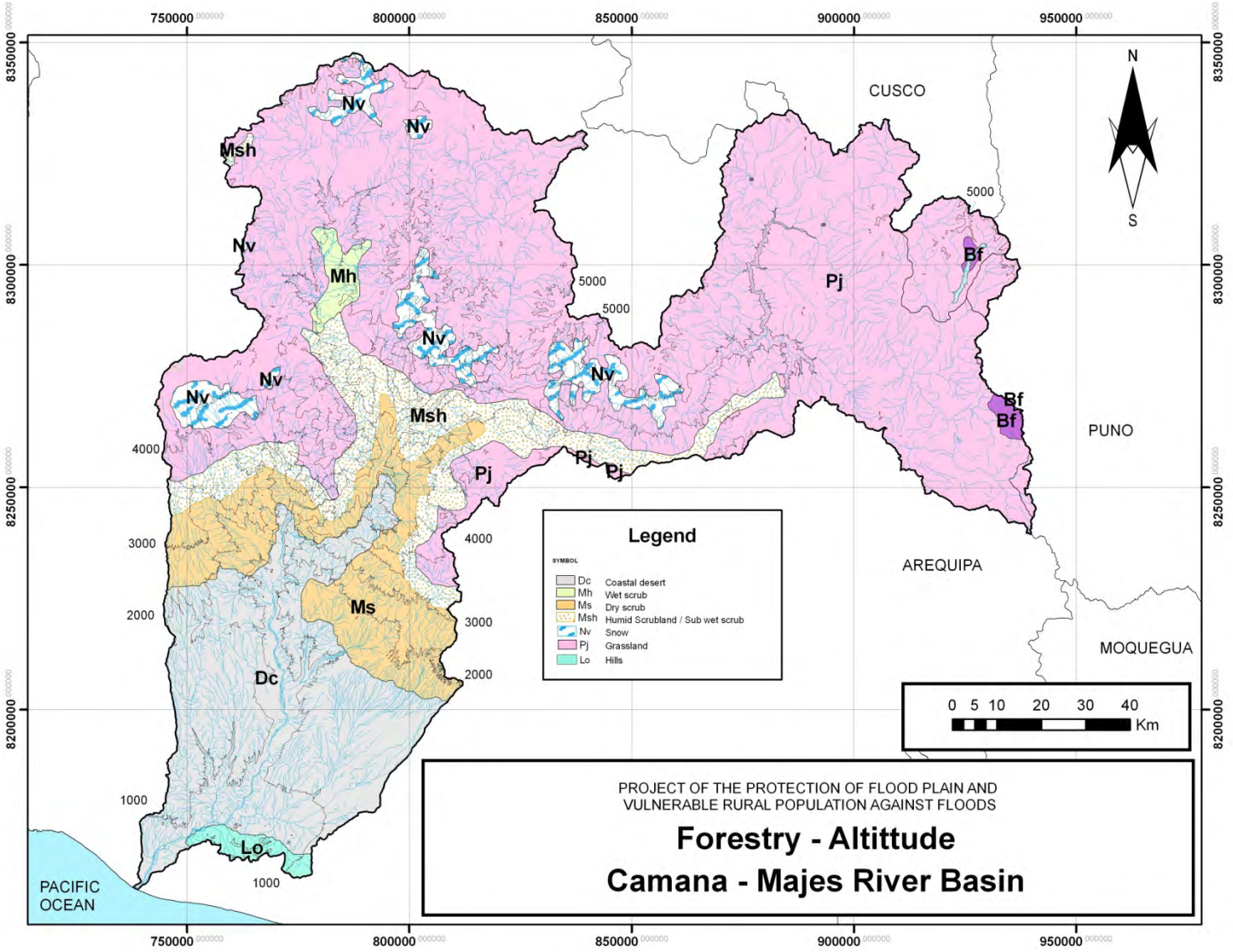
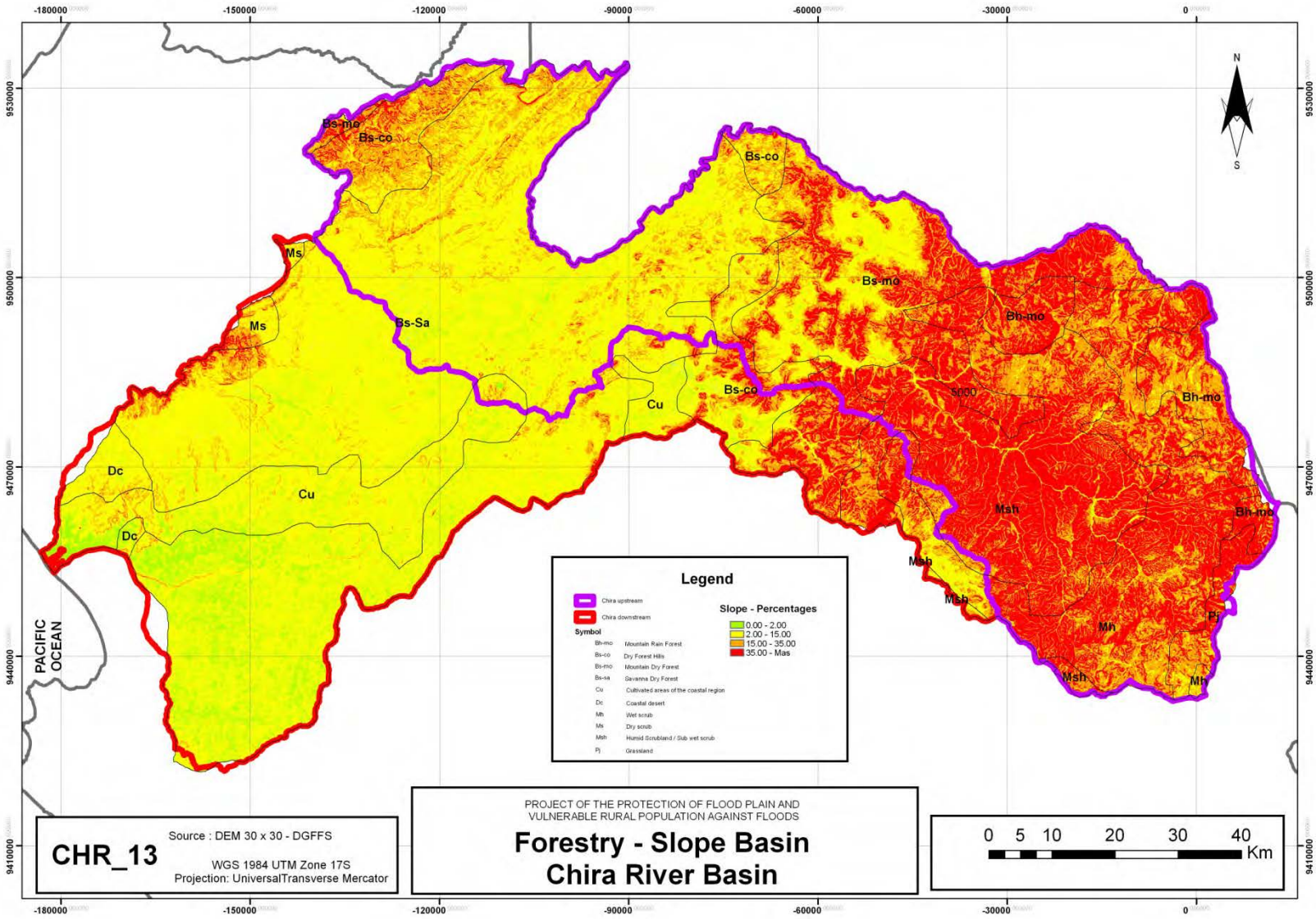
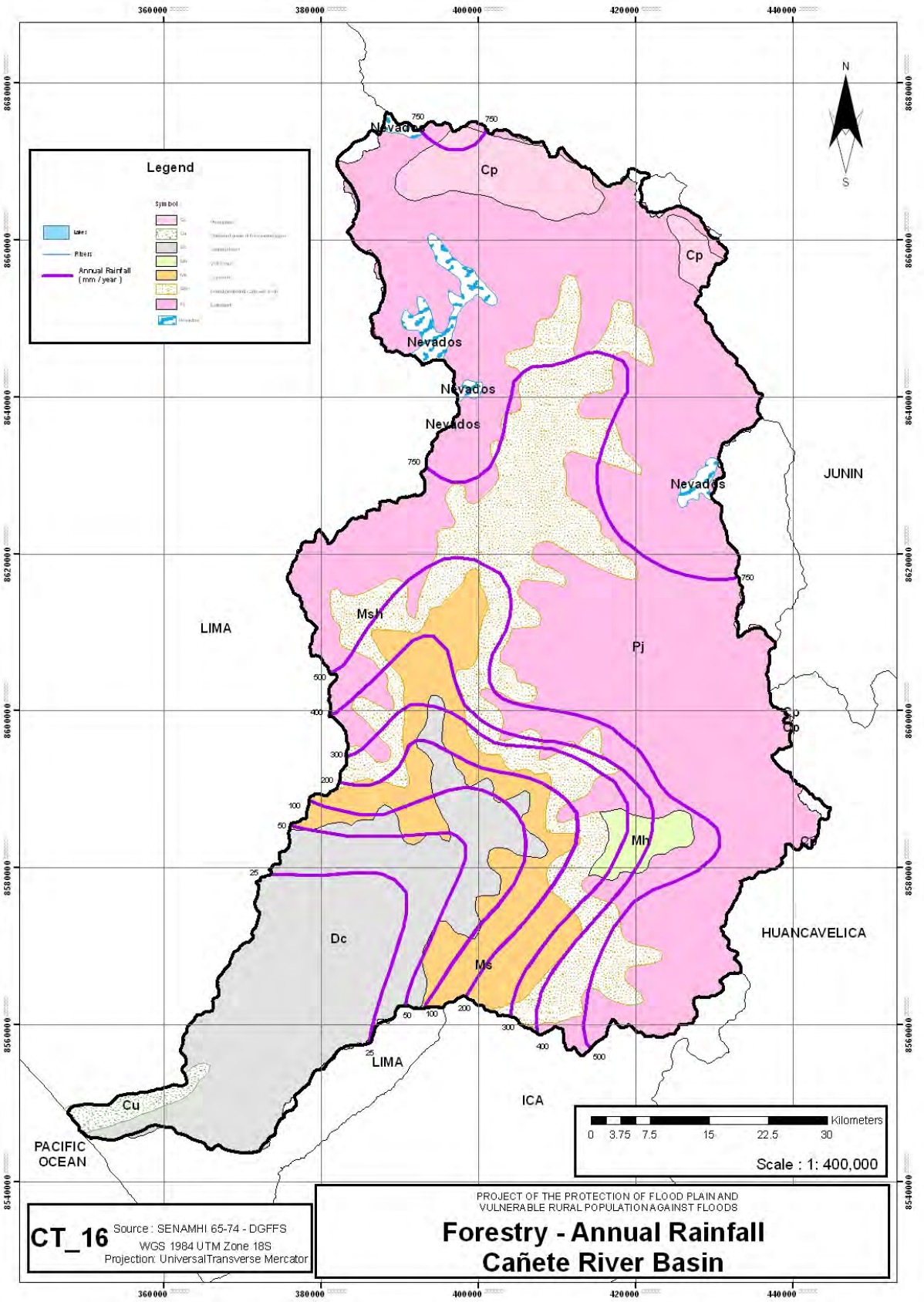


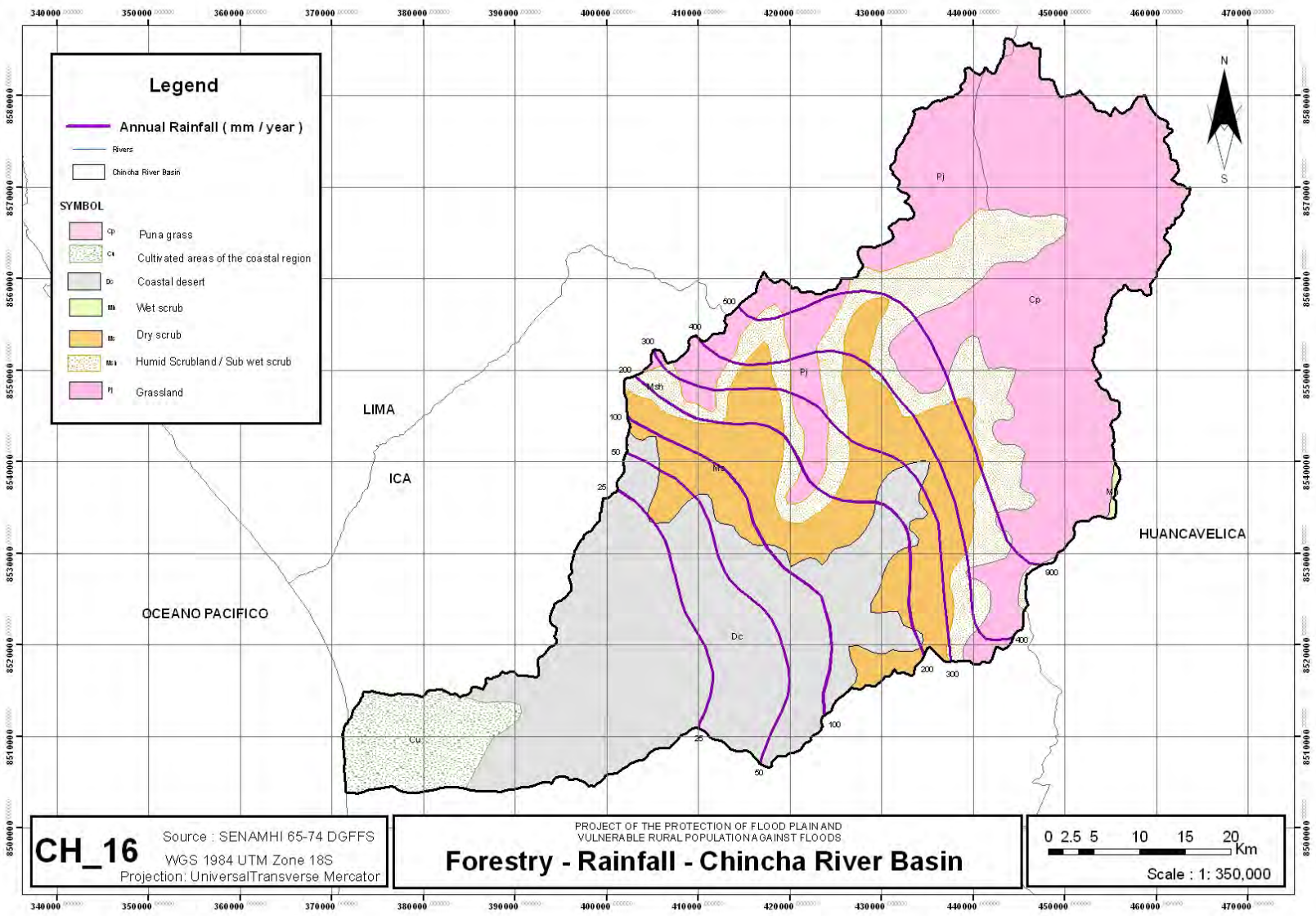
Appendix 7-Figure 2.5 Relation between Slope Angle and Vegetation (Camana-Majes River Basin)



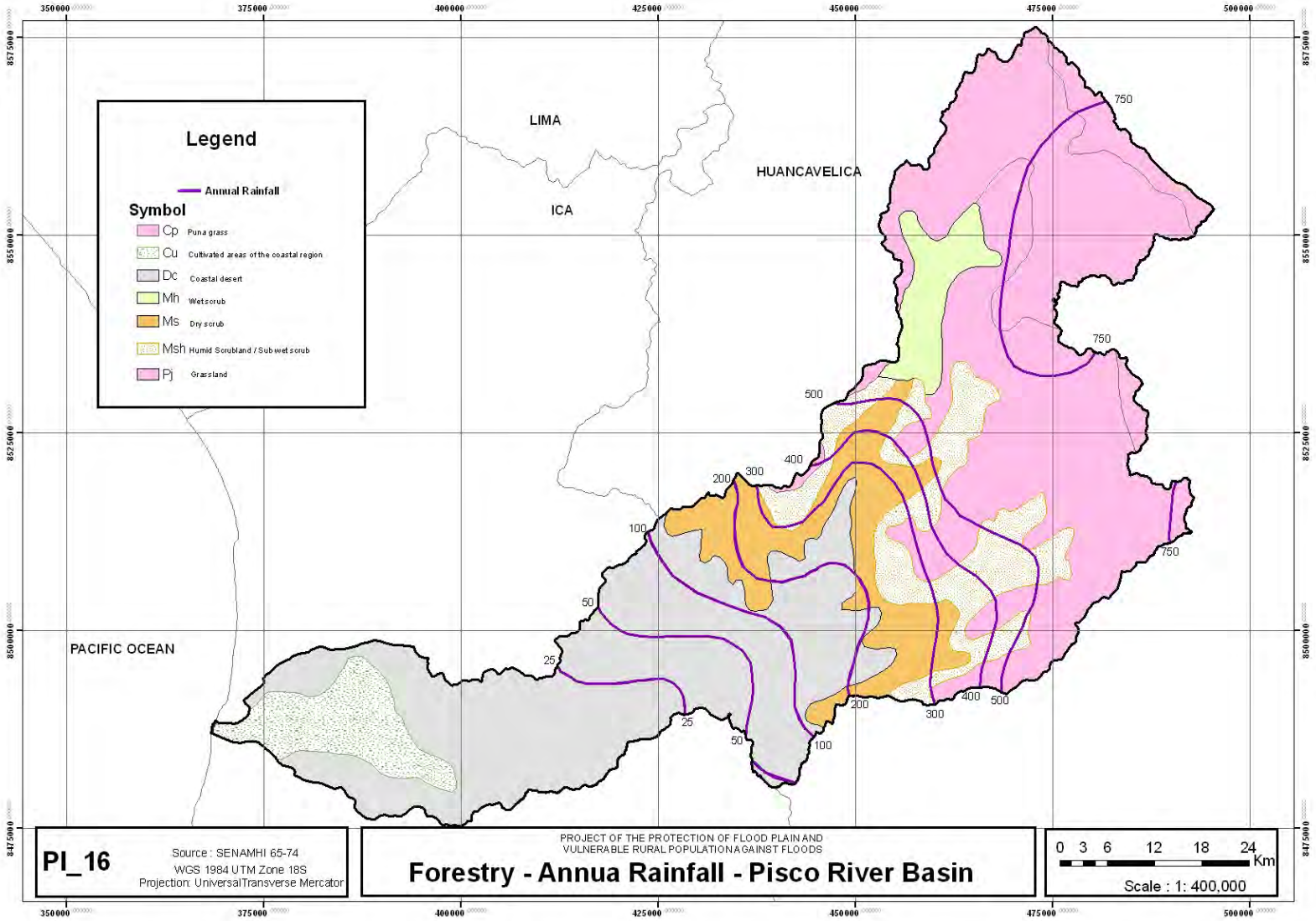
Appendix 7-Figure 2.6 Relation between Slope Angle and Vegetation (Chira River Basin)



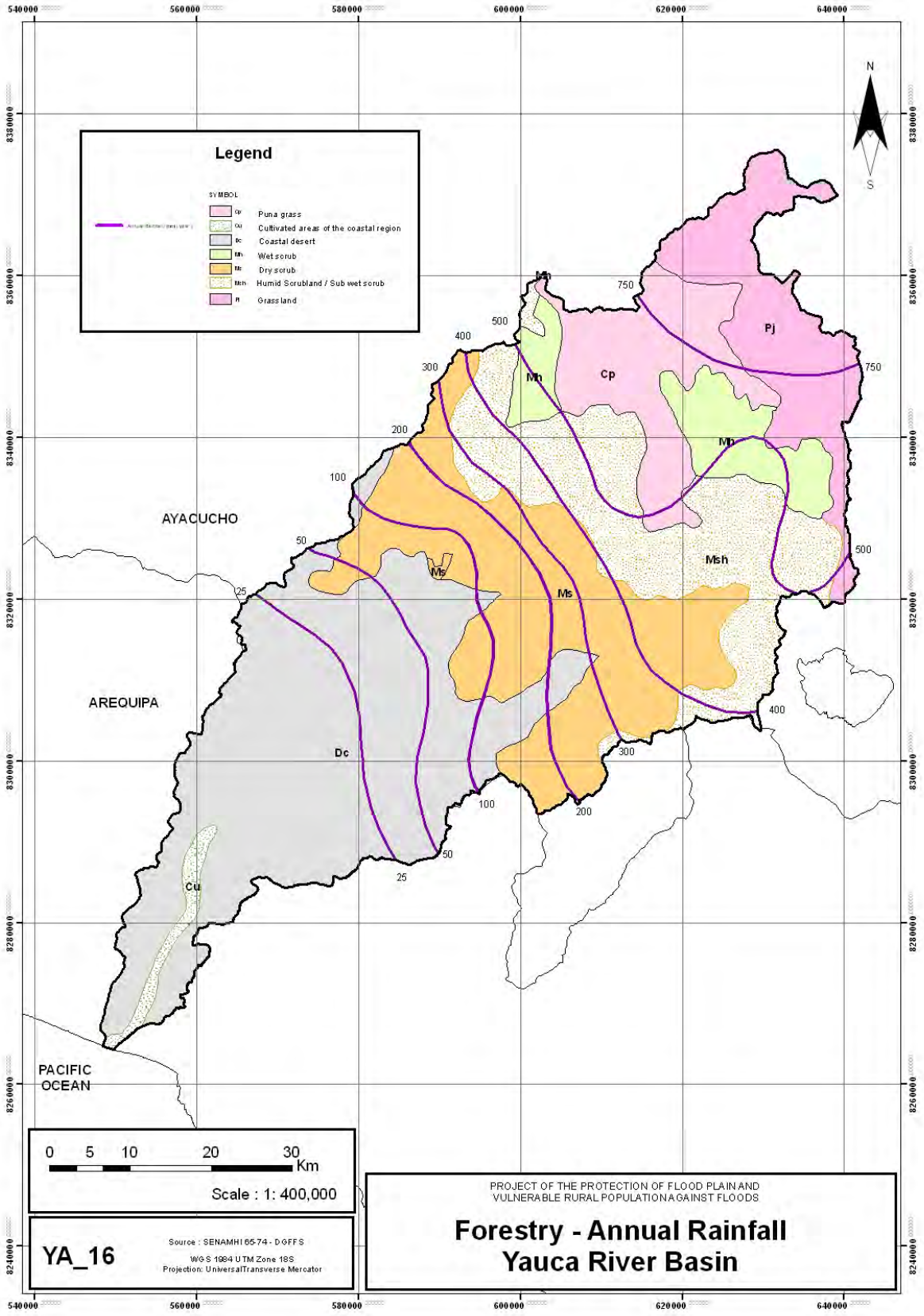
Appendix 7-Figure 3.1 Relation between Annual Rainfall and Vegetation (Canete River Basin)



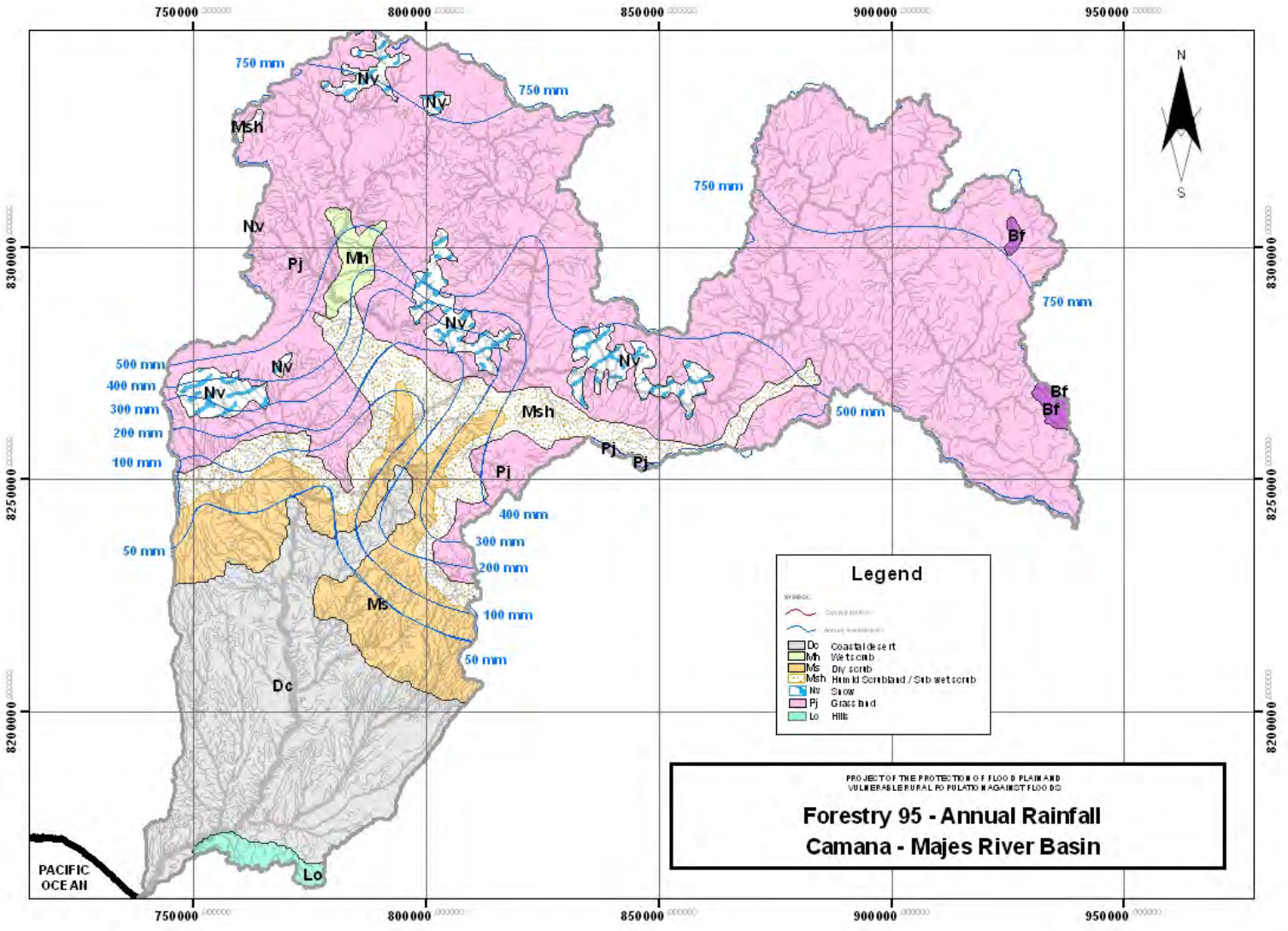
Appendix 7-Figure 3.2 Relation between Annual Rainfall and Vegetation (Chincha iver Basin)



