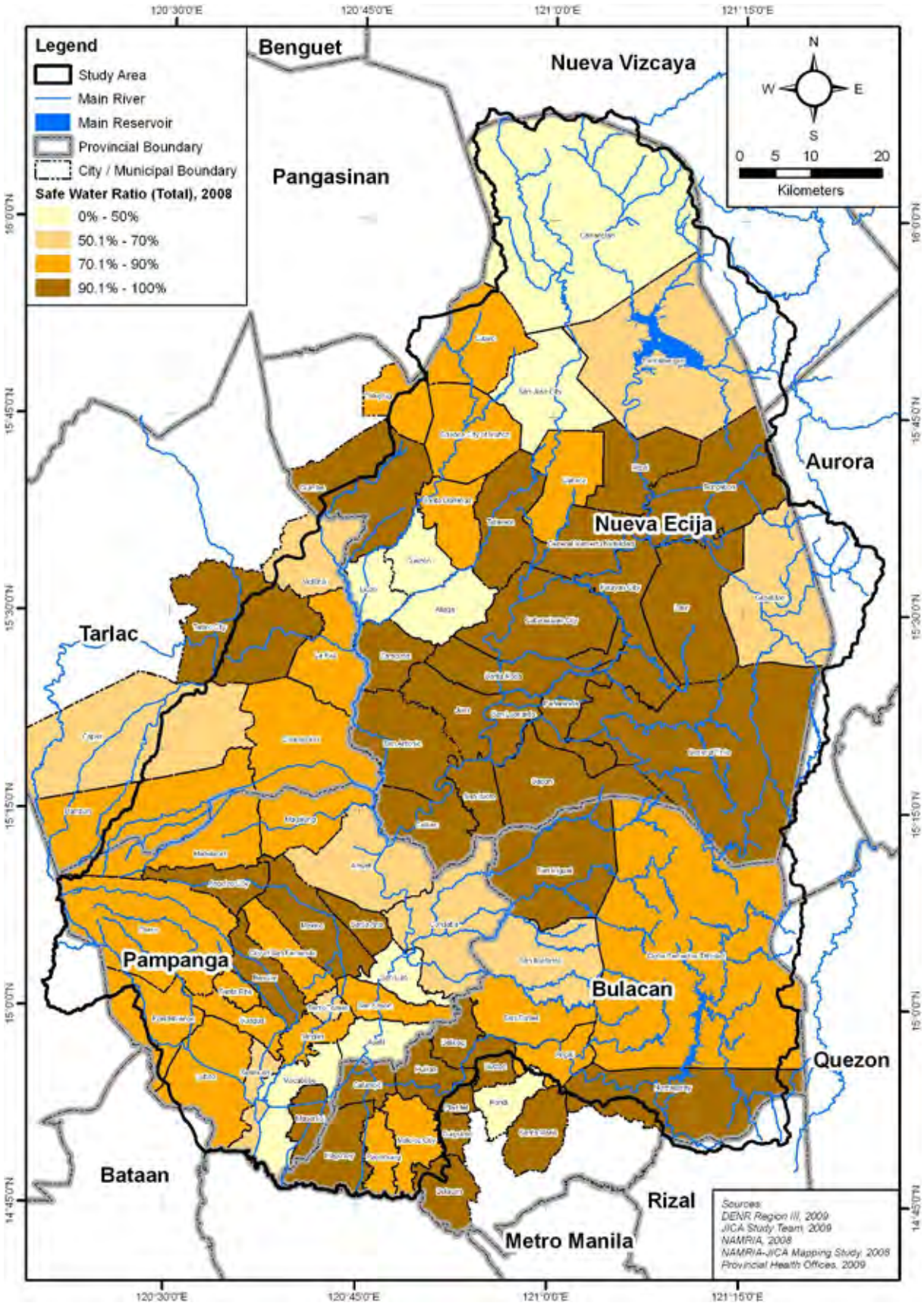
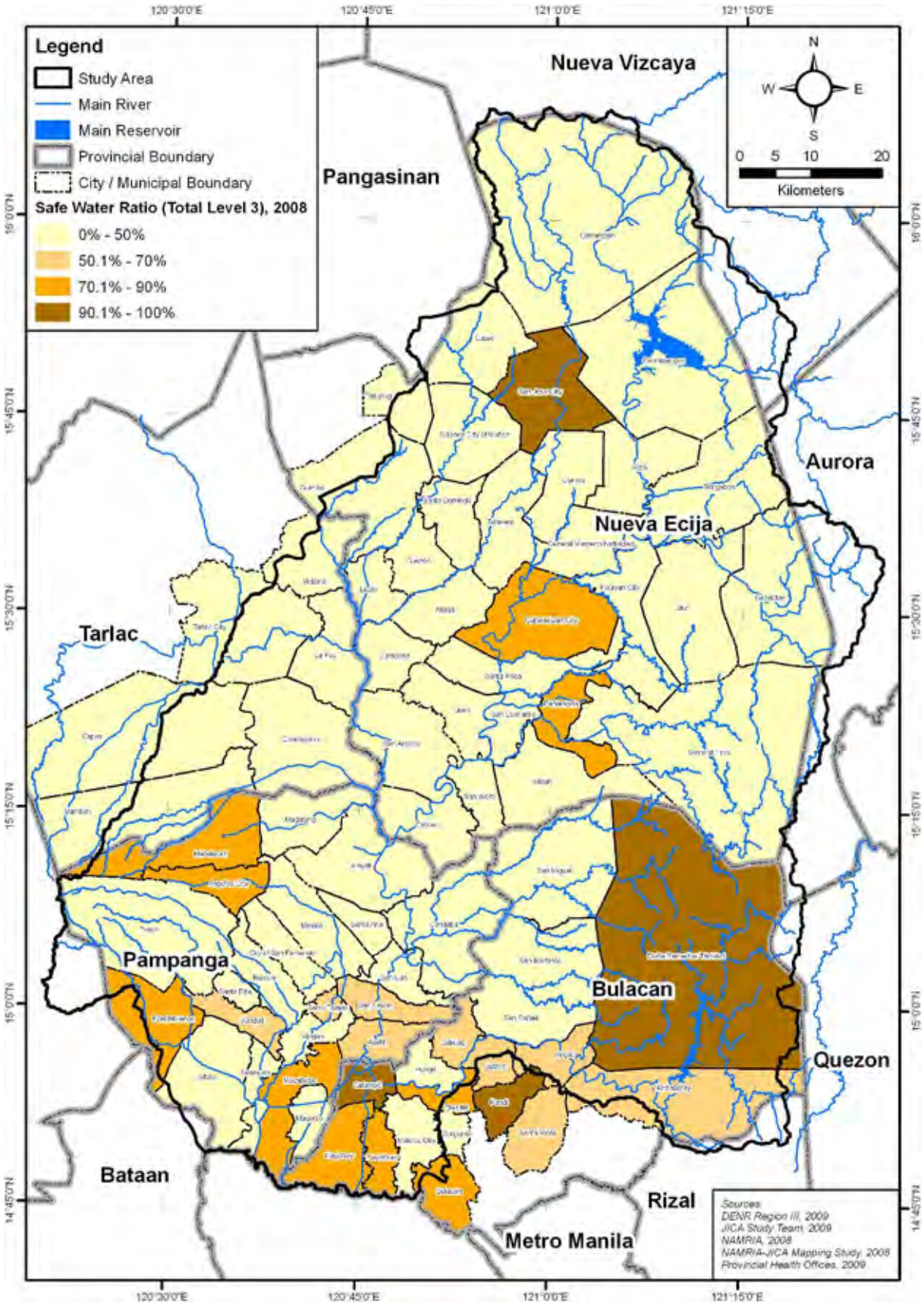
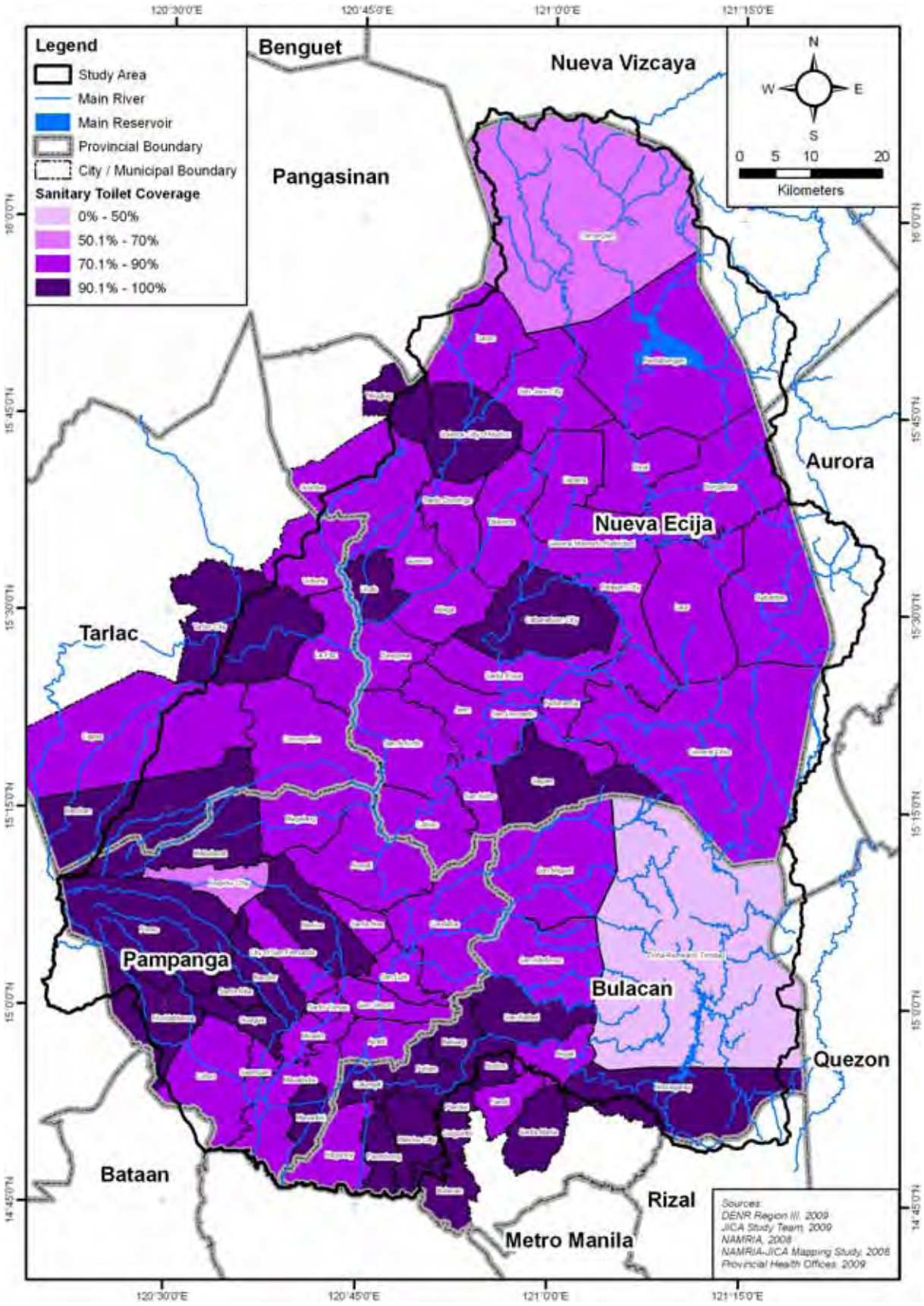
# *Annex-Figures*



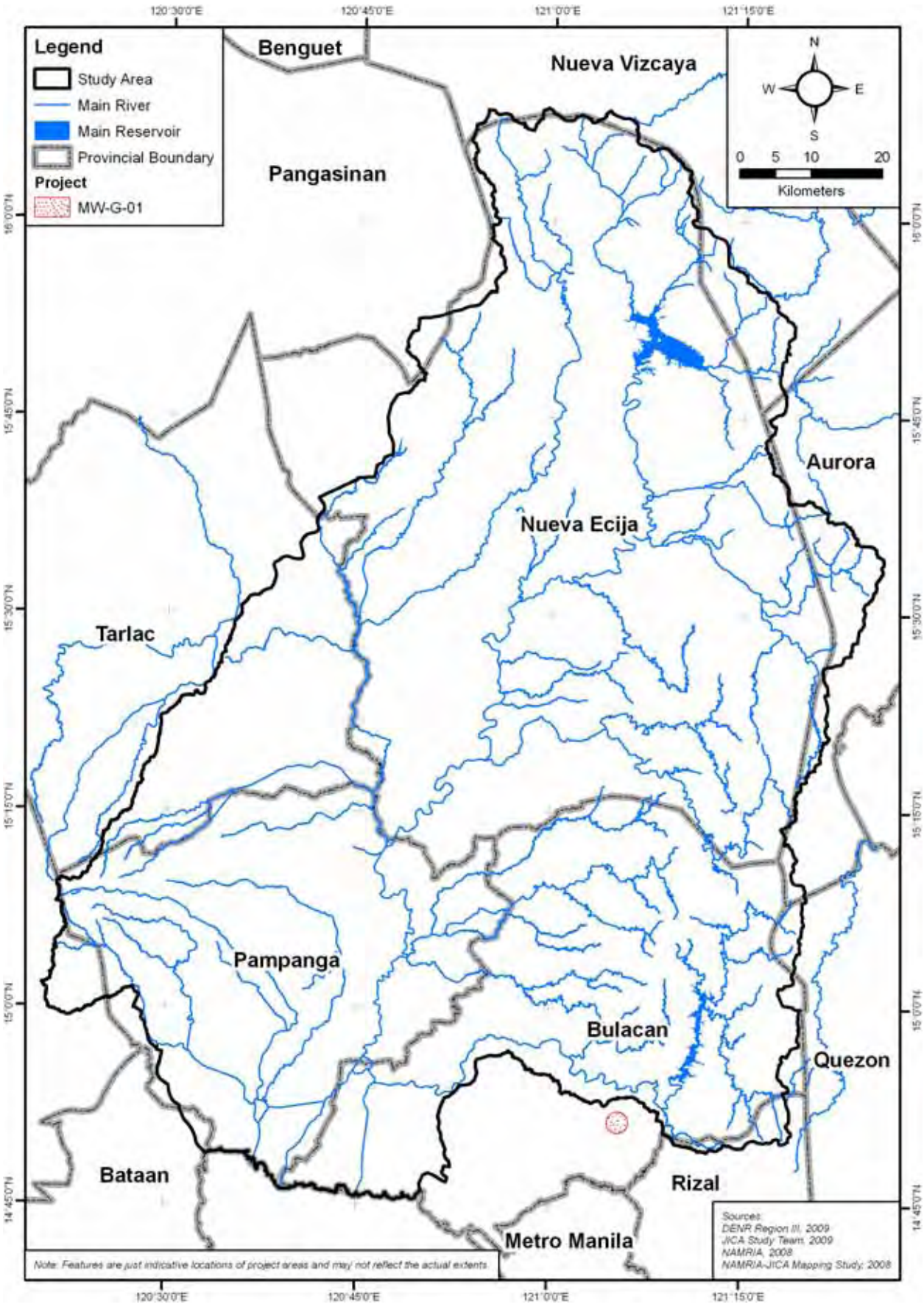

Annex-F D.2.3.1 Present Coverage of Water Supply Facilities for Access to Safe Drinking Water



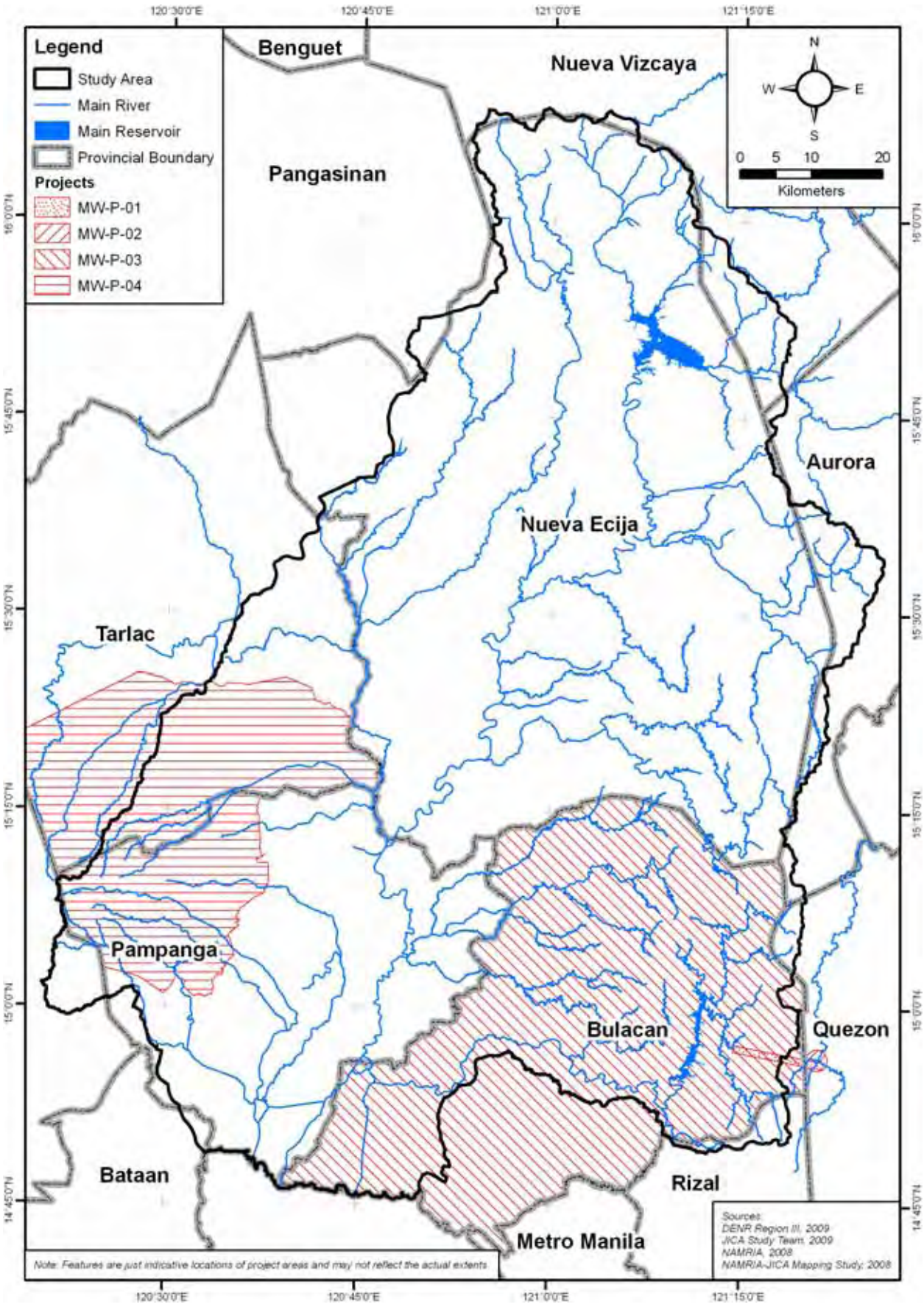

Annex-F D.2.3.2 Present Coverage of Level 3 Water Supply Facilities with Safe Water Access



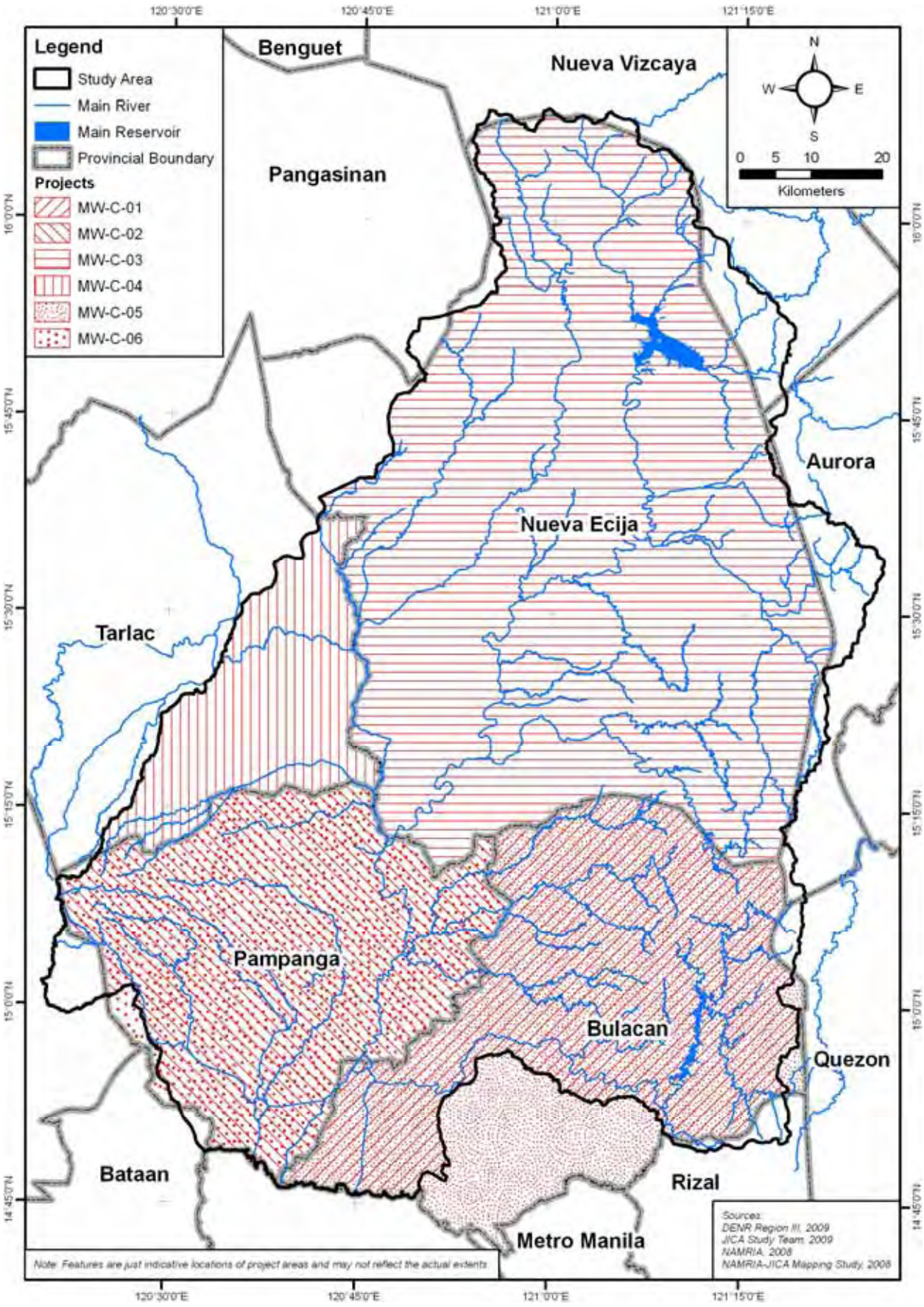

Annex-F D.2.4.1 Present Coverage of Sanitary Toilet



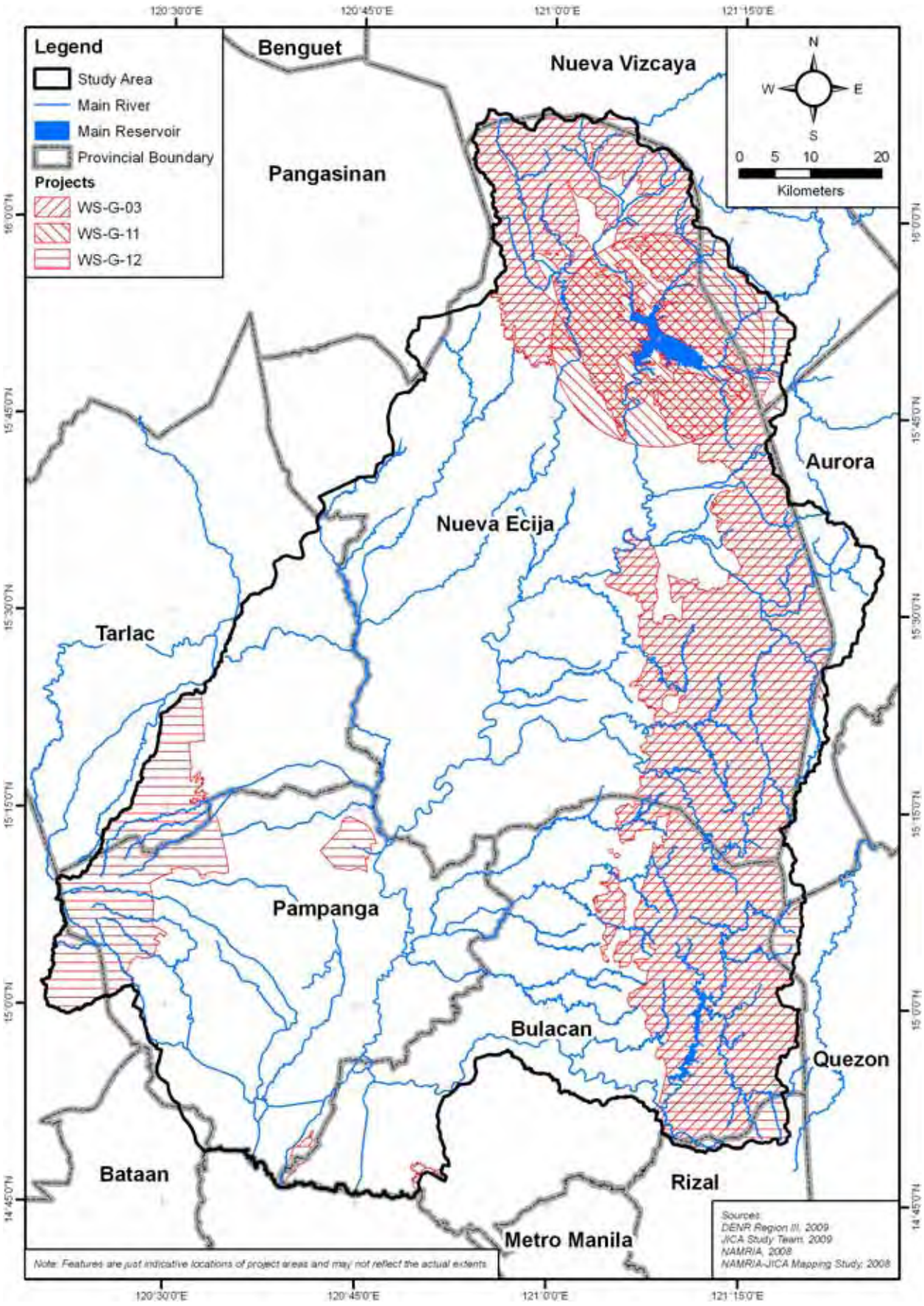

Annex-F D.3.2.1(1/7) Location of Projects in Municipal Water Supply, Sanitation and Sewerage



