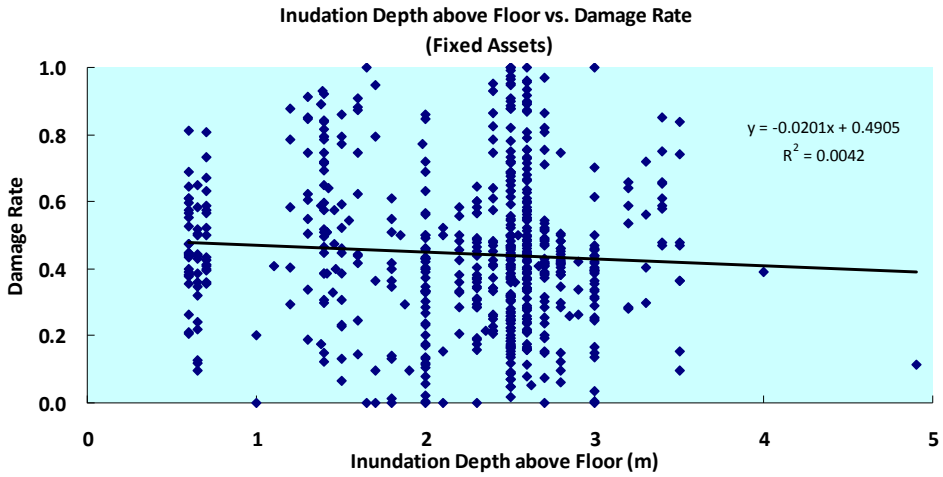


図 11.2.1　浸水深と資産被害率との関係（固定資産）

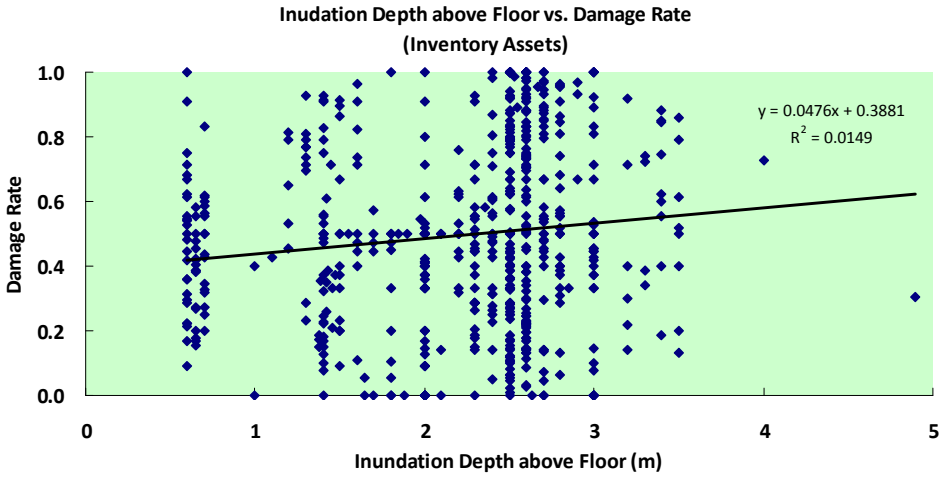


図 11.2.2　浸水深と資産被害率との関係（在庫資産）

(ii)　浸水深と資産被害率との関係（産業別）

全産業を対象とした解析では明瞭な関係が見いだせなかったため、以下に示す 5 産業に分類して浸水深と資産被害率の関係を調べた：I）食品・繊維、II）化学・金属、III）一般機械、IV）電子機械、V）その他。解析結果から、固定ならびに在庫資産ともに、決定係数の大きさは統計的有意差を示すまでに達しなかったことが明らかとなった。

(b)　家計

製造業と同様に、家計に対する被害分析についても、チャオプラヤ川流域の住民から得たアンケート調査結果を用いて実施した（2012 年 8 月～10 月）。解析結果及び評価は以下のとおりとなった。

(i)　浸水深と資産被害率との関係（全産業）

製造業で用いた方法と同様に、アンケート調査から得られた結果のうち、解析に適したデータを用いて、床上浸水深と建物・家財を含む資産被害率との関係を調べた。

グラフ解析より得られた決定係数（R^2）は、建物が 0.0994、家財 が 0.1161 で、統計的な関係はほとんどなかった。

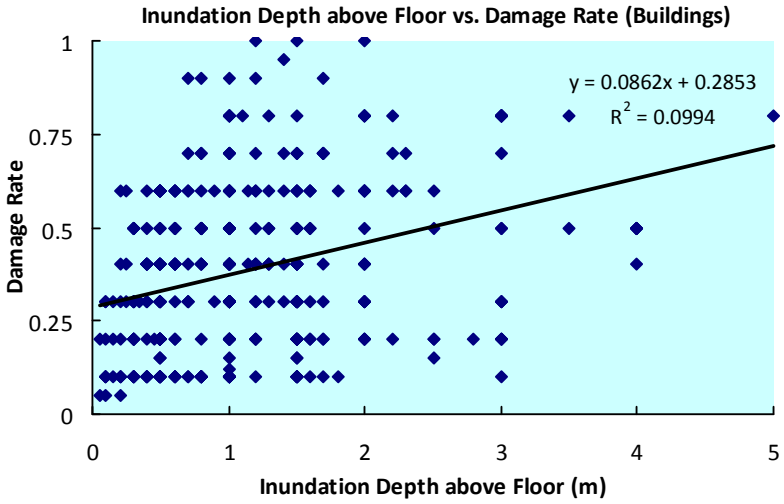


図 11.2.3　浸水深と被害率との関係（建物）

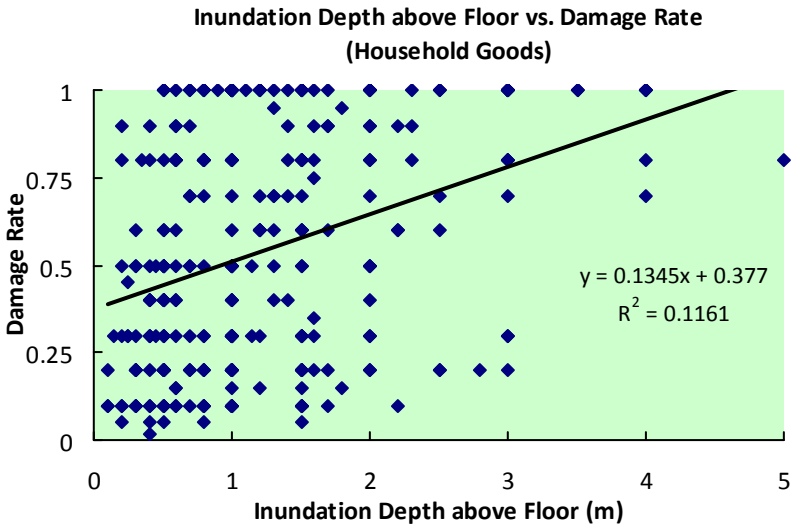


図 11.2.4　浸水深と被害率との関係（家財）

(ii)　浸水深と資産被害率との関係（床面積別）

生活水準別の被害規模を調べるために、一人当たりの占有床面積が生活水準を表わす因子の 1 つと仮定した。床面積区分は、データの均配を考慮して I）30 m^2/人未満、II）30-100 m^2/人、III）100 m^2/人超の 3 区分とした。決定係数はある区分では高い値を示したものの、洪水被害推計に用いるための統計的有意性はなかった。

(iii)　浸水深と資産被害率との関係（建物階別）

家屋構造が洪水による被害に影響を与える可能性があるという仮定に基づき、床上浸水深と資産被害率との相関関係を建物階別（平屋及び 2 階建）に調べた。

この 2 つの指標間には有意な関係は見られなかったが、2 階建では比較的大きな相関関係が示された。他方、平屋では負の相関関係を示した。

11.2.2 費　用

費用は経済費用であり、租税などの移転項目は除かれる。以下の項目が経済費用として含まれる：(1) 建設、(2) エンジニアリング、(3) その他（環境影響評価、事務管理)、(4) 物理的予備費、(5) 土地収用、(6) 補償、(7) 維持管理。(1) ～ (6) の資本費用が建設前あるいは建設時に1回発生する。維持管理費用については、建設が完了して施設の供用が開始した後に毎年発生する。資本費用の内訳は下表のとおりである。

表 11.2.1　経済的資本費用（SCWRM M/P）

(Unit: Million Baht)

Item		New Dams	Retarding Area	River Improve-ment	Diversion Channel		Flood Forecasting System	Total
		Kaeng Sua Ten, Nam Kheg and Mae Wong Dam	Total of N1 - N5, C1 - C8	Dyke Improvement	West Diversion Channel (W1500-1)	Outer Ring Road Diversion Channel (O500-1)		
1.	Construction	41,071	30,564	6,364	119,733	47,908	2,727	248,368
2.	Engineering	4,107	3,056	636	11,973	4,791	273	24,837
3.	Other (EIA, Adm.)	6,777	5,043	1,050	19,756	7,905	450	40,981
4.	Physical Contingency	5,196	3,866	805	15,146	6,060	345	31,419
5.	Land Acquisition	7,706	1,083	1,800	30,776	18,821	0	60,186
6.	Compensation	2,054	0	0	1,910	482	0	4,446
Total		66,911	43,613	10,655	199,294	85,968	3,795	410,236

表 11.2.2　経済的資本費用（提案の組み合わせ 1）

(Unit: Million Baht)

Item		River Improvement		Diversion Channel	Flood Forecasting System	Total
		Dyke Improvement	Ayutthaya By-Pass	Outer Ring Road Diversion Channel (O500-1)		
1.	Construction	6,903	9,407	47,908	2,727	66,945
2.	Engineering	690	941	4,791	273	6,694
3.	Other (EIA, Adm.)	1,139	1,552	7,905	450	11,046
4.	Physical Contingency	873	1,190	6,060	345	8,469
5.	Land Acquisition	2,646	4,208	18,821	0	25,675
6.	Compensation	1,010	66	482	0	1,558
Total		13,261	17,363	85,968	3,795	120,387

表 11.2.3　経済的資本費用（提案の組み合わせ 2）

(Unit: Million Baht)

Item		River Improvement		Diversion Channel	Flood Forecasting System	Total
		Dyke Improvement	Ayutthaya By-Pass	Outer Ring Road Diversion Channel (O1000-1)		
1.	Construction	6,903	9,407	68,187	2,727	87,223
2.	Engineering	690	941	6,819	273	8,722
3.	Other (EIA, Adm.)	1,139	1,552	11,251	450	14,392
4.	Physical Contingency	873	1,190	8,626	345	11,034
5.	Land Acquisition	2,646	4,208	29,701	0	36,555
6.	Compensation	1,010	66	772	0	1,848
Total		13,261	17,363	125,355	3,795	159,774

11.2.3 便　益

評価の手法のセクションで述べたように、事業の便益は期待される直接的・間接的被害の軽減で捉えられる。洪水被害については、以下に製造業、一般家庭、農業、その他の産業、インフラ・公共のセクターごとに検討を加える。

(1) 製造業セクター

(a) 直接被害

(i) 製造業セクターの潜在的被害額

工場の固定資産（建物、機械、車両、事務機器、什器等）及び在庫資産（原材料、部品、仕掛品、完成品、転売用商品）を製造業セクターの潜在的被害資産として検討している。

入手データ

“Factory Data 2011”が工業省製作作業局（DIW）のウェブサイトで入手可能である。この資料には、各工場の名称、タイプ、所在地、敷地面積、従業員数、その他のデータが含まれている。潜在的浸水被害地域のある 24 の Province には 40,594 の工場が立地している。

国家統計局（NSO）では"The 2007 Industrial Census"を公表しており、これには 2006 年末時点での固定資産及び在庫資産（簿価）、さらに従事者数のデータが、各 Province について業種ごとに集計されている。

潜在的被害額は、以下のように計算される：

1. “The 2007 Industrial Census”から各 Province 別に業種ごとの従事者一人当たりの固定資産及び在庫資産の額を算定する。
2. “Factory Data 2011”に含まれる工場の従事者数に従事者数一人当たりの資産額を乗じて、その工場の資産額を算出する。
3. “Factory Data 2011”には、工場の位置データが含まれているため、資産額の位置が同定され、洪水シミュレーションに利用することが可能となる。

計算結果の修正

上記により求められた工場の資産額は、下記の理由により修正される。

1. 上記で算定された資産額を Province ごとに集計し、“The 2007 Industrial Census”に含まれている各 Province の実際の資産額の合計と比較する。前者の数字が後者に一致するように調整する。
2. 資産額は 2006 年時点のものであるため、2006 年からの卸売物価の上昇分 1.288 を乗じて 2011 年価格に調整する。

表 11.2.4　タイ国の卸売物価指数

	2005	2006	2007	2008	2009	2010	2011
Wholesale price index (2005 = 100)	100.0	107.1	110.5	124.3	119.6	130.8	137.9
Comparison with 2006 (times)	–	1.000	1.032	1.160	1.116	1.221	1.288

Source: World Bank
Note: Data is availabe for years up to 2011

潜在的被害額の推定結果

表 11.2.5 に潜在的浸水被害地域（約 35,000 km^2）における潜在的被害額を示す。なお、潜在的浸水被害地域は過去に主要な洪水により実際に浸水した地域を含むように設定されている（図 11.2.5 参照）。

表 11.2.5　潜在的浸水被害地域の工場資産額

Number	Province	Damageable Values (Million Baht)		
		Fixed Assets	Inventory Assets	Total
1	Bangkok	458,158	213,011	671,169
2	Nonthaburi	36,352	15,324	51,676
3	Pathum Thani	365,725	91,629	457,354
4	Ayutthaya	244,642	57,851	302,493
5	Ang Thong	10,192	2,416	12,608
6	Lopburi	12,830	4,413	17,243
7	Singburi	10,144	5,471	15,615
8	Chainat	2,436	1,036	3,472
9	Saraburi	45,169	14,537	59,706
10	Samut Prakarn	440,810	196,883	637,693
11	Chachoengsao	121,789	47,093	168,882
12	Nakhon Nayok	942	359	1,301
13	Ratchaburi	1,231	551	1,782
14	Suphan Buri	7,040	2,296	9,336
15	Nakhon Pathom	57,889	23,067	80,956
16	Samut Sakhon	136,800	102,835	239,635
17	S. Songkhram	334	124	458
18	Auttaradit	2,146	1,058	3,203
19	Nakhon Sawan	9,841	2,569	12,410
20	Uthai Thani	830	160	990
21	Kampaeng Phet	29	10	39
22	Sukhothai	1,607	615	2,222
23	Phitsanu Lok	5,677	1,222	6,899
24	Phichit	2,499	1,244	3,743
	Total	1,975,112	785,774	2,760,886

(ii)　被害計算

直接被害は潜在的被害額に被害率（浸水深の関数）を乗じることで推定される。コンピューターの洪水シミュレーションにより、潜在的洪水被害地域の 2 km メッシュごとに浸水深が計算される。これにより、被害がメッシュ単位で計算される。

2km メッシュごとの潜在的被害額

DIW の“Factory Data 2011”には、各工場の所在地情報が Tambon レベルで含まれている。Tambon 内で潜在的被害額が一様に分布していると仮定すると、Tambon 内の被害額もメッシュ内で一様に分布していることになる。下図は上記の仮定に基づいて得られたメッシュごとの潜在的被害額を示す。

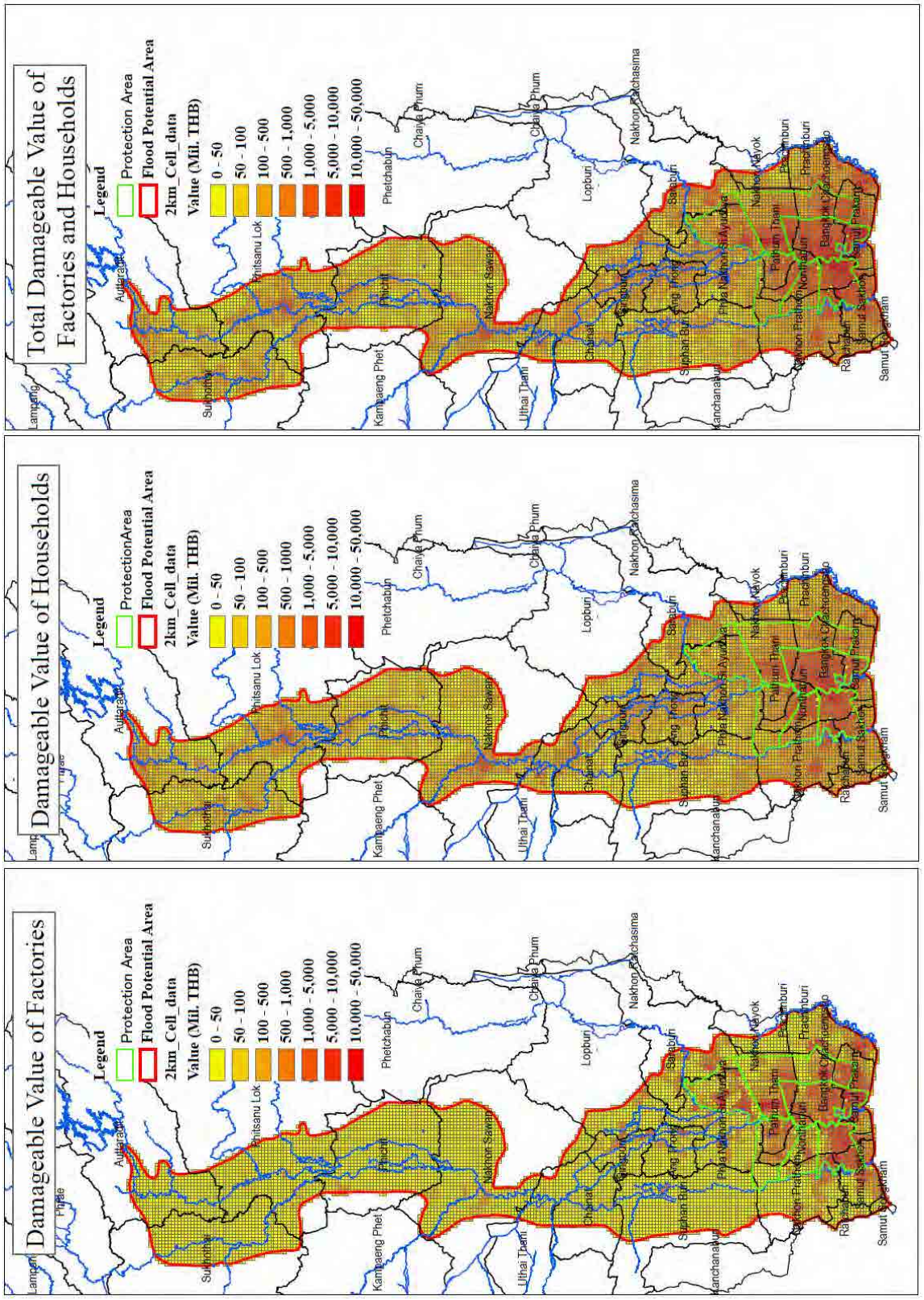


図 11.2.5 潜在的被害額

床高と被害率

固定資産及び在庫資産に対する直接被害を推定するために、床高と被害率の 2 つのパラメーターを設定する必要がある。

床高は、工場に被害もたらさない最大値として定義される。一般的にタイ国民は洪水に慣れているため、工場の建屋は常習的な洪水による水位（過去の経験から例えば少なくとも 2 年確率）からある程度の高さを持って建てられていると想定される。他方で、幾度も実施された現場踏査の結果によれば、2011 年の洪水で大きな被害を受けた防護地域（バンコク及びその周辺の経済地区）内の工業団地では床高が低く、他に比べてより脆弱であると見られる。従って、床高は、防護地域では 2 年確率洪水による浸水深とし、他の地域では 2 年確率洪水による浸水深+50 cm と想定した。

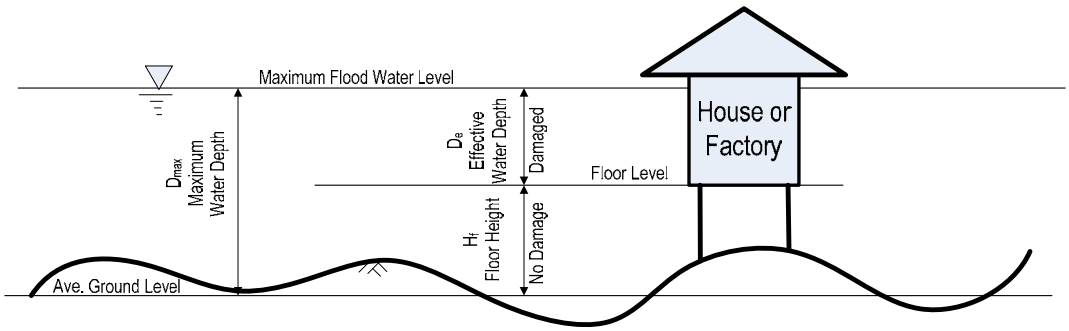


図 11.2.6　床高の概念図

被害率に関して、聞き取り調査では被害と浸水深との間に明確な関係は見出せなかった。従って、下表に示す、日本で採用されている被害率を適用する。

表 11.2.6　床高と被害率

Floor Level		Damage Rate*					
Protection Area	Other Areas	Damageable Value	Flood Depth over Floor Level				
			0-0.5m	0.5-1m	1-2m	2-3m	Greater than 3m
Flood inundation level of 2-year return period	Flood inundation level of 2-year return period + 50cm	Fixed Assets	0.232	0.453	0.789	0.966	0.995
		Stocks	0.128	0.267	0.586	0.897	0.982

*) Source: “Manual for Economic Analysis for Flood Control Projects in Japanese”, Ministry of Infrastructure, Land and Transport, Japan

2001 年洪水による直接被害額の推定

上述の潜在的被害額、床高及び被害率を用いて、直接被害は洪水シミュレーションによる浸水深から推定される。次表では本件調査で推定した直接被害と工業省が推定したものとを比較している。

この表によると、総直接被害額の推定値は 6,440 億バーツであり、工業省による推定値 5,140 億バーツに大変近い値となっている。とくに経済地域（防御地区）のバンコク、ノンタブリ、パトゥンタニ県での推定値はそれぞれ近い値となっている。したがって、床高や被害率は適切に設定されたものと考えられる。

表 11.2.7　2011 年洪水による直接被害の推定

No.	Province	Estimated by JICA Study Team (Mil. THB)			Estimated by Ministry of Industry (Mil. THB)		
		Fixed Assets	Inventory Assets	Total	7 industrial estates	Others	Total
1	Bangkok	135,123	40,400	175,523		39,100	39,100
2	Nonthaburi	33,768	8,327	42,096		31,200	31,200
3	Pathum Thani	134,925	19,830	154,756	237,400	62,900	391,600
4	Ayutthaya	80,686	11,063	91,749		91,300	
5	Ang Thong	478	65	543		1,400	1,400
6	Lopburi	3,445	889	4,335		37,500	37,500
7	Singburi	458	129	587			
8	Chainat	383	97	480		4,400	4,400
9	Saraburi	748	143	892			
10	Samut Prakarn	44,908	12,918	57,825			
11	Chachoengsao	15,829	3,419	19,248			
12	Nakhon Nayok	18	2	20			
13	Ratchaburi	0	0	0			
14	Suphan Buri	862	139	1,001			
15	Nakhon Pathom	24,567	6,041	30,609			
16	Samut Sakhon	42,038	18,340	60,378			
17	S. Songkhram	0	0	0			
18	Auttaradit	5	4	9			
19	Nakhon Sawan	1,158	202	1,360		8,300	8,300
20	Uthai Thani	115	26	141		200	200
21	Kampaeng Phet	989	38	1,026			
22	Sukhothai	142	37	179			
23	Phitsanu Lok	601	84	686			
24	Phichit	526	52	578			
	Total	521,772	122,248	644,020	237,400	276,400	513,800

将来シナリオに基づく直接被害の推定

いくつかの将来開発シナリオに基づく直接被害の推定を下表に示す。

表 11.2.8　将来シナリオに基づく直接被害の推定

Case No.	Return Period	Direct Damages to Manufacture Sector (Mil. THB)		
		Fixed Assets	Inventory Assets	Total
Reproduction of 2011 Flood		521,772	122,248	644,020
0-1 (Without Project)	2 years	6,327	1,626	7,954
	10 years	155,891	30,764	186,655
	30 years	187,727	36,860	224,587
	50 years	204,844	42,733	247,578
	100 years	303,341	68,661	372,001
1-1 (Master Plan by SCWRM)	2 years	-	-	0
	10 years	138,466	25,952	164,418
	30 years	146,279	28,829	175,108
	50 years	158,943	31,316	190,259
	100 years	183,827	35,441	219,269
11-0 (Proposed Combination-1)	2 years	-	-	0
	10 years	145,928	27,384	173,312
	30 years	170,293	32,722	203,015
	50 years	162,888	32,684	195,572
	100 years	193,114	37,807	230,922
11-1 (Proposed Combination-2)	2 years	-	-	0
	10 years	145,511	27,134	172,645
	30 years	161,781	31,617	193,398
	50 years	163,230	32,441	195,670
	100 years	188,546	36,587	225,133

(b) 間接被害

EIRR 及びその他の指標の計算のため、間接被害は財務省及び世銀の調査結果に基づき、全体被害額のうちの比率により推定している。詳細なデータについては、(4) その他のセクターと間接被害参照。

(2) 一般家庭セクター

(a) 直接被害

(i) 一般家庭セクターの潜在的被害額

洪水により、家屋と家庭資産に対して直接的な被害が生じる。1 世帯あたりの家屋と家庭資産額の平均を求め、Department of Provincial Administration（DOPA）が発表しているそのエリアの世帯数から、そのエリアの資産額の合計が求められる。

1 世帯あたりの家屋の平均額

以下のデータを用いて 1 世帯あたりの平均家屋建築費を推定した。

1) NSO による “The 2010 Population and Housing Census” : 各 Province の、家屋のタイプ（一戸建て、アパート、高層マンション等）別、建築材（木造、レンガ）別の家屋数
2) 財務省による各 Province の、家屋のタイプ別、建築材別の床面積あたり建築費
3) 内務省による家屋のタイプ別標準総床面積
4) 関係する Province の都市計画部局によるマンションやアパート等の高層建築物の平均階数

高層建築物については直接被害を受けるのはその 1 階と想定している。従って、*n* 階建ての場合は 1/*n* に減額している。
さらに、建築後経過年数の比率はどの年数についても同じと想定し、最終的に減価償却（価値の減耗分）として 50%を適用している。

1 世帯あたりの家庭資産の平均額

以下のデータを用いて 1 世帯あたりの平均家庭資産額を推定した。

1) NSO による”The 2010 Population and Housing Census” : 各 Province の家庭資産（テレビ、VCD/DVD プレイヤー、パソコン、冷蔵庫、電子レンジ、洗濯機、エアコン、自動車、オートバイ等）保有率
2) 商務省による商品の標準価格

高層建築物については直接被害を受けるのはその 1 階と想定している。従って、*n* 階建ての場合は 1/*n* に減額している。
さらに、購入後経過年数の比率はどの年数についても同じと想定し、最終的に減価償却（価値の減耗分）として 50%を適用している。

潜在的被害額の推定結果

上述の資産平均額と世帯数から一般家庭セクターの潜在的被害額を推定した（表 11.2.9 参照）。

表 11.2.9　Province 別一般家庭セクターの潜在的被害額

Number	Province	Number of Households	Damageable Values (Million THB)		
			House Buildings	Household Assets	Total
1	Bangkok	2,337,074	564,559	381,232	945,791
2	Nonthaburi	556,018	168,451	127,497	295,948
3	Pathum Thani	471,813	131,841	84,800	216,641
4	Ayutthaya	286,925	81,280	38,737	120,017
5	Ang Thong	89,282	24,305	17,623	41,928
6	Lopburi	71,178	20,172	15,009	35,181
7	Singburi	70,306	21,977	13,918	35,895
8	Chainat	74,391	22,206	13,457	35,663
9	Saraburi	100,084	32,134	21,353	53,487
10	Samut Prakarn	531,985	141,410	87,606	229,016
11	Chachoengsao	119,656	36,709	23,874	60,583
12	Nakhon Nayok	19,388	5,849	3,907	9,756
13	Ratchaburi	24,719	8,138	5,372	13,510
14	Suphan Buri	134,367	39,128	27,891	67,019
15	Nakhon Pathom	336,977	112,743	73,062	185,804
16	Samut Sakhon	240,518	73,702	29,339	103,041
17	S. Songkhram	7,022	1,791	1,137	2,928
18	Auttaradit	93,758	25,374	16,200	41,574
19	Nakhon Sawan	209,380	61,871	38,000	99,871
20	Uthai Thani	23,773	7,251	4,065	11,315
21	Kampaeng Phet	526	142	95	236
22	Sukhothai	135,815	31,030	23,186	54,216
23	Phitsanu Lok	208,699	59,324	40,568	99,892
24	Phichit	148,104	35,986	25,937	61,923
	Total	6,291,756	1,707,370	1,113,866	2,821,235

(ii)　被害計算

直接被害は潜在的被害額に被害率（浸水深の関数）を乗じることで推定される。コンピューターの洪水シミュレーションにより、潜在的洪水被害地域の 2 km メッシュごとに浸水深が計算される。これにより、被害がメッシュ単位で計算される。

2km メッシュごとの潜在的被害額

DOPA によるデータに Tambon レベルでの世帯数が含まれている。製造業セクターと同様に、Tambon 内で潜在的被害額が一様に分布していると仮定すると、Tambon 内の被害額もメッシュ内で一様に分布していることになる。図 11.2.5 は上記の仮定に基づいて得られたメッシュごとの潜在的被害額を示す。

床高と被害率

工場のケースと同様に、家屋と家庭資産に対する直接被害を推定するために、床高と被害率の 2 つのパラメーターを設定する必要がある。

現地調査によれば、先祖から受け継がれてきた過去の洪水経験から家主は工場主よりも注意深いためか、家屋の床高は一般的に工場のそれよりも高いようである。そこで防護地域（バンコク及びその周辺の経済地区）内外を問わず、床高は 5 年確率洪水による浸水深+50 cm と想定した。

被害率に関して、聞き取り調査では被害と浸水深との間に明確な関係は見出せなかった。従って、表 11.2.10 に示す、日本で採用されている被害率を適用する。

表 11.2.10 床高と被害率

Floor Level	Damage Rate*					
	Damageable Value	Flood Depth over Floor Level				
		0-0.5m	0.5-1m	1-2m	2-3m	Greater than 3m
Flood inundation level of 5-year return period +50cm	House Buildings	0.092	0.119	0.266	0.580	0.834
	Household Assets	0.145	0.326	0.508	0.928	0.991

*) Source: "Manual for Economic Analysis for Flood Control Projects in Japanese", Ministry of Infrastructure, Land and Transport, Japan

2011 年洪水による直接被害額の推定

上述の潜在的被害額、床高及び被害率を用いて、直接被害は洪水シミュレーションによる浸水深から推定される。表 11.2.11 では本件調査で推定した直接被害と世銀・財務省が"Post Disaster Needs Assessment（PDNA）"において推定したものとを比較している。これによると、被災世帯数は PDNA によるものと非常に近く、少なくとも上記の床高の設定は妥当と見なされる。一方日本の被害率では PDNA よりも大きめの被害額が計算される。

表 11.2.11 2011 年洪水による直接被害の推定

No.	Province	Estimated by JICA Study Team				Estimated under PDNA			
		Number of Affected Households	Direct Damages (Mil. THB)			Number of Affected Households	Direct Damages (Mil. THB)		
			House buildings	Household Assets	Total		House buildings	Household Assets	Total
1	Bangkok	994,159	22,302	24,454	46,756	761,725	1,954	14,843	16,797
2	Nonthaburi	509,095	14,190	16,927	31,117	204,920	654	3,974	4,628
3	Pathum Thani	243,902	6,270	6,357	12,627	237,394	1,116	4,616	5,732
4	Ayutthaya	128,323	3,383	2,637	6,020	196,929	1,294	3,835	5,129
5	Ang Thong	5,638	141	161	303	50,579	263	981	1,244
6	Lopburi	38,717	1,564	2,177	3,741	33,280	173	645	818
7	Singburi	5,057	145	145	291	21,078	91	408	499
8	Chainat	17,802	759	810	1,569	20,088	106	389	495
9	Saraburi	5,484	162	169	331	23,459	192	455	647
10	Samut Prakarn	17,088	666	694	1,359	-	-	-	-
11	Chachoengsao	84	2	2	5	61,780	326	1,198	1,524
12	Nakhon Nayok	1,414	39	41	81	19,942	199	386	585
13	Ratchaburi	0	0	0	0	-	-	-	-
14	Suphan Buri	30,113	807	907	1,713	84,841	418	1,645	2,063
15	Nakhon Pathom	132,953	4,097	4,202	8,299	89,571	358	1,737	2,095
16	Samut Sakhon	56,188	1,781	1,520	3,300	19,378	31	378	409
17	S. Songkhram	0	0	0	0	-	-	-	-
18	Auttaradit	3,558	264	273	537	-	-	-	-
19	Nakhon Sawan	86,161	2,357	2,328	4,685	51,411	396	1,005	1,401
20	Uthai Thani	10,646	309	302	611	4,440	23	86	109
21	Kampaeng Phet	9,846	305	412	717	-	-	-	-
22	Sukhothai	6,202	438	436	875	-	-	-	-
23	Phitsanu Lok	22,732	728	1,020	1,748	10,946	44	212	256
24	Phichit	21,197	475	544	1,019	14,826	63	287	350
	Total	2,346,359	61,184	66,518	127,702	1,906,587	7,701	37,080	44,781

将来シナリオに基づく直接被害の推定

いくつかの将来開発シナリオに基づく直接被害の推定を下表に示す。

表 11.2.12 将来シナリオに基づく直接被害の推定

Case No.	Return Period	Number of Affected Households	Direct Damages to Households (Mil. THB)		
			House buildings	Households Assets	Total
Reproduction of 2011 Flood		2,346,359	61,184	66,518	127,702
0-1 (Without Project)	2 years	-	-	-	0
	10 years	230,469	6,749	6,556	13,305
	30 years	418,839	13,477	16,078	29,555
	50 years	521,828	18,437	22,713	41,150
	100 years	656,637	24,187	28,961	53,148
1-1 (Master Plan by SCWRM)	2 years	-	-	-	0
	10 years	22,969	799	732	1,531
	30 years	197,678	5,891	5,584	11,475
	50 years	292,421	8,718	8,635	17,352
	100 years	383,362	11,405	11,702	23,107
11-0 (Proposed Combination-1)	2 years	-	-	-	0
	10 years	96,435	2,832	2,692	5,524
	30 years	270,240	8,241	8,354	16,594
	50 years	306,706	9,433	9,821	19,255
	100 years	436,994	13,768	15,872	29,640
11-1 (Proposed Combination-2)	2 years	-	-	-	0
	10 years	77,137	2,262	2,148	4,410
	30 years	245,635	7,520	7,598	15,118
	50 years	296,099	9,091	9,436	18,527
	100 years	409,633	12,632	14,238	26,869

(b) 間接被害

一般家庭セクターの間接被害については EIRR 及びその他の指標の計算のため、財務省及び世銀の調査結果に基づき、全体被害額のうちの比率により推定している。詳細なデータについては、(4) その他のセクターと間接被害参照。

(3) 農業セクター

2011 年洪水による農業への被害は、当初 100 年確率よりも大きい洪水の発生がもたらすと想定された被害額に比べてかなり小さい。これは、MOAC や RID が洪水発生の何年も前から行っていた作付指導の効果によるものである。しかしながら、農家が保有するトラック、農業機械や養殖魚に対する被害は避けられなかった。そうした避けられなかった被害は、農民一人当たりの平均で 1,500 バーツと推定される。

北部の Province では農家 1 世帯あたりの年収は 24 万 9 千バーツ、南部で 38 万 1 千バーツと推定されており、洪水の被害は農家所得の 0.4～0.6%程度と見込まれる。これは、大規模な洪水であったにもかかわらず、その被害は毎年発生する生産高の変動程度内に留まっているということである。農業機械、生産物加工機械、脱穀機等の一部の被害が未だに公表されていない点に留意する必要があるが、そうした被害を考慮しても、農家 1 世帯あたりの年収の数パーセントにすぎない。

表 11.2.13 洪水による農業被害総額

(Unit: Million Baht)

Category / Area	Annual Crop	Fruit Trees	Other Tree Crop	Livestock	Inland Fish Culture	Agri. Prod. Facilities	Farmland Rehabili-tation	Total
Northern CP	488	931	31	44	436	1,445	552	3,927
Central CP	1,465	7,509	254	236	415	2,590	401	12,870
Total	1,953	8,440	285	280	851	4,034	953	16,797
(Share)	(11.6%)	(50.2%)	(1.7%)	(1.7%)	(5.1%)	(24.0%)	(5.7%)	(100.0%)

Source: Ministry of Agriculture and Cooperatives
(Notes)
Annual Crop: maize, cassava, sugar cane, etc.
Fruit Trees: banana, mango, etc.
Other Tree Crop: oil palm, para-rubber, etc.
Livestock: cattle, swine, poultry, etc.

