

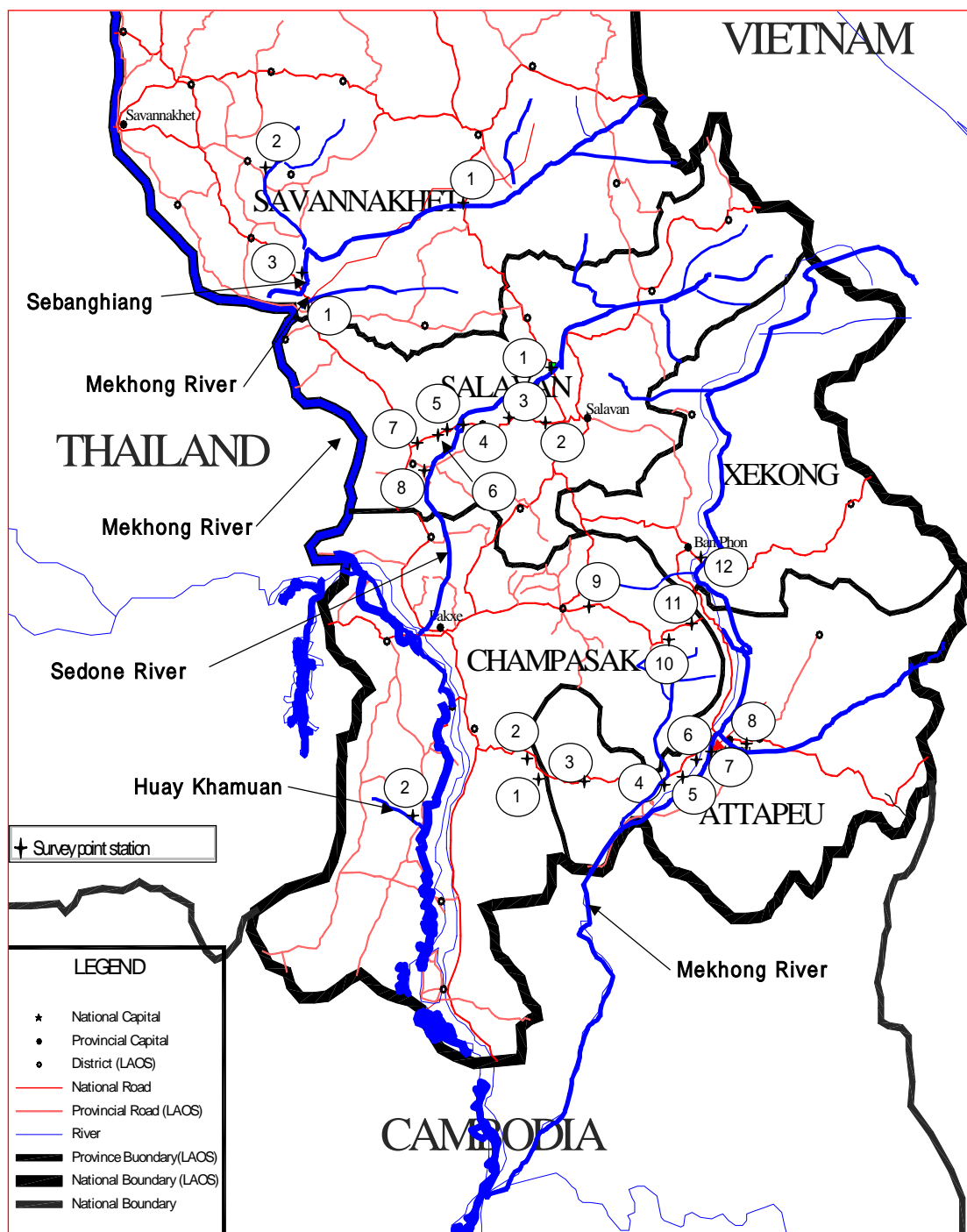
# **ANNEXES FOR MASTER PLAN**

**ANNEX M-3**

**FIELD SURVEY SHEET OF RIVER  
SITUATION**







ANNEX M-3 FIELD SURVEY SHEET OF RIVER SITUATION

(1) Location of Field Survey






**(2) Field Survey Sheet For River Situation**







**1) Sebanghiang River Basin (1/1)**

Map No. ; Road No.		①	R.1G	②		③	R.13
<b>River Name</b>		Sebanghiang		Sechamphone		Sebanghiang	
<b>Location &amp; EL</b>		16°17.00'		16°27.00'	125 m	16°05.9'	EL
		105°57.00'		105°12.1'		105°17.7'	
<b>Catchment Area</b>	km2	8,900		2,730		19,850	
<b>River Width</b>	m	Max 150	Min 100	Max 90	Min 60	Max 300	Min 250
<b>River Depth</b>	m	Max	Min 0.3	Max 9	Min 0.1	Max 140	Min 0.5
<b>Slope</b>		1/200 - 1/500		1/200 - 1/500		>1/1000	
<b>Velocity</b>	m/s	Max	Min 0.3	Max	Min 0.5	Max	Min 0.3
<b>Bed material</b>		Rock , Sand		Gravel , Sand		Rock , Sand	
<b>River Bank Condition</b>		Unstable		Unstable		Stable	
<b>Bridge Condition</b>		No		Steel girder		Steel Girder	
<b>Flood E,L</b>							
<b>Picture</b>							
							





**2) Sebangnuan & Huaykhamvan Basin (1/1)**

Map No. ; Road No.		①	R.13	②	R.14		
River Name		Sebangnuan		Huaykhamuan			
Location & EL		16°00.3'	EL	14°38.00'	EL		
		105°55.2'		105°55.2'			
Catchment Area	km2	1,400		1,100			
River Width	m	Max 140	Min 80	Max 70	Min 40		
River Depth	m	Max 10	Min 0.5	Max	Min		
Slope		1/200 - 1/500		>1/1000			
Velocity	m/s	Max	Min	Max	Min 0.5		
Bed material		Rock , Sand		Sand			
River Bank Condition		Unstable		Unstable			
Bridge Condition							
Flood E,L							
Picture							
							





3) Sedone River Basin (1/3)

Map No. ; Road No.		①	R.1G	②	R.15	③	R.15
River Name		Sedone			Xe Set		
Location & EL		15°47.3'	170 m	15°42.2'	100 m	15°42.4'	165 m
		106°17.7'		106°13.2'		106°08.9'	
Catchment Area	km2	2,800		100		700	
River Width	m	Max 130	Min 100	Max 46	Min 20	Max 55	Min 40
River Depth	m	Max 10	Min 0.5	Max 6	Min 0.5	Max 6	Min 1.0
Slope		1/200 - 1/500		1/200 - 1/500		1/200 - 1/500	
Velocity	m/s	Max	Min 0.5	Max	Min 0.5	Max	Min 0.3
Bed material		Gravel , Sand		Bolder , Rock		Sand	
River Bank Condition		Unstable		Stable		Unstable	
Bridge Condition		Broken		Baly Bridg		Baly Bridg	
Flood E,L		Old Pier fall down by flood in 1940					
Picture							
							

**Sedone River Basin (2/3)**





<b>Map No. ; Road No.</b>		④	R.15	⑤	R.15	⑥	R.15
<b>River Name</b>		Sedone			Sedone		
<b>Location &amp; EL</b>		15°41.7'	130 m	15°42.00'	130 m	15°40.4'	135 m
		106°02.00'		106°58.8'		105°56.4'	
<b>Catchment Area</b>	km2	4,500			90		30
<b>River Width</b>	m	Max 170	Min 130	Max 70	Min 50	Max 60	Min
<b>River Depth</b>	m	Max 12	Min 2.0	Max 10-13	Min 0.0	Max	Min
<b>Slope</b>		<b>1/200 - 1/500</b>			<b>1/200 - 1/500</b>		<b>1/200 - 1/500</b>
<b>Velocity</b>	m/s	Max	Min 0.3	Max	Min	Max	Min
<b>Bed material</b>		<b>Sand</b>			<b>Sand</b>		<b>Sand</b>
<b>River Bank Condition</b>		Unstable			Unstable		Unstable
<b>Bridge Condition</b>		Under Water Concrete Bridge			Baly Bridg		Baly Bridg
<b>Flood E,L</b>		+10m From Concrete Bridge Face					
<b>Picture</b>							
							

**Sedone Basin (3/3)**






<b>Map No. ; Road No.</b>		⑦	R.15	⑧	R.13		
<b>River Name</b>		Sedone D					
<b>Location &amp; EL</b>		15°39.1'	130 m	15°34.5'			
		105°55.2'		105°48.9'			
<b>Catchment Area</b>	km2						
<b>River Width</b>	m	Max 70	Min 60	Max	Min		
<b>River Depth</b>	m	Max 8	Min 0.0	Max	Min		
<b>Slope</b>		1/200 - 1/1000					
<b>Velocity</b>	m/s	Max	Min 0.3	Max	Min		
<b>Bed material</b>		Sand					
<b>River Bank Condition</b>		Unstable					
<b>Bridge Condition</b>		Baly Bridg					
<b>Flood E,L</b>							
<b>Picture</b>							
							




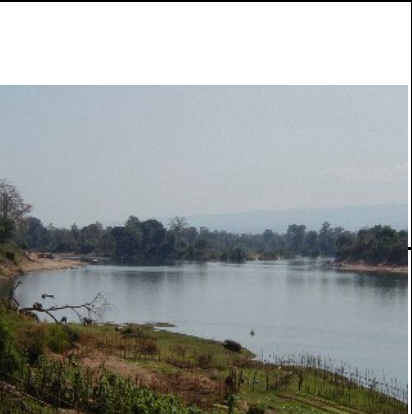

4) Sekhong River Basin (1/4)

Map No. ; Road No.		①	R.18	②	R.18	③	R.18
River Name		Sekhampho		Huay Lathy			
Location & EL		14°43.2'	145 m	14°42.7'	150 m	14°41.5'	93 m
		106°12.0'		106°12.6'		106°16.7'	
Catchment Area	km2	290		50		90	
River Width	m	Max 90	Min 50	Max 30	Min 15	Max 50	Min 30
River Depth	m	Max 6	Min 0.3	Max	Min 0.3	Max	Min 1.0
Slope		1/200 - 1/500		1/200 - 1/500		< 1/200	
Velocity	m/s	Max 4-5	Min 0.5	Max	Min 0.5	Max	Min 1.0
Bed material		Rock		Sand,Clay		Bolder	
River Bank Condition		Stable		Stable		Stable	
Bridge Condition		Nothing		Nothing		Nothing	
Flood E,L		Right bank	0.5 m H.W.L				
		Left bank	0 m H.W.L				
Picture							
							

**Sekhong River Basin (2/4)**

<b>Map No. ; Road No.</b>		④	R.18	⑤	R.18	⑥	R.18
<b>River Name</b>		Sepian		Huay doua			
<b>Location &amp; EL</b>		14°42.3'	78 m	14°40.4'	73 m	14°42.5'	80 m
		106°16.7'		106°35.6'		106°39.7'	
<b>Catchment Area</b>	km2	1,040		9		35	
<b>River Width</b>	m	Max 150	Min 100	Max 65	Min 10	Max 80	Min 20
<b>River Depth</b>	m	Max 10	Min 1.0	Max 13	Min 0.2	Max 13	Min 0.3
<b>Slope</b>		1/200 - 1/500		1/200 - 1/500		> 1/1000	
<b>Velocity</b>	m/s	Max	Min 0.5	Max	Min	Max	Min
<b>Bed material</b>		Rock		Sand , Clay		Clay	
<b>River Bank Condition</b>		Stable		Unstable		Stable	
<b>Bridge Condition</b>		No		Wood Bridge		Wood Bridge	
<b>Flood E,L</b>		Both bank 1996 +1.0 m ; 1968 +1.5m					
		2weak be Flooded					
<b>Picture</b>							
							