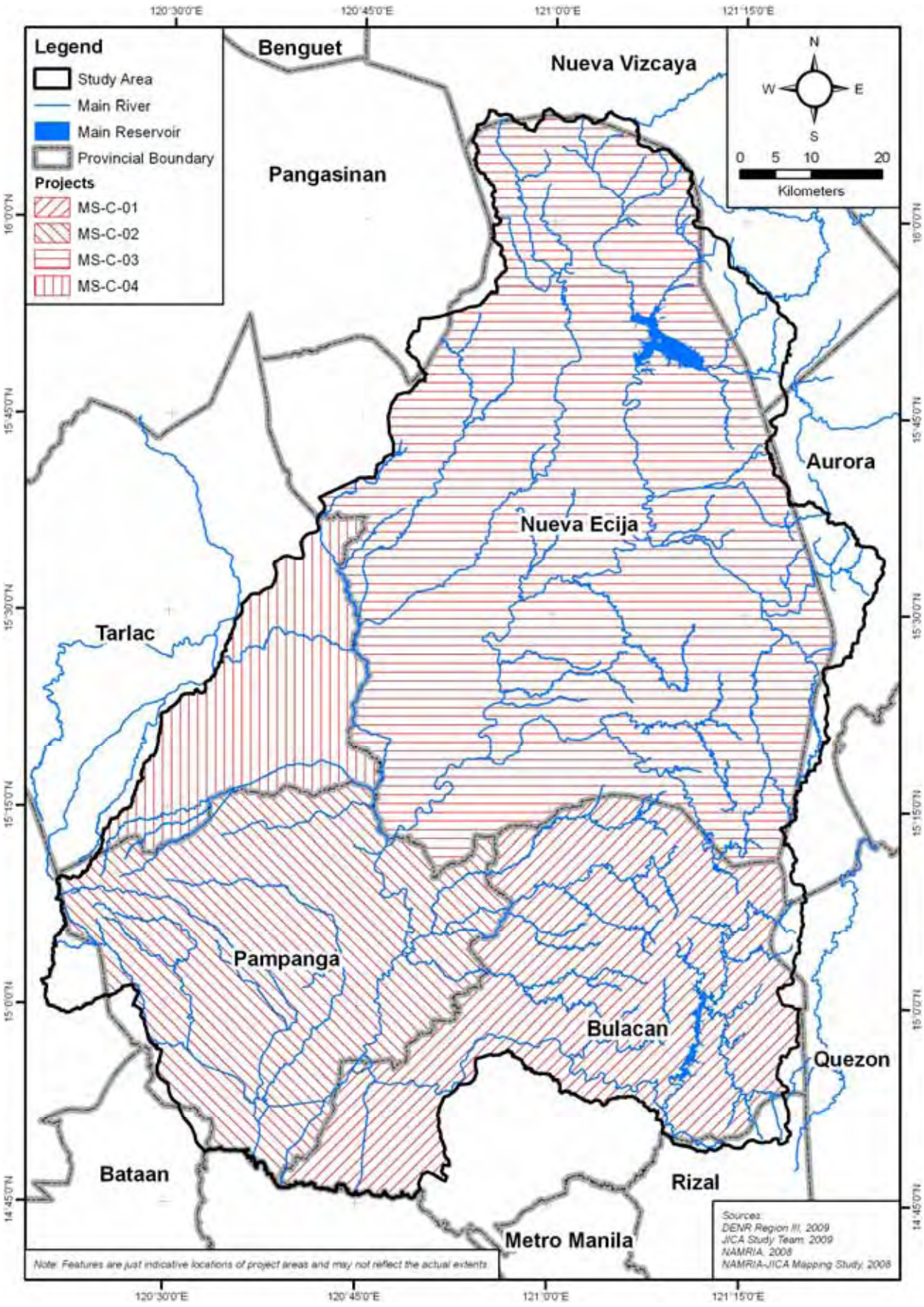

Annex-F D.3.2.1(2/7) Location of Projects in Municipal Water Supply, Sanitation and Sewerage



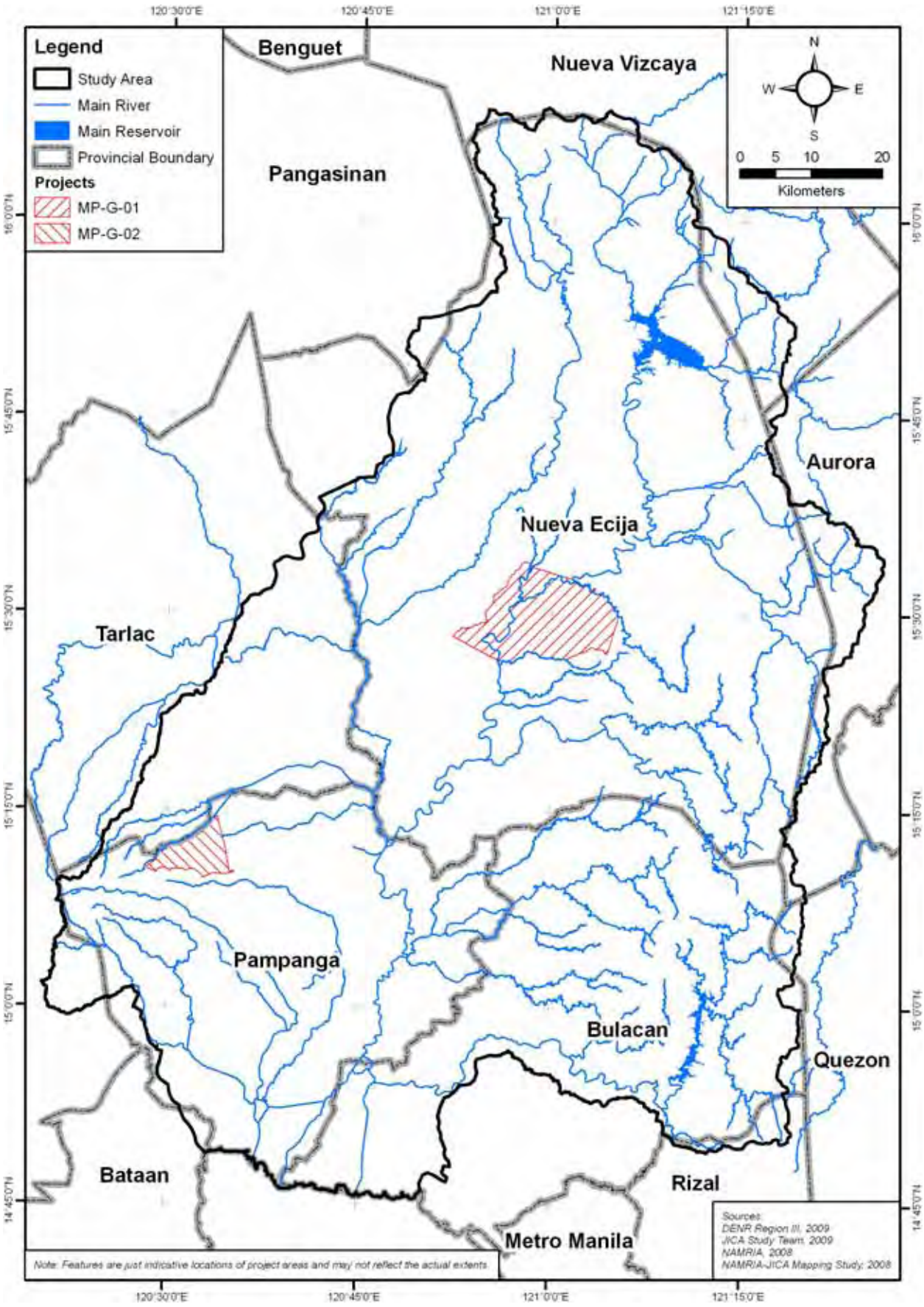

Annex-F D.3.2.1(3/7) Location of Projects in Municipal Water Supply, Sanitation and Sewerage




Annex-F D.3.2.1(4/7) Location of Projects in Municipal Water Supply, Sanitation and Sewerage




Annex-F D.3.2.1(5/7) Location of Projects in Municipal Water Supply, Sanitation and Sewerage

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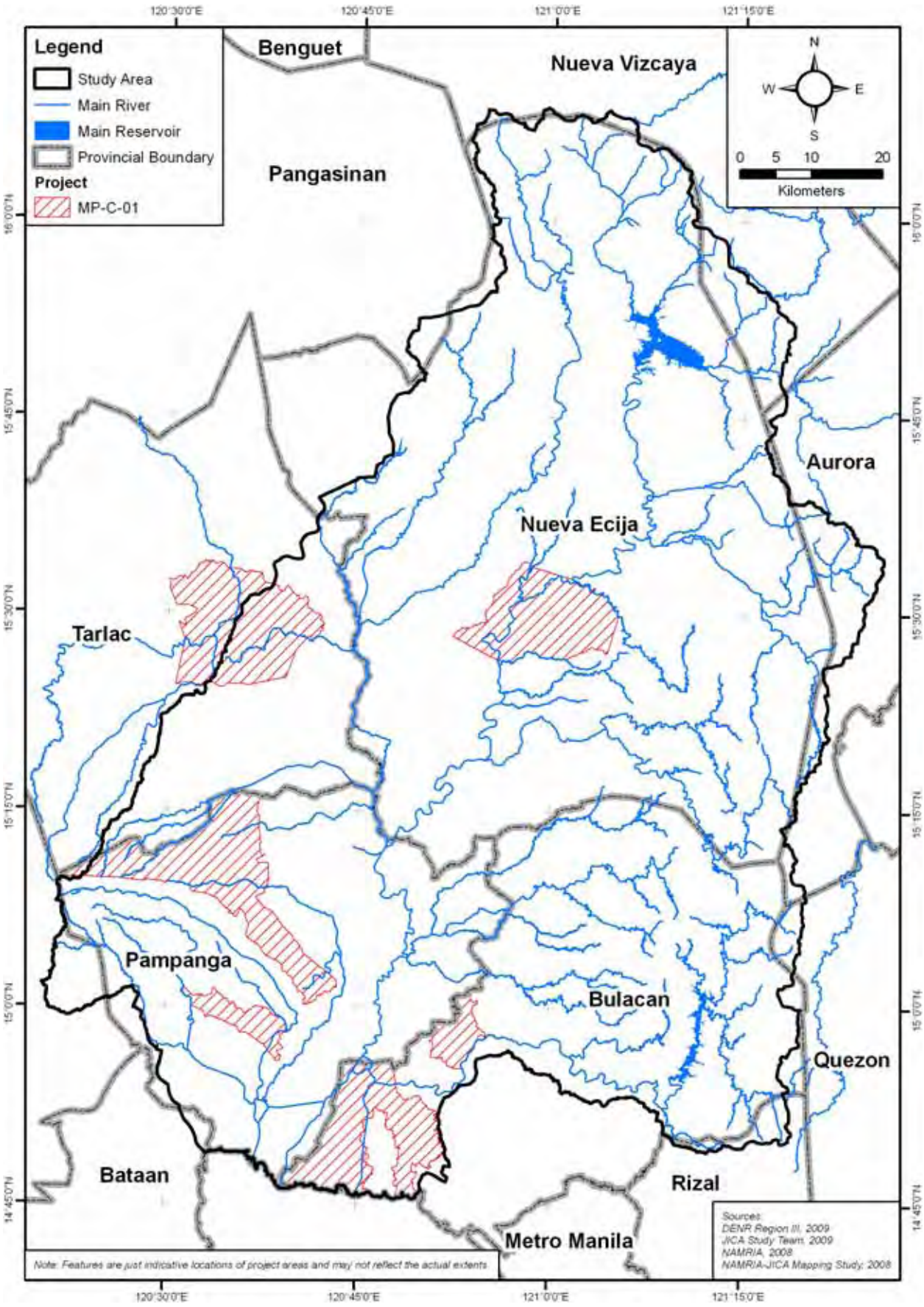
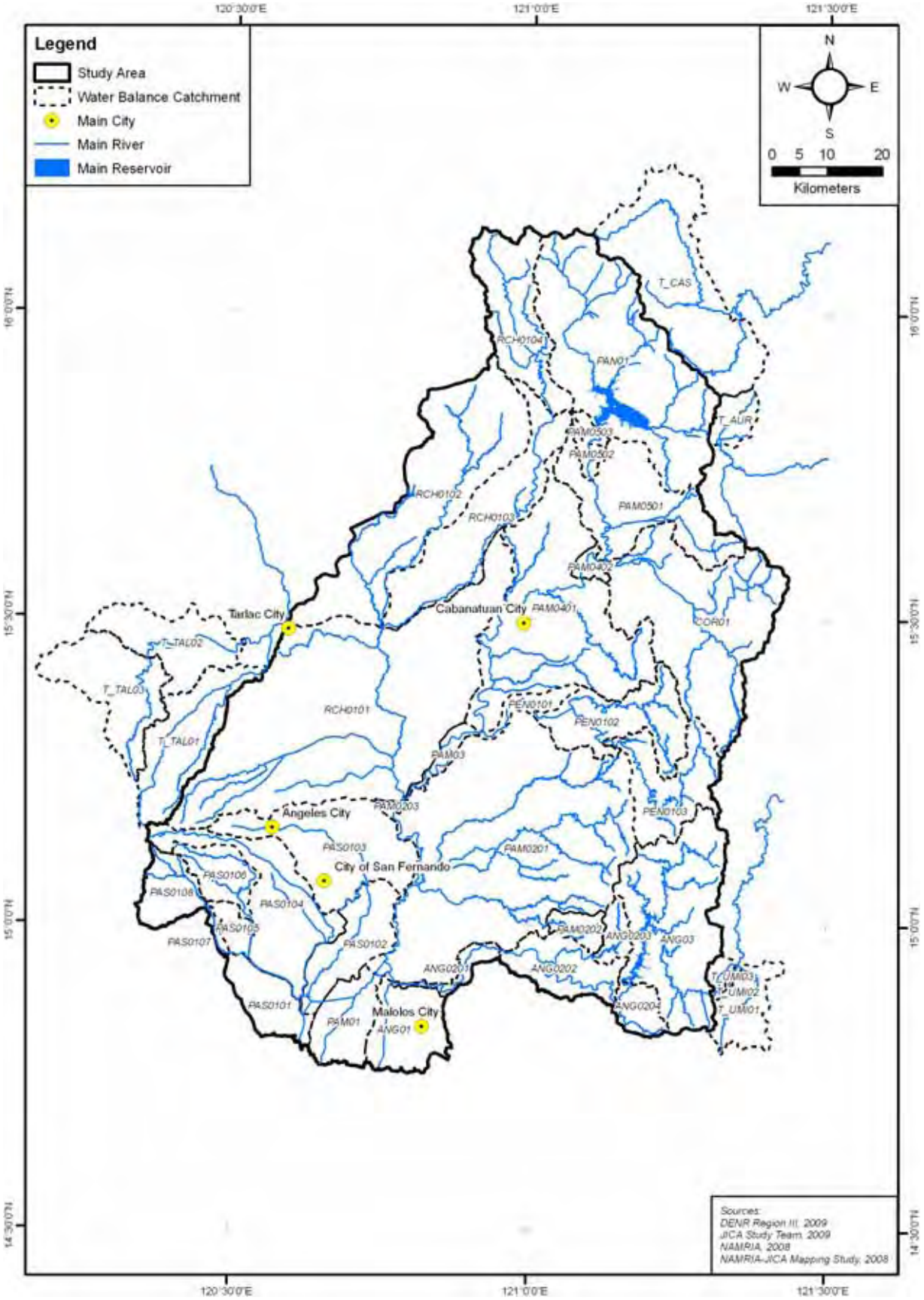



Annex-F D.3.2.1(7/7) Location of Projects in Municipal Water Supply, Sanitation and Sewerage




Annex-F D.4.1.1 Water Balance Catchments

# *Sector E*

# *Flood and Sediment Disaster Management*

# Sector E. Flood and Sediment Disaster Management

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# Sector E. Flood and Sediment Disaster Management

## E.1 Present Conditions of Flood and Sediment Disaster Management

### E.1.1 Flood and Sediment Disaster

#### E.1.1.1 Flood Disaster

The Regional Disaster Coordinating Committee (RDCC) for Region III recorded the recent flood damages from 2003 to 2006 in the three provinces of Bulacan, Pampanga and Nueva Ecija, which are centered in the study area, as shown in Table E.1.1.1 (refer to Annex-T E.1.1.1). According to the flood damage records, the provinces have suffered from the extensive flood damages, which include 30 to 750 thousand of population affected by the flood, every year. In 2004 in particular, the large flood damages successfully occurred three times in a year.

**Table E. 1.1.1 Recent Recoded Major Flood Damage in Pampanga, Bulacan and Nueva Ecija Province**

| Time of Flood | Typhoon | Affected Population | Number of Casualties | | Number of Houses Damaged | |
|---|---|---|---|---|---|---|
| | | | Dead | Injured | Totally | Partially |
| Jul. 2003 | Haurot | 163,309 | 5 | | | |
| Aug. 2004 | Marce | 757,070 | 14 | 1 | 120 | 1,200 |
| Nov. 2004 | Violeta | 9,562 | 2 | | | |
| Nov. 2004 | Winnie | 537,058 | 16 | 2 | 602 | 1,409 |
| Nov. 2004 | Toyong | 324,498 | 8 | 2 | 94 | 162 |
| Sep. 2005 | Labuyo | 43,631 | | | | |
| Jul. 2006 | Glenda | 30,831 | | | | |
| Oct. 2006 | Mienyo | 34,045 | 1 | 0 | 274 | 1,610 |

Source: RDCC-Region III

The recent largest flood damage was caused by Typhoon Marce in August 2004. The remote sensing analysis by Dartmouth Flood Observatory shows that the flood area by Typhoon Marce spreads over about 1,151km$^2$ or about 11% of the study area, which encompasses Pampanga Delta area, a substantial part along the midstream of Pampanga River and its tributary Rio Chico River (refer to Annex-F E.1.1.1). The population within the flood area is estimated at about 920 thousand or 15.6% of the whole population in the study area as listed below: Of this total population, about 493 thousand are in Pampanga Province corresponding to about 22% of the whole provincial population in the study area. After Pampanga Province, Bulacan Province has the second largest population of about 361 thousand or 22.2% of the whole provincial population in the study area. Thus, both of Pampanga and Bulacan Province are more vulnerable to the flood.

**Table E. 1.1.2 Estimated Extent of Flood Area and Population in the Flood Area for the Typhoon Marce, Aug. 2004**

| Province | Flooded Area (km$^2$) | | | | Population in the Flooded Areas | | | |
|---|---|---|---|---|---|---|---|---|
| | Populated area | Other areas | Total | | Populated area | Other areas | Total | |
| Pampanga | 27.7 | 595.2 | 623.0 | 30.4% | 439,665 | 53,024 | 492,689 | 22.2% |
| Bulacan | 16.1 | 212.8 | 228.8 | 11.3% | 335,195 | 25,744 | 360,938 | 27.0% |
| Nueva Ecija | 2.7 | 228.8 | 231.5 | 4.5% | 33,716 | 16,439 | 50,155 | 2.9% |
| Tarlac | 0.7 | 60.6 | 61.3 | 7.4% | 10,206 | 4,699 | 14,905 | 2.6% |
| Others | 0.1 | 6.3 | 6.3 | 1.8% | 866 | 555 | 1,420 | 7.1% |
| Total | 47.3 | 1,103.7 | 1,151.0 | 11.0% | 819,647 | 100,461 | 920,108 | 15.6% |

Note: (1) The "populated area" in the above table is the area defined as the "built-up area" or "settlement area" shown in the land cover map in Chapter 3.3.

(2) The percentages in the parenthesis are the rate of the flood area to the whole administrative area overlapped with the study area and/or the rate of population in the flooded area to the whole population in the study area.

Source: Population Census by NSCB
Dartmouth Flood Observatory (http://www.dartmouth.edu/~floods/)

As stated above, the large flood damage with death of people occurs almost every year in the study area, and the most serious damage is in the area of Pampanga Delta. The principal cause of such frequent and large scale flood damage would be attributed to the extremely small river flow capacity.

The channel flow capacities for the downstream and midstream sections of Pampanga River were preliminarily estimated, as listed in Table E.1.1.3, in the previous relevant study in 1982[1)]. According to the results of estimation, the flow capacities of the whole sections of Pampanga River from Masantol to Cabiao (the stretches of about 14km to 54km upstream from the river mouth) are evaluated to hardly cope with even the 5-year return period flood.

**Table E. 1.1.3 River Channel Flow Capacity and Probable Peak Runoff Discharge**

(unit: $m^3/s$)

| River | Stretch | Channel Flow Capacity | Probable Peak Flood Runoff Discharge | |
|---|---|---|---|---|
| | | | 5-year return period | 10-year return period |
| Pampanga | River Mouth – Masantol | 4,300 (500)* | 2,654 | 3,517 |
| | Masantol – Sulipan | 2,200 | 2,654 | 3,517 |
| | Sulipan – Arayat | 1,800 | 2,349 | 2,731 |
| | Arayat – Cabiao | 2,000 | 2,424 | 3,071 |
| | Cabiao - San Isidro | 2,500 | 2,408 | 3,051 |
| Angat | Calumpit - Expressway Bridge | 900 | 737 | 854 |
| San Fernando | Sexmoan - San Fernando | 200 | 272 | 363 |

Note: *: The channel flow capacity was increased from 500 to 4,300 $m^3/s$ through PPDP-Phase I in 1993
Source: Feasibility Report on the Pampanga Delta Development Project, 1982, JICA[1)]

The widening of river channel, together with the construction of embankment was made for the river stretch of 14km in length from the river mouth to Masantol through Pampanga Delta Development Project (hereinafter referred to as "PDDP") Phase I in 1993. As a result of this project, the channel flow capacity of the section from the river mouth to Masantol had increased from 500 to 4,300$m^3/s$, which could cope with the probable flood of 20-year return period. The PDDP was originally scheduled to continue as Phase II in order to increase the channel flow capacity for the further upstream sections, but Phase II is being held as a plan examined due to the extremely large scale of house relocation required.