(4) その他のセクターと間接被害

財務省および世銀が実施した 2011 年洪水の調査結果が下表に取りまとめられている。製造業と一般家庭の直接被害額は全直接被害額の 88.8%、直接＋間接被害額の合計は全被害額の 76.5%に上り、これらが 2011 年洪水の大部分を占めていることが分かる。その他の産業では、観光業がタイで重要な産業であるが、直接被害は 0.8%で、間接被害も 11.3%である。製造業、一般家庭、農業を除いたその他のセクターの合計は、直接被害で 10.3%、間接被害で 28.8%に留まる。

表 11.2.14 2011 年洪水の被害

(Unit: Million Baht)

	Direct Damage		Indirect Damage		Total	
Infrastructure						
Water Resources Management	8,715	1.4%	-	-	8,715	0.6%
Transport	23,538	3.7%	6,938	0.9%	30,476	2.1%
Telecommunication	1,290	0.2%	2,558	0.3%	3,848	0.3%
Electricity	3,186	0.5%	5,716	0.7%	8,901	0.6%
Water Supply and Sanitation	3,497	0.6%	1,984	0.2%	5,481	0.4%
Productive						
Agriculture, Livestock and Fishery	5,666	0.9%	34,715	4.4%	40,381	2.8%
Manufacturing	513,881	81.5%	493,258	62.0%	1,007,139	70.6%
Tourism	5,134	0.8%	89,673	11.3%	94,808	6.7%
Finance & Banking	-	-	115,276	14.5%	115,276	8.1%
Social						
Health	1,684	0.3%	2,133	0.3%	3,817	0.3%
Social	-	-	-	-	-	-
Education	13,051	2.1%	1,798	0.2%	14,849	1.0%
Housing	45,908	7.3%	37,889	4.8%	83,797	5.9%
Cultural Heritage	4,429	0.7%	3,076	0.4%	7,505	0.5%
Cross Cutting						
Environment	375	0.1%	176	0.0%	551	0.0%
TOTAL	630,354	100.0%	795,191	100.0%	1,425,544	100.0%

Source: Ministry of Finance, Royal Thai Government and World Bank, "Thailand Flooding 2554 Rapid Assessment for Resilient Recovery and Reconstruction Planning

11.2.4 EIRR の計算

製造業セクターと一般家庭セクターの直接被害以外の被害について、財務省・世銀調査の結果からそれぞれの被害の比率（%）を用いて推定し、さらに、以下の想定をして、EIRR その他の指標の計算を行っている：

- 資産は経済成長に応じて増加すると見込んでいる。そのため、便益は GDP 予測が行われている 2022 年までの間 GDP 成長率で増加させている。
- 3 年間の調査および設計の後、整備期間において工事の進捗に応じて便益が発生する。

EIRR とその他の指標の計算結果は下表のとおりである。

表 11.2.15 計算結果のまとめ

Case	EIRR	便益/費用（B/C）	純現在価値（NPV）(Billion Baht)
SCWRM M/P	13.0%	1.08	20.46
提案の組み合わせ 1	29.3%	2.68	137.21
提案の組み合わせ 2	24.6%	2.17	127.24

11.2.5 感応度分析

便益ないし費用が変化した場合のいくつかのケースについて感応度分析を行い、その結果を下表にまとめた。基のケースでの数値が高いため、一定程度の不利な変化（便益の減少ないし費用の増大）によっても原則として高い数値を維持している。費用増加のケースに比べて、便益減少のケースの方が数字の悪化が大きいことに留意すべきである。

表 11.2.16 感応度分析（SCWRM M/P）

Case	IRR	便益/費用（B/C）	純現在価値（NPV）(Billion Baht)
便益 10%減少	9.1%	0.72	-68.22
便益 20%減少	7.3%	0.53	-114.02
費用 10%増加	11.8%	0.99	-4.04
費用 20%増加	10.8%	0.90	-28.54

表 11.2.17 感応度分析（提案の組み合わせ 1）

Case	IRR	便益/費用（B/C）	純現在価値（NPV）(Billion Baht)
便益 10%減少	21.7%	2.12	91.38
便益 20%減少	17.9%	1.71	58.31
費用 10%増加	27.1%	2.43	129.03
費用 20%増加	25.2%	2.23	120.84

表 11.2.18 感応度分析（提案の組み合わせ 2）

Case	IRR	便益/費用（B/C）	純現在価値（NPV）(Billion Baht)
便益 10%減少	18.7%	1.72	77.84
便益 20%減少	15.4%	1.39	42.21
費用 10%増加	22.6%	1.97	116.35
費用 20%増加	21.0%	1.81	155.47

11.3 環境社会配慮

11.3.1 評価対象プロジェクト概要

(1) 名 称

1) アユタヤバイパス水路
2) 外郭環状道路放水路
3) チャオプラヤ川下流堤防整備
4) タチン川流域堤防整備及び捷水路

(2) 目 的

タイにおける効果的な洪水対策については様々な検討を経て、産業拠点が集中するチャオプラヤ川下流域を洪水から防御する経済的かつ効果的な手段として、他の構造的・非構造的対策と合わせチャオプラヤ川流域にて上記(1)に示したアユタヤバイパス水路ならびに外郭環状道路放水路建設と下流域の堤防整備が、またタチン川下流域での堤防整備と捷水路建設をすることが提案された。本項では、これらについて環境ならびに社会面からの評価を実施する。

11.3.2 環境社会配慮を要する活動

水路建設事業で環境社会配慮を要する活動は下記のとおり。

1) 水路工（土工、道路工、ライニング、土地改良）
2) 施設工（道路橋、水門）
3) 護岸工（盛土）
4) 堤防工（低防壁、嵩上げ）
5) 資材運搬（トラック操業）

これら必要とされる工事概要を表 11.3.1 に示す。

表 11.3.1 工事概要（水路工、施設工、護岸工、堤防工）

建設物	工種	説明	主要機械
水路	土工	掘削、土廃棄、堤防	バックホー、ブルドーザ
	道路工	基礎(上下僧路盤), 仕上げ (アスファルト路面)	モーターグレーダー、 振動ローラ、タイヤローラ、 アスファルトフィニッシャ
	ライニング	コンクリート仕上げ	コンクリミキサー車、クレーン
施設	道路橋	通行用跨道橋	コンクリミキサー車、クレーン、杭打ち機
	水門	取・排水口での設置	ユニック車、バックホー、ブルドーザ、 杭打ち機、バイブロハンマー
護岸	盛土	護岸建設のための埋立	バックホー、ブルドーザ、スクレーパー
堤防	堤防壁	パラペットウォール据付	バックホー、ブルドーザ、コンクリミキサー車、クレーン
	嵩上げ	余裕高確保のための嵩上げ	コンクリミキサー車、クレーン

11.3.3 プロジェクト及び環境評価のカテゴリー

タイ国では、関連法[1]が定める 34 事業で環境影響評価（EIA）の実施ならびに国の審査を求めている。しかしながら、現行法の下ではバイパス水路や放水路、堤防整備は EIA 対象外になっている。他方、プロジェクトでは主に建設工事が環境影響をもたらす可能性がある。また、事業予定地に住む住民や家屋が他所に移転を余儀なくされることも考えられる。従って、これら条件を勘案すると、JICA 環境社会配慮指針に準拠する初期環境調査（IEE）を実施し、環境社会影響を調査することが必要であるとの結論に至った。

11.3.4 事業対象地の概要及び調査対象

(1) アユタヤバイパス水路

事業対象地域は、プラナコン・シ・アユタヤ（アユタヤ）市北部及びバンサイ南部でともにチャオプラヤ川右岸と交差する国道 347 号の西側に位置し、その大部分は平坦な農耕作地帯である。家屋は、計画バイパス水路が途中で交差する幹線道路（3263 号線）等、数カ所で散見されるがその数は多くない。工業団地等、主要な商工業地はチャオプラヤ川左岸で展開している。また、当地においては少数民族、国立・自然公園、特筆すべき生態系、歴史的建造物は分布していない。なお、計画バイパス水路は農耕地を縦横する 14 既設用水路及び 2 自動車道路とも交差する。

(2) 外郭環状道路放水路

事業対象地域は、プラナコン・シ・アユタヤ（アユタヤ）県 バンパイン工業団地南部のチャオプラヤ川左岸を起点とし、東部外環状道路（国道 9 号）東側をほぼ並行南下、スワンナプーム空港東側を抜けクロン・ダンでタイランド湾に到達する、全体を通じて水田と社会活動集積地（住居、商工業施設、学校等）が広がる低地帯である。主に上流部には社会活動集積地が、下流部は水田・低湿地が占めているが、近年バンコク東部は開発が進み下流部も経済活動拠点へと変容している。当地においては少数民族、国立・自然公園、特筆すべき生態系、歴史的建造物は分布していない。また、地域全体が低湿地であるため、計画放水路近傍の所々に沼、ため池、水路があり、その周辺の小規模灌木林とともに、地域の生態系を形成している。なお、計画放水路は、事業対象地内で既存の 14 幹線道路、2 鉄道、及び 85 水路と交差する。

(3) チャオプラヤ川下流堤防整備

堤防整備の対象地域は、河口から上流約 100 km 地点までのチャオプラヤ川下流域である。本地域は商工業が集積するチャオプラヤデルタに位置する。バンコク都ならびにその都市圏が対象地域のほとんどをカバーしている。プロジェクトが特に用地取得を要することはないと考えられるが、それは作業の大部分が既存の堤防壁（0-60 km 地点、BMA が建設）及び二線堤（DOH が建設）の余裕高確保のための嵩上げであるためである。また、全ての作業域は RID や関係機関の ROW 内にある。アユタヤバイパス水路と同様に、当地においては少数民族、国立・自然公園、特筆すべき生態系、歴史的建造物は分布していない。

(4) タチン川流域堤防整備及び捷水路

タチン川は、チャオプラヤ川の分流の一つでタイ中央平原を流れる。本プロジェクトにおいては、堤防整備は河口部の左岸側から Bunlue 水路合流点まで及び Bunlue 水路南側が対象である。捷水路は、この堤防整備工事範囲内に導入される。対象区域には、寺院や家屋、商店などが散見される。ほとんどの用地が農業利用されている。人口密集地域は河口部のみである。対象区域内のタチン川は、6 幹線道路と 1 鉄道と交差する。タチン川は、水上交通、灌漑、給水、余暇のみならず、排水場としても機能し多目的利用されている。

[1] The Enhancement and Conservation of National Environmental Quality Act (NEQA) of B.E. 2535 (1992)

11.3.5 自然環境配慮

(1) 共通事項

施工中は工事車両や建設資機材による騒音・振動、運搬車両による交通量の増加が考えられる。また、掘削工事を伴うため、掘削土等の建設副産物処理も課題となる。工作物供用時は、水環境では地表水（土砂による濁り）及び地下水（水位）、土壌環境（地形・地質、地盤沈下）、景観への配慮が求められる。事業対象地域の大部分が二次林及び水田（農耕地）で占められていることから、希少動植物への影響は少ないと考えられる。ただし、掘削による土壌生物への影響は考慮を要する。

(2) アユタヤバイパス水路

事業対象地付近は、近傍の国道 347 号以外に大型構造物がないため、バイパス水路供用後の景観に影響を与えることが危惧される。

(3) 外郭環状道路放水路

タイ湾（排水部）からの塩水遡上により、放水路内水または土壌の塩水化の懸念がある。事業対象地には様々な構造物が存在するものの、放水路供用後の景観には配慮することが必要である。

(4) チャオプラヤ川下流堤防整備

特筆すべき配慮項目はない。

(5) タチン川流域堤防整備及び捷水路

アユタヤバイパス水路と同様に、工事後の景観が一部住民との間で課題となる可能性がある。捷水路建設が河川長さを圧縮し、タイ湾からの塩水がより上流域に遡上することが懸念される。

11.3.6 社会環境配慮

(1) 共通事項

分放水路ならびに建設工事用車両道路のための用地取得や確保が必要となる。また、事業対象地域は水田地帯に拡がるため、農業生産機会の損失のための補償への考慮も求められる。既存幹線道路等との交差部では、所轄官庁との調整も要する。事業対象用地内に分散する家屋に対する移転や補償については、交渉を円滑に進めるため入念な家計調査とタイ国法規則に準じた補償交渉が必要となる。

(2) アユタヤバイパス水路

事業計画地の大半が農耕地であるにもかかわらず、80 家屋以上が移転対象となる可能性がある（図 11.3.1 及び図 11.3.2 を参照）。

(3) 外郭環状道路放水路

事業の影響を受ける家屋数または人数（PAPs）は、設定後の流下能力により変化することが予測され、推定影響家屋数は約 600 軒（500 m^3/s）もしくは約 900 軒（1,000 m^3/s）である。既存構造物との交差部が、事業対象地域全体に広がっている（図 11.3.3 及び図 11.3.4 を参照）。

(4) チャオプラヤ川下流堤防整備

計画地域では既に事業が開始されており、新たな用地取得がないため、住民の非自発的移転は生じないと考える（図 11.3.5 参照）。

(5) タチン川流域堤防整備及び捷水路

堤防壁導入では、河口部の幾つかの家屋が移転対象となる可能性があるものの、影響住民数は不明である。その他の地域では殆ど影響がないと考えられる（図 11.3.6、図 11.3.7 参照）。

図 11.3.1 事業対象地域（全体）
-アユタヤバイパス水路-

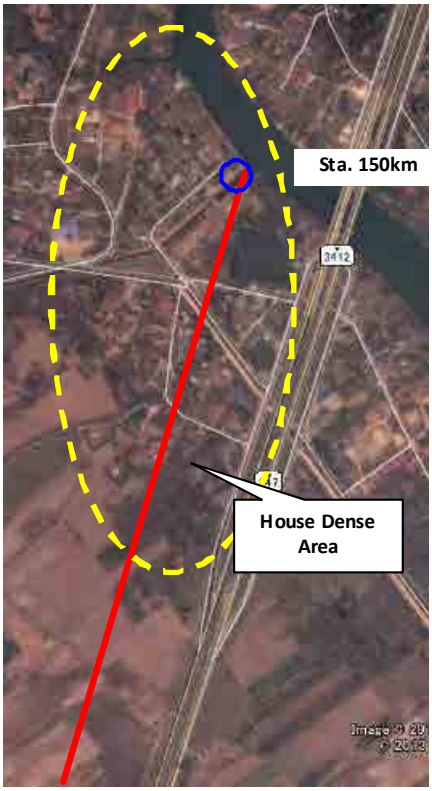


図 11.3.2 事業対象地域
（家屋密集地区）

図 11.3.3 事業対象地域（全体）
-外郭環状道路放水路-

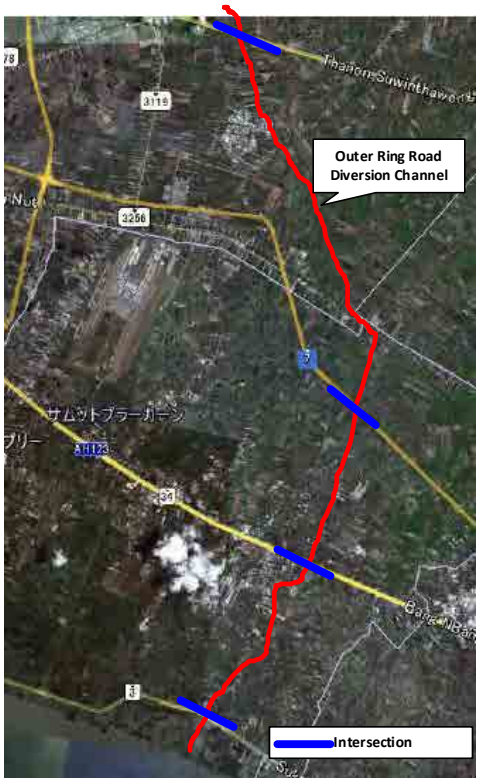


図 11.3.4 事業対象地域（下流域）

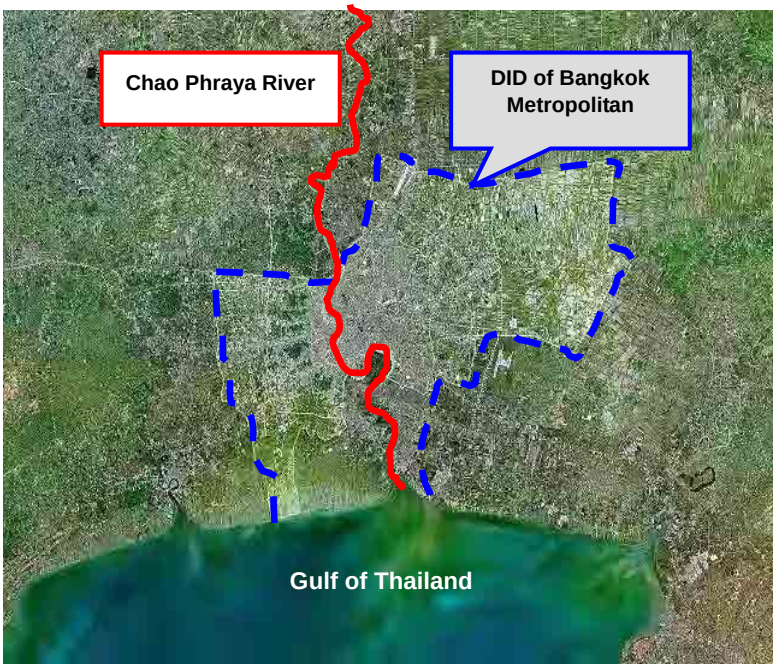


図 11.3.5　事業対象地域（全体）
-チャオプラヤ川下流堤防整備-

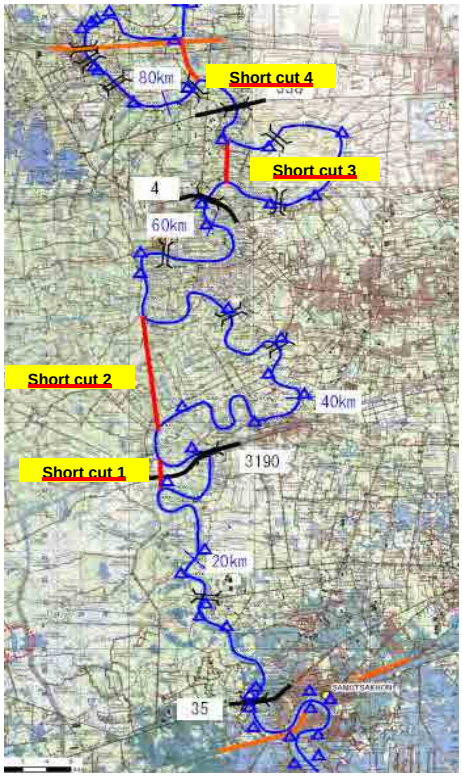


図 11.3.6　事業対象地域（捷水路）
-タチン川流域堤防整備及び捷水路-

図 11.3.7　事業対象地域
（河口部人口密集地）
-タチン川流域堤防整備及び捷水路-

11.3.7 自然環境及び社会環境に対する影響要因

地域特性を考慮すると、2 つのプロジェクトが自然環境ならびに社会環境に与える影響は僅かであると考えられる。しかしながら、表 11.3.2 に示す項目については何らかの対策が必要であると考える。

表 11.3.2 自然環境及び社会環境に対する影響要因

プロジェクトステージ			工事前/工事中			供用時
工種			施設工	水路		運用
				掘削工	堤防工	
自然環境配慮						
大気質		粉じん	○			-
		騒音・振動	○			-
		悪臭	-	○	-	○
水質	表層水	水質汚濁	○			○
		塩水遡上	-			○
	地下水	水位	-	○	-	○
		塩類化	-			○
土壌環境	地形・地質		○			○
	地下水位低下による地盤沈下		○			○
生態系 (動植物)			○			○
景 観			○			○
廃棄物		工事に伴う副産物	○		-	-
社会環境配慮						
用地取得・生活補償			○			-
非自発的移転			○			○
既設インフラに対する影響 (道路、水路など)			○			-

備考: “○”印の項目は、影響をおよぼす可能性があるものを示す。

11.3.8 総合評価及び軽減策

これら新放水路等の建設工事、また放水路設備における直接改変等による構造物存在がもたらす影響については、表 11.3.3 に示す保全処置を実施することで概ね回避又は低減できるものと考える。とりわけ、事業進捗に影響を与える可能性がある用地取得、住民移転への配慮・実施には慎重に対処すべきである。

表 11.3.3 軽減策概要

影響要因	軽減策
自然環境配慮	
大気質	工事の平準化
	工事車両の運行ルートの分散化
	建設機械の維持管理の徹底
	法令順守のためのモニタリング活動
水質汚濁	汚濁水処理装置の設置ならびに監視
	法令順守のためのモニタリング活動

影響要因	軽減策
塩水遡上・塩類化	河口部での潮止堰設置
	上流からの放流で塩水遡上を防止
地形・地質	現地踏査や文献調査による重要地形・地質の調査
地盤沈下	軟弱地盤での施工回避
	地下水位の監視
生態系 (動植物)	工事着手前での重要種の確認調査
	(存在した場合の)重要種の移植・保全
景観	施工ヤードや工事車両道路の適切な配置
	完成予定図等を示しての計画段階での住民との合意形成
廃棄物	掘削土の汚染回避及び適切な処理 (可能ならばリサイクル)
社会環境配慮	
用地取得・生活補償	パブリックコンサルテーション等を通じた影響住民との理解促進
	影響住民の移転計画(RAP)作成、実施及びフォローアップ
非自発的移転	地域特性を反映させた移転計画(RAP)の作成
	建設工事により移転対象住民の生活が不利益を受けないよう配慮する(例：インタビューによるフォローアップ)
既設インフラに対する影響	当該インフラを所轄する関係省庁との密な連携の構築

11.4 プロジェクト評価の結果

プロジェクト全体の費用は、洪水管理予算を超過すると考えられるので、最も費用効率の良いプロジェクトの組合せを求めるべきである。提案のプロジェクトの組合せ 1 又は 2 は、SCWRM M/P の費用の 40%以下となる。プロジェクト評価指標である EIRR は 25%以上であり、SCWRM M/P に比べると非常に高い値である。

タイの現行法によれば、バイパス水路や放水路は EIA 対象外になっているので、このプロジェクトは EIA の実施及び国の承認を取る必要がない。他方、環境への影響はプロジェクトの建設工事が環境影響をもたらす可能性がある。また、事業予定地に住む住民又は家屋が他所に移転を余儀なくされることも考えられる。これらの状態を勘案すると、JICA 環境社会配慮指針に準拠する初期環境調査（IEE）の実施が不可欠であると結論した。環境社会配慮の観点から、提案の事業は環境上、社会上の厳しい有害な影響はない。ただし、工事の進行に影響する用地取得や住民移転には注意深い配慮と対策が不可欠である。

以上のことから、費用効率の良い提案の下記の事業組合せについて、政府は実施に向けて更に検討を進めるべきであると結論付けられる。

1) 既存ダムの運用効率化
2) 外郭環状道路放水路（流量: 500 or 1,000 m^3/s）
3) 河川改修工事（含む：タチン川改修）
4) アユタヤバイパス水路（流量: 1,400 m^3/s）
5) 洪水予報

Note : バンサイのピーク流量は「組合せ1」で3,800 m^3/s、「組合せ2」で3,500 m^3/s と推定された。バンサイの2011 年洪水時チャオプラヤ川の下流域（バンサイの下流）では越流被害がなかったが、日ピーク流量は 3,900 m^3/s が記録されている。このことから、流量 3,800 m^3/s では、洪水による被害はないものとして、EIRR 及び B/C を計算している。3,800 m^3/s で被害が発生するとした場合、「組合せ2」の EIRR 及び B/C は、「組合せ1」に比べ値が大きくなる可能性がある。

第12章　　結論と勧告

12.1　結　論

調査団はタイ政府のチャオプラヤ川流域の洪水管理計画を見直した。政府の洪水管理計画は、2011 年 12 月に水資源管理戦略委員会（SCWRM）が作成、本調査はこの政府のコンセプトを、レーザープロファイラーによる精密な地形情報及び最新の知見を用いて、工学的且つ定量的に対策の組合せを評価したものである。なお、2013 年 3 月に水資源・洪水管理委員会（WRFMC）が SCWRM の計画を一部修正しているが、本調査で取得したレーザープロファイラーによる精密な地形情報などは用いておらず、充分な検討精度を有しているとは思えない。調査団による見直しの結果を以下に要約する。

<u>不定流計算</u>

- 潮位により影響を受ける下流域の流下能力を評価するために、本調査では、洪水追跡及び氾濫解析に不定流解析を用いた。不定流は水位や流量などが時間的に変化する流れと定義される。チャオプラヤ川下流の河川流は潮位により影響され、河口に近い水位は潮位により強く規定される。この現象（変動し続ける水位）を再現するためには、不定流解析の使用が不可欠である。ナコンサワン（C2）からタイ湾の海岸線まで、河床勾配及び地表勾配はほとんど平坦であり、河川の流れ及び洪水の流れは河床及び地表勾配だけでなく、水面の水頭の差に大きく支配される。

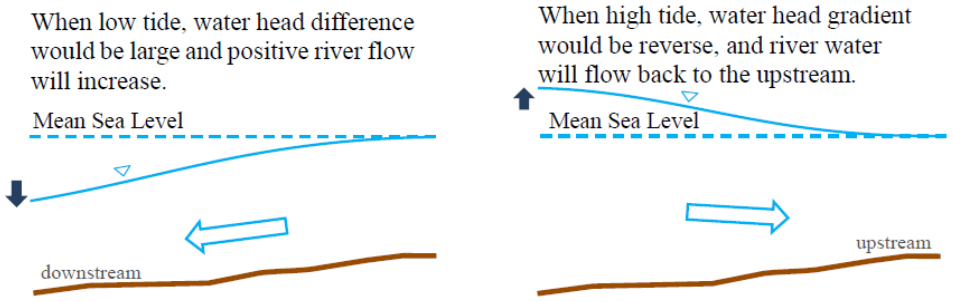
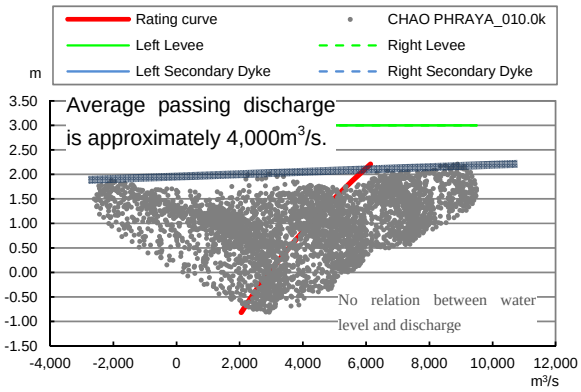
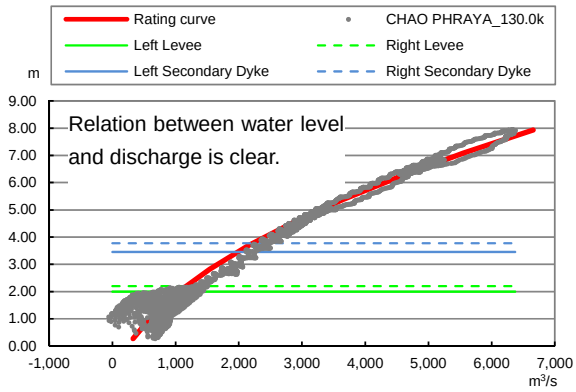


図 12.1.1　潮位の影響

- 水位と流量との関係が無いので、水位流量曲線による流下能力の推定は困難である。チャオプラヤ川の最下流では、洪水規模に関係なく、水位は上昇しない。しかしながら、潜在的流下量は、流下能力と同等であり、高水位の評価に使用している。



Chao Phraya River: 10.0km



Chao Phraya River: 130.0km

図 12.1.2　チャオプラヤ川の H-Q Plotting（氾濫なし）

河川流下能力に比べて大きな洪水流量

- 洪水災害管理を中心に、水資源・洪水管理に関する現状の調査及び評価を通して、チャオプラヤ川流域の中央平原には、乾期には農業地域として活用され、雨期には自然の遊水地として機能する広大な低平地・湿地があり、流域の住民は洪水と共存していることが明らかになった。氾濫の主な特徴の一つとして、河川流域からの潜在的な洪水流量は河川/水路の流下能力よりかなり大きく、河川から氾濫原への洪水の移動は雨期には頻繁にある。更に、処によっては河川/水路の堤防は無いか又は低いので、氾濫水、地点降雨、残流域からの流入量からなる氾濫原の溜まり水は容易に河川/水路に戻る。

  上記の通り、洪水氾濫及び洪水氾濫原からの戻り水により、ナコンサワンからタイ湾に向けて設けられる大規模な放水路（流下能力 1,500m^3/s）や貯留能力の小さな新ダム建設の洪水制御効果は、下流域において低減する。

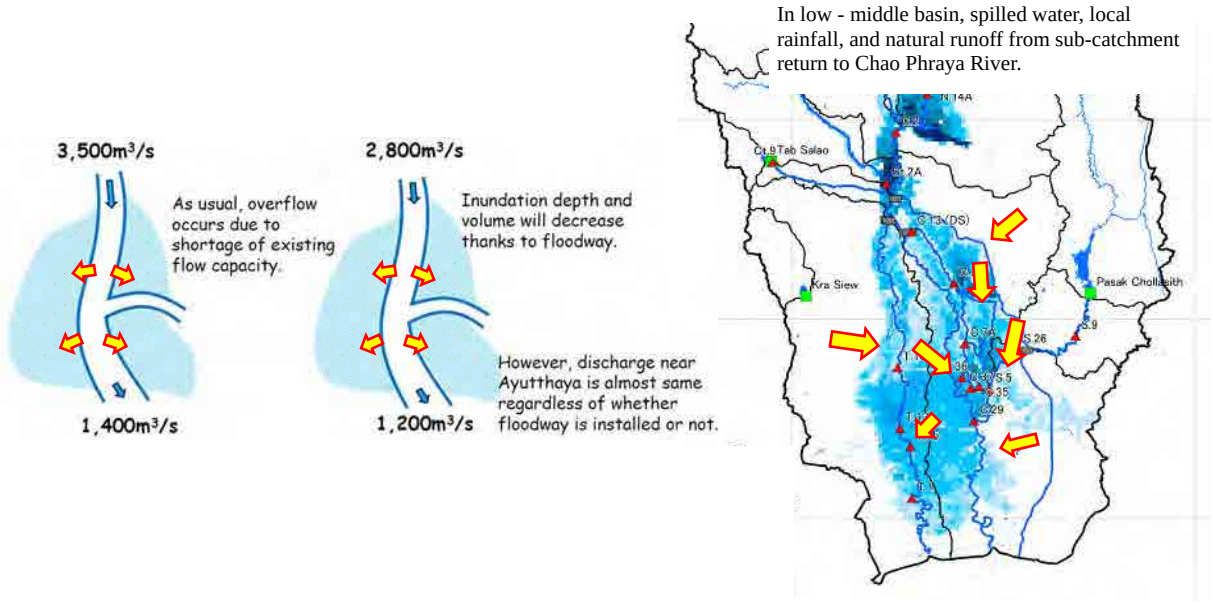


図 12.1.3　河川/水路からの氾濫と氾濫原から河川/水路への戻り水

Design High Water Level（DHWL）

- 洪水防御、氾濫制御、河道計画といった河川管理を効果的に実施するためには、DHWL の設定が非常に重要である。河川流量や流下能力は堤防の高さに依存する。仮に上流域において広範囲に築堤を行った場合、上流から下流へ流れる洪水流量は増加し、下流において氾濫被害を引き起こす可能性がある。従って、河川の流下能力や河川沿いの土地利用、上・下流の治水安全度のバランス等を十分に考慮し、DHWL を設定する必要がある。例えば、バンコクは洪水災害から防御しなければならないため、堤防高を高くしなければならない。一方で、自然地や農業地域を流下する河川では、堤防高は現状を維持すべきである。これは高い堤防により河川氾濫を制御することで周辺の土地を自然遊水池として活用できなくなるためである。さらに、高い堤防の設置は灌漑用水の取水に障害となる。また、河口では、潮汐を考慮して DHWL を設定しなければならない。河口付近の水位は洪水時においても潮汐の影響をうけるためである。このような地域では、一端破堤がおきると無限ともいえる海水が陸地に氾濫し、沿岸部に壊滅的な被害を与える恐れがある。

- チャオプラヤ川河口から 0～90km 付近に位置するバンコク首都圏においては、洪水防御を目的に BMA がパラペット堤を嵩上げする予定である。パラペット堤の高さはチャオプラヤ川の既往最高水位を参考に設定されたと推察される。パラペット堤の高さは、下図の破線に示すように階段状に設定されている。実際、河川の水面勾配は階段状になることはないため、

縦断方向の堤防勾配は水面勾配に倣って傾斜をつけることが望ましい。本調査で検討した DHWL に基づき、バンコク周辺に設置するパラペット堤は縦断勾配をつけて設置することを提案する。

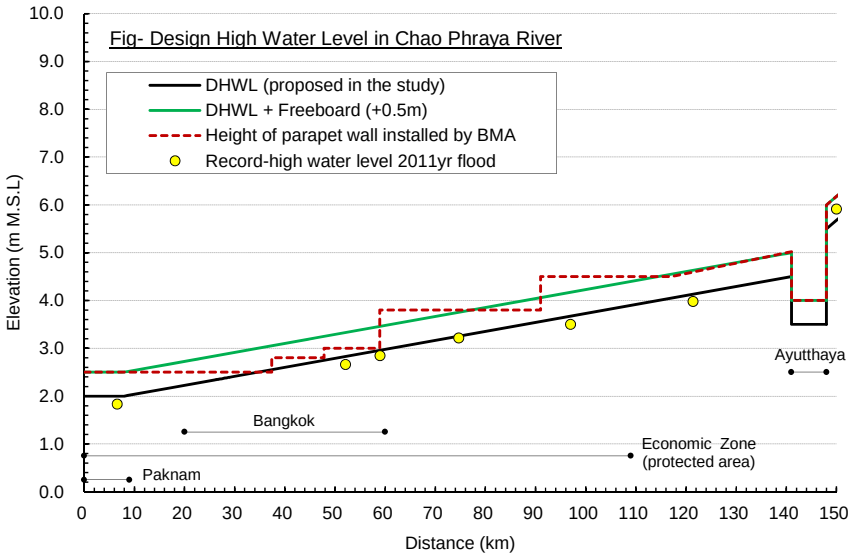


図 12.1.4　チャオプラヤ川河口部の DHWL の設定

道路嵩上げの影響

- 2013 年 6 月末時点において、DOH および DOR によって優先防御地域の道路嵩上げが開始されている。シミュレーション結果の Case0-0（現況）と Case0-1（道路嵩上げ事業完了後）を比較した結果、道路嵩上げ事業によってバンサイ北西部に位置するラトゥ・ブア・ルアン（下図の氾濫ブロック 14 を参照）の浸水深と氾濫ボリュームが大きく増加する。これは極端な例ではあるが、盛土構造の高速道路や堤防兼道路といった連続構造物は、少なからず氾濫状況に影響を与える。このため、洪水氾濫解析によって連続構造物の影響を調査し、連続構造物によって洪水被害が拡大する場合は、必要に応じて対策をとらなければならない。