**Sekhong River Basin (3/4)**

<b>Map No. ; Road No.</b>		⑦		⑧		⑨	R.16A
<b>River Name</b>		Sekong		Sekong		Huay Chan	
<b>Location &amp; EL</b>		14°48.0'	87 m	14°48.3'	m	15°10.6'	1,150 m
		106°50.0'		106°50.5'		106°24.2'	
<b>Catchment Area</b>	km2	17,000		10,500		20	
<b>River Width</b>	m	Max 270	Min 210	Max 200	Min 140	Max 25	Min 20
<b>River Depth</b>	m	Max 19	Min 5.0	Max 15	Min 3.0	Max 2	Min 0.5
<b>Slope</b>		>1/1000		>1/1000		<1/200	
<b>Velocity</b>	m/s	Max	Min	Max	Min 1.0	Max	Min 1.0
<b>Bed material</b>		Sand , Clay		Sand,Clay		Rock , Bolder	
<b>River Bank Condition</b>		Unstable		Unstable		Stable	
<b>Bridge Condition</b>		Water level guaging station No.92		Water level guaging station No.73		Bayly Bridge	
<b>Flood E,L</b>							
<b>Picture</b>							

**Sekhong River Basin (4/4)**

<b>Map No. ; Road No.</b>		①	R.16A	①	R.16A	①	R.16A
<b>River Name</b>		Sekatam		Senamnoy		Sekong	
<b>Location &amp; EL</b>		15°07.2'	500 m	15°07.7'	400 m	15°20.5'	120 m
		106°37.7'		106°40.4'		106°44.00'	
<b>Catchment Area</b>	km2	240		1,400		4,450	
<b>River Width</b>	m	Max 50	Min 30	Max 60	Min 40	Max 250	Min 170
<b>River Depth</b>	m	Max 5	Min 1.0	Max 5	Min 1.0	Max 14	Min 3.0
<b>Slope</b>		<1/200		<1/200		1/200 - 1/500	
<b>Velocity</b>	m/s	Max	Min 1.0	Max	Min 1.5	Max	Min 0.5
<b>Bed material</b>		<b>Bolder</b>		<b>Bolder</b>		<b>Rock , Sand</b>	
<b>River Bank Condition</b>		Stable		Stable		Unstable	
<b>Bridge Condition</b>		Steel Girder Bridge		Steel Girder Bridge		Water level guaging station No.71	
<b>Flood E,L</b>							
<b>Picture</b>							
							

**ANNEX M-4**

**POPULATION DISTRIBUTION**

## ANNEX M-4 POPULATION DISTRIBUTION

## (1) Population by District 1995-2020 Central

Code	District	1995	2000	2005	2010	2015	2020
<b>13</b>	<b>Savannakhet</b>						
01	Khanthabouly	124,896	137,742	155,766	175,805	196,686	219,080
02	Outhoomphone	69,025	76,124	86,086	97,161	108,700	121,077
03	Atsaphangthong	48,743	53,756	60,791	68,611	76,760	85,500
04	Phine	40,994	45,210	51,126	57,704	64,557	71,908
05	Sepone	35,731	39,406	44,562	50,295	56,269	62,676
06	Nong	16,723	18,443	20,856	23,540	26,335	29,334
07	Thapangthong	24,011	26,481	29,946	33,798	37,812	42,118
08	Songkhone	81,864	90,284	102,098	115,233	128,919	143,598
09	Champhone	86,550	95,452	107,942	121,829	136,299	151,817
10	Xonbuly	34,602	38,161	43,154	48,706	54,491	60,695
11	Xaybuly	42,936	47,352	53,548	60,437	67,616	75,314
12	Vilabuly	24,560	27,086	30,630	34,571	38,677	43,081
13	Atsaphone	64,108	70,702	79,953	90,239	100,957	112,452
	<b>Total</b>	<b>694,743</b>	<b>766,197</b>	<b>866,459</b>	<b>977,930</b>	<b>1,094,080</b>	<b>1,218,649</b>
<b>14</b>	<b>Saravan</b>						
01	Salavan	66,096	75,400	85,267	96,237	107,667	119,925
02	Ta oi	19,799	22,586	25,542	28,828	32,251	35,924
03	Toomlarn	16,262	18,551	20,979	23,678	26,490	29,506
04	Lakhonepheng	30,480	34,771	39,321	44,379	49,650	55,303
05	Vapy	26,755	30,521	34,515	38,956	43,582	48,545
06	Khongxedone	46,252	52,763	59,667	67,344	75,342	83,920
07	Lao ngarm	42,938	48,982	55,392	62,518	69,944	77,907
08	Samuoi	7,649	8,726	9,868	11,137	12,460	13,878
	<b>Total</b>	<b>256,231</b>	<b>292,301</b>	<b>330,550</b>	<b>373,076</b>	<b>417,386</b>	<b>464,909</b>
<b>15</b>	<b>Sekong</b>						
01	Lamarm	18,237	20,803	23,525	26,552	29,705	33,087
02	Kaleum	13,746	15,680	17,732	20,013	22,390	24,939
03	Dakcheung	16,949	19,334	21,864	24,676	27,607	30,751
04	Thateng	15,238	17,382	19,657	22,185	24,820	27,646
	<b>Total</b>	<b>64,170</b>	<b>73,199</b>	<b>82,777</b>	<b>93,427</b>	<b>104,523</b>	<b>116,424</b>
<b>16</b>	<b>Champasack</b>						
01	Pakse	65,220	74,396	84,132	94,955	106,233	118,329
02	Sanasamboon	55,716	63,555	71,872	81,118	90,753	101,086
03	Bachiangchaleunsoo	34,354	39,188	44,316	50,017	55,957	62,329
04	Pakxong	44,518	50,782	57,427	64,815	72,513	80,769
05	Pathoomphone	43,142	49,212	55,652	62,811	70,272	78,273
06	Phonthong	73,704	84,074	95,076	107,307	120,052	133,721
07	Champasack	49,242	56,170	63,521	71,693	80,208	89,340
08	Sukhuma	38,051	43,405	49,085	55,399	61,979	69,036
09	Moonlapamok	32,228	36,762	41,573	46,922	52,494	58,471
10	Khong	65,212	74,387	84,121	94,944	106,220	118,314
	<b>Total</b>	<b>501,387</b>	<b>571,932</b>	<b>646,773</b>	<b>729,981</b>	<b>816,682</b>	<b>909,667</b>
<b>17</b>	<b>Attapeu</b>						
01	Xaysetha	25,691	29,275	33,106	37,365	41,803	46,562
02	Samakhixay	19,331	22,028	24,910	28,115	31,454	35,035
03	Sanaxay	19,627	22,365	25,292	28,545	31,936	35,572
04	Sanxay	12,252	13,961	15,788	17,819	19,936	22,205
05	Phouvong	10,328	11,769	13,309	15,021	16,805	18,718
	<b>Total</b>	<b>87,229</b>	<b>99,397</b>	<b>112,404</b>	<b>126,865</b>	<b>141,933</b>	<b>158,093</b>



(2) Population by District 1995-2020 High

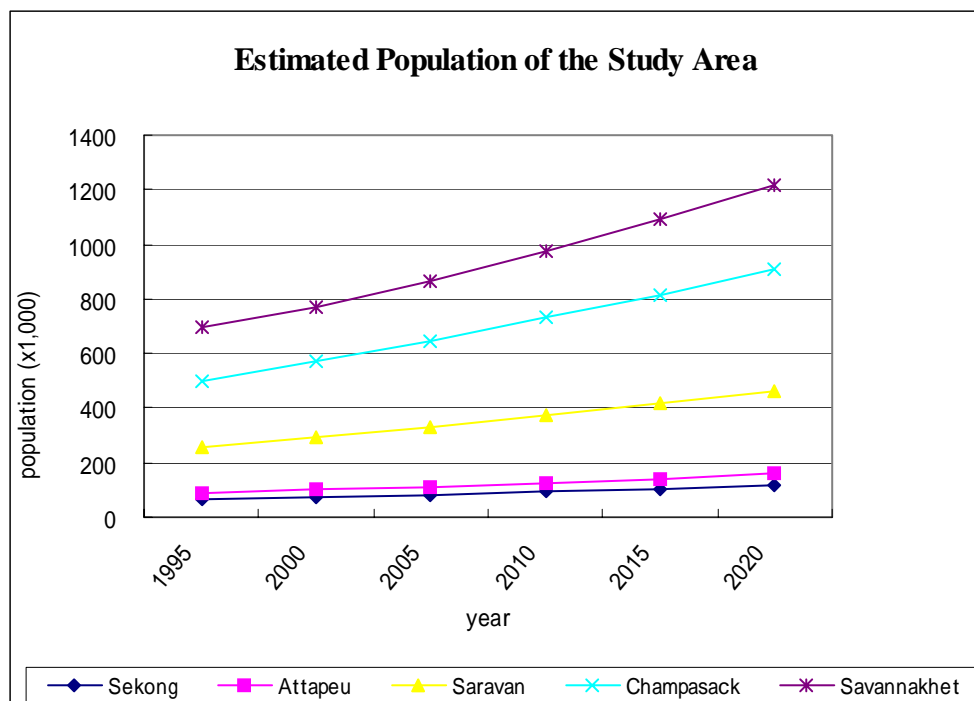
Code	District	1995	2000	2005	2010	2015	2020
<b>13</b>	<b>Savannakhet</b>						
01	Khanthabouly	124,896	137,742	156,527	177,615	200,564	224,275
02	Outhoomphone	69,025	76,124	86,506	98,161	110,843	123,948
03	Atsaphangthong	48,743	53,756	61,088	69,318	78,274	87,528
04	Phine	40,994	45,210	51,376	58,298	65,830	73,613
05	Sepone	35,731	39,406	44,780	50,813	57,378	64,162
06	Nong	16,723	18,443	20,958	23,782	26,855	30,029
07	Thapangthong	24,011	26,481	30,092	34,146	38,558	43,116
08	Songkhone	81,864	90,284	102,597	116,419	131,461	147,003
09	Champhone	86,550	95,452	108,470	123,083	138,986	155,417
10	Xonbuly	34,602	38,161	43,365	49,208	55,565	62,135
11	Xaybuly	42,936	47,352	53,810	61,059	68,949	77,100
12	Vilabuly	24,560	27,086	30,780	34,927	39,440	44,102
13	Atsaphone	64,108	70,702	80,344	91,168	102,947	115,118
	<b>Total</b>	<b>694,743</b>	<b>766,197</b>	<b>870,694</b>	<b>987,997</b>	<b>1,115,649</b>	<b>1,247,546</b>
<b>14</b>	<b>Saravan</b>						
01	Salavan	66,096	75,400	85,684	97,227	109,789	122,769
02	Ta oi	19,799	22,586	25,666	29,124	32,887	36,775
03	Toomlarn	16,262	18,551	21,081	23,921	27,012	30,206
04	Lakhonepheng	30,480	34,771	39,513	44,836	50,629	56,615
05	Vapy	26,755	30,521	34,684	39,357	44,442	49,696
06	Khongxedone	46,252	52,763	59,959	68,037	76,827	85,910
07	Lao ngarm	42,938	48,982	55,663	63,162	71,323	79,755
08	Samuoi	7,649	8,726	9,916	11,252	12,705	14,208
	<b>Total</b>	<b>256,231</b>	<b>292,301</b>	<b>332,166</b>	<b>376,916</b>	<b>425,615</b>	<b>475,933</b>
<b>15</b>	<b>Sekong</b>						
01	Lamarm	18,237	20,803	23,640	26,825	30,291	33,872
02	Kaleum	13,746	15,680	17,819	20,219	22,832	25,531
03	Dakcheung	16,949	19,334	21,971	24,930	28,152	31,480
04	Thateng	15,238	17,382	19,753	22,414	25,310	28,302
	<b>Total</b>	<b>64,170</b>	<b>73,199</b>	<b>83,182</b>	<b>94,388</b>	<b>106,584</b>	<b>119,184</b>
<b>16</b>	<b>Champasack</b>						
01	Pakse	65,220	74,396	84,543	95,933	108,328	121,135
02	Sanasamboon	55,716	63,555	72,223	81,953	92,542	103,483
03	Bachiangchaleunsoc	34,354	39,188	44,532	50,532	57,061	63,806
04	Pakxong	44,518	50,782	57,707	65,482	73,942	82,684
05	Pathoomphone	43,142	49,212	55,924	63,458	71,657	80,129
06	Phonthong	73,704	84,074	95,541	108,412	122,419	136,892
07	Champasack	49,242	56,170	63,831	72,431	81,789	91,458
08	Sukhuma	38,051	43,405	49,324	55,970	63,201	70,673
09	Moonlapamok	32,228	36,762	41,776	47,405	53,529	59,858
10	Khong	65,212	74,387	84,533	95,921	108,314	121,120
	<b>Total</b>	<b>501,387</b>	<b>571,932</b>	<b>649,935</b>	<b>737,496</b>	<b>832,782</b>	<b>931,237</b>
<b>17</b>	<b>Attapeu</b>						
01	Xaysetha	25,691	29,275	33,268	37,749	42,627	47,666
02	Samakhixay	19,331	22,028	25,032	28,404	32,074	35,866
03	Sanaxay	19,627	22,365	25,415	28,839	32,565	36,415
04	Sanxay	12,252	13,961	15,865	18,003	20,329	22,732
05	Phouvong	10,328	11,769	13,374	15,176	17,136	19,162
	<b>Total</b>	<b>87,229</b>	<b>99,397</b>	<b>112,954</b>	<b>128,171</b>	<b>144,731</b>	<b>161,842</b>