According to the results of field reconnaissance, the fish ponds are being expanding in Pampanga Delta in particular, and such expansion of some fishing ponds are deemed to narrow the river channel width, which accelerates reduction of the channel flow capacity and induces the more frequent occurrence of flood. Moreover, the recent remarkable progress of the land subsidence could also aggravate the flood conditions.

### E.1.1.2 Sediment Disaster

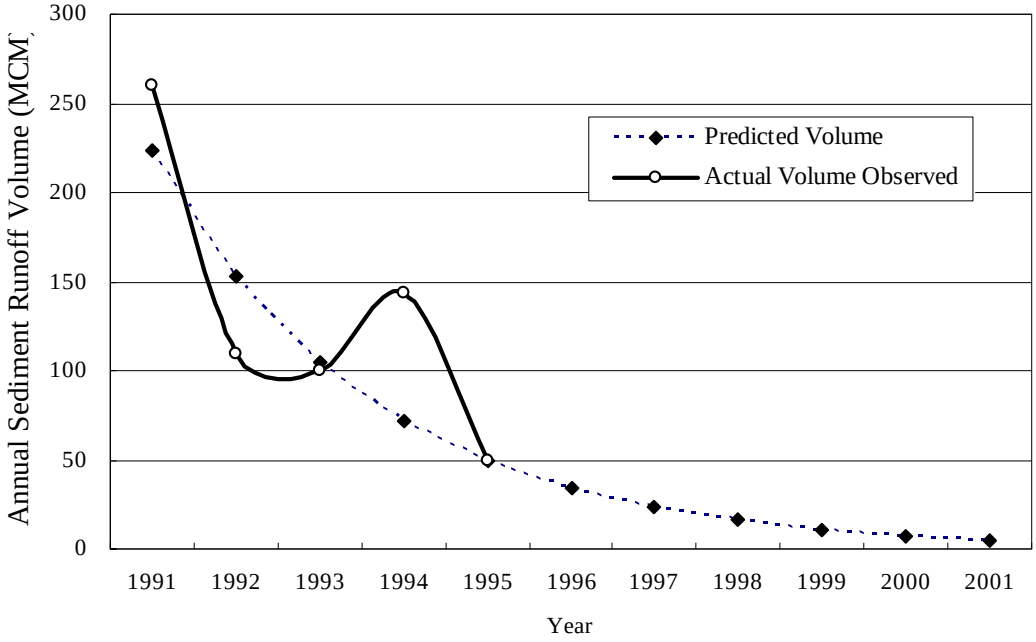
In addition to the above flood problems, the study area has the sediment disaster problems and incidental flood problems. Mt. Pinatubo, which is located in the southwestern part of the study area, erupted in 1991, and produced an extremely large volume of lahar runoff, which flowed down as the mudflow to the rivers in eastern Pinatubo areas such as Sacobia-Bamban river (the tributary of Pampanga River), and the tributaries of Porac River namely Abacan River, Pasig-Potrero River and Gumain River.

The runoff volume of lahar immediately after the eruption was estimated at about 1,650MCM, and since then the annual runoff volume of more than 100 MCM continued for three years from 1992 to 1994. On the other hand, PHILVOLCS predicted that such large volume of the lahar runoff would rapidly subside as shown in Figure E.1.1.1[2)].

The Study Team confirmed the lahar runoff has substantially subsided through the field reconnaissance and interview survey to the relevant organizations.

Although the runoff of the lahar has subsided, the volume of lahar of about 900 MCM still accumulates in the upper reaches of the river basin, and the sediment continues to runoff from the accumulated volume. As the results, the current sediment runoff volume into the river channel is estimated at about four times of those before eruption of Mt. Pinatubo as listed in Table E.1.1.4[3)]. The annual specific yield of sediment before eruption of Mt. Pinatubo was 17$m^3$/ha/year, while the

present yield is 62m$^3$/ha/year in Pasig-Potrero river basin. Likewise, Porac-Gumain has the annual specific yield of 14m$^3$/ha/year before eruption, while 56m$^3$/ha/year at present. These present larger sediment runoff is estimated to continue for more than 100years, and a substantial part of them would accumulate in the river channel causing reduction of the channel flow capacity, unless certain countermeasures are taken such as the river dredging to remove the sediment and reforestation to reduce the sediment runoff.




Source: The Study on Flood and Mudflow Control for Sacobia Banban/Abacan River Draining from Mt. Pinatubo, 1996, JICA[2)]

**Figure E. 1.1.1 Observed and Predicted Runoff Volume of Lahar by PHILVOLCS**

**Table E. 1.1.4 Annual Sediment Runoff Volume from Eastern Pinatubo Area in Pre-Eruption of Mt. Pinatubo and Present Stationary Phase**

| River Basin | Before Eruption of Mt. Pinatubo | | | Present as of 2001 | | |
|---|---|---|---|---|---|---|
| | Drainage Area (km$^2$) | Annual Sediment Yield | | Drainage Area (km$^2$) | Annual Sediment Yield | |
| | | Total Yield (MCM/year) | Specific Yield (m3/ha/year) | | Total Yield (MCM/year) | Specific Yield (m3/ha/year) |
| Abacan | 77 | No Available Record | | 77 | 0.4 | 52 |
| Pasig-Potrero | 280 | 0.47 | 17 | 307* | 1.9 | 62 |
| Porac-Gumain | 302 | 0.43 | 14 | 302 | 1.7 | 56 |

Note:* Increment of drainage area occurred due to the piracy from Sacobia Bamban river basin
Source: The Study Pinatubo Hazard Urgent Mitigation Project, Monitoring and Planning of Flood Control Works on the Pasac Delta (including Porac-Gumain River) and Third River Channel, JICA, 2002

In addition to the above problems of sediment runoff, another important issue is addressed to the drainage of San Fernando River, which functions as the principal drainage channel for San Fernando City. The large volume of mudflow from Mt. Pinatubo blocked up the waterway from San Fernando River to Pasig-Potrero River. As the results, the flood water flowing into San Fernando River is currently hardly drained, which induces the frequent and serious flood damage in San Fernando City. In order to cope with this drainage problem, an alternative route called “the Pilot Cannel” was newly excavated to drain the flood water of San Fernando River into Manila Bay. Nevertheless, the flow capacity of the Pilot Channel could cope with the probable flood runoff discharge of less than 2-year return period.

### E.1.2 Flood and Sediment Disaster Prevention and Management Works

#### E.1.2.1 Completed Works

The major structures for flood and sediment disaster prevention in the study area are as listed in Table E.1.2.1 (refer to Annex-T E.1.2.1 and Annex-F E.1.2.1). Of these structures, Arnedo Dike of 36 km in length was constructed along the right bank of the midstream of Pampanga River from Apalit to Arayat in 1940s. The Dike is the first essential defense line against the flow overflow of Pampanga River.

After Amadeo Dike, most of the existing flood mitigation structures including Pantabangan storage dam were founded in 1970s. The Pantabangan storage dam was placed in the upper reaches of Pampanga river basin having the flood control capacity of 330MCM. Of the river dikes/levees, Arayat-Apalit-Masantol Setback Levee has the largest length of 40km, and it was placed above the aforesaid Arnedo Dike to raise the dike crown level. However, the levee protects only the right bank of Pampanga River against the flood, and the more serious flood overflow tends to rush into the left bank area, where Candaba Municipality covering the Candaba Swamp and other two municipalities of San Luis and Simonn are located. Moreover, other river dikes/levees principally aim at protecting the river bank erosion and/or fix of the river alignment and hardly contribute to increment of the river channel flow capacity.

**Table E. 1.2.1 Completed Major Structural Flood Mitigation Projects**

| River System | Principal Project Contents | Purpose* | Implementation Period | Project Cost (billion pesos) |
|---|---|---|---|---|
| Pampanga | Arnedo Dike | FC | 1940s | Unknown |
| | Arayat-Aparit-Masantol Setback Levee on Right Bank | FC | 1970s | Unknown |
| | Arayat – Cabiao Ring Levee | FC | 1970s | Unknown |
| | Candaba Floodway | FC | 1970s | Unknown |
| | Cabiao - San Isidro – Gapan Levee | FC | 1970s | Unknown |
| | Bebe - San Esteban Diversion Channel | FC | 1970s | Unknown |
| | Pampanga Delta Development Project (PDDP) -Phase I | FC | 1990s-2000s | 2.90 |
| Rio Chico | Rio Chico River Control | FC | 1970s | Unknown |
| | PHUMP-Phase I (for Sacobia-Bamban River) | FC/SB | 1990s | 3.50 |
| Angat | Hagonoy-Calumpit-Plaridel-Bustos Levee on Left Bank | FC | 1970s | Unknown |
| | Labangan Floodway | FC | 1970s – 1980s | Unknown |
| | Abacan River Improvement | FC | 1970s to 1980s | Unknown |
| Porac | Mega Dike and Transverse Dike on Pasig-Potrero River | FC/SB | 1990s | 0.90 |
| | PHUMP-Phase II (for Pasig - Potrero River and San Fernando River) | FC/SB | 2000s | 4.55 |

Note *: FC = Flood Control, SB = Sabo Works
**: Aside from the projects as listed above, a variety of channel maintenance and rehabilitation projects have been undertaken in Pampanga River Basin.
Source: F/S and Project Implementation Phase I of PPDP[1)], and Data furnished from DPWH Region III

Most of the downstream and midstream sections of Pampanga River have the small channel flow capacities, which could not cope with even the probable flood runoff discharge of 5-year return period, as described in the foregoing subsection E.1.1. In order to increase such small channel flow capacity, the Pampanga Delta Development Project (PDDP) was lunched out in 1982 and the Phase I of the PDDP was implemented in 1992 to 2002. The project was completed at a reduced scale due to the budgetary constraints and difficulty of land acquisition of the Philippine government. The target river channel improvement length was 14.2km while the completed length was only 13.9km. Further work on the PDDP is being held as a plan examined.

In addition to the above flood mitigation works, the sediment prevention works had been made in the eastern area of Mt. Pinatubo in 1990s and 2000s in order to cope with a large volume of sediment runoff caused by the eruption of Mt. Pinatubo. The major projects for the sediment prevention and management are such as: (a) Pinatubo Hazard Urgent Mitigation Project (PHUMP)-Phase I for Sacobia-Bamban River (a tributary of Pampanga River), (b) Construction of Mega Dike and Transverse Dike for Pasig-Potrero River (a tributary of Pasac River) and (c) PHUMP-Phase II for Pasig-Potrero River and San Fernando River.

All of the above flood and sediment prevention works are categorized as the structural approaches. On the other hand, the flood forecasting and warning system as one of the non-structural approaches have been also adopted in the study area. The basin-wide flood forecasting and warning system was established for Pampanga River, and its rehabilitation works were further undertaken in 1981 as listed in Table E.1.2.2 (refer to Annex-F E.1.2.2). After this, the flood forecasting and warning system for the sake of the effective reservoir operation of Pantabangan storage dam and the Angat storage dam was established in 1994.

All of the above flood forecasting and warning systems are connected by telemeter system and their synchronized operation is now being made, at the central government level, by PAGASA in collaboration with NPC, NIA and DPWH. In addition to this, the province of Bulacan had set up the community-based flood forecasting and warning system through technical assistance by PAGASA in 2005. The system is composed of a network of hydrological monitoring stations and the communication equipment for information transfer among the monitoring stations, the municipal/ barangay disaster action teams, and the provincial operations center.

**Table E. 1.2.2 Completed Major Non-Structural Flood Mitigation Projects**

| Name of Project | Target Beneficial Area | Completion Year |
|---|---|---|
| Flood Forecasting and Warning System for Pampanga River Basin | Pampanga River Basin | 1973 |
| Rehabilitation of the Flood Forecasting and Warning System for Pampanga River Basin | Pampanga River Basin | 1981 |
| Flood Forecasting and Warning for Dam Operation of Angat and Pantabangan Dam | Pampanga and Angat River Basin | 1982 |
| Community Based Flood Early Warning System for Bulacan Province by Bulacan Province | Bulacan Province | 2005 |

Source: JICA Study Team

### E.1.2.2 On-going and Proposed Structural Works

The on-going and proposed structural works for flood and sediment disaster prevention and management are as listed below (refer to Annex-T E.1.2.2 to E.1.2.3 and Annex-F E.1.2.3).

**Table 1.2.1 On-going and Proposed Major Structural Flood Mitigation Projects**

| Name of Project | Target River Basin | Status | Principal Purpose of Project | Families to be Relocated | Project Cost (billion pesos) |
|---|---|---|---|---|---|
| PHUMP Phase III /1 | Pasac | On-going (2005-2010) | Flood mitigation for Pasac Delta | 40 to 80 | 4.70 |
| PHUMP Phase IV /1 | Pasac | Proposed | Flood mitigation for San Fernando River and its connecting channels | 100 | 3.30 |
| PDDP FC Phase II /2 | Pampanga | Proposed | Flood mitigation for Pampanga Delta | 6,700 | 8.80 |
| PDDP FC Phase III /3 | Pampanga | Proposed | Flood Mitigation for South Candaba Swamp area | Unknown | Unknown |
| Maintenance/ Rehabilitation Works /4 | Pampanga | Proposed (2008-2014) | River channel maintenance and rehabilitation | Nil | 0.20 |

Source: /1: Pinatubo Hazard Urgent Mitigation Project-Phase II, Monitoring and Planning of Flood Control Works on the Pasac Delta (including Porac-Gumain River) and Third River Channel, 2002[3)]
/2: Pampanga Delta Development Project (Flood Control Component, Review Study for Phase II, 2003[5)]
/3: Feasibility Report on the Pampanga Delta Development Project, 1982[1)]
/4: DPWH Region III

The above structural works are broadly classified into the following three groups: (a) Pinatubo Hazard Urgent Mitigation Project (PHUMP)-Phase III and Phase IV, which aim at coping with the flood and sediment disasters in the eastern area of Mt. Pinatubo, (b) Pampanga Delta Development Project (PDDP)-Phase II and Phase III, which aim at coping with the frequent flood overflow of Pampanga River and (c) the maintenance and rehabilitation works for the existing flood and sediment prevention and management structures. The detailed of these groups are as described hereinafter:

**(1) Pinatubo Hazard Urgent Mitigation Project (PHUMP)-Phase III and Phase IV**

The objectives of PHUMP-Phase III are placed to Porac-Gumain River and its vicinity rivers/creeks such as Dalan Bapor River and Lower Guagua River (refer to Annex-F E.1.2.3). A large volume of sediment has accumulated in these rivers since eruption of Mt. Pinatubo, which reduced the channel flow capacity causing the serious flood damages. In order to cope with these flood and sediment problems, a flood diversion channel of 18.7km in length is now being constructed in the lower reaches of Porac River in order to safely discharge the flood runoff from the river basin into Manila bay. At the same time, the channel dredging for Porac-Gumain River and its vicinity is being undertaken to maintain the channel flow capacity.

Succeeding to the above on-going PHUMP-Phase III, the PHUMP-Phase IV is now being proposed (refer to Annex-F E.1.2.3). The principal purpose of the project is to widen the existing outlet diversion channel called "Pilot Channel", which currently functions to drain the flood discharge of San Fernando River into Manila Bay. As described in the foregoing subsection E.1.1, San Fernando River had flowed into Pasig-Potrero River before eruption of Mt. Pinatubo. However, the waterway from San Fernando River to Pasig-Potrero River was blocked up by the mudflow accumulated in Pasig-Potrero River immediately after eruption of Mt. Pinatubo in 1991. In order to cope with this drainage problem, the small creak named Manpi Mesapinit River, which was another route to lead the flow of San Fernando River into Manila Bay, was newly widened and/or re-aligned as an alternative outlet waterway for San Fernando River. This alternative outlet waterway is now called Pilot Channel. The channel flow capacity of the Pilot Channel is, however, designed to cope with the probable flood runoff discharge of 2-year return period only. Hence, PHUMP-Phase IV was proposed to widen the Pilot Channel so as to increase the channel flow capacity from the present design scale of 2-year return period to 20-year return period. The Pilot Channel is renamed as the Third Channel after completion of widening of the Pilot Channel.

**(2) Pampanga Delta Development Project (PDDP)-Phase II and Phase III**

As described above, PDDP-Phase I was implemented in 1990 to 2002 in order to mitigate the frequent flood over flow of Pampanga River, while the project was completed at a reduced scale due to the budgetary constraints and difficulty of land acquisition of the Philippine government. According to the original proposal of PDDP, the target river improvement section stretches along: (a) Pampanga River of 45km in length from the river mouth to the confluence point of Maasim River, (b) Banban River of 4.5km, which connects between Pampanga and Angat Rivers, and (c) Labangan Floodway of 16.8km, which connects Angat River to the river mouth. On the other hand, the river channel improvement section completed through PDDP-Phase I is limited to 13.9km of Pampanga River from the river mouth to Masantol (refer to Annex-F E.1.2.3). The termination on the PDDP Phase II and Phase III has not been officially declared. It is, however, virtually difficult to pursue those proposed project due to the relocation of 6,700 houses required and the strong opposition of the relevant LGUs and communities against such large number of house relocations.

**(3) Maintenance and Rehabilitation for Existing Flood and Sediment Prevention and Management Structures**

Most of the existing river dikes, levees, river slope protection and other river structures in Pampanga river basin in particular were originally constructed more than 40 years ago, and they are seriously damaged in spite of the previous maintenance/rehabilitation works. Moreover, the serious sediment accumulation in the river channel is now in progress due to the large volume of lahar deposit in the eastern area of Mt. Pinatubo and logging activities in the upper reached of river basin. In order to cope with such degradation of the river structures as well as river channels, DPWH Region III proposed to rehabilitate the deteriorated dike and river slope protection of 28.6km in length with using a budget of 201 million pesos in total for a period from 2005 to 2010 (refer to Annex-T E.1.2.3).

### E.1.2.3 On-going and Proposed Non-structural Works

There are two principal non-structural works for flood and sediment disaster prevention and management, which are now in progress or proposed, in the study area as listed in Table E.1.2.3 (Annex-T E.1.2.4). One is the on-going project for upgrading of the aforesaid flood forecasting and warning system in Pampanga river basin and for dam reservoir operation of the Angat and Pantabangan storage dams (refer to Annex-F E.1.2.2). Another is PHUMP-Phase III-Part 2, which is proposed as continuation of the aforesaid PHUMP-Phase III in order to mitigate the flood and sediment runoff in Porac river basin. This Project includes several sub-project components such as those for watershed management, land use management, flood management by FFW and institutional management.

**Table E. 1.2.3 On-going and Proposed Principal Non-structural Flood Mitigation Project**

| Name of Project | Target River Basin | Project Features | |
|---|---|---|---|
| | | Item | Contents |
| The Project for Upgrading of Flood Forecasting and Warning System in the Pampanga and Agno River Basins<br><br>(on-going) | The Whole Pampanga River Basin | Principal Purpose of the Project | Upgrading of flood forecasting and warning system for Pampanga, Angat and Pasac River Basins |
| | | Implementation Period | 2007 to 2010 (32 months) |
| | | Project Proponent | PAGASA |
| | | Beneficial Area | The whole Pampanga River Basin and Angat River Basin |
| | | Project Cost | 0.6 billion pesos (1.2 billion yen) |
| PHUMP-Phase III -Part 2<br><br>(Projected) | Porac Gumain and Pasig Potrero River Basin | Principal Purpose of the Project | Plan formulation and capacity building in aspects of watershed management, land use management, flood management by FFW and institutional management |
| | | Implementation Period | 2009 to 2010 |
| | | Project Proponent | DPWH |
| | | Beneficial Area | Pasac River Basin |
| | | Project Cost | To be estimated through the Study. |

Source: Basic Design Study Report on the Project for Upgrading of Flood Forecasting and Warning System in the Pampanga and Agno River and Basins, 2007[6)]

Inception Report for Part 2: Monitoring and Planning of Non-structure Measure and Institutional Capacity Building, PHUMP-Phase III, 2009[7)]

# E.2 Problems and Issues of Flood and Sediment Disaster Management Sector on IWRM Plan

### E.2.1 Occurrence of Chronic and Aggravating Flood Damages

The Regional Disaster Coordinating Committee (RDCC) for Region III recorded the recent flood damages from 2003 to 2006 in the three provinces of Bulacan, Pampanga and Nueva Ecija, which are centered in the study area, as shown in Table E.1.1.1. According to the flood damage records, the provinces have suffered from the extensive flood damages, which include 30 to 750 thousand of population affected by the flood, every year. In 2004 in particular, the large flood damages successfully occurred three times in a year.

The recent largest flood damage was caused by Typhoon Marce in August 2004. The remote sensing analysis by Dartmouth Flood Observatory shows that the flood area by Typhoon Marce spreads over about 1,151km$^2$, which corresponds to about 11% of the whole study area and encompasses a substantial part of the deltas of Pampanga River and Pasac River. The population, who resides within the flood area, is estimated at about 920 thousand corresponding to about 15.6% of the whole population in the study area: Of this total population, about 493 thousand are in Pampanga Province corresponding to about 53.5% of the whole population in the flooded area. After Pampanga Province, Bulacan Province has the second largest population of about 361 thousand or 39.2% of the whole population in the flooded area. Thus, a substantial part of the potential flood inundation areas in Pampanga river basin are in Pampanga and Bulacan Province.

### E.2.2 Insufficient Structural Capacity for Flood Mitigation

As stated above, the serious flood damage with death of people occurs almost every year in the study area, and it is unevenly distributed to Pampanga and Bulacan Province. One of the principal causes of such frequent and large scale flood damage would be attributed to the extremely small river flow capacity and the large siltation of river ways as described hereinafter.

#### E.2.2.1 Small River Channel Flow Capacity

The channel flow capacities for the downstream and midstream sections of Pampanga River were preliminarily estimated, as listed in Table E.1.1.3, in the previous relevant study on PDDP FC in 1982. According to the results of estimation, the flow capacities of the whole sections of Pampanga River from Masantol to Cabiao (the stretches of about 14km to 54km upstream from the river mouth) are evaluated to hardly cope with even the 5-year return period flood.

#### E.2.2.2 Prolonged Large Sediment Runoff

Mt. Pinatubo which is located in the southwestern part of the study area, erupted in 1991 and produced an extremely large volume of lahar runoff. Of the lahar produced by the eruption, there still remains a volume of about 900MCM in the upper reaches of the river basin, from which the sediment continues to flow to the downstream river stretches.

The current sediment runoff volume into the river channel is estimated at about four times of those before eruption of Mt. Pinatubo. A substantial part of these present larger sediment runoff would accumulate in the river channel causing reduction of the channel flow capacity, unless certain countermeasures are taken such as the river dredging to remove the sediment and reforestation to reduce the sediment runoff.

### E.2.3 Increment of Flood Damage Potential

The aforesaid flood damages in Pampanga river basin are evaluated, in the stakeholder meetings, to be further aggravated in the future due to the complex factors such as:

(1) Increase of the surface runoff-discharge inflicted by expansion of the built-up area, and the poor watershed management,

(2) Increase of the assets/properties in the flood hazard area caused by the unplanned and/or rapid urban expansion,

(3) Encroachment of illegal settlers into the waterways,

(4) Unregulated quarrying in the river channels, and

(5) Climate changes.

### E.2.4 Inadequate Information and Knowledge on Flood Mitigation

The following issues were also pointed out in the stakeholder meetings:

(1) Inadequate real-time information on the flood: The necessary information on the flood forecasting and warning are hardly disseminated to the residents on the real-time base during a flood time,

(2) Inadequate information on the flood hazard area: The information on the flood hazard areas are seldom diffused among the residents.