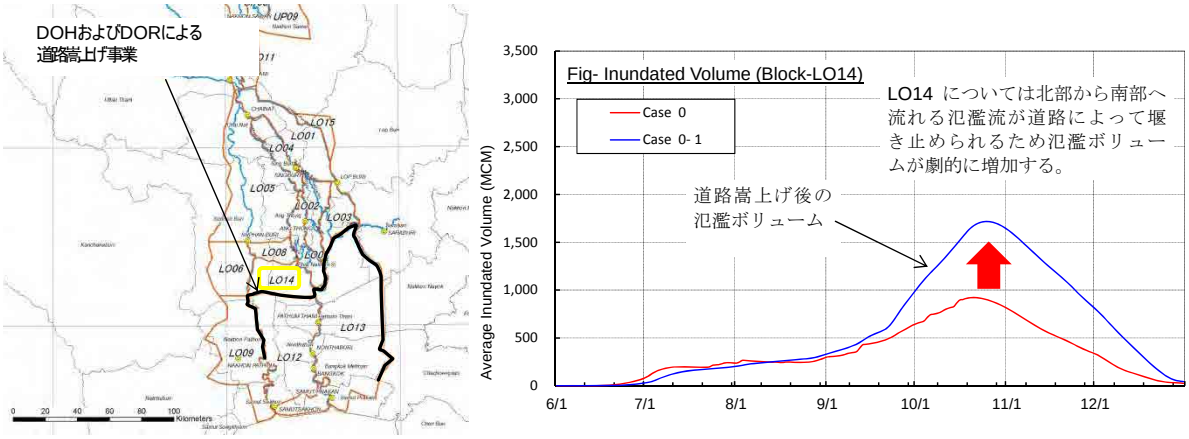


図 12.1.5　LO14 における氾濫ボリュームの変化（道路嵩上げによる影響）

優先防御地域内に設置されたポンプの排水能力

- DOH および DOR による道路嵩上げ事業など、周囲堤の設置によって、内水氾濫が悪化する可能性がある。これは、降雨が周辺に排水されず周囲堤内部に貯まり、浸水深が深くなるためである。チャオプラヤ川の下流域では、地形がほぼ平坦であるため、降雨は自然排水では

なくポンプ排水によって河川や水路へ排水されている。本調査では、現在設置されているポンプ排水能力 1,590m^3/s が内水排除を行うにあたり十分な排水能力を有するかどうか検討を行っている（主報告書第 10 章、10.2.12　内水対策を参照）。検討の結果、2011 年洪水規模の内水氾濫に対しては、十分に対応できることが明らかとなった。ただし、これは優先防御地域全体を対象に調査した概略検討結果であるため、別途、排水地域区分毎に詳細な内水対策を検討することを提案する。

<u>洪水管理計画</u>

- タイ政府が取り纏めたマスタープランは、チャオプラヤ川流域の統合的・持続的水資源と洪水管理の達成を目的にしており、提案している対策はある程度の洪水管理効果を持っている。しかしながら、実施に当たっては、技術、経済、社会及び環境等様々な観点から、優先順位、妥当性を検討すべきである。対策は構造物対策及び非構造物対策からなるが、対策によっては実施に長期間を必要とするものもあり、計画期間内に目的・目標を達成する最適な対策組合せについてその効果を考慮すべきである。

- 2011 年洪水時における既存ダムの運用は、ブミポンダムとシリキットダムが合計 120 億 m³ の洪水流量を貯留するなど、洪水災害軽減に極めて効果的であった。しかし、治水・利水の観点から、既存ダム運用効率に向上の余地があることが明らかになった。本調査では、運用の指標として、『Target Curve』と『Alert Curve for Drought』を提案している。『Target Curve』は、利水のための目標となる貯留量であるとともに、治水面では、貯留量の上限を示す。『Alert Curve for Drought』は、渇水年であるかの指標となる。『10% Probability』は、10 年に一回の渇水の危険性、『20% Probability』は 5 年に一回の渇水の危険性を意味する。

  7 月末までは、提案の『Target Curve』に従いダム貯水位を維持（流入水をそのまま放流）、8 月からダム放流量を最大でブミポンダム 210 m³/s、シリキットダム 190 m³/s として洪水流量を貯留することを提案している。この運用を 2011 年洪水に適用した場合、ナコンサワン（C2）の洪水ピーク流量を 400 m³/s 低減することが可能である。貯水量が提案の『Target Curve』を下回る場合、流入水をさらにダムに貯留する。この時の放流量は環境維持を目的とする最小放流量（ブミポンダム：8 m³/s、シリキットダム：35 m³/s ）以上とする。ダム運用は、潅漑目的の水の供給と同時に洪水被害を最小化することを目的として、より柔軟な水資源管理を行なうことが必要である。

- チャオプラヤ川沿いには、河岸の本堤と背後地の灌漑水路沿い堤防道路の二線堤の 2 タイプの堤防があり、二線堤がチャオプラヤ川の洪水氾濫防止施設と考えられている。しかし、河岸沿いにも多くの都市・集落が位置しており、二つの堤防の間には無数の人が生活している。提案の治水施設実施後もチャオプラヤ中央平原の広い氾濫地域は残り、無数の人々が洪水と共生することが必要である。氾濫管理地域の推進には、コミュニティベースの洪水災害管理のような対策が不可欠となることが明らかになった。

- 本調査では、バンコク及び周辺地域をチャオプラヤ川の洪水から守る最適な対策の組合せとして、(i) 効果的な既存ダムの運用、(ii) 外郭環状道路放水路の建設、(iii) 河川改修（タチン川改修含む）の実施及び、(iv) アユタヤバイパス水路の建設を提案した。提案の対策は、技術的、経済的に妥当であり、出来る限り速やかに実施することが望まれる。また、提案の洪水災害管理の適切な実施には、土地利用規制などの非構造物対策が必要であり、これについても早急な実施が望まれる。

提案の対策組合せは以下の通りである。

(1) 提案の組合せ 1

a) 既存ダム運用の効率化

b) 外郭環状道路放水路（流量 500 m^3/s）

c) 河川改修工事（タチン川改修を含む）

d) アユタヤバイパス水路（流量 1,400 m^3/s）

(2) 提案の組合せ 2

a) 既存ダム運用の効率化

b) 外郭環状道路放水路（流量 1,000 m^3/s）

c) 河川改修工事（タチン川改修を含む）

d) アユタヤバイパス水路（流量 1,400 m^3/s）

e) 洪水予報

(3) 他の非構造物対策

a) 植林と森林回復

b) 洪水予報

c) 氾濫管理地域の土地利用規制

- 調査の結果として、調査後 RID が利用できるよう、調査で収集したデータは GIS データベースを構築・整理している。
- 流域の水理解析モデル及び洪水解析モデル（MIKE 11、MIKE21 使用）として、新しい地形データを組み込み、流出・氾濫モデルを開発した。洪水及び氾濫シミュレーションを、より確度の高い洪水リスク管理に利用することが可能である。

12.2 勧　告

優先防御地域の洪水被害を避け、チャオプラヤ川流域の洪水リスクを軽減するために、タイ政府は、チャオプラヤ川流域の総合的洪水管理計画の実施に係る下記について、速やかに対応を取ることを勧告する。

各論に入る前に、以下の点について特に勧告しておきたい。

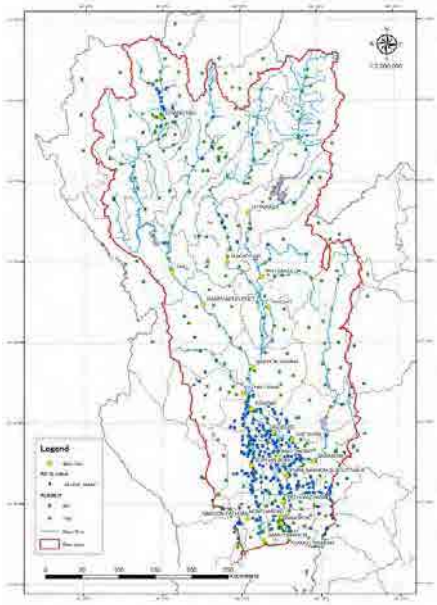
- 本調査で取得したレーザープロファイラーによる精密な地形情報を関係組織に即刻配布し、この情報を活用した検討をあらゆる組織・機関が行うべきである。この精密地形情報を用いずに行った提案は「絵に描いた餅」であり、チャオプラヤ川のような広大で極端な低平地では、工学的な意味を持たない。
- 本調査の不定流の検討で示されたチャオプラヤ川の河道や氾濫原の貯留効果は非常に大きく、上流での放水路によるカット効果は下流に行くに従って漸減し、放水路の位置によっては下流で殆ど効果が無いことも有り得る。上流でのカット効果は一律下流まで効果があるかのような考えの下に、単純な水路、人工水路での不変流量の組み合わせのような洪水制御論議は誤った施策を導くこととなり、厳に慎むべきである。
- 本検討で提示された感潮域の流下能力の検討手法は、これまでのバンコク周辺地域の河川管理のあり方の根本にかかわるものであり、良く理解されたい。

洪水管理計画についての勧告

- 提案の利水・治水効果を考慮した既設ダム（ブミポンダム、シリキットダム）の効果的運用計画を実施する。
- 提案の対策：タチン川を含む河川改修事業、外郭環状道路放水路（500 m³/s 又は 1,000 m³/s）、アユタヤバイパス水路（1,400 m³/s）の F/S 調査の実施及び調査で提案した非構造物対策を実施する。
- 事業実施の優先順位に関して、チャオプラヤ川上下流域の治水安全度を考慮する必要がある。アユタヤバイパス水路事業のみを実施した場合、下流域の流量は約 300m^3/s 増加し（解析結果より）、下流域の洪水リスクが大きくなる。このことから、アユタヤバイパス水路事業完成前に、外郭環状道路放水路を完成させることを強く勧告する。
- 氾濫管理地域の防御策を推進するために、(i) 2012 年に JICA が作成したレーザープロファイラーデータをベースに、洪水氾濫原の正確なベース・マップを作成する、(ii) 洪水氾濫管理地域について土地利用規制を制定、土地利用計画を策定する、(iii) 氾濫管理地域に必要な構造物、非構造物対策、コミュニティベースの洪水災害管理を推進する、(iv) 情報、伝達及び教育（IEC）の改善を通して、治水・利水に対する住民意識の向上を図る。
- GIS データ及び河川解析モデルは、意思決定支援システム又は管理ツールとして有効であり、チャオプラヤ川流域の水・洪水災害管理に効果的に活用するために継続的な維持・更新を実施する。

水文データ観測システムについての勧告

この調査において指摘する水文データ観測システムの課題を下表に示す。

No.	課題	勧告
1	降雨観測所の不足及び不均一な分布 本調査においてチャオプラヤ川流域で約700観測所から降雨データを収集した。チャオプラヤ川流域では降雨観測所の密度は高くなく約 300 km^2/箇所である。加えて、多くの降雨観測所が不均一に位置している。RID の大半の降雨観測所はナコンサワン（C.2）下流の潅漑地域に集中している。 適切な水資源計画の検討や洪水制御計画の確立、水利用計画のためには、降雨観測所の増設、適確な配置が必要である。 なお、日本では均一の降水状況を示す降雨観測所の理想的密度は 50 km^2/箇所と考えられている。	特に、パサック川流域、スコタイからナコンサワン間など中流域に降雨観測所が不足しており、新たに設置すべきである。 降雨観測所は全国に均一に設置するのが理想的である。当然のことであるが、山間部に高い密度で観測所を配置するのは好ましい。  降雨観測所の位置（2011 年時点）
2	観測間隔（水位観測所） 洪水到達時間が長いことから、チャオプラヤ川流域の降雨解析は日データを用いることで可能である。しかし、感潮区域では毎時水位観測を実施すべきである。感潮区域の水位は定期的に変動し、通常高/低潮位は干満により一日 2 回起き、河川の流れを規定する。2013 年 6 月時点において、TC.54、TC.12、TC.22、TC.55 及び C.29A のテレメータ観測所で水位の毎時観測が実施されている。しかし、大半の観測所の観測データは誤差を含み、時間水位データは利用不可であった。	第一に、既存の毎時観測の水位観測所を維持修繕することが必要である。 河口からアユタヤ（河口から 141 km 上流）の河床勾配は殆ど平坦で感潮区域であることから、少なくともアユタヤまでの区間においては、水位の毎時観測を実施すべきである。 同様に、感潮区域であるタチン川下流部においても水位の毎時観測を実施すべきである。
3	洪水期の流量観測 洪水時の水文データ取得は非常に重要である。特に、河口に近い感潮区域の流量データが重要である。毎時流量観測は ADCP（Acoustic Doppler Current Profiler）で実施することが望ましい。	洪水期に感潮区域で ADCP による毎時流量観測の実施を勧告する。 現在の技術においては、ADCP による流量データ観測が正確である。RID の ADCP による流量観測モニタリングチームは、観測活動を他の観測点にも広げるべきである。
4	水位と流量を観測する新水文観測所の設置 モデルを用いた洪水解析結果から、河川からの氾濫、また、洪水氾濫原から河川への氾濫流戻りがナコンサワンからアユタヤ間で頻繁に発生することが明らかとなった。この現象を確認するために、水位/流量観測をすべきである。	洪水及び氾濫を制御するには、河川からの氾濫、また、河川への氾濫流戻りの理解が必要である。そのため、新しい水文観測所を設置すべきである。 特に、チャオプラヤダムとナコンサワン間は水位観測所が無いので、水文観測所が必要である。 更に、支川流域からの流入は主流の流況に影響するので、Noi 川、Lop Buri 川及び Chainat Pasak 水路を含む主要支川に於いて水位/流量観測を実施すべきである。

水文データ管理についての勧告

水位、流量、降雨を含む水文観測データは、統合的水管理計画、洪水制御、潅漑計画等の確立のための貴重な情報である。調査を通じて得られたデータ管理の課題を下表に示す。

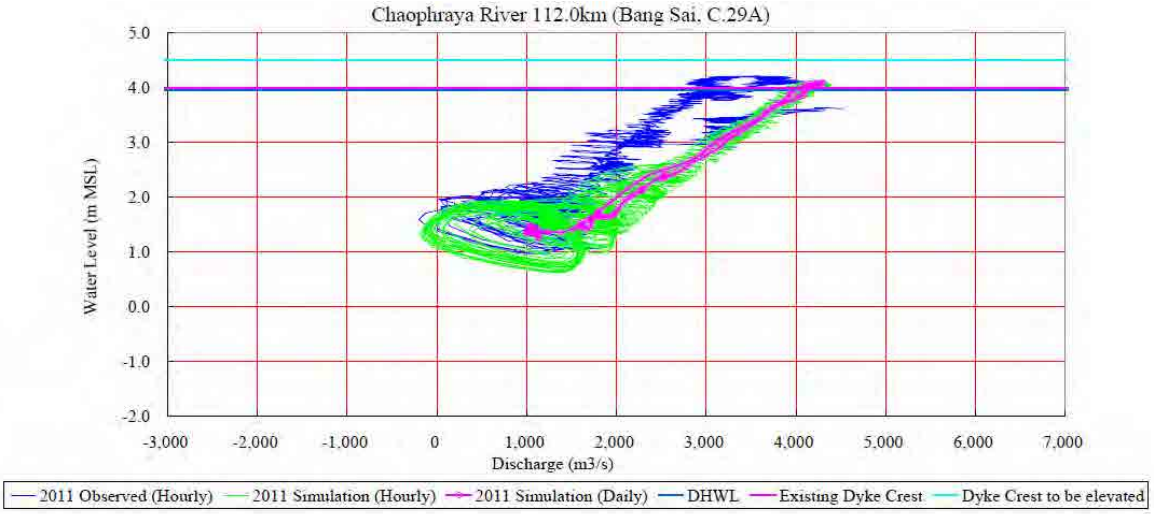
No.	課題	勧告
1	水文観測所の状況 降雨観測所の位置（緯度/経度）が間違っている場合が多くある。また、観測状況（観測中、観測終了等）が不明であり、洪水防御及び他の関連プロジェクトの計画立案の際の障害となっている。	全ての観測所について現地調査を実施、状態を把握、正確な位置（緯度/経度）と標高を明確にするべきである。RTSD が定めた first-class のベンチマークに基づく RID の公のベンチマークを水文観測所の付近に設けることが望ましい。特に、河口に近い観測所は、地盤沈下により水位計の標高が低くなっている可能性があり、十分な注意が必要である。
2	データ収集システム データ収集システムに改善の余地がある。 主に、RID Hydro Center は、管内の観測データ及び情報を収集、整理し、それらを Web に公表している。しかし、更新の頻度は Hydro Center によって異なり、情報が常には更新されてない。また、新しいデータが、バンコク本部に送付されていない。	観測データはバンコク本部で統合的に管理すべきである。データ収集システムを見直し、データ収集の技術上のガイドラインを作成、地方の Hydro Center に配布する。また、水文観測機器について定期的な維持作業を実施すべきである。
3	品質管理 観測データは、データ記録、機器の故障等による大きな誤差を含んでいる。観測データは注意深く検証する必要がある。	観測データの高い精度及び信頼性を保つには、データを歴史的データとの比較及び近傍データとのクロスチェックにより検証するべきである。 データの品質管理のガイドラインを作成すべきである。
4	洪水時の映像記録 洪水状況に関する映像記録等、多くの情報は、洪水制御計画等の策定に対して効果的及び効率的である。	洪水時の映像を記録・保存すべきである。これらの資料は、河川の水理的動きを理解し、洪水防御計画を確立するのに非常に有用である CCTV カメラを主要な水文観測所に設置、映像を記録、保存し、関係機関と共有することが望ましい。RID 事務所に近い河川の流れ状況について、少なくともビデオカメラ等で記録すべきである。
5	横断測量 洪水防御計画、水資源等の水管理計画は、最新の河川状況を考慮して検討すべきである。	河川横断面は、河川改修工事、土地開発等によって変化する。 チャオプラヤ川下流域では、DOH 及び DOR が優先防御地域周囲の道路堤防嵩上げを実施、これは洪水期の流況及び氾濫条件に大きな影響を与える。 従って、定期的に河川横断測量を実施し、河川形状の変遷を確認すべきである。特に、深い河床低下が認められるチャオプラヤ川のノイ川合流点下流については、道路堤防完成後は、河床低下が更に発達することが予想され注意が必要である。

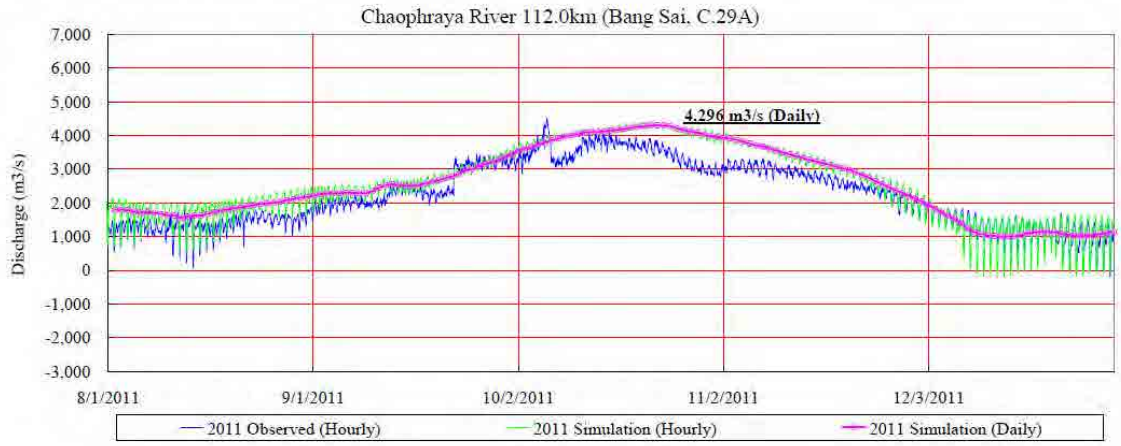
チャオプラヤ川下流感潮区域の時間流量及び日流量について

チャオプラヤ川下流感潮区域の時間流量及び日流量を明らかにすることを勧告する。2011 年洪水時、バンサイの日ピーク流量は 3,900 m^3/s が記録されており、チャオプラヤ川の下流域では越流被害がほとんど発生していない状況であった。チャオプラヤ川の下流域は潮位変動に支配されており、この記録は H-ADCP（Horizontal Acoustic Doppler Current Profiler）による時間毎の H-Q 自動観測を基にしている。しかし、バンサイ地点の河道幅が 500 m 以上あるにもかかわらず、この H-ADCP の最大測定範囲は 300 m であり、この記録が正しいかどうかは不明な状況である。よって、チャオプラヤ川下流域の時間・日流量を明らかにするために、V-ADCP（Vertical Acoustic Doppler Current Profiler）による継続観測の実施を勧告する。潮位変動を踏まえた下流域の時間・日最大流量観測結果は、洪水リスク評価に最も重要な値の一つとして有効である。

図 12.2.1　RID が使用している河川サーベイヤー M9（V-ADCP）

なお、バンサイ（河口から 112 km）、TC12（河口から 59 km）、河口から 20 km 及び河口に於ける 2011 年洪水時の日ピーク流量についてシミュレーションした結果（優先防御地域周囲の堤防嵩上げ有り）は、それぞれ 4,300 m^3/s、4,320 m^3/s、4,440 m^3/s、4,490 m^3/s であった。このとき、時間ピーク水位は、それぞれ 4.1 m MSL、2.9 m MSL、2.2 m MSL、1.9 m MSL である。TC12、20 km 地点及び河口の既設パラペット壁の天端高はそれぞれ 3.0 m MSL、2.5 m MSL、2.0 m MSL である。これは、河川水位は、Bangkok 周囲のパラペット壁の天端より低いことを意味している（次頁以下の図参照）。





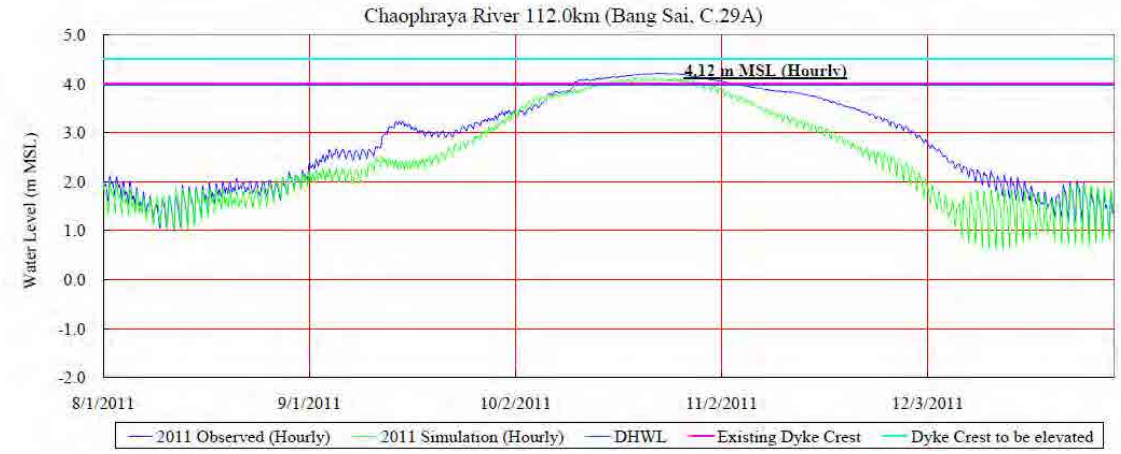
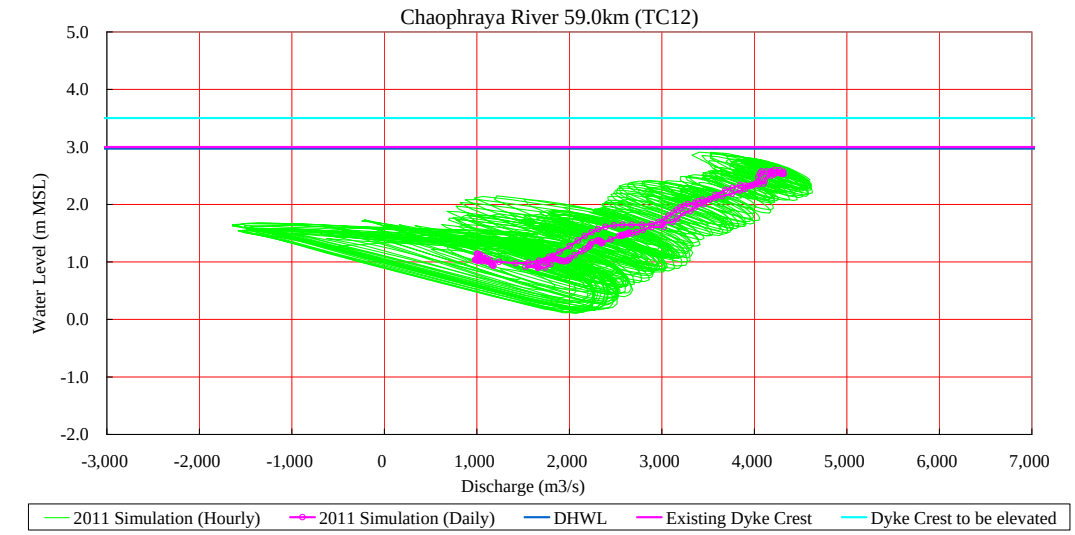
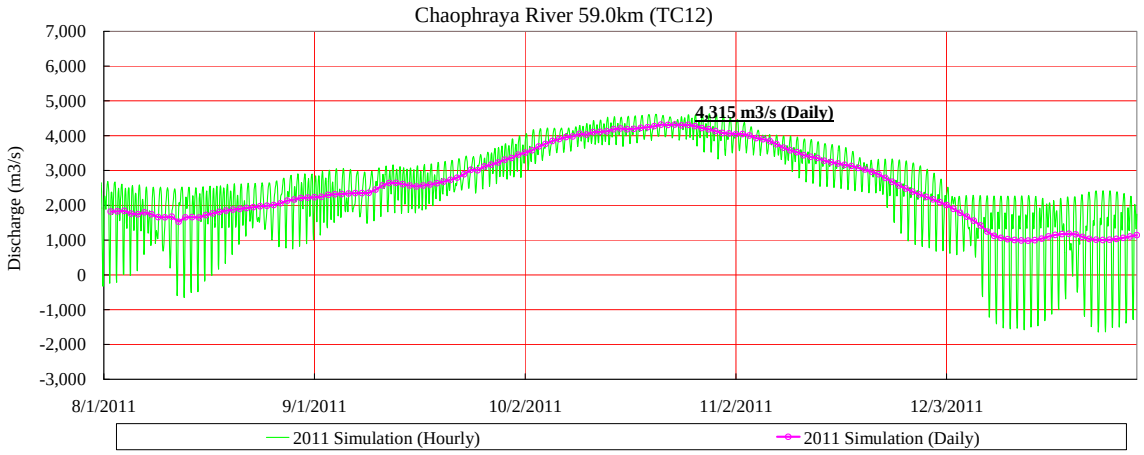


図 12.2.2　河口から 112km 地点（Bang Sai、C29A）の水位及び流量





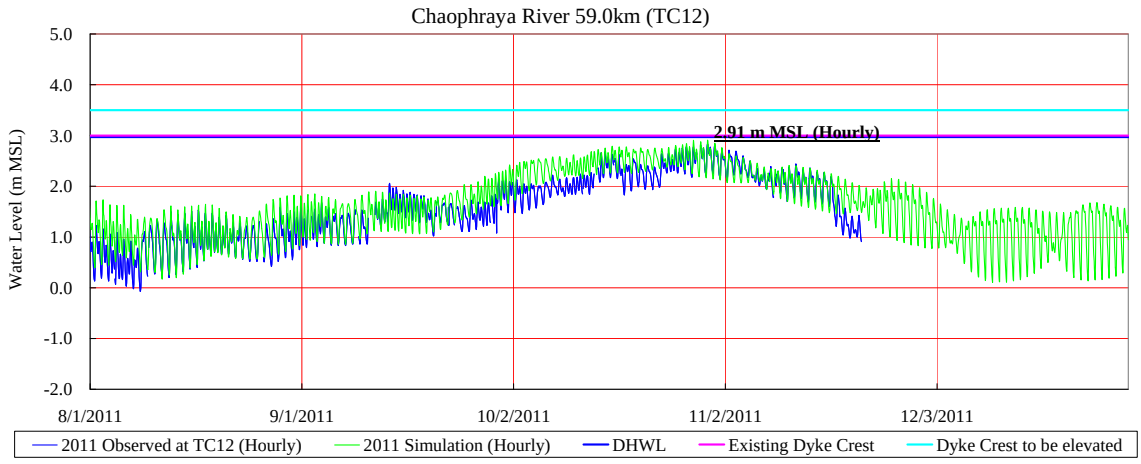


図 12.2.3　河口から 59km 地点（TC12）の水位及び流量

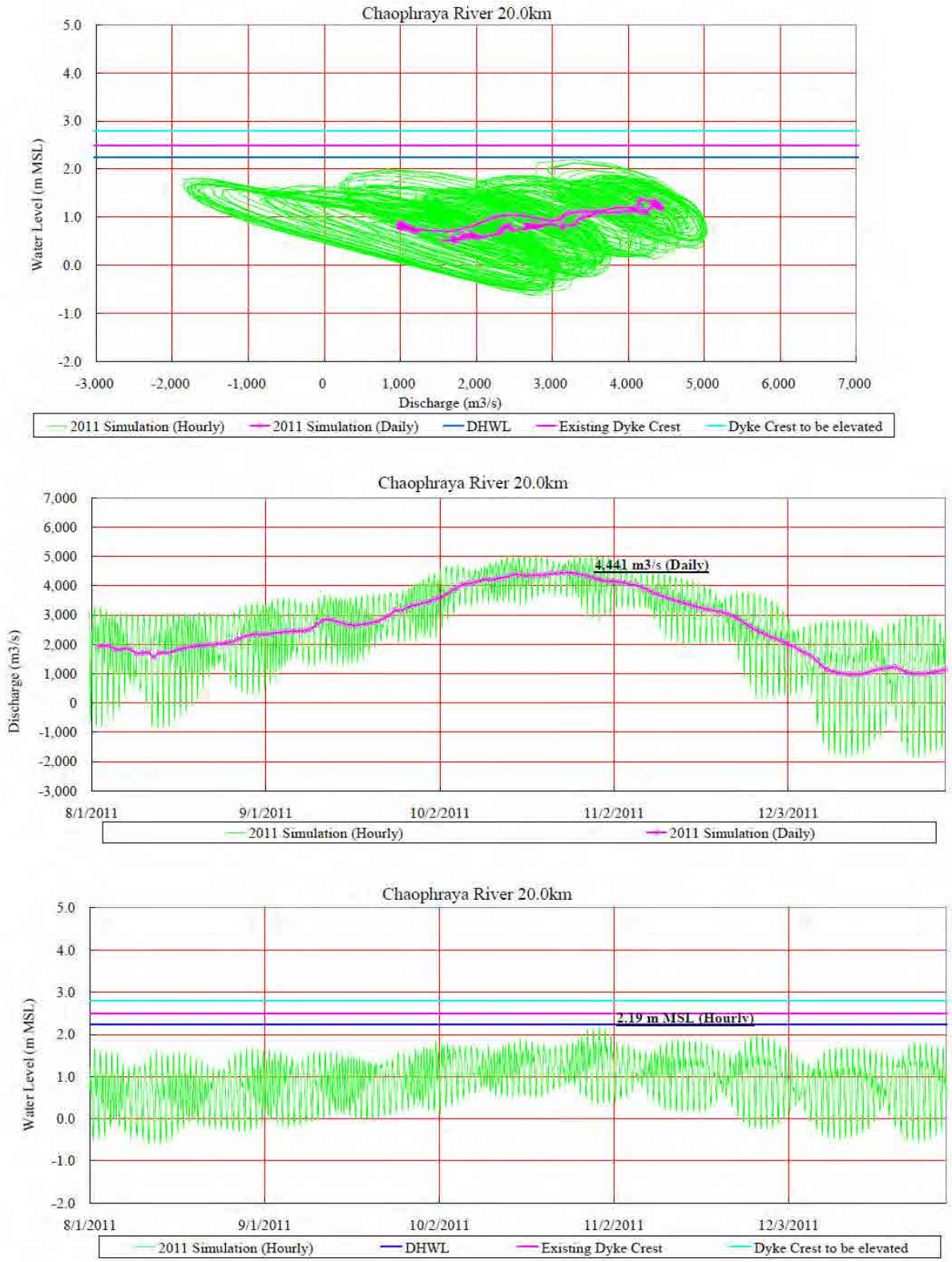


図 12.2.4　河口から 20km 地点の水位と流量

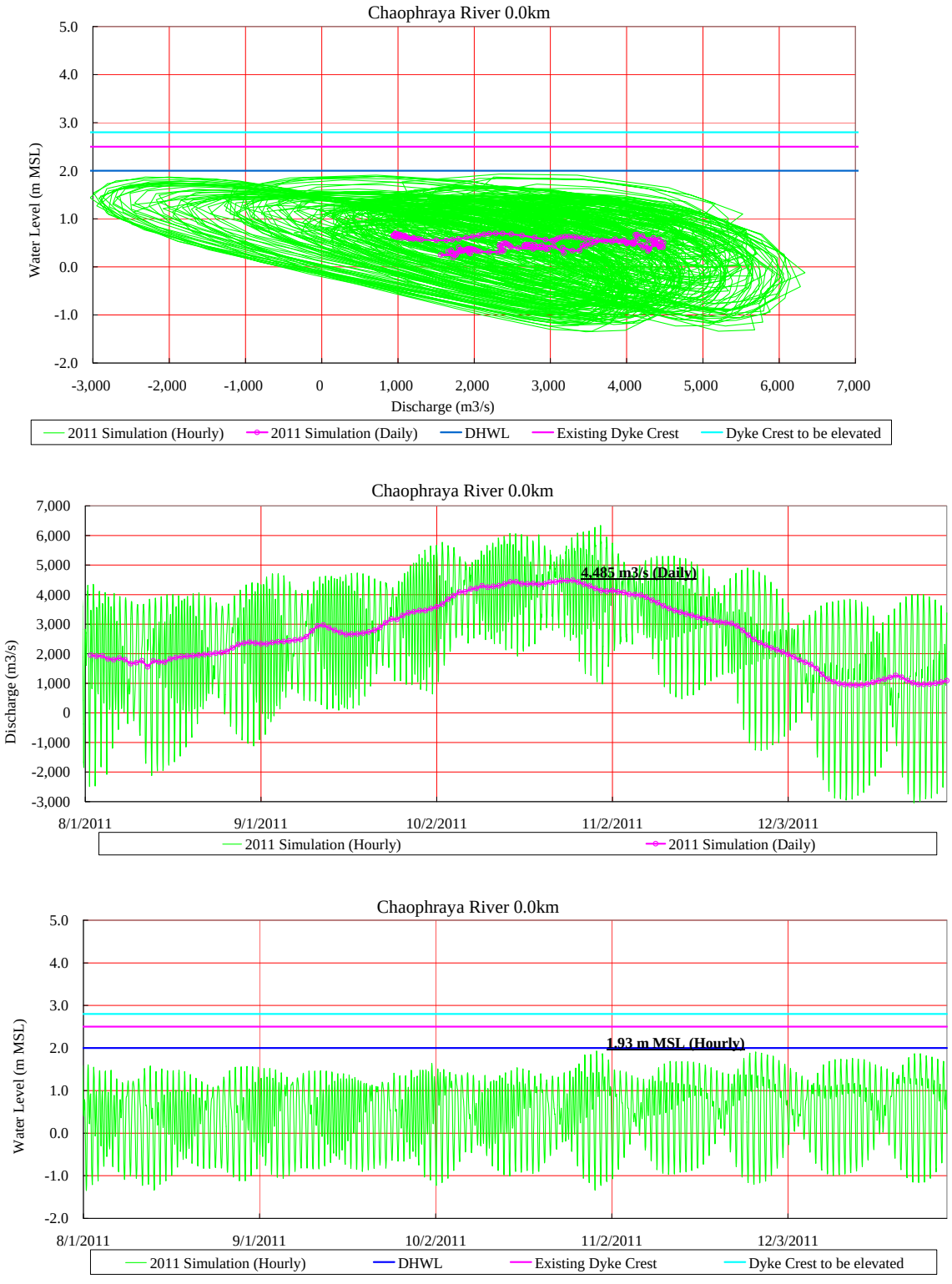


図 12.2.5　河口の水位と流量

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1-1 Kickoff Meeting or Technical Working Group Meeting or Steering Committee Meeting

1-1-1 Kickoff Meeting for Component 1-2 (15 February, 2012)

MINUTES OF MEETING

ON

KICKOFF MEETING

FOR

SUBCOMPONENT 1-2 OF

PROJECT FOR COMPREHENSIVE FLOOD MANAGEMENT PLAN FOR THE CHAO PHRAYA RIVER BASIN IN KINGDOM OF THAILAND

AGREED UPON BETWEEN
OFFICE OF NATIONAL ECONOMIC AND SOCIAL DEVELOPMENT BOARD (NESDB)
ROYAL IRRIGATION DEPARTMENT, MINISTRY OF AGRICULTURE AND COOPERATIVES (RID/MOAC)
DEPARTMENT OF WATER RESOURCES, MINISTRY OF NATURAL RESOURCES AND ENVIRONMENT (DWR/MNRE)
AND
THE CONSULTANT TEAM OF JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

Bangkok, February 15, 2012

Mr. Prasit Sitho
Chief Engineer (Executive Advisor in Survey and/or Design), RID

Mr. Yoshiharu MATSUMOTO
Leader,
The Consultant Team of Japan International Cooperation Agency

I. Introduction

Based on the Record of Discussions on the Project for Comprehensive Flood Management Plan for the Chao Phraya River Basin (hereinafter referred to as "the Project") signed on 13 January 2012 among National Economic and Social Development Board (hereinafter referred to as NESDB), Royal Irrigation Department, Ministry of Agriculture and Cooperatives (hereinafter referred to as "RID"), Department of Water Resources, Ministry of Natural Resources and Environment (hereinafter referred to as "DWR") and the Japan International Cooperation Agency (hereinafter referred to as "JICA"), the Kickoff Meeting of its Subcomponent 1-2 was held on 15 February 2012 with the presence of 36 participants from the headquarters and the regional offices of RID, DWR, the Thai International Cooperation Agency (hereinafter referred to as "TICA"), and JICA.