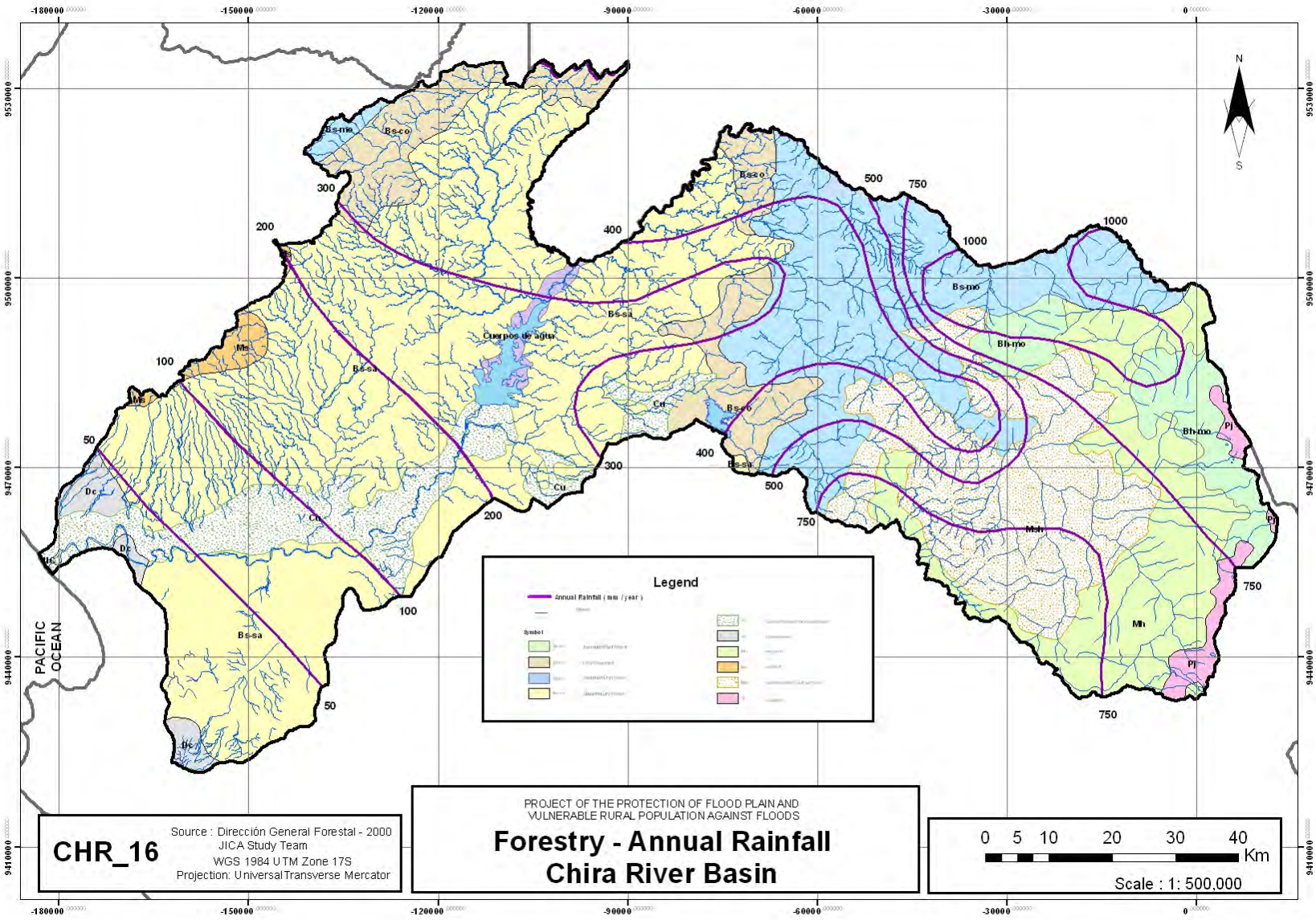
Appendix 7-Figure 3.3 Relation between Annual Rainfall and Vegetation (Pisco River Basin)



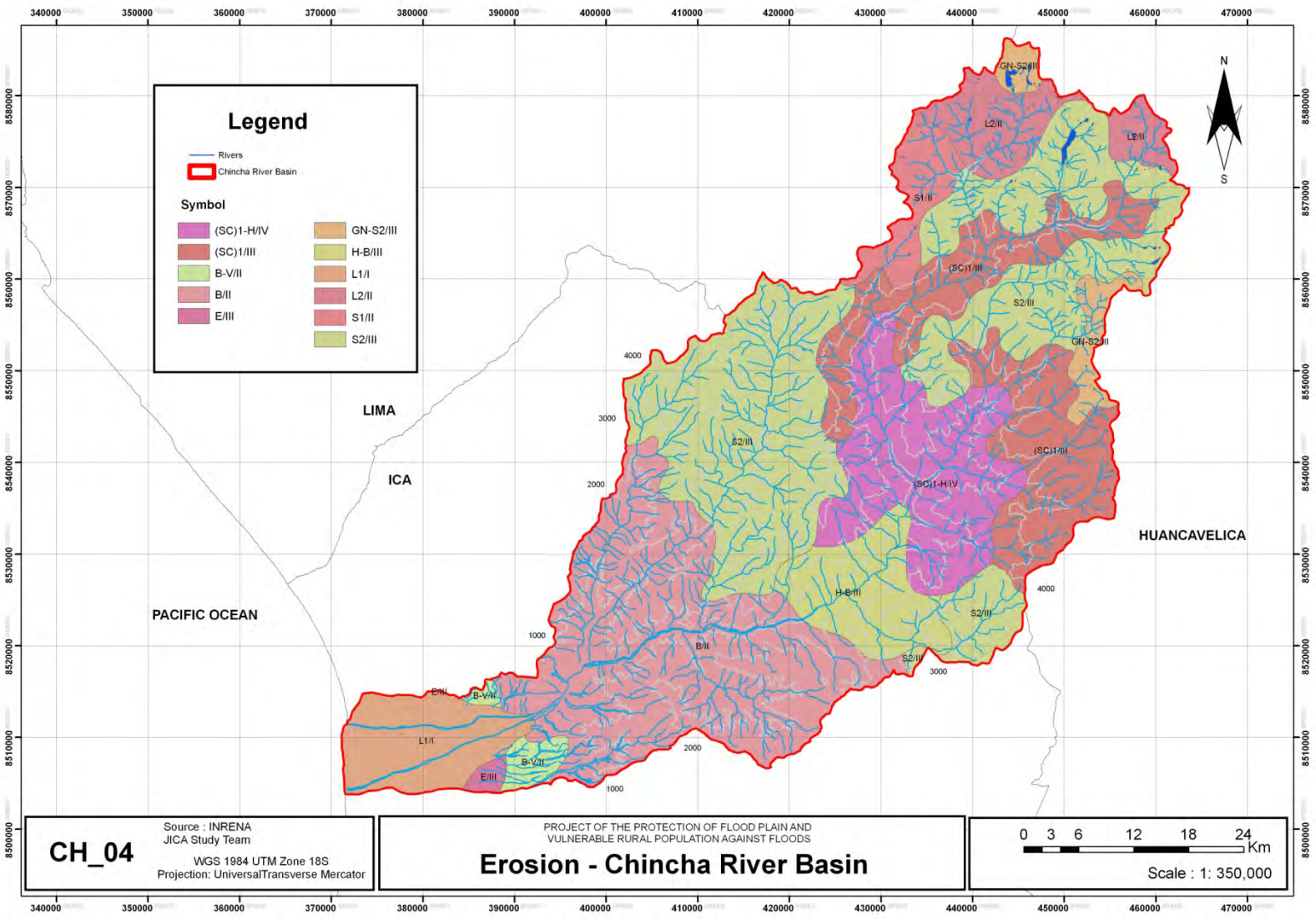
Appendix 7-Figure 3.4 Relation between Annual Rainfall and Vegetation (Yauca River Basin)



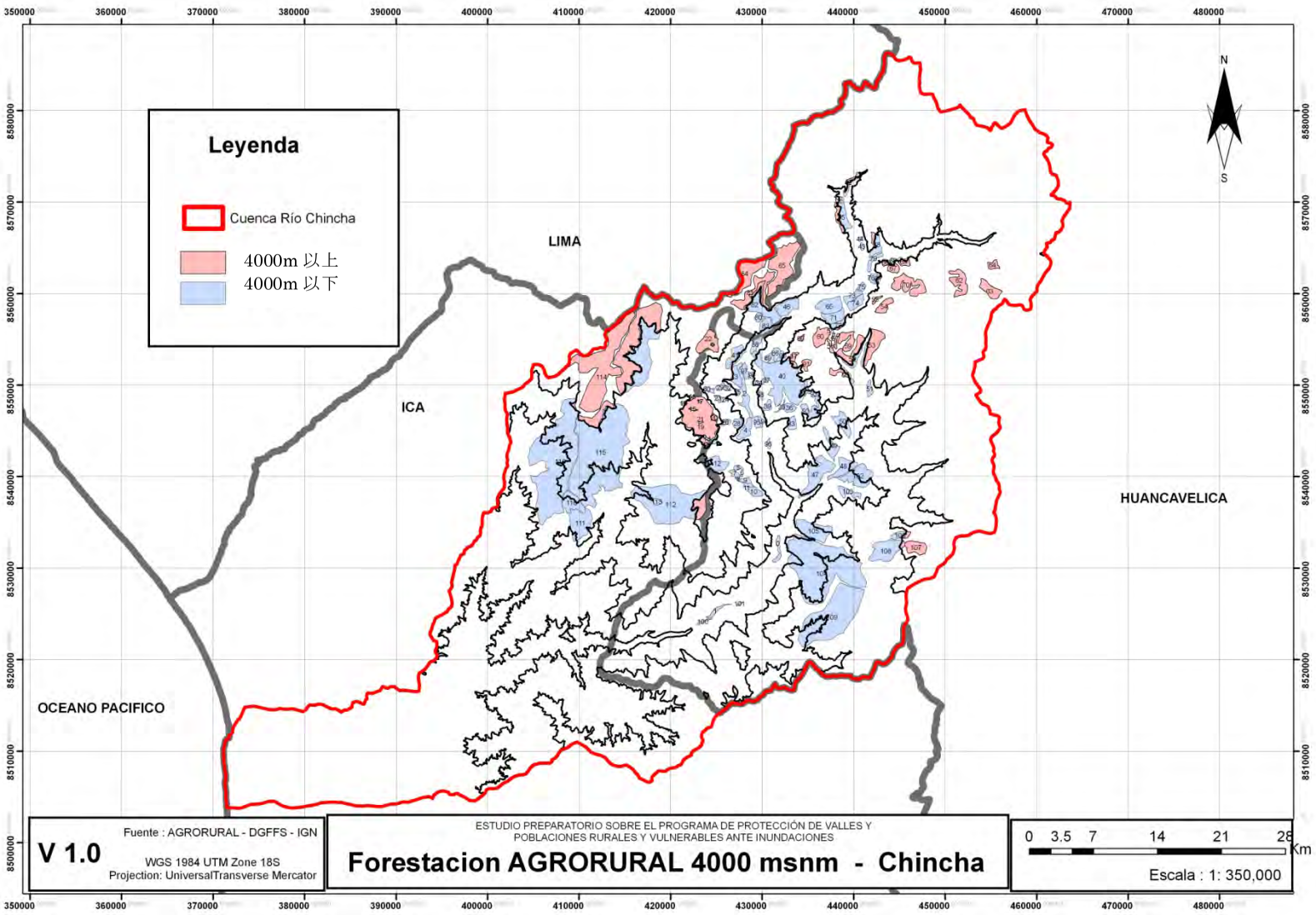
Appendix 7-Figure 3.5 Relation between Annual Rainfall and Vegetation (Camana-Majes River Basin)



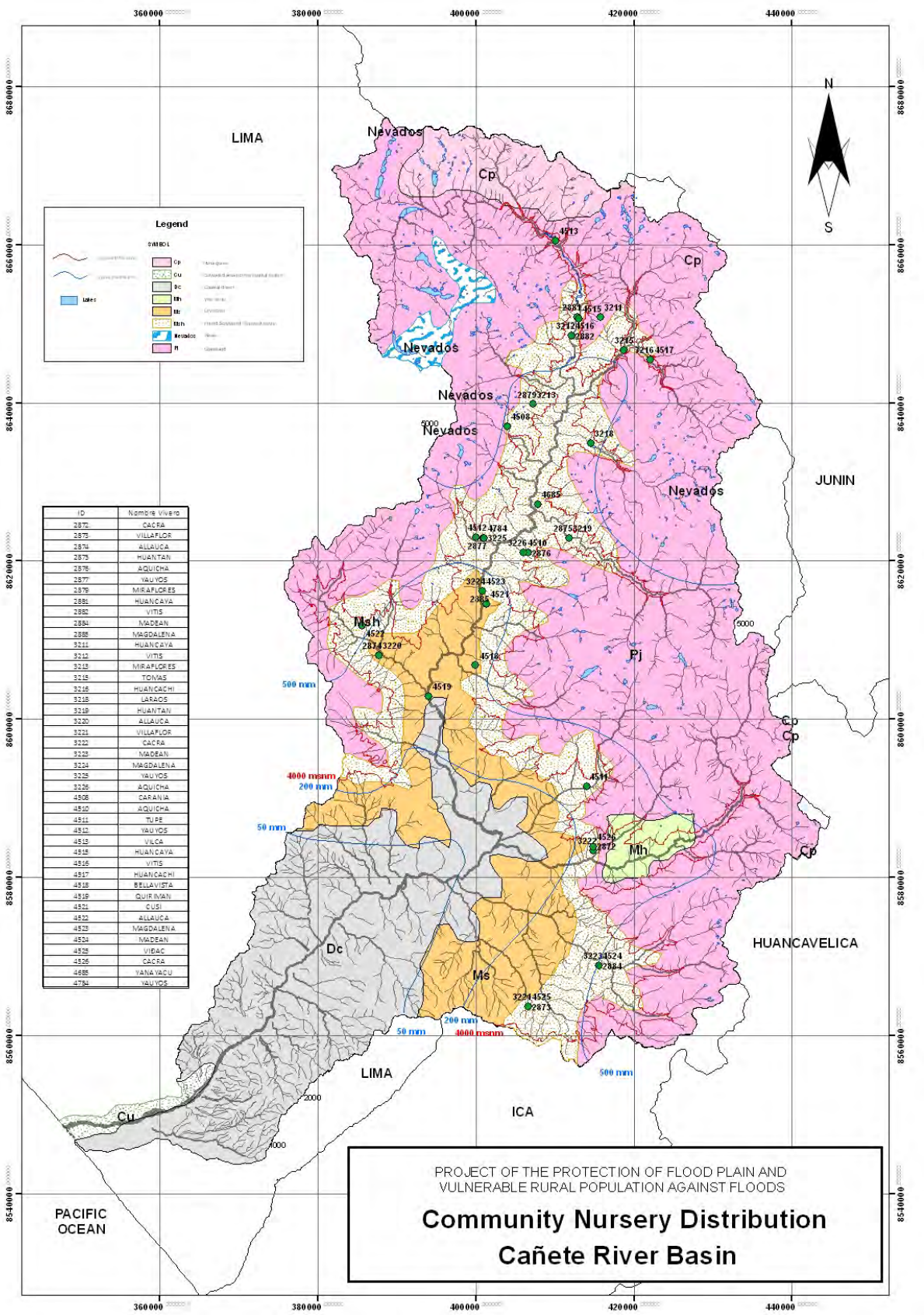
Appendix 7-Figure 3.6 Relation between Annual Rainfall and Vegetation (Chira River Basin)



Appendix 7-Figure 4 Erosion Risk (Chincha River Basin)

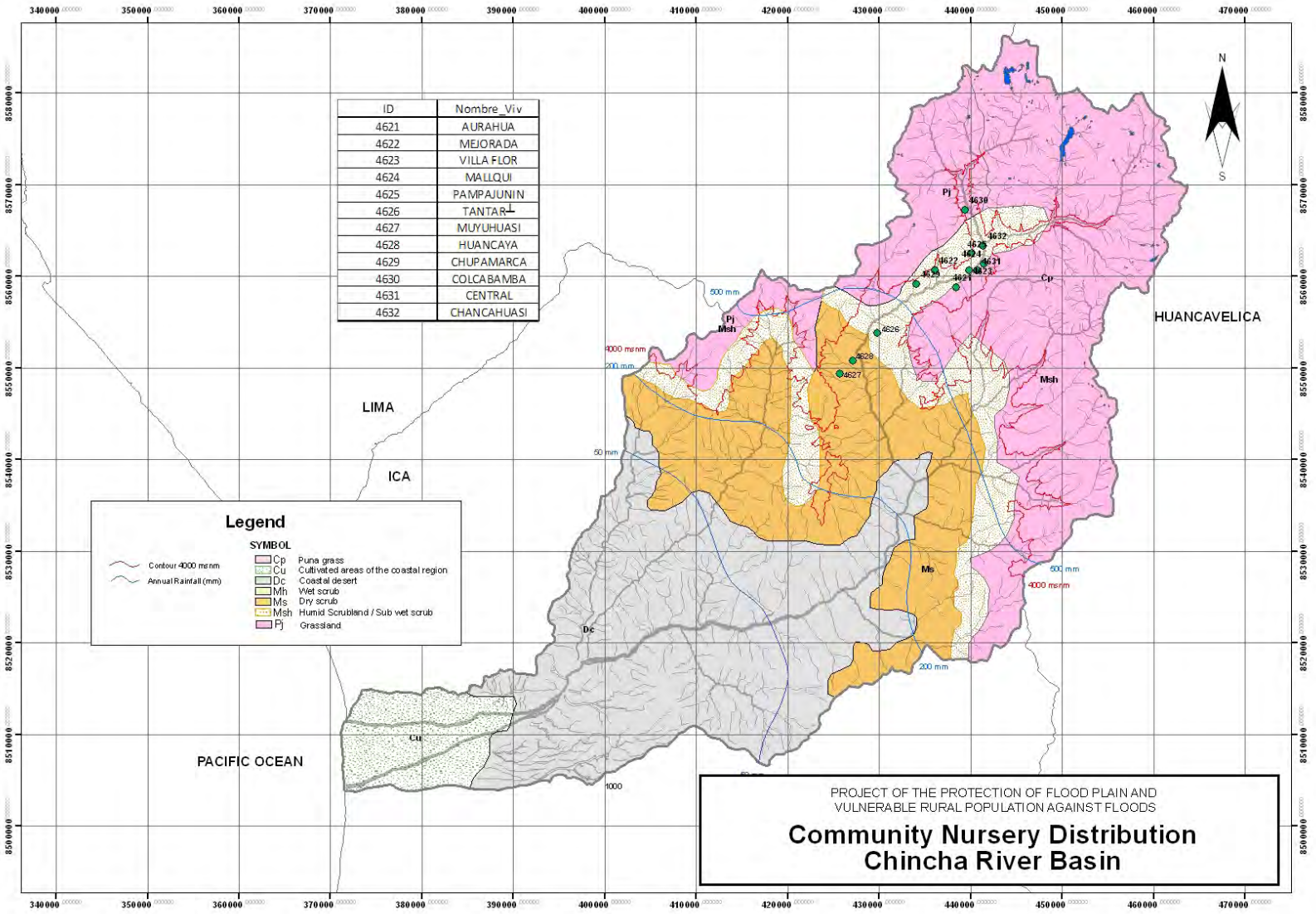


Appendix 7-Figure 5 Reforestation Plan by AGRORURAL and Altitude (Chincha River Basin)

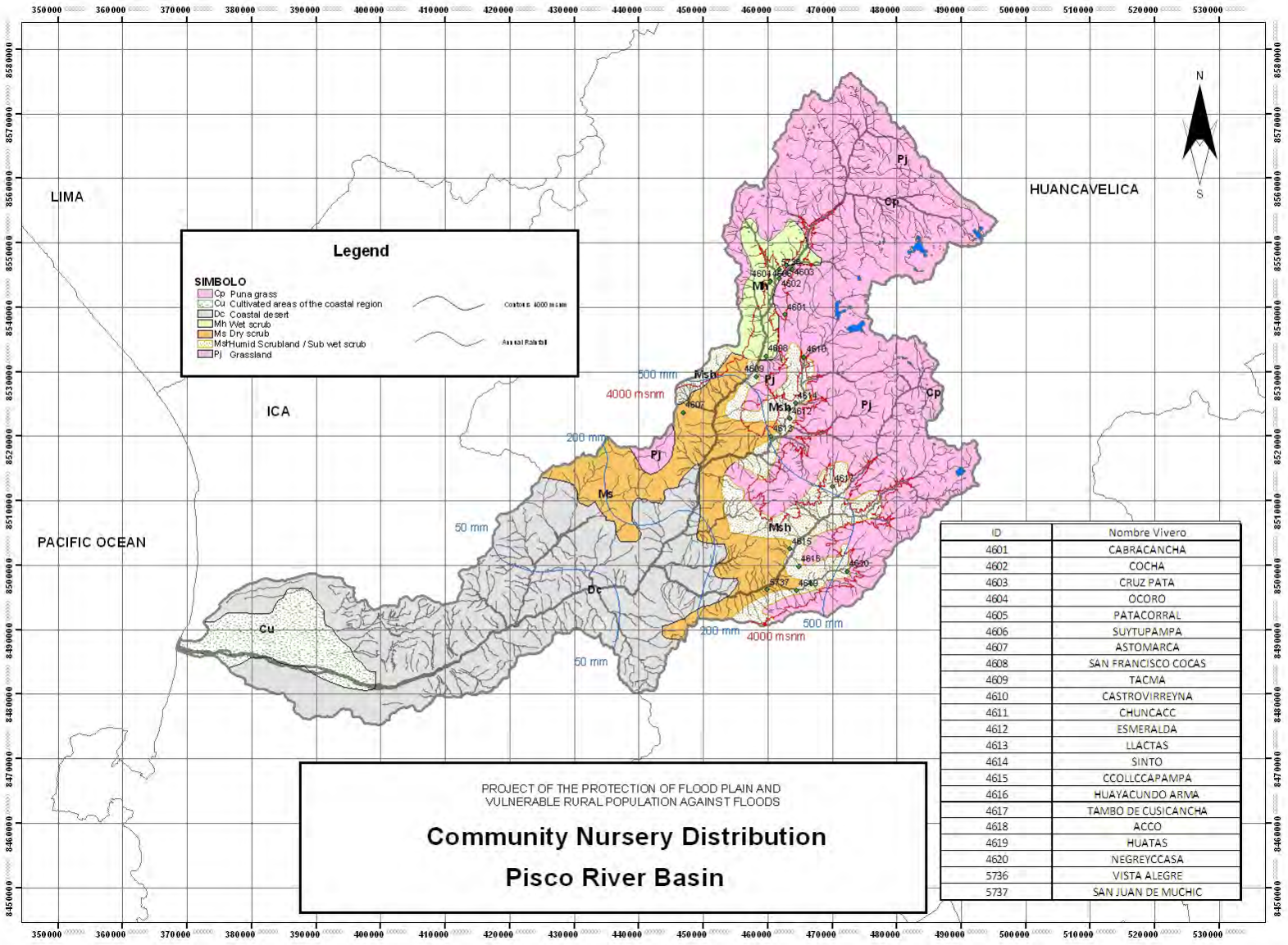


ID	Nombre Vivero
2872	CACRA
2873	VILLAFLOR
2874	ALLAUCA
2875	HUANTAN
2876	AQUICHA
2877	YAUYOS
2879	MIRAFLORES
2881	HUANCAYA
2882	VITIS
2884	MADEAN
2885	MAGDALENA
3211	HUANCAYA
3212	VITIS
3213	MIRAFLORES
3215	TOMAS
3216	HUANCACHI
3218	LARAOS
3219	HUANTAN
3220	ALLAUCA
3221	VILLAFLOR
3222	CACRA
3223	MADEAN
3224	MAGDALENA
3225	YAUYOS
3226	AQUICHA
4508	CARANIA
4510	AQUICHA
4511	TUPE
4512	YAUYOS
4513	VILCA
4515	HUANCAYA
4516	VITIS
4517	HUANCACHI
4518	BELLAVISTA
4519	QUIRIVAN
4521	CUSI
4522	ALLAUCA
4523	MAGDALENA
4524	MADEAN
4526	VIBAC
4526	CACRA
4685	YANAYACU
4784	YAUYOS

Appendix 7-Figure 6.1 Distribution of Community Nurseries (Canete River Basin)