(3) Untimely release of dam water: There is a risk such that the existing dams release the excessive discharge, which leads to the man-made flood, during a flood time.

(4) Garbage disposal into the water ways: A large volume of garbage is being dumped into the rivers and drainage channels, which hampers the safe flood flow.

# E.3 Projects as Components of the Proposed IWRM Plan

## E.3.1 Policy on Management for Flood and Sediment Disasters

The "Medium Term Development Plan (MTPDP), 2004-2010" pointed out the necessity of the efficient maintenance and rehabilitation of the existing flood mitigation facilities including dredging of the waterways, riverbank protection, relocation of informal settlers along the river/drainage channels so as to fulfill the inherent flood control capacity of the existing facilities. The MTPDP also emphasizes the necessity of the adequate investment to the twelve (12) nationwide priority flood mitigation projects, two (2) of which are addressed to the Mt. Pinatubo Hazard Urgent Management II and III in the study area.

In addition to the above two policies raised in MTPTP, the "Regional Physical Framework Plan (RPFP) for Region III in 2005-2030" states that the flooding/sediment disasters are the great hindrance to the development in the region, and it deters the inflow of investments both foreign and local thus affecting job opportunities in the region. In order to cope with such problems, the RPFP raised two regional policies for flood management: The first policy is oriented to adoption of the comprehensive flood mitigation project emphasizing the necessity of the nonstructural measures such as: watershed management, land use planning, flood forecasting and warning system and participative planning.

The second policy of the RPRP is addressed to strengthening of the flood detention capacity by the river basin. The RPFP states that the floodwater shall be held back in the upper and middle reaches by a suitable reservoir or a low retention basin. This would insure better control over floods and, at the same time, create the possible water resources development for irrigation, municipal water supply and other various uses of water.

## E.3.2 Projects as the Countermeasures against the Problems/Issues on Management for Flood and Sediment Disasters

The projects for management of flood and sediment disasters are selected in line with the aforesaid national and/or regional policy on the flood management. At the same time, they cope with the problems and issues on the management for flood and sediment disasters in the study area, which are as described in the foregoing Chapter E.2. Table E.3.2.1 shows the identified projects related to the problems and issues. Table E.3.2.2 further shows the list of the programs and projects (refer to the project profiles shown in Annex -T E.3.2.1 and the location map of the projects in Annex-F E.3.2.1).

**Table E. 3.2.1 Ongoing, Proposed and Conceptual Projects related to Problems and Issues on Management of Flood and Sediment Disasters**

| Problems and Issues/Causes | Countermeasures | Programs and Projects | Sector* |
|---|---|---|---|
| **1. Insufficient Structural Capacity for Flood Mitigation**<br>• Siltation of river ways<br>• Extremely small river channel flow capacity due to expansion of residential areas in potential flood hazard area | 1.1 Flood mitigation by the new structural measures such as<br>1) River channel improvement<br>2) Construction of flood diversion channel, and<br>3) Construction of flood retarding basin<br><br>1.2 Modification/ Maintenance/ Rehabilitation of the existing flood mitigation structures | • FL-G-01: Pinatubo Hazard Urgent Project (PHUMP) Phase III Part I<br>• FL-G-03 : Maintenance and Rehabilitation Works for River Dike and Slope<br>• FL-P-01: Flood Control Measures in Mt. Pinatubo Devastated Area-Focus on Pasac Delta<br>• FL-P-02: Bacolor Comprehensive Rehabilitation Master<br>• FL-C-01: Flood Mitigation for Pampanga Delta<br>• FL-C-03: Maintenance, Rehabilitation and Improvement for Drainage and Flood Control Facilities under Jurisdiction of LGUs | FL<br>FL<br>FL<br>FL<br>FL<br>FL |
| **2. Increment of Flood Damage Potential**<br>• Increasing surface run-off in the urban built-up<br>• Poor watershed vegetation cover<br>• Unplanned and rapid urban expansion<br>• Encroachment of illegal settlers and fishponds along river ways<br>• Unregulated quarrying | 2.1 Flood mitigation by the new non-structural measures such as:<br>1) Watershed management by reforestation, hillside-works, and sabo works.<br>2) Development of flood forecasting and warning system<br>3) Development of flood hazard map<br>4) Land Zoning<br>5) Capacity building<br><br>2.7 Updating the design of the existing flood control structures in relation to dam activities | • FL-G-02 Pinatubo Hazard Urgent Project (PHUMP) Phase III Part II | FL |
| **3. Inadequate Information and Knowledge Relevant to Flood Mitigation**<br>• Inadequate information on the real-time flood information<br>• Inadequate information on flood hazard area<br>• Untimely release of dam water<br>• Garbage disposal in river ways | 3.1 Capacity Building<br>3.2 Development of Flood Monitoring and Dissemination System<br>3.3 Introduction of the Study on IWRM to Elementary & High School Curriculum | • FL-G-04 Flood Forecasting and Warning System Capacity Building Project upon Dam Release in the Project<br>• FL-C-02 Community Based Flood Early Warning System<br>• FL-C-04: Integration of Salient Points of IWRM for Pampanga River Basin into School Curricula | FL<br>FL<br>FL |

Source: JICA Study Team
Note: *: FL - Flood and Sediment Disaster Management

**Table E. 3.2.2 List of On-going, Proposed and Conceptual Projects for Flood and Sediment Disaster Management**

| No. | Code | Title of Program/ Project | Implementing Agency | Status |
|---|---|---|---|---|
| 1 | FL-G-01 | Pinatubo Hazard Urgent Project (PHUMP) Phase III Part I | DPWH | On-going |
| 2 | FL-G-02 | Pinatubo Hazard Urgent Project (PHUMP) Phase III Part II | DPWH | On-going |
| 3 | FL-G-03 | Maintenance and Rehabilitation Works for River Dike and Slope | DPWH | On-going |
| 4 | FL-G-04 | Flood Forecasting and Warning System Capacity Building Project upon Dam Release in the Philippines | PAGASA | On-going |
| 5 | FL-P-01 | Flood Control Measures in Mt. Pinatubo Devastated Area- Focus on Pasac Delta | DPWH | Proposed |
| 6 | FL-P-02 | Bacolor Comprehensive Rehabilitation Master Plan | DPWH/ Bacolor Municipality | Proposed |
| 7 | FL-C-01 | Flood Mitigation for Pampanga Delta | DPWH | Conceptual |
| 8 | FL-C-02 | Community Based Flood Early Warning System for Provinces of Pampanga, Tarlac and N. Ecija | LGUs/ PAGASA | Conceptual |
| 9 | FL-C-03 | Maintenance, Rehabilitation and Improvement for Drainage and Flood Control Facilities under Jurisdiction of LGUs | LGUs | Conceptual |
| 10 | FL-C-04 | Integration of Salient Points of IWRM for Pampanga River Basin into School Curricula | DE-Region III | Conceptual |

The details of the programs and projects related to the issues/problems are elaborated in the following items (1) to (4)

**(1) Programs/Projects to Address Insufficient Structural Capacity for Flood Mitigation**

The insufficient structural capacity for flood mitigation is caused by: (a) siltation of river and (b) extremely small river channel flow capacity due to expansion of residential areas in potential flood hazard area. The possible countermeasures for the issue are such as: (a) river channel improvement, (b) construction of flood diversion channel, (c) construction of flood retarding basin and (d) modification/maintenance/rehabilitation of the existing flood mitigation structures. The programs and projects, which could cope with the said issues/problems, are as numerated below:

(a) **FL-G-01: Pinatubo Hazard Urgent Project (PHUMP) Phase III Part I:** The Project is expected to increase the flood control capacity of Pasac rivers system through construction of the Porac-Gumain Diversion Channel and dredging of the rivers/drainage channels.

(b) **FL-G-03: Maintenance and Rehabilitation Works for River Dike and Slope:** The Project could make a great contribution to recovery of the inherent flood control capacity of the existing facilities through rehabilitation for them.

(c) **FL-P-01: Flood Control Measures in Mt. Pinatubo Devastated Area-Focus on Pasac Delta:** This Project could increase the channel flow capacity of Abacan River and San Fernando River through construction of the Third River Channel (the diversion channel), which connects San Fernando River and the mainstream of Pasac River).

(d) **FL-P-02: Bacolor Comprehensive Rehabilitation Master Plan:** This Project could make a contribution to increment of the flow capacity of the local drainage systems in Municipality of Bacolor through construction of dikes, channel excavation, construction of the new drainage channels and installation of new drainage pumps.

**FL-C-01: Flood Mitigation for Pampanga Delta:** This project is oriented to increase of flood control capacity of the downstream/mid-stream of Pampanga River and reduction of the potential flood damage by adapting of the appropriate measures such as river channel improvement and construction of flood retarding basin.

(e) **FL-C-03: Maintenance, Rehabilitation and Improvement for Drainage and Flood Control Facilities under Jurisdiction of LGUs:** The cities/municipalities in the study area suffer from the chronic flood inundation due to deterioration of the existing drainage/flood control facilities and/or inadequate urban drainage systems. In order to retrieve such drainage problems, the LGUs (the governments of the city/municipality) have proposed maintenance, rehabilitation and improvement of the drainage systems in their jurisdiction areas as a part of the "Medium Term Development Plan 2010-2013". However, the implementation period of the plan is limited to a three-year period from 2010-2013, while the sustainable rehabilitation and improvement are deemed to be indispensable. From this point of view, a conceptual plan for the captioned project is worked out assuming that the project shall be implemented as the annual regular program toward 2025.

**(2) Programs/Project to Cope with Increment of Flood Damage Potential**

The increase of flood damage potential would be attributed to (a) increasing surface run-off in the urban built-up, (b) degradation of watershed vegetation, (c) excessive urban expansion, (d) encroachment of illegal settlers and fishponds into waterways, and (e) unregulated quarrying. The Project of **"FL-G-02: Pinatubo Hazard Urgent Project (PHUMP) Phase III Part II"** is expected to cope with this issue by providing of the proper land zoning plan and the watershed management plan, whereby the excessive urban development is controlled and the incremental flood damage potential could be minimized.

**(3) Programs/Projects to Improve Inadequate Information and Knowledge relevant to Flood Mitigation**

The issues on the inadequate information and knowledge relevant to flood mitigation includes: (a) inadequate information on the real-time flood information, (b) inadequate information on flood hazard area, (c) untimely release of dam water, and (d) garbage disposal in river ways. In order to cope with these problems and issues, the information education campaign/capacity buildings and development of the flood forecasting and waning system is to be undertaken through the following projects:

(a) **FL-G-04: Flood Forecasting and Warning System Capacity Building Project upon Dam Release in the Philippines**

(b) **FL-C-02:Community Based Flood Early Warning System for Provinces of Pampanga, Tarlac and Nueva Ecija**

(c) **FL-C-04: Integration of Salient Points of IWRM for Pampanga River Basin into School Curricula:** One of the important issues on IWRM is addressed, in the stakeholder meeting, to improvement of the residents' awareness on the water-related management works. Moreover, improvement of public morals is important to refraining of the unfavorable activities against IWRM such as garbage dumping into the waterways, and encroachment along the river areas. In order to attain such improvement of public awareness and public morals, this captioned project is worked out.

## E.3.3 Comparative Study on Alternative Approach on Flood Mitigation for Pampanga Delta

### E.3.3.1 Basic Concept

#### (1) Principal Issue on Flood Risk in Pampanga River Basin

Since eruption of Mt. Pinatubo had occurred in 1991, the several projects have been undertaken to cope with the flood problems associated with a large volume of sediment run off in Pasac river basin (i.e., the eastern Pinatubo Area). Moreover the new structural and non-structural projects for flood mitigation such as PHUMP III Parts 1 & 2 are further being practiced in Pasac river basin (refer to subsection E.3.2).

As for Pampanga river basin, however, any prominent flood mitigation plans have not been introduced since the "Pampanga Delta Development Project Flood Component (PDDP-FC) Phase-I" was completed at a reduced scale in 2002. Under such conditions, the large-scale flood damages occur along the down/midstream of Pampanga River almost every year as described in the foregoing subsection E.2. Accordingly, execution of the flood mitigation work as the post-PDDP Phase-I for Pampanga River would be one of the important issues in the IWRM for the Study Area.

The principal hindrance in implementing the flood mitigation works for the downstream of Pampanga River would be addressed to the houses densely packed along the river channel, which requires a large number of resettlements for widening of river channel. The completed PDDP Phase-I, which had the river improvement length of 14.2km, had required the resettlement of 1,851households, and the proposed PDDP Phase-II would further require resettlement of about 6,709 households for its target river channel improvement of 30km in length. The relevant LGUs and communities could hardly accept such extremely large number of resettlements, which led to suspension of PDDP Phase-I and indefinite postponement of implementation of PDDP Phase-II.

Taking the occurrence of frequent disastrous flood damages and difficulties in implementing the river channel improvement works into account, alternative flood mitigation measures for the aforesaid Phase-II river channel improvement are preliminarily examined in this section.

#### (2) Objective Area

The PDDP FC is divided into three (3) Phases, namely Phase-I, Phase-II and Phase-III. Among others, the Phase-I had been completed at a reduced scale in 2002. The channel improvement of 13.9km in length had been completed through the Phase I, however; another projected improvement section of 0.3km had been left behind. The Phase-II is proposed to cover the river channel improvement in the lower reaches from Apalit. The Phase III is further proposed, as a part of the master plan for PDDP, to undertake the channel improvement of Pampanga River from Apalit to the confluence with the Maasim River[1)] (refer to Figure E.3.3.1).

The extent of the objective flood mitigation areas is about 324km$^2$ in total covering the beneficial area of PDDP Phase-II and III as listed in Table E.3.3.1, and administratively belongs to three municipalities in Bulacan Province and two municipalities in Pampanga Province, namely the Municipalities of Calumpit, Hagonoy and Paombong in the Province of Bulacan and Municipalities of Macabebe and Apalit in the Province of Pampanga.

**Table E. 3.3.1 Extent of and Population in the Objective Area for Alternative Plan on Flood Mitigation in Pampanga Delta**

| Division | Extent (km$^2$) | Population |
|---|---|---|
| Objective Area of PDDP-Phase-II | 155 | 245,000 |
| Objective Area of PDDP-Phase-III | 169 | 263,000 |
| Total | 324 | 508,000 |

Source: JICA Study Team

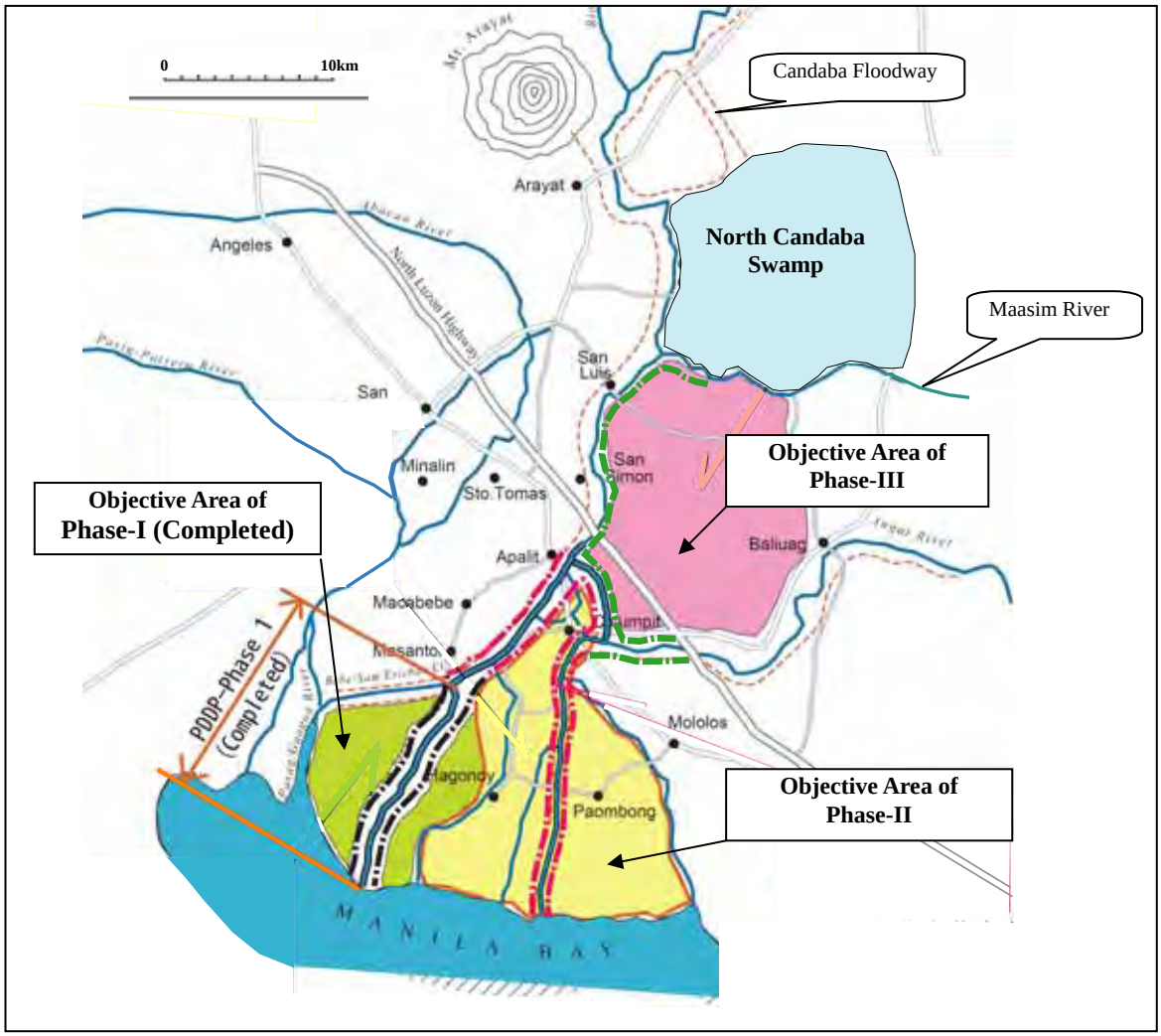



**Figure E. 3.3.1 Objective Flood Mitigation Area for PDDP-FC**

### E.3.3.2 Possible Options for Flood Mitigation Measures

Taking the topographic and hydrological conditions in the objective area into account, the possible options for the flood mitigation are assumed to be (a) river channel improvement along the downstream of Pampanga River and (b) construction of flood retarding basin in the Candaba and San Antonio Swamp along the midstream of Pampanga River.

In addition, the design flood scale for the flood mitigation measures could be also optional. PDDP adapted 20-year return period as the design flood scale. However, Pampanga River has caused the flood overflow almost every year, and therefore, the flood mitigation work with even the design flood scale of less than 20-year return period is expected to bring out a substantial flood mitigation effect. At the same time, the less design scale for the flood mitigation project would requires less number of houses to be resettled. From this point of view, the optimum design scale shall be also clarified taking various evaluation factors such as the economic viabilities, the number of houses to be resettled and the other various points for evaluation. The alternative flood mitigation measures with consideration of the alternative design flood scales are as described hereinafter.

#### (1) Option 1: River Channel Improvement

The river channel improvement undertaken in the PDDP-FC Phase-I had increased the channel flow capacity of the downstream of Pampanga River from 500m$^3$/s to 4,300m$^3$/s, which could cope with the probable flood of 20-year return period. However, the upper river stretch above the improvement section of the Phase-I still hardly copes with the probable flood of even 5-year return period as listed in Table E.3.3.2. Hence, the river channel

improvement to increase the channel flow capacity could be regarded as one of the possible options for the flood mitigation.

**Table E. 3.3.2 Present Peak Channel Flow Capacity and Design Flood Discharge of Pampanga River**

| Stretch | Channel Flow Capacity | Probable Peak Flood Runoff Discharge | | |
|---|---|---|---|---|
| | | 5-yr return period | 10-yr return period | 20-yr return period |
| Arayat – Sulipan | 1,800 | 2,349 | 2,731 | 3,100 |
| Masantol – Sulipan | 2,200 | 2,654 | 3,517 | 4,300 |
| River Mouth – Masantol | 4,300* | 2,654 | 3,517 | 4,300 |

Note: *: The channel flow capacity was increased from 500 to 4,300 $m^3/s$ through PPDP-Phase-I in 2002
Source: Feasibility Report on the Pampanga Delta Development Project, 1982, JICA

The necessary length and size of the channel cross-sections for the optional channel improvement are variable depending on the design flood scales and the flood detention capacity of the flood retarding basin in the upper reaches. The maximum length and channel cross-sections of the optional river channel improvement could be equivalent to those proposed in the PDDP-FC, which is subject to the design flood scale of 20-year return period and without-flood retarding basin in the upper reaches.

The PDDP FC proposed the target improvement stretch of 85.9km in length for its further implementation phases (i.e., Phase-II and Phase-III as shown in Table E.3.3.3). The standard design channel cross-section for Phase-II is the "Dual Dike System" with the low water channel width of 200m and the high water channel width of 750m as shown Figure E.3.3.2. These channel improvement length and scale of the channel cross-section proposed by the PDDP-FC could be provisionally assumed as the maximum limits for the optional river channel improvement.

**Table E. 3.3.3 Target Stretch for River Channel Improvement in PDDP FC Phase-II and III**

| Phasing | Stretch | Length |
|---|---|---|
| Phase-II | Pampanga River below the confluence of Bagbag River | 8.7km |
| | Labangan Floodway | 16.8km |
| | Bagbag River (the Channel connecting Pampanga River and Labangan Floodway | 4.5km |
| | Sub-total | 30.0km |
| Phase-III | Pampanga River between the confluences with Bagbag River and Maasim River | 22.0km |
| | Angat River (above the confluence with Labangan Floodway) | 5.0km |
| | Maasim River (above the confluence with Pampanga River) | 8.9km |
| | Bebe San Estaban Short Cut Channel | 20.0km |
| | Sub-total | 55.9km |
| Grand Total | | 85.9km |

Source: Feasibility Study on Pampanga Delta Development Project, 1982
Pampanga Delta Development Project Flood Control Component, Review Study for Phase-II by Nippon Koei

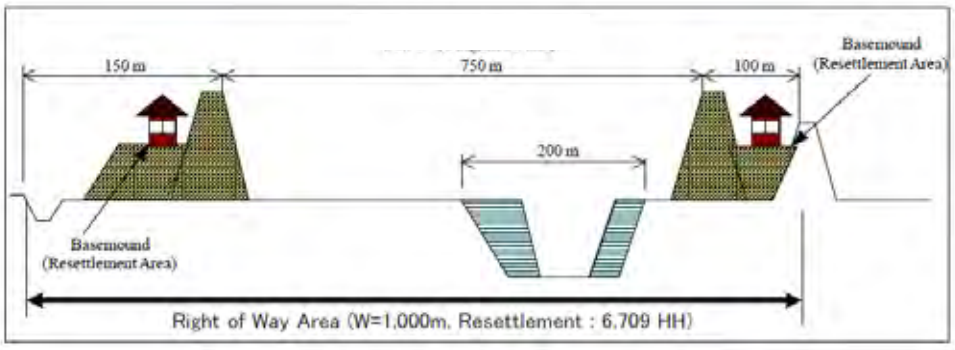
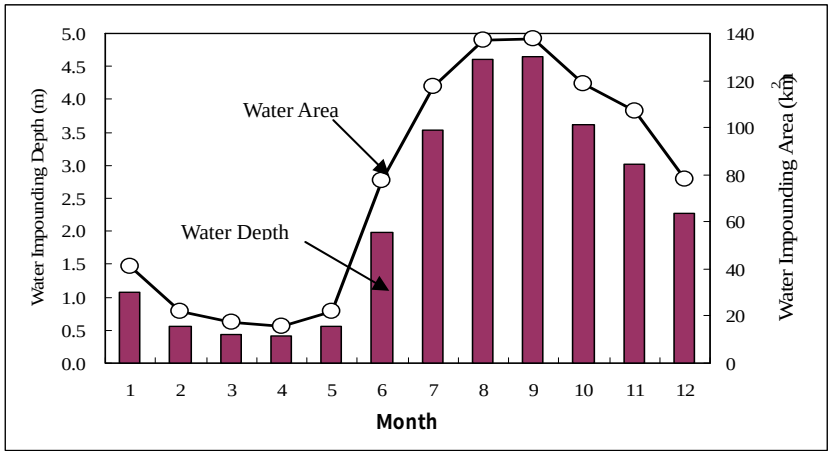



**Figure E. 3.3.2 Typical Cross Section for River Channel Improvement in Phase-II (Typical River Cross Section for River Channel Improvement with the Design Level of 20-year Return Period and without Construction of Flood Retarding Basin)**

### (2) Option 2: Construction of Flood Retarding Basin

The technical viability on the flood retarding basin in North Candaba Swamp is preliminarily examined based on the available data/information on the topography and hydrology. The Existing San Antonio Swamp could be another candidate of the site for the flood retarding basin. Due to the very limited eligible data/information related to the San Antonio Swamp, however, the potential capacity of the flood retarding basin is to be focused to that in the North Candaba Swamp in this study stage.