The agenda for the meeting is Item 1: Introduction, Item 2: Report of Record of Discussions and substantial issues, Item3: 3.1 Presentation of Work Plan, 3.2 Requested information, 3.3 Propose Counterpart Team/Technical Working Group, Item 4: Other business (if any)

In this meeting the Work Plan for Subcomponent 1-2 was presented by the JICA Consultant Team and was generally accepted by the Thai side. The manner for data collection was also discussed in the meeting.

The list of attendance is presented in Annex.

II. Major Items Discussed

Major discussions made in the Kickoff Meeting among NESDB, TICA, DWR, RID and JICA are as follows:

1. Report on Record of Discussions

It was explained that the cooperation agreement on the Project between Thailand and Japan had been made in the Record of Discussions dated 13 January 2012. The backgrounds, components, and implementation period of the Project, set-up of a steering committee and inputs from JICA and Thai side were also explained in the meeting.

2. Updating of Other Components

Mr. Taniguchi of the JICA Thailand Office updated the progress of the other project components.

- Flight permission for the LiDAR survey (Subcomponent 1-1) will be applied for on 22 February 2012. The flight will be hopefully possible from a week after the permission is issued.
- Department of Highway and RID agreed on the grant-aid projects (Component-2). Official requests prepared by the two agencies will be sent to the Japanese Embassy through TICA. This process is going to be finished by 24 February 2012.
- There is no specific project for the Pilot Project (Component-3) at this time due to the urgent implementation schedule. Candidate projects are still welcomed.

3. Work Plan

Mr. Matsumoto, the Leader of the JICA Consultant Team presented the Work Plan for the Subcomponent 1-2. The Work Plan is composed of four chapters, Chapter 1: Introduction, Chapter 2: Outline of Master Plan proposed by Strategic Formulation Committee for Water Resources Management (hereinafter referred to as "SCWRM"), Chapter 3: Plan of Operation and Chapter 4: Inputs and Undertakings. After the presentation, discussions were made as

summarized below:

(1) Involvement of Other Agencies

RID expressed their concern how to involve other concerned organizations besides RID and DWR to participate in the Study. The JICA Consultant Team answered that NESDB should play a role as a coordinator among relevant agencies as agreed in the Minutes of Meetings dated 22 December 2011 (Annex-1 of the Work Plan).

(2) Detailed Work Plan

RID requested the JICA Consultant Team to make clear scope and details of the Work Plan , since RID have to study by themselves on the tasks that the JICA Study could not be covered within the JICA Study period (1.5-year). The JICA Consultant Team answered the study in principle will cover the project components of the action plan of integrated and sustainable flood mitigation in Chao Phraya River basin, which were unveiled by Thai Government Master Plan in January 20, and more concrete work plans based on preliminary studies by the Integrated Study Project on Hydro-meteorological Prediction and Adaptation to Climate Change in Thailand (hereinafter referred to as "IMPAC-T") and the International Center for Water Hazard and Risk Management (hereinafter referred to as "ICHARM") could be presented to Thai side in April 2012.

(3) Flood Simulation Software and Technical Transfer

It was agreed that MIKE series software would be used for the flood simulation in the Study. The JICA Consultant Team also agreed to convey a request of Thai side on seminar or training on the software application.

(4) Other Suggestions

The JICA Consultant Team generally agreed to take into consideration the following requests by RID:

- Study based on topographic data for appropriate design of dikes and flood walls.
- Concept of shelter that is accessible and away from potential flood area.
- Inclusion of the 2008 and 2010 floods in addition to those in 1995, 1996, 2006 and 2011 for verification of the flood simulation model, depending on the available time of project study.

4. Data Collection

Mr. Katayama, Deputy Leader of the JICA Consultant Team requested RID to urgently appoint counterpart personnel to facilitate the data collection. RID proposed to set up an inter-department committee as well as a technical working group for the purpose of inter-department coordination including data collection and agreed to appoint such representatives by the end of this week. Mr. Kanchadin of RID will act as a coordinator of RID. Regarding the set up of the inter-department committee and technical working group, JICA Consultant Team answered that the Team would convey the proposal to JICA.

ANNEX

List of Attendance

Thai Attendants (Royal Irrigation Department)

NAME	POSITION
Mr. Prasit Sitho	Chief Engineer (Executive Advisor in Survey and/or Design)
Mr. Pongsthakorn Suvanpimol	Expert on Hydrology for Deputy Director General on Operation and Management
Mr. Somkiat Prajamwong	Director of Project Management Office
Mr. Suwanna Yuvananon	Senior Expert on Survey and Photogrammetry, For Director of Office of Engineering and Topographical and Geotechnical Survey
Mr. Phonchai Klinkhachorn	Chief of Hydrological Information and Forecast Group, For Director of Office of Water Management and Hydrology
Mr. Tosapol Wongwan	Chief of Budget Analysis Group, For Director of Budget Programming Division
Mr. Chatchai Boonlue	Director of Foreign Financed Project Administration Division, Office of Project Management
Mrs. Phattaporn Mekpruksawong	Chief of Project Planning Group 1, Office of Project Management
Mr. Kanchadin Srapratoom	Chief of Loan Project Branch, Foreign Financed Project Administration Division,
Mrs. Sakuntala Bhatitrummarak	Foreign Relations Officer (Professional Level) For Director of International Cooperation Division
Mrs. Janjira Buddhawong	Foreign Relations Officer (Professional Level) Foreign Financed Project Administration Division
Ms. Sakaoduan Khayanying	Foreign Relations Officer (Professional Level) International Cooperation Division
Mrs. Jira Sukklam	Chief of Research and Applied Hydrology Group, Office of Water management and hydrology
Ms. Wanwisa Mama	Engineer Office of Water management and hydrology
Mrs. Patcharawee Suwannik	Civil Engineer (Professional Level) Office of Water management and hydrology
Mr. Weera Wangworawong	Engineer (Professional Level) Foreign Financed Project Administration Division
Mr. Vipob Teamsuwan	Civil Engineer (Professional Level) Office of Water management and hydrology
Mr. Charoen Amornmorakot	Engineer (Professional Level) Foreign Financed Project Administration Division

Thai Attendants (Royal Irrigation Department)

NAME	POSITION
Mr. Noppadol Kowsuwan	Representative of Regional Irrigation Office 1
Mr. Kanching Kawsard	Representative of Regional Irrigation Office 3
Mr. Boonthum Panpiamphot	Representative of Regional Irrigation Office 4
Mr. Teerawat Thamniyom	Representative of Regional Irrigation Office 10
Mr. Chairat Chaisawat	Representative of Regional Irrigation Office 12
Mr. Sekchai Chauewanitchakorn	Representative of Regional Irrigation Office 13

Thai Attendants (Other Agencies)

NAME	POSITION
Mr. Pradet Sangsawang	Representative of Department of Water Resources
Mr. Satja Promsorn	Representative of Department of Water Resources
Mrs. Somsuan How	Representative of Thailand International Development Cooperation Agency
Mrs. Panthila Sangjun	Representative of Thailand International Development Cooperation Agency

NESDB: National Economic and Social Development Bureau
TICA: Thailand International Development Cooperation Agency
DWR: Department of Water Resources
RID: Royal Irrigation Department

Japanese Attendants

NAME	POSITION
Mr. Hajime Taniguchi	JICA Thailand Office
Mr. Kobchai Songsrisanga	JICA Thailand Office
Mr. Matsumoto Yoshiharu	JICA Study Team
Mr. Katayama Masami	JICA Study Team
Mr. Akio Shichijugari	JICA Study Team
Mr. Takayuki Hatano	JICA Study Team
Mrs. Mizuyori Tomoko	JICA Study Team
Mr. Kazutoshi Masuda	JICA Study Team

1-1-2 Technical Group Meeting for Component 1-2 (24 April, 2012)

MINUTES OF MEETING
ON
THE TECHNICAL GROUP MEETING
FOR
COMPONENT 1-2

OF

PROJECT FOR COMPREHENSIVE FLOOD MANAGEMENT PLAN FOR
THE CHAO PHRAYA RIVER BASIN IN THE KINGDOM OF THAILAND

AGREED UPON BETWEEN
ROYAL IRRIGATION DEPARTMENT, MINISTRY OF AGRICULTURE AND COOPERATIVES
(RID/MOAC)
AND
THE STUDY TEAM OF JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

Bangkok, April 24, 2012

Dr. Somkiat PRAJAMWONG
Director of Office of Project Management
Royal Irrigation Department
Ministry of Agriculture and Cooperatives

Mr. Yoshiharu MATSUMOTO
Leader,
JICA Study Team for Subcomponent 1-2

I. Introduction

In accordance with the proposal in the Kickoff Meeting held on February 24th, Technical Working Group (hereinafter referred as The Technical Group) was organized by the RID Order No. Chor 314 /B.E. 2555 (AD 2012) in order to proceed the smooth and effective implementation of the study on the Project for Comprehensive Flood Management Plan for the Chao Phraya River Basin (hereinafter referred as Study). The mandates of the Technical Group include (1) to work with the JICA Study Team, (2) to give appropriate and useful technical options which are necessary for the study, and (3) to coordinate with other agencies in order to achieve the objectives of the study. The First Technical Working Group Meeting between members of the Technical Group and the JICA Study Team was held on 24 April 2012 with the presence of 31 participants from the headquarters and the regional offices of RID, the JICA Tokyo office, the JICA Thailand office, and the JICA Study Team. On this occasion, the Technical Group requested JICA to introduce the contents of the materials used in the meeting on the Integrated Plan for Flood Mitigation in Chao Phraya River Basin organized by Office of the National Economic and Social Development Board, Royal Irrigation Department, Department of Water Resources, and Japan International Cooperation Agency by JICA held on February 26th. Then, the topic on the meeting was also included in the agenda of this Technical Working Group Meeting.

The agenda for the meeting is Item 1: Opening Address and Acknowledgement by Chair, Item 2: Presentation of Contents for Meeting Held on April 26th, Item 3: Presentation on Study Strategy by JICA Study Team, Item 4: Confirmation of Further Data Collection and Item 5: Others.
The list of attendees is presented in Annex.

II. Presentation and Discussion

1. Item 2: Presentation on Contents for Meeting held on April 26th

For the introduction of contents of meeting held on April 26th, Mr. Takaya, a member of JICA advisory committee of the Study, presented the following contents:

- Progress of Laser Profiler Airborne Survey covering the area of 26,000 km^2 including inundated area. (The final product will be available in July 2012 and will be shared with RID and the JICA Study Team.)
- Historical background of flood control conducted by Japanese Government
- Introduction of output by IMPAC-T on hydrological analysis including flood runoff analysis together with proposal on modification of current dam operation rule
- Introduction of output by ICHARM on simulation results using flood inundation analysis model together with the effectiveness of the flood diversion channel

For the presentation, the Technical Group expressed a sincere gratitude and asked JICA to have opportunity for the discussion on the models used for hydrological analysis, runoff analysis and flood inundation analysis. JICA agreed to have an opportunity for discussions with Japanese experts from IMPAC-T and ICHARM on April 26th after the meeting. And also, the Technical Group

requested the LiDAR to be included in the simulation model for the detailed analysis. JICA answered that the simulation results presented today is in the phase one and the detailed analysis will be conducted in the phase two by replacing the current topographic data with the LiDAR data.

2. Item 3: Presentation on Study Strategy by JICA Study Team

Mr. Matsumoto, the Leader of the JICA Study Team, presented the study strategy for the Component 1-2 including study procedures of important flood mitigation measures, study schedule and items to be confirmed.

In the meeting the study strategy for Component 1-2 was generally accepted by the Thai side.

In the meeting, the following comments, proposals and information were brought from the Technical Group members:

- The Technical Group informed that there are several flood control measures which are currently under consideration, including a drainage system in the east side of the mid Chao Phraya River basin between Chainat and the Gulf of Thailand with the cooperation of the Department of Highways, improvement works on the existing drainage system in the west side of the Chao Phraya, and construction of diversion dams of which dimensions will be similar to the Chao Phraya diversion dam.
- The Technical Group proposed that for cost-benefit analysis, the direct and indirect benefits should be analyzed.
- The Technical Group proposed joint activities and on-the-job training between the Technical Group members and the JICA Study Team so that the transfer of the JICA project will be smoothly and effectively conducted between the Technical Group and the JICA Study Team once the study is completed in 2013.
- The Technical Group proposed to review the meeting handouts and provide the JICA Study Team with comments by 30 April, 2012.

For the above comments, proposals and information, the JICA Study Team answered as follows:

- For the several flood control measures currently undertaken, the JICA Study Team carefully examines their effectiveness and/or influence to this JICA Master Plan Study. In this connection, the JICA Study Team will ask to Thai side to provide more detailed information for these measures.
- Regarding the cost benefit analysis, the JICA Study Team will carefully conduct cost-benefit analysis including the direct and indirect benefits.
- Regarding the proposal on joint activities and on-the job training, the JICA Study Team proposed and agreed to have periodical meeting with the Technical Group, in principle, once a month in order to present the progress of the study and also to transfer of knowledge of the methodology relating to formulation of the Master Plan, especially on the flood inundation analysis model as well as run-off and rainfall analysis model.
- Regarding the comments, the JICA Study Team will welcome comments from the Technical Group, if any.

3. Item 4: Confirmation of Further Data Collection

Ms. Watanabe, the JICA Study Team, briefly presented the progress on the data collection and requested the RID regional offices to provide the JICA Study Team with the requested data listed in the handouts in a timely manner. The Technical Group agreed to continuously cooperate with the JICA Study Team on providing the requested data.

ANNEX

LIST OF ATTENDEES

Thai Side Attendees (Royal Irrigation Department)

No.	NAME		ORGANIZATION
1	Mr. Somkiet	Prajumwong	Office of Project Management
2	Mr. Thana	Suwatkon	Office of Project Management
3	Mrs. Suwanna	Yuwananon	Office of Engineering Topographical and Geotechnical Survey
4	Mr. Pongsathorn	Sirion	Office of Engineering and Architecture Design
5	Mr. Somjit	Amnatsarn	Office of Hydrology and Water Management
6	Mr. Noppadol	Kosuwan	Regional Irrigation Office 1
7	Mr. Witoon	Thitithanapat	Regional Irrigation Office 2
8	Mr. Kanching	Kawsaart	Regional Irrigation Office 3
9	Mr. Boontham	Panpiamphot	Regional Irrigation Office 4
10	Mr. Atthaporn	Panyachohm	Regional Irrigation Office 10
11	Mr. Pongsak	Arunwichitkul	Regional Irrigation Office 11
12	Mr. Chawalit	Wanprasert	Regional Irrigation Office 12
13	Mr. Pisarn	Pongnorrapat	Regional Irrigation Office 13
14	Mr. Supanat	Pariyachat	Office of Project Management
15	Mr. Kanchadin	Srapratoom	Office of Project Management
16	Mr. Pratya	Chaiwatthana	Office of Project Management
17	Mr. Chatchai	Boonlue	Office of Project Management
18	Mrs. Phattaporn	Mekpruksawong	Office of Project Management
19	Mr. Kuersak	Thathong	Office of Project Management
20	Mr. Dachapol	Rukamatu	Office of Project Management
21	Mr. Weera	Wangwarawong	Office of Project Management

Japanese Side Attendees

No.	NAME		ORGANIZATION
22	Mr. Shinya	Ejima	JICA
23	Mr. Kimio	Takeya	JICA
24	Mr. Taichi	Minamitani	JICA
25	Mr. Tomoyuki	Kawabata	JICA
26	Mr. Yoshiharu	Matsumoto	JICA Study Team
27	Mr. Masami	Katayama	JICA Study Team
28	Ms. Akira	Watanabe	JICA Study Team
29	Mr. Donpapob	Manee	JICA Study Team Technical Assistant
30	Ms. Kamolnit	Ariyakamolpat	JICA Study Team Interpreter
31	Ms. Nattamon	Tanyapanit	JICA Study Team Interpreter

1-1-3 Progress Meeting for Subcomponent 1-2 and Component 2 and Inception Meeting for Component 3 (27 July, 2012)

(49)

MINUTES OF MEETINGS
ON
PROGRESS MEETING FOR SUBCOMPONENT 1-2 AND COMPONENT 2
AND
INCEPTION MEETING FOR COMPONENT 3
OF
PROJECT FOR COMPREHENSIVE FLOOD MANAGEMENT PLAN
FOR THE CHAO PHRAYA RIVER BASIN IN THE KINGDOM OF THAILAND

AGREED UPON BETWEEN
THE OFFICE OF NATIONAL ECONOMIC AND SOCIAL DEVELOPMENT BOARD (NESDB)
AND
ROYAL IRRIGATION DEPARTMENT, MINISTRY OF AGRICULTURE AND COOPERATIVES (RID/MOAC)
AND
DEPARTMENT OF WATER RESOURCES, MINISTRY OF NATURAL RESOURCES AND ENVIRONMENT (DWR/MNRE)
AND
THE CONSULTANT TEAMS OF JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

Bangkok, July 27, 2012

Mr. Chachawal Punyavateenun
Deputy Director General for Engineering
Royal Irrigation Department,
Ministry of Agriculture and Cooperative

Mr. NUNOMURA Akihiko
Leader
Consultant Team for Component 3

Mr. MISHINA Takahiro
Leader
Consultant Team for Subcomponent 1-2 and Component 2

1. Introduction

Based on the Minutes of Meetings on the Amendment of Record of Discussions for the Project for Comprehensive Flood Management Plan for the Chao Phraya River Basin (hereinafter referred to as "the Project") singed on May 31, 2012 between Japan International Cooperation Agency (hereinafter referred as "JICA") and the Authorities Concerned of the Government of the Kingdom of Thailand, which are composed of National Economic and Social Development Board (hereinafter referred to as "NESDB"), Royal Irrigation Department, Ministry of Agriculture and Cooperatives (hereinafter referred to as "RID" and Department of Water Resources, Ministry of Natural Resources and Environment (hereinafter referred to as "DWR").

For confirmation of the understanding of the Inception Report of the Component 3, JICA Headquarters dispatched Mr. AMANO Yusuke on June 26, 2012 to Bangkok. The Thai side, the JICA Headquarters' Mission and the Consultant Teams held a meeting on the Inception Report of the subcomponent 3 and the progress of the subcomponent 1-2 and Component 2 at RID on July 27, 2012. The meeting was chaired by Mr. Chachawal Punyavateenun, Deputy Director General for Engineering, RID.

Mr. AMANO explained about the relation of the three components, the new Consultant Team from the Foundation of River & Basin Integrated Communications, Japan (hereinafter referred as "FRICS" for the component 3 and a new JICA expert to RID. The progress of the subcomponent 1-2 (the Master Plan Study) was briefed by Mr. TANAKA Hajime and the component 2 (the Grant Aid Project) was done by Mr. MISHINA Takahiro, and the Inception Report for the component 3 was presented by Mr. KURIKI Minoru.

After short explanation and presentation of the projects, discussions were made by the participants. As a result of the discussion, the Thai side accepted the basic concept, approach and plan of operation proposed in the Inception Report (July 2012) in principle.

Through the discussions, several items were clarified as presented in "2. Discussion" below.

2. Discussion

Major points of the discussions are summarized as follows:

Subcomponent 1-2

(1) Periodical reporting of progress of the study

RID requested the Consultant Team to report the progress for the master plan study about once a month to RID in order to let them understand what are going on and to have timely discussions on encountered problems during the study between RID and the Consultant Team and also suggested the delay of submission of Interim Report 1.

The Consultant Team answered that the Consultant Team will report the progress about once a month to RID in order to avoid any misunderstanding between RID and the Consultant Team.

(2) Schedule of technology transfer seminar or workshop

RID asked the Consultant Team about arrangement of technology transfer seminar or workshop

during the study because it will be most beneficial for Thai engineers to get technology transfer for formulation of comprehensive master plan.

The consultant team explained that we have a plan to hold seminars in December after submission of Interim Report 2 (December 2012), March before submission of Draft Final report (May 2013) and in May after submission of Draft Final Report (May 2013). The consultant team would like to have meeting with RID staff on Rainfalls, run-off meeting (September 5, 2012).

Component 2

(3) The Royal Irrigation Department and JICA selected to construct Kra Mang and Han Tra floodgates as Grant Aid Project. The Consultant Team explained the following schedule:

- The Exchange of Notes between the Government of Japan and the Government of the Kingdom of Thailand dated July 5, 2012,
- The reference documents necessary for tendering will be submitted at the end of August,
- Tender opening of the Project will be in December in Japan,
- The Contract between RID and Contractor will be in December in Japan and
- The construction period is estimated to be 17 months.

Component 3

(4) Real-time data collection

Mr. Somkiat Prajamwong, Director of Project Management Office, RID, while not objecting any data request by the JICA Consultant Team, asked clarification on the nature of the real-time data.

The Consultant Team answered that real-time data that it required for the flood forecasting were daily (rainfall) data routinely collected and tabled by different organizations concerned for their own use.

(5) Time frame of developing forecasting system

Mr. Somkiat asked the developing timeframe of a flood forecasting system. He was afraid that the system would not be formulated before the rainy season 2012, considering the time required for setting models up.

The Consultant Team explained that the models to be used in the flood forecasting were those already had developed, calibrated, and verified in the Chao Phraya River by research organizations in Japan. The team would establish a prototype system in early September 2012, which would provide some information including predictions. The accuracy of the system would be improved continuously incorporating data would become available time to time. The Consultant Team was expecting that LiDAR data would improve the accuracy of the system.

The Consultant Team explained that the accuracy of flood forecasting was a big issue. That was why the risk of forecasting flood should be properly managed, and presenting a range (minimum, maximum) of forecast, rather than a single figure, was proposed. Will the counterpart of

Component 3 be appointed. The Office of Water Management and Hydrology is required to assign an additional staff/official to co-operate to the Study Team.

All Components

(6) Improvement of data collection

JICA Consultant Teams have requested an enormous amount of data from NESDB and other agencies individually. NESDB recommended that the Consultant Teams are to make a list of what data is needed and from which agency, so NESDB can accommodate and provide accurate data smoothly.

The Consultant Teams agree to improve the method of data collection.

The list of participants is shown in Annex-1.

Annex-1: List of Attendees for the Meeting on July 27, 2012 at 3rd Floor Meeting Room of RID Samsen

1. Thai Attendants (RID, NESDB and DWR)

No	Name	Position
1	Mr. Chachawal Punyavateenun	Deputy Director General for Engineering (Chairman)
2	Mr. Prasit Sitho	Chief Engineer (Executive Advisor in Survey or Design) (Consultant)
3	Mr. Phuwanade Thongrungroj	Chief Engineer (Executive Advisor in Water Allocation and Maintenance) (Consultant)
4	Mr. Somkiat Prajamwong	Director of Project Management Office
5	Mr. Kosol Tienthongnukul	Director of Office of Engineering Topographical and Geotechnical Survey
6	Mr. Panuphan Artsalee (representative of Mr. Somkiet Tangjatuporn)	Civil Engineer, Expert Level (Design)
7	Mr. Thongpeaw Kongjun	Director of Office of Engineering and Architecture Design
8	Mr. Noppadol Kosuwan (representative of Mr. Winai Pongjinda)	Chief of Improvement and Maintenance Division
9	Mr. Chaiyong Jongaresachart	Director of Regional Irrigation Office 2
10	Mr. Kanching Kawsard (representative of Mr. Sophon Thamraksa)	Chief of Operation and Maintenance Division of Regional Irrigation Office 3
11	Mr. Boonthum Panpiamphot (representative of Mr. Arejit Suwanitchawong)	Chief of Water Management of Regional Irrigation Office 4
12	Mr.Ugrid Thawonklaikool (representative of Mr. Nopporn Chaipichit	Director of Operation and Maintenance Division of Regional Irrigation Office 10
13	Mr. Chainarin Panpinyaporn	Director of Regional Irrigation Office 11
14	Mr. Darongkorn Somton	Director of Regional Irrigation Office 12
15	Mr. Preecha Jarnthong	Director of Regional Irrigation Office 13
16	Mr. Jamnong Phungpuk (representative of Mr. Montri Boonpanit)	Director of Office of the National Economic and Social Development Board (NESDB)
17	Mr. Jirawat Ratisunthorn (representative of Mr.Boonjong Jaratdamrongnit)	Director of Water Crisis Prevention Center
18	Mr. Chatchai Boonlue	Director of Foreign Financed Project Administration Division, Office of Project Management
19	Mr. Jirawat Prachimlang (representative of Mr. Sathit Seuprasertsuk)	Civil Engineer, Practitioner Level
20	Mr.Kanchadin Srapratoom	Chief of Loan Project Branch, Foreign Financed Project Administration Division
21	Ms. Sukontha Airkarat (representative of Mr. Singhadet Chu-Amnat)	Representative of Director Bureau of Coordination for International Cooperation
22	Mr. Prayoon Yenjai (representative)	Chief of Water Management Division of Regional Irrigation Office 13
23	Mr. Chonlathep Thatri	Chief of Water Management Division of Regional Irrigation Office 3
24	Mr. Suparat Kosumapinan	Chief of Design Group of Regional Irrigation Office 10
25	Mr. Klaileuk Inchayanan	
26	Mr. Pinyo Gessa	Policy Analyst of Department of Water Resources
27	Ms. Kobkul Rangsiyaroj	Plan and Policy Analyst, Senior Professional Level
28	Mr. Jaroern Amornmorakot	Engineer, Professional Level, Foreign Financed Project Administration Division
29	Mr.Weera Wangworawong	Irrigation Engineer, Professional Level, Foreign

		Financed Project Administration Division

2. Japanese Attendants

No	Name	Position
1	Mr. AMANO Yusuke	JICA Headquarters
2	Mr. NUNOMURA Akihiko	Consultant Team (Component 3)
3	Mr. KURIKI Minoru	Consultant Team (Component 3)
4	Mr. KANAZAWA Hirokatsu	Consultant Team (Component 3)
5	Mr. INOUE Yasushi	Consultant Team (Component 3)
6	Mr. MISHINA Takahiro	Consultant Team (Subcomponent 1-2 and Component 2)
7	Mr. TANAKA Hajime	Consultant Team (Subcomponent 1-2 and Component 2)
8	Mr. Chuchat Suwut	Consultant Team (Subcomponent 1-2 and Component 2, Local Staff)
9	Ms. Kamolnit Ariyakamolpat	Consultant Team (Subcomponent 1-2 and Component 2, Local Staff)
10	Ms. Melyn Chutumstid	Consultant Team (Subcomponent 1-2 and Component 2, Local Staff)

1-1-4 Second Technical Working Group Meeting for Subcomponent 1-2 and Component 3 (29 October, 2012)

MINUTES OF MEETING
ON
THE SECOND TECHNICAL WORKING GROUP MEETING
FOR
SUBCOMPONENT 1-2 AND COMPONENT 3

OF

PROJECT FOR COMPREHENSIVE FLOOD MANAGEMENT PLAN FOR
THE CHAO PHRAYA RIVER BASIN IN THE KINGDOM OF THAILAND

AGREED UPON BETWEEN

TECHNICAL WORKING GROUP
AND
THE STUDY TEAMS OF JAPAN INTERNATIONAL COOPERATION
AGENCY (JICA)

Bangkok, October 29, 2012

Dr. Somkiat Prajamwong	Mr. Takahiro MISHINA	Mr. Akihiko NUNOMURA
Director , Office of Project Management Royal Irrigation Department	Leader, The Study Team of Japan International Cooperation Agency (Subcomponent 1-2)	Leader, The Study Team of Japan International Cooperation Agency (Component 3)

I. Introduction

The Second Technical Working Group Meeting between members of the Working Group and the JICA Study Teams for Subcomponent 1-2 and Component 3 was held on 29th October, 2012 with the presence of 35 participants from the headquarters and the regional offices of RID, the JICA Tokyo office, and the JICA Study Teams.

The agenda for the meeting is divided into those for Subcomponent 1-2 and Component 3, as follows:

Program I: Subcomponent 1-2

1. Presentation of "Progress of master Plan's Basic Concept" by JICA Study Team Subcomponent 1-2
2. Comments and Suggestions of RID Technical Working Group

Program II: Component 3

1. Presentation of "Urgent Action Plan Report" by JICA Study Team Component 3
2. Monitor Responses to the Flood Risk Information System
3. Comments and Suggestions of RID Technical Working Group

Contents of the presentations by the two JICA Study Teams were generally accepted by the RID Technical Working Group.

The list of attendees is presented in Annex.

II. Presentation and Discussion for Program I: Subcomponent 1-2

1. Presentation of "Progress of Master Plan's Basic Concept"

Mr. Mishina, the Leader of JICA Study Team for Subcomponent 1-2, presented "Progress of Master Plan's Basic Concept" including six (6) basic conditions and seven (7) action plans as shown in Figure 2.1.1 in the meeting material, focusing on:

- Basic Approach of Master Plan Study
- Evaluation of Flow Capacity including Flood Analysis Model
- Setting Protection Area
- Habitual Flood Area
- Countermeasures such as Flood Diversion Channel

2. Comments and Suggestions of RID Technical Working Group

The Working Group stated that it would provide comments and suggestions on the presentation in writing to the JICA Study Team. The Working Group also requested the JICA Study Team to have opportunities for further discussions on three items including (1) the models used for hydrological

analysis, runoff analysis and flood inundation analysis, (2) the data which are used in the Study and (3) the countermeasures which are proposed in the presentation. The JICA Study Team agreed to have separate meetings for each item with appropriate representatives from both sides.

III. Presentation and Discussion for Program II: Component 3

1. Presentation of "Progress of Master Plan's Basic Concept"

Mr. Kuriki, the Deputy Leader of JICA Study Team for Component 3 explained "The Urgent Activities Action Plan Report", which described the necessary activities for establishment of a flood data analysis and flood forecasting system (the Flood Risk Information system for the Chao Phraya River basin) to serve as a flood countermeasure during 2012 flood season.

The Flood Risk Information system for the Chao Phraya River basin, the prototype of which became operational in mid-September 2012, provided the past, present, and forecast (up to 7 days) flow rate and water level, as well as forecast (up to 7 days) inundation extent. Information was expressed in (i) the schematic diagram of the river, (ii) flow rate and water level graphs, and (iii) inundation extent on Google map. The schematic diagram provided color-coded risk level of stations. The flow rate graph and water level graph would be shown after users click at station from the schematic diagram. The flow rate graph would show maximum forecast values (corresponded to maximum rainfall), and minimum forecast values (with no rain). The forecast inundation extent indicated the flood risk (1-7 day flood forecast) using color-coded high risk level (dark blue) and risk level (light blue) legends, shown on Google map. The definition of "High Risk Area" was the area with the possibility of inundation (with the inundation depth of 20 cm. or more) in case of the minimum rainfall; "Risk Area" was the area with the possibility of inundation in case of the maximum rainfall.

In order to introduce and receive feedbacks and comments on the Flood Risk Information system from potential users, briefing seminars were held on 4 September 2012, hosted by the JICA, for some 200 Japanese firms, and 9 September 2012, hosted by the JICA and the National Economics and Social Development Board, for some 70 representatives from the Thai government organizations related to the water management. As of 26 October, there were 218 Japanese monitors and 53 Thai monitors.

Outstanding issues of the Flood Risk Information system were categorized into three:

(i) Technical Issues, such as rainfall forecast and inundation risk;
(ii) Operational Issues, such as observation data acquisition and operation of the system; and
(iii) Utilization Issues, such as information delivery and user interface.

The Study Team proposed a small Task Force composed of experts from RID, DWR and other related organizations to discuss the solution strategies for these issues.

2. Comments and Suggestions of RID Technical Working Group

Dr. Somkiat, Director of Project Management Office and Chairman of the meeting, commented that the Technical Working Group must assist the Study Team in verifying the contents of the system before presenting it to the public.

Comment and suggestions given by the participants were as follows:

(1) "No rain" for the minimum expected rainfall should be reconsidered;
(2) System should help decision makers to warn people;
(3) Satellite images and the LiDAR data should be properly utilized;
(4) Factors required by the simulation models should reflect the conditions of Thailand;
(5) Definition of inundation risk should be defined taking the difference in agricultural areas and city areas into consideration;
(6) Schematic diagrams used by the Components should be the same;
(7) Information of upper Chao Phraya River areas should be added;
(8) Data of side flow rivers should be added to the system;
(9) Schematic diagram should include more facilities, such as branch canals, canal retention, floodgates, big pumps, dams, and retention areas at the downstream; and
(10) Projects of upper rivers should be considered.

The Chairman suggested that all factors that help people to better understand the situation should be included, such as location of pumping stations and water gates, as well as their operation status.