(3) Population by District 1995-2020 Low

Code	District	1995	2000	2005	2010	2015	2020
<b>13</b>	<b>Savannakhet</b>						
01	Khanthabouly	124,896	137,742	154,705	172,151	190,068	208,517
02	Outhoomphone	69,025	76,124	85,499	95,141	105,043	115,239
03	Atsaphangthong	48,743	53,756	60,377	67,185	74,178	81,378
04	Phine	40,994	45,210	50,778	56,504	62,385	68,440
05	Sepone	35,731	39,406	44,259	49,250	54,376	59,654
06	Nong	16,723	18,443	20,714	23,050	25,449	27,919
07	Thapangthong	24,011	26,481	29,742	33,096	36,540	40,087
08	Songkhone	81,864	90,284	101,402	112,837	124,582	136,674
09	Champhone	86,550	95,452	107,207	119,296	131,713	144,497
10	Xonbuly	34,602	38,161	42,860	47,694	52,658	57,769
11	Xaybuly	42,936	47,352	53,184	59,181	65,341	71,683
12	Vilabuly	24,560	27,086	30,422	33,852	37,376	41,003
13	Atsaphone	64,108	70,702	79,409	88,363	97,560	107,030
	<b>Total</b>	<b>694,743</b>	<b>766,197</b>	<b>860,557</b>	<b>957,600</b>	<b>1,057,268</b>	<b>1,159,890</b>
<b>14</b>	<b>Saravan</b>						
01	Salavan	66,096	75,400	84,686	94,236	104,044	114,143
02	Ta oi	19,799	22,586	25,368	28,228	31,166	34,191
03	Toomlarn	16,262	18,551	20,836	23,185	25,599	28,083
04	Lakhonepheng	30,480	34,771	39,053	43,457	47,980	52,637
05	Vapy	26,755	30,521	34,280	38,146	42,116	46,204
06	Khongxedone	46,252	52,763	59,261	65,944	72,807	79,874
07	Lao ngarm	42,938	48,982	55,015	61,219	67,590	74,151
08	Samuoi	7,649	8,726	9,800	10,906	12,041	13,209
	<b>Total</b>	<b>256,231</b>	<b>292,301</b>	<b>328,299</b>	<b>365,320</b>	<b>403,343</b>	<b>442,492</b>
<b>15</b>	<b>Sekong</b>						
01	Lamarm	18,237	20,803	23,365	26,000	28,706	31,492
02	Kaleum	13,746	15,680	17,611	19,597	21,637	23,737
03	Dakcheung	16,949	19,334	21,715	24,163	26,678	29,268
04	Thateng	15,238	17,382	19,523	21,724	23,985	26,313
	<b>Total</b>	<b>64,170</b>	<b>73,199</b>	<b>82,213</b>	<b>91,484</b>	<b>101,006</b>	<b>110,810</b>
<b>16</b>	<b>Champasack</b>						
01	Pakse	65,220	74,396	83,559	92,981	102,659	112,623
02	Sanasamboon	55,716	63,555	71,382	79,432	87,699	96,212
03	Bachiangchaleunsoc	34,354	39,188	44,014	48,977	54,075	59,323
04	Pakxong	44,518	50,782	57,036	63,467	70,073	76,875
05	Pathoomphone	43,142	49,212	55,273	61,506	67,907	74,499
06	Phonthong	73,704	84,074	94,428	105,077	116,013	127,274
07	Champasack	49,242	56,170	63,088	70,202	77,509	85,032
08	Sukhuma	38,051	43,405	48,750	54,248	59,894	65,707
09	Moonlapamok	32,228	36,762	41,290	45,946	50,728	55,652
10	Khong	65,212	74,387	83,548	92,970	102,646	112,609
	<b>Total</b>	<b>501,387</b>	<b>571,932</b>	<b>642,368</b>	<b>714,806</b>	<b>789,204</b>	<b>865,806</b>
<b>17</b>	<b>Attapeu</b>						
01	Xaysetha	25,691	29,275	32,880	36,588	40,396	44,317
02	Samakhixay	19,331	22,028	24,740	27,530	30,396	33,346
03	Sanaxay	19,627	22,365	25,119	27,952	30,861	33,857
04	Sanxay	12,252	13,961	15,681	17,449	19,265	21,135
05	Phouvong	10,328	11,769	13,218	14,709	16,240	17,816
	<b>Total</b>	<b>87,229</b>	<b>99,397</b>	<b>111,639</b>	<b>124,228</b>	<b>137,158</b>	<b>150,470</b>



