ECONOMIC ANALYSIS
(LAO PDR)

A. Introduction

1. In Lao People's Democratic Republic, (PDR) the Greater Mekong Subregion Flood and Drought Risk Management and Mitigation Project (the Project) will finance the Rehabilitation of the Vientiane Flood Embankment along the left bank of the Mekong River in Vientiane Capital extending downstream from the existing embankment financed by Korea and the following section proposed to be financed by PR China. The impact area of the investment covers the southern part of Vientiane Capital that includes all of Hadxaifong District and parts of Mayparkngum, Xaythany and Xaysetha Districts.

Figure 1: Map of the Proposed Project Location

2. The overall Project will be implemented in three countries - Viet Nam, Lao PDR and Cambodia involving different co-financiers in each country. In Lao PDR, the investment is proposed to be co-financed by Korean EXIM Bank in the amount of $5 million. The Lao PDR structural flood and drought works will be implemented in two subprojects, namely: (i) rehabilitation and upgrading of flood protection embankment and associated roads and structures on the left bank of the Mekong River; and (ii) upgrading irrigation structures and distribution canals in Project flood protection area.

3. Counterpart contributions will be provided by the central Government for taxes for sealing the road on the embankment, control gates together with earthworks associated with the irrigation pumping station and the electrical connections and supplies and other civil works associated with the drainage pumping stations. Vientiane Capital will finance all land resettlement costs (land re-allocation for land) while ADB will finance all other resettlement costs. The proposed Executing Agency, the Ministry of Agriculture and Forestry (MAF), has considerable experience with internationally financed development through ADB, World Bank and other bilaterally funded initiatives in water resource management and is familiar with the

financial management and reporting requirements of development partners. The overall project impact will be 'reduced economic losses and fatalities resulting from flood or drought events.'

4. The outcome will be improved preparedness to manage and mitigate the impacts of flood and drought events. The reduction of flood and drought risk will enable communities to achieve enhanced livelihood resilience and sustainability through: (i) avoidance of loss of properties and reduced casualties (deaths, injuries and water-borne diseases during and after floods); (ii) increased agricultural productivity and incomes due to the improved management and availability of water; (iii) improved access by improved rural roads and canals; and (iv) reduction of economic losses from disruption of business and agricultural activities. The overall Project will improve flood and drought risk management on over 170,000 ha and reduce the vulnerability to floods of over 2.5 million people in the lower Mekong basin.

5. Project outputs include: (i) regional coordination for drought and flood management strengthened, (ii) water management infrastructure developed and/or upgraded, (iii) capacity for community-based flood and drought management enhanced, and (iv) effective subproject implementation management. Investments in Lao PDR include: (i) support for the National Flood Early Warning Centre located in the Water Resources and Environmental Administration, (ii) the rehabilitation of the Mekong River left embankment in the vicinity of Thadeua and water control structures to facilitate improved irrigation and drainage within the impact area, (iii) community based initiatives to improve flood and drought mitigation that will also include road safety training for communities alongside the rehabilitated alignment, and (iv) provisions to support a provincial project implementation unit and a national project management office with associated technical assistance in areas considered necessary to ensure quality of design and works.

6. In Lao PDR, the total investment is estimated at $32.0 million with 6% being allocated to Regional Coordination in Drought and Flood Management, 82% to rural infrastructure development, 2% to Community Based Flood and Drought Management, and 10% to implementation management (of base costs). To assess the overall impact of the investment, an economic and financial (E&F) analysis has been prepared for this subproject. No assessment has been attempted for the impact from investments in regional coordination and community based flood and drought risk management as these are considered to have been taken into account in the subproject impact.

7. **Subproject Description**. The subproject impact area is surrounded by Houy Deua River in north, the Mak Hiao River in the south and the Mekong River to the west. It incorporates the floodplains of these rivers and the extensive wetlands to the south west of Vientiane township including some 60,000 ha of paddy (39,000 ha of wet season and 21,000 ha of irrigated dry season crop) and densely populated settlements along the Mekong River. An incremental 1,200 ha of paddy land will be irrigated in the dry season while improved drainage and sluice gates will allow better control of water in agricultural areas as well as the wetlands to preserve their environmental function critical to Vientiane's waste water and drainage system. This subproject involves increasing the height of the left embankment of the Mekong River from the end of the planned PR China financed embankment downstream to the point where the Mak Hiao River delivers into the Mekong River. The embankment will include earthworks to raise the height of the embankment along 30 kms of the river bank, flood control gates (2), sluice and flap gates in culverts (5), and the asphalt surfacing of the road along the crest of the embankment.

