Sistema de Gestión Ambiental, Social, de Salud y Seguridad Industrial (ESHS MS)

Plan de Acción sobre Biodiversidad

Número de Documento:
02/ES/PJ/PN/009/A01

El presente documento constituye una traducción libre al español, efectuada por PERU LNG S.R.L. al documento original en inglés.

ÍNDICE

1.0 INTRODUCCIÓN 5
1.1 ANTECEDENTES DEL PROYECTO 5
1.2 PROMOTORES DEL PROYECTO 5
1.3 IMPACTOS SOBRE EL TERRENO Y LA POBLACIÓN 6
1.4 OBJETIVO 6
1.5 ALCANCE DEL BAP 7
1.51 RELACIÓN CON OTROS PLANES Y PROGRAMAS DE PERU LNG 7
1.52 ALCANCE GEOGRÁFICO 7
1.6 CONTENIDO Y ESTRUCTURA DEL BAP 8
2.0 POLÍTICA 9
2.1 POLÍTICAS AMBIENTALES Y SOCIALES DE PERU LNG 9
2.2 PLANES DE ACCIÓN SOBRE BIODIVERSIDAD EN EL SECTOR DE HIDROCARBUROS10
2.3 CONVENIOS, NORMAS Y POLÍTICAS INTERNACIONALES 10
2.3.1 CONVENIO SOBRE DIVERSIDAD BIOLÓGICA 10
2.3.2 NORMA DE DESEMPEÑO NO. 6 DE LA CIF, CONSERVACIÓN DE LA BIODIVERSIDAD Y MANEJO SOSTENIBLE DE LOS RECURSOS NATURALES 11
2.3.3 POLÍTICA DE MEDIO AMBIENTE Y CUMPLIMIENTO DE SALVAGUARDIAS DEL BID – DIRECTIVA NO. B.9 SOBRE HÁBITATS NATURALES Y SITIOS CULTURALES 12
2.4 MARCO DE LA POLÍTICA NACIONAL 12
2.4.1 CONSTITUCIÓN POLÍTICA DEL PERÚ 12
2.4.2 AGENDA AMBIENTAL NACIONAL 13
2.4.3 POLÍTICA AMBIENTAL NACIONAL 13
2.4.4 ESTRATEGIA NACIONAL SOBRE DIVERSIDAD BIOLÓGICA 14
3.0 EVALUACIÓN DE LA BIODIVERSIDAD DURANTE EL PROCESO DE PLANEAMIENTO DEL DUCTO 17
3.1 CONCEPCIÓN INICIAL DEL PROYECTO 17
3.1 EVALUACIÓN DE LAS RUTAS ALTERNATIVAS DEL DUCTO 18
3.2 PROCESO DEL ESTUDIO DE IMPACTO AMBIENTAL Y SOCIAL 19
3.3.1 ESTUDIOS DE REFERENCIA BIOLÓGICA INICIAL 19
3.3.2 IDENTIFICACIÓN DE HÁBITATS SENSIBLES 20
3.3.3 CONSULTAS CON LOS GRUPOS DE INTERÉS 21
4.0 PLANEAMIENTO DEL MANEJO DE LA BIODIVERSIDAD PARA LA FASE DE CONSTRUCCIÓN 23
4.1 REQUERIMIENTOS DEL PLAN GENERAL DE MANEJO AMBIENTAL Y SOCIAL 23
4.1.1 VEGETACIÓN 23
4.1.2 FAUNA 24
4.1.3 RECURSOS HIDROBIOLÓGICOS 26
4.2 PLAN DE RESTAURACIÓN Y REVEGETACIÓN 26
4.3 CÓDIGO DE CONDUCTA 26

4.4 RECONOCIMIENTO ECOLÓGICO DEL CAMPO 26
4.4.1 SENSIBILIDAD DE LAS ESPECIES 26
4.4.2 HÁBITATS SENSIBLES 42
4.5 PLAN DE MANEJO ECOLÓGICO 46
4.5.1 PLAN DE MANEJO ECOLÓGICO DE PERU LNG 46
4.5.2 PLAN DE MANEJO PARA CONTRATISTAS (EMP) CORRESPONDIENTE AL MANEJO ECOLÓGICO DEL DUCTO 46
4.5.3 PLAN DE MANEJO DE CAMÉLIDOS 47
4.5.4 PROGRAMA DE PLANTAS MEDICINALES 47
4.6 PLAN DE BIORESTAURACIÓN 47
4.6.1 PLAN DE BIORESTAURACIÓN DE PERU LNG 47
4.6.2 PLAN DE MANEJO PARA CONTRATISTAS (CMP) CORRESPONDIENTE A LA BIORESTAURACIÓN DEL DUCTO 48
4.7 MICRO RUTA FINAL DEL DERECHO DE VÍA 48
4.7.1 EVALUACIONES HIDROLÓGICAS Y DE LOS PANTANOS ANDINOS 48
5.0 MONITOREO DE LA BIODIVERSIDAD 49
5.1 OBJETIVOS 49
5.2 MARCO DE LA POLÍTICA 49
5.2.1 POLÍTICA DE PERU LNG 49
5.2.2 LINEAMIENTOS DE IPIECA 49
5.2.3 REQUERIMIENTOS DE LOS PRESTAMISTAS 49
5.2.4 COMPROMISOS DEL EIAS 50
5.3 MARCO CIENTÍFICO E INSTITUCIONAL 50
5.4 ESPECIES Y ECOSISTEMAS OBJETIVO 51
5.4.1 ESPECIES AMENAZADAS 51
5.4.2 ESPECIES ENDÉMICAS DE RANGO LIMITADO 51
5.4.3 ESPECIES FORÁNEAS INVASIVAS 51
5.4.4 VEGETACIÓN DEL DDV 51
5.4.5 FAUNA DEL DDV 51
5.4.6 PANTANOS 51
5.5 INDICADORES SOCIALES 52
5.5.1 USO DE BOFEDALES 52
5.5.2 PLANTAS MEDICINALES 52
5.6 METODOLOGÍAS DE MONITOREO DIRECTO DE LA BIODIVERSIDAD 52
5.6.1 ENFOQUE DE MUESTREO 52
5.6.2 VEGETACIÓN Y FLORA 54
5.6.3 HERPETOFAUNA 54
5.6.4 AVES 54
5.6.5 MAMÍFEROS 54
5.6.6 BIOTA DE AGUA DULCE Y HÁBITATS 55

5.7 METODOLOGÍAS DE MONITOREO A NIVEL PAISAJÍSTICO 55
5.8 CRONOGRAMA DE ACTIVIDADES 55
5.9 REPORTES 55
6.0 INVERSIÓN AMBIENTAL 55
6.1 ALCANCE Y OBJETIVOS 55
6.1.1 ALCANCE 55
6.1.2 OBJETIVOS 56
6.2 COMITÉ DE GESTIÓN 56
6.3 PARTICIPACIÓN DE LOS GRUPOS DE INTERÉS 57
6.4 PROCESO DE PRIORIZACIÓN 57
6.5 PROCESO DE SELECCIÓN DE PROYECTOS 57
6.5.1 PROCESO Y CRITERIOS GENERALES 57
6.5.2 PROPUESTAS 58
6.5.3 CRITERIOS PARA LA SELECCIÓN DE SOCIOS 60
6.6 IMPLEMENTACIÓN DE LOS PROYECTOS 61
6.6.1 CONTRATO DE IMPLEMENTACIÓN 61
6.6.2 PROCESO DE IMPLEMENTACIÓN 61
6.7 SEGUIMIENTO Y REPORTE 62
6.7.1 MONITOREO Y EVALUACIÓN 62
6.7.2 REPORTE Y COMUNICACIONES 63
7.0 LITERATURA CITADA 64
APPENDIX 1: ENVIRONMENTAL REGIONAL ACTION PLAN FOR AYACUCHO UP TO 2013 AND REGIONAL ENVIRONMENTAL AGENDA FOR AYACUCHO 65
APPENDIX 2: ENVIRONMENTAL REGIONAL AGENDA FOR HUANCAVELICA 2005 – 2006 AND REGIONAL ENVIRONMENTAL ACTION PLAN FOR HUANCAVELICA UP TO 2015 66
APPENDIX 3: ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT FINDINGS 67
APPENDIX 4: RESULTS OF STAKEHOLDER CONSULTATIONS 68
APPENDIX 5: ECOLOGICAL FIELD SURVEY 69
APPENDIX 6: PIPELINE ECOLOGICAL CONTRACTOR MANAGEMENT PLAN 70
APPENDIX 7: PIPELINE BIORESTORATION CONTRACTOR MANAGEMENT PLAN 71
APPENDIX 8: PERU LNG BAP PRIORITIZATION RESULTS 2006 72
APPENDIX 9: OUTLINE REQUEST FOR PROPOSALS (RFP) AND LOG FRAME MATRIX 73

1.0 INTRODUCCIÓN

1.1 Antecedentes del Proyecto

PERU LNG está desarrollando un Proyecto de exportación de gas natural licuado (GNL) que incluye la construcción de un ducto que se inicia cerca de la ciudad de Ayacucho y llega hasta Pampa Melchorita, ubicada en la costa del Pacífico al sur de Lima. El gas natural para el proyecto será producido en los yacimientos de gas natural del Lote 56 en la Región del Cusco. El gas natural será transportado inicialmente por el gasoducto de Camisea existente (desde el KP0 hasta el KP211). Desde este punto, cerca de Chiquintirca en Ayacucho, se construirá un ducto de 34 pulgadas de diámetro con una extensión de 408 Km. (el Ducto) para culminar el transporte del gas natural hasta una planta de licuefacción en donde será preparado para ser exportado como GNL.

El Ducto abarca una zona de influencia social y ambiental que, desde un punto de vista geopolítico, comprende cuatro regiones (Lima, Ica, Huancavelica y Ayacucho), ocho provincias y 23 distritos.

Como parte de sus políticas internas y en cumplimiento con las normas peruanas, PERU LNG preparó un Estudio de Impacto Ambiental y Social (EIAS) para el ducto, que describe las características ambientales y sociales dentro de un corredor de 3 – 7 Km. de ancho a lo largo del derecho de vía (DdV) del ducto. El EIAS fue aprobado el tercer trimestre de 2006.

1.2 Promotores del Proyecto

PERU LNG es una empresa con fines específicos conformada por un consorcio liderado por Hunt Oil Company, SK Corporation y Repsol y estas compañías son denominadas conjuntamente los “Promotores”. El propósito específico es el desarrollo, construcción y operación de una planta de gas natural licuado (GNL) que está compuesta por un tren de licuefacción de 4.45 millones de toneladas por año e instalaciones conexas, que incluyen un nuevo gasoducto de 34 pulgadas de diámetro y 408 km. de extensión, que en conjunto conforman el “Proyecto”, que conectará la Planta de GNL al gasoducto existente de Transportadora de Gas del Perú (TGP) al final del segmento del ducto de 32 pulgadas de TGP que se extiende desde la planta de separación de gas en Las Malvinas cerca de los yacimientos de gas de Camisea cruzando el bosque tropical y terminando aproximadamente a la altura del km. 211.

PERU LNG es de propiedad de los Promotores con el siguiente porcentaje de participación:

Tabla 1.1 Participación en el Proyecto

Promotor	Participación
Hunt Oil Company	50%
SK Corporation	30%
Repsol YPF, S.A.	20%
Total	**100%**

1.3 Impactos sobre el Terreno y la Población

El terreno que el proyecto requiere se resume en la Tabla 1.2.

Tabla 1.2 Área de Terreno requerida para el Ducto de PERU LNG

Rubro		Área Aproximada por Rubro
DdV para Construcción (Servidumbre)		25 m (ancho) x 408 Km. del Ducto (1020 hectáreas)
DdV para las Operaciones (Servidumbre)		20 m (ancho) x 408 Km. del Ducto (816 hectáreas)
AGI Sitio1 (Instalaciones sobre el Suelo) (Adquisición Permanente)	Sitios de válvulas(14)	440 m^2
	Instalaciones de raspatubos (Melchorita) (1)	5,320 m^2
	Instalaciones de raspatubos (Occollo) (1)	5,000 m^2
	Estación de reducción de presión (1)	5,500 m^2
	Estación de medidores(1)	10,000 m^2

Ochocientas dieciséis hectáreas se utilizarán temporalmente sólo durante el período de construcción del Ducto de PERU LNG (aproximadamente tres años). El proyecto deberá obtener este terreno para la construcción del ducto. La titularidad de las 816 hectáreas de terreno permanecerá en poder de los propietarios actuales. Una vez concluida la construcción, los propietarios podrán reanudar el uso de sus tierras con algunas restricciones (Sección 7).

1.4 Objetivo

El objetivo del Plan de Acción sobre Biodiversidad (BAP, por sus siglas en inglés) es proporcionar una estrategia global y acciones específicas y posibles de implementar con el objetivo de proteger y conservar la biodiversidad durante la construcción y operación del ducto.

La construcción y operación del ducto de PERU LNG afectará directa a indirectamente los recursos biológicos sensibles dentro y en los alrededores del DdV (las zonas afectadas se denominan conjuntamente la zona de influencia del ducto). Aunque muchos de los hábitats por donde cruza el DdV del ducto están caracterizados por tener una sensibilidad biológica media a moderada, aproximadamente el veinte por ciento del DdV del ducto contiene hábitats sensibles (definidos como aquellos que albergan una o múltiples especies de animales o plantas de sensibilidad alta o media), incluyendo los valles de bosques secos de las cuencas de los ríos Apúrimac y Mantaro, las formaciones de arbusteras y de cactus de la sierra occidental, los hábitats hidromórficos isleños de las llanuras de arena de Pisco, los ecosistemas ribereños de las llanuras costeñas. Adicionalmente, el DdV del ducto alberga a cuatro especies (4 plantas y 1 animal) que son consideradas altamente sensibles debido a su condición de protección nacional y/o internacional, distribución geográfica, uso por las comunidades locales y desplazamiento (esto es, capacidad de huir en el caso ser perturbadas).

La presencia de hábitats y especies altamente sensibles dentro de la zona de influencia del ducto requiere de acciones de manejo específicas para el sitio y/o la especie para proteger a estos recursos. Por consiguiente, el objetivo del Plan de Acción sobre Biodiversidad (BAP) es proporcionar una estrategia global durante la construcción y operación del ducto, utilizando medidas específicas que serán puestas en práctica para la protección y conservación de los recursos biológicos específicos presentes dentro de la zona de influencia del ducto.

1.5 Alcance del BAP

1.51 Relación con otros Planes y Programas de PERU LNG

El BAP es un documento maestro que resume e incorpora los diversos planes y programas de PERU LNG relativos a la protección de la biodiversidad durante la construcción y operación del ducto y las instalaciones conexas. Adicionalmente, el BAP incluye programas adicionales además de aquellos requeridos por la legislación peruana o los prestamistas:

- Planes de Manejo Ambiental y Social de PERU LNG, incluyendo el Plan de Manejo Ecológico y el Plan de Biorestauración;
- Planes de Manejo para Contratistas de PERU LNG, incluyendo los Planes de Manejo Ecológico y Biorestauración para Contratistas; y
- Los Planes de Inversión de Desarrollo Comunitario.

1.52 Alcance Geográfico

El BAP se podrá aplicar a proyectos ubicados en los Departamentos de Lima (sólo en el Distrito de Cañete), Ica, Huancavelica y Ayacucho, Perú (Figura 1). Estas áreas abarcan los lugares por donde pasa el ducto de gas natural de PERU LNG. En estas zonas, la conservación de la biodiversidad será implementada teniendo en cuenta las prioridades de biodiversidad en lugar de la ubicación de las instalaciones del proyecto. La justificación de este alcance es:

- Proporcionar beneficios adicionales a las zonas afectadas por las instalaciones del proyecto;
- Reconocer el valor de la biodiversidad presente en partes de las regiones;
- Reconocer la condición de Ayacucho y Huancavelica como los dos departamentos más pobres del país y la dependencia de la población local en los recursos naturales y las presiones resultantes;
- Ayudar con cualquier apoyo logístico para los proyectos a ser implementados bajo el BAP; y
- Facilitar el reconocimiento del beneficio que el proyecto puede proporcionar para la biodiversidad en vista de que las personas se familiarizarán más con el proyecto que en los lugares que se encuentran lejos de las zonas del proyecto.

Figura 1.1 Ruta del ducto de PERU LNG y departamentos, provincias y distritos vecinos (divisiones administrativas de primer, segundo y tercer orden, respectivamente).

1.6 Contenido y estructura del BAP

El BAP está compuesto por cinco secciones:

1. Política;
2. Evaluación de la Biodiversidad durante el Proceso de Planeamiento del Proyecto;
3. Planeamiento de Manejo de la Biodiversidad durante la Construcción;
4. Programa de Monitoreo de la Biodiversidad; y
5. Plan de Inversión Ambiental.

La Introducción describe los objetivos, política, alcance, contenido y estructura del BAP.

La sección de Evaluación de la Biodiversidad durante el Proceso de Planeamiento del Proyecto detalla las acciones tomadas durante la concepción, planeamiento y diseño del proyecto, incluyendo la evaluación del trazo del ducto y otras alternativas de ubicación, el proceso del Estudio de Impacto Ambiental y Social, y los aspectos de biodiversidad del Plan de Manejo Ambiental y Social.

El Planeamiento del Manejo de la Biodiversidad durante la etapa de Construcción resume los diversos planes y mecanismos desarrollados para minimizar los impactos sobre la biodiversidad durante la fase de construcción del proyecto, incluyendo el Plan de Manejo Ambiental y Social (ESMP por sus siglas en inglés), la Restauración y Revegetación, el Código de Conducta, la Evaluación Ecológica de Campo, el Plan de Manejo Ecológico, el Plan de Manejo de Camélidos, el Proyecto de Plantas Medicinales, el Plan de Biorestauración, y la micro ruta final del derecho de vía del ducto.

El Plan de Monitoreo de la Biodiversidad proporciona un marco para el desarrollo e implementación de actividades para monitorear la biodiversidad a lo largo del Ducto de PERU LNG y su zona de influencia.

El Plan de Inversión Ambiental (EIP por sus siglas en inglés) establece el marco para priorizar, seleccionar e implementar proyectos sobre biodiversidad y temas ambientales más amplios a cualquier escala (esto es, local, regional o zonal) dentro de la Zona del Plan de Acción sobre Biodiversidad. El Plan de Inversión Ambiental no está limitado estrictamente a temas relacionados con la biodiversidad, sino más bien tiene la intención de abarcar temas ambientales más amplios relacionados con el paisaje y las comunidades de la zona de influencia de PERU LNG, incluyendo aspectos tales como suelos, agua, aire y ruido. Asimismo, el Plan de Inversión Ambiental considerará proyectos enfocados hacia el uso sostenible directo e indirecto de la biodiversidad y hábitats, incluyendo el ecoturismo sostenible y el uso de fauna y flora nativa.

2.0 Política

2.1 Políticas Ambientales y Sociales de PERU LNG

Este BAP fue desarrollado para que sea consistente con las políticas ambientales y sociales de PERU LNG, incluyendo:

Política Ambiental

Manejo Ambiental

- Integrar la integridad ambiental, la equidad social y la viabilidad social en procesos comerciales;
- Cumplir a cabalidad con la legislación y reglamentos ambientales;
- Manejar cuidadosamente el uso de los recursos naturales y mejorar la eficiencia energética; y
- Llevar a cabo las operaciones con el objetivo de prevenir la polución, conservar los recursos y abordar con responsabilidad los temas ambientales del pasado.

Mejoramiento Continuo

- Fomentar una filosofía novedosa en el desarrollo e implementación de nuevas ideas relativas a la integridad ambiental;
- Medir el desempeño a través de auditorías generales; y
- Establecer metas y objetivos ambientales para mejorar el desempeño.

Comunicación

- Responder a las inquietudes y puntos de vista de los grupos de interés de manera oportuna y abierta;
- Establecer relaciones efectivas con las partes interesadas, para discutir las operaciones comerciales y su relación con las comunidades y el medio ambiente afectados; y
- Proporcionar una información clara y transparente acerca de los productos, servicios y operaciones para los clientes, empleados, agencias del gobierno y el público, según sea el caso.

Política Social

- Llevar a cabo las operaciones de conformidad con los más elevados estándares de integridad personal y comportamiento ético;
- Respetar las leyes y normas de los gobiernos y las creencias y valores de las comunidades, y

- Facilitar un intercambio abierto de información que sea claro y pertinente entre la población local, los líderes de las comunidades, las partes afectadas y la compañía.

2.2 Planes de Acción sobre Biodiversidad en el Sector de Hidrocarburos

La *International Petroleum Industry Environmental Conservation Association (*IPIECA) desarrolló guías de orientación para el desarrollo de Planes de Acción sobre Biodiversidad para proyectos de hidrocarburos (IPIECA, 2005), las cuales identifican los siguientes pasos principales en el desarrollo de un BAP:

- Decisión sobre si debe crearse un BAP – comprensión de los motivos legales, de biodiversidad y negocios;
- Cumplimiento den los pre-requisitos – planeamiento de la integración con los sistemas para el manejo del emplazamiento o del proyecto y el manejo de los recursos;
- Preparación del BAP – establecer las prioridades de conservación;
- Monitoreo, evaluación y mejora – seguimiento del avance y efectividad de la implementación; y
- Reporte, comunicación y verificación del desempeño – mejoramiento del proceso de establecer relaciones efectivas y obtener el apoyo de los grupos de interés y socios.

La IPIECA recalca que cada uno de estos pasos debe estar acompañado por un relacionamiento efectivo y consultas con los grupos de interés, lo cual es congruente con las políticas sociales y ambientales de la Corporación Internacional de Finanzas (CIF) y el Banco Interamericano de Desarrollo (BID).

Las guías de la IPIECA también estipulan que un BAP debe considerar y estar alineado, en la medida de lo posible, con los objetivos y prioridades de cualquier programa(s) sobre biodiversidad.

2.3 Convenios, Normas y Políticas Internacionales

EL BAP fue desarrollado para que sea consistente con los lineamientos y normas internacionales, particularmente el *Convenio sobre Diversidad Biológica* (CBD por sus siglas en inglés) (UNEP, 1993) *y la Legislación Peruana*, así como los de la CIF, BID, e IPIECA.

2.3.1 Convenio sobre Diversidad Biológica

El Convenio sobre Diversidad Biológica tiene el objetivo de fomentar el bienestar de la naturaleza y del ser humano. El Convenio sobre Diversidad Biológica fue iniciado en la Cumbre de Río sobre la Tierra de 1992 y ratificado pro 150 gobiernos, incluyendo el Perú en el año 1993. Tiene tres metas principales.

- La conservación de la diversidad biológica (o la biodiversidad)
- El uso sostenible de sus componentes; y
- Una distribución justa y equitativa de los beneficios derivados de los recursos genéticos.

La Resolución No. 03, que es un Apéndice del Convenio sobre Diversidad Biológica que trata sobre la agricultura sostenible, tiene un significado particular para el BAP de PERU LNG. Este tema es de especial importancia en la región debido a la importancia y alcance del uso de la tierra para fines agrícolas en los alrededores del ducto: la economía de la mayor parte de la población de la región se sustenta en la producción agropecuaria. La importancia de la biodiversidad agrícola se resalta en la Estrategias y Planes de Acción sobre Diversidad Biológica Nacionales y Regionales del Perú.

El Convenio sobre Diversidad Biológica requiere que los gobiernos que lo ratificaron preparen informes sobre el estado de la biodiversidad dentro de su país y desarrollen planes de acción para atender los problemas claves. Estos planes constituyen el marco de acción para una amplia gama de especies y sus hábitats así como para temas ambientales más amplios tales como el agua, aire y los cambios climáticos.

El Perú ha desarrollado estrategias nacionales y regionales para implementar los acuerdos del Convenio sobre Diversidad Biológica (ver la Sección 2.4.4); sin embargo, los informes sobre estas estrategias se han estancado en los últimos años. El Segundo Informe Nacional para el Convenio sobre Diversidad Biológica fue presentado en el año 2001 y se desconoce el estado en que se encuentra el Tercer Informe Nacional, que debió ser presentado en mayo de 2005. En el año 2002 se presentó un breve Informe Temático sobre los Ecosistemas Andinos. Con el apoyo del Banco Mundial, el Perú viene desarrollando una Evaluación Ambiental del País, pero los últimos documentos datan del año 2005.

2.3.2 Norma de Desempeño No. 6 de la CIF, Conservación de la Biodiversidad y Manejo Sostenible de los Recursos Naturales

La Norma de Desempeño No. 6 reconoce que la protección y conservación de la biodiversidad y su capacidad de cambiar y evolucionar es un aspecto fundamental para el desarrollo sostenible. Aunque se preocupa por garantizar el desarrollo apropiado, los principios contenidos en la norma son adecuados para ser considerados en el desarrollo del BAP. Específicamente:

- El reconocimiento del papel importante que el sector privado puede desempeñar en la protección y conservación de la biodiversidad para las generaciones futuras y en fomentar el manejo y uso sostenible de los recursos naturales renovables.
- El hecho que, dada la importancia de la biodiversidad no sólo en términos ambientales sino también en lo económico, social, cultural y científico, los diversos componentes de la biodiversidad pueden tener valores distintos para los distintos grupos de interés, y estos valores distintos deben ser aclarados a través de consultas.
- El reconocimiento del hábitat natural crítico como un sub conjunto del hábitat tanto natural como modificado que merece atención particular, incluyendo:
  - zonas con una biodiversidad de alto valor (tales como zonas que cumplen con los criterios de clasificación de la Unión Mundial para la Naturaleza (IUCN, por sus siglas en inglés), incluyendo hábitats requeridos para la supervivencia de especies en peligro o en peligro crítico (tal como se definen en la Lista Roja de Especies Amenazadas de la Unión Mundial para la Naturaleza o como se definan en cualquier legislación nacional);
  - zonas con una importancia especial para especies endémicas o de rango restringido; lugares que son críticos para la supervivencia de especies migratorias;
  - zonas que albergan concentraciones globalmente importantes o que están asociadas con procesos clave de evolución o que proporcionan servicios clave para los ecosistemas; y
  - zonas en donde existe una biodiversidad de importancia social, económica o cultural para las comunidades locales.
- Las especies foráneas constituyen una amenaza importante para la biodiversidad, en vista de que pueden tornarse invasivas, propagándose rápidamente y desplazando a las especies nativas.

2.3.3 Política de Medio Ambiente y Cumplimiento de Salvaguardias del BID – Directiva No. B.9 sobre Hábitats Naturales y Sitios Culturales

El BID sólo financiará operaciones y actividades que cumplan con las directivas de su Política de Medio Ambiente y Cumplimiento de Salvaguardias y que sean consistentes con las estipulaciones pertinentes de otras políticas del BID. La Directiva No. B.9 sobre Hábitats Naturales y Sitios Culturales establece que el BID no apoyará operaciones que, en su opinión trastornen significativamente o degraden los hábitats naturales. Adicionalmente, el BID no apoyará operaciones que trastornen o degraden hábitats naturales, a menos que:

- No hayan alternativas viables aceptables para el BID;
- Un análisis integral demuestre que los beneficios globales de la operación son mucho mayores que los costos ambientales; y
- Medidas de mitigación y compensación aceptables para el BID, incluyendo, de ser el caso, la minimización de la pérdida de hábitat y que establezcan y mantengan una zona ecológica protegida similar hayan sido adecuadamente financiadas, implementadas y monitoreadas.

Según la definición del BID, los hábitats críticos naturales son:

- Las zonas protegidas existentes, las zonas propuestas oficialmente por los gobiernos como sitios de protección o que mantienen condiciones que son vitales para la viabilidad de las zonas antes mencionadas; y
- Zonas no protegidas que tienen un alto valor de conservación conocido.

Las zonas protegidas existentes pueden incluir reservas que reúnen los criterios de las Zonas Protegidas de la IUCN, Categorías I a VI; Lugares considerados como Patrimonio Mundial; áreas protegidas bajo la Convención de RAMSAR sobre Humedales; las principales zonas de la Reserva de la Biosfera Mundial; y las zonas incluidas en la Lista de las Naciones Unidas de Parques Nacionales y Áreas Protegidas.

En la opinión del BID, las zonas de alto valor de conservación son aquellas que podrían ser:

- Sumamente adecuadas para la conservación de la biodiversidad;
- Cruciales para las especies en peligro crítico, en peligro, vulnerables o potencialmente amenazadas incluidas como tales en la Lista Roja de Especies en Peligro de la IUCN; o
- Críticas para la viabilidad de las rutas migratorias de las especies migratorias.

Finalmente, el BID no apoyará operaciones que introduzcan especies invasivas.

2.4 Marco de la Política Nacional

El Convenio sobre Diversidad Biológica requiere que los Gobiernos que lo han ratificado desarrollen políticas y marcos para atender la biodiversidad. Las siguientes secciones describen las políticas y planes nacionales del Perú que son pertinentes para el BAP de PERU LNG. Según las guías del IPIECA, cada uno de estos planes fue considerado durante el desarrollo del BAP de PERU LNG.

2.4.1 Constitución Política del Perú

Los Artículos 66 al 69 de la Constitución Política del Perú proporcionan un marco general para la conservación y el uso sostenible de la diversidad biológica del Perú. Estos artículos contienen principios que están incluidos en el Convenio sobre Diversidad Biológica, tales como la

conservación y mantenimiento in situ de las prácticas tradicionales de las comunidades nativas y locales.

2.4.2 Agenda Ambiental Nacional

La Agenda Ambiental Nacional 2005-2007 (CONAM, 2005), incluye las siguientes metas que son importantes para el BAP:

- La revisión y aprobación de las políticas ambientales regionales y locales:
  - Meta: para el año 2007 todos los Gobiernos Regionales deberán tener Políticas Ambientales Regionales (Ica y Lima están enumeradas como dos de los ocho departamentos que aún no habían desarrollado tales políticas).
  - Meta: generar condiciones para la implementación de las 17 Políticas que ya han sido aprobadas para el 2007 (Ayacucho y Junín están enumerados como dos de los departamentos que requieren implementar sus políticas regionales aprobadas).
  - Meta: por los menos una municipalidad en cada departamento del Perú debe tener una Política Ambiental Aprobada para el 2007 dentro del Marco de los Sistemas Locales de Manejo Ambiental.
- Desarrollo de capacidad para mejorar el manejo ambiental local en temas importantes de las convenciones sobre diversidad biológica, cambios climáticos y desertificación.
- Manejo y conservación de la diversidad biológica en los departamentos de Amazonas, Ancash, Apurímac, Arequipa, Ayacucho, Cajamarca, Callao, Cusco, Huancavelica, Huánuco, Ica, Junín, La Libertad, Lambayeque, Loreto, Madre de Dios, Moquegua, Pasco, Piura, Puno, San Martín, Tacna, Tumbes, y Ucayali.

Podría darse la oportunidad de que el BAP apoye a los gobiernos regionales y locales en el desarrollo e implementación de sus políticas ambientales.

2.4.3 Política Ambiental Nacional

La Política Ambiental Nacional de 2005 (también conocida como la Política de Estado No. 19, establecida bajo la Ley General del Medio Ambiente No. 28611) contiene guías para el manejo de problemas ambientales, según las cinco políticas siguientes:

1. *Promoción del Desarrollo Sostenible y del Manejo Ambiental Nacional, Regional y Local:* Integrar el manejo de temas ambientales como las políticas económicas, sociales y culturales a nivel local, nacional e internacional, con el fin de contribuir a superar la pobreza y lograr el desarrollo sostenible del Perú;
2. *Gestión de los Recursos Naturales*: Promover la conservación y el uso sostenible de los recursos naturales como la base para el desarrollo sostenible del país, con una visión integrada de los ecosistemas dentro de un marco de planeamiento del uso de la tierra;
3. *Gestión de la Calidad Ambiental*: Proteger y controlar la calidad ambiental, la habitabilidad urbana, y prevenir la polución, promoviendo las mejores prácticas y la responsabilidad ambiental y social corporativa, con el objetivo de garantizar la salud y el derecho fundamental de las personas a vivir en un medio ambiente saludable.
4. *Gestión y Promoción de la Sensibilización y Cultura Ambiental*: Promover la educación, sensibilización y cultura ambiental a través de la participación de la ciudadanía en las decisiones ambientales y el acceso a la información ambiental y justicia ambiental; y
5. *Gestión del Comercio y del Ambiente*: Insertar al Perú en los acuerdos comerciales internacionales de forma tal que refleje las necesidades del país a la luz de las iniciativas ambientales planteadas por las naciones desarrolladas. Asimismo, crear un sistema nacional que facilite el reconocimiento internacional de las etiquetas y marcas y la certificación de normas ISO.

La Política Ambiental Nacional, contiene la Política de Gestión de los Recursos Naturales, que está conformada por cuatro programas nacionales que están estrechamente relacionados con la conservación de la biodiversidad:

- Planeamiento Ambiental;
- Uso y Conservación de los Recursos Naturales;
- Evaluación y Valorización del Patrimonio Natural; e
- Implementación de la Estrategia Nacional sobre Diversidad Biológica (ENDB, ver abajo).

Dentro del Programa sobre el Uso y Conservación de los Recursos Naturales, el valor e importancia de algunos hábitats dentro de la zona de influencia del ducto de PERU LNG están explícitamente reconocidos, incluyendo la zona Andina y los bofedales.

2.4.4 Estrategia Nacional sobre Diversidad Biológica

La ENDB fue iniciada en el año 1998 para implementar los acuerdos del Convenio sobre Diversidad Biológica. El Consejo Nacional de Medio Ambiente (CONAM) implementó la ENDB y la Comisión Nacional de Diversidad Biológica (CONADIB) promueve la participación de las instituciones públicas y privadas que implementan la ENDB.

Bajo el marco de la ENDB, un total de 19 Estrategias Regionales y 3 Estrategias Macro Regionales han sido desarrolladas hasta la fecha, incluyendo Estrategias Regionales para tres de los cuatro departamentos dentro de la zona de influencia del Ducto: Ayacucho, Huancavelica y Lima. El Departamento de Ica aún no ha desarrollado una Estrategia Regional. Cada una de las Estrategias Regionales contiene una Agenda Ambiental Regional y un Plan de Acción. Las Comisiones Ambientales Regionales – CARs, implementan las Estrategias Regionales.

Estrategias Regionales de Ayacucho y Huancavelica Regional, Agendas Ambientales y Planes de Acción

Los principales temas estratégicos delineados en las Estrategias Regionales de Ayacucho y Huancavelica son:

- La conservación in situ de la biodiversidad (paisajes naturales, campos cultivados, etc.) incorporando el conocimiento común de los campesinos y pastores quienes pueden contribuir grandemente a la conservación de la biodiversidad; y
- La conservación ex-situ, a través de:
  - El apoyo a lugares en donde se almacenan plantas y animales o especimenes (herbarios, bancos de germoplasma, jardines botánicos, zoológicos);
  - Implementación de investigación sobre biodiversidad; y
  - Apoyo para los investigadores (particularmente taxónomos).

El Plan de Acción Ambiental Regional para Ayacucho hasta el 2013 y la Agenda Ambiental Regional para Ayacucho se incluyen en el *Apéndice 1.* Los principales objetivos y acciones definidos en la Agenda Ambiental Regional para Ayacucho que son de importancia para el BAP son los siguientes

Objetivo: Desarrollo de la agro ecología.
Líneas de acción:

- Promover la reducción del uso de productos tóxicos agroquímicos.
- Promover el uso de las tomas de agua naturales y productos biodegradables para la producción agrícola.
- Promover la comercialización de productos orgánicos

Objetivo: Manejo y Conservación de la Biodiversidad y Áreas Naturales Protegidas
Líneas de acción:

- Promover y crear bancos de germoplasma para los cultivos andinos, tropicales y subtropicales.
- Promover programas de reforestación y/o forestación con especies nativas e introducidas.
- Desarrollar el manejo, conservación e inventario de la biodiversidad.

Objetivo: Categorización Económica Geográfica y Ecológica
Líneas de acción:

- Realizar estudios de vulnerabilidad de las zonas rurales de mayor riesgo.
- Promover el desarrollo de la categorización macro, meso y micro ecológica.
- Promover el desarrollo de un Plan de Ordenamiento Territorial

Objetivo: Manejo y Conservación de las Cuencas Hidrográficas.
Líneas de acción:

- Identificación y evaluación de las sub cuencas y micro cuencas.
- Promover la forestación y la reforestación de las sub cuencas y de las micro cuencas de la región de Ayacucho.
- Promover el manejo y la conservación de los pastos naturales.

La Agenda Ambiental Regional para Huancavelica 2005 – 2006 y el Plan de Acción Ambiental Regional hasta el 2015 se incluyen en el *Apéndice 2*. Los principales objetivos y metas que se definen en la Agenda Ambiental Regional de Huancavelica que son importantes para el BAP son los siguientes:

Objetivo: Avances en la conservación y uso sostenible del suelo, reforestación y manejo de pastos naturales y servicios ambientales de los ecosistemas forestados.
Meta a dos años: El uso sostenible de 1,000 hectáreas de recursos forestados y la producción de productos y servicios ambientales del bosque y la conservación del suelo.

Objetivo: Avances en la conservación y protección de la biodiversidad.
Meta a dos años: Creación de un Comité Regional de Uso Sostenible; protección de la flora de la parte norte de la región de Huancavelica; protección de la fauna de las regiones alto andinas.

Objetivo: Avance en la caracterización geográfica y manejo de la cuenca.
Meta a dos años: Fortalecer el Comité de Usuarios del Agua en la región de Huancavelica; manejo integrado de las micro cuencas de San Juan Chiris-Sinto (Castrovirreyna) y Huaytara; integración de la sub cuenca de Tayacaja a la Administración Técnica Distrital de Riego (ATDR) de Huancavelica.

Objetivo: Lograr la distribución acordada de los recursos de agua con beneficios sociales
Metas a dos años: Promoción y calificación en la diversidad del uso de agua en las micro cuencas de San Juan Chiris-Sinto (Castrovirreyna) y Huaytara; para promover un Programa de Construcción de presas, infraestructura de irrigación y la implementación de tecnología en la Vertiente del Pacífico.

Las líneas estratégicas y acciones relevantes para el Plan de Acción Regional de Huancavelica son las siguientes:

Línea estratégica: Avance, fortalecimiento y apoyo integrado de la conservación del suelo, reforestación y manejo de pastos naturales.

Líneas de acción: Promoción del manejo de recursos naturales; programa de manejo para suelos, bosque, pastos y agua en los ecosistemas forestados.
Línea estratégica: Avanzar con la conservación y protección de la biodiversidad.
Líneas de acción: Establecimientos de Áreas Naturales Protegidas por la Región y el Estado.

Línea estratégica: Avanzar con la caracterización geográfica y el manejo integrado de la cuenca.
Líneas de acción: Promoción del uso adecuado de los recursos hídricos; mejorar el manejo de las micro cuencas.

Línea estratégica: Lograr la distribución acordada de los recursos hídricos con beneficios sociales.
Líneas de acción: Promoción y calificación en la diversidad de usos de agua; promover un Programa de Construcción de presas, infraestructura de irrigación y tecnología para su implementación

Líneas estratégicas: Promover actividades rentables que sean económicas y sustentables.
Líneas de acción: Promover los sistemas de producción agro ecológica; automatización de las actividades agrícolas; fortalecimiento de los comités de productores.

En términos de agro biodiversidad, en el año 2001 la Dirección Regional Agraria de Ayacucho y Huancavelica, los Gobiernos Regionales, el Consejo Nacional de Camélidos Sudamericanos y otras organizaciones culminaron un análisis de fortalezas, debilidades, oportunidades y amenazas (SWOT, por sus siglas en inglés) para identificar oportunidades y facilitar la preparación de Planes Estratégicos para el Desarrollo Regional. Los dos objetivos principales de los Planes Estratégicos fueron identificados en base a este análisis:

- Proporcionar mayor apoyo para la investigación científica y tecnológica y para la transferencia de tecnología entre productores y organizaciones relacionadas con el sector agropecuario; y
- Procurar la explotación racional, conservación de los recursos naturales y el desarrollo competitivo de la producción (tubérculos andinos, plantas aromáticas y medicinales, vegetales, árboles frutales, frutos del cactus, y cochinilla) para poder satisfacer las demandas del mercado nacional e internacional .

El Consejo Nacional de Camélidos Sudamericanos (CONACS) preparó un plan estratégico regional para Huancavelica para fomentar la crianza de camélidos en las zonas alto andinas y fortalecer a las asociaciones de criadores de alpaca existentes incluyendo la Asociación de Criadores de Camélidos Sudamericanos de Huancavelica (APROCASH), la Asociación de Criadores Registrados de Alpaca de Huancavelica (APRA) y la Asociación de Promotores de Alpaca.

Estos temas son importantes para la zona del BAP, ya que la economía de la mayoría de la población de la región se sustenta en el cultivo de especies nativas tales como la papa, el maíz y los granos y en la crianza de ganado, principalmente vacas y ovejas. La región también tiene la mayor población de camélidos sudamericanos (especialmente vicuña y alpaca) y una gran riqueza de plantas medicinas utilizada en la medicina tradicional.

Estrategia Regional, Agenda Ambiental y Plan de Acción de Lima

La Estrategia Regional de Lima se desarrolló en el año 1999 y consta de un breve documento de 29 páginas, incluyendo los apéndices. Este documento identifica los siguientes ecosistemas y especies prioritarios:

- Ecosistemas
  - Lomas costeras (ecosistemas cubiertos de niebla estacional en los cerros costeros con flora y fauna única);
  - La Cuenca del Río Rimac (la Cuenca suministra el agua potable a la ciudad de Lima);
  - Las Lagunas de Chucchún (aproximadamente 80 lagunas andinas a una altura de 3,800 a 4,000 msnm); y
  - Los Pantanos de Villa, ubicados en las afueras de ciudad de Lima.
- Especies
  - Ocho especies marinas de peces de interés comercial;
  - Cuatro especies marinas de moluscos de interés comercial; y
  - Un cangrejo marino de interés comercial

Con la excepción de posibles formaciones de lomas costeras aisladas, ninguno de los ecosistemas y especies prioritarios identificados en la Estrategia Regional de Lima se encuentra en la Zona de influencia del BAP en Cañete.

Las acciones propuestas por la Estrategia Regional de Lima se agrupan en dos categorías: Análisis General y Expectativas de Desarrollo, que incluyen lo siguiente

- Análisis General:
  - Fortalezas
  - Debilidades;
  - Oportunidades; y
  - Amenazas.
- Expectativas de Desarrollo (proyección a cinco años):
  - Planes y Estrategias de Manejo Ambiental;
  - Planeamiento y Manejo de Cuencas;
  - Proyecto de Sensibilidad, Educación e Investigación de la Diversidad biológica (BOTZOOWASI);
  - Conservación y Manejo Sostenible de los Ecosistemas
  - Recuperación de la Cobertura Vegetal;
  - Artes Culinarios;
  - Uso Sostenible de la Biodiversidad;
  - Recuperación de las Tecnologías Tradicionales;
  - Recuperación de las Especies en Peligro;
  - Control de la Contaminación, e
  - Investigación y Desarrollo.

El BAP puede apoyar algunas de estas acciones en la Provincia de Cañete del Departamento de Lima.

3.0 EVALUACIÓN DE LA BIODIVERSIDAD DURANTE EL PROCESO DE PLANEAMIENTO DEL DUCTO

3.1 Concepción Inicial del Proyecto

El concepto original del proyecto de PERU LNG incluyó un posible tramo del ducto entre la Planta de Separación de Gas en Las Malvinas y tierras bajas de la amazonía de la Región de Bajo Urubamba y la zona de Chiquintirca en los Andes al este de Ayacucho. Sin embargo, PERU LNG pudo llegar a un acuerdo con TGP para enlazarse con el Ducto de TGP en los Andes al oeste del Valle del Río Apurímac en Chiquintirca. Con esto se evitó la necesidad, y los impactos asociados con un nuevo ducto en las laderas orientales Andinas que cruzara vastas zonas de bosques tropicales.

3.2 Evaluación de las Rutas Alternativas del Ducto

En el mes de abril de 2004, Walsh Peru presentó un estudio titulado *Evaluación Preliminar para el Diseño de la Ruta de un Gasoducto*. Esta evaluación de gabinete identificó los principales problemas relacionados con dos rutas alternativas para el gasoducto entre Huayahura y Melchorita, definidas como la RUTA DIRECTA (norte) y la RUTA PARALELA (Sur), con el objetivo de establecer las ventajas y desventajas de cada una desde una perspectiva ambiental. La evaluación consideró aspectos de distintas especialidades, incluyendo biología, geomorfología, arqueología y social.

Los criterios biológicos incluyeron los siguientes:

- Diversidad del mosaico de los distintos hábitats;
- Incremento en la fragmentación como resultado de la construcción del ducto;
- Presencia de humedales;
- Zonas con la presencia de cactus;
- Probable presencia de bosques de Polylepis;
- Presencia de bosques secos con árboles de la familia de los bombaceos;
- Presencia de zonas endémicas de aves;
- Presencia de pequeñas lagunas;
- Presencia de Áreas Protegidas; y
- Presencia de mamíferos y animales que podrían tener una distribución restringida en la zona.

Aunque la comparación de ambas rutas no indicó que habían diferencias importantes en términos de sensibilidad biológica, el estudio concluyó que era necesario realizar una evaluación más detallada de la composición de las especies de los distintos hábitats en ambas rutas, y que probablemente sería posible prevenir los impactos sobre estos hábitats modificando ligeramente la ubicación del DdV (esto es, micro rutas), o reconstruyendo los hábitats afectados (esto es, biorestauración).

Una vez seleccionada la ruta Paralela o Sur, PERU LNG contrató a Walsh Peru para que realice el trabajo del trazo de la primera etapa. Este trabajo se realizó entre marzo y abril de 2005 con 6 biólogos, 6 arqueólogos y 2 científicos físicos especializados (geología y suelos). Se agruparon en cuatro equipos que trabajaron simultáneamente para poder cubrir oportunamente la gran zona involucrada. La ruta de 402.8 km. (horizontalmente) de extensión cruza el bosque montano alto de este a oeste (primeros 5 km.), luego las cordilleras internas y la puna, antes de descender a la costa. Esta ruta modificada corría básicamente en paralelo y relativamente cerca al ducto de TGP (PTS, por sus siglas en Inglés) en unos 163 km. y lejos del PTS en hasta 20 km. en los 240 km. restantes del ducto.

Durante el trazado de la primera etapa, todas las zonas fueron recorridas a pie. El equipo de topógrafos profesionales fue asesorado por arqueólogos, biólogos y especialistas en estabilidad física. El trazado de la primera etapa permitió a PERU LNG evaluar las distintas variables de la ruta, y permitió también definir la mejor ruta, efectuando los cambios necesarios para minimizar el impacto.

Cuando se encontraron elementos ambientalmente sensibles que podrían ser afectados, tales como arbustos o bosques solitarios, se propuso una variación de la ruta in situ y ésta fue incorporada por el representante del campo. Aunque en la mayoría de los casos la modificación de esa sección se efectuó en el campo, en algunas ocasiones el equipo de topografía no pudo implementar las variaciones recomendadas para la ruta debido a consideraciones técnicas de construcción. Algunos aspectos resaltantes de los cambios efectuados en el campo incluyen los siguientes:

- Se identificaron muchos humedales a lo largo de la ruta, principalmente en Acocro, Occollo, Patibamba, Choclococha, y Jarimayo, la gran mayoría de los cuales fue evitada. En los casos de aquellos que no pudieron ser evitados, se propusieron medidas específicas en el ESMP para preservar la flora y la fauna.
- En las laderas ubicadas entre Uraypampa y Mayobamba, se registraron cactus de matucana del género Oroya,. Estos cactus serán evitados en la mayor medida posible durante la construcción, implementado medidas mayores para evitarlos que las que se tomaron durante el levantamiento detallado del trazo.
- En la parte alta de la Quebrada de Tantacce, se registraron dos parcelas relativamente densas de bosques solitarios. La más grande tenía una extensión de aproximadamente 900 m y se evitó totalmente al momento de realizar el reajuste de la ruta.
- Con respecto a la fauna, en Tayapampa se hizo una variación debido a la presencia del Zorro Andino (*Pseudalopex culpaeus*), el puma (*Puma concolor*), el zorrino (*Conepatus chinga*), el venado de cola blanca (*Odocoileus virginianus*) y la viscacha del norte (*Lagidium peruanum*). Asimismo, en la primera sección del ducto, la ruta fue modificada para evitar las poblaciones de viscacha.
- En el Cerro Choccehuatgra los afloramientos rocosos fueron reconocidos como zonas sensibles de flora y fauna (tinamou, viscacha, roedores y lagartijas pequeñas). Debido al registro frecuente de fauna asociada con estos afloramientos, un cambio en el trazo fue considerado pero no pudo ser implementado, de tal manera que el ESMP planteará medidas para mitigar los impactos en esta zona.
- El equipo del trazo también realizó otro cambio para evitar cruzar los bosques secos solitarios dominados por *pati* (*Eriotheca* cf. *ruizii*) en Patibamba, un árbol sagrado para los Wari debido a que puede curar enfermedades.
- En Chiquintirca, se modificó el trazo para evitar el hábitat de la viscacha del monte.

3.3 Proceso del Estudio de Impacto Ambiental y Social

Un resumen más detallado de las conclusiones del Estudio de Impacto Ambiental y Social (EIAS) se incluye en el *Apéndice 3*.

3.3.1 Estudios de Referencia Biológica Inicial

Un elemento importante del proceso del EIAS fue un estudio referencia inicial en dos estaciones (seca y lluvia) a lo largo de toda la extensión del Estudio del Corredor del DdV propuesto. Este estudio incluyó el muestreo en lugares ubicados en un corredor de 3-7 km. de ancho centrado en la alineación del DdV y que corresponde a las micro cuencas hidrográficas.

La variedad de especies correspondientes a los distintos grupos taxonómicos reportados por la Referencia Biológica Inicial se presenta en el siguiente cuadro:

Tabla 3.1 Variedad de Especies de los Distintos Grupos Taxonómicos Reportados en la Referencia Biológica Inicial del EIAS

Grupo Taxonómico	Época de Lluvia	Época Seca	Total
Plantas			673 (Reportados como potenciales)
Peces	8	8	9
Anfibios	5	6	8
Reptiles	12	14	16
Aves	215	279	307
Mamíferos	37	38	45

3.3.2 Identificación de Hábitats Sensibles

La Referencia Biológica Inicial identificó los segmentos más sensibles del DdV, a saber :

- Kp 0+000 a Kp 10+000. Corresponde a la cuenca hidrográfica del este.
- Kp 55+000 a Kp 75+000: Corresponde a los dos extremos de la zona del estudio (sensibilidad alta) así como los dos segmentos intermedios con sensibilidad media. Estos se encuentran principalmente en la zona cultivada de Acocros .
- Kp 115+000 a Kp 120+000: Corresponde a la zona cultivada del Río Vinchos.
- Kp 120+000 a Kp 200+000: Corresponde a la zona alto andina 4, entre el Río Vinchos y el Lago Taccracocha. Incluye puna, pastizales, pantanos cubiertos de juncos, y lagos.
- Kp 245+000 a Kp 250+000: Corresponde al último segmento de la puna antes de descender hacia las vertientes occidentales cerca de Huaytará.

En base a estos resultados, la Referencia Biológica Inicial del EIAS concluye que los ecosistemas más sensibles son las cuencas hidrográficas del este, las áreas cultivadas y la puna (particularmente la zona alto andina 4).

En términos de especies en peligro y en peligro crítico, la Referencia Biológica Inicial del EIAS identificó las siguientes en el corredor del estudio:

Tabla 3.2 Especies el Peligro Crítico Identificadas en la Referencia Biológica Inicial del Corredor del Estudio

Especie	Categoría de INRENA[1]	Tipo de Hábitat	KP Aproximado
Plantas			
Aralia soratensis	CR	Bosque seco del este	40-41
Carica candicans	CR	Arbustera de la ladera del Pacífico	246-247
Chersodoma arequipensis	CR	Arbustera de la ladera del Pacífico	258-259
Ephedra rupestris	CR	Puna	235
Kageneckia lanceolata	CR	Vegetación espinosa del sector occidental	32-34
Polylepis racemosa	CR	Bosque de Quenuales	28-29, 32-33
Puya raimondii	EN	Puna	196
Aves			
Cinclodes palliatus Mono araña de panza blanca	CR	Humedales de la puna	167-167, 204-205
Poospiza rubecula Pinzón Pechirrufo	EN	Arbusteras mixtas	249 rió abajo en la Quebrada Salvia (Cuenca del Río Huaytará)
Vultur gryphus Cóndor Andino	EN	Probablemente en gran parte del DdV	**Probablemente en gran parte del DdV**
Mamíferos			
Platalina genovensium Murciélago longirrostro peruano	CR	Arbustos y cactus de la ladera del Pacífico	299
Pudu mephistophiles Pudu del norte	EN	Bosque montano del este	Reportado por el levantamiento en la zona del río Pallja-Alfarpampa

Especie	Categoría de INRENA[1]	Tipo de Hábitat	KP Aproximado
Tremarctos ornatus Oso de anteojos	EN		Reportado por el levantamiento en la zona del bosque montano del este
Lama guanicoe Guanaco	EN	Presente en partes de Ica, Huancavelica, y Ayacucho	No reportado pero considerado posible.

[1]CR: En peligro crítico; EN: en peligro

3.3.3 Consultas con los Grupos de Interés

Como parte de las actividades de consulta realizadas para el EIAS del Ducto, se conversó con una gama de grupos de interés en toda la zona del proyecto acerca de temas de biodiversidad. Las consultas con los diversos grupos de interés se describen en la siguiente sección.

Talleres Participativos de Evaluación Rural

Aunque no estuvieron específicamente dirigidos hacia el desarrollo del BAP, durante la preparación del EIAS se recolectó información básica sobre la condición actual de los recursos forestales y animales en las reuniones con las comunidades campesinas a lo largo de la ruta propuesta del ducto y las propiedades privadas. A los habitantes de cada comunidad se les pidió que identifiquen los cultivos, ganado y animales de granja, recursos forestales y animales silvestres de importancia para sus comunidades. De este modo, se abordó la agro-biodiversidad y biodiversidad desde una perspectiva de uso de recursos locales. Aproximadamente 4,660 personas de 13 distritos (9 distritos de Ayacucho y 4 distritos de Huancavelica) estuvieron involucradas en este proceso. El idioma Quechua fue utilizado y las actividades se llevaron a cabo tomando en consideración las tradiciones y costumbres locales. Ninguna reunión con las comunidades se llevó a cabo en la zona costera de la región de Lima e Ica, en vista de que en la opinión de PERU LNG los asentamientos de este Distrito no representaban comunidades coherentes capaces de identificar los recursos que valoraban. Dichos asentamientos podrían identificar prioridades distintas a las de las comunidades en Ayacucho y Huancavelica.

Los resultados de estos talleres se presentan en la Tabla A4-1 en el *Apéndice 4*.

Reuniones sobre el BAP a Nivel de la Comunidad

En septiembre de 2005 se realizaron talleres sobre el BAP específicamente para las comunidades en los cuales participaron 1150 personas en 12 Distritos (8 distritos de Ayacucho y 4 distritos de Huancavelica). El objetivo era presentar el proceso de preparación del BAP e identificar las especies (o grupos de especies objetivo) y/o los ecosistemas que tuvieran la mayor importancia e interés de conservación para la población. En base a las prioridades de los Talleres Participativos de Evaluación Rural sumado a las prioridades identificadas por las comunidades, se les solicitó que identifiquen en orden de prioridad, las cinco especies y/o ecosistemas más importantes y esenciales para su comunidad las cuales fueron luego calificadas por el Distrito en orden de prioridad. La Tabla A4.2 del *Apéndice 4* muestra las especies y ecosistemas identificados por las comunidades como los más importantes. Se discutieron ideas de proyectos para promover la conservación de la biodiversidad de las especies identificadas como importantes para las comunidades. Del mismo modo que los Talleres Participativos, no se realizaron en Lima e Ica y las discusiones se centraron en la biodiversidad y el uso de recursos naturales.

Reuniones con CONAM

En septiembre de 2005 se realizaron varias reuniones con CONAM para presentar la iniciativa del BAP y evaluar el nivel de apoyo para el BAP, la disposición de participar y la identificación de proyectos potenciales. El CONAM mostró mucho interés en la iniciativa y especialmente en el desarrollo de una base de datos de biodiversidad para Ayacucho y Huancavelica, que podría estar disponible para las universidades locales, las empresas privadas y otras organizaciones gubernamentales.

Reuniones con las ONGs

En julio de 2005 se llevaron a cabo cuatro talleres con las ONGs de Ayacucho, Huancavelica, Ica y Lima, con la asistencia de 68 representantes. Las ONGs invitadas a participar fueron una muestra representativa de las ONGs de las comunidades locales y no necesariamente especializadas o centradas en temas de biodiversidad. Parte de la reunión (aproximadamente 40 minutos) se dedicó a explicar la propuesta de desarrollar un BAP para promover la conservación y el uso sostenible de la biodiversidad y obtener las opiniones y comentarios de los asistentes. Se proporcionó información acerca de los objetivos del BAP, los resultados de la identificación de las especies y hábitats sensibles a lo largo del corredor de ducto para el EIAS y las sugerencias de proyectos para apoyar las conservación y el uso sostenible de recursos. Se debe tener en cuenta que las organizaciones que participaron en las reuniones no fueron específicamente seleccionadas como las que tienen más conocimiento o participación en temas de biodiversidad; más bien, representaron la una amplia gama de organizaciones sociales y ambientales, las cuales en algunos casos incluyeron a los gobiernos locales o regionales, los cuales no son ONGs.

En Lima, Chincha, Huancavelica y Ayacucho, PERU LNG ofreció exposiciones y se llevó a cabo una discusión enfocada en los siguientes aspectos:

- Definición del BAP;
- Mecanismo de participación de los grupos de interés, obtención de comentarios y sugerencias;
- Contenido del BAP; y
- Ideas para proyectos basadas en la información de referencia inicial recopilada.

Adicionalmente, durante los talleres se obtuvieron aportes sobre los criterios metodológicos e implementación de proyectos así como sobre especies con un interés de conservación.

Los asistentes a las reuniones y las acciones sobre biodiversidad sugeridas se incluyen en la Tabla A4-3 en el *Apéndice 4.*

Las especies de animales de interés para las ONGs consultadas fueron: los camélidos (especialmente, la llama, alpaca y vicuña); la viscacha del norte; el oso de anteojos; el cernícalo, el cuy, bagre, monos y la trucha (exótica). En términos de plantas , la *Puya raimondii*, el árbol *Polylepis*, las plantas medicinales, el cactus, las orquídeas, la tara (*Caesalpinia spinosa*) eran de interés. Entre los ecosistemas más importantes estaban la zona de la Ladera Occidental de los Andes, la zona identificada en el EIAS del ducto como Zona Altoandina 4, entre las montañas de Llasac y Chihuiri y lagunas de Bernal y Morón (debido al uso de la totora).

4.0 PLANEAMIENTO DEL MANEJO DE LA BIODIVERSIDAD PARA LA FASE DE CONSTRUCCIÓN

4.1 Requerimientos del Plan General de Manejo Ambiental y Social

4.1.1 Vegetación

A fin de mitigar los impactos sobre la vegetación, en el Plan de Manejo Ambiental y Social se propusieron las siguientes medidas:

a. **Prohibir la recolección de flora silvestre**

- Está prohibida la recolección de plantas silvestres.
- Por lo general, está prohibido encender fogatas en las áreas de trabajo. Sin embargo, se podrá encender fogatas en las áreas autorizadas por el Proyecto de PERU LNG y por el Supervisor Ambiental.
- Está prohibido introducir vegetación foránea/no adaptada a los campamentos y áreas de trabajo.

b. **Limitar el desbroce de vegetación a aquellas áreas que son estrictamente necesarias**

- Sólo se desbrozará vegetación leñosa del DdV. Las raíces quedarán en el suelo para incrementar la estabilidad.
- No se desbrozará vegetación herbácea porque ésta no interferirá con la operación de la maquinaria.
- La vegetación desbrozada será colocada en lugares alejados del agua superficial. Los restos voluminosos de vegetación leñosa serán colocados a lo largo del borde externo del DdV del ducto en áreas desbrozadas. Las ramitas, las ramas y los trozos de vegetación pueden ser convertidos en abono, conjuntamente con los desechos biodegradables generados en el campamento y en las áreas de trabajo.
- Si un árbol cae al canal de un río, será retirado de inmediato, independientemente de si el caudal está alto o bajo.

c. **Humedecer el DdV**

Las áreas de construcción del DdV, los caminos de acceso y los caminos de servicio serán humedecidos regularmente para suprimir el polvo. Las áreas que generan polvo serán humedecidas cuando existan áreas agrícolas cercanas u otra vegetación sensible que podría dañarse si sus hojas, flores o frutos se cubren de polvo. El Supervisor Ambiental de PERU LNG determinará con qué frecuencia se humedecerán las distintas áreas y caminos en base al suministro de agua disponible en el área de trabajo y a la sensibilidad de la vegetación.

d. **Promover la revegetación**

La revegetación ayudará a estabilizar las laderas o superficies susceptibles a la erosión ya que promoverá el desarrollo de una cubierta herbácea (en vista de que los árboles y arbustos tienen un sistema de enraizamiento profundo, luego de completados los trabajos de construcción las áreas deberán ser revegetadas especialmente con pastos para promover un rápido establecimiento de la cubierta vegetativa). Los detalles del proceso de revegetación se presentan en el *Plan de Restauración y Revegetación* (Capítulo 7.0 del Plan de Manejo Ambiental y Social).

Las áreas impactadas serán revegetadas de acuerdo con sus respectivas características, aplicando las siguientes medidas:

- Restauración de los horizontes superiores del suelo para contribuir a la recuperación y regeneración de la vegetación luego de completada la construcción del ducto y de los caminos de acceso temporales.
- Colocación de la madera obtenida del desbroce de la vegetación dentro del suelo excavado (si la vegetación fuese leñosa, se utilizará material de menos de 5.0 cm. de diámetro, incluyendo ramas con hojas) para incrementar el nivel de nutrientes y materia orgánica, promover la retención de humedad y reducir la escorrentía.
- En las áreas costeras donde se han identificado especies de cactus columnar, la construcción del DdV final tratará en la medida de lo posible de minimizar los impactos sobre estas especies.
- Se favorecerá la regeneración del suelo en aquellas áreas del DdV donde se detecte la presencia de vegetación arbustiva espinosa con el fin de promover la regeneración natural desde el banco de semillas del suelo.
- Cualquier área compactada por el uso de maquinaria, tractores y otros vehículos durante los trabajos de construcción será escarificada para incrementar el proceso de oxigenación y optimizar la humedad del suelo.

4.1.2 Fauna

La Referencia Biológica Inicial del EIAS identificó una serie de sectores del ducto que son ecológicamente sensibles, a saber:

- El área ubicada entre los puntos KP 298 y KP 309 (Río Seco) es un área ambientalmente sensible. Esta sección, que está rodeada de cáctuses, se encuentra cerca de una mina abandonada (La Bolívar) donde habita el murciélago longirrostro peruano (*Platalina genovensium*). Esta especie nocturna se alimenta del néctar de la flor del cactus, es un importante polinizador y está en peligro crítico de acuerdo con la legislación nacional.
- Los pantanos que se encuentran cerca de la ciudad de Bernales, en el departamento de Pisco, son pequeñas lagunas interconectadas donde habita una gran variedad de fauna.
- El venado de cola blanca (*Odocoileus virginianus*) fue avistado en el valle de Uras (Departamento de Ayacucho) y en los bosques circundantes. Esta especie es cazada por los cazadores y actualmente es escasa.
- Los pantanos en general y la isla rocosa ubicada en la parte alta del pantano que se encuentra cerca de Chaupi, en el Distrito de Pilpichaca (Provincia de Huaytará, Huancavelica) sirven de refugio a un grupo de vizcachas que raramente se encuentran en otras áreas.
- En los pastizales de la puna, en el Distrito de Ayaví (Provincia de Huaytará, Huancavelica), existe un criadero de vicuñas bastante grande que pertenece a la comunidad de Ayaví.

Se han propuesto medidas de prevención y mitigación ambiental para evitar alterar los hábitats de todas aquellas especies de fauna que han sido incluidas en las listas de especies protegidas a nivel internacional y nacional.

Al momento de efectuarse el desbroce de vegetación del DdV, el grupo a cargo del monitoreo ambiental verificará la presencia de especies en peligro de extinción o que provocan alguna inquietud especial. Este grupo, que incluirá a un ecologista calificado entre sus miembros, propondrá medidas adicionales al Gerente Ambiental de PERU LNG, quien luego dará instrucciones específicas al contratista y se asegurara que estas instrucciones sean cumplidas.

Las siguientes medidas generales fueron propuestas en el Plan de Manejo Ambiental y Social para proteger la fauna durante la fase de construcción:

a. **Prohibir la caza y la compra de especies de fauna silvestre**

- Está absolutamente prohibido cazar y comprar cualquier especie de fauna silvestre, independientemente de si las especies están vivas o se trata de especies preservadas o de pieles de animales. Si se encontraran cazadores o personas extrañas dentro del área del proyecto, se dará aviso al Supervisor Ambiental de PERU LNG, luego de lo cual el Gerente Ambiental procederá a reportar el problema a las autoridades apropiadas.
- Está prohibido tener mascotas en los campamentos.
- Si algún animal silvestre ingresara al campamento, se dará aviso el Gerente del Campamento y se pedirá que todo el personal evacúe el área con cautela. El Supervisor Ambiental de PERU LNG, el jefe del campamento y el personal de seguridad determinarán cómo retirar al animal de las instalaciones. Se evitará poner en riesgo al animal, a menos que exista algún riesgo inminente para alguna persona.
- Está prohibido alterar los hábitats de las aves y/o animales, las especies jóvenes, los huevos, etc.

b. **Controlar el nivel del ruido**

La maquinaria y los dispositivos utilizados para controlar el ruido deberán ser mantenidos en buenas condiciones para evitar alterar los hábitats y refugios.

Las áreas más sensibles deberán ser monitoreadas para detectar cualquier alteración del hábitat o los efectos del ruido, especialmente en aquellos lugares donde las aves se alimentan o aparean, como por ejemplo las áreas de apareamiento o anidamiento.

c. **Limitar el tránsito vehicular**

Se reducirá el límite de velocidad en aquellas áreas donde la vegetación natural es densa y en las áreas cercanas a los caminos. Sin embargo, si se matara algún animal silvestre, se procederá a identificar la especie, tamaño y características básicas del animal para luego reportar dicha información al Supervisor Ambiental de PERU LNG.

Se evitarán aquellas áreas donde exista evidencia de vida silvestre. Estas áreas serán monitoreadas por el Supervisor Ambiental.

En base a la experiencia del PTS (TGP 2001), PERU LNG evaluará la posibilidad de colaborar con las comunidades para cercar las áreas donde se encuentran los rebaños de vicuñas. Esto se podría efectuar en los pastizales de la puna del Distrito de Ayaví, donde existe un rebaño de vicuñas bastante grande que pertenece a la comunidad de Ayaví.

En estas áreas, se limitará la velocidad de los vehículos en el DdV para evitar accidentes. Asimismo, se colocarán letreros para alertar a los conductores sobre el posible tránsito de animales en estas áreas.

4.1.3 Recursos Hidrobiológicos

En el Plan de Manejo Ambiental y Social se propusieron las siguientes medidas generales para proteger los recursos hidrobiológicos durante la construcción:

- Está prohibido pescar en los ríos y riachuelos del área del proyecto.
- Se programarán los trabajos de construcción en el cruce del Río Pisco para evitar los principales períodos de reproducción de los camarones Changallo (*Cryphiops caementarius*) (de enero a abril) y los períodos de desove de algunos peces.
- Las plantas acuáticas retiradas de los cursos de agua durante los trabajos de construcción serán colocadas en tierra para evitar crear barreras aguas abajo.
- Se cumplirá con los procedimientos de construcción establecidos en la *Descripción del Proyecto* (Capítulo 5.0 del EIAS, Volumen I) para el cruce de ríos y riachuelos.

4.2 Plan de Restauración y Revegetación

El Plan de Manejo Ambiental y Social incluye un Plan de Restauración y Revegetación (Plan de Manejo Ambiental y Social, Sección 7.0). Este Plan establece los compromisos y lineamientos generales del proyecto para la restauración física y biológica de todas las áreas afectadas por la construcción y operación del Ducto.

4.3 Código de Conducta

Un elemento clave del Sistema de Manejo Ambiental y Social es la implementación y cumplimiento del Código de Conducta (Sección 11.3 del Plan de Manejo Ambiental y Social) y las Políticas sobre Campamentos ubicados en Áreas Remotas (Sección 11.4 del Plan de Manejo Ambiental y Social). Estos documentos describen las prohibiciones y restricciones específicas establecidas para proteger la biodiversidad del Área del Proyecto durante todas las fases del Proyecto, como por ejemplo las prohibiciones establecidas con respecto a la caza, la pesca y la compra de plantas o animales.

4.4 Reconocimiento Ecológico del Campo

A fin de continuar mejorando el nivel de detalle de la información de referencia inicial disponible con respecto al corredor del DdV de 25 m. de ancho, en noviembre de 2006 PERU LNG encomendó que se llevara a cabo un Reconocimiento Ecológico de Campo (EFS por sus siglas en inglés) que cubriera toda la longitud del DdV. En mayo de 2007, PERU LNG emitió el borrador del informe del Reconocimiento Ecológico de Campo (*Apéndice 5).* El Reconocimiento Ecológico de Campo identificó 14 Unidades Paisajísticas Ecológicas (ELUs por sus siglas en inglés) a lo largo del DdV, así como las especies y hábitats sensibles de cada ELU.

4.4.1 Sensibilidad de las Especies

Uno de los objetivos clave de la Evaluación Ecológica de Campo (EFS) fue identificar los elementos y sectores más sensibles del DdV, en base a y validando las conclusiones del EIAS, con el fin de permitir el desarrollo del Plan de Manejo Ecológico del Ducto y el Plan de Biorestauración del Ducto.

Se determinó la sensibilidad de cada una de las especies documentadas en el Reconocimiento Ecológico de Campo en base a cuatro características, a saber:

1) Estado de protección;
2) Distribución geográfica;
3) Uso por parte de las comunidades locales; y

4) Movilidad (capacidad de huir de un impacto).

Las especies fueron clasificadas en base a estas características, asignándose un puntaje que fluctuó entre 0 y 14.

Sensibilidad Alta:

- Cualquier especie clasificada como EN ó CR por la Unión Mundial para la Naturaleza (IUCN) o por el Instituto Nacional de Recursos Naturales (INRENA) y que es Inmóvil.
- Cualquier otra especie con un puntaje de 11 o mayor.

Sensibilidad Media:

- Cualquier especie clasificada como EN ó CR por la Unión Mundial para la Naturaleza (IUCN) o por el Instituto Nacional de Recursos Naturales (INRENA) y que es Móvil.
- Cualquier especie clasificada como NT ó VU por la Unión Mundial para la Naturaleza (IUCN) o por el Instituto Nacional de Recursos Naturales (INRENA) y que es Inmóvil.
- Cualquier otra especie con un puntaje que fluctúe entre 6 y 10.

Sensibilidad Baja:

- Cualquier especie con un puntaje menor o igual a 5.

Las siguientes tablas resumen la sensibilidad de las especies analizadas por grupo taxonómico y luego incluyen una lista de las especies sensibles o críticas.

Tabla 4.1 Sensibilidad de las especies por grupo taxonómico

Grupo	Baja	Media	Alta	Total
Plantas	66	41	4	111
Crustáceos	0	0	1	1
Peces	3	4	0	7
Anfibios	2	5	0	7
Reptiles	4	15	0	19
Aves	90	7	0	97
Mamíferos	29	5	0	34
Todos	194	76	5	276

Tabla 4.2 Especies categorizadas como sensibles o críticas en el Reconocimiento Ecológico de Campo

Grupo	Nombre Común	Especie	KP de Referencia	Puntaje	Sensibilidad
Crustáceos	Camarón Changallo	*Cryphiops caementarius*	334+800	10	Sensible
Peces	Terror verde	*Aequidens rivulatus*	329+600, 329+000, 334+800	7	Sensible
Peces	Pez	*Astroblepus sp.*	62+500	6	Sensible
Peces	Pez	*Trichomycterus rivulatus*	362+500, 364+500	6	Sensible
Peces	Pez	*Trichomycterus rivulatus*	62+500	6	Sensible
Anfibios	Sapo	*Chaunus limensis*	334+700, 361+500	6	Sensible
Anfibios	Rana	*Phrynopus* sp.	1+000	6	Sensible
Anfibios	Rana	*Telmatobius* sp.	73+400	6	Sensible
Anfibios	Rana	*Telmatobius* sp.	92+000	8	Sensible
Reptiles	Lagartija	*Ctenoblepharys adspersa*	397+500	10	Sensible
Reptiles	Lagartija	*Dicrodon heterolepis*	329+600, 329+000, 361+500, 389+300	10	Sensible
Reptiles	Lagartija	*Liolaemus* cf. *Melanogaster*	137+000, 160+000	6	Sensible
Reptiles	Lagartija	*Liolaemus* cf. *williamsi*	216+000, 202+000	6	Sensible
Reptiles	Lagartija	*Liolaemus* cf. *Polystictus*	199+500, 210+000	6	Sensible
Reptiles	Lagartija	*Liolaemus* sp. 1	92+000	8	Sensible
Reptiles	Lagartija	*Liolaemus* sp. 2	185+000	10	Sensible
Reptiles	Lagartija	*Liolaemus* sp. 3	210+000, 217+000, 227+000	6	Sensible
Reptiles	Lagartija	*Liolaemus* sp. 4	210+000, 217+000	6	Sensible
Reptiles	Lagartija	*Microlophus* aff. *tigris*	255+000, 259+500	9	Sensible
Reptiles	Lagartija	*Microlophus thoracicus*	329+600, 329+000	6	Sensible
Reptiles	Lagartija	*Microlophus tigris*	298+000, 306+000, 389+300	9	Sensible
Reptiles	Lagartija	*Phyllodactylus lepidopygus*	308+000	6	Sensible

Grupo	Nombre Común	Especie	KP de Referencia	Puntaje	Sensibilidad
Crustáceos	Camarón Changallo	*Cryphiops caementarius*	334+800	10	Sensible
Peces	Terror verde	*Aequidens rivulatus*	329+600, 329+000, 334+800	7	Sensible
Peces	Pez	*Astroblepus sp.*	62+500	6	Sensible
Peces	Pez	*Trichomycterus rivulatus*	362+500, 364+500	6	Sensible
Peces	Pez	*Trichomycterus rivulatus*	62+500	6	Sensible
Anfibios	Sapo	*Chaunus limensis*	334+700, 361+500	6	Sensible
Anfibios	Rana	*Phrynopus* sp.	1+000	6	Sensible
Anfibios	Rana	*Telmatobius* sp.	73+400	6	Sensible
Anfibios	Rana	*Telmatobius* sp.	92+000	8	Sensible
Reptiles	Lagartija	*Ctenoblepharys adspersa*	397+500	10	Sensible
Reptiles	Lagartija	*Dicrodon heterolepis*	329+600, 329+000, 361+500, 389+300	10	Sensible
Reptiles	Lagartija	*Liolaemus* cf. *Melanogaster*	137+000, 160+000	6	Sensible
Reptiles	Lagartija	*Liolaemus* cf. *williamsi*	216+000, 202+000	6	Sensible
Reptiles	Lagartija	*Liolaemus* cf. *Polystictus*	199+500, 210+000	6	Sensible
Reptiles	Lagartija	*Liolaemus* sp. 1	92+000	8	Sensible
Reptiles	Lagartija	*Liolaemus* sp. 2	185+000	10	Sensible
Reptiles	Lagartija	*Liolaemus* sp. 3	210+000, 217+000, 227+000	6	Sensible
Reptiles	Lagartija	*Liolaemus* sp. 4	210+000, 217+000	6	Sensible
Reptiles	Lagartija	*Microlophus* aff. *tigris*	255+000, 259+500	9	Sensible
Reptiles	Lagartija	*Microlophus thoracicus*	329+600, 329+000	6	Sensible
Reptiles	Lagartija	*Microlophus tigris*	298+000, 306+000, 389+300	9	Sensible
Reptiles	Lagartija	*Phyllodactylus lepidopygus*	308+000	6	Sensible
Reptiles	Lagartija	*Proctoporus* sp. nov.	1+500, 7+000, 7+500, 11+500, 15+000, 15+500, 21+500, 25+000	11	Sensible

Grupo	Nombre Común	Especie	KP de Referencia	Puntaje	Sensibilidad
Crustáceos	Camarón Changallo	*Cryphiops caementarius*	334+800	10	Sensible
Peces	Terror verde	*Aequidens rivulatus*	329+600, 329+000, 334+800	7	Sensible
Peces	Pez	*Astroblepus sp.*	62+500	6	Sensible
Peces	Pez	*Trichomycterus rivulatus*	362+500, 364+500	6	Sensible
Peces	Pez	*Trichomycterus rivulatus*	62+500	6	Sensible
Anfibios	Sapo	*Chaunus limensis*	334+700, 361+500	6	Sensible
Anfibios	Rana	*Phrynopus* sp.	1+000	6	Sensible
Anfibios	Rana	*Telmatobius* sp.	73+400	6	Sensible
Anfibios	Rana	*Telmatobius* sp.	92+000	8	Sensible
Reptiles	Lagartija	*Ctenoblepharys adspersa*	397+500	10	Sensible
Reptiles	Lagartija	*Dicrodon heterolepis*	329+600, 329+000, 361+500, 389+300	10	Sensible
Reptiles	Lagartija	*Liolaemus* cf. *Melanogaster*	137+000, 160+000	6	Sensible
Reptiles	Lagartija	*Liolaemus* cf. *williamsi*	216+000, 202+000	6	Sensible
Reptiles	Lagartija	*Liolaemus* cf. *Polystictus*	199+500, 210+000	6	Sensible
Reptiles	Lagartija	*Liolaemus* sp. 1	92+000	8	Sensible
Reptiles	Lagartija	*Liolaemus* sp. 2	185+000	10	Sensible
Reptiles	Lagartija	*Liolaemus* sp. 3	210+000, 217+000, 227+000	6	Sensible
Reptiles	Lagartija	*Liolaemus* sp. 4	210+000, 217+000	6	Sensible
Reptiles	Lagartija	*Microlophus* aff. *tigris*	255+000, 259+500	9	Sensible
Reptiles	Lagartija	*Microlophus thoracicus*	329+600, 329+000	6	Sensible
Reptiles	Lagartija	*Microlophus tigris*	298+000, 306+000, 389+300	9	Sensible
Reptiles	Lagartija	*Phyllodactylus lepidopygus*	308+000	6	Sensible
Reptiles	Lagartija	*Stenocercus* aff. *Apurimacus*	37+000, 37+500, 37+700, 40+000, 40+500, 41+100	6	Sensible
Aves	Gaucho andino	*Agriornis andicola*	17+000, 27+000	6-7	Sensible

Grupo	Nombre Común	Especie	KP de Referencia	Puntaje	Sensibilidad
Crustáceos	Camarón Changallo	*Cryphiops caementarius*	334+800	10	Sensible
Peces	Terror verde	*Aequidens rivulatus*	329+600, 329+000, 334+800	7	Sensible
Peces	Pez	*Astroblepus sp.*	62+500	6	Sensible
Peces	Pez	*Trichomycterus rivulatus*	362+500, 364+500	6	Sensible
Peces	Pez	*Trichomycterus rivulatus*	62+500	6	Sensible
Anfibios	Sapo	*Chaunus limensis*	334+700, 361+500	6	Sensible
Anfibios	Rana	*Phrynopus* sp.	1+000	6	Sensible
Anfibios	Rana	*Telmatobius* sp.	73+400	6	Sensible
Anfibios	Rana	*Telmatobius* sp.	92+000	8	Sensible
Reptiles	Lagartija	*Ctenoblepharys adspersa*	397+500	10	Sensible
Reptiles	Lagartija	*Dicrodon heterolepis*	329+600, 329+000, 361+500, 389+300	10	Sensible
Reptiles	Lagartija	*Liolaemus* cf. *Melanogaster*	137+000, 160+000	6	Sensible
Reptiles	Lagartija	*Liolaemus* cf. *williamsi*	216+000, 202+000	6	Sensible
Reptiles	Lagartija	*Liolaemus* cf. *Polystictus*	199+500, 210+000	6	Sensible
Reptiles	Lagartija	*Liolaemus* sp. 1	92+000	8	Sensible
Reptiles	Lagartija	*Liolaemus* sp. 2	185+000	10	Sensible
Reptiles	Lagartija	*Liolaemus* sp. 3	210+000, 217+000, 227+000	6	Sensible
Reptiles	Lagartija	*Liolaemus* sp. 4	210+000, 217+000	6	Sensible
Reptiles	Lagartija	*Microlophus* aff. *tigris*	255+000, 259+500	9	Sensible
Reptiles	Lagartija	*Microlophus thoracicus*	329+600, 329+000	6	Sensible
Reptiles	Lagartija	*Microlophus tigris*	298+000, 306+000, 389+300	9	Sensible
Reptiles	Lagartija	*Phyllodactylus lepidopygus*	308+000	6	Sensible
Aves	Canastero de cola pálida	*Asthenes dorbignyi (huancavelicae)*	141+300, 179+500, 188+000, 212+700, 223+400	7	Sensible
Aves	Churrete ventriblanca	*Cinclodes palliatus*[1]	167+000	12	Crítica

Grupo	Nombre Común	Especie	KP de Referencia	Puntaje	Sensibilidad
Crustáceos	Camarón Changallo	*Cryphiops caementarius*	334+800	10	Sensible
Peces	Terror verde	*Aequidens rivulatus*	329+600, 329+000, 334+800	7	Sensible
Peces	Pez	*Astroblepus sp.*	62+500	6	Sensible
Peces	Pez	*Trichomycterus rivulatus*	362+500, 364+500	6	Sensible
Peces	Pez	*Trichomycterus rivulatus*	62+500	6	Sensible
Anfibios	Sapo	*Chaunus limensis*	334+700, 361+500	6	Sensible
Anfibios	Rana	*Phrynopus* sp.	1+000	6	Sensible
Anfibios	Rana	*Telmatobius* sp.	73+400	6	Sensible
Anfibios	Rana	*Telmatobius* sp.	92+000	8	Sensible
Reptiles	Lagartija	*Ctenoblepharys adspersa*	397+500	10	Sensible
Reptiles	Lagartija	*Dicrodon heterolepis*	329+600, 329+000, 361+500, 389+300	10	Sensible
Reptiles	Lagartija	*Liolaemus* cf. *Melanogaster*	137+000, 160+000	6	Sensible
Reptiles	Lagartija	*Liolaemus* cf. *williamsi*	216+000, 202+000	6	Sensible
Reptiles	Lagartija	*Liolaemus* cf. *Polystictus*	199+500, 210+000	6	Sensible
Reptiles	Lagartija	*Liolaemus* sp. 1	92+000	8	Sensible
Reptiles	Lagartija	*Liolaemus* sp. 2	185+000	10	Sensible
Reptiles	Lagartija	*Liolaemus* sp. 3	210+000, 217+000, 227+000	6	Sensible
Reptiles	Lagartija	*Liolaemus* sp. 4	210+000, 217+000	6	Sensible
Reptiles	Lagartija	*Microlophus* aff. *tigris*	255+000, 259+500	9	Sensible
Reptiles	Lagartija	*Microlophus thoracicus*	329+600, 329+000	6	Sensible
Reptiles	Lagartija	*Microlophus tigris*	298+000, 306+000, 389+300	9	Sensible
Reptiles	Lagartija	*Phyllodactylus lepidopygus*	308+000	6	Sensible
Aves	Montañés barbudo	*Oreonympha nobilis*	27+000, 62+450, 110+000	6	Sensible
Aves	Bandurria de cara negra	*Theristicus melanopis*	16+500, 22+500, 127+500	6	Sensible
Aves	Fringilo apizarrado	*Xenospingus concolor*	327+100, 329+600	6	Sensible

Grupo	Nombre Común	Especie	KP de Referencia	Puntaje	Sensibilidad
Crustáceos	Camarón Changallo	*Cryphiops caementarius*	334+800	10	Sensible
Peces	Terror verde	*Aequidens rivulatus*	329+600, 329+000, 334+800	7	Sensible
Peces	Pez	*Astroblepus sp.*	62+500	6	Sensible
Peces	Pez	*Trichomycterus rivulatus*	362+500, 364+500	6	Sensible
Peces	Pez	*Trichomycterus rivulatus*	62+500	6	Sensible
Anfibios	Sapo	*Chaunus limensis*	334+700, 361+500	6	Sensible
Anfibios	Rana	*Phrynopus* sp.	1+000	6	Sensible
Anfibios	Rana	*Telmatobius* sp.	73+400	6	Sensible
Anfibios	Rana	*Telmatobius* sp.	92+000	8	Sensible
Reptiles	Lagartija	*Ctenoblepharys adspersa*	397+500	10	Sensible
Reptiles	Lagartija	*Dicrodon heterolepis*	329+600, 329+000, 361+500, 389+300	10	Sensible
Reptiles	Lagartija	*Liolaemus* cf. *Melanogaster*	137+000, 160+000	6	Sensible
Reptiles	Lagartija	*Liolaemus* cf. *williamsi*	216+000, 202+000	6	Sensible
Reptiles	Lagartija	*Liolaemus* cf. *Polystictus*	199+500, 210+000	6	Sensible
Reptiles	Lagartija	*Liolaemus* sp. 1	92+000	8	Sensible
Reptiles	Lagartija	*Liolaemus* sp. 2	185+000	10	Sensible
Reptiles	Lagartija	*Liolaemus* sp. 3	210+000, 217+000, 227+000	6	Sensible
Reptiles	Lagartija	*Liolaemus* sp. 4	210+000, 217+000	6	Sensible
Reptiles	Lagartija	*Microlophus* aff. *tigris*	255+000, 259+500	9	Sensible
Reptiles	Lagartija	*Microlophus thoracicus*	329+600, 329+000	6	Sensible
Reptiles	Lagartija	*Microlophus tigris*	298+000, 306+000, 389+300	9	Sensible
Reptiles	Lagartija	*Phyllodactylus lepidopygus*	308+000	6	Sensible
Mamíferos	Gato de los Andes[2]	*Leopardus jacobita*	103+000, 133+000, 154+000	7	Sensible
Mamíferos	Oso anteojero	*Tremarctos ornatus*	3+000	9	Sensible
Mamíferos	Vicuña	*Vicugna vicugna*	103+000, 201+000, 230+000	7	Sensible
Plantas	Orquídea	*Aa* sp.	50+000	6	Sensible

Grupo	Nombre Común	Especie	KP de Referencia	Puntaje	Sensibilidad
Crustáceos	Camarón Changallo	*Cryphiops caementarius*	334+800	10	Sensible
Peces	Terror verde	*Aequidens rivulatus*	329+600, 329+000, 334+800	7	Sensible
Peces	Pez	*Astroblepus sp.*	62+500	6	Sensible
Peces	Pez	*Trichomycterus rivulatus*	362+500, 364+500	6	Sensible
Peces	Pez	*Trichomycterus rivulatus*	62+500	6	Sensible
Anfibios	Sapo	*Chaunus limensis*	334+700, 361+500	6	Sensible
Anfibios	Rana	*Phrynopus* sp.	1+000	6	Sensible
Anfibios	Rana	*Telmatobius* sp.	73+400	6	Sensible
Anfibios	Rana	*Telmatobius* sp.	92+000	8	Sensible
Reptiles	Lagartija	*Ctenoblepharys adspersa*	397+500	10	Sensible
Reptiles	Lagartija	*Dicrodon heterolepis*	329+600, 329+000, 361+500, 389+300	10	Sensible
Reptiles	Lagartija	*Liolaemus* cf. *Melanogaster*	137+000, 160+000	6	Sensible
Reptiles	Lagartija	*Liolaemus* cf. *williamsi*	216+000, 202+000	6	Sensible
Reptiles	Lagartija	*Liolaemus* cf. *Polystictus*	199+500, 210+000	6	Sensible
Reptiles	Lagartija	*Liolaemus* sp. 1	92+000	8	Sensible
Reptiles	Lagartija	*Liolaemus* sp. 2	185+000	10	Sensible
Reptiles	Lagartija	*Liolaemus* sp. 3	210+000, 217+000, 227+000	6	Sensible
Reptiles	Lagartija	*Liolaemus* sp. 4	210+000, 217+000	6	Sensible
Reptiles	Lagartija	*Microlophus* aff. *tigris*	255+000, 259+500	9	Sensible
Reptiles	Lagartija	*Microlophus thoracicus*	329+600, 329+000	6	Sensible
Reptiles	Lagartija	*Microlophus tigris*	298+000, 306+000, 389+300	9	Sensible
Reptiles	Lagartija	*Phyllodactylus lepidopygus*	308+000	6	Sensible
Plantas	Árbol	*Acacia macracantha*	40+000, 336+000, 391+000	8	Sensible
Plantas	Hierba	*Aequatorium tovarii*	261+300	6	Sensible
Plantas	Cactus	*Armatocereus procerus*	300+200	6	Sensible
Plantas	Arbusto	*Aristeguietia discolor*	35+000	8	Sensible
Plantas	Cactus	*Browningia candelaris*	281+000	10	Sensible
Plantas	Grass	*Chersodoma*	261+300	12	Crítica

Grupo	Nombre Común	Especie	KP de Referencia	Puntaje	Sensibilidad
Crustáceos	Camarón Changallo	*Cryphiops caementarius*	334+800	10	Sensible
Peces	Terror verde	*Aequidens rivulatus*	329+600, 329+000, 334+800	7	Sensible
Peces	Pez	*Astroblepus sp.*	62+500	6	Sensible
Peces	Pez	*Trichomycterus rivulatus*	362+500, 364+500	6	Sensible
Peces	Pez	*Trichomycterus rivulatus*	62+500	6	Sensible
Anfibios	Sapo	*Chaunus limensis*	334+700, 361+500	6	Sensible
Anfibios	Rana	*Phrynopus* sp.	1+000	6	Sensible
Anfibios	Rana	*Telmatobius* sp.	73+400	6	Sensible
Anfibios	Rana	*Telmatobius* sp.	92+000	8	Sensible
Reptiles	Lagartija	*Ctenoblepharys adspersa*	397+500	10	Sensible
Reptiles	Lagartija	*Dicrodon heterolepis*	329+600, 329+000, 361+500, 389+300	10	Sensible
Reptiles	Lagartija	*Liolaemus* cf. *Melanogaster*	137+000, 160+000	6	Sensible
Reptiles	Lagartija	*Liolaemus* cf. *williamsi*	216+000, 202+000	6	Sensible
Reptiles	Lagartija	*Liolaemus* cf. *Polystictus*	199+500, 210+000	6	Sensible
Reptiles	Lagartija	*Liolaemus* sp. 1	92+000	8	Sensible
Reptiles	Lagartija	*Liolaemus* sp. 2	185+000	10	Sensible
Reptiles	Lagartija	*Liolaemus* sp. 3	210+000, 217+000, 227+000	6	Sensible
Reptiles	Lagartija	*Liolaemus* sp. 4	210+000, 217+000	6	Sensible
Reptiles	Lagartija	*Microlophus* aff. *tigris*	255+000, 259+500	9	Sensible
Reptiles	Lagartija	*Microlophus thoracicus*	329+600, 329+000	6	Sensible
Reptiles	Lagartija	*Microlophus tigris*	298+000, 306+000, 389+300	9	Sensible
Reptiles	Lagartija	*Phyllodactylus lepidopygus*	308+000	6	Sensible
		arequipensis			
Plantas	Cactus	*Cleistocactus acanthurus*	300+000, 301+000	11	Sensible
Plantas	Cactus	*Cleistocactus morawetzianus*	63+000	6	Sensible
Plantas	Hierba	*Cnidoscolus basiacanthus*	300+200	9	Sensible

Grupo	Nombre Común	Especie	KP de Referencia	Puntaje	Sensibilidad
Crustáceos	Camarón Changallo	*Cryphiops caementarius*	334+800	10	Sensible
Peces	Terror verde	*Aequidens rivulatus*	329+600, 329+000, 334+800	7	Sensible
Peces	Pez	*Astroblepus sp.*	62+500	6	Sensible
Peces	Pez	*Trichomycterus rivulatus*	362+500, 364+500	6	Sensible
Peces	Pez	*Trichomycterus rivulatus*	62+500	6	Sensible
Anfibios	Sapo	*Chaunus limensis*	334+700, 361+500	6	Sensible
Anfibios	Rana	*Phrynopus* sp.	1+000	6	Sensible
Anfibios	Rana	*Telmatobius* sp.	73+400	6	Sensible
Anfibios	Rana	*Telmatobius* sp.	92+000	8	Sensible
Reptiles	Lagartija	*Ctenoblepharys adspersa*	397+500	10	Sensible
Reptiles	Lagartija	*Dicrodon heterolepis*	329+600, 329+000, 361+500, 389+300	10	Sensible
Reptiles	Lagartija	*Liolaemus* cf. *Melanogaster*	137+000, 160+000	6	Sensible
Reptiles	Lagartija	*Liolaemus* cf. *williamsi*	216+000, 202+000	6	Sensible
Reptiles	Lagartija	*Liolaemus* cf. *Polystictus*	199+500, 210+000	6	Sensible
Reptiles	Lagartija	*Liolaemus* sp. 1	92+000	8	Sensible
Reptiles	Lagartija	*Liolaemus* sp. 2	185+000	10	Sensible
Reptiles	Lagartija	*Liolaemus* sp. 3	210+000, 217+000, 227+000	6	Sensible
Reptiles	Lagartija	*Liolaemus* sp. 4	210+000, 217+000	6	Sensible
Reptiles	Lagartija	*Microlophus* aff. *tigris*	255+000, 259+500	9	Sensible
Reptiles	Lagartija	*Microlophus thoracicus*	329+600, 329+000	6	Sensible
Reptiles	Lagartija	*Microlophus tigris*	298+000, 306+000, 389+300	9	Sensible
Reptiles	Lagartija	*Phyllodactylus lepidopygus*	308+000	6	Sensible
Plantas	Cactus	*Corryocactus quadrangularis*	35+000, 62+500	11	Sensible
Plantas	Cactus	*Echinopsis peruviana* subsp. *puquiensis*	63+000, 109+800	10	Sensible
Plantas	Hierba	*Ephedra americana*	123+000, 295+000, 305+000	6	Sensible
Plantas	Árbol	*Eriotheca vargasii*	40+000	8	Sensible

Grupo	Nombre Común	Especie	KP de Referencia	Puntaje	Sensibilidad
Crustáceos	Camarón Changallo	*Cryphiops caementarius*	334+800	10	Sensible
Peces	Terror verde	*Aequidens rivulatus*	329+600, 329+000, 334+800	7	Sensible
Peces	Pez	*Astroblepus sp.*	62+500	6	Sensible
Peces	Pez	*Trichomycterus rivulatus*	362+500, 364+500	6	Sensible
Peces	Pez	*Trichomycterus rivulatus*	62+500	6	Sensible
Anfibios	Sapo	*Chaunus limensis*	334+700, 361+500	6	Sensible
Anfibios	Rana	*Phrynopus* sp.	1+000	6	Sensible
Anfibios	Rana	*Telmatobius* sp.	73+400	6	Sensible
Anfibios	Rana	*Telmatobius* sp.	92+000	8	Sensible
Reptiles	Lagartija	*Ctenoblepharys adspersa*	397+500	10	Sensible
Reptiles	Lagartija	*Dicrodon heterolepis*	329+600, 329+000, 361+500, 389+300	10	Sensible
Reptiles	Lagartija	*Liolaemus* cf. *Melanogaster*	137+000, 160+000	6	Sensible
Reptiles	Lagartija	*Liolaemus* cf. *williamsi*	216+000, 202+000	6	Sensible
Reptiles	Lagartija	*Liolaemus* cf. *Polystictus*	199+500, 210+000	6	Sensible
Reptiles	Lagartija	*Liolaemus* sp. 1	92+000	8	Sensible
Reptiles	Lagartija	*Liolaemus* sp. 2	185+000	10	Sensible
Reptiles	Lagartija	*Liolaemus* sp. 3	210+000, 217+000, 227+000	6	Sensible
Reptiles	Lagartija	*Liolaemus* sp. 4	210+000, 217+000	6	Sensible
Reptiles	Lagartija	*Microlophus* aff. *tigris*	255+000, 259+500	9	Sensible
Reptiles	Lagartija	*Microlophus thoracicus*	329+600, 329+000	6	Sensible
Reptiles	Lagartija	*Microlophus tigris*	298+000, 306+000, 389+300	9	Sensible
Reptiles	Lagartija	*Phyllodactylus lepidopygus*	308+000	6	Sensible
Plantas	Arbusto	*Escallonia myrtilloides*	37+000, 55+000, 74+200, 88+400, 112+500, 116+100, 118+700	10	Sensible

Grupo	Nombre Común	Especie	KP de Referencia	Puntaje	Sensibilidad
Crustáceos	Camarón Changallo	*Cryphiops caementarius*	334+800	10	Sensible
Peces	Terror verde	*Aequidens rivulatus*	329+600, 329+000, 334+800	7	Sensible
Peces	Pez	*Astroblepus sp.*	62+500	6	Sensible
Peces	Pez	*Trichomycterus rivulatus*	362+500, 364+500	6	Sensible
Peces	Pez	*Trichomycterus rivulatus*	62+500	6	Sensible
Anfibios	Sapo	*Chaunus limensis*	334+700, 361+500	6	Sensible
Anfibios	Rana	*Phrynopus* sp.	1+000	6	Sensible
Anfibios	Rana	*Telmatobius* sp.	73+400	6	Sensible
Anfibios	Rana	*Telmatobius* sp.	92+000	8	Sensible
Reptiles	Lagartija	*Ctenoblepharys adspersa*	397+500	10	Sensible
Reptiles	Lagartija	*Dicrodon heterolepis*	329+600, 329+000, 361+500, 389+300	10	Sensible
Reptiles	Lagartija	*Liolaemus* cf. *Melanogaster*	137+000, 160+000	6	Sensible
Reptiles	Lagartija	*Liolaemus* cf. *williamsi*	216+000, 202+000	6	Sensible
Reptiles	Lagartija	*Liolaemus* cf. *Polystictus*	199+500, 210+000	6	Sensible
Reptiles	Lagartija	*Liolaemus* sp. 1	92+000	8	Sensible
Reptiles	Lagartija	*Liolaemus* sp. 2	185+000	10	Sensible
Reptiles	Lagartija	*Liolaemus* sp. 3	210+000, 217+000, 227+000	6	Sensible
Reptiles	Lagartija	*Liolaemus* sp. 4	210+000, 217+000	6	Sensible
Reptiles	Lagartija	*Microlophus* aff. *tigris*	255+000, 259+500	9	Sensible
Reptiles	Lagartija	*Microlophus thoracicus*	329+600, 329+000	6	Sensible
Reptiles	Lagartija	*Microlophus tigris*	298+000, 306+000, 389+300	9	Sensible
Reptiles	Lagartija	*Phyllodactylus lepidopygus*	308+000	6	Sensible
Plantas	Árbol	*Escallonia resinosa*	28+000, 35+000	10	Sensible
Plantas	Arbusto	*Kageneckia lanceolata*	38+000	11	Sensible
Plantas	Orquídea	*Myrosmodes* sp.	50+000	6	Sensible
Plantas	Cactus	*Neoraimondia arequipensis*	295+000, 305+000	6	Sensible

Grupo	Nombre Común	Especie	KP de Referencia	Puntaje	Sensibilidad
Crustáceos	Camarón Changallo	*Cryphiops caementarius*	334+800	10	Sensible
Peces	Terror verde	*Aequidens rivulatus*	329+600, 329+000, 334+800	7	Sensible
Peces	Pez	*Astroblepus sp.*	62+500	6	Sensible
Peces	Pez	*Trichomycterus rivulatus*	362+500, 364+500	6	Sensible
Peces	Pez	*Trichomycterus rivulatus*	62+500	6	Sensible
Anfibios	Sapo	*Chaunus limensis*	334+700, 361+500	6	Sensible
Anfibios	Rana	*Phrynopus* sp.	1+000	6	Sensible
Anfibios	Rana	*Telmatobius* sp.	73+400	6	Sensible
Anfibios	Rana	*Telmatobius* sp.	92+000	8	Sensible
Reptiles	Lagartija	*Ctenoblepharys adspersa*	397+500	10	Sensible
Reptiles	Lagartija	*Dicrodon heterolepis*	329+600, 329+000, 361+500, 389+300	10	Sensible
Reptiles	Lagartija	*Liolaemus* cf. *Melanogaster*	137+000, 160+000	6	Sensible
Reptiles	Lagartija	*Liolaemus* cf. *williamsi*	216+000, 202+000	6	Sensible
Reptiles	Lagartija	*Liolaemus* cf. *Polystictus*	199+500, 210+000	6	Sensible
Reptiles	Lagartija	*Liolaemus* sp. 1	92+000	8	Sensible
Reptiles	Lagartija	*Liolaemus* sp. 2	185+000	10	Sensible
Reptiles	Lagartija	*Liolaemus* sp. 3	210+000, 217+000, 227+000	6	Sensible
Reptiles	Lagartija	*Liolaemus* sp. 4	210+000, 217+000	6	Sensible
Reptiles	Lagartija	*Microlophus* aff. *tigris*	255+000, 259+500	9	Sensible
Reptiles	Lagartija	*Microlophus thoracicus*	329+600, 329+000	6	Sensible
Reptiles	Lagartija	*Microlophus tigris*	298+000, 306+000, 389+300	9	Sensible
Reptiles	Lagartija	*Phyllodactylus lepidopygus*	308+000	6	Sensible
Plantas	Cactus	*Oroya peruviana*	105+200, 118+100, 123+000	6	Sensible
Plantas	Árbol	*Orthopterygium huaucui*	300+200	6	Sensible
Plantas	Arbusto	*Parastrephia quadrangularis*	101+800, 103+700	9	Sensible
Plantas	Hierba	*Perezia coerulescens*	50+000	9	Sensible

Grupo	Nombre Común	Especie	KP de Referencia	Puntaje	Sensibilidad
Crustáceos	Camarón Changallo	*Cryphiops caementarius*	334+800	10	Sensible
Peces	Terror verde	*Aequidens rivulatus*	329+600, 329+000, 334+800	7	Sensible
Peces	Pez	*Astroblepus sp.*	62+500	6	Sensible
Peces	Pez	*Trichomycterus rivulatus*	362+500, 364+500	6	Sensible
Peces	Pez	*Trichomycterus rivulatus*	62+500	6	Sensible
Anfibios	Sapo	*Chaunus limensis*	334+700, 361+500	6	Sensible
Anfibios	Rana	*Phrynopus* sp.	1+000	6	Sensible
Anfibios	Rana	*Telmatobius* sp.	73+400	6	Sensible
Anfibios	Rana	*Telmatobius* sp.	92+000	8	Sensible
Reptiles	Lagartija	*Ctenoblepharys adspersa*	397+500	10	Sensible
Reptiles	Lagartija	*Dicrodon heterolepis*	329+600, 329+000, 361+500, 389+300	10	Sensible
Reptiles	Lagartija	*Liolaemus* cf. *Melanogaster*	137+000, 160+000	6	Sensible
Reptiles	Lagartija	*Liolaemus* cf. *williamsi*	216+000, 202+000	6	Sensible
Reptiles	Lagartija	*Liolaemus* cf. *Polystictus*	199+500, 210+000	6	Sensible
Reptiles	Lagartija	*Liolaemus* sp. 1	92+000	8	Sensible
Reptiles	Lagartija	*Liolaemus* sp. 2	185+000	10	Sensible
Reptiles	Lagartija	*Liolaemus* sp. 3	210+000, 217+000, 227+000	6	Sensible
Reptiles	Lagartija	*Liolaemus* sp. 4	210+000, 217+000	6	Sensible
Reptiles	Lagartija	*Microlophus* aff. *tigris*	255+000, 259+500	9	Sensible
Reptiles	Lagartija	*Microlophus thoracicus*	329+600, 329+000	6	Sensible
Reptiles	Lagartija	*Microlophus tigris*	298+000, 306+000, 389+300	9	Sensible
Reptiles	Lagartija	*Phyllodactylus lepidopygus*	308+000	6	Sensible
Plantas	Arbusto	*Perezia pinnatifida*	137+000, 141+000	9	Sensible
Plantas	Quinual	*Polylepis pauta*	4+000, 9+000	8	Sensible
Plantas	Arbusto	*Ribes sp.*	118+700	13	Crítica
Plantas	Arbusto	*Tecoma arequipensis*	40+000	10	Sensible

Grupo	Nombre Común	Especie	KP de Referencia	Puntaje	Sensibilidad
Crustáceos	Camarón Changallo	*Cryphiops caementarius*	334+800	10	Sensible
Peces	Terror verde	*Aequidens rivulatus*	329+600, 329+000, 334+800	7	Sensible
Peces	Pez	*Astroblepus sp.*	62+500	6	Sensible
Peces	Pez	*Trichomycterus rivulatus*	362+500, 364+500	6	Sensible
Peces	Pez	*Trichomycterus rivulatus*	62+500	6	Sensible
Anfibios	Sapo	*Chaunus limensis*	334+700, 361+500	6	Sensible
Anfibios	Rana	*Phrynopus* sp.	1+000	6	Sensible
Anfibios	Rana	*Telmatobius* sp.	73+400	6	Sensible
Anfibios	Rana	*Telmatobius* sp.	92+000	8	Sensible
Reptiles	Lagartija	*Ctenoblepharys adspersa*	397+500	10	Sensible
Reptiles	Lagartija	*Dicrodon heterolepis*	329+600, 329+000, 361+500, 389+300	10	Sensible
Reptiles	Lagartija	*Liolaemus* cf. *Melanogaster*	137+000, 160+000	6	Sensible
Reptiles	Lagartija	*Liolaemus* cf. *williamsi*	216+000, 202+000	6	Sensible
Reptiles	Lagartija	*Liolaemus* cf. *Polystictus*	199+500, 210+000	6	Sensible
Reptiles	Lagartija	*Liolaemus* sp. 1	92+000	8	Sensible
Reptiles	Lagartija	*Liolaemus* sp. 2	185+000	10	Sensible
Reptiles	Lagartija	*Liolaemus* sp. 3	210+000, 217+000, 227+000	6	Sensible
Reptiles	Lagartija	*Liolaemus* sp. 4	210+000, 217+000	6	Sensible
Reptiles	Lagartija	*Microlophus* aff. *tigris*	255+000, 259+500	9	Sensible
Reptiles	Lagartija	*Microlophus thoracicus*	329+600, 329+000	6	Sensible
Reptiles	Lagartija	*Microlophus tigris*	298+000, 306+000, 389+300	9	Sensible
Reptiles	Lagartija	*Phyllodactylus lepidopygus*	308+000	6	Sensible
Plantas	Arbusto	*Tecoma sambucifolia*	29+000, 33+000, 35+000,	9	Sensible

[1] Esta especie no fue observada durante el Reconocimiento Ecológico de Campo, pero fue reportada en el Estudio de Impacto Ambiental y Social y se deberá considerar que posiblemente está presente en el área.
[2] Uno de los nuevos resultados del Reconocimiento Ecológico de Campo fue el avistamiento del Gato de los Andes (*Leopardus jacobitus*) en tres localidades. El Gato de los Andes ha sido clasificado como una especie en peligro por la Unión Mundial para la Naturaleza (IUCN) y el Instituto Nacional de Recursos

Naturales (INRENA). Estas observaciones se efectuaron en el extremo noroccidental del área, pero están dentro del rango estimado de estas especies que son raramente avistadas.