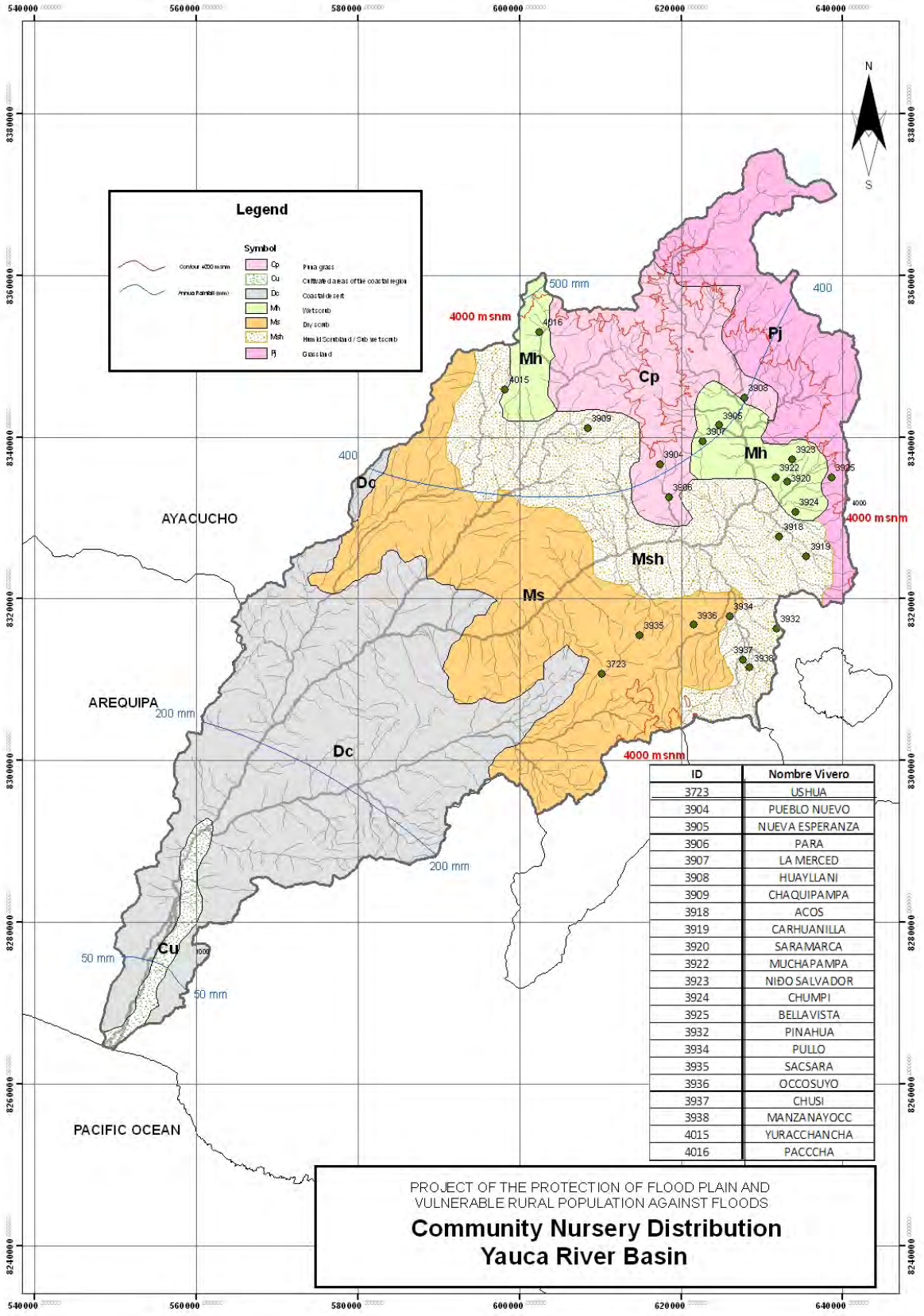


Appendix 7-Figure 6.2 Distribution of Community Nurseries (Chincha River Basin)

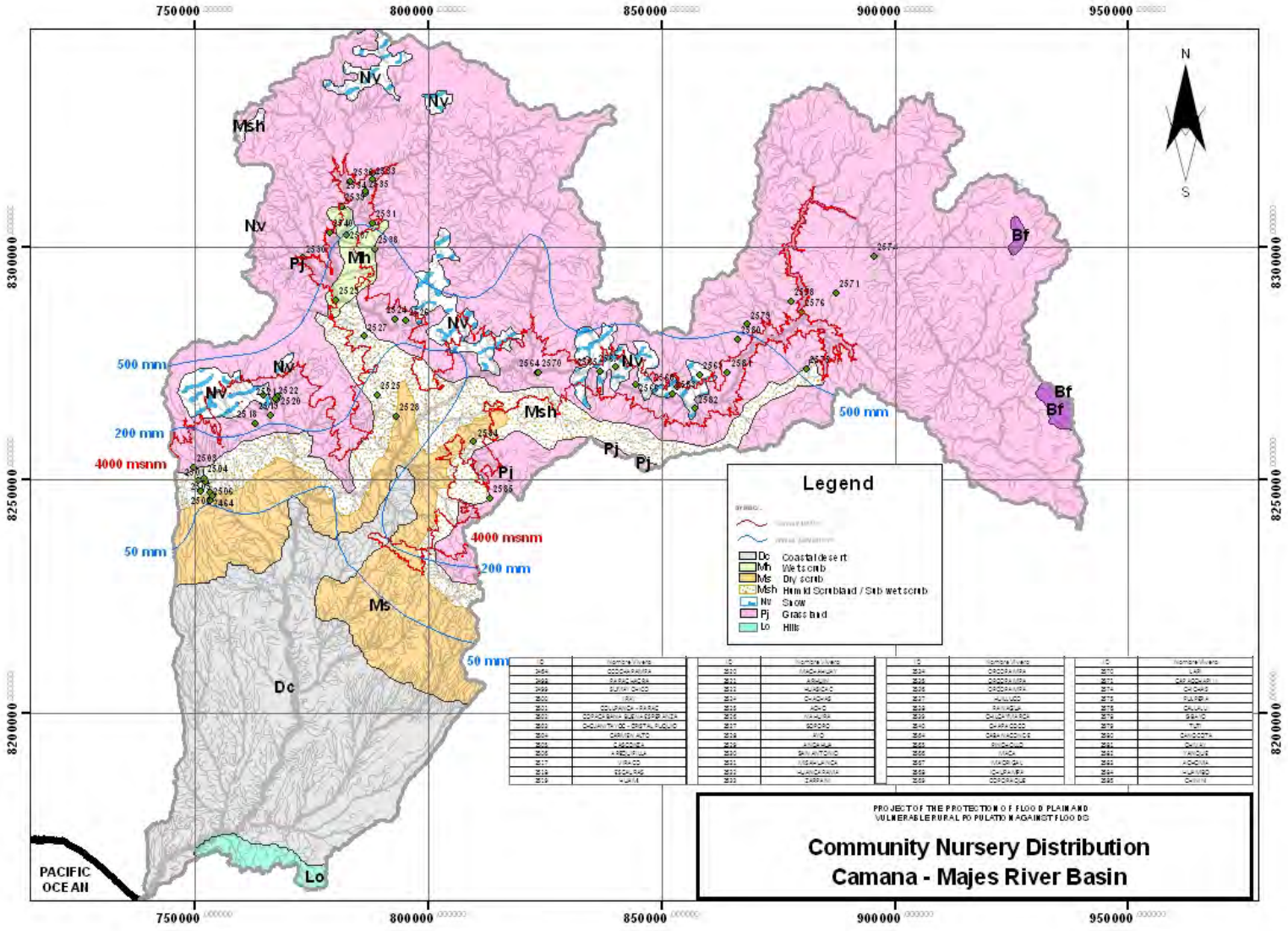


ID	Nombre Vivero
4601	CABRACANCHA
4602	COCHA
4603	CRUZ PATA
4604	OCORO
4605	PATACORRAL
4606	SUYTUPAMPA
4607	ASTOMARCA
4608	SAN FRANCISCO COCAS
4609	TACMA
4610	CASTROVIRREYNA
4611	CHUNCACC
4612	ESMERALDA
4613	LLACTAS
4614	SINTO
4615	CCOLLCCAPAMPA
4616	HUAYACUNDO ARMA
4617	TAMBO DE CUSICANCHA
4618	ACCO
4619	HUATAS
4620	NEGREYCCASA
5736	VISTA ALEGRE
5737	SAN JUAN DE MUCHIC

Appendix 7-Figure 6.3 Distribution of Community Nurseries (Pisco River Basin)



Appendix 7-Figure 6.4 Distribution of Community Nurseries (Yauca River Basin)



Appendix 7-Figure 6.5 Distribution of Community Nurseries (Camana-Majes River Basin)

Appendix 7 Table 1 List of Seedling Providers

Area	River Basin	Name of Provider	Address of Provider	Contact Person	E-mail
Piura	Chira	AGRORURAL	Lambayeque	Ing. Bernardino Lalopu	dzlambayeque@agrorural.gob.pe
Piura	Chira	FOMECO SAC	Lima	Ing. Fanny Palomino	fpalomino@fomeco.gpb.pe
Piura	Chira	MONTAÑA AZUL SAC	Chepén	Lilia Navarro	montanazul@yahoo.es
Lima	Canete	AGRORURAL	Santa Eulalia	Ing. Allen Basurto	dzlima@agrorural.gob.pe
Lima	Canete	FOMECO SAC	Lima	Ing. Fanny Palomino	fpalomino@fomeco.gpb.pe
Lima	Canete	AGRIMEX EIRL	Lima	Silvia Flores	agrimex@live.com
Huancavelica	Cuenca de Andes	AGRORURAL	Huancavelica	Ing. Enrique Conde	dzhuancavelica@agrorural.gob.pe
Huancavelica	Cuenca de Andes	FOMECO SAC	Lima	Ing. Fanny Palomino	fpalomino@fomeco.gpb.pe
Huancavelica	Cuenca de Andes	GAMESA SAC	Huancayo	Ing. John Rosales	jrosales@gamesa.com.pe
Arequipa	Yauca	AGRORURAL	Arequipa	Ing. Daniel Torpoco	dzarequipa@agrorural.gob.pe
Arequipa	Yauca	FOMECO SAC	Lima	Ing. Fanny Palomino	fpalomino@fomeco.gpb.pe
Ica	Pisco	AGRORURAL	Santa Eulalia	Ing. Allen Basurto	dzlima@agrorural.gob.pe
Ica	Chincha	FOMECO SAC	Lima	Ing. Fanny Palomino	fpalomino@fomeco.gpb.pe
Ica	Pisco	AGRIMEX EIRL	Lima	Silvia Flores	agrimex@live.com
Arequipa	Camaná-Majes	APAIC	Ciudad de Arequipa	Ing. Jorge Malluex	jmalleux@gmail.com
Arequipa	Camaná-Majes	Grupo Vierdes	Ciudad de Arequipa	Sr. Julio	ventas@vierdes.com.pe
Arequipa	Camaná-Majes	Los Girasoles de Florentino	Ciudad de Arequipa	Sr. José Florntino Sotomayor	florentinograss123@hotmail.com eyorelmac@gmail.com
Arequipa	Camaná-Majes	AGRORURAL	Ciudad de Arequipa	Ing. Alfonso Pedraza	pedrazagda@gmail.com

Fuente： Información recaudada por los productores de plantones forestales

Apéndice 7-Tabla 2 Informatiob of Seedling Costs

Forestation along River Protection Structure

Species	Seedling Provider	Seedling Production Site	Plantation Site	Unit Price (soles /seedling)	Transpotation Cost (soles /Seedling)	Total Cost (w/o VAT) (soles /seedling)	Used Cost (w/o VAT) (soles /seedling)
Plantation site: Piura River Basin							
Plantation Species: Algarrobo, Tamarix, Casuarina							
Aliso	AGRIMEX	Lima	Piura	1.5	0.4	1.9	
Algarrobo	Montaña Azul	Piura	Piura	1.0	0.2	1.2	1.3
Algarrobo	AGRIMEX	Lima	Piura	1.0	0.4	1.4	
Algarrobo	FOMECO	Lima	Piura	1.5	0.4	1.9	
Caucho	Montaña Azul	Piura	Piura	10.0	0.2	10.2	
Caña	Montaña Azul	Piura	Piura	2.3	0.2	2.5	
Sauce (1m de alto)	Montaña Azul	Piura	Piura	8.0	0.2	8.2	
Tamarix	Montaña Azul	Piura	Piura	5.1	0.2	5.3	5.4
Tamarix	AGRIMEX	Lima	Piura	7.0	0.4	7.4	
Pájaro bobo	Montaña Azul	Piura	Piura	1.0	0.2	1.2	
Bambú	Montaña Azul	Piura	Piura	7.2	0.2	7.4	
Bambú	AGRIMEX	Lima	Piura	3.0	0.4	3.4	
Pino	AGRIMEX	Lima	Piura	1.5	0.4	1.9	
Molle	FOMECO	Lima	Piura	1.5	0.4	1.9	
Molle (para altitudes altas)	Montaña Azul	Piura	Piura	1.0	0.2	1.2	
Casuarina	Montaña Azul	Piura	Piura	1.1	0.2	1.3	1.9
Casuarina	AGRIMEX	Lima	Piura	2.0	0.4	2.4	
Eucalipto	Montaña Azul	Lima	Piura	1.0	0.2	1.2	
Eucalipto	AGRIMEX	Lima	Piura	1.2	0.4	1.6	
Huarango (*Acacia macracantha*)	Montaña Azul	Piura	Piura	1.0	0.2	1.2	
Huarango (*Acacia macracantha*)	FOMECO	Lima	Piura	1.5	0.4	1.9	
Hualtaco	Montaña Azul	Piura	Piura	1.0	0.2	1.2	
Plantation site: Cañete River Basin							
Plantation Species: Huarango (*Prosopis limensis*), Eucalipto, Casuarina							
Aliso	AGRIMEX	Lima	Lima	1.5	0.2	1.7	
Algarrobo	AGRIMEX	Lima	Lima	1.0	0.2	1.2	
Algarrobo	Montaña Azul	Piura	Lima	1.0	0.4	1.4	
Algarrobo	FOMECO	Lima	Lima	1.5	0.2	1.7	
Caucho	Montaña Azul	Piura	Lima	10.0	0.4	10.4	
Caña	Montaña Azul	Piura	Lima	2.3	0.4	2.7	
Sauce (1m de alto)	Montaña Azul	Piura	Lima	8.0	0.4	8.4	
Tamarix	Montaña Azul	Piura	Lima	3.1	0.4	3.5	
Tamarix	AGRIMEX	Lima	Lima	7.0	0.2	7.2	
Pájaro bobo	Montaña Azul	Piura	Lima	1.0	0.4	1.4	
Bambú	Montaña Azul	Piura	Lima	2.2	0.4	2.6	
Bambú	AGRIMEX	Lima	Lima	3.0	0.2	3.2	
Pino	AGRIMEX	Lima	Lima	1.5	0.2	1.7	
Molle	FOMECO	Lima	Lima	1.5	0.2	1.7	
Molle (para altitudes altas)	Montaña Azul	Piura	Lima	1.0	0.4	1.4	
Casuarina	Montaña Azul	Piura	Lima	1.1	0.4	1.5	1.9
Casuarina	AGRIMEX	Lima	Lima	2.0	0.2	2.2	
Eucalipto	AGRIMEX	Lima	Lima	1.2	0.2	1.4	1.4
Eucalipto	Montaña Azul	Piura	Lima	1.0	0.4	1.4	
Huarango (*Acacia Macracantha*)	Montaña Azul	Piura	Lima	1.0	0.4	1.4	1.6
Huarango (*Acacia Macracantha*)	FOMECO	Lima	Lima	1.5	0.2	1.7	
Hualtaco	Montaña Azul	Piura	Lima	1.0	0.4	1.4	
Plantation site: Chincha and Pisco River Basins							
Plantation Species: Huarango (*Prosopis limensis*), Eucalipto, Casuarina							
Aliso	AGRIMEX	Ica	Ica	1.5	0.2	1.7	
Algarrobo	AGRIMEX	Ica	Ica	1.0	0.2	1.2	
Algarrobo	FOMECO	Lima	Ica	1.5	0.3	1.8	
Tamarix	AGRIMEX	Ica	Ica	7.0	0.2	7.2	
Bambú	AGRIMEX	Ica	Ica	3.0	0.2	3.2	
Pino	AGRIMEX	Ica	Ica	1.5	0.2	1.7	
Molle	FOMECO	Lima	Ica	1.5	0.3	1.8	
Casuarina	AGRIMEX	Ica	Ica	2.0	0.2	2.2	2.2
Eucalipto	AGRIMEX	Ica	Ica	1.2	0.2	1.4	1.4
Huarango (*Acacia macracantha*)	FOMECO	Lima	Ica	1.5	0.3	1.8	1.8
Plantation site: Yauca River Basin							
Plantation Species: Huarango (*Prosopis limensis*), Eucalipto, Casuarina							
Aliso	AGRIMEX	Ica	Arequipa	1.5	0.3	1.8	
Algarrobo	AGRIMEX	Ica	Arequipa	1.0	0.3	1.3	
Algarrobo	FOMECO	Huacayo	Arequipa	1.5	0.3	1.8	
Tamarix	AGRIMEX	Ica	Arequipa	7.0	0.3	7.3	
Bambú	AGRIMEX	Ica	Arequipa	3.0	0.3	3.3	
Pino	AGRIMEX	Ica	Arequipa	1.5	0.3	1.8	
Molle	FOMECO	Huacayo	Arequipa	1.5	0.3	1.8	
Casuarina	AGRIMEX	Ica	Arequipa	2.0	0.3	2.3	2.3
Eucalipto	AGRIMEX	Ica	Arequipa	1.2	0.3	1.5	1.5
Huarango (*Acacia macracantha*)	FOMECO	Huacayo	Arequipa	1.5	0.3	1.8	1.8

Forestation along River Protection Structure

Species	Seedling Provider	Seedling Production Site	Plantation Site	Unit Price (soles /seedling)	Transpotation Cost (soles /Seedling)	Total Cost (w/o VAT) (soles /seedling)	Used Cost (w/o VAT) (soles /seedling)
Plantation site: Camaná-Majes River Basin							
Plantation Species: Sauce, Casuarina							
Tara	APAIC	Arequipa	Arequipa	1.2	0.3	1.5	
Tara	LHDF	Arequipa	Arequipa	2.3	0.5	2.8	
Sauce	Grupo Verdes	Arequipa	Arequipa	1.7	0.5	2.2	2.3
Sauce	LHDF	Arequipa	Arequipa	2.3	0.5	2.8	
Casuarina	LHDF	Arequipa	Arequipa	2.3	0.5	2.8	2.8
Huarango	Grupo Verdes	Arequipa	Arequipa	1.7	0.5	2.2	
Alamo	LHDF	Arequipa	Arequipa	2.3	0.5	2.8	
Molle	LHDF	Arequipa	Arequipa	2.3	0.5	2.8	
Sauce	AGRORURAL	Arequipa	Arequipa	0.8	0.4	1.2	
Huarango	AGRORURAL	Arequipa	Arequipa	0.8	0.4	1.2	
Tara	AGRORURAL	Arequipa	Arequipa	1.4	0.4	1.8	*
Acacia	AGRORURAL	Arequipa	Arequipa	0.8	0.4	1.2	
Casuarina	AGRORURAL	Arequipa	Arequipa	0.8	0.4	1.2	

Nota: (Camaná-Majes River Basin)
- LHDF is an abbreviation of Los Girasoles de Florentino
- Height of seedlings provided by LHDF are 0.3 to 0.5m
- The seedling costs are estimated by a case of order of a hundred seedlings (except Casuarina)
- The price of AGRORURAL is just a reference, because the seedlings will be provided by communities. Therefore, the production number is not secured.

Forestation in Sierra

Species	Seedling Provider	Seedling Production Site	Plantation Site	Unit Price (soles /seedling)	Transpotation Cost (soles /Seedling)	Total Cost (w/o VAT) (soles /seedling)	Used Cost (w/o VAT) (soles /seedling)
Plantation site: Chincha River Basin							
Plantation Species: Pino, Queñual, Eucalipto							
Alamo	AGRORURAL	Huancavelica	Huancavelica	0.7	0.2	0.9	
Aliso	AGRIMEX	Ica	Huancavelica	1.5	0.4	1.9	
Aliso	AGRIMEX	Ica	Huancavelica	1.5	0.4	1.9	
Queñual	AGRORURAL	Huancavelica	Huancavelica	0.7	0.2	0.9	0.9
Colle	AGRORURAL	Huancavelica	Huancavelica	0.7	0.2	0.9	
Colle	FOMECO	Huancavelica	Huancavelica	1.5	0.2	1.7	
Tara	FOMECO	Lima	Huancavelica	1.5	0.4	1.9	
Pino	AGRORURAL	Huancavelica	Huancavelica	0.7	0.2	0.9	1.4
Pino	AGRIMEX	Ica	Huancavelica	1.5	0.4	1.9	
Eucalipto	AGRORURAL	Huancavelica	Huancavelica	0.7	0.2	0.9	
Eucalipto	AGRIMEX	Ica	Huancavelica	1.2	0.4	1.6	1.5
Eucalipto	FOMECO	Lima	Huancavelica	1.5	0.4	1.9	

Source: JICA Study Team based on Hearing from Seedling Prodivers

Appendix 7 Table 3　List of Communitiy Nurseries

(1)

River Basin	No. of Nurseries	Legion	Province	District	Name of Nurseries	Capacities of Nurseries (Seedlings/nursery)	Area of Nurseries (m2)	Date of Starting Production
Cañete	2872	LIMA	YAUYOS	CACRA	CACRA	2500	150	
	2873	LIMA	YAUYOS	AZANGARO	VILLAFLOR	0	80	
	2874	LIMA	YAUYOS	AYAUCA	ALLAUCA	7500	200	
	2875	LIMA	YAUYOS	HUANTAN	HUANTAN	10000	200	
	2876	LIMA	YAUYOS	YAUYOS	AQUICHA	7500	150	
	2877	LIMA	YAUYOS	YAUYOS	YAUYOS	2500	90	
	2879	LIMA	YAUYOS	MIRAFLORES	MIRAFLORES	5000	170	
	2881	LIMA	YAUYOS	HUANCAYA	HUANCAYA	5000	150	
	2882	LIMA	YAUYOS	VITIS	VITIS	7500	200	
	2884	LIMA	YAUYOS	MADEAN	MADEAN	5000	150	
	2885	LIMA	YAUYOS	YAUYOS	MAGDALENA	5000	80	
	3211	LIMA	YAUYOS	HUANCAYA	HUANCAYA	5000	150	
	3212	LIMA	YAUYOS	VITIS	VITIS	7500	200	
	3213	LIMA	YAUYOS	MIRAFLORES	MIRAFLORES	5000	170	
	3215	LIMA	YAUYOS	TOMAS	TOMAS	5000	180	
	3216	LIMA	YAUYOS	TOMAS	HUANCACHI	10000	200	
	3218	LIMA	YAUYOS	LARAOS	LARAOS	10000	190	
	3219	LIMA	YAUYOS	HUANTAN	HUANTAN	10000	200	
	3220	LIMA	YAUYOS	AYAUCA	ALLAUCA	7500	200	
	3221	LIMA	YAUYOS	AZANGARO	VILLAFLOR	0	80	
	3222	LIMA	YAUYOS	CACRA	CACRA	2500	150	
	3223	LIMA	YAUYOS	MADEAN	MADEAN	5000	150	
	3224	LIMA	YAUYOS	YAUYOS	MAGDALENA	5000	80	
	3225	LIMA	YAUYOS	YAUYOS	YAUYOS	2500	90	
	3226	LIMA	YAUYOS	YAUYOS	AQUICHA	7500	150	
	4508	LIMA	YAUYOS	CARANIA	CARANIA	10000	220	01/01/2010
	4510	LIMA	YAUYOS	YAUYOS	AQUICHA	10000	100	
	4511	LIMA	YAUYOS	TUPE	TUPE	10000	250	
	4512	LIMA	YAUYOS	YAUYOS	YAUYOS	10000	120	
	4513	LIMA	YAUYOS	HUANCAYA	VILCA	10000	150	
	4515	LIMA	YAUYOS	HUANCAYA	HUANCAYA	10000	250	01/03/1999
	4516	LIMA	YAUYOS	VITIS	VITIS	10000	120	01/03/2006
	4517	LIMA	YAUYOS	TOMAS	HUANCACHI	10000	220	01/03/1999
	4518	LIMA	YAUYOS	COLONIA	BELLA VISTA	0	0	15/03/2009
	4519	LIMA	YAUYOS	AYAUCA	QUIRIMAN	10000	100	13/05/2010
	4521	LIMA	YAUYOS	COLONIA	CUSI	10000	200	14/04/2010
	4522	LIMA	YAUYOS	AYAUCA	ALLAUCA	10000	250	01/11/2009
	4523	LIMA	YAUYOS	YAUYOS	MAGDALENA	10000	275	19/11/2008
	4524	LIMA	YAUYOS	MADEAN	MADEAN	10000	150	01/04/2009
	4525	LIMA	YAUYOS	AZANGARO	VIÑAC	10000	220	01/01/2000
	4526	LIMA	YAUYOS	CACRA	CACRA	0	150	01/01/2009
	4685	HUANCAVELICA	HUANCAVELICA	MOYA	YANAYACU	2000	180	01/03/2010
	4784	LIMA	YAUYOS	YAUYOS	YAUYOS	10000	120	01/01/2010
Chincha	4621	HUANCAVELICA	CASTROVIRREYNA	AURAHUA	AURAHUA	10000	690	02/04/2006
	4622	HUANCAVELICA	CASTROVIRREYNA	CHUPAMARCA	MEJORADA	5000	224	12/02/2008
	4623	HUANCAVELICA	CASTROVIRREYNA	CHUPAMARCA	VILLA FLOR	4500	60	15/02/2008
	4624	HUANCAVELICA	CASTROVIRREYNA	AURAHUA	MALLQUI	6000	112	12/03/1998
	4625	HUANCAVELICA	CASTROVIRREYNA	CHUPAMARCA	PAMPAJUNIN	8000	255	01/04/2009
	4626	HUANCAVELICA	CASTROVIRREYNA	TANTARA	TANTARÁ	7500	500	12/01/2003
	4627	HUANCAVELICA	CASTROVIRREYNA	HUAMATAMBO	MUYUHUASI	10000	500	22/02/1999
	4628	HUANCAVELICA	CASTROVIRREYNA	HUAMATAMBO	HUANCAYA	2500	40	01/01/2008
	4629	HUANCAVELICA	CASTROVIRREYNA	CHUPAMARCA	CHUPAMARCA	8500	150	01/03/2008
	4630	HUANCAVELICA	CASTROVIRREYNA	CHUPAMARCA	COLCABAMBA	5000	500	12/
	4631	HUANCAVELICA	CASTROVIRREYNA	AURAHUA	CENTRAL	5000	236	04/04/2000
	4632	HUANCAVELICA	CASTROVIRREYNA	CHUPAMARCA	CHANCAHUASI	5000	300	01/04/2005
Pisco	4601	HUANCAVELICA	CASTROVIRREYNA	CASTROVIRREYNA	CABRACANCHA	8000	625	01/04/2008
	4602	HUANCAVELICA	CASTROVIRREYNA	CASTROVIRREYNA	COCHA	5000	400	01/04/2008
	4603	HUANCAVELICA	CASTROVIRREYNA	CASTROVIRREYNA	CRUZ PATA	5000	400	01/04/2008
	4604	HUANCAVELICA	CASTROVIRREYNA	HUACHOS	OCORO	15000	960	01/04/2008
	4605	HUANCAVELICA	CASTROVIRREYNA	CASTROVIRREYNA	PATACORRAL	5000	600	02/02/2008
	4606	HUANCAVELICA	CASTROVIRREYNA	HUACHOS	SUYTUPAMPA	6000	300	04/04/2008
	4607	HUANCAVELICA	CASTROVIRREYNA	MOLLEPAMPA	ASTOMARCA	7500	350	01/01/2008
	4608	HUANCAVELICA	CASTROVIRREYNA	COCAS	SAN FRANCISCO COCAS	5000	170	15/01/2008
	4609	HUANCAVELICA	CASTROVIRREYNA	COCAS	TACMA	4500	100	30/01/2008
	4610	HUANCAVELICA	CASTROVIRREYNA	CASTROVIRREYNA	CASTROVIRREYNA	7000	320	10/04/2008
	4611	HUANCAVELICA	CASTROVIRREYNA	CASTROVIRREYNA	CHUNCACC	7500	40	01/03/2008
	4612	HUANCAVELICA	CASTROVIRREYNA	CASTROVIRREYNA	ESMERALDA	5000	200	01/03/2008
	4613	HUANCAVELICA	CASTROVIRREYNA	TICRAPO	LLACTAS	6000	340	01/03/2008
	4614	HUANCAVELICA	CASTROVIRREYNA	CASTROVIRREYNA	SINTO	5000	180	01/03/2008
	4615	HUANCAVELICA	HUAYTARA	QUITO-ARMA	CCOLLCCAPAMPA	14000	100	01/03/2008
	4616	HUANCAVELICA	HUAYTARA	HUAYACUNDO ARMA	HUAYACUNDO ARMA	1000	100	01/05/2010
	4617	HUANCAVELICA	HUAYTARA	CUSICANCHA	TAMBO DE CUSICANCHA	8000	250	01/03/2008
	4618	HUANCAVELICA	HUAYTARA	HUAYTARA	ACCO	5000	150	01/02/2006
	4619	HUANCAVELICA	HUAYTARA	HUAYTARA	HUATAS	12000	450	01/03/2008
	4620	HUANCAVELICA	HUAYTARA	HUAYTARA	NEGREYCCASA	10000	300	01/03/2008
	5736	HUANCAVELICA	CASTROVIRREYNA	CASTROVIRREYNA	VISTA ALEGRE	6500	300	01/03/2011
	5737	HUANCAVELICA	HUAYTARA	HUAYTARA	SAN JUAN DE MUCHIC	10000	400	06/05/2010