8. The subproject will also construct four irrigation pumping stations at Sanbouahor, Dong Kouay, Na Long 3, and Mak Hiao 2 to irrigate an incremental 1,200 ha for dry season rice

together with the associated secondary canals and water control structures in Ban Sanbouahor Scheme, Ban Donkouay Scheme, Ban Na Long 3 Scheme, and Ban Makhio 2 Scheme. It will also construct two drainage pumping stations at Houay Mak Hiao and Houay Due including buildings, electrical connections and pumps.

B. Methodology

9. Only quantifiable and significant benefits and costs are examined to assess subproject viability and to understand the anticipated impact on the economy and society as a whole. Costs and benefits are calculated under two alternative scenarios: "with" and "without" the subproject. Benefits have been quantified from reduced flood damage to agricultural output, public infrastructure, private property and the reduced need for evacuation in the more extreme events. The subproject's impact on industrial output is considered too small to assess independently. Benefits have also been estimated from savings in vehicle operating costs (VOC) with the resurfaced alignment as well as from irrigation. The command area[1] is examined under both scenarios, based on the full irrigated area after rehabilitation of delivery canals and water management structures. In the "without" project scenario this command is assumed to be irrigated only in the wet season and subject to inundation with consequent impact on crop yield. The analysis takes into account what might be produced on this land "without" the proposed development. The intent is to identify the incremental value of production and of losses prevented that can be attributed subproject investments (over its expected economic life) and compare this value to the cost of implementing the subprojects and of operating and maintaining (O&M) the rehabilitated or new infrastructure.

10. To develop a model for the analysis, assumptions are made regarding future farming practice (both "with" and "without" the subproject) and the reduced threat of flood events (based on six separately identified severities - return periods) together with the valuation of inputs and outputs. These include:

- Subproject life is 25 years. That is, assuming adequate maintenance, the flood and/or drought management system should be able to maintain its expected benefits for 25 years before another major renovation is required.
- "Without" the subproject, existing cultivation patterns and technology are expected to continue for the life of the subproject.
- "With" the subproject, the full command area is expected to continue to be irrigated throughout the effective life of the subproject, allowing farmers to adopt higher value cropping patterns and technology as appropriate.
- Some agricultural outputs may be consumed within the household, but are valued as if sold.
- Some agricultural inputs such as farm labor are provided by the farming household but are valued at the market rate as if hired.
- Output values are expressed in constant 2011 terms so as to exclude inflation.

[1] The command area is that area that can be efficiently irrigated from the rehabilitated canal and water management structures. Where rehabilitation is the dominant activity - the command area often remains the same with and without the subproject whereas in the case of extension into new areas, the command area will increase in addition to the improved productivity on the established irrigated area.

- Costs are expressed in constant 2011 Kip (local costs) and constant 2011 US dollars (foreign currency costs). Future price predictions in current terms are adjusted to constant 2011 terms using the Multipliers Unit Value (MUV) index as published by the World Bank.[2]

- The Lao PDR Kip is the unit of currency. The exchange rate used is the mid year rate with the US dollar for any conversions necessary.

- Future production on command areas are estimated based on historic achievements but modified post subproject to reflect the improved water management and reduced flooding resulting from the investment.

11. Financial prices used in this analysis were identified through field visits during the preparation studies. These prices have been cross-checked with prices identified in other projects and secondary sources.

12. To assess subproject contributions to the economy of Lao PDR, financial values have been converted to their economic equivalents. Economic valuations exclude transfers from one part of society to another (i.e. taxes, subsidies and compensation costs) and attempt to facilitate the comparison of subproject benefits and real opportunity costs to the economy by translating all prices into a common, undistorted footing. Basic assumptions (in addition to those above) used in the economic analysis include:

- The use of a domestic price numeraire.

- In the case of major tradable commodities (food grains and fertilizers), economic values are based on border parity prices.

- For non-traded goods and services, a standard conversion factor (SCF) of 0.9 is used. For rural labor, a shadow wage rate factor (SWRF) of 0.85 is applied. The SWRF reflects the productivity of rural labor in the area.

- Transfer payments such as taxes, subsidies and compensation are excluded in the calculation of economic values. The administration cost of compensation is included.