4.4.2 Hábitats Sensibles

De acuerdo con el EIAS, Volumen II-B, páginas 6-51, los segmentos más sensibles del DdV son los siguientes:

- Del punto KP 0+000 al punto KP 10+000. Este segmento corresponde a la cuenca este.
- Del punto KP 55+000 al punto KP 75+000: Este segmento corresponde a los dos extremos del área de estudio (sensibilidad alta), así como a los dos segmentos intermedios con sensibilidad media. Esto corresponde básicamente al área cultivada de Acocros.
- Del punto KP 115+000 al punto KP 120+000: Este segmento corresponde al área cultivada del Río Vinchos.
- Del punto KP 120+000 al punto KP 200+000: Este segmento corresponde a la zona Altoandina 4, entre el Río Vinchos y la laguna de Taccracocha e incluye formaciones cubiertas de pasto, tierras de pastoreo, pantanos cubiertos de juncia y lagunas.
- Del punto KP 245+000 al punto KP 250+000: Este segmento corresponde al último segmento de la Puna, justo antes de descender hacia las cuencas occidentales cerca de Huaytará.

Los ecosistemas más sensibles son las cuencas orientales, las áreas cultivadas y el área de la puna (especialmente la zona altoandina 4).

El área total de los “ecosistemas más sensibles”, tal como se indica en el EIAS, abarca 120 km, lo cual equivale al 29.8% de toda la extensión del DdV.

A continuación se incluye una comparación entre las conclusiones del EIAS y del Reconocimiento Ecológico de Campo:

- Del punto KP 0+000 al punto KP 10+000. Este segmento corresponde al Ecotono del Bosque Montano Alto del Río Apurímac y la Sierra de Campana. Se considera un área de Sensibilidad Media en la Evaluación Ecológica de Campo.
- Del punto KP 55+000 al punto KP 75+000: Este segmento corresponde casi íntegramente al Valle del Río Yucay (Del punto KP 56+800 al punto KP 74+000). El Reconocimiento Ecológico de Campo considera el hábitat de este sector, compuesto por vegetación arbustiva resinosa, como un hábitat de Sensibilidad Alta.
- Del punto KP 115+000 al punto KP 120+000: Este segmento corresponde a la porción occidental del valle del Río Vinchos y a una pequeña porción de la Sierra Alta de Apacueta que está en el extremo más oriental. El Reconocimiento Ecológico de Campo lo considera como un hábitat de Sensibilidad Media.
- Del punto KP 120+000 al punto KP 200+000: Este segmento corresponde a la Sierra Alta de Apacheta, a las cuencas de los Ríos Pampas-Palmitos y a una parte del extremo más oriental de las Llanuras Altas y Montañas de Huaytará. No incluye el valle del Río Vinchos, pero sí incluye el área de la Laguna de Taccracocha; sin embargo, la laguna en sí está situada bastante lejos del área de influencia directa del DdV. Esto incluye pastizales fasciculados, pastos estoloníferos y turberas. El Reconocimiento Ecológico de Campo lo considera como un hábitat de Sensibilidad Media. No incluye el hábitat que se sabe está habitado por los monos araña de panza blanca.
- Del punto KP 245+000 al punto KP 250+000: Esta área corresponde al último segmento de los pastizales altoandinos (Llanuras Altas y Montañas de Huaytará) y los primeros 500 m de las arbustedas mixtas de la Línea Divisoria de la Cuenca Colectora de los Ríos Pisco-Ica, al suroeste del poblado de Huaytará. En el Reconocimiento Ecológico de

Campo, los pastizales no se consideran un hábitat sensible; sin embargo, las arbustedas mixtas que se encuentran a partir Del punto KP 245+000 y continúan en dirección oeste son consideradas de Sensibilidad Alta.

En base a las conclusiones del Reconocimiento Ecológico de Campo, los ecosistemas más sensibles son, en términos generales, los bosques secos de las cuencas de los Ríos Apurímac y Mantaro, los matorrales y formaciones con cáctuses de la parte occidental de los Andes, las islas de hábitat hidromórfico de las llanuras arenosas de Pisco y los ecosistemas ribereños de las llanuras de la costa.

Las tres diferencias principales entre las conclusiones del EIAS y el Reconocimiento Ecológico de Campo sobre los ecosistemas o hábitats sensibles son las siguientes: 1) el EIAS considera que el sector comprendido entre el punto KP 120+000 y el punto KP 200+000 es altamente sensible, mientras que el Reconocimiento Ecológico de Campo lo considera medianamente sensible; 2) El EIAS considera que el sector comprendido entre el punto KP+249+500 y el punto 300+000 es de sensibilidad media y el sector comprendido entre el punto KP+300+000 y el punto 308+000 es de sensibilidad baja, mientras que el Reconocimiento Ecológico de Campo considera que el sector comprendido entre el punto KP 249+500 y el punto 308+000 es altamente sensible; y 3) El EIAS considera que el sector comprendido entre el punto KP 325+000 y el punto KP 335+000 es un sector de sensibilidad baja, mientras que el Reconocimiento Ecológico de Campo considera que el sector comprendido entre el punto 326+000 y el punto 332+000 es altamente sensible.

Las siguientes tablas muestran los tipos de hábitat que existen a lo largo del corredor de construcción y su respectiva sensibilidad e ilustran qué parte del corredor corresponde a cada clase de hábitat.

Tabla 4.3 Hábitats de Sensibilidad Media y Alta por Unidad Paisajística Ecológica (ELU)

ELU	Tipos de Hábitat	Sensibilidad del Hábitat	Longitud del DdV (m)
1. Ecotono del Bosque Montano del Valle del Río Apurímac	Bosque Montano Alto	Media	4,495
	Pastizales fasciculados	Media	3,321
2. Sierra de Campana	Turberas	Media	1,834
	Pastos estoloníferos	Media	6,318
3. Valle del Río Torobamba	Áreas cultivadas	Alta	7,902
	Bosque seco caducifolio	Media	651
	Vegetación arbustiva espinosa	Alta	6,238
4. Sierra de Sillaccasa	Pastizales fasciculados	Media	10,333
5. Valle del Río Yucay	Vegetación arbustiva espinosa	Media	171
	Vegetación arbustiva resinosa	Alta	1,630
	Río Yucay	Media	26
6. División de la Cuenca Colectora Huamanga-Vischongo	Pastizales fasciculados	Media	27,246
7. Valle del Río Vinchos	Áreas cultivadas	Media	12,074
8. Sierra Alta de Apacheta	Áreas altoandinas con escasa vegetación	Media	21,083
	Pastos estoloníferos	Media	17,481
	Pastizales Fasciculados	Media	6,900
9. Cuencas de los Ríos Pampas-Palmitos	Pastizales fasciculados	Media	11,741

ELU	Tipos de Hábitat	Sensibilidad del Hábitat	Longitud del DdV (m)
10. Llanuras Altas y Montañas de Huaytará	Áreas altoandinas con escasa vegetación	Media	3,599
	Pastos estoloníferos	Media	16,127
	Pastos fasciculados	Media	33,616
11. División de la Cuenca Colectora de los Ríos Pisco-Ica	Vegetación arbustiva mixta	Alta	17,910
	Vegetación arbustiva espinosa	Alta	4,590
12. Montañas costeras donde habitan murciélagos	Arbustos del desierto	Alta	15,924
	Cactus columnar y arbustos	Alta	20,076
13. Llanuras arenosas de Pisco	Islas y lagunas hidromórficas	Alta	4,800*
14. Llanuras costeras de Ica-Lima	Áreas cultivadas	Media	18,197
	Desiertos estériles	Media	46,430
	Corredores ribereños	Alta	875

*Distancia del sector donde el DdV pasa cerca de los hábitats de isla y laguna hidromórfica o atraviesa dichos hábitats. Los hábitats por los que atraviesa el DdV tienen una longitud de aproximadamente 274 m.

Tabla 4.4 Distribución de la sensibilidad de los hábitats a lo largo del DdV

Sensibilidad	Longitud (m)	Porcentaje
Baja	80,412	20.0
Media	241,643	60.1
Alta	79,945	19.9
Total	402,000	100.0

En el Reconocimiento Ecológico de Campo, el 19.9% del DdV está clasificado dentro de la categoría de sensibilidad más alta, mientras que en el EIAS el 29.8% del DdV está clasificado dentro de la categoría de sensibilidad más alta.

Los Hábitats de Sensibilidad Baja y Media requieren de las mejores prácticas y de procedimientos de manejo ecológico que cumplan con todos los compromisos aplicables del EIAS, del Plan de Manejo Ecológico y del Plan de Biorestauración (ECOMP y BRP por sus siglas en inglés, respectivamente). Adicionalmente, se aplican medidas específicas para los Hábitats de Sensibilidad Alta, tal como se describe en el Plan de Manejo Ecológico y en el Plan de Biorestauración.

Cuando el hábitat de un área se clasifica como Hábitat de Sensibilidad Alta, dicha clasificación significa que durante el Reconocimiento Ecológico de Campo se ha comprobado la presencia de por lo menos una Especie de Sensibilidad Alta o por lo menos dos especies de animales de sensibilidad media o por lo menos tres especies de plantas de sensibilidad media. Esta clasificación requiere que el Proyecto tenga especial cuidado en identificar la ubicación de los elementos sensibles dentro del tipo de hábitat en cuestión y desarrollar medidas de mitigación apropiadas para esta ubicación antes del inicio de los trabajos de construcción. De conformidad con la Norma de Desempeño 1 de la Corporación Internacional de Finanzas (CIF), en aquellas áreas donde se encuentran Hábitats de Sensibilidad Alta no se pueden realizar actividades relacionadas con el proyecto, a menos que se cumplan los siguientes requerimientos:

- No se generen impactos adversos mensurables sobre la capacidad del hábitat crítico de apoyar a la comunidad de especies establecidas o a las funciones del hábitat crítico.

- No se reduzca la comunidad de cualquier especie reconocida que se encuentre en peligro crítico o en peligro.
- Se tomen medidas de mitigación para que no se produzca una pérdida neta de la biodiversidad, en la medida de lo posible, lo cual podría incluir, sin limitación alguna, la adopción de algunas medidas como por ejemplo la restauración post-operación de los hábitats afectados, la compensación de las pérdidas mediante el establecimiento de áreas ecológicamente comparables cuya biodiversidad sea manejada adecuadamente, y el otorgamiento de compensación a los usuarios directos de la biodiversidad.

A continuación se presenta un breve resumen de los Hábitats de Sensibilidad Alta identificados en el Reconocimiento Ecológico de Campo:

1. Áreas Cultivadas del Valle del Río Torobamba. A pesar del fuerte desbroce de vegetación debido a prácticas agrícolas intensivas, existen parcelas y corredores de vegetación nativa entre los campos que contienen especies clasificadas y endémicas que son típicas de los bosques secos y las arbustedas del Sistema de Bosques Secos de Apurímac. Entre estas especies figuran el cáctus *Corryocactus quadrangularis* que se encuentra en peligro y el arbusto rosáceo *Kageneckia lanceolata* que se encuentra en peligro crítico.
2. Vegetación Arbustiva Espinosa del Valle del Río Torobamba. En la parte alta de las laderas del valle, las parcelas de vegetación arbustiva espinosa albergan al arbusto rosáceo *Kageneckia lanceolata* que se encuentra en peligro crítico, a otras plantas sensibles de bosques secos y vegetación arbustiva, y al gaucho andino que pertenece a la familia de los papamoscas y se encuentra en peligro.
3. Vegetación Arbustiva Resinosa del Valle del Río Yucay. El valle seco del Río Yucay presenta parcelas de vegetación nativa que pertenecen al Sistema de Bosques Secos del Mantaro, las mismas que incluyen comunidades de cáctuses *Corryocactus quadrangularis* que se encuentran en peligro y comunidades de cáctuses *Echinopsis peruviana puquiensis* que se encuentran en estado vulnerable.
4. Vegetación Arbustiva Mixta y Espinosa de la Línea Divisoria de la Cuenca Colectora de los Ríos Pisco-Ica. Las laderas altas de los Andes occidentales que drenan hacia el Océano Pacífico albergan especies de plantas muy bien adaptadas, como por ejemplo el arbusto *Chersodoma arequipensis* que se encuentra en peligro crítico y la especie endémica regional *Aequatorium tovarii*. Durante el Reconocimiento Ecológico de Campo se detectó una posible nueva especie de lagartija del género *Microlophus* dentro de la vegetación arbustiva mixta que se encuentra a gran altitud. Estos hábitats también podrían albergar a poblaciones del pinzón pechirrufo que se encuentran en peligro, tal como se documenta en el EIAS.
5. Vegetación Arbustiva del Desierto y Cáctuses Columnares de las Montañas Costeras donde Habitan Murciélagos. Las laderas desérticas bajas de las estribaciones de los Andes albergan vegetación diversa pero escasa y distintas especies amenazadas y endémicas de cáctuses y arbustos, incluyendo la especie *Cleistocactus acanthurus* que se encuentra en peligro. Esta hábitat alberga al murciélago longirrostro peruano (*Platalina genovensium*), una especie en peligro crítico que se alimenta exclusivamente del polen y néctar de los cáctuses que florecen de noche.
6. Islas y Lagunas Hidromórficas de las Llanuras Arenosas de Pisco. Entre las dunas de arena al sur del Río Pisco bajo, se encuentran pequeños oasis de vegetación de pantano que por lo general están rodeados de pequeños cuerpos de agua permanente, como por ejemplo la laguna de Bernal y la laguna de Morón. Estos hábitats inusuales albergan especies de fauna que no podrían sobrevivir en otros hábitats del desierto circundante. Por ejemplo, el pinzón pechirrufo, un ave endémica y vulnerable del desierto costero que anida sólo en áreas hidromórficas y ribereñas, fue avistado en estos hábitats. Aunque no contienen especies de sensibilidad alta, estos hábitats son considerados altamente sensibles por ser únicos en su género, por tener una distribución geográfica limitada, por

incluir distintas especies de sensibilidad media y porque se han perdido hábitats similares en la región debido a la conversión agrícola.

7. Corredores Ribereños de las Llanuras Costeras de Ica-Lima. Las llanuras costeras del sur-centro del Perú están atravesadas por distintos ríos y riachuelos altamente estacionales. La vegetación natural de estos ríos y riachuelos incluía anteriormente densos bosques y matorrales ribereños; sin embargo, la mayor parte de estos bosques y matorrales se han perdido debido al desarrollo de técnicas agrícolas con irrigación en los estrechos valles de los ríos. Sólo quedan algunos pequeños fragmentos de estos hábitats. Los mismos ríos se han visto afectados por la agricultura y la urbanización. Sin embargo, el Río Pisco alberga a una especie crítica desde un punto de vista socioeconómico; esto es, el camarón de agua dulce *Cryphiops caementarius*, una especie importante que tiene un aporte significativo para la economía local.

4.5 Plan de Manejo Ecológico

4.5.1 Plan de Manejo Ecológico de PERU LNG

Este documento establece el enfoque general y los lineamientos necesarios para que PERU LNG, a nivel corporativo, maneje los temas y compromisos ecológicos y de biodiversidad resultantes de la construcción y operación del Ducto. El Plan de Manejo Ecológico de PERU LNG establece los roles y responsabilidades de PERU LNG y sus contratistas. Éste es un plan de una jerarquía mayor que regirá el desarrollo e implementación de planes, procedimientos y proyectos más específicos y ejecutables. El Plan de Manejo Ecológico de PERU LNG incluirá todos los compromisos relevantes del EIAS, del Plan de Manejo Ambiental y Social y de otros documentos fuente y se convertirá en un mecanismo de garantía de cumplimiento.

4.5.2 Plan de Manejo para Contratistas (EMP) correspondiente al Manejo Ecológico del Ducto

Este Plan, que se adjunta como *Apéndice 6,* identifica los compromisos asumidos en el Proyecto con relación al manejo de los asuntos ecológicos, lo cual incluye flora, fauna, hábitats, ecosistemas y biodiversidad. Describe las medidas que se deben adoptar para llevar a cabo las actividades del Proyecto en hábitats críticos durante la construcción del Ducto. Los lineamientos generales que se describen en este Plan servirán de guía al Contratista de Construcción para el manejo ecológico del Ducto y de los trabajos conexos durante la fase de construcción del Proyecto. Este Plan se basa en el EIAS y en el Plan de Manejo Ambiental y Social ya que incorpora las conclusiones del Reconocimiento Ecológico de Campo y las aclaraciones adicionales sobre los temas ecológicos del Ducto y del DdV. El Plan sólo aborda los compromisos y requerimientos específicamente relacionados con la construcción del Ducto entre Ayacucho y la Planta de GNL de Pampa Melchorita. No aborda otros compromisos relacionados con la Planta misma u obras conexas, incluyendo la Cantera GNL-2 y las obras del terminal marítimo.

Entre los elementos más importantes del Plan de Manejo para Contratistas (EMP) correspondiente al Manejo Ecológico del Ducto figuran la reubicación de animales sensibles de baja movilidad y plantas en peligro o en peligro crítico fuera del DdV y de otras áreas donde se producirá el desbroce de vegetación, antes de la apertura de dichas áreas. En la medida factible, el Contratista de Construcción deberá planificar sus actividades para evitar causar ruidos durante los períodos críticos (por ejemplo, durante los períodos de reproducción de las aves) en hábitats clave específicos identificados en el EIAS y en el Plan de Manejo para Contratistas (CMP) correspondiente al Manejo Ecológico del Ducto.

4.5.3 Plan de Manejo de Camélidos

Se está preparando un Plan de Manejo de Camélidos para garantizar que el proyecto del Ducto proteja los rebaños de vicuñas, alpacas y llamas de la zona altoandina, los cuales son importantes desde un punto de vista social y económico. Se están realizando trabajos de campo para identificar las áreas altamente sensibles (lugares críticos) para los camélidos dentro o cerca del DdV del Ducto, las mismas que se podrían ver adversamente afectadas durante los trabajos de construcción, y para preparar un Mapa de Restricciones que ilustre los lugares críticos y sea utilizado por los contratistas del ducto. El Plan de Manejo de Camélidos incluirá los procedimientos operativos a seguir para evitar o reducir al mínimo los impactos sobre los camélidos durante la construcción y los primeros 3-4 años de operación. También se preparará un Programa de Monitoreo de Camélidos en base a los compromisos asumidos en el EIAS y a las mejores prácticas establecidas para el manejo de camélidas por las entidades peruanas relevantes, las comunidades locales que se dedican a la crianza de camélidos, las ONGs y la literatura científica. Finalmente, se propondrán programas técnica y socialmente viables para el uso sostenible de los camélidos y las tierras de pastoreo, acrecentando los impactos positivos del proyecto en las comunidades altoandinas ubicadas dentro del área de influencia del proyecto.

4.5.4 Programa de Plantas Medicinales

En respuesta a las recomendaciones efectuadas por las comunidades locales durante el proceso del EIAS, PERU LNG desarrolló e implementó un programa de capacitación sobre plantas medicinales en Ayacucho. Este programa consideró la importancia que tienen las plantas medicinales nativas y aclimatadas para los habitantes de muchas de las comunidades ubicadas a lo largo del DdV. PERU LNG colaboró con los expertos en plantas medicinales de la Universidad de Huamanga, Ayacucho. También se llevó a cabo un taller sobre la identificación y evaluación de una serie de plantas medicinales, de modo que éstas pudieran ser consideradas durante el proceso de negociación de tierras y servidumbres. Adicionalmente, se preparó una guía donde se describen e ilustran las diferentes especies de plantas medicinales locales, la misma que fue distribuida gratuitamente entre las comunidades locales y otros grupos de interés.

4.6 Plan de Biorestauración

4.6.1 Plan de Biorestauración de PERU LNG

Para minimizar los impactos de mediano y largo plazo sobre la biodiversidad, resulta indispensable restaurar de manera oportuna y exitosa los procesos biológicos de las áreas donde se ha efectuado un desbroce de la vegetación y de los hábitats físicos durante la fase de construcción, especialmente dentro del DdV del Ducto. PERU LNG está desarrollando un Plan de Biorestauración específico que contempla las medidas a seguir para que los hábitats afectados por las actividades de construcción vuelvan a tener las condiciones necesarias para que se restablezcan los procesos de los ecosistemas dominantes y se vuelvan a desarrollar los hábitats que existían antes de la construcción. Este Plan definirá de manera clara las responsabilidades y obligaciones de PERU LNG, así como los detalles de las especies a ser restablecidas a lo largo del DdV, los lugares de donde se extraerán las semillas o plantas, la necesidad de que se establezcan viveros, las comunidades que trabajarán en la implementación de los viveros y el proceso de implementación. De acuerdo con el cronograma establecido, el Plan debería completarse antes del inicio de los trabajos de construcción durante el primer trimestre del año 2008.

4.6.2 Plan de Manejo para Contratistas (CMP) correspondiente a la Biorestauración del Ducto

En septiembre de 2007, PERU LNG emitió el Plan de Manejo para Contratistas (CMP) correspondiente a la Biorestauración del Ducto (*Apéndice 7*). Este Plan identifica específicamente los compromisos asumidos en el Proyecto, y que son responsabilidad del Contratista, con relación a la biorestauración y revegetación de todas las áreas y hábitats afectados por los trabajos de construcción, incluyendo el DdV del Ducto y los lugares que se encuentran fuera del DdV, como los caminos de acceso, los caminos de acceso temporales, los campamentos, los patios de tuberías, las pozas de material de préstamo y los botaderos (de material excedente). El alcance de este Plan se extiende desde luego de la conclusión de los trabajos de restauración física (esto es, limpieza) a ser realizados por el Contratista, los mismos que están descritos en detalle en el Plan de Manejo para Contratistas (CMP) correspondiente al Control de Erosión y Restauración, hasta la entrega final de las tierras ocupadas por el Proyecto, las mismas que se requieren para la construcción, a PERU LNG o a terceros.

Existen otros compromisos de biorestauración relacionados con el Proyecto que son de responsabilidad directa de PERU LNG, como la definición, recolección y compra de mezclas de semillas, el manejo de especies de plantas sensibles reubicadas, la propagación de nuevas plantas y la ejecución del programa de monitoreo biológico/de biodiversidad de largo plazo. Estas actividades son abordadas en un documento separado que también ha sido preparado por PERU LNG. Este Plan aborda sólo aquellos compromisos y requerimientos relacionados con la construcción del Ducto desde Ayacucho hasta la Planta de GNL de Pampa Melchorita y no aborda aquellos compromisos que están específicamente relacionados con la Planta de GNL o con las obras conexas, como la Cantera GNL-2 y las obras del terminal marítimo, las mismas que son materia de un contrato separado entre PERU LNG y otros contratistas. Este Plan de Manejo para Contratistas (CMP) se centra en el manejo de la capa superficial del suelo y en el uso por parte de PERU LNG, en la medida de lo posible, de semillas nativas y otros materiales vegetativos que contribuyan con los esfuerzos de biorestauración.

4.7 Micro Ruta Final del Derecho de Vía

4.7.1 Evaluaciones Hidrológicas y de los Pantanos Andinos

En el año 2006, PERU LNG llevó a cabo evaluaciones de los pantanos y riachuelos andinos durante la estación de lluvias (marzo-abril, mayo-junio) y durante la estación seca (octubre-diciembre) en los departamentos de Ayacucho y Huancavelica, cubriendo con ello toda la extensión del DdV desde el punto KP 0+000 hasta el punto KP 260+000.

En agosto de 2006, Golder Associates Perú S.A. realizó estudios adicionales. Se evaluó la sensibilidad del medio con respecto a los posibles impactos resultantes de la construcción y operación del ducto dentro del DdV o cerca del mismo, tal como se indica a continuación: PERU LNG identificó 55 fuentes de agua en la Región Altoandina comprendida entre el km 4 y el km 246 y Walsh identificó 6 fuentes costeras entre el km 326 y el km 330.

En base a los hallazgos y recomendaciones de estos estudios, PERU LNG ha efectuado numerosas modificaciones de la ruta de alineación del DdV con el propósito de proteger los pantanos y riachuelos andinos.

5.0 MONITOREO DE LA BIODIVERSIDAD

5.1 Objetivos

Esta sección sirve como referencia y guía para el desarrollo del Programa de Monitoreo de la Biodiversidad (BMP por sus siglas en inglés) que se implementará para comprobar que las especies y ecosistemas no se vean afectados adversamente por las actividades del proyecto de PERU LNG durante las fases de post-construcción y operación, mediante la implementación de un programa cabal y sistemático para el monitoreo in situ y remoto de las especies clave de la flora y la fauna y de los hábitats.

5.2 Marco de la Política

5.2.1 Política de PERU LNG

El marco general del Sistema de Manejo Ambiental y Social de PERU LNG reconoce la importancia de monitorear los indicadores clave con el fin de evitar los impactos y minimizar los riesgos, así como para verificar y evaluar el desempeño y el cumplimiento.

5.2.2 Lineamientos de IPIECA

En los Lineamientos del Plan de Acción sobre Biodiversidad (BAP) de la Asociación Internacional de Conservación Ambiental de la Industria Petrolera (IPIECA, 2005) se recomienda efectuar un trabajo de monitoreo como parte del BAP con el fin de evaluar el estado de la biodiversidad, efectuar un seguimiento de la implementación del BAP y efectuar los reajustes necesarios para reflejar cualquier cambio en la biodiversidad resultante de las actividades realizadas por la compañía. Los promotores del Proyecto deberán:

- Identificar la organización u organizaciones que estarán a cargo del manejo de las actividades de monitoreo y de reportar el avance logrado con respecto a acciones específicas.
- Efectuar un seguimiento de la implementación del BAP (monitorear cómo es que el BAP está siendo implementado).
- Monitorear la biodiversidad, comparándola con la referencia inicial, con el fin de evaluar la situación de la biodiversidad, las actividades del BAP y los resultados del proyecto. El programa de monitoreo deberá tomar en cuenta los requerimientos específicos del área o del proyecto. El monitoreo no necesita ser un proceso complejo: algunas compañías utilizan una base de datos simple o una hoja de cálculo para registrar y monitorear la información cuantitativa.

5.2.3 Requerimientos de los Prestamistas

La Norma de Desempeño 1 del CIF – Sostenibilidad Social y Ambiental – considera que el monitoreo es esencial para cualquier Sistema de Manejo Social y Ambiental, incluyendo los procedimientos para monitorear y medir la efectividad del programa de manejo, los controles operativos pertinentes y los mecanismos dinámicos, como por ejemplo las inspecciones y las auditorías, en la medida aplicable, para verificar el cumplimiento y avance logrados con respecto al logro de los resultados deseados.

5.2.4 Compromisos del EIAS

Los requerimientos de monitoreo están contenidos en el Plan de Manejo Ambiental y Social, específicamente en el Plan de Auditoría y Monitoreo Ambiental. La sección 3.6.1 de este plan indica que se deberá aplicar el enfoque BACI "Antes/Después-Control/Impacto" para detectar cualquier cambio en los indicadores ambientales resultante del Proyecto. Más aún, requiere que se efectúen comparaciones estadísticas entre las áreas antes y después del Proyecto siguiendo un diseño de muestreo apropiado y que al comparar una variable dos veces distintas o en dos áreas distintas, las "diferencias estadísticamente significativas" sean consideradas como evidencia de la presencia de un impacto, si se producen dentro del intervalo de confianza respectivo.

La sección 3.8.2.5 del EIAS indica que el monitoreo del proceso de revegetación documentará la recuperación de la cubierta vegetativa del DdV e identificará y corregirá cualquier dificultad encontrada durante el proceso de revegetación. El monitoreo será anual y se efectuará luego de la estación de lluvias. El monitoreo podría consistir en la adquisición de imágenes de alta resolución o en la aplicación de otros métodos efectivos y la evaluación de la cubierta vegetativa de las áreas afectadas por el proyecto. La evaluación se llevará a cabo hasta que la cubierta vegetativa del DdV sea equivalente al 90% de la cubierta vegetativa de las áreas adyacentes no impactadas por el proyecto. A medida que los distintos sectores cumplan con los límites establecidos, el alcance del monitoreo irá reduciéndose.

El Plan de Monitoreo Biológico presentado en el Apéndice 5.2 de las Respuestas a los Comentarios sobre el EIAS de junio de 2006 propone utilizar la información de "referencia inicial" para representar la condición "antes" del área del proyecto. Más aún, el Plan propuesto se centraría en estudiar el efecto de la distancia del DdV sobre las comunidades biológicas (plantas y aves). Cada "ubicación" de muestreo estaría compuesta por un juego "triple" de puntos de referencia a 0 m., 800 m. y 1,200 m., medidos desde el borde del DdV. Se propuso que las plantas y las aves fuesen muestreadas en los mismos lugares. Las comunidades de aves y plantas serían evaluadas para determinar su abundancia y diversidad, tomándose inventarios forestales adicionales de áreas selectas con árboles. La propuesta sugirió un total de aproximadamente 130 ubicaciones que serían muestreadas semestralmente durante la fase de pre-construcción y durante los primeros dos años del período de construcción.

Asimismo, en la Primera Ronda de Respuestas a las Observaciones del MEM se describe el monitoreo del ruido en áreas específicas clasificadas como hábitats sensibles (074-2006-MEMAAE/JC).

5.3 Marco Científico e Institucional

PERU LNG busca colaborar con la comunidad científica y las instituciones nacionales e internacionales para asegurarse que el Plan de Manejo de la Biodiversidad sea coherente con las prácticas aceptadas de monitoreo y evaluación de última generación y garantizar además que los resultados del monitoreo sean puestos a disposición de los investigadores, de las autoridades encargadas de la formulación de las políticas, del público en general y de las comunidades locales de manera abierta y oportuna.

El monitoreo de campo estará a cargo de consultores peruanos e investigadores de instituciones nacionales, bajo la supervisión de PERU LNG y con el control de calidad y verificación de expertos internacionales.

5.4 Especies y Ecosistemas Objetivo

5.4.1 Especies Amenazadas

El Proyecto busca asegurar que no se produzcan impactos adversos mensurables sobre la capacidad de los hábitats críticos de servir de apoyo a las poblaciones establecidas de especies en peligro o en peligro crítico o las funciones de los hábitats críticos, y que no se reduzca la población de ninguna especie reconocida que se encuentre en peligro crítico o en peligro.

En la Referencia Biológica Inicial del EIAS, en el Reconocimiento Ecológico de Campo efectuado en el año 2006 y en la Evaluación de la Vegetación del DdV efectuada en el año 2007 se han identificado comunidades de especies de flora y fauna en peligro y en peligro crítico dentro del DdV del Ducto o en las áreas inmediatamente adyacentes.

El BMP monitoreará la abundancia de estas especies en las áreas adyacentes al DdV y en las áreas en las que estas especies sean reubicadas con arreglo a las disposiciones del Plan de Manejo Ecológico.

5.4.2 Especies Endémicas de Rango Limitado

La flora y la fauna del área cubierta por el Plan de Acción sobre Biodiversidad de PERU LNG se caracterizan por la presencia de distintas especies endémicas de rango limitado en los Andes y a lo largo de los desiertos de la costa. Estas especies son de interés para los esfuerzos de conservación, a pesar de que en este momento podrían no estar sujetas a ninguna amenaza significativa. El Reconocimiento Ecológico de Campo identifica tales especies en el caso de cada Unidad Paisajística Ecológica.

5.4.3 Especies Foráneas Invasivas

Los monitores del Plan de Manejo de la Biodiversidad-BMP recibirán capacitación en la identificación de especies foráneas invasivas y tratarán específicamente de localizar dichas especies dentro del área de influencia de DdV.

5.4.4 Vegetación del DdV

El restablecimiento de la cubierta vegetativa del DdV será monitoreado y evaluado de acuerdo con los requerimientos del Plan de Manejo de la Biodiversidad -BMP y los resultados serán comparados con la información obtenida de las áreas de control no afectadas que se encuentran en lugares adyacentes al DdV.

5.4.5 Fauna del DdV

El proceso de uso y recolonización del DdV con especies de fauna será documentado en el Plan de Manejo de la Biodiversidad-BMP mediante observaciones directas e indirectas.

5.4.6 Pantanos

La condición y función de los pantanos afectados por el DdV serán evaluadas en el Plan de Manejo de la Biodiversidad-BMP.

5.5 Indicadores Sociales

5.5.1 Uso de Bofedales

En el Plan de Manejo de la Biodiversidad-BMP se tratará el tema del uso de los bofedales como pastizales por parte de las comunidades locales a fin de garantizar que los servicios de los ecosistemas sean restaurados en las áreas impactadas por la construcción del DdV.

5.5.2 Plantas Medicinales

En virtud del Plan de Manejo de la Biodiversidad-BMP, se efectuará un monitoreo de las áreas donde existan las plantas medicinales identificadas en el EIAS, en la Evaluación de la Vegetación del DdV y en consulta con las comunidades para garantizar que el acceso a estos recursos no se vea adversamente afectado por el Proyecto.

5.6 Metodologías de Monitoreo Directo de la Biodiversidad

5.6.1 Enfoque de Muestreo

Debido a la heterogeneidad natural del paisaje, especialmente en las áreas escarpadas de los Andes, será necesario seleccionar puntos de referencia que probablemente no estarán dispuestos de manera lineal. La selección inicial de puntos de “control” a 800 y 1200 metros será una tarea desafiante, pero crítica.

Otro aspecto importante es que la información de referencia inicial del EIAS se recolectó en un corredor de 3 a 7 km. de ancho que no coincidió necesariamente con el DdV. Sin embargo, la referencia inicial del EIAS debería ser considerada como una caracterización instantánea de la flora y fauna presente en la región cubierta por el DdV, efectuándose una estratificación proporcional del muestreo en base a las principales unidades vegetativas. El monitoreo biológico podría efectuarse de manera similar, en lugar de que se efectúe una comparación de punto a punto que tendría poco valor en vista de la variabilidad inherente de las condiciones ambientales y las contingencias históricas del paisaje. El monitoreo tendrá mayor valor a medida que se documenten las respuestas de largo plazo de la flora y de la fauna, tanto en el DdV como en los puntos de control. Con el tiempo, el uso de la información de referencia inicial como información de referencia será menos relevante y los tres puntos de cada área triple de puntos de referencia podrán ser comparados entre sí para determinar las tendencias y trayectorias de las especies en el transcurso del tiempo.

La información de muestreo individual (ya sea de parcelas o de transectos) refleja el número de especies presentes en cada lugar; sin embargo, cuando dicha información se combina, refleja el conjunto de especies de un tipo de vegetación específica, que casi siempre será mayor que el que se encuentra en un solo lugar. Los lugares brindan una variedad de valores que se podría esperar que se encuentren en cualquier lugar en particular y sirven de base para comparar la información de un punto con la información sobre “recuperación” (la cual es contraria a la información sobre el “impacto” en sí); estos valores constituyen el objetivo del trabajo de restauración.

Estratificación de las Muestras

El esfuerzo de muestreo será proporcional al área cubierta por cada tipo de hábitat afectado.

Recomendaciones Preliminares para Determinar la Intensidad del Muestreo por Tipo de Vegetación, en base a la Presunción de que el Muestreo materia del EIAS fue estratificado en Proporción a la Distribución de las Unidades Vegetativas a lo largo del DdV:

Tabla 5.1 Recomendaciones Preliminares para Determinar la Intensidad de Muestreo por Tipo de Vegetación

Tipo de Vegetación	Número de Lugares	
	EIAS	BMP
Bosque Montano Alto (Intacto)	2	3
Bosque Montano Alto (Degradado)	3	4
Áreas Cultivadas	10	0
Pastos Estoloníferos	14	19
Pantanos Andinos	22	30
Vegetación Arbustiva Espinosa	5	7
Vegetación Arbustiva Resinosa	7	9
Bosque Seco	1	2
Plantaciones de Eucalipto	1	0
Bosque Siempreverde Poco Denso	1	2
Pastizales Fasciculados	10	14
Áreas Altoandinas con Escasa Vegetación	1	2
Vegetación Arbustiva Mixta	5	7
Vegetación Arbustiva de Desierto	6	8
Cactus Columnar	3	4
Tillandsias	4	6
Áreas Estériles Desérticas	4	6
Islas Hidromórficas Costeras	3	3
Vegetación Arbustiva Ribereña	3	4
Total	105	130

Los puntos de control brindarán información sobre las tendencias regionales, más allá de cualquier efecto que el DdV del Ducto pudiera tener. Durante los primeros dos años de la fase de construcción, el muestreo se efectuará aproximadamente cada seis meses en cada área triple de puntos de referencia para cubrir las condiciones prevalecientes tanto en la estación de lluvias como en la estación seca. Cada área triple de puntos de referencia estará marcada permanentemente en el campo y georeferenciada; además, será fotografiada en cada muestreo desde un punto fijo.

En cada área triple de puntos de referencia, se marcará con estacas de acero un transecto de vegetación permanente (herbácea y arbustiva) o parcela (bosque). Dicho transecto también estará georeferenciado. Se aplicarán las metodologías de muestreo del EIAS para garantizar la consistencia y comparabilidad de la información. Para brindar un nivel mínimo de replicación, se ubicarán por lo menos dos áreas triples de puntos de referencia en cada tipo de vegetación. Sin embargo, en el estudio de referencia inicial, el Bosque Seco, el Bosque Siempreverde Poco Denso y las Áreas Altoandinas con Escasa Vegetación sólo fueron muestreados en un punto individual.

5.6.2 Vegetación y Flora

Parcelas

La referencia inicial del EIAS contiene información sobre 10 inventarios forestales: 4 corresponden a plantaciones de eucalipto, 2 corresponden a Bosques Secos Caducifolios, 2 corresponden a Bosques Montanos Altos, 1 corresponde a un grupo de alisos (*Alnus acuminata*), y 1 corresponde a un grupo de *Escallonia resinosa-Polylepis racemosa*. Estos inventarios contienen información sobre árboles que tienen por lo menos 15 cm. de diámetro a la altura del pecho (DAP) en dos parcelas de replicación de 20 m x 50 m (0.10 hectáreas). El Plan de Manejo de la Biodiversidad requiere del monitoreo de estas parcelas forestales para evaluar sus trayectorias.

Asimismo, se establecerán parcelas adicionales en hábitats boscosos representativos.

Transectos

En los hábitats compuestos por pastizales y pantanos, la cubierta vegetativa será estimada en base a transectos punto-paso. En las arbustedas, la cubierta será estimada en base a transectos línea-intercepción.

5.6.3 Herpetofauna

Resulta indispensable efectuar un muestreo no destructivo para minimizar los impactos; por lo tanto, durante la búsqueda no se moverán rocas ya que se podrían dañar los lugares donde se refugia la herpetofauna y en algunos casos incluso se podrían aplastar algunas especies.

La mayoría de las lagartijas pueden ser contadas mediante observaciones visuales, caminando a lo largo de los transectos. En la medida de lo posible, se deberá llevar un control de la hora del día en que se efectúan las observaciones, de las condiciones climáticas, de la pendiente/aspecto y de la estructura del hábitat. Las lagartijas más reservadas (como por ejemplo las lagartijas *Phyllodactylus* y *Proctoporus*) y los anfibios que viven en el suelo podrían ser muestreados utilizando tablones, cercos móviles o pozos trampa. La rana *Telmatobius* acuática es más difícil de muestrear de manera sistemática. Los anfibios arbóreos del Bosque Montano Alto deberían ser censados durante los encuentros visuales nocturnos y a través de evaluaciones auditivas.

5.6.4 Aves

Las aves serán censadas mediante conteo en puntos específicos para así estimar la abundancia de cada especie y medir su riqueza y diversidad. El conteo se efectuará en 10 puntos distintos de cada área triple de puntos de referencia. El lugar donde se ubiquen los puntos de cada área de muestreo dependerá de cada caso específico a fin de garantizar un proceso de muestreo óptimo.

5.6.5 Mamíferos

La presencia y abundancia de mamíferos grandes será determinada mediante observaciones visuales directas e indirectas. Las observaciones indirectas podrían incluir huellas, pieles, etc. Para el muestreo de mamíferos pequeños se utilizarán trampas Sherman. Luego de capturados y muestreados, dichos mamíferos serán liberados.

5.6.6 Biota de Agua Dulce y Hábitats

Para el muestreo de los ríos, riachuelos, lagos y lagunas se aplicarán los mismos enfoques aplicados en la Referencia Biológica Inicial del EIAS y en el Reconocimiento Ecológico de Campo, con énfasis en los indicadores de la calidad del hábitat acuático, en el camarón Changallo y en la rana *Telmatobius*.

5.7 Metodologías de Monitoreo a nivel Paisajístico

PERU LNG obtendrá imágenes remotas de alta resolución, como por ejemplo imágenes Ikonos o QuickBird, para monitorear fenómenos a nivel paisajístico, como por ejemplo el estado de la revegetación del DdV y cambios en los patrones locales de uso de tierras.

5.8 Cronograma de Actividades

Durante la fase de pre-construcción y durante los primeros dos años de la fase de construcción, el monitoreo se efectuará semestralmente para detectar cualquier variabilidad asociada con el verano/estación de lluvias y con el invierno/estación seca en las comunidades de plantas y aves. Luego de este período inicial, se evaluará la necesidad de efectuar un trabajo de monitoreo posterior a la luz de los resultados obtenidos hasta ese momento.

5.9 Reportes

En cumplimiento de las políticas de PERU LNG y de los Prestamistas, los métodos y resultados del Plan de Manejo de la Biodiversidad serán compartidos con los grupos de interés regionales y con cualquier otra parte interesada a través del Informe Anual de Monitoreo Biológico. Sin embargo, los interesados pueden tener acceso a la información disponible en cualquier momento en caso que así lo soliciten.

6.0 INVERSIÓN AMBIENTAL

6.1 Alcance y Objetivos

La presente sección sirve como referencia y guía para el desarrollo de un Plan de Inversión Ambiental (EIP por sus siglas en inglés) que aportará beneficios ambientales adicionales, más allá de los compromisos establecidos en los dispositivos legales y los requerimientos establecidos por los prestamistas para el área de influencia de PERU LNG, a través de la promoción de proyectos de conservación y desarrollo ambiental sostenibles.

6.1.1 Alcance

Geográfico

El Plan de Inversión Ambiental considerará todos aquellos proyectos que aborden temas ambientales a cualquier nivel (esto es, a nivel local o regional o a nivel de una área) dentro del Área cubierta por el Plan de Acción sobre Biodiversidad-BAP que se describe en la Sección 1.3.2 precedente.

Temático

El Plan de Inversión Ambiental no se limita a temas exclusivamente relacionados con la biodiversidad, ya que tiene como propósito considerar un rango más amplio de temas ambientales relacionados con los paisajes y comunidades del área de influencia de PERU LNG, incluyendo aspectos como suelo, agua, aire y ruido.

Asimismo, el Plan de Inversión Ambiental considerará proyectos que se centren en el uso directo e indirecto sostenible de la biodiversidad y de los hábitats, incluyendo proyectos de ecoturismo sostenible y de uso de especies de fauna y flora nativa.

Temporal

El Plan de Inversión Ambiental abarca el período que se inicia con la construcción de las instalaciones del ducto de PERU LNG y termina en la fase de operaciones, que se anticipa empezará a mediados del año 2010. Sin embargo, si los proyectos de inversión ambiental y los mecanismos de financiamiento pertinentes se seleccionan y diseñan de manera juiciosa, los beneficios de las inversiones que se realicen en la fase de construcción serán de largo plazo y sostenibles. Las necesidades ambientales serán reevaluadas para la fase de operación y el Plan de Inversión Ambiental será modificado para abordar dichas necesidades, considerar las "lecciones aprendidas" de los proyectos ambientales implementados durante la fase de construcción y tomar en cuenta los objetivos operativos y la rentabilidad de PERU LNG.

6.1.2 Objetivos

El objetivo general del Plan de Inversión Ambiental consiste en aportar beneficios ambientales adicionales, más allá de los compromisos establecidos en los dispositivos legales y los requerimientos establecidos por los prestamistas para el área de influencia de PERU LNG, a través de la promoción de proyectos de conservación y desarrollo ambiental sostenibles. Entre los objetivos específicos figuran los siguientes:

- Mejorar la calidad de vida de la población de las comunidades ubicadas dentro del área de influencia de las actividades de PERU LNG a través del uso sostenible de los recursos de la biodiversidad.
- Optimizar los gastos que realiza PERU LNG para lograr beneficios ambientales desarrollando asociaciones prudentes con entidades gubernamentales, ONGs, empresas y organizaciones financieras.
- Satisfacer las expectativas de los grupos de interés locales y de las instituciones prestamistas del Proyecto con respecto a la inversión ambiental y la inversión en proyectos de responsabilidad ambiental corporativa.
- Desarrollar y mantener una relación de trabajo sólida entre las comunidades, las ONGs ambientalistas y PERU LNG.
- Generar beneficios mutuos para las comunidades, el gobierno y PERU LNG.
- Crear y mantener una imagen pública positiva para PERU LNG, lo cual incluye las medidas necesarias para que lograr que se reconozca el nombre de la compañía, obtener apoyo comunitario y generar confianza.
- Reducir los riesgos operativos que la oposición de las comunidades, de las ONGs o del gobierno podrían generar para PERU LNG, fortaleciendo las sinergias y generando respeto y lealtad en el área de influencia del Proyecto.

6.2 Comité de Gestión

La implementación del Plan de Inversión Ambiental estará a cargo de un Comité de Gestión que podría estar compuesto por representantes de las siguientes organizaciones:

- Los socios del consorcio PERU LNG;
- Alguna institución ambiental gubernamental, como por ejemplo CONAM, CAR ó INRENA;
- Las autoridades regionales;
- ONGs nacionales o internacionales; e
- Instituciones académicas y de investigación nacionales o internacionales.

El Comité de Gestión podría tener los siguientes roles, entre otros:

- Evaluación y refinamiento de metas durante la evaluación de la propuesta, conjuntamente con los posibles Socios que estarán a cargo de la implementación de los proyectos (Socios Ejecutores);
- Administración de subvenciones relacionadas con aspectos técnicos, financieros, de salud y de seguridad industrial; y
- Evaluación de proyectos en base a los Informes Trimestrales presentados por los Socios Ejecutores.

PERU LNG nombrará a los miembros del Comité de Gestión y los miembros nombrados cumplirán sus funciones al servicio de PERU LNG.

6.3 Participación de los Grupos de Interés

Para tener éxito en el planeamiento e implementación de los proyectos, resulta crítico mantener a las autoridades gubernamentales, al público afectado y a las partes interesadas informadas en todos los momentos apropiados sobre el desarrollo e implementación de los respectivos proyectos. El proceso de consulta con los grupos de interés no consiste simplemente en notificar las actividades programadas, sino incluye más bien los pasos necesarios para compartir información con los grupos de interés con el fin de intercambiar ideas, recibir aportes y comentarios, lograr consenso y obtener el respaldo y compromiso de las partes interesadas. El proceso de consulta requerirá de la participación del socio ejecutor y, cuando sea apropiado, de los representantes de PERU LNG. Las consultas consistirán en comunicaciones escritas, conversaciones informales, reuniones y talleres.

6.4 Proceso de Priorización

El Plan de Inversión Ambiental se basará en los resultados del proceso del EIAS y del proceso de Consulta con los Grupos de Interés, en el Reconocimiento Ecológico de Campo y en otras medidas que han continuado brindando información sobre la biodiversidad y las prioridades generales de conservación ambiental en el área de influencia del Ducto de PERU LNG.

Se identificarán las prioridades anuales del Plan de Inversión Ambiental con respecto a los siguientes temas específicos de dicho Plan:

- Conservación de las especies (Amenazadas, Endémicas y de Rango Restringido);
- Conservación y Restauración de los Ecosistemas; e
- Iniciativas Comunitarias de Conservación y Sostenibilidad, incluyendo programas educativos.

El proceso de priorización y los resultados del borrador del Plan de Acción sobre Biodiversidad correspondiente al período 2005-2006 preparado por Walsh Peru están resumidos en el *Apéndice 8*.

6.5 Proceso de Selección de Proyectos

6.5.1 Proceso y Criterios Generales

PERU LNG seleccionará e implementará todos aquellos proyectos que se identifiquen de distintas maneras, específicamente a través del:

- Proceso de Priorización del Plan de Inversión Ambiental;
- El EIAS y el Plan de Manejo Ambiental y Social;

- Iniciativas comunitarias;
- Proyectos gubernamentales;
- Solicitudes o propuestas no solicitadas (de la comunidad, del gobierno, de ONGs, etc.); y
- La respuesta de PERU LNG a las necesidades identificadas.

Se estima que la mayor parte del presupuesto del Plan de Inversión Ambiental se invertirá en las actividades determinadas como resultado de las evaluaciones específicamente realizadas para identificar y priorizar las especies y ecosistemas del área de influencia del Ducto. Sin embargo, también se implementarán proyectos para cumplir con los compromisos asumidos en el Plan de Manejo Ecológico del Ducto y en el EIAS del Ducto. Los proyectos resultantes del resto de las fuentes identificadas anteriormente, aunque no sean necesariamente sostenibles, cumplirán con los criterios de selección pertinentes que se describen a continuación.

A fin de acortar la lista de posibles proyectos e incluir sólo aquellos apropiados para ser puestos en práctica, resulta ventajoso aplicar criterios justos y coherentes durante el proceso de selección (etapa de Selección de Proyectos). Estos criterios se basan en los estándares y mejores prácticas internacionales sobre inversión ambiental, en los criterios desarrollados para programas similares y en la experiencia local ganada a través de la implementación de proyectos similares en la región. Los criterios que se aplican a la selección de proyectos son los siguientes:

Sostenibilidad: El Proyecto genera beneficios duraderos, sin que sea necesario recibir asistencia externa o subsidios permanentes para lograr los objetivos de largo plazo.

Productividad: Entre los resultados figuran la mayor disponibilidad o acceso a recursos y/u oportunidades clave para mejorar la calidad de vida.

Equidad Social: Los beneficios llegan a un amplio segmento de la comunidad, en una forma que minimiza los conflictos sociales. Los beneficios directos podrían llegar a un grupo limitado, pero los beneficios indirectos deberían llegar a la mayor parte de la población objetivo. El Plan de Inversión Ambiental tiene como propósito evitar el favoritismo, pero se considerará la vulnerabilidad de la población.

Valor: El valor esperado de los beneficios justifica el costo de la inversión y la asignación de recursos. El proyecto convierte eficientemente la inversión en resultados que serán valorados por las comunidades beneficiarias. Los costos y el dinero deberán ser manejados de manera efectiva y controlada para optimizar los recursos.
Factibilidad: Los objetivos del proyecto son claros, aconsejables, alcanzables y mensurables tomando en cuenta las condiciones locales, la cultura, las normas/estructura social, la experiencia disponible y los recursos que serán comprometidos.

Plazo: El plazo que se requiere hasta la conclusión cumple con las necesidades y objetivos de las partes interesadas, como por ejemplo los de PERU LNG, de las entidades gubernamentales relevantes y de los beneficiarios de las comunidades.

Cronología: En la medida aplicable, la cronología de implementación aprovecha la etapa de desarrollo del Proyecto o evita perder oportunidades postergando la implementación.

6.5.2 Propuestas

Aunque los proyectos pequeños y de corta duración podrían ser manejados directamente por PERU LNG, los proyectos más grandes requerirán de recursos y habilidades externas para garantizar el éxito y eficiencia de su implementación. Los proyectos que sean iniciados y manejados por PERU LNG se ceñirán a un modelo similar al de los proyectos diseño-construcción o diseño-licitación-construcción. Los proyectos de diseño-construcción requieren de

una sola entidad (por ejemplo, una firma de diseño o un contratista de construcción) para diseñar y construir un proyecto en base a las especificaciones/requerimientos o planes preliminares proporcionados por el titular. Los proyectos de diseño-licitación-construcción dividen la responsabilidad de diseño y construcción entre distintas entidades, de modo que el diseñador (por ejemplo, el arquitecto o ingeniero) entregue los planos detallados de diseño al titular. El titular luego selecciona a un contratista de construcción, generalmente a través de un proceso de licitación, para construir el proyecto de acuerdo con el diseño detallado proporcionado por la firma de diseño. En el caso de proyectos de desarrollo comunitario, el "diseño" por lo general será el perfil detallado del proyecto y el plan de acción, los mismos que pueden ser entregados al socio ejecutor como un diseño completo del proyecto o, de lo contrario, para su modificación, o también podría ser desarrollado por el socio ejecutor como un tipo de proyecto "diseño-construcción" completo.

PERU LNG buscará a organizaciones para que se conviertan en sus socios ejecutores y cumplan de la mejor manera posible con los objetivos dentro del cronograma y presupuesto establecidos. Dentro de este contexto, la selección no sólo se basará en el costo, sino también en otros factores que determinen el mejor valor, como por ejemplo la calidad de las propuestas, el impacto socioeconómico y ambiental, la experiencia, la competencia, el entendimiento de los requerimientos de PERU LNG y el compromiso, así como la capacidad de entregar productos de calidad que satisfagan los objetivos del proyecto, dentro del cronograma de tiempo y los recursos disponibles.

La Solicitud de Propuestas (RFP por sus siglas en inglés) es uno de los mecanismos de selección que se pueden utilizar para seleccionar los proyectos o los socios ejecutores de aquellos proyectos que ya hayan sido definidos. En vista de que PERU LNG no tiene la intención de solicitar el aporte de ideas de distintas fuentes para los proyectos, se espera que el proceso de Solicitud de Propuestas sirva básicamente para la selección del socio ejecutor de los proyectos que ya han sido conceptualizados (diseño-construcción) o diseñados (diseño-licitación-construcción). Este proceso permite contar con un enfoque transparente para seleccionar a socios ejecutores calificados en base a criterios pre-determinados. La Solicitud de Propuestas se ciñe a un proceso pre-establecido para solicitar y evaluar propuestas que culminen en un contrato o en la firma de un acuerdo similar entre PERU LNG y el socio o los socios ejecutor(es)

Un proceso de Solicitud de Propuestas típico incluirá lo siguiente:

- Términos de referencia
- Alcance del trabajo y de otros requerimientos del proyecto.
- Cronología general del proyecto
- Términos contractuales propuestos
- Procedimientos para efectuar preguntas y presentar propuestas.

En el *Apéndice* 9 se incluye un modelo de Solicitud de Propuestas y la Matriz Marco. También se podrían presentar presupuestos, si fuera apropiado y se considerara que sería beneficioso para alcanzar los objetivos del proyecto. La Solicitud de Propuestas proporcionará criterios claros sobre el contenido de las propuestas y los resultados esperados a fin de garantizar la equidad e imparcialidad de la información recibida por todas las organizaciones interesadas. Adicionalmente, la Solicitud de Propuestas podría alentar a ONGs calificadas y experimentadas, así como a otras organizaciones competentes, a que presenten sus propuestas de manera individual o colectiva. En dicho caso, se alentaría a las ONGs internacionales interesadas a que incluyan a ONGs nacionales y locales en sus propuestas.

La opción de encargar la implementación del proyecto a un solo socio es también una opción viable en casos específicos, como por ejemplo los siguientes:

- Cuando existe un número limitado de proponentes con experiencia específica en el área del proyecto;
- Cuando existe un número limitado de proponentes con experiencia en el área geográfica del proyecto;
- Cuando existe un número limitado de proponentes que han desarrollado relaciones con algunas comunidades y gozan de su confianza;
- Cuando el proyecto fue conceptualizado y recibido del socio ejecutor como una propuesta no solicitada por PERU LNG; o
- Cuando el socio ejecutor tiene claramente mayor experiencia u ofrece ventajas logísticas con respecto a los posibles rivales que podría tener en un proyecto en particular.

Es probable que se solicite que PERU LNG participe o que PERU LNG solicite participar en iniciativas gubernamentales o no-gubernamentales que cumplen con los lineamientos del Plan Maestro para Proyectos de Inversión en Desarrollo Comunitario. Los proyectos de terceros (entidades gubernamentales, ONGs, etc.) en los que PERU LNG decida invertir serán similares a la relación que existe entre una asociación en participación y una asociación o entre un accionista y un inversionista. Esta forma de inversión comunitaria requerirá de un menor manejo directo de PERU LNG, pero a menudo requerirá de igual o mayor vigilancia para garantizar que los fondos sean invertidos de acuerdo con los principios y criterios establecidos en este Plan Maestro para Proyectos de Inversión en Desarrollo Comunitario. En cuanto a financiamiento se refiere, estos tipos de proyectos serán analizados de acuerdo con los mismos criterios que se aplican al análisis de propuestas recibidas a través del proceso de Solicitud de Propuestas, con sujeción a ciertas modificaciones menores que consideren el proceso de revisión no competitivo.

En los casos apropiados, se pedirá que los posibles socios ejecutores de iniciativas específicas diseñen y se encarguen de la implementación de los proyectos, de acuerdo con sus respectivas áreas de especialización y experiencia. En la mayoría de los casos, el socio ejecutor se desempeñará como gerente del proyecto y estará a cargo del manejo de todos los aspectos del proceso de implementación, incluyendo planeamiento, presupuesto, dotación de personal, asignación de recursos, procesos de consulta pública y participación, logística, compras y ejecución.

6.5.3 Criterios para la Selección de Socios

A los posibles socios ejecutores contactados a través del proceso de Solicitud de Propuestas se les entregará un perfil del proyecto u otros lineamientos para que puedan preparar sus propuestas. Para proyectos de mayor valor (esto es, de más de $500,000), los accionistas de PERU LNG tendrán la oportunidad de efectuar una revisión antes de que se formalice un acuerdo con el proponente que ganó la licitación. A los accionistas de PERU LNG se les mantendrá informados sobre el desarrollo de los proyectos ambientales durante las etapas apropiadas del proyecto, a través del Comité de Desarrollo Sostenible. Adicionalmente, PERU LNG podría solicitar que expertos externos revisen los proyectos propuestos y/o las propuestas presentadas por los socios ejecutores de los proyectos. Habrá un proceso de comunicación permanente con los grupos de interés durante todo este proceso.

Las revisiones de las propuestas se ceñirán a un proceso de evaluación justo y transparente que incluirá un método de asignación de puntajes bien documentado y equitativo, una descripción de la cronología de eventos, la recomendación sobre la adjudicación del contrato y la notificación de adjudicación. Las propuestas no solicitadas también serán consideradas y analizadas de acuerdo con los criterios que se señalan a continuación.

El proceso de evaluación y selección de propuestas tomará en cuenta los siguientes criterios:

Estructura Gerencial / Experiencia Organizativa: Capacidad organizativa y experiencia en la implementación de proyectos similares, incluyendo capacidad de apoyo técnico, político y logístico. Nexos con organizaciones gubernamentales, privadas y de otra índole en términos de posibles conflictos de intereses y sinergias.

Manejo del Proyecto: Calificaciones del gerente o gerentes del proyecto y experiencia en el manejo de proyectos similares y en brindar apoyo gerencial y técnico efectivo.

Metodología: Coherencia del diseño general del proyecto, participación histórica y propuesta entre el socio o los socios ejecutores y las comunidades, claridad y factibilidad del plan, incluyendo indicadores que puedan ser verificados de manera objetiva.

Cronograma del Proyecto: Coherencia entre el cronograma propuesto para el proyecto y los objetivos del proyecto. Se deberán brindar detalles suficientes que aseguren que el proponente comprende el proyecto y puede cumplir con el cronograma.

Concepto del Proyecto: Entendimiento claro de los conceptos del proyecto, tal como lo demuestren las actividades propuestas, y logro de objetivos específicos. Las actividades propuestas deberán demostrar capacidad de innovación, si fuese aplicable, así como conocimiento de la infraestructura política y social requerida para el éxito.

Presupuesto y Eficiencia de Costos: Nivel de detalle e integridad del presupuesto propuesto, valor en términos de dinero y alcance de la participación de los costos, fondos de contrapartida y apalancamiento. Controles financieros dentro de la organización.

Los criterios de selección de socios aplicados a un proceso de asignación de puntajes previamente establecido permiten que las propuestas sean calificadas de manera justa y coherente. El gerente del Plan de Inversión Ambiental efectúa un análisis de todas las propuestas y de los posibles socios en base a los criterios establecidos y recomienda que se otorgue el contrato de implementación al socio seleccionado. La recomendación del gerente del Plan de Inversión Ambiental será analizada internamente por los líderes funcionales internos, como por ejemplo por el líder de Medio Ambiente, de Asuntos Comunitarios, de Relaciones Públicas y de Compras y por la alta gerencia de PERU LNG y de COLP. Los accionistas de PERU LNG estarán informados de la decisión o participarán en la misma, según sea aplicable, a través del Comité de Desarrollo Sostenible de PERU LNG.

6.6 Implementación de los Proyectos

6.6.1 Contrato de Implementación

Aquellas propuestas que sean aceptadas para ser implementadas serán materia de un contrato o acuerdo a ser firmado con el socio o socios ejecutores, el mismo que especificará los términos y condiciones del contrato, el alcance del trabajo, los términos acordados por las partes para el desembolso de fondos y cualquier otro requerimiento contractual de PERU LNG. Los proyectos acordados con las entidades gubernamentales serán formalizados para especificar la forma y grado de participación de las partes (por ejemplo, financiera, de logística, especialización, etc.), responsabilidades, alcance del trabajo y otros términos y condiciones.

6.6.2 Proceso de Implementación

El proceso de implementación empieza cuando los fondos u otros recursos son comprometidos para un proyecto seleccionado para ser implementado. El proceso de implementación se ceñirá a los procesos comerciales y a los procedimientos de control de PERU LNG.

En la medida aplicable, se incentivará a que los socios ejecutores lleven a cabo estudios durante las etapas tempranas de la implementación respectiva a fin de cerrar cualquier brecha de información resultante del desarrollo de los perfiles de los proyectos. Los socios ejecutores también serán responsables del proceso de comunicación y consulta con las comunidades afectadas y posibles beneficiarios, asegurando al mismo tiempo que los representantes de relaciones comunitarias y medio ambiente de PERU LNG participen en el proceso.

El personal de medio ambiente de PERU LNG brindará apoyo y supervisión para la implementación global del Plan de Inversión Ambiental. Dicho personal y el gerente del Plan de Inversión Ambiental servirán de nexo entre los socios ejecutores, las comunidades y PERU LNG. Los socios ejecutores estarán obligados a presentar reportes de avance y reportes financieros sobre una base regular. En general, los sistemas de manejo y reporte deberán cumplir con los estándares e instrumentos aplicados por PERU LNG y por el personal de medio ambiente.

Hay varios modelos que se pueden utilizar, dependiendo del rol y nivel de participación directa de PERU LNG en la implementación del proyecto. La mayoría de los proyectos ambientales requerirán de la participación de socios ejecutores que sean entidades (por lo general, se espera que sean entidades gubernamentales, ONGs o consultores) que celebran acuerdos con PERU LNG para implementar los proyectos especificados o algunos componentes de los mismos.

El socio al que se le adjudique el contrato o acuerdo de implementación pasará a la fase de Ejecución y Control del Proyecto una vez que empiece el trabajo real que se le ha encomendado. Esta fase concluirá cuando el proyecto haya sido completamente desarrollado, aceptado y transferido del modo de inversión de PERU LNG al modo de conclusión o al modo de funcionamiento sostenible.

Los socios ejecutores estarán sujetos a la revisión y auditoría de PERU LNG, quien verificará que los procedimientos y prácticas de ejecución y reporte cumplan con los requerimientos de PERU LNG y que existan controles internos para evaluar adecuadamente el desempeño, tomar acciones preventivas y correctivas efectivas, cumplir con los requerimientos regulatorios y manejar los fondos. Los socios ejecutores también serán monitoreados para verificar que estén cumpliendo con los procedimientos y prácticas sociales y ambientales establecidas.

6.7 Seguimiento y Reporte

6.7.1 Monitoreo y Evaluación

El Monitoreo y la Evaluación, como un proceso combinado, constituye una herramienta que se utiliza para determinar el rendimiento e incentivar una mejora continua y constituye además uno de los principales componentes involucrados en la implementación del Plan de Acción sobre Biodiversidad (IPIECA, 2005). Deberá brindar la información necesaria para mejorar el manejo y la responsabilidad de todas las partes involucradas. El Monitoreo y la Evaluación participativos también brindan la oportunidad de que los grupos de interés participen en el proyecto y en un programa de inversión comunitaria más amplio, participando en la medición y revisión del rendimiento, así como en la determinación de las oportunidades de mejora.

Los trabajos de monitoreo y evaluación de los distintos proyectos se basarán en el Marco Lógico o en otros indicadores desarrollados para el proyecto, aunque los indicadores podrían ser reajustados a medida que se vaya avanzando con el desarrollo del proyecto para garantizar que los resultados brinden información útil sobre el desempeño mostrado para lograr las metas y objetivos. Se espera que se lleven a cabo talleres participativos durante las fases tempranas de los respectivos proyectos para revisar el marco lógico y los medios de verificación con los grupos de interés y socios relevantes. Los talleres deberán servir para que los usuarios de información relevantes comprendan el proceso e identifiquen sus inquietudes y necesidades.

Aunque el momento en que se efectuarán los trabajos de monitoreo y evaluación será distinto en cada proyecto, cada proyecto empezará con una referencia inicial y estará sujeto a una o más evaluaciones en un punto intermedio (no necesariamente a la mitad del proyecto) y a una evaluación post-implementación. Los indicadores de monitoreo y evaluación serán determinados antes de la ejecución del proyecto y serán modificados según se requiera para brindar información útil sobre desempeño, cualquier diferencia que exista entre el resultado deseado y el resultado efectivo, y la necesidad de modificar los recursos, los roles definidos, el manejo, etc. La información de cada proyecto individual será utilizada para una revisión global del Plan de Inversión Ambiental. La evaluación o evaluaciones que se realice(n) en un punto intermedio del proyecto brindará(n) información sobre el avance logrado para alcanzar los objetivos específicos del programa de inversión comunitaria en general o de proyectos específicos. El proceso de evaluación se utilizará para determinar el avance logrado, las oportunidades que existen para mejorar la inversión ambiental sostenible y el éxito del desarrollo de relaciones positivas entre PERU LNG y los grupos de interés.

La revisión de los resultados de la evaluación por parte de la gerencia de PERU LNG y de COLP, así como la implementación de acciones preventivas/correctivas, ayudará a una mejora continua del Plan de Inversión Ambiental.

6.7.2 Reporte y Comunicaciones

De conformidad con los lineamientos del CIF, BID e IPIECA, el Plan de Inversión Ambiental incluirá procedimientos de reporte y comunicación que incluyan la divulgación de actividades y del desempeño a los grupos de interés, incluyendo el gobierno, los prestamistas y las comunidades, entre otros.

Los Socios Ejecutores deberán presentar informes trimestrales para que el Comité de Gestión pueda evaluar el avance. Dichos informes describirán el avance del trabajo de implementación, los resultados, los retos, los riesgos y el avance financiero.

Un aspecto importante del Plan de Acción sobre Biodiversidad es conocer cómo es que el plan es percibido externamente. Tanto los reportes como la comunicación pueden ayudar a obtener el respaldo de los grupos de interés internos y externos y a incrementar las probabilidades de éxito de las actividades que se realicen en el presente o en el futuro con respecto a la biodiversidad. Para ello, se desarrollará una Estrategia de Comunicaciones específica para el Plan de Inversión Ambiental. De acuerdo con las políticas de PERU LNG y con las mejores prácticas internacionales, PERU LNG presentará informes periódicos sobre las actividades y logros del Plan de Inversión Ambiental a los grupos de interés y también realizará talleres y presentaciones como otra forma de revelación y comunicación. La información que se brinde será clara, efectiva y específicamente diseñada para el nivel de audiencia a la que se dirija. La responsabilidad de los requerimientos de comunicación será identificada claramente en cualquier estructura gerencial futura.

Se alentará a los Socios Ejecutores a que publiquen las conclusiones de los proyectos implementados con el apoyo del Plan de Inversión Ambiental en los medios locales, nacionales e internacionales apropiados. En dicha publicación, deberán reconocer el apoyo brindado por PERU LNG e incluir un descargo de responsabilidad en el que se señale que las conclusiones, recomendaciones y opiniones son las del Socio Ejecutor y podrían no reflejar las conclusiones, recomendaciones y opiniones de PERU LNG.

7.0 LITERATURA CITADA

CONAM. 2001. *Perú: Estrategia Nacional sobre Diversidad Biológica.* Consejo Nacional del Ambiente: Lima.

CONAM. 2005. *Agenda Nacional Ambiental 2005-2007.* Consejo Nacional del Ambiente: Lima.

IPIECA. 2005. *A Guide to Developing Biodiversity Action Plans for the Oil and Gas Sector (Guía para Desarrollar Planes de Acción sobre Biodiversidad para el Sector de Petróleo y Gas)* International Petroleum Industry Environmental Conservation Association: London (Asociación Internacional de Conservación Ambiental de la Industria Petrolera, Londres).

UNCED. 1993. Resolución Nº 03, Apéndice de la Convención sobre Diversidad Biológica.

UNEP. 1993. Convención sobre Diversidad Biológica. Tratado de las Naciones Unidas de 1760 *Serie* 143, 31 I.L.M. 818.

Walsh Peru. 2004. Evaluación Ambiental Preliminar para el Diseño de la Ruta de un Gaseoducto. Walsh Peru: Lima.

Walsh Peru. 2005. Evaluación de Impacto Ambiental y Social del Proyecto del Ducto de Gas Natural que se extenderá desde Ayacucho hasta la Planta de Licuefacción. Walsh Peru: Lima.

APPENDIX 1: ENVIRONMENTAL REGIONAL ACTION PLAN FOR AYACUCHO UP TO 2013 AND REGIONAL ENVIRONMENTAL AGENDA FOR AYACUCHO

Environmental Regional Action Plan for Ayacucho up to 2013

Green Front: Sustainable use of Natural Resources and Biological Diversity Conservation		
Objectives	***Lines of action***	***Indicators***
Development of the agro ecology	To promote the reduction of the use of agrochemical toxic products.	By 2013, the use of agrochemical toxic products is eliminated.
		By 2013, the use of agrochemical considered lightly toxic is reduced in 50%.
	To promote the use for natural intakes and biodegradable products for the agricultural production.	60% of the farmers of the region use natural intakes and biodegradable products.
	To promote the commercialization of organic products.	By 2008, 6 biological products from Ayacucho region are commercialized in national and international markets.
Management and Conservation of Biodiversity and Protected Natural Areas	To promote and create germplasm banks for Andean crops, tropical and sub tropical.	By 2008, each provincial capital has a germplasm bank of Andean crops and/or tropical and sub tropical from the region.
	To demand fulfillment of the Environmental and Social Impact Assessment (ESIA) for development projects.	From 2004, there will be no execution of development projects without an Environmental and Social Impact Assessment (ESIA)
	To promote reforestation and/or forestation programs with native and introduced species.	By 2013, the region will have forest cover in 30% of the territories with forest aptitude and in 40% of those of production
	To stimulate the establishment of Regional Protected Natural Areas by the Government-SINANPE (National System for Protected Natural Areas).	By 2013, the region will have 10 Protected Natural Areas (PNA) recognized by the biodiversity
	To develop the management, conservation and inventory of biodiversity	By 2008, there will be a team of professionals capacitated in management and conservation of the biodiversity.
		By 2013, there will be 3 international agreements for the management and conservation of biodiversity.
Geographical and Ecological Economical Categorization	To make studies of vulnerability of the rural areas of greater risk	By 2013, there is a study of vulnerability in the rural area
	To promote the development of the macro, meso and micro	By 2013, 1 study of macro categorization, 11 studies on

Green Front: Sustainable use of Natural Resources and Biological Diversity Conservation		
Objectives	***Lines of action***	***Indicators***
	ecological and economic categorization	meso categorization and 20 studies of micro categorization
	To promote the development of a Plan for Territorial Ordering	By 2008, there is a Plan for Territorial Ordering for the region
Management and Conservation of Hydrographic Watersheds	Identification and evaluation of sub watersheds and micro watersheds	By 2013, there are digitalized maps of all the sub watersheds and micro watersheds of the region.
	To promote the forestation and reforestation of the sub watersheds and micro watersheds of Ayacucho's region	By 2013, 10 000 hectares have been forested in the sub watersheds and micro watersheds of the region
	Creation and implementation of an autonomous Authority in Hydrographic Watersheds Management.	By 2006, there is a team specialized in management of Hydrographic watersheds
	To promote the management and conservation of natural pastures	By 2013 there is management for 30 % of natural pastures.

Regional Environmental Agenda for Ayacucho

Green Front: Sustainable Use of Natural Resources and Conservation of Biodiversity			
Action Line	***Activities***	***Goal***	***Responsible***
Objective: Development of the agro ecology			
1. To promote the reduction of the use of agrochemical toxic products.	1.1 To develop diagnostics for the use of agrochemical products in farming activities	01 diagnostic	MINAG, SENASA, INIA y NGOs
	1.2 Develop qualification programs to eliminate the use of agrochemical toxic products	01 qualification program	MINAG, SENASA, INIA y NGOs
	1.3 Develop awareness campaigns to fulfill with the regulations that forbids the commercialization of chemical toxic products	02 awareness campaigns	MINAG, SENASA
	1.4 Make radio programs in the regional area	200 advertising spots per year	Regional Government, MINAG, SENASA, NGOs
2. To promote the use for natural intakes and biodegradable products for the agricultural production.	2.1 Creation of an Experimental Pilot Center of production of organic intakes	01 Experimental Pilot Center	INIA, MINAG, UNSCH
	2.2 Qualification to farmers in the preparation of organic intakes	11 provincial qualification events	MINAG, NGOs, INIA, UNSCH
3. To promote the commercialization of organic products.	3.1 Identification of market niches	01 market study for organic products	“Centro de Competitividad de Ayacucho”, Commerce Chamber, NGOs
	3.2 Identify and promote the potential organic products	10 potential organic products	“Centro de Competitividad de Ayacucho”, Commerce Chamber, NGOs
	3.3 To promote the organization of producers of organic products	02 producers of organic products committees	MINAG, NGOs
	3.4 Written and radio information of the benefits of the organic products	200 advertising spots per year	Regional Government, MINAG, NGOs
Objective: Management and Conservation of Biodiversity and Protected Natural Areas			
4. To promote and	4.1 To elaborate the situational diagnostic	01 situational diagnostic of	INIA, MINAG, UNSCH

Green Front: Sustainable Use of Natural Resources and Conservation of Biodiversity			
Action Line	***Activities***	***Goal***	***Responsible***
create germplasm banks for Andean crops, tropical and sub tropical.	of the existing investigation centers of germplasm	the existing investigation centers of germplasm	
	4.2 To implement the existing centers of germplasm	02 centers of germplasm implemented	
5. To demand fulfillment of the Environmental and Social Impact Assessment (ESIA) for development projects	5.1 Identify and evaluate the existing regulations about ESIA	01 regulatory evaluation	Regional Government, MINAG, INRENA
	5.2 Elaborate a data base of the ESIA specialists	01 data base elaborated	
6. To promote reforestation and/or forestation programs with native and introduced species.	6.1 Identify and evaluate the lands with forestall aptitude	01 evaluation study	MINAG, PRONAMACHCS, Municipalities, NGOs
	6.2 Identify the native species by its ecological level	01 identification study	
	6.3 Implement institutional and communal green houses in the region	11 provincial green houses for the production of forestall plants	
7. To stimulate the establishment of Regional Protected Natural Areas by the Government-SINANPE (National System for Protected Natural Areas)	7.1 Identify priority areas for conservation of biological diversity	02 established and recognized Protected Natural Areas	Regional Government, UNSCH, Local Governments, NGOs
	7.2 Formulate the technical expedients for the Protected Natural Areas proposals		
8. To develop the management, conservation and inventory of biodiversity	8.1 Qualification of professionals and technical personal in the conservation and management of biodiversity in the community	25 capacitated professionals and technicians in biodiversity conservation and management	Regional Government, UNSCH, Local Governments, NGOs
	8.2 Develop awareness campaigns about conservation of biodiversity in the community	02 awareness campaigns	

Green Front: Sustainable Use of Natural Resources and Conservation of Biodiversity			
Action Line	***Activities***	***Goal***	***Responsible***
	8.3 Formulate a private project for the conservation of biodiversity	01 formulated project	
Objective: Geographical and Ecological Economical Categorization			
9. To make studies of vulnerability of the rural areas of greater risk	9.1 Conformation of a technical multidisciplinary team for the identification of the most vulnerable areas	01 diagnostic for vulnerable areas	Regional Government with its sectors
	9.2 Identification of the areas with more risk and the immediate taking of decisions		
10. To promote the development of the macro, meso and micro ecological and economic categorization	10.1 Conformation a technical team	01 macro categorization study	Regional Government with its sectors
	10.2 Elaborate the ecological and economical macro categorization		
11. To promote the development of a Plan for Territorial Ordering	11.1 Elaborate the diagnostic for the Huamanga province	01 Huamanga diagnostic	Huamanga Provincial Municipality
	11.2 Formulate the program for urban categorization in Huamanga province	01 Categorization Plan for Huamanga	
	11.3 Update or elaborate the director plan for the Huamanga province	01 Director Plan for Huamanga	
Objective: Management and Conservation of Hydrographic Watersheds			
12. Identification and evaluation of sub watersheds and micro watersheds	12.1 Conformation of technical group	01 sub watershed and micro watershed diagnostic	MINAG, PRONAMACHCS, INRENA
	12.2 Elaborate diagnostic for sub watersheds and micro watersheds		
	12.3 Elaboration of digitalized maps from the sub watersheds and micro watersheds	05 digitalized maps of the prioritized sub watersheds and micro watersheds	
13. To promote the forestation and reforestation of the sub watersheds and micro watersheds of	13.1 Forestation and reforestation of the sub watersheds and micro watersheds with native plants	04 forested and reforested watersheds	MINAG, PRONAMACHCS, INRENA

Green Front: Sustainable Use of Natural Resources and Conservation of Biodiversity			
Action Line	***Activities***	***Goal***	***Responsible***
Ayacucho's region			
14. Creation and implementation of an autonomous Authority in Hydrographic Watersheds Management.	14.1 Conformation of a technical multi sector team	01 proposal for the creation and implementation of an autonomous Authority	Regional Government, PRONAMACHCS
	14.2 Implementation proposal		
15. To promote the management and conservation of natural pastures	15.1 Elaborate map for natural pastures	01 digitalized map of natural pastures	Regional Government, UNSCH, MINAG

APPENDIX 2: ENVIRONMENTAL REGIONAL AGENDA FOR HUANCAVELICA 2005 – 2006 AND REGIONAL ENVIRONMENTAL ACTION PLAN FOR HUANCAVELICA UP TO 2015

Environmental Regional Agenda

Environmental Regional Agenda for Huancavelica from 2005 to 2006: Green Front - Sustainable use of Natural Resources and Biological Diversity Conservation

Green Front: Sustainable use of Natural Resources and Biological Diversity Conservation			
Objectives	**Goals for 2 years**	**Actions**	**Principal Responsible**
1. **Advance in the conservation and sustainable** use of soil, reforestation, management of natural pastures and environmental services of the forestall ecosystems	Sustainable use of 1000 hectares or forestall resources and the production of environmental products and services from the forest and the conservation of the soil	- Elaborate the Regional Forestall Strategy - Elaboration of Management Plans of high Andean pastures - Conformation of the forestall development committees for each province - To spread and apply the legal requirements about forestall and fauna and environmental code. - Elaboration of calculations for the volumes of the resources (quantity, quality and continuity) in the forestall ecosystems - Enhance the agriculture border with soil conservation	- Regional Government of Huancavelica, INRENA - CONACS, FEDECH and PRONAMACHCS - DRA, PRONAMACHCS, INRENA, NGOs, DREH and private sector - Regional Government of Huancavelica, INRENA - INRENA - DRA, PRONAMACHCS, Responsible Government, Coordinator for the Huancavelica Region
	Conformation of the Sustainable Use Regional Committee	- Assembly for the public institutions authorities, private and civil society - Public hearings	- Regional Government of Huancavelica, INRENA, PRONAMACHCS, CONAM, DIRESA, DREM, DRPRO, Municipality, other actors from the civil society - Regional Government of Huancavelica, INRENA,

Green Front: Sustainable use of Natural Resources and Biological Diversity Conservation			
Objectives	**Goals for 2 years**	**Actions**	**Principal Responsible**
			PRONAMACHCS, CONAM, DIRESA, DREM, DRPRO, Municipality, other actors from the civil society. Responsible Government, Coordinator for the Huancavelica Region
2. Advance in the **conservation**, protection of biodiversity	Protection of flora from the north oriental part of the region on Huancavelica	- Inventorying of native and vulnerable species, and determination of their geographical localization and preservation by 30% - Declare reserved areas and protection of the regional flora	- Regional Government of Huancavelica, Local Governments, INRENA, CONAM and Charity Community. - SINANPE, DRA, Regional Government of Huancavelica, INRENA Responsible Coordinator
	Protection of fauna from the high andean parts	- Inventorying of vulnerable endemic species and determinate their geographical localization and habitat preserving by 30% - Declare regional reserved area - Formulation of 03 protection projects.	- Regional Government of Huancavelica, Local Governments, UNH, CONACS, INRENA and Charity Community - SINANPE, DRA, Charity Community - Regional Government of Huancavelica, INRENA Responsible Coordinator.
3. Advance in the geographical characterization and watershed management.	Fortifying of the Water Users Committee in Huancavelica region	- To spread and apply the legal requirements for autonomous watersheds - To elaborate the Statute of the commissions for the use of the micro watershed	- Water Resources Commissariat, Technical Administration of the Irrigation of the District (ATDR for it's acronyms in Spanish) Irrigation Committee, Responsible - Coordinator of the ATDR Huancavelica

Green Front: Sustainable use of Natural Resources and Biological Diversity Conservation			
Objectives	**Goals for 2 years**	**Actions**	**Principal Responsible**
	Integrated management of the San Juan Chiris-Sinto (Castrovirreyna) and Huaytara micro watershed	- Carry out the studies for the micro watershed potentialities - Inventorying the water resources of the micro watershed - Count with a management committee for the micro watershed	- PRONAMACHCS, ATDR - PRONAMACHCS, ATDR - PRONAMACHCS, Responsible Coordinator of PRONAMACHCS
	Integration of the sub watershed Tayacaja to the Technical Administration of the Irrigation of the District (ATDR for it's acronyms in Spanish) of Huancavelica	- Integrate the territorial space of the Tayacaja sub watershed to the ATDR Huancavelica - Create the Irrigation Committee of Tayacaja	- INRENA, Water Commissariat ATDR Huancavelica, Regional Huancavelica Government. - ATDR, Responsible Coordinator of ATDR Huancavelica
4. Accomplish the agreed distribution of the water resource with social benefits	Promotion and qualification in the water use diversity in the San Juan Chiris-Sinto (Castrovirreyna) and Huaytara micro watershed	- Fortifying the organization of the water users - Qualification for the water users	- ATDR Chincha Pisco, ATDR Ica - ATDR Chincha Pisco, ATDR Ica, Responsible Coordinator of ATDR Chincha and Ica
	To promote a Construction Program of dams, irrigation infrastructure and its implementation of technology in the Pacific Slope	- Construction of 01 dam - Construction and rehabilitation of 04 kilometers of irrigation channels	- ATDR Chincha Pisco, ATDR Ica - ATDR Chincha Pisco, ATDR Ica, Responsible Coordinator of ATDR Chincha and Ica

Regional Environmental Action Plan for Huancavelica up to 2015

Environmental Regional Action Plan for Huancavelica - Green Front: Sustainable use of Natural Resources and Biological Diversity Conservation

Green Front: Sustainable Use of Natural Resources and Conservation of Biodiversity			
Strategic Objectives	***Action Lines***	***Goal up to 5 years***	***Goal up to 11 years***
1. Advance, fortify and strengthen in an integral way the conservation of soil, reforestation, management of native pastures	Promotion of the management of natural resources	- Elaboration of the Regional Forestall Strategy - Conformation of the Regional Committee for Forestall Development - Update the Inventory of Natural Resources - Valorization of the cost of use of 10% of the forestall surface for natural resources of the region	- Registry of natural and cultivated forests - Valorization of the cost of use of 50% of the forestall surface for natural resources of the region
	Management program for soils, forest, pastures and water if forestall ecosystems	- Reforestation of 35,000 hectares at regional level. - Recovery of 30,000 hectares of pastures. - Upgrade of water levels in 04 high Andean sub watersheds - Recovery of 250 hectares of soil - Development of local capacities in at least 40% of the registered communities	- Reforestation 100,000 hectares at regional level. - Recovery of 80,000 hectares of pastures. - Recovery of 80% of soil - Development of local capacities in 80% of the registered communities
2. Advance in the conservation, protection of biodiversity	Establishment of Protected Natural Areas by the Region and the State	- 07 Regional Natural Reserves in the Huancavelica, Angaraes, Acobamba, Huaytará, Castrovirreyna, Tayacaja and Churcampa provinces	- 10 Regional Natural Reserves
3. Advance in the geographical characterization and	Promotion of the adequate use of the water resources.	- Fortify the Water Users Committee of Huancavelica Region and of its bases as well as constituting	- Create the Autonomous Authority of watershed management.

Green Front: Sustainable Use of Natural Resources and Conservation of Biodiversity			
Strategic Objectives	***Action Lines***	***Goal up to 5 years***	***Goal up to 11 years***
integrated watershed management		Committees where there aren't. - 80% of the water resources inventory - Rural Cadastre by capacity of greater use of the ground to the 80%	- 100% of the Inventory of Water Resources - Rural Cadastre by capacity of greater use of the ground to the 100%
	Improvement in the micro watershed management.	- To count on at least 05 micro water sheds in process of integration for an improvement of the management of water sheds	- To count on at least 10 micro water sheds in process of integration for an improvement of the management of water sheds
4. Accomplish the agreed distribution of the water resource with social benefits	Promotion and qualification in the diversity of water uses.	- Enhanced up to 60 % irrigation efficiency - 100% volume of water pick	- Enhanced up to 70 % irrigation efficiency - 100% volume of water pick
	To promote a Construction Program of dams, irrigation infrastructure and its implementation of technology.	- 03 dams - Construction and rehabilitation of 10 kilometers of irrigation channels (quality, quantity and continuity)	- 06 dams - Construction and rehabilitation of 20 kilometers of irrigation channels
5. To promote the profitable economical and sustainable activities	Promotion of agro ecological production systems	- Create 05 agro ecological productive chains - Conformation of a Regional Committee of agro ecological producers and fortifying of its bases	- Accomplish the sustainability of the productive chains - Fortify the Regional Committee of agro ecological producers
	Automatization of the agricultural activity	- Enhance up to 50% the genetically improved cattle - Improvement of the competitiveness and quality of the fiber up to 50%	- 100% genetically improved cattle - Improvement of the competitiveness and quality of the fiber up to 100%
	Fortifying of the producers committees	- To operate 10 agricultural productive chains	- To obtain autonomous productive chains

APPENDIX 3: ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT FINDINGS

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT FINDINGS

The Environmental and Social Impact Assessment (ESIA) for the project area of influence was completed in September 2005.

Regarding wildlife, it should be indicated that the main problem is the lack of biological data as this region represents one of the largest information gaps in Peru. The hunting of wild animals for human consumption has been observed in the study area (vizcacha, tinamou, *Telmatobius* frogs, etc.), and the Andean fox and spectacled bear for extermination purposes, as they are considered harmful for agriculture.

This section presents data selected from the Biological Baseline in the ESIA regarding the richness of species in the area of influence of the project (both those found in the summer [wet] and winter [dry] seasons), highlighting those considered under some type conservation category. Experts from the San Marco University Natural History Museum, the La Molina National Agrarian University took part in the collection of field data and data analysis, with the collaboration of local specialists.

1.0 VEGETATION

The Biological Baseline of the ESIA (Vol. IIB., Chap. 3.1) identified 20 vegetation units in the study area. In the summer, the highest number of species (125) was recorded in the puna (i.e., high-Andean) tussock grassland, followed by the resinous scrubland (113), and puna wetlands (93). In winter, the puna tussock grassland also showed the largest richness (126 species), followed by puna wetlands (98 species), the upper montane forest (86) and the resinous scrubland (62 species). In both seasons, the lowest number of species was recorded for columnar cacti vegetation and for desert *Tillandsia* stands, with four and two species respectively. On the other hand, no plant species were recorded in the desert barrens unit.

Of the total species, the list of plant species under protection by Peruvian legislation as well as those included in international conservation lists (IUCN and CITES) such as cactaceae and orchids, and the list of endemic species are detailed in the Biological Baseline of the ESIA (Chap. 3.1 Vegetation, Vol. IIB.). According to national legislation (Ministry Resolution N° 01710-77-AG/DGFF), species under conservation categories such as *Polylepis racemosa, Polylepis pauta* and *Puya raimondii Harms* are considered “in danger of extinction”. It must be pointed out that said Ministry Resolution is being revised by INRENA. It is expected the new list will include additional species that have been entered under a conservation category since M.R. N° 01710-77-AG/DGFF was published.

2.0 BIRDS

According to the Biological Baseline of the ESIA (Vol. IIB, Chap. 3.2), 301 avian species were recorded in the summer and 219 species in winter in the study area. The vegetation unit with the highest number of species was the cultivated area, followed by montane forests in summer and by thorn bush scrubland in winter. In the puna zones made up by wetlands, tussock grassland, and sward-forming herbaceous formations, the wetlands showed the highest number of avian species.

Of the total avian species assemblage recorded by the ESIA baseline in summer and winter, thirteen are included under a conservation category in national legislation (S.D. 034-2004-AG). Species considered most endangered are: white-bellied cinclodes (*Cinclodes palliatus*), Andean condor (*Vultur gryphus*), white-tailed shrike-tyrant (*Agriornis andicola*) and rufous-breasted warbling-finch (*Poospiza rubecula*), the first one "critically endangered" and the next three "endangered".

3.0 MAMMALS

According to the ESIA Biological Baseline (Vol. IIB, Chap. 3.3), 37 mammal species were recorded in summer and 38 species in winter, included in 13 families and 6 taxonomic orders. Rodents had the highest number of species (23 species) and the predominant family was Muridae. The second group in richness was carnivores with 10 species comprising four families: Canidae, Ursidae, Mustelidae and Felidae. The third richest group was the bats with six species included in two families: Phyllostomidae and Vespertilionidae. Marsupials were the least diverse, with only two species.

Of mammals recorded in the ESIA, seven species are protected by the S.D. 034-2004-AG. The Peruvian long-snouted bat (*Platalina genovensium*) is "critically endangered"; the spectacled bear (*Tremarctos ornatus*) and northern pudu (*Pudu mephistophiles*) are "endangered"; Kalinowski's oldfied mouse (*Thomasomys kalinowskii*) and gray woolly monkey (*Lagothrix cana*) are in the "vulnerable" category; "nearly threatened" are cougar (*Puma concolor*) and vicuña (*Lama vicugna*).

However, it should be noted the the presence of the northern pudu and woolly monkey are based on circumstantial evidence and not confirmed by direct observations. The spectacled bear is present only in the extreme eastern sector in the Chiquintirca area and is not representative of the greater project area of influence.

3.0 AMPHIBIANS AND REPTILES

According to the Biological Baseline of the ESIA (Vol. IIB, Chap. 3.4), a total of 17 species were recorded in summer, which included three families of the class Amphibia and five families of the class Reptilia; while a total of 20 species were recorded in winter, including three families of Amphibia and six of Reptilia.

The vegetation unit where the highest number of herpetofauna species was recorded in summer was the puna tussock grasslands, followed by wetlands, Andean cultivated areas, and riparian woodland.

Six of the recorded species are included under a category of threatened species in national legislation (D.S. 034-2004-AG). The Roedinger's viper (*Bothrops roedingeri*) is "endangered"; the "painted viper" (*Bothrops pictus*), the "eyelashed sand lizard" (*Ctenoblepharis adspersa*) and "redhead lizard" (*Dicrodon heterolepis*) are in the "vulnerable" category, while the "tiger lava lizard" *Microlophus tigris* and the Andean spiny toad (*Chaunus spinulosus*) are "nearly threatened".

4.0 HYDROBIOLOGY

According to the Biological Baseline of the ESIA (Vol. IIB, Chap. 3.5) a total of nine fish species was recorded in the study area, eight of these were recorded in both seasons. Most of the fish in the Andean region are native catfish of order Siluriformes (*Astroblepus* and *Trichomycterus*), and cichlid and tilapia of order Perciformes (*Aequidens* and *Oreochromis*) on the coast. Out of the total nine species, six are native of Peruvian continental waters and three (guppy, tilapia and trout) have been introduced from other continents. Six fish species were recorded in the Andean region; almost all of them recognized at the main lotic environments of the inter-Andean region, while no fish were detected in any wetland.

Trout (*Oncorhynchus mykiss*) was found in the Vinchos, Sachapampa and Alfarpampa rivers, while native catfish *Astroblepus* and *Trichomycterus* were found at the Vinchos, Yucay and Torobamba river valleys. An endemic species of *Orestias* was recorded at lagoon Tagraccocha and the Leche Leche river but no other species were recorded at these two habitats. Three fish species were recorded on the coast, with guppy being the most common and abundant species. Tilapia (*Oreochromis niloticus*) is predominant at Lagunillas and Morón lagoon.

5.0 SENSITIVE ECOSYSTEMS

The ESIA determined the sensitivities of ecosystems along the planned gas pipeline ROW (Vol. IIB, Chap. 6.0) and also identified “fragile ecosystems” (Vol. III, Chap. 2.0). The ESIA sensitivity analysis identified sensitive sectors according to criteria such as diversity at landscape level, species diversity (plants and birds), percent of habitats considered as significant (crops, wetlands, lagoons), sensitivity of plant species, and ecosystem stability.

Landscape was evaluated according to patch mosaic diversity. This parameter is based on various plant formations making up a patch mosaic on which the Shannon-Wiener diversity index is calculated, where the most diverse mosaics would be easily impacted. The increase in patch number is another evaluation parameter at landscape level, which allows having a more detailed estimate of impact due to the fragmentation that would be caused by the gas pipeline alignment.

For calculation of species diversity, priority was assigned to plants and birds in view of the higher number of records obtained in the Biological Baseline of the ESIA and monitoring conducted during construction of the TgP pipeline (Knight Piesold 2003, 2004) that determined that birds are plants are groups for which data quality is good enough to allow for statistical analysis with the required accuracy.

Ecosystem stability is a parameter that was estimated from the absolute value of the seasonal change rate (summer and winter) for the number of species hosted by each plant formation type. This provides a stability value for each vegetation unit.

For this analysis, the total length of the pipeline alignment was divided in stretches (five kilometer long sectors) in order to identify sensitive sectors that could be impacted during pipeline construction and operation. 81 five-kilometer stretches were generated from Chiquintirca (Ayacucho) to the Liquefaction Plant (Lima). The detail of biological

sensitivity analysis is included in the ESIA (Chap. 6.0 Ecological summary, Vol. IIB, and Map 2-5, Vol. IIB).

5.1 Bernal and Moron Lagoons Sector

The Bernal and Morón lagoons sector, located in the province of Pisco (kp 327+000 through kp 330+000) was identified as fragile in the ESIA (Vol. III, Chap. 2.0). This sector presents one of the largest fauna (birds, mammals, reptiles and fishes) and flora diversities corresponding to coastal ecosystems (see ESIA, Vol. IIB). The wild guinea pig (*Cavia tschudii*), a species seldom found in other coastal habitats, was recorded in this ecosystem. The lagoons are of local interest and used for economic activities (extraction of "totora" reed), recreation, tourism, etc.

5.2 La Bolivar Mine Sector

The La Bolivar mine sector was identified as fragile in the ESIA (Vol. III, Chap. 2.0). At this sector (kp 298+000 – kp 309+000, Rio Seco creek), where columnar cacti and deciduous shrubs predominate, there is an abandoned mine, La Bolívar, hosting the Peruvian long-snouted bat (*Platalina genovensium*). This nectivorous bat is critically endangered according to national legislation (S.D. 034-2004 AG) and vulnerable according to the IUCN.

5.3 Eastern Watershed

According to the ESIA (Chap. 6.0 Ecological summary, Vol. IIB), this sector (between kp 0+000 and kp 10+000) is dominated by montane shrublands, upper montane forest, and cultivated areas, and presents the highest overall values for abundance, richness and diversity in the project area of influence.

Of the species recorded in these units, those under greater danger ("critically endangered" and "endangered") according to DS. 034-2004-AG, are: Kalinowski's old field mouse, grey woolly monkey, Andean bear and northern pudu; the first one recorded by capture and the others reported in interviews.

5.4 Cultivated Areas

According to the ESIA (Vol. IIB, Chap. 6.0), this sector comprising from kp 055+000 to kp 075+000 and from kp 115+000 to kp 120+000, presents high abundance, richness and diversity values.

The sector from kp 055+000 (Motoynioc hill) to kp 075+000 at Acocro in the Yucay River Valley, is considered highly sensitive in the outer zones, with a medium sensitivity area inside. In the Vinchos River Valley, high sensitivity cultivated areas are located from kp 115+000 to kp 120+000.

5.5 High-Andean Zone 4

According to ESIA (Vol. IIB, Chap. 6.0), the high sensitivity sector is located from kp 120+000 (Llasac hill) to kp 200+000 near the Tagracocha lagoon. The zone between kp 245+000 (Yanac Punto hill) and kp 250+000 (Chihuiri hill) is also considered as highly sensitive. In whole, the zone has been defined as sensitive due to its high mosaic

diversity, high percentage of lagoons and wetlands and species persistence in both evaluation seasons.

This zone is of great importance as grazing lands for High-Andean communities. According to the agrostological data in the ESIA (Chap. 2.6 and 3.6 of Vol. IIB), the zone shows signs of an inverted succession process from high grassland to low grassland and from low grassland to bare ground. This would have been caused by the intensive use and magnitude of disturbances such as seasonal burnings. The succession process is also applied to wetlands. According to the agrostological perspective, wetlands are segregated according to their productivity (poor condition and good condition) as a result of the intensive use they are subject to.

Table A3-1 summarizes ecosystems in the project area of influence identified as either sensitive or fragile in the ESIA (Vol IIB, Chap. 6. and Vol. III, Chap. 2).

Table A3-1 Ecosystems in the project area of influence identified as sensitive or fragile by the ESIA.

Location	**Sector**
KP 327+000 to KP 330+000	Bernal and Morón* lagoons
KP 298+000 to KP 309+000	La Bolívar* mine
KP 0+000 to KP 10+000	Eastern watershed
KP 055+000 to KP 075+000 and from KP 115+000 to KP 120+000	Acocro and Vinchos cultivation areas
KP 120+000 to KP 200+000 and from KP 245+000 to KP 250+000	High-Andean Zone 4

*Ecosystems identified as fragile (Chap. 2.0 Socioenvironmental Impacts, Vol. III).

The ESIA identifies the following Critically Endangered or Endangered species under Peruvian legislation:

Table A3-2 Species listed in Peruvian legislation

Species	**INRENA Category**	**Habitat Type**	**Approximate KPs**	**Comments**
Plants				
Aralia soratensis	CR	Eastern dry Forest	40-41	
Carica candicans	CR	Pacific slope scrub	246-247	
Chersodoma arequipensis	CR	Pacific slope scrub	258-259	
Ephedra rupestris	CR	Puna	235	
Kageneckia lanceolata	CR	Eastern spiny scrub	32-34	
Polylepis	CR	Quenual	28-29, 32-33	Relict in cultivated areas

Species	INRENA Category	Habitat Type	Approximate KPs	Comments
racemosa		forest		
Puya raimondii	EN	Puna	196	Near Tagracocha Lake
Birds				
Cinclodes palliatus White-bellied cinclodes	CR	Puna wetlands	167-167, 204-205	4400-5000 m, summer and winter. A species with estimated populations of less than 1000 worldwide, known population of less than 40???
Poospiza rubecula Rufous-breasted warbling finch	EN	Mixed scrub	Downslope from 249 in Quebrada Salvia (Río Huaytará basin)	Habitat could be along ROW in 252-254, was observed in winter. This appears to the the first record for the Huancavelica Department. Believed to be in range of 2300-3500 m. A species with estimated populations of less than 1000 worldwide.
Vultur gryphus Andean condor	EN	Likely along much of ROW	Likely along much of ROW	Not a range-restricted or endemic species. 0 to 5000 m
Mammals				
Platalina genovensium Long-snouted bat	CR	Pacific slope scrub and cactus	299	Found in the abandoned Bolivar Mine, 1350 m. Need to identify caves and rocks shelters where it may roost.
Pudu mephistopheles Northern pudu	EN	Eastern montane forest	Reported by survey from Pallja-Alfarpampa river zone	A type of dwarf deer.
Tremarctos ornatus Spectacled bear	EN		Reported by survey from the eastern montane forest zone	Not a range-restricted or endemic species.
Lama guanicoe Guanaco	EN	Present in parts of Ica, Huancavelica, and Ayacucho	Not reported, but possible.	Ayacucho has approximately 30% of the national population; however, they appear to be restricted to the Lucanas and Parinacochas provinces, both outside of the project area. Actual populations and distribution appear to be poorly known.

Other endangered mammals possibly occurring in areas traversed by the ROW include the guanaco (*Lama guanicoe*) and the Andean mountain cat (*Oreailurus jacobita*). The occurrence of these species, however, would represent only an occasional use of the ROW as part of large home ranges. The range of *Oreailurus* remains poorly known and it is not certain whether it ranges as far north as the project area.

APPENDIX 4: RESULTS OF STAKEHOLDER CONSULTATIONS

Table A4-1 Species, resource and/or ecosystem of community interest at district level by the communities of Ayacucho and Huancavelica

Dep	Province	District	Community	Forest resources	Wild animals
Ayacucho	Huamanga	Acocro	1) Pomapuquio 2) Virgen de Asunción de Seccelambras 3) Santo Domingo de Acocro	Eucalyptus, *molle*, cypress, alder, *tancar*, *motoy*, pine, genwa, broom, *tara*, *tasta, chilca, taya, chachacoma*, *pacar*, walnut, *toccta*, *ccehuincha*. Medicinal plants	Fox, skunk, deer, *viscacha*, wildcat, robin, goldfinch, dove, owl, bat, tinamou, parrot, kestrel, eagle, sparrow, falcon, hawk, toad, lizard, snake.
	Huamanga	Chiara	1) San Juan de Cochabamba Alta II 2) Paucho 3) Anexo de San Martín de Yanapiuro – Ichubamba (C.C. de San Martín Yanapiuro Ichubamba) 4) Llachoccmayo 5) Allpachaca 6) Basilio Auqui de Chupas 7) Huallccapucro 8) Santo Domingo de Chiara	Eucalyptus, alder (lambras), *chachas*, pine, quenual, myrtle, *mutuy*, *ccenhua*, cypress, *cully*, *rayan*, *taya*, *tancar*, *tasta, tara*, *puya raimondi*, *molle*, cactus, *huarango*, *pispita, tirte*, wild cherry, elderberry. Medicinal and aromatic plants.	Fox, skunk, deer, *vicuña*, female fox, *viscacha*, wild cat, little spotted cat, bat, rat, mouse, owl, robin, tinamou, Andean goose, eagle, hawk, *condor*, falcon, parrots, *pucupucu*, *leccles*, *acacllo*, kestrels, white-tipped dove, miner bird, *wachua*, *acchi*, *anka, kilinchu*, white-winged dove, sparrow, heron, *waychaw*, wild duck, owl, *akacllu*, lizard, toad, snake. Trout.

Dep	Province	District	Community	Forest resources	Wild animals
	Huamanga	Acos Vinchos	1) San Francisco de Asís de Mayupampa 2) Huaychao	Eucalyptus, *molle*, *tara*, poplar, *cabuya*, broom, *chillca*, *ambrancay*, *mutuy*, *huarango*, alder, bellflower, willow, *muña*.	Fox, deer, *viscacha*, dove, tinamou, white-winged dove, robin (chihuaco), *huaychao*, parrot, *chihuyllo*, river duck, hummingbird, white-tipped dove (urpito), *tuya*, white-winged dove, vulture, *condor*, hawk, mallard, *cullcu*, goldfinch, snake, toad, frog, lizard. Trout.
	Huamanga	Tambillo	1) Pinao – Yantapacha	Eucalyptus, broom, *chachacoma*, *chicha*, alder, *taya*, pine, cypress, cedar, walnut, *huamantirca*.	*Vicuña*, puma, fox, *viscacha*, deer, robin, hummingbird, hawk, falcon, duck, tinamou, *huayanacuy*, *acacllo*, antbird, *chalchaca*, kestrel, toad, snake, lizard.

Dep	Province	District	Community	Forest resources	Wild animals
	La Mar	San Miguel	1) General Córdova de Socos 2) Túpac Amaru de Patibamba 3) Uras 4) Virgen Cocharcas de Cochas (Attached areas of Cochas Alta, Cochas Baja, Putacca and Callhuapuquio	*Molle*, eucalyptus, pine, *pauca*, *onca*, alder, *tara*, *chachacoma*, *pati*, broom, *cabuya*, cypress, cactus, *huarango*, myrtle, *tantar, huamanripa, motoy, taya, quimsacuchos, kiswar, chamana, huaynacuri, muña*, wild berry. Medicinal plants.	Puma, little spotted cat, *viscacha*, deer, least weasel, skunk, fox, squirrel, bat, rat, owl, condor, kestrel, hawk, falcon, eagle, tinamou, *pucupucu*, *leccles, huachua*, dove, *alcen, tuya*, parrot, white-winged dove, eared dove, owl, goldfinch, *pichincha*, *wayanaquito*, *pariona*, wild duck, toad, snake, lizard. Trout.

Dep	Province	District	Community	Forest resources	Wild animals
	La Mar	Anco	1) Anexo de Ccollpa (C.C. de Chiquintirca) 2) Anchihuay	Elderberry (rayan), alder (lambras), cedar, *diablo rojo*, *huanchoi, chujal, quishuar*, *cocal*, quenual, *chachacoma*, avocado, mountain jungle cedar, giant reed, fern, wild olive, *pinco pinco, chucal, wanchuy*, cinnamon, eucalyptus, *mitaca, reja hullos, mojomojo, tucnay*, myrtle, *kiswuar, qellamisa*. Medicinal, aromatic plants.	Fox, spectacled bear, female fox, *viscacha*, skunk, deer, puma, agouti, mouse, least weasel (unchuchuco), lesser goldfinch, tinamou, great tinamou, *jujan, leccles, tacame*, goldfinch, condor, eagle, falcon, hawk, white-winged dove, heron, parrot, *acacllu, qeulla*, hummingbird, *pichcala, curapa churin, ancalai, nachara*, owl, robin (chihuaco), gull, nightingale (chiqullo), *sundor, riti pichinco, huico*, eagle, kestrel (quillinchu), *tacra* duck, *oturi*, agouti, *monte huallpa, yacupisqo*, lizard, snake.