Mr. Nunomura, Team Leader of Study Team, Component 3, replied that while it might be difficult to materialize all of the requests and suggestions at a time, important ones would be prioritized, and the system should be improved in collaboration with the Thai experts. He also pointed out that system output would become "information" only when it is utilized by the users.

Dr. Somkiat concluded the meeting by assigning the secretary of the meeting to arrange a meeting between the Study Team for Subcomponent 1-2 and Component 3, and the Technical Working Group the following week to make all issues clear and for the JICA study team and RID to go on the same direction. He also assigned the RID representatives who will go to the training in Japan to cooperate with the Study Team to learn and understand the concepts of the training and also requirements from Japan side before departure.

ANNEX

LIST OF ATTENDEES

THAI SIDE ATTENDEES (Royal Irrigation Department)

TECHNICAL WORKING GROUP MEMBER		
No.	**NAME - SURNAME**	**OFFICE**
1	Mr. Somkiat Prajamwong	Director of Project Management Office Office of Project Management
2	Mr. Pongsatorn Sirion	Chief of Irrigation System Design Group Office of Engineering and Architecture Design
3	Mrs. Phatcharawi Suwannik	Irrigation Engineer, Profession Level Office of Water Management and Hydrology
4	Mr. Noppadol Kowsuwan	Representative of Regional Irrigation Office 1 Regional Irrigation Office 1
5	Mr. Somwang Phonsitthito	Chief of Water Management Branch Regional Irrigation Office 2
6	Mr. Kanching Kawsard	Representative of Regional Irrigation Office 3 Regional Irrigation Office 3
7	Mr. Boonthum Panpiampoth	Chief of Water Management Branch Regional Irrigation Office 4
8	Mr. Chonlathep Thatree	Chief of Water Management Branch Regional Irrigation Office 4
9	Mr. Athaporn Punyachom	Chief of Water Management Branch Regional Irrigation Office 10
10	Mr. Thanaroj Worraratprasert	Chief of planning and water issue solution division Regional Irrigation Office 12
11	Mr. Phaisan Phongnoraphat	Director of Operation and Maintenance Division Regional Irrigation Office 14
12	Mr. Supanat Pariyachat	Chief of Project planning Group 4 Office of Project Management
13	Mr. Kanchadin Srapratoom	Chief of Loan Project Branch, Foreign Financed Project Administration Division Office of Project Management
14	Mr. Prachya Chaiwatthana	Civil Engineer, Professional level Office of Project Management

THAI SIDE ATTENDEES (Royal Irrigation Department)

SPECIAL INVITATION		
No.	NAME - SURNAME	OFFICE
15	Mr. Chatchom Chompadist	Director of Water Management Division Department of Royal Irrigation
16	Mr. Zombhob Intaraksa	A Specialist in Hydrology Hydrology Division
17	Mr. Thada Sukapunaphan	Director of Hydrology Division Hydrology Division
18	Mr. Chatchai Boonlue	Director of Foreign Financed Project Administration Division Office of Project Management

JAPANESE SIDE ATTENDEES

No.	NAME - SURNAME	OFFICE
19	Mr. Yusuke Amano	Senior Advisor to the Director General JICA Tokyo
20	Mr. Hideaki Matsumoto	Deputy Director, Disaster Management Division 1 JICA Tokyo
21	Mr. Tatsuo Kunieda	JICA Expert to Royal Irrigation Department JICA Expert to RID
22	Mr. Takahiro Mishina	Leader, JICA Study Team Subcomponent 1-2
23	Mr. Hajime Tanaka	Deputy Leader, JICA Study Team Subcomponent 1-2
24	Mr. Takashi Ono	JICA Study Team Subcomponent 1-2
25	Ms. Akira Watanabe	JICA Study Team Subcomponent 1-2
26	Mr. Satoshi Takata	JICA Study Team Subcomponent 1-2
27	Mr. Masami Katayama	JICA Study Team Subcomponent 1-2
28	Mr. Kazuhiro Nakamura	JICA Study Team Subcomponent 1-2
29	Mr. Chuchat Suwat	JICA Study Team Subcomponent 1-2
30	Ms. Kamolnit Ariyakamolpat	JICA Study Team Subcomponent 1-2
31	Mr. Akihiko Nunomura	Leader, JICA Study Team Component 3
32	Mr. Minoru Kuriki	Deputy Leader, JICA Study Team Component 3
33	Mr. Kiyotaka Koga	JICA Study Team Component 3
34	Ms. Nutthanicha Kasiolarn	JICA Study Team Component 3
35	Ms. Wanlaya Manutkasemsirikul	JICA Study Team Component 3

MINUTES OF MEETING
ON
THE TECHNICAL MEETING ON MODELING
FOR
SUBCOMPONENT 1-2

OF

PROJECT FOR COMPREHENSIVE FLOOD MANAGEMENT PLAN FOR THE CHAO PHRAYA RIVER BASIN IN THE KINGDOM OF THAILAND

AGREED UPON BETWEEN

TECHNICAL WORKING GROUP, ROYAL IRRIGATION DEPARTMENT, MINISTRY OF AGRICULTURE AND COOPERATIVES (RID/MOAC)

AND

THE STUDY TEAM OF JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

Bangkok, November 13, 2012

Dr. Somkiat PRAJAMWONG

Director,
Office of Project Management
Royal Irrigation Department
Ministry of Agriculture and Cooperatives

Mr. Takahiro MISHINA

Leader,
The Study Team of Japan International
Cooperation Agency (Subcomponent 1-2)

I. INTRODUCTION

At the RID Technical Working Group Meeting held on 29th October, 2012, as part of "Project on Comprehensive Flood Management Plan for the Chao Phraya River Basin in the Kingdom of Thailand" (hereinafter called as "Project"), the Technical Working Group (hereinafter called as "the Technical Group") requested the JICA Study Team (hereinafter called as "The Study Team") to have opportunities for further discussions on selected topics, which includes a meeting about the models which are used for hydrological and hydraulic analyses, runoff analysis and flood inundation analysis.

In response to the request, the technical meeting on modeling between members of the RID representatives (hereinafter called as "RID") and the Study Team for Subcomponent 1-2 was held on the 13th November, 2012 with the presence of 26 participants from the headquarters and the regional offices of RID and the Study Team. Of the 26 participants, seven (7) participants were the JICA Hydrologists and Hydraulic Engineers from Japan attended via internet to provide the technical supports.

The agenda for the meeting is as follows:

1. Presentation by JICA Expert: "Flood Analysis Model Used for the Project"
2. Discussion: comments and suggestions from RID representatives

Contents of the presentations by the Study Team were generally accepted by RID at the meeting.

The list of attendees is presented in Annex 1.

II. PRESENTATION AND DISCUSSION

1. Presentation of "Progress of Master Plan's Basic Concept"

Mr. Katayama, the River Basin Management Engineer of the Study Team for Subcomponent 1-2, presented "Flood Analysis Model" including six (6) topics:

- Overview of Modeling Work
- Flood Runoff Model (DHI-NAM)
- River Network Model (DHI-MIKE 11)
- Inundation Model (DHI-MIKE FLOOD)
- Flood Analysis Model; and
- Model Calibration

2. Comments and Suggestions of RID Representatives

RID stated that they would provide additional data and information as listed in Annex 2 which would be beneficial to the model analysis as discussed at the meeting.

[Runoff Model]

RID requested the Study Team to elaborate further on the criteria which were applied to divide the Chao Phraya River basin into twenty-seven sub-basins as listed in Table 1.2.1 in the meeting material. The Study Team responded that it is based on the watershed characteristics such as topographic, land slope, watershed size, land cover, locations of major features (dams, rivers, tributaries, canals), flood control points (at hydrological station such as C.2. Nakhon Sawan etc) and the 1999 JICA Study results.

The Study Team requested RID to provide with previously conducted studies related to the sub-basin division of Tha Chin River basin, if there is any. This is to confirm the basic idea of RID about how it needs to be made. RID agreed to provide the information to the Study Team.

RID suggested to use the term of "evapotranspiration" instead of "evaporation". The Study Team agreed to modify the term accordingly.

RID requested the runoff ratio for each basin in the model. The Study Team presented the analysis results that the ratio values vary from basin to basin, for example 50% for the Ping River basin and 70% for the Nan River basin, of which values are somewhat affected by the dam operations at the Bhumibol Dam and the Sirikit Dam, respectively. As an example of the river networks under a natural condition (without the influence of the dam operation), the Yom River basin would be referred with 60% runoff ratio. The Study Team emphasized that these values must be used only as a guide.

RID requested the upstream area adjacent to Yom and Nan Rivers, "Bang Ragam Area" (approximately 500,000 rai) as shown in Annex 3 also be considered as inland flooding area similar to the downstream of Chainat. The Study Team suggested analyzing calibration results. If the model can not represent the 2011-yr Flood reasonably well without the setting of the upper inland flooding area, the Study Team will to look into LiDAR Data and check the land features as suggested by RID.

[River Network Model]

RID agreed the Study Team's proposal that dummy cross section data generated from LiDAR data would be used where RID cross section data is not available.

RID agreed to provide the Study Team with the information of roughness coefficient of river and canal which were previously applied in the RID's models or studies.

The Study Team agreed that additional structures, such as DR2.8 Regulator, the cut-off on the Chao Phraya shall be included in the model and will be shown in the schematic diagram shown in Figures 1.3.3, 1.6.1 and 1.6.2 of the meeting material.

RID suggested that the location of hydrological stations of Y.16 and N. 60 be changed to the right locations in the schematic diagram shown in Figures 1.3.3, 1.6.1 and 1.6.2 in the meeting material. The suggested locations are shown in Annex 4. The Study Team agreed on the change.

The Study Team agreed to provide RID with a location map which indicates the areas to be modeled by one and two dimensional model.

[Inundation Model]

RID requested the Study Team to elaborate further on how to simulate the situation when the dyke will be breached. The Study Team explained that several steps will be taken (1) the breached location will be identified based on the 2011 observed/collected information by RID, and (2) a gate/weir will be virtually built in the model which will control the overflow condition of the dyke breach at each location.

RID requested an inundation map which will be generated based on the simulation results of flood analysis model. The Study Team agreed to prepare the map when the modeling results are ready to present.

RID requested the further explanation about how the continuous structures such as road shall be presented in the model. The Study Team explained that (1) extract elevation data of such structure features from LiDAR data, and (2) give the extracted elevation values to each mesh as the ground elevation value at location to represent such continuous structures in the model. In the inundation analysis, it is set that the flow will start overtopping when the water level exceeds the height of dyke/road.

RID requested to include additional pump stations in the model. The requested pump stations are included in Annex 2.

[Flood Analysis Model]

RID suggested that the upper boundary conditions set in Yom and Nan River networks be changed from Y.3A to Y.14 for the Yom River basin and from the Naresuan Dam to N.60 for the Nan River basin, respectively. In addition, RID suggested that the observed data at the Klong Hok Baht Regulator be utilized to reproduce the flow diversion into the Yom Koa River for the 2011-yr Flood flow instead of using the Ban Hat Saphan Chan Regulator (which is currently not considered in the calibration model due to low accuracy of data). The Study Team agreed to include the suggestions in the model.

RID suggested that the flood mark survey conducted in 2012 as one of sub-contract surveys by the Study Team be further utilized in the Project. The Study Team agreed with the suggestion.

RID requested that opportunities shall be given to RID representatives so that they have proper trainings to learn and fully utilize the Flood Analysis Model once it is handed over from the Study Team to RID after the completion of the Project. The Study Team agreed to look into the possibility of setting up the training opportunities for RID officers.

[Model Calibration]

RID requested that the Study Team to present results of the model analysis including the calibration analysis for chosen scenarios as early as possible.

Meeting adjourns at 16:30 pm.

ANNEX 1

LIST OF ATTENDEES

THAI SIDE ATTENDEES (Royal Irrigation Department)

TECHNICAL WORKING GROUP MEMBER				
No.	**NAME – SURNAME**			**OFFICE**
1	Mr.	Somkiat	Prajamwong	Office of Project Management
2	Mr.	Chonlathep	Thatree	Regional Irrigation Office 3
3	Mr.	Lerboon	Udomsap	Regional Irrigation Office 11
4	Mr.	Boonthum	Panplampoth	Regional Irrigation Office 4
5	Mrs.	Phattaporn	Mekpruksawong	Office of Project Management
6	Mr.	Supanat	Pariyachat	Office of Project Management
7	Mr.	Kanchadin	Srapratoom	Office of Project Management
8	Mrs.	Patcharawee	Suwannik	Office of Water Management and Hydrology
9	Mr.	Wirod	Khochalerd	Office of Project Management
10	Mr.	Pongpich	Yodying	Office of Project Management
11	Ms.	Supinda	Wattanakorn	Office of Project Management
Special Invitation				
12	Mr.	Tatsuo	Kunieda	Expert to JICA
13	Ms.	Paweesuda	Boonchuwong	Secretary of JICA Expert

JAPANESE SIDE ATTENDEES

No.	**NAME - SURNAME**			**OFFICE**
14	Mr.	Hajime	Tanaka	JICA Study Team, Component 1-2
15	Mr.	Masami	Katayama	JICA Study Team, Component 1-2
16	Ms.	Akira	Watanabe	JICA Study Team, Component 1-2
17	Mr.	Chuchat	Suwut	JICA Study Team, Component 1-2
18	Ms.	Melyn	Chutumstid	JICA Study Team, Component 1-2
19	Ms.	Nichapat	Rakpongthai	JICA Study Team, Component 1-2
Attended via Internet				
20	Mr.	Kazuhiro	Nakamura	JICA Study Team, Component 1-2
21	Mr.	Yoshitomo	Yonese	JICA Study Team, Component 1-2
22	Mr.	Tatsuya	Koga	JICA Study Team, Component 1-2
23	Ms.	Saeka	Yamada	JICA Study Team, Component 1-2
24	Mr.	Takayuki	Kawashima	JICA Study Team, Component 1-2
25	Mr.	Hitoshi	Nagata	JICA Study Team, Component 1-2
26	Ms.	Natsumi	Okamine	JICA Study Team, Component 1-2

ANNEX 2

LIST OF DATA RID AGRRED UPON
TO PROVIDE WITH THE JICA STUDY TEAM

NO.	DATA TO BE PROVIDED		CONTACT INFORMATION
	ITEM	DATA	
1	Khlong Hok Baht Regulator	Q (daily)	Regional Irrigation Office 4
2	Ban Hat Saphan Chan Regulator	Q (daily)	Regional Irrigation Office 4
3	Y.14 Gauging Station	Q, WL (daily)	Hydro-Center 2
4	N.60 Gauging Station	Q, WL (daily)	Hydro-Center 2
5	Bang Rakam Monkey Cheek Report	Report	Project Planning Group 1
6	Tha Chin River Basin Report	Report	Project Planning Group 1
7	Data of Pumping Stations in RID 11	-	Regional Irrigation Office 11
8	Khwae Noi Dam Break Report	Report	Project Planning Group 1

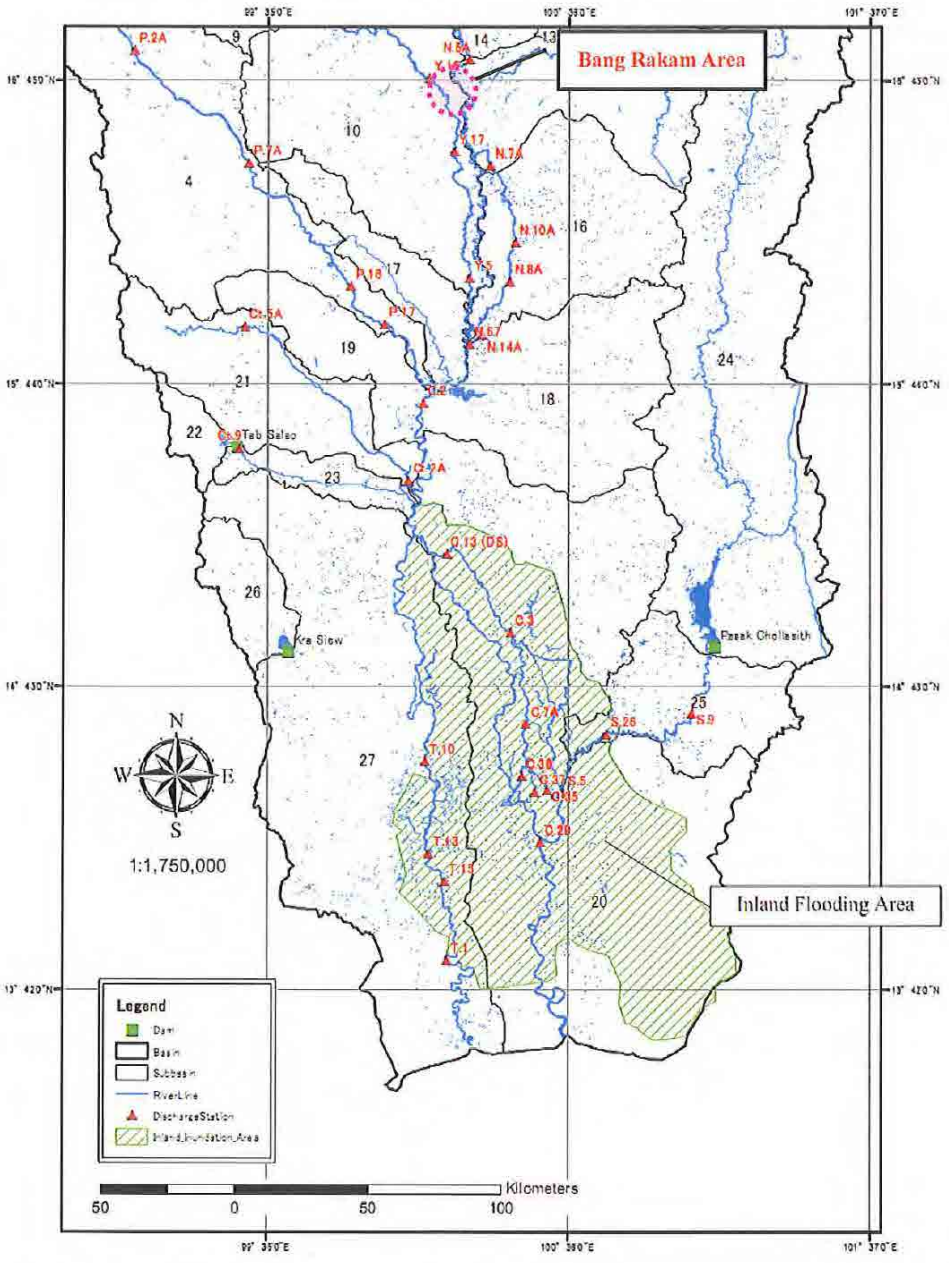
Remark

Q = Discharge

WL = Water Level

ANNEX 3

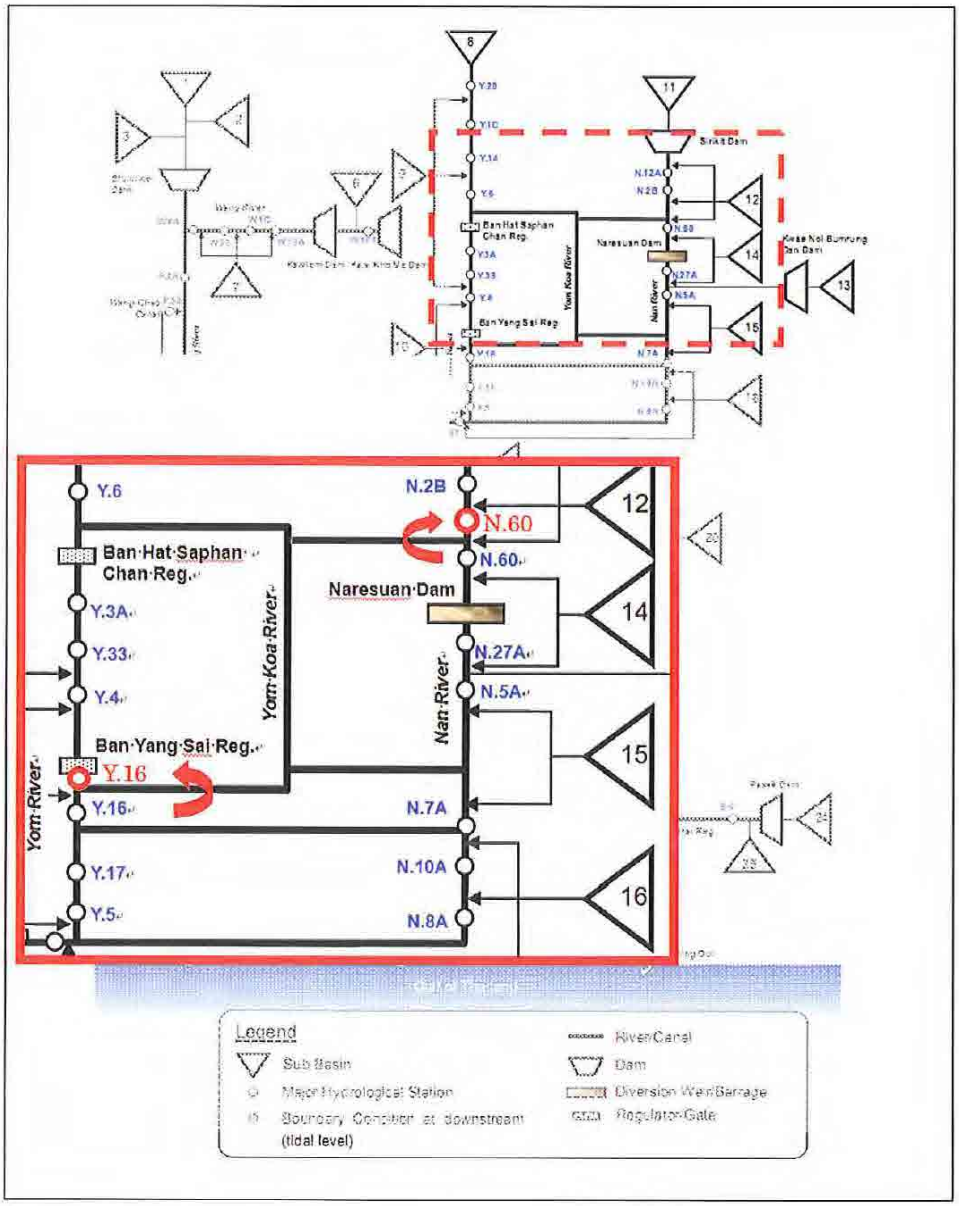
LOCATION MAP OFBANG RAKAM AREA



ANNEX 4

SKEMATIC DIAGRAM

LOCATION OF SUGGESTED CHANGE ON HYDROLOGICAL STATIONS



A-4

MINUTES OF MEETING

ON

THE STEERING COMMITTEE MEETING FOR SUBCOMPONENT 1-2 AND COMPONENT 3

OF

PROJECT FOR COMPREHENSIVE FLOOD MANAGEMENT PLAN

FOR THE CHAO PHRAYA RIVER BASIN IN THE KINGDOM OF THAILAND

AGREED UPON BETWEEN

THE ROYAL IRRIGATION DEPARTMENT, MINISTRY OF AGRICULTURE AND COOPERATIVES (RID/MOAC)

AND

THE JICA STUDY TEAMS OF JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

Bangkok, December 12, 2012

Mr. Chachawal Punyavateenun
Deputy Director General for Engineering
Royal Irrigation Department,
Ministry of Agriculture and Cooperatives

Mr. NUNOMURA Akihiko
Leader
JICA Study Team for Component 3

Mr. MISHINA Takahiro
Leader
JICA Study Team for Subcomponent 1-2

1 Introduction

The Steering Committee Meeting between members of the Steering Committee (The Committee) and the JICA Study Teams (The Study Team) for Subcomponent 1-2 and Component 3 was held on the 12th December, 2012 with the presence of 45 participants from the headquarters and the regional offices of RID, NESDB, DWR, the JICA Tokyo office, the JICA Thailand office and the Study Teams.

The agenda for the meeting is divided into two for Subcomponent 1-2 and Component 3, as follows:

Program I: Subcomponent 1-2

1. Presentation of "Interim Report on Formulation of Master Plan: Comprehensive Flood Management Plan for the Chao Phraya River Basin" by the Study Team Subcomponent 1-2; and
2. Comments and Suggestions of Steering Committee members.

Program II: Component 3

1. Presentation of "Overall Structure and State of Progress of Component 3" by the Study Team Component 3;
2. Preparation Status of Prototype and Open-to-public Version Flood Risk Information System;
3. Specific Ideas to be Included in the Flood Management System Basic Plan; and
4. Comprehensive Flood Management System Preparation Plan (to be implemented in Phase 2).

Contents of the presentations by the two JICA Study Teams were generally accepted by the Steering Committee. The list of attendees is presented in Annex.

2 Program I: Subcomponent 1-2

2.1 Presentation

Mr. Mishina, the leader of the Component 1-2, presented the interim report of the Master Plan. The main items presented are as follows:

1. Flood Condition of the 2011 year flood;
2. Basic Approach and Study Items;
3. Basic Study including Design Flood, Design High Water Level, Flood Capacity, Protection Area, Habitual Flood Area;
4. Study on Counter Measures including, Improvement of Dykes and River Channel, Effective Operation of Existing Dams, Flood Control Volume with New Dams, Flood Control with Diversion Channels, Possible Flood Control Volume in Retarding Basin and Retention ponds; and
5. Results of the Inundation Analysis.

2.2 Comments and Suggestions of Steering Committee Members

The Committee questioned about the Design High Water Level (DHWL) that how the JICA selected DHWL as 3.5 meters. The Committee also raised a question if the structures owned by

the Bangkok Metropolitan Administration (BMA) could accommodate the maximum water level at 3.50 meters level, as at the current condition BMA structures could only withstand against water level at 2.5 to 3.0 m. The Study Team answered that they knew the limitation within the Bangkok area. DHWL as 3.5 meters is selected at the point of 90 km from the river mouth. Around the Bangkok area, DHWL should be modified following water level at 2.5 m to 3.0 m. Also the DHWL showed in the meeting is the initial setting and the DHWL will be adjusted and decided after simulation with various countermeasures studied in the Master Plan of which the conceptual framework and countermeasures proposed are shown in the Figure attached.

The Committee questions that about the proposed floodways on the east and west sides of the Chao Phraya River that why the total discharge through floodways on both the west and east sides was calculated as 2,000 m^3/s. The existing structures on both sides are able to convey water at 250 m^3/s through the Chai Nat-Pasak Canal and at 500 to 600 m^3/s through the canals on the west side. The Study Team answered that the total discharge at 2,000 m^3/s was calculated based on the SCWRM proposal presented in January 2012 and the optimum flow capacity of the floodway would be evaluated based on the analysis of various alternative measures to be proposed in the Master Plan.

The Committee commented that the Study Team may need to discuss with BMA and WRFMC about setting DHWL. The Committee also commented about the current BMA's plan for the dyke improvement that Section from Spanput to Sangi hospital, BMA would increase the dyke height to 2.8 m, another section, Sangi Hospital to the Gulf of Thailand increase to 3.2 m msl. The Committee suggested that DHWL discussion would be continued at the Technical Meeting scheduled in the afternoon on December 12, 2012. The Study Team answered that the information of current BMA's plan for the dyke improvement has been collected. The Study Team agreed to discuss this matter further with the RID representatives at the Technical Meeting.

The Committee commented about the proposed total area of the retention area/monkey cheek that if this land area is outside of the already discussed 2.1 million rai of land, the subject should first be discussed with the Ministry of Agriculture and Cooperatives. The Study Team explained that the current study with the retention areas of 1.2 million rai followed the M/P and F/S conducted by RID in 2008. The Study Team agreed on the comment and the subject will be discussed again to formulate the optimum combination of countermeasures.

The Committee questioned about the presented four (4) floodway alternatives that why the Study Team conducted these four Alternatives although the difference between Alternative 1 and 2, and between Alternative 3 and 4 are insignificant. Also, relation between the proposed countermeasures and issues caused by the flood are not clear. The Study Team answered that without considering the various alternatives from the basin wide perspective, the solid conclusion

could not be reached. The Study Team will make clear the necessity of each countermeasure and propose the optimum combination of countermeasures for further discussion based on the additional cases of flood inundation analysis.

The Committee suggested and the Study Team agreed that several additional meetings with a small group of concerned RID representatives shall be set up and details must be discussed with them in depth before presenting the study results at the Committee.

3 Program II: Component 3

3.1 Presentation

The Study Team explained to the Committee the progress of the studies carried out under Component 3. Studies were on the following items:

1. Basic Concept;
2. Basic Plan;
3. Action Plan (urgent activity);
4. Implementation Plan (urgent activity); and
5. Establishment of Flood Data Analysis/Flood Forecasting System (urgent activity)

Flood Risk Information System (prototype) was developed in two months (July-August, 2012), and registered monitors were provided with daily-updated forecast information (water level, flow rate, and inundation area) in the Chao Phraya River Basin during 2012 flood season. Upon development, careful considerations were given to information needs, characteristics of the Chao Phraya River, accuracy/uncertainty of the forecast values, and calibration procedures. A simple and user-friendly website was realized. To upgrade the prototype system to the "open-to-public" version of the system, there remained a number of issues (technical, operational, utilization). Selected members of RID, DWR, HAII and SCC discussed these issues in multiple meetings in November 2012, to formulate proposed solutions (tentative). These proposals, combined with suggestions given in the responses to questionnaire surveys to the registered monitors, would be examined by the Study Team for consultation with the Thai government regarding their adoption in the system upgrading.

Basic Plan was being prepared with the following considerations taken into:

- Attach most importance not to the sender of information, but to the receiver of information, and how well they utilize the information;
- Understand the actual situation of Thailand appropriately, in comparison with the experiences and devices of Japan;
- Introduce effective new technologies, utilizing existing facilities in Thailand;
- Present specific proposals rather than abstract ones;
- Conduct unprecedented surveys and analyses related to information to formulate plans

and to be utilized in various considerations in the future by the Thai Government.

The draft Basic Plan would be presented at a workshop tentatively scheduled in end-January 2013 in Bangkok, to which executives of the Thai Government, individuals of flood-related government organizations, and mass media would be invited.

The report also described the following activities to be taken under the Phase 2 (February-June 2013) of the Component:

1. Action Plan on Construction and Operation of Flood Management System; and
2. Function Improvement of Flood Forecast System

3.2 Discussion

The Committee heard an opinion that the officials of RID, DWR and HAII being trained in Japan would be responsible for conveying the acquired knowledge to related officers and supporting phase 2 of the Component.

Regarding the agency in charge of the System, the Study Team explained that, while the servers were installed at RID, other agencies would be able to operate the system: It, however, would depend on the government's assignment that which agencies should be able to operate the system. JICA representative suggested that RID and DWR would be appropriate organizations in operating the system. However, the system operator(s) should cooperate with HAII to achieve the unity of appropriate flood forecasting system in Thailand as the government's requirement. In this regard, the Committee agreed that HAII and the Single Command Center, as well, should be involved in the system operation in order to cross check information from various agencies and unify the flood information of Thailand.

4 JICA Seminar Schedule

Mr. Matsumoto of the JICA Tokyo Office presented the schedule of the upcoming JICA Seminars as follows:

1) Seminar of the JICA Project
   Date: In late January 2013
   Place: Bangkok
   Participants: Executives and Officials of the Government of Thailand, and Medias
   Contents: 1) Draft Basic Plan of Flood Management System
   2) Preliminary Draft Master Plan of Comprehensive Flood Management

2) Seminar of the JICA Project
   Date: 20th February, 2013
   Place: Bangkok
   Participants: Executives and Officials of the Government of Thailand, International

Donors, Firms applying to the International Competition

Contents: 1) Draft Master Plan of Comprehensive Flood Management

2) Impact on Climate Change (IMPAC-T) <Tentative>

3) Establishment of Simulation Model (ICHARM) <Tentative>

Meeting adjourns at 12:20 pm.