Source: JICA Study Team based on hearing from AGRORURAL

Appendix 7 Table 3　List of Communitiy Nurseries

(2)

River Basin	No. of Nurseries	Legion	Province	District	Name of Nurseries	Capacities of Nurseries (Seedlings/nursery)	Area of Nurseries (m2)	Date of Starting Production
Yauca	3723	AYACUCHO	PAUCAR DEL SARA SARA	SAN JOSE DE USHUA	USHUA	2500	100	30/07/2008
	3904	AYACUCHO	LUCANAS	CHAVIÑA	PUEBLO NUEVO	7000	300	25/10/2008
	3905	AYACUCHO	LUCANAS	CHAVIÑA	NUEVA ESPERANZA	8000	400	25/10/2008
	3906	AYACUCHO	LUCANAS	CHAVIÑA	PARA	2500	600	25/10/2008
	3907	AYACUCHO	LUCANAS	CHAVIÑA	LA MERCED	7000	1000	25/10/2008
	3908	AYACUCHO	PARINACOCHAS	CORACORA	HUAYLLANI	7000	400	25/10/2008
	3909	AYACUCHO	LUCANAS	SANCOS	CHAQUIPAMPA	15000	650	15/10/2008
	3918	AYACUCHO	PARINACOCHAS	CHUMPI	ACOS	6000	720	15/02/2008
	3919	AYACUCHO	PARINACOCHAS	CHUMPI	CARHUANILLA	9500	1600	10/03/2008
	3920	AYACUCHO	PARINACOCHAS	CHUMPI	SARAMARCA	13000	400	15/03/2008
	3922	AYACUCHO	PARINACOCHAS	CORACORA	MUCHAPAMPA	7300	90	10/06/2008
	3923	AYACUCHO	PARINACOCHAS	CORACORA	NIÑO SALVADOR	8400	180	05/07/2008
	3924	AYACUCHO	PARINACOCHAS	CHUMPI	CHUMPI	10800	180	27/07/2008
	3925	AYACUCHO	PARINACOCHAS	CHUMPI	BELLAVISTA	5700	240	01/08/2008
	3932	AYACUCHO	PARINACOCHAS	PULLO	PINAHUA	15000	300	01/05/2008
	3934	AYACUCHO	PARINACOCHAS	PULLO	PULLO	12000	800	04/01/2008
	3935	AYACUCHO	PARINACOCHAS	PULLO	SACSARA	8000	400	13/05/2008
	3936	AYACUCHO	PARINACOCHAS	PULLO	OCCOSUYO	10000	600	03/01/2008
	3937	AYACUCHO	PARINACOCHAS	PULLO	CHUSI	12500	300	15/01/2008
	3938	AYACUCHO	PARINACOCHAS	PULLO	MANZANAYOCC	12500	300	16/01/2008
	4015	AYACUCHO	LUCANAS	SAN PEDRO	YURACCHANCHA	5000	300	2007
	4016	AYACUCHO	LUCANAS	SAN PEDRO	PACCCHA	5000	250	2007
Camaná Majes	2464	AREQUIPA	LA UNION	PAMPAMARCA	CCOCHAPAMPA	12000	140	05/08/2008
	2498	AREQUIPA	CONDESUYOS	CHUQUIBAMBA	PAPACHACRA	0	500	06/06/2008
	2499	AREQUIPA	CONDESUYOS	CHUQUIBAMBA	SUMAY CHICO	5000	200	03/03/2008
	2500	AREQUIPA	CONDESUYOS	IRAY	IRAY	9600	800	
	2501	AREQUIPA	CONDESUYOS	CHUQUIBAMBA	COLLPANCA - PARAC	6000	100	08/10/2008
	2502	AREQUIPA	CONDESUYOS	CHUQUIBAMBA	COPACABANA BUENA ESPERANZA	12000	100	06/06/2008
	2503	AREQUIPA	CONDESUYOS	CHUQUIBAMBA	CHOJANITAYOC - CRISTAL PUQUIO	1900	150	01/01/2008
	2504	AREQUIPA	CONDESUYOS	CHUQUIBAMBA	CARMEN ALTO	1300	48	09/08/2008
	2505	AREQUIPA	CONDESUYOS	IRAY	CASCONZA	1800	120	25/09/2008
	2506	AREQUIPA	CONDESUYOS	IRAY	AREQUIPILLA	12000	400	05/06/2008
	2517	AREQUIPA	CASTILLA	VIRACO	VIRACO	40000	300	02/09/2008
	2518	AREQUIPA	CASTILLA	PAMPACOLCA	ESCAURAS	6000	80	
	2519	AREQUIPA	CASTILLA	VIRACO	HUAMI	5000	60	01/03/2008
	2520	AREQUIPA	CASTILLA	MACHAGUAY	MACHAHUAY	5000	150	
	2521	AREQUIPA	CASTILLA	MACHAGUAY	ARHUIN	5000	100	02/03/2008
	2522	AREQUIPA	CASTILLA	MACHAGUAY	HUASICAC	5000	80	01/03/2008
	2524	AREQUIPA	CASTILLA	CHACHAS	CHACHAS	6000	120	01/11/2007
	2525	AREQUIPA	CASTILLA	AYO	ACHO	2500	120	16/12/2007
	2526	AREQUIPA	CASTILLA	CHACHAS	NAHUIRA	10000	200	01/12/2007
	2527	AREQUIPA	CASTILLA	ANDAGUA	SOPORO	6000	250	01/12/2007
	2528	AREQUIPA	CASTILLA	AYO	AYO	1400	100	16/01/2008
	2529	AREQUIPA	CASTILLA	ANDAGUA	ANDAHUA	2000	150	01/12/2007
	2530	AREQUIPA	CASTILLA	ANDAGUA	SAN ANTONIO	5000	250	01/10/2007
	2531	AREQUIPA	CASTILLA	ORCOPAMPA	MISAHUANCA	7500	600	01/12/2007
	2532	AREQUIPA	CASTILLA	ORCOPAMPA	HUANCARAMA	7000	500	01/10/2007
	2533	AREQUIPA	CASTILLA	ORCOPAMPA	ZARPANI	2000	100	01/12/2007
	2534	AREQUIPA	CASTILLA	ORCOPAMPA	ORCOPAMPA	1400	150	17/01/2008
	2535	AREQUIPA	CASTILLA	ORCOPAMPA	ORCOPAMPA	4500	400	16/12/2007
	2536	AREQUIPA	CASTILLA	ORCOPAMPA	ORCOPAMPA	1000	450	01/11/2007
	2537	AREQUIPA	CASTILLA	CHILCAYMARCA	HUILLUCO	2000	150	01/12/2007
	2538	AREQUIPA	CASTILLA	ORCOPAMPA	PANAGUA	0	200	01/01/2008
	2539	AREQUIPA	CASTILLA	CHILCAYMARCA	CHILCAYMARCA	4000	250	14/11/2007
	2540	AREQUIPA	CASTILLA	CHILCAYMARCA	CHAPACOCO	0	150	
	2564	AREQUIPA	CAYLLOMA	CABANACONDE	CABANACONDE	0	500	20/08/2008
	2565	AREQUIPA	CAYLLOMA	CABANACONDE	PINCHOLLO	8000	200	07/07/2008
	2566	AREQUIPA	CAYLLOMA	MACA	MACA	0	300	10/08/2008
	2567	AREQUIPA	CAYLLOMA	MADRIGAL	MADRIGAL	5000	300	
	2568	AREQUIPA	CAYLLOMA	ICHUPAMPA	ICHUPAMPA	8000	400	
	2569	AREQUIPA	CAYLLOMA	COPORAQUE	COPORAQUE	5000	500	
	2570	AREQUIPA	CAYLLOMA	LARI	LARI	8000	600	
	2571	AREQUIPA	CAYLLOMA	TISCO	CAPACCHAPI II	1500	300	
	2574	AREQUIPA	CAYLLOMA	CALLALLI	CHICHAS	2500	250	
	2575	AREQUIPA	CAYLLOMA	CALLALLI	PULPERA	2500	400	
	2576	AREQUIPA	CAYLLOMA	CALLALLI	CALLALLI	1400	400	
	2578	AREQUIPA	CAYLLOMA	SIBAYO	SIBAYO	20000	1242	
	2579	AREQUIPA	CAYLLOMA	TUTI	TUTI	10000	957	10/11/1986
	2580	AREQUIPA	CAYLLOMA	CHIVAY	CANOCOTA	20000	684	10/10/1995
	2581	AREQUIPA	CAYLLOMA	CHIVAY	CHIVAY	30000	673	
	2582	AREQUIPA	CAYLLOMA	YANQUE	YANQUE	30000	608	
	2583	AREQUIPA	CAYLLOMA	ACHOMA	ACHOMA	20000	516	
	2584	AREQUIPA	CAYLLOMA	HUAMBO	HUAMBO	12000	180	08/12/2007
	2585	AREQUIPA	CAYLLOMA	HUAMBO	CHININI	6000	180	10/11/2007

Source: JICA Study Team based on hearing from AGRORURAL

Ministry of Agriculture
Republic of Peru

THE PREPARATORY STUDY
ON
PROJECT OF THE PROTECTION OF FLOOD PLAIN AND VULNERABLE RURAL POPULATION AGAINST FLOOD IN THE REPUBLIC OF PERU

FINAL REPORT
I-6 SUPPORTING REPORT
ANNEX-8 FACILITY PLAN AND DESIGN

March 2013

JAPAN INTERNATIONAL COOPERATION AGENCY
(JICA)

YACHIYO ENGINEERING CO., LTD.
NIPPON KOEI CO., LTD.
NIPPON KOEI LATIN AMERICA –
CARIBBEAN Co., LTD.


COLOMBIA
ECUADOR
PIURA
LORETO
Iquitos
Amazon
Chira River
AMAZONAS
Chachapoyas
Moyobamba
Tarapoto
LAMBAYEQUE
CAJAMARCA
SAN MARTIN
BRAZIL
PERU
LA LIBERTAD
Pucallpa
ANCASH
Huaraz
HUANUCO
UCAYALI
SOUTH PASIFIC OCEAN
PASCO
LIMA
リマ州
JUNIN
MADRE DE DIOS
Canete River
CUSCO
Chincha River
HUANCAVELICA
Pisco River
APURIMAC
AYACUCHO
PUNO
ICA
イカ州
BOLIVIA
Yauca River
AREQUIPA
アレキパ州
MOQUEGUA
Majes-Camana River
TACNA
CHILE
Legend

Study Area

ABBREVIATION

Abbreviation	Official Form or Meaning
ANA	Autoridad Nacional del Agua/National Water Authority
ALA	Autoridad Local del Agua/Local Water Authority
B/C	Costo Benefit Ratio/Benefit Cost Ratio
GDP	Gross Domestic Product/Gross Domestic Product
GIS	Geographic Information System/Geographic Information System
DGAA	Dirección General de Asuntos Ambientales/General Directorate of Environmental Affairs
DGFFS	Dirección General de Forestal y de Fauna Silvestre/Directorate General of Forest and Wildlife
DGIH	Dirección General de Infraestructura Hidráulica/Directorate General for Water Infrastructure
DGPI (Paleo-DGPM)	Dirección General de Política de Inversiones/Directorate General of Investment Policy
DNEP	Dirección Nacional de Endeudamiento Público/National Directorate of Public Debt
DRA	Dirección Regional de Aguricultura/Regional Directorate Aguriculture
EIA	Evaluación de Impacto Ambiental/Environmental Impact Assessment
FAO	Agricultura y la Alimentación Organización de las Naciones Unidas/ Food and Agriculture Organization of the United Nations
F/S	Estudio de Factibilidad/ Feasibility Study
GORE	Gobierno Regional/Regional Government
HEC-HMS	Centros de Ingeniería Hidrológica Sistema de Modelación Hidrológica Método /Hydrologic Engineering Centers Hydrologic Modeling System Method
HEC-RAS	Centros de Ingeniería Hidrológica del Río de Análisis del Sistema Métode /Hydrologic Engineering Centers River Analysis System Method
IGN	Instituto Geográfico Nacional/National Geographic Institute
IGV	Impuesto General a Ventas/General Sales Tax
INDECI	Instituto Nacional de Defensa Civil/National Institute of Civil Defense
INEI	Instituto Nacional de Estadística/National Institute of Statistics
INGEMMET	Instituto Nacional Geológico Minero Metalúrgico/National Geological and Mining Metallurgical Institute
INRENA	Instituto Nacional de Recursos Naturales/Natural Resources Institute
IRR	Tasa Interna de Retorno (TIR)/Internal Rate of Return
JICA	Japonés de Cooperación Internacional /Japan International Cooperation Agency
JNUDRP	Junta Nacional de Usuarios de Distritos del Perú/National Board of Peru Districts Users
L/A	Convenio de Préstamo/Loan Agreement
MEF	Ministerio de Economía y Finanzas/Ministry of Economy and Finance
MINAG	Ministerio de Agricultura/Ministry of Agriculture
M/M	Acta de la reunion/Minutes of Meeting
NPV	Valor Actual Neto (VAN)/NET PRESENT VALUE

O&M	Operación y Mantenimiento /Operation and maintenance
OGA	Oficina General de Administración/General Office of Administration
ONERRN	Oficina Nacional de Evaluación de Recursos Naturales/National Bureau of Natural Resource Evaluation
OPI (OPP)	Oficina de Programación e Inversiones/Programming and Investment Office (Oficina de Planificación e Prespuesto/Office of Planning and Budget)
PBI	Producto Bruto Interno/Gross Domestic Product
PE	Exp. Proyecto Especial (PE) Chira-Piura/Exp. Special Project Chira-Piura
PES	Pago por Servicos Ambientales (PSA)/Payment for Environmental Services
PERFIL	PERFIL/PROFILE (Preparatory survey of project before investment)
Pre F/S	Estudio de Prefactibilidad /Pre-Feasibility Study
PERPEC	Programa de Encauzamiento de Ríos y protección de Estructura de Captación
PRONAMACHIS	Programa Nacional de Manejo de Cuencas Hidrográficas y Conservación de Suelos/National Program of River Basin and Soil Conservation Management
PSI	Programa de Sub Sectorial de Irrigaciones/Program of Sub Irrigation Sector
SCF	Factor de conversión estándar/Standard conversion factor
SENAMHI	Servicio Nacional de Meteorología y Hidrología/ National Service of Meteorology and Hydrology
SNIP	Sistema Nacional de Inversión Pública/National Public Investment System
UF	Unidad formuladora/Formulator unit
VALLE	Valle/Valley
VAT	Impuesto al valor agregado/Value-added tax

THE PREPARATORY STUDY ON PROJECT OF THE PROTECTION
OF
FLOOD PLAIN AND VULNERABLE RURAL POPULATION AGAINST FLOOD
IN THE REPUBLIC OF PERU
FEASIBILITY STUDY REPORT
SUPPORTING REPORT

Annex-8
Facility Plan and Design

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CHAPTER 1 BASIC POLICY FOR RIVER FACILITY PLAN

The sections which should be improved with high priorities for targeted six (6) rivers were selected based on requests by interview and outputs by flood analysis, etc. Basic policies for the river improvement works are shown as follows.

(1) The Basic Policy of Improvement Works

The basic policies for improvement works are to design flood control facilities for floods and sediment control in consideration of the characteristic of the rivers. The basic policies of the technical viewpoints are shown below.

1) Dike which fixes channel and riverbed excavation and channel widening which secure the discharge capacity
2) Revetment work which protects dike (including groin work)
3) Retarding basin which controls flood water
4) Erosion control facility which control sediment discharge (sand pocket, etc.)

As for the design method and the construction method, not only the cost and the technique of local contractors are taken into consideration, but also design for facilities is carried out in consideration of utilization of material with easy procurement near the sites.

(2) Considerations for Facility Plan and Design

1) Fixation of channel by dike, depth footing for revetment, and foot protection

In steep rivers with much sediment discharge like the targeted river, sand and gravel bars are formed on the river bed, and concentration of flood flow takes place.

Resulting from those phenomena, the dike collapse by the scouring and the erosion of riverbank makes a factor of flood disaster. A lot of sediment flow also makes a factor which urges advance of sand and gravel bar, and moves water colliding front. In consideration of making fix channel with dike and coping against move of water colliding front, sufficient depth of footing and revetment should be planned and designed. Moreover, installation of foot protection for the protection of dike and revetment shall be also planned and designed.

2) Groin

As one of the protection works for dike body and riverbank, groin is major measures. As for groins, length and intervals are important factors. In experiences of rivers in Japan, length of groin is commonly set less than 10% of river width in order to minimize influence to the opposite riverside. The structure of groin shall be planned and designed to bear with the high velocity in the river and collisions by stones and gravels.

3) Retarding Basin and Sand Pocket

Retarding basin and sand pocket are considered as mitigation measures for the flood and sediment discharge to downstream. Retarding basin is expected to be filled up immediately by sediment inflow and becomes difficult to secure the design storage volume. Therefore, it is considered to arrange the facility which can be expected the function of both for retarding water and storage of sand. In this case, the land acquisition and the periodical sediment removal for maintenance works shall be required.

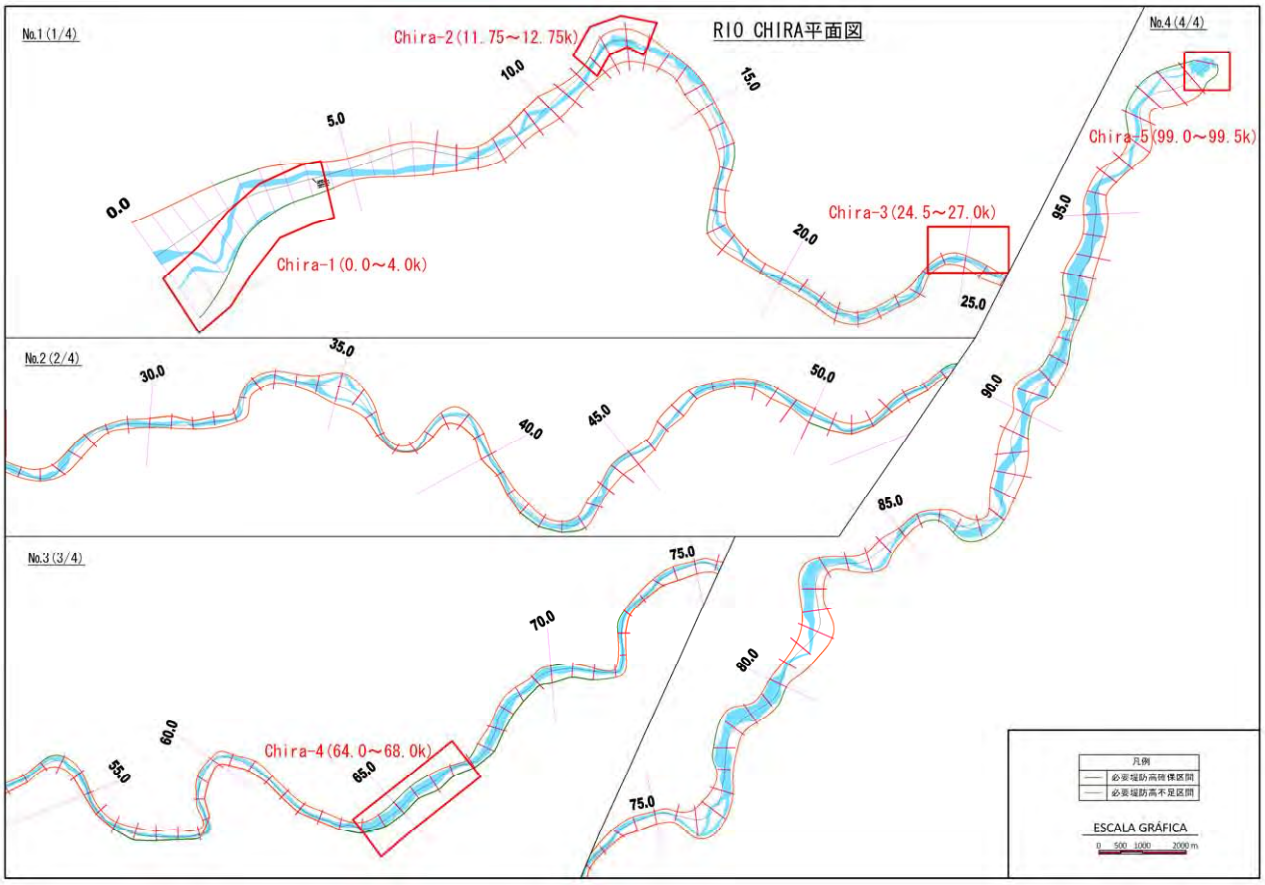
4) Sediment Control Facility Plan

The sediment control facility such as sand pocket shall be planned and designed in order to control the sediment discharge, and prevent the channel blockade as well as the river bed aggradation.

CHAPTER 2 RIVER FACILITY PLAN AND DESIGN

The improvement sections and facility plans in each river are shown as below.

2.1 Chira River



Overall plan

Since the discharge capacity is insufficient on the whole in the Chira River, flood water tend to overflows at all the points and flood flow spreads widely in the lowland along the river channel. In the Chira River, Poechos Dam has a role of flood control for small scaled floods, however, it cannot control for the scale exceeding the design probability of the dam operation, and make severe damages in downstream section.

Fundamentally, it is important for the river improvement plan for floods in the Chira River to commence from the downstream section. For planning, these sections for improvement plan are selected by taking into account the situations of hinterland, the important infrastructures in the areas as well as protecting damaged areas in the past.