Dep	Province	District	Community	Forest resources	Wild animals
	Huamanga	Vinchos	1) Anexo de Pampamarca – Pampancca (C.C. de Paccha) 2) Anexo de Ccoñani – Chucllahuaycco (C.C. de Paccha) 3) Anexo de Minas Corral (C.C. de Paccha) 4) Rosaspata 5) Anexo de Cayramayo (C.C. de Paccha) 6) Rosaspampa 7) Occollo 8) Anexo de Ccochapunku (C.C. de Vinchos) 9) Anexo de Rosaspampa (C.C. de Churia Rosaspampa) 10) Anexo de Ranracancha – Ccasanccay 11) Sallalli 12) Anexo de Ccasanccay, (C.C, de Vinchos) 13) Urpaypampa 14) Anexo de San Juan de Pichas 15) Anexo de Concahuaylla, (C.C. de Vinchos) 16) San José de Mayobamba and Anexo de Mayobamba I 17) Anexo de Orcconchupa	Eucalyptus, alder, pine, cypress, quenual, *puya raimondi, molle, tantar, kishuar, mutuy*, elderberry (rayan), *culli, colle*, myrtle, *chachacoma* (chachas), *falaris, taqsana, waraqo, tasta, taya, tancar, saqsa, itana, paco paco, santa lucia, chichicara, huamanripa, ayrampu, remilla, poya, conoca, occesacha, teccte, ccarhuincho. tola, huaracco, parga, pacha, paqas, huamanripa, qariqaras, junco*, Indian fig opuntia, wild cherry. Medicinal plants.	*Vicuña*, Peruvian guemal, *viscacha*, fox, skunk, deer, *viscacha*, puma, wild cat (oscco), little spotted cat, mouse, puna rat, female fox, robin, *yanahuico*, owl, *pucu-pucu*, eagle, condor, tinamou, dove, *huachua, huaychao, acacllu*, kestrel (quillinchu), falcon (huaman), gull, hawk (aqchi), *accchi*, sparrow, goldfinch, swallow, hummingbird, mallard, *chusiq* (night bird), *wiccucho* (night bird), owl, *quivio, leccles, qewlla, sacanca, culí culí, unchuchucu*, white-tipped dove, white-winged dove, *cullcu, pucopuco, chihuaco*, snake, lizard, *araranka*, toad. Trout

Dep	Province	District	Community	Forest resources	Wild animals
	Cangallo	Paras	1)Ccarhuaccpampa	Quenual, *chachacoma, conoca, masocopa, tasta*, saffron.	Kestrel, hawk, gull, bat, lizard, snake, toad, woodpecker, ground dove
	Huamanga	Socos	1) Toccyascca 2) Tambocucho	Eucalyptus, pine, cypress, *motoy, qenwa*, elderberry, *colle, chachacoma, quishuar, purupuro, lapampay, taya, pispita*. Medicinal plants	Deer, *vicuña*, fox, skunk, squirrel, white-winged dove, eagle, *urpitu*, owl, *leccles, pucupucu*, hawk, *tuco*, dove (cullco), tinamou, frog, toad, snake, lizard. Trout
Huancavelica	Huaytará	Ayaví	1) Ayaví	Eucalyptus, *molle*, willow, *tara*, broom, walnut, giant reed, pine, alder, cypress, *taya, choccra, toccare, tasta, tola* and *canlla*	Fox, deer, *viscacha*, parrot, tinamou, dove, American robin, *chihuaco*, canary, hawk, *liuli*, condor, *pizacca, acchi*, spotted sandpiper, lizard.
	Huaytará	Huaytará	1) Huaytará 2) Santa Cruz de Huancacasa	Eucalyptus, *molle, tara, huarango*, carrizal reed, eucalyptus, willow, carob tree, broom, alder, *ccenhua, chilco, tancar, taya, mito*, South American palm, Indian fig opuntia, *lloque, huanhua, huiscatay*, totora reed. Medicinal plants.	*Vicuña*, fox, skunk, deer, *viscacha*, tinamou, condor, hawk, dove, *acerillo*, *sortijilla*, viper, snake, frog, fish.

Dep	Province	District	Community	Forest resources	Wild animals
	Huaytará	Pilpichaca	1) Pilpichaca 2) Llillinta – Ingahuasi	Quenual, *taya, puya raimondi*.	Puma, *viscacha, vicuña*, deer, fox, trout, tinamou, condor, white-winged dove, *pucu puco, francolina, huallata*, gull, duck.
	Huaytará	Tambo	1) Santa Rosa de Tambo	Eucalyptus, alder, pine, *molle, qenwa*, elderberry, *sanque*.	Deer, Peruvian guemal, *vicuña, viscacha*, fox, condor. Trout.

Table A4-2 Fauna and flora species prioritized by the communities of Ayacucho and Huancavelica

Fauna	**Total Score**
Camelids	63
Trout	52
Viscacha	44
Telmatobius frogs	36
Cattle	26
Flora	**Total Score**
Woody plants	21
Natural grass	18
Potato	15
Medicinal plants	15
Muña	12

Table A4-3 NGO Priorities

NGO	Attendees	Biodiversity Conservation Proposals *
Lima - 20th July 2005		
Parks Watch	Diego Shoobridge	• Consider at least the three most important habitats of the project area of influence. • Enter into agreements with universities for students to conduct their research works and thesis. • Create nurseries with the participation of the community and universities. • Raise awareness through environmental education. • Importance of the conservation of wetlands, lagoons, and *Polylepis* stands.
IDEFE	Alexandra Cugler	
	Foro Ecológico	
	Rolando Quezada	
	Fanny Fernández	
Conservación Internacional - CI	Karen Burga	
	Nina Pardo	
Defensoría del Pueblo	Nancy García Yi	
	Catherine Cardich Salazar	
	Humberto Sheput	
	Carlos Soria	
	Ray Castilla	
	Sonia Lou	
Instituto del Bien Común - IBC	Javier Ormeño	
Sociedad Peruana de Derecho Ambiental - SPDA	Magnolia López de Castilla	
Caritas del Perú	Gladys Castillo Patiño	
EDU PLAN HEMISFÉRICO - OEA	Jesús Ángel Chávez Machado	
Gobierno Regional Lima	Lino A. Cerna Manrique	
HUAYHUASH PERU - Prensa	Ronald Silva Velásquez	
Cable Color – Canal 36 - Prensa	Jhoel Luna Marín	
Chincha – 19th July, 2005		
Mesa de lucha contra la Pobreza de Ica (MCLCP)	Marina Mendoza Espinoza	• Conservation of lagoons and springs. • Work on projects with aquatic species such as the tilapia, silverside (*pejerrey*) and snails. • Raise awareness on the conservation of biodiversity in the population
CIDECO	Santos Alejos Ipanaque	
Gobierno Regional de Chincha	Cesar A. Corrales Legua	
Defensoría del Pueblo	Jorge Luís Hernández	
Huancavelica – 16th July 2005		
ISIDEH	María Quintanilla	• Conservation of lagoons, rivers and valleys. • Work on projects with the following species: *Polylepis, Puya raimondii*, trout, and seagulls.
Transparencia	David Lloclla Maldonado	
CIADER	Gucerio Albujar C.	

NGO	Attendees	Biodiversity Conservation Proposals *
Lima - 20th July 2005		
IDESAM	Héctor Osorio	
	Miguel Quispe Pom	
Universidad Nacional de Huancavelica	Joré Ayaiponaz	
	Gobierno Regional	
	Beatriz Palomino Mora	
Ayacucho - 15 July, 2005		
INABIF	Hogar Urpi	• Work on projects with the following animal species: Camelids (*llama, alpaca* and *vicuña*), *viscacha*, spectacled bear, Guinea pig, trout, catfish and kestrels. • Work on projects with the following plant species: Medicinal plants, cactus, orchids, *tara* and fruit trees such as the avocado. • Conservation of forests and High-Andean zones.
	Edith Pacheco López	
	Maruja Tanampa de la Cruz	
World Vision	Crisólogo Rjorce	
Agenda Sur	Andrés Solari Andrade	
	Carlos Morales Chávez	
PAIDE	Elva Pozo Calderón	
CHIRAPAQ	Pedro Rivera	
CARE PERU	Julio Nishitara	
AMARES	Félix Auqui Baygorrea	
	Vecinos Perú	
	Jaime Galdos Cruz	
CICA Ayllu	Félix Loayza Curi	
Transparencia	William Sandoval Gutiérrez	

* Proposals are not linked to proposing NGO in the meeting reports

APPENDIX 5: ECOLOGICAL FIELD SURVEY

ECOLOGICAL FIELD SURVEY FOR THE PERU LNG NATURAL GAS PIPELINE PROJECT

Prepared with assistance from:

PERU LNG S.R.L.

Av. Víctor Andrés Belaúnde 147

Vía Real 185 – Torre Real Doce Piso 2

San Isidro

Lima -27 – PERU

May, 2007

INDEX

EXECUTIVE SUMMARY **1**
1.0 INTRODUCTION **14**
2.0 OBJECTIVES **15**
3.0 LEGAL AND INSTITUTIONAL FRAMEWORK **17**
3.1 ESIA COMMITMENTS 20
3.2 STAKEHOLDERS 21
4.0 EFS FIELD METHODOLOGY **23**
4.1 BIOLOGY 23
4.2 PHYSICAL ENVIRONMENT 23
4.3 SURVEY GAPS 24
5.0 ECOLOGICAL LANDSCAPE UNITS **25**
5.1 INTRODUCTION 25
6.0 HABITATS **32**
7.0 SPECIES AND HABITAT SENSITIVITY **38**
7.1 SPECIES SENSITIVITY 38
7.1.1 Species Sensitivity Criteria *38*
7.1.2 Species Sensitivity Categories *41*
7.2 HABITAT SENSITIVITY 42
8.0 ELU 1: APURIMAC RIVER VALLEY MONTANE FOREST ECOTONE (KP 00+000 - 20+511) 44
8.1 GENERAL DESCRIPTION 44
8.2 PHYSICAL CHARACTERISTICS 44
8.2.1 Precipitation *44*
8.2.2 Geology *45*
8.2.3 Soils *45*
8.2.4 Waterbodies ..... *41* ***Error! Bookmark not defined.***
8.2.5 Instability and Physical Risk *48*
8.2.6 Infrastructure *49*
8.3 HABITATS AND SPECIES 50
8.3.1 Habitat Distribution *50*
8.3.2 Habitat Descriptions *52*
8.3.3 Species Sensitivity Analysis *55*
8.3.4 Habitat Sensitivity Analysis *59*
8.4 KEY ISSUES AND RECOMMENDATIONS 59
9.0 ELU 2: CAMPANA WATERSHED (KP 20+511 – 25+115) **63**
9.1 GENERAL DESCRIPTION 63
9.2 PHYSICAL CHARACTERISTICS 64
9.2.1 Precipitation *64*
9.2.2 Geology *64*
9.2.3 Soils *64*
9.2.4 Waterbodies and Wetlands *65*

9.2.5 Infrastructure *66*
9.3 HABITATS AND SPECIES 67
9.3.1 Habitat Distribution *67*
9.3.2 Habitat Descriptions *68*
9.3.3 Species Sensitivity Analysis *69*
9.3.4 Habitat Sensitivity Analysis *72*
9.4 KEY ISSUES AND RECOMMENDATIONS 72
10.0 ELU 3: TOROBAMBA RIVER VALLEY (KP 25+115 - 44+300) 74
10.1 GENERAL DESCRIPTION 74
10.2 PHYSICAL CHARACTERISTICS 75
10.2.1 Precipitation *75*
10.2.2 Geology *75*
10.2.3 Soils *76*
10.2.4 Waterbodies ..... ***Error! Bookmark not defined.***
10.2.5 Instability and Physical Risk *78*
10.2.6 Infrastructure *78*
10.3 HABITATS AND SPECIES 79
10.3.1 Habitat Distribution *79*
10.3.2 Habitat Descriptions *81*
10.3.3 Species Sensitivity Analysis *83*
10.3.4 Habitat Sensitivity Analysis *87*
10.4 KEY ISSUES 87
11.0 ELU 4: SILLACCASA SIERRA (KP 44+300 - 56+783) 90
11.1 GENERAL DESCRIPTION 90
11.2 PHYSICAL CHARACTERISTICS 90
11.2.1 Precipitation *90*
11.2.2 Geology *91*
11.2.3 Soils *91*
11.2.4 Waterbodies and Wetlands *92*
11.2.5 Instability and Physical Risk *93*
11.2.6 Infrastructure *93*
11.3 HABITATS AND SPECIES 94
11.3.1 Habitat Distribution *94*
11.3.2 Habitat Descriptions *95*
11.3.3 Species Sensitivity Analysis *97*
11.3.4 Habitat Sensitivity Analysis *100*
11.4 KEY ISSUES AND RECOMMENDATIONS 100
12.0 ELU 5: YUCAY RIVER VALLEY (KP 56+783 – 74+199) 103
12.1 GENERAL DESCRIPTION 103
12.2 PHYSICAL CHARACTERISTICS 104
12.2.1 Precipitation *104*
12.2.2 Geology *104*
12.2.3 Soils *105*
12.2.4 Waterbodies ..... *9**Error! Bookmark not defined.***
12.2.5 Instability and Physical Risk *106*
12.2.6 Infrastructure *108*

12.3 HABITATS AND SPECIES 108
12.3.1 Habitat Distribution 108
12.3.2 Habitat Description 110
12.3.3 Species Sensitivity Analysis 112
12.3.4 Habitat Sensitivity Analysis 115
12.4 KEY ISSUES AND RECOMMENDATIONS 115
13.0 ELU 6: HUAMANGA-VISCHONGO WATERSHED DIVIDE (KP 74+199 TO 103+970) 118
13.1 GENERAL DESCRIPTION 118
13.2 PHYSICAL CHARACTERISTICS 119
13.2.1 Precipitation 119
13.2.2 Geology 119
13.2.3 Soils 120
13.2.4 Waterbodies and Wetlands 121
13.2.5 Instability and Physical Risk 122
13.2.6 Infrastructure 122
13.3 HABITATS AND SPECIES 122
13.3.1 Habitat Distribution 122
13.3.2 Habitat Descriptions 125
13.3.3 Species Sensitivity Analysis 127
13.3.4 Habitat Sensitivity Analysis 131
13.4 KEY ISSUES AND RECOMMENDATIONS 131
14.0 ELU 7: VINCHOS RIVER VALLEY (KP 103+970 TO 117+388) 133
14.1 GENERAL DESCRIPTION 133
14.2 PHYSICAL CHARACTERISTICS 133
14.2.1 Precipitation 133
14.2.2 Geology 134
14.2.3 Soils 134
14.2.4 Waterbodies and Wetlands 135
14.2.5 Instability and Physical Risk 136
14.2.6 Infrastructure 137
14.3 HABITATS AND SPECIES 137
14.3.1 Habitat Distribution 137
14.3.2 Habitat Descriptions 138
14.3.3 Species Sensitivity Analysis 139
14.3.4 Habitat Sensitivity Analysis 142
14.4 KEY ISSUES AND RECOMMENDATIONS 142
15.0 ELU 8: APACHETA HIGH SIERRAS (KP 117+388 TO 162+137) 145
15.1 GENERAL DESCRIPTION 145
15.2 PHYSICAL CHARACTERISTICS 146
15.2.1 Precipitation 146
15.2.2 Geology 146
15.2.3 Soils 147
15.2.4 Waterbodies and Wetlands 148
15.2.5 Instability and Physical Risk 150
15.2.6 Infrastructure 150

15.3 HABITATS AND SPECIES 152
15.3.1 Habitat Distribution 152
15.3.2 Habitat Descriptions 160
15.3.3 Species Sensitivity Analysis 162
15.3.4 Habitat Sensitivity Analysis 166
15.4 KEY ISSUES AND RECOMMENDATIONS 166
16.0 ELU 9: PAMPAS-PALMITOS RIVER BASINS (KP 162+137 TO 195+050) 169
16.1 GENERAL DESCRIPTION 169
16.2 PHYSICAL CHARACTERISTICS 169
16.2.1 Precipitation 169
16.2.2 Geology 170
16.2.3 Soils 170
16.2.4 Waterbodies and Wetlands 171
16.2.5 Instability and Physical Risk 173
16.2.6 Infrastructure 174
16.3 HABITATS AND SPECIES 175
16.3.1 Habitat Distribution 175
16.3.2 Habitat Descriptions 180
16.3.3 Species Sensitivity Analysis 181
16.3.4 Habitat Sensitivity Analysis 185
16.4 KEY ISSUES AND RECOMMENDATIONS 185
17.0 ELU 10: HUAYTARÁ HIGH PLAINS AND RIDGES (KP 195+050 TO 249+538) 189
17.1 GENERAL DESCRIPTION 189
17.2 PHYSICAL CHARACTERISTICS 189
17.2.1 Precipitation 189
17.2.2 Geology 190
17.2.3 Soils 190
17.2.4 Waterbodies and Wetlands 191
17.2.5 Instability and Physical Risk 193
17.2.6 Infrastructure 194
17.3 HABITATS AND SPECIES 195
17.3.1 Habitat Distribution 195
17.3.2 Habitat descriptions 200
17.3.3 Species Sensitivity Analysis 201
17.3.4 Habitat Sensitivity Analysis 205
17.4 KEY ISSUES AND RECOMMENDATIONS 205
18.0 ELU 11: PISCO-ICA WATERSHED DIVIDE (KP 249+538 TO 272+181) 209
18.1 GENERAL DESCRIPTION 209
18.2 PHYSICAL CHARACTERISTICS 209
18.2.1 Precipitation 209
18.2.2 Geology 210
18.2.3 Soils 211
18.2.4 Waterbodies 212
18.2.5 Instability and Physical Risk 213
18.2.6 Infrastructure 214
18.3 HABITATS AND SPECIES 215

18.3.1 Habitat Distribution *215*
18.3.2 Habitat Descriptions *216*
18.3.3 Species Sensitivity Analysis *217*
18.3.4 Species Sensitivity Analysis *218*
18.3.5 Habitat Sensitivity Analysis *220*
18.4 KEY ISSUES AND RECOMMENDATIONS 220
19.0 ELU 12: COASTAL BAT HILLS (KP 272+181 TO 308+000) 222
19.1 GENERAL DESCRIPTION 222
19.2 PHYSICAL CHARACTERISTICS 222
19.2.1 Precipitation *222*
19.2.2 Geology *223*
19.2.3 Soils *224*
19.2.4 Waterbodies and Wetlands *224*
19.2.5 Instability and Physical Risk *226*
19.2.6 Infrastructure *227*
19.3 HABITATS AND SPECIES 227
19.3.1 Habitat Distribution *227*
19.3.2 Habitat Description *228*
19.3.3 Species Sensitivity Analysis *229*
19.3.4 Habitat Sensitivity Analysis *232*
19.4 KEY ISSUES AND RECOMMENDATIONS 232
20.0 ELU 13: PISCO SAND PLAINS (KP 308+000 TO 332+940) 234
20.1 GENERAL DESCRIPTION 234
20.2 PHYSICAL CHARACTERISTICS 234
20.2.1 Precipitation *234*
20.2.2 Geology *235*
20.3 HABITATS AND SPECIES 236
20.3.1 Habitat Distribution *236*
20.3.2 Habitat Descriptions *237*
20.3.3 Species Sensitivity Analysis *239*
20.3.4 Habitat Sensitivity Analysis *242*
20.4 KEY ISSUES AND RECOMMENDATIONS 242
21.0 ELU 14: ICA-LIMA COASTAL PLAIN (KP 332+940 – 402+000) 244
21.1 GENERAL DESCRIPTION 244
21.2 PHYSICAL CHARACTERISTICS 244
21.3 HABITATS AND SPECIES 248
21.3.1 Habitat Distribution *248*
21.3.2 Habitat Descriptions *249*
21.3.3 Species Sensitivity Analysis *252*
21.3.4 Habitat Sensitivity Analysis *256*
21.4 KEY ISSUES AND RECOMMENDATIONS 256
22.0 CONCLUSIONS AND RECOMMENDATIONS 258
22.1 IDENTIFICACITION OF SENSITIVE HABITATS 258
22.2 CONCLUSIONS AND RECOMMENDATIONS RELATING TO THE ECOMP 270
22.3 CONCLUSIONS AND RECOMMENDATIONS RELATING TO THE RP 281
23.0 APPENDICES 283

23.1 CARTOGRAPHY 284
23.2 METHODOLOGY 285
23.2.1 VEGETATION 285
23.2.1.1 Team Organization 285
23.2.1.2 Data Recording 285
23.2.1.3 Sampling 287
23.2.2 ORNITHOLOGY 287
23.2.2.1 Team Organization 287
23.2.2.2 Data Recording 288
23.2.2.3 Sampling 288
23.2.3 HERPETOLOGY 288
23.2.3.1 Team Organization and Evaluated sites 288
23.2.3.2 Data Recording 292
23.2.3.3 Specimen Collection 293
23.2.4 MAMMALS 293
23.2.4.1 Team Organization and Evaluated Sites 293
23.2.4.2 Data Recording 294
23.2.4.3 Specimen Collection 294
23.2.5 HYDROBIOLOGY 295
23.2.5.1 Evaluated Sites 295
23.2.5.2 Data Recording 296
23.2.5.3 Sampling 297
23.2.6 SOILS 298
23.2.6.1 Team Organizationa and Evaluated Sites 298
23.2.6.2 Data Recording 300
23.2.6.3 Sampling 300
23.3 REFERENCES 301
23.3.1 GENERAL 301
23.3.1 BOTANY 301
23.3.3 HERPETOLOGY 304
23.3.4 MAMMALOGY 307
23.3.5 ORNITHOLOGY 309
23.3.6 HYDROBIOLOGY 310
23.3.7 SOILS 311
23.4 ACROMYMS AND GLOSSARY 312
23.5 PHOTOGRAPHIC GALLERY 318
23.6 LIST OF SPECIES REPORTED BY EFS FIELD SURVEY 347
23.7 HABITAT SENSITIVITY CRITERIA 365
23.8 HYDROBIOLOGY 372
23.9 SOILS DATA TABLE 375
23.10 MAP OF ECOLOGICAL LANDSCAPE UNITS 376

TABLES

TABLE 1 ECOLOGICAL LANDSCAPE UNITS (ELUS) 1
TABLE 2. SENSITIVITY OF SPECIES ANALYZED 3
TABLE ES.3. EFS MEDIUM AND HIGH SENSITIVITY HABITATS BY ECOLOGICAL LANDSCAPE UNIT 9
TABLE 3.1 LEGAL AND INSTITUTIONAL FRAMEWORK 18
TABLE 5.1. LEVEL 1 - ECOLOGICAL LANDSCAPE UNITS (ELUS) 26
TABLE 6.1. HABITAT TYPES IDENTIFIED ALONG THE PERU LNG NATURAL GAS PIPELINE RIGHT OF WAY. 32
TABLE 7.1. SPECIES SENSITIVITY CRITERIA: PROTECTION STATUS 39
TABLE 7.2. SPECIES SENSITIVITY CRITERIA: DISTRIBUTION 40
TABLE 7.3. SPECIES SENSITIVITY CRITERIA: LOCAL USE 40
TABLE 7.4. SPECIES SENSITIVITY CRITERIA: MOBILITY 41
TABLE 7.5. VALUE RANGE FOR SPECIES SENSITIVITY 41
TABLE 7.6. VALUE RANGE FOR HABITAT SENSITIVITY 43
TABLE 8.1. PRECIPITATION – ELU 1 45
TABLE 8.2. SURFACE HORIZON CHARACTERISTICS - ELU 1 46
TABLE 8.3. PRINCIPAL WATERBODY CROSSINGS - ELU 1 46
TABLE 8.4 INSTABILITY AND PHYSICAL RISK LEVELS – ELU 1 48
TABLE 8.5. PLANNED PROJECT INFRASTRUCTURES – ELU 1 49
TABLE 8.6. HABITATS SEQUENCE – ELU 1 50
TABLE 8.7. HABITAT SUMMARY – ELU 1 51
TABLE 8.8. WATERBODIES SAMPLED– ELU 1 54
TABLE 8.9. SPECIES SENSITIVITY CRITERIA – ELU 1 56
TABLE 8.10. KEY ISSUES AND RECOMMENDATIONS - ELU 1 61
TABLE 9.1. PRECIPITATION - ELU 2 64
TABLE 9.2. SURFACE HORIZON CHARACTERISTICS - ELU 2 65
TABLE 9.3. PRINCIPAL WATERBODY CROSSINGS – ELU 2 65
TABLE 9.4. INSTABILITY AND PHYSICAL RISK LEVELS - ELU 2 66
TABLE 9.5. PLANNED PROJECT INFRASTRUCTURES – ELU 2 66
TABLE 9.6. HABITAT SEQUENCE – ELU 2 67
TABLE 9.7. HABITATS SUMMARY - ELU 2 67
TABLE 9.8. WATERBODIES SAMPLED – ELU 2 69
TABLE 9.9. SPECIES SENSITIVITY CRITERIA - ELU 2 70
TABLE 9.10. KEY ISSUES AND RECOMMENDATIONS - ELU 2 73
TABLE 10.1. PRECIPITATION – ELU 3 75
TABLE 10.2. SURFACE HORIZON CHARACTERISTICS - ELU 3 77
TABLE 10.3. PRINCIPAL WATERBODY CROSSINGS – ELU 3 77

TABLE 10.4. DISTRIBUTION OF PHYSICAL RISK CATEGORIES - ELU 3 78
TABLE 10.5. PLANNED PROJECT INFRASTRUCTURES – ELU 3 79
TABLE 10.6. HABITAT SEQUENCE – ELU 3 79
TABLE 10.7. HABITATS SUMMARY – ELU 3 80
TABLE 10.8. WATERBODIES SAMPLED – ELU 3 82
TABLE 10.9. SPECIES SENSITIVITY CRITERIA - ELU 3 84
TABLE 10.10. KEY ISSUES - ELU 3 88
TABLE 11.2. SURFACE HORIZON CHARACTERISTICS - ELU 4 92
TABLE 11.3. PRINCIPAL WATERBODY CROSSINGS - ELU 4 93
TABLE 11.4. DISTRIBUTION OF PHYSICAL RISK CATEGORIES – ELU 4 93
TABLE 11.5. PLANNED PROJECT INFRASTRUCTURES – ELU 4 94
TABLE 11.6. HABITATS SEQUENCE – ELU 4 94
TABLE 11.7. HABITAT SUMMARY – ELU 4 95
TABLE 11.8. WATERBODIES SAMPLED – ELU 4 96
TABLE 11.9. SPECIES SENSITIVITY CRITERIA - ELU 4 98
TABLE 11.10. KEY ISSUES AND RECOMMENDATIONS – ELU 4 101
TABLE 12.1. PRECIPITATION - ELU 5 104
TABLE 12.2. SURFACE HORIZON CHARACTERISTICS - ELU 5 105
TABLE 12.3. PRINCIPAL WATERBODY CROSSINGS - ELU 5 106
TABLE 12.4. PHYSICAL RISK - ELU 5 107
TABLE 12.5. PLANNED PROJECT INFRASTRUCTURES – ELU 5 108
TABLE 12.6. HABITAT SEQUENCE – ELU 5 109
TABLE 12.7. HABITAT SUMMARY – ELU 5 110
TABLE 12.8. WATERBODIES SAMPLED – ELU 5 112
TABLE 12.9. SPECIES SENSTITIVITY CRITERIA - ELU 5 113
TABLE 12.10. KEY ISSUES AND RECOMMENDATIONS - ELU 5 116
TABLE 13.1. PRECIPITATION - ELU 6 119
TABLE 13.2. SURFACE HORIZON CHARACTERISTICS - ELU 6 120
TABLE 13.3. PRINCIPAL CROSSINGS - ELU 6 121
TABLE 13.4. PHYSICAL RISK - ELU 6 122
TABLE 13.5. HABITAT SEQUENCE – ELU 6 122
TABLE 13.6. HABITAT SUMMARY – ELU 6 124
TABLE 13.7. WATERBODIES SAMPLED – ELU 6 126
TABLE 13.8. SPECIES SENSITIVITY CRITERIA - ELU 6 128
TABLE 13.9. KEY ISSUES AND RECOMMENDATIONS - ELU 6 132
TABLE 14.2. SURFACE HORIZON CHARACTERISTICS - ELU 7 135
TABLE 14.3. PRINCIPAL WATERBODY CROSSINGS - ELU 7 135
TABLE 14.4. PHYSICAL RISK - ELU 7 136
TABLE 14.5. PLANNED PROJECT INFRASTRUCTURES – ELU 7 137
TABLE 14.6. HABITAT SEQUENCE – ELU 7 137

TABLE 14.7. HABITAT SUMMARY – ELU 7 138
TABLE 14.8. WATERBODIES SAMPLED – ELU 7 139
TABLE 14.9. SPECIES SENSITIVITY CRITERIA- ELU 7 140
TABLE 14.10. KEY ISSUES AND RECOMMENDATIONS - ELU 7 143
TABLE 15.1. PRECIPITATION - ELU 8 146
TABLE 15.2. RISK OF ARD – ELU 8 147
TABLE 15.3. SURFACE HORIZON CHARACTERISTICS - ELU 8 148
TABLE 15.4. PRINCIPAL WATERBODY CROSSINGS - ELU 8 149
TABLE 15.5. PHYSICAL RISK - ELU 8 150
TABLE 15.6. PLANNED PROJECT INFRASTRUCTURES – ELU 8 150
TABLE 15.7. HABITAT SEQUENCE – ELU 8 152
TABLE 15.8. HABITAT SUMMARY – ELU 8 156
TABLE 15.9. WATERBODIES SAMPLED – ELU 8 162
TABLE 15.10. SPECIES SENSITIVITY CRITERIA - ELU 8 163
TABLE 15.11. KEY ISSUES AND RECOMMENDATIONS – ELU 8 167
TABLE 16.1. ESTIMATED PEAK AND GENERAL WET SEASON 169
TABLE 16.2. SECTORS OF ARD RISK – ELU 9 170
TABLE 16.3. SURFACE HORIZON CHARACTERISTICS - ELU 9 171
TABLE 16.4. PRINCIPAL WATERBODY CROSSINGS - ELU 9 172
TABLE 16.5. INSTABILITY AND PHYSICAL RISK LEVELS - ELU 9 173
TABLE 16.6. PLANNED PROJECT INFRASTRUCTURES – ELU 9 174
TABLE 16.7. HABITAT SEQUENCE – ELU 9 175
TABLE 16.8. HABITAT SUMMARY – ELU 9 177
TABLE 16.9. WATERBODIES SAMPLED – ELU 9 181
TABLE 16.10. SPECIES SENSITIVITY CRITERIA - ELU 9 182
TABLE 16.11. KEY ISSUES AND RECOMMENDATIONS - ELU 9 187
TABLE 17.1. ESTIMATED PEAK AND GENERAL WET SEASON 190
TABLE 17.2. SURFACE HORIZON CHARACTERISTICS - ELU 10 191
TABLE 17.3. PRINCIPAL WATERBODY CROSSINGS - ELU 10 192
TABLE 17.4. INSTABILITY AND PHYSICAL RISK LEVELS – ELU 10 194
TABLE 17.5. PLANNED PROJECT INFRASTRUCTURES – ELU 10 195
TABLE 17.6. HABITAT SEQUENCE – ELU 10 195
TABLE 17.7. HABITAT SUMMARY – ELU 10 198
TABLE 17.8. WATERBODIES SAMPLED – ELU 10 201
TABLE 17.9. SPECIES SENSITIVITY CRITERIA - ELU 10 203
TABLE 17.10. KEY ISSUES - ELU 10 206
TABLE 18.1. ESTIMATED PEAK AND GENERAL WET SEASON PRECIPITATION RANGES - ELU 11 210
TABLE 18.2. SECTORS OF MEDIUM TO HIGH ARD RISK – ELU 11 211
TABLE 18.3. SURFACE HORIZON CHARACTERISTICS - ELU 11 211
TABLE 18.4. PRINCIPAL WATERBODY CROSSINGS - ELU 11 212

TABLE 18.5. INSTABILITY AND PHYSICAL RISK - ELU 11 214
TABLE 18.6. PLANNED PROJECT INFRASTRUCTURES – ELU 11 214
TABLE 18. 7. HABITAT SEQUENCE – ELU 11 215
TABLE 18.8. HABITAT SUMMARY – ELU 11 215
TABLE 18.9. SPECIES SENSITIVITY CRITERIA - ELU 11 218
TABLE 18.10. KEY ISSUES AND RECOMMENDATIONS - ELU 11 221
TABLE 19.1. ESTIMATED PEAK AND GENERAL WET SEASON 223
TABLE 19.2. SECTORS OF ARD RISK – ELU 12 224
TABLE 19.3. SURFACE HORIZON CHARACTERISTICS - ELU 12 224
TABLE 19.4. PRINCIPAL WATERBODY CROSSINGS - ELU 12 225
TABLE 19.5. INSTABILTY AND PHYSICAL RISK - ELU 12 226
TABLE 19.6. PLANNED PROJECT INFRASTRUCTURES – ELU 12 227
TABLE 19.7. HABITAT SEQUENCE – ELU 12 228
TABLE 19.8. SPECIES SENSITIVITY CRITERIA - ELU 12 230
TABLE 19.9. KEY ISSUES AND RECOMMENDATIONS - ELU 12 233
TABLE 20.1. ESTIMATED PEAK AND GENERAL WET SEASON PRECIPITATION RANGES - ELU 13 234
TABLE 20.2. SURFACE HORIZON CHARACTERISTICS - ELU 13 235
TABLE 20.3. PRINCIPAL WATERBODY CROSSINGS - ELU 13 236
TABLE 20.4 PRESENTS HABITAT SEQUENCE THROUGHOUT ELU 13 AND TABLE 20.5 PRESENTS A SUMMARY WITH SUBTOTALS OF EACH HABITAT. 236
TABLE 20.4. HABITAT SEQUENCE – ELU 13 237
TABLE 20.5. HABITAT SUMMARY – ELU 13 237
TABLE 20.7. SPECIES SENSITIVITY CRITERIA - ELU 13 240
TABLE 20.8. KEY ISSUES AND RECOMMENDATIONS - ELU 13 242
TABLE 21.1. ESTIMATED PEAK AND GENERAL WET SEASON PRECIPITATION RANGES - ELU 14 244
TABLE 21.2. SURFACE HORIZON CHARACTERISTICS - ELU 14 245
TABLE 21.3. PRINCIPAL WATERBODY CROSSINGS - ELU 14 246
TABLE 21.4. HABITAT SUMMARY – ELU 14 248
TABLE 21.5. HABITAT SUMMARY – ELU 14 249
TABLE 21.6. WATERBODIES SAMPLED – ELU 14 251
TABLE 21.7. SPECIES SENSITIVITY CRITERIA - ELU 14 253
TABLE 21.8. KEY ISSUES AND RECOMMENDATIONS - ELU 14 257
TABLE 22.1. SPECIES SENSITIVITIES BY TAXONOMIC GROUP 264
TABLE 22.2. MEDIUM AND HIGH SENSITIVITY HABITATS BY ECOLOGICAL LANDSCAPE UNIT ACCORDING TO THE EFS 266
TABLE 22.3. HABITAT SENSIVITY CATEGORY SUMMARY 268
TABLE 22.4. PROTECTED PLANTS IDENTIFIED ALONG ROW BY EFS 270
TABLE 22.5. PROTECTED ANIMAL SPECIES WITH POTENTIAL PRESENCE IN ROW BASED ON ESIA AND EFS FINDINGS. 274

TABLE 22.6. LOW-MOBILITY ENDEMIC ANIMAL SPECIES THAT MAY REQUIRE CAPTURE AND RELOCATION FROM ROW 279
TABLE 23.2.1. HERPETOLOGY SAMPLING POINTS 289
TABLE 23.2.2. MAMMALS SAMPLING POINTS 293
TABLE 23.2.3. HYDROBIOLOGY SAMPLING POINTS 295
TABLE 23.2.4. SOILS SAMPLING POINTS 298
TABLE 23.4.1. ACRONYMS 312
TABLE 23.4.2. GLOSSARY 313
TABLE 23.6.1 SPECIES SENSITIVITY 347
TABLE 23.7.1. MEDIUM AND HIGH SENSITIVE HABITATS 365
TABLE23.8.1. DATA OF STATIONS EVALUATED ALONG THE ROW 372
TABLE 23.9.1. FERTILIZER RECOMMENDATIONS FOR EACH ELU 375

FIGURES

FIGURE 3.1. ORGANIZATION OF ENVIRONMENTAL INSTITUTIONS 22
FIGURE 23.1.1 TOPOGRAPHIC PROFILE OF THE ROW 256
FIGURE 1. PLANTATIONS OF POLYLEPIS PAUTA. ALMOST 60% OF THE POPULATION IS INCLUDED IN THE ROW. 318
FIGURE 2. MIST NEST SET IN MONTANE FOREST, 10 M FAR FROM THE RIVER THAT GOES TO SP3. 319
FIGURE 3. SACHAPAMPA RIVER, KP 10+000. 319
FIGURE 4. *PROCTOPORUS SP*. KP 7+500 320
FIGURE 5. *PROCTOPORUS SP* IN KP 15+000 320
FIGURE 1. PEAT BOGS IN CAMPANA CREEK, KP 25+000. 321
FIGURE 2. VIEW OF CAMPANA KP 21+511 321
FIGURE 4. *LAGIDIUM PERUANUM* "VIZCACHA" OBSERVED OVER A STONE IN THORNY SCRUB ... 322
FIGURE 1. THORNY SCRUB, KP 33+000 323
FIGURE 2. PATI TREE, *ERIOTHECA VARGASII* IN KP 40+000 323
FIGURE 3. HUMMINGBIRD *LESBIA LUNA*, CAPTURED IN KP 30+000 324
FIGURE 4. THORNY SCRUB IN PATIBAMBA, KP 34+000 324
FIGURE 1. VIEW OF YANACOCHA LAGOON, KP 48+800 325
FIGURE 3. VIEW OF NINA ORCCO LAGOON KP 51+200 326
FIGURE 4. PLEUROTALIS SP. OVER THE ROW, KP 45+000 326
FIGURE 1 YUCAY RIVER VALLEY, KP 67+000 327
FIGURE 2. *CLEISTOCACTUS MORAWETZIANUS*. KP 63+000 327
FIGURE 3. *TELMATOBIUS SP*, KP 73+400 328
FIGURE 4. VIEW OF YUCAY RIVER KP 62+500 328

FIGURE 1. PUNA SCRUBLAND IN HUAMANGA-VISCHONGO DIVIDE, KP 75+000. 329
FIGURE 2. *AUSTROCYLINDROPUNTIA FLOCCOSA* "HUARACCO QUISQA", KP 100+700 329
FIGURE 3. *GEOSSITA TENUIRROSTRIS*, KP 102+000. 330
FIGURE 4. *LIOLAEMUS SP*, CAPTURED IN THE KP 92+000 330
FIGURE 1. VINCHOS RIVER VALLEY, KP 110+000. 331
FIGURE 2. *AUSTROCYLINDROPUNTIA FLOCCOSA, AUSTROCYLINDROPUNTIA SUBULATA* AND *OROYA PERUVIANA* KP 110+000 331
FIGURE 3. *DIGLOSSA BRUNEIVENTRIS* , KP 112+000. 332
FIGURE 4. *METRIOPELIA CECILIAE*. KP 112+000 332
FIGURE 1. VIEW OF RANRACANCHA, KP 120+000. 333
FIGURE 2. *EPHEDRA AMERICANA* BETWEEN *OPUNTIA FLOCCOSA* KP 120+000 333
FIGURE 3. *LIOLAEMUS SP.*, KP 160+000. 334
FIGURE 4. *PLEURODEMA MARMORATA*. KP CHURIAC 146+000 334
FIGURE 1. VIEW OF PAMPAS RIVER KP 186+500 335
FIGURE 2. MATAS DE *OPUNTIA FLOCOSA* IN THE ROW KP 175+00 335
FIGURE 3. VIEW OF HUAYCO CORRAL CREEK KP 173+800 336
FIGURE 4. *LIOLEMUS SP.* OBSERVED OVER STONE TAKING SUNSHINE KP 185+000 336
FIGURE 1. CAMELIDS GRAZING IN KP 201+000 337
FIGURE 2. VIEW OF TACCRA PET BOG ,KP 241+000 337
FIGURE 3. PUNA SCRUBLAND IN TACCRA, KP 227+000 338
FIGURE 4. *LIOLEMUS SP.* KP 227+000 338
FIGURE 1. *SENECIO TOVARII*, KP 261+300. 339
FIGURE 2. *MICROLOPHUS AFF. TIGRIS* CAPTURED IN , KP 255+000 339
FIGURE 3. MIXED SCRUB HABITAT IN THE KP 255+000. 340
FIGURE 4. *LUPINUS AFF. MUTABILIS*. KP 252+000 340
FIGURE 1. *ARMATOCEREUS PROCERUS* IN THE KP 301+000. 341
FIGURE 2. *LEPTASTHENURA STRIATA* CAPTURED IN KP 299+500 341
FIGURE 3. *NEORAIMONDIA AREQUIPENSIS*, KP 305+000. 342
FIGURE 4. *MICROLOPHUS TIGRIS*. KP 298+000 342
FIGURE 1. TILLANDSIAL DE *TILLANDSIA PALACEA* IN THE KP 310+000. 343
FIGURE 2. MORON LAGOON IN THE DESERT PISCO SAND PLANIS KP 329+600 343
FIGURE 3. *MICROLOPHUS THORACICUS*, KP 329+000. 344
FIGURE 4. *MYIOPHOBUS FASCIATUS* NEST, KP 329+000 344
FIGURE 1. *ACACIA MACRACANTHA* IN THE KP 390+800. 345
FIGURE 2. VIEW OF PISCO RIVER KP 334+800 345
FIGURE 3. *DICRODON HETEROLEPIS* KP 329+000. 346
FIGURE 4. *CRYPHIOPS CAEMENTARIUS* CAPTURED IN KP 334+800 346

EXECUTIVE SUMMARY

This Ecological Field Survey (EFS) is based on the ecological evaluation carried out within the Right of Way (ROW) which has been conceded to Peru LNG for the construction of the natural gas pipeline that will extend from near the town of Chiquintirca (Ayacucho Department) to the Gas Liquefaction Plant at Pampa Melchorita (Lima Department).

The information included herein is not only based on the fieldwork information gathered and analyzed by the EFS team, but also on the data from the Peru LNG Environmental and Social Impact Assessment (ESIA). Moreover, for the purposes of the present document, the ESIA was considered as a regional overview and the EFS as a more specific, local approach, considering that the ESIA had a 3 to 7 km wide study corridor and the EFS was restricted to a 50m-wide area. That is, the EFS focused on potential impacts within and along and immediately adjacent to the ROW and used the ESIA as a macro perspective of the ROW surroundings. The survey was based on the project footprint area (the ROW) as defined at the time the EFS was commissioned. It does not include additional work areas (beyond those provisionally identified in the ESIA) where the project footprint may be widened resulting from future proposals by Peru LNG's construction contractor for pipeline construction support facilities such as camps, storage yards, pipe yards, access roads, and shooflies and extra work space along the ROW.

Also, using biogeographical information and ecological criteria, the EFS team defined 14 Ecological Landscape Units (ELUs) within the 402-km pipeline ROW route (Table 1). In order to describe every ELU, the type of vegetation was used as the primary criterion for the definition of habitat types within each ELU.

Table 1 Ecological Landscape Units (ELUs)

No.	Ecological Landscape Units	KPs	Elevation (m)		Wet Season Precipitation Range (mm)
			Min.	Max.	
1	Apurimac River Valley Montane Forest Ecotone	0+000 – 20+511	2,966	4,066	600 - 2000
2	Campana Watershed	20+511 – 25+115	3,414	4,066	500 - 700
3	Torobamba River Valley	25+115 – 44+300	2,400	3,674	300 - 600
4	Sillaccasa Sierra	44+300 – 56+783	3,566	4,222	500 - 700
5	Yucay River Valley	56+783 – 74+199	2,850	3,864	500 - 700
6	Huamanga-Vischongo Watershed Divide	74+199 – 103+970	3,864	4,250	600 - 700
7	Vinchos River Valley	103+970 – 117+388	3,200	4,000	600 - 800
8	Apacheta High Sierras	117+388 – 162+137	3,841	4,900	700 - 1000

9	Pampas-Palmitos River Basins	162+137 – 195+050	4,000	4,700	700 - 1000
10	Huaytará High Plains and Ridges	195+050 – 249+538	4,000	4,650	400 - 800
11	Pisco-Ica Watershed Divide	249+538 – 272+181	2,850	4,000	300 - 500
12	Coastal Bat Hills	272+181 – 308+000	750	3,100	10 - 400
13	Pisco Sand Plains	308+000 – 332+940	256	750	0 - 50
14	Ica-Lima Coastal Plain	332+940 – 402+000	125	368	0 - 10

Source: Domus.

Species Sensitivity

A key objective of the EFS was to identify the most sensitive elements and sectors of the RoW, building upon and validating the ESIA findings, in order to permit the development of the Pipeline Ecological Management Plan and the Pipeline Restoration Plan. The EFS was not intended to develop a new baseline study, thus the species lists are focused on sensitive elements and are not intended to be complete lists of species present in any given habitat type or landscape unit. For example, common, widespread, abundant species were not specifically addressed by the EFS. Also, the ESIA reports species observed at sampling points located within 3 to 7 km wide corridor, while the EFS focused on the ROW itself. Thus, the EFS findings are not intended to replace the ESIA baseline species data and they cannot be directly compared with the ESIA species data given the differences in the aims and methods of the EFS and ESIA.

Species sensitivity was determined for each species documented by the EFS on the basis of four characteristics: 1) protected status; 2) geographic distribution; 3) use by local communities, and 4) mobility (ability to flee from a disturbance). Species were scored on these characteristics with a potential range of scores from 0 to 14.

High Sensitivity:

- Any species listed as either EN or CR by IUCN[1] or INRENA **and** that is Immobile.
- Any other species with a score of 11 or higher.

Medium Sensitivity:

- Any species listed as either EN or CR by IUCN or INRENA **and** that is Mobile.
- Any species listed as either NT or VU by IUCN or INRENA **and** that is Immobile.
- Any other species with a score of from 6 to 10.

Low Sensitivity:

- Any species with a score less than or equal to 5.

[1] CR = Critically Endangered; EN = Endangered; VN = Vulnerable; NT = Near Threatened

The sensitivity of the species analyzed is summarized in Table 2 by taxonomic group.

Table 2. Sensitivity of Species Analyzed

Group	Low	Medium	High	Total
Plants	83	25	4	112
Crustaceans	0	0	1	1
Fish	2	5	0	7
Amphibians	2	5	0	7
Reptiles	4	17	0	21
Birds	218	4	0	222
Mammals	32	3	0	35
All	341	59	5	405

Sensitive Habitats

According to the ESIA, Vol. II-B, p. 6-51,

"…*the most sensitive RoW segments are:*

- *Kp 0+000 to Kp 10+000. This corresponds to the eastern watershed.*
- *Kp 55+000 to Kp 75+000: This corresponds to the two end points of the study area (high sensitivity) as well as the two intermediate segments with medium sensitivity. This is mostly in the Acocros cultivated area.*
- *Kp 115+000 to Kp 120+000: Corresponds to the Vinchos River cultivated area.*
- *Kp 120+000 to Kp 200+000: Corresponds to high-Andean zone 4, between the Vinchos River and Taccracocha Lake. This includes grass formations, grazing lands, sedge swamps, and lakes.*
- *Kp 245+000 to Kp 250+000: Corresponds to the last segment of the puna before descending towards the Western watersheds near Huaytará.*

Therefore, the most sensitive ecosystems are the eastern watersheds, cultivated areas, and the puna area (particularly high-Andean zone 4)."

The total length of the "most sensitive ecosystems" as identified by the ESIA is 120 km, which is equivalent to 29.8% of the RoW length.

A comparison of the ESIA findings against the EFS follows:

- Kp 0+000 to Kp 10+000. Corresponds to the portions of Apurimac Valley Upper Montane Forest Ecotone and the Campana Sierra. Considered to be of Medium Sensitivity by the EFS.
- Kp 55+000 to Kp 75+000: Corresponds almost entirely to the Yucay River Valley (KP 56+800 to Kp 74+000). The EFS considers the Resinous Scrub habitat in this sector to be of High Sensitivity.
- Kp 115+000 to Kp 120+000: Corresponds to the western portion of the Vinchos River Valley and a small portion of the easternmost Apacheta High Sierras. Considered to be of Medium Sensitivity by the EFS.
- Kp 120+000 to Kp 200+000: Corresponds to Apacheta High Sierras, Pampas-Palmitos River Basins, and a portion of the easternmost Huaytará High Plains and Ridges. It does not include the Vinchos River Valley. It does include the Taccracocha Lake area; however, the lake itself is located well beyond the direct area of influence of the RoW. This includes tussock and sward-forming grasslands and peat bogs. Considered to be of Medium Sensitivity by the EFS. Does not include habitat known to be inhabited by the white-bellied cinclodes.
- Kp 245+000 to Kp 250+000: Corresponds to the last segment of the high Andean grasslands (Huaytará High Plains and Ridges) and the first 500 m of the mixed scrublands of the Pisco-Ica Watershed Divide southwest of the town of Huaytará. The grasslands are not considered to be sensitive by the EFS; however, the mixed scrubland from KP 245+000 and westward are considered to be of High Sensitivity.

Based on the EFS findings, the most sensitive ecosystems are, in general terms, the dry forest river valleys of the Apurimac and Mantaro basins, the western Andean scrublands and cactus formations, the hydromorphic habitat islands of the Pisco sand plains, and the riverine ecosystems of the coastal plain.

The three major differences between the ESIA and EFS findings on sensitive ecosystems or habitats are that 1) the ESIA considers the sector from KP 120+000 to KP 200+000 to be highly sensitive while the EFS find this zone to be largely of medium sensitivity, 2) The ESIA considers the sector from KP 249+500 to KP 300+000 to be of medium sensitivity and the sector for KP+300+000 to 308+000 to be of low sensitivity, while the EFS finds the sector from KP 249+500 to 308+000 to be of high sensitivity, and 3) the ESIA considers the sector from KP 325+000 to KP 335+000 to be of low sensitivity, while the EFS finds the sector from 326+000 to 332+000 to be largely of high sensitivity.

Table ES 3.1 HIGH AND MEDIUM SENSITVITY SPECIES BY ECOLOGICAL LANDSCAPE UNIT (ELU)

Species	Description	Level of Sensitivity
1. Apurimac River Valley Montane Forest Ecotone, KP 0+000 – 20+511		

Phrynopus sp	Frog	HIGH
Polylepis pauta	Quenual Tree	Medium
Eleutherodactylus discoidalis	Frog	Medium
Proctoporus	Lizard	Medium
Tremarctos ornatus	Spectacled Bear	Medium
Agriornis ardicola	Bird (Tyrant)	Medium
Theristicus melanopis	Bird (Ibis)	Medium
2. Campana Watershed, KP 20+511 – 25+115		
Escallonia resinosa	Shrub	Medium
Myrosmodes sp.	Bog Orchid	Medium
Tecoma sambuxifolia	Shrub	Medium
Proctoporus sp.	Lizard	Medium
Theristicus melanopis	Bird (Ibis)	Medium
3. Torobamba River Valley, KP 25+115 – 44+350		
Corryocactus quadrangularis	Cactus	HIGH
Kageneckia lanceolota	Shrub	HIGH
Acacia macracantha	Tree	Medium
Ariestiguieta discolor	Shrub	Medium
Berberis flexuosa	Shrub	Medium
Echinopsos peruviana puquiensis	Cactus	Medium
Eriotheca vargasii	Shrub	Medium
Escallonia myrtilloides	Shrub	Medium
Escallonia resinosa	Shrub	Medium
Tecoma arequipensis	Shrub	Medium
Tecoma sumbucifolia	Shrub	Medium
Chanus spinulosus	Toad	Medium
Stenocercus aff. apurimacus	Lizard	Medium

Agriornis andicola	Bird (Tyrant)	Medium
Vultur gryphus	Condor	Medium
4. Siliccasa Sierra, KP 44+350 – 56+738		
Aaa Sp.	Orchid	Medium
Distichia muscoides	Bog Moss	Medium
Escallonia myrtilloides	Shrub	Medium
Myrosmodes sp.	Bog Orchid	Medium
Perezia coerulescens	Herb	Medium
Vultur gryphus	Condor	Medium
5. Yucay River Valley, KP 56+783 – 74+199		
Corryocactus quadrangularis	Cactus	HIGH
Berberis flexuosa	Shrub	Medium
Chaunus spinulosus	Toad	Medium
Cleistocactus morawetzianus	Cactus	Medium
Echinopsis peruviana spp. Puquiensis	Cactus	Medium
Escallonia myrtilloides	Shrub	Medium
Orestias sp.	Killifish	Medium
Trichomycterus rivulatus	Andean catfish	Medium
Liolaemus sp.	Lizard	Medium
Stenocercus frittsi	Lizard	Medium
Telmatobbius sp.	Frog	Medium
Vultur gryphus	Condor	Medium
6. Huamanga-Viscongo Watershed Divide, KP 74+199 – 103+970		
Escallonia myrtilloides	Shrub	Medium
Parastrephia quadrangularis	Shrub	Medium
Orestias sp.	Killifish	Medium
Liolaemus sp.	Lizard	Medium

Telmatobius sp.	Frog	Medium
Leopardus (oreailurus) jacobitus	Mountain Cat	Medium
Vicugna vicugna	Vicuna	Medium
7.Vinchos River Valley, KP 103+970 – 117+388		
Echinopsis peruviana ssp. Puquiensis	Cactus	Medium
Escallonia myrtilloides	Shrub	Medium
Oroya peruviana	Cactus	Medium
Trichomycterus rivulatus	Andean catfish	Medium
8. Apacheta High Sierras, KP 117+388 – 162+137		
Berberis sp.	Bush	Medium
Ephedra Americana	Bush	Medium
Escallonia myrtilloides	Shrub	Medium
Oroya peruviana	Cactus	Medium
Perezia coerulensis	Herb	Medium
Perezia pinnatifida	Herb	Medium
Ribes sp.	Plant	Medium
Liolaemus cf. melanogaster	Lizard	Medium
Liolaemus melanogaster	Lizard	Medium
Leopardus (oreailurus) jacobitus	Mountain Cat	Medium
Vicugna vicugna	Vicuna	Medium
Asthenes dorbignyi (huancavelica)	Bird (Canastero)	Medium
Theristicus melanopis	Bird (Ibis)	Medium
Vultur gryphus	Condor	Medium
9. Pampas-Palmitos River Basins, KP 162+137 – 195+050		
Perezia coerulescens	Herb	Medium
Distachia muscoides	Bog Moss	Medium
Liolaaemus sp.	Lizard	Medium

Leopardus (oreailurus) jacobitus	Mountain Cat	Medium
Vicugna vicugna	Vicuna	Medium
Asthenes dorbignyi (huancavelica)	Bird (Canastero)	Medium
10. Huaytara High Plains and Ridges, KP 195+050 – 249+538		
Perezia coerulescens	Herb	Medium
Liolaemus sp. (ramirez)	Lizard	Medium
Liolaemus cf. polystictus	Lizard	Medium
Vicuna vicugna	Vicuna	Medium
Asthenes dorbignyi (huancavelica)	Bird (Canastero)	Medium
11. Pisco-Ica Watershed Divide, KP 249+538 – 272+181		
Chersodoma arequipensis	Shrub	HIGH
Senocio tovari	Cactus	Medium
Liolaaemus sp.	Lizard	Medium
Microlophus affitigris	Lizard	Medium
12. Coastal Bat Hills, KP 272+181 – 308+000		
Cleistocactus acanthurus	Cactus	HIGH
Browningra candelaris	Cactus	Medium
Cridoscolus basiacanthus	Herb	Medium
Ephedra Americana	Shrub	Medium
Loasa incana	Shrub	Medium
Neoralmondia arequipensis	Cactus	Medium
Orthopterygium huaucui	Tree	Medium
Microlophus tigris	Lizard	Medium
Phyllodactylus lepidopygus	Gecko Lizard	Medium
13. Pisco Sand Plains, KP 308+000 – 332+940		
Dicrodoa heterolepis	Lizard	Medium
Microlophus thoracicusicae	Lizard	Medium

Phyllodactylus lepidopygus	Gecko Lizard	Medium
Xenospingus concolor	Bird (Finch)	Medium
14. Ica-Lima Coastal Plain, KP 332+940 – 408+000		
Cryphiops caementarius	Shrimp	HIGH
Acacia macracantha	Tree	Medium
Trichomyctarus rivulatus	Andean catfish	Medium
Alsopphis sp.	Snake	Medium
Chaunus limensis	Toad	Medium
Ctenblepharys adspersa	Lizard	Medium
Dicrodon heterolepis	Lizard	Medium
Microlophus tigris	Lizard	Medium

Source: Ecological Field Survey

Table ES.3.2 EFS Medium and High Sensitivity Habitats by Ecological Landscape Unit

ELU	HABITAT TYPES	HABITAT SENSITIVITY	RoW Length (m)
1. Apurimac River Valley Montane Forest Ecotone	Upper Montane Forest	Medium	4,495
	Tussock Grassland	Medium	3,321
2. Campana Watershed	Peat Bog	Medium	1,834
	Sward-forming Grassland	Medium	6,318
3. Torobamba River Valley	Cultivated Areas	High	7,902
	Dry Deciduous Forest	Medium	651
	Thorny Scrub	High	6,238
4. Sillaccasa Sierra	Tussock Grassland	Medium	10,333
5. Yucay River Valley	Thorny Scrub	Medium	171
	Resinous Scrub	High	1,630
	Yucay River	Medium	26

6. Huamanga Vischongo Watershed Divide	Tussock Grassland	Medium	27,246
7. Vinchos River Valley	Cultivated Areas	Medium	12,074
8. Apacheta High Sierras	Scarcely Vegetated High Andean Areas	Medium	21,083
	Sward-forming Grassland	Medium	17,481
	Tussock Grassland	Medium	6,900
9. Pampas Palmitos River Basins	Tussock Grassland	Medium	11,741
10. Huaytará High Plains and Ridges	Scarcely Vegetated High Andean Areas	Medium	3,599
	Sward-forming Grassland	Medium	16,127
	Tussock Grassland	Medium	33,616
11. Pisco Ica Watershed Divide	Mixed Scrub	High	17,910
	Thorny Scrub	High	4,590
12. Coastal Bat Hills	Desert Scrub	High	15,924
	Columnar Cacti and Scrub	High	20,076
13. Pisco Sand Plains	Hydromorphic Islands and Lagoons	High	4,800*
14. Ica-Lima Costal Plain	Cultivated Areas	Medium	18,197
	Desert Barrens	Medium	46,430
	Riverine Corridors	High	875

*Distance of sector where RoW passes near or crosses hydromorphic island and lagoon habitats. Actual length of such habitats traversed by RoW is approximately 274 m.

In summary, the distribution of habitat sensitivity categories over the length of the RoW is as follows:

Sensitivity	Length (m)	Percent
Low	80,412	20.0
Medium	241,643	60.1

High	79,945	19.9
Total	402,000	100.0

The EFS categorizes 19.9% of the RoW within the most sensitive category, versus 29.8% in the "most sensitive" category in the ESIA.

Low and Medium Sensitivity Habitats require good practice ecological management procedures that comply with all applicable ESIA commitments, the Ecological Management Plan (ECOMP) and Pipeline Restoration Plan (RP). In addition, site-specific measures apply to High Sensitivity Habitats as described by the ECOMP and RP.

The designation of High Sensitivity Habitat Type means that the specified area is a habitat type within which the EFS has verified the presence of either at least one High Sensitivity Species or at least two medium sensitivity animal species or at least three medium sensitivity plant species. Applying the precautionary principal, this designation requires that the Project take special care to identify the location of sensitive elements within the habitat type and develop appropriate mitigation measures for these specific locations prior to the start of construction.

In accordance with IFC Performance Standard 1, in areas of High Sensitivity Habitat, no project activities will be implemented unless the following requirements are met:

- There are no measurable adverse impacts on the ability of the critical habitat to support the established population of species or the functions of the critical habitat
- There is no reduction in the population of any recognized critically endangered or endangered species
- Mitigation measures are implemented to achieve no net loss of biodiversity where feasible, which may include but are not limited to actions such as post-operation restoration of habitats, offset of losses through the creation of ecologically comparable area(s) that is managed for biodiversity, and compensation to direct users of biodiversity.

The EFS High Sensitivity Habitats are summarized briefly below:

1. Torobamba River Valley Cultivated Areas. Despite extensive land clearing for intensive cultivation, there are patches and corridors of native vegetation between the fields that contain listed and endemic species typical of dry forests and scrublands of the Apurimac Dry Forest System. Among these species are the endangered cactus *Corryocactus quadrangularis* and the critically endangered rosaceous shrub *Kageneckia lanceolata*.
2. Torobamba River Valley Thorny Scrub. Higher up the valley slopes, patches of thorny scrub harbor the critically endangered rosaceous shrub *Kageneckia lanceolata* and other sensitive dry forest and scrub plants, as well as the endangered white-tailed shrike tyrant, a bird of the flycatcher family.
3. Yucay River Valley Resinous Scrub. The dry Yucay River Valley contains patches of native vegetation belonging to the Mantaro Dry Forest System, including populations of the endangered cactus *Corryocactus quadrangularis* and the vulnerable cactus *Echinopsis peruviana puquiensis*.

4. Pisco-Ica Watershed Divide Mixed and Thorny Scrub. The upper slopes of the western Andes which drain to the Pacific Ocean support highly adapted plant species such as the critically endangered composite shrub *Chersodoma arequipensis* and the regional endemic *Aequatorium tovarii*. A possible new lizard species of the genus *Microlophus* was found by the EFS in high elevation mixed scrub. Also, these habitats may support populations of the endangered rufous-breasted warbling finch, as documented by the ESIA.
5. Coastal Bat Hills Desert Scrub and Columnar Cacti. The lower desert slopes of the Andean foothills support sparse yet diverse vegetation with various threatened and endemic species of cacti and shrubs, including the endangered *Cleistocactus acanthurus*. This habitat supports populations of the critically endangered long-snouted bat (*Platalina genovensium*), a species that feeds exclusively on the pollen and nectar of night-blooming cacti.
6. Pisco Sand Plains Hydromorphic Islands and Lagoons. Among the sand dunes south of the lower Pisco River, there are small oases of wetland vegetation, often surrounding small permanent water bodies such as the Bernal and Morón lagoons. These unusual habitat islands support fauna that could not otherwise survive in the surrounding desert environment. For example, the vulnerable slender-billed finch, an endemic coastal desert bird that nests only in hydromorphic thickets and riparian areas, was observed in these habitats. While not containing any highly sensitive species, these habitats are considered to be highly sensitive due to their uniqueness, limited geographic distribution, presence of various medium sensitivity species, and loss of similar habitats in the region to agricultural conversion.
7. Ica-Lima Coastal Plain Riverine Corridors. The coastal plain of south-central Peru is traversed by various highly seasonal rivers and streams. The natural vegetation along these streams was formerly a dense riparian woodland and thicket, but these have largely been lost with the development of irrigated agriculture in the narrow river valleys. Only small fragments of these habitats remain. The rivers themselves have been affected by agriculture and urbanization. Nevertheless, the Pisco River supports a critical species from a socioeconomic perspective, the freshwater river shrimp *Cryphiops caementarius*, an important fishery species with an important contribution to the local economy.

Highly Unstable Sectors (HUS)

HUSs were obtained from the ESIA´s *Map of Stability Physical Risk* (Vol. V) and complemented with EFS fieldwork observations. This concept includes soils with erosion vulnerability and geotechnical instability, as well as zones with generation of Acid Rock Drainage (medium and high risk) defined in the ESIA, each of which could pose a risk to ecologically sensitive resources, such as water bodies. For the purposes of the EFS, three categories of instability are utilized: low, medium, and high. Low instability includes the "stable" and "slightly unstable" categories of the ESIA (Vol IIA, Section 5.4). Medium instability is equivalent to the "moderately unstable" category of the ESIA. High instability includes the "unstable" and "highly unstable" categories of the ESIA. Thus, the HUSs presented in the EFS include the areas mapped as either "unstable" and "highly unstable" by the ESIA. The purpose of including HUSs in the EFS is to identify and highlight areas where physical instability of the ROW could present risks to the integrity of water bodies and wetlands if measures are not implemented to protect these sensitive receptors.

The EFS field team was unable to survey the zone between KP 270+000 and KP 285+000 due to security risks and logistical complexity. To analyze this stretch, existing information from the ESIA was used. However, based on the available information, there are no unique ELUs or habitat types present in this stretch that were not studied in the remainder of the ROW during the EFS, nor any specific concerns or constraints that will pose a unique problem during construction and reinstatement.

The EFS is intended, above all, to be the main source of information to inform the development of the Ecological Management Plan and the Restoration Plan, especially with regards to translocation of species from the RoW prior to construction and the development of techniques and measures to revegetate the RoW during restalment. It also provides a baseline level of information that may be useful reference material for Peru LNG and its pipeline contractor during construction and also for long-term monitoring during the operation phase of the pipeline.

1.0 INTRODUCTION

The Ecological Field Survey (EFS) is an extension of the Environmental and Social Impact Assessment (ESIA) prepared for Peru LNG, expanding on the ecological information obtained at that phase of the Project. It is also a precursor document for the development of the Project's Ecological Management Plan (ECOMP) and the Restoration Plan (RP), whose objectives are to manage and protect ecological resources during the construction phase of the Project and facilitate reinstatement and restoration of the project footprint area after installation of the pipeline. The EFS includes a database that will offer consistent and useful information for the characterization and management of the ecological conditions of the pipeline right of way (ROW) and to ensure that the impacts that may occur can be controlled and managed during the construction activities. The EFS field survey covers a 50-m wide swath centered on the proposed ROW alignment from the town of Chiquintirca (Ayacucho) to Pampa Melchorita (Lima).

The database includes two main categories of information. The first category is biological, based on information from the biological components previously identified in the ESIA and revisited and enhanced in the EFS fieldwork. The second category is physical, which covers information on environmental components which due to its natural conditions or potential to undergo some change or impact during the construction can become a risk for the project. The database also includes information on the use of natural resources by the local population and the characterization of special sites, such as the crossings of water bodies and roads.

The database verifies and enhances the information provided by the ESIA of the project. For the construction of the database, the team of specialists has undertaken the scoping of the ROW environment. The scoping helped prepare a detailed fieldwork plan and directing the efforts of data collection during this phase. The fieldwork collected new information that will allow for an improved characterization of the habitats and landscapes through simple but meaningful parameters. These parameters also help identify monitoring indicators throughout the project's lifetime.

Likewise, the specialists have defined the information criteria that have been used in the GIS database. The outcome of the criteria analysis was the definition of 14 Ecological Landscape Units (ELUs), which are shown as maps to facilitate a spatial understanding of their distribution and other attributes. This final information is then used to define the needs of the ECOMP for the construction of the pipeline and the RP for the post-construction reinstatement stage.

In order to facilitate the understanding of this document, Appendix 23.4 (Glossary) identifies key concepts and acronyms supported by a brief description.

2.0 OBJECTIVES

The general objective of the Ecological Field Survey is to contribute to the Project's environmental and social sustainability, especially in the areas of conservation and management of local biodiversity by identifying the existing ecological conditions and defining the impacts which could result from the construction and operation of the Peru LNG natural gas pipeline.

The specific objectives of the EFS are to:

- Validate and build upon the ESIA data baseline information, creating an updated and ROW-focused data bank that will serve as an input for the development of the Ecological Management Plan and the Restoration Plan that serve to minimize impacts during construction and facilitate the return of the disturbed area to its original pre-construction condition.
- Identify critical habitats (as defined by IFC Performance Standard 6)[2].
- Identify plants requiring relocation or re-generation elsewhere to maintain critical habitats.
- Identify zones of steep slopes that may require hydro seeding to facilitate the re-establishment of vegetative cover for erosion control during post-construction reinstatement.
- Identify natural sources of seed and other propagules for revegetation activities.
- Follow-up on the near-threatened, vulnerable, endangered, and critically endangered species suspected to be present or identified in the ESIA, identifying their areas of occurrence within and adjacent to the ROW and other areas affected by the construction of the Project, with special emphasis on potential nesting, roosting, or refuge sites (such as caves, rock shelters, tree cavities, etc.).
- Follow-up on the Changallo shrimp (*Cryphiops caementarius*) populations in the Pisco River and other rivers to be crossed by the pipeline.
- Identify areas with medium or high sensitivity species that will require identification, capture, and relocation immediately prior to clearing activities. This shall include the reasons and alternatives for such actions.
- Identify spreads requiring minimization of the ROW width or other mitigation measures.
- Confirm existing data obtained to date and identify any additional water body or wetland crossings and other zones requiring special construction procedures.

[2] Defined by the IFC as "areas with high biodiversity value, including habitat required for the survival of critically endangered or endangered species; areas having special significance for endemic or restricted-range species; sites that are critical for the survival of migratory species; areas supporting globally significant concentrations or numbers of individuals of congregatory species; areas with unique assemblages of species or which are associated with key evolutionary processes or provide key ecosystem services; and areas having biodiversity of significant social, economic or cultural importance to local communities."

- Provide site specific data that will allow for the determination of restoration and mitigation requirements, including species mixes, density targets, drainage conditions, soil properties, and streambed characteristics.

3.0 LEGAL AND INSTITUTIONAL FRAMEWORK

The Peruvian environmental legal framework is a preventive element intended to avoid environmental damage from taking place. The regulations that are encompassed in it are distributed among those that regulate the protection and conservation of the environment in a general way setting forth environmental policies and general principles and those developed at sector level, which regulate the conditions so that the economic activities are environmentally sustainable. Table 3.1 summarizes the key regulations, international standards, and environmental institutions in the areas of ecological management and biodiversity conservation.

Table 3.1 Legal and Institutional Framework

NATIONAL ENVIRONMENTAL POLICY					INTERNATIONAL AGREEMENTS	ENVIRONMENTAL INSTITUTIONS
Political Constitution of Peru					Rio Declaration on Environment and Development	Ministry Council Presidency - PCM
General Law of the Environment					Convention on Biological Diversity	National Environment Council - CONAM
National Agreement					Millennium Objectives	National Institute for the Development of Andean, Amazonian and Afroperuvian Peoples -INDEPA
General Environmental Policy					World Charter for Nature	**Energy and Mining Ministry:** - General Office of Environmental Issues - General Office of Oil and Gas
Natural Resources and Conservation: -Law of Natural Protected Areas -Forestry and Wildlife Law - Organic Law for the Sustainable Use of Natural Resources - Law for Conservation and sustainable Use of Biological Diversity	**Species Protection:** - Forestry and Wildlife Law - Supreme Decree N° 034-2004-AG	**Soil and Land:** - General Law of the Environment - Law for Public Investment in Development of Economic Activities in National Lands and Native and Peasant Farmer Community Lands.	**Waters:** - General Law of the Environment - Organic Law for the Sustainable Use of Natural Resources - General Law of Water Resources.	**Civic Participation:** - Political Constitution of Peru - Organic Law for the Sustainable Use of Natural Resources - Law for Conservation and sustainable Use of Biological Diversity - Participation	**International Finance Corporation Standards (IFC)** Performance Standards on Social & Environmental Sustainability. April, 2006	Supervision Office of Energy and Mines Investment - OSINERGMIN **Health Ministry:** -General Office of Environmental Health
					Inter-American Development Bank (IDB): Environment and Safeguards Compliance Policy, January 2006. - IDB Guidelines for ESIA. Private Sector - Involuntary Resettlement Policy. IDB (Op-710; 1998) - Private Sector Guide for Public Participation in ESIAs. IDB (2001)	**Ministry of Agriculture:** -National Institute of Natural Resources - INRENA - Special Project for Land Titling -PETT - National Program for Watershed Management and Soil Conservation - PRONAMACHS **Ministry of Education:** -National Culture Institute - INC

NATIONAL ENVIRONMENTAL POLICY					INTERNATIONAL AGREEMENTS	ENVIRONMENTAL INSTITUTIONS
				Rights Law and Civilian Control - General Law of the Environment	**Proposed International Standards for Oil and Gas Industry:** - Energy and Biodiversity Initiative (The EBI) - International Petroleum Industry Environmental Conservation Association (IPIECA)	**Ombudsman**
						Ministry of Transport and Communications: -Provías Rural
						Regional and Local Instances: - Regional Governments - Regional Offices of Agriculture - Local Governments - Universities - Water Use Commissions - Peasant Farmer Communities

Source: Domus.

3.1 ESIA COMMITMENTS

The principal commitments of the ESIA specifically related to biodiversity and restoration are embodied in the following sections of the ESIA, its Environmental and Social Management Plan (ESMP), and Responses to Comments:

- Construction Procedures on River Crossings, Ravines and Irrigation Infrastructure (ESIA Vol. I - 5.7.3.4).
- Construction Procedures in Andean Wetland Areas (ESIA Vol. I -5.7.3.3).
- Surface Water (ESMP Section 2.4.2.3).
- Vegetation (ESMP Section 2.4.2.6).
- Wildlife (ESMP Section 2.4.2.7).
- Hydro-biological Resources (ESMP Section 2.4.2.8).
- Trenching (ESMP Section 2.5.8).
- Hydrostatic Testing (ESMP Section 2.5.10).
- Major River Crossings (ESMP Section 2.5.11.1).
- Small River Crossings (Streams and Drains) (ESMP Section 2.5.11.2).
- Borrow Areas and Quarries (ESMP Section 2.5.14).
- Surface Water Quality Monitoring (ESMP Section 3.7.2.3).
- Ecological Emergencies (ESMP Section 5.8.13).
- Pipeline Crossing Bodies of Water (ESMP Section 6.6.9).
- Pipeline Crossing Wetlands (ESMP Section 6.6.10).
- Restoration and Revegetation Plan and Revegetation Monitoring components (ESMP Sections 7.0 and 3.8.2.5, respectively).
- Biological Monitoring Plan (Appendix 5.2 of Peru LNG's June 2006 responses to comments on the ESIA).

ESIA commitments are mandatory and must be complied with as appropriate by Peru LNG and its construction contractors.

The ECOMP and RP documents will reference the ESIA-ESMP commitments as necessary to provide for an auditable link between the two. The ECOMP and RP are implementation documents that are a follow-up to the approved ESIA-ESMP, the Responses to Comments, and the ESMP Framework Plan and complement the other Contractor Management Plans (CMPs) developed by PERU LNG. CONTRACTOR will prepare its own Environmental and Social Implementation Plans (ESIPs) in response to these plans.

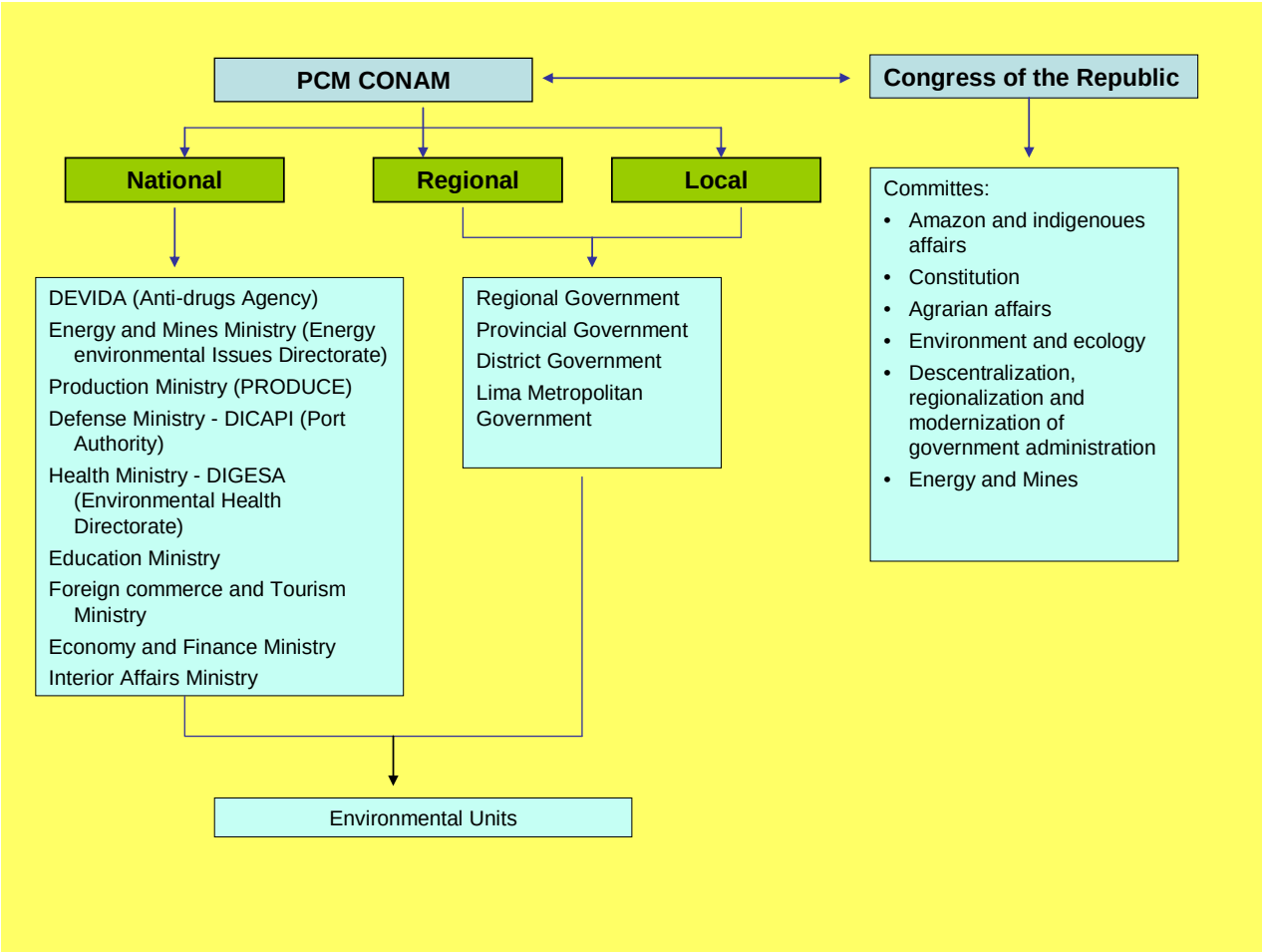
3.2 STAKEHOLDERS

The EFS analyzes the Peruvian environmental institutions that have a stake in the Plan and the effective management of ecological resources in the Project footprint area. In this context, it has been important to identify the competencies in environmental matters at the level of each sector as well as its linkages with the regional governments and involved municipalities.

National institutions, such as the National Environmental Council (*Consejo Nacional del Ambiente*, CONAM), and their coordination levels with the Regional Governments through the Regional Environmental Committees and with the Municipalities deserve special attention.

The rural communities, the local NGOs, and the academic institutions also play an important role for the project execution. Figure 3.1 shows the organization of environmental institutions.

Figure 3.1. Organization of Environmental Institutions



Source: Domus.

4.0 EFS FIELD METHODOLOGY

Detailed information about EFS field methodologies is provided in Appendix 23.2.

4.1 BIOLOGY

For the biological component, field surveys were conducted along the entire ROW route in order to document the key aspects of the natural environments, with the exception of the stretch between KP 270+000 and KP due 285+000 due to security constraints and logistics issues. The presence of ecologically sensitive species and environments was observed in detail along the route. This screening procedure was done on the ground by a team of specialists, selected for their detailed knowledge of the study area; 4 botanists, 4 ornithologists, 2 herpetologists (reptile and amphibian specialists), 3 mammalogists, and 2 experts in hydrobiology took part in the field survey. The group was supervised by a senior ecologist from the planning and assessment phases of the work.

The acquired information was organized into a database that included, among other data, the records of geographical positioning, living organisms and environments presence and status, sensitivity ranking, photographic records and other interpretative attributes. The information allows for the definition and location of sensitive species and habitats, providing the framework for the development of mitigation, management and restoration procedures for each specific case of potentially significant biological impact.

4.2 PHYSICAL ENVIRONMENT

The soils sampling plan was designed based on lateral transects on the ROW alignment and carrying out samplings using two trial pits, the first on the ROW and the second at approximately 30 to 50 m away. The pit descriptions were carried out in the most sensitive areas. In addition to the analysis of soil samples, a field data form was completed with complementary information as slopes, geology, altitude, and degree of sensitivity due to the pipeline construction activities. In the areas not visited by soils specialists, samples of organic soils were collected by the vegetation team for the corresponding chemical analyses.

4.3 SURVEY GAPS

The field survey was able to cover the entire length of the ROW, with the exception of the zone between KP 270+000 and 285+000. It was not possible to continue in this sector due to the high security risks presented by the illicit activities carried out in this zone and the logistical complexity due to the lack of water sources and inaccessibility to vehicles. The scoping and gap analysis did not indicate any areas of high biological priority to be present in this zone. The EFS used the ESIA information in order to complete this gap of the information.

5.0 ECOLOGICAL LANDSCAPE UNITS

5.1 INTRODUCTION

Based upon the findings of the field surveys, an analysis of the project footprint area has been developed, proposing a classification of ecological units that is more suitable for the development of the activities of the project.

This study has developed two classification scales: 1) the major ecological landscapes that exist on and characterize the ROW that will be named subsequently as Ecological Landscape Units (ELUs) and 2) the habitat types based on the local characteristics of soil moisture regimes and the physiognomy of the vegetation at a more detailed level within each ELU.

The delimitation of these Ecological Landscape Units (ELUs) along the ROW provides the overall template for the stratification of zones within which the sensitive elements and areas are identified. Additionally this subdivisional framework of the Project's region of influence facilitates the conceptualization, unification, and organization of the mitigation, management, restoration and environmental preservation activities into discrete and workable geographic zones that represent areas with unique characteristics and management requirements.

An ELU classification system has been defined that is intended to be understandable even for non-ecological specialists, while not diminishing its scientific and technical integrity. It is based primarily on the recognition of the macro-scale units with existing ecological similarity along the ROW, as for example valleys, mountains, plains, plateaus, or deserts in relatively wide tracts.

Fourteen major units of this type have been identified, which in order from east to west are: the Apurimac River Valley Montane Forest Ecotone, the Campana Watershed, the Torobamba River Valley, the Sillaccasa Sierra, the Yucay River Valley, the Huamanga-Vischongo Watershed Divide, the Vinchos River Valley, the Apacheta High Sierras, the Pampas-Palmitos River Basins, the Huaytará High Plains and Ridges, the Pisco-Ica Watershed Divide, the Coastal Bat Hills, the Pisco Sand Plains and the Ica-Lima Coastal Plain.

The spans and kilometers corresponding to these major ecological landscape units in relation to the pipeline and the minimum and maximum elevations for each unit are shown in Table 5.1.

Table 5.1. Level 1 - Ecological Landscape Units (ELUs)

No.	Ecological Landscape Units	KPs	Elevation (m)		Wet Season Precipitation Range (mm)
			Min.	Max.	
1	Apurimac River Valley Montane Forest Ecotone	0+000 – 20+511	2,966	4,066	600 - 2000
2	Campana Watershed	20+511 – 25+115	3,414	4,066	500 - 700
3	Torobamba River Valley	25+115 – 44+300	2,400	3,674	300 - 600
4	Sillaccasa Sierra	44+300 – 56+783	3,566	4,222	500 - 700
5	Yucay River Valley	56+783 – 74+199	2,850	3,864	500 - 700
6	Huamanga-Vischongo Watershed Divide	74+199 – 103+970	3,864	4,250	600 - 700
7	Vinchos River Valley	103+970 – 117+388	3,200	4,000	600 - 800
8	Apacheta High Sierras	117+388 – 162+137	3,841	4,900	700 - 1000
9	Pampas-Palmitos River Basins	162+137 – 195+050	4,000	4,700	700 - 1000
10	Huaytará High Plains and Ridges	195+050 – 249+538	4,000	4,650	400 - 800
11	Pisco-Ica Watershed Divide	249+538 – 272+181	2,850	4,000	300 - 500
12	Coastal Bat Hills	272+181 – 308+000	750	3,100	10 - 400
13	Pisco Sand Plains	308+000 – 332+940	256	750	0 - 50
14	Ica-Lima Coastal Plain	332+940 – 402+000	125	368	0 - 10

Source: Domus.

Appendix 23.6 presents a Photographic Gallery that shows images of representative landscapes and key findings taken during fieldwork, arranged by KPs and ELUs.

1. Apurimac River Valley Montane Forest Ecotone (KP 00+000 - 20+511)

The easternmost zone of the ROW begins near the upper limits of the montane forests of the Apurimac River Valley area of influence. This landscape is dominated by high elevation montane forest (23.50% of the length of the ROW within the ELU), much of which has been subjected to shifting agricultural practices historically, resulting in patches of degraded forests in various stages of recovery. The other natural habitats

are tussock (30.62%) and sward-forming (27.67%) grasslands and peat bog wetlands (8.92%). Actively cultivated areas occupy 9.29% of the ROW. The climate is cool and wet, as this zone is closest to the source of the moist Amazonian air masses and starts at an elevation of approximately 2,966 m at the lowest point near the Alfarpampa River and rising to just over 4,066 m. This unit includes the small settlements of Chiquintirca and Anchiguay. This area is known to harbor spectacled bears (*Tremarctos ornatus*), a wide-ranging Andean species that is listed as vulnerable by the International Union for the Conservation of Nature's (IUCN) *Red List of Threatened Species* and as endangered by Peru's National Institute of Natural Resources (INRENA). However, no bears were directly observed during either the ESIA or EFS field surveys.

2. Campana Watershed (KP 20+511 – 25+115)

From KP 20+511, the ROW rises rapidly into the highlands of the Campana area, with elevations from 3,414 to 4,066 m, which is also cool to cold and wet, dominated by sward-forming grassland (42.79%) and tall tussock grassland (30.23%), with minor areas of peat bog wetlands (20.76%). Cultivated areas occupy the remaining 6.21% of the ROW in the ELU. Large mammals reported here include white-tailed deer (*Odocoileus virginianus*) reported by ESIA and pumas or mountain lions (*Puma concolor*), a species listed as near-threatened by the IUCN and the INRENA. This area is home to an undescribed species of the lizard genus *Proctoporus* that was first collected by the EFS survey.

3. Torobamba River Valley (KP 25+115 – 44+300)

This ELU includes the Torobamba Valley and the Uras Valley, starting near the settlement of Cochas and progressing westwards to near Pampachacra and constitutes a landscape dominated by cultivated areas (41.18%) and thorny scrub (33.02%), with minor areas of the native resinous scrub (15.61%) deciduous dry forests (3.39%), and evergreen woodlands (2.67%). The Torobamba River crossing at approximately 2,400 m is the lowest point of the ROW in the Ayacucho Department and this is reflected by the warmer and drier climate, with seasonal rainfall during the summer months, producing subtropical tree crops such as avocadoes, pacay, and tangerines. The unique climate and the predominance of scrublands and dry forest are a result of a local rain shadow effect.[3] The dry valley belongs to the Apurimac Dry Forest System defined by Linares-Palomino (2004). A characteristic element of the dry forest remnants is the pati tree

[3] The rain shadow effect is created by the drying of moist air from the Amazon as it passes over the Andes from east to west. The east-facing slopes force the air to rise creating fog and rainfall in ELUS 1 and 2. As the air descends into the Torobamba Valley, it is warmed and becomes lower in relative humidity, creating drier conditions.

(*Eriotheca vargasii*), a species endemic[4] to the Apurimac system. The Torobamba Valley is also home to an endemic dry forest lizard, *Stenocercus* aff. *apurimacus*.

4. Sillaccasa Sierra (KP 44+300 - 56+783)

This mountain range separates the Mantaro (Yucay River to west) and Apurimac (Torobamba River to east) watersheds. The Cerro Sillaccasa is the highest point of this high mountain landscape, ranging from approximately 3,566 m to 4,222 m, which is nearly entirely dominated by tussock grasslands (82.64%), with small areas of sward-forming grassland (12.45%), peat bog wetlands (3.52%), resinous scrub (1.39%), and lagoons such as Laguna Yanacocha. The tussock grasslands contain an uncommon orchid of the genus *Aa*, which is usually found in localized damp conditions near small streams. A unique floristic element of the wetlands is *Myrmosodes* orchids, which are considered to be near-threatened by the INRENA. Listed animals include the puma (near-threatened under IUCN and INRENA) and Andean condor (*Vultur gryphus*), which is near-threatened in the IUCN list and endangered under the INRENA. Also, the silvery grebe (*Podiceps occipitalis*), listed as near-threatened by the INRENA, frequents the lagoons.

5. Yucay River Valley (KP 56+783 – 74+199)

Extensive cultivated areas around the villages of Chunucancha, Huaychao, Acocro, Tambo, Cuchucancha, and others occupy 81.76% of the ROW in this dry valley landscape of the upper Yucay River Basin, which, at 2,850 m, is the second lowest river crossing of ROW in the Ayacucho Department. Among the cultivated areas and villages, there are plantations of *Eucalyptus* (6.24%), used largely by local communities for firewood and timber. The patches of relict native vegetation are comprised of resinous (10.48%) and thorny (0.98%) scrublands. One peat bog was found along ELU 5 (0.26%). The natural vegetation is part of the Mantaro Dry Forest System (Linares-Palomino, 2004), which is recognized as biogeographically distinct from the dry forests of the Torobamba Valley. This difference is also reflected in the fauna, where each valley has a unique species of the *Stenocercus* Andean dry forest lizard, the Mantaro Basin endemic *Stenocercus frittsi* in the case of the Yucay Valley. The dry scrub vegetation includes various cacti, among which the more notable include the INRENA-endangered *Corryocactus quadrangularis* and the INRENA-vulnerable *Echinopsis peruviana puquiensis*. The shrub *Escallonia myrtilloides* was also found in this ELU and is listed as vulnerable by the INRENA. In the stream and riparian environments, an aquatic *Telmatobius* frog was observed as well as the widespread INRENA-near-threatened toad *Chaunus spinulosus*. *Telmatobius* frogs are generally considered threatened by the IUCN.

[4] Endemic species are those that are restricted to a certain geographic area, i.e. not widespread.

6. Huamanga-Vischongo Watershed Divide (KP 74+199 - 103+970)

The ROW rises up and follows the watershed divide between the Huamanga Valley (Mantaro Basin) to the north and the Vischongo River Basin (Apurimac Basin) to the south, passing almost entirely through tall tussock grassland (91.31%), with occasional narrow stretches of sward-forming grassland (2.53%), and peat bog wetlands (5.62%), and cultivated areas (0.54%). Elevations range from 3,864 to 4,250. Floristically, this ELU contains populations of the INRENA-vulnerable shrubs *Parastrephia quadrangularis* and *Escallonia myrtilloides*. The rarely observed Andean cat *Leopardus jacobitus* (IUCN/INRENA endangered) was sighted in this ELU by the EFS field team. The area has some importance for the production of the vicuña (*Vicugna vicugna*), a semi-wild relative of the llama with highly-valued wool. *Telmatobius* frogs are found in some of the small streams within the ELU, indicating high-quality habitat.

7. Vinchos River Valley (KP 103+970 - 117+388)

The ROW descends abruptly from the Huamanga-Vischongo watershed ridge top into a largely cultivated valley landscape (89.89%), with relict patches of resinous scrubland (8.63%) and tussock grassland (1.48%). The Vinchos River flows northward into the Mantaro basin, with an elevation of approximately 3,200 at the ROW crossing. To the west, the valley is limited by the Apacheta Mountains starting at about 4,000 m elevation. The Vinchos River Valley harbors various species of cacti, including the INRENA-vulnerable *Echinopsis peruviana puquiensis* and the regional endemic *Oroya peruviana*. The Vinchos River Valley is noted as the most important ELU for birds along the ROW route due the presence of numerous uncommon species observed during the EFS field survey; however, the only species considered sensitive is the bearded mountaineer hummingbird.

8. Apacheta High Sierras (KP 117+388 - 162+137)

West of the Vinchos River Valley, the ROW runs essentially from east to west over a series of ridges (3,841 to 4,900 m) in this high Andean landscape dominated by scarcely vegetated zones (39.26% of the ROW length), sward-forming grasslands (33.34%), tussock grasslands (14.34%), and peat bog wetlands (11.65%), with minor areas of cultivated areas (1.07%) and resinous scrublands (0.34%). This high area is subject to seasonal snow, primarily in June to July, but occasionally in all other months. While largely very sparsely vegetated, this ELU contains sensitive plant species such as *Ephedra americana* (INRENA near-threatened), *Escallonia myrtilloides* (INRENA vulnerable), *Oroya peruana* (regional endemic), *Perezia coerulescens* (INRENA vulnerable), and *Perezia pinnatifida* (INRENA vulnerable). Of particular note, a potentially new species of *Ribes* (currant or gooseberry) was collected by the EFS field team. This sparsely populated area harbors populations of sensitive mammals such as pumas or mountain lions and Andean cats (*Leopardus jacobitus*), While not observed by the EFS team, the ESIA reported sightings of the IUCN-endangered/INRENA-critically-endangered white-bellied cinclodes (*Cinclodes palliatus*), a bird endemic to high-Andean wetlands of central Peru.

9. Pampas-Palmitos River Basins (KP 162+137 - 195+050)

This is another high-Andean landscape with elevations ranging from 4,000 to 4,700 m and dominated by tussock grasslands (46.96%), sward-forming grasslands (31.82%) and scarcely vegetated areas (17.96%), with minor areas of peat bog wetlands (3.25%) in the valleys and drainages of the Pampas and Palmitos rivers, both of which are crossed by the ROW and drain into the Apurimac Basin. A potentially new species of *Liolaemus* lizard was collected by the field team in this ELU. Among the birds observed in the Pampas-Palmitos basins during the survey, the pale-tailed canastero (*Asthenes dorbignyi huancavelicae*) is listed by INRENA as vulnerable and was sighted in sward-forming grasslands.

10. Huaytará High Plains and Ridges (KP 195+050 - 249+538)

To the west of the steeper and more rugged mountain ranges, of ELUs 8 and 9, this landscape unit is comprised of relatively flat broad ridge tops, plains and rolling topography from 4,000 to 4,650 m in elevation, dominated by increasingly drier and lower-statured tussock grassland (61.69%) and sward-forming grassland (29.60%), with minor areas of scarcely vegetated areas (6.51%) and peat bog wetlands (2.13%). *Perezia coerulescens* (INRENA vulnerable) are relatively common elements of the sward-forming grasslands. Vicuñas are common in the grasslands of this ELU managed by the communities of the Ayaví district. The ESIA identified the Chaupi area (KP 202 to KP 205) as an Ecologically Sensitive Area due to the presence of numerous northern vizcachas (*Lagidium peruanum*); large rock-dwelling rodents that are of value to local communities as food item and are endemic to Peru.

11. Pisco-Ica Watershed Divide (KP 249+538 - 272+181)

To the west of the town of Huaytará, the mountain ridges narrow and descend from 4,000 to 2,850 m towards the Pacific coast. The vegetation changes abruptly from grasslands to mixed scrublands (78.93%) and spiny scrublands (20.27%), and desert scrub (0.80%). Of botanical interest, the INRENA-listed critically endangered *Chersodoma arequipensis* is a sensitive composite shrub that was encountered in this ELU by the EFS field team. A possibly undescribed species of *Microlophus* lizard was discovered by the field team in the high scrubland along the ROW alignment, well above 3,000 m in the eastern portion of this landscape and may represent the highest elevation locality for the genus (Appendix 23.5).

12. Coastal Bat Hills (KP 272+181 - 308+000)

In this high coastal desert landscape, the ROW runs largely along the ridges of local watershed divides (elevations from 750 to 3,100 m) through desert scrub (43.95%) before descending into the valley of the Seco River (elevations from 750 to 1,100 m) with columnar cacti and scrub (56.05%). This arid and rocky landscape is home to threatened species such as long-snouted bats (*Platalina genovensium,* IUCN-

vulnerable/INRENA-endangered) and the lizard *Microlophus tigris* (INRENA-NT). This unit corresponds to the Seco River Basin and is named after the presence of the *Platalina* bats as well as the Quebrada Murciélagos, which translates to "Bat Stream".

13. Pisco Sand Plains (KP 308+000 - 332+940)

This sandy desert landscape extends westward from the edge of the "Bat Hills" in the alluvial plains of the Seco River at about 750 m above sea level, running to parallel to east-west trending hills to the north, and entering the plains to the south of the Pisco River, descending gradually to an elevation near 256 m northwest of the Morón Lagoon. The land cover of this ELU is dominated by desert barrens (75.09%) without any substantial vegetative cover. Other zones (22.91%) are dominated by mat-forming bromeliads (*Tillandsia latifolia* and *Tillandsia palacea*) that lie upon the sandy substrates and obtain moisture directly from the fogs (*garua*) typical of the coastal deserts. There are isolated pockets of hydromorphic vegetation in depressional areas (0.23%), sometimes associated with open water, such the Morón and Bernal lagoons. These lagoons contain fish native to coastal Peru such as the green terror (*Aequidens rivulatus*), a species consumed occasionally by local communities. The INRENA-listed vulnerable lizard *Dicrodon heterolepis* was observed along the ROW during the EFS survey. The survey also documented that patches of hydromorphic vegetation in this ELU support populations of the slender-billed finch (*Xenospingus concolor*), a species listed as near threatened by the IUCN and vulnerable by INRENA.

14. Ica-Lima Coastal Plain (KP 332+940 – 402+000)

The final stretch of the ROW runs through the dry coastal plain of western Ica into the southern Lima department, at elevations of between just under 125 m (the Topará Stream crossing is the lowest point along the entire pipeline route) and 368 m. The dominant natural land cover is unvegetated desert (67.23%). Scattered patches of *Tillandsia* bromeliads are locally important (5.79%). Various seasonal streams and perennial rivers cross the plains and the ROW, some of which are lined by narrow belts of riparian vegetation (1.27% or 874 total linear meters). Despite its desert setting with annual precipitation of generally less than 10 mm, there are extensive cultivated areas under irrigation (25.71%). *Ctenoblepharys adspersa* and *Dicrodon heterolepis,* INRENA-listed vulnerable lizards, have been found along the ROW alignment in this landscape.

6.0 HABITATS

The second level of ecological classification is Habitats. These EFS identified 19 distinctive and differing habitats types which exist within the ELUs (first level of ecological classification, equivalent to a regional landscape). The habitats are largely determined by local physical characteristics (slope, relief, soil drainage, soil fertility, microclimate, etc.) and the land use history of the area, which is reflected by the characteristics of the general vegetation types (e.g., grasslands, wetlands, scrublands, and forests) and finer variations of these general categories (e.g., tussock grasslands versus sward-forming grasslands).

These habitat categories are described in the following paragraphs and summarized in Table 6.1.

Table 6.1. Habitat types identified along the Peru LNG Natural Gas Pipeline Right of Way.

Habitat Type	ELUs where present	Length along ROW (km)	Length along ROW (%)
Wetland and Riparian Areas			
Riparian vegetation	14	875	0.22%
Hydromorphic islands	13	58	0.01%
Peat bogs	1, 2, 4, 6, 8, 9, 10	13434	3.34%
Grasslands			
Sward-forming grassland	1, 2, 4, 6, 8, 9, 10	51517	12.82%
Tussock grassland	1, 2, 4, 6, 7, 8, 9, 10	98466	24.49%
Other Herbaceous Formations			
Tillandsia mats	13, 14	9712	2.42%
Scrublands			
Resinous scrub	3, 4, 5, 6, 7, 8, 11	6273	1.56%
Thorny scrub	2, 3, 5	11096	2.76%
Mixed scrub	11	17910	4.46%
Desert scrub	12	15924	3.96%
Forests			
Upper montane forest	1, 2	4821	1.20%
Dry deciduous forest	3	651	0.16%
Low broadleaf evergreen forest	3	513	0.13%

Cactus-dominated Formations			
Columnar cacti and scrub	12	20076	4.99%
Anthropogenic Areas			
Eucalyptus plantations	5	1088	0.27%
Cultivated areas	1, 2, 3, 5, 6, 7, 8, 14	55256	13.75%
Natural Unvegetated Areas			
Scarcely vegetated high-Andean areas	8, 9, 10	29173	7.26%
Coastal desert barrens	13, 14	65157	16.21%

The habitat types defined in these EFS correspond generally to Vegetation Units described in the ESIA. Notable improvements of the EFS classification include 1) the clarification of the nature of what the ESIA described as "Puna Scrubland", which in reality corresponds to Tussock Grassland with only scattered, if any woody plants and 2) the recognition of what was categorized as "Montane Shrubland" as a degraded phase of Upper Montane Forest.

Wetland and Riparian Areas

These are areas in which there is a distinctive presence of water, including those areas that are flooded permanently or seasonally inundated with water for a period of the year. Within this category, the following formations occur in the Project area:

Riparian vegetation

This type of formation is found along the banks of watercourses in the Ica-Lima Coastal Plain ELU. The composition of the flora is varied, including as common elements species of composites (*Tessaria, Baccharis*), grasses, and legumes, among others. The riverside areas usually have high ecological importance because they constitute habitats corridors, refuges, nesting areas, and places where fauna congregates, as well as for their roles in the stabilization of soils and flood control. Riparian thickets and forests in the coast of southern Peru are a key habitat of the slender-billed finch (*Xenospingus concolor*),

Hydromorphic islands

These are islands of distinctive vegetation found within isolated patches of seasonally or permanently waterlogged soil, and they are also of great importance as a habitat for the native fauna. In the coastal areas, they are characterized by the predominance of plants of the genera *Tessaria, Pluchea,* and *Typha*. These islands are also important for populations of the slender-billed finch in the Pisco Sand Plains ELU.

Peat Bogs

Peat bogs, known locally in Peru as *bofedales*, are high-Andean wetland formations, frequently dominated by the cushion-forming rush *Distichia muscoides*, which forms a

very dense peat, usually with a depth of several centimeters. The peat bogs are hydrologically critical for their high water retention and storage capacity, serving as sources and regulators of water for the lower reaches of the basins. Also, they are of biodiversity significance due to the presence uniquely adapted species; for example, some peat bog wetlands contain small orchids of the genus *Myrosmodes*. Mineral-rich peat bogs are the sole habitat of the white-bellied cinclodes (*Cinclodes palliatus*), an IUCN-endangered, INRENA-critically endangered bird endemic to the central Peruvian Andes. Peat Bogs are observed in seven of the fourteen ELU's, east of KP 250 which forms the edge of the Andean high plains and ridges.

Grasslands

Sward-forming grassland
These are herbaceous formations with a prevalence of diverse low-statured grasses and sedges, forming a more or less continuous sward or sod, without a dominance of tussock-forming species (i.e., bunchgrasses). Within these habitats, there may be many broadleaved herbaceous (forbs) or semi-woody plants, including small shrubs and cushion plants.

The term "cushion" means that these plants grow in a low, tight clump and have the appearance of a cushion. Cushion plants are more common in the higher elevations where their growth habit helps protect them from the dry air and cold. One of the representative species of cushion plants in the project area is *Plantago rigida*.

Tussock grasslands
These are herbaceous formations dominated by tussock-forming grasses (bunch grasses) of the genera *Stipa*, *Festuca, Jarava,* and *Calamagrostis,* collectively known locally as "ichu". The tussock grasslands are characterized by having a usually greater height than the sward-forming grasslands. These grasslands may also have scattered low forbs, shrubs, or cushion plants.

Both types of grasslands are important as natural grazing lands (rangelands) for both native and introduced livestock of the local communities.

Other Herbaceous Formations

Tillandsia *mats*
Tillandsias are small bromeliads (members of the pineapple family) which form extensive carpets or mats in coastal desert areas of Peru. These plants obtain moisture directly from fog, rather than from soil through roots. While these habitats are characterized by low diversity in species, they harbor endemic reptiles of conservation concern such as *Ctenoblepharys adspersa* sand lizards and *Phyllodactylus* geckoes.

Scrublands

The scrublands include habitats dominated by woody bushes and shrubs, often with grasses scattered between the shrubs. Scrublands are often associated with semi-arid environments, growing in areas too dry for larger trees and or dense grasslands, but with enough moisture to support low-growing drought-tolerant woody plants, often armed with spines, thorns, or chemical defenses (aromatic substances and resins in their leaves) to prevent animals from browsing upon them.

Resinous scrub
This is a formation with prevalence of shrubs, and with a peculiar dominance of species impregnated with resinous, aromatic substances. These species are commonly known as "tolas", and within them, there are several genera of the Asteraceae family (i.e., the composite or sunflower family), especially *Baccharis* and *Parastrephia*. This formation is characteristic of the flanks of the mountain range of the Andes.

Thorny scrub
This formation is dominated by thorny shrubs, primarily of the Solanaceae (*Dunalia*), Berberidaceae (*Berberis*), Fabaceae (*Acacia*) and Verbenaceae (*Duranta*) families, among others. These scrublands are locally important in biodiversity, often serving as habitat for rare bird species.

Mixed scrub
This category includes scrublands with a prevalence of non-resinous and non-thorny plants, belonging to varied plant families. These scrublands may be locally important in biodiversity, often serving as habitat for rare bird species such as the rufous-breasted warbling finch (*Poospiza rubecula*), an IUCN/INRENA endangered species endemic to western Peru. It is only observed in the Pisco-Ica Watershed Divide ELU.

Desert scrub
This formation is characteristic of the coastal foothill desert areas and has a preponderance of species of the Asteraceae and the Solanaceae, and scattered cacti, usually of low diversity. It is only observed in the Coastal Bat Hills ELU.

Forests

Upper montane forest
This formation corresponds to the high-elevation forests near the treeline in the eastern Andes and it is characterized by a high diversity of tall trees. The presence of endemic or threatened elements of flora or fauna is frequent in this formation, for example the Quenual tree (*Polylepis pauta*) and range-restricted species of orchids and frogs. It is observed in the Apurimac River Valley montane Forest Ecotone ELU and Campana Watershed ELU.

Dry deciduous Forest
This formation is characterized by the dominance of trees that lose their leaves during the dry season, typically of the Bombacaceae, Caricaceae, Anacardiaceae and Fabaceae families, among others, often with rare or endemic species. It is only observed in the Torobamba River Valley ELU.

Low broadleaf evergreen forest
This formation has a prevalence of broadleaf evergreen trees and shrubs of varied and composition (the term "evergreen" should not be interpreted to mean pine trees and their kin, but rather plants that do not lose their leaves during any specific period of the year). Although the presence of leaves is observed throughout the year, the canopy of the forest is not dense, but rather sparse. In some cases, unique or endemic species are usually found in this formation type.

Cactus-dominated Formations

Columnar Cacti and Scrub
This formation is characterized by the prevalence of isolated taller tree-like or "organ-pipe" cacti, usually over a meter in height, within which there are species of the genera *Armatocereus*, *Echinopsis* and others. Among the cacti are scattered shrubs. Some of the cacti and associated organisms in this formation are of conservation interest such as the long-snouted bat (*Platalina genovensium*), a species that feeds on the nectar of night-blooming cacti and which as categorized as vulnerable by the IUCN and as critically endangered by the INRENA. This also a habitat favored by the INRENA near-threatened lizard *Microlophus tigris*. It is only observed in the Coastal Bat Hills ELU.

Anthropogenic Areas

In these areas, there is prevalence of human activity that has significantly altered the natural components of the landscape, resulting in their replacement with anthropogenic habitats.

Eucalyptus *plantations*
Eucalyptus are hardy fast-growing trees of Australian origin that thrive in the Andes, even at elevations over 3,000 m and are found in the Yucay River Valley ELU. They are widely planted by local communities for firewood, timber, windbreaks, and other uses, and they are highly visible in the landscape due to their heights reaching over 20 m and dark evergreen foliage.

Cultivated areas
Native Peruvian communities have cultivated much of their landscape for various millennia, with a diversity of native crops, under both irrigated and dry land systems. Cultivated areas may still harbor considerable wild biodiversity in areas along canals and

field or terraces boundaries. Areas of intensively managed artificial pastures are included under this habitat category. This habitat is common along the RoW, occurring in eight different ELUs

Naturally unvegetated areas

There are many zones along the ROW alignment with a prevalence of bare exposed soil or rocks. In these areas the levels of diversity and plant biomass are extremely low.