ATTENDEES LIST

[THAI SIDE]

Member of the Steering Committee

No	Name-Surname	Position	Committee
1	Mr. Prasit Sitho	Chief Engineer on Civil Engineering (Survey and Design)	Advisor
2	Mr. Phuwanet Thongrungrot	Chief Engineer on Irrigation Engineering (Water Distribution and Maintenance)	Advisor
3	Mr. Chachawal Punyavateenun	Deputy Director-general (Technical)	Chairman
4	Mr. Koson Thianthongnukun	Director of Office of Engineering Topographical & Geotechnical Survey	Member
5	Mr. Thongplew Kongjun	Director of Office of Water Management & Hydrology	Member
6	Mr. Montri Bunpanit	Director of Agriculture, Natural Resource and Environment Planning Office (NESDB)	Member
7	Mr. Kanchadin Srapratoom	Chief of Loan Project Branch	Member
8	Mr. Sathit Sueprasoetsuk	Director of Specific Area Protection (DWR)	Member
9	Mr. Surasit Indarapracha	Director of Office of Engineering and Architecture Design	Member

[SPECIAL INVITATION]

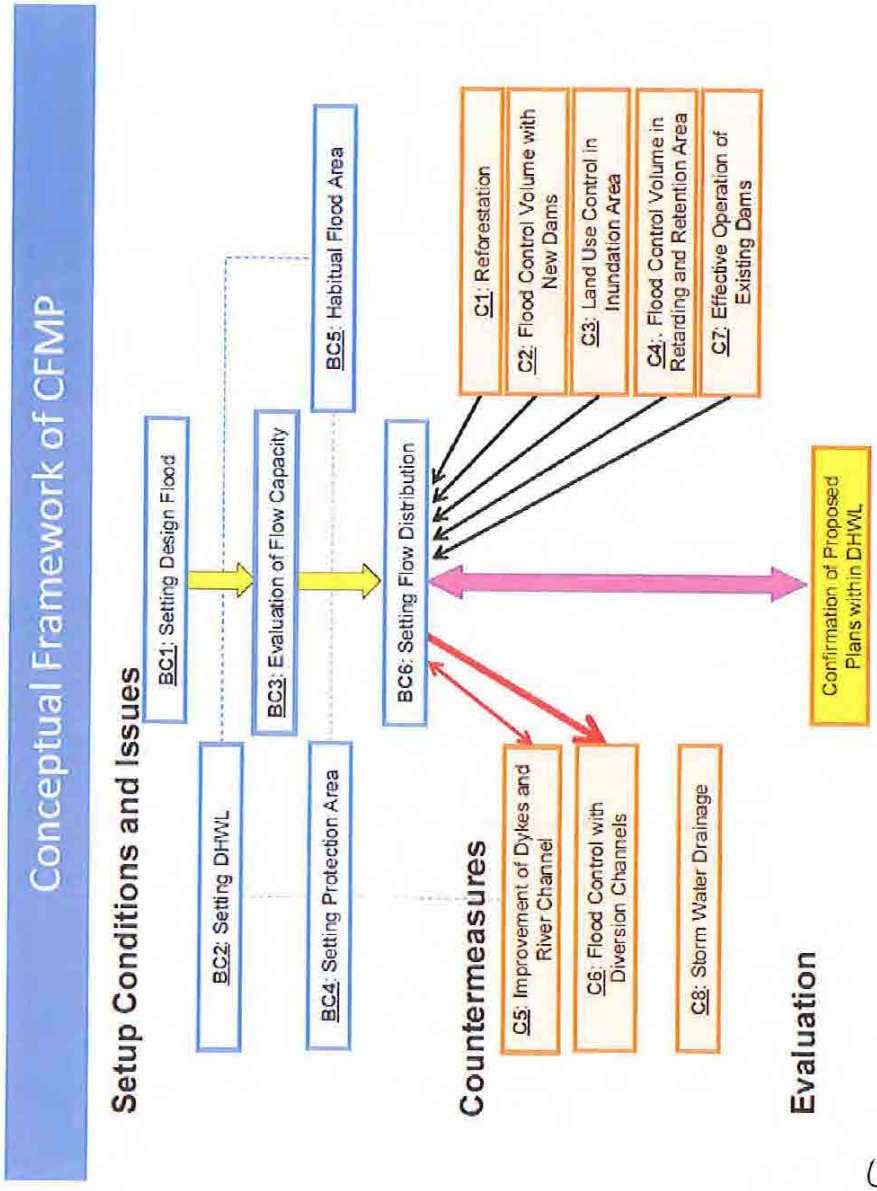
No	Name-Surname	Position
12	Mr. Sirawit Koit	Representative of Director of Regional Irrigation Office 2
13	Mr. Kanching Kowsard	Representative of Director of Regional Irrigation Office 4
14	Mr. Athaporn Punyachom	Representative of Director of Regional Irrigation Office 10
15	N/A	Representative of Director of Regional Irrigation Office 11
16	Mr. Nirut Riansuwong	Representative of Director of Regional Irrigation Office 12
17	N/A	Representative of Director of Regional Irrigation Office 13
18	Mr. Supanat Pariyachat	Chief of Project Planning Group 4
19	Mr. Thada Sukhapunnaphan	Director of Hydrology Division
20	Mr. Lerboon Udomsap	Chief of Water Management Branch
21	Mr. Pornchai Kansit	Representative of Project Planning Group 1
22	Mr. Thada Phunthawi	Representative of Water Management Division
23	Mr. Chaiwat Thamthong	Representative of Director of Regional Irrigation Office 4
24	Mr. Athons Suttigarn	Chief of Grant Projects Branch
25	Mr. Wasin Phutphat	Irrigation Engineer

[JAPANESE SIDE]

No.	Name	Affiliation	Position
26	Mr. Kimio TAKEYA	JICA Tokyo Office	-
27	Mr. Yusuke AMANO	JICA Tokyo Office	-
28	Mr. Hideaki MATSUMOTO	JICA Tokyo Office	-
29	Mr. Takahiro MISHINA	JICA Study Team, Component 1-2	Team Leader
30	Mr. Hajime TANAKA	JICA Study Team, Component 1-2	Deputy Leader
31	Mr. Masami KATAYAMA	JICA Study Team, Component 1-2	Senior Engineer
32	Mr. Kazuhiro NAKAMURA	JICA Study Team, Component 1-2	Engineer
33	Ms. Akira WATANABE	JICA Study Team, Component 1-2	Engineer
34	Mr. Chuchat Suwut	JICA Study Team, Component 1-2	Interpreter
35	Ms. Kamolnit Ariyakamolpat	JICA Study Team, Component 1-2	Interpreter
36	Ms. Nattamon Tanyapanit	JICA Study Team, Component 1-2	Interpreter
37	Mr. Paitaya Puenpatom	JICA Study Team, Component 1-2	Interpreter
38	Ms. Nichapat Rakpongthai	JICA Study Team, Component 1-2	Administrator
39	Mr. Akihiko NUNOMURA	JICA Study Team, Component 3	Team Leader
40	Mr. Minoru KURIKI	JICA Study Team, Component 3	Deputy Leader
41	Mr. Kiyotaka KOGA	JICA Study Team, Component 3	Engineer
42	Ms. Wanlaya MANUTKASEMSIRIKUL	JICA Study Team, Component 3	Secretary
43	Mr. Suchat Chutrakul	JICA Study Team, Component 3	Interpreter
44	Mr. Yoji Miyashita	JICA Thailand Office	-
45	Mr. Kobchai Songsrisanga	JICA Thailand Office	Program Officer

Attachment

Conceptual Framework of CFMP



1-1-7 Technical Group Meeting for Subcomponent 1-2 (19 December, 2012)

MINUTES OF MEETING
ON
TECHNICAL GROUP MEETING FOR SUBCOMPONENT 1-2
OF
PROJECT FOR COMPREHENSIVE FLOOD MANAGEMENT PLAN
FOR THE CHAO PHRAYA RIVER BASIN IN THE KINGDOM OF THAILAND

AGREED UPON BETWEEN
ROYAL IRRIGATION DEPARTMENT, MINISTRY OF AGRICULTURE AND COOPERATIVES
(RID/MOAC)

AND

THE JICA STUDY TEAM OF JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

Bangkok, December 19, 2012

Dr. Somkiat Prajamwong
Director ,
Office of Project Management
Royal Irrigation Department
Ministry of Agriculture and Cooperatives

Mr. MISHINA Takahiro
Leader
JICA Study Team for Subcomponent 1-2

1 Introduction

The Technical Group Meeting between members of the RID Technical Group (The Technical Group) and the JICA Study Team (the Study Team) for Subcomponent 1-2 was held on the 19th December, 2012 with the presence of 22 participants from the headquarter Offices of RID, the JICA Tokyo office, and the JICA Study Team.

The agenda for the meeting is as follows:

1. Presentation by Mr. Takeya of JICA Head Quarter;
2. Questions, Comments and Suggestions raised during the Sub-Meeting with RID Representatives;
3. Presentation of "Issued to be Discussed" and
4. Questions, Comments and Suggestions from RID Representatives.

Contents of the presentations by the Study Team were generally accepted by the Technical Group. The list of attendees is presented in Annex.

2 Presentation by Mr. Takeya of JICA Head Quarter

Mr. Takeya of JICA Head Quarter presented the background of the project.

3 Questions, Comments and Suggestions raised during Sub-Meetings

Refer to the Steering Committee Meeting held on the 12th of December, 2012, several sub-meetings with RID representatives are held, and RID submitted questions, comments and suggestions to the Study Team. Mr. Mishina, the Leader of Sub-Component 1-2, presented the answers as follows.

3.1 General

RID suggested that the Master Plan should clearly state that the countermeasures described in SCWRM's Master Plan are carefully considered. The Study Team answered that the eight (8) Countermeasures proposed by the Study Team are formulated based on the careful consideration of the SCWRM's Master Plan.

3.2 DHWL

RID commented that the Study should consider that DHWL managed by BMA is currently 2 to 2.5 m. The Study Team answered that the current condition has been taken into account to set up the DHWL.

RID suggested that the countermeasures proposed by the Master Plan should accommodate not only the 2011 flood, but the other historical floods. The Study Team explained to evaluate the

effectiveness of the countermeasures against the other historical six floods including 1970, 1975, 1980, 1994, 1995 and 2005 floods.

3.3 Ayutthaya Diversion Channel

RID said that as for the Ayutthaya Flood Diversion Channels, the Study should consider the optimal scale, backwater effects, alignment and impacts. Both positive and negative impacts on Ayutthaya Flood Diversion Channels should be carefully examined. The appropriate scale of Ayutthaya Flood Diversion Channels should be sought. The Study Team expressed that the optimal scale of Ayutthaya Flood Diversion Channel is evaluated by using the Flood Model Analysis. Both positive and negative impacts on Ayutthaya Flood Diversion Channels shall be examined and the analysis results shall be presented to the RID.

3.4 Diversion Channel

RID requested to examine if it is possible to discharge flood water into the sea by gravity. The Study Team answered that to evaluate the flow capacity of diversion channels, non-steady flood analysis is utilized.

3.5 Retarding Area or retention Area

RID requested to evaluate the effectiveness of Retarding and Retention Area. The Study Team explained that the Flood Model Analysis is utilized to evaluate the effectiveness of retarding and retention areas.

3.6 Case to be considered

RID requested to study a case without the construction of new dams. The Study Team agreed to include the case without new dams.

4 Presentation "Issues to be Discussed"

Mr. Mishina presented the issues to be discussed with RID representatives. The main items presented are as follows:

1. Basic Approach and Study Items;
2. Defining the Design Flood;
3. Defining the Preliminary Design High Water Level;
4. Evaluation of Current Flow Capacity: Tide Effect;
5. Defining Areas to be Protected and Flood Prone Area to be remained;
6. Eight Countermeasures;
7. Evaluation Method on Floodway Flow Capacity.

5 Questions, Comments and Suggestions from RID Representatives

Basic Condition BC2: Setting DHWL (Design High Water Level)

Dr. Somkiat confirmed that there are two kinds of dykes along the river namely the primary dyke to

protect communities located adjacent to the river, and the secondary dyke to protect the irrigation lands from flooding. Dr. Somkiat commented that the impacts on the areas between the primary and secondary dykes must be analyzed. In order to reduce or mitigate the risk due to flooding, the dyke height must be set with additional allowance. He also commented that if the excess amount of water is managed better in the upper basin, the height of the dykes may not need to be so high in the lower basin. Also the new dykes must be blended in the surrounding scenery without spoiling the existing condition.

Dr. Somkiat requested the Study Team to provide the following data/information:

1) The elevation data where the heightening of dykes is proposed.
2) The criteria that the Study Team set to analyze the proposed dyke height.

Basic Conditions BC4 & BC5: Setting Protection Area & Habitual Flood Area

Dr. Somkiat requested the Study Team to provide the following data/information:

3) The reasons behind the selection of the protection area proposed by the Study Team.

Countermeasures: Overall

Dr. Somkiat requested that the Study Team to propose their opinion based on RID's information, rather than just following the RID's current proposed projects. Dr. Somkiat requested that the JICA Study should not mention the specific dam name in their proposal/report. RID is currently in discussion with the Department of Highways about utilizing the Inner Ring Road and the floodway as the logistic route.

Dr. Somkiat requested the Study Team to provide the following data/information:

4) Targets for each countermeasure, such as how much water shall be stored in the retention and retarding areas, what the effects on these countermeasures, and the implementation plan.
5) How the each countermeasure effective for flooding and draught events.
6) "Know-How" on how to communicate with communities and local people in order to proceed with proposed projects at timely matter and smoothly.
7) Analyze various cases such as under the high-tide condition, and with barrage, against Tsunami, storm water drainage in Bangkok area.
8) Analyze the possible evacuation and logistic routes, including the route along the East Floodway which can be utilized as the evacuation road when a flood water flowing from the upper reach to lower reach.
9) Set priorities for countermeasures, such as (1) Must do, (2) Should Do, (3) Better to Do.

Countermeasure C6: Flood Control with Diversion Channels

Dr. Somkiat agreed with the proposal of three floodways including West Floodway, East Floodway and Ayutthaya Floodway. However, Dr. Somkiat commented that the RID's proposed flow capacity

of each floodway is much lower than the one proposed by the Study Team. Dr. Somkiat suggested the Study Team to share the information/idea with the RID experts on this matter.

RID requested the Study Team to provide the following data/information:

10) The reason why the Study Team selected the flow capacity of the floodway as 1,000 m^3/s. Is it because of selecting a permanent measure, or is it based on the economic implication?

Explanations to RID Representatives

Mr. Mishina explained that 8 countermeasures have been studied technically on the assumption of their structure scale including flow capacity. The Study Team already started to evaluate the relation between effectiveness of each countermeasure and its structure scale using the flood model analysis. In the next stage, the Study Team will make clear the necessity of the countermeasures and their structure scale including flow capacity.

6 Schedule of Next Meeting

Dr. Somkiat, the Chairman, proposed to set up the next meeting tentatively on the 10th of January, 2013 with the Study Team to discuss further on the Master Plan. The meeting details will be finalized between Dr. Somkiat and Mr. Kunieda (JICA Expert to RID) and the Study Team. The finalized meeting agenda shall be distributed among the meeting attendees in the beginning of January, 2013.

Meeting adjourns at 15:30 pm.

List of Meeting Attendees

Technical Group Meeting
December 19, 2012 at 1 PM
RID IEC Room 300

[Thai Side]

No.	Name-Surname		Position
Office of Project Management			
1	Mr. Somkiat	Prajamwong	Director of Project Management Office
2	Mr. Arthons	Suttigarn	Chief of Grant Projects Branch
3	Mr. Kanchadin	Sraprathoom	Chief of Loan Project Branch
4	Mrs. Phattaporn	Mekpruksawong	Chief of Project Planning Group 1
5	Mr. Supanat	Pariyachat	Chief of Project Planning Group 4
6	Mr. Chatchai	Boonlue	Director of Loan and Grant Project Division
7	Mr. Wirod	Khochalerd	Project Planning Group 1, Engineer
8	Mr. Jakraphan	Choyhiran	Civil Engineer
Office of Hydrology and Water Management			
9	Ms. Jira	Sukklam	Chief of Research and Applied Hydrology Group
RID			
10	Mr. Tatsuo	Kunieda	JICA Expert
11	Ms. Paweesuda	Boonchawang	Secretary to JICA Expert

[Japanese Side]

No.	Name-Surname		Position
JICA Head Quarter			
12	Mr. Kimio	Takeya	Senior Adviser
13	Mr. Yusuke	Amano	JICA HQ
14	Mr. Hideaki	Matsumoto	Deputy Director, Disaster Management Division 1, Global Environment Department
JICA Study Team, Component 1-2			
15	Mr. Takahiro	Mishina	Team Leader
16	Mr. Hajime	Tanaka	Deputy Leader
17	Ms. Akira	Watanabe	Civil Engineer
18	Mr. Paitaya	Puenpatom	English Interpreter
19	Ms. Nattamon	Tanyapanit	English Interpreter
20	Mr. Chuchat	Suwut	Japanese Interpreter
21	Mr. Peerasak	Chantngarm	Conference Interpreter
22	Ms. Rangsima	Boonsindulh	Conference Interpreter

1-1-8 Technical Group Meeting for Subcomponent 1-2 (10 January, 2013)

MINUTES OF MEETING
ON
THE TECHNICAL GROUP MEETING FOR SUBCOMPONENT 1-2
OF
PROJECT FOR COMPREHENSIVE FLOOD MANAGEMENT PLAN
FOR THE CHAO PHRAYA RIVER BASIN IN THE KINGDOM OF THAILAND

AGREED UPON BETWEEN
ROYAL IRRIGATION DEPARTMENT, MINISTRY OF AGRICULTURE AND COOPERATIVES
(RID/MOAC)

AND

THE STUDY TEAM OF JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

Bangkok, January 10, 2013

Dr. Somkiat PRAJAMWONG
Director ,
Office of Project Management
Royal Irrigation Department
Ministry of Agriculture and Cooperatives

Mr. Takahiro MISHINA
Leader
JICA Study Team for Subcomponent 1-2

1 INTRODUCTION

The Technical Group Meeting between members of the RID Technical Working Group (The Technical Group) and the JICA Study Team (The Study Team) for Subcomponent 1-2 was held on the 10th January, 2013 with the presence of 30 participants from the RID Headquarter Office, the JICA Headquarter office, and the JICA Study Team. The list of attendees is presented in Annex A.

The agenda for the meeting is as follows:

1 Presentation of "Results of Flood Analysis Model"
  1.1 Reproduction of the 2011 Flood Inundation;
  1.2 Reproduction of the 2011 Flood Inundation without Dyke Breach;
  1.3 Evaluation of Effectiveness of Countermeasures including Floodway; and
2 Questions, Comments and Suggestions from RID Representatives.

Contents of the presentations by the Study Team were generally accepted by the Technical Group.

2 PRESENTATION "RESULTS OF FLOOD ANALYSIS MODEL"

Mr. Mishina presented results of Flood Analysis Model conducted with seventeen (17) Study Cases presented in Annex B. The Study Team presented the following findings from the results of Flood Analysis Model as of January 2013;

1. In case of installation of diversion channels with 1,500 m^3/s flow capacity, effectiveness is reduced at the downstream area;
2. Increase of river flow by the construction of the Ayutthaya Diversion Channel does not cause major problems in combined operation with central diversion channel (Diversion channel along Outer Ring Road);
3. Combination of (1) Effective Operation of Existing Dams, (2) Ayutthaya Diversion Channel and (3) Central Diversion Channel (Diversion Channel along Outer Ring Road) has high priority; and
4. Detail study on flow capacity of Ayutthaya diversion channel, habitual inundation area, required dyke height, etc. will be continued.

The Study Team concluded that the analysis results of the Master Plan Study recommends Study Case 10, (combination of four (4) countermeasures such as, 1) C7: Improvement of Existing Dam Operation, 2) C5: Ayutthaya Diversion Channel: Capacity 1,400 m^3/s, 3) C6: Construction of Ring Road Diversion Channel: Capacity 500 m^3/s and 4) Control of Habitual Inundation Area) to RID/Thai Government.

3 QUESTIONS, COMMENTS AND SUGGESTIONS FROM RID REPRESENTATIVES

Dr. Somkiat, Chairman of the meeting, requested that the opportunities must be presented to the RID officers to learn in detail about the developed MIKE FLOOD model for the Chao Phraya River Basin in order for them to maximize understanding and utilization of the program. The JICA Headquarter Office accepted the RID's suggestion and offered to organize training courses upon RID's request.

RID also commended the following items;

Presentation Materials

- As for the presentation of various figures and graphs, location layout maps should be included in the handouts so that comparison can be made and the meeting attendees can follow the discussion effectively;
- In order for public to easily understand, the Risk Index Table needs to be presented in an image form with the information of the inundation duration;
- As for the results of Case 10 and Case 11, the presentation figure needs to be modified so that the significant difference in the inundated water depth between these cases can be easily seen; and
- In the longitudinal profiles, maximum values of each parameter (e.g. water level and discharge) shall be presented for the non-tidal effect sections whereas maximum and minimum values shall be presented for the tidal effect sections.

Analysis

- Prepare a comparison of project costs among proposed countermeasures;
- As a third party, discussion on operations of dams and other water management structures in 2011 needs to be included in the report, to answer publically raised questions whether mismanagement of such structures contributed to the 2011 flood or not;
- Develop 1) flood hazard map and 2) monitoring criteria for the Chao Phraya River Basin;
- Recommend the combination of countermeasures which gives maximum and minimum results (in terms of costs, impacts and inundated area etc.). Present a holistic view including the areas to be protected or the impacts to be reduced/minimized by the countermeasures;

4 NEXT STAGE

The Study Team presented that the items to be included in the next stage of the Master Plan Study are (1) analysis of storm surge in the Gulf of Thailand and (2) adaptation of climate change.

MEETING ADJOURNS AT 15:30 PM.

ANNEX A

List of Meeting Attendees

Technical Group Meeting
January 10, 2013 at 1 PM
RID IEC Room 300

[Thai Side]

No.	Name		Position
Project Management Office			
1	Dr. Somkiat	Prajamwong	Chair person, Director of Project Management Office
2	Mr. Kanchadin	Sraprathoom	Chief of Loan Project Branch, Foreign Financed Project Administration Division
3	Dr. Phattaporn	Mekpruksawong	Chief of Project Planning Group 1
4	Mr. Wirod	Khochalerd	Project Planning Group 1, Engineer
5	Mr. Supanat	Pariyachat	Chief of Project Planning Group 4
6	Mr. Chadin	Songchon	Civil Engineer
7	Mr. Wasin	Phutphat	Irrigation Engineer
Hydrology and Water Management Office			
8	Mr. Thada	Sukhapunaphan	Director of Hydrology Division
9	Mr. Chatchom	Chompradit	Director of Water Management Division
10	Mr. Somchit	Amnatsan	Chief of Water Management Group
11	Mr. Adisorn	Champathong	Irrigation Engineer
12	Ms. Patcharawee	Suwannik	Irrigation Engineer
Regional Irrigation Office			
13	Mr. Apiwat	Poomthaisong	Representative of RIO1
14	Mr. Chonlathep	Thatree	Representative of RIO 3
15	Mr. Boonthum	Panpiamphot	Chief of Water Management Branch, RIO 4
16	Mr. Thanaroj	Worraratprasert	Chief of Planning and Water Issue Solution Division, RIO 12
Others			
17	Mr. Tatsuo	Kunieda	JICA Expert to RID

ATTENDEE LISTS (continued)

[Japanese Side]

No.	Name-Surname		Position
JICA			
18	Mr. Kimio	Takeya	Headquarter Office
19	Mr. Yusuke	Amano	Headquarter Office
JICA Study Team, Component 1-2			
20	Mr. Takahiro	Mishina	Team Leader
21	Mr. Hajime	Tanaka	Deputy Leader
22	Mr. Masami	Katayama	Engineer
23	Mr. Satoshi	Takata	Engineer
24	Ms. Akira	Watanabe	Engineer
25	Ms. Nattamon	Tanyapanit	English Interpreter
26	Mr. Chuchat	Suwut	Japanese Interpreter
27	Mr. Peerasak	Chantngarm	Conference Interpreter
JICA Study Team, Component 3 (Special Invitation)			
28	Mr. Minoru	Kuriki	Deputy Leader
29	Mr. Yasushi	Inoue	-
30	Ms. Wanlaya	Manutkasemsirikul	Secretary

ANNEX B
LIST OF STUDY CASE FOR FLOOD ANALYSIS MODEL

Case	Rainfall in the Downstream Area	Dyke Breaching	Dyke elevating around the Economic Zone (by DOH, DOR and so on near Bangkok Area)	C2. Flood Control Volume with New Dams	C4. Flood Control Volume in Retention Ponds	C5-1. Dyke Raising up to DHWL + Freeboard of 0.5m	C5-2. Flood Control with Ayutthaya Diversion Channel	C6-1. Flood Control with East or West Diversion Channels	C6-2. Flood Control with Central Diversion Channels	C7. Effective Operation of Existing Dams	Primary Dyke elevating up to Peak Water Level
Case 0	◎	◎									
Case 0-0	◎										
Case 0-1			◎								
Case 9-1			◎							◎	
Case 9-2			◎	◎							
Case 9-3			◎		◎						
Case 9-4			◎				◎ 1,400 m^3/s				
Case 9-5			◎						◎ 500 m^3/s		
Case 9-6			◎					◎ 1,500 m^3/s			
Case 5			◎			◎					
Case 1			◎	◎	◎	◎		◎ 1,500 m^3/s		◎	
Case 2			◎	◎	◎	◎	◎ 1,400 m^3/s	◎ 1,500 m^3/s		◎	
Case 2-1			◎	◎	◎	◎	◎ 1,400 m^3/s	◎ 1,500 m^3/s	◎ 500 m^3/s	◎	
Case 7			◎			◎		◎ 1,500 m^3/s			
Case 8			◎								◎
Case 8-1			◎	◎	◎			◎ 1,500 m^3/s		◎	◎
Case 10			◎				◎ 1,400 m^3/s		◎ 500 m^3/s	◎	
Case 11			◎						◎ 500 m^3/s	◎	
Case 2-1-R	◎		◎	◎	◎	◎	◎ 1,400 m^3/s	◎ 1,500 m^3/s	◎ 500 m^3/s	◎	
Case 10-R	◎		◎				◎ 1,400 m^3/s		◎ 500 m^3/s	◎	

ANNEX B
LIST OF STUDY CASE FOR FLOOD ANALYSIS MODEL (continued)

1. Results of Flood Model Analysis

Using the flood model of reproducing the 2011 flood, cases with countermeasures are analyzed.

<CASE>

Case 0-0	- 2011 Flood without dyke breaches,
Case 0-1	- 2011 Flood without dyke breaches, - Dyke elevating around the economic zone by DOH, DOR near Bangkok area.
Case 9-1	- 2011 Flood without dyke breaches, - Dyke elevating around the economic zone by DOH, DOR near Bangkok area, C7 : Effective operation of existing dams.
Case 9-2	- 2011 Flood without dyke breaches, - Dyke elevating around the economic zone by DOH, DOR near Bangkok area, C2 : Flood control volume with new dams.
Case 9-3	- 2011 Flood without dyke breaches, - Dyke elevating around the economic zone by DOH, DOR near Bangkok area, C4 : Flood control volume in retention ponds.
Case 9-4	- 2011 Flood without dyke breaches, - Dyke elevating around the economic zone by DOH, DOR near Bangkok area, C5-2 : Flood control with Ayutthaya diversion channel (1,400m^3/s).
Case 9-5	- 2011 Flood without dyke breaches, - Dyke elevating around the economic zone by DOH, DOR near Bangkok area, C6-2 : Flood Control with central diversion channels (500 m^3/s).
Case 9-6	- 2011 Flood without dyke breaches, - Dyke elevating around the economic zone by DOH, DOR near Bangkok area, C6-1 : Flood control with east or west diversion channels (1,500 m^3/s).
Case 5	- 2011 Flood without dyke breaches, - Dyke elevating around the economic zone by DOH, DOR near Bangkok area, C5-1 : Dyke elevating up to DHWL + freeboard of 0.5m.
Case 1	- 2011 Flood without dyke breaches, - Dyke elevating around the economic zone by DOH, DOR near Bangkok area, C2 : Flood control volume with new dams, C4 : Flood control volume in retention ponds, C5-1 : Dyke elevating up to DHWL + freeboard of 0.5m, C6-1 : Flood control with east or west diversion channels (1,500 m^3/s), C7 : Effective operation of existing dams.
Case 2	- 2011 Flood without dyke breaches, - Dyke elevating around the economic zone by DOH, DOR near Bangkok area, C2 : Flood control volume with new dams, C4 : Flood control volume in retention ponds, C5-1 : Dyke elevating up to DHWL + freeboard of 0.5m, C5-2 : Flood control with Ayutthaya diversion channel (1,400m^3/s), C6-1 : Flood control with east or west diversion channels (1,500 m^3/s), C7 : Effective operation of existing dams.
Case 2-1	- 2011 Flood without dyke breaches, - Dyke elevating around the economic zone by DOH, DOR near Bangkok area, C2 : Flood control volume with new dams, C4 : Flood control volume in retention ponds, C5-1 : Dyke elevating up to DHWL + freeboard of 0.5m, C5-2 : Flood control with Ayutthaya diversion channel (1,400m^3/s), C6-1 : Flood control with east or west diversion channels (1,500 m^3/s), C6-2 : Flood Control with central diversion channels (500 m^3/s), C7 : Effective operation of existing dams.
Case 7	- 2011 Flood without dyke breaches - Dyke elevating around the economic zone by DOH, DOR near Bangkok area,

	C5-1 : Dyke elevating up to DHWL + freeboard of 0.5m, C6-1 : Flood control with east or west diversion channels (1,500 m^3/s).
Case 8	- 2011 Flood without dyke breaches, - Dyke elevating around the economic zone by DOH, DOR near Bangkok area, - Primary dyke elevating up to peak water level.
Case 8-1	- 2011 Flood without dyke breaches, - Dyke elevating around the economic zone by DOH, DOR near Bangkok area, C2 : Flood control volume with new dams, C4 : Flood control volume in retention ponds, C6-1 : Flood control with east or west diversion channels (1,500 m^3/s), C7 : Effective operation of existing dams, - Primary dyke elevating up to peak water level.
Case 10	- 2011 Flood without dyke breaches, - Dyke elevating around the economic zone by DOH, DOR near Bangkok area, C5-2 : Flood control with Ayutthaya diversion channel (1,400m^3/s), C6-2 : Flood Control with central diversion channels (500 m^3/s), C7 : Effective operation of existing dams.
Case 11	- 2011 Flood without dyke breaches, - Dyke elevating around the economic zone by DOH, DOR near Bangkok area, C6-2 : Flood Control with central diversion channels (500 m^3/s), C7 : Effective operation of existing dams.

1-1-9 Technical Group Meeting for Subcomponent 1-2 (21 January, 2013)

MINUTES OF MEETING
ON
THE TECHNICAL GROUP MEETING FOR SUBCOMPONENT 1-2
OF
PROJECT FOR COMPREHENSIVE FLOOD MANAGEMENT PLAN
FOR THE CHAO PHRAYA RIVER BASIN IN THE KINGDOM OF THAILAND

AGREED UPON BETWEEN
ROYAL IRRIGATION DEPARTMENT, MINISTRY OF AGRICULTURE AND COOPERATIVES
(RID/MOAC)

AND

THE STUDY TEAM OF JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

Bangkok, January 21, 2013

Dr. Somkiat PRAJAMWONG
Director,
Office of Project Management
Royal Irrigation Department
Ministry of Agriculture and Cooperatives

Mr. Takahiro MISHINA
Leader
JICA Study Team for Subcomponent 1-2

1 INTRODUCTION

The Technical Group Meeting between members of the RID Technical Group (The Technical Group) and the JICA Study Team (The Study Team) for Subcomponent 1-2 was held on the 21st January, 2013 with the presence of 48 participants from the Headquarter Offices of RID, the JICA Headquarter office (Tokyo), and the JICA Study Team. The list of attendees is presented in Annex A.

The agenda for the meeting is as follows:

1 Presentation of "Results of Flood Analysis Model" by JICA Study Team;
2 Presentation of "West Floodway Project" by Panya Consultant;
3 Presentation of "East Floodway Project" by Sigma Consultant; and
4 Discussion on Presented Materials.

Contents of the presentations by the Study Team were generally accepted by the Technical Group.

2 PRESENTATIONS

Mr. Amano from the JICA Headquarter presented about the method to calculate Risk Index (RI), and comparison among three selected cases including (1) East/West Diversion Channel (1,500 m^3/s) with Operation Efficiency of Existing Dams, (2) Ayutthaya Bypass Channel and Outer Ring Road Diversion Channel (500 m^3/s) with Operation Efficiency of Existing Dams, (3) all countermeasures. The Study Team concluded that the best combination of countermeasures to prevent the protected areas from flooding is Case (2) Ayutthaya Bypass Channel and Outer Ring Road Diversion Channel with Operation Efficiency of Existing Dams.

Mr. Mahunnopnatee of Panya Consultant, the RID's consultant for the East Floodway Project, presented the final finding of the East Floodway Project. This project covers 12 provinces with total area of 3.78 million rai which consists of agricultural area (65%), community-industrial areas (28%) and others (7%). The proposed project is divided into two sections (1) Chainat-Pasak Canal to be extend and improved, and (2) Pasak-Gulf of Thailand to construct new drainage canal with maximum drainage at 1,000 m^3/s. The project on the Chainat-Pasak Canal further divided into three components (1) lined concrete canal on the right bank of Chainat-Pasak Canal to distributes water at 210 m^3/s, (2) Chainat-Pasak Drainage Canal with maximum capacity at 1,000 m^3/s, and (3) Parallel canal on left bank to distribute water at 30 m^3/s (maximum capacity) with flume in the section where the canal passes Muang Lop Buri. This is the 113,989 million baths project with environmental/social impacts on agricultural lands (21,000 rai) and fisheries industry in coastal areas.

Dr. Boonprasert of Sigma Hydro, the RID's consultant for the West Floodway Project, presented

the Phase I Investigation of Conceptual Plan on the West Floodway Project. The detailed hydraulic analysis on the proposed floodway shall be conducted in February. This project was commenced on August 30th, 2012 and will be completed on October 23rd, 2013 to cover the study area of 17,557 km^2. After February 2013, the project proposal shall be presented to the public to obtain their consensus. The proposed project includes five cases including (1) Chao Phraya River Drainage Capacity Improvement, (2) Ta Chin River Drainage Capacity Improvement, (3) Improvement of Lower Western Chao Phraya Area (including Monkey Cheek area), (4) Improvement of Lower Western Ta Chin Area, and (5) Western Floodway Improvement. Regarding the Western Floodway project proposal, three routes shall be proposed to the public for their consideration including (A) Chao Phraya (Krokphra) – Mae Klong (Ban Pong), (B) Chao Phraya (Kao Loew) – Mae Klong (Ban Pong) and (C) Ping River (Khanu Woraluck Buri) – Mae Klong (U/S of Mae Klong Barrage, Tha Muang).

3 DISCUSSION ON PRESENTED NATERIAL

RID requested the Study Team to present;

- The study results regarding predicted water levels of Case 10 and Case 11 in order to show the difference between these two cases to prove the effectiveness of the Ayutthaya bypass canal.
- The site specific (upper, mid and lower basins) countermeasures with more detailed information to manage the basin with the holistic approach.
- The countermeasures to manage the inundation in areas between Chai Nat to Ayutthaya.
- The simulation results of the case with the floodway diverting water from the upstream of Nakhon Sawan.

RID also suggested to the Study Team

- To include the West Floodway project as a countermeasure in the JICA Study Report.
- To organize the results of Flood Analysis Model by presenting the inundation depth and period.
- To evaluate Risk Index for the Mid and Upper Basins to evaluate the effectiveness of countermeasures in the enter Chao Phraya River Basin.

Mr. Takeya from the JICA Headquarter responded to RID that the combination of countermeasures which brings the most effective outcome must be implemented first. Initially, the probability of the 2011 year flood was assumed to be about the 1 in 70 year; however the rainfall analysis concluded that it can be as close as the 1 in 100-year-flood which led the Study Team to propose the 1 in 100-year-flood as the target flood. With the Laser Profiler data (topography data with 10 cm vertical accuracy), the Study Team investigates the effectiveness of each countermeasure and the combination of these countermeasures under the 2011 flood event as well as the additional 6 severe rainfall events in the past. Current agricultural practice in Thailand tolerates inundation in agricultural lands in some extent that flood may not always bring damages but may also bring some

benefits to the public. If it changes to more modernized practice with less tolerance to inundation in the future, the effectiveness of countermeasures must be re-evaluated to reflect the changes. The lower basin can be protected from flooding by letting the controlled inundation occur in the upper reach.

MEETING ADJOURNS AT 17:30 PM.

ANNEX A

List of Meeting Attendees

Technical Group Meeting
January 21, 2013 at 15:00 PM – 17:30 PM
RID Meeting Room #2, Office of Project Management

[Thai Side]

No.	Name		Position
Project Management Office (RID)			
1	Dr. Somkiat	Prajamwong	Chair person, Director of Project Management Office
2	Dr. Phattaporn	Mekpruksawong	Chief of Project Planning Group 1
3	Mr. Arthon	Suttigarn	Chief of Grant Project Branch
4	Mr. Supanat	Pariyachat	Chief of Project Planning Group 4
5	Mr. Chadin	Songchon	Civil Engineer
6	Mr. Prachya	Chaiwattana	Civil Engineer
7	Mr. Pongpich	Yodying	Civil Engineer
8	Mr. Ratthapan	Thiramanat	Civil Engineer
9	Mr. Olan	Vesurai	Civil Engineer
10	Mr. Puvanet	Thongrungroj	Chief Engineer of Operation and Maintenance Division
Hydrology and Water Management Office (RID)			
12	Mr. Thada	Sukhapunaphan	Director of Hydrology Division
13	Mr. Chatchom	Chompradit	Director of Water Management
14	Ms. Patcharawee	Suwannik	Irrigation Engineer
15	Mr. Kosit	Lorsirirat	Hydrologist
Office of Engineering Topographical and Geotechnical Survey (RID)			
16	Ms. Suwanna	Euvananont	Survey Engineering
Office of Engineering and Architectural Design			
17	Mr. Sakchai	Thepkamai	Engineer
Regional Irrigation Office			
18	Mr. Athaporn	Panyachom	Chief of Water Management Branch, RIO 10
19	Mr. Pongsak	Arulvijitskul	Director of Operation and Maintenance Division, RIO 11
20	Mr. Boonthum	Panpiamphot	Chief of Water Management Branch, RIO 4
21	Mr. Somvong	Pholprasittito	Representative of RIO 2
22	Mr. Chanin	Kongyai	Representative of RIO 12
Special Invitation			
23	Mr. Tatsuo	Kunieda	JICA Expert to RID

[Thai Side] Continued

Bangkok Metropolitan Administration (BMA)			
24	Mr. Visnu	Charoen	-
25	Mr. Surart	Jaroenchaisakul	-
Thai Meteorological Department (TMD)			
26	Mr. Maytee	Mahayosanant	Meteorologist
Panya Consultants Co., Ltd.			
27	Mr. Nirand	Pluthikarmpae	Engineer
28	Mr. Somchai	Mahunnopnatee	Engineer
Sigma Hydro Consultants Co., Ltd.			
29	Mr. Sompong	Boonprasert	Senior Water Resource Engineer
30	Mr. Kittisak	Chotmunee	GIS/Water Resource Engineer
31	Mr. Paopong	Kararum	Irrigation Engineer

[Japanese Side]

No.	Name-Surname		Position
JICA			
32	Mr. Kimio	Takeya	Senior Advisor
33	Mr. Yusuke	Amano	Senior Advisor
JICA Study Team, Component 1-2			
34	Mr. Takahiro	Mishina	Team Leader
35	Mr. Hajime	Tanaka	Deputy Leader
36	Mr. Masami	Katayama	Engineer
37	Mr. Kazuhiro	Nakamura	Engineer
38	Mr. Satoshi	Takata	Engineer
39	Ms. Akira	Watanabe	Engineer
40	Ms. Kamolnit	Ariyakamolpat	English Interpreter
41	Mr. Chuchat	Suwut	Senior Administrator
42	Ms. Nichapat	Rakpongthai	Administrator
43	Mr. Peerasak	Chantngam	Conference Interpreter
JICA Study Team, Component 3			
44	Mr. Minoru	Kuriki	Deputy Leader
45	Mr. Yasushi	Inoue	-
46	Ms. Natthanicha	Kasiolarn	Japanese Interpreter
47	Ms. Wanlaya	Manutkasemsirikul	Secretary
Other			
48	Mr. Akihiko	Nanchuna	Kansai University

1-1-10 Technical Group Meeting for Subcomponent 1-2 (18 February, 2013)

Original

MINUTES OF MEETING

ON

THE TECHNICAL GROUP MEETING FOR SUBCOMPONENT 1-2

OF

PROJECT FOR COMPREHENSIVE FLOOD MANAGEMENT PLAN
FOR THE CHAO PHRAYA RIVER BASIN IN THE KINGDOM OF THAILAND

AGREED UPON BETWEEN
ROYAL IRRIGATION DEPARTMENT, MINISTRY OF AGRICULTURE AND COOPERATIVES
(RID/MOAC)

AND

THE STUDY TEAM OF JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

Bangkok, February 18, 2013

Dr. Somkiat PRAJUMWONG
Director,
Office of Project Management
Ministry of Agriculture and Cooperatives

Mr. Takahiro MISHINA
Leader
JICA Study Team for Subcomponent 1-2

1 INTRODUCTION

The Technical Group Meeting between members of the RID Technical Working Group (The Technical Group) and the JICA Study Team (The Study Team) for Subcomponent 1-2 was held on the 18th February 2013 with the presence of 18 participants from the RID Headquarter Office, the JICA Headquarter office, and the JICA Study Team. The list of attendees is presented in Annex A.