- To calculate the economic net present value (ENVP) of the subproject a discount rate of 12% is used as representing the opportunity cost of the capital invested.

C. Subproject Benefits

13. Benefits from the investment have been grouped into three sources - those derived from flood prevention, those from incremental irrigation and those from the impact of the road upgrading along the crest of the embankment. Flood benefits have been further broken down into those from the reduced need to evacuate people from flooded areas, from the impact of flooding upon agricultural output, from the prevention of damage to public infrastructure and to household and private assets. Irrigation benefits are derived from incremental rice production on the expanded dry season irrigated paddy area while the road benefits have been estimated from the reduction in VOCs and the incremental traffic volumes attracted by the sealed alignment. The methods used for estimating these impacts are discussed below.

[2] http://econ.worldbank.org/WBSITE/EXTERNAL/EXTDEC/EXTDECPROSPECTS/0,,contentMDK:20587651~menuPK:3279864~pagePK:64165401~piPK:64165026~theSitePK:476883,00.html

14. Flood benefits have been estimated considering six different flood return periods, a one in two year flood, a one in five year flood, a one in 10 year flood, a one in 20 year flood, a one in 50 year flood, and a one in 100 year flood. At each of these, progressively more water inundates an increasing area of land. The topographical analysis provided estimates of the areas inundated and the depths to which they would be inundated for each severity level of flooding (Table 1).

Table 1: Estimated Inundated Area by Depth of Flooding

Flood Return Period	Frequency of Event	Area Inundated by Depth (ha)						
		Total	None	0 - 0.5m	0.5 - 1m	1 - 2m	2 - 3m	>3m
1 in 2 years	50%	22,329	0	22,329	0	0	0	0
1 in 5 years	20%	25,350	0	24,448	471	431	0	0
1 in 10 years	10%	26,887	0	463	491	25,934	0	0
1 in 20 years	5%	27,855	0	500	429	1,001	25,925	0
1 in 50 years	2%	28,883	0	584	511	1,022	26,766	0
1 in 100 years	1%	29,583	0	385	415	1,007	977	26,799

Notes: ha – hectare, m – meter.
Source: Consultants estimates.

15. For each level of flood severity (i.e. the six levels described in Table 1), the extent of damage caused to human evacuation, agricultural output, public infrastructure, and household and private assets has been assumed based on available flood damage reports. By applying these damage estimates (Table 2) to the areas inundated (Table 1), a weighted average for the loss can be estimated for each level of flood.

Table 2: Loss Rates Due to Inundation (% of asset / output values)

Flood Return Period	Frequency of Event	Population Evacuation (%)	Agricultural Output (%)	Industrial Output (%)	Industrial Assets (%)	Public Infrastructure (%)	Household Assets (%)
1 in 2 years	50%	0%	0%	0%	0%	0%	0%
1 in 5 years	20%	0%	0%	0%	0%	0%	0%
1 in 10 years	10%	1%	10%	0%	0%	5%	5%
1 in 20 years	5%	2%	19%	5%	5%	9%	9%
1 in 50 years	2%	4%	19%	5%	5%	9%	9%
1 in 100 years	1%	5%	24%	9%	9%	14%	14%

Source: Consultants estimates.

16. These ratios were then applied to the local population within the impact area (51,100 people), to the agricultural output of the area ($61 million/annum), to the estimate of public infrastructure ($200 million), and to the estimate of private assets - houses (at an average of $10,000 per house). This generated a financial cost estimate of the level of damage caused by flooding at the various levels. In order to obtain economic terms, the financial figures were adjusted by the factors depending on their proportional composition including civil works (weighted conversion factor 0.84), materials (weighted conversion factor of 0.75), equipment (weighted conversion factor of 0.9), and labor (weighted conversion factor of 0.71). The resultant calculation provided an estimate of the economic losses incurred at each level of flood severity. It is these losses that would be avoided under the “with” subproject scenario. The estimate of annual damage in economic terms is presented in Table 3.

Table 3: Estimated Economic Damage by Level of Flooding

Flood Return Period	Frequency of Event	Population Evacuation ($ m. /yr)	Agricultural Output ($ m. /yr)	Industrial Output ($ m. /yr)	Industrial Assets ($ m. /yr)	Public Infrastructure ($ m. /yr)	Household Assets ($ m. /yr)	**Total** ($ m. /yr)
1 in 2 years	50%	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1 in 5 years	20%	0.0	0.1	0.0	0.0	0.1	0.1	0.3
1 in 10 years	10%	5.1	4.4	0.0	0.0	8.2	4.1	16.7
1 in 20 years	5%	10.2	8.5	0.0	0.0	16.1	8.1	32.8
1 in 50 years	2%	20.5	8.5	0.0	0.0	16.1	8.0	32.6
1 in 100 years	1%	25.6	10.6	0.0	0.0	24.0	12.0	46.6

Notes: $m/yr – US dollar millions per year.
Source: Consultants estimates.