Scarcely vegetated high-Andean areas
They are areas that include rocky areas and areas of exposed soil, characteristic of high-Andean areas and stretching form Apacheta High Sierras (KP 117) to the end of the Huaytara High Plains and Ridges ELU (KP 250).

Coastal Desert barrens
They are coastal areas where there is prevalence of exposed sandy substrate and without a significant macroscopic plant cover. They are observed only in the western segment of the RoW in the Pisco Sand Plains ELU and Ica – Lima Coastal Plain ELU between approximately KP 308 and KP 402.

7.0 SPECIES AND HABITAT SENSITIVITY

7.1 SPECIES SENSITIVITY

7.1.1 SPECIES SENSITIVITY CRITERIA

Each ELU contains species that, in accordance with their importance, can be identified as of either no, low, medium, or high sensitivity. To identify the category to which each species belongs, a scheme was developed that utilizes four criteria to evaluate the importance of the species. These criteria are: 1) protection status, 2) spatial distribution, 3) local use, and 4) mobility.

1. Protection Status

There are six different levels of protection that are defined by a species' categorization in the international IUCN[5] and national INRENA[6][7] lists of threatened species. In order to qualify the importance of each level an evaluation scale has been developed. The most protected status level is linked with the higher value of the scale and the lowest value for the species without protection status. Table 7.1 shows the description for each level and its respective quantification as applied by this study.

Currently, the IUCN uses a range of quantitative criteria for listing any taxon as Critically Endangered, Endangered, Vulnerable, Near Threatened, Least Concern, or Data Deficient. Meeting any one of these criteria qualifies a taxon for listing at that level of threat. The relevant factor is whether any one criterion is met, not whether all are appropriate or all are met. The criteria to be met are set in four categories: (1) reduction of population size, (2) geographic range, (3) population size by itself, and (4) quantitative analysis.

[5] IUCN. 2006. IUCN Red List of Threatened Species. Prepared by the IUCN Species Survival Commission. IUCN, Gland, Switzerland.
[6] Supreme Decree Nº 043-2006-AG. Categorization of Threatened Wild Flora.
[7] Supreme Decree Nº 034-2004-AG. Categorization of Threatened Wild Fauna Species.

Table 7.1. Species Sensitivity Criteria: Protection Status

Criteria: Protection Status			Quantification
Level	**Critically endangered (CR)**	A taxon is Critically Endangered when the best available evidence indicates that it is considered to be facing an extremely high risk of extinction in the wild.	6
	Endangered (EN)	A taxon is Endangered when the best available evidence indicates that it is considered to be facing a very high risk of extinction in the wild.	5
	Vulnerable (VU)	A taxon is Vulnerable when the best available evidence indicates that it is considered to be facing a high risk of extinction in the wild.	4
	Near Threatened (NT)	A taxon is Near Threatened when it has been evaluated against the criteria but does not qualify. However, it is close to qualifying for or is likely to qualify for a threatened category in the near future.	3
	Low (L)	Species categorized as Least Concern or Data Deficient by the IUCN. (These categories are not used by the INRENA.)	2
	Not Listed (N)	Widespread and abundant taxa which do not qualify for a threatened category	0

Source: Adapted from IUCN (2006).

2. Spatial Distribution

The spatial distribution criterion has defined three levels that describe how widely distributed a particular species is, that is whether is locally endemic, regionally endemic, or widespread. Table 7.2 describes each level and their quantification values. Locally endemic species receive a numerical score of 3 to reflect their higher inherent sensitivity due to their restricted geographic ranges. Regional endemics receive a score of 2 as they are more widespread, but still restricted to a particular geographic region, for example, the Central Andes Mountains of Peru. Widespread species are those found over a wide range of habitats, regions, countries, and even continents and are not scored because of their abundance and commonalty.

Table 7.2. Species Sensitivity Criteria: Distribution

Criteria: Spatial Distribution			Quantification
Level	**Local Endemic**	Only found in a specific biogeographic region, or only present in a small range in Peru.	3
	Regional Endemic	Found in part of the Andes or the coastal deserts.	2
	Widespread	Found widespread across major regions of South America or beyond.	0

Source: Domus.

3. Local Use

Local use of species is also defined on three levels: permanent use, seasonal use, and species without use. Table 7.3 shows their description and values on the quantification scale. Species utilized year round and frequently by local communities are assigned as score of 2, while those of only seasonal or occasional use are scored as 1. Species not used or only very rarely used are given a score of 0.

Table 7.3. Species Sensitivity Criteria: Local Use

Criteria: Local Use			Quantification
Level	**Permanent**	Used year round on and frequently	2
	Seasonal	Used seasonally or only occasionally	1
	Not used	Not used, or very rarely used	0

Source: Domus.

4. Mobility

The mobility criterion relates to the ability of an organism to move or flee in order to avoid a disturbance. Table 7.4 describes the two mobility categories: mobile and immobile. Small animals with limited ability to flee from their sites of refuge or perches, such as most reptiles, amphibians, and small mammals, are considered to be immobile and most susceptible to direct impacts of the clearing and grading activities associated with the open of pipeline rights of way, and are thus assigned a score of 3. Likewise, all

plants are considered to be immotile and are assigned a score of 3. Most birds and larger mammals, such as cats, sheep and camelids are readily able to flee from disturbances and are unlikely to be directly impacted by clearing and grading activities and are thus assigned a score of 0.

Table 7.4. Species Sensitivity Criteria: Mobility

Criteria: Mobility			Quantification
Level	**Immobile**	An organism which cannot move (i.e., plants), or which uses a very small or limited home range (e.g. small rodents, small reptiles and amphibians) and does not flee rapidly from its refuge when disturbed.	3
	Mobile	Organisms with the ability and tendency to flee or take flight upon being disturbed, such as adult birds and larger mammals.	0

Source: Domus.

7.1.2 Species Sensitivity Categories

A species sensitivity classification scheme was developed to identify to which category a species belongs. The quantification values of each criterion described above are summed for each species. High Sensitivity species are those with 11 or more points, Medium Sensitivity species are those with from 6 to 10 points. Species with 1 to 5 points are categorized as Low Sensitivity, and those with 0 points are considered to be of No Sensitivity. Table 7.5 shows the value range of each sensitivity classification.

Table 7.5. Value Range for Species Sensitivity

Category	Range
High	11 or higher
Medium	6 - 10
Low	1 - 5
None	0

Source: Domus.

Complete listings of the species observed during the EFS field survey are presented under the description of each ELU, including the sensitivity criteria values described above.

7.2 HABITAT SENSITIVITY

According to the Inter-American Development Bank (IDB) *Environment and Safeguards Compliance Policy*, a Critical Habitat is:

> "a subset of both natural and modified habitat that deserves particular attention. Critical habitat includes areas with high biodiversity value[8], including habitat required for the survival of critically endangered or endangered species[9], areas having special significance for endemic or restricted-range species; sites that are critical for the survival of migratory species; areas supporting globally significant concentrations or numbers of individuals of congregatory species; areas with unique assemblages of species or which are associated with key evolutionary processes or provide key ecosystem services; and areas having biodiversity of significant social, economic or cultural importance to local communities".

Following the IDB criteria, the EFS utilizes the results of the Species Sensitivity Analysis to develop a Habitat Sensitivity Analysis that considers the presence of High and Medium sensitivity species identified in each habitat of each ELU.

The habitat sensitivity analysis for a habitat within an ELU considers the number of medium and high sensitivity species present in that unit. A High Sensitivity Habitat is defined as a discrete and defined habitat within a specific ELU, which either contains at least one High Sensitivity species or at least seven Medium Sensitivity plant species or five Medium Sensitivity animal species.

A Medium Sensitivity habitat is defined as containing at least two Medium Sensitivity animal species or at least three Medium Sensitivity plant species. Low Sensitivity habitats are those that contain no High Sensitivity species, one or no Medium Sensitivity animal species, and not more than two Medium Sensitivity plant species. Table 7.6 shows the value range for habitat sensitivity.

[8]Such as areas that meet the criteria of the World Conservation Union (IUCN) classification.

[9]As defined by the IUCN Red List of Threatened Species or as defined in any national legislation.

Table 7.6. Value Range for Habitat Sensitivity

Category	Range
High	1 or more High Sensitivity Species
	7 or more Medium Sensitivity Plant Species or 5 or more Medium Sensitivity Animal Species
Medium	3 or more Medium Sensitivity Plant Species or 2 or more Medium Sensitivity Animal Species
Low	2 or fewer Medium Sensitivity Plant Species or 1 or no Medium Sensitivity Animal Species

Source: Domus.

General ESIA commitments and ECOMP and ecological good practice procedures are applicable to all High, Medium, and Low Sensitivity Habitats. In accordance with International Finance Corporation (IFC) and IDB policies, High Sensitivity Habitats[10] should be avoided by construction activities or otherwise will require more significant levels of protection, mitigation, or compensation, including site-specific mitigation measures.

The details of the results of the Habitat Sensitivity Analysis are shown in Appendix 23.7.

[10] Equivalent to IFC "Critical Natural Habitats" or IDB "Critical Habitats".

8.0 ELU 1: APURIMAC RIVER VALLEY MONTANE FOREST ECOTONE (KP 00+000 - 20+511)

8.1 GENERAL DESCRIPTION

The easternmost zone of the ROW passes along the upper limits of the montane forests of the Apurimac River Valley. This landscape has remnant patches of high elevation montane forest and scrublands, but has been subject to shifting agricultural practices, resulting historically in patches of degraded forests in various stages of recovery. From KP 07+500 to 11+000 close to the Sachapampa River, colluvial soils are very sensitive to water erosion process and landslides can occur during the wet season.

The climate is cool and wet, as this zone is close to the source of the moist Amazonian air masses but has elevations between 2,966 and 4,066 m. This ELU includes the small rural communities of Chiquintirca, Jollpa, and Anchihuay.

This ELU contains Highly Unstable areas[11] (KP 01+000 – 2+500; 08+400 – 11+000) that are very susceptible to mass wasting processes such as landslides and erosion.

8.2 PHYSICAL CHARACTERISTICS

This section describes the precipitation, geology, soils, water bodies, infrastructure and physical risk factors within the Apurimac River Valley Montane Forest Ecotone ELU

8.2.1 PRECIPITATION

Precipitation is highly seasonal. The wet season is from January to March, and is known locally as the "winter" or rainy season, even though it actually corresponds with the climatologically-defined austral summer. The dry season extends from April to December. Table 8.1 shows precipitation values for each season.

[11] Highly Unstable areas are defined by the ESIA, Vol. IIA, Section 5.4.

Table 8.1. Precipitation – ELU 1

KP Range	Estimated Precipitation (mm)	
	Peak (January – March)	General (September – April)
00+000 – 02+000	500 - 800	1000 - 2000
02+000 - 03+000	400 - 500	800 - 1000
03+000 - 07+000		700 - 800
07+000 - 13+000		800 - 1000
13+000 - 17+000		700 - 800
17+000 - 20+511		600 - 700

Source: ESIA, Vol. IIA.

8.2.2 GEOLOGY

The geological units of the Apurimac River Valley Montane Forest Ecotone landscape include slates, limestones, and sandstone, to a lesser extent siltstones and marls, sometimes alternating with superficial glacial and alluvial deposits of the Quaternary geologic period. The rocks of this ELU are very hard and do not pose significant risks of instability except for very isolated sectors, where highly fissured slates and marls are present. Stocks of porphyritic andesites (around KP 2+000), are found on Atampa Hill, which flanks Jollpa Stream to the northwest of Chiquintirca.

There is no risk of acid rock drainage (ARD) in this ELU.

8.2.3 SOILS

Soils are Entisols and Inceptisols with shallow to deep organic surface horizon and soil fertility is generally low based on the low levels of phosphorus typical in most of the soils. Soils have a strongly acidic pH (typically less than 5.5). Soils typically are of medium depth along the whole ELU, despite the variable slope. Organic matter content is high at several KPs, where soil samples were analyzed.

The soils present low fertility on the basis of available levels of phosphorus as shown in Table 8.2.

Table 8.2. Surface Horizon Characteristics - ELU 1

KP	pH	Surface horizon depth	Organic matter	Fertility	Slope (%)
00+500	Strongly acid	Medium	High	Low	60%
05+000	Strongly acid	Medium	High	Low	20%
15+000	Strongly acid	Medium	High	Low	20-40%

Source: ESIA, Domus.
pH: Strongly acid = Less than 5.5; Moderately acid = 5.6 to 6.0; Slightly acid = 6.1 – 6.5; Neutral = 6.6 - 7.0; Slightly alkaline = 7.1 – 7.8; Moderately alkaline = 7.9 to 8.4; Strongly alkaline = 8.5 or greater.
Surface horizon depth: Low = Less than 5 cm; Medium = 5 cm to 15 cm; High = More than 15 cm.
Organic matter: Low = Less than 2%; Medium = 2% to 4%; High = More than 4%.
Fertility based on Available Phosphorus: Low = Less than 7.0 ppm; Medium = 7.0 to 14.0 ppm; High = More than 14.0 ppm.

8.2.4 WATER BODIES

Within ELU 1, the ROW crosses three rivers (Alfarpampa, Qollpa and Sachapampa), and the Cochas bog, at KP 14+500. The ROW runs above the Jejamachay stream between approximately KP 7+200 to 9+800 and the Sachapampa river between approximately KP 10+000 to KP 14+500. The ROW does not cross lagoons or lakes in this ELU. Details are shown in Table 8.3.

Table 8.3. Principal Waterbody Crossings - ELU 1

Waterbody Type or Name	KP Mid-channel	Elevation (m)
Arroyos		
ARROYO	19+766.58	3928.65
Quebradas		
QUEBRADA	475.71	3013.99
QUEBRADA	4+503.45	3641.3
QUEBRADA	4+800	3562
QUEBRADA	5+031.39	3562.2
QUEBRADA	5+682.76	3702.9
QUEBRADA	5+974.37	3773.1
QUEBRADA	6+313.72	3861.3
QUEBRADA	6+811.78	3759.8
QUEBRADA	7+323.23	3663.1
QUEBRADA	7+591.88	3600
QUEBRADA	7+871.28	3532.2
QUEBRADA	8+404.55	3474
QUEBRADA JEJAMACHAY	8+861.99	3409.5
QUEBRADA JEJAMACHAY	9+013.88	3373.7
QUEBRADA	10+469.67	3330.6

QUEBRADA	11+270.65	3307.9
QUEBRADA	11+302.51	3313.6
QUEBRADA	11+419.39	3315.3
QUEBRADA	11+865.27	3370.3
QUEBRADA	11+898.06	3368.6
QUEBRADA	12+524.41	3391.9
QUEBRADA	13+068.51	3403.7
QUEBRADA	13+127.96	3405.9
QUEBRADA	13+193.56	3409.6
QUEBRADA	13+572.87	3429.4
QUEBRADA	17+347.16	3989.4
QUEBRADA	18+217.95	3933.1
QUEBRADA	19+010.83	3720.63
QUEBRADA	19+900	3932
Rivers		
ALFARPAMPA	0+196.09	2976.52
QOLLPA	0+475.71	3013.99
SACHAPAMPA	9+884.19	3199.6

Source: Peru LNG Pipeline Project Alignment Sheets (Gulf Interstate Engineering, 2006).

In addition to the rivers and streams, there are 3 peat bog crossings with a total length of 957 m approximately at KP 6+000 to 8+000. The Row passes near two peat bogs between KP 14+000 and 15+000 and approximately KP 20+300 to 20+500 (see Table 8.8 for more details).

8.2.5 INSTABILITY AND PHYSICAL RISK

Highly Unstable areas occupy the greatest proportion of the ROW length at 34.9%, with the other two categories split almost evenly. Table 8.4 shows the risk evaluation data.

Table 8.4 Instability and Physical Risk Levels – ELU 1

Risk Level	Kp Start	KP Finish	Length (m)	
Low	00+000	00+647	647	6834
	04+970	05+250	280	
	05+590	05+930	340	
	06+790	06+890	100	
	06+890	07+000	110	
	07+000	07+772	772	
	07+772	07+894	122	
	08+362	08+718	356	
	10+970	11+608	638	
	12+342	13+130	788	
	13+130	13+500	370	
	13+500	13+795	295	
	13+795	13+917	122	
	13+917	14+384	467	
	14+384	14+529	145	
	14+529	15+120	591	
	18+719	19+039	320	
	19+975	20+243	268	
	20+243	20+346	103	
Medium	01+380	04+970	3590	3840
	05+250	05+500	250	
High	00+647	01+380	733	9672
	05+500	05+590	90	
	05+930	06+790	860	
	07+894	08+362	468	
	08+718	10+970	2252	
	11+608	12+342	734	
	15+120	18+719	3,599	
	19+039	19+975	936	

Source: ESIA, Environmental Baseline.

8.2.6 INFRASTRUCTURE

No roads are crossed by the ROW in ELU 1. However, the project has planned the construction of a 4.2-km access road, starting in San Miguel to KP 04+255. Also, the construction of 5 shooflies is planned at approximately KPs 8+000, 10+000, 15+000, 17+000 and 20+000. A Base Camp is proposed in KP 00+500 and two Mobile Camps in KP 05+330 and KP 12+594, located in Japes and Anchihuay respectively. Table 8.5 shows infrastructure information.

Table 8.5. Planned Project Infrastructures – ELU 1

Type of Infrastructure	KP*	Name	Action	Related to
Camps	00+500	Sector PS3	Topsoil Protection / Erosion control devices and slope revegetation	ECOMP/RP
	05+330	Movil Japes	Topsoil Protection	ECOMP/RP
	12+594	Movil Anchihuay	Topsoil Protection	ECOMP/RP
Access roads	04+255	4.237	Topsoil protection / Erosion control devices and slope revegetation	ECOMP/RP
Shooflies	08+376	V152 to V156	Topsoil protection / Erosion control devices and slope revegetation	ECOMP/RP
	10+003	V142 to V144	Topsoil protection / Erosion control devices and slope revegetation	ECOMP/RP
	15+155	V100 to V115	Topsoil protection / Erosion control devices and slope revegetation	ECOMP/RP

	17+717	V100 to V104	Topsoil protection / Erosion control devices and slope revegetation	ECOMP/RP
	20+429	Secar Putaja	Topsoil protection / Erosion control devices and slope revegetation	ECOMP/RP

***KP as indicated by the ESIA provided for reference only**
Source: ESIA, Project Description.

8.3 HABITATS AND SPECIES

8.3.1 HABITAT DISTRIBUTION

The habitats of ELU 1 are listed in sequential order in Table 8.6, including the length of each habitat unit and associated start and finish ROW KPs. Table 8.7 presents habitat lengths over the ROW, including subtotals for each habitat type.

Table 8.6. Habitats Sequence – ELU 1

Habitat Type	Length (m)	KP Start	KP Finish
Cultivated areas	589	00+000	00+589
Intact Upper Montane Forest	134	00+589	00+723
Degraded Upper Montane Forest	809	00+723	01+532
Tussock grassland	2048	01+532	03+580
Degraded Upper Montane Forest	463	03+580	04+043
Cultivated areas	660	04+043	04+703
Degraded Upper Montane Forest	74	04+703	04+777
Sward-forming grassland	180	04+777	04+957
Peat bogs	26	04+957	04+983
Sward-forming grassland	1387	04+983	06+370
Tussock grassland	408	06+370	06+778
Peat bog	138	06+778	06+916
Tussock grassland	84	06+916	07+000
Sward-forming grassland	437	07+000	07+437
Peat bogs	432	07+437	07+869
Sward-forming grassland	82	07+869	07+951
Degraded Upper Montane Forest	1733	07+951	09+684

Cultivated areas	497	09+684	10+181
Intact Upper Montane Forest	61	10+181	10+242
Degraded Upper Montane Forest	1221	10+242	11+463
Tussock grassland	1273	11+463	12+736
Peat bogs	494	12+736	13+230
Cultivated areas	159	13+230	13+389
Sward-forming grassland	408	13+389	13+797
Peat bog	118	13+797	13+915
Sward-forming grassland	610	13+915	14+525
Peat bog	183	14+525	14+708
Sward-forming grassland	156	14+708	14+864
Upper montane forest	326	14+864	15+190
Sward-forming grassland	1177	15+190	16+367
Tussock grassland	2307	16+367	18+674
Sward-forming grassland	624	18+674	19+298
Peat bog	296	19+298	19+594
Sward-forming grassland	374	19+594	19+968
Peat bog	95	19+968	20+063
Sward-forming grassland	188	20+063	20+251
Peat bog	48	20+251	20+299
Sward-forming grassland	52	20+299	20+351
Tussock grassland	160	20+351	20+511

Source: ESIA Biological Baseline Map 2-1 and Domus

Table 8.7. Habitat Summary – ELU 1

Habitats		**Length (m)**	**KP Start**	**KP Finish**
Cultivated areas		589	00+000	00+589
		660	04+043	04+703
		497	09+684	10+181
		159	13+230	13+389
Subtotal		**1,905**	**9.29%**	
Upper Montane Forest	Intact	134	00+589	00+723
		61	10+181	10+242
	Degraded	809	00+723	01+532
		463	03+580	04+043
		74	04+703	04+777
		1733	07+951	09+684
		1221	10+242	11+463
		326	14+864	15+190

Subtotal	**4,821**	**23.50%**	
Peat bogs	26	04+957	04+983
	138	06+778	06+916
	432	07+437	07+869
	494	12+736	13+230
	118	13+797	13+915
	183	14+525	14+708
	296	19+298	19+594
	95	19+968	20+063
	48	20+251	20+299
Subtotal	**1,830**	**8.92%**	
Sward-forming grassland	180	04+777	04+957
	1387	04+983	06+370
	437	07+000	07+437
	82	07+869	07+951
	408	13+389	13+797
	610	13+915	14+525
	156	14+708	14+864
	1177	15+190	16+367
	624	18+674	19+298
	374	19+594	19+968
	188	20+063	20+251
	52	20+299	20+351
Subtotal	**5,675**	**27.67%**	
Tussock grassland	2048	01+532	03+580
	408	06+370	06+778
	84	06+916	07+000
	1273	11+463	12+736
	2307	16+367	18+674
	160	20+351	20+511
Subtotal	**6,280**	**30.62%**	
Total ELU 1:	**20,511**		

Source: ESIA, Domus.

8.3.2 Habitat Descriptions

Upper Montane Forest

The Upper Montane Forest has a local predominance of the quenual tree (*Polylepis pauta*), a species categorized as vulnerable by the IUCN and near threatened by the INRENA. In addition, this habitat can be characterized by the presence of various species of terrestrial and epiphytic orchids.

Gomphichis sp. terrestrial orchids are scarce and prefer rocky areas. *Pleurotalis* sp. was found within bushes. *Stelis* sp. and *Helianthus* sp., are epiphytic orchids, located on tree branches. These orchids are not considered to be sensitive species because they belong to widespread genera, but temporary or permanent relocation can be taken into account. Orchids constitute a very important group for Peruvian authorities because of their potential economic importance.

Less dense Upper Montane Forest was identified in the ESIA as Montane scrubland. The ESIA found *Weinnmania* spp., *Styrax andinus* and *Clusia* spp. as frequent tree species in this habitat type. The undercanopy strata includes *Morus insignis, Vallea stipularis* and *Hesperomeles* cf. *lanuginosa*, and *Chusquea* sp. A diversity of ferns and mosses cover the area during the humid season. Bushes in the transition, ecotone area, belong to *Hyptidendron* cf. *arboretum*, *Baccaharis latifolia, Rhynchoteca spinosa* and *Brachyotum naudinii*. The forestry inventory done by the ESIA revealed for the Upper Montane Forest, 580 trees and 89.54 m^3 per hectare.

Tussock grassland

Tussock grasslands in this ELU are likely a consequence of long-term degradation of the original Upper Montane Forest. *Festuca dolichophylla* and *Stipa obtusa* are the predominant species in tussock grassland habitat type, including almost 50% of the plant abundance.

Sward-forming grassland

In the Sward-forming grassland habitat type, the most common species are the grasses *Calamagrostis vicunarum,* and *Aciachne pulvinata*. Sward-forming grasslands are very important being used as preferred pastures and, like the tussock grassland, appear to be a result of historical human impacts in this ELU.

Peat bogs

Small peat bogs areas were found but with little ecological or economical importance. *Distichia muscoides, Plantago tubulosa*, and *Hypochaeris taraxacoides* are the most abundant species in this habitat type, and are common in other bogs along the ROW.

Cultivated Areas

Much of this ELU has been subjected to shifting cultivation practices and present approximately 19% of the ROW length is under recent cultivation of crops and pastures.

Key Fauna

A typical large mammal of this ELU is the spectacled bear (*Tremarctos ornatus*), that was reported by local people in the Chiquintirca area. However, none were directly

observed during either the ESIA or EFS field surveys. Other mammals registered are the northern vizcacha (*Lagidium peruanum*) and the skunk *Conepatus chinga.*

The puma or mountain lion (*Puma concolor*), listed as near-threatened by the IUCN and the INRENA, has been registered in this ELU. The White-tailed deer (*Odocoileus virginianus*) were reported by the ESIA in this area.

This ELU has high bird diversity, including the creamy-crested spinetail (*Cranioleuca albicapilla*), an endemic range-restricted species of the southern Andes of Peru. In addition, the black-faced Ibis (*Theristicus melanopis*) was found associated with wetlands, the white-tailed shrike tyrant (*Agriornis ardicola*) and the bearded Mountainer (*Oreotrochilus melanogaster*) was also recorded in this ELU.

EFS reptile and amphibian specialists found two potentially new species in this ELU: a lizard of the genus *Proctoporus* and a frog of the genus *Phrynopus*. The IUCN has categorized most species of *Phrynopus* as threatened due to the highly localized distributions and the threats to their habitats.

Rainbow trout (*Oncorhynchus mykiss*) have been recorded in the area, an introduced species that is a predator of native aquatic fauna, but which is considered an important resource by local communities. This species was reported near Anchihuay, 150 m away from the ROW in the Sachapampa River (KP 10+000) and again near KP 14+500 (Cochas peat bog).

Hydrobiology

Along each ELU, water bodies were sampled in order to determine any salient characteristic, including notable or dominant species. Table 8.8 presents all water bodies sampled in ELU 1 along with their locations and important species found. For ELU 1, samples of the trout, *Onchrhynchus mykiss*, which is a species of high economic importance for the surrounding communities, was found in two of the stations.

Table 8.8. Water bodies Sampled– ELU 1

Station	Habitat	Waterbody	Name	Height (m)	KP	Species
Hi-40	Altoandino	Laguna	Yanapaccha	3930	17+000	
Hi-41	Altoandino	Bofedal	Cochas	3404	14+500	*Oncrhynchus mykiss*
Hi-42	Interandino	Río	Sachapampa	3171	10+000	*Oncrhynchus mykiss*
Hi-43	Interandino	Quebrada	Qollpa	3033	0+500	
Hi-44	Interandino	Río	Alfarpampa	2971	0+000	

8.3.3 SPECIES SENSITIVITY ANALYSIS

Table 8.9 shows the high and medium sensitivity species found during the EFS fieldwork, based on the species sensitivity criteria presented in Section 7.1 of these EFS.

Table 8.9. Species Sensitivity Criteria – ELU 1

No	Species	Protection Status						Spatial Distribution			Local Use			Mobility		Σ
		CR	EN	VU	NT	L	N	Local	Regional	Widespread	Permanent	Seasonal	None	Immobile	Mobile	
	Plants															
	Aciachne pulvinata						0		2				0	3		5
	Calamagrostis vicunarum						0				2			3		5
	Distichia muscoides						0					1		3		4
	Festuca dolichophylla						0				2			3		5
1	*Gomphichis* sp.						0		2				0	3		5
	Hypochaeris taraxacoides						0		2					3		5
2	*Oncidium* sp.						0		2				0	3		5
	Plantago tubulosa						0									0
3	*Pleurothallis* sp.						0		2					3		5
4	*Polylepis pauta*				3					0	2			3		8
5	*Stelis* sp.						0		2					3		5
	Stipa obtusa						0			0			0	3		3
	Fish															
6	*Oncorhynchus mykiss*						0				2			3		5
	Reptiles and amphibians															
12	*Gastrotheca marsupiata*								2				0	3		5
7	*Eleutherodactylus discoidalis (sensus latus)*							3		0			0	3		6
8	*Phrynopus* sp.		5					3					0	3		11
9	*Proctoporus* sp.						0	3					0	3		6
10	*Tachymenis peruviana*						0			0			0	3	0	3
	Mammals															
11	*Akodon* cf. *torques*								2				0		0	2
12	*Odocoileus virginianus*									0			0		0	0
13	*Tremarctos ornatus*		5						2		2				0	9
19	*Conepatus chinga*						0			0			0		0	0
20	*Lagidium peruanum*						0	3			2				0	5
21	*Oligoryzomys* cf. *destructor*									0			0		0	0
22	*Phyllotis* cf. *xanthopygus posticalis*							3		0	2		0		0	5
23	*Puma concolor*				3					0			0		0	3
	Birds															
24	*Agriornis andicola*			4					2				0		0	6

14	*Ampelion rubrocristatus*									0			0		0	0
15	*Anisognathus igniventris*									0			0		0	0
16	*Anairetes parulus*									0			0		0	0
17	*Aratinga mitrata*								2				0		0	2
18	*Asthenes* sp.								2				0		0	2
19	*Basileuterus luteoviridis*									0			0		0	0
20	*Bolborhynchus orbygnesius*									0			0		0	0
21	*Buthraupis montana*									0			0		0	0
22	*Coeligena violifer*									0			0		0	0
23	*Contopus cinereus*									0			0		0	0
24	*Cranioleuca albicapilla*							3					0		0	3
25	*Crotophaga ani*									0			0		0	0
26	*Diglossa cyanea*									0			0		0	0
27	*Eriocnemis sapphiropygia*								2				0		0	2
28	*Euphonia laniirostris*									0			0		0	0
30	*Hemispingus superciliaris*									0			0		0	0
29	*Iridosornis analis*								2				0		0	2
30	*Margarornis squamiger*									0			0		0	0
31	*Metallura aeneocauda*							3					0		0	3
32	*Myiarchus tuberculifer*									0			0		0	0
33	*Myioborus miniatus*									0			0		0	0
32	*Myioborus ornatus*								2				0		0	2
33	*Notiochelidon flavipes*								2				0		0	2
34	*Oreotrochilus melanogaster*							3					0		0	3
34	*Ochthoeca rufipectoralis*								2				0		0	2
35	*Patagioenas fasciata*									0			0		0	0
36	*Patagioenas plumbea*									0			0		0	0
37	*Phrygilus erythronotus*								2				0		0	2
37	*Progne tapera*									0			0		0	0
38	*Psilopsiagon aurifrons*									0			0		0	0
39	*Pygochelidon cyanoleuca*									0			0		0	0
40	*Schizoeaca* sp.							3					0		0	3
41	*Schizoeaca vilcabambae*							3					0		0	3
42	*Scytalopus parvirostris*								2				0		0	2
43	*Sporophila luctuosa*									0			0		0	0
44	*Synallaxis azarae*									0			0		0	0
45	*Synallaxis unirufa*								2				0		0	2

40	*Theristicus melanopis*			4					2				0		0	6
46	*Thlypopsis rufieps*								2				0		0	2
47	*Troglodytes solstitialis*									0			0		0	0
48	*Turdus chiguanco*									0			0		0	0
49	*Vireo leucophrys*									0			0		0	0
50	*Turdus fuscater*									0			0		0	0

Protection Status*:
CR= Critically endangered 6 points
EN= Endangered 5 points
VU= Vulnerable 4 points
NT= Near threatened 3 points
B= Low (Others) 2 points
N= Not listed 0 points

Σ= Sensitivity value

1 - 5: Low
6 - 10: Medium
11 or higher: High

Species Distribution:
Local = (Endemic locally or to an EBA**) 3 points
Regional = (Regional endemic in Andes or Coast) 2 points
Widespread = (Across S. America or cosmopolitan) 0 points

Mobility:
Immobile = (restricted movement or in very short distance) 3 points
Mobile = 0 points

Local Uses:
Permanent= 2 points
Seasonal = 1 point
None = 0 points

***Protection Status:** According IUCN (2006) or National Legislation (D.S. No. 034-2004-AG/D.S. No. 043-2005-AG)
****EBA:** Areas determined by Birdlife International, which includes at least 2 bird species with less than 50,000 km2 of known distribution range.

8.3.4 Habitat Sensitivity Analysis

Based on the presence of high and medium sensitivity species presented in Table 8.9, the Upper Montane Forest, the Tussock Grassland and the Sward-forming Grassland habitats of the Apurimac River Valley Montane Forest Ecotone ELU are considered to be of Medium Sensitivity due to the presence of three, two and three Medium Sensitivity animal species respectively. None of the other habitats in this ELU meet the criteria for a high or medium sensitivity habitat as described in Section 7.2 of these EFS.

8.4 Key Issues and Recommendations

Precipitation

High precipitation values in the first two km of the ROW should be taken into consideration for the planning and execution of construction activities in relation to possible environmental impacts for all project activities, as higher and more intense precipitation on exposed soils will result in surface runoff, erosion, and sediment mobilization into adjacent water bodies.

Physical Risk

Taking into account wet season precipitation values (1,000 to 2,000 mm) in the first two KP of the ROW, the section between KP 01+000 and KP 02+700 could be a high risk area along with specific sections of the area between KPs 05+500 and KP 20+000. Approximately 37.5% of the ROW length is classified as Highly Unstable, with a high risk of mass wasting along the ROW especially during the rainy season. Erosion control during the construction phase must be focused on avoiding mass wasting and topsoil conservation practices with special focus on the implementation and maintenance of erosion control measures during the rainy season and especially on long, steep slopes and in the vicinity of water bodies.

There is a small section between KP 1+380 and 5+500 classified as a medium risk level area. Mass wasting risk in the rest of the ROW (33.6%) is quite low.

Soils

Bulk density and mechanical resistance of soils are high, creating a potential for compaction problems if soils are not properly managed. Careful attention should be placed on the handling of topsoil, particularly when wet, in the site clearance and grading and reinstatement phase.

A low to medium topsoil layer and low fertility are common characteristics of these types of soils. If these factors combine with steep slopes, erosion risk will be higher during the construction phase, where the ground loses it protective topsoil and vegetation cover. And it is a complicated zone for remediation during the restoration activities. According to this, it is important to consider fertilization in this ELU in site specific locations, especially close to water bodies and steep slopes where soil enrichment may accelerate the rate of revegetation and therefore ground stabilization. As the ELU has high levels of precipitation and steep topography, there is a need to promote vegetation quickly, in order to protect the soils. During the construction phase temporary erosion control devices such as silt fences, slope breakers and wooden barriers must be implemented and maintained and the topsoil must be protected with geojute and the establishment of vegetative cover.

Superficial topsoil in this ELU requires good practice protection during construction activities to ensure as much soil is returned to the ROW during reinstatement to facilitate ROW stabilization and habitat restoration. This will involve adequate topsoil stripping during site preparation and clearance, erosion control from the stockpile and protection from mixing and contamination by the materials such as earthworks subsoil and trench spoil.

Water bodies and Wetlands

Rivers and stream protection should be enforced, including peat bogs and other water bodies along the ROW, by designing and implementing temporary measures to prevent sedimentation of these water bodies and accelerated erosion of stream and river banks. Pollution prevention and control good practices should be adopted to control and minimize the risk of hydrocarbon contamination of wetlands and sensitive wetlands habitats.

There are also important peat bog areas (14+500) that provide important environmental services for local people and habitat for birds; these require special consideration for avoiding impacts by the construction works. Measures should be implemented where needed to protect the streams, lagoons, and bogs along the ROW. The EFS considers peat bogs as a special concern that requires particular attention as set out in the ESIA, which includes the control of the ROW width (25 m) and an accelerated construction program where practicable to minimize time disturbance in this locality. As part of the ECOMP measures, it is important to protect the topsoil and the natural vegetation during the construction phase in order to restore the habitat as close as possible to its pre-construction condition.

Habitats and Species

One High Sensitivity frog species *(Phrynopus sp*) was identified. Six medium sensitivity species have been identified in the Apurimac River Valley Montane Forest Ecotone: the quenual tree (*Polylepis pauta*) and six fauna species including the spectacled bear (*Tremarctos ornatus*), one frog (*Eleutherodactylus discoidalis*), a lizard (*Proctoporus* sp.)

and two birds, the white-tailed shrike tyrant and black faced ibis (*Agriornis andicola* and *Theristicus melanopsis*).

The quenual tree is commonly used in reforestation campaigns in the surrounding areas and material representing the local germplasm should be obtained for replanting during reinstatement of areas where these trees have been removed during ROW clearance.

Given the high mobility of the spectacled bear, there are no direct impacts from construction activities on this species and no specific actions are required for this species.

The frogs and lizards are less mobile and will require removal from the ROW and relocation to areas not affected by construction activities, if observed either during the pre-clearance survey or if observed on the ROW thereafter. The ECOMP and RP contain the criteria and procedures for the rehabilitation of the ROW habitat for each high and medium sensitivity species of fauna.

Key Issues Summary

Control of highly unstable soil conditions and the protection of topsoil and water bodies require attention during construction and reinstatement along the ROW in the Apurimac River Valley Montane Forest Ecotone. Table 8.10 shows the key ecological issues and recommendations for ELU 1.

Table 8.10. Key Issues and Recommendations - ELU 1

Issue	KP Reference	Recommendations	Reference
Risk of mass wasting in Highly Unstable terrains	01+000 – 02+000	Topsoil strip and protection Temporary erosion and sediment controls Reinstatement with special techniques (e.g. fertilization, hydro seeding, mulch) if required in the highest risk areas.	ECOMP
	02+000 -02+700		ECOMP
	05+500-05+590		ECOMP / RP
	05+930-06+790		
	08+400 – 11+000		
	15+120-18+719		
	19+039-19+975		
Peat bog habitat	07+770	Topsoil strip before construction and protection. Restoration of topsoil and plants during abandonment.	ECOMP / RP
	14+500	Restoration of topsoil and plants during abandonment.	ECOMP

Quenual tree *(Polylepis pauta)*	0 - 15	Planting of new trees during biorestoration of ROW	ECOMP
Birds – black-faced ibis and white-tailed shrike tyrant	Peat bog habitats	Identify any nests during pre-clearance survey if site clearance during the nesting season.	ECOMP
Reptiles/Amphibians – Froga and Lizards	ELU-wide	Pre-clearance survey to identify and relocate reptiles from ROW prior to site clearance activities.	ECOMP

Source: EFS Fieldwork

NOTE – The column 'KP Reference' is for indicative purposes only, suggesting where plant or fauna species or other issues were observed during the EFS or are likely to occur on the basis of other studies including the ESIA. This is not intended to be an exhaustive or exclusive list and must be verified at the time of construction with appropriate management actions taken accordingly wherever the issue is identified. This statement applies to all ELUs, 1-14.

9.0 ELU 2: CAMPANA WATERSHED (KP 20+511 – 25+115)

9.1 GENERAL DESCRIPTION

The ROW rises rapidly into the highlands of the Campana area through a landscape of irregular topography with a cool to cold climate with annual precipitation from 500 to 700 mm, depending on altitude. There are abundant sward-forming and tall tussock grasslands, and scattered peat bog wetlands. The altitude in this ELU fluctuates from approximately 3,414 to 4,066 m.

This unit includes the settlements of Putaja and Campana.

As in the Apurimac River Valley Montane Forest Ecotone, the soils of the Campana Watershed are Entisols and Inceptisols with shallow to deep organic topsoil at elevations from 3,670 to 3,725 m. Bulk density and mechanical resistance is high (meaning low total soil porosity) with the potential for compaction problems that will reduce water infiltration and increase runoff and soil erosion. In general, soil fertility ranges from low to medium level. Also low levels of phosphorus in most of the soils are very representative. There are peat bog areas with high organic carbon content from 15 to 50 cm in depth.

This ELU has four habitat types, dominated by sward-forming grassland (42.79%) and tall tussock grassland (30.23%), with areas of peat bog wetlands (20.76%) and cultivated areas occupy the remaining 6.21% of the ROW in the Campana Watershed ELU.

9.2 PHYSICAL CHARACTERISTICS

9.2.1 PRECIPITATION

Precipitation is seasonal in this ELU. The wet season is from January to March, and is known locally as the "winter" or rainy season, even though it corresponds with the austral summer. The dry season is from April to December. Table 9.1 shows precipitation values during each season.

Table 9.1. Precipitation - ELU 2

Estimated Precipitation (mm)			
Peak (January - March)		General (September - April)	
KP Range	Precipitation (mm)	KP Range	Precipitation (mm)
20+511 - 22+000	400 - 500	20+000 - 22+500	600-700
20+511 - 25+115	300 - 400	22+500 - 25+115	500-600

Source: ESIA, Environmental Baseline.

9.2.2 GEOLOGY

The geological units of the Campana watershed Ecotone landscape include slates, limestones and sandstones, to a lesser extent siltstones and marls, sometimes alternating with Quaternary glacial and alluvial deposits. The rocks of this ELU are very hard and do not pose significant risks of instability except for very isolated sectors where highly fissured slates and marls are present.

No Acid Rock Drainage (ARD) risk is present in this ELU.

9.2.3 SOILS

Soils have a neutral to strongly acidic pH with no salinization or carbonate problems. Surface horizon has a medium depth along the whole ELU, despite the variable slope. Organic matter content is low at KP 21+000. The topsoil is of medium depth at all sites evaluated.

The soils present low to medium fertility on the basis of available levels of phosphorus as shown in Table 9.2.

Table 9.2. Surface Horizon characteristics - ELU 2

KP	pH	Surface horizon depth	Organic matter	Fertility	Slope (%)
21+000	Neutral	Medium	Low	Low	20-40%

Source: ESIA, Environmental Baseline and EFS Field Work.
pH: Strongly acid = Less than 5.5; Moderately acid = 5.6 to 6.0; Slightly acid = 6.1 – 6.5; Neutral = 6.6 - 7.0; Slightly alkaline = 7.1 – 7.8; Moderately alkaline = 7.9 to 8.4; Strongly alkaline = 8.5 or greater.
Surface horizon depth: Low = Less than 5 cm; Medium = 5 cm to 15 cm; High = More than 15 cm.
Organic matter: Low = Less than 2%; Medium = 2% to 4%; High = More than 4%.
Fertility based on Available Phosphorus: Low = Less than 7.0 ppm; Medium = 7.0 to 14.0 ppm; High = More than 14.0 ppm.

Both the steep slopes and low fertility indicate potential restrictions to natural regeneration of vegetation in the area during reinstatement.

During the construction, erosion control devices such as diversion berms, silt fences, slope breakers and wooden barriers must be implemented.

9.2.4 WATER BODIES AND WETLANDS

Within ELU 2, the Uchuputara Huayco is crossed at KP 26+100. The ROW also crosses Campana Stream at KP 22+600. Table 9.3 shows details of the water bodies close to or to be crossed by the ROW.

Table 9.3. Principal Waterbody Crossings – ELU 2

Waterbody Type or Name	KP Mid-channel	Elevation (m)
Streams		
ARROYO	23+520.86	3836.31
Gullies		
QUEBRADA CAMPANA	22+600	3796
QUEBRADA	21+865.21	3835.76
QUEBRADA. PUTAJJA	23+538.51	3833.92
Rivers		
UCHUPUTARA HUAYCO	26+100	

Source: Peru LNG Pipeline Project Alignment Sheets (Gulf Interstate Engineering, 2006).

The ROW crosses one peat bog approximately at KP 22+400 to 22+700 and passes within a few meters of a peat bog near KP 22+000.

Instability and Physical Risk

Highly Unstable Sectors account for only 8.9% of the ROW length in the Campana Watershed ELU. Nevertheless, 81% of this ELU is considered to be Moderately Unstable. Table 9.4 shows risk evaluation data.

Table 9.4. Instability and Physical Risk Levels - ELU 2

Risk Level	Kp Start	KP Finish	Length (m)	
Slightly Unstable	22+230	22+286	56	564
	22+286	22+794	508	
Moderately Unstable	20+852	22+230	1,378	4,584
	22+794	26+000	3,206	
Highly Unstable	20+346	20+852	506	506

Source: ESIA, Environmental Baseline

9.2.5 INFRASTRUCTURE

No roads are crossed by the ROW in this ELU. However, the project has planned the construction of a shoofly, at approximately 24+000. A mobile camp is proposed at KP 23+173, near Campana stream. Table 9.5 shows infrastructure information.

Table 9.5. Planned Project Infrastructures – ELU 2

Type of Infrastructure	KP	Name	Action	Related to
Camps	23+173	Mobile near Campana	Topsoil Protection	ECOMP/RP
Shooflies	24+698	Putaja - Cochas	Topsoil protection / Erosion control devices and slope revegetation	ECOMP/RP

Source: ESIA, Project Description

9.3 HABITATS AND SPECIES

9.3.1 HABITAT DISTRIBUTION

The habitats of ELU 2 are listed in sequential order in Table 9.6, including the length of each habitat unit and associated start and finish ROW KPs. Table 9.7 summarizes the lengths of each habitat type within ELU 2, including subtotals for each habitat type.

Table 9.6. Habitat Sequence – ELU 2

Habitats	Length (m)	KP Start	KP Finish
Tussock grassland	743	20+511	21+254
Sward-forming grassland	667	21+254	21+921
Peat bog wetlands	32	21+921	21+953
Sward-forming grassland	10	21+953	21+963
Peat bog wetlands	84	21+963	22+047
Cultivated areas	286	22+047	22+333
Peat bog wetlands	436	22+333	22+769
Sward-forming grassland	316	22+769	23+085
Tussock grassland	253	23+085	23+338
Sward-forming grassland	381	23+338	23+719
Peat bog wetlands	404	23+719	24+123
Sward-forming grassland	596	24+123	24+719
Tussock grassland	396	24+719	25+115

Table 9.7. Habitats Summary - ELU 2

Habitats	Length (m)	KP Start	KP Finish
Peat Bog Wetlands	32	21+921	21+953
	84	21+963	22+047
	436	22+333	22+769
	404	23+719	24+123
Total	**956**	**20.76%**	
Sward-forming Grassland	667	21+254	21+921
	10	21+953	21+963
	316	22+769	23+085
	381	23+338	23+719
	596	24+123	24+719

Total	**1,970**	**42.79%**	
Cultivated areas	286	22+047	22+333
Total	**286**	**6.21%**	
Tussock Grassland	743	20+511	21+254
	253	23+085	23+338
	396	24+719	25+9115
Total	**1,392**	**30.23%**	
Total ELU 2:	**4,604**		

9.3.2 Habitat Descriptions

Peat Bog Wetlands

The ROW passes through four areas of peat bogs, occupying 20.76% of the length of the ROW in this ELU. The bogs associated with Campana Stream are very important for local communities like Putaja, Cochas Alto and Cochas, securing water supply for them. These bogs are dominated by *Plantago rigida,* known locally *as* "champa estrella" and *Lachemilla pinnata*, both herbs typical from bogs. Individuals of threatened terrestrial orchid *Myrosmodes sp* were also found in this habitat type.

Sward-forming grassland

This is the largest habitat type comprising 42.79% of the whole ELU, but its species richness is lower than in any other habitat types. In the Sward-forming grassland habitat type the most common species are the grasses *Calamagrostis vicunarum* and *Aciachne pulvinata*. Sward-forming grasslands are very important being used as preferred pastures by local farmers.

Sward forming grassland generally grows on flat land with moist soils and is an intermediate vegetation type between sedge swamps and grassland. This vegetation unit is fairly common in the Andean highlands, occurring in extensive areas.

Tussock grassland

Tussock grasslands are located in areas extremely cold, dry, with strong winds and occupy some 30.23% of the ROW in this ELU. The structure of the vegetation unit is very simple with only one herbaceous stratum of around 30 cm in height. The structure is dominated by tussock or bunch-forming grasses together with a few rosette-forming plants growing among the rocks.

The dominant species in the habitat type is the grass, *Stipa obtusa*. There also appear species of the Urticaceae, Geraniaceae, and Asteraceae plant families. All the grasses

and other herbs found in this habitat type are typical of degraded, overgrazed areas. The high-Andean endemic cactus *Austrocylindropuntia floccosa* appears in this habitat type. This low-growing cactus often forms dense mats or cushions.

Cultivated Areas

Cultivated areas occupy 6.21% of the ROW in the Campana Watershed ELU.

Fauna

This area is home to an undescribed species of the lizard genus *Proctoporus* that was first collected by the EFS survey.

Among the mammals, the white-tailed deer (*Odocoileus virginianus*) was reported by ESIA in this area.

For birds, the black-faced Ibis (*Theristicus melanopis*) was found associated with wetlands.

Hydrobiology

Table 9.8 presents water bodies sampled along ELU 2. No salient characteristics were found in this ELU.

Table 9.8. Water bodies Sampled – ELU 2

Station	Habitat	Waterbody	Name	Height (m)	KP
Hi-39	Altoandino	Quebrada	Campana	3800	22+700

9.3.3 Species Sensitivity Analysis

Table 9.9 shows the high and medium sensitivity species observed during the EFS Field Survey, based in the species sensitivity criteria presented in Section 7.1 of the EFS.

There are 5 Medium Sensitivity species identified in this ELU; 3 plant species, 1 reptile (lizard) and 1 bird (black-faced ibis).

Table 9.9. Species Sensitivity Criteria - ELU 2

No	Species	Protection Status						Spatial Distribution			Local Use			Mobility		Σ
		CR	EN	VU	NT	L	N	Local	Regional	Widespread	Permanent	Seasonal	None	Immobile	Mobile	
	Plants															
	Aciachne pulvinata						0		2				0	3		5
1	*Austrocylindropuntia floccosa*						0			0			0	3		3
	Calamagrostis vicunarum						0				2			3		5
2	*Castilleja* sp.						0			0	2			3		5
	Escallonia resinosa			4					2				0	3		9
3	*Hypochaeris taraxacoides*						0		2				0	3		5
4	*Lachemilla diplophylla*						0		2				0	3		5
5	*Lachemilla pinnata*						0		2				0	3		5
6	*Luzula racemosa*						0				2			3		5
7	*Myrosmodes* sp.				3			3						3		9
8	*Plantago rigida*						0		2				0	3		5
9	*Ranunculus flagelliformis*						0			0		1		3		4
	Stipa obtusa						0			0			0	3		3
	Tecoma Sambuxifolia				3				2			1		3		9
	Reptiles and amphibians															
11	*Liolaemus* cf. *walkeri*						0		2				0	3		5
12	*Gastrotheca marsupiata*						0		2				0	3		5
14	*Proctoporus* sp.						0	3					0	3		6
	Mammals															
16	*Abrothrix jelskii*						0			0			0		0	0
17	*Auliscomys pictus*						0		2				0		0	2
18	*Calomys sorellus*						0	3					0		0	3
	Birds															
25	*Anas flavirostris*						0			0			0		0	0
27	*Basileuterus coronatus*						0			0			0		0	0
28	*Chloephaga melanoptera*						0		2		2				0	4
29	*Cranioleuca albicapilla*						0	3					0		0	3
31	*Muscisaxicola albilora*						0			0			0		0	0
35	*Phalcoboenus megalopterus*						0			0			0		0	0
36	*Plegadis ridgwayi*						0			0			0		0	0
40	*Theristicus melanopis*			4					2				0		0	6
41	*Vanellus resplendens*						0		2				0		0	2

Protection Status*:
CR= Critically endangered 6 points
EN= Endangered 5 points
VU= Vulnerable 4 points
NT= Near threatened 3 points
B= Low (Others) 2 points
N= Not listed 0 points

Σ= Sensitivity value

1 - 5: Low
6 - 10: Medium
11 or higher: High

Species Distribution:
Local = (Endemic locally or to an EBA**) 3 points
Regional = (Regional endemic in Andes or Coast) 2 points
Widespread = (Across S. America or cosmopolitan) 0 points

Mobility:
Immobile = (restricted movement or in very short distance) 3 points
Mobile = 0 points

Local Uses:
Permanent= 2 points
Seasonal = 1 point
None = 0 points

***Protection Status:** According IUCN (2006) or National Legislation (D.S. No. 034-2004-AG/D.S. No. 043-2005-AG)
****EBA:** Areas determined by Birdlife International, which includes at least 2 bird species with less than 50,000 km2 of known distribution range.

9.3.4 Habitat Sensitivity Analysis

Based on the presence of medium sensitivity species presented in Table 9.9, the Peat Bog Wetlands of the Campana Watershed ELU are considered to be of Medium Sensitivity due to the presence of five Medium Sensitivity plant species. None of the other habitats in this ELU meet the criteria for a high or medium sensitivity habitat as described in Section 7.2 of these EFS.

9.4 Key Issues and Recommendations

Physical Risk

Approximately 9% of the ROW length in this ELU is considered to have High physical instability (Table 9.4), which require the implementation of erosion and mass wasting prevention measures. Mass wasting risk in the rest of the ROW is quite low.

Erosion control during construction phase must be focused on installing and maintaining erosion controls along the RoW, especially in areas of high erosion risk close to water bodies and peat bogs. Stripping and preservation of topsoil during construction will be critical to facilitate the revegetation of sensitive areas during reinstatement.

In the highest risk areas additional measures including hydro seeding and fertilizers application should be considered.

Water bodies and Wetlands

The Campana Stream is close to the ROW, requiring construction best practices with respect to erosion control and pollution prevention.

There are also important peat bog areas (KP 22+500) that provide important environmental services for local people and habitat for birds; these require special consideration for avoiding impacts by the construction works. Measures should be implemented where needed to protect the streams, lagoons, and bogs along the ROW.

Habitats and Species

The population of the *Escallonia resinosa* has high potential as seed source; however, this stand does form a continuous forest and the trees are mainly around cultivated lands.

Impacts on *Proctoporus* lizards should be addressed by the ECOMP and the RP, establishing measures for habitat protection and restoration, including removal from the

RoW during the site pre-clearance survey. During reinstatement the habitats should be restored as close as reasonably possible to its original form, including ground vegetation and morphology. There are 3 threatened plant species in this ELU. There are also 2 medium sensitivity animal species found in this ELU. Species are listed in Table 9.9.

The key issue for habitats is the peat bog wetlands, in particular the Campana Stream bog that provides an important water supply to locals.

Table 9.10 presents the key issues and recommendations for the Campana Watershed ELU.

Table 9.10. Key Issues and Recommendations - ELU 2

Issue	KP Reference	Recommendations	Reference
Risk of mass wasting in Highly Unstable terrains	20+346 to 20+852	Topsoil strip and protection Temporary erosion and sediment controls. Additional biorestoration measures (hydroseeding, fertilizer, mulch) considered in highest risk areas	ECOMP / RP
Peat bog habitat	22+500	Topsoil strip and storage during construction. Translocation of bog orchid (Myrosmodes sp) and shrubs (escallonia resinosa and tecoma sambucifolia) at peat bog habitat crossings prior to commencement of construction	ECOMP / RP
Proctopurus lizard	20+511 – 25+115	Pre-clearance survey to identify and relocate from ROW prior to site clearance activities. Monitoring of habitat after reinstatement.	ECOMP / RP
Black-faced ibis (Theristicus melanopis)	Peat bog habitats	Identify any nests during pre-clearance survey if site clearance during the nesting season.	ECOMP/RP

Source: EFS Fieldwork

10.0 ELU 3: TOROBAMBA RIVER VALLEY (KP 25+115 - 44+300)

10.1 General Description

This unit includes the Torobamba and Uras valleys, starting near the settlement of Cochas and progressing westwards to near Pampachacra. The climate is warmer and drier than in ELUs 1-2 corresponding to its lower elevation, with rainfall concentrated during the austral summer months, allowing for the production of subtropical tree crops such as avocadoes, pacay (*Inga* spp.), and tangerines. This ELU covers elevations between approximately 2,400m at the Torobamba River crossing to around 3,674 m. This unit includes the rural communities of General Cordova de Soccos, Patibamba, and Uras and the ROW passes near the small settlements of Uras, Cochas, Patibamba, and Soccos.

The dry valley belongs to the Apurimac Dry Forest System defined by Linares-Palomino (2004). A characteristic element of the dry forest remnants is the pati tree (*Eriotheca vargasii*), a species endemic to the Apurimac system. The Torobamba Valley is also home to an endemic dry forest lizard, *Stenocercus* aff. *apurimacus*.

There are two zones with very high risk of erosion at KP 29+500 and the other near the Torobamba River from KP 40+500 to KP 44+250 with predominance of landslides and gully erosion. Bulk density and mechanical resistance is high (meaning lower total soil porosity) with compacting problems that will reduce water infiltration and increase runoff and soil erosion with compacting problems. Alluvial soils at the bottom of the valley are very fertile with lower bulk density and mechanical resistance while in the colluvial areas topsoils are shallow with low fertility and very sensitive to being compacted. The high mountains are very slightly unstable with predominance of granite rocks.

This ELU has 6 habitat types, dominated by cultivated areas (41.18%) and thorny scrub (33.02%), with minor areas of the native resinous scrub (15.61%), tussock grassland (4.12%), deciduous dry forests (3.39%), and low broadleaf evergreen woodlands (2.67%).

10.2 PHYSICAL CHARACTERISTICS

10.2.1 PRECIPITATION

Precipitation is seasonal in this ELU. The wet season is from January to March, and is known locally as the "winter" or rainy season, even though it corresponds with the austral summer. The dry season is from April to December. Table 10.1 shows precipitation values during each season.

Table 10.1. Precipitation – ELU 3

Estimated Precipitation (mm)			
Peak (January - March)		General (September - April)	
KP Range	Precipitation (mm)	KP Range	Precipitation (mm)
25+115 – 37+000	300 - 400	25+115 - 27+000	500 - 600
37+000 – 41+000	200 - 300	27+000 - 37+000	400 - 500
41+000 – 44+300	300 - 400	37+000 - 40+000	300 - 400
		40+000 - 44+300	400 - 500

Source: ESIA, Environmental Baseline

Precipitation during rainy season with typically 300 – 400 mm will be the period of greatest soil erosion risk along the RoW.

10.2.2 GEOLOGY

The geological units of the Torobamba River Valley landscape include slates, limestones and sandstones, to a lesser extent siltstones and marls, sometimes alternating with Quaternary glacial and alluvial deposits. The rocks of this ELU are very hard and do not pose significant risks of instability except for very isolated sectors where highly fissured slates and marls are present.

In both flanks of the Torobamba River there are volcanic agglomerates, lava, sandstones and conglomerates, interspersed in some places with lutite. These rocks are mainly very hard and do not pose significant risks to stability, except for localized sectors on hillsides where highly weathered lutite outcrops, creating areas of loose and unstable clays.

There is a formation, consisting of sand and clay conglomerates, outcrops only between the Torobamba and Uras rivers. Because it is not very compact, this formation poses a certain risk of instability resulting in small rock falls.

On the left flank of the Torobamba River, forming the Cerro Buenavista mountain, and adjacent to Llajuapampa Stream (around KP 35+000), there are several small rhyolitic acid stocks in which the rock is light grey with grey and red phenocrysts.

There is no Acid Rock Drainage (ARD) risk present in this ELU

10.2.3 SOILS

The soils sampled in ELU 3 have a neutral to strongly acidic pH and no salinization or carbonate problems.

Near the settlement of Cochas, KP 29+000, the soils have developed on colluvial and alluvial quaternary deposits, being quite stony in the A horizon. At KP 31+000, there is a recent colluvium deposit that is stony, highly unstable, and has signs of superficial erosion.

At KP 41+000, near the Socosmayo River and the Patibamba settlement there is a recent alluvial deposit that is medium eroded, and has granite rocks. At KP 44+000, near the Socos settlement, soils have developed upon granitic rocks, with very steep slopes, and signs of superficial erosion.

Surface horizons depths are low to medium along KP 29+000 to KP 31+000 and medium from KP 41+000 to KP 44+000.

Organic matter content along the ROW is medium.

The soils are of medium to low fertility in most of the ELU as shown in Table 10.2. The A horizon and subsoils are mostly loamy sands, with lower nutrient and organic matter content in the subsoil. In general, the subsoil will not affect the movement of water because both effective horizons (A and B) presented a very good drainage. Aggregates are weakly united and therefore soil horizons have a low stability.

Table 10.2. Surface Horizon Characteristics - ELU 3

KP	pH	Surface horizon depth	Organic matter	Fertility	Slope (%)
26+000	Strongly acid	Medium	Low	Low	20-40%
28+000	Strongly acid	Medium	Medium	High	
29+000	Strongly acid	Medium	Medium	Medium	5-10%
30+000	Strongly acid	Medium	Medium	Low	
31+000	Strongly acid	Medium	Medium	Low	60-80%
32+000	Neutral	Medium	Medium	High	
35+000	Strongly acid	Medium	Medium	Medium	
41+000	Neutral	Medium	Low	Low	10-20%
44+000	Strongly acid	Medium	Medium	Low	>100%

Source: EFS Field Work.
pH: Strongly acid = Less than 5.5; Moderately acid = 5.6 to 6.0; Slightly acid = 6.1 – 6.5; Neutral = 6.6 - 7.0; Slightly alkaline = 7.1 – 7.8; Moderately alkaline = 7.9 to 8.4; Strongly alkaline = 8.5 or greater.
Surface horizon depth: Low = Less than 5 cm; Medium = 5 cm to 15 cm; High = More than 15 cm.
Organic matter: Low = Less than 2%; Medium = 2% to 4%; High = More than 4%.
Fertility based on Available Phosphorus: Low = Less than 7.0 ppm; Medium = 7.0 to 14.0 ppm; High = More than 14.0 ppm.

10.2.4 WATER BODIES

The ROW in ELU 3 passes near three streams: 500 m from the Yanaccacca at KP 29+000, 100 m from the Uras at KP 30+000. The main river crossing is at Torobamba River at KP 38+800.

The Uras Stream has greenish, fast moving water, a bed of coarse sand and boulders, and is located 100 m far from the ROW axis. There are no bogs or lagoons in ELU 3, as shown in Table 10.3.

Table 10.3. Principal Waterbody Crossings – ELU 3

Waterbody Type or Name	KP Mid-channel	Elevation (m)
Streams		
ARROYO	31+447.29	2851.26
ARROYO	33+120.48	3209.98
ARROYO	40+059.80	2471.8
ARROYO	41+952.38	2950.24
ARROYO	42+157.99	2969.14
Gullies		
QDA UCHUYPUTARA HUYJO	26+100	3688
QDA UCHUYPUTARA HUYJO	29+980	2586
QDA SECA	35+046.18	3095.06
QDA SECA	36+117.39	2883.18

QDA SECA	36+133.87	2882.57
QUEBRADA	37+365.37	2754.17
Rivers		
YANACCACCA	29+000	2590.00
URAS	30+042.43	2569.28
TOROBAMBA	38+823.90	2402.53

Source: Peru LNG Pipeline Project Alignment Sheets (Gulf Interstate Engineering, 2006).

10.2.5 INSTABILITY AND PHYSICAL RISK

Highly Unstable areas account for 38.6% of the ROW in the Torobamba River Valley ELU. Table 10.4 shows the distribution of the physical risk categories within ELU 3.

Table 10.4. Distribution of Physical Risk Categories - ELU 3

Risk Level	KP Start	KP Finish	Length (m)	
Low	26+000	27+253	1,253	4,279
	30+795	31+396	601	
	34+708	35+762	1,054	
	41+447	42+818	1,371	
Medium	27+253	28+268	1,015	6,918
	28+686	30+550	1,864	
	31+396	34+708	3,312	
	38+020	38+747	727	
High	28+268	28+686	418	7,053
	30+550	30+795	245	
	35+762	38+020	2,258	
	38+747	38+875	128	
	38+875	40+067	1,192	
	40+067	41+447	1,380	
	42+818	43+058	240	
	43+058	44+250	1,192	

Source: ESIA, Environmental Baseline

10.2.6 INFRASTRUCTURE

Two roads are crossed by the ROW in ELU 3, San Miguel Cochas and San Miguel Cochas Detour, both near KP 37+000. The project has planned the construction of 2 shooflies, in KP 35+280 and KP 40+032. A base camp is proposed to be installed in Patibamba, KP 38+928. The camp proposed to be placed in Patibamba is planned to provide lodging for 400 people.

Table 10.5 shows infrastructure information.

Table 10.5. Planned Project Infrastructures – ELU 3

Type of Infrastructure	KP	Name	Action	Related to
Camps	38+928	Patibamba	Topsoil strip prior to camp establishment. Reinstatement and revegetation after abandonment	ECOMP/RP
Shooflies	35+280	San Miguel - Cochas	Topsoil strip prior to establishment. Reinstatement and revegetation after abandonment	ECOMP/RP
	40+032	--	Topsoil strip prior to establishment. Reinstatement and revegetation after abandonment	ECOMP/RP

Source: ESIA, Project Description

10.3 HABITATS AND SPECIES

10.3.1 HABITAT DISTRIBUTION

The habitats of ELU 3 are listed in sequential order in Table 10.6, including the length of each habitat unit and associated start and finish ROW KPs. Table 10.7 summarizes the lengths of each habitat type within ELU 3, including subtotals for each habitat type.

Table 10.6. Habitat Sequence – ELU 3

Habitat Types	Length (m)	KP Start	KP Finish
Tussock grassland	790	25+115	25+905
Thorny scrub	2150	25+905	28+055
Cultivated Areas	1,938	28+055	29+993
Thorny Scrub	938	29+993	30+931
Cultivated Areas	1,249	30+931	32+180
Thorny Scrub	440	32+180	32+620
Low Broadleaf Evergreen Forest	513	32+620	33+133
Thorny Scrub	1,579	33+133	34+712
Cultivated Areas	1,811	34+712	36+523
Thorny Scrub	655	36+523	37+178

Cultivated Areas	1,100	37+178	38+278
Thorny Scrub	573	38+278	38+851
Cultivated Areas	1,202	38+851	40+053
Dry Deciduous Forest	651	40+053	40+704
Resinous Scrub	1,062	40+704	41+766
Cultivated Areas	601	41+766	42+367
Resinous Scrub	1,933	42+367	44+300

Table 10.7. Habitats Summary – ELU 3

Habitat Type	Length (m)	KP Start	KP Finish
Tussock grassland	790	25+115	25+905
Total	**790**	**4.12%**	
Low Broadleaf Evergreen Forest	513	32+620	33+133
Total	**513**	**2.67%**	
Dry Deciduous Forest	651	40+053	40+704
Total	**651**	**3.39%**	
Cultivated Areas	1,938	28+055	29+993
	1,249	30+931	32+180
	1,811	34+712	36+523
	1,100	37+178	38+278
	1,202	38+851	40+053
	601	41+766	42+367
Total	**7,901**	**41.18%**	
Thorny Scrub	938	29+993	30+931
	440	32+180	32+620
	1,579	33+133	34+712
	655	36+523	37+178
	573	38+278	38+851
	2150	25+905	28+055
Total	**6,335**	**33.02%**	
Resinous Scrub	1,062	40+704	41+766
	1,933	42+367	44+300
Total	**2,995**	**15.61%**	
Total ELU 3:	**19,185**		

Source: ESIA, Environmental Baseline and Domus.

10.3.2 HABITAT DESCRIPTIONS

Tussock Grassland

The high-Andean endemic cactus *Austrocylindropuntia floccosa* appears in this habitat type. This low-growing cactus often forms dense mats or cushions. This habitat type represents the 4.12% of the ELU.

Thorn Scrub

The major remaining natural habitat type in the Torobamba River Valley ELU is thorny scrub (33.02%). Mixed shrubs with *Dodonaea viscosa*, *Berberis flexuosa* and *Dasyphyllum ferox* have been registered as dominant species. Listed threatened species include *Tecoma sambuxifolia* (INRENA near threatened)*, Kageneckia lanceolata* (IUCN vulnerable, INRENA critically endangered), and *Corryocactus quadrangularis* (INRENA endangered). The most important families of shrubs are Asteraceae and Berberidaceae. Thorn underbrush throughout the study area was *Baccharis tricuneata*. Also, there are some elements of the Resinous Scrub surrounding cultivated areas, dominated by *Baccharis odorata* and *Escallonia resinosa* (listed as vulnerable by the INRENA).

Resin Scrub

Resinous scrub covers 15.61% of the ROW in the Torobamba River Valley ELU. The most common species are *Dodonaea viscosa, Tecoma arequipensis* (INRENA vulnerable)*,* and *Schinus molle*. In this ELU Resinous Scrubs are typically found in surrounding cultivated areas.

Low Broadleaf Evergreen Forest

Low Broadleaf Evergreen Forest (2.67%) grows in the warmer Andean valleys, with remnants often found along streams or drainage ditches in cultivated areas. The forest is characterized by trees with leaves present all year round forming shelter-belts or isolated plants. The low broadleaf evergreen forest is present around cultivated fields and associated with resinous scrub in the Torobamba and River Valley.

The ESIA include two plant communities dominated by different species in the Low Broadleaf Evergreen Forest: chachacomo (*Escallonia resinosa*) communities and alder (*Alnus acuminata*) communities. There are also small areas trees of the genera and several shrubs of the genera *Berberis*.

Dry Deciduous Forest

This ELU includes a small area (3.39%) covered by dry deciduous forests with predominance of the *Eriotheca vargasii* (pati, endemic to the Apurimac dry forests) and several special elements as *Tecoma arequipensis* (INRENA-vulnerable), the cacti *Echinopsis peruviana puquiensis* (INRENA-vulnerable), *Austrocylindropuntia floccosa,* and *A. subulata* (Andean endemics). *Tecoma arequipensis* has a medium sensitivity due to its relatively high abundance in this area. Cacti have a high sensitivity because of their scarcity.

Cultivated areas

41 % of this ELU has been converted to cultivated areas. While having undergone a major alteration, the cultivated areas still contains important biodiversity elements. *Aristeguietia discolor*, an IUCN-near-threatened bush that sometimes grows in association with *Escallonia resinosa*, was identified in cultivated areas, near KP 35+000. In Allpacorral, Uras and the lower zones there are *Tecoma sambuxifolia* shrubs (listed as near-threatened by the INRENA).

Fauna

Large mammals reported in this ELU include pumas or mountain lions (*Puma concolor*). The mountain lion (*Puma concolor*, IUCN/INRENA near threatened) was registered in the Torobabamba River Valley ELU. Bats registered in this ELU were *Desmodus rotundus* (vampire bats), *Artibeus lituratus, Sturnira erythromos* and species of the genus *Histiotus.* Other important mammals recorded were the skunk *Conepatus chinga.* the Andean fox (*Lycalopex culpaeus*), and the white-tailed deer (*Odocoileus virginianus*).

The threatened white-tailed shrike-tyrant (*Agriornis andicola*, IUCN-VU, INRENA-EN) was observed in this zone. The creamy-crested spinetail (*Cranioleuca albicapilla*) and the chestnut-breasted mountain-finch (*Poospiza caesar*) are endemic and range-restricted to the southern Andes of Peru present in this ELU. The endemic lizard *Stenocercus* aff. *apurimacus* and warty toad (Chaunus spinulosis) was found in this ELU.

Hydrobiology

Table 10.8 presents water bodies sampled along ELU 2. No salient characteristics were found in this ELU.

Table 10.8. Water bodies Sampled – ELU 3

Station	Habitat	Waterbody	Name	Height (m)	KP
Hi-36	Interandino	Río	Torobamba	2368	39+000
Hi-37	Interandino	Quebrada	Uras	2562	30+000
Hi-38	Interandino	Quebrada	Yanaccacca	2797	29+000

10.3.3 SPECIES SENSITIVITY ANALYSIS

Table 10.9 shows the sensitive species found in the Torobamba River Valley ELU during the EFS fieldwork.

Two High Sensitivity plant species were identified; a cactus (*Corryocactus quadrangularis)* and shrub (Kagneckia lanceolata). Nine other plant species were defined as Medium Sensitivity, two reptile species (lizard and warty toad) and two birds, the white-tailed shrike tyrant and the Andean condor*, vulture gryphus*.

Table 10.9. Species Sensitivity Criteria - ELU 3

No	Species	Protection Status						Spatial Distribution			Local Use			Mobility		Σ
		CR	EN	VU	NT	L	N	Local	Regional	Widespread	Permanent	Seasonal	None	Immobile	Mobile	
	Plants															
1	*Acacia macracantha*				3					0	2			3		8
2	*Agave americana*						0			0	2			3		5
3	*Ariestiguietia discolor*				3				2				0	3		8
4	*Austrocylindropuntia floccosa*						0			0			0	3		3
	Austrocylindropuntia subulata						0		2				0	3		5
5	*Baccharis odorata*						0		2				0	3		5
	Baccharis tricuneata						0			0	2			3		5
6	*Berberis flexuosa*						0	3		0			0	3		6
7	*Corryocactus quadrangularis*		5					3		0			0	3		11
8	*Cuphea* sp.						0		2				0	3		5
9	*Dasyphyllum ferox*						0		2				0	3		5
10	*Delostoma lobbii*						0			0			0	3		3
11	*Dodonaea viscosa*						0			0	2			3		5
12	*Dunalia spinosa*						0		2				0	3		5
	Echinopsos peruviana puquiensis			4			0	3					0	3		10
13	*Eriotheca vargasii*						0	3					0	3		6
14	*Escallonia myrtilloides*			4					2				0	3		9
15	*Escallonia resinosa*			4					2				0	3		9
17	*Gomphichis* sp.						0		2				0	3		5
18	*Kageneckia lanceolata*	6							2				0	3		11
19	*Lantana* sp.						0			0			0	3		3
20	*Pleurothallis* sp.						0		2				0	3		5
21	*Schinus molle*						0			0	2			3		5
22	*Tecoma arequipensis*			4					2			1		3		10
24	*Tecoma sambucifolia*				3				2			1		3		9
	Reptiles and amphibians															
25	*Chaunus spinulosus*				3					0			0	3		6
26	*Gastrotheca marsupiata*						0		2				0	3		5
27	*Liolaemus walkeri*						0		2				0	3		5
28	*Pleurodema marmorata*						0			0			0	3		3
29	*Stenocercus* aff. *apurimacus*						0	3					0	3		6
30	*Tachymenis peruviana*						0			0			0	3		3

	Mammals															
31	*Akodon* cf. *juninensis*						0	3		0			0		0	3
32	*Akodon subfuscus*						0		2				0		0	2
33	*Akodon* cf. *torques*						0	3					0		0	3
34	*Artibeus lituratus*						0			0			0		0	0
35	*Calomys sorellus*						0	3					0		0	3
36	*Conepatus chinga*						0			0			0		0	0
37	*Desmodus rotundus*						0			0			0		0	0
38	*Histiotus* sp.						0		2				0		0	2
39	*Lycalopex (Pseudalopex) culpaeus*								2				0		0	2
40	*Odocoileus virginianus*									0			0		0	0
41	*Phyllotis* cf. *xanthopygus posticalis*							3			2				0	5
42	*Puma concolor*				3					0			0		0	3
43	*Sturnira erythromos*									0			0		0	0
	Birds															
44	*Aglaeactis cupripennis*									0			0		0	0
45	*Agriornis andicola*			4					2				0		0	6
46	*Amazilia chionogaster*						0		2				0		0	2
47	*Anairetes flavirostris*						0			0			0		0	0
48	*Anas flavirostris*						0		0	0			0		0	0
49	*Asthenes* sp.						0		2				0		0	2
26	*Asthenes virgata*						0	3					0		0	3
50	*Buarremon torquatus*						0			0			0		0	0
51	*Cinclus leucocephalus*						0		2				0		0	2
52	*Chloephaga melanoptera*						0		2		2				0	4
53	*Colaptes rupicola*						0			0			0		0	0
54	*Colibri coruscans*						0			0	2				0	2
55	*Cranioleuca albicapilla*						0	3					0		0	3
56	*Crotophaga ani*						0			0			0		0	0
57	*Falco femoralis*						0			0			0		0	0
58	*Falco sparverius*						0			0			0		0	0
59	*Geranoaetus melanoleucus*						0			0			0		0	0
60	*Glaucidium jardinii*						0		2				0		0	2
61	*Knipolegus aterrimus*						0			0			0		0	2
62	*Lesbia nuna*						0		2		2				0	4
63	*Lophonetta specularioides*						0			0			0		0	0
64	*Nothoprocta ornata*						0		2				0		0	2
65	*Nothoprocta pentlandii*						0		2				0		0	2

66	*Notiochelidon murina*						0		2				0		0	2
67	*Ochthoeca leucophrys*						0		2				0		0	2
68	*Oreonympha nobilis*						0	3					0		0	3
69	*Oreotrochilus estella*						0		2				0		0	2
70	*Oxyura ferruginea*						0		2				0		0	2
71	*Patagioenas maculosa*						0		2				0		0	2
72	*Patagona gigas*						0			0			0		0	0
73	*Phalcoboenus megalopterus*						0			0			0		0	0
74	*Pheucticus aureoventris*						0			0			0		0	0
38	*Phrygilus plebejus*						0			0			0		0	0
39	*Phrygilus unicolor*						0			0			0		0	0
75	*Podiceps occipitalis*						0		2				0		0	2
76	*Poospiza caesar*						0	3					0		0	3
77	*Poospiza hispaniolensis*						0		2				0		0	2
78	*Rollandia rolland*						0			0			0		0	0
79	*Saltator aurantiirostris*						0			0			0		0	0
80	*Scytalopus* sp.						0		2				0		0	2
81	*Turdus chiguanco*						0			0			0		0	0
82	*Vultur gryphus*		5							0			0		0	5
83	*Zenaida auriculata*						0			0			0		0	0

Protection Status*:
CR= Critically endangered 6 points
EN= Endangered 5 points
VU= Vulnerable 4 points
NT= Near threatened 3 points
B= Low (Others) 2 points
N= Not listed 0 points

Σ= Sensitivity value

1 - 5: Low
6 - 10: Medium
11 or higher: High

Species Distribution:
Local = (Endemic locally or to an EBA**) 3 points
Regional = (Regional endemic in Andes or Coast) 2 points
Widespread = (Across S. America or cosmopolitan) 0 points

Mobility:
Immobile = (restricted movement or in very short distance) 3 points
Mobile = 0 points

Local Uses:
Permanent= 2 points
Seasonal = 1 point
None = 0 points

***Protection Status:** According IUCN (2006) or National Legislation (D.S. No. 034-2004-AG/D.S. No. 043-2005-AG)
****EBA:** Areas determined by Birdlife International, which includes at least 2 bird species with less than 50,000 km2 of known distribution range.

10.3.4 HABITAT SENSITIVITY ANALYSIS

Based on the presence of high and medium sensitivity species presented in Table 10.9, the Cultivated Areas and the Thorny Scrub of the Torobamba River Valley ELU are considered to be of High Sensitivity due to the presence of two High Sensitivity plant species and seven Medium Sensitivity plant species, and one High Sensitivity plant species respectively. The Dry Deciduous Forest of the Torobamba River Valley ELU is considered to be of Medium Sensitivity due to the presence of two Medium Sensitivity animal species. None of the other habitats in this ELU meet the criteria for a high or medium sensitivity habitat as described in Section 7.2 of these EFS.

The ESIA identified the "Uras valley and the adjacent thicket" as an area used by the white-tailed deer and spectacled bears (Tremarctos ornatus), based on anecdotal reports. The ESIA recognized this as one "of a number of sectors of the pipeline [identified by the biological baseline study] as ecologically sensitive" and noted that the deer are hunted and that "their presence is currently scarce."[12]

10.4 KEY ISSUES

Soils

Adequate topsoil stripping prior to construction and preservation during construction phase will enhance the success of revegetation after construction. Steep slopes and low fertility indicate potential restrictions to natural regeneration of plants in the area during reinstatement.

Taking into account the rainfall patterns, the project should focus on erosion control in the rainy season. During the construction phase temporary erosion control devices such as diversion berms, silt fences, slope breakers and wooden barriers must be implemented and maintained and the topsoil must be protected against contamination or loss.

Water bodies

Numerous water bodies are crossed by the ROW; and are listed in Table 10.3. To minimize sediments contamination of water bodies erosion control must be implemented and maintained on adjacent slopes and protective buffer zones left along the edge of

[12] ESIA, Vol IV (ESMP), page 2-10.

water bodies until immediately prior to pipe installation. Pollution prevention and control best practices should be followed along water bodies.

Physical Risk

According to the Physical analysis (Table 10.4), there are eight sectors of high physical sensitivity. Soil erosion control focused on mass movement in slopes and conservation of topsoil during its relocation in the ROW must be enforced, with particular attention during the rainy season when the risk is greatest.

It is considered that sectors with slightly unstable areas will not require special or additional biorestoration works, but highly unstable ones in areas of steps slopes or close to water bodies should be considered for additional biorestoration techniques such as fertilizers application and hydro seeding.

Habitats and Species

Odocoileus virginianus is a species of economic importance as a game species according to the ESIA although was not observed in the Ecological Field Survey.

Table 10.10 summarizes the key ecological issues and recommendations for ELU 3.

Table 10.10. Key Issues - ELU 3

Issue	KP Reference	Action	Reference
Risk of mass wasting in Unstable terrains	41+800 – 42+500	Erosion controls, biorestoration including fertilizers application and hydro seeding in highest risk areas	ECOMP/RP
Loss of cactus *(corryocactus quadrangularis)* and shrub *(Kageneckia lanceolota)* during ROW clearance	Thorn scrub habitat	Replacement with new cactus plants and shrubs during post-construction bioreinstaement	ECOMP/RP
Game bird, *Odocoileus virginianus* (Uras valley)	25+000 to 32+000	Pre-clearance Survey to identify and relocate from ROW prior to site clearance activities	ECOMP / RP
Reptiles – *Warty toad and lizards*	Across ELU	Pre-clearance Survey to identify and relocate from ROW prior to site clearance activities	ECOMP/RP
Bird – white-tailed shrike-tyrant	Across ELU	Identify any nests during Pre-clearance Survey if site clearance during nesting season	ECOMP

River and stream crossings	30+000, 32+000, 38+000, 29+000, 30+000 y 39+500	Buffer zone protection, erosion control, best practice crossing techniques to minimize turbidity	ECOMP

Source: EFS Fieldwork

11.0 ELU 4: SILLACCASA SIERRA (KP 44+350 - 56+783)

11.1 General Description

The Cerro Sillaccasa, at 4,222 m, is the highest point of this high mountain landscape dominated by puna, with small areas of sward-forming grassland and peat bog wetlands, and lagoons such as Laguna Yanacocha. ROW elevations range from approximately 3,566 to 4,222 m. Peat bogs (bofedales) are very important for local farmers who used them as pasture areas. This short ELU (12.55 km) includes the Socos, Sillaccasa, Incapara, and Motoynioc mountains.

The mean annual precipitation ranges from 500 to 600 mm, depending on altitude. This unit includes the settlements of Soccos and Huaychao. Soils are generally of low fertility. In general, this area is of high physical stability with only a small section of about 600 m of ROW classified as high risk. The ELU has 4 habitat types, with tussock grassland covering some 82% of the ROW.

11.2 Physical Characteristics

11.2.1 Precipitation

Precipitation is seasonal. The wet season is from January to March, and is known locally as the "winter" or rainy season, even though it actually corresponds with the climatologically-defined austral summer. The dry season extends from April to December. Table 11.1 shows precipitation values for each season.

Table 11.1. Precipitation - ELU 4

Estimated Precipitation (mm)			
Peak (January - March)		General (September - April)	
KP Range	Precipitation (mm)	KP Range	Precipitation (mm)
44+350 - 47+000	300 – 400	44+300 – 56+783	500-600
47+000 - 56+783	400 - 500		

Source: ESIA, Environmental Baseline

11.2.2 GEOLOGY

The geological units of the Sierra Sillaccasa ELU 4 include slates, limestones, and sandstones, with lesser contributions siltstones and marls, sometimes alternating with superficial glacial and alluvial deposits of the Quaternary period. The rocks of this ELU are very hard and do not pose significant risks of instability except for very isolated sectors where highly fissured slates and marls are present.

Near KP 45+000 and westward, there are granite rock outrcops, with varying slopes and levels of erosion.

11.2.3 SOILS

Soils in ELU 4 are generally stony, of variable depth, and of slightly to strongly acid pH.

The surface horizon has a sandy loam texture and a medium to shallow depth over the whole ELU, despite the steep slopes. Organic matter content registered was high in all points except at KP 45+000, where there is an extensive rocky area. Fertility based on phosphorus content is low.

Soils present low available levels of phosphorus in most of the ELU as shown in Table 11.2.

The subsoils are generally sandy loams, with lower nutrient and organic matter levels. Drainage is generally very good. Subsoils are very loose and soil aggregates are of low stability.

Table 11.2. Surface Horizon Characteristics - ELU 4

KP	pH	Surface horizon depth	Organic matter	Fertility	Slope (%)
45+000	Very stable rocky substrate with no topsoil development				
45+000	Slightly acid	Medium	Low	Low	
46+000	Strongly acid	High	High	Low	50-60%
47+000	Moderately acid	Medium	High	Medium	
53+000	Strongly acid	High	High	Low	>60%

Source: ESIA, Environmental Baseline and Domus.
pH: Strongly acid = Less than 5.5; Moderately acid = 5.6 to 6.0; Slightly acid = 6.1 – 6.5; Neutral = 6.6 - 7.0; Slightly alkaline = 7.1 – 7.8; Moderately alkaline = 7.9 to 8.4; Strongly alkaline = 8.5 or greater.
Surface horizon depth: Low = Less than 5 cm; Medium = 5 cm to 15 cm; High = More than 15 cm.
Organic matter: Low = Less than 2%; Medium = 2% to 4%; High = More than 4%.
Fertility based on Available Phosphorus: Low = Less than 7.0 ppm; Medium = 7.0 to 14.0 ppm; High = More than 14.0 ppm.

11.2.4 WATER BODIES AND WETLANDS

ELU 4 area includes four lagoons: Socos (48+000), Totoracocha (48+100), Yanacocha I (48+800) and Nina Orco (51+200). The lagoon closest to the ROW is Yanacocha I (20 m) and the most distant, Nina Orcco, is 700 m from the ROW.

Also the ROW at 250 m from Soccosmayo Stream, at KP 49+500. A bog is crossed at KP 48+128. All crossings are shown in Table 11.3.

Table 11.3. Principal Waterbody Crossings - ELU 4

Waterbody Type or Name	KP Mid-channel	Elevation (m)
Bug	48+128	
QUEBRADA	48+294.63	4097.86
QUEBRADA	48+902.23	4106.06
QUEBRADA	49+612.66	4102.05
QUEBRADA NINO ORCO	51+152.02	4103.60

Source: Peru LNG Pipeline Project Alignment Sheets (Gulf Interstate Engineering, 2006).

11.2.5 INSTABILITY AND PHYSICAL RISK

Low instability is a feature of this ELU with only about 5% of the ROW categorized as unstable towards the western edge of the section.

Table 11.4. Distribution of Physical Risk Categories – ELU 4

Type of risk	KP Start	KP Finish	Length (m)	
Low	44+315	45+816	1,501	11,956
	46+345	56+800	10,455	
High	44+250	44+315	65	594
	45+816	46+345	529	

Source: ESIA, Environmental Baseline

11.2.6 INFRASTRUCTURE

Table 11.5 shows information on accessory infrastructure planned for the Sierra Sillaccasa ELU.

Table 11.5. Planned Project Infrastructures – ELU 4

Type of Infrastructure	KP	Name	Action	Related to
Camps	50+836	Las Nubes 2 Mobile Camp	Topsoil strip prior to Camp construction	ECOMP
Shooflies	56+500	NN		
	57+505	KM 57.5	Topsoil protection / Erosion control devices and slope revegetation	ECOMP/RP

Source: ESIA, Project Description

11.3 HABITATS AND SPECIES

11.3.1 HABITAT DISTRIBUTION

Table 11.6 presents the series of habitat types found along the proposed pipeline ROW in the Sillaccasa Sierra ELU.

Table 11.6. Habitats Sequence – ELU 4

Habitat Type	Length (m)	KP Start	KP Finish
Resinous Scrub	173	44+350	44+473
Tussock grassland	3321	44+473	47+794
Peat Bogs	42	47+794	47+836
Tussock grassland	802	47+836	48+638
Peat Bogs	103	48+638	48+741
Sward-forming grassland	459	48+741	49+200
Peat Bogs	12	49+200	49+212
Tussock grassland	393	49+212	49+605
Peat Bogs	127	49+605	49+732
Sward-forming grassland	509	49+732	50+241
Peat Bogs	156	50+241	50+397
Sward-forming grassland	586	50+397	50+983
Tussock grassland	5800	50+983	56+783

Table 11.7 summarizes the lengths of the habitat types that comprise the Sillaccasa Sierra ELU.

Table 11.7. Habitat Summary – ELU 4

Habitat Units	Length (m)	KP Start	KP Finish
Peat Bog wetlands	42	47+794	47+836
	103	48+638	48+741
	12	49+200	49+212
	127	49+605	49+732
	156	50+241	50+397
Total	**440**	**3.52%**	
Sward-forming grassland	459	48+741	49+200
	509	49+732	50+241
	586	50+397	50+983
Total	**1554**	**12.45%**	
Resinous Scrub	173	44+300	44+473
Total	**173**	**1.39%**	
Tussock grassland	3321	44+473	47+794
	802	47+836	48+638
	393	49+212	49+605
	5800	50+983	56+783
Total	**10,316**	**82.64%**	
Total ELU 4:	**12,483**		

Source: ESIA, Environmental Baseline and Domus.

11.3.2 HABITAT DESCRIPTIONS

Tussock grassland

Tussock grasslands dominate the Sierra Sillaccasa landscape, covering about 82.64% of the ROW length. These grasslands are characterized by the dominance of the grass *Jarava ichu*, and the presence of a very scarce terrestrial orchid belonging to the genus *Aa*. The orchid was encountered near Yanacocha I lagoon and KP 50+000.

Peat bogs

In this ELU, peat bogs occupy approximately 3.52% of the ROW length and are characterized by the predominance of *Distichia muscoides* and the presence of the *Myrosmodes* orchid. These orchids are characteristic of very cold altitudes (above 3,500

m) and grow along the ground, protected by the grasses. These bogs are very important for the local population as forage livestock and water supply source.

Sward-forming grassland

Sward-forming grasslands cover about 12.45% of the ELU length, generally growing on flat land with moist soils. It is often an intermediate vegetation type between the peat bogs and tussock grassland. The most common species are the grasses *Calamagrostis vicunarum* and *Aciachne pulvinata*. Sward-forming grasslands are very important, being used as preferred pastures by locals. The shrub *Escallonia myrtilloides* and the herb *Perezia coerulescens* are classified as vulnerable species by INRENA.

Resinous Scrub

Resinous scrub habitat occupies only around 1.39% of this ELU, being restricted to the lowest areas near the Torobamba River Valley. Typical elements are *Tecoma arequipensis* and *Schinus molle*.

Key Fauna

Large fauna include the mountain lion (*Puma concolor*) and the Andean condor (*Vultur gryphus*). Other mammals reported in this ELU were the mice *Akodon juninens* and *Calomys sorellus.* Other key birds registered in this ELU were the Andean tinamou (*Nothoprocta pentlandii*), silvery grebe (*Podiceps occipitalis*), puna snipe *Gallinago andina,* and the band-tailed seedeater (*Catamenia analis*).

The lagoons support sensitive populations of silvery grebes (INRENA near threatened) and ducks.

Hydrobiology

Table 11.8 presents water bodies sampled along ELU 4. No salient characteristics were found in this ELU.

Table 11.8. Water bodies Sampled – ELU 4

Station	Habitat	Waterbody	Name	Height (m)	KP
Hi-32	Altoandino	Bofedal	Nina Orcco		53+200
Hi-33	Altoandino	Laguna	Nina Orcco	4080	51+200
Hi-34	Interandino	Quebrada	Soccosmayo	2459	49+500
Hi-35	Interandino	Laguna	Yanacocha	4115	48+800

11.3.3 SPECIES SENSITIVITY ANALYSIS

The *Aa* and *Myrosmodes* (INRENA near threatened) orchids are considered to be of Medium sensitivity due to their scarcity.

Escallonia myrtilloides and *Perezia coerulescens* are regional endemics and classified as vulnerable species by INRENA and are thus also considered to be of Medium sensitivity.

The bog moss, Distachia muscoides, is also considered to be of Medium Sensitvity because of its limited distribution and seasonal use by the local community.

Due to high its high mobility and widespread geographic ranges, the mountain lion is considered to be of low sensitivity and would not be directly affected by construction activities.

Under the EFS species sensitivity classification, the Andean condor, *vultur grypus,* is classified as Medium sensitivity.

Table 11.9 shows the sensitive species found during the EFS fieldwork.

Table 11.9. Species Sensitivity Criteria - ELU 4

No	Species	Protection Status						Spatial Distribution			Local Use			Mobility		Σ
		CR	EN	VU	NT	L	N	Local	Regional	Widespread	Permanent	Seasonal	None	Immobile	Mobile	
	Plants															
4	*Aa* sp.						0	3					0	3		6
2	*Aciachne pulvinata*						0		2				0	3		5
3	*Calamagrostis vicunarum*						0			0	2			3		5
4	*Distichia muscoides*						0		2			1		3		6
5	*Escallonia myrtilloides*			4						0	2			3		9
	Jarava ichu						0			0			0	3		3
6	*Lachemilla pinnata*						0			0			0	3		5
7	*Luzula racemosa*						0		2		2	1		3		4
8	*Myrosmodes sp.*				3			3					0	3		9
9	*Perezia coerulescens*			4			0		2				0	3		9
10	*Plantago rigida*						0		2				0	3		5
12	*Ranunculus praemorsus*						0			0		1		3		4
13	*Scirpus americanus*						0			0	2			3		5
	Schinus molle						0			2	2			3		5
15	*Werneria pygmaea*						0		2				0	3		5
	Reptiles and amphibians															
16	*Gastrotheca marsupiata*						0		2				0	3		5
17	*Liolaemus* cf. *walkeri*						0		2				0	3		5
18	*Liolaemus walkeri*						0		2				0	3		5
19	*Pleurodema marmorata*						0			0			0	3		3
	Mammals															
20	*Akodon* cf. juninensis						0	3					0		0	3
21	*Calomys sorellus*						0	3					0		0	3
22	*Lycalopex (Pseudalopex) culpaeus*						0		2				0		0	2
23	*Puma concolor*				3					0			0		0	3
	Birds															
24	*Asthenes* sp.						0		2				0		0	2
	Catamenia analis						0			0			0		0	0
25	*Gallinago andina*						0		2				0		0	2
26	*Metallura tyrianthina*						0			0			0		0	0

	Nothoprocta pentandlii						0		2				0		0	2
27	*Phrygilus plebejus*						0			0			0		0	0
28	*Phrygilus unicolor*						0			0			0		0	0
	Podiceps occipitalis						0		2				0		0	2
29	*Vultur gryphus*		5							0			0		0	5

Protection Status*:
CR= Critically endangered 6 points
EN= Endangered 5 points
VU= Vulnerable 4 points
NT= Near threatened 3 points
B= Low (Others) 2 points
N= Not listed 0 points

Σ= Sensitivity value

1 - 5: Low
6 - 10: Medium
11 or higher: High

Species Distribution:
Local = (Endemic locally or to an EBA**) 3 points
Regional = (Regional endemic in Andes or Coast) 2 points
Widespread = (Across S. America or cosmopolitan) 0 points

Mobility:
Immobile = (restricted movement or in very short distance) 3 points
Mobile = 0 points

Local Uses:
Permanent= 2 points
Seasonal = 1 point
None = 0 points

***Protection Status:** According IUCN (2006) or National Legislation (D.S. No. 034-2004-AG/D.S. No. 043-2005-AG)
****EBA:** Areas determined by Birdlife International, which includes at least 2 bird species with less than 50,000 km2 of known distribution range.

11.3.4 HABITAT SENSITIVITY ANALYSIS

Based on the presence of medium sensitivity species presented in Table 11.9 the Tussock Grassland of the Sillaccasa Sierra ELU is considered to be of Medium Sensitivity due to the presence of four Medium Sensitivity plant species. None of the other habitats in this ELU meet the criteria for a high or medium sensitivity habitat as described in Section 7.2 of these EFS.

11.4 KEY ISSUES AND RECOMMENDATIONS

Soils

Soils are generally strongly acidic, of low fertility and with steep slopes in some stretches. Soils will need special treatments to accelerate remediation results.

Considering into seasonal precipitation levels, implementation and maintenance of erosion control measures during construction should focus on the rainy season. During the construction, erosion control devices as silt fences, slope breakers and wooden barriers must be implemented.

Areas of steep slopes and low fertility should be considered for additional biorestoration techniques during reinstatement including hydro seeding and fertilizers application.

Water bodies and Wetlands

The ROW passes close to a sensitive habitat close to Yanacocha I lagoon (20m away from KP 48+800), which is important for flora, fauna, and the local population. As a wetland it is a resting place for migrant birds and supports waterfowls and other important birds. The impacts on the wetland should be managed by site-specific measures for wetland crossings.

Peat bogs are very important for local farmers who use them as pasture areas.

Flora and Fauna

Two plant species classified as sensitive could be managed by relocation or revegetation. Both, *Escallonia myrtilloides* and *Perezia coerulescens* are classified as vulnerable species by INRENA. The *Myrosmodes* and Aa Sp. orchid is considered to be sensitive due to its scarcity and whenever practicable the plants should be translocated from peat bog prior to construction.

Turf and topsoil strip prior to construction should assist with peat bog habitat regeneration including the bog moss, Distachia muscoides.

The Andean condor, although listed as an Endangered species, is highly unlikely to be impacted by construction, being mobile and likely to temporarily move away from any disturbed areas.

Table 11.10 summarizes the key issues and recommendations for the Sillaccasa Sierra ELU.

Table 11.10. Key Issues and Recommendations – ELU 4

Issue	KP Reference	Recommendations	Reference
Physical instability	44+250 – 44+315 45+816 – 46+345	Temporary and permanent erosion controls including consideration of additional biorestoration methods (fertilizer and mulch applications and hydro seeding) in highest risk areas	ECOMP
Yanacocha lagoon	48+800	Final routing to minimize disturbance to the lagoon and fringing wetlands.	ECOMP
Peat bog habitat	48+121 – 48+418	Translocation of orchids (*Aaa sp*. and *Myrosmodes sp*.) and shrubs Escalonia myrtilloides) before construction. Topsoil strip and protection during construction phase for respreading during reinstatement	ECOMP
		Turf and topsoil strip prior to construction. Restoration of topsoil and plants during abandonment. Native species seed mix, where practicable, during	RP

		bioreinstatement	

Source: EFS

12.0 ELU 5: YUCAY RIVER VALLEY (KP 56+783 – 74+199)

12.1 General Description

The Yucay River Valley ELU contains extensive cultivated areas around the villages of Chunucancha, Huaychao, Acocro, Tambo, Cuchucancha, Seccelambras, Pomapuquio, and others. The relict native vegetation patches are composed of resinous and thorny scrublands. The natural vegetation is part of the upper Mantaro Dry Forest System as is determined by the seasonally dry climate and elevations from 2,850 to 3,864 m. The ROW crossing the Yucay River at 2,850 m is the second lowest ROW elevation point in the Ayacucho Department.

The KP 58+900 – 62+600 around Huaychao area presents a high risk of water erosion and landslides and the formation of extensive gullies. Topsoil fluctuates from 0-15 to 0-30 cm depth depending on site-specific conditions. Bulk density and mechanical resistance is medium so compaction could be a concern if appropriate land conservation practices are not implemented. Colluvial and conglomerate soils predominate. Soil fertility is from low to medium.

The ELU has 6 habitat types. The largest habitat type is constituted by Cultivated Areas that represent the 81.76% of the ELU total length, and the smallest one, peat bogs sums 0.26%. Tables 12.6 and 12.7 show the sequence of the habitat types along the ROW and their total lengths, respectively.

12.2 PHYSICAL CHARACTERISTICS

12.2.1 PRECIPITATION

Precipitation in ELU 5 is seasonal. The wet season is from January to March, and is known locally as the "winter" or rainy season, even though it actually corresponds with the climatologically-defined austral summer. The dry season extends from April to December. Table 12.1 shows precipitation values during both seasons.

Table 12.1. Precipitation - ELU 5

Estimated Precipitation (mm)			
Peak		General	
(January - March)		(September - April)	
KP Range	Precipitation (mm)	KP Range	Precipitation (mm)
56+783 - 58+000	400 - 500	56+783 - 68+000	500 - 600
58+000 - 62+000	300 - 400		
62+000 - 72+000	200 - 300	68+000 - 74+199	600 - 700
72+000 - 74+199	300 - 400		

Source: ESIA, Environmental Baseline

12.2.2 GEOLOGY

Intrusive complexes of highly fractured grey to pink granites with granular texture dominate the Yucay River Valley ELU from KP 56+800 to near 61+000. These rocks are weathered on the surface, although the fragments are hard and strong.

Approaching KP 61+000 and westward, andesitic rocks and rather weathered granitic rocks predominate. Along this area there are signs of mass wasting and other erosive processes. Well defined outcrops occur near Acocro between KP 70+000 and KP 74+000.

12.2.3 SOILS

Soil pH ranges from slightly to strongly acidic, with one sample with a slightly alkaline characteristic at KP 61+000.

Surface Horizon Characteristics

Surface horizon depth is generally medium along the ELU, despite the variable slope. Organic matter content is variable, being high at KPs 59+000, 72+000 and 73+000, medium at KPs 63+000 and 69+000, and low at KPs 61+000 and 63+000. Slopes vary from nearly flat to very steep in some areas, especially at KP 73+000.

Based on available levels of phosphorus, the topsoil is of low fertility at KPs 59+000, 61+000 and 73+000; medium at KPs 63+000 and 66+00; and high at KPs 63+000 and 72+000.

Surface horizon characteristics are shown in Table 12.2.

Subsoil Characteristics

Subsoil physical characteristics like texture (fluctuating from sandy loam to sandy clay loam) are similar, but the level of nutrients and organic matter are lower. The Subsoil is generally well drained. Soils with higher sand content are very loose and soil aggregates are of low stability. A clayey Subsoil that could affect infiltration from the A horizon was observed at a depths of 15 to 50 cm at Kp 63+000.

Table 12.2. Surface Horizon Characteristics - ELU 5

KP	pH	Surface horizon depth	Organic matter	Fertility	Slope (%)
59+000	Strongly acid	Medium	high	low	20%
61+000	Slightly alkaline	High	low	low	10-15%
63+000	Moderately acid	Medium	low	medium	15-20%
69+000	Moderately acid	Medium	medium	high	30%
66+000	Slightly acid	Medium	medium	medium	20%
72+000	Strongly acid	Low	medium	high	30%
73+000	Strongly acid	medium	high	low	>100%

Source: ESIA, Environmental Baseline and Domus.
pH: Strongly acid = Less than 5.5; Moderately acid = 5.6 to 6.0; Slightly acid = 6.1 – 6.5; Neutral = 6.6 - 7.0; Slightly alkaline = 7.1 – 7.8; Moderately alkaline = 7.9 to 8.4; Strongly alkaline = 8.5 or greater.
Surface horizon depth: Low = Less than 5 cm; Medium = 5 cm to 15 cm; High = More than 15 cm.
Organic matter: Low = Less than 2%; Medium = 2% to 4%; High = More than 4%.
Fertility based on Available Phosphorus: Low = Less than 7.0 ppm; Medium = 7.0 to 14.0 ppm; High = More than 14.0 ppm.

12.2.4 WATER BODIES

The ROW crosses the Yucay River at approximately KP 62+380, it passes 200 m far from the Sontorohuaycco Stream, and for 200m parallel to another stream, which is a tributary of the Yucay River. At KP 71+000, the ROW gets closer to Jatunchancara Stream, 500 m away. In this ELU, the ROW crosses one peat bog and does not cross lagoons or lakes, as is shown in Table 12.3.

Table 12.3. Principal Waterbody Crossings - ELU 5

Waterbody Type or Name	KP Mid-channel	Elevation (m)
Quebradas		
QUEBRADA	63+460.18	3112.70
QUEBRADA	63+609.90	3112.01
QUEBRADA	64+963.24	3289.09
QUEBRADA	72+275.56	3613.93
QUEBRADA	72+537.51	3650.20
QUEBRADA	72+782.92	3689.34
QUEBRADA 2	73+405.19	3772.10
QUEBRADA 1	73+446.98	3773.46
Rivers		
YUCAY	62+380.52	2814.07

Source: Peru LNG Pipeline Project Alignment Sheets (Gulf Interstate Engineering, 2006).

12.2.5 INSTABILITY AND PHYSICAL RISK

Low physical risk zones cover 74.4% of the ELU, with Medium and High physical risk categories occupying 19.8% and 5.8% of the total length, respectively. The High risk areas are located in three zones between KP 58+900 and KP 62+626 on a long ridge top between the village of Huaychao and the Yucay River.

Table 12.4. Physical Risk - ELU 5

Risk Category	KP Start	KP Finish	Length (m)	
Low	56+800	57+140	340	12,789
	58+367	58+900	533	
	59+640	62+148	2,508	
	62+148	62+282	134	
	62+369	62+451	82	
	62+626	70+921	8,295	
	71+649	72+546	897	
Medium	57+140	58+367	1,227	3,409
	70+921	71+649	728	
	72+546	74+000	1,454	
High	58+900	59+640	740	1002
	62+282	62+369	87	
	62+451	62+626	175	

Source: ESIA, Environmental Baseline and Domus.

12.2.6 INFRASTRUCTURE

One shoofly is proposed for the Yucay River Valley ELU near KP 57+500. Two camps are considered in this ELU: the Central Huaychao at KP 60+020, and the Central Acocros at KP 70+623.

Table 12.7 shows infrastructure information.

Table 12.5. Planned Project Infrastructures – ELU 5

Type of Infrastructure	KP	Name	Action	Related to
Camps	60+020	Central – Huaychao	Topsoil strip and reinstatement	ECOMP/RP
	70+623	Central – Acocros	Topsoil strip and reinstatement	ECOMP/RP
Shooflies	56+519	KM 56.5	Topsoil protection / Erosion control devices and slope revegetation Reinstatement after construction	ECOMP/RP

Source: ESIA, Project Description

12.3 HABITATS AND SPECIES

12.3.1 HABITAT DISTRIBUTION

The habitats of ELU 5 are listed in sequential order in Table 12.6, including the length of each habitat unit and associated start and finish ROW KPs. Table 12.7 summarizes the lengths of each habitat type with ELU, including subtotals for each habitat type.

Table 12.6. Habitat Sequence – ELU 5

Habitats	Length (m)	KP Start	KP Finish
Thorny scrub	154	56+783	56+971
Cultivated areas	4347	56+971	61+318
Resinous Scrub	357	61+318	61+675
Cultivated areas	803	61+675	62+478
Resinous Scrub	1104	62+478	63+582
Cultivated areas	9116	63+582	72+698
Eucalyptus plantations	1088	72+698	73+786
Resinous Scrub	129	73+786	73+915
Peat Bogs	45	73+915	73+960
Resinous Scrub	239	73+960	74+199

Source: ESIA, Environmental Baseline and Domus.

Table 12.7. Habitat Summary – ELU 5

Habitat Types	Length (m)	KP Start	KP Finish
Peat bog	45	73+915	73+960
Total	**45**	**0.26%**	
Cultivated areas	4347	56+971	61+318
	803	61+675	62+478
	9116	63+582	72+698
Total	**14,266**	**81.76%**	
Eucalyptus plantations	1088	72+698	73+786
Total	**1,088**	**6.24%**	
Thorny scrub	171	56+800	56+971
Total	**171**	**0.98%**	
Resinous Scrub	357	61+318	61+675
	1104	62+478	63+582
	129	73+786	73+915
	239	73+960	74+199
Total	**1,829**	**10.48%**	
Tussock grassland	17	56+783	56+800
	32	74+167	74+199
Total	**49**	**0.28%**	
Total ELU 5:	**17,448**		

Source: ESIA, Environmental Baseline and Domus.