(4) Population 1995-2020 Central

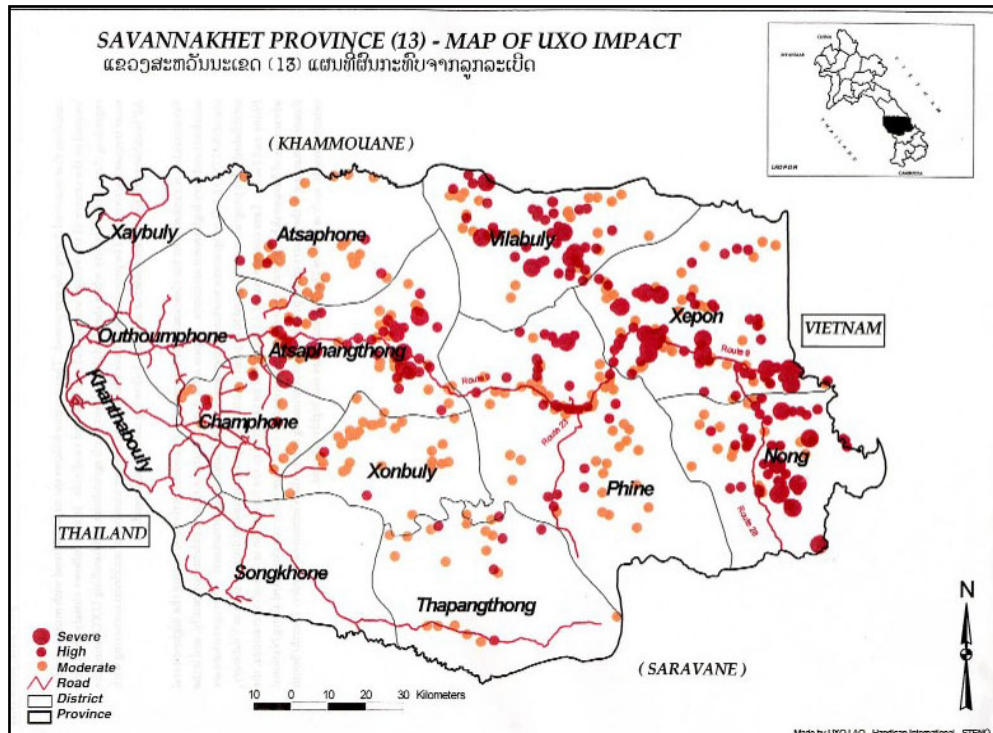


**ANNEX M-5**

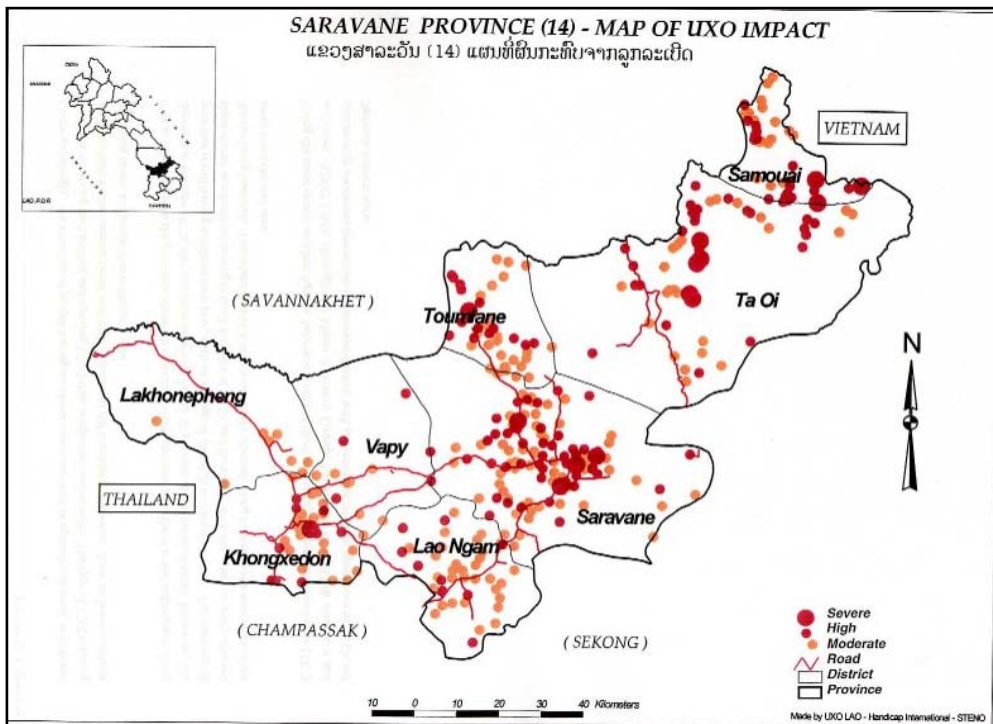
**UXO MAPS IN THE STUDY AREA**

ANNEX M-5 UXO MAPS IN THE STUDY AREA

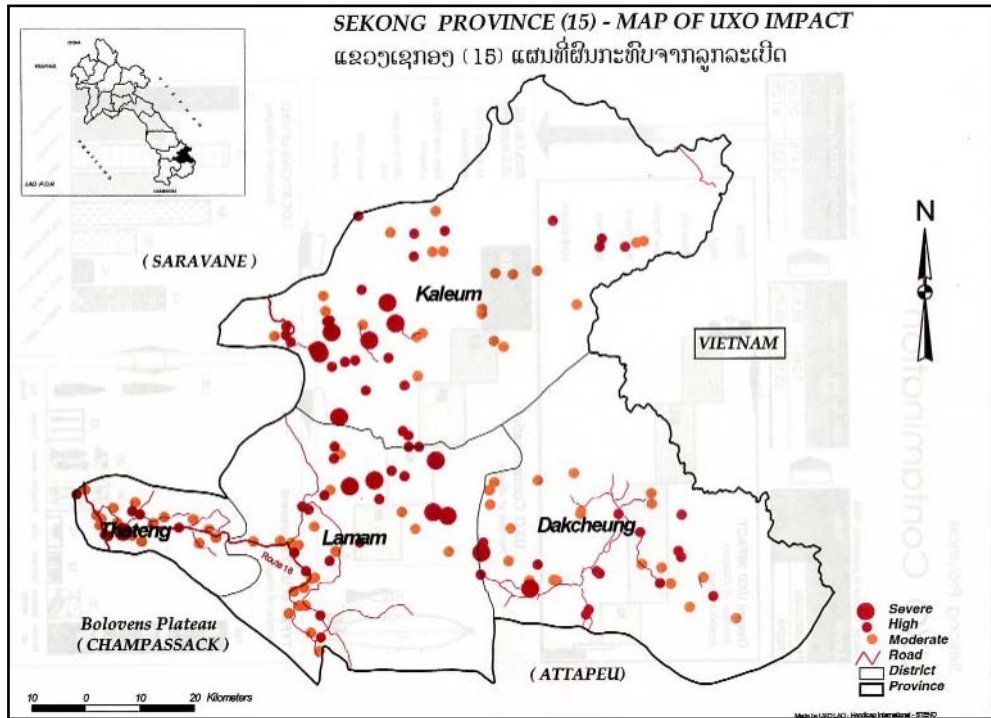
(1) Savannakhet Province



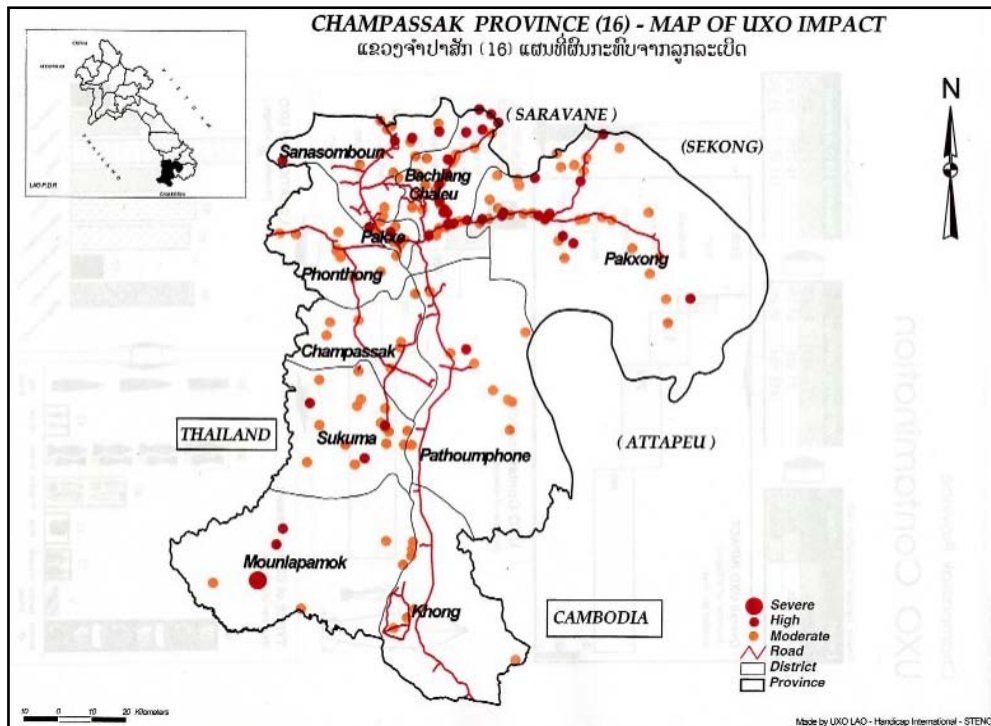
(2) Saravan Province



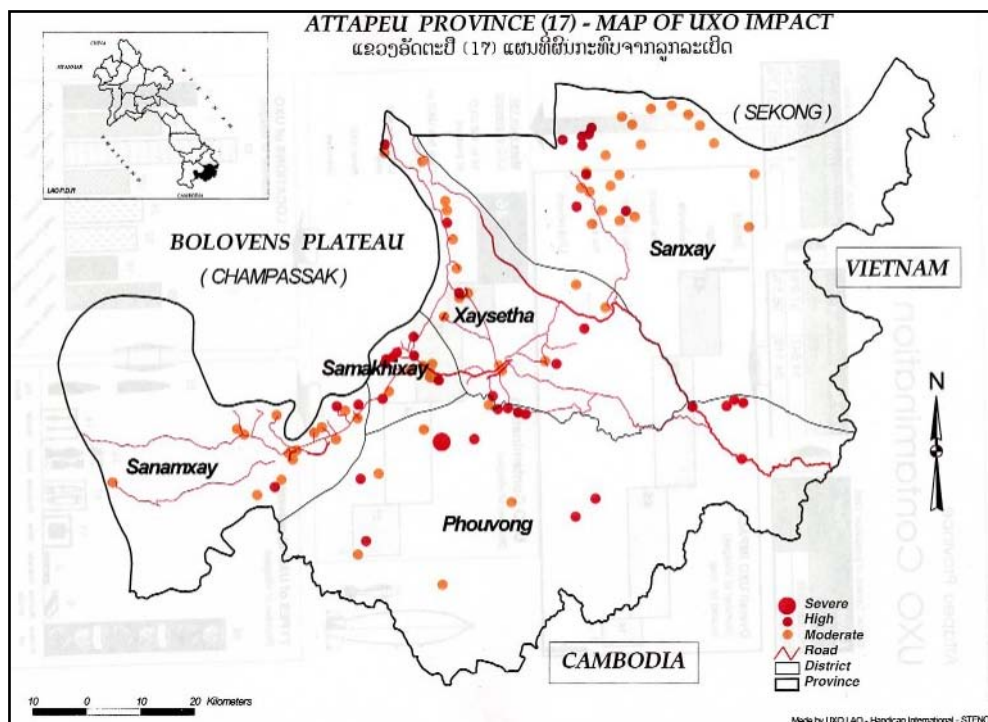
(3) Sekong Province



(4) Champassak Province



(5) Attapeu Province



Source: UXO LAO – Handicap International – STENO, 1997

**ANNEX M-6**

**COST BENEFIT ANALYSIS**

ANNEX M-6 COST BENEFIT ANALYSIS

(1) Route 1G

Route:	1G	Section:	Junct Rt.9 - Junct. Rt. 15	Diverted traffic km saved:	75	(in US\$'000)	
Distance:	130.0	Cost/km:	198.6	Generated %:	60		
Existing:	IRI 25	Improved:	IRI 3	Bridges:	18700	IRR:	0.4%

Year	Improvement Cost		Normal Traffic Vehicles/Day*				Diverted Traffic Vehicles/Day				Economic Benefits			Total Cost	Net Benefit	
	Construction	Maintenance	M/C	Car/Pick-Up	Medium Truck	Heavy Truck	Bus	M/C	Car/Pick-Up	Medium Truck	Heavy Truck	Bus	VOC			Time Savings
2001			84	26	2	2	12									
2002			89	27	2	2	13									
2003			95	29	2	2	13									
2004	8191		101	31	2	2	14									8191
2005	16383		108	32	3	3	15									16383
2006	16383		115	34	3	3	15									16383
2007		51	122	36	3	3	16	126	23	4	7	11	749	314	1063	51
2008		51	129	38	3	3	17	130	25	5	7	12	797	342	1140	51
2009		51	136	40	3	3	18	133	28	5	8	13	850	374	1223	51
2010		51	144	42	4	4	18	137	31	6	9	14	906	408	1314	51
2011		51	152	44	4	4	19	141	34	7	9	15	966	446	1412	51
2012		51	161	46	4	4	20	145	37	8	10	17	1031	487	1518	51
2013		51	170	49	4	4	21	149	41	9	11	18	1102	532	1634	51
2014		51	180	51	4	4	22	153	45	10	11	20	1178	581	1759	51
2015		51	190	54	5	5	24	157	50	12	12	21	1260	635	1896	51
2016		2392	201	57	5	5	25	162	55	14	13	23	1350	695	2044	2392
2017		51	213	60	5	5	26	166	60	16	14	25	1446	759	2206	51
2018		51	225	63	5	5	27	171	66	18	15	27	1551	830	2381	51
2019		51	237	67	6	6	29	176	73	21	16	29	1665	908	2573	51
2020		51	251	70	6	6	30	181	80	24	17	32	1788	994	2782	51
2021		51	269	74	6	6	31	194	85	25	18	33	1887	1086	2973	51
2022		51	287	79	7	7	32	207	90	26	19	35	1991	1188	3178	51
2023		51	307	83	7	7	34	222	95	28	20	36	2100	1298	3399	51
2024		51	329	88	7	7	35	237	101	29	21	37	2217	1420	3637	51
2025		51	352	94	8	8	36	254	107	31	22	39	2339	1553	3893	51
2026	-265	51	377	99	8	8	38	272	113	32	23	40	2469	1699	4169	-214

Note: \* for southernmost 33km only.