The agenda for the meeting is as follows:

1 Detail Explanation on Master Plan for Chao Phraya River Flood Management Plan;
2 Result of Preliminary Analysis of Storm Surge;
3 Adaptation to Climate Change;
4 Questions and Answers.

Contents of the presentations by the Study Team were generally accepted by the Technical Group.

2 PRESENTATION "RESULTS OF FLOOD ANALYSIS MODEL"

Mr. Amano of JICA HQ presented the following items which are summarized in the distributed handout: Executive Summary.

1 Controlled Inundation Areas;
2 Adaptation to Climate Change and Result of Preliminary Analysis of Storm Surge;
3 Project Effectiveness; and
4 Evaluation Method.
5 Recommendations

Mr. Amano presented that by regulating land use appropriately, inundation with a similar scale of the 2011 flood can be under control. The prospective controlled inundation areas are classified into five in accordance with the flood features. With implementing structural and non-structural measures, the low-lying areas can maintain its function which can lead the reduction in flood disaster risks and the enhancement of people's living conditions by considering co-existing with floods.

Mr. Amano also mentioned about study results on climate change and storm surge. Literature review concluded there will be precipitation increase and sea water level rise in some extent for next several decades. The storm surge simulation model was established, and these simulation results showed that the effect of the simulated storm surge is negligible in term of flood inundation.

Finally Mr. Amano presented the effectiveness of combination of countermeasures which was checked by flood discharge distribution, and the project evaluation which was evaluated by comparing both 1) cost of each project combination and 2) Degree of Reducing Dyke-Breach Risk..

Three combinations are studied and presented, including 1) SCWRM M/P, 2) JICA Proposed Combination 1 and 3) JICA Proposed Combination 2. The SCWRM M/P is consisted of six countermeasures 1) Effective operation of existing dams, 2) Construction of new dams, 3) Improvement of retarding/retention areas, 4) East/west diversion channel (capacity if 1,500 m^3/s), 5) Outer ring road diversion channel (Capacity of 500 m^3/s) and 6) River channel improvement works. The JICA Proposed Combinations 1 and 2 include 1) Effective operation of existing dams, 2) Outer ring road diversion channel (Combination 1: Capacity of 500 m^3/s and Combination 2: Capacity of 1,000 m^3/s), 3) River channel Improvement works and 4) Ayutthaya bypass channel (capacity of 1,400 m^3/s).

The results showed that the costs of the JICA Proposed Combinations were less than 40% of SCWRM M/P cost while the effectiveness was same as SCWRM M/P in terms of Degree of Reducing Dyke Breach Risk.. EIRR and Benefit/Cost of each combination were not presented at this meeting; however Mr. Amano mentioned that these will be prepared and presented at the Seminar on February 20th. Based on the current analysis on effectiveness and evaluation of project combinations, the JICA Study Team recommended that the Government should concentrate on implementing the proposed combination of projects (Proposed Combinations 1 or 2), 1) Effective Operation of Existing Dams, 2) Outer Ring Road Diversion Channel (Capacity: 500 or 1,000 m^3/s), 3) River Improvement Works and 4) Ayutthaya Bypass Channel (Capacity: 1,400 m^3/s). In addition, it is not recommendable for the Government to execute almost all of the projects proposed.

3 QUESTIONS, COMMENTS AND SUGGESTIONS FROM RID REPRESENTATIVES

Mr. Thada questioned about Controlled Inundation Areas in Figure 13, Executive Summary, that the reason why the areas LO6 and LO9 located west of Tha Chin River are divided into two separate categories, and also how to improve the inundation conditions in LO6 and LO9 as it takes time to drain water from these areas. Mr. Amano answered that it was divided in order to conduct an in-depth analysis on the inundation pattern in these areas, such as the inundation in LO6 was almost over by December 1, however LO9 inundation was still ongoing.

Mr. Thada questioned the inundation situation in LO14. Mr. Amano answered that LO14 is a complicated case, which the volume of flood water gets worse (increased) in LO14 as the land along the Bunlue Canal is elevated and the flood water is blocked within LO14.

Mr. Thada questioned about the effective countermeasures to improve/mitigate the inundation condition in the Lower Chao Phraya. Also Mr. Thada requested to present the effectiveness of each countermeasure by summarizing the results on maps similar to Figures 2.4, 2.5 and 2.6 in

Handout Document 4. In addition, Mr. Thada requested the JICA Study Team to propose countermeasures to mitigate inundation along the Tha Chin River including how to reduce the inundation time. Mr. Amano responded that the SCWRM M/P is effective to improve the condition only in LO6. The JICA Study Team agreed to analyze the Tha Chin River countermeasures.

Mr. Adisorn commended that there are more reports available on the impact of the climate change in Thailand, why the JICA Study Team only reviewed two reports by World Bank and START? Mr. Amano answered that more than two reports were reviewed and findings were presented in Handout Document 2. It should be noted that, according to the literature review, the sea level raise in the Gulf of Thailand is not significant.

Mr. Adisorn questioned about the reason why the costs of the JICA Proposed Combinations are much lower than the SCWRM M/P cost. Mr. Amano answered that it is because the proposed countermeasures are different, such as SCWRM M/P includes the floodway with 1,500 m^3/s connected to the Gulf of Thailand, whereas in the JICA Proposed Combinations in stead of constructing such large scale floodway, only countermeasures which will protect Bangkok and Ayutthaya areas were included. In the presentation at the seminar on February 20th, 2013, the JICA Study Team will explain these effectiveness and evaluation results by using EIRR (Risk Index will not be used).

Mr. Amano commented that even though all countermeasures proposed by SCWRM are implemented, there will be flood. It is necessary to inform the local people about the remaining risk of inundation, such as the unexpected inundation can be mitigated / minimized; on the other hand the expected inundation must be accommodated within the flood-prone zones. Mr. Thada responded that the Government idea is to implement countermeasures for each river basin, Ping, Wang, Yom and Nan River basins. Mr. Thada agreed the JICA's classifications of controlled inundation areas presented in Figure 12, Handout Executive Summary, however he is unclear about how to manage / drain water from these inundation areas in the Upper Chao Phraya, especially UP7 located along the Ping River, and the areas along Yom River. In addition, he requested the JICA to present the effective measures to mitigate the inundation in the area north of Bangkok (not necessary to be structural measures, but it can be non-structural measures such as implementing the effective operation rule at the existing structures, etc.), which measures, if reasonable, RID would like to implement in 2013 Flood season. Mr. Amano responded that the countermeasures for the Upper Chao Phraya will be analyzed after the seminar on February 20th including how to utilize the inundation area effectively etc. In order to conduct the in-depth analysis, the JICA Study Team requested RID to provide the information on the protected area (which area to be protected, such as Sukho Thai etc.) within the Upper Chao Phraya area.

Mr. Somkiat commended that 1) more explanation is needed on the proposed project costs, 2) Master Plan must cover everything, such as countermeasures to protect farmers and agricultural lands, 3) additional information is required on how to select which floodways (west or east) to be implemented. Mr. Takeya answered that with laser profiler data, Master Plan analyzed the holistically, and it is concluded that the inundation in the great Chao Phraya Basin cannot be eliminated completely even though all countermeasures are implemented. Our plan considers mitigating not only the inundation of the industrial areas but also the agricultural areas by proposing the 25 technical papers (prepared by another JICA Study Team).

Mr. Somkiat requested the JICA Study Team to provide the opportunities for RID officers to attend technical transfer and training sessions so that the JICA proposal to be fully utilized by RID officers in future.

Remarks:
LO = Lower Chao Phraya
UP = Upper Chao Phraya

MEETING ADJOURNS AT 12:10 PM.

ANNEX A

List of Meeting Attendees

Technical Group Meeting
February 18, 2013 at 9 AM
RID IEC Room 300

No.	Name – Surname	Title
[THAI SIDE]		
Office of Project Management		
1	Dr. Somkiat Prajamwong	Director, Office of Project Management
2	Mr. Kanchadin Sraprathoom	Chief of Loan Project Branch
3	Dr. Phattaporn Mekpruksawong	Chief of Project Planning Group 1
4	Mr. Wirod Khochalerd	Engineer, Project Planning Group 1
Office of Hydrology and Water Management		
5	Mr. Thada Sukhapunaphan	Director of Hydrology Division
6	Mr. Adisorn Champathong	Irrigation Engineer, Professional Level
[JAPANESE SIDE]		
JICA HQ		
7	Mr. Masami Fuwa	Director Genteral, Global Environment Department
8	Mr. Kimio Takeya	Visiting Senior Advisor
9	Mr. Yusuke Amano	Senior Advisor to Director General
10	Mr. Hidenaki Matsumoto	Deputy Director, Diasater Management Division 1
JICA Study Team (Component 1-2)		
11	Mr. Takahiro Mishina	Team Leader
12	Mr. Hajime Tanaka	Deputy Team Leader
13	Mr. Kazuhiro Nakamura	Engineer
14	Mr. Satoshi Takata	Engineer
15	Ms. Akira Watanabe	Engineer
16	Mr. Chuchat Suwut	Senior Administrator
17	Ms. Nattamon Tanyapanit	Interpreter
18	Mr. Peerasak Chantngam	Conference Interpreter

MINUTES OF MEETING

ON

THE TECHNICAL WORKING GROUP MEETING

FOR

SUBCOMPONENT 1-2 AND COMPONENT 3

OF

PROJECT FOR COMPREHENSIVE FLOOD MANAGEMENT PLAN FOR THE CHAO PHRAYA RIVER BASIN IN THE KINGDOM OF THAILAND

AGREE UPON BETWEEN

TECHNICAL WORKING GROUP

AND

THE SYUDY TEAMS OF JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

Bangkok, June 10, 2013

Dr.Somkiat Prajamwong	Mr.Takahiro MISHINA	Mr.Akihiko NUNOMURA
Director, Office of Project Management Royal Irrigation Department	Leader, The Study Team of Japan International Cooperation Agency (Subcomponent 1-2)	Leader, The Study Team of Japan International Cooperation Agency (Component 3)

I. Introduction

The Technical working Group Meeting between members of the Working Group and the JICA study Teams for Subcomponent 1-2 and Component 3 was held on 10th June, 2013 with the presence of 30 participants from the headquarters and the regional offices of RID, DWR, JICA headquarters and the JICA Study teams.

The agenda for the meeting is divided into those for Subcomponent 1-2 and Component 3, as follows:

Program I: Subcomponent 1-2

1) River Improvement Plan in the Tha Chin River
2) Verification of Effectiveness of the Management Plan by other floods
3) Others

Program II: Component 3

1) Transfer of System Management
2) Action Plan of Flood Management Information System
3) Presentation for the Final Seminar on 20 June, 2013

II. Presentation and discussion for Program I: Subcomponent 1-2

1) Presentation of Subcomponent 1-2

Mr. Yusuke Amano, Senior Adviser to the Director General of JICA, shared the results of the Master Plan Study on Flood Management for the Chao Phraya River. It is important to take note of ways and ideas to enhance in the Study. There are five materials distributed to the participants.

1. Executive Summary (revised version in June 2013)
2. TWG-Meeting Material 01 : River Improvement Plan in the Tha Chin River
3. TWG-Meeting Material 02 : Verification of Effectiveness of the Management Plan by other floods
4. TWG-Meeting Material 03 : Results of Model Analysis
5. TWG-Meeting Material 04 : Results of Model Analysis (New TOR)

The executive summary has already been distributed to the public in February 2013. The one given out today is a revised version. Mr. Amano then explained some finding on the Tha Chin River, as shown in Material 01. He mentioned about the status of the dike heightening for protection of the economic area that may affect flow of flood waters. He further shared that the after the completion of the dike heightening, flood water volume at west side of the Tha Chin River will be increasing, making it high risk for everyone residing the area. As the first step toward countermeasures for the Tha Chin River, design high water level is set up similar to the one of Chao Phraya River. The JICA team studied and finally selected two counter-measures in the Tha Chin River flood management:

1. Construct 4 shortcuts—this will contribute to drain water flood quickly.
2. Elevate existing dyke crest level and newly construction of dyke at the left side of Tha Chin River

The last page of the material show cases the result of the study. If countermeasures are not taken, waters could easily overflow from the dike.
Previous design high water level of the Chao Phraya River has stepwise part, and stepwise/horizontal part of design high water level is eliminated and slanted design high water level is set-up newly. The material showed the calculated water Level in the Chao Phraya River. It described how revised designed high water level be affected by 7 representative flood.

Mr. Amano then shifted to Technical Working Group Material 02 which shows the frequency and level of rainfall and flood water in the last 50 years. He refers back to the executive summary. Six representative floods (1970, 1975, 1980, 1994, 1995 and 2006) that have occurred in the Chao Phraya and Ta Chin Rivers are studied. Page 32 of Executive Summary provided information of the Verification Results of Project Effectiveness against 7 rainfalls. Mr. Amano said that there is not much difference between Combination 1 and Combination 2 studied at Nakhon Sawan, Ayutthaya and Bang Sai.
Mr. Amano said that the Thai Government prioritizes the following effective combinations:

1. Effective Operation of Existing Dams
2. Outer Ring Road Diversion Channel
3. River Improvement Works
4. Ayutthaya By-Pass Channel
5. Flood Forecasting

TWG Material 04 shows that effectiveness countermeasures mentioned in the new TOR issued on March 19, 2013. It also provided a chart on the Water Level/Discharge which includes a comparison among Combinations 1, 2 and SCWRM M/P.

2) Question & Answer for the First Part of the TWG Meeting

1. Mr. Sanae, representative of Mr. Phaisan Phongnorapha of Regional Irrigation Office 13: The participant explained that at the Tha Chin River and Pha Sri Charoen, water level has reached 2.13 meter, it even hit the level of at 3.996. There are dikes with an average height of 3-4.5 meters at that area. He also stressed that only an average of 100 cms can be released from the Tha Chin River. He insisted that these dikes are

important and pumping stations are important to manage water at the basin point. He asked if this is feasible and most recommended.

Mr. Amano said that the comment is very complicated. He referred to page 1-18 of Material 01. There is an attempt to set-up a high water level. The design high water level at the confluence/outlet of Pra Ya Bonlue canal is set at 4.7 meters. Dike height is 5.2 meters if considering that freeboard of dike is 50 cm. The Mahasawat channel has 3.7 meters of high water level. The JICA team would like to know more of these measurements and actions taken by RID.

Thai participant said that they already have a pumping structure that will help redirect/discharge flood water to the sea.

Mr. Amano complimented this comment.

2. Mr. Supanat Pariyachat begged for more articulation of the feasibility of a Pumping Station at the areas discussed in the report. There is a need to evaluate the number of Pumping stations to be recommended in the report. He also acknowledged that they did not include a study on Bang Pakong River.

   The Bang Pakong River is another river basin. The JICA team said that he will mention in the study report why they did not include Bang Paklong River.

3. Mr. Jirawat of the Water Resource Department said that there is a need to concentrate on water management. This directly affects water discharge on the lower reaches of the Chao Phraya River. He stressed on the need to focus on the process and the concept of countermeasure. This is for the sustainability of projects to be realized by the Thai Side. They must clearly provide guidelines on how to understand and execute the projects.

   Mr. Amano responded by pointing everyone to Page 30 of the Executive summary. They have already conducted a study on the river systems. They have also researched on the systems of Chao Phraya and Tha Chin River in terms of water discharge. Figure 24-Page 30 showed how flood discharge from one river affects water systems of other rivers.

4. At Page 34, it was recommended that government should implement the five proposed combination of projects. But the participant is confused about the statement: "it is not recommendable for the Government to execute almost all of the projects proposed."

Mr. Amano said that the English is not so good for this recommendation. He reiterated that all the five recommendations must be prioritized by the Thai Government.

5. Mr. Vitoon Thitinapak, Regional Irrigation Office 2: He had worked in Phitsanulok. He shared that the water drainage at the upper basin cannot release considerable amount of water from the Bhumibol and Sirikit dams due to existing paddy fields with low elevation. He asked for recommendation for water management, especially drainage in early rainy season.

   Dr. Somkiat Prajamwong, Director of Project Management, said that the JICA study is different from the RID study. The JICA study focuses on the lower basin. This is the reason why this issue is not well articulated. He also wanted to share about the limitations of RID in conducting research and performing relevant activities.

   Mr. Amano responded that the TWG meeting had already provided information about effective management of existing dam. The dam operation before 2011 had been effective. It is also undeniable that the dams worked well during the 2011 floods. Dam operations after the 2011 need to be enhanced and made more resilient and strong.

   For the first question, Page 27 of Material 03 showed the inundation area of the Chao Phraya River. The upper part of the basin had a flood depth of 4.0 to 5.0 meters. Mr. Amano said that water level on this area is discharged and inundated because of their low elevation. It actually serves a natural dam which they may utilize to effectively mitigate potential flood waters. The JICA team will review their analysis to examine further the possibility of water storage and mitigation, especially early rainy season.

6. Dr. Somkiat: It was requested to provide guidelines of effective management of reservoir operation rule curves. They must define the assumptions and risks of applying rule curves. These constrains must be stated in the report. They are worried about criticisms from other stakeholders.

   Mr. Amano said the proposal does not include any assumption on rule curves. He stressed that the rule curve guideline had been analyzed using more than 40 years inflow and outflow records. They will be preparing more information about the reservoir operation rule curve.

   Dr. Somkiat said that the efficiency of rule curves depends on case-to-case basis. Moreover, it comes in many forms and may be operate in various situations.

7. Mr. Kanching Kawsaard, Regional Irrigation Office 3: at page 31 of the Executive Summary, the participant is curious about the difference between the calculated and observed values used in the verification of project effectiveness. He also wondered that while the water levels in 2006 and 2011 are similar, why floods are not that severe during 2006.

   Mr. Amano said that studies performed during the periods when there were no dams yet. In 1993, they discovered that there was minimal flood occurrence. The calculation is anchored on similar preconditions.

8. Mr. Kanching observed that the observed and calculated values studied were particularly distinct and peculiar. He requested the JICA team to verify this by doing more research especially on the 2006 and 2011 flood rates.

   The JICA team also faced the same problem. They acknowledged that it is a strange observable value determined during 2006 at Nakhon Sawan. Water levels in 2006 are lower than in 2011. Moreover, water discharge during the former is more than the later year. What happened in Nakhon Sawan still remains strange values for the Japanese team. Mr. Amano said that they will do preliminary study and will tell them if there is an applicable method to verify this phenomenon.

9. Ms. Suphaporn wanted to know about the cost of the project evaluation. She wanted to know if the values is accurate.

   Mr. Amano said that they will include the conditions of cost estimate in the report.

10. Mr. Thanaraj Worraratprasert, Regional Irrigation Office 12, asked JICA to provide more information about water management measures on Chao Phraya basin because shortcuts create higher water levels to the left side of Tha Chin River especially around Bang Pla Ma and Song Pee Nong fields. The study should include appropriate water levels in the basin and amount of water to discharge from lower basins in each period.

    Mr. Amano will look for this in details.

III. Presentation and discussion for Program II: Component 3

1) Flood Management Information System

1.1 Transfer of System Management

The draft of transfer of system management was presented. There are 6 issues of system transfer; Opening of information delivery schedule (Early September 2013), Installation of system equipment (delayed to start in June), Technical transfer (by training course for Thai authorities in July), Publicity (by Thai Government with support of JICA/FRICS), Task Allocation to Thai government - RID (Telemetering Center and Hydro Center), DWR, TMD, SCC and others, and follow-up (FRICS will support Thai government on full-scale operation until late October.) Detail explanation will be made at a later date.

1.2 Action plan of Flood Management Information System

The basic plan of Flood Management Information System was already published in English and Thai and presented on February 20, 2013. The study team has consulted with RID and DWR technical officials and collected 6 suggestion items based on the request from Thai Government, as follows:

Development of the simulator for decision making on optimum operation of facilities such as dams and water gates;

Development of simulator for optimum emergency countermeasures such as installing emergency drainage pumps and large-scale sandbag;

Evaluation of forecasting and warning on landslide disasters such as flash flood and steep slope failure;

Evaluation of water level standards for warning information;

Set-up of issuing forecast and warning for disaster alleviation actions; and

Economic evaluation of flood forecasting system based on benefit analysis of non-structural countermeasures.

TWG agreed to proceed with development of action plans composed of these items.

1.3 Presentation for the final seminar on June 20, 2013

The study team will present current situation and future prospects of Flood Management Information System and also development and improvement of the system at the final seminar on June 20, 2013. At the seminar, the study team will also present the simulator function as water management judgment tool for government's internal tool.

2) Training Course for Technical Transfer

As the discussion on the schedule of training course, the meeting members agreed to hold the training on 29 July – 2 August 2013 at RID. The training consists of 2 levels – Basic knowledge level (Introduction and overview of the system) for executives, experts and practitioner officers and System operation and utilization for system operators (water management and equipment management). The trainees will be officials from RID and DWR. Secretary of the meeting (Mr. Supanat Pariyachat) and Mr. Somchit Amnatsan will consider list of trainees.

Dr. Somkiat Prajumwong, Chairman of the meeting asked the study team to submit letter, requesting for arranging a small working group meeting to discuss trainee list, agenda and contents of the training on June 21, 2013 together with agenda of the meeting.

IV. Schedule

Mr. Amano said that the Final Seminar involving government agencies and departments concerned will only be the ones invited. This is not open to the public. He reminded everyone to provide comments and inputs for the improvement of the executive summary and other materials. By the end of June, the draft final report will be distributed.

Timeframe to Remember: (as proposed by the JICA Team)

10 June: Technical Working Group Meeting
13 June: Deadline for Submission of Comments
20 June: Final Seminar (which includes government agencies and departments concerned will be invited)
By the end of June: Provision of Draft Final Report
Within two weeks after the Provision: Deadline for submission of comments on the Draft Final Report

END

List of Attendees

Thai side attendees

No.	Name - Surname		Office
1	Mr. Somkiat	Prajamwong	RID, Director of Project Management Office, Office of Project Management
2	Mrs. Suphaphorn	Wongweerakhan	RID, Expert on Economics Analysis for Water Resource Development Project
3	Mr. Thanar	Suwattana	RID, Director of Project Planning Division , Office of Project Management
4	Mr. Somchit	Amnatsan	RID, Chief of Water Management Group , Office of Water Management and Hydrology
5	Mr. Vitoon	Thititanapak	RID, Caretaker of Director of Operation and Maintenance Division, Regional Irrigation Office 2
6	Mr. Kanching	Kawsard	RID, Representative of Regional Irrigation Office 3, Regional Irrigation Office 3
7	Mr. Boonthum	Panpiamphot	RID, Chief of Water Management Branch, Regional Irrigation Office 4
8	Mr. Athaporn	Punyachom	RID, Chief of Water Management Branch, Regional Irrigation Office 10
9	Mr. Thanaroj	Worraratprasert	RID, Chief of Water Crisis Planning and Management Branch, Regional Irrigation Office 12
10	Mr. Phaisan	Phongnoraphat	RID, Director of Operation and Maintenance Division, Regional Irrigation Office 13
11	Mr. Supanat	Pariyachat	RID, Chief of Project planning Group 4, Office of Project Management
12	Mr. Kanchadin	Srapratoom	RID, Chief of Loan Project Branch, Foreign Financed Project Administration Division, Office of Project Management
13	Mr. Jiravat	Ratisoontorn	DWR, Director of Policy and Plan Division
14	Mr. Pitak	Dangprom	DWR, Policy and Plan Division
15	Mr. Satit	Sueprasertsuk	DWR

Japanese side attendees

No.	Name - Surname		Office
1	Mr. Yusuke	Amano	JICA Headquarter
2	Mr. Hideaki	Matsumoto	JICA Headquarter
3	Mr. Tomoya	Kikuta	JICA Headquarter
4	Mr. Takahiro	Mishina	JICA Study Team Component 1-2
5	Mr. Kazuhiro	Nakamura	JICA Study Team Component 1-2
6	Mr. Tatsuo	Kunieda	JICA Expert to RID
7	Mr. Akihiko	Nunomura	JICA Study Team Component 3
8	Mr. Yasushi	Inoue	JICA Study Team Component 3
9	Mr. Chuchat	Suwut	JICA Study Team Component 1-2
10	Ms. Gessarin	Gunthawong	JICA Study Team Component 1-2
11	Mr. Weerawat	Ittipanyakul	JICA Study Team Component 1-2
12	Ms. Kamolnit	Ariyakamolpat	JICA Study Team Component 1-2
13	Ms. Krittiya	Peerphayak	JICA Study Team Component 1-2
14	Ms. Wanlaya	Manutkasemsirikul	JICA Study Team Component 3
15	Ms. Paweesuda	Boonchuwong	JICA Study Team

1-2 Academic Meeting

1-2-1 Conference on the Chao Phraya Flood Management Master Plan

Conference on the Chao Phraya Flood Management Master Plan

Background

Responding the official request from Royal Thai Government, the technical assistance of updating flood management plan of the Chao Phraya River Basin has been started since January 2012 and will be wrapped up in coming June 2013.

The JICA consultant team has been working for wide range of studies on the Chao Phraya River flood management such as confirmation of topographical conditions and discharge capacities incorporating tidal effects, developing basin wide hydrological model, and preliminary economic, social and environmental assessment.

The titled conferences will exchange knowledge and experience among Thai academia, concerned government officials and the Study Team in order to deepen the understanding about the study results and improve the final output. In the 1st and 2nd conferences in May 2013, all the participants had active discussions and seemed to succeed in deepening understanding about the Flood Management Master Plan. Subsequent to them, 3rd and 4th conferences will be held as below.

Date and Venue:

1st Conference: May 22 2013, 9:00-12:00, at RID meeting room

2nd Conference: May 23 2013, 13:30-16:30, at RID meeting room

3rd Conference: June 10 2013, 13:30-17:30, at RID meeting room

4th Conference: June 11 2013, 13:30-17:30, at RID meeting room

Meeting subjects

1st Conference

Topic 1 Executive Summary

Topic 2 Runoff characteristics of the Chao Phraya River and approach for the Master Plan

Topic 3 Effectiveness of diversions; the Outer Ring Road channel, East and/or West diversion channels

2nd Conference

Topic 4 Effectiveness and adverse impact of Ayutthaya Bypass channel

Topic 5 Setup the design high water level considering secondary dyke and constraints of maximum height of dyke

3rd Conference

Topic 6 Optimal operation of existing dams

Topic 7 Follow-up discussions derived from previous conferences regarding;

- Flow capacity of downstream area, near the river mouth
- Effectiveness and limitation of all countermeasures
- Verification of the model by the inundation situation
- Flow distribution and discharge hydrograph, such as Sakae Krang and Tab Salao Rivers

4th Conference

Topic 8 Verification of flood control scenario by other rainfall patterns and another scenario

Topic 9 Consideration of flood mitigation in the Tachin River Basin

1-2-2 Questions and Answers Conference on the Chao Phraya Flood Management Master Plan (22 May, 2013)

Questions and Answers
Conference on the Chao Phraya Flood Management Master Plan

22 May 2013, 09.00 – 12.00 hrs.
Sippanondsa Ketudat meeting room, 1st Floor, Building 4
Office of the National Economic and Social Development Board

【QUESTIONS & ANSWERS, DISCUSSION RECORDS】

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1. A participant questioned about slides 13-16 of presentation that the reason why the discharges in the Sakae Krang River and Tab Salao River are different in slides 13 and 14. The participant also requested that JICA includes benefits of diversion channel in the final report.

JICA responded that the figure shows peak flow discharge. With the construction of diversion channel which made the water level in the Chao Phraya River decreased, it is easy to make discharge from the Sakae Krang River and the Tab Salao River flow in to the Chao Phraya River. If diversion channel is not going to be constructed, water level in the Chao Phraya River will be still high.

2. A participant questioned that in the slides from 13 – 16, how do JICA determine these canal capacities, especially for the Sakae Krang River and Tab Salao River (In Slide 13 "2011 Flood", Sakae Krang River is 0 m^3/s and Tab Salao River is 200 m^3/s. In Slide 14 "SCWRM M/P Full Menu", Sakae Krang River is 300 m^3/s and Tab Salao River is 800 m^3/s. Why numbers are different?).

JICA responded that the hydrograph of the Sakae Krang or Tab Salao Rivers gives the answer.

3. A participant commented that if the water is diverted to the diversion channel, the inundation of upstream side may be decreased, therefore the time of inundation also decrease. This should be included in the study report.

JICA responded that the figure shows the total area of inundation. The duration of inundation will be presented at the next meeting.

4. A Participant reminded that the 2011 flood was exceptional and it was not average occurring in Thailand. The participant questioned about the JICA proposal on the optimum dam operation that whether JICA used the right parameter in the simulation or not. Also, the participant requested JICA to clarify the peak discharge of the case without dam operations at Nakhon Sawan shown in slide 7, whether 6,587 m^3/s means the simulated data of the peak discharge without dam.

JICA agreed with the participant's comment regarding the dam operation that it is very challenging to answer the question about whether there are more effective dam operation exist or not. JICA considers the 2011 dam operation was the best all the above. In addition, in terms of the operation rule, there is always the room for the improvement. JICA clarified

that 6,587 m^3/s is the simulated peak discharge without dam, which means the natural discharge condition without dam.

5. A participant questioned 1) the reason why the discharge after optimizing the dam operation is still higher than the year 2011, 2) the flood volume in 2011 which was stored in 12.5 million Rai inundated area.

JICA replied that 1) the difference is made because one includes the countermeasures of construction of new dam and effective operation of existing dams, and another one only includes effective operation of existing dam.

6. A participant questioned that for the calculation of effectiveness of each countermeasure and internal rate of return, in addition to the inundation area, whether the depth and duration of inundation, and the local subsidence in terms of sea level were taking into account.

JICA replied that the depth and duration of inundation were already considered in the study. The duration in simulation is from July 1 to December 31st. Discharge from the Chao Phraya River and tributaries and also inundation areas are calculated for everyday. JICA answered that observed tidal level is used for the simulation and for the ground level the LiDAR topographic data is used.

7. A participant commended that the JICA study only includes the major rivers, and does not include the minor and small rivers. The flood damage is also occurred by the leakages through those small rivers. The participant also proposed to construct dykes along the coast as a solution.

8. A participant questioned 1) Page 13, whether the effects of the Sakae Krang River are reasonable or not as the figure shows different finding from the one worked in another working group, 2) assumption to use the 2011 Flood as a basis for the analysis is acceptable for long term planning or not, 3) the simulation without the dyke breach, this assumption is reasonable for the good planning or not, 4) JICA should present water level because in Thailand, overflow of dyke is always the issue.

9. A participant asked about whether the sea level is at 2 m above mean sea level or not.

JICA answered that sea level is observed data therefore not the constant value.

10. A participant asked about the accuracy of topographic survey used in simulation and whether JICA used LiDAR data for the area around Nakhon Sawan.

JICA replied that JICA used LiDAR data for topographic data, including Nakhon Sawan, which is precise and accurate with the error of 10 cm. For river channel, cross section data surveyed by RID was used.

11. A participant questioned that 1) whether inundation area was derived from satellite images, RADARSAT collected once or twice a week, or the data surveyed and

collected by GISTDA during flood in 2011, and 2) the reason why there is difference between the simulation result and GISTDA data.

JICA replied that GISTDA is a satellite image processing, which is why there are some differences between the GISTDA figure and the simulation result figure.

12. A participant questioned about 1) the method of runoff estimation in the flooding area, 2) the calibration of flood depth in the inundated area.

JICA replied that 1) Tissen method was applied to distribute the rainfall, and 2) the calibration was done by the comparison of water level and discharge in the river channel.

13. A participant questioned if the runoff coefficient can be roughly estimated.

JICA responded that this item will be presented in another meeting.

14. A participant asked to check the black lines of result in page 22 and 34.

JICA answered that the black line in page 22 is correct but there is mistake in page 34.

15. A participant questioned that 1) whether the 2011 case can be used as the base case, 2) any additional evidence which can prove the accuracy of the simulation results, 3) at the Nakhon Sawan station, the channel capacities for different combination of countermeasures such as with no dam, with effective dam operation etc, suggested by JICA is different from RID's findings. The effectiveness of the dam operation towards the Nakhon Sawan station need to be further discussed.

16. A participant commended that additional canals and tributaries need to be included so that Thai government can use this master plan as the river database system (development of national river inventory system).

JICA responded that some canals and tributaries are included as shown in the schematic diagram. If other tributaries or important canals need to be included, we could discuss this issue, however it is suggested by JICA that current river system is sufficient to simulate the 2011 flood.

17. A participant commented that the countermeasures must be effective for the flood mitigation as well as the drought mitigation.

JICA agreed with the participant's comment and responded that JICA proposed dam operation rule curve considering both flood and drought mitigations.

18. A participant questioned that with different land use in the future, whether the JICA proposed countermeasure would be different or not. The participant also questioned about the effectiveness of floodway.

JICA responded that it is a very important point; however JICA has only focused on current land use, therefore when the change in land use is significant, additional analysis must be

conducted. With the focus on the protection of the economic area (Bangkok and Ayutthaya areas), ring road dyke is much cost effective than the flood diversion.

19. A participant commended that 1) the model underestimates at the Bangsai area, 2) the objective of the study is 1 in 100 flood return period which must be clearly stated, 3) limitation must be stated, 4) rule curve information such as storing more water at the beginning of August etc, must be clearly stated.

JICA appreciated the suggestions.