12.3.2 HABITAT DESCRIPTION

Cultivated Areas

Extensive cultivated areas around the villages of Chunucancha, Huaychao, Acocro, Tambo, Cuchucancha, and others occupy 81.76% of the ROW in the dry valley landscape of the upper Yucay River Basin.

Resinous Scrub

Relictual stands of resinous shrubs with predominance of *Schinus molle*, and *Agave americana*, coexist with intervened areas such as along trails, cultivated areas, corrals, accounting for 10.48% of the ROW length. The presence of *Cleistocactus morawetzianus, Corryocactus quadrangularis,* and *Echinopsis peruviana puquiensis* was registered. The latter two of these cacti are endemic and threatened, respectively.

Eucalyptus Plantations

Eucalyptus plantations have minimum ecological value and cover 6.24% of the highly modified Yucay River Valley ELU. Eucalyptus trees are exotic species that do not bring resources for feeding or nesting to local fauna, and are of low biodiversity.

Thorny Scrub

Thorny shrub formations composed of *Berberis* spp*., Dunalia spinosa*, are present, along with *Escallonia myrtilloides*, a non-endemic vulnerable species. These dispersed shrubs coexist with intervened areas (roads, cultivated areas, corrals) and comprise only about 1% of the habitat in ELU 5.

Fauna

Human settlements are associated with introduced mice and rats that are dispersed around the villages, cultivated fields, and dumps. Native rodents like *Calomys lepidus,* and *Phyllotis posticalis* were found in this ELU. Molina's hog-nosed skunk (*Conepatus chinga*) were registered in this ELU.

The bearded mountaineer (*Oreonympha nobilis*), a regional endemic of the Andes of southern Peru, was registered here. The Andean tinamou (*Nothoprocta pentlandii*), and Andean flicker (*Colaptes rupicola*), are also important.

Water bodies are used by water frogs (*Telmatobius* sp.) and two species of Andean catfishes (*Trichomycterus rivulatus* and *Astroblepus* sp.) All of them classified as sensitive species. The warty toad (*Chaunus spinulosus*; INRENA near threatened) was observed near the Yucay River.

Stenocercus frittsi, a Mantaro basin endemic, was observed in ELU 5. Probable new species of the lizard genus *Euspondylus* and the snake genus *Sibynomorphus* found in the Mantaro basin near the city of Huamanga are likely to be found in the Yucay River Valley due to similarity of the habitats.

Hydrobiology

Table 12.8 presents water bodies sampled along ELU 5. Two species were found in one of the stations (Hi-31) on the Yucay River. The genus *Astrooblepus* presents endemic species and native species which can migrate to other water bodies when looking for food. *Trychomycterus sp*. is a native, low mobility species described for ELU 5.

Table 12.8. Water bodies Sampled – ELU 5

Station	Habitat	Waterbody	Name	Height (masl)	KP	Species
Hi-28	Interandino	Quebrada	Jatunchancara	3528	71+000	
Hi-29	Interandino	Quebrada	Affluent to Yucay	2848	62+500	
Hi-30	Interandino	Quebrada	Huaycco	2854	62+500	
Hi-31	Interandino	River	Yucay	2822	62+500	*Astroblepus sp.* *Trichomycterus sp.*

12.3.3 SPECIES SENSITIVITY ANALYSIS

Table 12.9 shows the sensitive species found during the EFS fieldwork.

One High Sensitivity plant species was identified (*Corryocactus quadrangularis*) and five other plant species were defined as Medium Sensitivity. Two fish species and three reptile species were also of Medium Sensitivity. One bird species was of Medium Sensitivity.

Table 12.9. Species Sensitivity Criteria - ELU 5

No	Species	Protection Status						Spatial Distribution			Local Use			Mobility		Σ
		CR	EN	VU	NT	L	N	Local	Regional	Widespread	Permanent	Seasonal	None	Immobile	Mobile	
	Plants									0						
	Agave americana						0			0	2			3		5
1	*Austrocylindropuntia subulata*						0		2				0	3		5
2	*Baccharis odorata*						0		2				0	3		5
3	*Baccharis tricuneata*						0		2				0	3		5
4	*Berberis flexuosa*						0	3					0	3		6
	Chaunus spinulosus				3					0			0	3		6
5	*Cleistocactus morawetzianus*						0	3					0	3		6
6	*Corryocactus quadrangularis*		5					3					0	3		11
7	*Echinopsis peruviana* ssp. *puquiensis*			4				3					0	3		10
8	*Escallonia myrtilloides*			4					2	0			0	3		9
	Schinus molle						0			0	2			3		5
	Fishes															
9	*Astroblepus* sp.						0			0	2			3		5
10	*Orestias* sp.						0		2		2		0	3		7
11	*Trichomycterus rivulatus*						0	3			2		0	3		8
	Reptiles and amphibians															
28	*Liolaemus* sp.						0	3					0	3		6
	Stenocercus frittsi						0	3					0	3		6
12	*Telmatobius* sp.			4				3					0	3		10
	Mammals															
13	*Calomys lepidus*						0			0			0		0	0
14	*Conepatus chinga*						0			0			0		0	0
15	*Desmodus rotundus*						0			0			0		0	0
16	*Lycalopex (Pseudalopex) culpaeus*						0		2				0		0	2
17	*Phyllotis* cf. *xanthopygus posticalis*						0	3		0	2		0		0	5
	Birds															
18	*Aeronautes andecolus*						0			0			0		0	0
19	*Aglaeactis cupripennis*						0			0			0		0	0
20	*Agriornis montanus*						0			0			0		0	0
21	*Anairetes flavirostris*						0			0			0		0	0
22	*Asthenes* sp.						0		2				0		0	2
23	*Bolborhynchus orbygnesius*						0			0		1			0	1

24	*Carduelis atrata*						0		2				0		0	2
25	*Carduelis magellanica*						0			0			0		0	0
26	*Catamenia analis*						0			0			0		0	0
27	*Catamenia inornata*						0			0			0		0	0
28	*Colaptes rupicola*						0			0			0		0	0
29	*Columba livia*						0			0			0		0	0
30	*Conirostrum cinereum*						0		2				0		0	2
31	*Diuca speculifera*						0		2				0		0	2
32	*Geranoaetus melanoleucus*						0			0			0		0	0
33	*Metriopelia melanoptera*						0			0			0		0	0
34	*Nothoprocta ornata*						0		2				0		0	2
35	*Nothoprocta pentlandii*						0		2				0		0	2
36	*Oreonympha nobilis*						0	3					0		0	3
37	*Phalcoboenus megalopterus*						0			0			0		0	0
38	*Pheucticus aureoventris*						0			0			0		0	0
39	*Polioxolmis rufipennis*						0		2				0		0	2
40	*Saltator aurantiirostris*						0			0			0		0	0
41	*Sicalis uropygialis*						0			0			0		0	0
42	*Turdus chiguanco*						0			0			0		0	0
43	*Vultur gryphus*		5							0			0		0	5

Protection Status*:
CR= Critically endangered 6 points
EN= Endangered 5 points
VU= Vulnerable 4 points
NT= Near threatened 3 points
B= Low (Others) 2 points
N= Not listed 0 points

Σ= Sensitivity value

1 - 5: Low
6 - 10: Medium
11 or higher: High

Species Distribution:
Local = (Endemic locally or to an EBA**) 3 points
Regional = (Regional endemic in Andes or Coast) 2 points
Widespread = (Across S. America or cosmopolitan) 0 points

Mobility:
Immobile = (restricted movement or in very short distance) 3 points
Mobile = 0 points

Local Uses:
Permanent= 2 points
Seasonal = 1 point
None = 0 points

***Protection Status:** According IUCN (2006) or National Legislation (D.S. No. 034-2004-AG/D.S. No. 043-2005-AG)
****EBA:** Areas determined by Birdlife International, which includes at least 2 bird species with less than 50,000 km2 of known distribution range.

12.3.4 HABITAT SENSITIVITY ANALYSIS

Based on the presence of high and medium sensitivity species presented in Table 12.9 the Resinous Scrub of the Yucay River Valley ELU is considered to be of High Sensitivity due to the presence of one High Sensitivity plant species. The Yucay River of the yucay River Valley ELU is considered to be of Medium Sensitivity due to the presence of two Medium Sensitivity animal species. None of the other habitats in this ELU meet the criteria for a high or medium sensitivity habitat as described in Section 7.2 of these EFS.

12.4 KEY ISSUES AND RECOMMENDATIONS

Soils

Physical Risk

Precipitation could produce erosive processes in the ELU, so preventive and mitigation measures should be implemented, especially in the zones categorized as presenting Medium and High physical risk.

Habitats and Species

Special consideration should be granted to the presence of the locally endemic cacti *Corryocactus quadrangularis* occurring in the Resinous Scrub habitat, which is listed as endangered by INRENA.

Streams and rivers must be protected to avoid contamination or any disturbance in order to protect native Andean fishes and aquatic frogs.

Although classified as Medium Sensitivity, the Andean condor, *Vulture gryphus,* is a mobile species and it is highly unlikely that it will be impacted by construction of require any special protective measures.

Table 12.10 summarizes the key issues and recommendations for the Yucay River Valley ELU.

Table 12.10. Key Issues and Recommendations - ELU 5

Issue	KP Reference	Recommendations	Related to
Risk of mass wasting in Unstable terrains	58+900 – 62+626	Erosion control and pollution prevention best practice is particularly important at water bodies including the Yucay River at KP 62+380 to safeguard water supply and avoid sediment inundation. Erosion controls and consideration of additional biorestoration measures including fertilizer and mulch application and hydro seeding in highest risk areas.	ECOMP/RP
River and stream crossings (Protection of fish species *Orestias sp.* and *Trichomycterus rivulatus*)	62+500, 62+500, 62+500, 71+000 and 72+000	Ditch in dry season if possible, use best practice crossing techniques to minimize sediments and turbidity. Retain vegetative buffer zones at watercourse crossings until immediately prior to pipeline crossing installation Silt fence controls at stockpile where ROW is aligned close to streams.	ECOMP
Resinous Scrubs high sensitivity habitats	61+318 – 61+675 62+478 – 63+582 73+786 – 73+915 73+960 – 74+199	Regeneration of Resinous Scrub habitats by replacement of cactus species such as *Corryocactus Quadrangularis* and *Echinopsis peruviana*	ECOMP/RP

		puquiensis and *Escallonia myrtilloides* where impractical to translocate existing plants from ROW.	
Reptiles – Lizard (*Liolaemus sp*. and *stenocercus* and Water frog (*Telmatobius sp*.)	Several habitats	Pre-clearance survey to identify and relocate from ROW prior to site clearance activities.	ECOMP

Source: EFS Fieldwork

13.0 ELU 6: HUAMANGA-VISCHONGO WATERSHED DIVIDE (KP 74+199 TO 103+970)

13.1 General Description

After passing the cultivated areas of the Yucay River Valley to the east, the ROW rises up and follows the watershed divide between the Huamanga Valley to the north and the Vischongo river basin to the south, passing primarily through tall tussock puna grassland (91% of the ELU), with occasional narrow stretches of sward-forming grassland and peat bog wetlands in valleys and depressions.

The climate is dry and cold, with elevations between 3,864 and 4,250 m. Precipitation ranges from 300 to 700mm per year, depending on altitude. This unit includes the rural communities of Pinao Yantapacha, San Martin de Yanapiruro Ichubamba, Chiara, Chupas, Toccyascca, Tambocucho and San Basilio de Chupas.

From KP 103+000 to the end of the ELU at KP 103+970, in both sides of the Vischongo River valley, colluvial and volcanic soils predominate, which are very sensitive to erosion and landslides. Cropping systems with potato and other crops are predominant in the valley areas where the level of fertility is from medium to high due to the use of fertilizers. The colluvial unstable area is of low fertility and low levels of phosphorous will represent a limitation to the rate of revegetation after construction.

13.2 PHYSICAL CHARACTERISTICS

13.2.1 PRECIPITATION

Precipitation is highly seasonal along the Huamanga-Vischongo divides, with the three-month wet season almost double the amount of the nine-month dry season. The wet season is from January to March, and is known locally as the "winter" or rainy season, even though it actually corresponds with the climatologically-defined austral summer. The dry season extends from April to December. Table 13.1 shows precipitation values for each season.

Table 13.1. Precipitation - ELU 6

KP Range	Estimated Precipitation (mm)	
	Peak	General
	(January – March)	(September – April)
74+199 – 103+970	300 – 400	600 - 700

Source: ESIA, Environmental Baseline

13.2.2 GEOLOGY

A volcanic formation extends approximately from the edge of the Yucay River Valley (KP 74+199) to the Sallalli hacienda (KP 104+200) and consists of tuffs and lava effusions alternating with clays and siltstones and diatomites. The tuffaceous lithology has little resistance to erosion and therefore fractured and weathered areas may pose the risk of landslides and rock falls, despite the generally gentle topography. Notable erosional features were observed near KP 100+000.

13.2.3 SOILS

Surface horizon characteristics

Soil pH in ELU 6 is strongly acidic. The surface horizon is generally of medium depth with isolated areas of deeper soils.

Organic matter content is predominantly high and soils of the ELU have a medium level fertility, based on phosphorus availability. Surface horizon characteristics are shown in Table 13.2.

Subsoil Characteristics

The Subsoil has a loamy sand texture, coarser than the sandy loam texture of the topsoil layer, and will not affect the movement of water. These layers are very loose and the aggregates are of low stability.

Table 13.2. Surface Horizon Characteristics - ELU 6

KP	pH	Surface horizon depth	Organic matter	Fertility	Slope (%)
75+000	Moderately acid	Medium	Low	Low	
78+000	Strongly acid	Medium	High	Medium	
81+000	Strongly acid	Medium	High	High	
84+000	Strongly acid	Medium	High	Medium	
87+000	Strongly acid	Medium	High	High	80%
88+000	Strongly acid	High	High	Medium	
90+000	Strongly acid	Medium	High	Medium	
93+000	Strongly acid	Medium	High	Medium	
96+000	Strongly acid	High	High	Medium	
99+000	Strongly acid	Medium	High	Medium	
100+000	Strongly acid	High	High	Low	30%
102+000	Strongly acid	Medium	Medium	Medium	

Source: ESIA, Environmental Baseline and EFS Field Work.
pH: Strongly acid = Less than 5.5; Moderately acid = 5.6 to 6.0; Slightly acid = 6.1 – 6.5; Neutral = 6.6 - 7.0; Slightly alkaline = 7.1 – 7.8; Moderately alkaline = 7.9 to 8.4; Strongly alkaline = 8.5 or greater.
Surface horizon depth: Low = Less than 5 cm; Medium = 5 cm to 15 cm; High = More than 15 cm.
Organic matter: Low = Less than 2%; Medium = 2% to 4%; High = More than 4%.
Fertility based on Available Phosphorus: Low = Less than 7.0 ppm; Medium = 7.0 to 14.0 ppm; High = More than 14.0 ppm.

13.2.4 WATERBODIES AND WETLANDS

ELU 6 passes within 250 m of the Choqueacgra lagoon, and within 500 m of 5 peat bogs, located between KP 80+800 and KP 92+500. It crosses one peat bog at KP 85+500. Waterbodies registered for this ELU are shown in Table 13.3.

Table 13.3. Principal Crossings - ELU 6

Waterbody Type or Name	KP Mid-channel	Elevation (m)
Arroyos		
ARROYO	79+570.36	4159.28
ARROYO	79+700.97	4149.14
ARROYO	80+697.27	4035.09
ARROYO CANMAYO	80+861.05	4023.62
ARROYO RODEAOHUAYCCO	83+158.73	4079.17
ARROYO	85+410.61	4017.99
ARROYO JATUN SALLAHUAYJO	85+561.50	4032.35
ARROYO	87+436.11	4066.75
ARROYO	88+982.82	4095.45
ARROYO ANCAPACHANHUAYCCO	90+365.12	4026.90
ARROYO	90+399.45	4027.98
ARROYO JOSCCO HUAYCCO	92+507.41	4117.64
ARROYO	95+248.77	4197.13
ARROYO	96+636.83	4166.83
ARROYO	96+966.41	4145.51
ARROYO SECO	99+208.35	4004.27
Quebradas		
QUEBRADA	77+592.61	4166.84
QUEBRADA SECA	77+606.10	4167.61
QDA TOROHUICHCANAN	99+100	4020

Source: Peru LNG Pipeline Project Alignment Sheets (Gulf Interstate Engineering, 2006).

13.2.5 INSTABILITY AND PHYSICAL RISK

Nearly the entire length (i.e., 97.9%) of the Huamanga-Vischongo Watershed divide ELU is categorized as having Low physical risk (Table 13.4). A combined length of only 606 m at the western and eastern end of the ELU is categorized as presenting a Medium physical risk.

Table 13.4. Physical Risk - ELU 6

Risk Level	KP Start	KP Finish	Length (m)		Action	Related To
Low	74+600	103-964	29,364	29,364	Topsoil protection	ECOMP / RP
Medium	74+000	74+600	600	606	Topsoil protection	ECOMP / RP
	103+964	103+970	6			

Source: ESIA, Environmental Baseline and Domus.

13.2.6 INFRASTRUCTURE

There is no information currently available on camps, shooflies, or other accessory infrastructure that are planned to be installed in the Huamanga-Vischongo Watershed Divide ELU.

13.3 HABITATS AND SPECIES

13.3.1 HABITAT DISTRIBUTION

Table 13.5. Habitat Sequence – ELU 6

Habitat Type	Length (m)	KP Start	KP Finish
Tussock grassland	5500	74+199	79+699
Peat Bogs	8	79+699	79+707
Tussock grassland	168	79+707	79+875
Peat Bogs	9	79+875	79+884
Tussock grassland	973	79+884	80+857
Peat Bogs	221	80+857	81+078
Tussock grassland	187	81+078	81+265
Peat Bogs	21	81+265	81+286

Tussock grassland	1863	81+286	83+149
Peat Bogs	17	83+149	83+166
Tussock grassland	1047	83+166	84+213
Peat Bogs	545	84+213	84+758
Tussock grassland	651	84+758	85+409
Peat Bogs	224	85+409	85+633
Tussock grassland	1712	85+633	87+345
Peat Bogs	10	87+345	87+355
Tussock grassland	1624	87+355	88+979
Peat Bogs	32	88+979	89+011
Tussock grassland	1028	89+011	90+039
Peat Bogs	25	90+039	90+064
Tussock grassland	1978	90+064	92+042
Peat Bogs	22	92+042	92+064
Tussock grassland	51	92+064	92+115
Peat Bogs	96	92+115	92+211
Tussock grassland	293	92+211	92+504
Peat Bogs	48	92+504	92+552
Tussock grassland	1807	92+552	94+359
Peat Bogs	52	94+359	94+411
Tussock grassland	783	94+411	95+194
Sward-forming grassland	31	95+194	95+225
Peat Bogs	26	95+225	95+251
Sward-forming grassland	65	95+251	95+316
Peat Bogs	43	95+316	95+359
Sward-forming grassland	31	95+359	95+390
Tussock grassland	1239	95+390	96+629
Peat Bogs	23	96+629	96+652
Tussock grassland	2486	96+652	99+138
Sward-forming grassland	146	99+138	99+284
Tussock grassland	1440	99+284	10+724
Peat Bogs	99	100+724	100+823
Tussock grassland	367	100+823	101+190
Peat Bogs	74	101+190	101+264
Tussock grassland	43	101+264	101+307
Peat Bogs	77	101+307	101+384
Tussock grassland	621	101+384	102+005
Sward-forming grassland	244	102+005	102+249
Tussock grassland	1132	102+249	103+381
Sward-forming grassland	237	103+381	103+618
Cultivated areas	161	103+618	103+779
Tussock grassland	191	103+779	103+970

Table 13.6. Habitat Summary – ELU 6

Habitat Type	Length (m)	KP Start	KP Finish
Tussock grassland	5500	74+199	79+699
	168	79+707	79+875
	973	79+884	80+857
	187	81+078	81+265
	1863	81+286	83+149
	1047	83+166	84+213
	651	84+758	85+409
	1712	85+633	87+345
	1624	87+355	88+979
	1028	89+011	90+039
	1978	90+064	92+042
	51	92+064	92+115
	293	92+211	92+504
	1807	92+552	94+359
	783	94+411	95+194
	1239	95+390	96+629
	2486	96+652	99+138
	1440	99+284	10+724
	367	100+823	101+190
	43	101+264	101+307
	621	101+384	102+005
	1132	102+249	103+381
	191	103+779	103+970
Total	**27,184**	**91.31%**	
Sward-forming grassland	31	95+194	95+225
	65	95+251	95+316
	31	95+359	95+390
	146	99+138	99+284
	244	102+005	102+249
	237	103+381	103+618
Total	**754**	**2.53%**	
Peat Bogs	8	79+699	79+707
	9	79+875	79+884
	221	80+857	81+078
	21	81+265	81+286
	17	83+149	83+166
	545	84+213	84+758
	224	85+409	85+633
	10	87+345	87+355

	32	88+979	89+011
	25	90+039	90+064
	22	92+042	92+064
	96	92+115	92+211
	48	92+504	92+552
	52	94+359	94+411
	26	95+225	95+251
	43	95+316	95+359
	23	96+629	96+652
	99	100+724	100+823
	74	101+190	101+264
	77	101+307	101+384
Total	**1672**	**5.62%**	
Cultivated areas	161	103+618	103+779
Total	**161**	**0.54%**	
Total ELU 6:	**29,771**		

Source: ESIA, Environmental Baseline and Domus.

13.3.2 HABITAT DESCRIPTIONS

Tussock grassland

Tussock grasslands cover almost the entire length (91.31%) of the Huamanga-Vischongo Divide. This habitat type is largely covered by grasses of the genera *Festuca, Stipa*, *Jarava*, and *Calamagrostis*. Shrubs present include *Escallonia myrtilloides,* and *Parastrephia quadrangularis*, both listed as vulnerable by the INRENA.

Sward-forming grassland

Sward-forming grasslands, while occupying only 2.53% of the ROW length in ELU 6, are very important and are used as preferred grazing lands by local farmers. In this habitat type the most common species are the grasses *Calamagrostis vicunarum* and *Aciachne pulvinata*.

Peat Bogs

Peat bogs in ELU 6, which form 5.62% of the total cover, and differ from the bogs in the previous ELUs due to the presence of many roseate species along the Huamanga-Vischongo divide. Dominant species are *Calamagrostis* cf. *vicunarum* "crespillo", *Plantago tubulosa, Hypochaeris* spp., *Baccharis* spp., and *Aciachne pulvinata.*

Cultivated areas

The small shrub *Parastrephia quadrangularis*, an INRENA-vulnerable species, was encountered in association with cultivated areas in ELU 6, between field boundaries and as living fences.

Fauna

Three felids and the vicuna (*Vicugna vicugna*; IUCN conservation dependent and INRENA near threatened) were registered in this ELU, demonstrating the importance and richness of the ecosystem, despite its proximity to the city of Huamanga (Ayacucho). Felids registered were the Andean mountain cat (*Leopardus jacobitus,* IUCN/INRENA endangered), the Pampas cat (*Leopardus pajeros*), and the mountain lion (*Puma concolor*).

At the south part of the Huamanga Valley, the most notable bird observed was the dark-winged miner (*Geositta saxicolina*), a range-restricted endemic species of the high Andes of south-central Peru. The ESIA also reported in this ELU the presence of the Vilcabamba thistletail *Schizoeaca vilcabambae*, an endemic bird, commonly found in the Apurimac valley, between 2500 to 3500 m.

At the south of the Huamanga Valley frogs and tadpoles of a species allied to the *Telmatobius jelskii* were found in a small stream near KP 92+500, indicating high conservation status, as frogs of the genus *Telmatobius* are highly sensitive to environmental degradation.

Hydrobiology

Table 13.7 presents waterdbodies sampled along ELU 6. One genus, *Orestias* was found.

Table 13.7. Waterbodies Sampled – ELU 6

Station	Habitat	Waterbody	Name	Height (masl)	KP	Species
Hi-24	Altoandino	Laguna	Choccehuacgra	4144	95+500	*Orestias sp.*
Hi-25	Altoandino	Bofedal	Chaquicocha	4053	92+200	
Hi-26	Altoandino	Bofedal	Achcacruz Orcco	3997	85+500	
Hi-27	Altoandino	Bofedal	Carimayo	4103	80+800	

13.3.3 SPECIES SENSITIVITY ANALYSIS

Table 13.8 shows the species found during the EFS fieldwork.

Shrubs of Medium Sensitivity present include *Escallonia myrtilloides* and *Parastrephia quadrangularis* which are included in the INRENA Vulnerable category and are very scarce in the ROW and surroundings. Their relocation and translocation should be attempted where practicable.

The rarely observed Andean cat *Leopardus jacobitus* (IUCN/INRENA endangered) was sighted in this ELU by the EFS field team. The area has importance for the production of the vicuña (*Vicugna vicugna*), a semi-wild relative of the llama with highly-valued wool and a member of the camelid family. *Telmatobius* frogs and the killifish (*Orestias sp.*) are found in some of the small streams within the ELU, indicating high-quality habitat, uncontaminated water.

Lizards (Liolaemus sp.), another Medium Sensitivity species, were observed in grassland habitats across the ELU.

Table 13.8. Species Sensitivity Criteria - ELU 6

No	Species	Protection Status						Spatial Distribution			Local Use			Mobility		Σ
		CR	EN	VU	NT	L	N	Local	Regional	Widespread	Permanent	Seasonal	None	Immobile	Mobile	
	Plants															
1	*Aciachne* cf. *acicularis*						0			0			0	3		3
2	*Aciachne pulvinata*						0		2				0	3		5
3	*Austrocylindropuntia floccosa*						0			0			0	3		3
4	*Azorella* sp.						0			0			0	3		3
	Baccharis spp.						0			0	2			3		5
5	*Calamagrostis* cf. *vicunarum*						0			0	2			3		5
7	*Erigeron* sp.						0			0			0	3		3
8	*Escallonia myrtilloides*			4					2	0			0	3		9
	Festuca sp.						0			0	2			3		5
9	*Gamochaeta* sp.						0			0			0	3		3
10	*Gentiana sedifolia*						0			0			0	3		3
11	*Hypochaeris* sp.						0			0			0	3		3
	Jarava sp.						0			0	2			3		5
12	*Juncus* cf. *bufonius*						0			0			0	3		3
13	*Lachemilla pinnata*						0		2				0	3		5
14	*Lysipomia* sp.						0			0			0	3		3
4	*Muhlenbergia* sp.						0			0	2			3		5
16	*Novenia acaulis*						0		2				0	3		5
17	*Oreithales integrifolia*						0			0			0	3		3
18	*Oreomyrrhis andicola*						0		2				0	3		5
19	*Parastrephia quadrangularis*			4				3		0			0	3		10
21	*Plantago tubulosa*						0			0			0	3		3
22	Poaceae						0			0			0	3		3
23	*Scirpus* cf. *rigidus*						0			0	2		0	3		5
24	*Stipa* sp.						0			0	2			3		5
25	*Viola pygmaea*						0		2				0	3		5
26	*Werneria nubigena*						0			0			0	3		3
	Fish															
27	*Orestias* sp.						0		2		2		0	3		7
	Reptiles and Amphibian															
28	*Liolaemus* sp.						0	3					0	3		6

29	*Telmatobius* sp.			4				3					0	3		10
	Mammals															
30	*Conepatus chinga*						0			0			0		0	0
31	*Leopardus (Oreailurus) jacobitus*		5						2				0		0	7
32	*Leopardus (Oreailurus) pajeros*						0		2				0		0	2
33	*Mustela frenata*									0			0		0	0
34	*Odocoileus virginianus*									0			0		0	0
35	*Phyllotis* cf. *xanthopygus posticalis*						0	3			2				0	5
36	*Puma concolor*				3					0			0		0	3
37	*Thylamys pallidior*									0	2				0	2
38	*Vicugna vicugna*		5							0	2				0	7
	Birds												0			0
39	*Aeronautes andecolus*						0			0			0		0	0
40	*Aglaeactis cupripennis*						0			0			0		0	0
41	*Amazilia amazilia*						0			0			0		0	0
42	*Anas flavirostris*						0			0			0		0	0
43	*Anas puna*						0		2			1			0	3
44	*Anthus furcatus*						0		2				0		0	2
45	*Asthenes humilis*						0		2				0		0	2
46	*Carduelis magellanica*						0			0			0		0	0
47	*Catamenia analis*						0			0			0		0	0
48	*Chloephaga melanoptera*						0		2		2				0	4
49	*Cinclodes atacamensis*						0		2				0		0	2
50	*Cinclodes fuscus*						0		2		2				0	4
54	*Geositta cunicularia*						0		2				0		0	2
55	*Geositta punensis*						0		2				0		0	2
56	*Geositta saxicolina*						0		2				0		0	2
57	*Hirundo rustica*						0			0			0		0	0
58	*Larus serranus*						0			0			0		0	0
59	*Muscisaxicola cinereus*						0		2				0		0	2
60	*Muscisaxicola maculirostris*						0			0			0		0	0
61	*Phrygilus alaudinus*						0			0			0		0	0

Protection Status*:
CR= Critically endangered 6 points
EN= Endangered 5 points
VU= Vulnerable 4 points
NT= Near threatened 3 points
B= Low (Others) 2 points
N= Not listed 0 points

Σ= Sensitivity value

1 - 5: Low
6 - 10: Medium
11 or higher: High

Species Distribution:
Local = (Endemic locally or to an EBA**) 3 points
Regional = (Regional endemic in Andes or Coast) 2 points
Widespread = (Across S. America or cosmopolitan) 0 points

Mobility:
Immobile = (restricted movement or in very short distance) 3 points
Mobile = 0 points

Local Uses:
Permanent= 2 points
Seasonal = 1 point
None = 0 points

***Protection Status:** According IUCN (2006) or National Legislation (D.S. No. 034-2004-AG/D.S. No. 043-2005-AG)
****EBA:** Areas determined by Birdlife International, which includes at least 2 bird species with less than 50,000 km2 of known distribution range.

13.3.4 HABITAT SENSITIVITY ANALYSIS

Based on the presence of medium sensitivity species presented in Table 13.8 the Tussock Grassland of the Huamanga Vischongo Watershed Divide ELU is considered to be of Medium Sensitivity due to the presence of four Medium Sensitivity animal species. None of the other habitats in this ELU meet the criteria for a high or medium sensitivity habitat as described in Section 7.2 of these EFS.

13.4 KEY ISSUES AND RECOMMENDATIONS

Soils

Standard topsoil stripping and protection measures should be applied to all areas.

Waterbodies and Wetlands

Waterbodies are near to or crossed by the ROW at KPs 80+800, 84+000, 85+500, 92+200, and 92+500. Buffer zones should be retained at watercourse crossings and erosion controls installed and maintained, especially during the rainy season to prevent erosion and watercourse inundation with sediments.

Several peat bogs are present between KP 79+669 and KP 101+384.

Physical Risk

The Huamanga-Vischongo Divide ELU has no zones categorized as having High physical risk and less than 700 m of ROW length are categorized as Medium risk. Standard erosion controls should be maintained in these areas during the construction phase.

Habitats and Species

There are 5 threatened species reported in this ELU and 7 medium sensitivity species. The *Escallonia* and *Parastrephia* plants are sensitive species responsive to management practices. The Andean mountain cat (*Leopardus jacobitus*) and the camelid Vicuna (*Vicugna vicugna*) are both sensitive. Felids usually avoid human presence and are highly unlikely to be affected by site clearance and construction activities. Vicunas should be treated with special measures because of their social economic importance to minimize the risk of harm. Specific measures will be set out in the Ecological Management Plan and summarized in Table 13.9.

Waterbodies should be monitored because they are environmentally important to maintain *Telmatobius* frog populations. Frogs and tadpoles should be removed during crossings activities and relocated to a suitable unaffected location upstream if identified at the time of watercourse crossing pipeline installation. Erosion control and pollution prevention good practice should be adopted at watercourses.

Table 13.9 summarizes the key issues and recommendations for Huamanga-Vischongo Watershed Divide ELU.

Table 13.9. Key Issues and Recommendations - ELU 6

Issue	KP Reference	Action	Related to
River and stream crossings. Protection of killifish *(Orestias sp.)*	80+800, 84+000, 85+500, 92+200, and 92+500.	Ditch in dry season if possible and use best practice crossing techniques to minimize turbidity and hydrocarbon contamination.	ECOMP
Vicunas	103+000	Fencing, participative management and other specific protection measures, such as worker training, signage, speed controls, waste management and fauna crossing points left in trench and pipe string. Consultation with local community farmers.	ECOMP
Shrubs (*Escallonia myrtilloides* and *Parastrephia quadrangularis*)	Grassland habitats and cultivated areas	Translocation of individual shrubs if practicable prior to site clearance. Or alternatively planting of new shrubs from cuttings or seed collection as part of bioreinstatement programme.	ECOMP/RP
Reptiles – lizard (Liolaemus sp.) and and Water frog (Telmatobius sp)	Grassland habitats	Pre-clearance Survey to identify and relocate from ROW prior to site clearance activities.	ECOMP
Peat bogs habitat	Several along KP 80+884 to KP 101+384	Relocation of plants and removal and storage of topsoil before construction.	ECOMP
		Restoration of topsoil and plants during reinstatement.	RP

Source: EFS Fieldwork

14.0 ELU 7: VINCHOS RIVER VALLEY (KP 103+970 TO 117+388)

14.1 General Description

The Vinchos River Valley is another largely cultivated valley landscape, with relict patches of resinous scrubland and perennial woodland, also part of the Mantaro basin as is the Yucay River Valley.

The climate is warm but dry and has elevations between 3,200 and 4,000 m. Mean annual precipitation ranges from 600 to 800 mm per year, with higher amounts on the higher eastfacing slopes. This ELU includes the small settlements of Urpaypampa, Mayopampa and Sallalli.

Colluvial and volcanic soils dominate both sides of the Vinchos River Valley from KP 104+000 to 105+000, which are very sensitive to erosion and landslides. Cropping systems with potato and other crops are predominant and so in the valley areas the level of fertility is from medium to high due to the use of fertilizers. The colluvial unstable area is of low fertility and low levels of phosphorous represent a problem.

The ELU has only 3 habitat types, of which cultivated areas represents 89.89% of the ROW length.

14.2 Physical Characteristics

14.2.1 Precipitation

Precipitation is highly seasonal. The wet season is from January to March, and is known locally as the "winter" or rainy season, even though it actually corresponds with the climatologically-defined austral summer. The dry season extends from April to December. Table 14.1 shows precipitation values for each season.

Table 14.1. Precipitation - ELU 7

Estimated Precipitation (mm)			
Peak (January - March)		General (September - April)	
KP Range	Precipitation (mm)	KP Range	Precipitation (mm)
103+970 - 107+000	300 - 400	103+970 - 109+000	600 - 700
107+000 - 117+388	400 - 500	109+000 - 117+388	700 - 800

Source: ESIA, Environmental Baseline

14.2.2 GEOLOGY

East of the Vinchos River, from KP 106+000 to 110+000, the ELU is dominated by intrusive complexes with pink-gray granites of granular texture that are highly fractured at the surface. To the west of the river, the landscape is formed from volcanic rocks with little resistance to erosion, as evidenced by the highly eroded rocks at KP 116+000. Despite the generally gentle topography, small rockfalls can occur on the slopes.

14.2.3 SOILS

Soil pH is moderately to strongly acid.

Surface Horizon Characteristics

Surface horizon has a medium depth along the ELU, with low to medium organic matter content. The terrain is mostly flat over large sectors, but with some very steep areas, as shown in Table 14.2. The surface horizon have low levels of available phosphorus in most of the ELU as shown in Table 14.2.

Subsoil Characteristics

The Subsoil has a loamy sand texture, coarser than the sandy loam texture of the surface horizon, and will not affect the movement of water. These layers are very loose and the aggregates are of low stability. Organic matter and nutrients are low in the Subsoil.

Table 14.2. Surface Horizon Characteristics - ELU 7

KP	pH	Surface horizon depth	Organic matter	Fertility	Slope (%)
108+000	Moderately acid	Medium	Medium	Medium	8–10%
111+000	Strongly acid	Medium	Medium	High	30%
114+000	Strongly acid	Medium	Medium	Low	10%
116+000	Strongly acid	High	Low	Low	15-60%
117+000	Strongly acid	Medium	Medium	Low	45%

Source: ESIA, Environmental Baseline and Domus.
pH: Strongly acid = Less than 5.5; Moderately acid = 5.6 to 6.0; Slightly acid = 6.1 – 6.5; Neutral = 6.6 - 7.0; Slightly alkaline = 7.1 – 7.8; Moderately alkaline = 7.9 to 8.4; Strongly alkaline = 8.5 or greater.
Surface horizon depth: Low = Less than 5 cm; Medium = 5 cm to 15 cm; High = More than 15 cm.
Organic matter: Low = Less than 2%; Medium = 2% to 4%; High = More than 4%.
Fertility based on Available Phosphorus: Low = Less than 7.0 ppm; Medium = 7.0 to 14.0 ppm; High = More than 14.0 ppm.

14.2.4 WATERBODIES AND WETLANDS

The ROW runs approximately 500 m from Vinchos River, and 200 m from the Moyobamba Stream. The ROW crossings are shown in Table 14.3.

The ROW crosses various streams and the Vinchos River in ELU 7. Also, there are considerable stretches within ELU 7 where the ROW runs more or less parallel to streams on narrow ridge tops from approximately KP 107+000 to 116+100.

Near KP 105+200, the ROW crosses the intermittent Huayjochacha stream above the small settlement of Sallalli, which likely utilizes this stream at least seasonally.

Table 14.3. Principal Waterbody Crossings - ELU 7

Waterbody Type or Name	KP Mid-channel	Elevation (m)
Arroyos		
ARROYO HUAYJOCHACHA	105+317.82	3693.57
ARROYO SECO	112+649.99	3355.13
ARROYO	116+027.48	3565.28

ARROYO	116+029.38	3565.29
ARROYO	116+589.57	3635.18
Quebradas		
QUEBRADA	110+180.42	3180.79
QUEBARADA PISCALAHUAYJO	110+200	3196
QUEBRADA JATUNPAMPAHUAYCCO	111+584.73	3168.81
QUEBRADA SECA JATUNPAMPAHUAYCCO	112+600	3368
Rivers		
RIO VINCHOS	110+682.68	3166.93

Source: Peru LNG Pipeline Project Alignment Sheets (Gulf Interstate Engineering, 2006).

14.2.5 INSTABILITY AND PHYSICAL RISK

High physical risk sectors comprise 55.1% of the ROW length in the Vinchos River Valley ELU, followed by Low risk at 28.7% and Medium risk at 16.2%.

Table 14.4 shows distribution of the physical risk categories.

Table 14.4. Physical Risk - ELU 7

Risk Level	KP Start	KP Finish	Length (m)	
Low	105+710	107+705	1,995	3,853
	109+639	111+135	1,496	
	117+038	117+400	362	
Medium	103+970	104+00	30	2,175
	104+000	105+000	1,000	
	115+893	117+038	1,145	
High	105+000	105+710	710	7,402
	107+705	109+639	1,934	
	111+135	115+893	4,758	

Source: ESIA, Environmental Baseline

14.2.6 INFRASTRUCTURE

A base camp and a pipe yard are proposed to be installed near the Vinchos River approximately 3 km south of KP 109 at a location used for this purpose during the construction of a previous regional pipeline. Table 14.5 shows infrastructure information.

Table 14.5. Planned Project Infrastructures – ELU 7

Type of Infrastructure	KP	Name	Action	Related to
Camps	106+803	Central Vinchos	Topsoil stripping, depending on existing site conditions	ECOMP/RP
Pipe Yards	106+803	Vinchos	Topsoil stripping and reinstatement	ECOMP/RP

Source: ESIA, Project Description

14.3 HABITATS AND SPECIES

14.3.1 HABITAT DISTRIBUTION

The habitats of ELU 7 are listed in sequential order in Table 14.6, including the length of each habitat unit as well as the associated start and finish ROW KPs. Table 17.7 presents habitat lengths over the ROW sorted by habitat type, with subtotals for each habitat.

Table 14.6. Habitat Sequence – ELU 7

Habitat Type	Length (m)	KP Start	KP Finish
Tussock grassland	198	103+970	104+168
Cultivated Areas	7,072	104+168	111+240
Resinous scrub	586	111+240	111+826
Cultivated Areas	590	111+826	112+416
Resinous scrub	380	112+416	112+796
Cultivated Areas	3,055	112+796	115+851
Resinous scrub	192	115+851	116+043
Cultivated Areas	1,345	116+043	117+4388

Table 14.7. Habitat Summary – ELU 7

Habitat Type	Length (m)	KP Start	KP Finish
Cultivated Areas	7,072	104+168	111+240
	590	111+826	112+416
	3,055	112+796	115+851
	1,345	116+043	117+400
Total	**12,062**	**89.89%**	
Resinous scrub	586	111+240	111+826
	380	112+416	112+796
	192	115+851	116+043
Total	**1,158**	**8.63%**	
Tussock grassland	168	104+000	104+168
Total	**198**	**1.48%**	
Total ELU 7:	**13,418**		

Source: ESIA, Environmental Baseline and Domus.

14.3.2 HABITAT DESCRIPTIONS

Cultivated Areas

Cultivated areas cover approximately 90% of the Vinchos River Valley ELU. Species of biological interest sometimes appear within the mosaic of cultivated areas, forming thickets and living fences, or living in the middle of cultivated areas including the Andean endemic cacti *Austrocylindropuntia floccosa* and *Oroya peruviana.*

Resinous Scrub

This habitat occurs over about 8.6% of the Vinchos River Valley ELU, representing small remnants of the original vegetation cover. These areas have an occasional presence of *Escallonia myrtilloides*, an INRENA-listed vulnerable species. Within this habitat type, there are areas with columnar cacti with the presence of the *Austrocylindropuntia subulata*, *Oroya peruviana* (regional endemic) and *Echinopsis peruviana puquiensis* (INRENA-vulnerable).

Tussock Grassland

Tussock grasslands are limited to only about 1.5% of ELU 7 and only at the transition to the Huamanga-Vischongo Watershed Divide ELU. This habitat type is largely covered by

grasses. Shrubs present include *Escallonia myrtilloides,* listed as vulnerable by the INRENA.

Key Fauna

Despite its domination by cultivated areas, the Vinchos River Valley ELU is an area with numerous uncommon species of birds, and where the bearded mountaineer (*Oreonympha nobilis*) is also found. Some other birds are the hummingbirds known as green-tailed trainbearers (*Lesbia nuna*), bare-faced ground-doves (*Metriopelia ceciliae*), and Andean flickers (*Colaptes rupicola*).

Hydrobiology

Table 14.8 presents waterdbodies sampled along ELU 7. The species *Trichomycterus sp,* was described in one of the stations (Hi-22).

Table 14.8. Waterbodies Sampled – ELU 7

Station	Habitat	Waterbody	Name	Height (masl)	KP	Species
Hi-22	Interandino	Río	Vinchos	3157	110+500	*Trichomycterus sp.*
Hi-23	Interandino	Quebrada	Urpaypampa	3210	110+000	

14.3.3 SPECIES SENSITIVITY ANALYSIS

Table 14.9 shows the sensitive species found during the EFS fieldwork.

Medium Sensitivity shrubs present include *Escallonia myrtilloides* and the cactus *Echinopsis peruviana ssp. Puquiensis* (INRENA – Vulnerable). Their relocation and translocation should be attempted.

The cacti, Oroya peruviana, is also considered to be of Medium Sensitivity. The Andean catfish (Trichomycterus sp) observed in the Vinchos River is also considered to be of Medium Sensitivity because of its limited local distribution and permanent local use.

Table 14.9. Species Sensitivity Criteria- ELU 7

No	Species	Protection Status						Spatial Distribution			Local Use			Mobility		Σ
		CR	EN	VU	NT	L	N	Local	Regional	Widespread	Permanent	Seasonal	None	Immobile	Mobile	
	Plants															
1	*Austrocylindropuntia floccosa*						0			0			0	3		3
2	*Austrocylindropuntia subulata*						0		2			0		3		5
3	*Echinopsis peruviana* ssp. *puquiensis*			4				3						3		10
4	*Escallonia myrtilloides*			4					2	0			0	3		9
	Oroya peruviana						0	3					0	3		6
	Fishes															
	Trichomycterus rivulatus						0	3			2		0	3		8
	Mammals															
7	*Oligoryzomys* cf. *destructor*						0			0			0		0	0
8	*Phyllotis amicus*						0			0			0		0	0
	Birds															
9	*Anairetes flavirostris*						0			0			0		0	0
10	*Anairetes reguloides*						0		2				0		0	2
11	*Carduelis magellanica*						0			0			0		0	0
12	*Catamenia analis*						0			0			0		0	0
13	*Catamenia inornata*						0			0			0		0	0
14	*Cinclodes fuscus*						0		2		2				0	4
15	*Colaptes rupicola*						0			0			0		0	0
16	*Diglossa brunneiventris*						0			0			0		0	0
17	*Falco sparverius*						0			0			0		0	0
18	*Geranoaetus melanoleucus*						0			0			0		0	0
19	*Leptotila verreauxi*						0			0			0		0	0
20	*Lesbia nuna*						0		2		2				0	4
21	*Metallura phoebe*						0		2		2				0	4
22	*Metriopelia ceciliae*						0		2				0		0	2
23	*Muscisaxicola maculirostris*						0			0			0		0	0
24	*Ochthoeca frontalis*						0		2				0		0	2
25	*Ochthoeca leucophrys*						0		2				0		0	2
26	*Oreonympha nobilis*						0	3					0		0	3
27	*Phrygilus fruticeti*						0			0			0		0	0

28	*Phrygilus punensis*						0		2				0		0	2
29	*Pterophanes cyanopterus*						0		2				0		0	2
30	*Sicalis* sp.						0			0			0		0	0
31	*Thraupis bonariensis*						0			0			0		0	0
32	*Thraupis cyanocephala*						0			0			0		0	0
33	*Troglodytes aedon*						0			0			0		0	0
34	*Turdus serranus*						0			0			0		0	0
35	*Zonotrichia capensis*						0			0			0		0	0

Protection Status*:
CR= Critically endangered 6 points
EN= Endangered 5 points
VU= Vulnerable 4 points
NT= Near threatened 3 points
B= Low (Others) 2 points
N= Not listed 0 points

Σ= Sensitivity value

1 - 5: Low
6 - 10: Medium
11 or higher: High

Species Distribution:
Local = (Endemic locally or to an EBA**) 3 points
Regional = (Regional endemic in Andes or Coast) 2 points
Widespread = (Across S. America or cosmopolitan) 0 points

Mobility:
Immobile = (restricted movement or in very short distance) 3 points
Mobile = 0 points

Local Uses:
Permanent= 2 points
Seasonal = 1 point
None = 0 points

***Protection Status:** According IUCN (2006) or National Legislation (D.S. No. 034-2004-AG/D.S. No. 043-2005-AG)
****EBA:** Areas determined by Birdlife International, which includes at least 2 bird species with less than 50,000 km2 of known distribution range.

14.3.4 HABITAT SENSITIVITY ANALYSIS

Based on the presence of medium sensitivity species presented in Table 14.9 the Cultivated Areas of the Vinchos River Valley ELU is considered to be of Medium Sensitivity due to the presence of three Medium Sensitivity plant species and one Medium Sensitivity animal species. None of the other habitats in this ELU meet the criteria for a high or medium sensitivity habitat as described in Section 7.2 of these EFS.

14.4 KEY ISSUES AND RECOMMENDATIONS

Soils

Some areas present some favorable conditions to restoration, as the stretch from KP 107+000 to KP 111+000, but in other areas the steeper slopes and low fertility are potential restrictions to natural regeneration of plants, during reinstatement.

Taking into account precipitation levels and the erodibility of the volcanic substrates to west of the Vinchos River, erosion controls should be implemented and maintained, especially in highly unstable areas set out in Table 14.4. During construction, erosion control devices as silt fences, slope breakers and wooden barriers must be implemented and the topsoil protected with geojute and revegetation.

Waterbodies and Wetlands

The ROW crosses the Vinchos River and tributary streams at several points in this ELU. Also the ROW runs parallel to and upslope of various streams in this ELU. Many of the crossings and places where the ROW is near waterbodies are areas mapped as having High Physical Risk. Therefore, waterbody protection is a key issue in the Vinchos River Valley ELU. Recommendations include scheduling crossings during the dry season using best practice techniques to minimize turbidity, river bank protection, erosion and sedimentation controls, and surface water quality monitoring during construction.

Infrastructure

A camp and a pipe storage yard are proposed to be installed near the Vinchos River. The selected location was used of this purpose in the past and is not a greenfield development.

Physical Risk

Low risk sectors will not require special restoration works, but Medium and High risk sectors will require detailed site review to determine if special restoration measures,

including fertilizers application and hydroseeding are appropriate during reinstatement to enhance revegetation.

Habitat and Species

The Vinchos River Valley is less diverse in habitats than other ELUs. It is mainly covered by cultivated areas.

Two medium sensitivity cactus species, *Echinopsis peruviana spp.* and Oroya peruviana, and the medium sensitivty shrub *Escallonia myrtilloides* are located in the higher parts of the ELU. Cactus plants lost during ROW clearance could be replaced by new plants established during the biorestoation phase after the completion of construction.

The Vinchos River contains a sensitive population of the Andean catfish (shrimp). *Trichmycterus rivulatus*, that could potentially be affected by works in the river during pipeline crossing installation.

Table 14.10 summarizes the key issues and recommendations.

Table 14.10. Key Issues and Recommendations - ELU 7

Issue	KP Reference	Action	Related to
Risk of mass wasting in Medium and High physical risk sectors	106+200 – 106+900	Install and maintain erosion controls especially during the rainy season. Topsoil strip and protection during construction. Possible extra biorestoration techniques (hydroseeding, mulch and fertilizer applications) during reinstatement in highest risk areas areas	ECOMP / RP
	107+900 – 111+600		ECOMP / RP
	113+200 – 117+388		ECOMP / RP
ROW crossings and proximity to the Vinchos River and other streams (Protection of Andean catfish *Trichomycterus rivulatus* in Vinchos River)	110+500	River bank protection and erosion/sedimentation controls. Water quality monitoring during construction. Pollution prevention best practices and best practice crossing techniques to	ECOMP/RP

		minimize turbidity	
Cactus (*Echinopsis peruviana spp*. and *Oroya peruviana*) and Shrub (*Escallonia myrtilloides)*	Resinous scrub	Plants lost during ROW clearance works to be replaced by new plants during biorestoration	ECOMP/RP

Source: EFS Field Work.

15.0 ELU 8: APACHETA HIGH SIERRAS (KP 117+388 TO 162+137)

15.1 General Description

In ELU 8, the ROW runs essentially from east to west over a series of high ridges with elevations ranging from 3,841 to 4,900 m in a landscape of scarcely vegetated zones, sward-forming grassland, peat bogs and tussock grassland.

The climate is cold and dry. The Maximum precipitation reaches 1000mm, on higher altitudes. This unit includes the Rural Communities of Occollo Azabran, Paccha, Churia and Rosaspampa.

This high area is subject to snow. Predominance of volcanic rock with high slopes greater than 60% but very stable because of its rocky (Granite) formation with no topsoil.

This ELU has 6 habitat types. The largest habitat type, the Scarcely Vegetated High Andean Area, represents 39.26% of the ELU length and the smallest one, Resinous scrub, 0.34%. The six habitat types are very fragmented. Tables 18.8 and 18.9 show the habitat types that comprise this ELU.

West of the Vinchos River Valley, the ROW runs essentially from east to west over a series of ridges (3,840 to 4,900 m). This high Andean landscape dominated by high areas is subject to seasonal snow, primarily in June to July, but occasionally in all other months. While largely very sparsely vegetated, this ELU contains sensitive plant species such as *Ephedra americana* (INRENA near-threatened), *Escallonia myrtilloides* (INRENA vulnerable), *Oroya peruana* (regional endemic), *Perezia coerulescens* (INRENA vulnerable), and *Perezia pinnatifida* (INRENA vulnerable). Of particular note, a potentially new species of *Ribes* (currant or gooseberry) was collected by the EFS field team. This sparsely populated area harbors populations of sensitive mammals such as pumas or mountain lions, Andean cats (*Leopardus jacobitus*), and vicuñas. While not observed by the EFS team, the ESIA reported sightings of the IUCN-endangered/INRENA-critically-endangered white-bellied cinclodes (*Cinclodes palliatus*), a bird endemic to high-Andean wetlands of central Peru.

15.2 PHYSICAL CHARACTERISTICS

15.2.1 PRECIPITATION

Precipitation has two very different seasons. The peak rain period is from January to March and is locally known as winter or rainy season (Wet Season) and the period of lesser precipitation from April to December known as the Dry Season. Table 15.1 shows precipitation values during both seasons.

Table 15.1. Precipitation - ELU 8

Estimated Precipitation (mm)			
Peak (January - March)		General (September - April)	
KP Range	Precipitation (mm)	KP Range	Precipitation (mm)
117+388 - 162+137	400 - 500	117+388 - 161+000	700 - 800
		161+000 - 162+137	800 - 1000

Source: ESIA, Environmental Baseline

Seasonal precipitation will influence the design of temporary erosion control measures and revegetation program along the RoW after construction completion.

15.2.2 GEOLOGY

The geological formations of the Apacheta High Sierras ELU are principally limestones interspersed in places with lutites, forming rugged mountains. Its rocks have been affected by karstic processes although the surface is little altered. The metallic mineralization present in certain areas of these rocks, visible at the surface as strongly colored bare soil with little vegetation, implies a risk of acid rock drainage (ARD).

There are local andesitic effusions, tuff and breccias, which result in an abundance of pyrite in the layers of this formation and also an increased risk of acid drainage.

Locally, there are Pleistocene glacial and fluvioglacial deposits, including morraines.

Table 15.2 shows the area with potential risk of acid rock drainage occurrence in the ROW, caused by construction phase activities.

Table 15.2. Risk of ARD – ELU 8

Risk of Generation ARD	Length (m)		Action	Related to
High Risk	KP 145+000 to KP 175+000	30,000	Isolate stockpiled material from waterbodies. Use geomembranes where practicable. Embankments and ditches to divert ARD away from sensitive watercourses and habitats. Water quality monitoring during rainy season.	ECOMP

Source: ESIA, Environmental Baseline.

15.2.3 SOILS

Soil pH is generally strongly acidic in the Apacheta High Sierras ELU, with a slightly alkaline sample collected at KP 155+000.

Surface Horizon Characteristics

Surface horizon of medium to high depth throughout ELU 8, despite the variable slope. Organic matter content is mostly low in most soil except in Kp 131 and 135 that presented high levels in a very deep topsoil.

Subsoil Characteristics

The sandy Subsoils will not affect the movement of water because both effective horizons (A and B) are well drained. Organic matter and nutrient levels are lower in the Subsoil.

Fertility, based on available phosphorus, is medium to high, as it can be seen in Table 15.3.

Table 15.3. Surface Horizon Characteristics - ELU 8

KP	pH	Surface horizon depth	Organic matter	Fertility	Slope (%)
120+000	Strongly acid	Medium	High	Medium	20%
130+000	Strongly acid	Medium	Medium	High	10%
131+000	Strongly acid	High	High	Medium	10-15%
134+000	Strongly acid	Medium	Low	High	30%
135+000	Strongly acid	medium	High	Medium	15%
140+000	Strongly acid	Medium	Medium	Medium	20%
145+000	Strongly acid	Medium	Low	High	15%
150+000	Strongly acid	Medium	Low	High	15%
155+000	Slightly alkaline	Medium	Low	Medium	35%
160+000	Strongly acid	Medium	Low	Medium	30%

Source: ESIA, Environmental Baseline and Domus.
pH: Strongly acid = Less than 5.5; Moderately acid = 5.6 to 6.0; Slightly acid = 6.1 – 6.5; Neutral = 6.6 - 7.0; Slightly alkaline = 7.1 – 7.8; Moderately alkaline = 7.9 to 8.4; Strongly alkaline = 8.5 or greater.
Surface horizon depth: Low = Less than 5 cm; Medium = 5 cm to 15 cm; High = More than 15 cm.
Organic matter: Low = Less than 2%; Medium = 2% to 4%; High = More than 4%.
Fertility based on Available Phosphorus: Low = Less than 7.0 ppm; Medium = 7.0 to 14.0 ppm; High = More than 14.0 ppm.

15.2.4 WATERBODIES AND WETLANDS

The ROW crosses the Churiac River at KP 147+500, and passes close to 5 lagoons (Yanacocha II, Challhuacocha, and three unnamed). It runs parallel Quebrada Chojehuaray from KP127+000 to 129+200.

The ROW is located next to Antacocha Stream near 149+500, 135 m away from Soytusoytu bog near KP 135+000, and 75 m away from Yaurilla peat bog near KP 162+000.

ELU 8 presents a wide distribution of peat bogs which the ROW crosses or passes nearby especially between KP 121+000 to 158+000.

The principal waterbody crossings are shown in Table 15.4

Table 15.4. Principal Waterbody Crossings - ELU 8

Waterbody Type or Name	KP Mid-channel	Elevation (m)
Quebradas		
QUEBRADA PANPANCCAHUAYCCO	123+574.17	3875.25
QUEBRADA	123+609.60	3875.75
QUEBARADA PANPANCCAHUAYCCO	124+250	3924
QUEBRADA CHOJEHUARAY	127+051.25	4030.38
QUEBRADA CHOJEHUARAY	129+200	4242
QUEBRADA	143+986.39	4648.04
QUEBRADA	146+824.23	4690.46
QUEBRADA	147+502.04	4571.05
QUEBRADA	147+824.09	4497.07
QUEBRADA	148+924.68	4575.86
QUEBRADA	149+109.05	4570.61
QUEBRADA	149+234.78	4551.74
QUEBRADA ANTACOCHA	149+540.40	4521.87
QUEBRADA	149+603.20	4522.91
QUEBRADA	149+769.55	4517.67
QUEBRADA	151+777.30	4677.20
Estero		
ESTERO	129+241.68	4233.28

Source: Peru LNG Pipeline Project Alignment Sheets (Gulf Interstate Engineering, 2006).

15.2.5 INSTABILITY AND PHYSICAL RISK

The Apacheta High Sierras comprise a stable landscape, with 95.33% of the ROW length falling into the Low physical risk category, 1.61% in the Medium risk category, and 3.04% in the High risk category, can be derived from the data presented in Table 15.5.

Table 15.5. Physical Risk - ELU 8

Risk Level	KP Start	KP Finish	Length (m)	
Low	117+400	122+708	5,308	42,651
	123+430	131+172	7,742	
	131+355	131+392	37	
	131+665	131+733	68	
	132+641	162+137	29,496	
Medium	122+708	123+430	722	722
High	131+172	131+355	183	1,364
	131+392	131+665	273	
	131+733	132+641	908	

Source: ESIA, Environmental Baseline and Domus.

15.2.6 INFRASTRUCTURE

The construction of a Base camp is proposed near KP 127+248 Ocollo 2, with lodging capacity for 300 people. Also there are 9 proposed shooflies in ELU 8 as shown in Table 15.6.

Table 15.6. Planned Project Infrastructures – ELU 8

Type of Infrastructure	KP	Name	Action	Related to
Camps	127+248	Ocollo 2	Topsoil Protection	ECOMP/RP
Shooflies	142+075	V187 to V191	Topsoil protection / Erosion control devices and slope revegetation Reinstatement to include compaction relief, topsoil respreading and revegetation using native or naturalized species typical of the surrounding area	ECOMP/RP
	144+415	V180 to V181	Topsoil protection / Erosion control devices and slope revegetation Reinstatement to include compaction relief, topsoil	ECOMP/RP

			respreading and revegetation using native or naturalized species typical of the surrounding area	
	147+202	V168 to V169	Topsoil protection / Erosion control devices and slope revegetation Reinstatement to include compaction relief, topsoil respreading and revegetation using native or naturalized species typical of the surrounding area	ECOMP/RP
	148+549	V166 to V167	Topsoil protection / Erosion control devices and slope revegetation Reinstatement to include compaction relief, topsoil respreading and revegetation using native or naturalized species typical of the surrounding area	ECOMP/RP
	149+299	NN	Topsoil protection / Erosion control devices and slope revegetation Reinstatement to include compaction relief, topsoil respreading and revegetation using native or naturalized species typical of the surrounding area	ECOMP/RP
	149+502	Shoe Fly to Km. 57.5	Topsoil protection / Erosion control devices and slope revegetation Reinstatement to include compaction relief, topsoil respreading and revegetation using native or naturalized species typical of the surrounding area	ECOMP/RP
	150+142	V161 to V165	Topsoil protection / Erosion control devices and slope revegetation Reinstatement to include compaction relief, topsoil respreading and revegetation using native or naturalized species typical of the surrounding area	ECOMP/RP
	157+750	V127 to V132	Topsoil protection / Erosion control devices and slope revegetation	ECOMP/RP
	159+536	V117 to V119	Reinstatement to include compaction relief, topsoil respreading and revegetation using native or naturalized species typical of the surrounding area	ECOMP/RP

Source: ESIA, Project Description

15.3 HABITATS AND SPECIES

15.3.1 HABITAT DISTRIBUTION

The habitats of ELU 8 are listed in sequential order in Table 15.7, including the length of each habitat unit and associated start and finish ROW KPs. Table 15.8 presents habitat lengths over the ROW sorted by habitat type, with subtotals for each habitat.

Table 15.7. Habitat Sequence – ELU 8

Habitat Types	Length (m)	KP Start	KP Finish
Cultivated Areas	12	117+388	117+400
Tussock grassland	400	117+400	117+800
Resinous Scrub	150	117+800	117+950
Tussock grassland	2446	117+950	120+396
Cultivated Areas	465	120+396	120+861
Sward-forming grassland	1195	120+861	122+056
Peat Bogs	24	122+056	122+080
Sward-forming grassland	92	122+080	122+172
Peat Bogs	71	122+172	122+243
Sward-forming grassland	392	122+243	122+635
Tussock grassland	705	122+635	123+340
Sward-forming grassland	147	123+340	123+487
Peat Bogs	76	123+487	123+563
Sward-forming grassland	616	123+563	124+179
Peat Bogs	11	124+179	124+190
Sward-forming grassland	15	124+190	124+205
Peat Bogs	41	124+205	124+246
Sward-forming grassland	2808	124+246	127+054
Peat Bogs	31	127+054	127+085
Sward-forming grassland	798	127+085	127+883
Peat Bogs	25	127+883	127+908
Sward-forming grassland	1505	127+908	129+413
Peat Bogs	546	129+413	129+959
Sward-forming grassland	439	129+959	130+398
Peat Bogs	153	130+398	130+551
Sward-forming grassland	231	130+551	130+782

Scarcely Vegetated High Andean Areas	605	130+782	131+387
Peat Bogs	39	131+387	131+426
Scarcely Vegetated High Andean Areas	155	131+426	131+581
Peat Bogs	85	131+581	131+666
Sward-forming grassland	339	131+666	132+005
Peat Bogs	22	132+005	132+027
Sward-forming grassland	390	132+027	132+417
Scarcely Vegetated High Andean Areas	486	132+417	132+903
Sward-forming grassland	350	132+903	133+253
Peat Bogs	58	133+253	133+311
Sward-forming grassland	84	133+311	133+395
Peat Bogs	33	133+395	133+428
Sward-forming grassland	57	133+428	133+485
Peat Bogs	103	133+485	133+588
Sward-forming grassland	493	133+588	134+081
Peat Bogs	81	134+081	134+162
Sward-forming grassland	5	134+162	134+167
Tussock grassland	336	134+167	134+503
Peat Bogs	29	134+503	134+532
Sward-forming grassland	249	134+532	134+781
Peat Bogs	24	134+781	134+805
Sward-forming grassland	73	134+805	134+878
Peat Bogs	25	134+878	134+903
Sward-forming grassland	48	134+903	134+951
Peat Bogs	36	134+951	134+987
Sward-forming grassland	76	134+987	135+063
Peat Bogs	26	135+063	135+089
Sward-forming grassland	125	135+089	135+214
Peat Bogs	359	135+214	135+573
Sward-forming grassland	124	135+573	135+697
Tussock grassland	982	135+697	136+679
Sward-forming grassland	77	136+679	136+756
Peat Bogs	21	136+756	136+777
Sward-forming grassland	49	136+777	136+826
Tussock grassland	429	136+826	137+255
Sward-forming grassland	69	137+255	137+324
Peat Bogs	30	137+324	137+354
Sward-forming grassland	22	137+354	137+376
Peat Bogs	63	137+376	137+439

Sward-forming grassland	61	137+439	137+500
Tussock grassland	91	137+500	137+591
Peat Bogs	22	137+591	137+613
Tussock grassland	82	137+613	137+695
Peat Bogs	10	137+695	137+705
Tussock grassland	85	137+705	137+790
Peat Bogs	29	137+790	137+819
Tussock grassland	103	137+819	137+922
Sward-forming grassland	49	137+922	137+971
Peat Bogs	98	137+971	138+069
Sward-forming grassland	16	138+069	138+085
Tussock grassland	242	138+085	138+327
Sward-forming grassland	150	138+327	138+477
Tussock grassland	57	138+477	138+534
Sward-forming grassland	18	138+534	138+552
Peat Bogs	40	138+552	138+592
Sward-forming grassland	12	138+592	138+604
Tussock grassland	368	138+604	138+972
Sward-forming grassland	162	138+972	139+134
Tussock grassland	93	139+134	139+227
Scarcely Vegetated High Andean Areas	3086	139+227	142+313
Sward-forming grassland	137	142+313	142+450
Peat Bogs	150	142+450	142+600
Sward-forming grassland	7	142+600	142+607
Scarcely Vegetated High Andean Areas	969	142+607	143+576
Sward-forming grassland	210	143+576	143+786
Scarcely Vegetated High Andean Areas	463	143+786	144+249
Peat Bogs	138	144+249	144+387
Scarcely Vegetated High Andean Areas	1444	144+387	145+831
Sward-forming grassland	112	145+831	145+943
Scarcely Vegetated High Andean Areas	57	145+943	146+000
Peat Bogs	650	146+000	146+650
Scarcely Vegetated High Andean Areas	563	146+650	147+213
Sward-forming grassland	464	147+213	147+677
Peat Bogs	240	147+677	147+917
Sward-forming grassland	315	147+917	148+232

Scarcely Vegetated High Andean Areas	473	148+232	148+705
Sward-forming grassland	256	148+705	148+961
Scarcely Vegetated High Andean Areas	523	148+961	149+484
Sward-forming grassland	98	149+484	149+582
Peat Bogs	444	149+582	150+026
Sward-forming grassland	35	150+026	150+061
Peat Bogs	37	150+061	150+098
Sward-forming grassland	745	150+098	150+843
Peat Bogs	150	150+843	150+993
Sward-forming grassland	647	150+993	151+640
Scarcely Vegetated High Andean Areas	3267	151+640	154+907
Peat Bogs	33	154+907	154+940
Scarcely Vegetated High Andean Areas	78	154+940	155+018
Peat Bogs	18	155+018	155+036
Scarcely Vegetated High Andean Areas	258	155+036	155+294
Peat Bogs	22	155+294	155+316
Scarcely Vegetated High Andean Areas	215	155+316	155+531
Peat Bogs	5	155+531	155+536
Scarcely Vegetated High Andean Areas	675	155+536	156+211
Peat Bogs	69	156+211	156+280
Scarcely Vegetated High Andean Areas	547	156+280	156+827
Peat Bogs	414	156+827	157+241
Scarcely Vegetated High Andean Areas	429	157+241	157+670
Peat Bogs	46	157+670	157+716
Scarcely Vegetated High Andean Areas	749	157+716	158+465
Peat Bogs	129	158+465	158+594
Scarcely Vegetated High Andean Areas	438	158+594	159+032
Sward-forming grassland	128	159+032	159+160
Peat Bogs	39	159+160	159+199
Sward-forming grassland	102	159+199	159+301
Scarcely Vegetated High Andean Areas	1112	159+301	160+413
Peat Bogs	216	160+413	160+629

Scarcely Vegetated High Andean Areas	548	160+629	161+177
Peat Bogs	41	161+177	161+218
Scarcely Vegetated High Andean Areas	367	161+218	161+585
Peat Bogs	163	161+585	161+748
Sward-forming grassland	328	161+748	162+076
Scarcely Vegetated High Andean Areas	61	162+076	162+137

Table 15.8. Habitat Summary – ELU 8

Habitat Type	Length (m)	KP Start	KP Finish
Scarcely Vegetated High Andean Areas	605	130+782	131+387
	155	131+426	131+581
	486	132+417	132+903
	3086	139+227	142+313
	969	142+607	143+576
	463	143+786	144+249
	1444	144+387	145+831
	57	145+943	146+000
	563	146+650	147+213
	473	148+232	148+705
	523	148+961	149+484
	3267	151+640	154+907
	78	154+940	155+018
	258	155+036	155+294
	215	155+316	155+531
	675	155+536	156+211
	547	156+280	156+827
	429	157+241	157+670
	749	157+716	158+465
	438	158+594	159+032
	1112	159+301	160+413
	548	160+629	161+177
	367	161+218	161+585
	61	162+076	162+137
Total	**17568**	**39.26%**	
Sward-forming grassland	1195	120+861	122+056
	92	122+080	122+172
	392	122+243	122+635
	147	123+340	123+487

	616	123+563	124+179
	15	124+190	124+205
	2808	124+246	127+054
	798	127+085	127+883
	1505	127+908	129+413
	439	129+959	130+398
	231	130+551	130+782
	339	131+666	132+005
	390	132+027	132+417
	350	132+903	133+253
	84	133+311	133+395
	57	133+428	133+485
	493	133+588	134+081
	5	134+162	134+167
	249	134+532	134+781
	73	134+805	134+878
	48	134+903	134+951
	76	134+987	135+063
	125	135+089	135+214
	124	135+573	135+697
	77	136+679	136+756
	49	136+777	136+826
	69	137+255	137+324
	22	137+354	137+376
	61	137+439	137+500
	49	137+922	137+971
	16	138+069	138+085
	150	138+327	138+477
	18	138+534	138+552
	12	138+592	138+604
	162	138+972	139+134
	137	142+313	142+450
	7	142+600	142+607
	210	143+576	143+786
	112	145+831	145+943
	464	147+213	147+677
	315	147+917	148+232
	256	148+705	148+961
	98	149+484	149+582
	35	150+026	150+061
	745	150+098	150+843
	647	150+993	151+640

	128	159+032	159+160
	102	159+199	159+301
	328	161+748	162+076
Total	**14,920**	**33.34%**	
Tussock grassland	400	117+400	117+800
	2446	117+950	120+396
	705	122+635	123+340
	336	134+167	134+503
	982	135+697	136+679
	429	136+826	137+255
	91	137+500	137+591
	82	137+613	137+695
	85	137+705	137+790
	103	137+819	137+922
	242	138+085	138+327
	57	138+477	138+534
	368	138+604	138+972
	93	139+134	139+227
Total	**6,419**	**14.34%**	
Peat bog	24	122+056	122+080
	71	122+172	122+243
	76	123+487	123+563
	11	124+179	124+190
	41	124+205	124+246
	31	127+054	127+085
	25	127+883	127+908
	546	129+413	129+959
	153	130+398	130+551
	39	131+387	131+426
	85	131+581	131+666
	22	132+005	132+027
	58	133+253	133+311
	33	133+395	133+428
	103	133+485	133+588
	81	134+081	134+162
	29	134+503	134+532
	24	134+781	134+805
	25	134+878	134+903
	36	134+951	134+987
	26	135+063	135+089
	359	135+214	135+573
	21	136+756	136+777

	30	137+324	137+354
	63	137+376	137+439
	22	137+591	137+613
	10	137+695	137+705
	29	137+790	137+819
	98	137+971	138+069
	40	138+552	138+592
	150	142+450	142+600
	138	144+249	144+387
	650	146+000	146+650
	240	147+677	147+917
	444	149+582	150+026
	37	150+061	150+098
	150	150+843	150+993
	33	154+907	154+940
	18	155+018	155+036
	22	155+294	155+316
	5	155+531	155+536
	69	156+211	156+280
	414	156+827	157+241
	46	157+670	157+716
	129	158+465	158+594
	39	159+160	159+199
	216	160+413	160+629
	41	161+177	161+218
	163	161+585	161+748
Total	**5,215**	**11.65%**	
Cultivated Areas	12	117+388	117+400
	465	120+396	120+861
Total	**477**	**1.07%**	
Resinous Scrub	150	117+800	117+950
Total	**150**	**0.34%**	
Total ELU 8:	**44,749**		

Source: ESIA, Environmental Baseline and Domus.

15.3.2 HABITAT DESCRIPTIONS

Scarcely Vegetated High Andean Areas

The Apacheta High Sierras ELU is characterized by extensive zones with no vegetation, and rocky areas, which account for approximately 39.26% of the ROW length. This ELU contains the highest elevation habitats crossed by the RoW, reaching elevations over 4800 m between KP 150 and KP 160 with a maximum elevation over 4900 m at KP 159.

Sward-forming grassland

Sward-forming grasslands cover some 33.34% of the ROW in ELU 8. Dominant species identified are *Aciachne* cf. *acicularis*, *Lachemilla pinnata*, *Pycnophyllum molle* and *Perezia pinnatifida*. Important species for conservation like *Perezia coerulecens*, *P. pinnatifida*, *Ephedra americana* and *Austrocylindropuntia floccosa* were observed. Both *Perezia* species are of vulnerable status according to INRENA. The *Ephedra*, despite its list as near threatened by the INRENA, is quite common along the ROW and the entire region. These grasslands are of importance to local communities as grazing lands for camelids, including llamas, alpacas and vicunas.

Tussock grassland

Tussock-forming grasses of the genera *Calamagrostis*, and *Jarava* characterize about 14.34% of the ROW length in ELU 8. Some *Berberis* bushes were found in this habitat type, along with *Escallonia myrtilloides*.

The relocation and translocation of this last one should be attempted. *Oroya peruviana* is a globular and endemic species that grows in spots at KPs 118+000 and 123+000, Its relocation and translocation is recommended. An important finding was a potential new species of currant or gooseberry (*Ribes* sp.) that was collected in rocky areas near KP 118+800.

Peat Bogs

The Apacheta High Sierras ELU is characterized by a large number of small bogs, occupying about 11.65% of the ELU. However, most of these are passed by rather than directly crossed by the ROW. Only near KP 140+000 and 150+000 are significant bogs crossed by the ROW. All bogs in the area are under high grazing pressure and are therefore in degraded condition. *Distichia muscoides* and *Plantago rigida* cushion plants are common in this habitat type.

Cultivated Areas

Cultivated areas are uncommon in ELU 8 due to the colder climate, accounting for only 1.07% of the ROW length.

Resinous Scrub

The only stand of resinous scrub is at the transition with the Vinchos River Valley ELU. The cactus *Austrocylindropuntia floccosa* was found here.

Key Fauna

In the Apacheta Sierra the endangered Andean mountain cat *Leopardus jacobitus* (IUCN/INRENA-EN) was sighted near KP 156+000. This may be the first confirmed sighting of this species in the Huancavelica Department. Two other felids were registered: the Pampas cat (*Leopardus pajeros*) and the mountain lion (*Puma concolor*). Camelids like llamas and vicunas were registered in the area too and form an important component of livestock farming.

A critical species not recorded during the field evaluation, but registered in the ESIA (Walsh 2006), is the White-bellied cinclodes (*Cinclodes palliatus*). It is tied to mineral-rich well-watered cushion-plant bogs (Bofedales) such as the ones covered by *Distichia* (Fjeldsa 1990). The White-bellied cinclodes is considered Critically Endangered by INRENA (2004), and it is restricted to a very small area in the high parts of the central Andes of Peru. It is considered critically endangered because of the destruction of peat bogs throughout its distribution range.

Other important birds registered are the Black-faced Ibis *Theristicus melanopis,* Andean condor *Vultur gryphus,* Gray-breasted Seedsnipe *Thinocorus orbignyianus,* and Andean flicker *Colaptes rupicola,* among others.

The lizard *Liolaemus cf melanogaster* was registered in the area. Naturalized species like the *Oncorhynchus mykiss* or Rainbow trout were registered in this ELU, as an important economic fish species (149+500 KP and 156+000 KP). This species was found in the Antacocha Stream and the Yanacocha II Lagoon.

Hydrobiology

Table 15.9 presents waterdbodies sampled along ELU 8. The species *Oncorhynchus mykiss,* was described in two of the stations (Hi-17 and hi-18). This species is of economic importance to the surrounding communities and therefore particular attention is required during construction for the protection of watercourses.

Table 15.9. Waterbodies Sampled – ELU 8

Station	Habitat	Waterbody	Name	Height (masl)	KP	Species
Hi-17	Altoandino	Laguna	Yanacocha	4622	156+000	*Oncorhynchus mykiss*
Hi-18	Altoandino	Quebrada	Antacocha	4487	149+500	*Oncorhynchus mykiss*
Hi-19	Altoandino	Bofedal	Yanacancha		145+500	
Hi-20	Altoandino	Laguna	Challhuacocha	4498	136+700	
Hi-21	Altoandino	Bofedal	Soytusoytu	4391	135+000	

15.3.3 SPECIES SENSITIVITY ANALYSIS

Table 15.10 shows the critical and sensitive species found during the EFS fieldwork. There are seven Medium Sensitivity plant species, two lizard species, two mammal species (Andean mountain cat and vicuna) and three bird species.

Table 15.10. Species Sensitivity Criteria - ELU 8

No	Species	Protection Status						Spatial Distribution			Local Use			Mobility		Σ
		CR	EN	VU	NT	L	N	Local	Regional	Widespread	Permanent	Seasonal	None	Immobile	Mobile	
	Plants															
1	*Aciachne* cf. *acicularis*						0			0			0	3		3
2	Asteraceae						0			0			0	3		3
3	*Austrocylindropuntia floccosa*						0			0			0	3		3
	Berberis sp.						0	3					0	3		6
	Calamagrostis sp.						0			0	2			3		5
4	*Dissanthelium* sp.						0			0	2			3		5
5	*Distichia muscoides*						0			0		1		3		4
6	*Ephedra americana*				3				2				0	3		8
7	*Escallonia myrtilloides*			4					2	0			0	3		9
	Jarava sp.						0			0	2			3		5
8	Juncaceae						0			0			0	3		3
9	*Lachemilla pinnata*						0		2				0	3		5
10	*Oroya peruviana*						0	3		0			0	3		6
11	*Perezia coerulensis*			4					2				0	3		9
12	*Perezia pinnatifida*			4					2				0	3		9
13	*Plantago rigida*						0		2				0	3		5
14	*Plettkea* sp.						0		2				0	3		5
15	Poaceae						0			0			0	3		3
16	*Pycnophyllum molle*						0			0	2			3		5
17	*Ribes* sp.						0	3				1		3		7
	Fish															
17	*Oncorhynchus mykiss*						0			0	2			3		5
	Reptiles and Amphibian															
18	*Liolaemus walkeri*						0		2				0	3		5
19	*Liolaemus* cf. *melanogaster*						0	3					0	3		6
20	*Liolaemus melanogaster*						0	3					0	3		6
21	*Pleurodema marmorata*						0			0			0	3		3
	Mammals															
22	*Lagidium peruanum*						0	3			2				0	5
23	*Leopardus (Oreailurus) jacobitus*		5						2				0		0	7

24	*Leopardus (Oreailurus) pajeros*						0		2				0		0	2
25	*Mustela frenata*						0			0			0		0	0
26	*Odocoileus virginianus*						0			0			0		0	0
27	*Puma concolor*				3					0			0		0	3
28	*Thylamys pallidior*						0			0	2				0	2
	Vicugna vicugna		5							0	2				0	7
	Birds															
29	*Asthenes dorbignyi (huancavelicae)*			4				3					0		0	7
30	*Asthenes ottonis*						0	3					0		0	3
31	*Asthenes wyatti*						0		2				0		0	2
32	*Attagis gayi*						0			0			0		0	0
33	*Buteo leucorrhous*						0			0			0		0	0
34	*Buteo magnirostris*						0			0			0		0	0
35	*Buteo poecilochrous*						0		2				0		0	2
36	*Carduelis magellanica*						0			0			0		0	0
37	*Chloephaga melanoptera*						0		2		2				0	4
38	*Cinclodes fuscus*						0		2		2				0	4
40	*Colaptes rupicola*						0			0			0		0	0
41	*Geositta punensis*						0		2				0		0	2
42	*Geositta saxicolina*						0		2				0		0	2
43	*Geranoaetus melanoleucus*						0			0			0		0	0
44	*Lessonia oreas*						0		2				0		0	2
45	*Mecocerculus stictopterus*						0			0			0		0	0
46	*Metriopelia aymara*						0		2				0		0	2
47	Muscisaxicola cinereus						0		2				0		0	2
48	*Muscisaxicola rufivertex*						0		2				0		0	2
49	*Oreopholus ruficollis*						0			0			0		0	0
50	*Oreotrochilus estella*						0		2				0		0	2
51	*Phalcoboenus megalopterus*						0			0			0		0	0
52	*Plegadis ridgwayi*						0			0			0		0	0
53	*Petrochelidon pyrrhonota*						0			0			0		0	0
54	*Phrygilus plebejus*						0			0			0		0	0

55	*Phrygilus unicolor*						0			0			0		0	0
56	*Polyonymus caroli*						0		2				0		0	2
57	*Sicalis luteola*						0			0			0		0	0
58	*Sicalis uropygialis*						0			0			0		0	0
59	*Streptoprocne zonaris*						0			0			0		0	0
60	*Theristicus melanopis*			4			0		2	0			0		0	6
61	*Thinocorus orbignyianus*						0			0	2				0	2
62	*Tringa melanoleuca*						0			0			0		0	0
63	*Upucerthia jelskii*						0		2				0		0	2
64	*Vanellus resplendens*						0		2				0		0	2
65	*Vultur gryphus*		5				0			0			0		0	5

Protection Status*:
CR= Critically endangered 6 points
EN= Endangered 5 points
VU= Vulnerable 4 points
NT= Near threatened 3 points
B= Low (Others) 2 points
N= Not listed 0 points

Σ= Sensitivity value

1 - 5: Low
6 - 10: Medium
11 or higher: High

Species Distribution:
Local = (Endemic locally or to an EBA**) 3 points
Regional = (Regional endemic in Andes or Coast) 2 points
Widespread = (Across S. America or cosmopolitan) 0 points

Mobility:
Immobile = (restricted movement or in very short distance) 3 points
Mobile = 0 points

Local Uses:
Permanent= 2 points
Seasonal = 1 point
None = 0 points

***Protection Status:** According IUCN (2006) or National Legislation (D.S. No. 034-2004-AG/D.S. No. 043-2005-AG)
****EBA:** Areas determined by Birdlife International, which includes at least 2 bird species with less than 50,000 km2 of known distribution range.

15.3.4 HABITAT SENSITIVITY ANALYSIS

Based on the presence of medium sensitivity species presented in Table 15.10 the Scarcely Vegetated High Andean Areas of the Apacheta High Sierras ELU are considered to be of Medium Sensitivity due to the presence of four Medium Sensitivity animal species. The Sward-forming Grassland of the Apacheta High Sierras are considered to be of Medium Sensitivity due to the presence of five Medium Sensitivity plant species and two Medium Sensitivity animal species. The Tussock Grassland of the Apacheta High Sierras is considered to be of Medium Sensitivity due to the presence of five Medium Sensitivity plant species and three Medium Sensitivity animal species. None of the other habitats in this ELU meet the criteria for a high or medium sensitivity habitat as described in Section 7.2 of these EFS.

15.4 KEY ISSUES AND RECOMMENDATIONS

Soils

Soils in the ELU generally have medium to high fertility, which will facilitate revegetation

In order to prevent and mitigate the potential impact of the ARD the ESIA consider rocks isolation from waterbodies, and the use of geomembranes. Other measures listed are the construction of embankments and ditches to encourage acid runoff to drain away from watercourses and monitoring of water from acid rock areas, to determine how acidic it is.

Physical Risk

There is a section oh highly unstable ground between KP 131 to KP 132 that will be especially vulnerable to erosion during the rainy season. In addition to the installation and maintenance of temporary and permanent erosion controls, biorestoration techniques should be considered.

Waterbodies and Wetlands

Peat bogs are frequently crossed by the RoW and are sensitive areas to be protected as much as possible, taking notice of the highly previous human impact in the area. These wetland areas are an important source of water for all crops downstream during the dry winter season (May to November). Peat bogs must be considered sensitive areas, taking special measures during all activities, and taking care of the potential white-bellied cinclodes (*Cinclodes palliatus*) habitat. Bog species should be translocated when possible

prior to construction and adequate topsoil strip should be undertaken for respreading and habitat recreation after completion of construction.

Habitats and Species

The relocation of *Escallonia myrtilloides* and the *Ribes and other sensitive plant species* should be attempted prior to construction. *Oroya peruviana* is an endemic globular cactus that grows in isolated sites at KPs 118+000 and 123+000. Where cleared during ROW preparation it could be replaced by new plants during biorestoration after the completion of construction.

The vicuna, which occurs throughout the ELU should be managed by special measures summarized in Table 15.11. Being a mobile species and sensitive to noise it is not envisaged that the Andean mountain cat or the Andean condor, *Vultur gryphus* will be impacted by construction works.

Table 15.11 summarizes the key issues and recommendations for the Apacheta High Sierras ELU.

Table 15.11. Key Issues and Recommendations – ELU 8

Issue	KP Reference	Recommendations	Reference
Risk of mass wasting in Medium and High physical risk sectors	117+388 - 117+400	Install and maintain erosion controls, especially in the rainy season. Permanent erosion controls during reinstatement and consideration of extra biorestoration techniques (hydroseeding, mulching and fertilizer applications) in the highest risk areas.	ECOMP / RP
Lagoons River and stream crossings	Churiac river in KP 120+000 to 162+137, several wetlands	Ditch in dry season if possible using best practices crossings techniques to minimize turbidity. River bank protection	ECOMP
		Protection of the Tagracocha lake	
Vicunas	Along the ELU, several areas	Fencing, participative management and other specific protection measures, such as worker training, signage, speed controls, waste management and fauna crossing points left in trench and pipe string. Consultation with local community farmers.	ECOMP
Acid Rock Drainage	KP 145+000 to 162+137	Isolation of materials, water quality monitoring during rainy season	ECOMP
Bog Habitat/	123+000 – 162+137	Translocation of shrubs *(Escallonia myrtilloides etc)* prior to construction. Strip and store and protect topsoil from respreading during reinstatement.	ECOMP

		Erosion control to minimize sediment inundation of adjacent bog habitats. Revegetate with native plants during biorestoration.	
Birds - White-belled cinclodes *(Cinclodes palliates*), Pale-tailed *canastero (Asthenes dorbignyi (Huancavelica)* and black-faced ibis *(Theristicus melanopis)*	Bog Habitat	Protection and restablish bog habitat after construction. Noise monitoring during construction as per ESIA requirements. Identify any nests during pre-clearance survey if site clearance during the nesting season.	
Lizards (*Liolaemus sp.)*	Grassland Habitat	Pre-clearance Survey to identify and relocate from ROW prior to site clearance activities.	

Source: EFS Field Work.

16.0 ELU 9: PAMPAS-PALMITOS RIVER BASINS (KP 162+137 TO 195+050)

16.1 General Description

With elevations ranging between 4,000 and 4,700 m, the Pampas-Palmitos River Basins ELU is another very high Andean landscape dominated by tussock grasslands, sward-forming grasslands and scarcely vegetated areas, with smaller areas of peat bog wetlands and lagoons in the stream and river valleys. The high sierra landscape is dissected in two major places by the deep valleys of the Rivers Pampas and Palmitos at KP 175 and KP186 respectively. The climate is generally cold and dry characterized by seasonal precipitation. This unit includes the rural community of Caruaccpampa.

16.2 Physical Characteristics

16.2.1 Precipitation

Precipitation is seasonal, with a general wet season from September to April but with most of the precipitation falling between January and March, and a dry season from May to August.

Table 16.1 shows estimated precipitation ranges for the peak and general wet seasons. At these high elevations, during parts of the year some of the precipitation will be in the form of snow.

Table 16.1. Estimated Peak and General Wet Season Precipitation Ranges - ELU 9

Estimated Precipitation (mm)			
Peak (January - March)		General (September - April)	
KP Range	Precipitation (mm)	KP Range	Precipitation (mm)
162+137 - 166+000	500 - 600	162+137 - 169+000	800 - 1000
166+000 - 195+050	400 - 500	169+000 - 195-050	700 - 800

Source: ESIA Physical Baseline Maps 1.2-1 and 1.2-2.

16.2.2 GEOLOGY

The dominant geological formation in the Pampas-Palmitos River Basins ELU is comprised principally of limestones interspersed in places with lutites, forming a rugged mountain landscape. Its rocks have been affected by karstic processes although the surface is little altered. The metallic mineralization present in certain areas of these rocks implies a high risk of acid rock drainage (ARD), which could become temporarily accelerated in association with pipeline installation earthworks activities.

Table 16.2 lists the sectors with potential risk of acid rock drainage (ARD) occurrence along the ROW.

Table 16.2. Sectors of ARD Risk – ELU 9

Level of Risk	KP Range	Length (m)
High	170+000 – 175+000	5,000
High	190+000 – 195+000	5,000

Source: ESIA Physical Baseline Appendix 3.3.4.

Additionally, there are zones of glacial and fluvioglacial deposits, including moraines. Some areas such as KP 175+000 and KP 187+000 have colluvio-alluvial deposits, associated with erosion and depositional processes at steep slopes and in river valleys.

16.2.3 SOILS

Surface Horizon Characteristics

The EFS collected eight surface horizon samples in ELU 9. The surface horizon pH in all EFS samples was strongly acidic (less than 5.5) and is of a medium to deep depth along the whole ELU, which is typical of peat bog habitats and high sierra grasslands. Organic matter content along the ROW is variable with four samples low, one medium and one high. Based on levels of available phosphorus, fertility on the surface horizon was mostly low (4 out 8 samples), with three medium and one high sample. Surface horizon sample characteristics are presented in Table 16.3.

Table 16.3. Surface Horizon Characteristics - ELU 9

KP	pH	Surface horizon depth	Organic matter	Fertility	Slope (%)
165+000	Strongly acidic	Medium	Low	Medium	80-100%
170+000	Strongly acidic	Medium	Low	Medium	45%
175+000	Strongly acidic	Deep	Low	Medium	15-80%
180+000	Strongly acidic	Medium	Medium	High	30%
185+000	Strongly acidic	Medium	High	Low	25%
187+000	Strongly acidic	Deep	High	Low	15-100%
190+000	Strongly acidic	Medium	High	Low	60%
195+000	Strongly acidic	Medium	Low	Low	10-15%

Source: ESIA Physical Baseline and Domus.
pH: Strongly acidic = Less than 5.5; Moderately acidic = 5.6 to 6.0; Slightly acidic = 6.1 – 6.5; Neutral = 6.6 - 7.0; Slightly alkaline = 7.1 – 7.8; Moderately alkaline = 7.9 to 8.4; Strongly alkaline = More than or equal to 8.5.
Surface horizon depth: Shallow = Less than 5 cm; Medium = 5 cm to 15 cm; Deep = More than 15 cm.
Organic matter: Low = Less than 2%; Medium = 2% to 4%; High = More than 4%.
Fertility based on Available Phosphorus: Low = Less than 7.0 ppm; Medium = 7.0 to 14.0 ppm; High = More than 14.0 ppm.

Subsoil Characteristics

The subsoil texture is a generally loamy sand texture, like that of the surface horizon, and does not hinder the infiltration of water. However, both the surface horizon and subsoil are very loose and the stability of the soil aggregates is low. Organic matter and nutrients are generally low in the subsoil.

Overall, the soils are typical of a vegetated mountain environment of moderately high elevation with acidic, organic soils of low fertility and a distinctive surface horizon horizon.

16.2.4 WATERBODIES AND WETLANDS

The ROW will require 29 stream and quebrada crossings and 2 major river crossings in ELU 9,. Table 16.4 details the stream and river crossings for the Pampas-Palmitos River Basins ELU.

The ROW runs parallel to the Huayco Corral stream, at distances of approximately 45 to 265 m upslope from the stream, from approximately KP 170+000 to KP 173+873, where it crosses the stream. The RoW also runs parallel to Quebrada. Jaccachayocc at approximately KP 175+000 to 178+000.

The ROW passes within 25 m of a lagoon near KP 173+900.

Table 16.4. Principal Waterbody Crossings - ELU 9

Waterbody Type or Name	KP Mid-channel	Elevation (m)
Arroyos		
ARROYO	170+851.56	4474.49
ARROYO	170+999.44	4451.08
ARROYO	172+075.76	4404.14
ARROYO	172+315.76	4395.17
ARROYO	173+139.21	4362.74
ARROYO	179+257.44	4684.51
ARROYO	180+206.35	4672.20
ARROYO	181+900.57	4537.50
ARROYO	182+866.12	4447.89
ARROYO	186+023.52	4107.91
ARROYO	192+932.54	4569.56
ARROYO	192+990.85	4569.44
ARROYO	193+136.44	4567.87
ARROYO	193+928.69	4590.07
ARROYO	194+111.62	4587.84
ARROYO	194+532.56	4601.24
ARROYO	194+590.08	4597.20
Quebradas		
QUEBRADA	163+800	4790
QUEBRADA	165+200	4746
QUEBARADA	167+100	4672
QUEBRADA	170+193.68	4506.34
QDA. HUAYCO CORRAL	173+873.20	4332.54
QUEBRADA JACCACHAYOC	176+504.66	4300.86

QUEBRADA	178+169.15	4521.01
QUEBRADA	178+392.68	4582.50
QUEBRADA	178+558.75	4621.66
QUEBRADA	179+025.39	4654.42
QUEBRADA SECA	191+696.98	4514.03
QUEBRADA SECA	192+466.78	4566.57
QUEBARADA SECA	194+600	XXX
Rivers		
RIO PALMITOS	175+216.31	4123.46
RIO PAMPAS	186+773.05	3998.09

Source: Peru LNG Pipeline Project Alignment Sheets (Gulf Interstate Engineering, 2006).

In addition to the rivers and streams, there are many peat bog crossings typically less than 100 m each. However, the three largest and most important crossings are a 243-m section starting at KP 178+712, a 189-m section starting at KP 188+372, and 95-m section starting at KP 191+603 (see Table 16.8 for complete listing of peat bogs).

16.2.5 INSTABILITY AND PHYSICAL RISK

The level of instability and physical risk in ELU 9 is categorized as Low in 73.1 % of the ROW length and as Medium in the remaining 26.9% of the ROW (Table 16.5).

Table 16.5. Instability and Physical Risk Levels - ELU 9

Risk Level	KP Start	KP Finish	Length (m)	
Low	162+1370	170+365	8228	26,137
	170+477	170+771	294	
	171+000	176+048	5,048	
	177+887	180+363	2,476	
	181+726	181+755	29	
	183+050	186+332	3,282	
	186+435	186+827	392	
	187+273	193+000	5,727	
	193+388	193+450	62	
	193+679	194+278	599	

Medium	170+365	170+477	112	6,726
	170+771	171+000	229	
	176+048	177+887	1,839	
	180+363	181+726	1,363	
	181+755	183+050	1,295	
	186+332	186+435	103	
	186+827	187+273	446	
	193+000	193+388	388	
	193+450	193+679	229	
	194+278	195+000	722	

Source: ESIA Physical Baseline Map 1.1-4 and Domus.

16.2.6 INFRASTRUCTURE

The Central Rumichaca Base Camp, with lodging facilities for 500 people, and pipe yard may be installed at a site used formerly for these purposes and, therefore, does not represent a greenfield development. The site is located along the Pilpichaca-Rumichaca road just north of the latter community, at a distance of approximately 3,800 m from the ROW.

Table 16.6 lists the infrastructure information for ELU 9.

Table 16.6. Planned Project Infrastructures – ELU 9

Type of Infrastructure	KP	Name
Camp and Pipe Yard	188+063*	Central Rumichaca

***KP as indicated by the ESIA provided for reference only.**
Source: ESIA Project Description.

16.3 HABITATS AND SPECIES

16.3.1 HABITAT DISTRIBUTION

The habitats of ELU 9 are listed in sequential order in Table 16.7, including the length of each habitat unit and associated start and finish ROW KPs. Table 16.8 presents habitat lengths over the ROW arranged by habitat type, with subtotals for each habitat.

Table 16.7. Habitat Sequence – ELU 9

Habitat Type	Length (m)	KP Start	KP Finish
Scarcely Vegetated High Andean Areas	152	162+137	162+289
Peat Bogs	89	162+289	162+378
Scarcely Vegetated High Andean Areas	340	162+378	162+718
Peat Bogs	25	162+718	162+743
Scarcely Vegetated High Andean Areas	610	162+743	163+353
Peat Bogs	48	163+353	163+401
Scarcely Vegetated High Andean Areas	89	163+401	163+490
Peat Bogs	88	163+490	163+578
Sward-forming grassland	169	163+578	163+747
Peat Bogs	58	163+747	163+805
Scarcely Vegetated High Andean Areas	60	163+805	163+865
Peat Bogs	42	163+865	163+907
Scarcely Vegetated High Andean Areas	480	163+907	164+387
Peat Bogs	17	164+387	164+404
Scarcely Vegetated High Andean Areas	221	164+404	164+625
Peat Bogs	74	164+625	164+699
Sward-forming grassland	149	164+699	164+848
Peat Bogs	359	164+848	165+207
Sward-forming grassland	20	165+207	165+227
Peat Bogs	285	165+227	165+512
Sward-forming grassland	223	165+512	165+735
Peat Bogs	79	165+735	165+814

Sward-forming grassland	115	165+814	165+929
Peat Bogs	43	165+929	165+972
Sward-forming grassland	810	165+972	166+782
Peat Bogs	27	166+782	166+809
Sward-forming grassland	215	166+809	167+024
Scarcely Vegetated High Andean Areas	509	167+024	167+533
Peat Bogs	72	167+533	167+605
Scarcely Vegetated High Andean Areas	1054	167+605	168+659
Sward-forming grassland	405	168+659	169+064
Tussock grassland	357	169+064	169+421
Sward-forming grassland	455	169+421	169+876
Tussock grassland	124	169+876	170+000
Tussock Grassland	170	170+000	170+170
Sward-forming Grassland	91	170+170	170+261
Peat Bog	18	170+261	170+279
Sward-forming Grassland	105	170+279	170+384
Tussock Grassland	96	170+384	170+480
Sward-forming Grassland	66	170+480	170+546
Peat Bog	29	170+546	170+575
Sward-forming Grassland	91	170+575	170+666
Tussock Grassland	471	170+666	171+137
Sward-forming Grassland	626	171+137	171+763
Tussock Grassland	665	171+763	172+428
Sward-forming Grassland	1753	172+428	174+181
Tussock Grassland	73	174+181	174+254
Sward-forming Grassland	976	174+254	175+230
Peat Bog	23	175+230	175+253
Sward-forming Grassland	220	175+253	175+473
Peat Bog	63	175+473	175+536
Sward-forming Grassland	79	175+536	175+615
Tussock Grassland	316	175+615	175+931
Peat Bog	138	175+931	176+069
Tussock Grassland	264	176+069	176+333
Peat Bog	27	176+333	176+360
Tussock Grassland	166	176+360	176+526
Peat Bog	62	176+526	176+588
Tussock Grassland	1310	176+588	177+898
Sward-forming Grassland	434	177+898	178+332
Tussock Grassland	380	178+332	178+712
Peat Bog	243	178+712	178+955

Sward-forming Grassland	592	178+955	179+547
Scarcely Vegetated High Andean Areas	637	179+547	180+184
Sward-forming Grassland	64	180+184	180+248
Scarcely Vegetated High Andean Areas	1271	180+248	181+519
Peat Bog	162	181+519	181+681
Scarcely Vegetated High Andean Areas	33	181+681	181+714
Tussock Grassland	6970	181+714	188+684
Sward-forming Grassland	775	188+684	189+459
Peat Bog	9	189+459	189+468
Sward-forming Grassland	54	189+468	189+522
Scarcely Vegetated High Andean Areas	219	189+522	189+741
Sward-forming Grassland	183	189+741	189+924
Tussock Grassland	345	189+924	190+269
Sward-forming Grassland	1334	190+269	191+603
Peat Bog	38	191+603	191+641
Sward-forming Grassland	116	191+641	191+757
Scarcely Vegetated High Andean Areas	2110	191+757	193+867
Sward-forming Grassland	397	193+867	194+264
Tussock Grassland	515	194+264	194+779
Scarcely Vegetated High Andean Areas	271	194+779	195+050

Source: ESIA Biological Baseline Map 2-1 and Domus.

Table 16.8. Habitat Summary – ELU 9

Habitat Type	Length (m)	KP Start	KP Finish
Tussock Grassland	357	169+064	169+421
	124	169+876	170+000
	170	170+000	170+170
	96	170+384	170+480
	471	170+666	171+137
	665	171+763	172+428
	73	174+181	174+254
	316	175+615	175+931
	264	176+069	176+333

	166	176+360	176+526
	1310	176+588	177+898
	380	178+332	178+712
	6970	181+714	188+684
	345	189+924	190+269
	515	194+264	194+779
Subtotal	**12,222**	**46.96%**	
Sward-forming Grassland	169	163+578	163+747
	149	164+699	164+848
	20	165+207	165+227
	223	165+512	165+735
	115	165+814	165+929
	810	165+972	166+782
	215	166+809	167+024
	405	168+659	169+064
	455	169+421	169+876
	91	170+170	170+261
	105	170+279	170+384
	66	170+480	170+546
	91	170+575	170+666
	626	171+137	171+763
	1753	172+428	174+181
	976	174+254	175+230
	220	175+253	175+473
	79	175+536	175+615
	434	177+898	178+332
	592	178+955	179+547
	64	180+184	180+248
	775	188+684	189+459
	54	189+468	189+522
	183	189+741	189+924
	1334	190+269	191+603
	116	191+641	191+757
	397	193+867	194+264
Subtotal	**10,517**	**31.82%**	
Scarcely Vegetated High Andean Areas	152	162+137	162+289
	340	162+378	162+718
	610	162+743	163+353
	89	163+401	163+490
	60	163+805	163+865
	480	163+907	164+387
	221	164+404	164+625

	509	167+024	167+533
	1054	167+605	168+659
	637	179+547	180+184
	1271	180+248	181+519
	33	181+681	181+714
	219	189+522	189+741
	2110	191+757	193+867
	271	194+779	195+050
Subtotal	**8,056**	**17.96%**	
Peat Bog	89	162+289	162+378
	25	162+718	162+743
	48	163+353	163+401
	88	163+490	163+578
	58	163+747	163+805
	42	163+865	163+907
	17	164+387	164+404
	74	164+625	164+699
	359	164+848	165+207
	285	165+227	165+512
	79	165+735	165+814
	43	165+929	165+972
	27	166+782	166+809
	72	167+533	167+605
	18	170+261	170+279
	29	170+546	170+575
	23	175+230	175+253
	63	175+473	175+536
	138	175+931	176+069
	27	176+333	176+360
	62	176+526	176+588
	243	178+712	178+955
	162	181+519	181+681
	9	189+459	189+468
	38	191+603	191+641
Peat Bogs Subtotal	**2118**	**3.25%**	
ELU 9 Total ROW Length:	**32,913**		

Source: ESIA Biological Baseline Map 2-1 and Domus.

16.3.2 HABITAT DESCRIPTIONS

Tussock Grasslands

Tussock grasslands are the most extensive habitat type in the Pampas-Palmitos River Basins ELU, occupying about 46.96% of the ROW length and typical of the high sierra landscape. Characteristic elements of the tussock grasslands in ELU 9 include the grass *Dissanthelium* sp. and the composite *Senecio* sp. There are also highly dispersed patches of the cactus *Austrocylindropuntia floccosa*.

Sward-forming Grassland

Sward-forming grasslands cover approximately 31.82% of the ROW in ELU 9 and are dominated by *Aciachne* cf. *acicularis, Lachemilla pinnata, and Pycnophyllum molle*.

Scarcely Vegetated High Andean Areas

Some 17.96% of the ROW in ELU 9 is more or less devoid of vegetative cover, with bare mineral soil and rock at the surface. This corresponds to screen slopes and rocky outcrops and the highest sections of the RoW above the deep valleys cut by the Pampas and Palmitos rivers.

Peat Bogs

The remaining 3.25% of the ROW in the Pampas-Palmitos River Basins ELU is comprised on peat bog wetlands dominated by *Distichia muscoides* and *Plantago rigida*. These habitats have generally been highly degraded by alpaca grazing.

Key Fauna

Mammals registered in this ELU were Andean fox (*Lycalopex culpaeus*), the Andean Mountain Cat (*Leopardus jacobitus*), and Molina's hog-nosed skunk (*Conepatus chinga*).

Important Peruvian endemic bird species appear in this ELU like the black-breasted hillstar (*Oreotrochilus melanogaster*) and the Pale-tailed canastero (*Asthenes dorbignyi huancavelicae*; INRENA-vulnerable). Other birds registered are the Andean tinamou (*Nothoprocta pentlandii*), the torrent duck (*Merganetta armata*), and the gray-breasted seedsnipe (*Thinocorus orbignyianus*).

The series of *Liolaemus* lizards collected in the Pampa-Palmitos River Basin by the EFS field team appears to represent an undescribed species of the *montanus* section, related to the *L. melanogaster/polystictus* complex.

Hydrobiology

Table 16.9 presents waterdbodies sampled along ELU 9. No salient characteristics were observed for this ELU.

Table 16.9. Waterbodies Sampled – ELU 9

Station	Habitat	Waterbody	Name	Height (masl)	KP
Hi-13	Altoandino	Río	Pampas	4027	186+500
Hi-14	Altoandino	Quebrada	Pichjahuasi	4326	175+500
Hi-15	Altoandino	Quebrada	Huaycco Corral	4153	173+800
Hi-16	Altoandino	Bofedal	Yuarilla	4814	162+000

16.3.3 SPECIES SENSITIVITY ANALYSIS

Table 16.10 shows the high and medium sensitivity species observed during the EFS Field Survey, based on the species sensitivity criteria presented in Section 7.1 of the EFS.

There are two Medium Sensitivity plant species, one lizard species, two mammal and one bird species that were identified during the EFS fieldwork. Another sensitive bird species, the cinclodes, was identified in the ESIA but not observed along the ROW or surrounding area during the field survey.