(2) Route 1H

Route:	1H	Section:	Junction Rt. 20 - Junction Rt.16.	Generated %:	20%	(in US\$'000)	
Distance:	22.5	Cost/km:	189	Bridges:	0	IRR:	10.5%
Existing:	IRI 15	Improved:	IRI 3				

Year	Improvement Cost		Normal Traffic Vehs/Day				Economic Benefits			Total Cost	Net Benefit	
	Construction	Maintenance	M/C	Car/Pick-Up	Medium Truck	Heavy Truck	Bus	VOC	Time Savings			Total Benefit
2001			82	47	10	29	21					
2002			93	53	11	31	23					
2003			106	59	12	34	25					
2004	1956		120	66	13	36	28				1956	-1956
2005	1956		136	74	14	39	31				1956	-1956
2006		9	154	82	15	42	34	249	22	271	9	262
2007		9	175	92	16	45	37	273	25	298	9	289
2008		9	189	101	18	48	39	295	28	323	9	314
2009		9	205	111	19	52	42	320	31	350	9	342
2010		9	222	122	21	55	45	346	34	380	9	371
2011		9	240	134	23	59	48	374	39	413	9	404
2012		9	260	148	25	64	51	405	43	448	9	439
2013		9	281	163	28	68	54	438	48	487	9	478
2014		9	305	179	30	73	58	475	54	528	9	520
2015		414	330	197	33	78	61	514	60	574	414	160
2016		9	357	216	37	84	65	557	67	624	9	615
2017		9	386	238	40	90	70	603	75	678	9	669
2018		9	418	261	44	97	74	654	84	738	9	729
2019		9	453	287	48	104	79	708	94	802	9	793
2020		9	490	316	53	111	84	768	105	873	9	864
2021		9	524	335	56	117	87	809	115	924	9	915
2022		9	561	355	58	122	91	853	125	978	9	969
2023		9	600	376	61	128	94	899	136	1035	9	1026
2024		9	642	399	64	135	98	947	149	1096	9	1087
2025	-1276	9	687	423	68	142	102	998	162	1161	-1267	2428

(3) Route 14A(i-1)

Route:	14A(i-1)	Section:	Junct Rt.16 - Champasack	Diverted traffic km saved:	35	(in US\$'000)	
Distance:	25.0	Cost/km:	236	Bridges:	1980	Generated %:	40
Existing:	None	Improved:	IRI 3	IRR:	30.7%		

Year	Improvement Cost		Normal Traffic Vehicles/Day					Diverted Traffic Vehicles/Day					Economic Benefits			Total Cost	Net Benefit	
	Construction	Maintenance	M/C	Car/Pick-Up	Medium Trck	Heavy Truck	Bus	M/C	Car/Pick-Up	Medium Trck	Heavy Truck	Bus	VOC	Time Savings	Total Benefit			
2001			0	0	0	0	0											
2002			0	0	0	0	0											
2003			0	0	0	0	0											
2004	1450		0	0	0	0	0										1450	-1450
2005	2900		0	0	0	0	0										2900	-2900
2006	2900		0	0	0	0	0										2900	-2900
2007		10	0	0	0	0	0	518	205	67	49	131	1986	244	2230	10	2220	
2008		10	0	0	0	0	0	552	221	72	52	138	2117	268	2385	10	2375	
2009		10	0	0	0	0	0	589	238	77	56	145	2257	294	2550	10	2540	
2010		10	0	0	0	0	0	628	257	82	60	152	2406	322	2728	10	2718	
2011		10	0	0	0	0	0	670	276	87	64	160	2565	353	2918	10	2908	
2012		10	0	0	0	0	0	714	298	93	68	169	2735	387	3122	10	3112	
2013		10	0	0	0	0	0	762	321	100	73	177	2916	425	3341	10	3331	
2014		10	0	0	0	0	0	812	346	107	78	187	3110	466	3576	10	3566	
2015		10	0	0	0	0	0	866	373	114	84	196	3317	511	3828	10	3818	
2016		460	0	0	0	0	0	923	402	122	90	207	3538	561	4099	460	3639	
2017		10	0	0	0	0	0	985	433	130	96	217	3774	615	4389	10	4379	
2018		10	0	0	0	0	0	1050	467	139	102	229	4026	675	4701	10	4691	
2019		10	0	0	0	0	0	1120	503	149	109	241	4295	741	5036	10	5027	
2020		10	0	0	0	0	0	1194	542	159	117	253	4583	813	5397	10	5387	
2021		10	0	0	0	0	0	1278	575	167	123	263	4829	885	5714	10	5705	
2022		10	0	0	0	0	0	1367	609	175	129	274	5088	964	6052	10	6042	
2023		10	0	0	0	0	0	1463	646	184	135	285	5362	1049	6412	10	6402	
2024		10	0	0	0	0	0	1565	684	193	142	296	5652	1143	6794	10	6784	
2025		10	0	0	0	0	0	1675	725	203	149	308	5957	1244	7201	10	7192	
2026	-978	10	0	0	0	0	0	1792	769	213	157	320	6279	1356	7635	-968	8603	

(4) Route 14A(i-2)

Route:	14A(i-2)	Section:	Champasack-Route 14C1	Generated %:	20	(in US\$'000)	
Distance:	29.0	Cost/km:	189	Bridges:	1744	IRR:	10.0%
Existing:	IRI 15	Improved:	IRI 3				

Year	Improvement Cost		Normal Traffic Vehicles/Day					Economic Benefits			Total Cost	Net Benefit	
	Construction	Maintenance	M/C	Car/Pick-Up	Medium Trck	Heavy Truck	Bus	VOC	Time Savings	Total Benefit			
2001			106	57	21	18	40						
2002			113	59	23	19	42						
2003			121	61	24	19	44						
2004	1329		129	63	26	20	47					1329	-1329
2005	2659		137	65	28	21	49					2659	-2659
2006	2659		146	67	31	21	52					2659	-2659
2007		11	156	69	33	22	55	450	57	506	11	495	
2008		11	168	74	35	24	58	481	63	544	11	532	
2009		11	181	80	38	25	62	515	69	584	11	573	
2010		11	194	87	40	27	65	552	76	628	11	617	
2011		11	209	93	43	29	69	591	84	675	11	664	
2012		11	225	101	46	32	73	633	93	726	11	714	
2013		11	242	109	49	34	78	678	102	780	11	769	
2014		11	261	117	52	36	82	726	113	839	11	828	
2015		11	281	127	56	39	87	778	125	903	11	891	
2016		534	302	137	59	42	92	833	138	971	534	438	
2017		11	325	147	63	45	98	893	152	1045	11	1034	
2018		11	350	159	68	49	103	956	168	1125	11	1113	
2019		11	376	171	72	52	110	1024	186	1210	11	1199	
2020		11	405	185	77	56	116	1098	205	1303	11	1292	
2021		11	433	196	81	59	121	1155	224	1379	11	1368	
2022		11	464	208	85	62	125	1216	243	1460	11	1448	
2023		11	496	220	89	65	130	1280	265	1546	11	1534	
2024		11	531	234	94	68	136	1348	289	1637	11	1625	
2025		11	568	248	98	71	141	1419	314	1734	11	1723	
2026	-947	11	608	262	103	75	147	1495	343	1837	-935	2773	



(5) Route 14A(i)

Route:	14A(i)	Section:	Junct Rt.16 - Champasack	Diverted traffic km saved:	35
Distance:	54.0	Cost/km:	210.7	Generated %:	40
Existing:	IRI 15*	Improved:	IRI 3	IRR:	23.2%

(in US\$'000)

Year	Improvement Cost		Normal Traffic Vehicles/Day*				Diverted Traffic Vehicles/Day+				Economic Benefits			Total Cost	Net Benefit		
	Construction	Maintenance	M/C	Car/Pick-Up	Medium Trck	Heavy Truck	Bus	M/C	Car/Pick-Up	Medium Trck	Heavy Truck	Bus	VOC			Time Savings	Total Benefit
2001			106	57	21	18	40										
2002			113	59	23	19	42										
2003			121	61	24	19	44										
2004	2779		129	63	26	20	47								2779	-2779	
2005			137	65	28	21	49								5557	-5557	
2006		5557	146	67	31	21	52								5557	-5557	
2007		21	156	69	33	22	55	518	205	67	49	131	2526	359	2885	21	2864
2008		21	168	74	35	24	58	552	221	72	52	138	2695	395	3089	21	3068
2009		21	181	80	38	25	62	589	238	77	56	145	2875	434	3309	21	3288
2010		21	194	87	40	27	65	628	257	82	60	152	3068	477	3545	21	3523
2011		21	209	93	43	29	69	670	276	87	64	160	3274	524	3798	21	3777
2012		21	225	101	46	32	73	714	298	93	68	169	3494	576	4070	21	4049
2013		21	242	109	49	34	78	762	321	100	73	177	3730	633	4363	21	4341
2014		21	261	117	52	36	82	812	346	107	78	187	3981	696	4677	21	4656
2015		21	281	127	56	39	87	866	373	114	84	196	4250	765	5015	21	4994
2016		994	302	137	59	42	92	923	402	122	90	207	4538	841	5379	994	4385
2017		21	325	147	63	45	98	985	433	130	96	217	4845	925	5770	21	5749
2018		21	350	159	68	49	103	1050	467	139	102	229	5173	1017	6191	21	6169
2019		21	376	171	72	52	110	1120	503	149	109	241	5525	1119	6643	21	6622
2020		21	405	185	77	56	116	1194	542	159	117	253	5900	1231	7131	21	7110
2021		21	433	196	81	59	121	1278	575	167	123	263	6215	1340	7555	21	7534
2022		21	464	208	85	62	125	1367	609	175	129	274	6548	1458	8006	21	7985
2023		21	496	220	89	65	130	1463	646	184	135	285	6899	1588	8487	21	8465
2024		21	531	234	94	68	136	1565	684	193	142	296	7269	1729	8998	21	8977
2025		21	568	248	98	71	141	1675	725	203	149	308	7660	1883	9544	21	9522
2026		-1924	608	262	103	75	147	1792	769	213	157	320	8073	2052	10125	-1902	12027

Note: \* for southern 29km - generated traffic 20%  
+ for northern 25km

(6) Route 14A1

Route:	14A1	Section:	Junct Rt.14B - Junct Rt.14A	Generated %:	20
Distance:	32.0	Cost/km:	189	Bridges:	1639
Existing:	IRI 15	Improved:	IRI 3	IRR:	15.6%

(in US\$'000)

Year	Improvement Cost		Normal Traffic Vehicles/Day				Economic Benefits			Total Cost	Net Benefit	
	Construction	Maintenance	M/C	Car/Pick-Up	Medium Trck	Heavy Truck	Bus	VOC	Time Savings			Total Benefit
2001			167	88	34	26	66					
2002			196	98	38	29	73					
2003			230	110	42	32	80					
2004	1414		270	123	46	35	89				1414	-1414
2005	2829		316	138	51	39	98				2829	-2829
2006	2829		371	155	57	43	108				2829	-2829
2007		12	435	173	63	47	119	751	95	846	12	833
2008		12	467	186	68	51	127	807	105	912	12	899
2009		12	502	200	73	55	135	867	116	983	12	971
2010		12	539	216	79	59	144	932	128	1061	12	1048
2011		12	579	232	86	64	153	1002	142	1144	12	1132
2012		12	622	250	92	70	163	1077	157	1234	12	1222
2013		12	667	269	100	75	174	1157	174	1331	12	1319
2014		12	717	289	108	81	185	1244	193	1437	12	1424
2015		12	770	312	116	88	197	1337	213	1550	12	1538
2016		589	827	335	125	95	210	1438	236	1673	589	1085
2017		12	888	361	135	103	223	1545	261	1806	12	1794
2018		12	954	388	146	111	238	1661	289	1950	12	1938
2019		12	1024	418	157	120	254	1786	320	2106	12	2093
2020		12	1100	450	170	130	270	1920	354	2274	12	2262
2021		12	1177	477	179	137	281	2021	385	2406	12	2393
2022		12	1259	506	187	143	292	2127	419	2546	12	2533
2023		12	1348	536	197	150	304	2238	456	2694	12	2682
2024		12	1442	568	207	158	316	2356	496	2852	12	2840
2025		12	1543	602	217	166	328	2480	540	3020	12	3008
2026		-1159	1651	638	228	174	342	2611	588	3199	-1146	4345