Outline of Facility (Chira River－1)

No	Sections for Improvement	Improvement Plan
Chira River -1	0.0km～4.0km (Left-bank side)	This section is in the situation that the revetment works is not done, although the present dike is constructed, and the dike had scoring by the flood in 1998. Therefore, when flood continues over long period, erosion progresses and dike break occurs, the important facilities (gas fields, farmlands, etc.) located in the hinterland will be damaged. Moreover, the sections which groin installed instead of revetment are also damaged. Although the groin has a function for turning of water course, taking into consideration on importance of infrastructures in the hinterland, revetment work shall be done in these sections. **<Characteristic of Sections for Improvement>** • Sections where the dike received erosion by the flood in 1998 • Sections which has the possibility that the dike receives erosion and collapses in case of large-scale flood due to no revetment. • Sections which needs the revetment works for measures against erosion **<Protected Areas>** o Vast farmland and natural-gas field, etc. Which spread in the left-bank side in the section for improvement **<Improvement Plan (How? / How much?)>** ▼ Existing bank shall be used effectively, the embankment works and the revetment works shall be carried out, and discharge capacity shall be secured, and the measures against bank erosion shall be also implemented. ▼ In order to protect the vast farmlands and gas fields, the facilities shall be designed in consideration of enduring against the discharge of about 3600m3/s (about 1/50 year probable flood scale) suffering damages at the time of El Nino in the past.

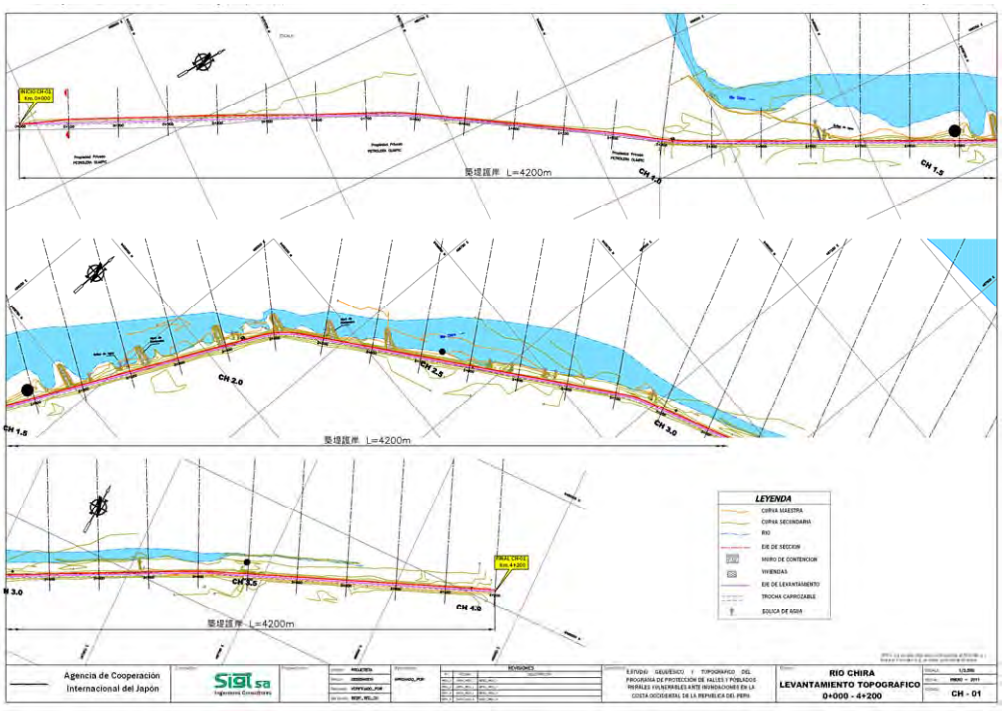


Figure 2.1　Facility Plan in Chira River -1

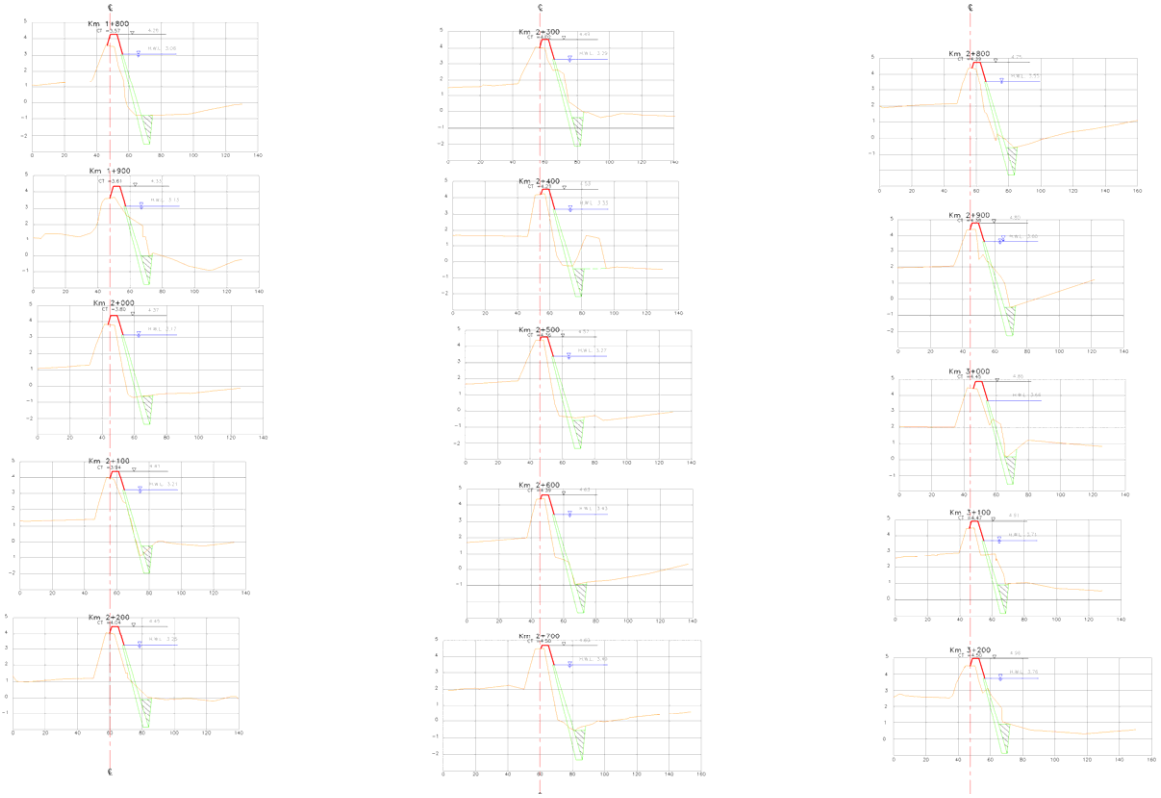


Figure 2.2 Typical Cross Section in Chira River-1

Outline of Facility (Chira-2)

No	Sections for Improvement	Improvement Plan
Chira River -2	11.75km～ 12.75km (Right-bank side)	This section curves greatly, the right-bank is eroded remarkably, and the present channel is formed. When leave present situation as it is, there is very high possibility of collapse in local main roads located in the right-bank. Therefore, revetment works shall be done, and present channel shall be maintained as much as possible. Maintaining the storage effects by river channel, the planning for road shall be done. (In consideration of the impacts to the regional economy caused by road collapse). **<Characteristic of Sections for Improvement>** • Sections where there is high danger of local main road collapsing by the dike erosion at the time of flood • Sections which should carry out the erosion control of riverbank and the functional preservation for local main roads, simultaneously. **<Protected Areas>** o Local main roads located in the right-bank **<Improvement Plan >** ▼ Since the impact by collapsing of local main road is great, the safety level shall be ensured for the scale of occurrence of El Nino, etc. (about 1/50 year probable flood scale). ▼ Revetment works shall be done in sections eroded by disasters.

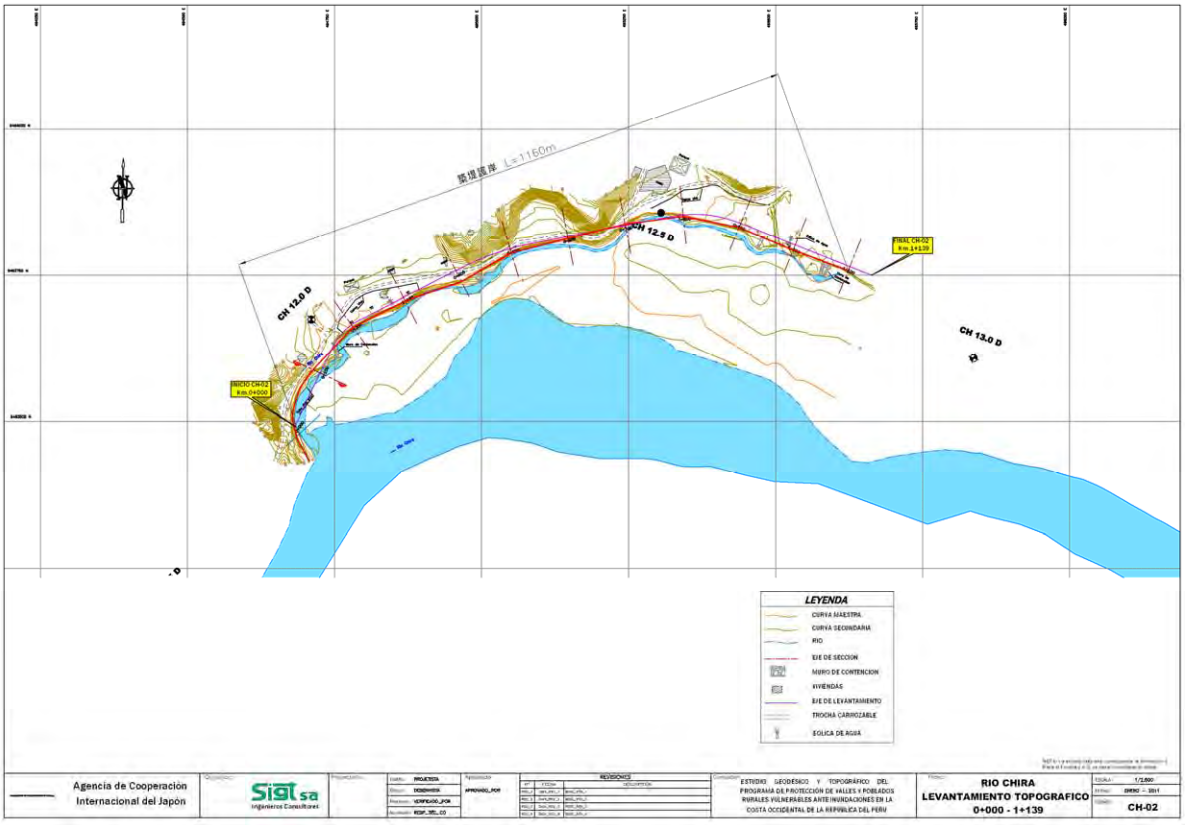


Figure 2.3 Facility Plan in Chira River-2

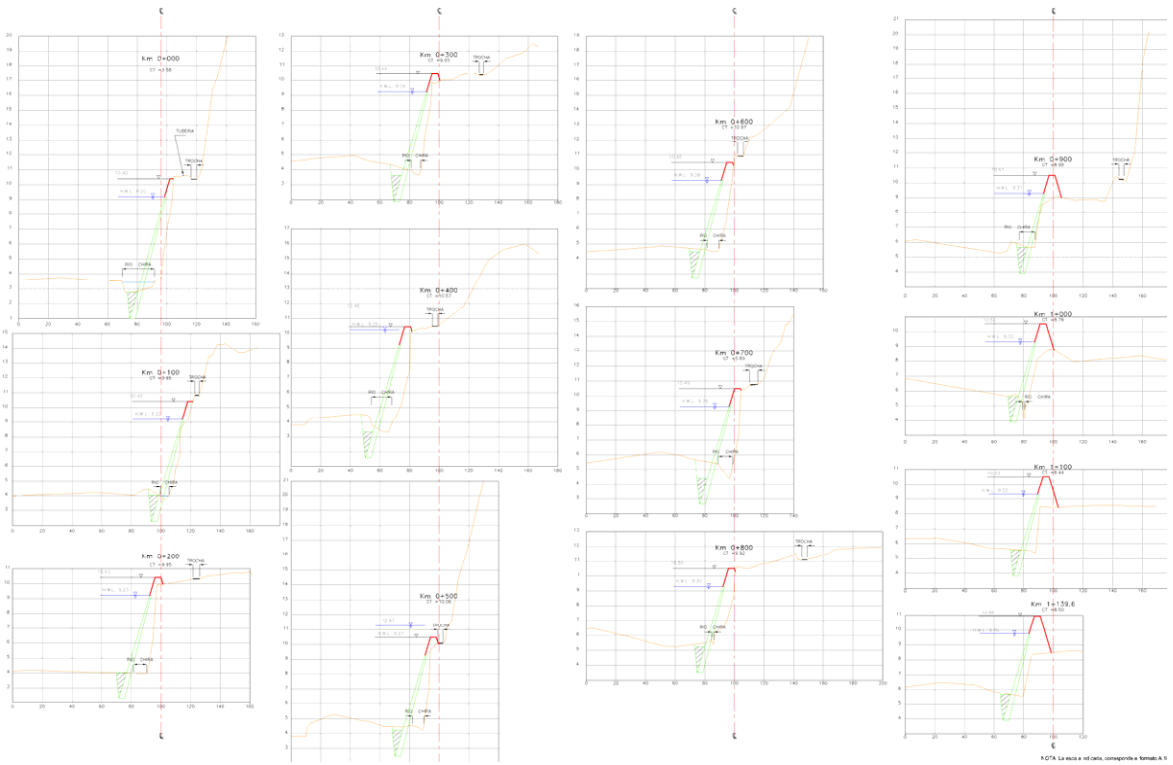


Figure 2.4 Typical Cross Section in Chira River-2

Outline of Facility (Chira River-3)

No	Sections for Improvement	Improvement Plan
Chira River-3	24.5km～27.0km (Right-bank side)	Sections where the right-bank side suffered serious damage by the past flood. The tentative dike with road combination has been constructed, and the maintenance which utilized this facility is important. By constructing the tentative dike with large width than usual, the retarding effects are enhanced, and the water level in the upstream is raise. In order to raising the safety factor in flood control plan in the Chira River , it is important to design many retention areas like these sections, and to lower the water level in the whole river. Since height of current tentative dike is not planned by designated design height, raise of bank shall be needed for the secure of retention function as much as possible against the floods. **<Characteristic of Sections for Improvement>** • Sections where the dike had eroded by the flood in 1998 • Sections which should use the present tentative dike effectively, should heighten the retention effect, and should plan the upstream water-level going down **<Protected Areas>** o Farmland in the right-bank in the planned sections **<Improvement Plan (How? and How much?)>** ▼ In order to protect the vast farmlands of the right-bank side, and to raise retention effect as much as possible, while utilizing the function of present tentative bank effectively, based on experiences which suffered damage from past El Nino, river improvement which does not suffer a great deal of damages even if El Nino occurs shall be done. ▼ By heightening the bank road improved after disaster, the discharge capacity and the retarding effect shall be secured.

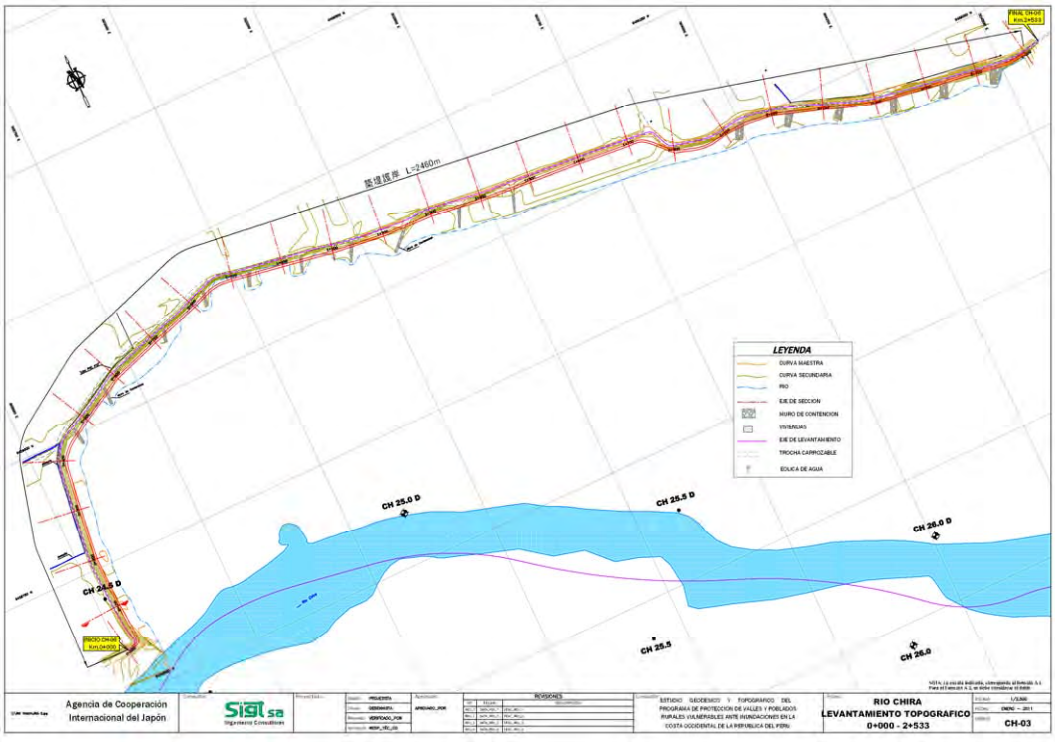


Figure 2.5 Facility Plan in Chira River-3

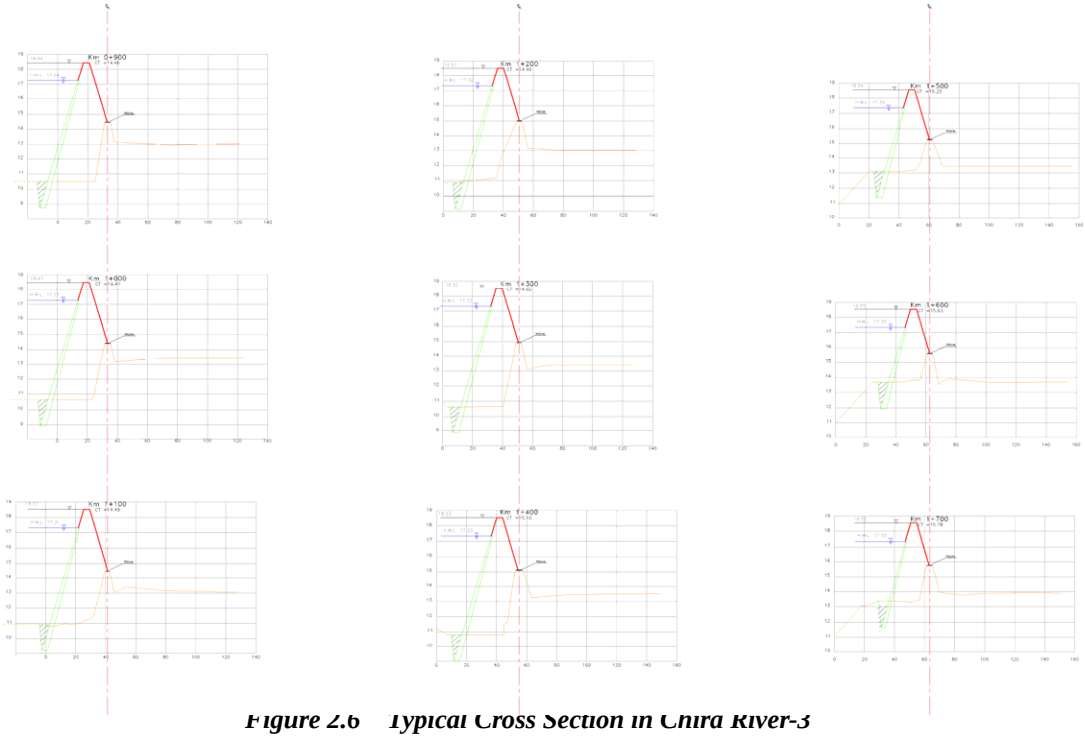


Figure 2.6 Typical Cross Section in Chira River-3

Outline of Facility (Chira River-4)

No	Sections for Improvement	Improvement Plan
Chira River-4	64.0km～68.0km (Whole area)	Sections where the large-scale intake weir (Sullana Weir) is constructed. In the present condition of Sullana Weir, sediment deposits and growth of trees are in progress in the upstream part of the right-bank of the fixed weir (spillway). Caused by influences, the left-bank side which is the opposite side is eroded. If it is neglected as it is, there is possibility that the growth of trees and the function of the sluicegate weir in the left-side bank will be spoiled. Therefore, from the viewpoint of importance of the weir and safety securement of the movable weir, removing the trees and sedimentation in the right-bank of the upstream part of the fixed weir is important in order to stabilize the flow regime at the time of flood, and also to maintain the facility. **<Characteristic of Sections for Improvement>** • Sections where sediment accumulates and trees grow in the right-bank side in the upstream part of the intake weir • Sections where the flood flow concentrates to the movable weir, and the erosion advances in left-bank side. **<Protected Areas>** o Intake weir (Sullana Weir) **<Improvement Plan (How? and How much?)>** ▼ Since the Sullana Weir has the most important roles as river facilities, and has the big influences when damaged by floods, this weir shall be designed to avoid severe damages. ▼ In order to secure the discharge capacity of the upstream of the Sulyana Weir, the trees thickly covered in the upper right-bank of the weir should be cut down, and sediment deposit shall be also dredged.