Table 16.10. Species Sensitivity Criteria - ELU 9

No	Species	Protection Status						Spatial Distribution			Local Use			Mobility		Σ
		CR	EN	VU	NT	L	N	Local	Regional	Widespread	Permanent	Seasonal	None	Immobile	Mobile	
	Plants															
1	*Aciachne* cf. *acicularis*						0			0			0	3		3
2	*Astragalus* sp.						0			0			0	3		3
3	*Austrocylindropuntia floccosa*						0			0			0	3		3
4	*Baccharis odorata*						0		2				0	3		5
	Dissanthelium sp.						0			0	2			3		5
5	*Distichia muscoides*						0		2			1		3		6
	Lachemilla pinnata						0		2				0	3		5
6	*Perezia coerulescens*			4					2				0	3		9
	Plantago rigida						0		2				0	3		5
8	*Poaceae*						0			0			0	3		3
	Pycnophyllum molle						0			0	2			3		5
9	*Senecio* sp.						0		0			2			3	5
10	*Valerianaceae*						0		0			0		3		3
	Reptile															
10	*Liolaemus* sp.						0	3					0	3		6
	Mammals															
11	*Conepatus chinga*						0			0			0		0	0
25	*Leopardus (Oreailurus) jacobitus*		5						2				0		0	7
12	*Lycalopex (Pseudalopex) culpaeus*						0		2				0		0	2
	Vicugna vicugna		5							0	2				0	7
	Birds															
13	*Anas flavirostris*						0			0			0		0	0
14	*Asthenes dorbignyi (huancavelicae)*			4				3					0		0	7
16	*Attagis gayi*						0			0			0		0	0
17	*Buteo polyosoma*						0			0			0		0	0
18	*Chloephaga melanoptera*						0		2		2				0	4
19	*Geranoaetus melanoleucus*						0			0			0		0	0
20	*Haplochelidon andecola*						0		2				0		0	2

47	*Larus serranus*						0			0			0		0	0
48	*Lessonia oreas*						0		2				0		0	2
21	*Merganetta armata*						0			0			0		0	0
22	*Nothoprocta ornata*						0		2				0		0	2
23	*Nothoprocta pentlandii*						0		2				0		0	2
24	*Nycticorax nycticorax*						0			0			0		0	0
55	*Phalcoboenus megalopterus*						0			0			0		0	0
25	*Phrygilus plebejus*						0			0			0		0	0
26	*Phrygilus unicolor*						0			0			0		0	0
27	*Ochthoeca oenanthoides*						0		2				0		0	2
28	*Oreotrochilus melanogaster*						0	3					0		0	3
29	*Phalcoboenus megalopterus*						0			0			0		0	0
30	*Sicalis luteola*						0			0			0		0	0
31	*Sicalis olivascens*						0			0			0		0	0
32	*Sicalis uropygialis*						0			0			0		0	0
33	*Thinocorus orbignyianus*						0			0	2				0	2
34	*Upucerthia jelskii*						0		2				0		0	2
68	*Vanellus resplendens*						0		2				0		0	2

Protection Status*:
CR= Critically endangered 6 points
EN= Endangered 5 points
VU= Vulnerable 4 points
NT= Near threatened 3 points
B= Low (Others) 2 points
N= Not listed 0 points

Σ= Sensitivity value

1 - 5: Low
6 - 10: Medium
11 or higher: High

Species Distribution:
Local = (Endemic locally or to an EBA**) 3 points
Regional = (Regional endemic in Andes or Coast) 2 points
Widespread = (Across S. America or cosmopolitan) 0 points

Mobility:
Immobile = (restricted movement or in very short distance) 3 points
Mobile = 0 points

Local Uses:
Permanent= 2 points
Seasonal = 1 point
None = 0 points

***Protection Status:** According IUCN (2006) or National Legislation (D.S. No. 034-2004-AG/D.S. No. 043-2005-AG)
****EBA:** Areas determined by Birdlife International, which includes at least 2 bird species with less than 50,000 km2 of known distribution range.

16.3.4 HABITAT SENSITIVITY ANALYSIS

Based on the presence of medium sensitivity species presented in Table 16.10 the Tussock Grasssland of the Pampas Palmitos River Basins ELU is considered to be of Medium Sensitivity due to the presence of 2 Medium Sensitivity animal species. None of the other habitats in this ELU meet the criteria for a high or medium sensitivity habitat as described in Section 7.2 of this EFS.

16.4 KEY ISSUES AND RECOMMENDATIONS

Geology

The ESIA defined a high potential for Acid Rock Drainage in the sectors between KPs 170+000-175+000 and KPs 190+000-195+000. These sections of the ROW cross numerous small streams and 2 rivers that could be vulnerable to additional loadings of acidity caused by ARD, especially during the rainy season. Excavated materials such as from earthwork cuts and trench spoils should be isolated from waterbodies. Runoff or seepage from ROW stockpiled material should be managed by use of geomembranes, embankments, and ditches to limit the effects of potentially acidic runoff entering waterbodies and wetlands. Routine water quality monitoring of these areas should be performed in these areas especially during the rainy season.

Soils

Some areas with deep and relatively fertile topsoils present some favorable conditions to restoration, such as the stretch from KP 175+000 to KP 180+000, but in other areas the steep slopes and low fertility indicate potential restrictions to natural regeneration of plants, during and after the construction phase. This is especially critical in these high elevation areas where climatic extremes and short growing season inhibit plant growth. In grassland habitats, use of nitrogen-fixing species to promote soil fertility should be used.

Taking into account precipitation levels, especial in the wet season, erosion controls should be installed and maintained, especially in the rainy season. During the construction, erosion and sediment control devices as silt fences, slope breakers and wooden barriers are especially important on steep slopes near watercourses. Topsoil best practice is also critical during construction as preservation of the material will be critical in successful long-term reinstatement of these mountain habitats. Topsoil should be carefully stripped during site clearing and grading and protected from loss or deterioration caused by erosion or contamination during construction.

Waterbodies and Wetlands

There are more than 25 waterbodies and 10 wetlands to be crossed by the ROW in this ELU where best practice erosion and sedimentation controls and pollution prevention must be followed to protect waterbodies against possible contamination by sediment and hydrocarbons. Especially important are the upland waterbodies of the Rivers Pampas and Palmitos at KP 175 and KP 186 respectively.

Vegetative buffer zones should be retained along the edges of these waterbodies where crossed by the RoW and only cleared immediately before pipeline crossing and installation works.

Waterbody and wetlands crossing must at minimum meet the requirements of the ESIA's ESMP, with scheduling to minimize the time the wetland stretches remain open. Temporary erosion and sedimentation controls should be employed at all Waterbody crossings to prevent or minimize the amount of sediment entering during rain events. Special care should be taken in terms of erosion and sedimentation controls along the ROW for the sector where it runs parallel to the Huayco Corral stream.
Physical Risk

Sectors categorized as Medium physical risk in Table 16.5 will require temporary erosion controls during construction and permanent controls during reinstatement. In areas of particular vulnerability, including waterbodies, river and stream crossings, additional restoration measures including hydroseeding and fertilizer application should be considered.

Habitats and Species

The shrub *Perezia coerulescens*, listed as Medium sensitivity in Table 16.10, should be translocated from the habitat locations prior to construction.

Any sensitive lizards (*Liolaemus* sp.), which are especially likely to be found in the Tusssock Grassland habitats should be identified along the RoW prior to site clearing and grading so that they can be relocated to safe undisturbed areas beyond the RoW. The lizards will be moved to an area of same or similar habitat at a reasonable distance outside the zone of impact by construction activities.

Table 16.11 summarizes the key issues and recommendations for the Pampas-Palmitos River Basins ELU.

Noise monitoring of construction activities should be undertaken in areas known to be nesting sites of the white-bellied cinclodes and pale-tailed canastero. Where possible, construction activities should be scheduled to avoid or minimize noise disturbances at the most sensitive time of the year including breading and nesting.

Table 16.11. Key Issues and Recommendations - ELU 9

Issue	KP Reference	Recommendations	Reference
Generation of ARD	170+000 – 175+000 and 190+000 – 195+000	Isolate material from water. Use of geomembranes. Embankments and ditches. Visual and empirical monitoring.	ECOMP
Lagoons River and stream crossings	190+000 – 195+000	Ditch in dry season if possible, use less intrusive technique. River bank protection	ECOMP
		Protection of the Tagracocha lake. Erosion and Sedimentation Control & Pollution Prevention Best Practices.	
Vicunas	Along the ELU, several areas	Fencing, participative management and other specific protection measures, such as worker training, signage, speed controls, waste management and fauna crossing points left in trench and pipe string. Consultation with local community farmers.	ECOMP
Peat bog Habitat, *Distichia muscoides*	162+137 - 163+000 See Table 16.8	Relocation of plants and topsoil storage before construction. Turf and topsoil strip, storage and protection during construction.	ECOMP / RP
		Restoration of topsoil and plants during reinstatement. Use of native species, where practicable, during bioreinstatement.	
Risk of physical instability	See Table 16.5	Temporary and permanent erosion controls.	ECOMP / RP
		Restoration of topsoil and plants during reinstatement.	
Lizards (Liolaemus)	See Table 16.10	Pre-Clearance Survey to identify and relocate from ROW prior to site clearance activities.	ECOMP
Birds - Pale-tailed canastero (Asthenes dorbignyi (Huancavelica) and white-bellied cinclodes	Bog Habitats	Identify any nests during pre-clearance survey if site clearance during the nesting season. Reinstatement of original habitat after construction.	ECOMP
Acid Rock Drainage	KP 162+137 to 175+000	Isolation of materials, water qualitymonitoring	ECOMP

Source: EFS Fieldwork

17.0 ELU 10: HUAYTARÁ HIGH PLAINS AND RIDGES (KP 195+050 TO 249+538)

17.1 GENERAL DESCRIPTION

The Huaytará High Plains and Ridges landscape unit is composed of relatively flat, broad ridge tops, plains and rolling topography at high altitude, dominated by increasingly drier and shorter tussock grasslands, sward-forming grasslands, peat bogs, and scarcely vegetated areas, where vicuñas are common and important as a resource to local communities. At elevations between 4,000 and 4,650 m, the climate is generally cold and dry with precipitation becoming progressively lower from east to west.

Although the Huaytara highlands are generally very stable there is a small area from KP 218+000 to 220+000, where there are steeper mountains with colluvial soils that are very sensitive to water erosion and landslides.

17.2 PHYSICAL CHARACTERISTICS

17.2.1 PRECIPITATION

Precipitation is seasonal, with a general wet season from September to April with most rain falling between January and March, and a dry season from May to August.

Table 17.1 shows estimated precipitation ranges for the peak and general wet seasons based on the isohyets developed by the ESIA.

Table 17.1. Estimated Peak and General Wet Season Precipitation Ranges - ELU 10

Estimated Precipitation			
Peak (January – March)		General (September – April)	
KP Range	Precipitation (mm)	KP Range	Precipitation (mm)
195+050 – 233+000	400 - 500	195+050 – 216+000	700 - 800
233+000 - 245+000	300 - 400	216+000 - 231+000	600 - 700
245+000 - 249+538	200 - 300	231+000 - 249+538	500 - 600

Source: ESIA Physical Baseline Maps 1.2-1 and 1.2-2.

Total wet season precipitation ranges from 500 mm in the western sector to 800 mm in the eastern sector of the Huaytará High Plains and Ridges ELU and this drying trend is visible by the increasingly sparser vegetation towards the west.

17.2.2 GEOLOGY

The Huaytará highlands formation consists of well-bonded quartzite sandstone posing no significant risk of instability. Another formation frequently in the ELU is composed of very dense volcanic lava, which also poses no risk of instability. The ESIA Physical Baseline does not identify any sectors along the ROW identified as having Medium or High risk of Acid Rock Drainage.

17.2.3 SOILS

Surface Horizon Characteristics

The EFS collected eight surface horizon samples in ELU 10. The pH in seven of the EFS samples was strongly acidic, with one moderately acidic sample. According to EFS samples, surface horizon is of medium (6 samples) to deep (2 samples) depths along the whole ELU, despite the variable slope. Organic matter content from samples along

the ROW is generally low (4 samples) to medium (3 samples), with a single high sample. Conversely, fertility of EFS surface horizon samples, based on levels of available phosphorus, was mostly high (5 samples) to medium (2 samples), with a single sample of low fertility. Surface Horizon sample characteristics are presented in Table 17.2.

Table 17.2. Surface Horizon Characteristics - ELU 10

KP	pH	Surface horizon depth	Organic matter	Fertility	Slope (%)
200+000	Strongly acid	Medium	Low	Medium	10-15%
205+000	Strongly acid	Medium	Low	High	15%
210+000	Strongly acid	Deep	Low	Medium	20%
215+000	Strongly acid	Medium	Medium	High	10%
220+000	Moderately acid	Medium	High	High	50%
225+000	Strongly acid	Medium	Medium	High	30%
227+000	Strongly acid	Deep	Medium	High	50%

Source: ESIA Physical Baseline and Domus.
pH: Strongly acid = Less than 5.5; Moderately acid = 5.6 to 6.0; Slightly acid = 6.1 – 6.5; Neutral = 6.6 - 7.0; Slightly alkaline = 7.1 – 7.8; Moderately alkaline = 7.9 to 8.4; Strongly alkaline = 8.5 or greater.
Surface horizon depth: Shallow = Less than 5 cm; Medium = 5 cm to 15 cm; Deep = More than 15 cm.
Organic matter: Low = Less than 2%; Medium = 2% to 4%; High = More than 4%.
Fertility based on Available Phosphorus: Low = Less than 7.0 ppm; Medium = 7.0 to 14.0 ppm; High = More than 14.0 ppm.

Subsoil Characteristics

The sandy loam texture of the subsoil is like that of the surface horizon and will not affect the movement of water. However, both the surface horizon and subsoil are very loose and the stability of the soil aggregates is low. Subsoil organic matter is medium.

17.2.4 WATERBODIES AND WETLANDS

ELU 10 crosses three rivers the Leche Leche, Canya, and Llactachayoc, and the Quinsacocha lagoon at KP 211+500.

The ROW in this ELU does not cross lakes, but passes near 3 streams, crossing 2 more, Canya (KP 212+000) and Tacpampa (224+000). Waterbodies associated with this ELU are shown in Table 17.3.

The ROW runs parallel to a creek from approximately KP 198+000 to 201+000 where it crosses it.

Table 17.3. Principal Waterbody Crossings - ELU 10

Waterbody Type or Name	KP Mid-channel	Elevation (m)
Arroyos		
ARROYO	196+103.25	4532.85
ARROYO	198+234.60	4478.99
ARROYO	198+318.40	4472.87
ARROYO	198+443.47	4467.01
ARROYO	198+556.48	4462.40
ARROYO	202+934.54	4359.12
ARROYO	203+055.33	4349.49
ARROYO	204+762.82	4415.67
ARROYO	205+306.40	4451.20
ARROYO	205+853.78	4442.96
ARROYO	206+384.16	4445.47
ARROYO	206+613.31	4437.93
ARROYO	206+661.92	4436.18
ARROYO	206+773.69	4430.65
ARROYO	206+954.61	4424.70
ARROYO	209+412.01	4465.88
Quebradas		
QUEBRADA	196+766.75	4499.37
QUEBRADA	200+554.26	4379.94
QUEBRADA	200+996.12	4344.97
QUEBRADA	201+015.14	4344.50
QDA. TAYARANGRA	201+576.38	4366.02

QDA AGUADA	202+950	XXXX
QDA CHAUPI	203+100	XXXX
QDA CUCHUHUASI	205+800	XXXX
QUEBRADA PUCAMACHAY	212+291.33	4400.78
QUEBRADA	214+000	XXXX
QUEBRADA	215+258.77	4432.10
QUEBRADA	216+409.48	4465.50
QDA TANTACCE	218+300	XXXX
QUEBRADA	219+569.74	4207.50
QUEBRADA	219+675.99	4173.08
QUEBRADA	219+736.10	4158.28
QUEBRADA	222+600	XXXX
QDA SECA	224+000	XXXX
QDA SECA	225+600	XXXX
QDA TEPERUMI	231+200	XXXX
QDA SECA	243+400	XXXX
QUEBRADA	246+244.55	4267.60
QUEBRADA	249+451.24	4012.71

Source: Peru LNG Pipeline Project Alignment Sheets (Gulf Interstate Engineering, 2006).

17.2.5 INSTABILITY AND PHYSICAL RISK

The level of instability and physical risk in ELU 10 is categorized as Low in 85.4 % of the ROW length, as Medium 11.2% of the ROW, and as High in the remaining 3.4% (Table 17.4).

Table 17.4. Instability and Physical Risk Levels – ELU 10

Type of risk	Initial Kp	KP Finish	Length (m)	
Low	195+192	196+687	1495	46559
	197+694	216+192	18498	
	218+452	218+509	57	
	219+921	224+421	4500	
	225+577	243+753	18176	
	244+584	246+121	1537	
	247+204	249+500	2296	
Medium	195+050	195+192	142	6027
	196+687	197+694	1007	
	216+192	218+000	1808	
	224+421	225+577	1156	
	243+753	244+584	831	
	246+121	247+204	1083	
High	218+000	218+452	452	1864
	218+509	219+921	1412	

Source: ESIA Physical Baseline Map 1.1-4.

17.2.6 INFRASTRUCTURE

Infrastructure requirements such as camps and access roads are based on assumptions set out in the ESIA Project Description and are subject to change, depending on the specific details of the construction program.

The Central Huaytará Base Camp, with lodging facilities for 400 people, and pipe yard will be installed at a site which has been used formerly for these purposes and, therefore, does not represent a greenfield development. The site is located at a distance of approximately 1 km m from the ROW to the southeast of KP 233.

Table 17.5 lists the infrastructure information for ELU 10.

Table 17.5. Planned Project Infrastructures – ELU 10

Type of Infrastructure	KP	Name
Camp and Pipe Yard	233	Central Huaytará

Source: ESIA Project Description.

17.3 HABITATS AND SPECIES

17.3.1 HABITAT DISTRIBUTION

The habitats of ELU 10 are listed in sequential order in Table 17.6, including the length of each habitat unit and associated start and finish ROW KPs. Table 17.7 presents habitat lengths over the ROW sorted by habitat type, with subtotals for each habitat.

Table 17.6. Habitat Sequence – ELU 10

Habitat Type	Length (m)	KP Start	KP Finish
Scarcely Vegetated High Andean Area	1158	195+050	196+208
Sward-forming Grassland	217	196+208	196+425
Scarcely Vegetated High Andean Area	181	196+425	196+606
Peat Bogs	24	196+606	196+630
Scarcely Vegetated High Andean Area	102	196+630	196+732
Sward-forming Grassland	333	196+732	197+065
Scarcely Vegetated High Andean Area	526	197+065	197+591
Sward-forming Grassland	96	197+591	197+687
Tussock Grassland	214	197+687	197+901
Sward-forming Grassland	768	197+901	198+669
Scarcely Vegetated High Andean Area	1055	198+669	199+724
Sward-forming Grassland	1017	199+724	200+741
Peat Bogs	26	200+741	200+767
Sward-forming Grassland	683	200+767	201+450
Peat Bogs	14	201+450	201+464

Sward-forming Grassland	1330	201+464	202+794
Tussock Grassland	156	202+794	202+950
Sward-forming Grassland	437	202+950	203+387
Tussock Grassland	219	203+387	203+606
Sward-forming Grassland	250	203+606	203+856
Peat Bogs	249	203+856	204+105
Sward-forming Grassland	416	204+105	204+521
Tussock Grassland	228	204+521	204+749
Sward-forming Grassland	420	204+749	205+169
Tussock Grassland	949	205+169	206+118
Sward-forming Grassland	135	206+118	206+253
Tussock Grassland	126	206+253	206+379
Sward-forming Grassland	393	206+379	206+772
Tussock Grassland	61	206+772	206+833
Sward-forming Grassland	287	206+833	207+120
Tussock Grassland	273	207+120	207+393
Sward-forming Grassland	515	207+393	207+908
Tussock Grassland	1974	207+908	209+882
Peat Bogs	54	209+882	209+936
Tussock Grassland	293	209+936	210+229
Peat Bogs	60	210+229	210+289
Tussock Grassland	2131	210+289	212+420
Sward-forming Grassland	197	212+420	212+617
Tussock Grassland	117	212+617	212+734
Sward-forming Grassland	168	212+734	212+902
Tussock Grassland	295	212+902	213+197
Sward-forming Grassland	397	213+197	213+594
Tussock Grassland	100	213+594	213+694
Sward-forming Grassland	547	213+694	214+241
Tussock Grassland	1653	214+241	215+894
Scarcely Vegetated High Andean Area	527	215+894	216+421
Tussock Grassland	1892	216+421	218+313
Sward-forming Grassland	345	218+313	218+658
Tussock Grassland	3160	218+658	221+818
Sward-forming Grassland	1151	221+818	222+969
Tussock Grassland	1136	222+969	224+105
Sward-forming Grassland	381	224+105	224+486
Tussock Grassland	1496	224+486	225+982
Sward-forming Grassland	205	225+982	226+187
Tussock Grassland	1602	226+187	227+789
Sward-forming Grassland	375	227+789	228+164

Tussock Grassland	551	228+164	228+715
Sward-forming Grassland	122	228+715	228+837
Tussock Grassland	1445	228+837	230+282
Sward-forming Grassland	226	230+282	230+508
Tussock Grassland	1285	230+508	231+793
Sward-forming Grassland	147	231+793	231+940
Tussock Grassland	120	231+940	232+060
Sward-forming Grassland	69	232+060	232+129
Tussock Grassland	1569	232+129	233+698
Sward-forming Grassland	87	233+698	233+785
Tussock Grassland	303	233+785	234+088
Sward-forming Grassland	142	234+088	234+230
Tussock Grassland	2491	234+230	236+721
Sward-forming Grassland	483	236+721	237+204
Tussock Grassland	367	237+204	237+571
Sward-forming Grassland	92	237+571	237+663
Tussock Grassland	164	237+663	237+827
Sward-forming Grassland	235	237+827	238+062
Tussock Grassland	406	238+062	238+468
Peat Bogs	265	238+468	238+733
Tussock Grassland	424	238+733	239+157
Sward-forming Grassland	770	239+157	239+927
Tussock Grassland	1084	239+927	241+011
Sward-forming Grassland	263	241+011	241+274
Tussock Grassland	420	241+274	241+694
Sward-forming Grassland	2428	241+694	244+122
Tussock Grassland	4852	244+122	248+974
Peat Bogs	466	248+974	249+440
Tussock Grassland	98	249+440	249+538

Table 17.7. Habitat Summary – ELU 10

Habitat Type	Length (m)	KP Start	KP Finish
Scarcely Vegetated High Andean Area	1158	195+050	196+208
	181	196+425	196+606
	102	196+630	196+732
	526	197+065	197+591
	1055	198+669	199+724
	527	215+894	216+421
Total	**3,549**	**6.51%**	
Peat Bogs	24	196+606	196+630
	26	200+741	200+767
	14	201+450	201+464
	249	203+856	204+105
	54	209+882	209+936
	60	210+229	210+289
	265	238+468	238+733
	466	248+974	249+440
Total	**1,158**	**2.13%**	
Sward-forming grassland	217	196+208	196+425
	333	196+732	197+065
	96	197+591	197+687
	768	197+901	198+669
	1017	199+724	200+741
	683	200+767	201+450
	1330	201+464	202+794
	437	202+950	203+387
	250	203+606	203+856
	416	204+105	204+521
	420	204+749	205+169
	135	206+118	206+253
	393	206+379	206+772
	287	206+833	207+120
	515	207+393	207+908
	197	212+420	212+617
	168	212+734	212+902
	397	213+197	213+594
	547	213+694	214+241
	345	218+313	218+658
	1151	221+818	222+969
	381	224+105	224+486

	205	225+982	226+187
	375	227+789	228+164
	122	228+715	228+837
	226	230+282	230+508
	147	231+793	231+940
	69	232+060	232+129
	87	233+698	233+785
	142	234+088	234+230
	483	236+721	237+204
	92	237+571	237+663
	235	237+827	238+062
	770	239+157	239+927
	263	241+011	241+274
	2428	241+694	244+122
Total	**16,127**	**29.60%**	
Tussock grassland	214	197+687	197+901
	156	202+794	202+950
	219	203+387	203+606
	228	204+521	204+749
	949	205+169	206+118
	126	206+253	206+379
	61	206+772	206+833
	273	207+120	207+393
	1974	207+908	209+882
	293	209+936	210+229
	2131	210+289	212+420
	117	212+617	212+734
	295	212+902	213+197
	100	213+594	213+694
	1653	214+241	215+894
	1892	216+421	218+313
	3160	218+658	221+818
	1136	222+969	224+105
	1496	224+486	225+982
	1602	226+187	227+789
	551	228+164	228+715
	1445	228+837	230+282
	1285	230+508	231+793
	120	231+940	232+060
	1569	232+129	233+698
	303	233+785	234+088
	2491	234+230	236+721

	367	237+204	237+571
	164	237+663	237+827
	406	238+062	238+468
	424	238+733	239+157
	1084	239+927	241+011
	420	241+274	241+694
	4852	244+122	248+974
	60	249+440	249+500
Total	**33,616**	**61.69%**	
Mixed Scrub	38	249+500	249+538
Total	**38**	**0.07%**	
Total ELU 10:	**54,488**		

Source: ESIA, Environmental Baseline and EFS fieldwork.

17.3.2 HABITAT DESCRIPTIONS

Tussock Grassland

This is the most dominant habitat in ELU 10 forming 61.7% of the area crossed by the RoW. This habitat type is largely covered by grasses of the genera *Senecio* sp. Due to increasing aridity along the transect from east to west, the tussock grasslands in the Huaytará High Plains and Ridges ELU are much lower in stature and of lower density than those of more humid ELUs to the east.

Sward-forming grassland

This habitat type is notable because of its higher species richness than tussock grassland. Dominant species are *Aciachne* cf *acicularis*, and *Perezia coerulecens. Perezia coerulecens* is considered vulnerable for Peru but in this particular area is quite common, so populations will not be significantly damaged. All the habitat type is significantly damaged by camelids overgrazing.

Scarcely Vegetated High Andean Areas

Some 6.51% of the ROW in ELU 10 is more or less devoid of vegetative cover, with bare mineral soil and rock at the surface, with highly dispersed elements of other habitat types. These occur at the highest elevations of the ELU between KP 195 to KP 200 (at approximately 4600 m) and KP 215 to KP 216 (4500 m)

Peat Bogs

Peat Bogs are not particularly dominant in this ELU, only 2.13%, although at least 8 sections, typically of a 100 m or less are crossed. These peat bogs are dominated by

Distichia muscoides and *Plantago* sp. While they have been degraded by overgrazing, still provide water and grazing lands.

Fauna

Vicuñas (*Vicugna vicugna*) are common throughout the Huaytará High Plains and Ridges ELU.

The EFS Field Survey also reported also the Andean fox (*Lycalopex culpaeus*).

The pale-tailed canastero (*Asthenes dorbignyi huancavelicae*), considered as sensitive species was registered in this ELU. The Andean flicker (*Colaptes rupicola*) and the gray-breasted seedsnipe (*Thinocorus orbignyianus*), were also registered.

The ESIA reported for this ELU the presence of *Asthenes pudibunda*, Canyon canastero, and a bird fairly common in rocky montane scrubs, endemic to Peru. This bird was not registered by the EFS field team.

Three species of *Liolaemus* lizard were identified in this ELU. Two of them could represent a new species for science.

Hydrobiology

Table 17. presents waterdbodies sampled along ELU 10. No salient characteristics were described for this ELU.

Table 17.8. Waterbodies Sampled – ELU 10

Station	Habitat	Waterbody	Name	Height (m)	KP
Hi-07	Altoandino	Bofedal	Taccra	4304	241+000
Hi-08	Altoandino	Quebrada	Tacpampa	4031	224+000
Hi-09	Altoandino	Quebrada	Canya	4431	212+200
Hi-10	Altoandino	Laguna	Quinsacocha	4479	211+500
Hi-11	Altoandino	Río	Leche Leche	4344	209+500
Hi-12	Altoandino	Quebrada	NN (Tayarangra)	4373	201+000

17.3.3 SPECIES SENSITIVITY ANALYSIS

Vicuñas are considered a medium sensitivity species because of their economic importance, sensitivity to pipeline construction activities and legal protection (endangered species).

The bird species Asthenes dorbigny (*huancavelicae*) is also considered of medium sensitivity, classified as vulnerable and of only local distribution.

Lizards (*liolaemus sp. Ramirez* and *liolaemus cf. polystictus*) are also considered of medium sensitivity because of their limited local distribution and immobility.

Only one plant species is classified as medium sensitivity (*perezia coerulescens*) being designated of vulnerable protection status, immobility and regional distribution status.

No plants or animals species were identified of High Sensitivity.

Table 17.9 shows sensitivity of species observed during the EFS Field Survey, based on the species sensitivity criteria presented in Section 7.1 of the EFS.

Table 17.9. Species Sensitivity Criteria - ELU 10

No	Species	Protection Status						Spatial Distribution			Local Use			Mobility		Σ
		CR	EN	VU	NT	L	N	Local	Regional	Widespread	Permanent	Seasonal	None	Immobile	Mobile	
	Plants															
1	*Aciachne* cf. *acicularis*						0			0			0	3		3
	Distichia muscoides						0			0		1		3		4
2	*Perezia coerulescens*			4			0		2				0	3		9
	Plantago rigida						0		2				0	3		5
	Senecio sp.						0			0	2			3		5
	Reptiles						0									
3	*Liolaemus* sp. (Ramirez)						0	3					0	3		6
4	*Liolaemus* cf. *polystictus*						0	3					0	3		6
5	*Liolaemus* cf. *wiliamsi*						0		2				0	3		5
	Mammals						0									
6	*Lycalopex (Pseudalopex) culpaeus*						0		2				0		0	2
7	*Phyllotis xanthopygus posticalis*						0	3			2				0	5
8	*Vicugna vicugna*		5							0	2				0	7
	Birds						0									
9	*Anthus bogotensis*						0			0			0		0	0
10	*Asthenes dorbignyi (huancavelicae)*			4				3					0		0	7
	Attagis gayi						0			0			0		0	0
	Buteo polyosoma						0			0			0		0	0
16	*Chloephaga melanoptera*						0		2		2				0	4
17	*Colaptes rupicola*						0			0			0		0	0
18	*Geositta tenuirostris*						0		2				0		0	2
19	*Geranoaetus melanoleucus*						0			0			0		0	0
20	*Muscisaxicola albifrons*						0		2				0		0	2
21	*Muscisaxicola alpinus*						0		2				0		0	2
22	*Phalcoboenus megalopterus*						0			0			0		0	0
23	*Phrygilus plebejus*						0			0			0		0	0
24	*Phrygilus unicolor*						0			0			0		0	0
25	*Sicalis luteola*						0			0			0		0	0
26	*Sicalis uropygialis*						0			0			0		0	0

27	*Stelgidopteryx andecola*						0		2				0		0	2
28	*Thinocorus orbignyianus*						0			0	2				0	2
29	*Vanellus resplendens*						0		2				0		0	2

Protection Status*:

CR= Critically endangered 6 points
EN= Endangered 5 points
VU= Vulnerable 4 points
NT= Near threatened 3 points
B= Low (Others) 2 points
N= Not listed 0 points

Σ= Sensitivity value

1 - 5: Low
6 - 10: Medium
11 or higher: High

Species Distribution:
Local = (Endemic locally or to an EBA**) 3 points
Regional = (Regional endemic in Andes or Coast) 2 points
Widespread = (Across S. America or cosmopolitan) 0 points

Mobility:
Immobile = (restricted movement or in very short distance) 3 points
Mobile = 0 points

Local Uses:
Permanent= 2 points
Seasonal = 1 point
None = 0 points

***Protection Status:** According IUCN (2006) or National Legislation (D.S. No. 034-2004-AG/D.S. No. 043-2005-AG)
****EBA:** Areas determined by Birdlife International, which includes at least 2 bird species with less than 50,000 km2 of known distribution range.

17.3.4 HABITAT SENSITIVITY ANALYSIS

Based on the presence of medium sensitivity species presented in Table 17.9 the Scarcely Vegetated High Andean Areas, the Sward-forming Grassland and the Tussock Grassland habitats of the Huaytará High Plains and Ridges ELU are considered to be of Medium Sensitivity due to the presence of two, three and four Medium Sensitivity animal species respectively. None of the other habitats in this ELU meet the criteria for a high or medium sensitivity habitat as described in Section 7.2 of this EFS.

The ESIA identifies the Chaupi area (KP 202 to 205) as a Sensitive Sector because it is inhabited by numerous viscachas (part rabbit, part chinchilla).

17.4 KEY ISSUES AND RECOMMENDATIONS

ELU 10, Huaytará high plains and ridges, is a typical high Andean area, used extensively as grazing lands by camelids, particularly vicuñas. Overgrazing as a common practice is causing degradation of all habitat types.

The ROW crosses or passes by several waterbodies, including 3 rivers, 5 streams and several small peat bogs. Also, there are unstable areas classified as Moderately Unstable and Highly Unstable areas between KP 218 to 220. Therefore erosion prevention measures need to be implemented during construction phase. Areas of high instability should be considered for additional biorestoration techniques such as fertilizers application and hydroseeding during reinstatement.

Three threatened species were identified in this ELU, along with one medium sensitivity plant species and four medium sensitivity animal species.

This ELU is dominated by cespitose vegetation and relatively sparse tussock grasslands of low sensitivity, with impacts due to the presence of camelids. Management of camelids in the area during construction activities must be an issue considered in the ECOMP.

Soils

Some areas present some favorable conditions to restoration, as the stretch from KP 215+000 to KP 227+000. However, a medium erosion risk could exist between KP 215+000 and 227+000, caused by precipitation and gradient.

During the construction, erosion control devices as silt fences, slope breakers and wooden barriers must be implemented and permanent erosion controls installed during reinstatement.

Habitats and Species

The ESIA describes a sector where vicuñas should be protected at KP 226+000 to 232+000. Fencing and speed reduction should be applied in this area.

According to ESIA commitments, the Viscacha population at KP 202+000 to 205+000 must be protected as well although these were not observed at the time of the Field Survey.

Table 17.10. Key Issues - ELU 10

Issue	KP Reference	Action	Reference
Risk of mass wasting in high Unstable terrains	218+000 – 220+000	Soil erosion control focused on mass movement in slopes and conservation of topsoil during its relocation in ROW.	ECOMP
Peat bog near Chaupi	202+000 - 205+000	Relocation of wild vischacias prior to site clearing	ECOMP
Vicuñas	195+000 – 250+000	Fencing, participative management and other specific protection measures, such as worker training, signage, speed controls, waste management and fauna crossing points left in trench and pipe string.	ECOMP

		Consultation with local community farmers.	
Peat bog Habitat	241+000	Turf and topsoil strip and protection during construction.	ECOMP
		Restoration of topsoil and plants during abandonment.	RP
Lizards *(Liolaemus spp.)*	195+000 – 250+000	Pre-Clearance Survey to identify and relocate from ROW prior to site clearance activity.	ECOMP
Herb (*Perezia coerulescens*)	Sword forming grassland habitats	Collect seed where practicable to use for RoW reseeding during bioreinstatement.	RP
Viscacha	KP 202-205	Pre-Clearance Survey (above) and monitoring during topsoil strip/earthworks to facilitate relocation to safe areas if burrows are disturbed by machines.	ECOMP
Birds – Pale-tailed canastero *(Asthenes dorbignyi (Huancavelica)*	Bog habitats	Identify any nests during pre-clearance survey if site clearance during the nesting season. Noise monitoring. Schedule construction to minimize noise generation during breeding and nesting season	ECOMP/RP

		Reinstatement of original habitat after construction.	

Source: EFS Field Work.

18.0 ELU 11: PISCO-ICA WATERSHED DIVIDE (KP 249+538 TO 272+181)

18.1 General Description

To the west of the town of Huaytará, the ridges narrow and lower towards the coast, and the dominant vegetation changes abruptly from grasslands to mixed and thorny scrublands.

The climate is dry and cold, and covers elevations between 2,850 and 4,000 m. Maximum precipitation ranges from 300 to 500 mm per year, depending on altitude. This ELU is comprises the lands of the Rural Communities of Huaytará, Ayavi and Huancacasa.

This ELU has three habitat types. The largest one is the Mixed Scrub which represents almost 79% of the ELU total length, the Thorny Scrub covers approximately 21% of the ELU and Desert Scrub which is less than 1% of the total length. Table 18.8 shows the habitat types that comprise this ELU.

18.2 Physical Characteristics

18.2.1 Precipitation

Precipitation is seasonal, with a general wet season from September to April with most of the precipitation falling between January and March, and a dry season from May to August.

Table 18.1 shows estimated precipitation ranges for the peak and general wet seasons based on the isohyets developed by the ESIA. No precipitation data are available for the dry season.

Table 18.1. Estimated Peak and General Wet Season Precipitation Ranges - ELU 11

Estimated Precipitation (mm)			
Peak (January – March)		**General (September – April)**	
KP Range	**Precipitation (mm)**	**KP Range**	**Precipitation (mm)**
249+538 - 272+181	200-300	249+538 – 257+000	400-500
		257+000 - 272+181	300-400

Source: ESIA, Environmental Baseline

18.2.2 GEOLOGY

This principal geological formation of the Pisco-Ica Watershed Divide ELU is composed of limestones and calcareous sandstones partially interspersed with lutite. The coastal batholith is a gigantic intrusion, with outcrops in the westernmost Andes starting in the western part of ELU 10 and extending to the eastern part of ELU 13. It comprises a set of intrusive formations that include tonalite, granites, monzonite, granodiorites, diorites, monzodiorites, monzogabros, and grabbros. These intrusions form a chain of steep hills, generally without thick covering of residue except at the toe of the slopes where there are thick colluvial deposits. Theses rocks are typically extremely hard below the superficial depth of weathering. They present a moderate to high level of fracturing and moderate to intense weathering at the ground surface.

The metallic mineralization present in certain areas of these rocks implies a risk of acid rock drainage (ARD), which could become temporarily accelerated in association with ground disturbance caused by pipeline installation earthworks activities.

Table 18.2 lists the sectors with potential risk of acid rock drainage (ARD) occurrence along the ROW.

Table 18.2. Sectors of Medium to High ARD Risk – ELU 11

Risk Level	Length (m)	
Medium	KP 255+000 to KP 265+000	10,000

Source: EFS Fieldwork

18.2.3 SOILS

Surface Horizon Characteristics

The EFS collected three surface horizon samples in ELU 11. The samples pH was either alkaline (2 samples) or strongly acidic (1 sample). The alkaline sample from KP 256+000 had high level of $CaCO_3$ (27.1%). According to EFS samples, surface horizon is of medium depth along the whole ELU. Organic matter content along the ROW is variable with one sample high and two medium. Fertility of the surface horizon, based on levels of available phosphorus, was mostly medium (two samples) or low (one sample). Surface horizon sample characteristics are presented in Table 18.3.

Table 18.3. Surface Horizon Characteristics - ELU 11

KP	pH	Surface horizon depth	Organic matter	Fertility	Slope (%)
251+000	Strongly acid	Medium	High	Low	70%
256+000	Lightly alkaline	Medium	Medium	Medium	80%
260+000	Lightly alkaline	Medium	Medium	Medium	80%

Source: ESIA Physical Baseline and Domus.
pH: Strongly acidic = Less than 5.5; Moderately acidic = 5.6 to 6.0; Slightly acidic = 6.1 – 6.5; Neutral = 6.6 - 7.0; Slightly alkaline = 7.1 – 7.8; Moderately alkaline = 7.9 to 8.4; Strongly alkaline = More than or equal to 8.5.
Surface horizon depth: Shallow = Less than 5 cm; Medium = 5 cm to 15 cm; Deep = More than 15 cm.
Organic matter: Low = Less than 2%; Medium = 2% to 4%; High = More than 4%.
Fertility based on Available Phosphorus: Low = Less than 7.0 ppm; Medium = 7.0 to 14.0 ppm; High = More than 14.0 ppm.

Subsoil Characteristics

The subsoil texture fluctuates from loamy sand to loam and does not hinder the infiltration of water. However, both the surface horizon and subsoil are very loose and the stability of the soil aggregates is low. Organic matter and nutrients are low in the subsoil.

Overall, the soils are typical of a vegetated mountain environment of moderately high elevation with acidic, organic soils of low fertility and a distinctive surface horizon.

18.2.4 WATERBODIES

ELU 11 is a very dry region with only intermittent streams typically flowing only during flash floods or parts of the rainy season. Also, the ROW has limited stream crossings due as well to its location being almost entirely along ridge tops.

According to the EFS data base, ELU 11 crosses only three streams referred to in Table 18.4.

Table 18.4. Principal Waterbody Crossings - ELU 11

Waterbody Type or Name	KP Mid-channel	Elevation (m)
Arroyos		
ARROYO	255+870.53	3678.31
ARROYO	256+353.70	3698.56
ARROYO	257+789.0	3443.43
Quebradas		
QUEBRADA	257+472.0	3464.93
QUEBRADA	259+170.67	3321.15
QUEBRADA	259+480.20	3348.59
QUEBRADA	261+210.52	3576.25

QUEBRADA	261+931.13	3502.35
QUEBRADA	261+952.75	3504.52
QUEBRADA	262+290.78	3521.04
QUEBRADA	262+307.84	3519.46
QUEBRADA	263+327.44	3433.30
QUEBRADA	263+444.70	3453.74
QUEBRADA	265+395.72	3029.38
QUEBRADA	266+206.91	2931.62
QUEBRADA	266+561.42	2907.50
QUEBRADA	267+638.25	2848.52
QUEBRADA	268+111.63	2879.79
QUEBRADA	268+268.31	2873.82
QUEBRADA	268+557.52	2861.06
QUEBRADA	268+995.32	2833.06
QUEBRADA	269+069.15	2808.32
QUEBRADA	269+778.35	2838.01
QUEBRADA	269+970.01	2803.82
QUEBRADA	270+125.36	2805.20

Source: Peru LNG Pipeline Project Alignment Sheets (Gulf Interstate Engineering, 2006).

18.2.5 INSTABILITY AND PHYSICAL RISK

The level of instability and physical risk in ELU 9 is categorized as Low in approximately 19% of the ROW length, and as Medium and High in the remaining 65% and 16% of the ROW, respectively (Table 18.5).

Table 18.5. Instability and Physical Risk - ELU 11

Risk Level	KP Start	KP Finish	Length (m)	
Low	249+538	249+643	105	4,260
	252+399	253+542	1143	
	256+731	259+743	3012	
Medium	249+643	252+399	2756	15,170
	253+542	255+000	1458	
	255+162	256+222	1060	
	260+163	263+524	3361	
	265+646	272+181	6535	
High	255+000	255+162	162	3,683
	256+222	256+731	509	
	259+743	260+163	420	
	263+524	265+646	2122	

Source: ESIA Physical Baseline Map 1.1-4 and Domus.

18.2.6 INFRASTRUCTURE

Infrastructure requirements such as camps and access roads are based on assumptions set out in the ESIA Project Description and are subject to change, depending on the requirements outlined in the Contractor's Plan of Work.
Six shooflies are proposed to facilitate the construction phase. A Base Camp is proposed near KP 266+369, Huancaccasa. This camp may include a pipe yard.

Table 18.6. Planned Project Infrastructures – ELU 11

Type of Infrastructure	KP	Name
Camps and Pipeyards	266+369	Huancaccasa
Shooflies	252+308	Km. 452 to KM 462
	259+140	VVR1 to VVR3
	263+828	VVR8 to VVR20
	268+506	VVR29 to VVR37
	270+847	VVR38 to VVR38A
	271+796	VVR39 to VVR40

Source: ESIA Project Description.

18.3 HABITATS AND SPECIES

18.3.1 HABITAT DISTRIBUTION

The habitats of ELU 11 are listed in sequential order in Table 18.7, including the length of each habitat unit and associated start and finish ROW KPs. Table 18.8 presents habitat lengths over the ROW sorted by habitat type, with subtotals for each habitat.

Table 18. 7. Habitat Sequence – ELU 11

Habitat Type	Length (m)	KP Start	KP Finish
Mixed Scrub	3,847	249+538	253+385
Thorny Scrub	916	253+385	254+301
Mixed Scrub	5,637	254+301	259+938
Thorny Scrub	3,674	259+938	263+612
Mixed Scrub	8,388	263+612	272+000
Desert Scrub	181	272+000	272+181

Table 18.8. Habitat Summary – ELU 11

Habitat Type	Length (m)	KP Start	KP Finish
Thorny scrub	916	253+385	254+301
	3,674	259+938	263+612
Total	**4,590**	**20.27%**	
Mixed scrub (Mixed Underbrush - MM)	3,847	249+538	253+385
	5,637	254+301	259+938
	8,388	263+612	272+000
Total	**17,872**	**78.93%**	
Desert Scrub	181	272+000	272+181
Total	**181**	**0.80%**	
Total ELU 11:	**22,643**		

Source: ESIA Biological Baseline Map 2-1 and Domus.

18.3.2 HABITAT DESCRIPTIONS

Thorny scrub

In the Pisco-Ica Watershed Divide ELU, thorny scrub occupies 20.27% of the ROW length and tends to be located on medium to steep slopes and rocky substrates, where the combination of weakly developed soils, seasonal rainfall and steep slopes result in extensive erosion. In areas with more gradual slopes, more dense vegetation develops approaching heights of approximately 1.3 m. and *Berberis* spp. and *Dunalia* sp. are common shrubs in this habitat type.

Mixed Scrub

Mixed scrub habitats accounts for 78.93% of the ELU 11 ROW length and consists of poorly vegetated slopes with patches dominated by species of the genera *Lupinus,* and *Junellia*. The most important species observed in the mixed scrub of ELU 11 is *Chersodoma arequipensis* listed as critically endangered by the INRENA.

Desert Scrubs

This habitat accounts for less than 1% of the RoW from the final 200m of the western edge of the ELU. The cactus *Senocio tovari,* was observed in this habitat.

Key Fauna

A pampas cat (*Leopardus pajeros*) was registered in this ELU (KP 253+000). Other mammals registered were the rodents *Phyllotis* cf. *xanthopygus* and *Calomys* sp. Locals mentioned the presence of the pallid fat-tailed opossum (*Thylamys pallidior*), Andean fox (*Lycalopex culpaeus*), long-tailed weasel (*Mustela frenata*), Molina´s hog-nosed skunk (*Conepatus chinga*) and northern viscacha (*Lagidium peruanum*).

Birds registered in this ELU were the aplomado falcon (*Falco femoralis*), red-back hawk (Buteo polyosoma), Andean flicker (*Colaptes rupicola*), among others. The ESIA reported an observation of the rufous-breasted warbling-finch (*Poospiza rubecula*), a species listed as endangered by both the IUCN and the INRENA, from a location in Mixed Scrub about 1,300 m downslope of the ROW near KP 249+000.

The EFS Field Survey collected lizards in mixed scrub at elevations between 3760 and 3900 m, that may be an undescribed montane form related to *Microlophus tigris* (INRENA-NT) or a unique high elevation population of this species. The lizard *Microlophus tigris* (INRENA-NT) and *Liolaemus spp*. were common among the rocks.

Hydrobiology

No hydrobiologic analsis was performed in this ELU.

18.3.3 SPECIES SENSITIVITY ANALYSIS

Table 18.9 shows the high and medium sensitivity species observed during the EFS Field Survey, based on the species sensitivity criteria presented in Section 7.1 of the EFS.

One high sensitivity plant species (*Chersodoma arequipensis*) was observed in the ELU which is of critically endangered protection status, of localized spatial distribution and used locally.

There is one other plant species of Medium Sensitivity (*Senecio tovari*) which is not classified as threatened but is only of local distribution.

Two reptile species (*lioaemus sp*) and *microlophus affitigiris* are also of Medium Sensitivity.

18.3.4 SPECIES SENSITIVITY ANALYSIS

Table 18.9. Species Sensitivity Criteria - ELU 11

No	Species	Protection Status						Spatial Distribution			Local Use			Mobility		Σ
		CR	EN	VU	NT	L	N	Local	Regional	Widespread	Permanent	Seasonal	None	Immobile	Mobile	
	Plants															
1	*Chersodoma arequipensis*	6						3			2			3		14
2	*Croton ruizianus*						0		2	0			0	3		5
3	*Dunalia spinosa*						0		2				0	3		5
4	*Erodium cicutarium*						0			0			0	3		3
5	*Junellia juniperina*						0		2	0			0	3		5
6	*Senecio tovari*						0	3			2		0	3		8
7	*Solanum* sp.						0			0			0	3		3
8	*Stenomesson incarnatum*						0		2				0	3		5
	Reptiles and amphibians															
9	*Liolaemus* sp.						0	3					0	3		6
10	*Microlophus* aff. *tigris*				3				2				0	3		8
	Mammals															
11	*Conepatus chinga*						0			0			0		0	0
12	*Lagidium peruanum*						0	3			2				0	5
13	*Leopardus (Oreailurus) pajeros* (L. *colocolo garieppi)*						0		2				0		0	2
14	*Lycalopex (Pseudalopex) culpaeus*						0		2				0		0	2
15	*Mustela frenata*						0			0			0		0	0
16	*Phyllotis amicus*						0			0			0		0	0
17	*Phyllotis magister*						0			0			0		0	0
18	*Phyllotis xanthopygus posticalis*						0	3		0	2		0		0	5
19	*Thylamys pallidior*						0			0	2				0	2
	Birds															
20	*Buteo polyosoma*						0			0			0		0	0
21	*Colaptes atricollis*						0		2				0		0	2
22	*Colaptes rupicola*						0			0			0		0	0
23	*Falco femoralis*						0			0			0		0	0
24	*Geranoaetus melanoleucus*						0			0			0		0	0
25	*Nothoprocta ornata*						0		2				0		0	2

26	*Phalcoboenus megalopterus*						0			0			0		0	0
27	*Thinocorus orbignyianus*						0			0	2				0	2
28	*Vanellus resplendens*						0		2				0		0	2

Protection Status*:

CR= Critically endangered 6 points
EN= Endangered 5 points
VU= Vulnerable 4 points
NT= Near threatened 3 points
B= Low (Others) 2 points
N= Not listed 0 points

Σ= Sensitivity value

1 - 5: Low
6 - 10: Medium
11 or higher: High

Species Distribution:
Local = (Endemic locally or to an EBA**) 3 points
Regional = (Regional endemic in Andes or Coast) 2 points
Widespread = (Across S. America or cosmopolitan) 0 points

Mobility:
Immobile = (restricted movement or in very short distance) 3 points
Mobile = 0 points

Local Uses:
Permanent= 2 points
Seasonal = 1 point
None = 0 points

***Protection Status:** According IUCN (2006) or National Legislation (D.S. No. 034-2004-AG/D.S. No. 043-2005-AG)
****EBA:** Areas determined by Birdlife International, which includes at least 2 bird species with less than 50,000 km2 of known distribution range.

18.3.5 HABITAT SENSITIVITY ANALYSIS

Rufous-breasted warbling-finch (*Poospiza rubecula*) and pale-tailed canastero (*Asthenes huancavelicae*) were reported by ESIA in Huaytará area, between KP 245+000 to 250+000, proposed by ESIA sensitivity analysis as a sensitive sector. However none were observed during the EFS survey.

Based on the information presented in Table 18.10, the Mixed Scrub and the Thorny Scrub habitats of the Pisco Ica Watershed Divide habitats of ELU 11 are considered to be of High Sensitivity due to the presence of one High Sensitivity plant species (C*hersodoma arequipensis*) in each.

The potential occurrence of populatons of the endangered rufous-breasted warbling finch would also raise the Mixed Scrub to the High Sensitivity category.

18.4 KEY ISSUES AND RECOMMENDATIONS

Soils

Precipitation in this ELU is not high, but steep slopes combined with rain during the wet season can cause erosion. The Highly Unstable area (KP 255+000 to KP 265+000) needs special measures to avoid erosive processes. Biorestoration techniques including hydroseeding should be considered for this stretch.

This ELU presents some characteristics that are favorable to revegetation. During the construction, erosion control devices as silt fences, slope breakers and wooden barriers must be implemented.

Instability and Physical Risk

A Highly Unstable area was registered in 264+900 - 267+000. It is considered that stretches with Slightly Unstable areas will not require special Biorestoration works, but Moderately Unstable ones need some measures that are described in the Key Issues section (Table 18.10).

Habitats and Species

Chersodoma arequipensis is listed as a critically-endangered species by the INRENA and should thus receive special attention. *Senecio tovari* is a local endemic species sensitive to habitat loss. Collection of seeds of both species should be arranged for later propagation prior to RoW clearance to be used to revegetate the habitats as close as reasonably possible to the original conditions during reinstatement.

Where lizards (*Liolaemus sp* and *Microlophus*) are identified in the RoW during the pre-clerance survey, especially in the mixed scrub habitats abive 3400 m, these should be relocated to safe areas prior to site clearing and grading construction activities commence.

Sightings of the Rufous-breasted warbling finch (*Poospiza rubecula*) were reported from slopes below the ridge to the north of the ROW in the ESIA but not observed at the time of the EFS. The construction schedule for RoW site clearance should be designed to minimse the impact on this species' breeding and nesting season and pre-construction survey should identifiy the presence of any active nests.

Table 18.10 summarizes the key issues and recommendations for the Pisco-Ica Watershed Divide ELU.

Table 18.10. Key Issues and Recommendations - ELU 11

Issue	KP Reference	Action	Reference
Risk of mass wasting in Highly Unstable terrains	264+900 - 267+000	Geotectonic and hydro-geologic studies on-going to inform final permanent design.	ECOMP/RP
		Soil erosion control focused on mass movement in slopes and protection of topsoil for use during reinstatement. Extra biorestoration techniques (hydroseeding, mulching, fertilizer) considered in highest risk areas.	
Chersodoma arequipensis and *senocio tovari*	253+385 – 254+301 259+938 – 263+612 (Mixed Scrub, Thorny Scrub)	Collection and storeage of *Chersodoma arequipensis* seeds prior to site clearance for production of plants for ROW bioreinstatement.	ECOMP/RP
Lizards *(Liolaemus and Microlophus)*	All areas	Pre-Clearance Survey to identify and relocate from ROW pror to site clearance activities.	ECOMP
Rufous-breasted warbling finch (Endangered bird)	249+000 – 260+000	Design of construction schedule to minimize impacts of site clearance during bird nesting season	ECOMP/RP

Source: EFS Fieldwork

19.0 ELU 12: COASTAL BAT HILLS (KP 272+181 TO 308+000)

19.1 General Description

This high coastal desert foothills landscape is dominated by drought-adapted scrub and scattered cacti in dry hills and valleys at elevations from 750 to 3,100 m.

This ELU is arid with very scarce rains ranging from less than 50 mm each wet season in the west to over 200 mm in the higher elevations to the east. The topography is very variable, with mountains and dry river beds, which occasionaly can transport water and large boulders in the form of flash floods.

This arid and rocky landscape is home to threatened species such as long-snouted bats (*Platalina genovensium*) and the lizard *Microlophus tigris*. This unit corresponds to the Seco river basin and is named after the presence of the *Platalina* bats as well as the Quebrada Murciélagos ("Bat Stream").

19.2 Physical Characteristics

19.2.1 Precipitation

Precipitation is seasonal, with a general wet season from September to April with most of the precipitation falling between January and March, and a dry season from May to August.

Precipitation is markedly less at the westernmost end of the ELU at the foot of the Andes Mountains and the edge of the coastal plain at elevations between 750 to 1.000 m.

Table 19.1 shows estimated precipitation ranges for the peak and general wet seasons based on the isohyets developed by the ESIA. No precipitation data are available for the dry season.

Table 19.1. Estimated Peak and General Wet Season Precipitation Ranges - ELU 12

Estimated Precipitation			
Peak (January – March)		General (September-April)	
KP Range	Precipitation (mm)	KP Range	Precipitation (mm)
272+181 – 282+000	200-300	272+181 – 279+000	300-400
282+000 - 288+000	100-200	279+000 - 286+000	200-300
288+000 - 302+000	50-100	286+000 - 297+000	100-200
302+000 - 308+000	0 - 5	297+000 - 304+000	50-100
		304+000 - 308+000	10 - 50

Source: ESIA Physical Baseline Maps 1.2-1 and 1.2-2.

19.2.2 GEOLOGY

The geology of the Coastal Bat Hills ELU is dominated by intrusive formations, with gabbro, diorities, tonalites, and granodiorites, resulting in a steep, rocky landscape between KPs 272+181 and 299+000. These are intrusive formations interrupted by the volcanic Copará formation between KPs 277+700 and 284+300, which is the highest elevation sector of the ELU. From KP 299+000 westward, the ROW follows the valley floor margin of the Seco River through Pleistocene and Holocene alluvial deposits.

The metallic mineralization present in certain areas of these rocks implies a risk of acid rock drainage in the event of an extraordinary rainy event, which could become temporarily accelerated in association with pipeline installation earthworks activities.

Table 19.2 lists the sectors with potential risk of acid rock drainage (ARD) occurrence along the ROW.

Table 19.2. Sectors of ARD Risk – ELU 12

Level of Risk	Length (m)	
Medium	KP 285+000 to KP 300+000	15,000

Source: ESIA Physical Baseline Appendix 3.3.4.

Due to the low rainfall values and the absence of perennial waterbodies or wetlands in this desert ELU, the risk associated with potential ARD materials in this ELU is minimal.

19.2.3 SOILS

One surface horizon sample was taken in ELU 12 (Table 19.3). Soil pH was moderately alkaline, but without evidence of salinization. Organic matter and fertility based on available phosphorus were low. The surface horizon has a high depth along all the ELU, despite the variable slope in the ROW. The surface horizon and subsoil textures are sandy and the soil is very well drained.

Table 19.3. Surface Horizon Characteristics - ELU 12

KP	pH	Surface horizon depth	Organic matter	Fertility	Slope (%)
290+000	Moderately alkaline	High	low	low	30%

Source: ESIA Physical Baseline and Domus.
pH: Strongly acidic = Less than 5.5; Moderately acidic = 5.6 to 6.0; Slightly acidic = 6.1 – 6.5; Neutral = 6.6 - 7.0; Slightly alkaline = 7.1 – 7.8; Moderately alkaline = 7.9 to 8.4; Strongly alkaline = More than or equal to 8.5.
Surface horizon depth: Shallow = Less than 5 cm; Medium = 5 cm to 15 cm; Deep = More than 15 cm.
Organic matter: Low = Less than 2%; Medium = 2% to 4%; High = More than 4%.
Fertility based on Available Phosphorus: Low = Less than 7.0 ppm; Medium = 7.0 to 14.0 ppm; High = More than 14.0 ppm.

19.2.4 WATERBODIES AND WETLANDS

The Coastal Bat Hills are highly dissected and the ROW crosses various channels that have only ephemeral or intermittent flows. Nevertheless, the ROW runs parallel to some quebradas between approximately KP 299+000 to 308+000. Table 19.4 details waterbody crossings for this ELU.

Table 19.4. Principal Waterbody Crossings - ELU 12

Waterbody Type or Name	KP Mid-channel	Elevation (m)
Quebradas		
QUEBRADA	274+144.39	2897.86
QUEBRADA	274+818.40	2905.72
QUEBRADA	275+001.16	2891.35
QUEBRADA	276+046.52	2768.90
QUEBRADA	277+055.21	2854.79
QUEBRADA	277+407.77	2851.91
QUEBRADA	277+485.01	2844.74
QUEBRADA	277+585.10	2843.88
QUEBRADA	277+790.04	2828.27
QUEBRADA	277+839.27	2824.35
QUEBRADA	277+948.08	2820.98
QUEBRADA	277+987.86	2822.16
QUEBRADA	278+297.31	2844.46
QDA. SAN JUAN	288+019.73	1803.69
QUEBRADA	288+108.01	1811.05
QUEBRADA	288+192.82	1831.48
QUEBRADA	299+464.46	1088.14
QUEBRADA	299+651.25	1081.98
QUEBRADA	299+974.68	1076.10
QUEBRADA	300+010.90	1078.30
QUEBRADA	300+022.54	1077.98
QUEBRADA	300+048.90	1078.55
QUEBRADA	300+062.14	1076.41
QUEBRADA	300+222.01	1062.36
QUEBRADA	300+377.53	1045.59

QUEBRADA	300+560.63	1036.73
QUEBRADA	301+580.95	997.98
QUEBRADA	302+080.34	965.74
QUEBRADA	302+177.93	961.42
QUEBRADA	302+437.05	962.24
QUEBRADA	302+521.15	960.85
QUEBRADA	302+588.47	961.03
QUEBRADA	302+996.79	930.33
QUEBRADA	303+292.84	914.66
QUEBRADA	304+237.93	874.70
QUEBRADA	307+334.02	745.48
QUEBRADA	307+420.16	742.29
QUEBRADA	307+922.88	728.94

Source: Peru LNG Pipeline Project Alignment Sheets (Gulf Interstate Engineering, 2006).

19.2.5 INSTABILITY AND PHYSICAL RISK

Precipitation levels in the ELU are not enough to promote significant erosion processes, except in unusual years or occasional storms.

Table 19.5. Instabilty and Physical Risk - ELU 12

Risk Level	KP Start	KP Finish	Length (m)	
Low	274+387	278+578	4191	6,564
	293+241	294+895	1654	
	303+574	304+123	549	
	304+776	304+946	170	
Medium	272+181	274+387	2206	17,365
	278+578	280+150	1572	
	280+394	286+273	5879	
	288+467	293+241	4774	
	297+865	298+854	989	
	298+908	299+149	241	
	299+655	300+620	965	
	301+426	302+165	739	

High	280+150	280+394	244	11,890
	286+273	288+467	2194	
	294+895	297+865	2970	
	298+854	298+908	54	
	299+149	299+655	506	
	300+620	301+426	806	
	302+165	303+574	1409	
	304+123	304+776	653	
	304+946	308+000	3054	

Source: ESIA, Environmental Baseline

19.2.6 INFRASTRUCTURE

Four shooflies are proposed at this ELU and listed in Table 19.6

Table 19.6. Planned Project Infrastructures – ELU 12

Type of Infrastructure	KP	Name
Shooflies	276+297	VVR56 to VVR58
	278+217	VVR60 to VVR37-38
	278+831	VVR60 to VVR61
	289+088	San Juan Stream right margin

Source: ESIA Project Description.

19.3 HABITATS AND SPECIES

19.3.1 HABITAT DISTRIBUTION

ELU 12 has only two habitat types as detailed in Table 19.7. Within the Project area, both of these habitats are found only in the Coastal Bat Hills ELU.

Table 19.7. Habitat Sequence – ELU 12

Habitat Type	Length (m)	Percentage of Length	KP Start	KP Finish
Desert Scrub	15,743	43.95%	272+181	287+924
Columnar Cacti and Scrub	20,076	56.05%	287+924	308+000

Source: ESIA Biological Baseline Map 2-1 and Domus.

19.3.2 HABITAT DESCRIPTION

Desert Scrub

Desert scrub is present in the eastern sector part of the ELU between KPs 272 and 288, largely in zones with rainfall exceeding 200 m. This habitat type is dominated by saltbush (*Atriplex peruviana*). Columnar cacti such as *Browningia candelaris* (INRENA vulnerable) and *Cleistocactus* sp. appear sporadically. Other important species in this habitat type are the shrub *Bulnesia retama* and the locally endemic cacti *Armatocereus procerus* and *Cleistocactus acanthurus* (INRENA endangered).

Columnar Cacti and Scrub

This formation is characterized by the prevalence of taller tree-like or "organ-pipe" cacti, usually over a meter in height, which are species of the genera *Armatocereus*.

At the bottom of the Seco River, near the Bolivar mine, there is a patch of columnar cacti with deciduous shrubs that stands out due to the presence of species of conservation interest such as the locally endemic cacti *Armatocereus procerus, Neoraimondia arequipensis* and *Cleistocactus acanthurus* (INRENA endangered), and the locally-endemic drought-deciduous tree *Orthopterygium huaucui*.

Another notable plant observed by the EFS Survey within the columnar cacti and scrub habitat was the INRENA near-threatened *Ephedra americana*.

Key Fauna

Although not observed during the EFS Field Survey, the ESIA field studies documented the presence of the long-snouted bat (*Platalina genovensium*) at the Bolívar Mine (located approximately 800 from the ROW near KP 299+000), a species that feeds on the nectar of night-blooming cacti and which as categorized as vulnerable by the IUCN and as critically endangered by the INRENA. This species is included in the ESIA commitments.

Other representative mammals registered in the ELU were Andean fox (*Lycalopex culpaeus*), Argentine gray fox (*Lycalopex* cf. *griseus*), Molina´s hog-nosed skunk (*Conepatus chinga*), mice of the genus *Phyllotis*, and montane guinea pig (*Cavia tschudii*).

Birds registered in the area were the streaked tit-spinetail (*Leptasthenura striata,* thick-billed miner (*Geositta crassirostris*), coastal miner (*Geositta peruviana*), and the cactus canastero (*Asthenes cactorum*).

The INRENA near-threatened lizard *Microlophus tigris* is a typical element of the rock-strewn habitats which was observed by the EFS Field Survey. The gecko lizard, *Phyllodactylus lepidopygus*, was also observed in this ELU.

Hydrobiology

No hydrobiologic analysis was performed in this ELU.

19.3.3 Species Sensitivity Analysis

Table 19.8 shows the high and medium sensitivity species observed during the EFS Field Survey, as well as those documented by the ESIA, based on the species sensitivity criteria presented in Section 7.1 of the EFS.

One High Sensitivity plant species observed was *Cleistocactus acanthurus*, which is listed as Endangered, is only of local distribution and has a local use for the community.

There are six Medium Sensitivity plant species with protection status and only local or regional distribution.

Two Medium Sensitivity reptile species were also observed, *Microlophus tigris* and *Phyllodactylus lepidopygus.*

Table 19.8. Species Sensitivity Criteria - ELU 12

No	Species	Protection Status						Spatial Distribution			Local Use			Mobility		Σ
		CR	EN	VU	NT	L	N	Local	Regional	Widespread	Permanent	Seasonal	None	Immobile	Mobile	
	Plants															
1	*Alternanthera halimifolia*						0			0			0	3		3
2	*Armartocereus procerus*						0		2	0			0	3		5
3	*Atriplex peruviana*						0		2				0	3		5
4	*Boerhavia coccinea*						0			0	2			3		5
5	*Browningia candelaris*			4					2					3		9
6	*Bulnesia retama*						0		2	0			0	3		5
7	*Cleistocactus acanthurus*		5					3			2			3		13
8	*Cnidoscolus basiacanthus*			4					2				0	3		9
9	*Ephedra americana*				3				2				0	3		8
10	*Loasa incana*						0	3					0	3		6
11	*Neoraimondia arequipensis*						0	3					0	3		6
12	*Orthopterygium huaucui*						0	3					0	3		6
13	*Tiquilia paronychioides*						0		2				0	3		5
	Reptiles and amphibians															
14	*Microlophus tigris*				3				2				0	3		8
15	*Phyllodactylus lepidopygus*						0	3					0	3		6
	Mammals															
16	*Cavia tschudii*						0			0			0		0	0
17	*Conepatus chinga*						0			0			0		0	0
18	*Didelphis pernigra*						0			0			0		0	0
19	*Histiotus* sp.						0		2				0		0	2
20	*Lycalopex (Pseudalopex) culpaeus*								2				0		0	2
21	*Lycalopex (Pseudalopex) griseus*						0		2				0		0	2
22	*Mus musculus*						0			0			0		0	0
23	*Phyllotis amicus*						0			0			0		0	0
24	*Phyllotis limatus*						0		2				0		0	2
25	*Thylamys pallidior*						0			0	2				0	2
	Birds															
26	*Asthenes cactorum*						0	3					0		0	3
27	*Athene cunicularia*						0		2				0		0	2

28	*Chordeiles acutipennis*						0			0			0		0	0
29	*Columbina cruziana*						0		2				0		0	2
30	*Falco sparverius*						0			0			0		0	0
31	*Gallinula chloropus*						0			0			0		0	0
32	*Geositta crassirostris*						0		2				0		0	2
33	*Geositta peruviana*						0		2				0		0	2
34	*Leptasthenura striata*						0		2				0		0	2
35	*Myrtis fanny*						0		2				0		0	2
36	*Muscisaxicola maclovianus*						0			0			0		0	0
37	*Passer domesticus*						0			0			0		0	0
38	*Rhodopis vesper*						0		2		2				0	4

Protection Status*:
CR= Critically endangered 6 points
EN= Endangered 5 points
VU= Vulnerable 4 points
NT= Near threatened 3 points
B= Low (Others) 2 points
N= Not listed 0 points

Σ= Sensitivity value

1 - 5: Low
6 - 10: Medium
11 or higher: High

Species Distribution:
Local = (Endemic locally or to an EBA**) 3 points
Regional = (Regional endemic in Andes or Coast) 2 points
Widespread = (Across S. America or cosmopolitan) 0 points

Mobility:
Immobile = (restricted movement or in very short distance) 3 points
Mobile = 0 points

Local Uses:
Permanent= 2 points
Seasonal = 1 point
None = 0 points

***Protection Status:** According IUCN (2006) or National Legislation (D.S. No. 034-2004-AG/D.S. No. 043-2005-AG)
****EBA:** Areas determined by Birdlife International, which includes at least 2 bird species with less than 50,000 km2 of known distribution range.

19.3.4 HABITAT SENSITIVITY ANALYSIS

Based on the information presented in Table 19.8, the Desert Scrub and the Columnar Cacti and Scrub habitat of the Coastal Bat Hills ELU meets the criteria for a High Sensitivity habitat due to the presence of one High Sensitivity plant species in each, and seven Medium Sensitivity plant species in the Columnar Cacti and Scrub habitat.

19.4 KEY ISSUES AND RECOMMENDATIONS

Physical Environment

Due to the arid climate and rare rain events, there is little risk of significant ARD, erosion, sedimentation, or instability issues.

Habitat and Species

The Columnar Cacti with Scrub habitat contains six Medium Sensitivity and one High Sensitivity plant species and two Medium Sensitivity lizard species presented by Table 19.8. All of these species could be properly managed with avaliable techniques for plant translocation or replacement or fauna capture and relocation process.

The most practicable proposal is to replace the cacti and reestablish the shrubs by seed.

The long-snouted bat (*Platalina genovensium*) is a critically endangered species under Peruvian legislation. This bat depends upon the presence of reproductively mature (i.e., flowering) columnar cacti for its food source; thus, conservation efforts for this bat should focus on the protection of cactus habitat by replacement of lost plants cleared from the ROW.

A Pre-Clearance Survey should be undertaken immediately prior to construction clearing, grading and topsoil strip activities to identify any sensitive lizards (*Microplophus tigris* and *Phyllodactylus lepidopygus*), which are especially likely to be found in rocky areas of the Columnar Cacti habitat. The lizards should be moved to a safe area of same or similar habitat at a reasonable distance outside the zone of impact by construction activities.

Table 19.9. Key Issues and Recommendations - ELU 12

Issue	KP Reference	Recommendations	Reference
High and Medium Sensitivity Cacti *(Cleistocactus acanthurus, browningia candelaris, neoralmondia arequipensis)*	Cactus Habitat	Replace lost cacti by propagation from cutting.	ECOMP
Medium Sensitivity Shrubs and Sub-Shrubs (*Cnidoscolus basiacanthus* and *Ephedra Americana, loasa incana and orthopterygium huaucui*)	295+000 300+200 305+000	Use of native seeds from these species during construction.	ECOMP
Lizards (*Microlophus tigris and Phyllodactylus lepidoygus*)	ELU Wide	Pre-Clearance Survey to identify and relocate lizards from ROW prior to site clearing activities.	ECOMP

Source: Domus.

20.0 ELU 13: PISCO SAND PLAINS (KP 308+000 TO 332+940)

20.1 General Description

This ELU consists of sandy plains areas within the Pisco Sand Plains on the western edge of the Andes. Altitude ranges from 256m on the plains to 750 m in the lower foothills of the Andes. Given the very low rainfall and the scant development of soils, most of the ELU is devoid of vegetation, with the exception of areas with mat-forming bromeliads (*Tillandsia* spp.) or islands of vegetation in depressions with high watertables or standing water. This ELU includes the settlement of Bernales.

20.2 Physical Characteristics

20.2.1 Precipitation

The eastern sector near the foothills has an annual precipition from 10 to 50 mm, while west of of KP 318+000, annual precipation does not exceed 10 mm (Table 20.1).

Table 20.1. Estimated Peak and General Wet Season Precipitation Ranges - ELU 13

Estimated Precipitation			
Peak (January – March)		General (September-April)	
KP Range	Precipitation (mm)	KP Range	Precipitation (mm)
308+000 - 318+000	5 - 50	308+000 - 317+000	10 - 50
318+000 - 332+940	0 - 5	317+000 - 332+940	0 - 10

Source: ESIA Physical Baseline Maps 1.2-1 and 1.2-2.

20.2.2 GEOLOGY

From KP 308+000 to about KP 314+000, the ROW traverses Quaternary alluvium from the Seco River Basin. Between approximately KP 314+000 and 319+000, the ROW passes over monzonite intrusions that form a chain of steep hills, generally without thick covering of residue except at the toe of the slopes where there are thick colluvial desposits. These rocks are typically extremely hard below the depth of weathering. They present a moderate to high level of fracturing and moderate to intense weathering at the ground surface. Westward of KP 391+000, the landscape is dominated by Quaternary aeolian deposits, with areas of extensive dune fields.

Soils

The sandy or rocky substrates present in the Pisco Sand Plains ELU have undergone minimal soil development. There is no organically enriched topsoil horizon in these sandy alluvial and aeolian deposits. PH is moderately alkaline, with medium salt content in the subsoil, very low phosphorus content, and medium to high levels of potassium. Due to the absence of clays and very low organic matter content, cation exchange capacity (CEC) is low. Table 20.2 summarizes key characteristics of the surface horizion of the two profiles examined in ELU 13.

Table 20.2. Surface Horizon Characteristics - ELU 13

KP	pH	Surface horizon Depth (cm)	Organic matter	Fertility	Slope (%)
309+000	Moderately alkaline	20	Low	Low	2%
310+000	Moderately alkaline	50	Low	Low	5%

Source: Domus.
pH: Strongly acidic = Less than 5.5; Moderately acidic = 5.6 to 6.0; Slightly acidic = 6.1 – 6.5; Neutral = 6.6 - 7.0; Slightly alkaline = 7.1 – 7.8; Moderately alkaline = 7.9 to 8.4; Strongly alkaline = More than or equal to 8.5.
Surface horizon depth: Shallow = Less than 5 cm; Medium = 5 cm to 15 cm; Deep = More than 15 cm.
Organic matter: Low = Less than 2%; Medium = 2% to 4%; High = More than 4%.
Fertility based on Available Phosphorus: Low = Less than 7.0 ppm; Medium = 7.0 to 14.0 ppm; High = More than 14.0 ppm.

Waterbodies and Wetlands

The primary waterbodies in this Pisco Sand Plains ELU are isolated lagoons that occur in swales between sand dunes in the sector between KPs 326+000 and 332+000.

These wetlands and lagoons, some of are believed to be related to palaeochannels, appear to be fed by seepage from the Pisco River which flows roughly parallel to this sector some 3.5 km to the north.

Table 20.3. Principal Waterbody Crossings - ELU 13

Waterbody Type or Name	KP Mid-channel	Elevation (m)
Quebradas		
QUEBRADA	330+640.40	266.90

Source: Peru LNG Pipeline Project Alignment Sheets (Gulf Interstate Engineering, 2006).

Instability and Physical Risk

There is no risk to waterbodies or wetlands or other sensitive ecological receptors due to instability or physical risk of ROW sectors in ELU 13 due to the near absence of rainfall in the ELU.

The land surfaces within the Pisco Sand Plains ELU have been subject to aeolian and episodic fluvial deposition events throughout the Quaternary geologic period; thus the habitats and species in this ELU have evolved under these dynamic environmental conditions.

Infrastructure

The ESIA Project Description does not identifiy any additional infrastructure to be built in this ELU.

Infrastructure requirements such as camps and access roads are based on assumptions set out in the ESIA Project Description and are subject to change, depending on the requirements outlined in the Contractor's Plan of Work.

20.3 HABITATS AND SPECIES

20.3.1 HABITAT DISTRIBUTION

Table 20.4 presents habitat sequence throughout ELU 13 and Table 20.5 presents a summary with subtotals of each habitat.

Table 20.4. Habitat Sequence – ELU 13

Habitat Type*	Length (mt)	KP Start	KP Finish
Desert Barrens	4,770	308+000	312+770
Tillandsia mats	1,819	312+770	314+589
Desert Barrens	673	314+589	315+262
Tillandsia mats	3,896	315+262	319+158
Desert Barrens	11,424	319+158	330+582
Coastal Hydromorphic Islands	58	330+582	330+640
Desert Barrens	1,860	330+640	332+500
Cultivated Areas	440	332+500	332+940

Source: ESIA Biological Baseline Map 2-1 and Domus.

Table 20.5. Habitat Summary – ELU 13

Habitat Type	Length (m)	KP Start	KP Finish
Tillandsia mats	1,819	312+770	314+589
	3,896	315+262	319+158
Total	**5,715**	**22.91%**	
Desert Barrens	4,770	308+00	312+770
	673	314+589	315+262
	11,424	319+158	330+582
	1,860	330+640	332+500
Total	**18,727**	**75.09%**	
Coastal Hydromorphic Islands	58	330+582	330+640
Total	**58**	**0.23%**	
Cultivated Areas	440	332+500	332+940
Total	**440**	**1.76%**	
Total ELU 13:	**24,940**		

Source: ESIA Biological Baseline Map 2-1 and Domus.

20.3.2 HABITAT DESCRIPTIONS

Desert Barrens

These are expansive areas that are devoid of vegetation due to the extreme aridity of the climate and the inability of the sandy or rocky substrates to retain moisture necessary to promote plant growth. Nevertheless, these habitats still support specialized desert fauna, primarily lizards.

Tillandsia mats

These are areas carpeted by mats of *Tillandsia latifolia* and *T. palacea,* which are sand-dwelling bromeliads or "air plants" which receive their moisture directly from fog and rainfall rather than rooting in the droughty sands. There is a formation of Tillandsias on Cerro Serpiente between KPs 315+000 to 320+000.

Coastal Hydromorphic Islands

There are various patches or islands of vegetation growing under the influence of localized depressions with groundwater seepage at the surface during all or part of the year. These small and isolated habitats are found among the sand dunes between KP 326+000 to KP 332+000. These habitats include zones of wetlands dominated by cattails (*Typha domingensis*) and zones of saltgrass (*Distichlis spicata*). Other zones are dominated by woody plants typical of floodplains such as *Tessaria integrifolia* and *Pluchea chingoyo.* From a floristic perspective, these habitats are of low value as their flora is composed of common widespread species and introduced elements such the reed *Phragmites australis*. However, they are of great importance to local populations of fauna.

Fauna

Pampas cat (*Leopardus pajeros*), was reported in this ELU (KP 329+000), as well as the montane guinea pig (*Cavia tschudii*) at Laguna Morón, and the mouse *Oryzomys xantheolus*. The Norwegian rat *Rattus norvergicus* is a common invasive pest in the area. A rodent not registered by the field team was the *Oligoryzomys arenalis,* species registered by ESIA.

Among the more notable birds, slender-billed finch (*Xenospingus concolor*) and coastal miners (*Geositta peruviana*) and were observed by the EFS Field Survey in this ELU. Miners are terrestrial nesting birds.

The slender-billed finch is an endemic element of coastal desert riparian and hydromorphic formations and is listed as near threatened by the IUCN and as vulnerable by the INRENA.

The Peruvian coastal endemic lizards, *Dicrodon heterolepis*, and *Microlophus thoracicus icae* and the gecko lizard *Phyllodactylus lepidopygus* were documented by the EFS Field Survey.

A native coastal fish observed in this ELU was the Green Terror *Aequidens rivulatus*.

Hydrobiology

The green terror (*Aequidens rivulatus*), a small but aggressive fish commonly marketed in the international aquarium trade, was found in the Morón and Lagunillas lagoon. This fish is native to the northern coast of Peru. However, invasive exotic species were also found in these lagoons. Tilapia (*Oreochromis niloticus*) were found in both Morón and Lagunillas, while guppies (*Poecilia reticulata*) were found in Morón only.

Table 20.6. Waterbodies Sampled – ELU 13

Station	Habitat	Waterbody	Name	Height (masl)	KP	Species
Hi-05	Costero	Laguna	Morón	282	329+600	*Aequidens sp.* *Oreochromis sp.*
Hi-06	Costero	Laguna	Lagunillas		329+000	*Aequidens sp.* *Oreochromis sp.*

20.3.3 Species Sensitivity Analysis

Table 20.7 shows the high and medium sensitivity species observed during the EFS Field Survey, based on the species sensitivity criteria presented in Section 7.1 of the EFS. 3 reptile species and one bird species were identified as Medium Sensitivity.

Table 20.7. Species Sensitivity Criteria - ELU 13

No	Species	Protection Status						Spatial Distribution			Local Use			Mobility		Σ
		CR	EN	VU	NT	L	N	Local	Regional	Widespread	Permanent	Seasonal	None	Immobile	Mobile	
	Plants															
1	*Bromus catharticus*						0			0			0	3		3
2	*Distichlis spicata*						0			0			0	3		3
3	*Phragmites australis*						0			0			0	3		3
4	*Pluchea chingoyo*						0			0	2			3		5
	Tessaria integrifolia						0							3		3
	Tillandsia latifolia						0		2					3		5
5	*Tillandsia paleacea*						0		2				0	3		5
6	*Typha domingensis*						0			0	2			3		5
	Fishes															
7	*Aequidens rivulatus*						0		2				0	3		5
8	*Oreochromis niloticus*						0			0	2			3		5
	Poecilia reticulata						0				2			3		5
	Reptiles															
9	*Dicrodon heterolepis*			4				3					0	3		10
10	*Microlophus thoracicus icae*						0	3					0	3		6
11	*Phyllodactylus lepidopygus*						0	3					0	3		6
	Mammals															
12	*Cavia tschudii*						0			0			0		0	0
13	*Conepatus chinga*						0			0			0		0	0
14	*Didelphis pernigra*						0			0			0		0	0
15	*Leopardus (Oreailurus) pajeros (L. colocolo garieppi)*						0		2				0		0	2
16	*Lycalopex (Pseudalopex) culpaeus*						0		2				0		0	2
17	*Lycalopex (Pseudalopex) griseus*						0		2				0		0	2
18	*Oryzomys xantheolus*						0		2				0		0	2
19	*Rattus norvegicus*						0			0			0		0	0
20	*Sturnella bellicosa*						0		2				0		0	2
21	*Thylamys pallidior*						0			0	2				0	2
	Birds															
22	*Butorides striata*						0			0			0		0	0

23	*Camptostoma obsoletum*						0			0			0		0	0
24	*Cathartes aura*						0			0			0		0	0
25	*Egretta thula*						0			0			0		0	2
26	*Falco sparverius*						0			0			0		0	0
27	*Fulica ardesiaca*						0			0			0		0	0
28	*Geositta peruviana*						0		2				0		0	2
29	*Hemispingus atropileus*						0		2				0		0	2
30	*Mimus longicaudatus*						0		2				0		0	2
31	*Myiotheretes striaticollis*						0		2				0		0	2
32	*Nycticorax nycticorax*						0			0			0		0	0
33	*Pardirallus sanguinolentus*						0			0			0		0	0
34	*Podiceps major*						0			0			0		0	0
35	*Sporophila simplex*						0		2				0		0	2
36	*Sturnella bellicosa*						0		2				0		0	2
37	*Volatinia jacarina*						0			0			0		0	0
38	*Xenospingus concolor*			4					2				0		0	6

Protection Status*:

CR= Critically endangered 6 points
EN= Endangered 5 points
VU= Vulnerable 4 points
NT= Near threatened 3 points
B= Low (Others) 2 points
N= Not listed 0 points

Σ= Sensitivity value

1 - 5: Low
6 - 10: Medium
11 or higher: High

Species Distribution:
Local = (Endemic locally or to an EBA**) 3 points
Regional = (Regional endemic in Andes or Coast) 2 points
Widespread = (Across S. America or cosmopolitan) 0 points

Mobility:
Immobile = (restricted movement or in very short distance) 3 points
Mobile = 0 points

Local Uses:
Permanent= 2 points
Seasonal = 1 point
None = 0 points

***Protection Status:** According IUCN (2006) or National Legislation (D.S. No. 034-2004-AG/D.S. No. 043-2005-AG)
****EBA:** Areas determined by Birdlife International, which includes at least 2 bird species with less than 50,000 km2 of known distribution range.

20.3.4 HABITAT SENSITIVITY ANALYSIS

Based on the information presented in Table 20.7, the Coastal Hydromorphic Islands and Lagoons habitat of the Pisco Sand Plains ELU meets the criteria for a High sensitivity habitat.

While not containing any highly sensitive species, these habitats are considered to be highly sensitive due to their uniqueness, limited geographic distribution, presence of various medium sensitivity species, and loss of similar habitats in the region to agricultural conversion.

20.4 KEY ISSUES AND RECOMMENDATIONS

Waterbodies and Wetlands

The lagoons and hydromorphic vegetation complex in this ELU has been studied by Golder (2007) and it was determined that depth of the pipeline grade would not affect the groundwater sources that feed these and that no special construction management is required in these areas.

Nevertheless, the supply of surface water to the Morón Lagoon from the Lagunillas wetlands presently provided by the drainage should be interrupted as briefly as possible during the construction phase and restored completely during reinstatement.

Habitats and Ecosystems

A Pre-Clearance Survey should be undertaken immediately prior to construction clearing, grading and topsoil strip activities to identify any sensitive lizards that need to be relocated to safe areas outside the ROW (listed in Table 20.6).

The lizards will be moved to an area of same or similar habitat at a reasonable distance outside the zone of impact by construction activities.

Table 20.8. Key Issues and Recommendations - ELU 13

Issue	KP reference	Action	Reference

Lizard species	All habitats	Pre-Clearance survey to identify and relocate lizards from ROW prior to site clearance activities.	ECOMP
Waterbodies Moron Lagoon	326+000 -332+000	Minimise project footprint area (25 metres) where practicable. Erosion control devices to minimize sediment runoff beyond the RoW. Best practice pollution prevention and control measures to minimize risk of hydrocarbon contamination to surrounding habitat. Site-specific environmental training / refresher toolbox talks for Crew Supervisors and workers.	ECOMP
Birds – Slender-billed finch (*Xenospingus concolor*)	ELU-wide	Identify any nests during Pre-Clearance Survey if ROW site clearance during nesting season.	ECOMP

Source: EFS Field Work.

21.0 ELU 14: ICA-LIMA COASTAL PLAIN (KP 332+940 – 402+000)

21.1 General Description

The Ica-Lima Coastal Plain ELU includes the entire zone from the Pisco River Valley north to the LNG Plant at Pampa Melchorita. Despite absence of appreciable rainfall, there are extensive cultivated areas under irrigation, occasional crossings of rivers with narrow belts of riparian vegetation, scattered tillandsias, and unvegetated desert. This ELU is generally flat, with elevations ranging between approximately 125 and 368 m. This unit includes a diverse series of settlements of the Departments of Pisco and Lima.

21.2 Physical Characteristics

Precipitation

Precipitation along the coastal desert plain is very low or sometimes nonexistent, with a typical maximum of 10 mm over the entire 'wet' season (September – April). However, on a decadal scale, occassional heavy rains may fall during El Niño meteorological events which result in precipitation levels considerably above the mean annual figure.

Table 21.1. Estimated Peak and General Wet Season Precipitation Ranges - ELU 14

KP Range	Estimated Precipitation (mm)	
	Peak (January – March)	General (September-April)
332+940 - 402+000	0-5	0-10

Source: ESIA Physical Baseline Maps 1.2-1 and 1.2-2.

Geology

The Ica-Lima Coastal Plain ELU is covered by a combination of Holocene-aged alluvium (floodplains of the Pisco, Matagente, and Chico rivers and the Topará stream), torrential deposits (gravels, cobbles, and subangular boulders) from episodic extreme flows, and aeolian deposits.

Soils

The sandy and coarser substrates of the coastal plain with very sparse vegetation cover and hydrological processes have undergone minimal soil development. With the exception of cultivated agricultural soils and narrow riparian zones in limited floodplain areas, there is no organically enriched topsoil horizon in these sandy alluvial and aeolian deposits.

Soils are affected by aeolian erosion and mainly influenced by sand dunes. These soils have neutral to alkaline characteristics.

Soils have low fertility based on phosphorus availability. In alkaline conditions the solubility of phosphate rock is low. The texture of Horizon A and Subsoil fluctuates from sandy to sandy loam so drainage will be very high. Organic matter and other nutrients are low.

Table 21.2 summarizes the key characteristics of the surface horizion of the four profiles examined in ELU 14.

Table 21.2. Surface Horizon Characteristics - ELU 14

KP	pH	Surface horizon Depth	Organic matter	Fertility	Slope (%)
334+000	Slightly alkaline	High	Low	High	5%
364+000	Slightly alkaline	High	Low	High	20%
380+000	Slightly alkaline	High	Low	Low	2%
390+000	Neutral	Medium	Low	Medium	2%

Source: Domus.
pH: Strongly acidic = Less than 5.5; Moderately acidic = 5.6 to 6.0; Slightly acidic = 6.1 – 6.5; Neutral = 6.6 - 7.0; Slightly alkaline = 7.1 – 7.8; Moderately alkaline = 7.9 to 8.4; Strongly alkaline = More than or equal to 8.5.
Surface horizon depth: Shallow = Less than 5 cm; Medium = 5 cm to 15 cm; Deep = More than 15 cm.
Organic matter: Low = Less than 2%; Medium = 2% to 4%; High = More than 4%.
Fertility based on Available Phosphorus: Low = Less than 7.0 ppm; Medium = 7.0 to 14.0 ppm; High = More than 14.0 ppm.

Waterbodies

The ROW crosses various rivers and streams in the Ica-Lima Coastal Plain ELU (Table 21.3), the largest being the Pisco River, whose active floodplain and channel area at

present lies approximately between KPs 334+382 and 335+114. All of these streams and rivers have highly seasonal flows, dependent on time of year and occasional storm events and have been historically affected by the development of irrigation agriculture throughout the ELU, which by abstraction has led to reduced mean discharges in the lower reaches of these watercourses.

Table 21.3. Principal Waterbody Crossings - ELU 14

Waterbody Type or Name	KP Mid-channel	Elevation (m)
Quebrada		
QUEBRADA	353+606.34	253.29
QUEBRADA	353+675.37	253.28
QUEBRADA	353+998.84	248.64
QUEBRADA	354+437.68	240.70
QUEBRADA	354+593.87	236.77
QUEBRADA	354+716.18	233.85
QUEBRADA	354+841.67	232.66
QUEBRADA	354+932.97	231.19
QUEBRADA	355+265.65	224.32
QUEBRADA	355+378.66	222.48
QUEBRADA	355+484.49	221.06
QUEBRADA	356+026.88	215.53
QUEBRADA	357+808.91	213.07
QUEBRADA	359+893.67	173.59
QUEBRADA	360+205.57	169.03
QUEBRADA SECA	371+800	176
QUEBRADA SECA	372+600	174
QUEBRADA SECA	375+750	184
QUEBRADA SECA	377+300	190
QUEBRADA	377+506.28	187.70

QUEBRADA	378+211.41	189.47
QUEBRADA	378+336.85	189.40
QDA. SECA	380+541.23	170.94
QUEBRADA	380+710.19	169.75
QUEBRADA	380+826.24	168.29
QUEBRADA	381+677.33	165.20
QUEBRADA	381+944.69	166.56
QUEBRADA	381+996.24	166.42
QUEBRADA	382+191.82	166.38
QDA. SECA	382+577.46	167.21
QDA. SECA	383+246.63	170.33
QDA. SECA	383+808.37	171.45
QDA. SECA	384+283.97	170.82
QUEBRADA	387+764.87	159.45
QDA CORRALES	389+077.24	128.14
QDA. TOPARA	389+437.86	126.68
Rivers		
PISCO	334+968.01	231.93
MATAGENTE	362+608.84	163.43
CHICO	364+486.74	153.66

Source: Peru LNG Pipeline Project Alignment Sheets (Gulf Interstate Engineering, 2006).

Instability and Physical Risk

There is no risk to waterbodies or wetlands or other sensitive ecological receptors due to instability or physical risk of ROW sectors in ELU 14 due to the near absence of erosion associated rainfall in the ELU. The land surfaces within the Pisco Sand Plains ELU have been subject to aeolian and episodic fluvial deposition events throughout the Quaternary geologic period and the habitats and species in this ELU have evolved under these dynamic environmental conditions.

Infrastructure

The ESIA does not identifiy any additional infrastructure to be built in this ELU although this could be subject to change, depending on the details to be developed by the Project for the construction programme.

21.3 HABITATS AND SPECIES

21.3.1 HABITAT DISTRIBUTION

The habitats of ELU 14 are listed in sequential order in Table 21.4, including the length of each habitat unit and associated start and finish ROW KPs. Table 21.5 presents habitat lengths over the ROW sorted by habitat type, with subtotals for each habitat.

Table 21.4. Habitat Summary – ELU 14

Habitat Type	Length (m)	KP Start	KP Finish
Cultivated Areas	1,757	332+940	334+697
Riparian Vegetation	386	334+697	335+083
Cultivated Areas	8,455	335+083	343+538
Desert Barrens	16,386	343+538	359+924
Cultivated Areas	2,539	359+924	362+463
Riparian Vegetation	152	362+463	362+615
Cultivated Areas	1,730	362+615	364+345
Riparian Vegetation	218	364+345	364+563
Cultivated Areas	3,071	364+563	367+634
Desert Barrens	4,502	367+634	372+136
Tillandsia Mats	113	372+136	372+249
Desert Barrens	2,832	372+249	375+082
Tillandsia Mats	727	375+082	375+809
Desert Barrens	1,414	375+809	377+222
Tillandsia Mats	1,285	377+222	378+507
Desert Barrens	1,483	378+507	379+990
Tillandsia Mats	1,201	379+990	381+191
Desert Barrens	7,944	381+191	389+135
Cultivated Areas	206	389+135	389+341
Riparian Vegetation	118	389+341	389+459
Desert Barrens	7,599	389+459	397+058
Tillandsia Mats	672	397+058	397+730
Desert Barrens	4,270	397+730	402+000

Source: ESIA Biological Baseline Map 2-1 and Domus.

Table 21.5. Habitat Summary – ELU 14

Habitat Type	Length (m)	KP Start	KP Finish
Desert Barrens	16,386	343+538	359+924
	4,502	367+634	372+136
	2,832	372+249	375+082
	1,414	375+809	377+222
	1,483	378+507	379+990
	7,944	381+191	389+135
	7,599	389+459	397+058
	4,270	397+730	402+000
Total	**46,430**	**67.23%**	
Cultivated Areas	1,757	332+940	334+697
	8,455	335+083	343+538
	2,539	359+924	362+463
	1,730	362+615	364+345
	3,071	364+563	367+634
	206	389+135	389+341
Total	**17,758**	**25.71%**	
Tillandsia Mats	113	372+136	372+249
	727	375+082	375+809
	1,284	377+222	378+507
	1,201	379+990	381+191
	672	397+058	397+730
Total	**3,998**	**5.79%**	
Riparian Vegetation	386	334+697	335+083
	152	362+463	362+615
	218	364+345	364+563
	118	389+341	389+459
Total	**874**	**1.27%**	
Total ELU 14:	**69,060**		

Source: ESIA Biological Baseline Map 2-1 and Domus.

21.3.2 HABITAT DESCRIPTIONS

Desert Barrens

About 67% of the ROW length in ELU 14 is desert, devoid of vegetation due to the extreme aridity of the climate and the inability of the sandy or rocky substrates to retain moisture necessary to promote plant growth and allow soil development. Nevertheless, these habitats still support very specialized fauna, primarily lizards, adapted to the harsh

desert environment. The desert habitat is occasionally interspersed with patches of tillandsias, and strips of riparian vegetation and cultivated areas beside sources of water such as rivers, streams, aquifers and oases.

Cultivated Areas

The availability of water from rivers draining the western slopes of the Andes has allowed for the development of irrigation-based agriculture in coastal Peru over the past 4,000 years. Cultivated areas cover approximately 25% of the length of the ROW in the Ica-Pisco Coastal Plain ELU. Despite the extensive transformation of the landscape and habitats, the cultivated areas still contain elements of native biodiversity, particularly in living fences, windbreaks, and vegetation-lined irrigation canals. The EFS Field Survey identified huarango trees (*Acacia macracantha*), a species listed by the INRENA as near threatened, in such microenvironments with this habitat type.

Tillandsia mats

Desert areas with concentrations of mat-forming bromeliads or "air plants" (*Tillandsia latifolia* and *Tillandsia palacea*) account for around 6% of the ROW in ELU 14. These mats provide habitats for small fauna including lizards.

Riparian Vegetation

Along the major watercourses, there are remnants of natural woody vegetation growing upon the banks and floodplains. The most common species in this habitat are the shrub *Baccharis salicifolia* and the small tree *Tessaria integrifolia,* both of which are widespread riparian species in South America. There are also individuals of the INRENA near threatened huarango tree (*Acacia macracantha*).

Key Fauna

Larger mammals observed by the EFS Field Survey include the Pampas cat (*Leopardus pajeros*) and two species *Lycalopex* foxes[13]. Peruvian miner (*Geositta peruviana*) were registered in this ELU. Miners are terrestrial nesting birds.

The Peruvian coastal endemic lizards *Ctenoblepharys adspersa*, *Dicrodon heterolepis*, and *Microlophus tigris* were documented by the EFS Field Survey, as well as the snake *Alsophis elegans*.

The ESIA suggested the presence of the pit viper *Bothrops roedingeri*, a species listed as endangered by the INRENA, based on the finding of a shed skin. Although not observed by the EFS Field Survey, the presence of this rare snake in ELU 14 should be considered

[13] *Lycalopex culpaeus* and a second species which may be either *L. sechura*, which is documented as far south as Lima Department, or *L. griseus*, which is documented as far north as Arequipa Department. The identity of the foxes in Ica Department remains unsettled.

highly probable, especially in riparian habitats, as its documented range is from the Department of La Libertad to the Department of Arequipa.

Hydrobiology

The Pisco River has important populations of the Changallo shrimp (*Cryphiops caementarius*), an economically important natural resource for local populations. These were observed by the EFS Field Survey in the Pisco River and also reported by local residents from the Chico and Matagente rivers (requires confirmation during wet season). Due to the high commercial value of this crustacean, the Peruvian Ministry of Production established legal open and closed seasons for this species through Ministerial Resolution N° 312-2006-PRODUCE. This species may be taken from April 1 through December 19, while it may not be taken, processed, transported, commercialized, or utilized between December 20 and March 31.

Eight individuals of *Cryphiops caementarius* were caught with a net from the canal offtake at the Murga bridge within a 20 minute span in a zone of the Pisco River with a depth of less than 30 cm. A local fisherman informed the EFS team that the shrimp increase in abundance mid-spring due to the migration of the shrimp towards the mouth of the river where they lay eggs in the nearshore marine environment. Egg laying is completed by mid-summer when the adults and new recruits return upstream to elevations of approximately 1,200 m in the Pisco river and its tributaries.

The fishes registered in the rivers of ELU 14 were the green terror (*Aequidens rivulatus*) and a catfish (*Trichomycterus* rivulatus).

Table 21.6. Waterbodies Sampled – ELU 14

Station	Habitat	Waterbody	Name	Height (masl)	KP	Species
Hi-01	Costero	Quebrada	Topará	113	389+400	
Hi-02	Costero	Río	Chico	164	364+500	*Trichomycterus sp.* *Poecilia sp.* *Oreochromis sp.*
Hi-03	Costero	Río	Matagente	192	362+500	*Trichomycterus sp.* *Poecilia sp.* *Oreochromis sp.*
Hi-04	Costero	Río	Pisco	240	334+800	*Aequidens sp.* *Oreochromis sp.* *Poecilia sp.*

21.3.3 SPECIES SENSITIVITY ANALYSIS

Table 21.7 shows the high and medium sensitivity species observed during the EFS Field Survey, based on the species sensitivity criteria presented in Section 7.1 of the EFS.

One High Sensitivity species (the Changello shrimp) is observed in the ELU which is listed as Vulnerable. There is 1 Medium Sensitivity fish species, *Trichomycterus rivulatus* which is of only local distribution and has a use throughout the year by local communities.

Additionally, there are 5 reptile species of Medium Sensitivity including three lizard species, a toad species and a snake species.

The huarango tree, *Acacia macracantha,* is also classified as Medium Sensitivity.

Table 21.7. Species Sensitivity Criteria - ELU 14

No	Species	Protection Status						Spatial Distribution			Local Use			Mobility		Σ
		CR	EN	VU	NT	L	N	Local	Regional	Widespread	Permanent	Seasonal	None	Immobile	Mobile	
	Plants															
1	*Acacia macracantha*				3					0	2			3		8
2	*Alternanthera halimifolia*						0			0			0	3		3
3	*Baccharis salicifolia*						0			0	2			3		5
4	*Boerhavia difusa*						0			0	2			3		5
5	*Cynodon dactylon*						0			0	2			3		5
6	*Eriochloa* sp.						0			0			0	3		3
	Tessaria integrifolia						0			0			0	3		3
7	*Tillandsia latifolia*						0		2				0	3		5
8	*Tillandsia paleacea*						0		2				0	3		5
	Fishes and shrimps															
	Aequidens rivulatus						0		2		0		0	3		5
	Cryphiops caementarius ***			4					2			2		3		11
	Oreochromis niloticus						0			0		2		3		5
	Poecilia reticulata						0			0	2			3		5
	Trichomycterus rivulatus						0	3			2			3		8
	Reptiles and amphibians															
14	*Alsophis* sp.						0	3					0	3		6
15	*Alsophis elegans*						0			0			0	3		3
16	*Chaunus limensis*							3					0	3		6
17	*Ctenoblepharys adspersa*			4				3					0	3		10
18	*Dicrodon heterolepis*			4				3					0	3		10
19	*Microlophus tigris*						0	3			2		0	3		8
	Mammals															
20	*Cavia tschudii*						0			0			0		0	0
21	*Conepatus chinga*						0			0			0		0	0
22	*Leopardus (Oreailurus) pajeros*						0		2				0		0	2

25	*Lycalopex (Pseudalopex) culpaeus*						0		2				0		0	2
26	*Lycalopex (Pseudalopex) griseus*						0		2				0		0	2
27	*Mus musculus*						0			0			0		0	0
28	*Oryzomys xantheolus*						0		2				0		0	2
29	*Thylamys pallidior*						0			0	2				0	2
	Birds															
30	*Actitis macularius*						0			0			0		0	0
31	*Anas bahamensis*						0			0	2				0	2
32	*Ardea alba*						0			0			0		0	0
33	*Bubulcus ibis*						0			0			0		0	0
34	*Burhinus superciliaris*						0		2				0		0	2
35	*Butorides striata*						0			0			0		0	0
36	*Calidris alba*						0			0			0		0	0
37	*Cathartes aura*						0			0			0		0	0
38	*Chaetura pelagica*						0			0			0		0	0
39	*Charadrius vociferus*						0			0			0		0	0
40	*Coragyps atratus*						0			0			0		0	0
41	*Crotophaga sulcirostris*						0			0			0		0	0
42	*Dives warszewiczi*						0		2				0		0	2
43	*Egretta caerulea*						0			0			0		0	0
44	*Elaenia albiceps*						0		2				0		0	2
45	*Euscarthmus meloryphus*						0			0			0		0	0
46	*Falco sparverius*						0			0			0		0	0
47	*Gallinula chloropus*						0			0			0		0	0
48	*Geositta maritima*						0		2				0		0	2
49	*Geositta peruviana*						0		2				0		0	2
50	*Molothrus bonariensis*						0			0			0		0	0
51	*Muscigralla brevicauda*						0		2				0		0	2
52	*Myiophobus fasciatus*						0			0			0		0	0
53	*Parabuteo unicinctus*						0			0			0		0	0

54	*Petrochelidon rufocollaris*						0		2				0		0	2
55	*Pyrocephalus rubinus*						0			0			0		0	0
56	*Saltator striatipectus*						0			0			0		0	0
57	*Sicalis raimondii*						0		2				0		0	2
58	*Sporophila simplex*						0		2				0		0	2
59	*Sporophila peruviana*						0		2				0		0	2
60	*Sporophila telasco*						0		2				0		0	2
61	*Thaumastura cora*						0		2				0		0	2
62	*Tiaris obscurus*						0			0			0		0	0
63	*Tringa flavipes*						0			0			0		0	0
64	*Tyrannus melancholicus*						0			0			0		0	0
65	*Tyto alba*						0			0			0		0	0
66	*Zenaida meloda*						0		2				0		0	2

Protection Status*:
CR= Critically endangered 6 points
EN= Endangered 5 points
VU= Vulnerable 4 points
NT= Near threatened 3 points
B= Low (Others) 2 points
N= Not listed 0 points

Σ= Sensitivity value

1 - 5: Low
6 - 10: Medium
11 or higher: High

Species Distribution:
Local = (Endemic locally or to an EBA**) 3 points
Regional = (Regional endemic in Andes or Coast) 2 points
Widespread = (Across S. America or cosmopolitan) 0 points

Mobility:
Immobile = (restricted movement or in very short distance) 3 points
Mobile = 0 points

Local Uses:
Permanent= 2 points
Seasonal = 1 point
None = 0 points

***Protection Status:** According IUCN (2006) or National Legislation (D.S. No. 034-2004-AG/D.S. No. 043-2005-AG)
****EBA:** Areas determined by Birdlife International, which includes at least 2 bird species with less than 50,000 km2 of known distribution range.

21.3.4 HABITAT SENSITIVITY ANALYSIS

Based on the information presented in Table 21.7 the Cultivated Areas of the Ica-Lima Costal Plain ELU meet the criteria for Medium Sensitivity habitat due to the presence of four Medium sensitivity animal species. The Desert Barrens found in this ELU, meet the criteria for Medium Sensitivity habitat due to the presence of three Medium Sensitivity plant species. The Riparian Corridors habitat meets the criteria for a High sensitivity species due to the presence of one High Sensitivity animal species. The Pisco River supports a critical species from a socioeconomic perspective, the freshwater river shrimp *Cryphiops caementarius*, an important fishery species in local markets.

21.4 KEY ISSUES AND RECOMMENDATIONS

Waterbodies and Wetlands

Best practice crossing techniques and pollution prevention and control should be adopted to minimize turbidity and hydrocarbon impacts generated during construction on water quality. The channel morphology and bed characteristics should be restored post-construction and riparian vegetation should be restored during reinstatement.

Habitats and Species

Mature huarango trees (*Acacia macracantha*) and other riparian vegetation should be left in place to the extent possible. Alternatively, where trees must be cleared on the ROW, seeds should be collected from local huarango trees for the production of seedlings in a nursery for replanting during bioreinstatement.

Changallo shrimp *Cryphiops caementarius* is an economically important species, whose harvesting is regulated by national legislation. Construction of the Pisco River crossing should be scheduled to take place during the open, dry season for this species between April 1 and December 19, which avoid impacts to migrating and breeding and spawning shrimp during their peak reproductive season during the peak of the wet season (December to April).

A Pre-Clearance Survey should be undertaken immediately prior to construction clearing, grading and topsoil strip activities to identify any sensitive reptiles and amphibians including lizards, snakes and toads (listed in Table 21.7), which are especially likely to be found in association with semi-natural micro-habitats in Cultivated Areas such as field borders and along irrigation channels and riparian zones. These reptiles and amphibians will be moved to an area of same or similar habitat at a reasonable distance outside the zone of impact by construction activities. Snakes should be approached with extreme care and encouraged to move off the ROW without direct handling. Direct handling of

snakes should only ever be undertaken at any time on the ROW by a recognized snake handler who can competently identify and safely handle such repiltes.

Table 21.8. Key Issues and Recommendations - ELU 14

Issue	KP Reference	Recommendations	Reference
River and creek crossings	See Table 21.3	Ditch in dry season if possible using best practice crossing techniques to minimize turbidity.	ECOMP/RP
Lizards, Toads and Snakes	ROW	Pre-Clearance survey to identify and relocate from ROW prior to site clearance activities.	ECOMP
Cryphiops caementarius Changallo shrimp and Trichmycterus rivulatus	Pisco River	Ditch in dry season (April to December) using best practice techniques to minimize risk of turbidity and hydrocarbon contamination.	ECOMP
Native fish	Pisco, Matagente, and Chicho Rivers	Ditch in dry season (April to December) using best practice techniques to minimize risk of turbidity and hydrocarbon contamination.	ECOMP
Huarango trees *(Acacia macracantha)*	See Table 21.7	Collect seed, produce seedlings, plant during bioreinstatement if not possible to retain any trees within ROW during site clearance.	ECOMP/RP

Source: Domus.