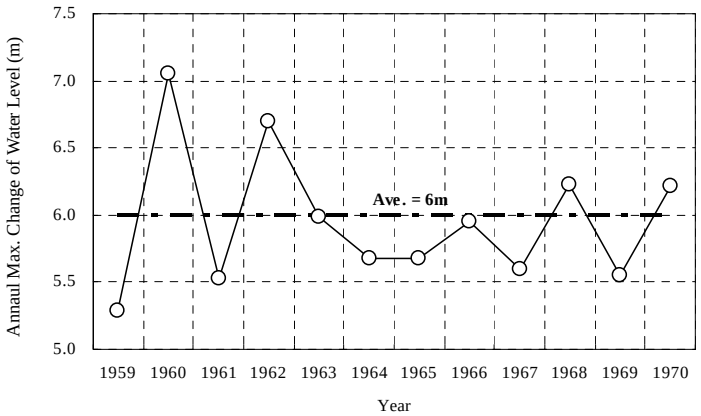
The monthly average water depths and extents of impounding area in Candaba Swamp during a dry season are estimated at less than 1m and 5.8km$^2$, respectively, while they increase to more than 4.5m and 160 km$^2$ in August and/or September in the mid of a rainy season as shown in Figure E.3.3.3. Thus, there are large differences in the water impounding extents and depths in the dry season and the rainy season.




Source: Philippine Water Resources Summary Data/ JICA Study Team

**Figure E. 3.3.3 Monthly Average Water Depth and Impounding Area of Candaba Swamp**

It is further observed that the annual maximum daily water depths of Candaba Swamp fluctuates from about 5 to 7m according the gauging data from 1959 to 1970, and the annual average maximum water level is estimated at 6m as shown in Figure E.3.3.4. This average annual maximum water depth causes the water impounding area of about 160km$^2$, which could be regarded as the approximate boundary of the water impounding area in Candaba Swamp. It was confirmed from the satellite image given from Google Map that all of the houses/ buildings are located out of this maximum water impounding area.




Source: National Water Resources Summary Data, NWRC

**Figure E. 3.3.4 Annual Maximum Water Level of Candaba Swamp**

The Swamp currently confines a part of the flood overflow discharge from Pampanga River, which makes a contribution to reduction of the peak flow discharge at the downstream river sections. However, since the Swamp continues to increase its impounding volume throughout a rainy season, it tends to reduce the available storage capacity for the flood overflow discharge toward the end of the rainy season. If a considerable part of the impounding water of the Swamp could be drained immediately after the flood subsides, the storage capacity of the Swamp for the next flood could be increased. Moreover, if the area used for the flood retarding basin is surrounded by the Dike, the storage capacity could be further increased.

From the above points of view, effectiveness of Candaba Swamp as the flood retarding basin against the probable flood runoff discharge of 10 and 20-year return period was preliminarily estimated on the premises of the following conditions into account:

(a) The existing channel flow capacity of downstream sections of Pampanga River below Candaba Swamp is less than 1,800$m^3$/s (refer to Table E.3.3.2). When the probable runoff discharge from the upstream of Candaba Swamp exceeds the downstream channel flow capacity of 1,800$m^3$/s, the exceeding discharge is diverted into Candaba Swamp through Candaba Floodway.

(b) The concept of flood diversion into Candaba Swamp in case of flood runoff of 10-year return period is as illustrated in Figure E.3.3.5.

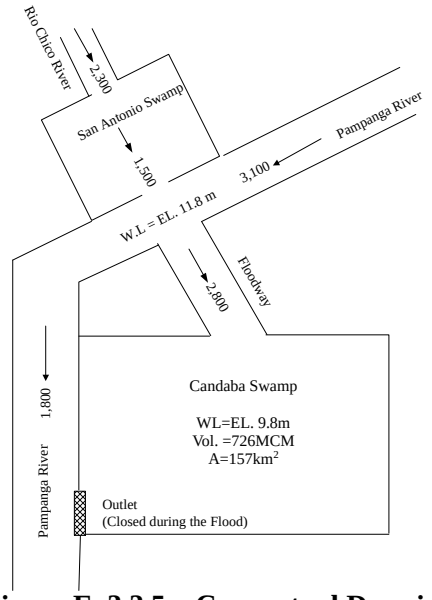



**Figure E. 3.3.5 Conceptual Drawing on Flood Retarding Effect of Candaba Swam for Flood of 10-year Return Period**

(c) In order to confine the above diverted flood discharge from Pampanga River into Candaba Swamp, the dike is to be constructed surrounding the flood retarding basin. The dike is preliminarily called as the Surrounding Dike, and its allowable crown level is assumed to be less than 2m above the ground level and 1m above the design high water level of the flood retarding basin (i.e., the freeboard of the Surrounding Dike is assumed at 1m). The alignment of the dike is designed to secure the necessary storage volume for all of the diverted discharge.

(d) The area within the above Surrounding Dike is the actual extent for the flood retarding basin. Any excavation work and/or other land reforming work within the extent for the flood retarding basin is not to be made so as to preserve the present land use as well as the water-related environment.

(e) The outlet channel is placed at the downstream of Candaba Swamp along Pampanga River as shown in Figures E.3.3.5 and E.3.3.6. The flood discharge once diverted from Pampanga River into Candaba Swamp is drained through this outlet channel immediately after the flood subsides.

(f) The above outlet channel is designed to keep the usual water impounding area of 41$km^2$ with the water depth of 2m at the lowest part of Candaba Swamp. This water impounding area is called as the “Dead Storage”, which could not make a contribution to the flood retarding effect (refer to Figure E.3.3.6). However, the Dead Storage is the important space for the migratory birds to inhabit during a rainy season. At the same time, the usual impounding water could be used as the source of irrigation for the surrounding paddy field and other agricultural land during a dry season.

Taking the above conditions into account, it was estimated that when the design flood scale of 10-year return period is adopted and the flood retarding basin in Candaba Swamp could possess the flood storage area of 157km$^2$, which is the maximum allowable extent not to require the house resettlement as described above, a substantial part of the downstream stretches of Pampanga River would no longer require no channel improvement work. The principal features of the flood retarding basin for the maximum storage area of 157km$^2$ and the design flood scale of 10-year return period are as shown in Table E.3.3.4 and Figure E.3.3.6.

On the other hand, when the design scale of 20-year return period is adopted, the river channel improvement along the downstream is indispensable regardless to the scale of flood retarding basin in Candaba Swamp.

**Table E. 3.3.4 Principal Features of Flood Retarding Basin in North Candaba Swamp (Under Assumption of the Maximum Impounding Area for Design Flood of 10-year return period)**

| Description | | Features |
|---|---|---|
| 1. Design Flood Level | | 10-year return period |
| 2. Storage Area | (1) Maximum Storage Area | 157 km$^2$ |
| | (2) Minimum Storage Area | 5.8 km$^2$ |
| 3. Storage Volume | (1) Gross Storage Volume | 752 MCM |
| | (2) Active Storage Volume | 726 MCM |
| | (3) Dead Storage Volume | 23 MCM |
| 4. Design Water Level | (1) Design Crown Level of Surrounding Dike | EL. 10.8m |
| | (2) High Water Level of Flood Retarding Basin | EL. 9.8 m |
| | (3) Low Water of Flood Retarding Basin | EL. 3.0m |
| | (4) High Water of Pampanga River at Diversion Point | EL. 11.8m |
| 5. Design Discharge | (1) Inflow Discharge to Flood Retarding Basin | 3,100 m$^3$/s |
| | (2) Discharge to Downstream of Pampanga River | 1,800 m$^3$/s |
| 6.. Width of Inlet Channel to Flood Retarding Basin | | 341 m |

Source: JICA Study Team

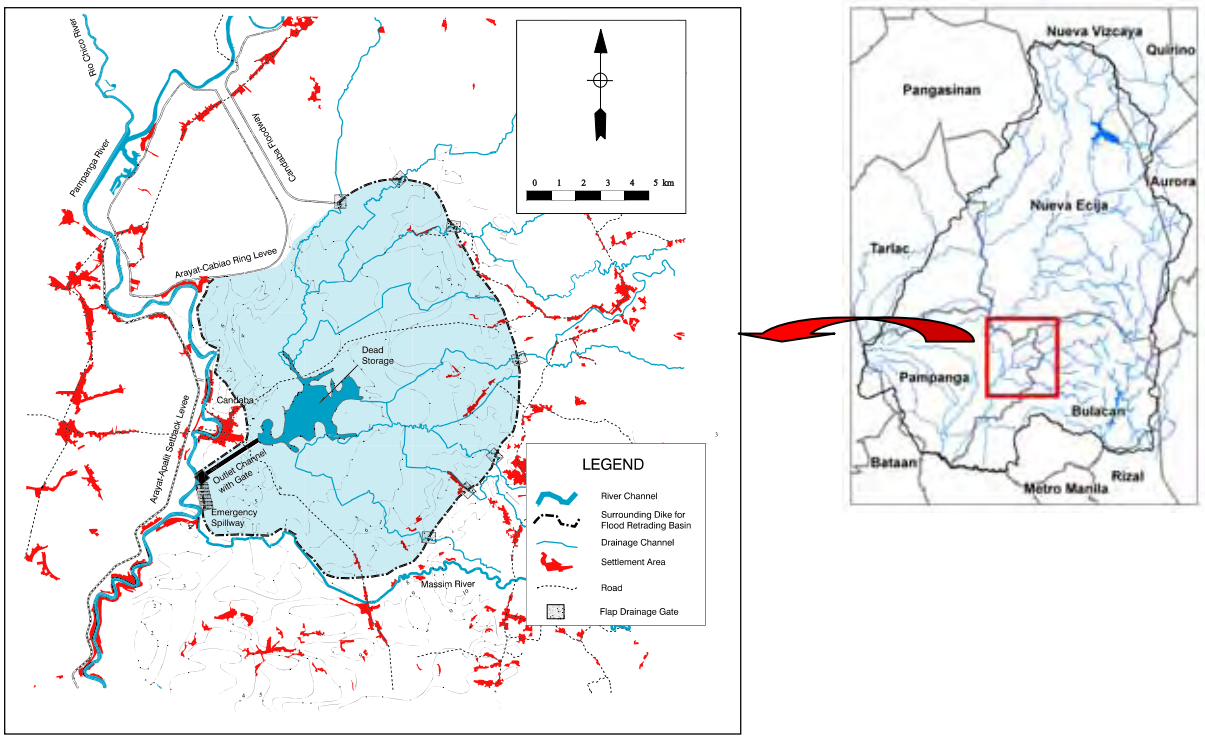



**Figure E. 3.3.6 Conceptual Plan for Proposed Flood Retarding Basin in Candaba Swamp**

### E.3.3.3 Selection of Alternatives

The alternative flood mitigation plans have the various combination of the aforesaid two (2) optional flood mitigation measures (i.e., the Option 1 for the river channel improvement along the downstream/middle stream of Pampanga River and its tributaries and the Option 2 for the flood retarding basin in North Candaba Swamp and/or San Antonio Swamp). The alternative flood mitigation plans would also possess the various optional design scales within the limits of 20-year return period.

Based on the assumption on the above combination of the options, the nine (9) alternatives for flood mitigation of the lower/middle Pampanga River are conceived i as shown in Table E.3.3.5.

**Table E. 3.3.5 Alternatives for Flood Mitigation of the Lower/Middle Reaches of Pampanga River**

| Design Scale / Optional Flood Mitigation Measures | 5-year return period | 10-year return period | 20-year return period |
|---|---|---|---|
| Option 1 Only ( = Sole river channel improvement without flood retarding basin) | Alternative – 1 | Alternative - 2 | Alternative -3 |
| Option 2 Only (= Sole flood retarding basin without river channel improvement) | Alternative - 4 | Alternative - 5 | Alternative – 6 |
| Combination of Option 1 and Option 2 | Alternative - 7 | Alternative - 8 | Alternative – 9 |

Note: *: The design flood scale of 20-year return period is hardly attained sole by the flood retarding basin in Candaba Swamp without the river channel improvement.

### E.3.3.4 Evaluation of Alternatives

The above nine (9) alternatives are evaluated from seven (7) points of evaluation as summarized in Table E.3.3.6.

**Table E. 3.3.6 Summary of Evaluation of Alternative Plans**

| Alt. No. | Points of Evaluation | | | | | | |
|---|---|---|---|---|---|---|---|
| | (1) Technical Viability | (2) Economic Viability | (3) Impacts to Social Environment | (4) Impacts to Natural Environment | (5) Benefit to Water Use | (6) Regional Equity in the Flood Safety Level | (7) Adaptation to Climate Change |
| 1 | High | C | **A-** | B- | | **A-** | |
| 2 | High | C | **A-** | B- | | B- | |
| 3 | High | B+ | **A-** | B- | | | |
| 4 | Fair | C | B- | **A-** | A+ | **A-** | B+ |
| 5 | Fair | C | B- | **A-** | A+ | B- | B+ |
| 6 | **Low** | C | C | **A-** | C | | C |
| 7 | Fair | C | B- | **A-** | A+ | **A-** | B+ |
| 8 | Fair | C | B- | **A-** | A+ | B- | B+ |
| 9 | Fair | B+ | **A-** | **A-** | A+ | | B+ |

Note:
Technical Viability: "High=The technical viability has been already confirmed", "Fair =the technical viability has not been confirmed yet but no particular technical difficulty in executing the project is foreseeable", "Low= There remain uncertainties in the technical viability of the project"
Other Evaluation: A+ stands for large positive impact, A-for large negative impact,
B+ for medium positive impact, B- for medium positive impact,
C for uncertain, and
No Score for no or negligible impact,

The above summary of evaluation for each of the alternatives is further elaborated as described hereinafter:

**(1) Technical Viability**

The technical viability for the Alternatives-1, 2 and 3, which are made solely by the river channel improvement, had been verified through .the "Feasibility Study on Pampanga Delta

Development Project by JICA in 1982". Any technical difficulties in implementing the Alternative 4, 5, 7, 8 and 9 are also not foreseeable as preliminarily examined in this Study.

However, technical viability of the Alternative -6, which is to cope with the design flood scale of 20-year return period solely by flood retarding basin is hardly verified as described in the above item (2) in subsection E.3.3.2.

**(2) Economic Viability**

The EIRR for the Altternative-3 had been estimated at 10.8% in the "Feasibility Study on Pampanga Delta Development Project by JICA in 1982". The Alternatives-9 takes the same design flood scale of 20-year return period as Alternative-3 and the lower project cost than Alternative-3. Accordingly, the EIRR of Alternatives-9 would be more than the value of 10.8% for Alternative-3. As for other alternatives, their economic viabilities are unknown. Nevertheless, their EIRRs would be compatible with that of the Alternative-3, since they are expected not to contain the extremely low value of the benefit nor high project cost as compared with the Alternative-3.

**(3) Impact to the Social Environments**

The Alternatives-1, 2, 3 and 9 are subject to the large scale of river channel improvement along the downstream of Pampanga River and they would require some thousand houses to be resettled as estimated in the previous study[5)].

In contrast, the Alternatives-4, 5, 7 and 8 are subject to use of Candaba Swamp as the flood retarding basin not requiring the major river channel improvement, and therefore, the number of house resettlements could be extremely reduced. However, these alternatives require the land acquisition of the following extents in the swamp area:

- The extent of about 600ha used as the year-round impounding space (the dead storage shown in Figure E.3.3.6) for the flood retarding basin: This extent is currently the private land and used as the agricultural land or fishpond during the dry season, while it would be submerged throughout a year after construction of the flood retarding basin,
- The extent of about 16,000ha used as the impounding area for the flood retarding basin only during the flood time: This extent currently has the similar land use status as above during the dry season, and its substantial part is submerged during the rainy season. Accordingly, usage of the Swamp as the flood retarding basin during the rainy season would not cause the dynamic changes of the present land use status.

**(4) Impacts to the Natural Environments**

The Alternatives-4 to 9, which use the Candaba Swamp as the flood retarding basin, may cause the serious impacts to the present natural environments in the Swamp because of impounding of the flood water in the Swamp. The Candaba Swamp is the important habitat for the migratory birds during the rainy season and declared as the bird sanctuary by LGU. Moreover, the Swamp is proposed as the candidate for the Ramsar Site and/or the East Asian-Australasian Flyway. Judging from these statuses of the Swamp, difficulties in constructing the flood retarding basin in the Swamp are foreseeable:

**(5) Benefit to Water Use**

The Alternatives 4, 5, 6, 8 and 9 could secure a year-round water impounding pond of about 23 MCM as a part of the flood retarding basin in Candaba Swamp. This year-round water impounding pond could be used as the water sources for uses of irrigation and fishponds in the surrounding areas.

**(6) Regional Equity in the Flood Safety Level**

The DPWH Guidelines specify a 50-year return period flood as the design level for river channel improvement[8)]. In spite of this specification, most flood mitigation projects for river

basins in the Philippines have employed the design level of 10 to 20-year return period[9]. In the study area, the major completed flood mitigation projects such as the PDDP FC Phase-I and PHUMP Phase-I and II also adopted the design flood scale of 20-year return period.

Judging from the above the design flood scales adapted in Philippines and the study area, the 20-year return period flood would be the most preferable design scale and 10-year return period flood would be the minimum requirement from the viewpoint of the regional equity in the flood safety level. From these viewpoints, the Alternatives-1, 4 and 7, which adapt 5-year return period as the design scale, are judged to be negative against the regional equity in the flood safety level.

**(7) Adaptation to Climate Change**

The on-going global warming would cause the stronger storm rainfall intensity and larger scale of flood in the future. As the results, the extra-ordinary floods, which exceed the design flood scale, would occur more often. The flood retarding basin could possess a certain detention capacity effect even for such extraordinary flood, while the river channel improvement hardly prevent such extraordinary flood from overflowing the river channel. From this point of view, the Alternatives, which contain the flood retarding basin as their component of flood mitigation measures, could be judged to be more adaptable to the climate change.

### E.3.3.5 Selection of the Optimum Plan

As described above, all alternatives, which contain the large scale of the river channel improvement for the downstream of Pampanga River, would cause the critical issue on resettlement of the household. Likewise, the alternatives, which are subject to usage of the Candaba Swamp as the flood retarding basin, could cause the serious adverse impact to the natural environments of the Swamp, especially to the migratory birds, which take the Swamp as the habitat during the rainy season.

As for the alternative design scales for flood mitigation, it is evaluated that the alternatives which adopt the design scale of 20-year return period may lead to the dynamic increment of houses to be resettled, while the alternatives which have the design scale of 5-year return period is hardly verified from the viewpoint of regional equity in the flood safety level.

As stated above, any alternatives are still hardly selected as optimum plan at this preliminarily study stage due to the estimated serious negative impacts in the aspects of the resettlement required and the preservation of the natural environment. Under this condition, the non-structural flood mitigation measures such as usage of the flood forecasting and warning system and promotion of the watershed management (i.e. reforestation and hillside works on the steep slope area) are expected to take an important role for the chronic flood damages in Pampanga river basin, which occur almost every year. The existing and proposed non-structural measures for Pampanga river basin are as enumerated below:

- The flood forecasting and warning system for the entire Pampanga river basin had been established in 1981 through the financial and technical assistance of Government of Japan., and it is now being operated and managed by PAGASA. The real time information on the storm rainfall and river flow discharge could be gauged and used for early flood forecasting and evacuation.
- The flood forecasting and warning system for operation of Pantabangan and Angat dam reservoirs had been established in 1994 through the financial and technical assistance of Government of Japan., and it is now being operated and managed by PAGASA. Moreover, the capacity building for operation of the system is now being carried out through the technical assistance by JICA on the premises of the target completion of 2015. This system is expected to enhance the effective reservoir operation for flood control, which could lead to mitigation of the flood damage in the lower reaches of Pampanga River.
- The community-based flood warning system aims at establishing the methods and procedures for issuance of flood warning and evacuation and providing the necessary equipment for them in each of provinces. The system had been already completed in Bulacan Province in 2006,

and establishment of the new systems is further proposed for Provinces of Pampanga, Tarlac and Nueva Ecija.

- The twelve (12) major watershed management projects are now being implemented expanding the forest coverage in Pampanga river basin, which could lead to increase the basin detention capacity of the storm rainfall and reduce the flood damages in the lower reaches of Pampanga river basin. Moreover, proposed is the Project of "WS-C-01: Upland Development Plan" in the study, which aims at reforestation as well as hillside works on the steep slope leading to reduction of the peak flood discharge and sediment runoff.

It is indispensable to carry out a further feasibility study in due consideration of: (a) the effectiveness of the above non-structural measures and (b) the results of the topographic/river channel surveys, the hydrological/hydraulic analysis and other basic surveys/analyses.

***References***

1) JICA: Feasibility Study on Pampanga Delta Development Project, February 1982.
2) JICA: The Study on Flood and Mudflow Control for Sacobia Bamban/Abacan River Draining from Mt. Pinatubo, 1996.
3) JICA: The Study Pinatubo Hazard Urgent Mitigation Project, Monitoring and Planning of Flood Control Works on the Pasac Delta (including Porac-Gumain River) and Third River Channel, 2002.
4) JICA: The Feasibility Study on Pasac Delta and Third River Channel Final Report, July 2002.
5) Pampanga Delta Development Project (Flood Control Component, Review Study for Phase II, 2003.
6) JICA: Basic Design Study Report on the Project for Upgrading of Flood Forecasting and Warning System in the Pampanga and Agno River and Basins, 2007.
7) JICA: Inception Report for Part 2: Monitoring and Planning of Non-structure Measure and Institutional Capacity Building, PHUMP-Phase III, 2009
8) DPWH: Design Guidelines, Criteria and Standards for Public Works and Highways"
9) JICA: The Flood Control for Rivers in Selected Urban Centers, 1995.