Conference on the Chao Phraya Flood Management Master Plan

Organized by
Office of the National Economic and Social Development Board
Japan International Cooperation Agency

Attendees List: 22 May 2013

No.	Name-Surname	Title
Academics		
1	Dr. Sucharit Koontanakulwong	Chulalongkorn University
2	Dr. Phaisan Santitamnont	Chulalongkorn University
3	Dr. Sutat Weesakul	Director of Research Project, Asian Institute of Technology
4	Prof Dr. Thanawat Jarupongsakul	Chulalongkorn University
Thailand Development Research Institute (TDRI)		
5	Mr. Niphon Puapongsakorn	
Royal Irrigation Department		
6	Mr. Thongplew Kongjun	Director, Office of Water Management and Hydrology
7	Mr. Kanchadin Srapratoom	Chief of Loan Projects, Office of Project Management
8	Mr. Sompop Sucharit	Senior Expert of Irrigation Engineer
9	Mr.Thada Sukhapunnaphan	Director of Hydrology Division, Office of Water Management and Hydrology
10	Mr. Somchit Amnatsan	Head of Water Operation Group, Office of Water Management and Hydrology
11	Mr. Pakorn Phakdeepredasakul	Civil Engineer, Project Planning Group 4, Office of Project Management
12	Mr. Jakraphan Choyhiran	Civil Engineer, Project Planning Group 4, Office of Project Management
13	Dr. Phattaporn Mekpruksawong	Chief of Project Planning Group 1, Office of Project Management
Department of Water Resources (DWR)		
14	Mr. Kanapoj Wandee	Director of Water Operation Division
Office of the National Economic and Social Development Board (NESDB)		
15	Ms. Ladawan Kumpa	Deputy Secretary - General
16	Mr. Montree Boonpanich	Director, The office of Agriculture Natural Resource and Environment
17	Ms. Kanyave Payunsit	

18	Dr. Chamnong Paungpook	Policy and Plan Analyst, Senior Professional Level
19	Mr. Boonchub Songtakunsak	Policy and Plan Analyst, Senior Professional Level
20	Ms. Jinna Tansaraviput	Policy and Plan Analyst, Senior Professional Level
21	Ms. Aim-on Pruksuriya	Policy and Plan Analyst, Operational level
22	Mr. Pitsanu Woranapa	Policy and Plan Analyst, Senior Professional Level
23	Mr. Chanchai Rukkhawattanakul	Policy and Plan Analyst
24	Mr. Supapong Tansupap	Staff, NESDB
25	Ms. Nisarat Nantasen	Staff, NESDB
26	Ms. Kamonrat Pramotphan	Staff, NESDB
Japan International Cooperation Agency (JICA)		
27	Mr. Tatsuo Kunieda	JICA Expert to Royal Irrigation Department, Thailand
28	Mr. Yasuke Amano	Senior Expert
29	Mr. Hideaki Matsumoto	Deputy Director, Disaster Management Division 1, Global Environment Department
30	Mr. Takahiro Mishina	Component 1-2, Team Leader
31	Ms. Akira Watanabe	Engineer
32	Mr. Chuchat Suwut	JICA Study team
33	Ms. Nattamon Tanyapanit	JICA Study team
34	Ms. Kamolnit Ariyakamolpat	JICA Study team
35	Mr. Weerawat Ittipanyakul	JICA Study team
36	Ms. Siripen Sinpo	JICA Study team
37	Ms. Paweesuda Boonchuwong	JICA Study team

1-2-3 Questions and Answers Conference on the Chao Phraya Flood Management Master Plan (23 May, 2013)

Questions and Answers
Conference on the Chao Phraya Flood Management Master Plan

23 May 2013, 13.30 – 16.00 hrs.
Sippanondsa Ketudat meeting room, 1st Floor, Building 4
Office of the National Economic and Social Development Board

【QUESTIONS & ANSWERS, DISCUSSION RECORDS】

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1. A participant commented that RID is not responsible for all structures as some structures are managed by DOR, DOH and municipality. The participant raised his concern about conflicts among government agencies and social impacts.

JICA replied with sharing the measure taken by Japanese government about 40 to 50 years ago that all houses were moved out from the river courses to manage the situation. JICA suggested that from the engineering point of view, instead of heightening the primary dyke, the secondary dyke must be maintained.

2. A participant shared his appreciation for JICA to produce the H-Q curve. Also the participant questioned that whether using the averaged rating curve is appropriate or not.

JICA responded that the averaged rating curve is used to evaluate the averaged flow capacity during the flood. Therefore, the rating curve should be modified for another purpose, such as navigation purpose.

3. A participant questioned 1) the required size of the monkey cheek in order to accommodate flood water, 2) whether the secondary dyke was included in the simulation.

JICA suggested to see the Material No.4 for the required size of the monkey cheek and answered that the secondary dyke was included in the simulation.

4. A participant requested to elaborate further that 1) without dyke breach on the secondary dyke in the 2011 flood, what would be happened, 2) the channel capacity of the lower Chao Phraya River with the tidal effect.

JICA responded that 1) the simulation result of without dyke breach in the 2011 flood can be seen in Material No.4 page 24, 2) the flow capacity depends on tidal level, however according to the analysis the average flow capacity is 3,000 m^3/s as shown in Material No.2 page 28.

5. A participant commended that BMA has a plan to construct the dyke of 3.5 meter high and the channel capacity of the lower Chao Phraya River should not exceed 3,500 m^3/s. Another participant questioned the definition of the channel capacity as

3,500 m^3/s if it means that although water level increased at the lower Chao Phraya River, the water can be contained within the channel.

JICA responded that due to the limitation on observation data in this area, JICA is only able to present the calculation result. JICA recommends that it would be beneficial to obtain the H-Q relation per hour, rather than the data per day.

6. A participant questioned about 1) the assumption on the capacity calculation from Bang Sai to the Gulf of Thailand, 2) the reason behind why the inlet of the Outer Ring Road Diversion Channel is located as proposed.

JICA responded 1) by showing Figure 1.2.27 in Material 02 of page 1 to 28, and 2) the inlet location was selected in order to drain the water from the Pasak River.

7. A participant commented that it would be effective if the Ayutthaya bypass channel can drain water directly to the sea and the bypass does not contribute to increase the discharge.

JICA responded that the Ayutthaya bypass is proposed in order to increase the flow capacity in the bottle neck section in Ayutthaya; therefore, it does not increase the channel capacity further downstream.

8. A participant questioned that 1) the construction of Ayutthaya bypass can increase the flow from Bang Sai to the Gulf of Thailand, where the increased amount of water flow, and 2) the equation used for the simulation whether it was steep slope with upstream control or mild flow with downstream (tidal) control. The participant also questioned that whether JICA analysis is socially or logically acceptable or not.

JICA responded that the basic understanding is the lower channel has sufficient capacity to accommodate such increased flow. Ayutthaya bypass gives adverse impact, whereas Outer Ring Road Diversion Channel has positive impact. For the calculation, the observed sea level was used. JICA questioned that whether it is more socially acceptable if JICA proposal includes only the Outer Ring Road Diversion Channel.

9. A participant commented that 1) the real situation is three dimensional however the model is two dimensional, 2) the Ayutthaya bypass is a good idea however it can only improve the condition in the Ayutthaya area. In order to protect Bangkok, the construction of bypass directly from Bang Sai to the Gulf of Thailand is required. Another participant requested to elaborate further on the inundation pattern occurred in each inundated area.

JICA referred Material No.6 for the explanation.

10. A participant commented that the protected areas are different from the inundated areas in the 2011 flood. The participant expressed his concern on the adverse impacts on the enlarged protected areas.

JICA replied that the protected areas are based on Thai government's suggestion.

11. A participant requested to present the effectiveness of the proposed countermeasures for other flood.

JICA replied that the results will be presented at the next meeting in June.

12. A participant questioned about the current capability of flood protection system.

JICA responded that the objective of the study is to determine the optimum combination of countermeasures in order to accommodate 1 in 100 year flood return period event. The next step would be analyzing 1) the current capacity and 2) the method of improvement.

Conference on the Chao Phraya Flood Management Master Plan

Organized by
Office of the National Economic and Social Development Board
Japan International Cooperation Agency

Attendees List: 23 May, 2013

No.	Name-Surname	Title
Academics		
1	Assoc.Prof.Dr.Kampanad Bhaktikul	Dean of Faculty of Environment and Resource Studies, Mahidol
2	Dr. Phaisan Santitamnont	Chulalongkorn University
3	Dr. Sutat Weesakul	Director of Research Project, Asian Institute of Technology
4	Prof Dr. Thanawat Jarupongsakul	Chulalongkorn University
5	AssocProf.Dr. Usa Humphries	King Mongkut's University of Technology Thonburi
Royal Irrigation Department		
6	Mr. Kanchadin Srapratoom	Chief of Loan Projects, Office of Project Management
7	Mr. Sompop Sucharit	Senior Expert of Irrigation Engineer
8	Mr.Thada Sukhapunnaphan	Director of Hydrology Division, Office of Water Management and Hydrology
9	Mr. Jakraphan Choyhiran	Civil Engineer, Project Planning Group 4, Office of Project Management
10	Mr. Supanat Pariyachat	Chief of Project Planning Group 4, Office of Project Management
11	Mr. Wuttinan Phudenpa	Civil Engineer
Thailand Development Research Institute (TDRI)		
12	Ms. Nujpanit Narkpitaks	President Affairs Coordinator/ Researcher
13	Ms. Jidapa Meepean	Researcher
14	Ms. Devina Pande	Researcher
Office of the National Economic and Social Development Board (NESDB)		
15	Ms. Ladawan Kumpa	Deputy Secretary – General
16	Dr. Chamnong Paungpook	Policy and Plan Analyst, Senior Professional Level
17	Ms. Chanokamon Ruyaporn	Policy and Plan Analyst, Professional Level
18	Ms. Jinna Tansaraviput	Policy and Plan Analyst, Senior Professional Level
19	Ms. Aim-on Pruksuriya	Policy and Plan Analyst, Operational level
20	Mr. Pitsanu Woranapa	Policy and Plan Analyst, Senior Professional Level
21	Mr. Supapong Tansupap	Staff NESDB

22	Ms. Nisarat Nantasen	Staff NESDB
23	Ms. Kamonrat Pramotphan	Staff NESDB
Japan International Cooperation Agency (JICA)		
24	Mr. Yusuke Amano	Senior Expert
25	Mr. Hideaki Matsumoto	Deputy Director, Disaster Management Division 1, Global Environment Department
26	Mr. Tatsuo Kunieda	JICA Expert to Royal Irrigation Department, Thailand
27	Mr. Takahiro Mishina	Component 1-2, Team Leader
28	Ms. Akira Watanabe	Engineer
29	Mr. Chuchat Suwut	JICA Study team
30	Ms. Nattamon Tanyapanit	JICA Study team
31	Mr. Weerawat Ittipanyakul	JICA Study team
32	Ms. Siripen Sinpo	JICA Study team
33	Ms. Paweesuda Boonchuwong	JICA Study team
34	Ms. Gessarin Gunthawong	JICA Study team
35	Mr. Peerasak Chantngarm	Interpreter

1-2-4 Questions and Answers Conference on the Chao Phraya Flood Management Master Plan (10 June, 2013)

Questions and Answers
Conference on the Chao Phraya Flood Management Master Plan

10 June 2013, 13:00-17:00 hrs.
IEC 300 Room, 3rd Floor, IEC Building
Royal Irrigation Department

【QUESTIONS & ANSWERS, DISCUSSION RECORDS】

Questions & Answers

1. A participant argued there are no existing irrigation schemes from Nakhon Sawan to Chainat. They are mostly pump irrigation schemes. The irrigation systems from Chao Phraya Dam are found mostly downstream of Chainat and not between Nakhon Sawan and Chainat. The participant requested to clarify if the water is released for the purpose of irrigation.

JICA said that water is released for navigation and ecological reasons as well. Another participant asserted that the water that they discharged is irrigation water. The participant then echoed the report on Page 29 about the maximum amount of water supply to irrigation areas in the East and the West. In downstream of Nakhon Sawan, the minimum amount of water supply is about 120 MCM/month. Another participant commented that the discharge at the Chao Phraya is at least 70 m^3/s (50 m^3/s for water supply and 20 m^3/s for sanitation) during dry season.

2. A participant pointed out a number of issues:

   - RID's Mismanagement of the massive 2011 Floods was publicly blamed. The participant requested to clear that the simulation done by JICA was a post-flood simulation. In 2011, they did not expect the massive amount of water that hit the Chao Phraya River. The participant stressed that there is water shortage every other year in the country. In response to that, from April-May of 2011, they decided not to release waters (based on the excessive discharge of water in 2010).

   - Thailand experiences a bi-model peak flow twice a year (May and August), therefore the participant is concerned about having only one rule curve. The Rule Curve must ideally have two modes. The participant requested that the JICA Study Team to re-evaluate the effectiveness of this rule curve.

   - Bhumibol and Sirikit Dams' rule curves are based on the output of power distribution. According to A1, the JICA Study Team recommends to revise the lower rule curve of Sirikit Dam.

JICA responded to the fundamental question, "How much amount of water can pass Nakhon Sawan during Dry Season?" JICA came up with the 1,340 MCM/month. But if the Thai participants consider it is inaccurate; JICA will revise the report.

3. A participant said that the effective volume for both dams should be 12 billion m^3 for the whole (dry) season (November-April). The amount of water released and utilized are not the same for every month. The participant also recommended that assumption on water allocation to be checked.

JICA said that this can be found in Material 05-page 12 (as experienced on 1 November to 30 April 2006).

JICA requested to provide additional information about the ideal threshold and exact timing of the release of water from reservoirs. A participant replied that the threshold is at the Chao Phraya diversion dam. Thai government already has an existing system to monitor the discharge from Sirikit and Bhumibol Dams to Nakhon Sawan and Chao Phraya Dam.

4. A participant shared that in November, the EGAT (The Electricity Generating Authority of Thailand--agency that operates Bhumibol and Sirikit Dams) and RID will organize a meeting to identify the availability of water before planning for water distribution during dry season for next summer. This is more practical because it allows to provide advice to farmers about the amount of water available during dry season. The participant added that during the past 3 years, there was not enough water for irrigation in Thailand.

JICA said that if the 1,340 MCM/month estimate is not enough, then the simulation study is not applicable. A participant said that this is not a straight-forward response; farmers are relying on the decision made by the concerned agencies.

5. A participant asserted 1) the serious flood in 2011 was a result of misinterpretation of global climate change (La Nina and El Nino). JICA must consider these when drafting recommendations, and 2) JICA must provide two kinds of Rule Curves (one for dry year and one for wet year).

JICA said that there are several studies on climate change in Thailand. The studies revealed that drought in the country are not really severe in general. The occurrence of flood is more troublesome. JICA also have a 40-year record of La Nina and El Nino in a global scale. As for the two kinds of options, JICA stressed that they tried to combine all recommendations in one master plan. JICA recommends having only one rule in terms of dam management and water control. This is more practical and feasible for concerned agencies.

6. A participant shared that if the Thai government follows the one-way Rule Curve policy, they would not be able to allocate irrigation water. The general impression of the JICA

Master Plan is that it only focuses on flood control. The result of the operation will affect the water system scheme of the following years. Another participant argued that they cannot predict the type of year (dry or wet) that they will encounter. Another participant added that this is the reason why the Thai government has to use two model Rule Curves.

JICA replied that it is difficult to understand the point of this practice. A participant said Thai government would prefer forecasting based on an average amount of water rather than foreseeing a maximum amount (as prescribed by the Japanese). JICA responded that the feasibility of the Thai officers' proposals will be studied.

JICA said that they made an assumption about water distribution at the downstream of Nakhon Sawan, therefore JICA acknowledged the participant's opinion that the study is overly ideal.

ITEM 2: Flood Mark Survey
Questions & Answers

1. A participant commented that the size of the block would make a big difference on the survey result. Some blocks are bigger and possess more depth and volume. JICA must also consider if the area is protected or not-protected. Another participant asked if the survey can basically help agencies to identify high risk flood areas.

JICA said the flood mark survey is one of the main purposes of the JICA study. A participant pointed out the inaccuracy/inconsistency of pictures in the report. JICA responded that this is due to technical glitches and human error (e.g. memory retention of interview respondents).

2. A participant requested to elaborate further about the prediction of inundation in Pathumthani in late November. Another participant questioned that comparing real time event and GISDA, whether the model is enough to predict future floods.

JICA responded that the prediction is presented in the report (it is marked blue in the map). JICA responded the master plan simulation is effectively utilized for the planning purpose. In terms of the efficiency to predict new floods, rain even must be forecasted. JICA is currently conducting another project on flood forecasting information system. The technology/model is already shared with RID.

ITEM 3: Discharge Capacity near River Mouth
Questions & Answers

1. A participant said that the 3500 m^3/s forecast is being used for 30 years. The participant is doubtful of the validity of the simulation work (specially the 4,000 cubic meter forecast).

JICA said that the survey technique employed at the river mouth is impractical in other countries. JICA agreed with the participant's comment that it is very difficult to predict flow discharge at the river mouth. JICA suggested to predict the discharge (in Chao Phraya, Bang Sai) based on observed data.

2. A participant suggested that the final report should include the data with concrete evidence to support the proposal.

JICA responded that the JICA's proposal can raise important point of views in order to validate information of flow discharge at the Chao Phraya River. JICA agreed to present the concrete evidence in the report and recommended the Thai government agencies such as RID to carry out further survey or analysis which will be helpful for Thailand's better flood management system.

3. A participant commented that tidal waves may affect the traffic of the water in the Chao Phraya River. This may affect the flow in the channel particularly the adverse flow of sea water into the river mouth.

JICA explained the condition of flow discharge and adverse flow during flood season and replied that the difference of the discharge between high and low tides gets smaller once big flood occurs. This is one aspect that the Thai government agencies such as RID will be required to conduct further study in detail along with the tidal effect.

4. A participant questioned that if the capacity of the Chao Phraya River in Bang Sai is at 4,000 m^3/s and the capacity of the Chao Phraya River in Bangkok is also at 4,000 m^3/s, will flood occur between Bang Sai and Bangkok? The participant also mentioned that if this is the case then, there shouldn't be any floods in Nonthaburi and Pathumthani.

JICA replied that there is an inland water problem—they must have an inland pumping station to release water out.

5. A participant requested to elaborate further on the capacity of the Chao Phraya River in Bangkok which is 4000 m^3/s.

Conference on the Chao Phraya Flood Management Master Plan

Organized by
Office of the National Economic and Social Development Board
Japan International Cooperation Agency

Attendees List: 10 June, 2013

No.	Name	Post/Organization
Royal Irrigation Department		
1	Mr. Thada Sukhapunnaphan	Director, Hydrology Division
2	Mr. Somchit Amnatsan	Chief of Water Management Group
3	Mr. Supanat Pariyachat	Chief of Project Planning Group 4
4	Mr. Kanchadin Sraprathum	Chief of Loan Projects
5	Mr. Nirut Reansuwong	Senior Expert
6	Mr. Phaisan Phongnoraphat	Director, Operation and Maintenance Division RID 13
7	Mr. Chonlathep Thatree	Engineer, RID 3
8	Mr. Kanching Kawsard	Representative of Regional Irrigation Office 3
9	Mr. Sompop Sucharit	Senior Expert of Irrigation Engineer
10	Mr. Chatchai Boonbue	Director of Foreign Financed Project Administration Division
11	Mr. Pongsak Arulvijitskul	Expert Engineer, RID 11
12	Mr. Athaporn Punyachom	Chief of Water Management Branch, RID 10
13	Mr. Boonthum Panpiamphot	Chief of Water Management Branch
Academics		
14	Dr. Nuanchan Singkran	Faculty of Environment and Resource Studies, Mahidol
15	Dr. Phaisan Santitamnont	Faculty of Engineering, Chulalongkorn University
16	Dr. Sutat Weesakul	AIT Asian Institute of Technology
Japan International Cooperation Agency (JICA)		
17	Mr. Yusuke Amano	Senior Expert
18	Mr. Hideaki Matsumoto	Deputy Director, Disaster Management Division 1, Global Environment Department
19	Mr. Tomoya Kikuta	JICA Headquarter
20	Mr. Yojiro Miyashita	JICA Thailand Office

21	Mr. Tatsuo Kunieda	JICA Expert to Royal Irrigation Department, Thailand
22	Mr. Takahiro Mishina	Component 1-2, Team Leader
23	Mr. Kazuhiro Nakamura	Component 1-2
24	Mr. Chuchat Suwut	JICA Study team
25	Mrs. Kamonit Ariyakamonpat	JICA Study team
26	Mr. Werawat Ittipabyakul	JICA Study team
27	Ms. Gessarin Gunthawong	JICA Study team
28	Ms. Krittiya Peerphayak	JICA Study team
29	Ms. Paweesuda Boonchuwong	JICA Study team

1-2-5 Questions and Answers Conference on the Chao Phraya Flood Management Master Plan (11 June, 2013)

Questions and Answers
Conference on the Chao Phraya Flood Management Master Plan

11 June, 2013, 13:00-17:00 hrs.
IEC 300 Room, 3rd Floor, IEC Building
Royal Irrigation Department

【QUESTIONS & ANSWERS, DISCUSSION RECORDS】

Flood Cases in Thailand
Questions & Answers

1. A participant requested to verify the peak discharge in 1980 and 1995 shown in Table 5, Executive Summary Page 32.

JICA answered that at Bang Sai, the peak discharge is very large as presented in the Table. JICA Study Team selected only extreme rainfall cases to conduct this analysis.

2. A participant asked about spatial distribution of rainfall, especially about how the rainfall was enlarged to the simulated rainfall and how to calculate the averaged river basin rainfall.

JICA answered that enlarged weight was applied to each rainfall event which means the rainfall values were enlarged at all the points in same ratio. To calculate the averaged river basin rainfall, JICA Study Team applied Thiessen method.

3. A participant commented that it was interesting in reviewing the spatial distribution of rainfall to see the six different rainfall cases. If the majority of rainfall fell in upstream of reservoir, then the discharge will be the controlled-discharge, on the other hand, if the rainfall fell in the reach of downstream of reservoir, the discharge will be uncontrolled-discharge. The participant asked JICA Study Team whether they have considered such rainfall case.

JICA answered that if the rainfall intensively falls in upper river basin, we might catch some water in dam reservoir which means we can control discharge easier. If the rainfall falls in lower basin, there are not many effective control facilities, so it might be more challenging to control. However, the JICA Study's simulation does not consider any of these particular cases. The JICA Study Team places the project combinations in the simulation model and applies the enlarged rainfall. For example, the rainfall in 1980 fell relatively intensively in downstream of the Cao Phraya River Basin. As the result show, the proposed countermeasure combinations were able to accommodate such rainfall event effectively. Not only the 2011 flood event, the JICA Study Team has evaluated the proposed

countermeasure combinations against other rainfall events, including the enlarged ranfall cases. The countermeasure's effectiveness is basically owing to the Outer Ring Road, which is located downstream of the Chao Phraya River Basin.

4. A participant questioned the reasons behind the additional analysis applying other rainfall cases because the purpose of the study is just to focus on the 2011 flood.

Another participant responded that the various rainfall cases will provide the big picture about the flood situation in Thailand. This is important to give us a clear idea of how water moves in the Chao Phraya River and other neighboring rivers.

5. A participant suggested that for the 1970 peak discharge, the observed value is 4,420 m^3/s, however the peak discharge in Table 5 is 4,000 m^3/s. The participant questioned why the simulation result is different from the observed value.

JICA answered that the data in 1970 shows the results with a different land use (there was more forest area before). However, the 2011 conditions including land use and operation rule were applied in the simulation.

6. A participant requested to elaborate further on the effectiveness of the by-pass to divert the flood water, because the by-pass inlet is located on the Chao Phraya River at the upper stream of Bang Sai.

JICA answered that as shown in the Figure 26 on page 31 of Executive Summary, which describes the flow discharge distribution after the countermeasure combination was implemented. Ayuttaya by-pass would carry most of the flood water from east side of the Chao Phraya River, including the flow from the Pa Sak River.

7. A participant then asked that why the Pa Sak River Basin was not discussed much when there was a discussion about Nakhon Sawan and Bang Sai peak discharges.

JICA answered that this is based on the fundamental assumption which was derived from the Priority Protection Area proposed by the Thai Government (as shown in Figure 1, Page 5 of Executive Summary). According to the figure, the priority protection area is surrounded by two rivers, the north edge by the Pa Sak River and the west edge by the Chao Phraya River. Therefore, JICA Study Team proposed the countermeasure combinations which can effectively lower the water level along the reach of two rivers adjacent to the protection area.

The Evaluation of the Tha Chin River
Questions & Answers

8. A participant asked about the discharge capacity of the Tha Chin River. RID usually accepts the discharge of 250 m^3/s and the maximum discharge of 400 m^3/s. However the JICA's recommendation is 700 m^3/s.

JICA referred to Figure 1.2 of Page 1-2 of Material 01 which shows water level and discharge of the Tha Chin River. Between stations of 320km to 100 km from the river mouth, the discharge is less than 200 m^3/s observed upstream reach, and then the discharge drastically increased toward the mouth of river channel. This is due to the same reason as the one for the Chao Phraya River.

9. A participant asked if the discharge shown in Figure 1.2 is a net flow discharge.

JICA answered that it is the average of hourly discharge which is calculated by the simulation. According to Figure 1.20 of page 1-16 of Material 01 showed the H-Q Plotting in the Lower Tha Chin River, at the high tide, the reversed flow can be observed at the river section near the river mouth. On the other hand, during low tide, flow discharge is positive value. During the flood event, the discharge will be increased, however the water level will not be exceeded more than 2.00 m.

10. A participant questioned how to determine the H-Q curve for the downstream reach near the river mouth.

JICA answered that the JICA Study Team has tried to formulate the H-Q curve as shown; however no correlation was found.

11. A participant questioned about the methodology JICA applied to calculate the water level and flow discharge shown in Figure 1.20 of Material 01.

Another participant explained that even though the water level is the same, say at 2.00 m, due to the tidal effect, more than one discharge value will be recorded, one for the high tide (smaller discharge) and another for the low tide (larger discharge). The participant also commented that he appreciates JICA Study Team to prepare Figure 1.20 as this will provide the detailed information on the tidal effects on H-Q relationship. As the relationship is dynamic, it can only be calculated by using the equations, such as continuity, momentum, and energy equations.

JICA further elaborated that 10 km. area from the river mouth at the Chao Phraya River was severely affected by the reverse flow (tidal effect). According to the JICA's finding, the circles shown in the figure tend to move towards upper right, which means water level and discharge have the trend to be increased, during the flood event. Therefore, it was

concluded that the tidal effect plays an important role in controlling water level and flood discharge.

12. A participant questioned about model calibration for the Tha Chin River.

JICA replied that there is no water level data available, therefore only tidal data was used for calibration. JICA commented that RID faces challenges to observe discharge at the mouth of river as the discharge fluctuate constantly (ever changing water level). Therefore, the measurement has to be taken at least every hour in order to understand this natural phenomenon. Equipment such as H-ADCP can be utilized for such constant measurement; however the equipment range is quite short, actually shorter than the river channel width of 500 m. With the additional observed data at stations near the river mouth, the JICA Study Team would be able to tune its model up for better accuracy.

13. A participant commented that according to his past experience, the discharge measurement by such equipment is 20% larger than the actual rate. Therefore, BMA set the conservative discharge capacity of 3,500 m^3/s to the channel of the lower Chao Phraya River.

JICA replied that because it is difficult to observe tidal effect at the lower reach of the rivers, flow discharge must be assumed and determined before conducting the study. It is particularly important because the Tha Chin and Chao Phraya Rivers are the only two channels to discharge flood water.

14. A participant requested to elaborate the meaning of Figure 1.7 (Material 01).

JICA explained that this is a figure showing the discharge capacity of each cases, black line is the case when the water level is equal to the DHWL (Design High Water Level), whereas red and blue lines are the estimated discharge when the water levels are at the right and left bank heights, respectively. The JICA Study Team agrees to provide additional explanation of Figure 1.7 in the report.

15. A participant asked that why there is 500 m^3/s difference in the discharge capacity of existing river channel, between the maximum discharge found in Figures 1.7 (almost 1,000 m^3/s) and the discharge capacity in Figure 1.2 (1,500 m^3/s).

JICA answered that the discharge capacity presented in Figure 1.7 describes the actual channel capacity, whereas Figure 1.2 includes the volume of inundated water coming back from the inundated area to the channel. Ideally, flood water should only pass through the river channel, however in the case of the Tha Chin River, flood water inundated the adjacent areas with much higher water level as compared to the dyke height.

16. A participant commented that in 2011 inundation occurred at the mouth of the Tha Chin River which severely affected many people. Therefore, it is important to estimate the channel capacity at the river mouth. RID considers that the river capacity at the mouth of the Tha Chin River is 300 to 400 m^3/s, however the JICA Study analysis revealed that the capacity can be more than 400 m^3/s, at some location even close to 1,000 m^3/s. The participant questioned about the duration of the maximum discharge, because the maximum discharge will be observed at the low tides which assumed to be last for 5 minutes to half an hour. In addition, daily average flow discharge will not be useful for adjacent residents because this value does not provide them with clear information on when to evacuate.

JICA responded that for the warning purpose, it is important to look into the worst case, such as maximum water level and discharge. However, for the planning purpose, the daily average flow capacity is important in order to analyze how to deal with the large quantity of rainfall fell within the Chao Phraya River Basin, and also to determine the channel capacity.

17. A participant questioned to elaborate further on the boundary conditions of the calculation shown in Figure 1.7 of Material 01 and the assumptions of the calculation shown in Figure 1.2 of Materila 01.

JICA answered that as for the calculation of Figure 1.7, it includes the artificial high wall and also the flow only in the channel. This figure was used only to determine the discharge at each section. As for Figure 1.2, the results includes the inundate volumes which amount will be reduced once the dyke road is elevated. The simulation used the actual rainfall and assumed the overbank flow from the river. The inundate water was assumed to be returned back to the river channel not by overbank flow, but through control structures such as pump and sluice gate. The returning flow was only assumed when the water level in the channel recedes.

18. A participant commented that with the limited capacity of the Tha Chin River, some storage of 1 meter of water needs to be considered; this means that some overflow must be allowed to adjacent areas. Currently, a committee is working on to determine the location of primary and secondary dykes along the Tha Chin River. This dykes include DOH road that is located on approximately 1 km from the river channel on the east side and expected to increase the flow capacity 500-700 m^3/s. Another participant further elaborated that Phuttamonthon Sai 5 and 6 along the Tha Chin River at Nakhon Pathom serve as secondary dikes, however the participant disagrees with the idea of dyke construction. Historically, excess amount of water in the Chao Phraya River was stored in the upper/middle reach such as Sukhothai and Phitsanulok. With the dyke construction, overflow is controlled and these areas no

longer accommodate excessive amount of water. Therefore, the increased volume of flood water rushes to downstream which led the water level increase in the Tha Chin River.

JICA replied that the JICA Study Team does not propose the secondary dyke for the Tha Chin River due to the limitation of the available information. What the JICA Study proposes is the construction of four shortcuts which is effective to lower the water level in lower reach of the Tha Chin River.

19. A participant pointed out that Wat Chonglom Temple occupies the whole area to the Tha Chin River. Even though the four proposed shortcuts are constructed, with the restriction of Wat Chonglom, the increased volume of flood water is unable to flow into the sea.

JICA replied that the characteristics of the lower parts of the Tha Chin and the Chao Phraya Rivers is that, even though the discharge of flood water increases, the water level in the lower parts does not increase much. Therefore, no channel widening will be required. In addition, these shortcuts would provide the benefits by shortening the travel time of transportation as well as the travel time of flood water. This is a way to efficiently release the water out to the sea.

20. A participant commended that currently his committee is working on evaluating how to manage "ponding area" located in the western part of the Tha Chin River, especially the duration and timing of "ponding", control structures to manage the water flow in and out from "ponding area".

JICA replied that the JICA Study will state in the report regarding the basic precondition of inland water system, including the ponding system.

21. A participant commented that it is important to consider using the model proposed by JICA for the operational purposes as well.

JICA answered that the original purpose of this simulation model is just for planning purpose. To respond the requests by RID and DWR, JICA has launched another project to develop the simulation model for operational purposes. This model was effectively applied during the 2012 flood. Currently, another JICA Study Team responsible for the development of such model is working on to determine whether it is required to improve operational facilities and the way to transfer the model and technology to RID.

22. A participant requested to provide them with more information about 1) enforcement mechanisms on land use planning, which is the weak point in Thailand,

2) the step-by-step procedure that leads to implement countermeasures in the proposed master plan.

JICA answered that the land use control practice will be elaborated in the final report and executive summary. As for 2), the JICA Study Team will consider the suggestion made by the participant.

23. A participant observed that the study focused on the benefits and damages at the basin in lower region. Therefore it should not be compared with the full menu proposed by SCWRM. Another participant suggested that the report should include the remarks; benefits are calculated for the entire river basin.

JICA answered that the countermeasures proposed in Combinations 1 and 2 only emphasizes within the lower basin, however the benefit is determined for enter river basin. The JICA Study Team agreed to elaborate further on the calculation method on benefits in the report (benefit is expressed by the decreased amount of damages through countermeasures).

24. A participant commended that this master plan should be discussed openly with the public.

JICA replied that the JICA Study Team has held any meetings with the counterparts and also seminars to gather input from the concerned governmental agencies and the public on this study. At this moment, holding additional seminar (open to the public) is not the favorable option to JICA.

25. A participant recommended preparing a short version of the master plan in Thai.

No comments were provided from JICA.

26. Thai side discussed about which agencies and individuals will take responsibility on recommendations in this Report, especially to implement each countermeasure. A participant explained that Outer Ring Road was initially proposed by DOH, however current arrangement is not certain. Another participant suggested that the responsible agencies for the implementation of each countermeasure must be determined prior to the report submission.

27. JICA reminded the participants about the upcoming events as follows:

- **10 June:** **Technical Working Group Meeting**
- **13 June:** **Deadline for submission of comments on Executive Summary**
- **20 June:** **Final Seminar (Government agencies and department concerned will be invited)**

- **End of June: Provision of Draft Final Report**

Remarks: Within two weeks after Provision of DFR: Deadline for submission of comments on the Draft Final Report. All the questions and comments (in English) must be submitted to mishina@ctii.co.jp or watanabe-akira@ctii.co.jp

Conference on the Chao Phraya Flood Management Master Plan

Organized by

Office of the National Economic and Social Development Board

Japan International Cooperation Agency

Attendees List: 11 June, 2013

No.	Name	Post/Organization
Royal Irrigation Department		
1	Mr. Sompop Sucharit	Senior Expert of Irrigation Engineer
2	Dr.Phattaporn Mekpruksawong	Chief of Project Planning Group 4
3	Mr.Kanchadin Sraprathum	Chief of Loan Projects
4	Mr.Phaisan Phongnoraphat	Director, Operation and Maintenance Division RID 13
5	Mr.Athaporn Punyachom	Chief of Water Management Branch, RID 10
6	Mr.Chamnong Thammason	Irrigation Engineer Experienced.
7	Mr.Kanching Kawsard	Representative of Regional Irrigation Office 3
Academics		
8	Prof.Dr. Thanawat Jarupongsakul	Faculty of Science, Chulalongkorn University
9	Dr. Sucharit Koontanakulwong	Faculty of Engineering, Chulalongkorn University
10	Mr.Supote Thammasittirong	AIT Asian Institute of Technology
NESDB		
11	Ms. Suwannee Arunchokchai	Policy and Plan Analyst, Professional Level
Japan International Cooperation Agency (JICA)		
12	Mr. Yusuke Amano	Senior Expert
13	Mr. Hideaki Matsumoto	Deputy Director, Disaster Management Division 1, Global Environment Department
14	Mr.Tomoya kikuta	JICA Headquarter
15	Mr. Tatsuo Kunieda	JICA Expert to Royal Irrigation Department, Thailand
16	Mr. Takahiro Mishina	Component 1-2, Team Leader
17	Mr. Kazuhiro Nakamura	Component 1-2
18	Mr.Chuchat Suwut	JICA Study team
19	Mrs.Kamonit Ariyakamonpat	JICA Study team
20	Mr.Werawat Ittipabyakul	JICA Study team
21	Ms.Gessarin Gunthawong	JICA Study team
22	Ms. Krittiya Peerphayak	JICA Study team
23	Ms. Paweesuda Boonchuwong	JICA Study team