(7) Route 15

Route:	15	Section:	Junct Rt.13S - Saravane				
Distance:	73.0	Cost/km:	202.1	Bridges:	7008	Generated %:	30
Existing:	IRI 15	Improved:	IRI 3	IRR:	7.8%		

(in US\$'000)

Year	Improvement Cost		Normal Traffic Vehicles/Day					Economic Benefits			Total Cost	Net Benefit
	Construction	Maintenance	M/C	Car/Pick-Up	Medium Trck	Heavy Truck	Bus	VOC	Time Savings	Total Benefit		
2001			151	51	15	6	34					
2002			166	61	17	7	37					
2003			183	74	19	8	41					
2004	4004		202	89	22	10	45				4004	-4004
2005	8008		222	107	24	12	49				8008	-8008
2006	8008		244	130	27	14	54				8008	-8008
2007		58	269	156	31	16	59	1150	146	1297	58	1239
2008		58	293	166	33	17	62	1228	161	1389	58	1331
2009		58	319	178	36	19	64	1312	176	1488	58	1430
2010		58	348	189	39	21	67	1401	194	1595	58	1537
2011		58	379	202	41	23	70	1497	213	1710	58	1652
2012		58	412	216	45	25	73	1600	234	1833	58	1775
2013		58	449	230	48	27	76	1710	257	1967	58	1909
2014		58	489	245	52	30	79	1828	282	2110	58	2052
2015		58	533	262	56	32	83	1955	310	2265	58	2207
2016		2705	580	279	60	35	86	2090	342	2432	2705	-273
2017		58	632	298	64	38	90	2236	376	2612	58	2554
2018		58	689	318	69	42	94	2393	414	2807	58	2749
2019		58	750	339	74	46	98	2561	455	3016	58	2958
2020		58	817	362	80	50	102	2741	502	3243	58	3185
2021		58	874	384	84	53	106	2892	548	3440	58	3382
2022		58	935	407	88	55	110	3052	599	3650	58	3593
2023		58	1001	431	93	58	115	3220	654	3874	58	3816
2024		58	1071	457	97	61	119	3398	715	4113	58	4055
2025		58	1146	484	102	64	124	3586	781	4367	58	4310
2026	-1623	58	1226	514	107	67	129	3785	854	4639	-1565	6204

(8) Route 16A

Route:	16A	Section:	Junction Rt.16 - Junction Rt.11		Diverted traffic km saved:	42	
Distance:	71.0	Cost/km:	188	Bridges:	1585	Generated %:	30
Existing:	IRI 20	Improved:	IRI 3	IRR:	15.1%		

(in US\$'000)

Year	Improvement Cost		Normal Traffic Vehicles/Day					Diverted Traffic Vehicles/Day				Economic Benefits			Total Cost	Net Benefit	
	Construction	Maintenance	M/C	Car/Pick-Up	Medium Trck	Heavy Truck	Bus	M/C	Car/Pick-Up	Medium Trck	Heavy Truck	Bus	VOC	Time Savings			Total Benefit
2001			84	55	8	10	14										
2002			94	60	9	11	16										
2003			104	66	10	12	19										
2004	2744		116	72	11	13	22									2744	
2005	5488		129	78	13	14	25									5488	
2006	5488		144	85	14	15	29									5488	
2007		28	160	93	16	16	34	20	70	24	28	48	1160	180	1340	28	1312
2008		28	172	103	18	17	37	22	78	27	30	53	1274	204	1477	28	1449
2009		28	186	114	20	19	41	23	86	30	32	58	1398	232	1630	28	1602
2010		28	200	127	22	20	45	25	95	33	35	64	1535	263	1798	28	1770
2011		28	215	140	25	22	50	27	106	37	38	70	1686	299	1985	28	1957
2012		28	232	156	27	23	55	29	117	41	41	77	1852	339	2191	28	2163
2013		28	250	173	30	25	60	31	130	46	44	85	2034	385	2419	28	2391
2014		28	269	191	34	27	66	34	144	51	47	93	2235	438	2673	28	2645
2015		28	290	212	38	29	72	36	160	56	51	102	2455	498	2953	28	2925
2016		1306	313	235	42	31	80	39	177	63	55	112	2698	565	3264	1306	1957
2017		28	337	261	46	34	87	42	196	70	59	123	2966	643	3608	28	3580
2018		28	363	289	52	36	96	45	217	78	63	136	3260	730	3991	28	3963
2019		28	391	320	58	39	106	49	241	86	68	149	3585	830	4415	28	4387
2020		28	421	355	64	42	116	53	267	96	74	164	3942	944	4885	28	4857
2021		28	450	376	67	44	121	56	283	101	77	170	4147	1025	5172	28	5144
2022		28	482	399	71	46	125	60	300	106	81	177	4363	1115	5477	28	5449
2023		28	516	423	74	49	130	64	318	111	85	184	4591	1212	5802	28	5774
2024		28	552	448	78	51	136	69	337	117	89	192	4830	1317	6148	28	6120
2025		28	590	475	82	54	141	74	358	123	94	199	5083	1432	6516	28	6488
2026	-3364	28	632	504	86	56	147	79	379	129	98	207	5350	1558	6907	-3336	10243

(9) Route 18A

Route:	18A	Section:	Junct Rt.13S - Attapeu	Diverted traffic km saved:	48.5
Distance:	112.5	Cost/km:	193.5	Generated %:	30
Existing:	IRI 22	Improved:	IRI 3	Bridges:	17231
				IRR:	4.9%

(in US\$'000)

Year	Improvement Cost		Normal Traffic Vehicles/Day *					Diverted Traffic Vehicles/Day					Economic Benefits			Total Cost	Net Benefit	
	Construction	Maintenance	M/C	Car/Pick-Up	Medium Trck	Heavy Truck	Bus	M/C	Car/Pick-Up	Medium Trck	Heavy Truck	Bus	VOC	Time Savings	Total Benefit			
2001			104	34	9	4	20											
2002			114	31	10	4	21											
2003			125	29	10	5	22											
2004	7176		136	27	11	6	23										7176	-7176
2005	14352		149	25	12	6	24										14352	-14352
2006	14352		164	23	12	7	25										14352	-14352
2007		44	179	21	13	8	26	153	153	38	32	71	1647	306	1953	44	1909	
2008		44	189	23	13	8	27	163	162	40	33	73	1722	331	2053	44	2009	
2009		44	199	25	14	9	28	174	172	42	34	74	1801	357	2158	44	2114	
2010		44	210	27	14	9	30	186	182	44	36	76	1884	386	2270	44	2226	
2011		44	221	29	15	10	31	198	193	46	37	77	1971	418	2389	44	2345	
2012		44	233	31	15	10	32	211	205	49	39	79	2063	452	2515	44	2471	
2013		44	246	34	16	11	34	225	217	51	40	81	2160	489	2649	44	2604	
2014		44	260	37	16	12	35	240	230	54	42	83	2262	529	2791	44	2746	
2015		44	274	40	17	12	37	256	244	56	43	84	2369	573	2942	44	2897	
2016		2070	289	43	18	13	39	273	259	59	45	86	2482	620	3102	2070	1032	
2017		44	304	46	18	14	40	291	274	62	46	88	2601	672	3272	44	3228	
2018		44	321	50	19	14	42	310	291	65	48	90	2726	728	3454	44	3409	
2019		44	339	54	19	15	44	331	308	69	50	92	2858	789	3647	44	3603	
2020		44	357	59	20	16	46	353	327	72	52	94	2997	855	3852	44	3808	
2021		44	382	63	21	17	48	378	347	76	55	98	3159	933	4092	44	4048	
2022		44	409	66	22	18	50	404	367	79	57	102	3330	1018	4348	44	4304	
2023		44	437	70	23	19	52	432	389	83	60	106	3511	1111	4622	44	4577	
2024		44	468	74	24	19	54	463	413	88	63	110	3702	1212	4914	44	4870	
2025		44	501	79	26	20	56	495	438	92	66	114	3903	1323	5226	44	5182	
2026	362	44	536	84	27	21	58	530	464	96	70	119	4116	1444	5560	406	5154	

Note: on 15km section immediately west of Attapeu only.

**ANNEX M-7**

**ECONOMIC ANALYSIS OF PAKSE XE DON  
BRIDGE**

## ANNEX M-7 ECONOMIC ANALYSIS OF PAKSE XE DON BRIDGE

### M7.1 Introduction

Although this project is out of our study scope, it was undertaken in response to a strong request from the Laos side.

### M7.2 Economic Analysis

Pakse is a prosperous town, the focus of recent major infrastructure investment comprising the Mekong Bridge, improvement of Route 16 to the Thai Border and of Route 13S to the north and south of the town. Vehicle ownership levels are on a par with those of Vientiane and far higher than in any other part of the study area. The town itself is being transformed under the Secondary Towns Improvement Project, which will be completed in May 2003.

The 210m single lane Xe-Don bridge connects Pakse with urban areas to the west and north. It has an 18-tonne weight limit. The bridge was formerly part of National Road 13S, but with the construction of Pakse bypass, the bridge route is now designated as a provincial road. An illustrative economic analysis of bridge capacity, for reference only, has been made, as the bridge is not part of the national network.

The bridge is a bottleneck at peak hours, impeding local traffic flow in the Pakse area. Through traffic is adequately provided for by the bypass route, which has a 2-lane bridge over the river and at 3.4km is only 300m longer than the route via the bridge. Conditions on both routes in the evening peak were observed on Monday 18<sup>th</sup> February 2002 and in the morning peak on Friday 22<sup>nd</sup> February. Peak hour travel times end-to-end by the bypass and the bridge routes were 4'25" and 7'10" respectively (average of four runs), with the bypass route 2'45" shorter. Bridge traffic can thus be assumed to be predominantly local.

The bridge is controlled by manually-operated traffic signals, with staff at the western side advising the controller at the Pakse end when traffic has cleared the bridge. The distance between the queuing points at each side is about 350m. Queues are cleared from both sides each cycle. The morning peak was observed to be more intensive than the evening peak, with 12 cycles/hour compared to the evening peak's 15/cycles. The dominant flow in the morning peak is eastbound towards Pakse.

Average waiting time for the first vehicle in the queue in the evening peak was observed to be 2'40" and in the morning peak 3'40". Average waiting times for all vehicles are about half these times, as traffic signals are changed immediately on clearance of the queue. At peak hours few vehicles cross unimpeded. An additional delay compared to a 2-lane bridge is imposed by bunching of traffic over the bridge, say 0'10". Average delay in the morning peak is then 2'00" and in the evening peak 1'30". Passenger volume (combined directions) is estimated at 2500 per hour in the morning peak and at 1500 per hour in the evening peak. Delays would be largely eliminated by a replacement 2-lane bridge, or by an additional 1-lane bridge alongside the existing bridge.