# *Annex-Tables*

Annex-T E.1.1.1 Recorded Flood Damage in Provinces of Nueva Ecija, Pampanga and Bulacan

| Month of Flood Occurrence | Typhoon | Province | Population Affected | | Population Evacuated | | Casualty | | Number of Houses Damaged | | Cost of Damage (P million) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Families | Population | Families | Population | Dead | Injured | Totally | Partially | Infra-structure | Agri-culture | Total |
| Jul. 2003 | Haurot | Nueva Ecija | 33,013 | 163,038 | 1,179 | 3,861 | 3 | | | | 18.8 | 16.8 | 35.6 |
| | | Pampanga | 81 | 271 | 14 | 76 | 2 | | | | 12.3 | 0.8 | 13.1 |
| | | Sub-total | 33,094 | 163,309 | 1,193 | 3,937 | 5 | | | | 31.1 | 17.6 | 48.7 |
| Aug. 2004 | Marce | Nueva Ecija | 24,896 | 128,405 | | | | | 118 | 1,200 | 10.1 | 37.3 | 47.4 |
| | | Pampanga | 112,186 | 529,299 | 1,383 | 5,490 | 8 | 1 | 2 | | 63.3 | 170.6 | 233.9 |
| | | Bulacan | 20,278 | 99,366 | 5,079 | 24,916 | 6 | | | | 22.1 | | 22.1 |
| | | Sub-total | 157,360 | 757,070 | 6,462 | 30,406 | 14 | 1 | 120 | 1,200 | 96 | 208 | 303 |
| Nov. 2004 | Violeta | Nueva Ecija | 2,090 | 9,562 | | | 2 | | | | | | 0.0 |
| Nov. 2004 | Winnie | Nueva Ecija | 57,367 | 277,668 | 4,443 | 20,786 | 9 | 2 | 523 | 1,236 | 25.5 | 220.0 | 245.5 |
| | | Bulacan | 51,909 | 259,390 | 1,303 | 7,475 | 7 | | 79 | 173 | 11.4 | 250.1 | 261.5 |
| | | Sub-total | 109,276 | 537,058 | 5,746 | 28,261 | 16 | 2 | 602 | 1,409 | 37 | 470 | 507 |
| Nov. 2004 | Toyong | Nueva Ecija | 124 | 620 | 124 | 620 | 6 | 2 | 10 | | | | 9.5 |
| | | Pampanga | 4,200 | 18,400 | 452 | 2,343 | | | | | | 88.9 | 88.9 |
| | | Bulacan | 61,974 | 305,478 | 2,793 | 13,965 | 2 | | 84 | 162 | 11.1 | 250.1 | 261.2 |
| | | Sub-total | 66,298 | 324,498 | 3,369 | 16,928 | 8 | 2 | 94 | 162 | 11 | 339 | 360 |
| Sep. 2005 | Labuyo | Nueva Ecija | 2,743 | 12,958 | | | | | | | | | |
| | | Pampanga | 6,077 | 30,673 | | | | | | | | | |
| | | Sub-total | 8,820 | 43,631 | | | | | | | | | |
| Jul. 2006 | Glenda | Pampanga | 6,659 | 30,831 | | | | | | | | 24.3 | 24.3 |
| Oct. 2006 | Mienyo | Pampanga | 7,698 | 34,045 | 15 | 75 | | | 224 | 1,234 | | 71.3 | 71.3 |
| | | Bulacan | | | 480 | 2,301 | 1 | | 50 | 376 | | 7.7 | 7.7 |
| | | Sub-total | 7,698 | 34,045 | 495 | 2,376 | 1 | 0 | 274 | 1,610 | 0 | 79.0 | 79 |

Source: RDCC-Region III

Annex-T E.1.2.1 (1/2) Completed Major Structural Flood Mitigation Projects

| River System | Ref. No. | Name of Project | Purpose* | Construction Period | Major Project Component | Investment Cost (billion pesos) |
|---|---|---|---|---|---|---|
| Pampanga | Pam-1 | Arnedo Dike | FC | 1940s | • River dike construction along right bank of Pampanga River from Arayat to Aparit (total length if dike = 36km) | Unknown |
| | Pam-2 | Arayat-Aparit-Masantol Setback Levee on Right Bank | FC | 1970s | • Levee construction along right bank of Pampanga River from Arayat to Masantol (total length of levee = 40km) | Unknown |
| | Pam-3 | Arayat - Cabiao Ring Levee | FC | 1970s | • Const. of levee/river dike along main stream in North Candaba Swamp | Unknown |
| | Pam-4 | Candaba Floodway | FC | 1970s | • Floodway from Pampanga River to North Candaba Swamp | Unknown |
| | Pam-5 | Cabiao - San Isidro – Gapan Levee | FC | 1970s | • Levee construction along the left bank of Pampanga from Cabio to San Isidro and Gapan (total length of levee = 16km) | Unknown |
| | Pam-6 | Bebe - San Esteban Diversion Channel | FC | 1970s | • Diversion Channel of about 8km | Unknown |
| | Pam-7 | Pampanga Delta Development Project (PDDP) -Phase I | FC | 1990s-2000s | • Channel Dredging and embankment along the left/right bank of Pampanga River from river mouth to Masantol (total embankment lengthy 14.2km) | 2.90 |
| Rio Chico | Rio-1 | Rio Chico River Control | FC | 1970s | • River dike of 34km in length along right bank of Rio-Chico<br>• River dike of 26km in length along left bank of Rio-Chico<br>• River dike of 10km in length along right and left bank of Talavera River. | Unknown |
| | Rio-2 | PHUMP-Phase I (for Sacobia-Bamban River b) | FC/SB | 1990s | • Channel improvement for Bamban River with 21.6km in length<br>• Construction of training channel for Sacobia River with 10.7km in length<br>• Channel improvement of Sapang Cauayan River with 1,800m | 3.50 |

Note *: FC = Flood Control, SB = Sabo Works

**: Aside from the projects as listed above, a variety of channel maintenance and rehabilitation projects have been undertaken in Pampanga river basin.

Source: F/S and Project Implementation Phase I of PPDP, and Data furnished from DPWH Region III

Annex-T E.1.2.1 (2/2) Completed Major Structural Flood Mitigation Projects

| River System | Ref. No. | Name of Project | Purpose* | Construction Period | Major Project Component | Investment Cost (million pesos) |
|---|---|---|---|---|---|---|
| Angat | Ang-1 | Hagonoy-Calumpit-Plaridel-Bustos Levee on Left Bank | FC | 1970s | • River dike of 28km in length along Angat River | Unknown |
| | Ang-2 | Labangan Floodway | FC | 1970s – 1980s | • River dike of 5km in length along right bank of Labangan Floodway | Unknown |
| | Pas-3 | Abacan River Improvement | FC | 1970s to 1980s | • Channel realignment, construction of dike and channel dredging | Unknown |
| Pasag | Pas-1 | Sediment Management Scheme by Mega Dike and Transverse Dike for Pasig-Potrero River | FC/SB | 1990s | • Mega dike of 15.5km in total length (9.0km for East Lateral Dike with average height of 11m and 6.5km for West Lateral Dike with average height of 12m)<br>• Traverse Dike of 3.2km in length and 10m in height with two spillways of 150m in width each | 0.90 |
| | Pas-2 | PHUMP-Phase II (for Pasig - Potrero River) | FC/SB | 2000s | • Rising of the south west corner of Mega Dike of 7.0km in length by 4m<br>• Channel Improvement of the tributaries such as Baluyot River<br>• Construction of Tail Dike<br>• Pilot channel excavation/ dredging of Third River | 4.55 |

Note *: FC = Flood Control, SB = Sabo Works
Source: F/S and Project Implementation Phase I of PPDP, and Data furnished from DPWH Region III

Annex-T E.1.2.2 (1/3) On-going and Proposed Structural Flood Mitigation Projects

| Name and Status of Project | Target River Basin | Project Features | |
|---|---|---|---|
| | | Item | Contents |
| PHUMP Phase III (On-going) | Pasac | Principal Purpose of the Project | Flood mitigation for Pasac Delta including Porac-Gumain, Dalan Bapor, Lower Guagua, and Pasac river basins |
| | | Project Classification | D/D and Construction |
| | | Project Implementation Period | 2005-2010 |
| | | Previous Relevant Study and/or Project | M/P and F/S completed in 1996 and 2002 |
| | | Project Proponent | DPWH |
| | | Design Flood Scale | 20-year return period |
| | | Beneficial Area | 502 $km^2$ |
| | | Major Project Component | • Construction of Porac-Gumain Diversion (L=18.7km)<br>• Construction new bridge (5 bridge)<br>• Excavation & dredging of main rivers (Porac-Gumain, Dalan Bapor, Lower Guagua, and Pasac River) and local drainage channels<br>• Raising of road height of raising road by 1.1m (L=19km)<br>• Raising of bridges (12 bridges) |
| | | EIRR | 19.0% |
| | | Project Cost | 4.7 billion pesos |
| | | Families to be relocated by the Project | 40 to 80 families |
| PHUMP Phase IV (Proposed) | Pasac | Principal Purpose of the Project | Flood mitigation for Abacan River, San Fernando River and their connecting creeks/drainage channels |
| | | Project Classification | D/D and Construction |
| | | Project Implementation Period | Indefinite |
| | | Previous Relevant Study and/or Project | • M/P and F/S completed in 1996 and 2002<br>• On-going PHUMP Phase III |
| | | Project Proponent | DPWH |
| | | Design Flood Scale | 20-year return period |
| | | Beneficial Area | 573$km^2$ in the drainage area of Abacan River below Mexico Bridge of Gapan-San Fernando-Olongapo Road, and eastern drainage area of the existing “Tail Dike” covering some/a part of San Fernando City and seven municipalities of Mexico, San Luis, San Simon, Sto. Tomas, Minalin, Macabebe and Masanto in Pampanga Province |
| | | Major Project Component | • Widening of the existing “Pilot Third River Channel” (22.6km in length from the confluence with Abacan River/ San Fernando River up to the confluence with the Pasac River) to 60m in the bottom width from the existing bottom width of 30 to 60m<br>• Excavation of the Pasac River as an eastern alignment of the Pilot Third River Channel,<br>• Local drainage improvement connecting the San Fernando River to the Third River and the San Fernando River excavation (total length:29.6km)<br>• Key road raising to ensure that transportation routes can be maintained during floods |
| | | EIRR | 27.7% |
| | | Project Cost | 3.3 billion pesos |
| | | Families to be relocated by the Project | 100 families |

Source: Pinatubo Hazard Urgent Mitigation Project-Phase II, 2002

Annex-T E.1.2.2 (2/3) On-going and Proposed Structural Flood Mitigation Projects

| Name and Status of Project | Target River Basin | Project Features | |
|---|---|---|---|
| | | Item | Contents |
| PDDP FC Phase II (Proposed) | Pampanga | Principal Purpose of the Project | Flood mitigation for Pampanga Delta along Labangan Floodway |
| | | Project Classification | D/D and Construction |
| | | Project Implementation Period | Indefinite |
| | | Previous Relevant Study and/or Project | • M/P and F/S completed in 1982<br>• PDDP-FC Phase I completed in 2002 |
| | | Project Proponent | DPWH |
| | | Design Flood Scale | 20-year return period (*100-year return period was further proposed as the long-term target) |
| | | Beneficial Area | 142 $km^2$ in Pampanga Delta including the municipalities of (a) Macabebe, Apalit and San Simon in Pampanga Province and (b) Calumpit and Hagonoy in Bulacan Province |
| | | Major Project Component | Widening of channel and construction of river dike/levee along<br>• Pampanga River of 8.7 km below the confluence with Bagbag River,<br>• Bagbag River of 4.5km (the channel connecting Pampanga River and Labangan Floodway, and<br>• Labangan Floodway of 16.8km |
| | | EIRR | 10.8%* |
| | | Population to be served by the Project | 161,000 |
| | | Project Cost | 8.8 billion pesos |
| | | Families to be relocated by the Project | 4,811 families |
| PDDP FC Phase III (Proposed) | Pampanga | Principal Purpose of the Project | Flood Mitigation for South Candaba Swamp area |
| | | Project Classification | D/D and Construction |
| | | Project Implementation Period | Indefinite |
| | | Previous Relevant Study and/or Project | • M/P and F/S completed in 1982<br>• Projected works of 94% for PDDP-FC Phase I completed in 2002 (the remaining 6% is still suspended due to opposition of the LGUs ) |
| | | Project Proponent | DPWH |
| | | Design Flood Scale | 20-year return period (*100-year return period was further proposed as the long-term target) |
| | | Beneficial Area | 113$km^2$ in South Candaba Swamp area covering municipality of San Simon in Pampanga Province |
| | | Major Project Component | Widening of channel and construction of river dike/levee along<br>• Pampanga River of 22.0 km above the confluence with Bagbag River,<br>• Angat River of 5.0km above the confluence with Labangan Floodway<br>• Massim River of 8.9km above the confluence of Pampanga River<br>• Bebe San Estaban Short Cut Channel of 20.0km |
| | | EIRR | 10.8%* |
| | | Population to be served by the Project | 57,000 |
| | | Project Cost | To be reviewed |
| | | Families to be relocated by the Project | To be reviewed |

Note:*: The EIRR for the entire project of PDDP FC including Phases 1 to 3
Source: Pampanga Delta Development Project (Flood Control Component, Review Study for Phase II, 2003
Feasibility Report on the Pampanga Delta Development Project, 1982

Annex-T E.1.2.2 (3/3) On-going and Proposed Structural Flood Mitigation Projects (3/3)

| Name and Status of Project | Target River Basin | Project Features | |
|---|---|---|---|
| | | Item | Contents |
| Maintenance and Rehabilitation Works (Proposed) | Pampanga | Principal Purpose of the Project | River channel maintenance and rehabilitation of Pampanga Main River Channel and Rio Chico River |
| | | Project Classification | Construction |
| | | Project Implementation Period | 2008 – 2014 |
| | | Previous Relevant Study and/or Project | None |
| | | Project Proponent | DPWH |
| | | Design Flood Scale | Unknown |
| | | Beneficial Area | Flood prone area along Pampanga Main River Channel and Rio Chico River |
| | | Major Project Component | ➢ Dike slope protection<br>➢ Dike rehabilitation<br>➢ Channel excavation and dredging |
| | | EIRR | Unknown |
| | | Population to be served by the Project | Unknown |
| | | Project Cost | 0.2 billion pesos |
| | | Families to be relocated by the Project | Nil |

Source: DPWH Region III

Annex-T E.1.2.3 Proposed Channel Maintenance and Rehabilitation Work for 2008 - 2014

| River System | Ref. No. | River | Location | | Measures | Approx. Work Length (km) | Cost (Mil. Pesos) |
|---|---|---|---|---|---|---|---|
| | | | Province | Municipality | | | |
| Pampanga | Pam-1 | Pampanga | Nueva Ecija | Cabiao to San Isidro | Dike Slope Protection and Provision of Boulder Spur Dike | 1.5 | 25.0 |
| | Pam-2 | Digmala | Nueva Ecija | Bongabon | Dike Slope Protection, Channel Excavation, Provision of Boulder Spur Dike | 6.5 | 30.0 |
| | Pam-3 | Pampanga | Pampanga | Arayat to Aparit | Dike Slope Protection (for Arredo Dike) | 0.5 | 30.0 |
| | Pam-4 | Pampanga | Pampanga | Aparit to Araya | Upgrading Levee (for Amarit-Arayat Setback Levee) | 8.0 | 7.0 |
| | Pam-5 | Bebe San-Estaban | Pampanga | Masantol | Dike Slope Protection | 0.2 | 10.0 |
| | Pam-6 | Jaen | Nueva Ecija | Jaen | Dike Slope Protection | 0.8 | 15.0 |
| | Pam-7 | Penaranda | Nueva Ecija | Penaranda | Channel Excavation and Dike Rehabilitation | 1.3 | 14.0 |
| | Sub-total | | | | | 18.8 | 131.0 |
| Rio Chico | Rio-1 | Rio Chico | Tarlac & Nueva Ecija Tarlac | La Paz, San Antonio to Zaragosa | Dredging & Dike Slope Protection | 4.5 | 30.0 |
| | Rio-2 | Hinukay | Nueva Ecija | Zaragos to St. Domingo, | Dike Rehabilitation | 2.8 | 30.0 |
| | Rio-3 | Rio Chico | Nueva Ecija Tarlac | San Antonio to Zaragosa La Paz | Dredging & Dike Slope Protection | 2.5 | 10.0 |
| | Subtotal | | | | | 9.8 | 70.0 |
| **Grand Total** | | | | | | 28.6 | 201.0 |

Note *: FC = Flood Control, SB = Sabo Works
**: Ongoing (2005-2010)
***: The project was completed before eruption of Mt. Pinatubo and aimed at solely flood control.

Source: PPDP Phase I, PHUMP Phase I, II and III and DPWH Region III

## Annex-T E.1.2.4 On-going and Proposed Nonstructural Flood Mitigation Project

| Target River Basin | Name of Project | Project Features | |
|---|---|---|---|
| | | Item | Contents |
| The Whole Pampanga River Basin | The Project for Upgrading of Flood Forecasting and Warning System in the Pampanga and Agno River Basins<br><br>(on-going) | Principal Purpose of the Project | Upgrading of flood forecasting and warning system for Pampanga, Angat and Pasac river basins |
| | | Project Classification | D/D and Construction |
| | | Project Implementation Period | 2007 to 2010 (32 months) |
| | | Previous Relevant Study and/or Project | 1. Flood Forecasting and Warning System for Pampanga River Basin in 1973<br>2. Rehabilitation of the Flood Forecasting and Warning System for Pampanga River Basin in 1981<br>3. Flood Forecasting and Warning for Dam Operation of Angat and Pantabangan Dam in 1982<br>4. Community Based Flood Early Warning System for Bulacan Province by Bulacan Province in 2005<br>5. Basic Design in Mar. 2007 through Japan's Grant Aid Scheme |
| | | Project Proponent | PAGASA |
| | | Beneficial Area | • The whole Pampanga river basin and Angat river basin |
| | | Major Project Components | • Renovation and increase of hydrological gauging and monitoring stations (7 rainfall gauging stations, 10 rainfall/water level gauging stations and 2 monitoring stations)<br>• Change of frequency of multiplex radio communication network<br>• Provision of new monitoring equipment and devices<br>• Provision of the new software for flood runoff prediction model and the flood inundation analysis |
| | | Project Cost | 0.6 billion pesos (1.2 billion yen) |
| Porac Gumain and Pasig Potrero River Basin | PHUMP-Phase III-Part II<br><br>(Projected) | Principal Purpose of the Project | Flood Mitigation for Pasac river basin |
| | | Project Classification | Plan Formulation and Capacity Building |
| | | Project Implementation Period | 2009 to 2010 |
| | | Previous Relevant Study and/or Project | 6. M/P for PHUMP in 1996<br>7. F/S-Phase II for PHUMP in 2002<br>8. PHUMP Phase III (On-going, 2005-2010) |
| | | Project Proponent | DPWH |
| | | Beneficial Area | Pasac river basin |
| | | Major Purpose of Project | The Study for plan formulation and capacity building in the aspects of:<br>• Watershed management<br>• Land use management<br>• Flood management by FFW<br>• Institutional capacity building |
| | | Major Project Components | • Watershed management for Porac Gumain and Pasig-Potrero river Basin<br>• Land use management for San Fernando City and its adjacent nine municipalities (Mexico, Santo Tomas, Bacolor, Guagua, Sasmuan, Floridablanca, Porac, and Santa Rita, Lubao)<br>• Flood management (study on FFW) for San Fernando City and its adjacent nine municipalities (Mexico, Santo Tomas, Bacolor, Guagua, Sasmuan, Floridablanca, Porac, and Santa Rita, Lubao) |
| | | Project Cost | The project implementation cost is to be estimated through the Study. |

Source: Basic Design Study Report on the Project for Upgrading of Flood Forecasting and Warning System in the Pampanga and Agno River and Basins, 2007
Inception Report for Part 2: Monitoring and Planning of Non-structure Measure and Institutional Capacity Building, PHUMP-Phase III, 2009

Annex-T E.3.2.1 (1/9) Project Profile for Flood and Sediment Disaster Management Sector

| | | |
|---|---|---|
| Project Code | FL-G-01 | |
| Project Title | Pinatubo Hazard Urgent Mitigation Plan (PHUMP) Phase III Part I | |
| Status of Project | On-going | |
| Objective Area | 502 $km^2$ covering Pasac river basin including San Fernando City and nine municipalities Mexico, Santo Tomas, Bacolor, Guagua, San Sasmuan, Floridablanca, Porac, Santa Rita and Lubao. | |
| Implementing Agency | DPWH | |
| Objectives | Flood mitigation by new structural measures to address insufficient structural capacity for flood mitigation | |
| Project Cost (Million Pesos) | Estimated by Project Proponent for 2005-2010 | Estimated by Study Team for 2011-2025 |
| | 4,700 as of 2009 | 470 as of 2009 |
| EIRR | 19%* | |
| Expected Source of Fund | GAA and JICA* | |
| Expected Implementation Schedule | 2005-2010* | |

Project Description

This Project aims at mitigating the flood risk along Pasac mainstream and its tributaries such as Porac-Gumain River and Guagua River through structural measures, which include construction of a diversion channel for Porac-Gumain River, excavation/dredging of the river channels and rising of the road.

The following components are included:

- Construction of Porac-Gumain Diversion (L=18.7km)
- Construction new bridge (5 bridge)
- Excavation & dredging of main rivers (Porac-Gumain, Dalan Bapor, Lower Guagua, and Pasac River) and local drainage channels
- Raising of road height of raising road by 1.1m (L=19km)
- Raising of bridges (12 bridges)
-

Remarks

- *: Estimated and/or proposed by project proponent
- Resettlement of 40 to 80 families required.
- For 2011-2025, 10% of the project cost (470Mil. Pesos) is considered.
-

Source of Information

- M/P and F/S completed in 1996 and 2002
-

Annex-T E.3.2.1 (2/9) Project Profile for Flood and Sediment Disaster Management Sector

| | | |
|---|---|---|
| Project Code | FL-G-02 | |
| Project Title | Pinatubo Hazard Urgent Mitigation Plan (PHUMP) Phase III Part II (Monitoring and Planning of Non-structural Measures and Institutional capacity Building) | |
| Status of Project | On-going | |
| Objective Area | 502 $km^2$ covering Pasac river basin including San Fernando City and nine municipalities Mexico, Santo Tomas, Bacolor, Guagua, San Sasmuan, Floridablanca, Porac, Santa Rita and Lubao. | |
| Implementing Agency | DPWH | |
| Objectives | Flood mitigation by new non-structural measures to address increment of flood damage potential | |
| Project Cost (Million Pesos) | Estimated by Project Proponent for 2009-2010 | Estimated by Study Team for 2011-2025 |
| | 50 as of 2009 | 5 as of 2009 |
| EIRR | (N/A) | |
| Expected Source of Fund | GAA and JICA* | |
| Expected Implementation Schedule | 2009-2010* | |

Project Description

This Project is a non-structural component of the PHUMP Phase III, and strengthens the flood mitigation effects achieved by the above structural component in the PHUMP Phase III Part I. The Project contains the following items as its principal tasks:

- Watershed management plan for reforestation/agro-forestry, improvement of the upland farming techniques, control for development of the upland farming activities, capacity building and community-based structural measures (hill-side works)
- Flood management plan for development of flood hazard map, FFWS/CBFEWS, CDP and community-based structural measures
- Land use management plan taking the areas vulnerable to flood and soil erosion into account

Remarks

- *: Estimated and/or proposed by project proponent
- For 2011-2025, 10% of the project cost (5Mil. Pesos) is considered.
-

Source of Information

- M/P for PHUMP in 1996
- F/S-Phase II for PHUMP in 2002
- PHUMP Phase III Part I (On-going, 2005-2010)

Annex-T E.3.2.1 (3/9) Project Profile for Flood and Sediment Disaster Management Sector

| | | |
|---|---|---|
| Project Code | FL-G-03 | |
| Project Title | Maintenance and Rehabilitation Works for River Dike and Slope | |
| Status of Project | On-going | |
| Objective Area | Pampanga river basin | |
| Implementing Agency | DPWH | |
| Objectives | River channel maintenance and rehabilitation (dike slope protection, dike rehabilitation, and channel excavation & dredging) of Pampanga Main River Channel, Rio Chico River and Pasac river system as a regular program | |
| Project Cost (Million Pesos) | Estimated by Project Proponent for 2008-2014 | Estimated by Study Team for 2011-2025 |
| | 450 as of 2009 | 679 as of 2009 |
| EIRR | (N/A) | |
| Expected Source of Fund | GAA* | |
| Expected Implementation Schedule | 2008-2014* | |

Project Description

Most of the existing river dikes, levees, river slope protection and other river structures in Pampanga river basin in particular were originally constructed more than 40 years ago, and they are seriously damaged at present. Moreover, a large volume of sediment accumulation in the river channel is now in progress due to the lahar deposit in the eastern area of Mt. Pinatubo and logging activities in the upper reached of river basin. In order to cope with such degradation of the river structures as well as river channels, DPWH Region III proposed to rehabilitate the deteriorated dike and river slope protection of 54km. Of the 54km in total, 28.6km is for the Pampanga main river channel and Rio Chico River. The remaining 25.4km is for Pasac river system.