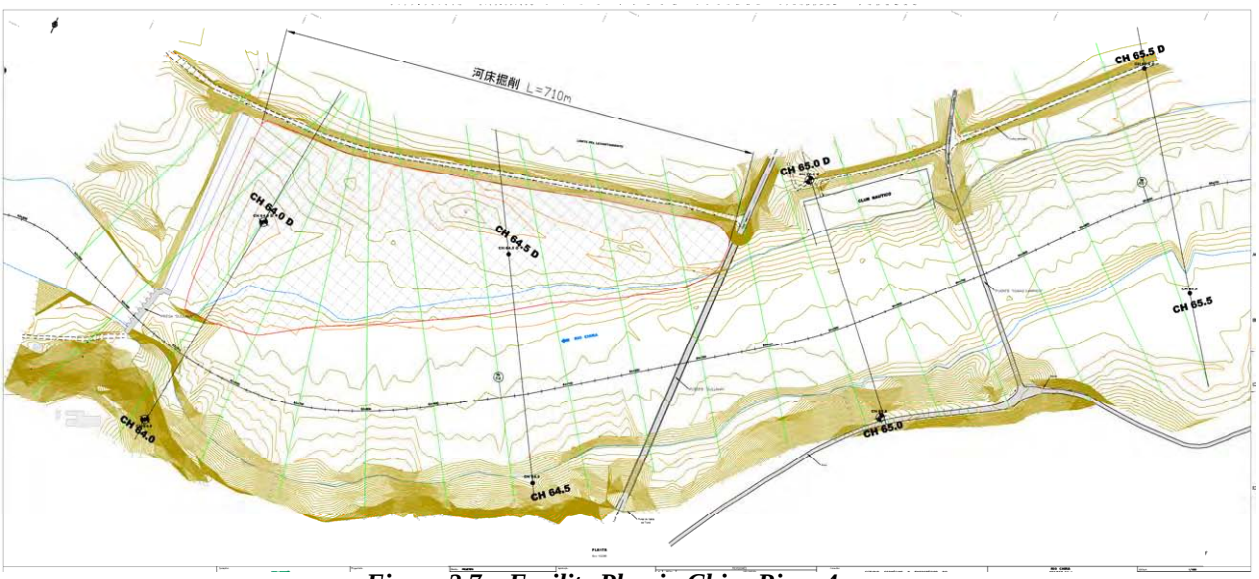


Figure 2.7 Facility Plan in Chira River-4

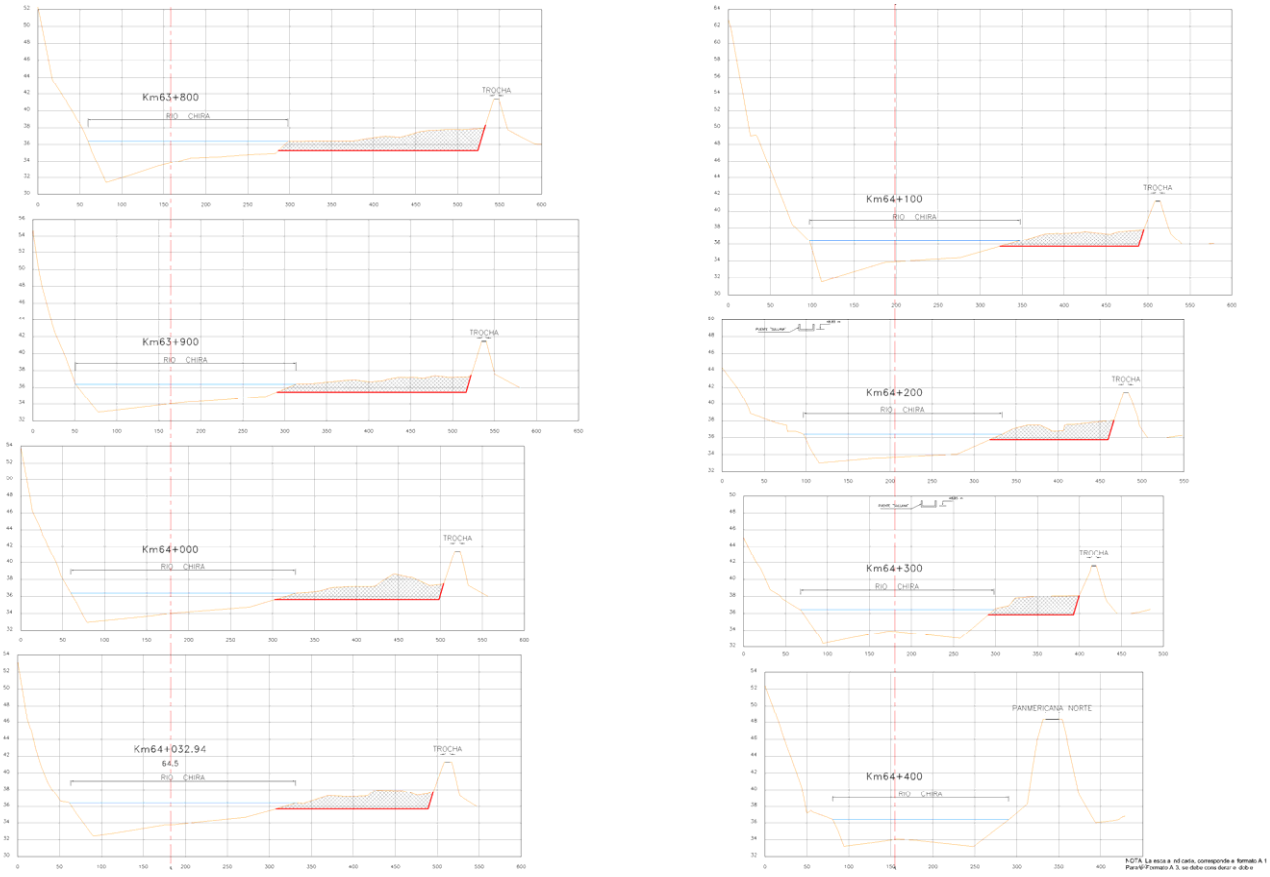
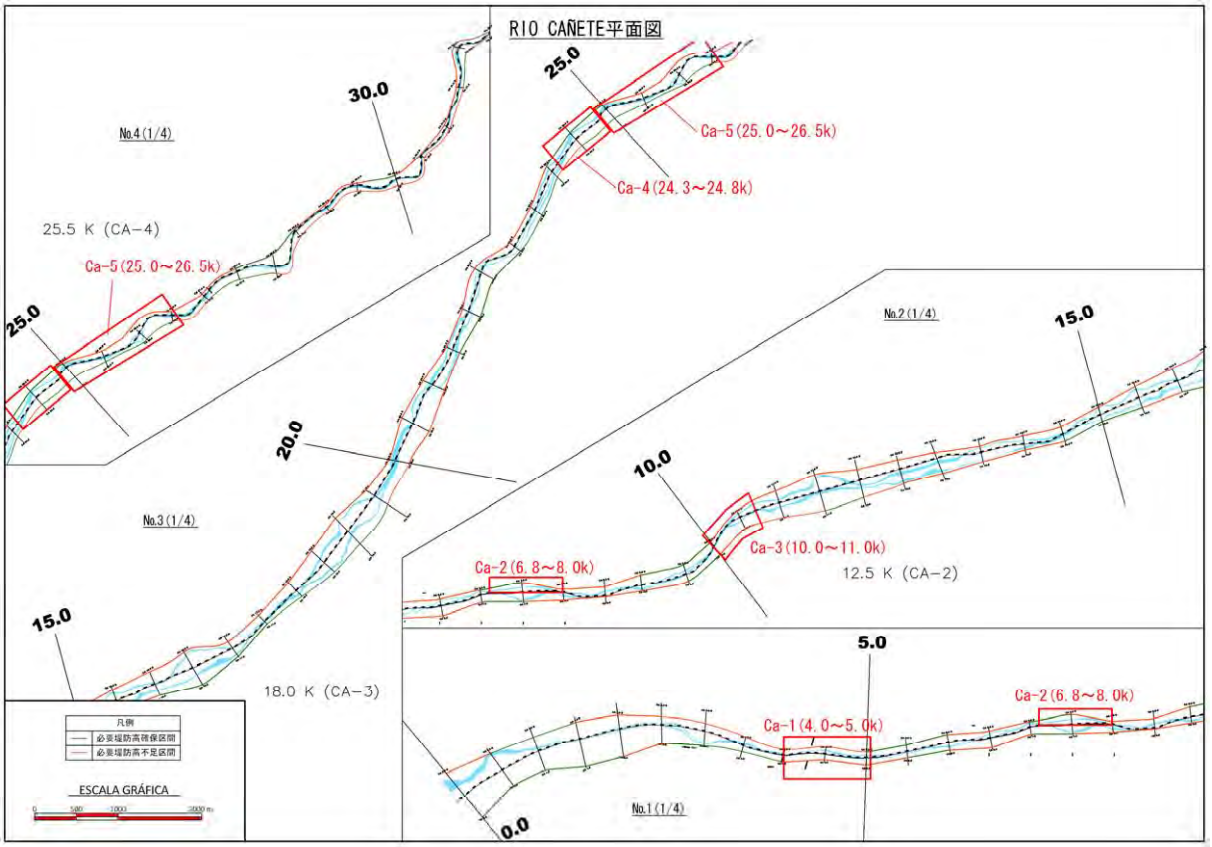


Figure 2.8 Typical Cross Section in Chira River-4

2.2 Canete River



Overall Plan

In the Canete River, main bridges and intake weirs are located in narrow areas, and it tends to occur inundation just upstream of each narrow area. Additionally, as characteristic of inundation, although inundation remains within the farmland along the river channel in the upstream section from the 10km distance mark, whereas the flood flow spreads greatly especially in the right-bank side in the downstream section from the 10km distance mark, and damages by flow is to be large.

Therefore, the river plans to be carried out in Canet River are the securement of discharge capacity in narrow areas and embankment/revetment works in the downstream from 10km mark where the damage potential is to be large.

In addition, discharge of the Canete River is rich and this river is close to the capital Lima, the tourist resorts are formed in the upstream areas. The protected plans (measures for bank erosion) for the important main roads as access to the upstream area are also selected from a viewpoint of effects in regional economy.

As for road bridge located in the narrow area of Pan American Road, the renewal was also considered, however, the traffic volume is very large and a substitute bridge and approach roads are needed, so that the project cost become huge. Through the meetings on renewal of bridge, DGIH replied that it was difficult to construct new bridge. Renewal plan of bridge is excluded from river improvement plan.

Outline of Facility (Canete-1)

No	Sections for Improvement	Improvement Plan
Canete River-1	4.0km～5.0km (Right-bank side) ＋ (Riverbed dredging in a part)	The road bridge of the Pan Americana which travels through the South American Continent exists in the sections. The narrow areas is existed and it is one of the section with the most low discharge capacity in the downstream of the Canete River . (Sections with remarkably insufficient discharge capacity in the downstream from 10km mark are this section and 6.5-8.5km section (right-and-left side bank) described in (2).) In the El Nino Flood in 1998, the riverbed aggradation occurred in the upper part and flood damage was occurred. Since the renewal of the bridge, etc. is judged to be impossible as the present stage, it is important to heighten the dike of the right-bank side to secure the discharge capacity by riverbed excavation near the bridge. **<Characteristic of Sections for Improvement>** • Narrow area (bridge section) and one of sections with the most insufficient discharge capacity in the Canete River • Sections which accumulates sediment in upstream according to the riverbed aggradation by narrow segment, and is promoting the flood of the upstream • Sections which can be planned in the water-level reduction effect of the upstream part by securing the discharge capacity by riverbed excavation **＜Protected Areas＞** o The vast farmland and dwelling areas which spread in downstream from the sections for improvement **<Improvement Plan >** ▼ A flood will begin at 1/10 year probable discharge scale, and damage will become serious at the 1/50 year probable discharge scale. ▼ For this reasons, the facilities which can flow down the discharge of 1/50 year probable flood scale are improved. ▼ While the existing dikes are used, the maintenance of the embankment of dike and the revetment in the right bank with insufficient height, and the riverbed excavation are adopted in order to secure the discharge capacity.

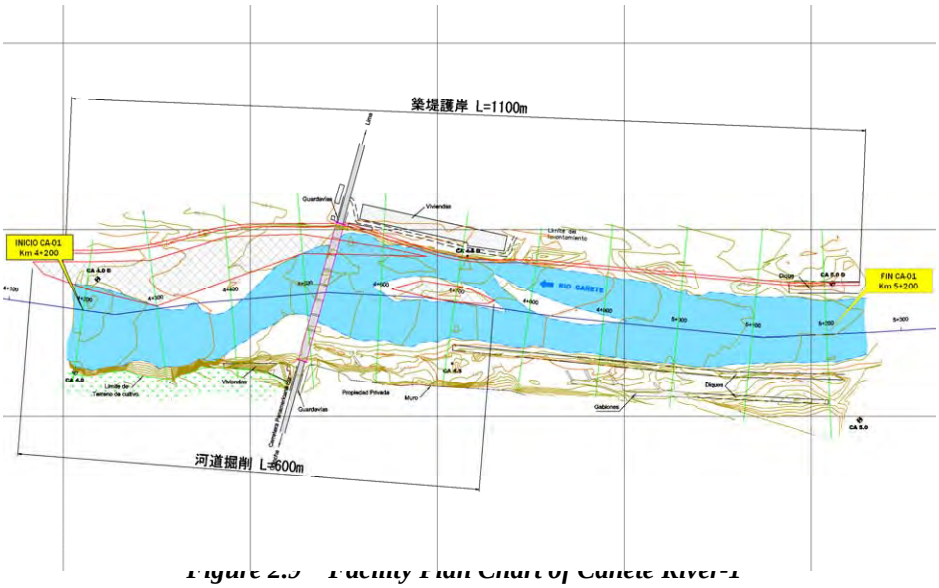


Figure 2.9 Facility Plan Chart of Canete River-1

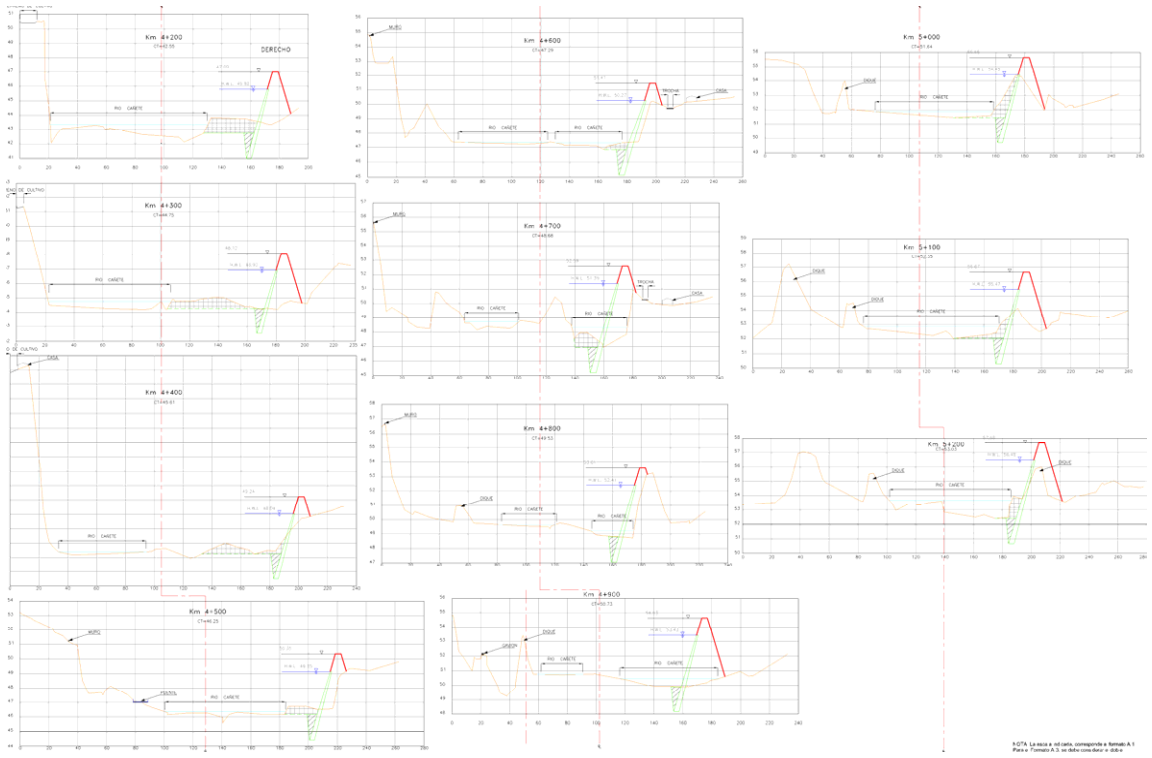


Figure 2.10 Typical Cross Section in Canete River-1

Outline of Facility (Canete River-2)

No	Sections for Improvement	Improvement Plan
Canete River-2	6.5km～8.1km (Right-bank side) + (Left-bank side)	The right bank of this section is damaged by bank erosion at the flood in the past, the bank collapsed, and great damage generated. Moreover, since this section is insufficient for discharge capacity, embankment/ revetment works as measures for bank erosion is required. In downstream from 10km, the flood flow spreads greatly especially in the right-bank side, and the damage becomes large. In left-bank side, the flood does not spread more greatly than the right-bank side, and the flood water expands limitedly to surrounding farmland. (The inundation area is wider than the upstream section) **< Characteristic of Sections for Improvement >** • Sections where the discharge capacity is most insufficient in the downstream of the Canete River • Sections where the flow velocity of flood flow is high, the riverbank is eroded, the dikes collapse, and the river overflows • Sections where the measures for bank erosion, embankment/ revetment works for securement of discharge capacity are required **< Protected Areas >** o Farmland which spreads in the right-and-left bank side **< Improvement Plan >** ▼ Flood will start at 1/10 year probable discharge scale, and damage will become serious to the 1/50 year probable discharge scale. For this reason, the river plan which can flow down the discharge of 1/50 year probable flood scale is adopted. ▼ In order to secure the discharge capacity, using the existing dike, the embankment and the revetment works are carried out (effective use of the existing bank in the right-bank side).

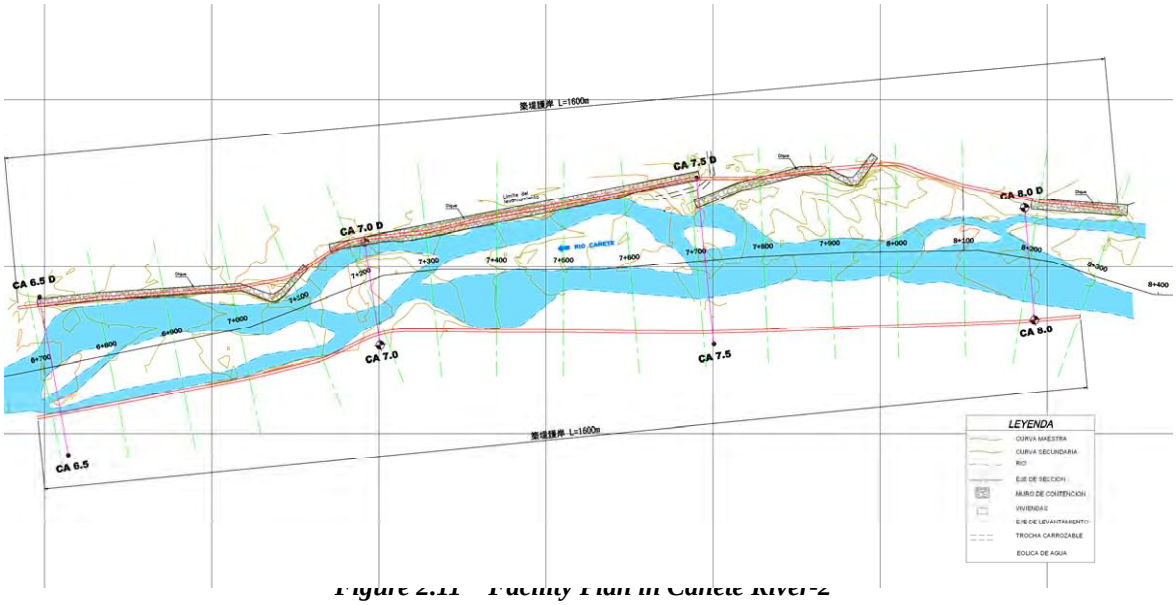


Figure 2.11 Facility Plan in Canete River-2

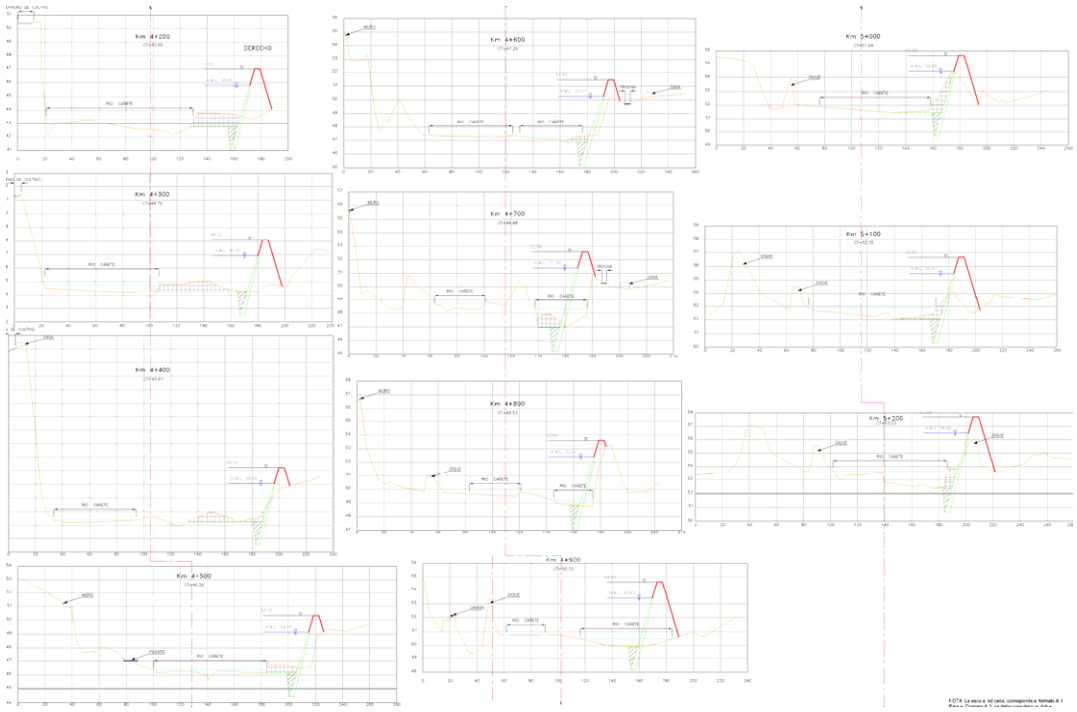


Figure 2.12 Typical Cross Section of Canete River-2

Outline of Facility (Canete River-3)

No	Sections for Improvement	Improvement Plan
Canete River-3	10.0km～11.0km (Channel widening in the left-bank side)	The intake weir currently existing in this section forms the narrow area, and makes water level in the upstream area goes up at the time of flood, and causes damage. In addition, the damage to farmland is most expanded in the upstream area from this section (10km mark). Therefore, in order to secure the discharge capacity, the channel widening and the riverbed excavation, etc. are required. Moreover, the effectiveness of increasing discharge capacity in the upstream can also be expected by excavation of the channel and lowering the water level in the channel. **<Characteristic of Sections for Improvement>** • Sections to be protected for intake weir • Sections which is narrow area compared with the up-and-down streams and has insufficient discharge capacity • Sections which can be planned in the effect of water-level reduction in upstream when channel excavation is carried out **<Protected Areas>** o Intake weir o Farmland which spreads in the left-bank side of the sections for Improvement **<Improvement Plan >** ▼ Intake weir is the most important facility in the river, and the influence affected to the area is serious in case of damaged by floods. ▼ For this reason, the safety is ensured at the scale of El Nino, etc. (1/50 year probable flood scale) occurs. ▼ River channel is widened, and it is devised so that flood flow may not concentrate near the intake weir.

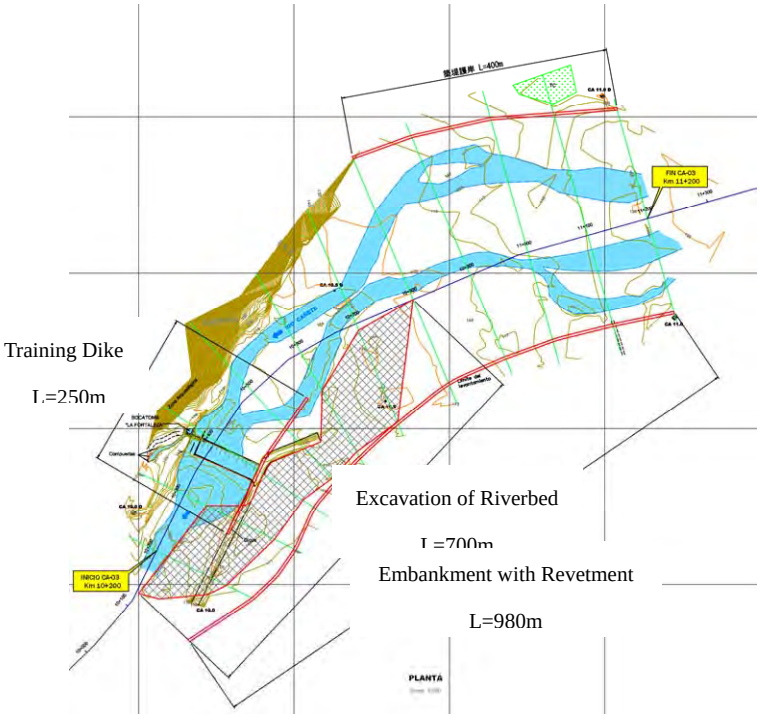


Figure 2.13 Facility Plan in Canete River-3

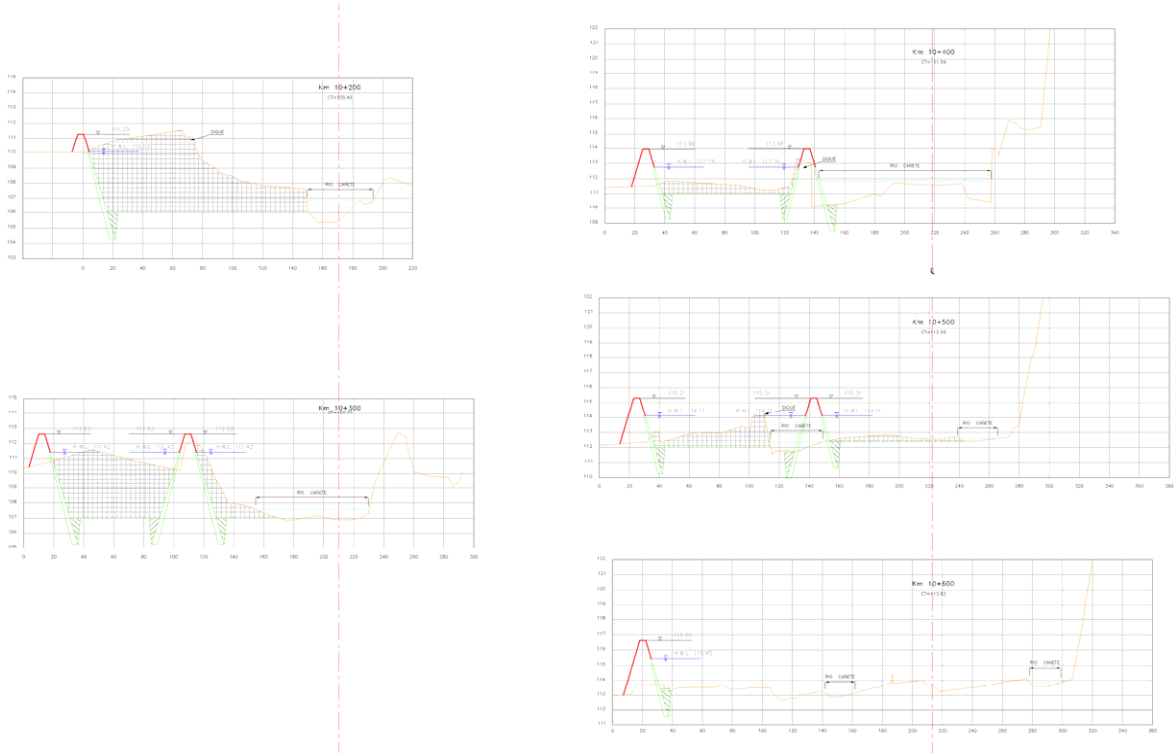


Figure 2.14 Typical Cross Section in Canete River-3

Outline of Facility (Canete River-4)

No	Sections for Improvement	Improvement Plan
Canete River-4	24.25km ～24.75km (Channel widening in the left-bank side)	The intake weir is installed in the sections. A lot of sediment deposited by the past El Nino flood, and the intake did not functioned during one month or more. Since sediment by floods has accumulated still now, and it is in the situation that the intake weir functions barely by maintenances such as excavation. When a large-scale flood is generated in the future, the function of the intake weir is lost, it is anxious about the great adverse effect to related farmland etc. Therefore, improvement of the diversion facility for proper discharge distribution is very important. **<Characteristic of Sections for Improvement>** • The sections which needs the measures for sediment inflow in intake weir **<Protected Areas>** o Intake weir **<Improvement Plan (How? / How much?)>** ▼ Since the intake weir is the most important facility in the river, and the influence affected to the area in case of no operation of the facility function is serious. Safety is ensured for the scale when El Nino, etc. (1/ 50 year probable scale) occurs. ▼ River improvement by taking into the current characteristics of river is carried out.