17. The difference between the flood damage under the “with” and “without” subproject scenarios, provides the net benefit stream in terms of flood related benefits - a base year estimate of the potential savings from flood damage in the current year. This was then escalated annually at 2% per annum in line with real GDP growth rate for the first 10 years after subproject completion and 1.5% thereafter to provide an estimate of annual benefits from the embankment in respect of flooding.

Table 4: Summary of Flood Damage Avoided 'with' and 'without' the Subproject

Return Period	Annual Flood Probability			Flood Damage Estimate			Annual
	Frequency	Difference in Frequency	Without Project	With Project	Net Damage	Average Damage	Damage Avoided
(years)	(%)	(%)	($ m. / yr)	($ m. / yr)	($ m. / yr)	($ m. / yr)	($ m. / yr)
(a) Population Evacuation							
5	20%		0.0	0.0	0.0		
		10%				2.6	0.26
10	10%		5.1	0.0	5.1		
		5%				7.7	0.38
20	5%		10.2	0.0	10.2		
		3%				15.3	0.46
50	2%		20.5	0.0	20.5		
		1%				23.0	0.23
100	1%		25.6	0.0	25.6		
Total							1.33
(b) Agricultural Output							
5	20%		0.1	0.0	0.1		
		10%				2.2	0.22
10	10%		4.4	0.0	4.4		
		5%				6.4	0.32
20	5%		8.5	0.0	8.5		
		3%				8.5	0.26
50	2%		8.5	0.0	8.5		
		1%				9.6	0.10
100	1%		10.6	0.0	10.6		
Total							0.90
(c) Public Infrastructure							
5	20%		0.1	0.0	0.1		
		10%				4.2	0.42
10	10%		8.2	0.0	8.2		
		5%				12.2	0.61
20	5%		16.1	0.0	16.1		
		3%				16.1	0.48
50	2%		16.1	0.0	16.1		
		1%				20.0	0.20
100	1%		24.0	0.0	24.0		
Total							1.71
(d) Household Assets							
5	20%		0.1	0.0	0.1		
		10%				2.1	0.21
10	10%		4.1	0.0	4.1		
		5%				6.1	0.30
20	5%		8.1	0.0	8.1		
		3%				8.1	0.24
50	2%		8.0	0.0	8.0		
		1%				10.0	0.10
100	1%		12.0	0.0	12.0		
Total							0.86
TOTAL							
5	20%		0.3	0.0	0.3		
		10%				11.1	1.1
10	10%		21.8	0.0	21.8		
		5%				32.4	1.6
20	5%		43.0	0.0	43.0		
		3%				48.0	1.4
50	2%		53.1	0.0	53.1		
		1%				62.6	0.6
100	1%		72.2	0.0	72.2		
Total							4.8

Notes:$m/yr – US dollar millions per year.
Source: Consultants estimates.

18. For the irrigation benefit, incremental production from a second dry season crop was compared to the one wet season crop on the same 1,200 ha. Wet season yields under the "without" subproject scenario were 4.5 t/ha whilst under the "with" subproject scenario, they were increased to 4.7 t/ha in view of the improved water management. Dry season production is not undertaken at present but with improved irrigation, yields would increase from 5.5-5.8 t/ha during the irrigated crop on the full 1,200 ha in view of the community based initiatives proposed under the design. Allowances have been incorporated for the period of construction under the "with" subproject scenario.