Remarks

- *: Estimated and/or proposed by project proponent
- It is assumed that the project continues till 2025 and the annual project cost for the maintenance and rehabilitation of Pampanga main river channel, Rio Chico River is 200Mil.Pesos/7years (28.6Mil.Pesos/year) and the annual project cost for the maintenance and rehabilitation of Pasac river system is 250Mil.Pesos/15years (16.7Mil.Pesos/year). The estimated annual project cost is 45.3Mil/ Pesos/year.

Source of Information DPWH Region III

Annex-T E.3.2.1 (4/9) Project Profile for Flood and Sediment Disaster Management Sector

| | | |
|---|---|---|
| Project Code | FL-G-04 | |
| Project Title | Flood Forecasting and Warning System Capacity Building Project upon Dam Release in the Philippines | |
| Status of Project | On-going | |
| Objective Area | The catchment areas of the following six (6) dams and their vicinities:<br>- Angat Dam and, Pantabangan Dam in Pampanga river Basin<br>- Ambuklao Dam and San Roque Dam in Agno river basin<br>- Magat Dam and Binga Dam in Cagayan river basin | |
| Implementing Agency | PAGASA | |
| Objectives | Capacity building on the flood forecasting and waning for the appropriate dam reservoir operation in Pampanga river basin as well as Agno and Cagayan river basin | |
| Project Cost (Million Pesos) | Estimated by Project Proponent for 2009-2012 | Estimated by Study Team for 2011-2025 |
| | 600 as of 2009 | 300 as of 2009 |
| EIRR | (N/A) | |
| Expected Source of Fund | GAA and JICA* | |
| Expected Implementation Schedule | 2009-2012* | |

Project Description

The flood forecasting and warning system (FFWS) for Pampanga river basin was initially established in 1973 by PAGASA through financial and technical assistance from Government of Japan. The financial assistance from the Government of Japan was further extended to Pampanga river basin providing with the supplementary facilities and equipment for the effective reservoir operation of Pantabangan and Angat Dams in 1982. A Japan Grant Aid Project was also undertaken, in a period from 2007 to 2009, in collaboration with PAGASA as the counterpart agency to upgrade the FFWSs, which have been constructed through the two projects.

This Project has been just commenced, with duration of 1,200days, immediately after the above upgrading of FFWS in order to achieve the capacity building on the flood forecasting and waning for the appropriate dam reservoir operation in Pampanga river basin as well as Agno and Cagayan river basin.

Remarks

- *: Estimated and/or proposed by project proponent
- For 2011-2025, 50% of the project cost (300Mil. Pesos) is considered.

Source of Information

- JICA

Annex-T E.3.2.1 (5/9) Project Profile for Flood and Sediment Disaster Management Sector

| | | |
|---|---|---|
| Project Code | FL-P-01 | |
| Project Title | Flood Control Measures in Mt. Pinatubo Devastated Area- Focus on Pasac Delta | |
| Status of Project | Proposed | |
| Objective Area | 573km$^2$ in the drainage area of Abacan River below Mexico Bridge of Gapan-San Fernando-Olongapo Road, and eastern drainage area of the existing "Tail Dike" | |
| Implementing Agency | DPWH | |
| Objectives | Flood mitigation by new structural measures to address insufficient structural capacity for flood mitigation | |
| Project Cost (Million Pesos) | Estimated by Project Proponent | Estimated by Study Team for 2011-2025 |
| | 4,320 as of 2009 | 4,320 as of 2009 |
| EIRR | (N/A) | |
| Expected Source of Fund | GAA and Export-Import Bank of Korea* | |
| Expected Implementation Schedule | (N/A) | |

Project Description

This Project has been proposed in 2009 on the premises of the financial and technical assistance from Export-Import Bank of Korea (Korea Eximbank) and Korea Water Resources Corporation (K-Water). The principal task of this Project is to increase the channel flow capacity of the existing Pilot Channel from the present 2-year return period to 20-year return period. The task of the Project is further expanded to repair/rehabilitation of seven sluice gates, which were constructed along the right bank of Pampanga mainstream through the under mentioned Pampanga Delta Development Project, Flood Component (PDDP FC) Phase I.

Flood mitigation for Abacan River, San Fernando River and their connecting creeks/drainage channels through the following works:

- Widening of the existing "Pilot Third River Channel" (22.6km in length from the confluence with Abacan River/ San Fernando River up to the confluence with the Pasac River) to 60m in the bottom width from the existing bottom width of 30 to 60m
- Excavation of the Pasac River as an eastern alignment of the Pilot Third River Channel,
- Local drainage improvement connecting the San Fernando River to the Third River and the San Fernando River excavation (total length:29.6km)
- Key road raising to ensure that transportation routes can be maintained during floods

Remarks

- *: Estimated and/or proposed by project proponent

Source of Information

- DPWH

Annex-T E.3.2.1 (6/9) Project Profile for Flood and Sediment Disaster Management Sector

| | | |
|---|---|---|
| Project Code | FL-P-02 | |
| Project Title | Bacolor Comprehensive Rehabilitation Master Plan | |
| Status of Project | Proposed (Draft of M/P has been completed in 2009) | |
| Objective Area | Bacolor Municipality covering an area of 74km$^{22}$ | |
| Implementing Agency | Bacolor Municipality and DPWH | |
| Objectives | Flood mitigation by new structural measures to address insufficient structural capacity for flood mitigation | |
| Project Cost (Million Pesos) | Estimated by Project Proponent | Estimated by Study Team for 2011-2025 |
| | 1,500 as of 2009 | 1,500 as of 2009 |
| EIRR | (N/A) | |
| Expected Source of Fund | GAA* | |
| Expected Implementation Schedule | (N/A) | |

Project Description

Bacolor Municipality has proposed the draft of the Rehabilitation Master Plan, which aims at rehabilitating and promoting the growth of the municipality's physical and socio-economic environments, which were damaged by eruption of Mt. Pinatubo. The Master Plan includes various flood mitigation projects such as improvement of creeks/drainage, construction of drainage pumps and construction of diversion channel from Pasig Potrero River to West Mega Dike.

The following components are included.

- Construction of Gugu Ring Dike (7.80km in length)
- Completion of the Unfinished Portion of Gugu Dike (1.00km in length)
- Channel excavation of Gugu Creek and other various creeks (20.00km in length)
- Slope protection of various creeks in Bacolor Municipality (11.00km in length)
- Construction of new drainage canals (47.50km in length)
- Installation of Floodwater Pumps in the southern part of Bacolor (2 units)
- Construction of Diversion Channel for Pasig-Potrero River

Remarks

- *: Estimated and/or proposed by project proponent

Source of Information

- Bacolor Comprehensive Rehabilitation Master Plan

Annex-T E.3.2.1 (7/9) Project Profile for Flood and Sediment Disaster Management Sector

| | | |
|---|---|---|
| Project Code | FL-C-01 | |
| Project Title | Flood Mitigation for Pampanga Delta | |
| Status of Project | Conceptual | |
| Objective Area | 255 $km^2$ in Pampanga Delta including the municipalities of (a) Macabebe, Apalit and San Simon in Pampanga Province and (b) Calumpit and Hagonoy in Bulacan Province | |
| Implementing Agency | DPWH | |
| Objectives | Flood mitigation for Pampanga Delta along Pampanga mainstream and Labangan Floodway | |
| Project Cost (Million Pesos) | Estimated by Project Proponent | Estimated by Study Team for 2011-2025 |
| | (N/A) | 5,468 as of 2009 |
| EIRR | (N/A) | |
| Expected Source of Fund | GAA* | |
| Expected Implementation Schedule | (N/A) | |

Project Description

The PDDP FC had aimed at mitigating the flood damage along the downstream of Pampanga by the river channel improvement, and the PDDP-FC Phase I was completed in 2002. The PDDP FC Phase II was scheduled to follow but has been differed due to a large number of house resettlements required.

The structural measures adapted in the above PDDP-FC Phase II are the river channel implement by construction of river bank and channel dredging/excavation. The major hindrance to such river channel improvement is addressed to the houses densely packed along the river channel, which require a large number of house relocations. In order to cope with such hindrance, adaptation of an appropriate resettlement plan and/or the alternative flood mitigation measures other than the construction of river bank would be required to pursue the PDDP-FC Phase I.

Remarks

- *: Estimated and/or proposed by project proponent
- The estimated project cost assumed the least cost option among the possible alternatives considered in the study.

Required Action to Upgrade to a Proposed Project for Implementation

- F/S level study would be required to re-study and select optimum measures to mitigate the flood condition based upon the result of the Phase I project.

Source of Information

- DPWH: Pampanga Delta Development Project (Flood Control Component), Review Study for Phase II, 2003.
- JICA Study Team

Annex-T E.3.2.1 (8/9) Project Profile for Flood and Sediment Disaster Management Sector

| | | |
|---|---|---|
| Project Code | FL-C-02 | |
| Project Title | Community Based Flood Early Warning System for Provinces of Pampanga, Tarlac and Neva Ecija | |
| Status of Project | Conceived (The CBFEWS for Bulacan Province has been established in 2005, and that for Pampanga Province is now being examined.) | |
| Objective Area | Provinces of Pampanga, Tarlac and Neva Ecija | |
| Implementing Agency | Provincial Gov. .of Pampanga, Tarlac and Neva Ecija, and PAGASA | |
| Objectives | Development of flood monitoring and dissemination system to address inadequate information and knowledge relevant to flood mitigation | |
| Project Cost (Million Pesos) | Estimated by Project Proponent | Estimated by Study Team for 2011-2025 |
| | (N/A) | 75 as of 2009 |
| EIRR | (N/A) | |
| Expected Source of Fund | Budget of Provincial Gov. .of Pampanga, Tarlac and Neva Ecija* | |
| Expected Implementation Schedule | (N/A) | |

Project Description

The major tasks of the CBFEWS includes (i) establishment of the simple monitoring and communication system managed by the community for flood warning, (ii) capacity building for the municipal/barangay persons to effectively operate, maintain and manage the flood warning system and (iii) Information Education Campaign (IEC) for the residents on the eligible flood evacuation routes/evacuation centers. These tasks would facilitate the participatory approach of the community to the effective flood warning and evacuation works. Moreover, the tasks would not require the huge cost for the project implementation.

The following components are included.

- Establishment of the System, which consists of network of rainfall and water level monitoring stations and communication equipment for data and information transfer,
- Capacity building dot the municipal and/or barangay personnel for operation and management of the System, and
- Information Education Campaign (IEC) for the residents on the CBFEWS
-

Remarks

- *: Estimated and/or proposed by project proponent

Required Action to Upgrade to a Proposed Project for Implementation

- Basic project components should be determined, referring the similar project in Bulacan

Source of Information

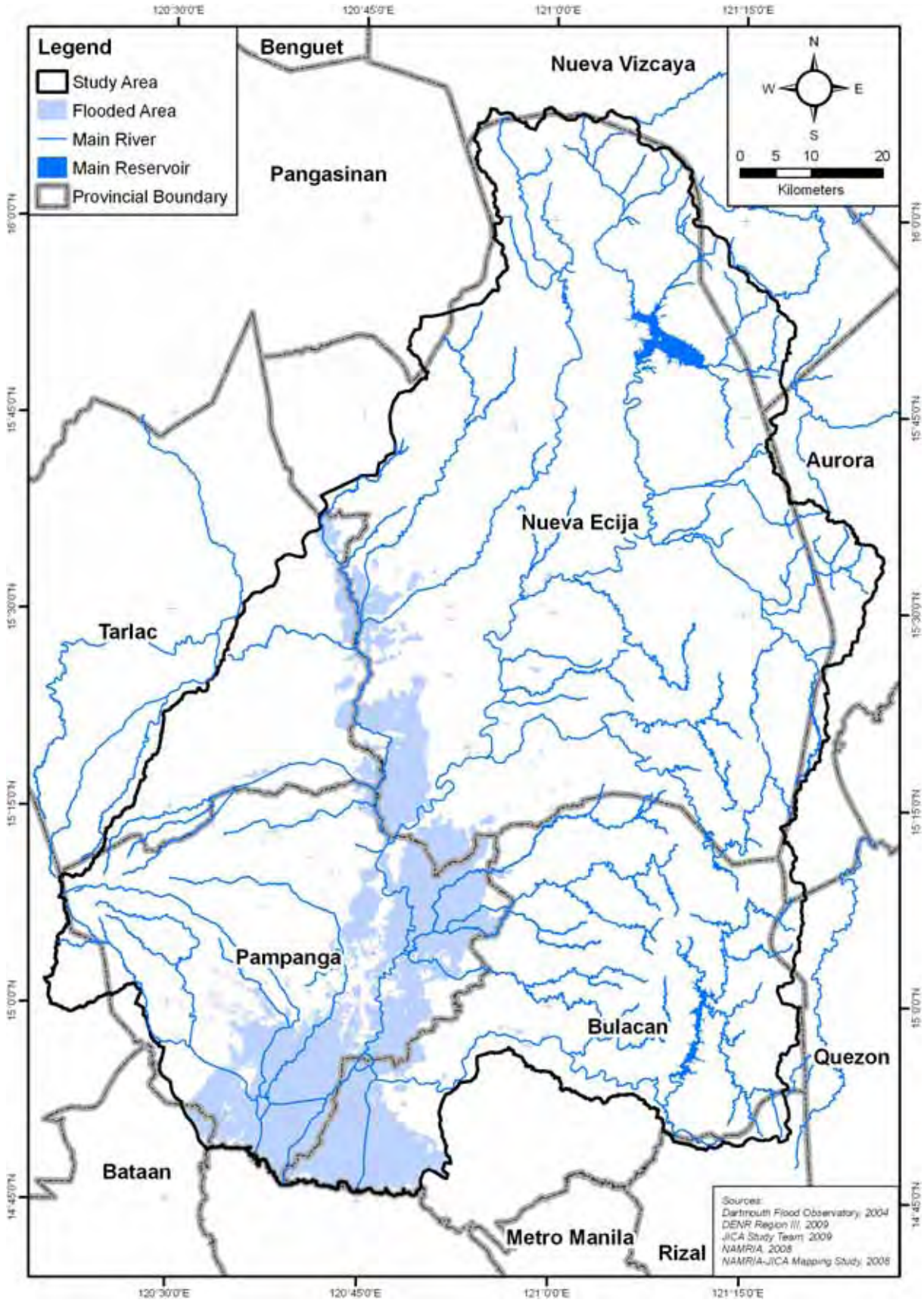
- JICA Study Team

Annex-T E.3.2.1 (9/9) Project Profile for Flood and Sediment Disaster Management Sector

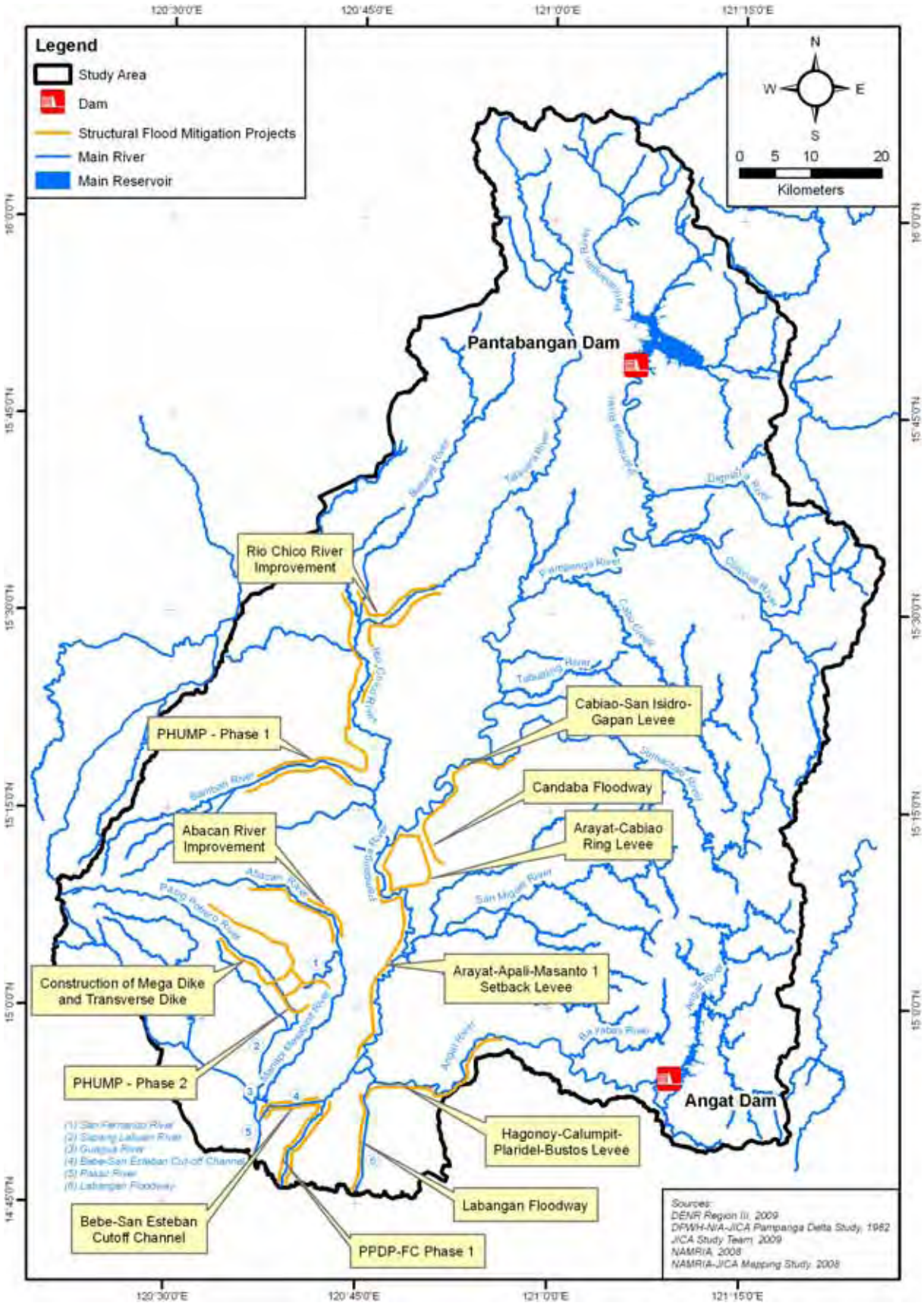
| | | |
|---|---|---|
| Project Code | FL-C-03 | |
| Project Title | Maintenance, Rehabilitation and Improvement for Drainage and Flood Control Facilities under Jurisdiction of LGUs | |
| Status of Project | Proposed | |
| Objective Area | Provinces of Bulacan, Pampanga, Tarlac and Neva Ecija | |
| Implementing Agency | Provincial Gov. .of Bulacan, Pampanga, Tarlac and Neva Ecija | |
| Objectives | Maintenance and rehabilitation of drainage and flood control facilities, which are under jurisdiction of LGUs | |
| Project Cost (Million Pesos) | Estimated by Project Proponent | Estimated by Study Team for 2011-2025 |
| | (N/A) | 3,000 as of 2009 |
| EIRR | (N/A) | |
| Expected Source of Fund | Budget of LGUs (City/Municipality) and DPWH* | |
| Expected Implementation Schedule | (N/A) | |
| Project Description<br>The city/municipal governments proposed the master plan called “Medium Term Development Plan 2010-2013”, which includes the component for maintenance, rehabilitation and improvement of the existing drainage and flood control facilities under the jurisdictions of city/municipal governments. Implementation period of the said maintenance, rehabilitation and improvement works is limited to a three-year period of 2010-2013. However, the sustainable maintenance, rehabilitation and improvement are deemed to be indispensable. From this point of view, a conceptual plan for the captioned project is worked out assuming that the project shall be implemented as the annual regular program toward 2025. | | |
| Remarks<br>- *: Estimated and/or proposed by project proponent | | |
| Source of Information<br>- JICA Study Team | | |

| | | |
|---|---|---|
| Project Code | FL-C-04 | |
| Project Title | Integration of Salient Points of IWRM for Pampanga River Basin into School Curricula | |
| Status of Project | Conceptual | |
| Objective Area | Whole Study Area | |
| Implementing Agency | Department of Education, Region III | |
| Objectives | Education on the subjects related to IWRM for Pampanga river basin through integration of the salient points of IWRM to the primary and secondary school curricula | |
| Project Cost (Million Pesos) | Estimated by Project Proponent | Estimated by Study Team for 2011-2025 |
| | (N/A) | 8 as of 2009 |
| EIRR | (N/A) | |
| Expected Source of Fund | Budget of Department of Education Region III* | |
| Expected Implementation Schedule | (N/A) | |
| Project Description<br>One of the important issues on IWRM is addressed, in the stakeholder meeting, to improvement of the residents’ awareness on the water-related management works. Moreover, improvement of public morals is important to refraining of the unfavorable activities against IWRM such as garbage dumping into the waterways, and encroachment along the river areas. In order to attain such improvement of public awareness and public morals, the captioned project is worked out. | | |
| Remarks<br>- *: Estimated and/or proposed by project proponent | | |
| Source of Information<br>- JICA Study Team | | |