The expenditure on increasing capacity justified on the basis of travel time savings is evaluated in Table M7.1. An equity value of time is generally used in feasibility studies, with the same time benefit applied to all of the study area – each person's time being considered to be of equal value. However, the economic cost of delays to local traffic in Pakse may in fact be higher than in the rest of the study area, considering relative levels of GDP. Disaggregated GDP data by district is not available, but GDP/capita in Pakse is estimated by the Study team at US\$1600, compared with the study area average of US\$410 (figures for 2000).

**Table M7.1 Pakse Xe-Don Bridge Time Benefits (in US\$'000)**

Year	TravelTime Benefit		Bridge Expenditure *	
	Pakse	Equity	Pakse	Equity
2002	58.2	34.0	1174	686
2003	70.9	41.4	1430	835
2004	86.4	50.5	1742	1017
2005	105.2	61.5	2122	1239
2006	128.2	74.9	2585	1510
2007	156.2	91.2	3149	1839
2008	190.3	111.1	3836	2241
2009	231.8	135.4	4673	2730
2010	282.4	164.9	5693	3325
2011	344.0	200.9		
2012	419.0	244.7		

Note: \* financial.

**Assumptions for 2002:**

Pakse GDP/capita = US\$1700, equity GDP/capita = US\$439  
 Pakse value of time = US\$1700/0.51/1920\*.3= US\$0.52/hour, equity US\$0.26  
 Increase in real value of time from 2002 = 3.5 per cent per annum  
 Traffic growth rate = 7 per cent p.a.  
 Increase in delay per trip =10 per cent p.a.  
 Delay: morning peak 2'00" minutes, evening peak 1'30" minutes.  
 Morning/evening peaks: 2 hours each.  
 Benefits to off-peak users = 50 per cent of total benefit in 4 peak hours.  
 Persons crossing per peak hour: morning 2500, evening 1500.  
 Financial cost of bridge = 12.5/0.92 times economic benefit in opening year.

The proportion of work-related trips by local bridge users is not known. It is assumed to be 30 per cent. A Pakse-resident's value of time (for 2002) would be US\$0.52 per hour, double the equity value of US\$0.26. Both would rise by 3.5 per cent annually, in line with the forecast growth in GDP per capita. The results on the basis of both time valuations are given in Table AN6.1. The Pakse-time analysis assumes that 70 per cent of bridge passengers are Pakse-residents, having the higher time value.

Traffic growth on the bridge route is assumed to be at a rate of 7 per cent a year. The average delay will increase rapidly when capacity is reached at peak periods and it is no longer possible to clear the queue each cycle. An increase in average delay of 10 per cent a year is expected, with a growing number of peak users having to wait one complete cycle. Some local trips will in fact divert to the bypass as the delay increases. The diversion cannot be estimated without an OD survey of bridge users. Diversion is however not assumed to significantly affect the results

of the analysis.

The investment in bridge capacity justified on the basis of time savings alone (there would in addition be savings in vehicle operating costs) can be estimated as a multiple of opening year benefits. An 8 per cent benefit for road improvement projects in the study area is equivalent to an EIRR of 12 per cent. This gives an economic construction cost of 12.5 times benefits. The multiple of benefits for financial cost, assuming ICB, is 13.6.

The financial expenditure (at 2002 price levels) to increase bridge capacity justified on the basis of time benefits is summarized in Table M7.2.

**Table M7.2 Xe-Don Bridge Improvement**

<b><u>Opening Year</u></b>	<b><u>Equity Time Value</u></b>	<b><u>Pakse Time Value</u></b>
	(in US\$ mill.)	
2002	0.69	1.17
2005	1.24	2.12
2010	3.33	5.69

The Study team’s estimated financial cost for the bridge is US\$4.71 million. The earliest economic opening date is end-2009 with the Pakse value of time and end-2012 with an equity value of time. These results are illustrative and it is recommended that a detailed study be undertaken to assess the timing. Pakse is undergoing rapid development and this could be earlier than indicated above.



**ANNEX M-8**

**MAINTENANCE & TRANSPORT**

**STANDARDS FOR CANDIDATE ROADS**

## ANNEX M-8 MAINTENANCE AND TRANSPORT STANDARDS FOR CANDIDATE ROADS

### (1) Evaluation Ranking for Defects

Ranking	Rank A	Rank B	Rank C	Rank D
Carriageway And Shoulder	(1) Minor defects (2) Vehicles can pass at normal Design speed for paved roads or at a speed of more than 60 km/hr for unpaved roads. (3) No immediate action but need to continue monitoring. (4) Removing obstructions	(1) Minor defects (2) Vehicles can pass at normal design speed for paved roads or at a speed of 60 to 40 km/hr for unpaved roads. (3) Normal routine maintenance required such as: - Local sealing, Crack sealing, Spot sealing - Grading - Patching - Manual reshaping - Sanding	(1) Major defects (2) Vehicles can pass at a speed of 40 to 20 km/hr, but running conditions are not smooth. (3) Routine or periodic maintenance required such as: - Heavy grading (recovery of material + compaction) - Manual heavy reshaping - Regravelling - Resealing	(1) Major defects (2) Vehicles cannot pass at a speed o more than 20 km/hr. (3) Routine or periodic maintenance required such as: - Heavy reshaping - Regravelling - Overlay, Surface dressing (4) Reconstruction including rehabilitation (5) Emergency maintenance required
Drain (Ditches)	(1) Minor defects (2) No immediate action but needs to continue monitoring.	(1) Minor defects such as: - Local erosion - 1/2 silted drainage (2) Collapse but functions maintained (3) Normal routine maintenance required such as: - Cleaning - Local reconstruction	(1) Major defects such as: - 3/4 silted drainage - Ditch lining is damaged - Ponding (2) Collapse but functions maintained (3) Routine or periodic maintenance required such as: - Cleaning - Repair lining - Reshape	(1) Major defects such as: - Erosion - Fully silted drainage (2) Collapse and functions lost (3) Routine or periodic maintenance required such as: - Cleaning (4) Reconstruction including rehabilitation (5) Emergency maintenance required

(Cont'd)

Ranking	Rank A	Rank B	Rank C	Rank D
Culvert	(1) Minor defects - Spot cracking (2) No immediate action but needs to continue monitoring.	(1) Minor defects such as: - Cracking - Local collapse - 1/2 silted culvert (2) Collapse but functions maintained (3) Normal routine maintenance required such as: - Sealing - Cleaning - Repair for local collapse	(1) Major defects such as: - Collapse - 3/4 silted culvert (2) Collapse but functions maintained (3) Routine or periodic maintenance required such as: - Cleaning - Local reconstruction	(1) Major defects such as: - Collapse - Fully silted culvert (2) Collapse and functions lost (3) Routine or periodic maintenance required such as: - Cleaning (4) Reconstruction including rehabilitation (5) Emergency maintenance required
Others	(1) Minor defects - Spot crack (2) No immediate action but needs to continue monitoring.	(1) Minor defects such as: - Local erosion - Dirty of road furniture - Crack (2) Collapse but functions maintained (3) Normal routine maintenance required such as: - Filling - Cleaning - Crack sealing	(1) Major defects such as: - Collapse - Damaged road furniture (2) Collapse but functions maintained (3) Routine or periodic maintenance required such as: - Local reconstruction - Repair of road furniture	(1) Major defects such as: - Collapse - Settlement - Earth slip/landslide - Missing road furniture (2) Collapse and functions lost (3) Routine or periodic maintenance required such as: - Replacement of road furniture (4) Reconstruction including rehabilitation (5) Emergency maintenance required

(2) **Summary of Bridge Standards applied to Previous Projects in Laos**

<b>Project name</b>	IDA	ADB-6	ADB-7
<b>Project Road</b>	-	Rt 16 & Rt 11	Rt 13S
<b>Section</b>	-	Pakson-Attapeu	Pakse-Cambodian border
<b>1. Bridge Width</b>	-	8.0(10.0)m	7.0m(9.0m)
<b>Carriageway</b>	7.0m	7.0m	7.0m
<b>Footpath</b>	0.5m (each side in near village)	1.0m (More than 100m)	1.0m (in populated area)
<b>2. Design Standard</b>	AASHTO	AASHTO	AASHTO(1989)
<b>Live Load</b>	HS25-44	HS25-44	HS20-44*1.25
<b>Design forces</b>	-	no wind ld	
<b>HWL Frequency</b>	-	50 yrs	-
<b>Freeboard</b>	-	0.6m	-
<b>3. Bridge Type</b>			
<b>RC</b>	-	12-15m span	-
<b>PC</b>	-	18-25m span	-

<b>Project name</b>	Road 9/Eastern Section	ADB-9	JICA
<b>Project Road</b>	Rt 9 Eastern	Rt 11, Rt 16-4, Provincial	Rt 13S
<b>Section</b>	Mouan Phin- Vietnam bd.		Thakekh - Pakse
<b>1. Bridge Width</b>	8.0,7.0(10.0)m	6.0m	9.0(11.0)m
<b>Carriageway</b>	7.0m	6.0m	7.0m
<b>Footpath</b>	1.0m	-	0.5 or 1.0m (populated area)
<b>2. Design Standard</b>		AASHTO(1992)	Japanese standard
<b>Live Load</b>	-	HS20-44*1.25	B type load (HS25 equivalent)
<b>Design forces</b>		Wind ld, braking ld	no wind ld, Kh=0.06
<b>HWL Frequency</b>	50yrs	50yrs	50yrs
<b>Freeboard</b>	0.5m	1.5m	0.75-1.2m (depending of discharge volume)
<b>3. Bridge Type</b>			
<b>RC</b>	-	-	10,15,18m span
<b>PC</b>	-	13,16,18,22,25m span	22,25,30m span

**(3) Maintenance Intervention Levels: Paved Roads**

Defect	Level	Extent (% of subsection length)	Climate/ traffic category	Defect	Extent (% of subsection length)	Action	Programmed	
stripping or fretting	any	<10	All	-	-	Spot sealing	Routine	
		>20	All	-	-	Resealing, Surface dressing, Overlay	Periodic	
Edge damage	Erosion from original edge >150mm	>20	All	-	-	Patching, Filling Spot Reconstruction	Routine	
		>50	All	-	-	Spot Reconstruction	Periodic	
Routine (surface dressing on granular base)	<10mm		Rainfall > 1500mm/yr or Traffic <1000 vehicles/day	Wheel track Cracking	<5	Crack sealing	Routine	
				Non-wheel track Cracking	>5	Surface dressing,	Periodic	
				Cracking	<10	Crack sealing	Routine	
			Rainfall > 1500mm/yr or Traffic <1000 vehicles/day	Cracking	>10	Surface dressing,	Periodic	
				Wheel track Cracking	<10	Crack sealing	Routine	
				Non-wheel track Cracking	>10	Surface dressing,	Periodic	
	10-15mm	>10	All	Any cracking	<20	None	-	
					>20	Surface dressing,		
	>15mm	<10	All	Cracking only associated with local ruts	-	-	Treat cracks depending on extent as above Further investigation	Routine/ Periodic
					-	-	Patching,	Routine
-					-	Patching excess rutting and treat cracks depending on extent as above	Routine/ Periodic	
	>10	All	Any cracking	-	-	Further investigation	-	