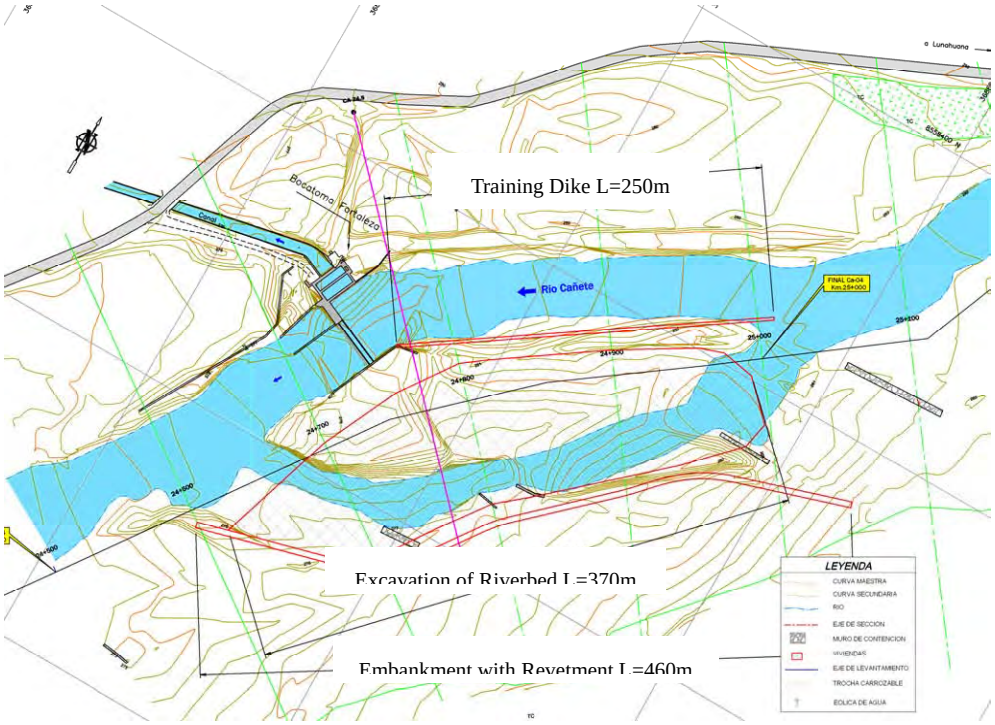


Figure 2.15 Facility Plan in Canete River-4

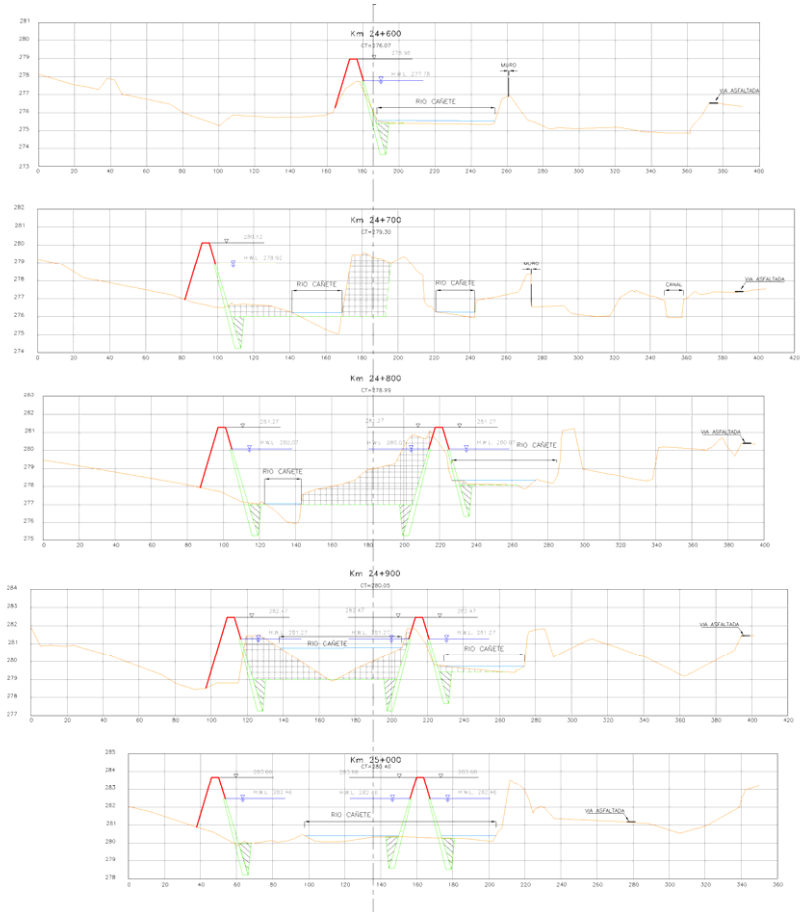


Figure 2.16 Typical Cross Section in Canete River-4

Outline of Facility (Canete River-5)

No	Sections for Improvement	Improvement Plan
Canete River-5	24.75km ～26.5km (Right-bank side)	In the sections concerned, bank erosion is processing caused by flood flow and the influence of erosion has reached even near the local main road. If it is neglected as it is, road will be collapsed and impacts in regional economy will be large (especially for tourist industry), the measures for erosion should be implemented immediately. **<Characteristic of Sections for Improvement>** • Sections with high possibility that the local main road will collapse by bank erosion. • Sections which should carry out erosion control for riverbank and functional preservation for the local main road, simultaneously. **<Protected Areas>** o The local main road located in the right-bank **<Improvement Plan >** ▼ Since the impacts to the regional economies is large, caused by collapsing in the local main road, the safety measures is ensured even if El Nino, etc. (1/50-year probable scale) is occurred. ▼ Although improving only the road part is to be considered for improvement plan, it is anxious that the farmland in the right-bank side during flood is eroded because of locating in the low land area. Improvement with easy flowing for discharge is the key measures.

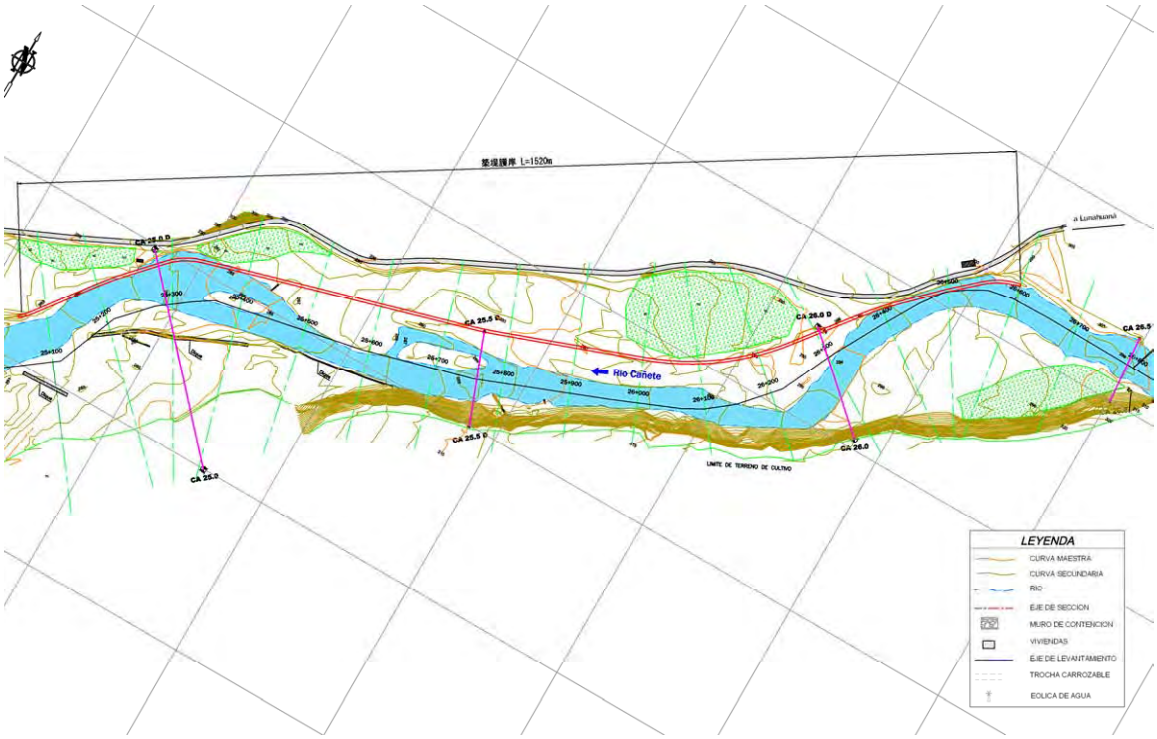


Figure 2.17 Facility Plan in Canete River-5

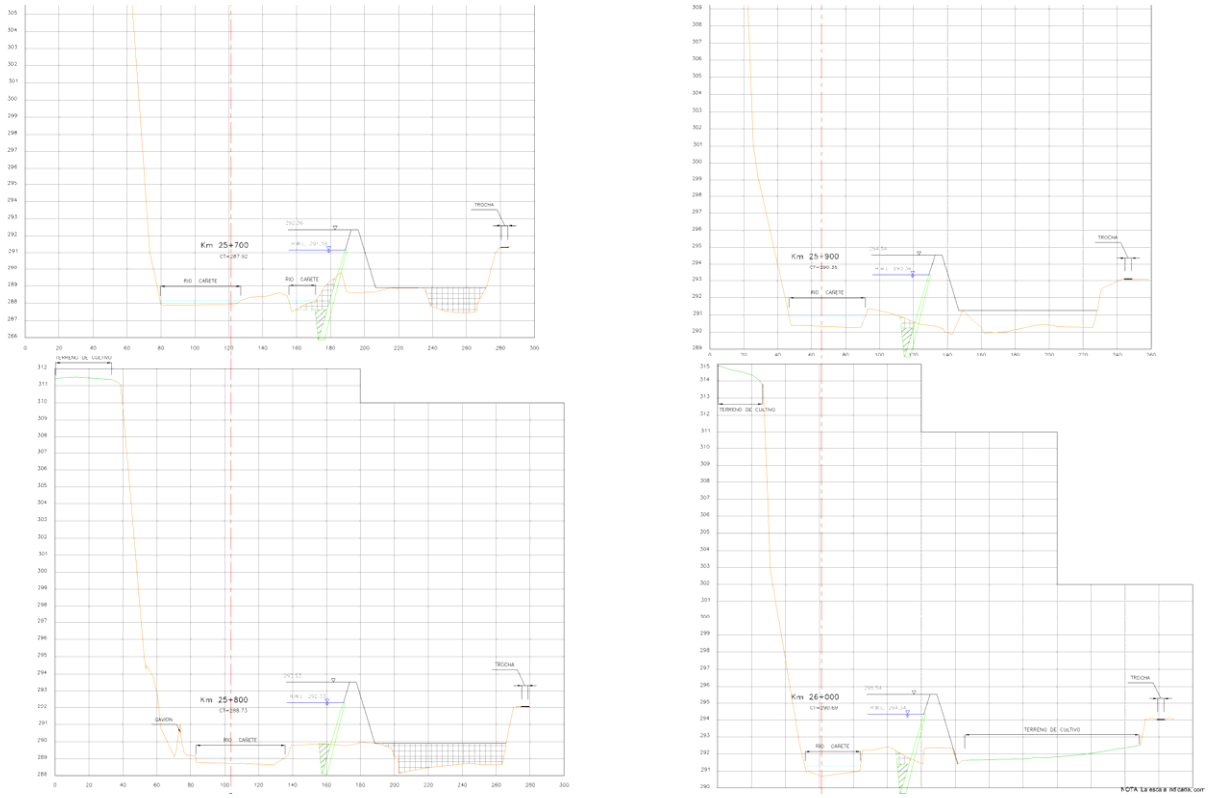
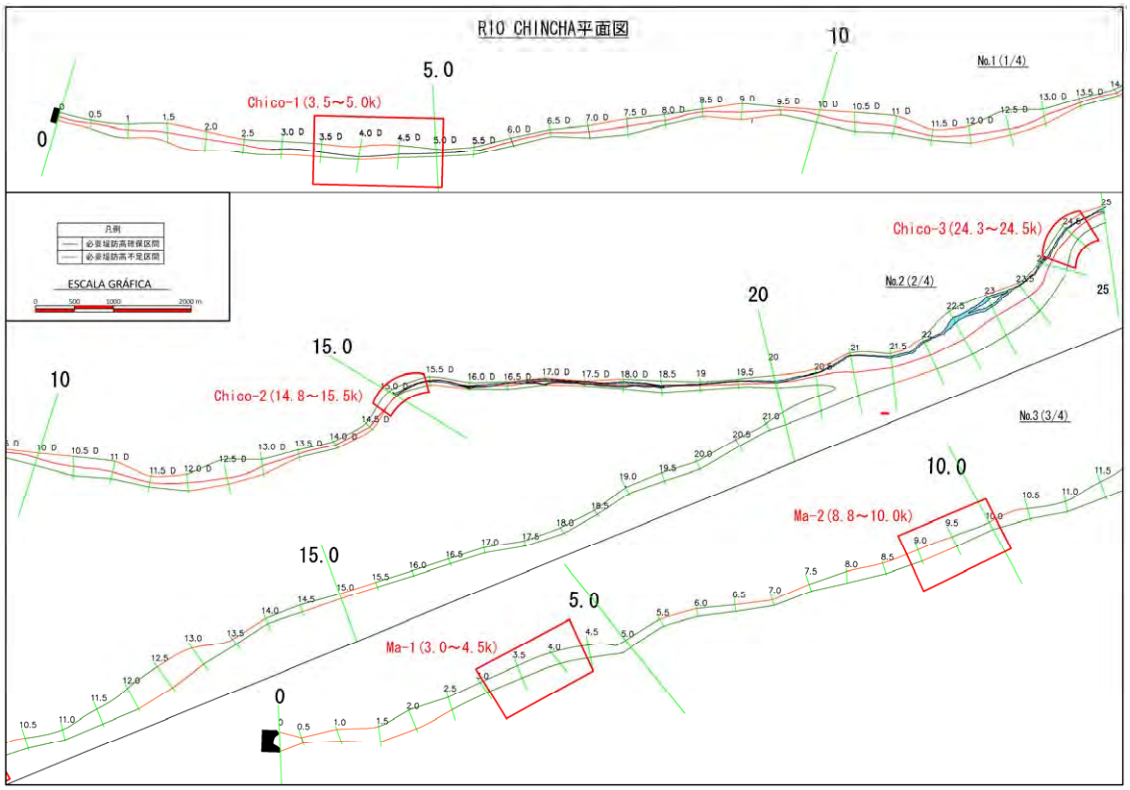


Figure 2.18 Typical Cross Section in Canete River-5

2.3 Chincha River



(1) Chico River

Issue in the Chincha River is insufficient function to divert flood water the Chico River and the Matagente River in the upstream part. When flood water flow either river, the discharge capacity is insufficient in all sections both the Chico River and the Matagente River, and then the possibility of severe damage is high. Furthermore, even if the flow diverts toward the Chico River and the Matagente River with properly ratio such as 1:1, their river banks are still insufficient for design discharge. In Chico River, there are sections of overflow in the vicinity of 15km mark and 4km mark from the river mouth, and the flood flow tend to spread greatly in the left-bank side. In Matagente River, there are also sections of overflow in the vicinity of 9km mark and 3km mark from the river mouth, the flood flow tend to spread greatly in the right-bank. Therefore, the fundamental river improvement plan is the construction of the diversion weir and improvement for securement of discharge capacity by embankment and reverbed excavation in existing insufficient sections.

The proposed improvement plan for every section is arranged on the basis of the case that flood flow is distributed properly to both the Chico River and the Matagente River.

Outline of Facility (Chico-1)

No	Sections for Improvement	Improvement Plan
Chico River-1	**Chico River** 3.0km～5.1km (Right-bank side) + (Left-bank side)	Since Discharge capacity in the sections mentioned above is most small in the downstream of the Chico Rive, the embankment/ revetment works which prevents expansion of damages in the left bank is required. Moreover, in the case of improvement in the upstream section, it is thought that overflow also occurs and water expands in the right-bank side, the sections concerned needs the embankment in both banks. **<Characteristic of Sections for Improvement>** • Sections where flood overflowed into the right-and-left both banks areas, and damaged to farmlands in the past. • Although sections where partial embankments are done in the left bank currently, flood expand accompanied by improvement in the upstream. • Sections where the discharge capacity is the most insufficient in the downstream **<Protected Areas>** o Vast farmland which spreads in the right-and-left both sides (especially left side) **<Improvement Plan >** ▼ Inundation starts at the scale of 1/10 year probable discharge, and damage occurs at the scale of the 1/50 year probable discharge seriously. For this reason, the river improvement which can flow down the discharge of 1/50 year probable flood is curried out. ▼ Since the existing dike is improved partially, they are utilized effectively and the embankment and the revetment works which secures the discharge capacity are also carried out.

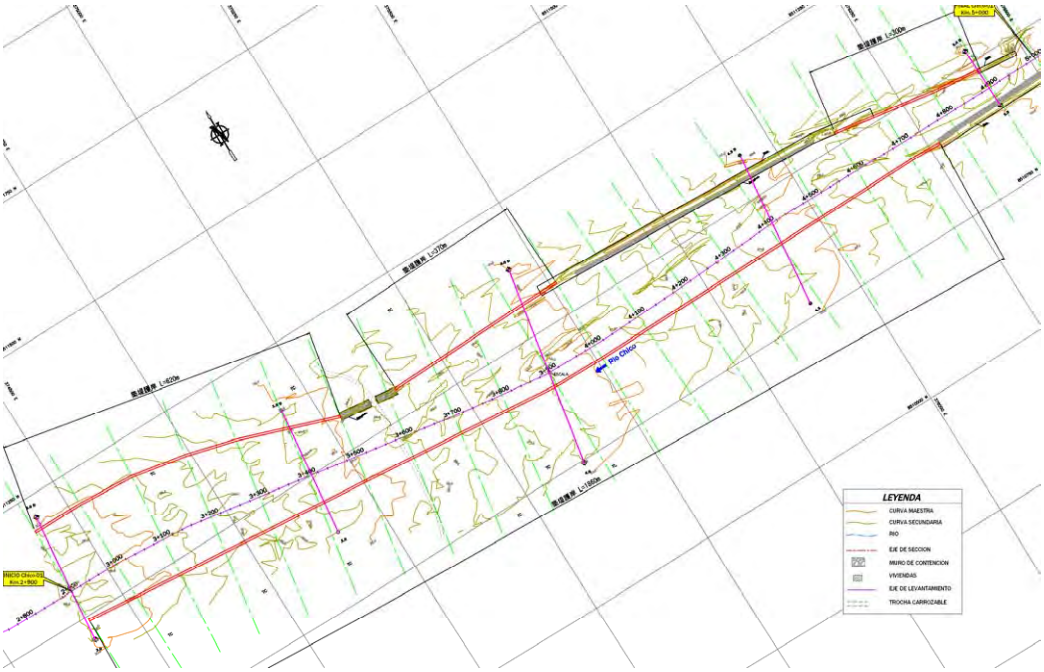


Figure 2.19 Facility Plan Chart in Chico River-1

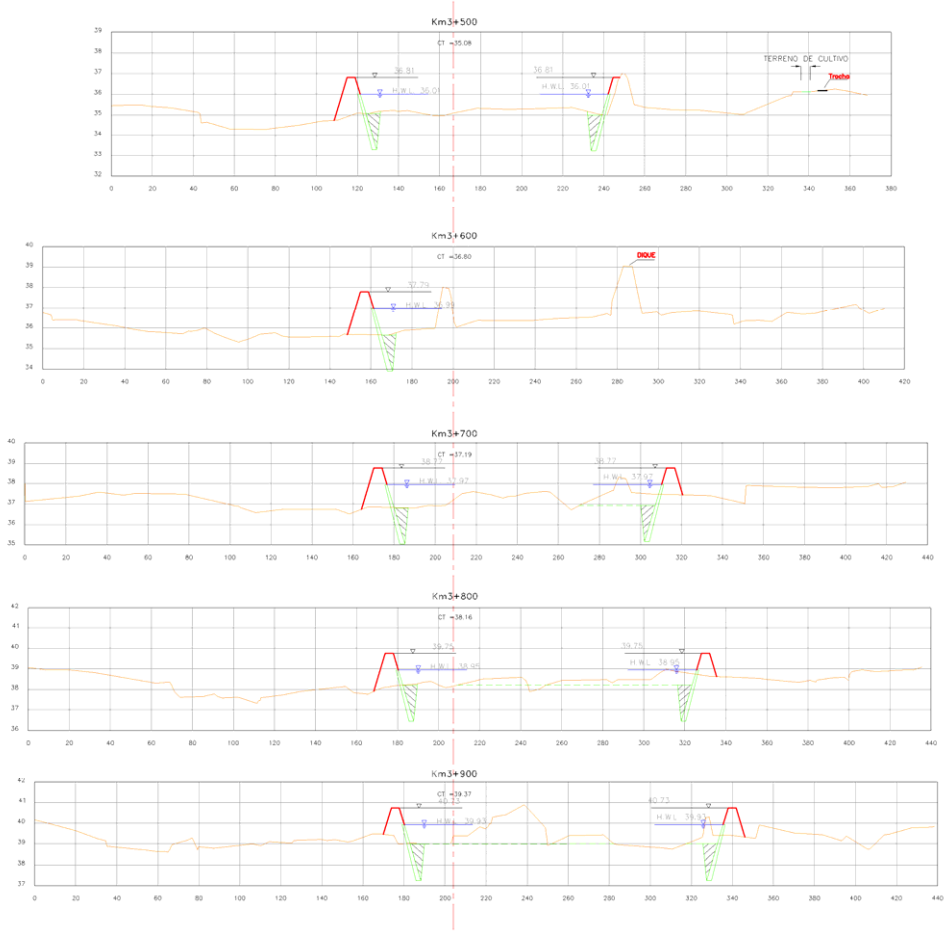


Figure 2.20 Typical Cross Section in Chico River-1

Outline of Facility (Chico River-2)

No	Sections for Improvement	Improvement Plan
Chico River-2	**Chico River** 14.8km～15.5km (Channel widening in left-bank side)	Sections where sedimentation of the vicinity of intake weir is remarkable and the discharge capacity is considerably insufficient. Therefore, the measures for sediment inflow around intake weir (construction of diversion weir with proper discharge distribution) and the securement of discharge capacity are adopted **<Characteristic of Sections for Improvement>** • Sections overflowed by the past floods • Sections in which the channel should be widen, and the measures against sediment inflow around intake weir and the increase of discharge capacity should be carried out. • Sections which the sedimentation is in progress in the tunnel of irrigation channel **<Protected Areas>** o Intake weir o Farmland which spreads in the left-bank side **<Improvement Plan >** ▼ Inundation starts at the scale of 1/10 year probable discharge, and damage occurs at the 1/50 year probable discharge. For this reason, the improvement which can flow down the discharge of 1/50 year probable flood is improved. ▼ Channel width is widened, and it is devised so that flood flow may not concentrate around the intake weir.

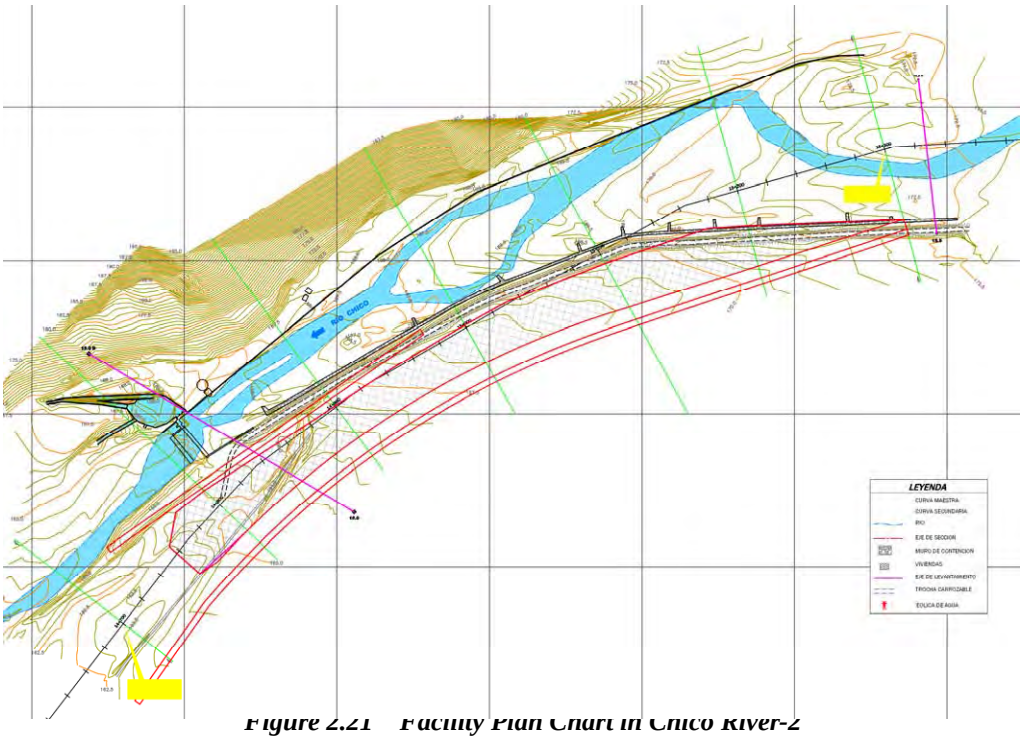


Figure 2.21 Facility Plan Chart in Chico River-2

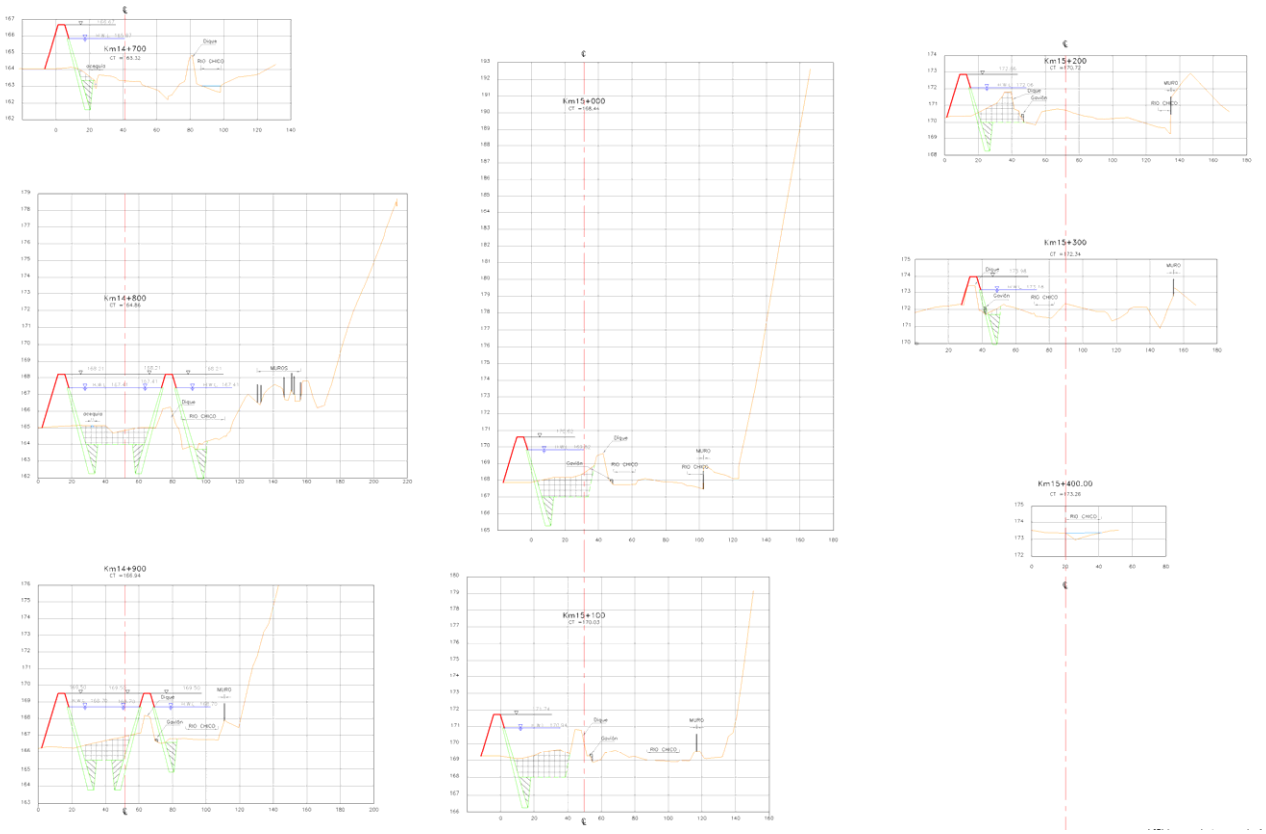


Figure 2.22 Typical Cross Section in Chico River-2

Outline of Facility (Chico River-3)

No	Sections for Improvement	Improvement Plan
Chico River-3	**Chico River** 24.2km～24.5km (Whole area)	Sections which the Chico River divert to both the Matagente River and the Chincha River, and is the most important section from the view point of improvement. (Bases for the flood control plan) Although the old diversion weir built in 1954 exists, and facility is aged remarkable. When floods coming and it continues, flood flow moves to the upstream of the weir, and flows into either the Chico River or the Matagente River. Finally, distribution function becomes insufficient situation. Therefore, the construction of the new diversion weir which distributes flood flow to both the Chico River and the Matagente River properly is the integral measures from the view point of the flood control plan in the Chincha River . **<Characteristic of Sections for Improvement>** • Due to meandering stream, in the case of which cannot distributed the discharge as designed ratio at 1:1, sections where there is possibility of large scale inundation occurrence in either the Chico River or the Matagente River so that suitable diversion facility is required. **<Protected Areas>** o All the areas in the Chico River and the Matagente River (It brings serious damage in one river of the two when discharge distribution is not carried out properly) **<Improvement Plan >** ▼ The facility which can distribute flood flow is improved.