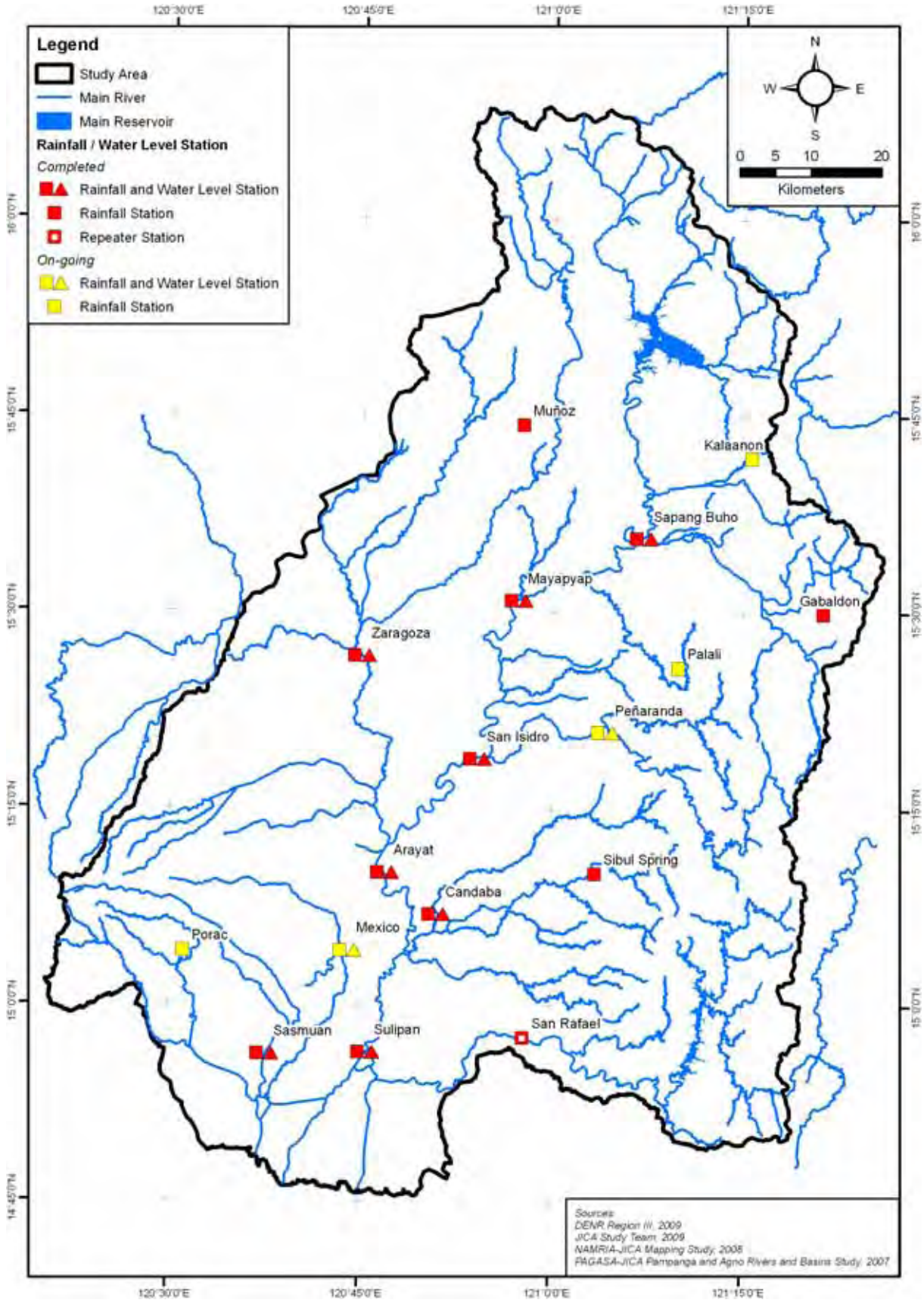
# *Annex-Figures*



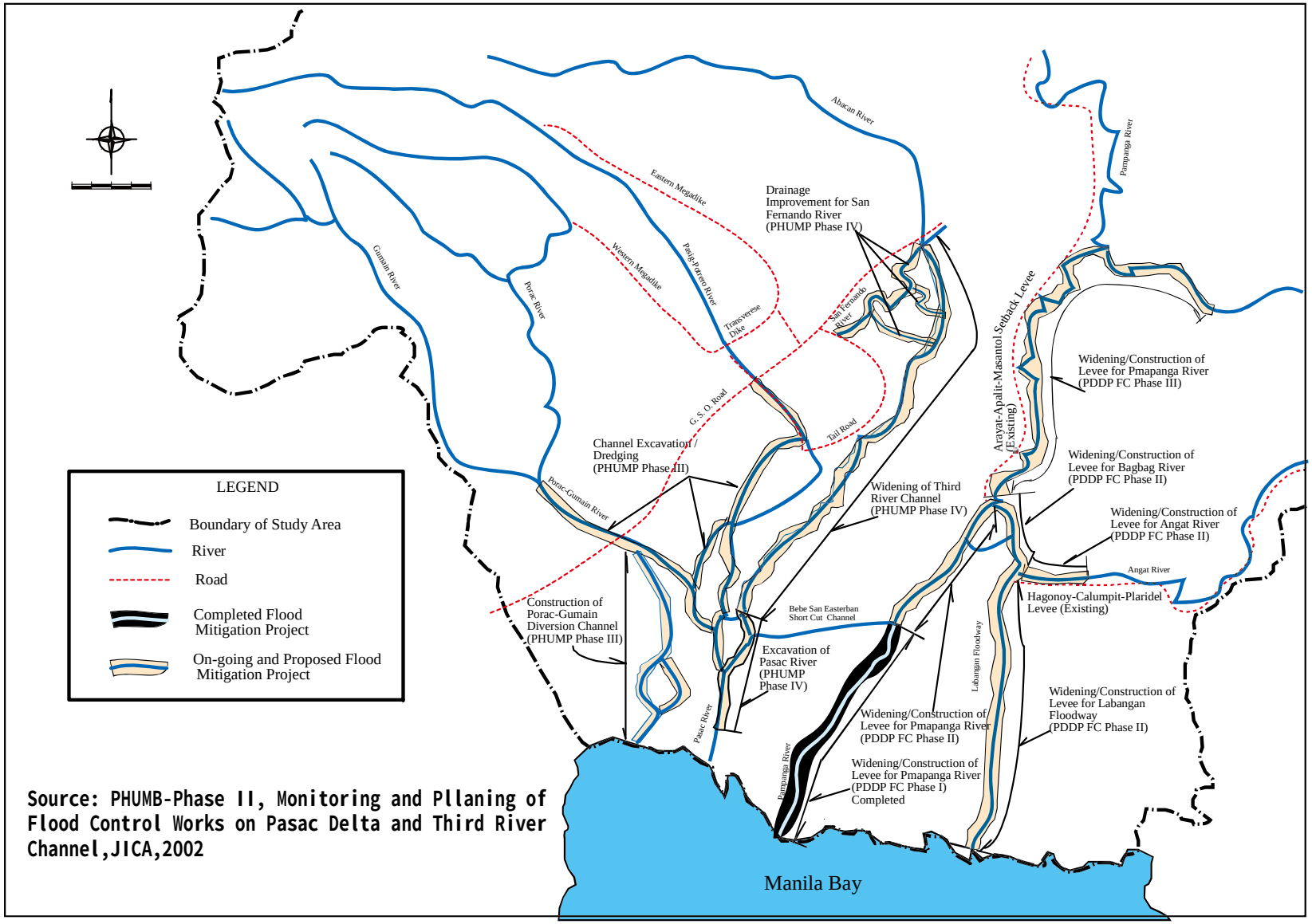

Annex-F E.1.1.1 Flooded Area in Typhoon Marce, August 2004



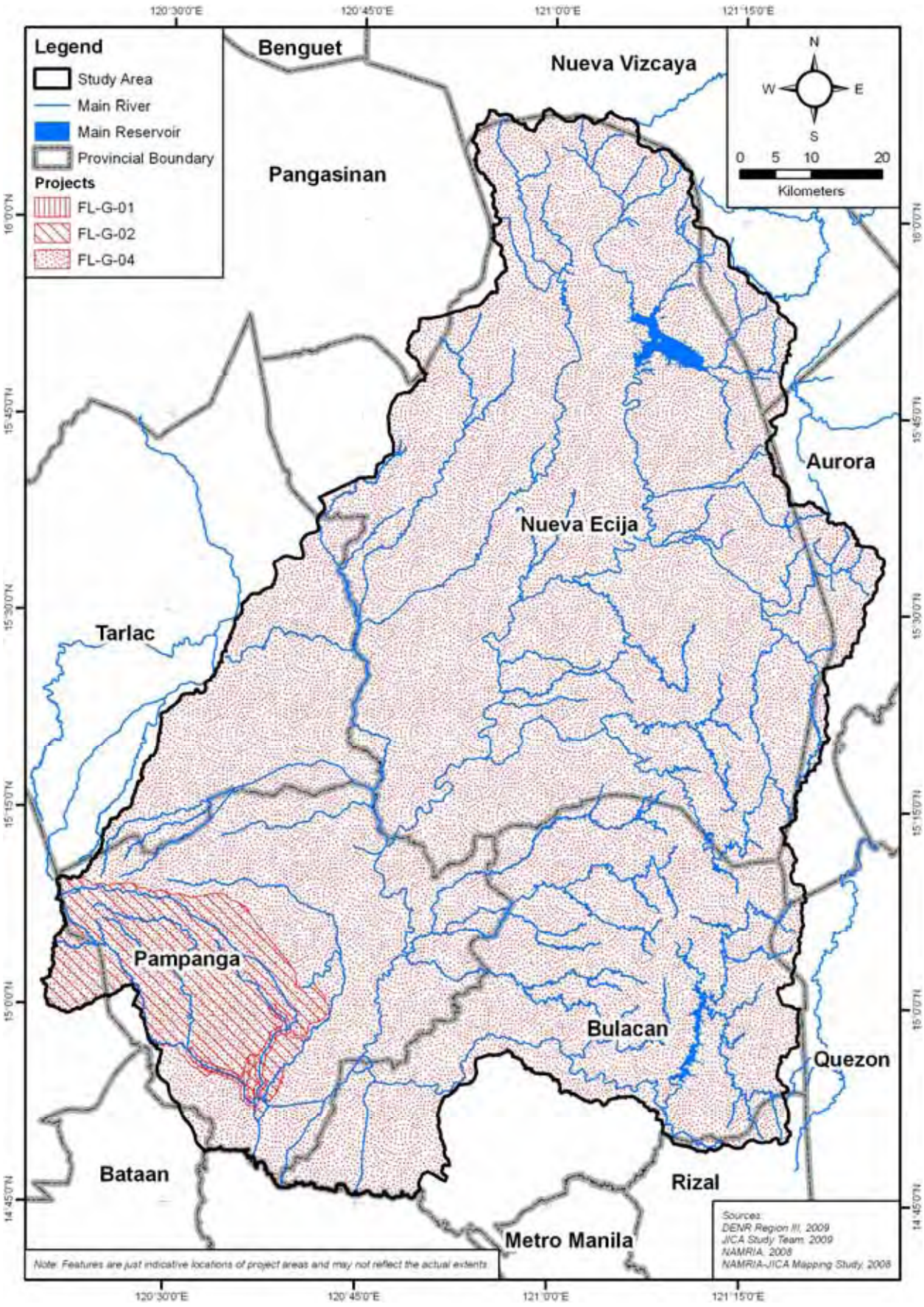

Annex-F E.1.2.1 Completed Major Flood and Sediment Disaster Prevention Works



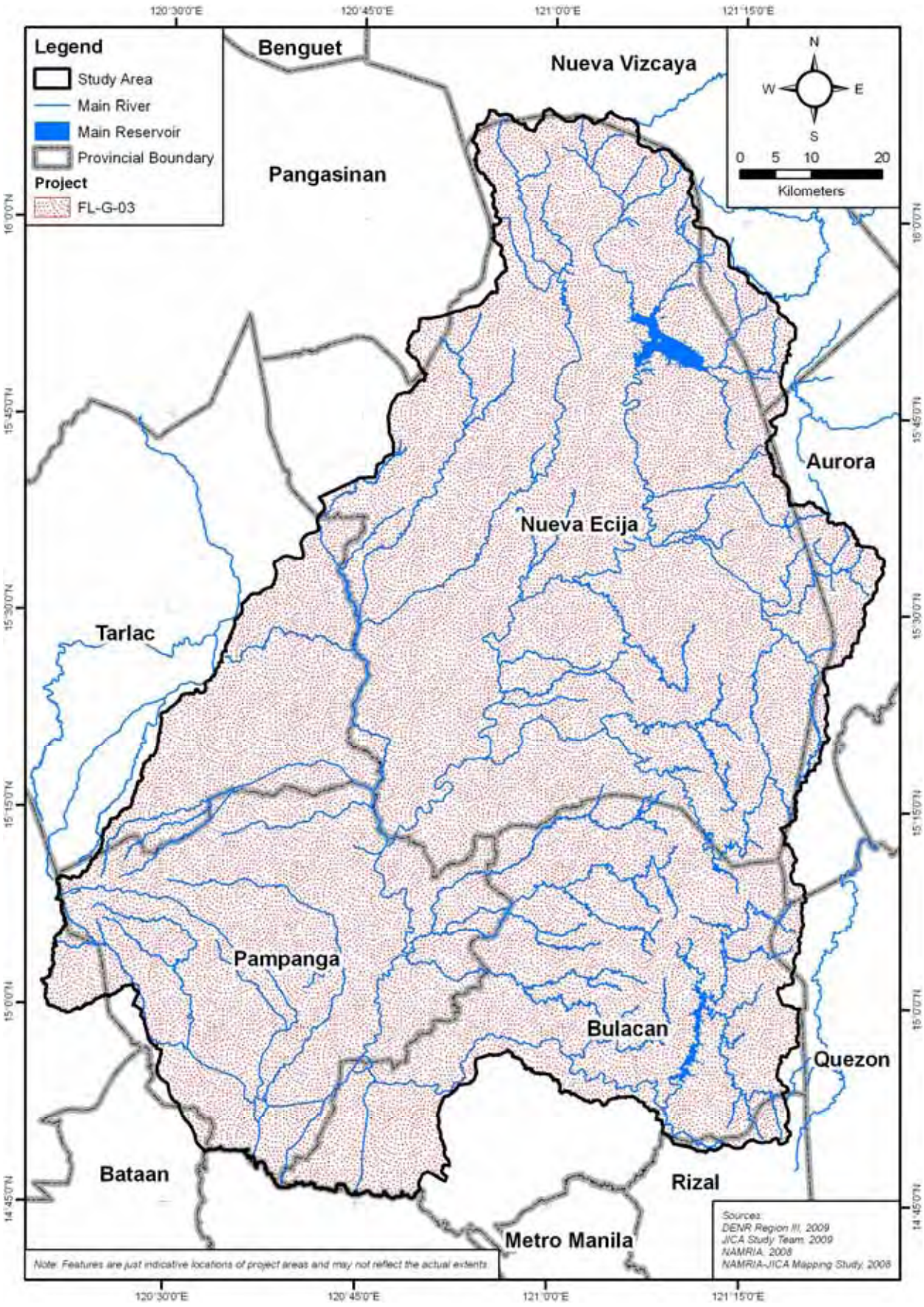

Annex-F E.1.2.2 Hydrological Gauging and Repeater Stations for Completed and On-going Flood Forecasting and Warning System in Pampanga River Basin



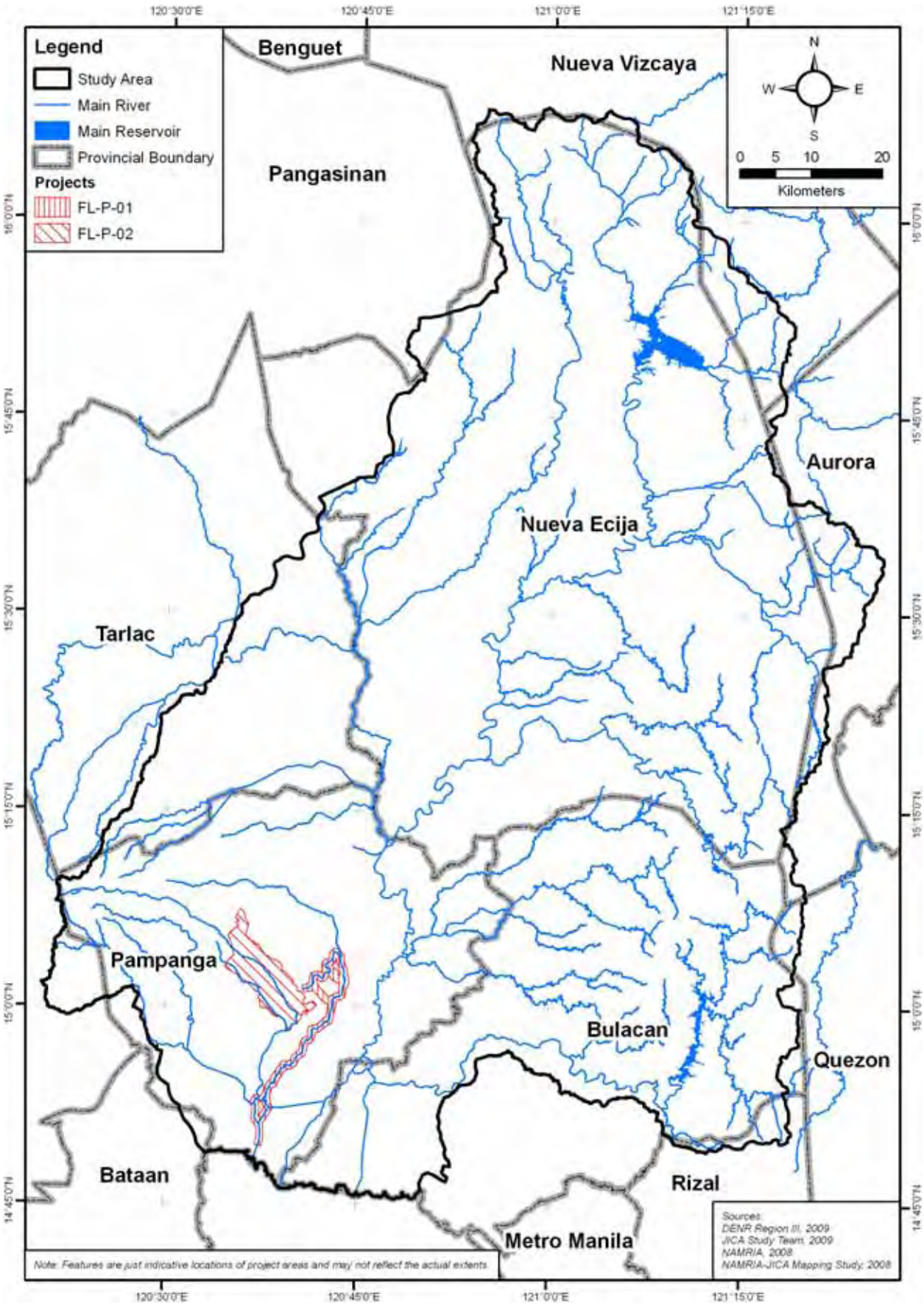

Annex-F E.1.2.3 On-going and Proposed Structural Flood Mitigation Works in Pampanga River Basin



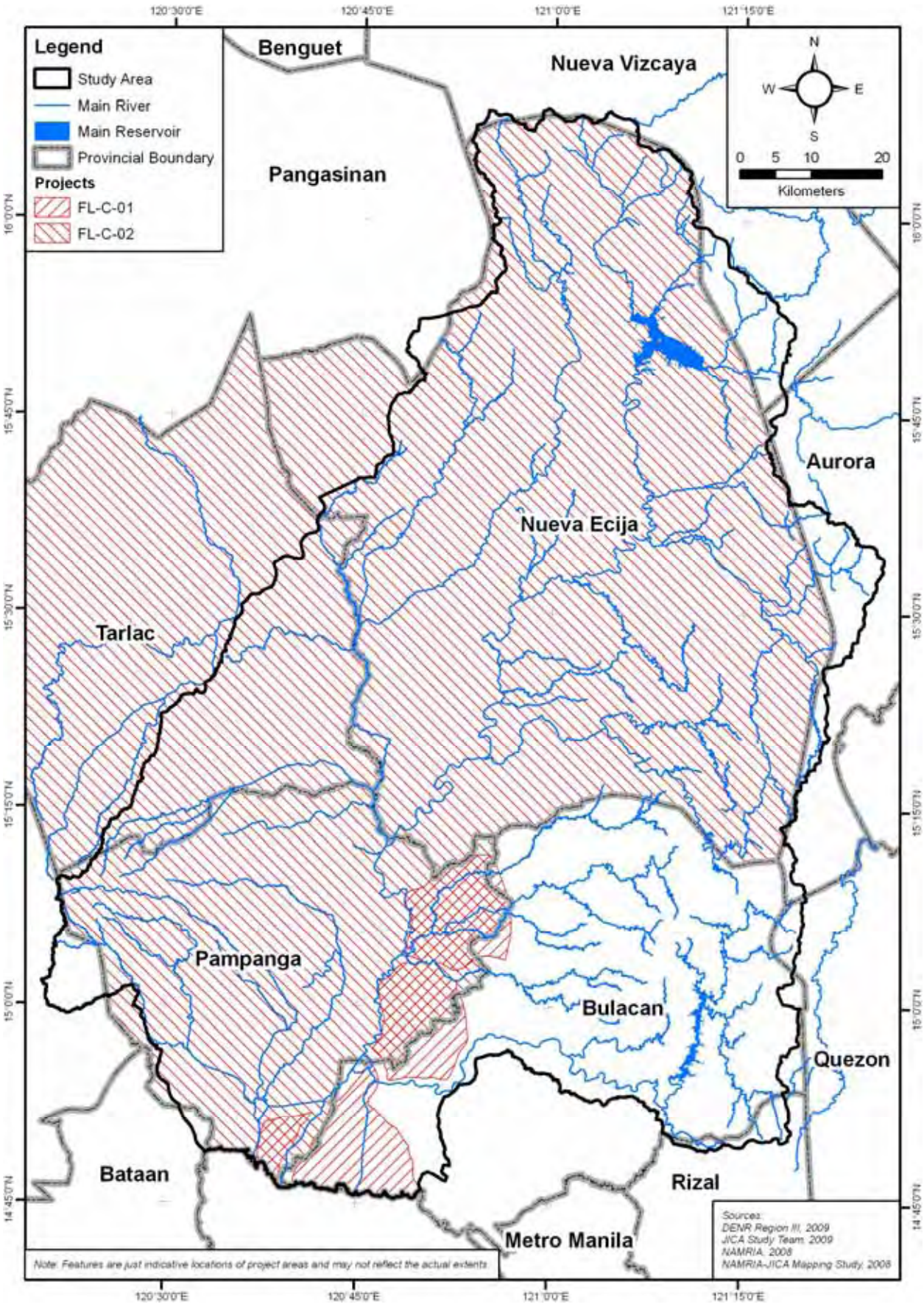

Annex-F E.3.2.1(1/5) Location of Projects on Flood and Sediment Disaster Management



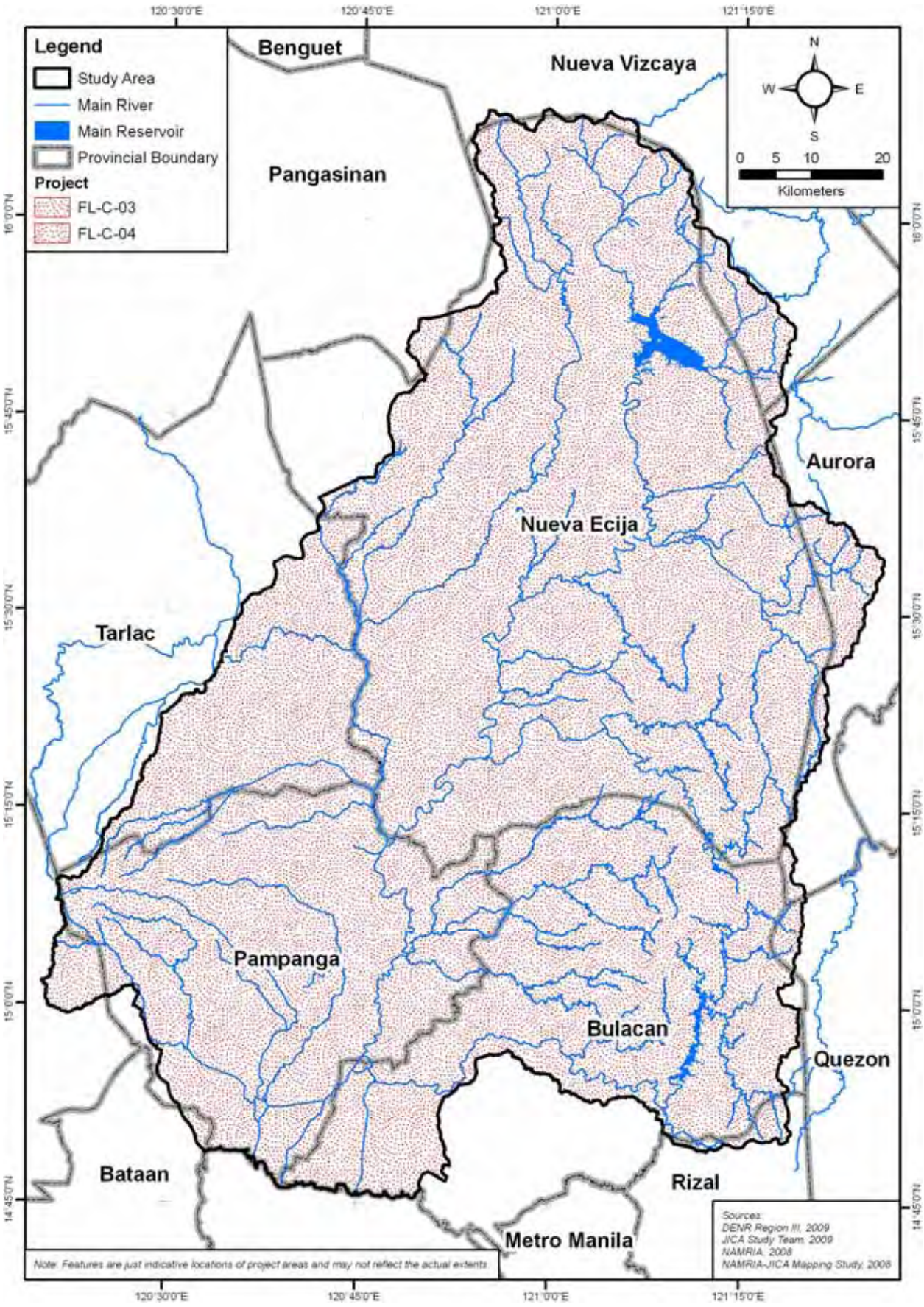

Annex-F E.3.2.1(2/5) Location of Projects on Flood and Sediment Disaster Management




Annex-F E.3.2.1(3/5) Location of Projects on Flood and Sediment Disaster Management




Annex-F E.3.2.1(4/5) Location of Projects on Flood and Sediment Disaster Management




Annex-F E.3.2.1(5/5) Location of Projects on Flood and Sediment Disaster Management