## (Cont'd)

Defect	Level	Extent (% of subsection length)	Climate/ traffic category	Defect	Extent (% of subsection length)	Action	Programmed	
Rutting (asphaltic concrete)	<10mm	-	Rainfall > 1500mm/yr or Traffic <1000 vehicles/day	Any cracking	<5	Crack sealing	Routine	
					.5-10	Surface dressing,	Periodic	
					>10	Further investigation	-	
		Rainfall > 1500mm/yr or Traffic <1000 vehicles/day	-	All	Any cracking	<10	Crack sealing	Routine
						.10-20	Surface dressing,	Periodic
						>20	Further investigation	-
	>10mm	<5	All	Cracking only associated with local ruts	-	Patching,	Routine	
				Other cracking	-	Patching excess rutting and treat cracks depending on extent as above	Routine/ Periodic	
>10mm	>5	All	Any cracking	-	Treat cracks depending on the extent as above	Routine/ Periodic		
					Further investigation	-		
Rutting (asphaltic concrete or surface dressing on stabilised road base)	<5mm	-	Rainfall > 1500mm/yr or Traffic <1000 vehicles/day	Any cracking	<10	Crack sealing	Routine	
					>10	Resealing and surface dressing	Periodic	
				Any cracking	<20	Seal cracks	Routine	
					>20	Resealing and surface dressing	Periodic	
	5-10mm	>10	All	Any cracking	-	Treat cracks depending on the extent as above	Routine/ Periodic	
						Further investigation	-	
	>10mm	<5	All	Cracking only associated with local ruts	-	Patching	Recurrent	
				Other cracking	-	Patching excess rutting and treat cracks depending on extent as above	Routine/ Periodic	
		>5	All	Any cracking	-	Further investigation	-	

**(4) Basic Unit Improvement Cost**

(Road Design Class III, Flat Terrain, Road Condition Rank 1)

Items	Unit	Unit Cost (US\$)	Quantity (per 1km)	Cost (US\$/km)
Earthwork				
Fill work	cu.m	2.0	3,540	7,080
Pavement work				
Graded crushed stone base	cu.m	23.0	2,060	47,380
Graded crushed stone subbase	cu.m	20.0	2,750	55,000
DBST	sq.m	3.6	9,000	32,400
Drainage				
Pipe culverts (D1.0m)	m	182.6	12	2,191
Sub Total (A)				144,051
Miscellaneous (A x 20%)				28,810
Sub Total (B) of Construction Cost				172,861
Physical contingency (B x 10%)				17,286
Sub Total (C)				190,148
Construction facilities (C x 2.5%)				4,754
Sub Total (D)				194,901
Detailed engineering & Construction supervision (D x 8%)				15,592
<b>Total (E)</b>				<b>210,493</b>

**(5) Basic Factors for Project Unit Cost**

**(i) Factors for Terrain Conditions**

Terrain	Existing Road Conditions (US\$/km)		
	Rank 1	Rank2	Rank 3
Flat/Rolling	1.00	1.05	1.10
Mountainous	1.05	1.20	1.30

**(ii) Unit Cost Factors for Road Design Class III**

Terrain	Existing Road Conditions (US\$/km)		
	Rank 1	Rank2	Rank 3
Flat/Rolling	1.00	1.05	1.10
Mountainous	0.95	1.10	1.15

**(iii) Unit Cost Factors for Road Design Class IV**

Terrain	Existing Road Conditions (US\$/km)		
	Rank 1	Rank 2	Rank 3
Flat	1.00	1.05	1.10
Rolling	0.90	0.95	1.00
Mountainous	0.85	1.00	1.05



## (6) Road Project Cost

Route	Road Class	Origin	Destination	Terrain	Present Conditions	Road Length (km)	Project Cost by 1km (1000US\$)	Project Cost (1000US\$)	Remarks
1G	IV	Junction of Route 9	Border of Province	F	1	35.0	189.0	6,615.0	
				R	3	32.0	189.0	6,048.0	Missing Link
		Border of Province	Junction of Route 15	F	2	38.0	198.5	7,543.0	
				F	3	25.0	207.9	5,197.5	
Total					130.0		25,403.5		
1H	IV	Junction of Route 20	Junction of Route 16	F	1	22.5	189.0	4,252.5	
1J	IV	Junction of Route 18B	Border of Cambodia	F	1	16.0	189.0	3,024.0	
				R	3	15.0	189.0	2,835.0	Missing Link
				M	3	50.0	198.5	9,925.0	Missing Link
Total					81.0		15,784.0		
14A	III IV	Phone Thong Dist. (16)	Ban Don Talath (14A1)	F	3	25.0	231.0	5,775.0	Missing Link
				F	1	18.0	189.0	3,402.0	
		Ban Don Talath (14A1)	Ban Sam Kha (14C1)	F	1	11.0	189.0	2,079.0	
		Ban Sam Kha (14C1)	Junction of Route 14C	F	2	13.0	198.5	2,580.5	
		M. Moonlapamok	Border of Cambodia	F	3	38.5	207.9	8,004.2	
Total					2	32.0	198.5	6,352.0	
14A1	IV	Ban Ang Kham (14B)	Ban Don Talath (14A)	F	1	32.0	189.0	6,048.0	
14B	IV	Junction of Route 16	Ban Ang Kham (14A1)	F	1	11.0	189.0	2,079.0	
		Ban Ang Kham (14A1)	Ban Phong Photh (14C2)	F	2	11.8	198.5	2,342.3	
		Ban Phong Photh (14C2)	Ban. Hieng (14C1)	F	2	39.3	198.5	7,801.1	
		Ban Hieng (14C1)	Ban Nong Nga (14C)	F	2	39.8	198.5	7,900.3	
		Ban Nong Nga (14C)	Border of Cambodia	F	3	47.1	207.9	9,792.1	
Total					149.0		29,914.7		
14C	IV	Ban Nong Nga (14B)	M. Moonlapamok	F	1	42.0	189.0	7,938.0	
14C1	IV	Ban Hieng (14B)	Ban Sam Kha (14A)	F	1	23.0	189.0	4,347.0	
14C2	IV	Ban Phong Photh (14B)	Ban Nong Te (14A)	F	1	6.0	189.0	1,134.0	
15	IV	Junction of Route 13S	Junction of Route 1H	F	2	73.0	198.5	14,490.5	
16A	IV	Junction of Route 16	Junction of Route 1H	F	1	32.1	189.0	6,066.9	
				R	2	17.9	179.6	3,214.8	
				M	2	21.0	189.0	3,969.0	
Total					71.0		13,250.7		
18A	IV	Junction of Route 13S	Border of Province	F	2	19.7	198.5	3,910.5	
				R	2	10.9	179.6	1,957.6	
		Border of Province	Se Piane River	R	3	39.7	189.0	7,503.3	
		Se Piane River	Junction of Route 18B	F	2	42.2	198.5	8,376.7	
Total					112.5		21,748.1		

(7) List of Unit Cost for PC Bridges in Previous Projects

Project name		ADB-4	ADB-5	ADB-6/4	ADB-7/D
Loan No.		1009Lao(SF)	1108Lao(SF)	12341Lao(SF)	1369Lao(SF)
	(Unit)				
Contract total	US\$	30,016,357	26,330,728	4,232,000	10,743,695
Bridge contract	US\$	3,534,594	5,560,694	4,232,000	1,494,140
Project site		Rt13N, Luang Prab'g-Kasi	Rt13N, Luang Prab'g-Pak Mong	Rt 16	Rt13S Nasmphan-Veunkham(Camb brd)
Work contents		PC bridges	not available	15 PC bridges, L=181.4(26*7), 8*19.1, 6*26.1, W=6 or 7+1.25*2	not available
Bridge deck area	m2	2,534	4,239	3,489	1,391
Unit cost	US\$	1,395	1,295	1,213	1,074
Contractor		CEI18, Vietnam	Sam Whan, Korea	CCC,Lao	Tianjin, China
Date of Contract		Jan-92	Mar-93	Oct-95	Apr-96
Source		Rd. infra. For rural devlop.	ditto	Dttio	ditto

Project name		WB HIP	Vietnam	JICA (Reference)
Loan No.		IDA2218LA		
	(Unit)			
Contract total	US\$	31,202,401	49,315,480	40,298,507
Bridge contract	US\$	7,282,904	14,879,340	17,026,145
Project site		Rt13S Namkading-Takhe	Rd 15 Saravan-Viet.border	Rt13S Xebangfai-Pakse
Work contents		Not available	33-PC bridges,L=108, 100,133.5,2*52.4,2*67.0,2*28.1,63.1,2*33.9, 8*26.6,6*21.6,7*18.9, W=8 or 10	39-PB bridges + 12- RC bridges: PC span 22-30m, RC span 15-18m
Bridge deck area	m2	3,395	11,223	13,186
Unit cost	US\$	2,145	1,326	1,291
Contractor		Tianjin, China	Vietnam	Hazama Corp., Japan
Date of Contract		Jun-98	Aug-01?	Sep-98
Source		ditto	Data from MCPTC	Rt13 bridge OC report
Remarks				

Remarks: \*1 Bridge billtaken as substructure+superstructure+common temporary works and transport components of contract prices  
 \*2 US\$=135yen  
 \*3 Deck area is calculated by 'width between kerb faces' \*' bridge length'

**(8) House Compensation Cost**

Route	Origin	Destination	Ranking of Conditions	Number of Houses	Compensation Unit Cost (1000US\$)	Compensation Cost (1000US\$)
1G	Junction of Route 9	Junction of Route 15	2	30	800	24,000
1H	Junction of Route 20	Junction of Route 16		0	0	0
1J	Junction of Route 18B	Border of Cambodia	2	20	800	16,000
14A	Phone Thong Dist. (16)	Ban Sam Kha (14C1)	1	30	4,000	120,000
			2	10	800	8,000
	Ban Sam Kha (14C1)	Junction of 14C		0	0	0
	M. Moonlapamok	Border of Cambodia	2	20	800	16,000
Total						144,000
14A1	Ban Ang Kham (14B)	Ban Don Talath (14A)	2	5	1,000	5,000
14B	Junction of Route 16	Border of Cambodia	2	30	800	24,000
14C	Ban Nong Nga (14B)	M. Moonlapamok		0	0	0
14C1	Ban Hieng (14B)	Ban Sam Kha (14A)		0	0	0
14C2	Ban Phong Photh (14B)	Ban Nong Te (14A)		0	0	0
15	Junction of Route 13S	Junction of Route 1H	2	20	2,000	40,000
16A	Junction of Route 16	Junction of Route 1I	2	5	1,500	7,500
18A	Junction of Route 13S	Border of Province	2	10	800	8,000
	Border of Province	Xe Piane River	2	10	500	5,000
	Se Piane River	Junction of Route 18B	2	10	800	8,000
Total						21,000

**(9) UXO Clearing Unit Cost Analysis**

Route	Length (Km)	Nos. of bomb./km	Unit cost of UXO clearance (\$/km)	Total UXO clearing (\$)
1G	130	33	3,000	390,000
1H	22.5	11	1,000	22,500
1J	81	6	1,000	81,000
14A(i)	54	1	0	0
14A(ii)	51.5	0	0	0
14A(iii)	32	0	0	0
14A1	32	0	0	0
14B	149	0	0	0
14C	42	0	0	0
14C1	23	0	0	0
14C2	6	0	0	0
15	73	18	3,000	219,000
16A	71	8	1,000	71,000
18A(i)	30	1	0	0
18A(ii)	40	2	0	0
18A(iii)	52.5	10	1,000	52,500