19. The benefit from the surfacing of the embankment is derived from two areas, the reduction in VOC for all modes of transport, and secondly, from the increased traffic volumes that are attracted by a sound road surface. Estimates of VOCs were prepared for each of the main types of vehicles using the alignment including motor cycles, hand tractors, motor cars, mini-buses, small trucks, and pick-ups. Under the "without" subproject scenario, VOCs were considered to increase by 50% for each mode of transport in view of the higher repairs and maintenance, the lower speeds necessitated and the increased depreciation from the uneven surfacing. Benefits were estimated for an assumed traffic volume without project scenario based on the reduction in VOCs. To these were added the savings that would be incurred with the additional traffic volumes made possible by the improved road surface. Experience in previous road rehabilitation projects suggest that the level in incremental traffic assumed will most likely be exceeded in reality as good surfaces attract traffic (Table 5). The VOC savings for the existing and incremental traffic volumes was then applied to the full length of the rehabilitated alignment as this does not constitute a local road and the majority of its traffic would travel its full length. Traffic volumes are progressively increased to reflect the growth in economic activity surrounding the embankment in-line with the GDP growth rate.

Table 5: Reduction in VOC and Changes in Traffic Volumes

Traffic Types	Without Rehabilitation				Projected With Rehabilitation			
	Traffic	Percent	VOC	Weighted Average[/a] VOC Savings	Traffic Increment	Percent	VOC	Weighted Average[/a] VOC Savings
	veh/day		Kip/km	Kip/km	veh/day		Kip/km	Kip/km
Motorized								
Motorcycle	300	50.8%	742	126	450	44.6%	495	110
Hand Tractor	30	5.1%	4,226	72	20	2.0%	2,817	28
Motor Car	100	16.9%	3,293	186	200	19.8%	2,196	217
Mini-bus	50	8.5%	3,842	109	100	9.9%	2,562	127
Small Truck	60	10.2%	4,490	152	90	8.9%	2,993	133
Pick-up	50	8.5%	3,310	93	150	14.9%	2,206	164
Total	590	100.0%		738	1010	100.0%		780

km- kilometer; veh/day – vehicles per day; VOC – vehicle operating cost.
Source: Consultants estimates.

D. Subproject Costs

20. Subproject cost estimates were prepared by PPTA consultants who prepared the initial feasibility study (as well as the identified subproject in Saravane). The provided estimates of the subproject base costs that were made up of earthworks, sluice gates, culverts, irrigation pumping stations and drainage pumping stations and pumping equipment. The estimate of resettlement was also prepared by the consultant based upon the proposed alignment of the

embankment and the survey of assets given the required setbacks. Only resettlement administration costs have been included in the analysis. Construction services costs were estimated for the detailed design, bid document preparation and construction supervision estimated at 5%, 2% and 4.5% respectively of the civil works value.

21. Subproject management costs have been estimated based on a proposed structure of a national project management unit together with a provincial project management unit in Vientiane Capital's provincial agriculture and forestry office. This includes the cost of incremental staff need to be appointed to the two offices as well as the costs for their operations and supervision of the subproject.

22. Estimates of operations and maintenance (O&M) of developed infrastructure are often overlooked in feasibility studies. In this subproject economic analysis, O&M estimates are based on 30% of the cost of civil works every 8 years for periodic maintenance and 3% for routine maintenance every year. This amount has been phased into subprojects in year 4 of implementation and increased to 60% of the recommended level by year 6. A summary of the economic investment costs is presented in Table 6. Costs associated with national coordination and implementation technical support have not been included in the assessment of the economic impact from the subproject. Similarly initiatives in support of the flood and drought early warning centre have not been separately assessed.

Table 6: Summary Economic Investment Costs

Items	Amount	
	Kip million	$ '000s
Civil Works	110,980.2	13,837.9
Equipment	12,063.5	1,504.2
Construction Services	11,509.4	1,435.1
Provincial Project Management	3,439.5	428.9
Resettlement and Compensation	300.6	37.5
Operations and Maintnance	1,887.5	235.3
Total	**140,180.7**	**17,478.9**

Source: Consultants estimates.

E. Economic Analysis

23. The economic analysis compares the identified net incremental benefits attributed to the investment with the costs for developing the embankment and irrigation and drainage structures. Based on the models developed to assess the economic benefits, the EIRR for the subproject is 24.2% and the NPV evaluated at 12% is $17.63 million. The EIRR suggests this investment will justify the commitment of public funds as it can be anticipated to return benefits that exceed the opportunity cost of capital (estimated at 12%). The composition of the benefits is dominated by those attributed to flood prevention. In the base year situation, the potential benefit from flood initiatives is estimated at $4.8 million per annum and that is dominated by the prevention of damage to public infrastructure ($1.7 million), followed by people evacuation ($1.3 million), agricultural output ($0.9 million), and household assets ($0.9 million) per annum. The incremental benefit attributed to irrigation of the 1,200 ha during the dry season is estimated at $0.6 million per annum while the net benefits from VOC savings and increased road utilization is

estimated at $0.7 million per annum. The estimated EIRR (24.2%) is reported in Table 7 suggesting this is a sound investment and likely to have a positive impact on the overall economy.