22.0 CONCLUSIONS AND RECOMMENDATIONS

This section summarizes the findings of the Ecological Field Survey and provides recommendations for the Ecological Management Plan (ECOMP) and the Restoration Plan (RP).

The information surveyed in the field in November-December 2006 and its subsequent analysis reflects a finer and more specific level of information to that previously indentified in the ESIA. The EFS was focused on identifying threatened, sensitive or economically important species that may be present in the ROW and to provide information that would allow the development of specific plans to protect and subsequently restore the ecology and biodiversity of the Row's direct area of influence.

22.1 IDENTIFICACITION OF SENSITIVE HABITATS

Species Sensitivity

A key objective of the EFS was to identify the most sensitive elements and sectors of the RoW, building upon and validating the ESIA findings, in order to permit the development of the Pipeline Ecological Management Plan and the Pipeline Restoration Plan. The EFS was not intended to develop a new baseline study, thus the species lists are focused on sensitive elements and are not intended to be complete lists of species present in any given habitat type or landscape unit. For example, common, widespread, abundant species were not specifically addressed by the EFS. Also, the ESIA reports species observed at sampling points located within 3 to 7 km wide corridor, while the EFS focused on the ROW itself. Thus, the EFS findings are not intended to replace the ESIA baseline species data and they cannot be directly compared with the ESIA species data given the differences in the aims and methods of the EFS and ESIA.

Species sensitivity was determined for each species documented by the EFS Survey on the basis of four characteristics: 1) protected status, 2) geographic distribution, 3) use by local communities, and 4) mobility (ability to flee from a disturbance). Species were scored on these characteristics with a potential range of scores from 0 to 14.

The three categories were determined as follows:

High Sensitivity:

- Any species listed as either EN or CR by IUCN or INRENA **and** that is Immobile.
- Any other species with a score of 11 or higher.

Medium Sensitivity:

- Any species listed as either EN or CR by IUCN or INRENA **and** that is Mobile.
- Any species listed as either NT or VU by IUCN or INRENA **and** that is Immobile.
- Any other species with a score of from 6 to 10.

Low Sensitivity:

- Any species with a score less than or equal to 5.

Table 22.1 lists high and medium sensitivity species by Ecological landscape Unit.

Table 22.1 HIGH AND MEDIUM SENSITVITY SPECIES BY ECOLOGICAL LANDSCAPE UNIT (ELU)

Species	**Description**	**Level of Sensitivity**
1. Apurimac River Valley Montane Forest Ecotone, KP 0+000 – 20+511		
Phrynopus sp	Frog	HIGH
Polylepis pauta	Quenual Tree	Medium
Eleutherodactylus discoidalis	Frog	Medium
Proctoporus	Lizard	Medium
Tremarctos ornatus	Spectacled Bear	Medium
Agriornis ardicola	Bird (Tyrant)	Medium
Theristicus melanopis	Bird (Ibis)	Medium

2. Campana Watershed, KP 20+511 – 25+115		
Escallonia resinosa	Shrub	Medium
Myrosmodes sp.	Bog Orchid	Medium
Tecoma sambuxifolia	Shrub	Medium
Proctoporus sp.	Lizard	Medium
Theristicus melanopis	Bird (Ibis)	Medium
3. Torobamba River Valley, KP 25+115 – 44+350		
Corryocactus quadrangularis	Cactus	HIGH
Kageneckia lanceolota	Shrub	HIGH
Acacia macracantha	Tree	Medium
Ariestiguieta discolor	Shrub	Medium
Berberis flexuosa	Shrub	Medium
Echinopsos peruviana puquiensis	Cactus	Medium
Eriotheca vargasii	Shrub	Medium
Escallonia myrtilloides	Shrub	Medium
Escallonia resinosa	Shrub	Medium
Tecoma arequipensis	Shrub	Medium
Tecoma sumbucifolia	Shrub	Medium
Chanus spinulosus	Toad	Medium
Stenocercus aff. apurimacus	Lizard	Medium
Agriornis andicola	Bird (Tyrant)	Medium
Vultur gryphus	Condor	Medium
4. Siliccasa Sierra, KP 44+350 – 56+738		
Aaa Sp.	Orchid	Medium
Distichia muscoides	Bog Moss	Medium

Escallonia myrtilloides	Shrub	Medium
Myrosmodes sp.	Bog Orchid	Medium
Perezia coerulescens	Herb	Medium
Vultur gryphus	Condor	Medium
5. Yucay River Valley, KP 56+783 – 74+199		
Corryocactus quadrangularis	Cactus	HIGH
Berberis flexuosa	Shrub	Medium
Chaunus spinulosus	Toad	Medium
Cleistocactus morawetzianus	Cactus	Medium
Echinopsis peruviana spp. Puquiensis	Cactus	Medium
Escallonia myrtilloides	Shrub	Medium
Orestias sp.	Killifish	Medium
Trichomycterus rivulatus	Andean catfish	Medium
Liolaemus sp.	Lizard	Medium
Stenocercus frittsi	Lizard	Medium
Telmatobbius sp.	Frog	Medium
Vultur gryphus	Condor	Medium
6. Huamanga-Viscongo Watershed Divide, KP 74+199 – 103+970		
Escallonia myrtilloides	Shrub	Medium
Parastrephia quadrangularis	Shrub	Medium
Orestias sp.	Killifish	Medium
Liolaemus sp.	Lizard	Medium
Telmatobius sp.	Frog	Medium
Leopardus (oreailurus) jacobitus	Mountain Cat	Medium
Vicugna vicugna	Vicuna	Medium

7.Vinchos River Valley, KP 103+970 – 117+388		
Echinopsis peruviana ssp. Puquiensis	Cactus	Medium
Escallonia myrtilloides	Shrub	Medium
Oroya peruviana	Cactus	Medium
Trichomycterus rivulatus	Andean catfish	Medium
8. Apacheta High Sierras, KP 117+388 – 162+137		
Berberis sp.	Bush	Medium
Ephedra Americana	Bush	Medium
Escallonia myrtilloides	Shrub	Medium
Oroya peruviana	Cactus	Medium
Perezia coerulensis	Herb	Medium
Perezia pinnatifida	Herb	Medium
Ribes sp.	Plant	Medium
Liolaemus cf. melanogaster	Lizard	Medium
Liolaemus melanogaster	Lizard	Medium
Leopardus (oreailurus) jacobitus	Mountain Cat	Medium
Vicugna vicugna	Vicuna	Medium
Asthenes dorbignyi (huancavelica)	Bird (Canastero)	Medium
Theristicus melanopis	Bird (Ibis)	Medium
Vultur gryphus	Condor	Medium
9. Pampas-Palmitos River Basins, KP 162+137 – 195+050		
Perezia coerulescens	Herb	Medium
Distachia muscoides	Bog Moss	Medium
Liolaaemus sp.	Lizard	Medium
Leopardus (oreailurus) jacobitus	Mountain Cat	Medium

Vicugna vicugna	Vicuna	Medium
Asthenes dorbignyi (huancavelica)	Bird (Canastero)	Medium
10. Huaytara High Plains and Ridges, KP 195+050 – 249+538		
Perezia coerulescens	Herb	Medium
Liolaemus sp. (ramirez)	Lizard	Medium
Liolaemus cf. polystictus	Lizard	Medium
Vicuna vicugna	Vicuna	Medium
Asthenes dorbignyi (huancavelica)	Bird (Canastero)	Medium
11. Pisco-Ica Watershed Divide, KP 249+538 – 272+181		
Chersodoma arequipensis	Shrub	HIGH
Senocio tovari	Cactus	Medium
Liolaaemus sp.	Lizard	Medium
Microlophus affitigris	Lizard	Medium
12. Coastal Bat Hills, KP 272+181 – 308+000		
Cleistocactus acanthurus	Cactus	HIGH
Browningra candelaris	Cactus	Medium
Cridoscolus basiacanthus	Herb	Medium
Ephedra Americana	Shrub	Medium
Loasa incana	Shrub	Medium
Neoralmondia arequipensis	Cactus	Medium
Orthopterygium huaucui	Tree	Medium
Microlophus tigris	Lizard	Medium
Phyllodactylus lepidopygus	Gecko Lizard	Medium
13. Pisco Sand Plains, KP 308+000 – 332+940		
Dicrodoa heterolepis	Lizard	Medium

Microlophus thoracicusicae	Lizard	Medium
Phyllodactylus lepidopygus	Gecko Lizard	Medium
Xenospingus concolor	Bird (Finch)	Medium
14. Ica-Lima Coastal Plain, KP 332+940 – 408+000		
Cryphiops caementarius	Shrimp	HIGH
Acacia macracantha	Tree	Medium
Trichomyctarus rivulatus	Andean catfish	Medium
Alsopphis sp.	Snake	Medium
Chaunus limensis	Toad	Medium
Ctenblepharys adspersa	Lizard	Medium
Dicrodon heterolepis	Lizard	Medium
Microlophus tigris	Lizard	Medium

Source: Ecological Field Survey

The sensitivity of the species analyzed is summarized in Table 22.2 by taxonomic group.

Table 22.2. Species Sensitivities by Taxonomic Group

Group	Low	Medium	High	Total
Plants	83	25	4	112
Crustaceans	0	0	1	1
Fish	2	5	0	7
Amphibians	2	5	0	7
Reptiles	4	17	0	21
Birds	218	4	0	222
Mammals	32	3	0	35

All	341	59	5	405

Sensitive Habitats

According to the ESIA, Vol. II-B, p. 6-51,

"…*the most sensitive RoW segments are:*

- *Kp 0+000 to Kp 10+000. This corresponds to the eastern watershed.*
- *Kp 55+000 to Kp 75+000: This corresponds to the two end points of the study area (high sensitivity) as well as the two intermediate segments with medium sensitivity. This is mostly in the Acocros cultivated area.*
- *Kp 115+000 to Kp 120+000: Corresponds to the Vinchos River cultivated area.*
- *Kp 120+000 to Kp 200+000: Corresponds to high-Andean zone 4, between the Vinchos River and Taccracocha Lake. This includes grass formations, grazing lands, sedge swamps, and lakes.*
- *Kp 245+000 to Kp 250+000: Corresponds to the last segment of the puna before descending towards the Western watersheds near Huaytará.*

Therefore, the most sensitive ecosystems are the eastern watersheds, cultivated areas, and the puna area (particularly high-Andean zone 4)."

The total length of the "most sensitive ecosystems" as identified by the ESIA is 120 km, which is equivalent to 29.8% of the RoW length.

A comparison of the ESIA findings against the EFS follows:

- Kp 0+000 to Kp 10+000. Corresponds to the portions of Apurimac Valley Upper Montane Forest Ecotone and the Campana Sierra. Considered to be of Medium Sensitivity by EFS.
- Kp 55+000 to Kp 75+000: Corresponds almost entirely to the Yucay River Valley (KP 56+800 to Kp 74+000). EFS considers the Resinous Scrub habitat in this sector to be of High Sensitivity.
- Kp 115+000 to Kp 120+000: Corresponds to the western portion of the Vinchos River Valley and a small portion of the easternmost Apacheta High Sierras. Considered to be of Medium Sensitivity by EFS.
- Kp 120+000 to Kp 200+000: Corresponds to Apacheta High Sierras, Pampas-Palmitos River Basins, and a portion of the easternmost Huaytará High Plains and Ridges. It does not include the Vinchos River Valley. It does include the Taccracocha Lake area; however, the lake itself is located well beyond the direct area of influence of the RoW. This includes tussock and sward-forming

grasslands and peat bogs. Considered to be of Medium Sensitivity by the EFS. Does not include habitats known to be inhabited by the white-bellied cinclodes.

- Kp 245+000 to Kp 250+000: Corresponds to the last segment of the high Andean grasslands (Huaytará High Plains and Ridges) and the first 500 m of the mixed scrublands of the Pisco-Ica Watershed Divide southwest of the town of Huaytará. The grasslands are not considered to be sensitive by the EFS; however, the mixed scrubland from KP 245+000 and westward are considered to be of High Sensitivity.

Based on the EFS findings, the most sensitive ecosystems are, in general terms, the dry forest river valleys of the Apurimac and Mantaro basins in the easternmost section of the RoW, the western Andean scrublands and cactus formations, the hydromorphic habitat islands of the Pisco sand plains, and the riverine ecosystems of the coastal plain in the westernmost section of the RoW.

The three major differences between the ESIA and EFS findings on sensitive ecosystems or habitats are that:

1) The ESIA considers the sector from KP 120+000 to KP 200+000 to be highly sensitive while the EFS find this zone to be largely of medium sensitivity,
2) The ESIA considers the sector from KP 249+500 to KP 300+000 to be of medium sensitivity and the sector for KP+300+000 to 308+000 to be of low sensitivity, while the EFS finds the sector from KP 249+500 to 308+000 to be of high sensitivity, and
3) The ESIA considers the sector from KP 325+000 to KP 335+000 to be of low sensitivity, while the EFS finds the sector from 326+000 to 332+000 to be largely of high sensitivity.

Table 22.3. Medium and High Sensitivity Habitats by Ecological Landscape Unit according to the EFS

ELU	HABITAT TYPES	HABITAT SENSITIVITY	RoW Length (m)
1. Apurimac River Valley Montane Forest Ecotone	Upper Montane Forest	Medium	4,495
	Tussock Grassland	Medium	3,321
2. Campana Sierra	Peat Bog	Medium	1,834
	Sward-forming Grassland	Medium	6,318
3. Torobamba River	Cultivated Areas	High	7,902

Valley	Dry Deciduous Forest	Medium	651
	Thorny Scrub	High	6,238
4. Sillaccasa Sierra	Tussock Grassland	Medium	10,333
5. Yucay River Valley	Thorny Scrub	Medium	171
	Resinous Scrub	High	1,630
	Yucay River	Medium	26
6. Huamanga Vischongo Watershed Divide	Tussock Grassland	Medium	27,246
7. Vinchos River Valley	Cultivated Areas	Medium	12,074
8. Apacheta High Sierras	Scarcely Vegetated High Andean Areas	Medium	21,083
	Sward-forming Grassland	Medium	17,481
	Tussock Grassland	Medium	6,900
9. Pampas Palmitos River Basins	Tussock Grassland	Medium	11,741
10. Huaytará High Plains and Ridges	Scarcely Vegetated High Andean Areas	Medium	3,599
	Sward-forming Grassland	Medium	16,127
	Tussock Grassland	Medium	33,616
11. Pisco Ica Watershed Divide	Mixed Scrub	High	17,910
	Thorny Scrub	High	4,590
12. Coastal Bat Hills	Desert Scrub	High	15,924
	Columnar Cacti and Scrub	High	20,076
13. Pisco Sand Plains	Hydromorphic Islands and Lagoons	High	4,800*
14. Ica-Lima Costal Plain	Cultivated Areas	Medium	18,197
	Desert Barrens	Medium	46,430

	Riverine Corridors	High	875

*Distance of sector where RoW passes near or crosses hydromorphic island and lagoon habitats. Actual length of such habitats traversed by RoW is approximately 274 m.

Table 22.4 summarizes the distribution of habitat sensitivity categories over the length of the RoW, showing that 19.9% of the RoW length falls under the High Sensitivity category.

Table 22.4 Habitat Sensivity Category Summary

Sensitivity	Length (m)	Percent
Low	80,412	20.0
Medium	241,643	60.1
High	79,945	19.9
Total	402,000	100.0

The EFS categorizes 19.9% of the RoW within the most sensitive category, versus 29.8% in the "most sensitive" category in the ESIA.

Low and Medium Sensitivity Habitats require best practice ecological management procedures that comply with all applicable ESIA commitments, the ECOMP and RP. In addition, site-specific measures apply to High Sensitivity Habitats as described by the ECOMP and RP.

The designation of High Sensitivity Habitat Type means that the specified area is a habitat type within which the EFS has verified the presence of either at least on High Sensitivity Species or at least two medium sensitivity animal species or at least three medium sensitivity plant species. Applying the precautionary principal, this designation requires that the Project take special care to identify the location of sensitive elements within the habitat type and develop appropriate mitigations for these specific locations prior to the start of construction.

In accordance with IFC Performance Standard 1, in areas of High Sensitivity Habitat, no project activities will be implemented unless the following requirements are met:

- There are no measurable adverse impacts on the ability of the critical habitat to support the established population of species or the functions of the critical habitat

- There is no reduction in the population of any recognized critically endangered or endangered species
- Mitigation measures are implemented to achieve no net loss of biodiversity where feasible, which may include but are not limited to actions such as post-operation restoration of habitats, offset of losses through the creation of ecologically comparable area(s) that is managed for biodiversity, and compensation to direct users of biodiversity.

The EFS High Sensitivity Habitats are summarized briefly below:

1. Torobamba River Valley Cultivated Areas. Despite extensive land clearing for intensive cultivation, there are patches and corridors of native vegetation between the fields that contain listed and endemic species typical of dry forests and scrublands of the Apurimac Dry Forest System. Among these species are the endangered cactus *Corryocactus quadrangularis* and the critically endangered rosaceous shrub *Kageneckia lanceolata*.
2. Torobamba River Valley Thorny Scrub. Higher up the valley slopes, patches of thorny scrub harbor the critically endangered rosaceous shrub *Kageneckia lanceolata* and other sensitive dry forest and scrub plants, as well as the endangered white-tailed shrike tyrant, a bird of the flycatcher family.
3. Yucay River Valley Resinous Scrub. The dry Yucay River Valley contains patches of native vegetation belonging to the Mantaro Dry Forest System, including populations of the endangered cactus *Corryocactus quadrangularis* and the vulnerable cactus *Echinopsis peruviana puquiensis*.
4. Pisco-Ica Watershed Divide Mixed and Thorny Scrub. The upper slopes of the western Andes which drain to the Pacific Ocean support highly adapted plant species such as the critically endangered composite shrub *Chersodoma arequipensis* and the regional endemic *Aequatorium tovarii*. A possible new lizard species of the genus *Microlophus* was found by the EFS in high elevation mixed scrub. Also, these habitats may support populations of the endangered rufous-breasted warbling finch, as documented by the ESIA.
5. Coastal Bat Hills Desert Scrub and Columnar Cacti. The lower desert slopes of the Andean foothills support sparse yet diverse vegetation with various threatened and endemic species of cacti and shrubs, including the endangered *Cleistocactus acanthurus*. This habitat supports populations of the critically endangered long-snouted bat (*Platalina genovensium*), a species that feeds exclusively on the pollen and nectar of night-blooming cacti.
6. Pisco Sand Plains Hydromorphic Islands and Lagoons. Among the sand dunes south of the lower Pisco River, there are small oases of wetland vegetation, often surrounding small permanent waterbodies such as the Bernal and Morón lagoons. These unusual habitat islands support fauna that could not otherwise survive in the surrounding desert environment. For example, the vulnerable slender-billed finch, an endemic coastal desert bird that nests only in

hydromorphic thickets and riparian areas, was observed in these habitats. While not containing any highly sensitive species, these habitats are considered to be highly sensitive due to their uniqueness, limited geographic distribution, presence of various medium sensitivity species, and loss of similar habitats in the region to agricultural conversion.

7. Ica-Lima Coastal Plain Riverine Corridors. The coastal plain of south-central Peru is traversed by various highly seasonal rivers and streams. The natural vegetation along these streams was formerly a dense riparian woodland and thicket, but these have largely been lost with the development of irrigated agricultural in the narrow river valleys. Only small fragments of these habitats remain. The rivers themselves have been affected by agriculture and urbanization. Nevertheless, the Pisco River supports a critical species from a socioeconomic perspective, the freshwater river shrimp *Cryphiops caementarius*, an important fishery species with an important contribution to the local economy.

22.2 CONCLUSIONS AND RECOMMENDATIONS RELATING TO THE ECOMP

The ECOMP should address all of the key issues and recommendations of the EFS, as well as the ESIA commitments relating to ecology and biodiversity.

Plant relocation and salvaging

Protected plant species indentified within the RoW and that should be considered for either relocation, salvaging or replacement, where practicable, prior to construction are listed in Table 22.5.

Table 22.5 Protected Plants Identified along RoW by EFS

Family	Scientific Name	Type of Plant	Category	ELU Habitat
Asteraceae	*Aristeguietia discolor*	Shrub	NT*	**Torobamba River Valley** Cultivated Areas
	Chersodoma arequipensis	Subshrub	CR	**Pisco-Ica Watershed Divide** Mixed and

				Thorny Scrub
	Parastrephia quadrangularis	Shrub	VU	**Huamanga-Vischongo Watershed Divide** Tussock Grassland
	Perezia coerulescens	Herb	VU	**Sierra Sillaccasa** Sward-forming Grassland **Apacheta High Sierra** Sward-forming Grassland **Huaytará High Plains and Ridges** Sward-forming Grassland
	Perezia pinnatifida	Herb	VU	**Apacheta High Sierras** Sward-forming Grassland **Pampas-Palmitos River Basins** Sward-forming Grassland
Bignoniaceae	*Tecoma arequipensis*	Shrub	VU	**Torobamba River Valley** Dry Deciduous Forest **Torobamba River Valley** Resinous Scrub
	Tecoma sambucifolia	Shrub	NT	**Torobamba River Valley** Thorny Scrub **Torobamba River Valley**

				Cultivated Areas
Cactaceae	*Browningia candelaris*	Cactus	VU	**Coastal Bat Hills** Desert Scrub **Coastal Bat Hills** Columnar Cacti and Scrub
	Cleistocactus acanthurus	Cactus	EN	**Coastal Bat Hills** Desert Scrub **Coastal Bat Hills** Columnar Cacti and Scrub
	Corryocactus quadrangularis	Cactus	EN	**Torobamba River Valley** Cultivated Areas **Yucay River Valley** Resinous Scrub
	Echinopsis peruviana puquiensis	Cactus	VU	**Yucay River Valley** Resinous Scrub; **Vinchos River Valley** Cultivated Areas
Euphorbiaceae	*Cnidoscolus basiacanthus*	Herb	VU	**Coastal Bat Hills** Columnar Cacti and Scrub

Ephedraceae	*Ephedra americana*	Subshrub	NT	**Apacheta High Sierra** Sward-forming Grassland **Coastal Bat Hills** Columnar Cacti and Scrub
Fabaceae	*Acacia macracantha*	Tree	NT	**Ica-Lima Coastal Plain** Cultivated Areas **Ica-Lima Coastal Plain** Riparian Vegetation **Torobamba River Valley** Cultivated Areas
Glossuraliaceae	*Escallonia myrtilloides*	Shrub	EN	**Yucay River Valley** Thorny Scrub **Huamanga-Vischongo Watershed Divide** Tussock Grassland **Vinchos River Valley** Tussock Grassland **Vinchos River Valley** Resinous Scrub **Apacheta High Sierra** Tussock Grassland

	Escallonia resinosa	Shrub	VU	**Torobamba River Valley** Thorny Scrub **Torobamba River Valley** Cultivated Areas
Orchidaceae	*Myrosmodes* sp.	Bog Orchid	NT	**Campana Watershed** Peat Bogs **Sillaccasa Sierra** Peat Bogs
Rosaceae	*Kageneckia lanceolata*	Shrub	CR	**Torobamba River Valley** Thorny Scrub
	Polylepis pauta	Tree	NT	**Apurimac Valley Montane Forest Ecotone** Upper Montane Forest

*IUCN listing only.

Further studies will be required to determine the specific situation of these species along the RoW, including numbers, distribution and where it is practicable to undertake salvage activities either by direct transplanting or by propagation from cuttings and seeds.

Fauna Relocation

The sensitive species of fauna either confirmed or with potential presence on the RoW are listed in Table 22.6.

Table 22.6 Protected fauna (animal) species with potential presence in RoW based on ESIA and EFS findings.

Scientific Name	Common Name	Category	ELU Habitats
Chaunus spinulosus	Warty toad	NT	**Torobamba River Valley** Cultivated Areas **Torobamba River Valley** Dry Deciduous Forest
Ctenoblepharys adspersa	Lizard	VU	**Ica-Lima Coastal Plain** Desert Barrens **Ica-Lima Coastal Plain** Tillandsia Mats
Dicrodon heterolepis	Lizard	VU	**Pisco Sand Plains** Desert Barrens **Ica-Lima Coastal Plain** Desert Barrens **Ica-Lima Coastal Plain** Riparian Vegetation
Microlophus tigris	Lizard	NT	**Coastal Bat Hills** Columnar Cati and scrub **Ica-Lima Coastal Plain** Desert Barrens
Bothrops pictus	Pit Viper	VU	**Ica-Lima Coastal Plain** Columnar Cacti and Scrub
Bothrops roedingeri	Pit Viper	EN	**Ica-Lima Coastal Plain** Columnar Cacti and Scrub
Agriornis andicola	White-tailed shrike-tyrant	EN	**Campana Watershed** Tussock Grassland **Torobamba River Valley** Thorny Scrub
Asthenes huancavelicae	Pale-tailed canastero	VU	**Apacheta High Sierras** Scarcely Vegetated High Andean Area

Scientific Name	Common Name	Category	ELU Habitats
			Tussock Grassland **Pampas-Palmitos River Basins** Scarcely Vegeated High Andean areas Tussock Grassland **Huaytará High Plains and Ridges** Tussock Grassland Sward-forming Grassland
Cinclodes palliatus	White-bellied cinclodes	CR	**Apacheta High Sierras** Peat Bog
Podiceps occipitalis	Silvery grebe	NT	**Sillaccasa Sierra** Peat Bog
Poospiza rubecula	Rufous-breasted warbling finch	EN	**Pisco-Ica Watershed Divide** Mixed and Thorny Scrub
Theristicus melanopis	Black-faced ibis	VU	**Apurimac River Valley Forest Ecotone** Peat Bogs **Campana Watershed** Peat Bog **Apacheta High Sierras** Peat Bog
Vultur gryphus	Andean condor	EN	**Torobamba River Valley** Resinous Scrub **Sillaccasa Sierra** Sward forming Grassland Tussock Grassland **Yucay River Valley** Thorny Scrub **Apacheta High Sierras**

Scientific Name	Common Name	Category	ELU Habitats
			Scarcely Vegeated High Andean Areas Sward-forming Grassland
Xenospingus concolor	Slender-billed finch	VU	**Pisco Sand Plains** Hydromorphic Islands
Lama guanicoe cacsilensis	Guanaco	EN	**Huamanga-Vischongo Watershed Divide, Apacheta High Sierras, Pampas-Palmitos River Basins and Huaytará High Plains and Ridges** Tussock Grassland Sward forming Grassland
Vicugna vicugna	Vicuña	NT	**Huaytará High Plains and Ridges** Tussock Grassland Sward-forming Grassland
Puma concolor	Puma	NT	**Apurimac River Valley Montane Forest Ecotone** Sward-forming grassland **Torobamba River Valley** Resinous Scrub Dry Deciduous Forest **Siliccasa Sierra** Tussock Grassland **Huamanga-Vischongo Watershed Divide** Tussock Grassland **Apacheta High Sierras** Scarcely Vegetated High Andean Areas
Leopardus jacobitus	Andean	EN	**Pampas-Palmitos River Basin**

Scientific Name	Common Name	Category	ELU Habitats
	mountain cat		Scarcely Vegetated High Andean Areas **Apacheta High Sierras** Scarcely Vegetated High Andean Areas Sward-forming Grassland **Huamanga-Vischongo Watershed Divide** Tussock Grassland
Tremarctos ornatus	Spectacled bear	EN	**Apurimac River Valley Forest Ecotone** Upper Montane Forest
Amorphochilus schnablii	Smoky bat	VU	**Coastal Bat Hills** Columnar Cacti and Scrub
Tomopeas ravus	Blunt-eared bat	CR	**Coastal Bat Hills** Columnar Cacti and Scrub
Platalina genovensium	Long-snouted bat	CR	**Coastal Bat Hills** Columnar Cacti and Scrub

Of the listed species, only the low-mobility amphibians and reptiles such as lizards, toads, frogs and snakes are unlikely to flee from the RoW during clearing activities and these should be identified and relocated immediately prior to the start of construction where observed as part of the Pre-Clearance Survey. Other high mobility species observed during the EFS such as the Andean cat, puma, spectacled bear and birds such as the condor and vulture are highly likely to readily move away from the area of construction disturbance and will therefore unlikely be significantly affected by construction. Camelids, particularly the vicuna which is found in high grassland puna areas between approximately KP 75 and 250 and of socio-economic aswell as ecological sensitivity should receive special management measures to avoid or minimize any impacts during construction.

Noise monitoring should be undertaken at a number of sites as set out in the ESIA to determine any impacts on white-bellied cinclodes, pale-tailed canastero, the rufous-breasted warbling finch and slender-billed finch during the nesting season and efforts

should be taken to identify any live nests which may occur as part of the Pre-Clearance Survey.

The EFS has also identified a number of additional medium sensitivity species, which because of their low mobility and inability to escape intrusive construction activities will require relocation from the RoW prior to site clearance. These are listed in Table 22.7.

Protection of sensitive aquatic habitats such as watercourses, swamps, bogs and marshes (bofadels) should be attained by design and implementation of pollution prevention and erosion control best practices during the construction phase minimizing the risk of contamination by sediment and hydrocarbons and acid rock drainage. Crossing of the Pisco River should be undertaken outside the rainy season to minimize the impacts on the changello shrimp population in this waterbody and crossing of all waterbodies should adopt best practice techniques to minimize the mobilization of sediment and downstream turbidity in the channel.

Bogs are one of the most sensitive habitats crossed by the ROW and are frequently occurring in several ELUs particularly the highland areas. Special techniques such as turf and topsoil strip and storage during construction, erosion controls and strict control of the working area should be adopted to preserved materials that will be critical to longterm reinstatement after completion of construction and prevent the widening of the project footprint beyond the approved area. Preservation and biorestoration of these areas should be dependent on species translocation where practicable prior to construction and seed and cutting collection and propogation to enable the disturbed area to return as closely as possible to its original species diversity as quickly as reasonably possible.

Table 22.7 Low-mobility endemic animal species that may require capture and relocation from RoW

Scientific Name	Type of Animal	Habitats
Chaunus limensis	Toad	**Ica-Lima Coastal Plain** Cultivated Areas Riparian Vegetation
Eleutherodactylus sp.	Andes frog	**Apurimac River Valley Montane Forest Ecotone** Upper Montane Forest
Phrynopus sp.	Andes frog	**Apurimac River Valley Montane Forest Ecotone** Upper Montane Forest

Scientific Name	Type of Animal	Habitats
Telmatobius sp.	Water frog	**Sillaccasa Sierra** Waterbodies **Huamanga-Vischongo Watershed Divide** Waterbodies
Proctoporus sp.	Lizard	**Apurimac River Valley Montane Forest Ecotone** Upper Montane Forest Tussock Grassland Sward-forming Grassland **Campana Watershed** Tussock Grassland Sward-forming Grassland
Liolaemus spp.	Lizards	All Tussock Grassland, Sward-forming Grassland, Scarcely Vegetated High Andean Areas for each ELU where they occur
Microlophus aff. *tigris*	Lizard	**Pisco-Ica Watershed Divide** Mixed Scrub
Stenocercus spp.	Lizards	**Torobamba River Valley** – all habitats within this ELU **Yucay River Valley** – all habitats within this ELU

22.3 CONCLUSIONS AND RECOMMENDATIONS RELATING TO THE PRP

Revegetation

Regeneration of the vegetation cover to restore original localized biodiversity, promote ground and soils stability and minimize erosion risk should be a combination of a natural regeneration process from the native seed bank in the soil and assisted regeneration by additional broadcast or hand seeding and planting of new shrubs, bushes and trees where practicable to replace those lost during site clearance activities where translocation is not possible.

Seed and Cutting Collection for Nurseries Creation

In the case of shrubs and bushes with deep roots and trees, seed and cutting collection programs should be carried out for the creation of nurseries, managed by local communities, which will provide seedlings for the revegetation process during the biorestoration phase after the completion of construction. A large variety of progenitor plants should be included to ensure the genetic variability of populations.

Nursery Maintenance

During the construction phase, nurseries should be preserved in order to have nursery plants for the revegetation programs, to ensure its continuity in case a larger process is needed, and to ensure the transference of the generated technology for future processes.

Seeding

Native species should be used wherever practicable using species representative of the ROW and surrounding habitats. When naturalized species use is required in the absence of native species or in high risk erosion areas where an accelerated process of revegetation cover is required to protect the ROW and which cannot be achieved by native species, strict control rules should be established in order to avoid that they become invasive and that they are representative of and compatible with the habitats on and surrounding the RoW.

Physical issues

The most sensitive areas regarding erosion processes and geologic instability are dominated by the steep slopes of very sheer hills with superficial soils and with granite outcrops that may require blasting or excavation with machinery that will demand considerable geo-engineering for the stabilization and the biorestoration alone will be a small complement to these engineering works where possible.

The depth and the quality of the topsoil and its preservation and protection during the construction phase will be important factors in the biorestoration process.

In areas with high and moderate slopes, bioestoration will play a very important role and the measures will depend on the conditions of structure and fertility of the soil at the particular location, since most of the assessed soils are from low to medium fertility levels and very few have high fertility.

The most restrictive factors are low phosphorus availability in most of the soils, followed by low organic matter content. These increase in cultivated areas.

In areas of greatest erosion and mass wasting risk such as steep slopes with thin and infertile topsoils and close to sensitive waterbodies, fertilizer application should be considered on a very localized basis to enhance the rate and extent of revegetation and hence promote ground protection and stabilization. The use of scarefully slected faster growing naturalized species should also be considered in thes locations. Fertilizer should not be used in wetland and bog habitats where a localized change in the pH of the soil and water could affect these delicate habitats and compromise acid-tolerant plant spcies.

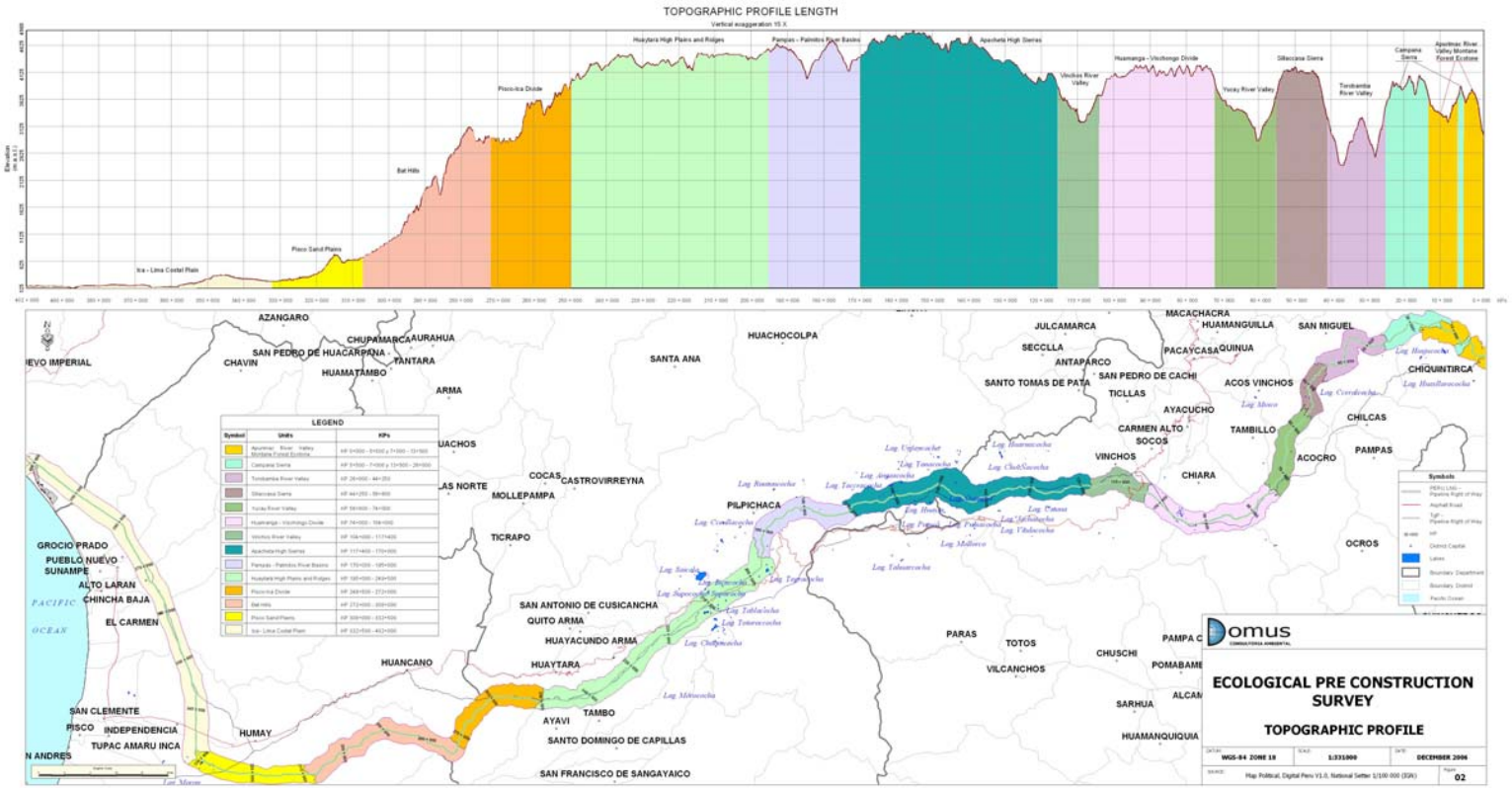
Hydroseeding should also be considered on a very localized scale in the highest risk areas such as steep, erodable slopes and close to major rivers, where it is practicable to undertake this measure.

Other biorestoration measures such as organic applications from mulching (hay/straw) to enhance soil fertility and structure, compost or manure and jute matting should be considered in risk areas.

23.0 APPENDICES

23.1 CARTOGRAPHY

Figure 23.1.1 Topographic Profile of the ROW



23.2 METHODOLOGY

23.2.1 Vegetation

23.2.1.1 Team Organization

The Vegetation Team was formed by 4 Field Survey Groups, each composed of a specialist and a local assistant. Each group covered a specific segment of the ROW, dividing their activities according to the physiographic conditions of the 402 km and the resources to be evaluated. The team collected not only flora information but also physical information as to complement the information of the soil evaluators. Soil and plant samples were collected as needed. (Note: the vegetation and ornithology groups worked and traveled together in the field).

23.2.1.2 Data Recording

In order to achieve with the EFS objectives, data obtained were focused on the identification of sensitive habitats for within and adjacent to the ROW. The focus was to determine the sites which support plant species considered important because of their conservation status as listed by 2006 IUCN Red List and the Peruvian DS N° 043-2006-AG (the INRENA list of threatened plant species), as well as the sites with high value of floral diversity or presence of endemic species.

Prior to the field evaluation, data from previous studies performed within the area were used to prepare documents to facilitate the identification of species and habitats in the field:

- Photo gallery of threatened species considered by the IUCN and the DS N°043-2006-AG, as well as endemic species suspected to be present within the area.
- Preliminary map of habitats that offer important environmental services (i.e., wetlands)
- Preliminary map of habitats with high value of floral diversity.

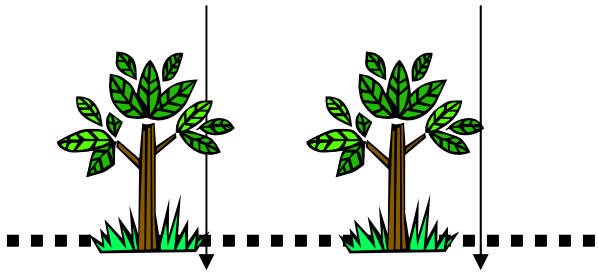
For the quantitative description of habitat types along the pipeline ROW, community sampling and plant specimen collection were performed in the area. The sampling consisted of a total of 30 50-m transects. In case of trees and shrubs, 4-m wide transects where all individuals from all the species present in the area were registered. The approximate coverage and phenology was also registered. In addition, "point

quadrat" method was used to determine the number of hits of each species with the help of a "needle" that goes from the soil to the highest part of the vegetation. This method offers an indirect measure of the biomass (repeated cover). A point was sampled each meter along the transect in areas with only herbaceous species.

"Point-Quadrat" Method

The point-quadrat is a method that was designed at the beginning to obtain the values of the frequency variable (presence-absence) in herb and bush communities. Later it was used to obtain cover data (projected area on the soil covered by plants). However, this method shows to be very useful generating "repeated cover" values that are calculated from the number of times a plant touches a "needle" ("zero" width and "infinite" length in theory). So the number of times the plant hits the needle will depend not only on the simple cover but also on the size and volume of the plant foliage becoming an indirect and non-destructive measure of the biomass. So that the repeated cover values has a high correlation with the ones of the biomass.

The following explains how the data was obtained:



As it can be observed, in the first case the needle hits the shrub three times and the herbaceous plant once. In the second case, the needle hits the shrub only once and does not touch any herbaceous cover. So the value for the first case is 4 and 1 for the second. For this study, 50 equally-spaced location points for the needles were used in a 50-m linear transect.

The plant species and the number of hits with the needle were registered in each point. The sum of values in the 50 points for each species was considered as the abundance measure ("repeated cover"). This measure was used to calculate the diversity indicators and the percentage of abundance (having as the total sum the number of hits in the 50 points of all the plant species). The following measures were calculated:

P1a = Number of hits between needle 1 and the species a.

ΣPa = (P1a + P2a + … + P50a) = Total Sum of hits between the needles and the species a.

ΣP = (ΣPa + ΣPb +…) = Total Sum of hits between needles and species.

Percentage of Abundance of species a = (ΣPa/ΣP) x 100

23.2.1.3 Sampling

A visual search of all plant species suspected to be present in the study area was performed separating every collection and/or record by location and type of vegetation.

A photographic record of the representative areas of each type of vegetation by sampling locations will be also performed, as well as a photographic record of the most important plant species (because its abundance, peculiarity, visual value, etc.).

Interviews applied to locals were made about the location of important species and the way they use those species.

Botanical samples were collected from plants with flowers and fruits, when possible. The specimens were preserved with 96% alcohol in botanical presses and later transported to Lima for their identification and donation to the herbaria of the San Marcos and La Molina universities.

23.2.2 Ornithology

23.2.2.1 Team Organization

The Ornithology Team consisted of 4 field groups which collectively covered nearly the entire length of the ROW to record the information on threatened or endemic birds present. These groups also made opportune observations of other faunal groups to complement the existing data and areas not covered by the Herpetology and Mammalogy teams.

23.2.2.2 Data Recording

During the evaluation, the following data were collected: day, starting time, final time and observer. Species were recorded as they were observed in the field. In the same census, all birds species encountered, visually or heard were registered according to the following data: species, number of individuals seen, habitat in which it was seen, place where it was seen, special remarks if any. In addition, all the species captured by means of mist nets were registered taking into account the following information: species, number of individuals, habitat and capture location special remarks if any.

The design of the study focused on the presence of rare species and habitat specialists, because common species adapt themselves easily to environmental changes and their presence could not be affected even though there is a strong environmental change. On the other side, rare species and specialists generally need a special adaptation with respect of any specific resource.

23.2.2.3 Sampling

In order to complete the total lists of birds for each site, mist nets were placed at 16 sites to complete censuses, and all individuals registered were released. In rapid evaluations such as the present EFS, mist nets provide little qualitative data for comparisons; however, they do provide important information on the presence of species which are not easily observed. More time would be required for each site to provide meaningful quantitative data.

23.2.3 Herpetology

23.2.3.1 Team Organization and Evaluated sites

The Herpetology Team consisted of two field groups. Highly sensitive areas identified from the Biological Sensitivity Map of the Environmental and Social Impact Study. The two groups of evaluators collected information in detail about habitats characteristics and species composition.

In some zones, these groups worked together with the Hydrobiology groups due to the habitat characteristics (mainly amphibians). Morning and evening inspections were carried out along transects. Voucher specimens were collected and sent for identification to the San Marcos University Natural History Museum.

Table 23.2.1. Herpetology Sampling Points

Sampling Points	Progressive	Habitat Type
1	397+500	Tillandsia Mat
2	389+300	Resinous Scrub/Cultivated Area
3	361+500	Thorny Scrub
4	334+700	Resinous Scrub
5	329+600	Coastal Hydromorphic Islands
6	329+000	Thorny Scrub
7	308+000	Tillandsia Mat
8	298+000	Columnar Cacti And Scrub
9	260+500	Desert Scrub
10	255+000	Mixed Scrub
11	251+000	Mixed Scrub
12	227+000	Tussock Grassland
13	217+000	Tussock Grassland
14	216+000	Scarcely Vegetated High Andean Areas
15	210+000	Sward-Forming Grassland
16	202+000	Sward-Forming Grassland
17	199+500	Scarcely Vegetated High Andean Areas
18	191+000	Peat Bog

Sampling Points	Progressive	Habitat Type
19	185+000	Tussock Grassland
20	164+000	Peat Bog
21	160+000	Scarcely Vegetated High Andean Areas
22	156+000	Peat Bog
23	154+000	Scarcely Vegetated High Andean Areas
24	146+000	Scarcely Vegetated High Andean Areas
25	137+000	Tussock Grassland
26	122+000	Sward-Forming Grassland
27	116+000	Resinous Scrub/Cultivated Area
28	114+000	Resinous Scrub
29	92+000	Peat Bog
30	74+500	Tussock Grassland
31	73+400	Eucalyptus Plantation
32	57+000	Thorny Scrub
33	56+500	Tussock Grassland
34	49+000	Sward-Forming Grassland
35	47+500	Tussock Grassland
36	46+500	Tussock Grassland
37	45+500	Tussock Grassland
38	45+000	Tussock Grassland

Sampling Points	Progressive	Habitat Type
39	44+000	Resinous Scrub
40	42+500	Resinous Scrub
41	41+000	Resinous Scrub
42	40+500	Dry Deciduous Forest
43	40+000	Cultivated Area
44	39+000	Thorny Scrub
45	38+800	Cultivated Area
46	37+000	Thorny Scrub
47	36+000	Cultivated Area
48	33+000	Thorny Scrub
49	32+000	Cultivated Area
50	31+500	Cultivated Area
51	30+700	Thorny Scrub
52	30+500	Thorny Scrub
53	27+000	Thorny Scrub
54	25+500	Tussock Grassland
55	25+000	Tussock Grassland
56	23+000	Sward-Forming Grassland
57	22+000	Peat Bog/Sward-Forming Grassland
58	21+500	Sward-Forming Grassland
59	19+000	Sward-Forming Grassland

Sampling Points	Progressive	Habitat Type
60	17+000	Tussock Grassland
61	15+500	Sward-Forming Grassland
62	15+000	Sward-Forming Grassland
63	12+000	Tussock Grassland
64	11+500	Sward-Forming Grassland
65	7+500	Upper Montane Forest
66	7+000	Upper Montane Forest/Tussock Grassland
67	1+500	Upper Montane Forest
68	1+000	Upper Montane Forest

23.2.3.2 Data Recording

The study design was based on general observations and collections using the Visual Encounter Surveys (VES) method (Crump & Scott 1994), which consists on walking on an area or habitat searching for animals, during a specific time. This method among others is used to measure the species composition and determine their richness and abundance.

Points for study had been select using the ESIA information and available cartography. In the sampling points, transects were established around various habitats and micro-habitats. Transects will be traveled during the night with the help of headlamps after an inspection of the area was done during the day. Geographic coordinates and altitude were registered by means of a GPS. The height above ground were recorded for all individuals observed or captured, as well as the type of substrate or refuge where the specimen was found.

Standardized VES field forms were used to collect information about each specimen, and they were hand collected. Amphibians and reptile were put into plastic or cloth bags. Measures taken were snout-cloaca length (SVL) and the length of reptiles' tails with a

1.0 Mixed Scrub Vernier. Diagnostic photographs from the ventral, dorsal and lateral regions were taken, as well as general habit photographs.

23.2.3.3 Specimen Collection

Vouch specimens of amphibian specimens were euthanized with Orajel (anesthesic) or its equivalent. Reptile specimens were euthanized with Ketalar and then they were fixed in Formalin at 10% and preserved in alcohol at 70%. Tissue samples (muscles and/or liver) of every species were collected and preserved in ethanol at 95%. The identification photos were encoded with field specimen numbers in the photographic register.

23.2.4 MAMMALS

23.2.4.1 Team Organization and Evaluated Sites

The Mammals groups traveled along with the Herpetology groups and focused on the sampling localities listed in Table Nº 4 below.

Table 23.2.2. Mammals Sampling Points

Sampling Points	KP	Habitat Type
1	389+300	Resinous Scrub, Cultivated Area
2	362+500	Resinous Scrub
3	329+800	Coastal Hydromorphic Islands
4	308+500	Desert Barrens
5	304+300	Columnar Cacti And Scrub
6	298+500	Columnar Cacti And Scrub
7	297+500	Columnar Cacti And Scrub
8	253+000	Mixed Scrub
9	230+000	Sward-Forming Grassland
10	229+000	Tussock Grassland
11	201+000	Sward-Forming Grassland
12	186+500	Tussock Grassland
13	163+000	Scarcely Vegetated High Andean Areas
14	133+000	Sward-Forming Grassland
15	103+000	Tussock Grassland

16	92+200	Peat Bog
17	85+500	Peat Bog
18	72+000	Cultivated Area
19	71+000	Cultivated Area
20	62+500	Resinous Scrub/Cultivated Area
21	57+000	Thorny Scrub
22	56+000	Tussock Grassland
23	40+500	Dry Deciduous Forest
24	29+000	Cultivated Area
25	11+500	Sward-Forming Grassland
26	10+500	Upper Mountain Forest
27	10+200	Upper Mountain Forest
28	4+500	Cultivated Area
29	2+000	Upper Montane Forest

23.2.4.2 Data Recording

On each evaluation tract, transects were implemented. Within each transect, trap lines for small mammals were placed. Walkthroughs in the habitats previously identified on the base cartography were carried out for direct sightings of large and medium mammals with the help of binoculars. Transects was searched for indirect evidence of species such as tracks, burrows, scat, and skulls from owl pellets will be searched for. Locals were interviewed about the current and historical presence of mammal species in each zone, as well as uses for each species mentioned, with the aid of photos from specialized guidebooks. To the extent possible, photographic evidence was obtained to support observations.

Each transect was identified with GPS coordinates of endpoints and vertices. A photographic record of the dominant plant communities was also be obtained.

23.2.4.3 Specimen Collection

Following the procedures of Voss and Emmons (1996), 130 TOMCAT traps were placed in the afternoon to collect small mammals at each sampling locality and were checked the following morning.

Animals captured in the TOMCAT traps were measured, weighed and prepared to be fixed with Formalin at 10% and preserved with alcohol at 75%, following the procedures of Nagorsen and Peterson (1980).

Bats were captured for identification in mist nests set up at each sampling locality. Representative specimens of morphospecies that unidentified in the field were euthanized and preserved (as described above).

Collected specimens were identified at the Mammalogy Department laboratory of the UNMSM Natural History Museum. To accomplish the identification, inspection of skulls and external characters, as well as the use of specialized keys, a comparison between captured specimens and the museum collections will be necessary. The extraction and cleaning of skulls were done previously with the help of *Dermestes* larvae. Biological material from the samples were deposited in the Mammals Collection of the San Marcos Natural History Museum.

23.2.5 Hydrobiology

23.2.5.1 Evaluated Sites

Compared to terrestrial environments, aquatic ecosystems are often more sensitive to disturbance of their habitat because of the connectivity of their environment. Thus, 22 sampling stations have been determined through out the study area (Table Nº 5). Twenty five percent of the stations correspond to lentic environments (lakes or lagoons) and the remained to lotic environments (rivers and streams). The selection criteria include permanent aquatic bodies as well as the ones that could be refuge for endemic and native species, in the high Andean zones for fish (*Astroblepus, Orestias* and *Trichomycterius*), and in the coastal areas for aquatic invertebrates (*Cryphiops caementarius*).

Table 23.2.3. Hydrobiology Sampling Points

Sampling Point	KP	Description
1	389+400	Q. Topará
2	364+500	R. Chico
3	362+500	R. Matagente
4	334+800	R. Pisco
5	329+600	L. Morón
6	329+000	Lagunillas
7	241+000	B. Taccra
8	224+000	Q. TaSward-forming Grasslandampa

9	212+200	Q. Canya
10	211+500	L. Quisacocha
11	209+500	R. Leche Leche
12	201+000	Q nn
13	186+500	R. Pampas
14	175+500	Q. Pichjahuasi
15	173+800	Q. Huayco Corral
16	162+000	B. Yuarilla
17	156+000	L. Yanacocha
18	149+500	Q. Antacocha
19	145+500	B. Yanacancha
20	136+700	L. Challhuacocha
21	135+000	B. Soytusoytu
22	110+500	R. Vinchos
23	110+00	Q. Urpaypampa
24	95+500	L. Choquehuacgra
25	92+200	B. Chaquicocha
26	85+500	B. Acchacruz Orcco
27	80+800	B. Carimayo
28	71+000	Q. Jatunchancara
29	62+500	Q. Afluente
30	62+500	Q. Huayco
31	62+500	R. Yucay
32	53+200	B. Nina Orcco
33	51+200	L. Nina Orcco
34	49+500	Q. Soccosmayo
35	48+800	L. Yanacocha
36	39+000	R. Torobamba
37	30+000	Q. Uras
38	29+000	Q. Yanacaca
39	22+700	Q. Campana
40	17+000	L. Yanapacha
41	14+500	B. Cochas
42	10+000	R. Sachapampa
43	0+500	Q. Collpa R.
44	0+000	Alfarpampa

23.2.5.2 Data Recording

A field form was designed for the characterization of the physical structure of each of the sampling stations. This form was useful to ensure the comparability of the hydrobiological community structures evaluated.

Information such as type of environment, area, and associated vegetation was specified in the form mentioned above. A portable multiparameter measuring device (YSI 85) and a pH meter was used to register field parameters (temperature, conductivity, pH and dissolved oxygen). This information is relevant to know how these parameters are associated to the type of existing fauna.

23.2.5.3 Sampling

23.2.5.3.1 Benthos Evaluation

In the lotic and lentic environments, there are habitats associated to either hard substrates (boulders, stones, and gravel) or soft substrates (silts, clay, and sand), and habitats formed by aquatic vegetation (macrophytes, algas, and allochthonous material). The communities that have a wide diversity of aquatic macro-invertebrates on its riverside or environments entirely under water were evaluated with a 0,1 m^2 Surber net which has a 500 µm mesh. In each sampling station, a sample from each habitat was collected and put into a plastic bag with 10% Formalin neutralized with borax. Each sample was labeled with its corresponding identification label, specifying the date, sampling station and sample type. Benthos samples were determined taxonomically by the Entomology Laboratory of the Universidad Nacional Agraria La Molina.

23.2.5.3.2 Fish Evaluation

Fish evaluation ware take place in lotic environments within 100-m transects. Specimens were collected by an electric discharge device and put into 10-l plastic containers, so specialists could select any to later identification. Every specimen selected for identification was measured (mm) and weighed (g) in situ, the rest were returned to their natural environment. Then they were immersed in 10% Formalin neutralized with borax, labeled individually, and sent to Lima for their identification at the Ichthyology Department of the Natural History Museum - UNMSM.

In the lentic environments with depths of 50 cm or greater, a 0.5-inch-mesh cast net was used instead of an electric discharge device. 10 casts were carried out for each sampling station. The specimens captured will be determined and evaluated in situ, except those that could not be identified. They were immersed in Formalin neutralized with borax at 10%, labeled individually and sent to the Ichthyology Department of the Natural History Museum – UNMSM for their identification.

In the lentic environments with water levels of less than 50 cm, the electric device for fish capture was used.

Specimens weighing more than 200 g were injected with Formalin at 10% before putting them into the collection bags.

23.2.6 SOILS

23.2.6.1 Team Organizationa and Evaluated Sites

Two soils groups collect samples and described soils at pre-selected sites along the ROW corridor at locations listed in Table N° 5 below. Areas with agriculture (crops and plantations) and livestock production activities (pastures and natural rangelands), coastal wetlands, shrublands, and peat bogs were differentiated in order to have the information about the different uses of the soil.

Table 23.2.4. Soils Sampling Points

Sampling Point	Progressive	Number of samples
1	380+000	4
2	364+000	4
3	353+000	3
4	334+000	4
5	310+000	2
6	309+000	4
7	290+000	3
8	260+000	4
9	256+000	4
10	251+000	4
11	227+000	4
12	225+000	1
13	220+000	1
14	215+000	1
15	210+000	1
16	205+000	1
17	200+000	3
18	195+000	1
19	190+000	1
20	187+000	2

21	185+000	1
22	180+000	1
23	175+000	6
24	175+000	1
25	170+000	1
26	165+000	1
27	160+000	1
28	155+000	1
29	150+000	1
30	145+000	1
31	140+000	1
32	135+000	1
33	134+000	1
34	131+000	3
35	130+000	1
36	120+000	1
37	117+000	1
38	116+000	2
39	114+000	1
40	111+000	1
41	108+000	1
42	105+000	3
43	104+000	3
44	102+000	1
45	100+000	2
46	99+000	1
47	96+000	1
48	93+000	1
49	90+000	1
50	88+000	1
51	87+000	1
52	84+000	1
53	81+000	1
54	78+000	1
55	75+000	1
56	73+000	1
57	72+000	1
58	69+000	1

59	66+000	1
60	63+000	2
61	61+000	5
62	59+000	1
63	53+000	2
64	50+000	1
65	47+000	1
66	46+000	2
67	45+000	1
68	44+000	5
69	41+000	5
70	35+000	2
71	32+000	1
72	31+000	4
73	30+000	2
74	29+000	4
75	28+000	1
76	21+000	2
77	15+000	1
78	8+000	1
79	5+000	1
80	0+500	1

23.2.6.2 Data Recording

Data collected by each group of specialists in the field included topography, stoniness, gradients, soil fauna, erosion, drainage, riverside stability, slopes, etc.

23.2.6.3 Sampling

In the Andean sector, samples were taken every 10 km, with 2 samples in 2 positions at 2 depths of 0-10 cm and 10-30 cm. Samples taken exceed 150, more than 4 for each 10-km portion and 2 sites and at 2 depths (0-20 and 20-40 cm) were taken more or less every 20 km.

Apparent density was measured to estimate compaction and calculate nutrients reserves. Characterization analysis included texture, pH, salts, carbonates, organic matter content, available phosphorus, available potassium, cation exchange capacity, and exchangeable cations such as calcium, magnesium, potassium, and sodium.

23.3 REFERENCES

23.3.1 General

Peruvian normative:

- D.S. 034-2004-AG. Categorización de Especies Amenazadas de Fauna Silvestre.
- D.S. 043-2005-AG. Categorización de Especies Amenazadas de Flora Silvestre.

23.3.1 Botany

Alverson, W. S., B. A. Whitlock, R. Nyffeler, C. Bayer, & D. A. Baum. 1999. Phylogeny of the core Malvales: evidence from ndhF sequence data. American Journal of Botany 86: 1474–1486.

ANGIOSPERM PHYLOGENY GROUP. 2003. An update of the Angiosperm Phylogeny Group classification for the orders and families of flowering plants: APG II. Botanical Journal of the Linnean Society , 2003, 141:399–436.

Armesto J. J., C. Smith-Ramirez & R. Rozzi. 2001. Conservation strategies for biodiversity and indigenous people in Chilean forest ecosystems. Journal of The Royal Society oj New Zealand 31(4):865-877.

Baum, D., S.D. Smith, A. Yen, W.S. Alverson, R. Nyffeler, B.A. Whitlock & R.L. Oldham. 2004. Phylogenetic relationships of Malvatheca (Bombacoideae and Malvoideae; Malvaceae sensu lato) as inferred from plastid DNA sequences. American Journal of Botany 91:1863-1871.

Brack A. 1986. Ecología de un país Complejo. En: Gran Geografía del Perú. Naturaleza y Hombre. Volumen II, Pp. 175-319. ManferJuan Mejía Baca, Barcelona, España.

Comisión Nacional Forestal de México. Sin año. *Dodonaea viscosa*. SIRE-Paquetes tecnológicos. Comisión Nacional Forestal de México.

Gentry, A. H. 1992. Bignoniaceae - Part II (Tribe Tecomeae). In: Organization for Flora Neotropica, ed., Fl. Neotrop. Monogr. 25(2):284.

IUCN 2006. 2006 IUCN Red List of Threatened Species. <www.iucnredlist.org>. Downloaded on 8 December 2006.

Kessler, M. & A. N. Schmidt-Lebuhn. 2006. Taxonomical and distributional notes on Polylepis (Rosaceae). Org. Divers. Evol. 6, Electr. Suppl. 1: 1 - 10 (2006)

León, B.; J. Roque, C. Ulloa, N. Pitman, P. M. Jørgensen y A. Cano. (en prensa). El libro rojo de las plantas endémicas del Perú. Rev. peru. biol. Número especial 13(2).

Legislación peruana (D.S. 043-2006-AG), Aprueban categorización de flora silvestre.

Linares-Palomino, R. 2004. Los Bosques Tropicales Estacionalmente Secos: II. Fitogeografía y Composición Florística. Arnaldoa 11(1):103-138.

Ministerio de Ambiente, Vivienda y Desarrollo Territorial de Colombia. 2003. Restauración de Ecosistemas a partir del Manejo de la Vegetación: Guía Metodológica. Ministerio de Ambiente, Vivienda y Desarrollo Territorial de Colombia, Bogota.

Porter, M. 1970. The genus *Dodonaea* (Sapindaceae) in the Galápagos Islands. Occasional papers of the California Academy of Sciences 81:1-4.

Ramos, C. 2002. Producción de hojarasca en *Dodonaea viscosa* (Sapindaceae) un mecanismo que facilita la sucesión primaria. Acta Biológica Colombiana 7(1):53-56.

Reynel, C., Pennington, R., Pennington, T., Flores, C. y Daza, A. 2006. Árboles útiles del Ande Peruano. Una guía de identificación, ecología y propagación de las especies de la Sierra y los Bosques Montanos en el Perú. Herbario de la Facultad de

Ciencias Forestales de la Universidad Nacional Agraria – La Molina, Royal Botanic Gardens Kew, Royal Botanic Gardens Edingburgh e ICRAF. 466 p.

Romoleroux, K. 2004. The genus Lachemilla (Rosaceae) in the northern Andes of South America. Lyonia 7(1):21-32.

Stadler-Kaulich, N. 2004. Un Ensayo de Agroforestería Sucesional en el Valle de Cochabamba, Bolivia. Zonas Áridas 8:63-68.

Tate, J. A.; J. Fuertes Aguilar, S. J. Wagstaff, J. C. La Duke, T. A. Bodo Slotta & B. B. Simpson. 2005. Phylogenetic relationships within the tribe Malveae (Malvaceae, subfamily Malvoideae) as inferred from ITS sequence data. American Journal of Botany 92(4): 584 - 602.

University of Hawai at Manoa. 2001. *Dodonaea viscosa*. Hawaiian Native Plant Propagation Database. http://www2.hawaii.edu/~eherring/hawnprop/dod-visc.htm (Last updated: 18 September 2001, Revised: 3 December 2006).

USDA, ARS, National Genetic Resources Program. Germplasm Resources Information Network - (GRIN) [Online Database]. National Germplasm Resources Laboratory, Beltsville, Maryland. http://www.ars-grin.gov/cgi-bin/npgs/html/taxon.pl?105263 (8 December 2006)

Weberbauer A. 1945. El Mundo Vegetal de los Andes Peruanos. Estación Experimental Agrícola de La Molina, Lima, 776 pp.

Weigend, M.; E. Rodríguez & C. Arana. 2006. The relict forest of Northwest Peru and Southwest Ecuador. In: M. Weigend, E. Rodríguez & C. Arana (comps.) Los bosques relictos del Noroeste de Perú y Suroeste de Ecuador, Número especial Revista Peruana de Biología 12 (2): 185-194.

Weigend, M.; A. Cano & E. Rodríguez. 2006. New species and new records of the flora in Amotape-Huancabamba Zone: Endemics and biogeographic limits. In: M. Weigend, E. Rodríguez & C. Arana (comps.) Los bosques relictos del Noroeste de Perú y Suroeste de Ecuador, Número especial Revista Peruana de Biología 12 (2):249-274.

Williams, T. 2002. America's largest weed. Audubon 104:24-31.

23.3.3 Herpetology

Carrillo de Espinoza, N. & J. Icochea. 1995. Lista Taxonómica preliminar de los reptiles vivientes del Peru. Publicaciones del Museo de Historia Natural, UNMSM, (A) 49: 1-27.

Cei, J. 1993. Reptiles del noroeste, nordeste y este de la Argentina. Herpetofauna de las selvas Subtropicales, Puna y Pampas. Museo Regionale di Science Naturali. Monografía XIV.

Crump, M. y L. Scott. 1994. Visual Encounter Survey. En: Measuring and Monitoring Biological Diversity, Standard Methods for Amphibians. Heyer, W. R., Donnelly, M.A., McDiarmid, R.W., Hayek, L.A.C. y Foster M.S. (Eds). Smithsonian Institution Press (Washintong, D. C.). 364 pp.

Doan, T. y T. Castoe. 2005. Phylogenetic taxonomy of the Cercosaurini (Squamata: Gymnophthalmidae), with new genera for species Neusticurus and Proctoporus. Zoological Journal of the Linnean Society, 143: 405-416.

Duellman, W. y T. Fritts. 1972. A taxonomic review of the southern Andean marsupial frogs (Hylidae: Gastrotheca). Occasional Papers of the Museum of Natural History Museum the University of Kansas, Lawrence, Kansas 9: 1-37.

Duellman, W. y A. Veloso. 1977. Phylogeny of Pleurodema (Anura: Leptodactylidae): A Biogeographic model. Occasional Papers of the Museum of Natural History Museum the University of Kansas, Lawrence, Kansas 64: 1-46.

Duellman, W. 1978. Two new species of Eleutherodactylus (Anura: Leptodactylidae) from the Peruvian Andes. Transactions of the Kansas Academy of Science 81: 65-71.

Duellman, W. y A. Salas. 1991. Annotated checklist of amphibians and reptiles of Cusco Amazónico, Perú. Occas. Pab. Mus. Nat. Hist. Univ. Kansas 143:1-13

Duellman, W. y J. Pramuk. 1999. Frogs of the genus Eleutherodactylus (Anura: Leptodactylidae) in the Andes of northern Peru. Scientific Papers of the Museum of Natural History Museum the University of Kansas 13: 1-78.

El Peruano. 2004. D.S. N°034-2004-AG. p 276853 – 276856.

Etheridge, R, y R. Espinoza. 2000. A semi-annotated bibliography and taxonomy of the Liolaeminae (Squamata:Iguania:Tropiduridae). http://www.sci.sdsu.edu/etheridge/

FANPE 1996. Diversidad Biológica del Perú: Zonas prioritarias para su conservación. Ed. L. Rodríguez.Ministerio de Agricultura, Instituto Nacional de Recursos Naurales.

Fritts, T. 1974. A Multivariate Evolutionary Analysis of the Andean Iguanid Lizard of the genus Stenocercus. San Diego Society of Natural History Memoir 7: 1-89.

Gallardo, J. 1987. Anfibios argentinos: Guía par su identificación. Librería Agropecuaria S. A.

Köhler, G. y E. Lehr. 2004. Comments on Euspondylus and Proctoporus (Squamata: Gymnophthalmidae) from Peru, with description of three new species and a key to the Peruvian species. Herpetologica 60: 501-518.

Laurent, R. 1998. New forms of lizards of the subgenus Eulaemus of the genus Liolaemus (Reptilia: Squamata: Tropiduridae) from Perú and northern Chile. Acta Zoológica Lilloana 44(1): 1-26.

Lavilla, E. y I. De la Riva. Prólogo. En Estudios de las ranas andinas de los géneros Telmatobius y Bratrachophrynus. Eds. Lavilla, E. O. and De la Riva, I. Asociación Herpetológica Española, Valencia 7.

Lehr, E. 2002. Amphibien und Reptilien in Perú. Natur und Tier Verlag, Münster. 208 pp.

Lehr, E. 2006. Taxonomic status of some species of peruvian Phrynopus (Anura: Leptodactylidae), with the description of a new species from the Andes of southern Peru. Herpetologica 62: 331-347.

Lynch, J. 1989. Intrageneric relationships of mainland Eleutherodactylus (Leptodactylidae). I. A review of the frogs assigned to the Eleutherodactylus discoidalis species group. Milwaukee Public Museum Contributions in Biology and Geology, 79: 1-25.

Lips, K. R., J. K. Reaser, B. E. Young, and R. Ibáñez. 2001. Amphibian monitoring in Latin America: a protocol manual / Monitoreo de Anfibios en América Latina: Manual de protocolos. SSAR Herpetological Circular No. 30, 116 pp.

Péfaur, J. y W. Duellman. 1980. Community structure in high Andean herpetofaunas. Transactions of the Kansas Academy of Sciences 83(2): 45-65

Pefaur, J., P. Jiménez, E. López y A. Núñez. 1978. Distribución y clasificación de los reptiles de Arequipa, Perú. Bull. Inst. Fr. Et. And. 7:129-139.

Pineda, E. and G. Halffter. 2003. Species diversity and habitat fragmentation: frogs in a tropical montane landscape in Mexico. Biological Conservation : 1-10

Pramuck, J y F. Kadivar. 2003. A new species of Bufo (Anura: Bufonidae) from southern Ecuador. Herpetologica 59: 270-283.

Rodríguez, L.O., J.H. Córdova y J. Icochea. 1993. Lista preliminar de los anfibios del Perú. Publicaciones del Museo Historia Natural UNMSM (A) 45: 1-22.

Rodríguez, L. 1996. Áreas prioritarias para la conservación de anfibios en el Perú. En Diversidad Biológica del Perú, zonas prioritarias para su conservación. FAMPE, 1996.

Rodríguez, L. y J. Cadle. 1990. A prelyminary overview of the herpetofauna of Cosha Cashu, Manu Nacional Park, Perú. In: Gentry, A (ed) Four Neotropical Rainforest. Yale, New Haven.

Rueda-Almonacid, J., J, lynch, y A. Amézquita. (Eds.). 2004. Liobro rojo de anfibios de Colombia. Serie de libros rojos de especies amenazadas de Colombia. Conservación Internacional Colombia, Instituto de Ciencias Naturales-Universidad Nacional de Colombia, Ministerio de Medio Ambiente. Bogotá, Colombia. 384 pp.

Schlaepfer, M. y T. Gavin 2001. Edges effect on lizards and frog in tropical forest fragment. Conservation Biology 15 (4): 1079-1089.

Sinsch, U. 1986. Anfibios de la sierra central del Perú. Una clave de identificación para adultos y larvas. Boletín de Lima, (45): 23-32.

Vellard, J. 1955. Estudios sobre batracios andinos. III. Los Telmatobius del grupo jelskii. Memorias del Museo de Historia Natural 4: 1-28.

Vellard, J. 1959. Estudios sobre batracios andinos. V. El género Bufo. Memorias del Museo de Historia Natural 8: 1-48.

Vellard, J. 1960. El género Pleurodema en los Andes peruanos. Memorias del Museo de Historia Natural 10: 1-12.

Walsh, 2005. Estudio de Impacto Ambiental y Social del proyecto de transporte de gas natural por ducto de Ayacucho a la planta de licuefacción. Preparado para Perú LNG.

Young, B. E., S. N. Stuart, J. S. Chanson, N. A. Cox, and T. M. Boucher. 2004. Disappearing Jewels: The Status of New World Amphibians. Appendix 3. Comprehensive List of Species. Nature Serve, Arlington, Virginia.

http://www.embl-heidelberg.de/~uetz/LivingReptiles.html

http://research.amnh.org/herpetology/amphibia/index.php

http://amphibiaweb.org/

http://redlist.org/

23.3.4 Mammalogy

Brewer, S.W. and M. Rejmanek. 1999. Small rodents as significant dispersers of tree seeds in a Neotropical forest. Journal of Vegetation Science 10:165-174.

Cabrera, A. y Yepes, J. 1960. South American mammals. Historia Natural, Buenos Aires.

Carthew S. M. R. L. Goldingay 1997 Non-flying mammals as pollinators. Trends in Ecology and Evolution 12: 104-108

Cat specialist group .2004. Oreailurus jacobita. IUCN.

CITES 2006. Appendices I, II y III . < http://www.cites.org/eng/app/appendices.shtml>

Fleming, T. H. y Sosa, V. J. 1994. Effects of nectarivorous and frugivorous mammals on reproductive success of plants. Journal of Mammalogy. 75(4):845-851.

Greene, H.W. (1988). Species richness in tropical predators. In Almeda, F. and Pringle, C.M. (eds), Tropical rainforests. Calif. Acad. Sci. and AAAS Pacific Division, San Francisco. Pp. 259-280.

Hershkovitz, P. 1962. Evolution of Neotropical Cricetinae rodents (Muridae) with special reference to the Phyllotinae Group. Fieldiana Zoology 46: 524.

IUCN. 2006. *2006 IUCN Red List of Threatened Species.* <www.iucnredlist.org>.

Janson, C.H.; Terborgh, J.; Emmons, L.H. 1981. Non-flying mammals as pollinating agents in the Amazonian forest. Biotropica 13 (suppl.): 1-6.

Myers, 1990. A review of the *Boliviensis* Group of *Akodon* (Muridae: Sigmodontinae), with emphasis on Peru and Bolivia. Missellaneous Publication Museum of Zoology, University of Michigan 177: 1-104.

Pearson, O. 1982. Distribución de pequeños mamíferos en el altiplano y los desiertos del Perú. Zoología Neotropical. Actas del VIII Congreso Latinoamericano de Zoología (P. Salinas, Ed.) Merida, Venezuela, 263 – 284.

Pearson, O. 1972. New information on ranges and relationships within the rodent Genus Phyllotis in Peru and Ecuador. Journal of mammalogy, 53 (4): 677 – 686.

Perú LNG, 2005. Estudio de Impacto ambiental y social del proyecto de transporte de gas natural por ducto de Ayacucho a la planta de licuefacción. Volumen II B, Línea Base Biológica, Walsh Perú S.A. Proyecto N° PET – 1239.

Redford, K.H. and Eisenberg, J.F. 1992. Mammals of the Neotropics, Vol. 2: the southern cone. Univ. Chicago Press, Chicago

Rodríguez, L. (Ed.). 1996. Diversidad Biológica del Perú. Zonas Prioritarias para su Conservación. Proyecto FAMPE, GTZ-INRENA. Ministerio de Agricultura. INRENA.

Seidensticker, J. 1991b. Pumas. Pp 130-137 in J. Seidensticker and S. Lumpkin, eds. *Great cats.* Merehurst, London.

Vilá, B.L. y Cassini, M.H., 1994. Time allocation during the reproductive season in vicuñas. Ethology, 97: 226-235.

Voss, R.S. y L.H. Emmons. 1996. Mammals diversity in neotropical lowland rainforest: A preliminary assessment. Bull. Am. Mus. Nat. Hist. 230: 1-115.

Yensen E. y K.L. Seymour. 2000. Oreailurus jacobita. Mammalian Species 644: 1-6.

Yahner, R.H. & Smith, H.R. (1991) Small mammal abundance and habitat relationships on deciduous forested sites with different susceptibility to gypsy moth defoliation. Environmental Management, 15, 113–120.

Wilson, D. E., and D. M. Reeder (eds). 2005. Mammal species of the World. Johns Hopkins University Press, 2,142 pp. (Available from Johns Hopkins University Press, 1-800-537-5487 or (410) 516-6900 http://www.press.jhu.edu/)

23.3.5 Ornithology

Barrio, J. 2002. Evaluación Rápida de la Avifauna, Presencia de Mamíferos, y Prioridades de Conservación en el Parque Nacional Huascarán. Reporte Técnico para el Plan Maestro del Parque Nacional Huascarán. Instituto de Montaña, Huaraz, Perú.

Domus Consultoría Ambiental S.A.C. 2005. Determinación de Índices Medioambientales por Medio del Monitoreo de Aves en el Área de Influencia de la Mina Antamina. Domus Consultoría Ambiental S.A.C., Lima, Perú.

Domus Consultoría Ambiental S.A.C. 2006. Determinación de Índices Medioambientales por Medio del Monitoreo de Aves en el Área de Influencia de la Mina Antamina: segundo año. Domus Consultoría Ambiental S.A.C., Lima, Perú.

Fjeldså, J. 1987. Birds of relict forests in the high Andes of Peru and Bolivia. Technical report from the Polylepis forest expedition of the Zoological Museum, 1987, with some preliminary suggestions for habitat preservation. Zoological Museum, University of Copenhagen, Denmark.

Fjeldså, J. 1993. The avifauna of the Polylepis woodlands of the Andean highlands: the efficiency of basing conservation priorities on patterns of endemism. Bird Conservation International, 3: 37-55.

Frimer, O., & Moller-Nielsen, S. 1989. The status of Polylepis forests and their avifauna in Cordillera Blanca, Peru. Technical report from an inventory in 1988, with suggestions for conservation management. Zoological Museum, University of Copenhagen, Denmark.

23.3.6 Hydrobiology

Flury, B & H. Riedwyl. 1990. Multivariate Statistics: A Practical Approach. Chapman and Hall. London UK. 296 p.

Krebs, C. 1985. Ecología: Estudio de la Distribución y Abundancia. Editorial Harla. México

Krebs, C. 1989. Ecological Methodology. Harper & Row, Publishers. New York. 654 p.

Magurran, A. 1987. Diversidad Ecológica y su Medición. Ediciones Vedra. Barcelona, España. 200 p.

Maldonado, J; A, Ortega; Usma, J; G. Galdis; F. Villa; L, Vásquez; S, Prada y C. Ardilla. 2006. Peces de los Andes de Colombia: Guía de Campo. Instituto de Investigación de Recursos Biológicos Alexander Von Humboldt. Bogotá, Colombia. 346 p.

Margalef, R. 1974. Ecología. Ediciones Omega. Barcelona, España.

Odum, E. 1971. Ecología. Editorial Interamericana. México.

Parenti, L. 1984. A Taxonomic Revision of the Andean Killifish Genus Orestias (Cyprinodontiformes, Cyprinodontidae). Bulletin of the American Museum of Natural History. Vol. 178: Article 2. New York. 212 p.

23.3.7 Soils

Brady, N. 1990. The Nature and Properties of soils. 10ma edición. MacMillan Publishing Company.

Estrada J. y R. Bazan. 1970 Análisis de Suelos y Plantas. Facultad de Agronomía-Departamento de Suelos.

Havlin J, J. Beaton, S. Tisdale And W. Nelson. 1999 Soil Fertility and Fertilizar. Prentice Hall. New Jersey.

Marschner Horst 1995 Mineral Nutrition of Higher Plants. Academic Press. London. New York

Mengel K. y E. Kirkby 2000 Principios de Nutrición Vegetal. Internacional Potash Institute. Basel. Switzerland

Rengel Zdenko 1999. Mineral Nutrition of Crops: Fundamental Mechanisms and Implications. Food Products Press, New York.London. Oxford

Troeh F. and L. Thompson. 1993. Soils and Soil Fertility. 5ta Edición University Press. Ocford. Iowa State University.

23.4 ACROMYMS AND GLOSSARY

Table 23.4.1. ACRONYMS

English	Spanish	Description
RP	**PBR**	Restoration Plan
CMP	**PMC**	Contractor Management Plan
ELU	**UPE**	Ecological Landscape Unit
ECOMP	**PME**	Ecological Management Plan
ESIA	**EIA**	Environmental and Social Impact Assessment
ESMP	**PMSA**	Environmental and Social Management Plan
ESS	**SES**	Ecological Sensitive Sectors
GIS	**SIG**	Geographical Information System
MLU	**UMP**	Micro Landscape Unit
ROW	**DDV**	Right of Way

Table 23.4.2. GLOSSARY

English	Spanish	Description
ABANDONMENT	**ABANDONO**	It is the phase of a hydrocarbons activity in which the necessary measures are applied to correct any environmental adverse condition happened as consequence of operation activities. And to implement the necessary restoration works to turn the area to its natural state or to create appropriate conditions for its new use. Generally the actions for abandonment are developed under an Abandonment Plan that is part of the the management documents of a project. This Plan includes measures to avoid adverse impacts to the environment produce by solid, liquid and gaseous waste that can appear subsequently.
AGGREGATE	**AGREGADOS**	A group of primary soil particles that cohere to each other more strongly than to other surrounding particles.
ALLUVIAL	**ALUVIAL**	Sediments deposited by running water of streams and rivers. It may occur on terraces well above present streams, on the present flood plains or deltas, or as a fan at the base of a slope.
AMPHIBIAN	**ANFIBIOS**	A vertebrate animal of the Class Amphibia. Amphibia are a taxon of animals that include all tetrapods and four-legged vertebrates that do not have amniotic eggs, are ectotherms, and generally spend part of their time on land.
AQUATIC	**ACUÍCOLA**	Pertaining to water, living or growing in water, taking place in water
BAT	**MURCIÉLAGO**	A mainly nocturnal mammal, capable of sustained flight, with membranous wings that extend between the fingers and limbs. Order Chiroptera. It is guided in the darkness by the echoes of the ultrasound it emits; it is nocturnal and passes the day hanging with its head down; there are about 900 species, of very different sizes. Most of the bats are insectivorous, but there are also frugivorous and ichthyovorous. They are important for the dispersion of seeds and the control of insects.
BIRD	**AVES**	A warm-blooded egg-laying vertebrate animal of a class distinguished by the possession of feathers, wings, and a beak, typically able to fly.

English	Spanish	Description
PEAT BOG	**BOFEDAL**	Bog of moor or of Andean puna, created by the agricultural irrigation practices and the drinking trough practices in the soil. Characteristic of the Andean topography and hydrology.
BULK DENSITY	**DENSIDAD APARENTE**	The mass of dry soil (105°C) per unit volume.
BUSH	**ARBUSTO**	Perennial plant which has woody stems and branches and ranges in height from very low to the size of a small tree. Shrub.
CAMELID	**CAMÉLIDO**	Mammal of a family (Camelidae) comprising the camels together with the llama and its relatives.
COLLUVIAL	**COLUVIAL**	Pertaining to material or processes associated with transportation and/or deposition by mass movement (direct gravitational action) and local, unconcentrated runoff on side slopes and/or at the base of slopes. Rock detritus and soil accumulated at the foot of a slope.
COLLUVIAL	**COLUVIAL**	Rock detritus and soil accumulated at the foot of a slope.
DECIDUOUS	**CADUCIFOLIO**	Characteristic of a tree or shrub that sheds its leaves annually.
EDAPHOLOGY	**EDAFOLOGÍA**	Soil science.
EROSION	**EROSIÓN**	The wearing away of the land surface by rain or irrigation water, wind, ice, or other natural or anthropogenic agents that abrade, detach and remove geologic parent material or soil from one point on the earth's surface and deposit it elsewhere, including such processes as gravitational creep and so-called tillage erosion.
FISH	**PEZ**	Type of cold-blooded aquatic animal with fins and scales.
FULVIC ACID	**ACIDO FULVICO**	The pigmented organic material that remains in solution after removal of humic acid by acidification.
GULLY	**CÁRCAVA**	(also **gulley**) A channel resulting from erosion and caused by the concentrated but intermittent flow of water usually during and immediately following heavy rains.
HERPETOLOGY	**HERPETOLOGÍA**	Science that studies the reptiles.

English	Spanish	Description
HORIZON	**HORIZONTE**	A layer of soil or soil material approximately parallel to the land surface and differing from adjacent genetically related layers in physical, chemical, and biological properties or characteristics such as color, structure, texture, consistency, kinds and number of organisms present, degree of acidity or alkalinity.
HYDROBIOLOGY	**HIDROBIOLOGÍA**	The biological study of bodies of water, is the science of life and life processes in water.
HYDROSEEDING	**HIDROSIEMBRA**	The technique of spraying a slurry of seeds, tackifier, mulch and fertilizer on bare ground (often steeply sloping) to hold soil in place while awaiting germination of a ground cover.
IUCN (International Union For Conservation of Nature And Natural Resources, The World Conservation Union)	**UICN**	International conservation institution that annually elaborates the IUCN Red List of Threatened Species. This list provides taxonomic, conservation status and distribution information on taxa that have been globally evaluated using the IUCN Red List Categories and Criteria. This system is designed to determine the relative risk of extinction, and the main purpose of the IUCN Red List is to catalogue and highlight those taxa that are facing a higher risk of global extinction (i.e. those listed as **Critically Endangered**, **Endangered** and **Vulnerable**). The IUCN Red List also includes information on taxa that are categorized as **Extinct** or **Extinct in the Wild**; on taxa that cannot be evaluated because of insufficient information (i.e. are **Data Deficient**); and on taxa that are either close to meeting the threatened thresholds or that would be threatened were it not for an ongoing taxon-specific conservation programme (i.e. are **Near Threatened**).
LANDSLIDE	**DESLIZAMIENTO**	A general term for a mass movement landform and a process characterized by moderately rapid to rapid (greater than 30 cm per year) downslope transport, by means of gravitational stresses, of a mass of rock and regolith that may or may not be water saturated.
MAMMAL	**MAMÍFERO**	Member of the class Mammalia (class of warm-blooded vertebrate animals the female of which secrete milk to feed their young and characterized by a covering of hair on their bodies).
MASS MOVEMENT	**MOVIMIENTO EN MASA**	Dislodgement and downslope transport of soil and rock material as a unit under direct gravitational stress. The process includes slow displacements such as creep and solifluction, and rapid

English	Spanish	Description
		movements such as landslides, rock slides, and falls, earthflows, debris flows, and avalanches. Agents of fluid transport (water, ice, air) may play an important, if subordinate role in the process.
MECHANICAL RESISTANCE	**RESISTENCIA MECÁNICA**	The force applied to a soil with a penetrometer which determine the soil resistance and is giving in kg/cm^2.
PLAIN	**PLANO**	A flat, undulating, or even rolling area, larger or smaller, that includes few prominent hills or valleys, that usually is at low elevation in reference to surrounding areas, and that may have considerable overall slope and local relief.
QUENUAL	**QUEÑUAL**	Quenuales are relict forest formations, with predominance of tree genus *Polylepis*.
REPTILE	**REPTIL**	A cold-blooded vertebrate animal of a class (Reptilia) that includes snakes, lizards, crocodiles, turtles, and tortoises, typically having a dry scaly skin and laying soft-shelled eggs on land.
ROCKS	**ROCAS**	Hard material formed by minerals.
SEEDLING	**PLANTÓN**	Young tree or plant; plant or tree grown from a seed.
SHRUBLAND	**MATORRAL**	Shrubland is a habitat type dominated by woody shrubs. A shrub is a perennial woody plant that branches at ground level to form several stems.
SILT	**LIMO**	Fine particles of sand and other earthy matter which are carried and deposited by water.
SOIL ORGANIC MATTER	**MATERIA ORGÁNICA DEL SUELO**	The organic fraction of the soil exclusive of undecayed plant and animal residues.
SPAWN	**DESOVAR**	Reproduce, produce eggs in large numbers (about aquatic animals); bring forth, give rise to, generate.
TAXON (PL. TAXA)	**TAXÓN (PL. TAXA)**	Categorical classification. Taxa is a grouping of organisms given a formal taxonomic name such as species, genus, family, etc.
TERRACE	**TERRAZA**	(i) A step-like surface, bordering a stream or shoreline, that represents the former position of a flood plain, lake, or sea shore. (ii) A raised, generally horizontal strip of earth and/or

English	Spanish	Description
		rock constructed along a hill on or nearly on a contour to make land suitable for tillage and to prevent accelerated erosion. (iii) An earth embankment constructed across a slope for conducting water from above at a regulated flow to prevent accelerated erosion and to conserve water.
TILLANDSIA	**TILLANDSIA**	Large genus of epiphytic or terrestrial sparse-rooting tropical plants usually forming dense clumps or pendant masses.
TOPSOIL	**CAPA ARABLE**	Topsoil is the uppermost layer of soil, usually the top 15-20 cm. It has the highest concentration of organic matter and microorganisms, and is where most of the Earth's biological soil activity occurs. Plants generally concentrate their roots in, and obtain most of their nutrients from this layer. Topsoil can be measured as the depth from the surface to the first densely packed soil layer known as hardpan.
TREE	**ÁRBOL**	A woody perennial plant typically with a single stem or trunk growing to a considerable height and bearing lateral branches.
WETLAND	**HUMEDAL**	Area of land that has wet soil (such as a marsh or bog). Are sensitive and in general, legally protected areas.
XEROPHYTIC	**XERÓFITO**	A plant adapted for life and growth with a limited water supply.

23.5 PHOTOGRAPHIC GALLERY

ELU 1: Apurimac River Valley (KP 00+000 – 20+511)

Figure 1. Plantations of Polylepis pauta.

Figure 2. Mist nest set in Montane Forest, 10 m far from the river that goes to SP3.

Figure 3. Sachapampa River, KP 10+000.

Figure 4. *Proctoporus sp*. KP 7+500

Figure 5. *Proctoporus sp* in KP 15+000

ELU 2: Campana Watershed (KP 20+511 – 25+115)

Figure 1. Peat bogs in Campana Creek, KP 25+000.

Figure 2. View of Campana KP 21+511

Figure 4. *Lagidium peruanum* "Vizcacha" observed over a stone in thorny scrub

ELU 3: Torobamba River Valley (KP 25+115 – 44+448)

Figure 1. Thorny scrub, KP 33+000

Figure 2. Pati tree, *Eriotheca vargasii* in KP 40+000

Figure 3. Hummingbird *Lesbia luna*, captured in KP 30+000

Figure 4. Thorny Scrub in Patibamba, KP 34+000

ELU 4: Sillaccasa Sierra (KP 44+448 – 56+783)

Figure 1. View of Yanacocha lagoon, Kp 48+800

Figure 2. Echinopsis peruviana subsp. puquiensis, KP 45+000

Figure 3. View of Nina Orcco lagoon Kp 51+200

Figure 4. Pleurotalis sp. over the ROW, Kp 45+000

ELU 5: Yucay River Valley (KP 56+783 – 74+199)

Figure 1 Yucay River Valley, KP 67+000

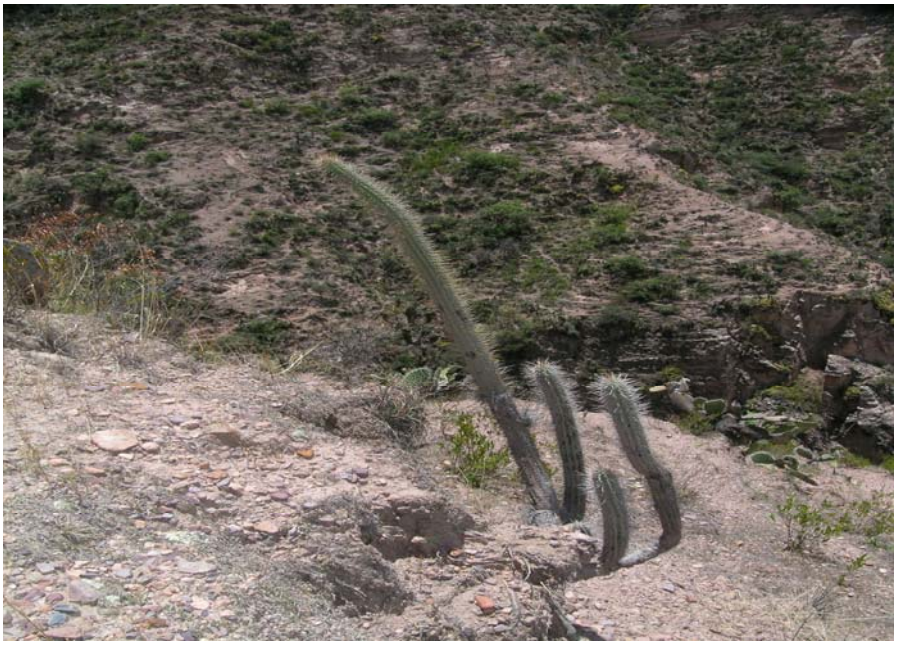


Figure 2. *Cleistocactus morawetzianus*. KP 63+000

Figure 3. *Telmatobius sp*, KP 73+400

Figure 4. View of Yucay River KP 62+500

ELU 6: Huamanga-Vischongo Divide (KP 74+199 to 103+970)

Figure 1. Puna Scrubland in Huamanga-Vischongo Divide, KP 75+000.

Figure 2. *Austrocylindropuntia floccosa* "Huaracco quisqa", Kp 100+700

Figure 3. *Geossita tenuirrostris*, KP 102+000.

Figure 4. *Liolaemus sp*, captured in the KP 92+000

ELU 7: Vinchos River Valley (KP 103+970 – 117+388)

Figure 1. Vinchos River Valley, KP 110+000.

Figure 2. *Austrocylindropuntia floccosa, Austrocylindropuntia subulata* and *Oroya peruviana* KP 110+000

Figure 3. *Diglossa bruneiventris* , KP 112+000.

Figure 4. *Metriopelia ceciliae*. KP 112+000

ELU 8: Apacheta High Sierras (KP 117+388 – 162+137)

Figure 1. View of Ranracancha, KP 120+000.

Figure 2. *Ephedra americana* between *Opuntia floccosa* KP 120+000

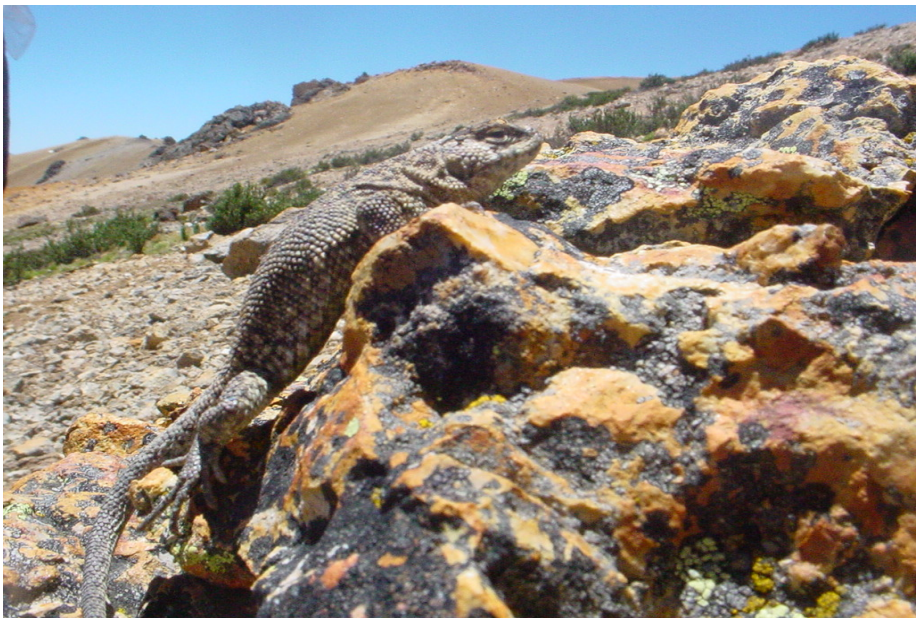


Figure 3. *Liolaemus sp.*, KP 160+000.

Figure 4. *Pleurodema marmorata*. KP Churiac 146+000

ELU 9: Pampas-Palmitos River Basins (KP 162+137 – 195+050)

Figure 1. View of Pampas River Kp 186+500

Figure 2. Matas de *Opuntia Flocosa* in the ROW kp 175+00

Figure 3. View of Huayco Corral Creek Kp 173+800

Figure 4. *Liolemus sp.* Observed over stone taking sunshine Kp 185+000

ELU 10: Huaytará High Plains and Ridges (KP 195+050 – 249+538)

Figure 1. Camelids grazing in Kp 201+000

Figure 2. View of Taccra Pet bog ,Kp 241+000

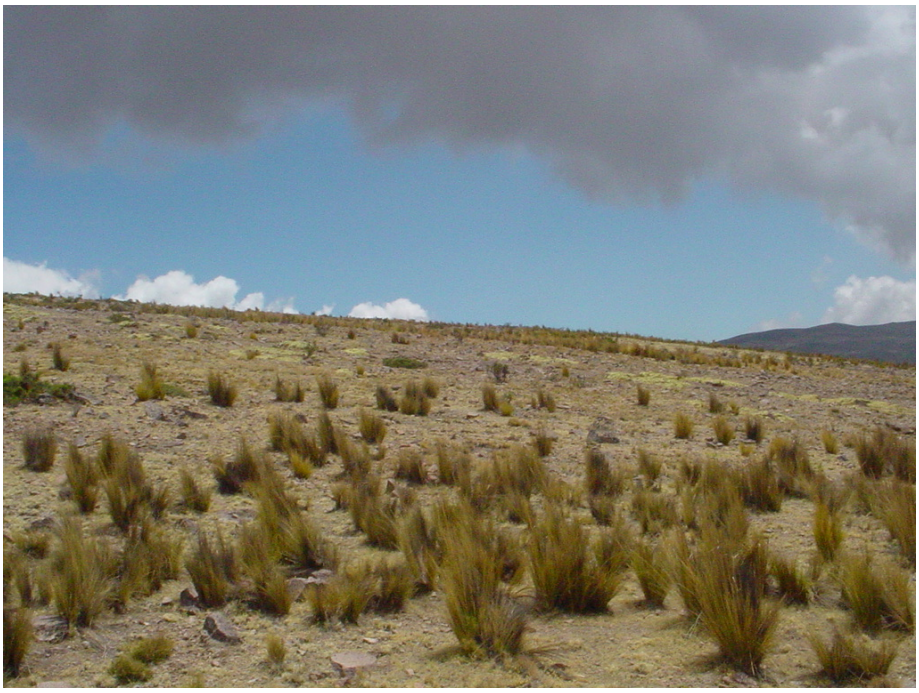


Figure 3. Puna Scrubland in Taccra, KP 227+000

Figure 4. *Liolemus sp.* KP 227+000

ELU 11: Pisco-Ica Divide (KP 249+538+000 to 272+181)

Figure 1. *Senecio tovarii*, KP 261+300.

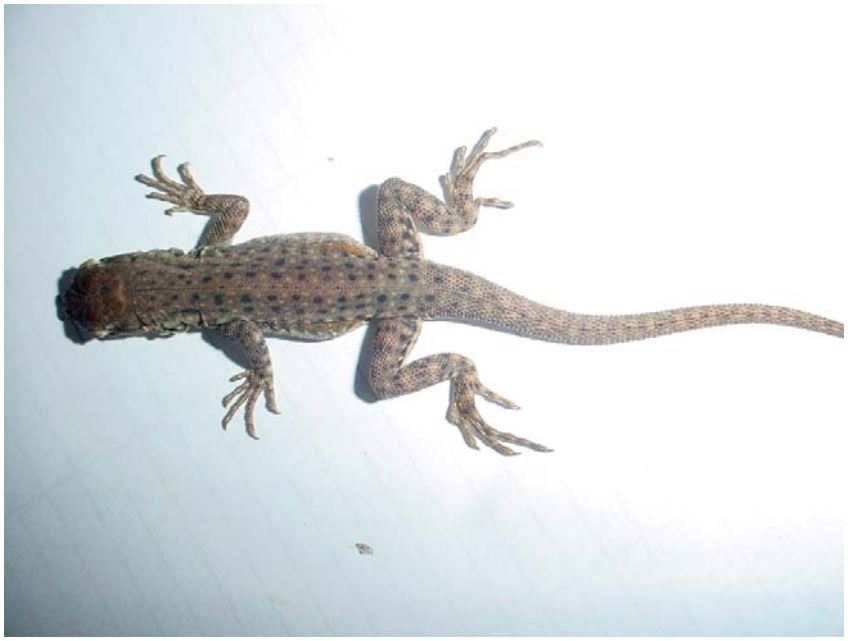


Figure 2. *Microlophus aff. tigris* Captured in , KP 255+000

Figure 3. Mixed Scrub habitat in the KP 255+000.

Figure 4. *Lupinus aff. mutabilis*. KP 252+000

ELU 12: Coastal Bat Hills (KP 272+181 to 308+000)

Figure 1. *Armatocereus procerus* in the KP 301+000.

Figure 2. *Leptasthenura striata* captured in KP 299+500

Figure 3. *Neoraimondia arequipensis*, KP 305+000.

Figure 4. *Microlophus tigris*. KP 298+000

ELU 13: Pisco Sand Plains (KP 308+000 to 332+940)

Figure 1. Tillandsial de *Tillandsia palacea* in the KP 310+000.

Figure 2. Moron Lagoon in the desert Pisco Sand Planis KP 329+600

Figure 3. *Microlophus thoracicus*, KP 329+000.

Figure 4. *Myiophobus fasciatus* nest, KP 329+000

ELU 14: Ica-Lima Coastal Plain (KP 332+940 – 402+000)

Figure 1. *Acacia macracantha* in the KP 390+800.

Figure 2. View of Pisco River KP 334+800

Figure 3. *Dicrodon heterolepis* KP 329+000.