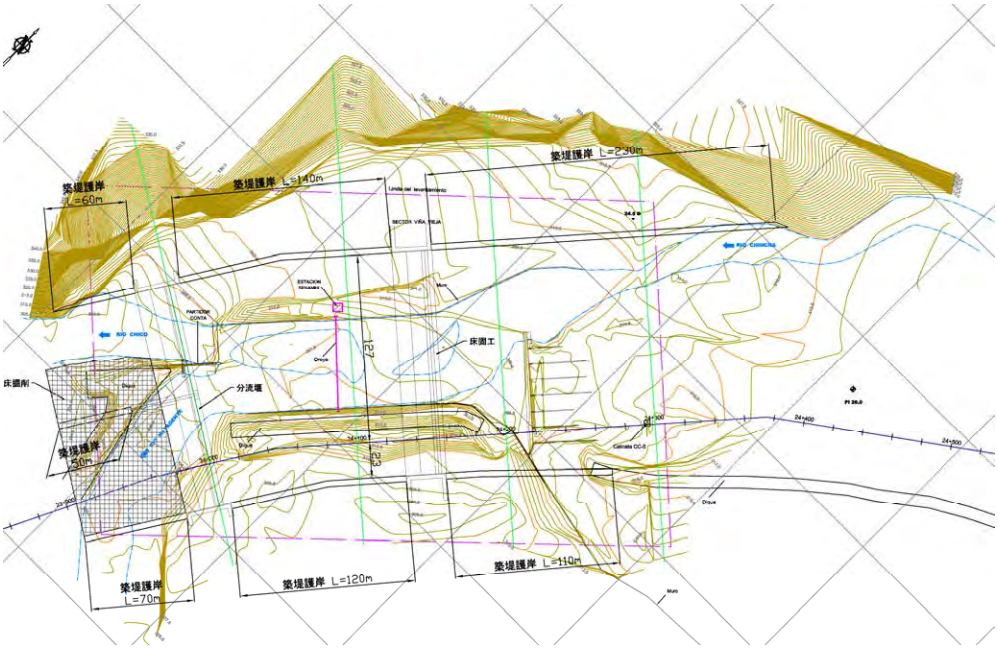


Figure 2.23 Facility Plan in Chico River-3

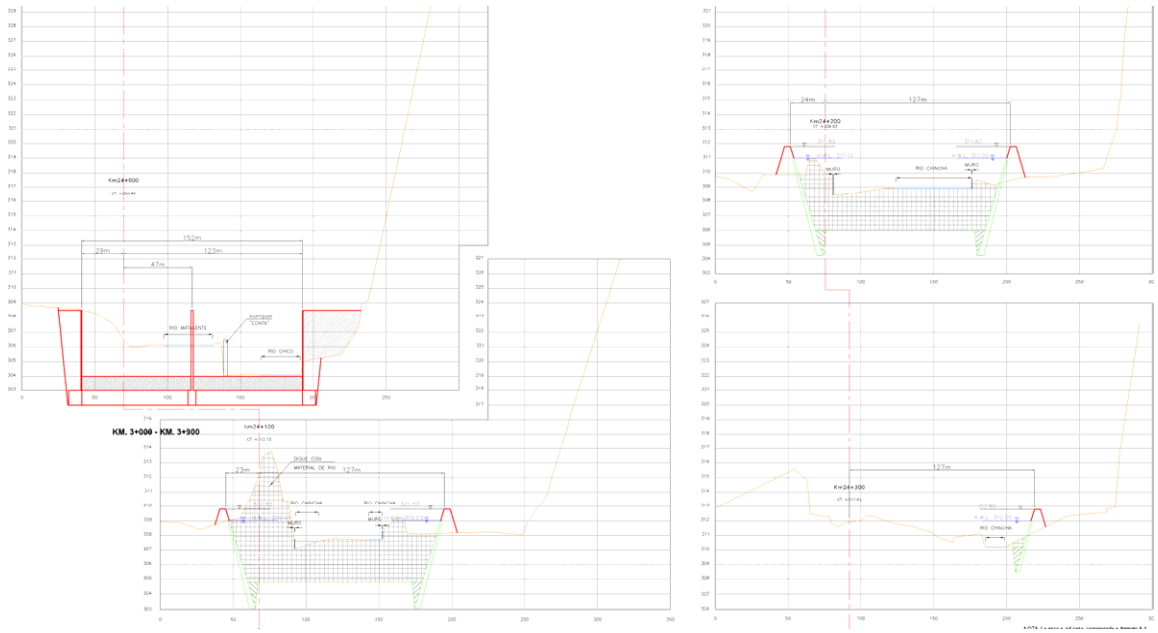


Figure 2.24 Typical Cross Section in Chico River-3

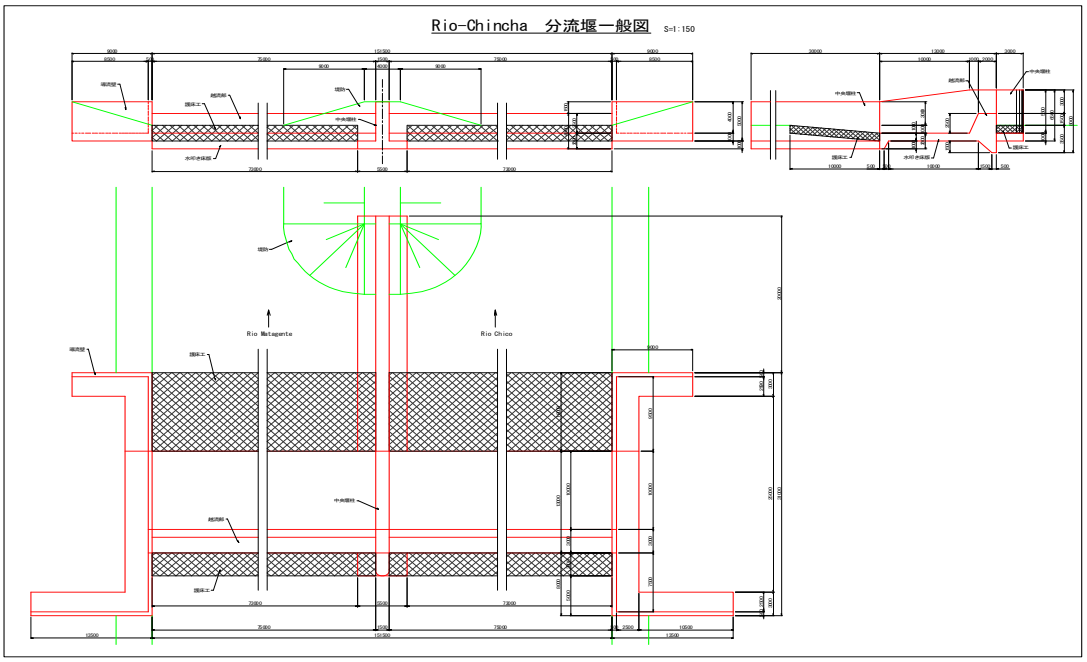


Figure 2.25 Diversion Weir in Chico River-3

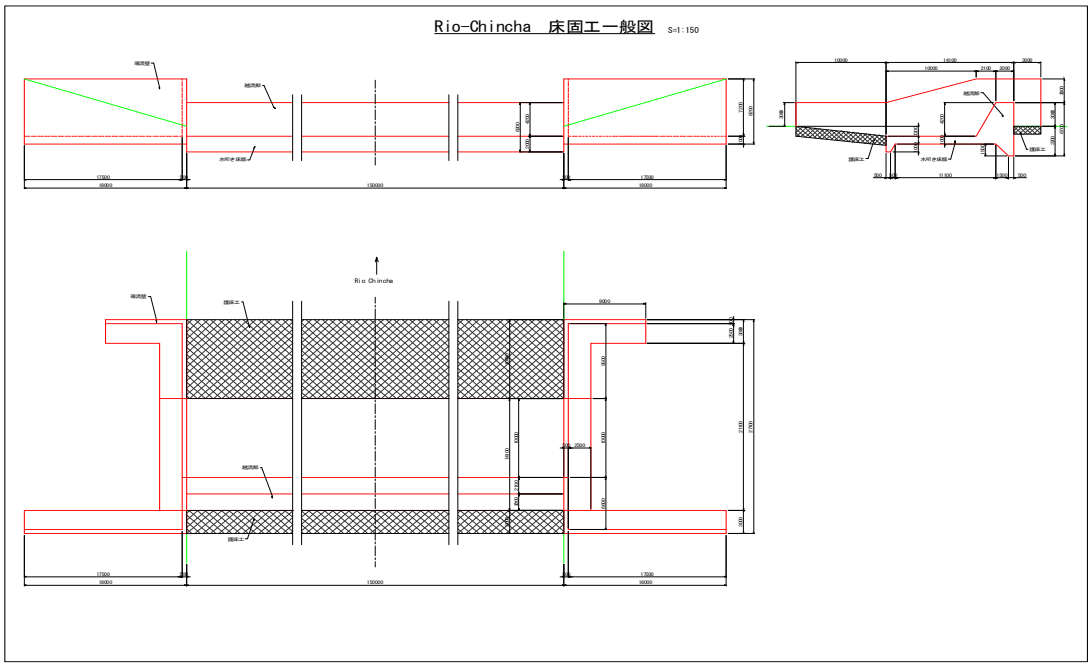


Figure 2.26 Consolidation Works in Chico River-3

(2) Matagente River

Outline of Facility (Matagente-1)

No	Sections for Improvement	Improvement Plan
(4)	**Matagente River** 2.5km～5.0km (Whole area)	Sections concerned is the past overflow point, and flood flow tend to spread greatly in the right-bank side. Moreover, since the embankment was made disorderly for rehabilitation by flood, it is thought that inundation will also occur and expand in the left-bank in case of upstream improvement. For this reason, the section concerned needs the embankment in both sides of bank. **<Characteristic of Sections for Improvement>** • Sections where the discharge capacity is insufficient in the downstream • Sections where it overflowed in both sides and serious damage caused to farmland etc. by past floods. • Section where disorderly embankment was carried out **<Protected Areas>** o Vast farmland which spreads in the right-and-left both sides in the sections for improvement (especially the right-bank side) **<Improvement Plan >** ▼ Bank improvement and revetment woks and slope protection shall be done. ▼ Inundation starts at the scale of 1/10 year probable discharge, and damage will become serious at the 1/50 year probable discharge. For this reason, the facility plan which can flow down the discharge of 1/50 year probable flood scale shall be adopted.

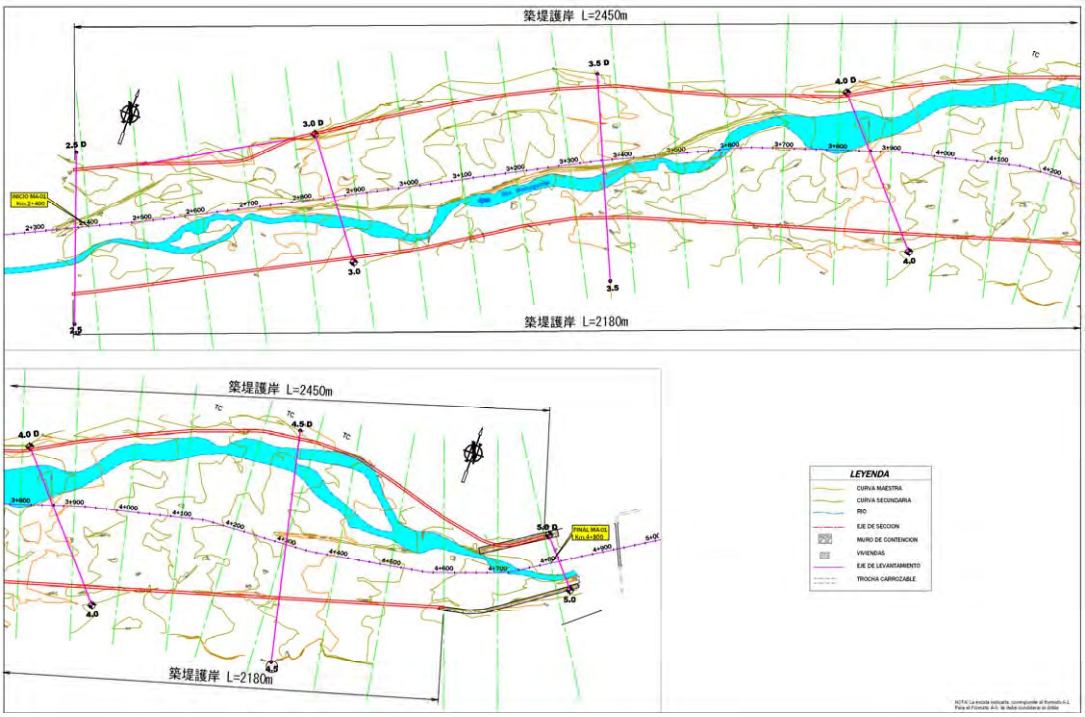


Figure 2.27 Facility Plan in Matagente River-1

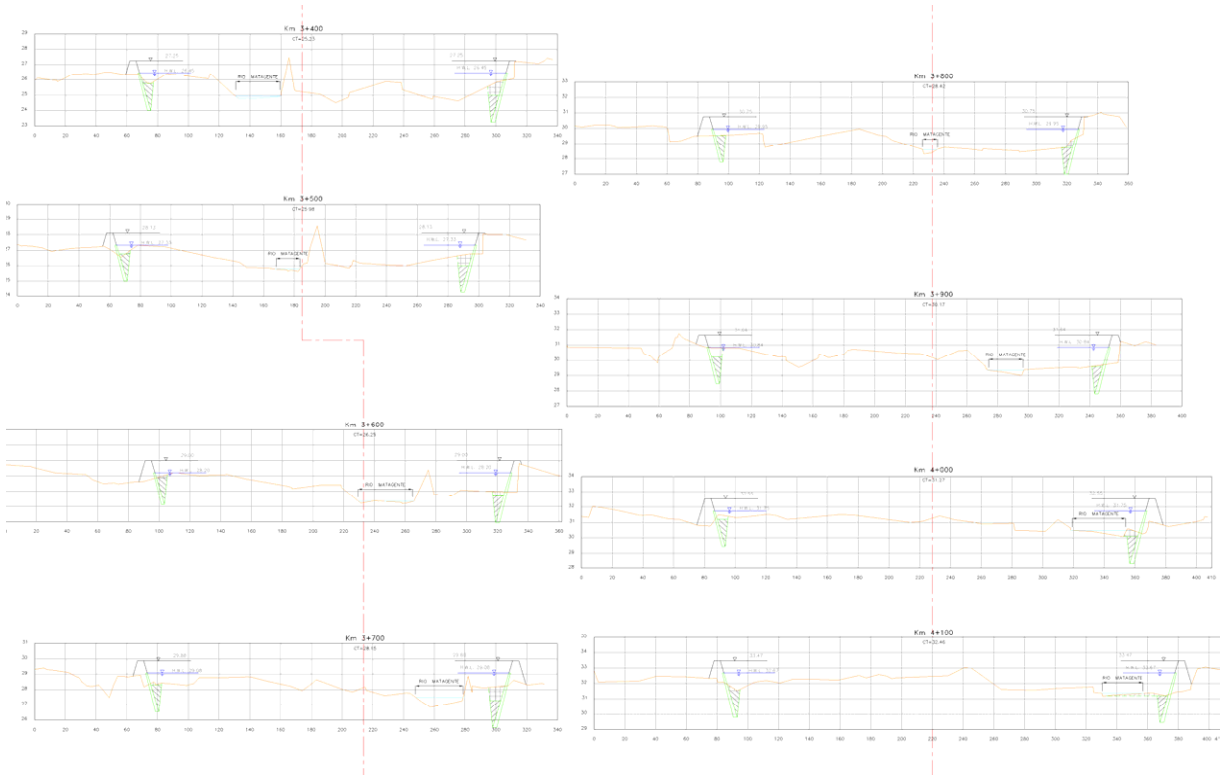


Figure 2.28 Typical Cross Section in Matagente River-1

Outline of Facility (Matagente-2)

No	Sections for Improvement	Improvement Plan
(5)	**Matagente River** 8.0km～10.5km (Whole area)	The sections concerned are damaged by the past floods. While the discharge capacity have been insufficient in the narrow area (at road bridge), the riverbed has risen by about 4-5m in the last 50 years. While the riverbed is excavated, and discharge capacity is enhance (taking into account the foundation at the road bridge), the embankment is needed in the both banks. **<Characteristic of Sections for Improvement>** • Sections where discharge capacity is insufficient for the narrow area near 8.9km mark (road bridge) • Sections where sediment have deposited in an upper part caused by riverbed aggradation by road bridge **<Protected Areas>** o Vast farmland which spreads in both sides of the sections for improvement (especially the right-bank side) **<Improvement Plan >** ▼ Since the riverbed tend to rising, the channel excavation, which can expect the securement of discharge capacity of the area concerned and the water-level lowering effect in the upstream, shall be carried out. ▼ Inundation will start at the scale of 1/10 year probable discharge, and damage will become serious at the scale of 1/50 year probable discharge. For this reason, the improvement plan which can flow down the discharge of 1/50 year probable flood shall be done.

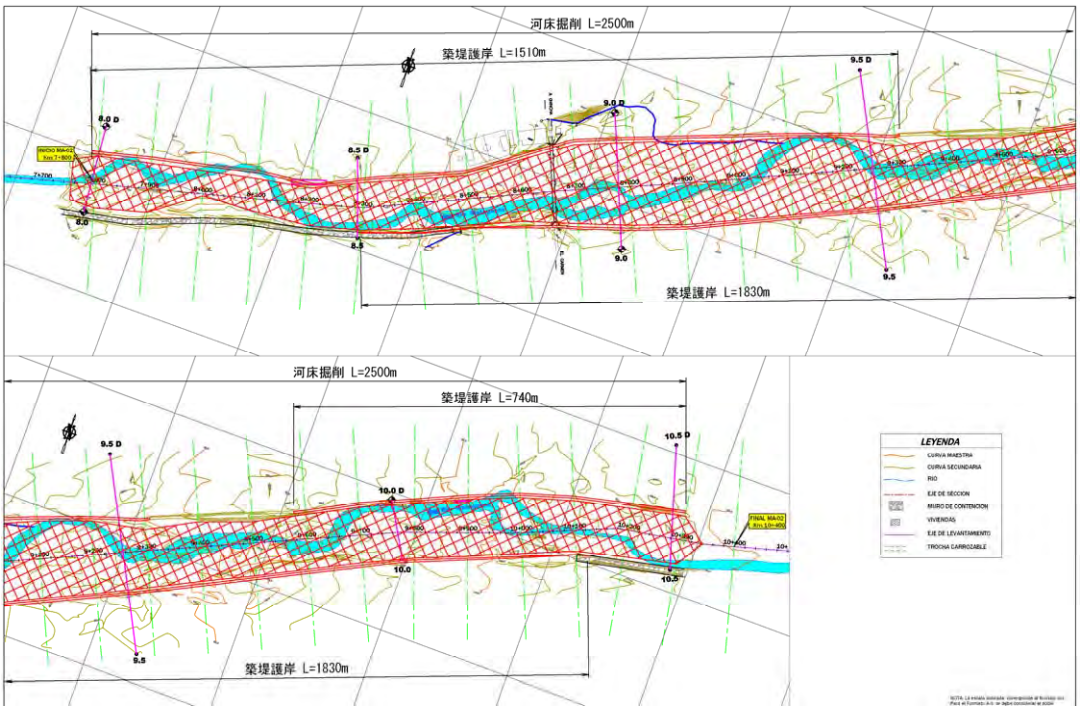


Figure 2.29 Facility Plan in Matagente River-2

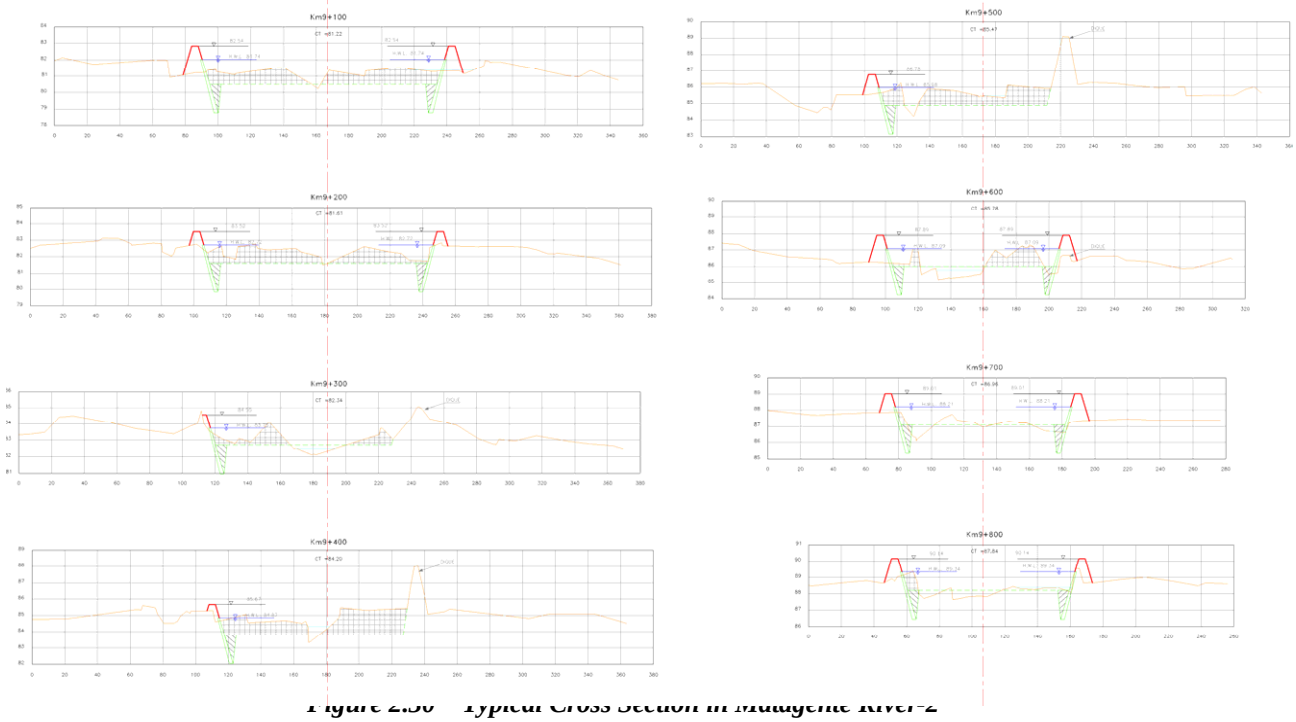


Figure 2.30 Typical Cross Section in Malagente River-2