Table 7: Estimated EIRR and Sensitivity Analysis for the Embankment Subproject

Evaluation Results				ENPV	EIRR					
				($ million)	%					
Base Case				17.6	24.2%					
Variables	Change	NPV (base case)	NPV (after)	EIRR (base case)	EIRR (after)	Discount Rate	SI (EIRR)	SV (EIRR)	SI (NPV)	SV (NPV)
Investment Cost	10%	17.63	16.40	24.23%	22.63%	12%	1.309	0.764	0.701	1.427
Investment Cost	20%	17.63	15.16	24.23%	21.23%	12%	1.225	0.816	0.701	1.427
Flood Benefit	-10%	17.63	14.95	24.23%	22.69%	12%	-1.261	-0.793	-1.522	-0.657
Flood Benefit	-20%	17.63	12.27	24.23%	21.06%	12%	-1.296	-0.772	-1.522	-0.657
Irrigation Benefits	-10%	17.63	17.38	24.23%	24.09%	12%	-0.114	-8.751	-0.146	-6.853
Irrigation Benefits	-20%	17.63	17.12	24.23%	23.95%	12%	-0.115	-8.724	-0.146	-6.853
Road Benefits	-10%	17.63	16.36	24.23%	23.48%	12%	-0.614	-1.629	-0.722	-1.385
Road Benefits	-20%	17.63	15.43	24.23%	22.92%	12%	-0.537	-1.863	-0.626	-1.597

Notes: EIRR – economic internal rate of return; ENPV – economic net present value; NPV – net present value; SI – sensitivity index; SV – switching value.
Source: Consultants estimates.

24. Sensitivity analyses were undertaken for the subproject based on the potential risks envisaged. These included construction cost escalation, reduced flood benefits, reduced irrigation benefits and for road benefits, reduced VOC savings and traffic volumes applied simultaneously - all at 10% and 20% variations around the base case scenario. Switching values were calculated by comparing the change in EIRRs and NPVs in response to each of the imposed risk factors.

25. The investment is relatively robust to increases in investment costs. A 10% increase in capital costs had the effect of reducing the EIRR by 1.6%. A 20% increase in the investment costs resulted in a further 1.4% decline in the EIRR suggesting the investment is relatively stable to changes in the investment costs. This is confirmed by the switching value that identifies at which level the investment would become unprofitable. Cost would need to increase by 76% before this situation arose - an unlikely outcome and not considered a significant risk.

26. Sensitivities to flood benefits were run as a once-off variable as changes in flood benefits are likely to be incurred across all the identified flood benefits. But here too, reductions in the benefits from flood prevention are relatively robust to the outcome of the investment. While flood benefits dominate the EIRR estimate (80% of the long term benefits) the model suggests that even significant changes are unlikely to introduce unacceptable risks to the investment. With a reduction of 10% of flood benefits, the EIRR estimate declines to 22.7% and with a 20% reduction in benefits - it declines further to 21.1%. This reflects the fact that levels of damage to infrastructure, whilst relatively small at even significant levels of flooding, the capital already invested in public infrastructure is significant and the higher levels of damage are recorded only in extreme flood events - return periods of 1:50 and higher. Given that flood protection is the primary objective of the subproject, it can be confirmed that the outcome is robust in respect of flood benefits.

27. For irrigation, the contribution to the overall benefit stream is about 10% and one would not expect changes in this variable to have a significant impact on the success of the investment. The sensitivity checks confirm this fact with reductions of 10% and 20% of irrigation benefits reducing the EIRR by 0.1% and 0.2% respectively. The model is therefore extremely robust, even to significant changes in the irrigation benefits. If the impact of the irrigation was removed from the benefit stream, the EIRR remains at 22.8%. Clearly the flood impacts dominate the benefit stream as is intended.

28. Road benefits similarly are considered incremental benefits from the investment and these too have little impact upon the overall outcome. A 10% and 20% reduction in road related benefits reduced the EIRR estimates to 23.5 and 22.9% respectively. The model is therefore robust to very significant changes in the road related benefits and like the irrigation benefit, is not going to impact on the value of the investment of removed completely. Overall the investment is considered sound and not likely to be threatened by the foreseen potential risk factors identified.