Figure 4. *Cryphiops caementarius* captured in KP 334+800

23.6 List of Species Reported by EFS Field Survey

Table 23.6.1 Species Sensitivity

	Grp	Species	KP reference	Protection Status						Spatial Distribution			Local Use			Mobility		Σ
				CR	EN	VU	NT	L	N	Local	Reg.	Wide.	Perm.	Seas.	None	Inmob.	Mob.	
1	b	*Actitis macularius*	335+200									0			0		0	0
2	b	*Aeronautes andecolus*	62+150 67+400 82+000 94+900									0			0		0	0
3	b	*Aglaeactis cupripennis*	40+100 72+500 76+500									0			0		0	0
4	b	*Agriornis andicola*	17+000 21+650 27+000 30+000			4					2				0		0	6
5	b	*Agriornis montanus*	62+150 67+400									0			0		0	0
6	b	*Amazilia amazilia*	76+500									0			0		0	0
7	b	*Amazilia chionogaster*	40+100								2				0		0	2
8	b	*Ampelion rubrocristatus*	03+400									0			0		0	0
9	b	*Anairetes flavirostris*	40+100 72+500 109+000									0			0		0	0
10	b	*Anairetes parulus*	03+400 12+600									0			0		0	0
11	b	*Anairetes reguloides*	109+100								2				0		0	2
12	b	*Anas bahamensis*	365+250 397+900 389+500									0	2				0	2
13	b	*Anas flavirostris*	21+650 42+550 94+900 103+600 163+400 171+000 176+100									0			0		0	0
14	b	*Anas puna*	88+250 94+900								2			1			0	3
15	b	*Anisognathus igniventris*	03+400									0			0		0	0
16	b	*Anthus bogotensis*	204+900									0			0		0	0
17	b	*Anthus furcatus*	82+000 94+900								2				0		0	2
18	b	*Aratinga mitrata*	05+000								2				0		0	2

19	b	*Ardea alba*	335+200									0			0		0	0
20	b	*Asthenes cactorum*	299+200							3					0		0	3
21	b	*Asthenes huancavelicae*	136+600 141+300 176+100 192+070 204+800 212+700 218+400 223+400			4				3					0		0	7
22	b	*Asthenes humilis*	98+300								2				0		0	2
23	b	*Asthenes modesta*	122+100 135+250 178+600 180+300 190+100 221+850									0			0		0	0
24	b	*Asthenes ottonis*	154+600							3					0		0	3
25	b	*Asthenes* sp.	12+200 35+000 51+200 61+600								2				0		0	2
26	b	*Asthenes virgata*	25+200							3					0		0	3
27	b	*Asthenes wyatti*	132+200								2				0		0	2
28	b	*Athene cunicularia*	286+000 299+200								2				0		0	2
29	b	*Attagis gayi*	136+600 152+800 163+400 171+000 218+400									0			0		0	0
30	b	*Basileuterus coronatus*	25+100									0			0		0	0
31	b	*Basileuterus luteoviridis*	02+450									0			0		0	0
32	b	*Bolborhynchus orbygnesius*	05+000 62+150									0		1			0	1
33	b	*Buarremon torquatus*	26+100									0			0		0	0
34	b	*Bubulcus ibis*	334+600 363+000 365+250 397+900 389+500									0			0		0	0
35	b	*Burhinus superciliaris*	362+100								2				0		0	2
36	b	*Buteo leucorrhous*	135+200									0			0		0	0
37	b	*Buteo magnirostris*	125+400									0			0		0	0
38	b	*Buteo poecilochrous*	130+000								2				0		0	2
39	b	*Buteo polyosoma*	192+070 204+800 252+700									0			0		0	0
40	b	*Buthraupis montana*	00+500									0			0		0	0
41	b	*Butorides striata*	316+120 329+800 334+600 365+250									0			0		0	0

			397+900 389+500															
42	b	*Calidris alba*	389+600									0			0		0	0
43	b	*Calidris bairdii*	239+000									0			0		0	0
44	b	*Calidris melanotos*	212+200									0			0		0	0
45	b	*Camptostoma obsoletum*	315+200									0			0		0	0
46	b	*Carduelis atrata*	67+400								2				0		0	2
47	b	*Carduelis magellanica*	62+150 67+400 72+500 76+500 109+000 114+300 118+600									0			0		0	0
48	b	*Catamenia analis*	62+150 67+400 76+500 109+000 114+300									0			0		0	0
49	b	*Catamenia inornata*	67+400 109+000									0			0		0	0
50	b	*Cathartes aura*	316+120 329+800 363+000 365+250 389+500 397+900									0			0		0	0
51	b	*Chaetura pelagica*	362+500									0			0		0	0
52	b	*Charadrius vociferus*	390+100									0			0		0	0
53	b	*Chloephaga melanoptera*	130+000 136+600 163+400								2		2				0	4
54	b	*Chloephaga melanoptera*	21+650 42+550 88+250 171+000 176+100 204+800 218+400								2		2				0	4
55	b	*Chordeiles acutipennis*	295+100									0			0		0	0
56	b	*Cinclodes atacamensis*	82+000 88+250								2				0		0	2
57	b	*Cinclodes fuscus*	76+500 82+000 88+250 103+600 114+300 118+600								2		2				0	4
58	b	*Cinclus leucocephalus*	40+100								2				0		0	2
59	b	*Circus cinereus*	86+200									0			0		0	0
60	b	*Coeligena violifer*	05+000									0			0		0	0
61	b	*Colaptes atricollis*	251+800								2				0		0	2

62	b	*Colaptes rupicola*	40+100 67+400 88+250 103+600 109+000 114+300 118+600 121+400 204+800 224+000 250+200									0			0		0	0
63	b	*Colibri coruscans*	40+100									0	2				0	2
64	b	*Columba livia*	60+000									0			0		0	0
65	b	*Columbina cruziana*	305+600								2				0		0	2
66	b	*Conirostrum cinereum*	59+800								2				0		0	2
67	b	*Contopus cinereus*	11+500									0			0		0	0
68	b	*Coragyps atratus*	395+400									0			0		0	0
69	b	*Cranioleuca albicapilla*	05+000 15+800 21+650 27+000 30+000							3					0		0	3
70	b	*Crotophaga ani*	05+200 40+100 334+600									0			0		0	0
71	b	*Crotophaga sulcirostris*	334+600									0			0		0	0
72	b	*Diglossa brunneiventris*	109+000									0			0		0	0
73	b	*Diglossa cyanea*	02+100									0			0		0	0
74	b	*Diuca speculifera*	72+800								2				0		0	2
75	b	*Dives warszewiczi*	341+200								2				0		0	2
76	b	*Egretta caerulea*	335+200									0			0		0	0
77	b	*Egretta thula*	327+800									0			0		0	0
78	b	*Elaenia albiceps*	334+600 363+000 365+250 389+500 397+900								2				0		0	2
79	b	*Eriocnemis sapphiropygia*	05+000								2				0		0	2
80	b	*Euphonia laniirostris*	02+400									0			0		0	0
81	b	*Euscarthmus meloryphus*	395+200									0			0		0	0
82	b	*Falco femoralis*	30+000 40+100 250+200									0			0		0	0
83	b	*Falco sparverius*	30+000 40+100 103+600 109+000 286+000 299+200 316+120 329+600 334+600 363+000 365+250									0			0		0	0

84	b	*Fulica ardesiaca*	329+800									0			0		0	0
85	b	*Gallinago andina*	46+600								2				0		0	2
86	b	*Gallinula chloropus*	260+100 395+200									0			0		0	0
87	b	*Geositta crassirostris*	286+000								2				0		0	2
88	b	*Geositta cunicularia*	103+600								2				0		0	2
89	b	*Geositta maritima*	389+400								2				0		0	2
90	b	*Geositta peruviana*	299+200 316+400 329+600 334+800 353+500 363+000 389+500 397+900								2				0		0	2
91	b	*Geositta punensis*	88+250 121+400								2				0		0	2
92	b	*Geositta saxicolina*	94+900 121+400								2				0		0	2
93	b	*Geositta tenuirostris*	224+000								2				0		0	2
94	b	*Geranoaetus melanoleucus*	30+000 40+100 56+900 114+300 130+000 176+100 224+000 252+700									0			0		0	0
95	b	*Glaucidium jardinii*	40+100								2				0		0	2
96	b	*Haplochelidon andecola*	185+200 187+500 193+300								2				0		0	2
97	b	*Hemispingus atropileus*	312+200								2				0		0	2
98	b	*Hemispingus superciliaris*	16+100									0			0		0	0
99	b	*Hirundo rustica*	84+700									0			0		0	0
100	b	*Iridosornis analis*	03+200								2				0		0	2
101	b	*Knipolegus aterrimus*	40+100									0			0		0	2
102	b	*Larus serranus*	103+600 163+400									0			0		0	0
103	b	*Leptasthenura striata*	286+000 299+200								2				0		0	2
104	b	*Leptotila verreauxi*	112+000									0			0		0	0
105	b	*Lesbia nuna*	40+100 109+000								2		2				0	4
106	b	*Lessonia oreas*	130+400 135+600 165+400 168+200								2				0		0	2
107	b	*Lophonetta specularioides*	42+550									0			0		0	0
108	b	*Margarornis squamiger*	03+200									0			0		0	0

109	b	*Mecocerculus stictopterus*	154+200									0			0		0	0
110	b	*Merganetta armata*	176+100									0			0		0	0
111	b	*Metallura aeneocauda*	00+300							3					0		0	3
112	b	*Metallura phoebe*	114+300								2		2				0	4
113	b	*Metallura tyrianthina*	45+200									0			0		0	0
114	b	*Metriopelia aymara*	118+600								2				0		0	2
115	b	*Metriopelia ceciliae*	109+000								2				0		0	2
116	b	*Metriopelia melanoptera*	63+100									0			0		0	0
117	b	*Mimus longicaudatus*	325+400								2				0		0	2
118	b	*Molothrus bonariensis*	395+200									0			0		0	0
119	b	*Muscigralla brevicauda*	335+600								2				0		0	2
120	b	*Muscisaxicola albifrons*	221+100								2				0		0	2
121	b	*Muscisaxicola albilora*	23+000									0			0		0	0
122	b	*Muscisaxicola alpinus*	225+400								2				0		0	2
123	b	*Muscisaxicola cinereus*	82+000 118+600								2				0		0	2
124	b	*Muscisaxicola maclovianus*	290+200									0			0		0	0
125	b	*Muscisaxicola maculirostris*	82+000 109+000									0			0		0	0
126	b	*Muscisaxicola rufivertex*	118+600								2				0		0	2
127	b	*Myiarchus tuberculifer*	18+900									0			0		0	0
128	b	*Myioborus miniatus*	15+200									0			0		0	0
129	b	*Myioborus ornatus*	00+250								2				0		0	2
130	b	*Myiophobus fasciatus*	392+400									0			0		0	0
131	b	*Myiotheretes striaticollis*	329+600								2				0		0	2
132	b	*Myrtis fanny*	286+000 299+200								2				0		0	2

133	b	*Nothoprocta ornata*	30+000 40+100 56+900 192+070 250+200 252+700								2				0		0	2
134	b	*Nothoprocta pentlandii*	30+000 42+550 56+900 176+100								2				0		0	2
135	b	*Notiochelidon flavipes*	05+200								2				0		0	2
136	b	*Notiochelidon murina*	40+100								2				0		0	2
137	b	*Nycticorax nycticorax*	192+070 316+120 329+800									0			0		0	0
138	b	*Ochthoeca frontalis*	112+200								2				0		0	2
139	b	*Ochthoeca leucophrys*	40+100 109+000								2				0		0	2
140	b	*Ochthoeca oenanthoides*	192+070								2				0		0	2
141	b	*Ochthoeca rufipectoralis*	05+200								2				0		0	2
142	b	*Oreonympha nobilis*	27+000 30+000 62+150 110+000							3					0		0	3
143	b	*Oreopholus ruficollis*	160+300									0			0		0	0
144	b	*Oreotrochilus estella*	40+100 121+400								2				0		0	2
145	b	*Oreotrochilus melanogaster*	16+300 171+000							3					0		0	3
146	b	*Oxyura ferruginea*	42+550								2				0		0	2
147	b	*Parabuteo unicinctus*	363+000									0			0		0	0
148	b	*Pardirallus sanguinolentus*	316+120 329+800									0			0		0	0
149	b	*Passer domesticus*	295+200									0			0		0	0
150	b	*Patagioenas fasciata*	05+000									0			0		0	0
151	b	*Patagioenas maculosa*	40+100								2				0		0	2
152	b	*Patagioenas plumbea*	05+000									0			0		0	0
153	b	*Patagona gigas*	40+100									0			0		0	0
154	b	*Petrochelidon pyrrhonota*	145+400									0			0		0	0
155	b	*Petrochelidon rufocollaris*	350+600								2				0		0	2

156	b	*Phalcoboenus megalopterus*	21+650 30+000 40+100 56+900 121+400 130+000 136+600 152+800 163+400 171+000 176+100 192+070 204+800 218+400 224+000 250+200 252+700									0			0		0	0
157	b	*Pheucticus aureoventris*	27+200 57+800									0			0		0	0
158	b	*Phrygilus alaudinus*	85+500									0			0		0	0
159	b	*Phrygilus erythronotus*	15+200								2				0		0	2
160	b	*Phrygilus fruticeti*	104+700									0			0		0	0
161	b	*Phrygilus plebejus*	25+500 55+800 125+100 130+000 144+150 150+500 167+700 174+800 215+400 218+500 226+100									0			0		0	0
162	b	*Phrygilus punensis*	109+000								2				0		0	2
163	b	*Phrygilus unicolor*	25+500 55+800 129+700 144+150 150+500 167+700 174+800 215+400 218+500 226+100									0			0		0	0
164	b	*Plegadis ridgwayi*	21+650 152+800									0			0		0	0
165	b	*Podiceps major*	316+120 329+800									0			0		0	0
166	b	*Podiceps occipitalis*	42+550								2				0		0	2
167	b	*Polioxolmis rufipennis*	58+300								2				0		0	2
168	b	*Polyonymus caroli*	135+400								2				0		0	2
169	b	*Poospiza caesar*	27+000 30+000							3					0		0	3
170	b	*Poospiza hispaniolensis*	27+200								2				0		0	2
171	b	*Progne tapera*	12+800									0			0		0	0
172	b	*Psilopsiagon aurifrons*	12+800									0			0		0	0
173	b	*Pterophanes cyanopterus*	112+500								2				0		0	2
174	b	*Pygochelidon cyanoleuca*	05+200 12+400									0			0		0	0

175	b	*Pyrocephalus rubinus*	394+700									0			0		0	0
176	b	*Rhodopis vesper*	286+000 299+200								2		2				0	4
177	b	*Rollandia rolland*	40+100									0			0		0	0
178	b	*Saltator aurantiirostris*	27+200 62+600									0			0		0	0
179	b	*Saltator striatipectus*	395+200									0			0		0	0
180	b	*Schizoeaca* sp.	05+200							3					0		0	3
181	b	*Schizoeaca vilcabambae*	05+200							3					0		0	3
182	b	*Scytalopus parvirostris*	02+300								2				0		0	2
183	b	*Scytalopus* sp.	40+100								2				0		0	2
184	b	*Sicalis luteola*	122+800 129+100 177+200 210+100									0			0		0	0
185	b	*Sicalis olivascens*	177+200									0			0		0	0
186	b	*Sicalis raimondii*	395+100								2				0		0	2
187	b	*Sicalis* sp.	105+200									0			0		0	0
188	b	*Sicalis uropygialis*	63+900 121+100 133+500 153+400 177+200 205+100 220+000 226+900									0			0		0	0
189	b	*Sporophila luctuosa*	08+900									0			0		0	0
190	b	*Sporophila peruviana*	385+600								2				0		0	2
191	b	*Sporophila simplex*	329+800 334+800								2				0		0	2
192	b	*Sporophila telasco*	385+600								2				0		0	2
193	b	*Stelgidopteryx andecola*	215+000								2				0		0	2
194	b	*Streptoprocne zonaris*	122+200									0			0		0	0
195	b	*Sturnella bellicosa*	314+800								2				0		0	2
196	b	*Synallaxis azarae*	02+300									0			0		0	0
197	b	*Synallaxis unirufa*	12+800								2				0		0	2
198	b	*Thaumastura cora*	335+400								2				0		0	2
199	b	*Theristicus melanopis*	16+500 21+650 130+000			4					2				0		0	6

200	b	*Thinocorus orbignyianus*	136+600 171+000 204+800 218+400 224+000 250+200 252+700									0	2				0	2
201	b	*Thlypopsis ruficeps*	02+300								2				0		0	2
202	b	*Thraupis bonariensis*	109+000									0			0		0	0
203	b	*Thraupis cyanocephala*	107+200 112+000									0			0		0	0
204	b	*Tiaris obscurus*	335+400									0			0		0	0
205	b	*Tringa flavipes*	400+300									0			0		0	0
206	b	*Tringa melanoleuca*	150+200									0			0		0	0
207	b	*Troglodytes aedon*	109+000									0			0		0	0
208	b	*Troglodytes solstitialis*	05+100									0			0		0	0
209	b	*Turdus chiguanco*	05+200 28+100 61+500									0			0		0	0
210	b	*Turdus fuscater*	05+200									0			0		0	0
211	b	*Turdus serranus*	111+300									0			0		0	0
212	b	*Tyrannus melancholicus*	335+400									0			0		0	0
213	b	*Tyto alba*	335+200									0			0		0	2
214	b	*Upucerthia jelskii*	130+100 132+800 152+600 174+400 179+500								2				0		0	2
215	b	*Vanellus resplendens*	21+650 121+400 136+600 152+800 163+400 204+800 218+400 224+000 250+200 252+700								2				0		0	2
216	b	*Vireo leucophrys*	12+400									0			0		0	0
217	b	*Volatinia jacarina*	309+500									0			0		0	0
218	b	*Vultur gryphus*	42+550 48+500 49+000 56+900 151+000 152+800		5							0			0		0	5
219	b	*Xenospingus concolor*	329+600		5						2				0		0	7
220	b	*Zenaida auriculata*	40+100									0			0		0	0
221	b	*Zenaida meloda*	400+300						0		2				0		0	2
222	b	*Zonotrichia capensis*	109+000									0			0		0	0
223	c	***Cryphiops***	334+800					4	0		2		2			3		11

		caementarius																
224	f	*Aequidens rivulatus*	328+700 329+700 334+900						0		2				0	3		5
225	f	*Astroblepus* sp.	62+200 62+500						0			0	2			3		5
226	f	*Oncorhynchus mykiss*	09+700 13+050 14+500 148+800 155+800						0				2			3		5
227	f	*Oreochromis niloticus*	329+000 329+600 364+500 362+500 334+800						0			0	2			3		5
228	f	*Orestias* sp.	62+500 95+800 62+500						0		2		2		0	3		7
229	f	*Poecilia reticulata*	364+500 362+500 334+800						0			0	2			3		5
230	f	*Trichomycterus rivulatus*	62+200 110+000 364+500 363+000						0	3			2		0	3		8
231	ha	*Chaunus limensis*	334+100 362+500							3					0	3		6
232	ha	*Chaunus spinulosus*	38+900 40+200 40+450				3		0			0			0	3		6
233	ha	*Eleutherodactylus* aff. *discoidalis*	01 + 500							3					0	3		6
234	ha	*Gastrotheca marsupiata*	18+900 21+500 25+300 26+000 40+100 56+500								2				0	3		5
235	ha	*Phrynopus* sp.	01 + 500							3					0	3		6
236	ha	*Pleurodema marmorata*	40+250 48+300 155+800									0			0	3		3
237	ha	*Telmatobius* sp.	73+400 92+000			4				3					0	3		10
238	hr	*Alsophis elegans*	364+500						0			0			0	3		3
239	hr	*Alsophis* sp.	389+300							3					0	3		6
240	hr	*Ctenoblepharys adspersa*	397+500 397+900			4				3					0	3		10
241	hr	*Dicrodon heterolepis*	329+000 329+600 389+500 362+500 389+500			4				3					0	3		10
242	hr	*Liolaemus* cf. *melanogaster*	159+700 136+700						0	3					0	3		6
243	hr	*Liolaemus* cf. *polystictus*	199+500 202+000 209+300 210+000 217+000 216+000 210+000 227+000						0	3					0	3		6

244	hr	*Liolaemus* cf. *walkeri*	25+500 45+000 47+500 56+500						0		2				0	3		5
245	hr	*Liolaemus* cf. *wiliamsi*	202+000 216+000						0	3					0	3		6
246	hr	*Liolaemus melanogaster*	160+000 146+000						0	3					0	3		6
247	hr	*Liolaemus* sp. 1	73+400						0	3					0	3		6
248	hr	*Liolaemus* sp. 2	185+000						0	3					0	3		6
249	hr	*Liolaemus* sp. 3	227+000 217+000 210+000						0	3					0	3		6
250	hr	*Liolaemus walkeri*	25+300 40+250 56+500 122+400						0		2				0	3		5
251	hr	*Microlophus* aff. *tigris*	259+800 254+900							3	2				0	3		8
252	hr	*Microlophus thoracicus icae*	329+000 329+600						0	3					0	3		6
253	hr	*Microlophus tigris*	298+800 299+200 304+900 389+500				3				2				0	3		8
254	hr	*Phyllodactylus lepidopygus*	304+900						0	3					0	3		6
255	hr	*Proctoporus* sp.	01+600 06+500 07+000 11+500 15+150 21+500 24+800						0	3					0	3		6
256	hr	*Stenocercus* aff. *apurimacus*	30+700 37+000 37+500 40+000 40+500 41+000						0	3					0	3		6
257	hr	*Stenocercus frittsi*	61+800							3					0	3		6
258	hr	*Tachymenis peruviana*	12+000 15+000 30+500						0			0			0	3	0	3
259	m	*Abrothrix jelskii*	21+700									0			0		0	0
260	m	*Akodon* cf. *juninensis*	33+000 48+000						0	3					0		0	3
261	m	*Akodon* cf. *torques*	12+200 40+150								2				0		0	2
262	m	*Akodon subfuscus*	28+500						0		2				0		0	2
263	m	*Artibeus lituratus*	40+150						0			0			0		0	0
264	m	*Auliscomys pictus*	21+700						0		2				0		0	2
265	m	*Calomys sorellus*	21+700 40+150 44+500 48+000						0	3					0		0	3
266	m	*Calomys lepidus*	62+500									0			0		0	0

267	m	*Cavia tschudii*	298+000 304+900 329+800 363+000						0			0			0		0	0
268	m	*Conepatus chinga*	14+200 33+000 63+000 103+000 186+400 253+000 297+000 298+000 304+900 329+800 362+000 363+000 389+000						0			0			0		0	0
269	m	*Desmodus rotundus*	40+150 63+000						0			0			0		0	0
270	m	*Didelphis pernigra*	298+000 304+900 329+800						0			0			0		0	0
271	m	*Histiotus* sp.	40+150 295+800						0		2				0		0	2
272	m	*Lagidium peruanum*	14+200 132+600 253+000						0	3			2				0	5
273	m	*Leopardus jacobitus*	103+000 132+600 154+000 163+100		5						2				0		0	7
274	m	*Leopardus pajeros*	103+000 132+600 253+000 329+800 363+000						0		2				0		0	2
275	m	*Lycalopex culpaeus*	28+500 33+000 40+150 48+000 63+000 71+000 186+400 230+000 253+000 298+000 304+900 329+800 363+000								2				0		0	2
276	m	*Lycalopex* cf. *griseus*	297+000 298+000 304+900 329+800 363+000								2				0		0	2
277	m	*Mus musculus*	298+000 363+000						0			0			0		0	0
278	m	*Mustela frenata*	103+000 132+600 253+000									0			0		0	0
279	m	*Odocoileus virginianus*	4+000 40+150 103+000 132+600									0			0		0	0
280	m	*Oligoryzomys* cf. *destructor*	18+300 107+300									0			0		0	0
281	m	*Oryzomys xantheolus*	329+800 363+000 389+300								2				0		0	2
282	m	*Phyllotis amicus*	107+300 253+000 298+000									0			0		0	0
283	m	*Phyllotis* cf. *xanthopygus posticalis*	14+200 28+500 63+000 103+000						0	3			2				0	5

284	m	*Phyllotis limatus*	298+900 299+000 304+900						0		2				0		0	2
285	m	*Phyllotis magister*	250+100 253+000									0			0		0	0
286	m	*Phyllotis xanthopygus posticalis*	200+000 253+000						0	3			2				0	5
287	m	*Puma concolor*	14+200 40+150 44+000 48+000 103+000 132+600				3					0			0		0	3
288	m	*Rattus norvegicus*	329+800						0			0			0		0	0
289	m	*Sturnella bellicosa*	314+800								2				0		0	2
290	m	*Sturnira erythromos*	39+800									0			0		0	0
291	m	*Thylamys pallidior*	103+000 132+600 253+000 298+000 304+900 329+800 363+000									0	2				0	2
292	m	*Tremarctos ornatus*	04+000		5						2		2				0	9
293	m	*Vicugna vicugna*	103+000 201+000 227+100 230+000		5							0	2				0	7
294	m	*Vicugna vicugna*			5							0	2				0	7
295	p	*Aa* sp.	48+800						0	3					0	3		6
296	p	*Acacia macracantha*	39+250 334+900 391+000				3					0	2			3		8
297	p	*Aciachne* cf. *acicularis*	85+400 141+150 165+800 170+690 171+200 204+000						0			0			0	3		3
298	p	*Aciachne pulvinata*	48+300 85+400						0		2				0	3		5
299	p	*Agave americana*	39+250						0			0	2			3		5
300	p	*Alternanthera halimifolia*	299+000 334+900						0			0			0	3		3
301	p	*Ariestiguietia discolor*	35+000				3				2				0	3		8
302	p	*Armartocereus procerus*	299+000						0		2				0	3		5
303	p	Asteraceae sp.	135+900						0			0			0	3		3
304	p	*Astragalus* sp.	165+800						0			0			0	3		3
305	p	*Atriplex peruviana*	279+000						0		2				0	3		5
306	p	*Austrocylindropuntia floccosa*	25+000 36+700 79+000 109+800 122+800 165+800 170+690 171+200						0			0			0	3		3
307	p	*Austrocylindropuntia*	63+000 109+800						0		2				0	3		5

		subulata																
308	p	*Austrocylindropuntia subulata*							0		2				0	3		5
309	p	*Azorella* sp.	76+200						0			0			0	3		3
310	p	*Baccharis odorata*	36+700 56+900 171+200						0		2				0	3		5
311	p	*Baccharis salicifolia*	334+900						0			0	2			3		5
312	p	*Baccharis tricuneata*	56+900						0		2				0	3		5
313	p	*Berberis flexuosa*	36+700 56+900						0	3					0	3		6
314	p	*Boerhavia coccinea*	299+000						0			0	2			3		5
315	p	*Boerhavia difusa*	334+900						0			0	2			3		5
316	p	*Bromus catharticus*	328+900						0			0			0	3		3
317	p	*Browningia candelaris*	281+000			4					2					3		9
318	p	*Bulnesia retama*	305+000						0		2				0	3		5
319	p	*Calamagrostis* cf. *vicunarum*	77+500 85+400						0			0	2			3		5
320	p	*Calamagrostis vicunarum*	48+800						0			0	2			3		5
321	p	*Cardionema* sp.	76+200						0			0			0	3		3
322	p	*Castilleja* sp.	22+350						0			0	2			3		5
323	p	***Chersodoma arequipensis***	259+100	6						3			2			3		14
324	p	***Cleistocactus acanthurus***	299+000 300+000 301+000		5					3			2			3		13
325	p	*Cleistocactus morawetzianus*	62+900						0	3					0	3		6
326	p	*Cnidoscolus basiacanthus*	299+000			4					2				0	3		9
327	p	***Corryocactus quadrangularis***	35+000 62+900		5					3					0	3		11
328	p	*Croton ruizianus*	259+100						0		2				0	3		5
329	p	*Cuphea* sp.	40+250						0		2				0	3		5
330	p	*Cynodon dactylon*	334+900						0			0	2			3		5
331	p	*Dasyphyllum ferox*	36+700						0		2				0	3		5
332	p	*Delostoma lobbii*	36+700						0			0			0	3		3
333	p	*Dissanthelium* sp.	122+800						0			0	2			3		5
334	p	*Distichia muscoides*	48+300 48+800 141+150 149+700 171+200						0			0		1		3		4
335	p	*Distichlis spicata*	328+900						0			0			0	3		3

336	p	*Dodonaea viscosa*	36+700 40+250						0			0	2			3		5
337	p	*Dunalia spinosa*	36+700 259+100						0		2				0	3		5
338	p	*Echinopsis peruviana puquiensis*	62+900 109+800			4				3					0	3		10
339	p	*Ephedra americana*	122+800 295+000 299+000				3				2				0	3		8
340	p	*Erigeron* sp.	85+400						0			0			0	3		3
341	p	*Eriochloa* sp.	334+900						0			0			0	3		3
342	p	*Eriotheca vargasii*	40+000						0	3					0	3		6
343	p	*Erodium cicutarium*	259+100						0			0			0	3		3
344	p	*Escallonia myrtilloides*	37+000 55+000 56+900 88+350 112+500 116+100 118+700			4					2					3		9
345	p	*Escallonia resinosa*	28+000 35+000			4					2					3		9
346	p	*Euphorbia* sp.	40+250						0			0			0	3		3
347	p	*Gamochaeta* sp.	76+200						0			0			0	3		3
348	p	*Gentiana sedifolia*	85+400						0			0			0	3		3
349	p	*Gomphichis* sp.	04+000 09+000 27+214						0		2				0	3		5
350	p	*Hypochaeris* sp.	85+400						0			0			0	3		3
351	p	*Hypochaeris taraxacoides*	22+350						0		2				0	3		5
352	p	*Jarava* sp.	76+200						0			0	2			3		5
353	p	Juncaceae sp.	122+800						0			0			0	3		3
354	p	*Juncus* cf. *bufonius*	76+200						0			0			0	3		3
355	p	*Junellia juniperina*	259+100						0		2				0	3		5
356	p	***Kageneckia lanceolata***	36+700	6							2				0	3		11
357	p	*Lachemilla diplophylla*	22+350						0		2				0	3		5
358	p	*Lachemilla pinnata*	22+350 48+800 76+200 85+400 122+800 135+900 165+800 170+690 171+200						0		2				0	3		5
359	p	*Lantana* sp.	40+250						0			0			0	3		3
360	p	*Loasa incana*	299+000						0	3					0	3		6
361	p	*Luzula racemosa*	22+350 48+255						0				2			3		5
362	p	*Lysipomia* sp.	76+200						0			0			0	3		3
363	p	*Muhlenbergia* sp.	77+500 85+400						0				2			3		5

364	p	*Myrosmodes* sp.	22+240 48+800				3			3						3		9
365	p	*Neoraimondia arequipensis*	295+000 299+000						0	3					0	3		6
366	p	*Novenia acaulis*	76+900						0		2				0	3		5
367	p	*Oncidium* sp.	04+000 09+000						0		2				0	3		5
368	p	*Oreithales integrifolia*	76+200 77+500						0			0			0	3		3
369	p	*Oreomyrrhis andicola*	76+200						0		2				0	3		5
370	p	*Oroya peruviana*	105+100 118+700 122+800						0	3		0			0	3		6
371	p	*Orthopterygium huaucui*	299+000						0	3					0	3		6
372	p	*Parastrephia quadrangularis*	101+800 103+700						0	3					0	3		6
373	p	*Peperomia* sp.	76+900						0			0			0	3		3
374	p	*Perezia coerulensis*	48+800 118+700 122+800 170+690 204+000			4			0		2				0	3		9
375	p	*Perezia pinnatifida*	135+900 140+300			4					2				0	3		9
376	p	*Phragmites australis*	329+800						0			0			0	3		3
377	p	*Plantago rigida*	22+350 48+300 141+150 149+700 170+690						0		2				0	3		5
378	p	*Plantago tubulosa*	77+500 85+400						0			0			0	3		3
379	p	*Plettkea* sp.	165+800						0		2				0	3		5
380	p	*Pleurothallis* sp.	04+000 09+000 42+880						0		2					3		5
381	p	*Pluchea chingoyo*	329+800						0			0	2			3		5
382	p	Poaceae sp. 1	122+800 137+000 141+000 150+000 166+000						0			0			0	3		3
383	p	Poaceae sp. 2	76+200 76+900 85+400						0			0			0	3		3
384	p	*Polylepis pauta*	04+000 09+000				3					0	2			3		8
385	p	*Pycnophyllum molle*	140+300									0	2			3		5
386	p	*Ranunculus flagelliformis*	22+350						0			0		1		3		4
387	p	*Ranunculus praemorsus*	48+800						0			0		1		3		4
388	p	*Ribes* sp.	118+700						0	3				1		3		7
389	p	*Schinus molle*	36+700 40+250						0			0	2			3		5
390	p	*Scirpus americanus*	48+300						0			0	2			3		5

391	p	*Scirpus* cf. *rigidus*	76+200						0			0	2			3		5
392	p	*Senecio* sp.	171+200						0			0	2			3		5
393	p	*Senecio tovari*	259+100						0	3			2			3		8
394	p	*Solanum* sp.	259+100						0			0			0	3		3
395	p	*Stelis* sp.	04+000 09+000						0		2					3		5
396	p	*Stenomesson incarnatum*	259+100						0		2				0	3		5
397	p	*Tecoma arequipensis*	40+250			4					2			1		3		10
398	p	*Tecoma sambucifolia*	29+000 33+000 35+000 36+700				3				2			1		3		9
399	p	*Tillandsia latifolia*	397+800						0		2				0	3		5
400	p	*Tillandsia paleacea*	308+200 348+600						0		2				0	3		5
401	p	*Tiquilia paronychioides*	299+000						0		2				0	3		5
402	p	*Typha domingensis*	329+800 328+900						0			0	2			3		5
403	p	Valerianaceae sp.	170+690						0			0			0	3		3
404	p	*Viola pygmaea*	77+500 85+400						0		2				0	3		5
405	p	*Werneria nubigena*	76+200						0			0			0	3		3
406	p	*Werneria pygmaea*	48+300 48+800						0		2				0	3		5

23.7 HABITAT SENSITIVITY CRITERIA

Table 23.7.1. Medium and High Sensitive Habitats

GROUP	SPECIES	KP	SPECIES SENSITIVITY	ELU	HABITAT TYPES	HABITAT SENSITIVITY
Plants	*Pleurothallis* sp.	004+000 009+000	Medium	1. Apurimac River Valley Montane Forest Ecotone	Upper Montane Forest	Medium
Plants	*Polylepis pauta*	004+000 009+000	Medium			
Amphibians	*Phrynopus* sp.	001+500	Medium			
Amphibians	*Eleutherodactylus* aff. *discoidalis*	001+500	Medium			
Reptiles	*Proctoporus* sp.	007+000 011+500	Medium			
Reptiles	*Proctoporus* sp.	001+500 007+500	Medium		Tussock Grassland	Medium
Mammalogy	*Tremarctos ornatus*	003+000	Medium			
Reptiles	*Proctoporus* sp.	015+500 021+500	Medium		Sward-forming Grassland	Medium
Birds	*Agriornis andicola*	017+000	Medium			
Birds	*Theristicus melanopis*	016+500	Medium			
Plants	*Castilleja* sp.	022+350	Medium	2. Campana Watershed	Peat Bog	Medium
Plants	*Hypochaeris taraxacoides*	022+350	Medium			
Plants	*Lachemilla diplophylla*	022+350	Medium			
Plants	*Plantago rigida*	022+350	Medium			
Plants	*Luzula racemosa*	022+350	Medium			
Birds	*Theristicus melanopis*	022+500	Medium			
Plants	*Corryocactus quadrangularis*	035+000	High	3. Torobamaba River Valley	Cultivated Areas	High
Plants	*Kageneckia lanceolata*	038+000	High			

Plants	*Acacia macracantha*	040+000	Medium			
Plants	*Ariestiguietia discolor*	035+000	Medium			
Plants	*Eriotheca vargasii*	040+000	Medium			
Plants	*Escallonia resinosa*	035+000	Medium			
Plants	*Tecoma arequipensis*	040+000	Medium			
Plants	*Tecoma sambucifolia*	029+000	Medium			
Plants	*Tecoma sambucifolia*	035+000	Medium			
Amphibians	*Chaunus spinulosus*	038+900	Medium			
Reptiles	*Stenocercus* aff. *apurimacus*	037+500 037+700 040+000	Medium			
Plants	*Tecoma arequipensis*	040+250	Medium		Dry Deciduous Forest	Medium
Amphibians	*Chaunus spinulosus*	040+200 040+450	Medium			
Reptiles	*Stenocercus aff. apurimacus*	040+500	Medium			
Plants	*Kageneckia lanceolata*	036+700	High		Thorny Scrub	High
Plants	*Escallonia myrtilloides*	037+000	Medium			
Plants	*Escallonia resinosa*	028+000	Medium			
Plants	*Tecoma arequipensis*	040+250	Medium			
Plants	*Tecoma sambucifolia*	036+700	Medium			
Reptiles	*Stenocercus* aff. *apurimacus*	030+700 037+000	Medium			
Birds	*Agriornis andicola*	027+000	Medium			
Birds	*Oreonympha nobilis*	027+000	Medium			
Plants	*Aa* sp.	050+000	Medium	4. Sillaccasa Sierra	Tussock Grassland	Medium
Plants	*Escallonia myrtilloides*	055+000	Medium			
Plants	*Myrosmodes* sp.	048+800 050+000	Medium			
Plants	*Perezia coerulescens*	050+000	Medium			
Plants	*Corryocactus quadrangularis*	062+500	High	5. Yucay River Valley	Resinous Scrub	High
Plants	*Cleistocactus morawetzianus*	062+900 063+000	Medium			

Reptiles	*Stenocercus frittsi*	062+900	Medium			
Plants	*Echinopsis peruviana subsp. puquiensis*	062+900	Medium			
Aquatic Fauna	*Astroblepus* sp.	062+500	Medium		Yucay River	Medium
Aquatic Fauna	*Trichomycterus rivulatus*	062+500	Medium			
Plants	*Escallonia myrtilloides*	088+400	Medium	6. Huamanga Vischongo Watershed Divide	Tussock Grassland	Medium
Plants	*Parastrephia quadrangularis*	101+800	Medium			
Amphibians	*Telmatobius* sp.	092+000	Medium			
Reptiles	*Liolaemus* sp. 1	092+000	Medium			
Mammals	*Leopardus jacobitus*	103+000	Medium			
Mammals	*Vicugna vicugna*	103+000	Medium			
Plants	*Echinopsis peruviana subsp. puquiensis*	109+800	Medium	7. Vinchos River Valley	Cultivated Areas	Medium
Plants	*Escallonia myrtilloides*	116+100 116+300	Medium			
Plants	*Oroya peruviana*	105+200	Medium			
Birds	*Metallura phoebe*	114+300	Medium			
Birds	*Oreonympha nobilis*	110+000	Medium			
Plants	*Perezia pinnatifida*	140+300 141+000	Medium	8. Apacheta High Sierras	Scarcely Vegetated High Andean Areas	Medium
Plants	*Plantago rigida*	141+150	Medium			
Reptiles	*Liolaemus* cf. *melanogaster*	160+000	Medium			
Reptiles	*Liolaemus melanogaster*	160+000 146+000	Medium			
Birds	*Asthenes dorbignyi (huancavelicae)*	141+300	Medium			
Mammals	*Leopardus jacobitus*	132+600 154+000 163+100	Medium			
Plants	*Ephedra americana*	122+800	Medium		Sward-forming Grassland	Medium
Plants	*Escallonia myrtilloides*	118+700	Medium			
Plants	*Oroya peruviana*	122+800 118+700	Medium			
Plants	*Perezia coerulensis*	122+800 118+700	Medium			
Plants	*Perezia pinnatifida*	135+900, 137+000	Medium			

Reptiles	*Liolaemus* cf. *melanogaster*	136+700	Medium			
Birds	*Theristicus melanopis*	127+500	Medium			
Plants	*Ribes* sp.	118+700	Medium		Tussock Grassland	Medium
Plants	*Escallonia myrtilloides*	118+700	Medium			
Plants	*Oroya peruviana*	118+100 123+000	Medium			
Plants	*Perezia coerulensis*	118+700 122+800	Medium			
Plants	*Perezia pinnatifida*	135+900	Medium			
Reptiles	*Liolaemus cf. melanogaster*	137+000	Medium			
Birds	*Asthenes dorbignyi (huancavelicae)*	136+600	Medium			
Mammals	*Leopardus jacobitus*	132+600, 154+000, 163+100	Medium			
Reptiles	*Liolaemus* sp. 2	185+000	Medium	9. Pampas-Palmitos River Basins	Tussock Grassland	Medium
Birds	*Asthenes dorbignyi (huancavelicae)*	176+100 179+500	Medium			
Reptiles	*Liolaemus* cf. *williamsi*	216+000	Medium	10. Huaytará High Plains and Ridges	Scarcely Vegetated High Andean Areas	Medium
Birds	*Asthenes dorbignyi (huancavelicae)*	199+500	Medium			
Reptiles	*Liolaemus* cf. *polystictus*	212+700	Medium		Sward-forming Grassland	Medium
Birds	*Asthenes dorbignyi (huancavelicae)*	204+800	Medium			
Mammals	*Vicugna vicugna*	201+000	Medium			
Birds	*Asthenes dorbignyi (huancavelicae)*	212+700 218+400 223+400	Medium		Tussock Grassland	Medium
Reptiles	*Liolaemus* sp. 3	210+000	Medium			
Reptiles	*Liolaemus* sp. 4	217+000	Medium			
Mammals	*Vicugna vicugna*	227+100 230+000	Medium			
Plants	*Chersodoma arequipensis*	259+100	High	11. Pisco Ica Watershed Divide	Mixed Scrub	High
Plants	*Aequatorium tovarii*	259+100	Medium			

Reptiles	*Microlophus* aff. *tigris*	254+900 255+000 259+500 259+800	Medium			
Plants	*Chersodoma arequipensis*	261+300	High		Thorny Scrub	High
Plants	*Aequatorium tovarii*	261+300	Medium			
Plants	*Cleistocactus acanthurus*	281+000	High	12. Coastal Bat Hills	Desert Scrub	High
Plants	*Armatocereus procerus*	281+000	Medium			
Plants	*Browningia candelaris*	281+000	Medium			
Plants	*Bulnesia retama*	281+000	Medium			
Birds	*Rhodopis vesper*	286+000	Medium			
Plants	*Cleistocactus acanthurus*	299+000 300+000 301+100	High		Columnar Cacti and Scrub	High
Plants	*Armatocereus procerus*	300+200	Medium			
Plants	*Bulnesia retama*	305+000	Medium			
Plants	*Cnidoscolus basiacanthus*	299+000 300+200	Medium			
Plants	*Ephedra americana*	295+000 299+000 305+000	Medium			
Plants	*Loasa incana*	299+000	Medium			
Plants	*Neoraimondia arequipensis*	295+000 299+000 305+000	Medium			
Plants	*Orthopterygium huaucui*	299+000 300+200	Medium			
Reptiles	*Microlophus tigris*	298+000 298+800 299+200 304+900 306+000	Medium			
Reptiles	*Phyllodactylus lepidopygus*	304+900	Medium			

Mammalogy	*Thylamys pallidior*	298+000 304+900	Medium			
Birds	*Rhodopis vesper*	286+000 299+200	Medium			
Reptiles	*Dicrodon heterolepis*	329+000, 329+600	Medium	13. Pisco Sand Plains	Coastal Hydromorphic Islands and Lagoons	High
Reptiles	*Microlophus thoracicus icae*	329+000 329+600	Medium			
Birds	*Xenospingus concolor*	327+100 329+600	Medium			
Aquatic Fauna	*Aequidens rivulatus*	329+600	Medium			
Plants	*Acacia macracantha*	336+000	Medium	14. Ica-Lima Costal Plain	Cultivated Areas	Medium
Reptiles	*Alsophis* sp.	389+300	Medium			
Reptiles	*Chaunus limensis*	334+100, 361+500	Medium			
Reptiles	*Dicrodon heterolepis*	361+500 389+300	Medium			
Reptiles	*Microlophus tigris*	389+300	Medium			
Plants	*Acacia macracantha*	391+000	Medium		Desert Barrens	Medium
Plants	*Tillandsia latifolia*	397+800	Medium			
Plants	*Tillandsia paleacea*	348+600	Medium			
Reptiles	*Ctenoblepharys adspersa*	397+900	Medium			
Aquatic Fauna	*Cryphiops caementarius*	334+800	High		Riparian Corridors	High
Plants	*Acacia macracantha*	334+900	Medium			
Reptiles	*Chaunus limensis*	334+700, 362+500	Medium			
Aquatic Fauna	*Aequidens rivulatus*	334+800	Medium			
Aquatic Fauna	*Trichomycterus rivulatus*	362+500, 363+000 364+500	Medium			

Habitat Sensitivity Calification

Category	Habitat Sensitivity Range
High	1 or more High Sensitivty Species 7 or more Medium Sensitivity Plant Species; 5 or more Medium Sensitivity Animal Species.
Medium	3 or more Medium Sensitivity Plant Species; 2 or more Medium Sensitivity Animal Species.

23.8 HYDROBIOLOGY

Table23.8.1. Data of Stations Evaluated along the ROW

Ecological Landscape Units (EUL) by Stations Evaluated							Physicochemical Parameters					List of Fish
ELU	Station	Habitat	Water Body	Name	Altitude (masl)	KP	T (°C) *	pH	Disolved Oxygen (mg/L)	Electric Conductivity (µS/cm)	Aquatic Environment	Especies
ELU14	Hi-02	Coastal	River	Chico	164	364+500					Chico (R)	*Trichomycterus* sp. *Poecilia* sp. *Oreochromis* sp.
	Hi-03	Coastal	River	Matagente	192	362+500					Matagente (R)	*Trichomycterus* sp. *Poecilia* sp. *Oreochromis* sp.
ELU13	Hi-04	Coastal	River	Pisco	240	334+800	25.1	8.6	8.6	480 *	Pisco (R)	*Aequidens* sp. *Oreochromis* sp. *Poecilia* sp
	Hi-05	Coastal	Lake	Morón	282	329+600	27.8	7.9	3.6	176	Morón (L)	*Aequidens* sp. *Oreochromis* sp.
	Hi-06	Coastal	Lake	Lagunillas	ca. 300	329+000	29.6	7.9	3.5	127.6	Lagunillas (L)	*Aequidens* sp. *Oreochromis* sp.
ELU10	Hi-07	High Andean	Peat Bog	Taccra	4304	241+000	16.6	3.8 *	5.3	113.8	Taccra (B)	
	Hi-08	High Andean	Quebrada	Tacpampa	4031	224+000	12.6	8.8 **	7.1	98.8	Tacpampa (Q)	
	Hi-09	High Andean	Quebrada	Canya	4431	212+200	12.4	8.6	6.1	60.1	Canya (Q)	
	Hi-10	High Andean	Lake	Quinsacocha	4479	211+500	17.1	10.1 **	5.1	39.9	Quinsacocha (L)	
	Hi-12	High Andean	Quebrada	NN (Tayarangra)	4373	201+000	10.3	7	6.9	182.6	NN_Tayarangra (Q)	
ELU9	Hi-13	High Andean	River	Pampas	4027	186+500	12.9	8.6	7	281 **	Pampas (R)	
	Hi-14	High Andean	Quebrada	Pichjahuasi	4326	175+500	14.8	9 **	6.2	167.7	Pichjahuasi (Q)	
	Hi-15	High Andean	Quebrada	Huaycco Corral	4153	173+800	16.5	9.1 **	6	188.5	Huaycco Corral (Q)	

ELU8	Hi-16	High Andean	Peat Bog	Yuarilla	4814	162+000	7.5	7.4	5.9	47.1	Yuarilla (B)	
	Hi-17	High Andean	Lake	Yanacocha	4622	156+000	10.8	8.1	6.4	184.6	Yanacocha (L)	*Oncorhynchus mykiss*
	Hi-18	High Andean	Quebrada	Antacocha	4487	149+500	13.5	7.4	5.5	35.5	Antacocha (Q)	*Oncorhynchus mykiss*
	Hi-20	High Andean	Lake	Challhuacocha	4498	136+700	21.7	7.3	4.4	119.6	Challhuacocha (L)	
	Hi-21	High Andean	Peat Bog	Soytusoytu	4391	135+000	21.7	7.5	4.4	119.6	Soytusoytu (B)	
ELU7	Hi-22	Inter - Andean	River	Vinchos	3157	110+500	16.7	7.4	6.8	84.5	Vinchos (R)	*Trichomycterus* sp.
	Hi-23	Inter - Andean	Quebrada	Urpaypampa	3210	110+000	17.3	7.4	6.4	36.8	Urpaypampa (Q)	
ELU6	Hi-24	High Andean	Lake	Choccehuacgra	4144	95+500	14.4	7.1	5.6	37.7	Choccehuacgra (L)	*Orestias* sp.
	Hi-25	High Andean	Peat Bog	Chaquicocha	4053	92+200	14.8	7.4	5.7	42.8	Chaquicocha (B)	
	Hi-26	High Andean	Peat Bog	Achcacruz Orcco	3997	85+500	15.3	7.8	6.2	35.9	Achcacruz Orcco (B)	
	Hi-27	High Andean	Peat Bog	Carimayo	4103	80+800	15.7	8.3	5.7	42.3	Carimayo (B)	
ELU5	Hi-28	Inter - Andean	Quebrada	Jatunchancara	3528	71+000	22.7	7.3	4.7	45.8	Jatunchancara (Q)	
	Hi-29	Inter - Andean	Quebrada	Affuent to Yucay	2848	62+500	20.5	6.9	5.3	46.8	Affluent to Yucay (Q)	
	Hi-30	Inter - Andean	Quebrada	Huaycco	2854	62+500	20	8.4	5.6	48.5	Huaycco (Q)	
	Hi-31	Inter - Andean	River	Yucay	2822	62+500	14.6	7.8	7.3	50.8	Yucay (R)	*Astroblepus* sp. *Trichomycterus* sp.
ELU4	Hi-33	High Andean	Lake	Nina Orcco	4080	51+200	13.6	8.6	6.2	83.8	Nina Orcco (L)	
	Hi-34	Inter - Andean	Quebrada	Soccosmayo	2459	49+500	15.6	8.4	5.4	88.9	Soccosmayo (Q)	
	Hi-35	Inter - Andean	Lake	Yanacocha	4115	48+800	17.7	8.6	4.8	85.4	Yanacocha (L)	
ELU3	Hi-36	Inter - Andean	River	Torobamba	2368	39+000	15.5	7.8	7.5	98.3	Torobamba (R)	

	Hi-37	Inter - Andean	Quebrada	Uras	2562	30+000	14	8.4	7.6	102.2	Uras (Q)	
	Hi-38	Inter - Andean	Quebrada	Yanaccacca	2797	29+000	24.1	7.8	4	144.5	Yanaccacca (Q)	
ELU2	Hi-39	High Andean	Quebrada	Campana	3800	22+700	18.2	7.7	5.8	93.4	Campana (Q)	
	Hi-40	High Andean	Lake	Yanapaccha	3930	17+000	10.6	8.6	6.9	99.3	Yanapaccha (L)	
	Hi-41	High Andean	Peat Bog	Cochas	3404	14+500	14	8.5	6.7	71.4	Cochas (B)	*Oncorhynchus mykiss*
ELU1	Hi-42	Inter - Andean	River	Sachapampa	3171	10+000	11.5	7.8	7.5	111.6	Sachapampa (R)	*Oncorhynchus mykiss*
	Hi-43	Inter - Andean	Quebrada	Qollpa	3033	0+500	11.7	7.6	7.7	123.2	Qollpa (Q)	
	Hi-44	Inter - Andean	River	Alfarpampa	2971	0+000	14	7.5	7.2	123.3	Alfarpampa (R)	

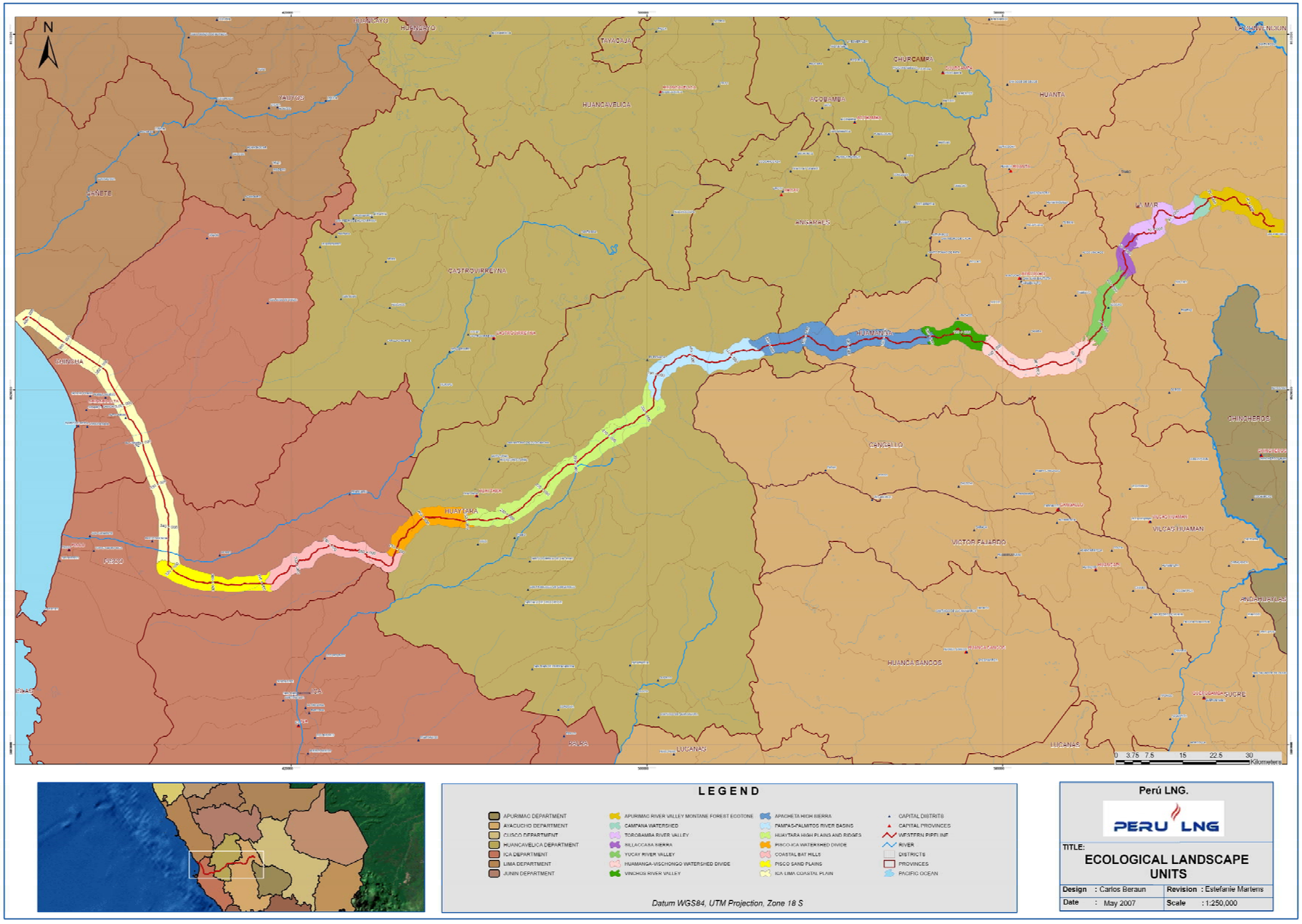
23.9 SOILS DATA TABLE

Table 23.9.1. Fertilizer Recommendations for each ELU

High Risk Areas – site-specific within each ELU, defined during construction by Peru LNG and Contractor, where bio-restoration techniques including fertilizer application are considered beneficial in addition to other reinstatement measures, to restoring vegetation cover more quickly in the most vulnerable areas

ELU	SECTOR	FERTILIZER	KG/HA
1	High Risk Areas	CaCO3	1000
		Phosphate	150
2	High Risk Areas	CaCO3	1000
		Phosphate	150
3	High Risk Areas	CaCO3	1000
		Phosphate	150
4	High Risk Areas	CaCO3	1000
		Phosphate	150
5	High Risk Areas	Phosphate	150
6	High Risk Areas	Phosphate	150
7	High Risk Areas	CaCO3	1000
		Phosphate	150
8	High Risk Areas	CaCO3	1000
		Phosphate	150
9	High Risk Areas	CaCO3	1000
		Phosphate	150
10	High Risk Areas	CaCO3	1000
	High Risk Areas	Phosphate	150
11	High Risk Areas	Phosphate	150
12	High Risk Areas	Phosphate	150
13	-	-	-
14	-	-	-

23.10 MAP OF ECOLOGICAL LANDSCAPE UNITS



APPENDIX 6: PIPELINE ECOLOGICAL CONTRACTOR MANAGEMENT PLAN

Environment, Social, Health and Safety
Management System (ESHS MS)

Pipeline Ecological Contractor Management Plan

Document Number:
02/ES/PL/PN/014/A01

TABLE OF CONTENTS

1.0 INTRODUCTION 4
2.0 POLICY AND LEGISLATIVE REQUIREMENTS 5
2.1 CORPORATE OBJECTIVES 5
2.2 PERUVIAN LEGISLATIVE REQUIREMENTS 5
2.3 INTERNATIONAL STANDARDS AND GUIDELINES 6
3.0 ROLES AND RESPONSIBILITIES 8
4.0 ECOLOGICAL MANAGEMENT: PLANNING, DESIGN AND PRECONSTRUCTION PHASE9
4.1 COORDINATION 9
4.2 PROJECT DESIGN AND PLANNING 9
4.3 ASSESSMENT OF ADDITIONAL LAND 9
4.4 ASSESSMENT OF OTHER FACILITIES 9
4.5 ENVIRONMENTAL AND SOCIAL MANAGEMENT ORGANIZATION 10
4.6 BIODIVERSITY ACTION PLAN 10
4.7 CONTRACTOR PRECONSTRUCTION SURVEYS AND INSPECTIONS 10
4.7.1 Physical Habitat and Soils 11
4.7.2 Flora and Vegetation 11
4.7.3 Protected Fauna Clearance and Relocation 18
4.8 METHOD STATEMENTS 22
4.9 EXCESS ROCK AND SUBSOIL DISPOSAL PLANNING 22
4.10 VERIFICATION AND MONITORING PLAN 23
4.10.1 Contractor Monitoring Responsibilities 23
4.10.2 Company Monitoring Responsibilities 23
4.11 REPORTING 23
5.0 CONSTRUCTION PHASE – GENERAL REQUIREMENTS 24
5.1 CODE OF CONDUCT AND CAMP SITES POLICIES 24
5.2 ECOLOGICAL TRAINING 24
5.3 GENERAL ECOLOGICAL MANAGEMENT 25
5.4 PROTECTION OF AQUATIC FAUNA 25
5.5 PROTECTION OF TERRESTRIAL FAUNA 26
5.5.1 General Requirements 26
5.5.2 Site-Specific Requirements 29
5.6 PROTECTION OF FLORA AND VEGETATION 33
5.6.1 Bofedales / Wetlands 34
5.7 WATERBODY PROTECTION 35
5.7.1 Pollution Prevention 35
5.7.2 Sediment Control 35
5.7.3 Acid Rock Drainage 35
5.7.4 Pipeline Crossing Installation 36
5.8 TOPSOIL PROTECTION 36
5.9 HYDROSTATIC TESTING 36
5.10 ENVIRONMENTAL AUDIT, MONITORING AND REPORTING 36

5.11 BIOLOGICAL MONITORING PROGRAM 37
APPENDIX 1: CONTRACTOR ECOLOGICAL ACTION PLAN / CHECKLIST 38

1.0 INTRODUCTION

Peru LNG S.R.L. (hereafter PERU LNG) is developing a liquefied natural gas (LNG) export Project (the Project) that includes the construction of a 408 km pipeline (hereafter the Pipeline) from near the city of Ayacucho to a natural gas liquefaction facility at Pampa Melchorita south of Lima. The construction of the Pipeline is the subject of various environmental and social commitments which have been identified from the Environmental and Social Impact Assessment (ESIA), Peruvian legislation requirements and International Finance Institutions (IFI) international standards and guidelines.

These requirements are being managed by PERU LNG through the development of an Environmental and Social Management Plan (ESMP) which comprises a number of Contractor Management Plans (CMPs), including this Pipeline Ecological Contractor Management Plan (hereafter referred to as the Plan).

This Plan has been developed based on the findings of the ESIA (2005) and a subsequent Ecological Field Survey (EFS) of the project footprint completed in 2007 by Domus Consultoria Ambiental (a Peruvian environmental consultancy firm) on behalf of PERU LNG. Together with the ESIA, the EFS forms an important source document to be used as a basis for developing and informing this Plan and should be referred to by CONTRACTOR for more detailed reference information.

This Plan identifies the commitments made by the Project for management measures relating to ecological issues which encompasses flora, fauna, habitats, ecosystems and biodiversity. It includes the actions required for managing Project activities in critical habitats during the construction of the Pipeline.

The Plan addresses only those commitments and requirements specifically related to construction of the Pipeline between Ayacucho and the LNG Plant at Pampa Melchorita. It does not address other commitments relating to either the LNG Plant itself or associated works including GNL-2 Quarry and marine works.

Any deviations that involve measures different from those contained in this Plan will only be permitted upon approval by PERU LNG.

Due to the large quantity of commitments quoted in the ESIA relating broadly to ecological management (approximately 500), this Plan has not copied them verbatim. To ensure this document is usable and workable, a number of commitments have been combined and the intent of other commitments captured.

However, CONTRACTOR should be aware of all related commitments made in the ESIA (included in the Commitment Register Document) and if a commitment or its intent has not been captured directly or explicitly within this Plan, CONTRACTOR shall still be expected to comply with the ESIA requirements.

Because of the close link between ecology and other key environmental issues including water quality, erosion and sediment control, biorestoration, pollution prevention and waste management, this Plan should be used in conjunction with other CMPs developed by PERU LNG and issued to CONTRACTOR including:

- Environmental and Social Management Plan (Framework Document)
- Footprint CMP
- Erosion Control and Reinstatement CMP
- Pollution Prevention CMP
- Waste Management CMP

- Hydrostatic Test Water CMP
- Biorestoration CMP
- Compliance Monitoring CMP

As part of its planning and readiness for construction, CONTRACTOR is required to prepare its own specific Environmental and Social Implementation Plans (ESIPs) setting out how it intends to meet and comply with the specific Project commitments set out in each CMP developed by PERU LNG. In this regard, CONTRACTOR is required to prepare an ESIP for Ecological Management.

The Environmental and Social Management Plan (Framework Document) provides an explanation of the linkage between the CMPs and ESIPs.

2.0 POLICY AND LEGISLATIVE REQUIREMENTS

PERU LNG intends that its corporate objectives, Peruvian legislative requirements, applicable IFI international standards and guidelines, as well as Project ESIA commitments, all of which are identified and described in this Plan, will guide the Project's ecological management activities and performance.

2.1 CORPORATE OBJECTIVES

The corporate objectives of PERU LNG are set out in the Environment, Health and Safety (EHS) and Community Relations Policies and Guidelines Section of the Environmental and Social Impact Assessment, PERU LNG Export Project, 2005.

PERU LNG's objectives in terms of its plans for ecological management are given in the Pipeline ESIA Volume IV, Environmental and Social Management Plan.

2.2 PERUVIAN LEGISLATIVE REQUIREMENTS

The following Peruvian legislative instruments are relevant to ecological management during pipeline construction.

- Political Constitution of Peru
- Law 28611, Environmental General Law, dated October 15, 2005.
- Law 26834, Law of Natural Protected Areas, dated June 30, 1997.
- Law 27308, Forestry and Wildlife Law, dated July 15, 2000.
- Law 26821, Organic Law for the Sustainable Use of Natural Resources, dated June 26, 1997.
- Law 26839, Law for Conservation and Sustainable Use of Biological Diversity, dated July 8, 1997.
- Law 17752, General Law of Water Resources, dated July 24, 1969
- Law for Public Investment in Development of Economic Activities in National Lands and Native and Peasant Farmer Community Lands.
- Participation Rights Law and Civilian Control
- Supreme Decree 041-99-EM, Regulation for the Transportation of Hydrocarbons through Pipelines, dated September 15, 1999.
- Supreme Decree 15-2006-EM, Environmental Protection Regulations for Hydrocarbon Activities, dated March 3, 2006.
- Supreme Decree N° 034-2004-AG, Fauna threatened species categorization, dated September 17, 2004

2.3 INTERNATIONAL STANDARDS AND GUIDELINES

CONTRACTOR is intended to fulfill the requirements of the World Bank/International Finance Corporation (IFC) and Inter-American Development Bank (IDB) policies on social and environmental sustainability and with particular reference to ecological and biodiversity issues which are the subject of this Plan.

The applicable IFC Performance Standards on Social and Environmental Sustainability are:

- IFC Performance Standard 1: *Social and Environmental Assessment and Management System*, which establishes requirements for assessment, management, organizational capability, training, community engagement, monitoring, and reporting
- IFC Performance Standard 4: *Community Health, Safety and Security*, which requires Projects to avoid or minimize adverse impacts due to Project activities on soil, water, and other natural resources in use by affected communities
- IFC Performance Standard 6: *Biodiversity Conservation and Sustainable Natural Resource Management*

Of particular importance and relevance to this Plan, IFC Performance Standard 6 sets out the following requirements:

i. Assess the significance of Project impacts on all levels of biodiversity as an integral part of the Social and Environmental Assessment process

ii. Minimize any conversion or degradation of modified habitat, and, depending on the nature and scale of the Project, identify opportunities to enhance habitat and protect and conserve biodiversity as part of the Project's operations

iii. Do not significantly convert or degrade such habitat, unless the following conditions are met:
   - There are no technically and financially feasible alternatives
   - The overall benefits of the Project outweigh the costs, including those to the environment and biodiversity
   - Any conversion or degradation is appropriately mitigated

iv. Design natural habitat mitigation measures to achieve no net loss of biodiversity where feasible, which may include a combination of actions, such as:
   - Post-operation restoration of habitats
   - Offset of losses through the creation of ecologically comparable area(s) that is managed for biodiversity
   - Compensation to direct users of biodiversity

v. In areas of critical habitat, no Project activities will be implemented unless the following requirements are met:
   - There are no measurable adverse impacts on the ability of the critical habitat to support the established population of species or the functions of the critical habitat
   - There is no reduction in the population of any recognized critically endangered or endangered species
   - Any lesser impacts are mitigated in accordance with point 4 above

vi. The client will not intentionally introduce any new alien species (not currently established in the country or region of the Project) unless this is carried out in accordance with the existing regulatory framework for such introduction, if such framework is present, or is subject to a risk assessment (as part of the client's Social and Environmental Assessment) to determine the potential for invasive behavior. The client will not deliberately introduce any alien species

with a high risk of invasive behavior or any known invasive species, and will exercise diligence to prevent accidental or unintended introductions

"Significant conversion or degradation" is defined by the IFC as: "*(i) the elimination or severe diminution of the integrity of a habitat caused by a major, long-term change in land or water use; or (ii) modification of a habitat that substantially reduces the habitat's ability to maintain viable population of its native species".*

A "Critical habitat" is defined by the IFC as: *"a subset of both natural and modified habitat that deserves particular attention. Critical habitat includes areas with high biodiversity value*[1]*, including habitat required for the survival of critically endangered or endangered species*[2]*, areas having special significance for endemic or restricted-range species; sites that are critical for the survival of migratory species; areas supporting globally significant concentrations or numbers of individuals of congregatory species; areas with unique assemblages of species or which are associated with key evolutionary processes or provide key ecosystem services; and areas having biodiversity of significant social, economic or cultural importance to local communities".*

This Plan will also assure compliance with the IDB's Environment and Safeguards Compliance Policy in regards to the protection of natural habitats by avoiding the significant conversion or degradation of such and prohibiting the introduction of invasive species.

The IDB defines "critical natural habitats" as: *"(i) existing protected areas, areas officially proposed by governments for protection or sites that maintain conditions that are vital for the viability of the aforementioned areas; and (ii) unprotected areas of known high conservation value. Existing protected areas may include reserves that meet the criteria of the IUCN Protected Area Management Categories I through VI; World Heritage Sites; areas protected under the RAMSAR Convention on Wetlands; core areas of World Biosphere Reserves; and areas in the UN List of National Parks and Protected Areas. Areas of known high conservation value are sites that, in the Bank's opinion, may be: (i) highly suitable for biodiversity conservation; (ii) crucial for critically endangered, endangered, vulnerable or near threatened species listed as such in the IUCN Red List of Endangered Species; or (iii) critical for the viability of migratory routes of migratory species."*

The IDB will not support operations that, in its opinion, significantly convert or degrade critical natural habitats.

The IDB defines "significant conversion" as: "*the elimination or severe diminution of the integrity of a critical or other natural habitat caused by a major, long-term change in land or water use. In both terrestrial and aquatic ecosystems, conversion of natural habitats can occur as the result of severe pollution. Conversion can result directly from the action of a Project or through an indirect mechanism (e.g., through induced settlement along a road)."*

Whenever feasible, IDB-financed operations and activities will be sited on lands already converted. In addition, the IDB will not support operations involving the significant conversion or degradation of natural habitats as defined in this policy, unless: (i) there are no feasible alternatives acceptable to the Bank; (ii) comprehensive analysis demonstrates that overall benefits from the operation substantially outweigh the environmental costs and; (iii) mitigation and compensation measures acceptable to the IDB – including, as appropriate, minimizing habitat loss and establishing and maintaining an ecologically similar protected area that is adequately funded, implemented and monitored. The IDB will not support operations that introduce invasive species.

[1]Such as areas that meet the criteria of the World Conservation Union (IUCN) classification.

[2]As defined by the IUCN Red List of Threatened Species or as defined in any national legislation.

3.0 ROLES AND RESPONSIBILITIES

PERU LNG has the ultimate responsibility for ecological management and assuring compliance with commitments in respect to the Project as a whole, including the progressive phases of planning, design and approvals, preconstruction, construction, commissioning, reinstatement, biorestoration operation and decommissioning and abandonment.

With respect to elements of the preconstruction phase and all of construction, CONTRACTOR is responsible for ensuring that relevant commitments incumbent on the Project during this phase are met.

In this regard, CONTRACTOR is responsible for complying with the policy and legislative requirements described in Section 2 of this Plan, implementing during the construction phase the specific actions described in Sections 4 through 5 of this Plan, as well as all contractual obligations.

This includes providing a description to PERU LNG of the roles and responsibilities of all key Project personnel, including the senior personnel representing any subcontractor organizations.

For each action described in Sections 4 through 5 of this Plan, the specific roles and responsibilities of PERU LNG and CONTRACTOR are delimited in the description of the action.

Where ecological responsibilities or commitments are incumbent specifically on PERU LNG rather than CONTRACTOR, these are clearly defined in this Plan and are included with the purpose of providing relevant background information for CONTRACTOR that may be helpful in meeting its own commitments.

A summary of ecological management responsibilities between PERU LNG and CONTRACTOR is set out in Table 3.1 below

TABLE 3.1 - SUMMARY OF ECOLOGICAL RESPONSIBILITIES BETWEEN PERU LNG AND CONTRACTOR

Key Issue/Activity	COMPANY	CONTRACTOR
Preconstruction site-specific identification and translocation of sensitive flora along Pipeline RoW	Movement of sensitive species, where appropriate, prior to CONTRACTOR entry onto RoW and extra/additional land areas	No action required
Preconstruction Survey along Pipeline RoW	Attended by PERU LNG Environmental Team	Verify ecological details set out in ESIA, EFS and ECOMP and measures to address site specific ecological requirements
Clearance Survey	Attended by PERU LNG Environmental Team	Immediately prior to construction clearing and grading to verify absence of sensitive fauna species
Relocation of Fauna species	Attended by PERU LNG Environment Team	Fauna species moved where applicable to adjacent similar habitats
Noise Monitoring of Bird Sensitive Areas	Noise Monitoring results reviewed by PERU LNG	During period of work activity in bird sensitive areas defined in this Plan
Additional land/extra work areas outside ESIA scope (e.g. camps, pipeyards, borrow pits, access roads)	Environmental Appraisal review	Environmental Appraisal of additional land/extra work space areas, including ecological aspects and impacts
General Ecological Management Commitments as per ESIA	Monitored and audited by PERU LNG	Implemented during construction

4.0 ECOLOGICAL MANAGEMENT: PLANNING, DESIGN AND PRECONSTRUCTION PHASE

All actions described in sections 4.1 through 4.11 of this Plan shall be performed prior to the commencement of any related construction activities. A summary of these actions (as well as those required during construction is presented in Appendix 1.

4.1 COORDINATION

CONTRACTOR will coordinate with PERU LNG and, where required, with Peruvian governmental agencies to obtain all appropriate ecological permits prior to conducting any works.

CONTRACTOR will develop specific procedures as required to prevent the introduction or spread of noxious or invasive weeds and/or soil pests resulting from construction and reinstatement activities.

4.2 PROJECT DESIGN AND PLANNING

All impact reduction measures will be incorporated into the Project's design. Consequently, mitigation will occur during Project planning, design and implementation.

4.3 ASSESSMENT OF ADDITIONAL LAND

Additional land (extra work space) refers to those areas that CONTRACTOR may require outside of the existing Project footprint described in the ESIA and beyond the approved 25 meter wide ROW corridor, for technical, safety or practical considerations. They may include:

- Steep slopes
- Side slopes

CONTRACTOR will undertake an ecological appraisal of these additional land areas with PERU LNG to determine the presence of any sensitive species identified in Section 4.7 of this Plan (or other sensitive species meeting the classification criteria if not already identified). Where appropriate, translocation of these species will be undertaken by PERU LNG.

4.4 ASSESSMENT OF OTHER FACILITIES

As well as areas of additional land identified in Section 4.3 there will also be other Project-related work areas proposed by CONTRACTOR and which where not already described in the ESIA, including:

- Camps
- Pipe yards/storage yards
- Works/mechanic yards and concrete batching plants
- Access roads and shooflies
- Hydrotest sites
- Borrow pits and
- Spoil (excess material) disposal sites

CONTRACTOR will be required to undertake an Environmental Appraisal of these areas including a review of ecological aspects and impacts for approval by PERU LNG. Full details of this requirement are set out in the Pipeline Footprint CMP.

Where CONTRACTOR identifies such areas required to support its construction program, a review and documentation of sensitive species that may require translocation prior to works should be

include in its Environmental Appraisal report submitted to PERU LNG. PERU LNG will undertake the translocation of such species where appropriate.

4.5 ENVIRONMENTAL AND SOCIAL MANAGEMENT ORGANIZATION

The framework for the Project's Environmental and Social Management System is provided by the Pipeline Environmental and Social Management Plan.

Environment, Community Affairs and Cultural Heritage Department
PERU LNG, as part of its environmental conservation and natural resource sustainable use policies, has established an Environment, Community Affairs and Cultural Heritage Department that, amongst other duties, will be responsible for management of ecological issues and verifying CONTRACTOR compliance with this Plan.

Commitment Register Document
A Commitment Register Document is formulated to contain all ecological commitments from the ESIA. A number of these commitments will be addressed directly by COMPANY and are the subject of a separate document. However, the majority of the ESIA commitments are the responsibility of CONTRACTOR and addressed by the CMPs including this Plan.

Contractor Management Plans
The CMPs developed by COMPANY describe the minimum environmental standards to be met by the Project in complying with conditions and commitments set out in the ESIA.

Environmental and Social Implementation Plans
CONTRACTOR will develop its own Environmental and Social Implementation Plans (ESIPs) in response to PERU LNG's CMPs including an Ecological Management ESIP. Full details of the Environment and Social Management Organization between PERU LNG and CONTRACTOR is set out in the Environmental and Social Management Plan (Framework Document).

Environmental Team
With particular reference to this Plan, CONTRACTOR will appoint a Field Ecologist with the appropriate practical experience to be able to fully understand and implement the requirements of this Plan including the relevant project ecological commitments and field knowledge of the specific flora and fauna issues as identified in this Plan. CONTRACTOR should ensure that the Field Ecologist is mobilized to the project in a timely manner in order to participate effectively in early project preparation works including preparation and review of relevant plans, procedures, method statements and the Pre-Construction Survey.

The Field Ecologist will report to the Field Environmental Manager. Other resources may be allocated by CONTRACTOR to assist the Field Ecologist where necessary.

4.6 BIODIVERSITY ACTION PLAN

PERU LNG is developing a Biodiversity Action Plan (BAP), voluntarily and independently of the ESIA, with the aim of contributing to wider sustainable use and conservation of natural resources and ecological enhancement in the broader region beyond the Pipeline ROW corridor and its immediate area of influence.

The BAP will be available for CONTRACTOR's information although does not explicitly document or relate to any commitments incumbent on CONTRACTOR in association with its Contract with PERU LNG.

4.7 CONTRACTOR PRECONSTRUCTION SURVEYS AND INSPECTIONS

4.7.1 Physical Habitat and Soils

Before any construction activities take place, CONTRACTOR will perform a staged, progressive Preconstruction Survey of the entire ROW and related work areas to establish the limits of the work and determine the condition of the land to be impacted.

This survey will as a minimum:

- Establish the centre line of the Pipeline and verify the boundaries of the ROW and other work areas,
- Identify and assess areas where additional working space beyond the approved 25-meter ROW corridor may be required, and
- Establish the boundaries of any other locations such as camps, pipeyards, storage areas, borrow pits, access roads, shooflies etc. that CONTRACTOR may be intending to utilize

CONTRACTOR shall ensure that during the survey a comprehensive photographic record (ground based) is made including key habitats or topographical features of ecological significance along the ROW prior to vegetation clearance, topsoil stripping, grading, cutting and other major earthworks to assist with the accuracy of physical reinstatement and biorestoration to the original pre-works condition after the completion of construction.

Features of ecological interest that will form part of the photographic record will include, as a minimum:

- Waterbody crossings, such as springs, streams, rivers, lakes, bofedales (Andean wetlands), lagoons, drainage ditches and water channels
- Woodlands, forests or meadows
- Distinctive topographical features such as gullies, canyons, slopes, rock fields, boulder fields, crags and other rocky outcrops
- Naturally unvegetated or bare areas
- Eroded or badland terrain
- Elements which are characteristic or typified habitats within each Ecological Landscape Unit (ELU) defined in the Ecological Field Survey
- High and Medium Sensitivity Habitats defined in Table 4.6-3

A copy of the photographic record will be provided by CONTRACTOR to PERU LNG either as an independent database or forming an appendix to the Preconstruction Survey report.

4.7.2 Flora and Vegetation

As part of its Preconstruction Survey, CONTRACTOR will review the areas defined by PERU LNG as high and medium sensitive species and habitats to determine the specific and current conditions of flora and fauna within the ROW and other work areas. This survey, as a minimum, will:

- Verify the occurrence, or otherwise, of sensitive and protected flora and fauna species in the proposed construction area
- Mark areas to be cleared and to be used as storage areas, such that plant cover is not excessively eliminated in sensitive areas
- Define any site-specific ecological restrictions or mitigation in relation to Project commitments or based on observations at the time of the survey

An ecological field study was carried out by PERU LNG along the Pipeline ROW in November-December 2006 to develop on the ecological detail set out in the ESIA. The results of this study were presented as an Ecological Field Survey (EFS) in 2007. Together with the ESIA, the EFS serves as a reference, source document from which this Plan was prepared.

The EFS defines 14 macro environments or Ecological Landscape Units (ELUs) (Table 4.7.1) along the Pipeline ROW which are meant to characterize broad geographical and topographical areas with distinctive and distinguishing elements of flora and fauna.

TABLE 4.7.1 – ECOLOGICAL LANDSCAPE UNITS (ELUS) ALONG THE ROW

No.	ECOLOGICAL LANDSCAPE UNIT	KP	ELEVATION (METRES)		WET SEASON PRECIPITATION RANGE
			MIN.	MAX.	
1	Apurimac River Valley Montane Forest ecotone	0+000 – 20+511	2,966	4,066	600-2000
2	Campana Watershed	20+511 – 25+115	3,414	4,066	500-700
3	Torobamba River Valley	25+115 – 44+300	2,400	3,674	300-600
4	Silicassa Sierra	44+300 – 56+783	3,566	4,222	500-700
5	Yucay River Valley	56+783 – 74+199	2,850	3,864	500-700
6	Huamanga-Vischongo Watershed Divide	74+199 - 103+970	3,864	4,250	600-700
7	Vinchos River Valley	103+970 – 117+388	3,200	4,000	600-800
8	Apacheta High Sierras	117+388 – 162+137	3,841	4,864	700-1000
9	Pampas-Palmitos River Basins	162+137 – 195+050	4,000	4,700	700-1000
10	Huaytara High Plains and Ridges	195+050 – 249+538	4,000	4,650	400-800
11	Pisco-Ica Watershed Divide	249+538 – 272+181	2,850	4,000	300-500
12	Coastal Bat Hills	272+181 – 308+000	750	3,100	10-400
13	Pisco Sand Plains	308+000 – 332+940	256	750	0-50
14	Ica-Lima Coastal Plain	332+940 – 402+000	125	368	0-10

Source: Ecological Field Survey (EFS), 2007

Within each Ecological Landscape Unit smaller areas or Habitats were defined. Across the entire ROW, 18 broad habitat types were defined (Table 4.7.2)

TABLE 4.7.2 – HABITAT TYPES ALONG THE ROW

HABITAT TYPE	ELU'S WHERE PRESENT
Wetland and Riparian Areas	
Riparian Vegetation	14
Coastal Hydromorphic Islands	13
Peat Bogs (Bofedales)	1,2,4,5,6,8,9,10
Grasslands	
Sward-forming Grassland	1,2,4,6,8,9,10
Tussock Grassland	1,2,3,4,5,6,7,8,9,10
Other Herbacaeous Formations	
Tillandsia Mats	13,14
Scrublands	
Resinous Scrub	3,4,5,7,8
Thorny Scrub	3,5,11
Mixed Scrub	10,11
Desert Scrub	11,12
Forests	
Upper Montane Forest	1
Dry Deciduous Forest	3
Low Broadleaf Evergreen Forest	3
Cactus-dominated Formations	
Columnar Cacti and Scrub	12
Anthropogenic Areas	
Eucalyptus Plantations	5
Cultivated Areas	1,2,3,5,6,7,8,13,14
Natural Unvegetated Areas	

TABLE 4.7.2 – HABITAT TYPES ALONG THE ROW	
HABITAT TYPE	ELU'S WHERE PRESENT
Scarcely Vegetated High-Andean Areas	8,9,10
Coastal Desert Barrens	13,14

Source: Ecological Field Survey (EFS), 2007

The sensitivity of each habitat was defined on the basis of the presence and number of sensitive flora and fauna species along that section of the Pipeline RoW. Sensitivity of individual flora and fauna species was defined in the EFS on the basis of the level of protection status from Peruvian agencies and international conservation bodies, species distribution, species mobility and local use. For example, a species is classified of higher sensitivity if it has the highest level of protection status, is limited to a local area, is immobile and has a permanent economic use to the community. A high or medium sensitivity species is often but not necessarily a species defined by Peruvian legislation as being a threatened (protected) species. Table 4.7.3 outlines high and medium sensitivity species identified by ELU within the EFS.

TABLE 4.7.3 HIGH AND MEDIUM SENSITVITY SPECIES BY ECOLOGICAL LANDSCAPE UNIT (ELU)		
SPECIES	DESCRIPTION	LEVEL OF SENSITIVITY
1. Apurimac River Valley Montane Forest Ecotone, KP 0+000 – 20+511		
Polylepis pauta	Quenual Tree	Medium
Eleutherodactylus discoidalis	Frog	Medium
Phrynopus sp	Frog	Medium
Proctoporus	Lizard	Medium
Tremarctos ornatus	Spectacled Bear	Medium
Agriornis ardicola	Bird (Tyrant)	Medium
Theristicus melanopis	Bird (Ibis)	Medium
2. Campana Watershed, KP 20+511 – 25+115		
Escallonia resinosa	Shrub	Medium
Myrosmodes sp.	Bog Orchid	Medium
Tecoma sambuxifolia	Shrub	Medium
Proctoporus sp.	Lizard	Medium
Theristicus melanopis	Bird (Ibis)	Medium
3. Torobamba River Valley, KP 25+115 – 44+350		
Corryocactus quadrangularis	Cactus	HIGH
Kageneckia lanceolota	Shrub	HIGH
Acacia macracantha	Tree	Medium
Ariestiguieta discolor	Shrub	Medium
Berberis flexuosa	Shrub	Medium
Echinopsos peruviana puquiensis	Cactus	Medium
Eriotheca vargasii	Shrub	Medium
Escallonia myrtilloides	Shrub	Medium
Escallonia resinosa	Shrub	Medium
Tecoma arequipensis	Shrub	Medium
Tecoma sumbucifolia	Shrub	Medium
Chanus spinulosus	Toad	Medium
Stenocercus aff. apurimacus	Lizard	Medium
Agriornis andicola	Bird (Tyrant)	Medium
4. Siliccasa Sierra, KP 44+350 – 56+738		
Aaa Sp.	Orchid	Medium
Distichia muscoides	Bog Moss	Medium
Escallonia myrtilloides	Shrub	Medium
Myrosmodes sp.	Bog Orchid	Medium
Perezia coerulescens	Herb	Medium
5. Yucay River Valley, KP 56+783 – 74+199		
Corryocactus quadrangularis	Cactus	HIGH

TABLE 4.7.3 HIGH AND MEDIUM SENSITVITY SPECIES BY ECOLOGICAL LANDSCAPE UNIT (ELU)		
SPECIES	DESCRIPTION	LEVEL OF SENSITIVITY
Berberis flexuosa	Shrub	Medium
Chaunus spinulosus	Toad	Medium
Cleistocactus morawetzianus	Cactus	Medium
Echinopsis peruviana spp. Puquiensis	Cactus	Medium
Escallonia myrtilloides	Shrub	Medium
Orestias sp.	Killifish	Medium
Trichomycterus rivulatus	Andean catfish	Medium
Liolaemus sp.	Lizard	Medium
Stenocercus frittsi	Lizard	Medium
Telmatobbius sp.	Frog	Medium
6. Huamanga-Viscongo Watershed Divide, KP 74+199 – 103+970		
Escallonia myrtilloides	Shrub	Medium
Oreomyrrhis andicola	Shrub	Medium
Parastrephia quadrangularis	Shrub	Medium
Orestias sp.	Killifish	Medium
Liolaemus sp.	Lizard	Medium
Telmatobius sp.	Frog	Medium
Leopardus (oreailurus) jacobitus	Mountain Cat	Medium
Vicugna vicugna	Vicuna	Medium
7.Vinchos River Valley, KP 103+970 – 117+388		
Echinopsis peruviana ssp. Puquiensis	Cactus	Medium
Escallonia myrtilloides	Shrub	Medium
Oroya peruviana	Cactus	Medium
Trichomycterus rivulatus	Andean catfish	Medium
8. Apacheta High Sierras, KP 117+388 – 162+137		
Berberis sp.	Bush	Medium
Ephedra Americana	Bush	Medium
Escallonia myrtilloides	Shrub	Medium
Oroya peruviana	Cactus	Medium
Perezia coerulescens	Herb	Medium
Perezia pinnatifida	Herb	Medium
Ribes sp.	Plant	Medium
Liolaemus cf. melanogaster	Lizard	Medium
Liolaemus melanogaster	Lizard	Medium
Leopardus (oreailurus) jacobitus	Mountain Cat	Medium
Vicugna vicugna	Vicuna	Medium
Asthenes dorbignyi (huancavelica)	Bird (Canastero)	Medium
Theristicus melanopis	Bird (Ibis)	Medium
9. Pampas-Palmitos River Basins, KP 162+137 – 195+050		
Perezia coerulescens	Herb	Medium
Perezia pinnatifida	Herb	Medium
Liolaaemus sp.	Lizard	Medium
Leopardus (oreailurus) jacobitus	Mountain Cat	Medium
Vicugna vicugna	Vicuna	Medium
Asthenes dorbignyi (huancavelica)	Bird (Canastero)	Medium
10. Huaytara High Plains and Ridges, KP 195+050 – 249+538		
Perezia coerulescens	Herb	Medium
Liolaemus sp. (ramirez)	Lizard	Medium
Liolaemus cf. polystictus	Lizard	Medium
Vicuna vicugna	Vicuna	Medium
Asthenes dorbignyi (huancavelica)	Bird (Canastero)	Medium
11. Pisco-Ica Watershed Divide, KP 249+538 – 272+181		
Chersodoma arequipensis	Shrub	HIGH
Senocio/Aequatorium tovarii	Cactus	Medium
Liolaaemus sp.	Lizard	Medium

TABLE 4.7.3 HIGH AND MEDIUM SENSITVITY SPECIES BY ECOLOGICAL LANDSCAPE UNIT (ELU)		
SPECIES	DESCRIPTION	LEVEL OF SENSITIVITY
Microlophus affitigris	Lizard	Medium
Vicuna vicugna	Vicuna	Medium
12. Coastal Bat Hills, KP 272+181 – 308+000		
Cleistocactus acanthurus	Cactus	HIGH
Browningra candelaris	Cactus	Medium
Cridoscolus basiacanthus	Herb	Medium
Ephedra Americana	Shrub	Medium
Loasa incana	Shrub	Medium
Neoralmondia arequipensis	Cactus	Medium
Orthopterygium huaucui	Tree	Medium
Microlophus tigris	Lizard	Medium
Phyllodactylus lepidopygus	Gecko Lizard	Medium
13. Pisco Sand Plains, KP 308+000 – 332+940		
Dicrodoa heterolepis	Lizard	Medium
Microlophus thoracicusicae	Lizard	Medium
Phyllodactylus lepidopygus	Gecko Lizard	Medium
Xenospingus concolor	Bird (Finch)	Medium
Tillandsia latifolia	Plant	Medium
Tillandsia paleacea	Plant	Medium
14. Ica-Lima Coastal Plain, KP 332+940 – 408+000		
Cryphiops caementarius	Shrimp	HIGH
Acacia macracantha	Tree	Medium
Trichomyctarus rivulatus	Andean catfish	Medium
Alsopphis sp.	Snake	Medium
Chaunus limensis	Toad	Medium
Ctenblepharys adspersa	Lizard	Medium
Dicrodon heterolepis	Lizard	Medium
Microlophus tigris	Lizard	Medium
Tillandsia latifolia	Plant	Medium
Tillandsia paleacea	Plant	Medium

Source: Ecological Field Survey (EFS), 2007

The sensitivity of a particular habitat within an Ecological Landscape Unit from low to medium to high was determined on the basis of the number of species of a particular level of sensitivity that were observed or known to occur within that habitat. The more flora or fauna species of medium or higher sensitivity that occurred in a particular habitat, the more likely that habitat would be defined as being of High Sensitivity.

CONTRACTOR should refer to the EFS (2007) for complete details on the methodology, assessment, significance, distribution and definition of species and habitat sensitivity.

Table 4.7.4 sets out medium and high sensitivity habitats by Ecological Landscape Unit.

TABLE 4.7.4 - HIGH AND MEDIUM SENSITIVITY HABITATS BY ECOLOGICAL LANDSCAPE UNIT			
ECOLOGICAL LANDSCAPE UNIT (ELU)	HABITAT TYPE	HABITAT SENSITIVITY	APPROX. ROW LENGTH (m)
1. Apurimac River Valley Montane Forest Ecotone	Upper Montane Forest	Medium	4,821
	Tussock Grassland	Medium	6,280
	Sward-forming Grassland	Medium	5,675
2. Campana Watershed	Peat Bog	Medium	956
3. Torobamba River Valley	**Cultivated Areas**	**High**	7,901
	Dry Deciduous Forest	Medium	651
	Thorny Scrub	**High**	6,335
4. Sillaccasa Sierra	Tussock Grassland	Medium	10,316
5. Yucay River Valley	**Resinous Scrub**	**High**	1,829
	Riparian Corridors	Medium	26
6. Huamanga-Vischongo Watershed Divide	Tussock Grassland	Medium	27,184
7. Vinchos River Valley	Cultivated Areas	Medium	12,062
8. Apacheta High Sierras	Scarcely Vegetated High Andean Areas	Medium	17,568
	Sward-forming Grassland	Medium	14,920
	Tussock Grassland	Medium	6,419
9. Pampas-Palmitos River Basins	Tussock Grassland	Medium	12,222
10. Huaytará High Plains and Ridges	Scarcely Vegetated High Andean Areas	Medium	3,549
	Sward-forming Grassland	Medium	16,127
	Tussock Grassland	Medium	33,616
11. Pisco-Ica Watershed Divide	**Mixed Scrub**	**High**	17,872
	Thorny Scrub	**High**	4,598
12. Coastal Bat Hills	**Desert Scrub**	**High**	15,743
	Columnar Cacti and Scrub	**High**	20,076
13. Pisco Sand Plains	**Hydromorphic Islands and Lagoons**	**High**	58
14. Ica-Lima Coastal Plain	Cultivated Areas	Medium	17,758
	Coastal Desert Barrens	Medium	46,430
	Riparian Corridors	**High**	874

Source: Ecological Field Survey (EFS), 2007

Notes:

- High Sensitivity areas are illustrated in BOLD
- The precise locations (KP points) where each of the sensitive habitats occurs in each ELU is set out in the Ecological Field Survey document which also sets out the methodology and criteria for classification and definition of habitat sensitivity and should be read in conjunction with this Plan.

Protected plant species (species listed as threatened by Peruvian legislation) identified in the ROW area by the EFS are set out in Table 4.7.5. Although generally consistent with high and medium sensitivity species defined in the EFS, there are some minor variations where a species defined as being of medium sensitivity by the EFS is not classified as a threatened (protected) species in Peru. Elevated sensitivity has been afforded to these species because of their unique socio-economic and cultural value or because of the importance that should be afforded to the species because of a particular commitment relating to that species in the ESIA regardless of its protection status.

TABLE 4.7.5: PROTECTED PLANTS IDENTIFIED ALONG ROW BY THE ECOLOGICAL FIELD SURVEY				
FAMILY	SCIENTIFIC NAME	TYPE OF PLANT	CATEGORY	ECOLOGICAL LANDSCAPE UNIT (HABITAT)
Asteraceae	*Aristeguietia discolor*	Shrub	NT	Torobamba River Valley (Cultivated Areas)
	Chersodoma arequipensis	Subshrub	CR	Pisco-Ica Watershed Divide (Mixed and Thorny Scrub)
	Parastrephia quadrangularis	Shrub	VU	Huamanga-Vischongo Watershed Divide (Tussock Grassland)
	Perezia coerulescens	Herb	VU	Sillaccasa Sierra (Sward-forming Grassland) Apacheta High Sierras (Sward-forming Grassland) Huaytará High Plains and Ridges (Sward-forming Grassland)
	Perezia pinnatifida	Herb	VU	Apacheta High Sierras (Sward-forming Grassland) Pampas-Palmitos River Basins (Sward-forming Grassland)
Bignoniaceae	*Tecoma arequipensis*	Shrub	VU	Torobamba River Valley (Dry Deciduous Forest) (Resinous Scrub)
	Tecoma sambucifolia	Shrub	NT	Torobamba River Valley (Thorny Scrub) (Cultivated Areas)
Cactaceae	*Browningia candelaris*	Cactus	VU	Coastal Bat Hills (Desert Scrub) (Columnar Cacti and Scrub)
	Cleistocactus acanthurus	Cactus	EN	Coastal Bat Hills (Desert Scrub) Coastal Bat Hills (Columnar Cacti and Scrub)
	Corryocactus quadrangularis	Cactus	EN	Torobamba River Valley (Cultivated Areas) Yucay River Valley (Resinous Scrub)
	Echinopsis peruviana puquiensis	Cactus	VU	Yucay River Valley (Resinous Scrub) Vinchos River Valley (Cultivated Areas)
Euphorbiaceae	*Cnidoscolus basiacanthus*	Herb	VU	Coastal Bat Hills (Columnar Cacti and Scrub)
Ephedraceae	*Ephedra americana*	Subshrub	NT	Apacheta High Sierra (Sward-forming Grassland) Coastal Bat Hills (Columnar Cacti and Scrub)
Fabaceae	*Acacia macracantha*	Tree	NT	Ica-Lima Coastal Plain (Cultivated Areas) (Riparian Vegetation) Torobamba River Valley (Cultivated Areas)
Glossuraliaceae	*Escallonia myrtilloides*	Shrub	EN	Yucay River Valley (Thorny Scrub) Huamanga-Vischongo Watershed Divide (Tussock Grassland) Vinchos River Valley (Tussock Grassland) (Resinous Scrub) Apacheta High Sierra (Tussock Grassland)

TABLE 4.7.5: PROTECTED PLANTS IDENTIFIED ALONG ROW BY THE ECOLOGICAL FIELD SURVEY				
FAMILY	SCIENTIFIC NAME	TYPE OF PLANT	CATEGORY	ECOLOGICAL LANDSCAPE UNIT (HABITAT)
	Escallonia resinosa	Shrub	VU	Torobamba River Valley (Thorny Scrub) Torobamba River Valley (Cultivated Areas)
Orchidaceae	*Myrosmodes* sp.	Bog Orchid	NT	Campana Watershed (Peat Bogs) Sillaccasa Sierra (Peat Bogs)
Rosaceae	*Kageneckia lanceolata*	Shrub	CR	Torobamba River Valley (Thorny Scrub)
	Polylepis pauta	Tree	NT	Apurimac Valley Montane Forest Ecotone (Upper Montane Forest)

Notes:
- CR – Critically Endangered
- EN – Endangered
- VU - Vulnerable
- NT – Near Threatened

Although the EFS defined plant species sensitivity on the basis of ecological technical evaluative criteria including protected status, high or medium sensitivity does not necessarily imply significant impacts to the species caused by construction of the Pipeline or require special mitigation such as translocation.

PERU LNG will be responsible for undertaking the translocation or transplanting of specific plant species along the ROW and other work areas prior to CONTRACTOR's readiness to commence works. CONTRACTOR will not be directly responsible for any plant translocation.

Species of sensitivity will be reviewed by PERU LNG on a species and case by case basis for translocation and salvage prior to construction, where practicable. For some species such as mature trees, cactus and bromeliads it will be impractical to physically translocate individuals because of their size and physical characteristics, extensive root system and handling difficulties and the likelihood of mortality caused by the stress induced by uprooting and relocation..

Before vegetation clearing and tree felling, topsoil strip and other earthmoving activities, the ROW will be marked carefully so that plant cover and other habitat elements (such as rocks) are not disturbed outside of approved work areas by clearing and grading or stockpiling of materials. Any sensitive plant species (Table 4.7-3 and 4.7-5) situated immediately adjacent to and on the edge of the ROW will be marked and flagged for protection so that they are not accidentally disturbed during clearing and grading works or damaged by unauthorized driving off the ROW or approved access roads.

4.7.3 Protected Fauna Clearance and Relocation

As part of the Preconstruction Survey, CONTRACTOR will perform an inspection of areas defined as being high or medium sensitivity species and habitats (Tables 4.7.3 and 4.7.4) immediately prior to construction to verify that animals belonging to protected species are absent from the construction area.

Not more than 48 hours prior to the start of ROW clearing and grading activities in each work front CONTRACTOR will ensure that fauna is not present on the ROW when stripping and earth moving activities commence.

CONTRACTOR should take particular care to identify fauna occurring in habitats defined by PERU LNG as of high or medium sensitivity (Table 4.7.3). Additionally, if CONTRACTOR identifies endemic species of low mobility, which cannot readily evacuate the ROW upon commencement of clearing activities, then all reasonable efforts should be taken by CONTRACTOR to relocate these species as well.

Fauna to be relocated to 'safe areas' outside the ROW by CONTRACTOR where observed and where practicable include relevant High and Medium Sensitivity species defined by the EFS (Table 4.7.3) and Protected Species listed as threatened by Peruvian legislation, (Table 4.7.6) and endemic species of low mobility (Table 4.7.7) that would likely suffer mortality without relocation assistance.

When not moving of their own instinct, larger animals of high mobility should be encouraged to flee from the ROW prior to the arrival of major machinery such as bulldozers and backhoes, while low mobility fauna may be captured and relocated to nearby suitable habitats that will not be affected by construction activities. Some species of high mobility such as birds, bats, Andean cat, mountain lion, puma, deer, spectacled bear and the condor are expected to naturally disperse from the ROW or surrounding area resulting from noise disturbance by Project activities unless in the unlikely event of being on nest in the case of birds.

TABLE 4.7.6: PROTECTED FAUNA WITH POTENTIAL PRESENCE ALONG ROW

SCIENTIFIC NAME	COMMON NAME	INRENA CATEGORY	ECOLOGICAL LANDSCAPE UNIT (HABITAT)
Chaunus spinulosus	Warty toad	NT	Torobamba River Valley (Cultivated Areas) (Dry Deciduous Forest)
Ctenoblepharys adspersa	Lizard	VU	Ica-Lima Coastal Plain (Desert Barrens) (Tillandsia Mats)
Dicrodon heterolepis	Lizard	VU	Pisco Sand Plains (Desert Barrens) Ica-Lima Coastal Plain (Desert Barrens) (Riparian Vegetation)
Microlophus tigris	Lizard	NT	Coastal Bat Hills (Columnar cacti and Scrub) Ica-Lima Coastal Plain (Desert Barrens)
Bothrops pictus	Pit Viper	VU	Ica-Lima Coastal Plain (Columnar Cacti and Scrub)
Bothrops roedingeri	Pit Viper	EN	Ica-Lima Coastal Plain (Columnar Cacti and Scrub)
Agriornis andicola	White-tailed shrike-tyrant	EN	Campana Watershed (Tussock Grassland) Torobamba River Valley (Thorny Scrub)
Asthenes huancavelicae	Pale-tailed canastero	VU	Apacheta High Sierras (Scarcely Vegetated High Andean Areas) (Tussock Grassland) Pampas-Palmitos River Basins (Scarcely Vegetated High Andean Areas) (Tussock Grassland) Huaytará High Plains and Ridges (Tussock Grassland) (Sward-forming Grassland)
Cinclodes palliatus	White-bellied cinclodes	CR	Apacheta High Sierras (Peat Bog)

TABLE 4.7.6: PROTECTED FAUNA WITH POTENTIAL PRESENCE ALONG ROW			
SCIENTIFIC NAME	COMMON NAME	INRENA CATEGORY	ECOLOGICAL LANDSCAPE UNIT (HABITAT)
Podiceps occipitalis	Silvery grebe	NT	Sillaccasa Sierra (Peat Bog)
Poospiza rubecula	Rufous-breasted warbling finch	EN	Pisco-Ica Watershed Divide (Mixed and Thorny Scrub)
Theristicus melanopis	Black-faced ibis	VU	Apurimac River Valley Forest Montane Forest Ecotone (Peat Bog) Campana Watershed (Peat Bog) Apacheta High Sierras (Peat Bog)
Vultur gryphus	Andean condor	EN	Torobamba River Valley (Resinous Scrub) Sillaccasa Sierra (Sward-forming Grassland) (Tussock Grassland) Yucay River Valley (Thorny Scrub) Apacheta High Sierras (scarcely Vegetated High Andean Areas) (Sward-forming Grassland)
Xenospingus concolor	Slender-billed finch	VU	Pisco Sand Plains (Hydromorphic Islands)
Lama guanicoe cacsilensis	Guanaco	EN	Huaytará High Plains and Ridges (Tussock Grassland) (Sward-forming Grassland)
Vicugna vicugna	Vicuña	NT	Huaytará High Plains and Ridges (Tussock Grassland) (Sward-forming Grassland)
Puma concolor	Puma	NT	Apurimac River Valley Montane Forest Ecotone (Sward-forming Grassland) Torobamba River Valley (Resinous Scrub) (Dry Decidious Forest) Sillaccasa Sierra (Tussock Grassland) Huamanga-Vischongo Watershed Divide (Tussock Grassland) Apacheta High Sierras (Scarcely Vegetated High Andean Areas)
Leopardus jacobitus	Andean mountain cat	EN	Pampas-Palmitos River Basin (Scarcely Vegetated High Andean Areas) Apacheta High Sierras (Scarcely Vegetated high Andean Areas) (Sward-forming Grassland) Huamanga-Vischongo Watershed Divide (Tussock Grassland)
Tremarctos ornatus	Spectacled bear	EN	Apurimac River Valley Montane Forest Ecotone (Upper Montane Forest)
Amorphochilus schnablii	Smoky bat	VU	Coastal Bat Hills (Columnar Cacti and Scrub)
Tomopeas ravus	Blunt-eared bat	CR	Coastal Bat Hills (Columnar Cacti and Scrub)
Platalina genovensium	Long-snouted bat	CR	Coastal Bat Hills

TABLE 4.7.6: PROTECTED FAUNA WITH POTENTIAL PRESENCE ALONG ROW			
SCIENTIFIC NAME	COMMON NAME	INRENA CATEGORY	ECOLOGICAL LANDSCAPE UNIT (HABITAT)
			(Columnar Cacti and Scrub)
Cryphiops caementarius	Shrimp	VU	Ica-Lima Coastal Plain (Pisco River etc.)

Notes:
- CR – Critically Endangered
- EN – Endangered
- VU - Vulnerable
- NT – Near Threatened

TABLE 4.7.7: LOW-MOBILITY ENDEMIC FAUNA SPECIES THAT MAY REQUIRE CAPTURE AND RELOCATION FROM ROW		
SCIENTIFIC NAME	TYPE OF ANIMAL	ECOLOGICAL LANDSCAPE UNIT (HABITATS)
Chaunus limensis	Toad	Ica-Lima Coastal Plain (Cultivated Areas) (Riparian Vegetation)
Eleutherodactylus sp.	Andes frog	Apurimac River Valley Montane Forest Ecotone (Upper Montane Forest)
Phrynopus sp.	Andes frog	Apurimac River Valley Montane Forest Ecotone (Upper Montane Forest)
Telmatobius sp.	Water frog	Sillaccasa Sierra (Waterbodies) Huamanga-Vischongo Watershed Divide (Waterbodies)
Proctoporus sp.	Lizard	Apurimac River Valley Montane Forest Ecotone (Upper Montane Forest) (Tussock Grassland) (Sward-forming Grassland) Campana Watershed (Tussock Grassland) (Sward-forming Grassland)
Liolaemus sp.	Lizard	(All Tussock Grasslands, Sward-forming Grasslands, Scarcely Vegetated High Andean Areas)
Microlophus aff. *Tigris*	Lizard	Pisco-Ica Watershed Divide (Mixed Scrub)
Stenocercus spp.	Lizard	Torobamba River Valley (All habitats) Yucay River Valley (All habitats)

CONTRACTOR's approach to the identification, trapping, capture, handling and relocation of amphibians and reptiles and other smaller mammals associated with site clearance activities will be developed before commencement of this activity by the preparation of a Fauna Handling Procedure by CONTRACTOR's Ecologist, based on details set out in the ESIA, the Environmental Field Survey and observations made during the CONTRACTOR Pre Construction Survey.

The capture of vertebrate fauna prior to and during clearance works shall be coordinated by CONTRACTOR Field Ecologist under the general supervision of the Field Environmental Manager and all methods of capture and handling shall employ sensitive methods that will not result in harm to the fauna. CONTRACTOR Environment Team will be required to coordinate closely with the Construction Clearance Crew.

Some fauna may be captured by hand, net, noose, Sherman or Tomahawk traps or snake hook working in front of and close to the clearance crew. In other instances, for certain species of

amphibians and reptiles these will need to be captured by baited pitfall traps or other appropriate methods with preparations made in advance.

As part of the Fauna Handling Procedure, CONTRACTOR will set out its methodology for setting traps in certain areas along the ROW, including the definition of relevant species, location (KP) and type of traps used, based on the species identification along the ROW listed in the Ecological Field Survey (Sections 23.6 and 23.7) and also any observations made during the Pre Construction Survey and documented in the Pre Construction Survey Report.

The capture and handling of large mammals such as deer, camelids, or spectacled bears is not envisioned for any purpose and shall not be attempted by the CONTRACTOR without authorization by PERU LNG, except in emergency situations.

Captured fauna should be held only for the minimum time necessary to transport them to relocation sites. Captured individuals shall be protected from exposure to adverse thermal or humidity conditions while in temporary storage or transit.

Rescued fauna shall be released in nearby suitable habitats away from the ROW or other work areas, where authorization for entry has been obtained in advance. Suitable habitat is understood as similar habitat and environment as the one from where the individual was removed. Snakes with protected status but which are dangerously venomous including the pit viper (*Bothrops* spp.) found in the coastal cactus and shrub habitat of the Ica-Lima Coastal Plain will only be handled and rescued by the Field Ecologist or any other fully trained snake expert and released at points at least 1km from the nearest human settlement.

4.8 METHOD STATEMENTS

CONTRACTOR will prepare Ecological Method Statements for the following:

- Acid Rock Drainage (refer Erosion Control and Reinstatement Plan)
- Moron and Bernal Lagoons area, KP 326+000 – 332+000
- Pisco River Crossing, KP 334+500 – 335+000
- Vicuna grazing areas, KP 74+000 – 104+000 and KP 220+000 – 280+000
- Bird Sensitive Areas (refer Tables 5-1 and 5-2)

Method Statements for major river crossings, streams and wetlands (bofedales) are addressed in the Erosion Control and Reinstatement CMP.

4.9 EXCESS ROCK AND SUBSOIL DISPOSAL PLANNING

Spoil (excess material) disposal sites will be assessed by CONTRACTOR for ecological sensitivity and any mitigation and management measures required in accordance with Project requirements and commitments as described in Section 4.3 of this Plan (Assessment of Additional Land) and the Footprint CMP.

4.10 VERIFICATION AND MONITORING PLAN

4.10.1 Contractor Monitoring Responsibilities

The Pipeline Compliance Monitoring CMP identifies CONTRACTOR's commitments made for the Project in relation to compliance monitoring for the following aspects:

- Water (including sedimentation at river crossings)
- Erosion and Sedimentation Control
- Air
- Noise
- Pollution Prevention
- Waste Management

In addition to the Pipeline Compliance Monitoring CMP, CONTRACTOR will perform additional verification and monitoring activities in accordance with the implementation of this Plan.

4.10.2 Company Monitoring Responsibilities

PERU LNG will ensure that CONTRACTOR will fulfill Project commitment with regards to ecological management set up in this Plan.

PERU LNG will develop a strategy for each applicable environmental component related to the Project so that the monitoring plan is integrated for the different internal audits scheduled to be carried out.

4.11 REPORTING

CONTRACTOR will report to PERU LNG on a weekly basis on this Plan and include information from the field-based ecological team. This information shall address (at least) the following ecological aspects:

- Any fauna trapped, handled and removed from the ROW during site clearance activities
- Any injuries to fauna caused by Project vehicles
- Any incidents or spillages in wetland areas or watercourses
- Noise monitoring results in bird sensitive areas
- Any third party complaints in relation ecological issues
- Any incidents of soil erosion or turbidity that have ecological impacts
- Reporting of other environmental aspects relating to air quality, noise, water quality, waste management and soil and erosion control, revegetation and biorestoration and which are directly or indirectly linked to ecological management are addressed in the other CMPs as listed in Section 1 (Introduction) of this Plan.

CONTRACTOR's Field Environmental Manager, Field Ecologist and other Field Environmental Officers will discuss the weekly reports to plan compliance strategies for the following week.

In addition, CONTRACTOR will prepare a comprehensive Monthly Environmental Report for submittal to PERU LNG, detailing all activities carried out during the previous month and the working plan for next month. This report will contain all relevant issues relating to ecological management.

PERU LNG will make this report available as a consultation and disclosure document for the authorities and other stakeholders, including the general public.

5.0 CONSTRUCTION PHASE – GENERAL REQUIREMENTS

For the purposes of this Plan, the ROW Construction Phase begins with the start of the Preconstruction Survey and early works and ends with the completion of physical reinstatement activities. Revegetation of the ROW including seeding and planting is addressed in the Biorestoration Plan.

This section describes the actions that need to be undertaken by CONTRACTOR. A summary of these actions (as well as those required during pre-construction is presented in Appendix 2.

5.1 CODE OF CONDUCT AND CAMP SITES POLICIES

All CONTRACTOR's personnel will be required to comply with the Code of Conduct and Camp Site Policies described in the ESMP Community Relations Plan.

5.2 ECOLOGICAL TRAINING

All CONTRACTOR's personnel must receive a General Environmental Induction prior to admittance to the ROW and other work areas. This Induction will include ecological issues and general construction best practices to safeguard ecological resources such as flora and fauna, waterbodies and habitats as set out in this Plan.

In addition, CONTRACTOR will arrange specialized and more detailed environmental training courses in general or specific topics of ecological management for certain staff such as Managers and Supervisors. Individual Supervisors will also receive training from the Field Environmental Manager on key environmental issues that affect or could be affected by their specific work activity.

The information gained by Supervisors during training will be cascaded to the rest of the work team, including laborers and general operatives, by routine toolbox talks. Any ecological conditions set out in CONTRACTOR Method Statements must also be demonstrated to Works Supervisors and their crews where they relate to their activities.

The ecological training key subjects will include:

- PERU LNG's environmental policy
- Local environmental legislation
- Appropriate management solid residues and effluents
- Pollution prevention for water and soil
- Fuel and lubricants handling
- Waste management
- Erosion and sedimentation control
- Recognition of protected species
- Flora and fauna protection
- Environmental incidents and emergencies response
- Delineation of high and medium sensitivity habitats
- Camelids protection
- Working in wetlands/bofedales
- Bird Sensitive areas
- Flagged/marked protected areas

5.3 GENERAL ECOLOGICAL MANAGEMENT

Fires
Fires if left unattended or are mismanaged can get out of control and spread across the surrounding environment resulting in widespread damage to neighboring ecological habitats, including flora and fauna. Lighting of fires for cooking or heating purposes can also result in the felling of live trees and bushes for firewood.
Lighting of fires by CONTRACTOR along the ROW and other work areas is generally prohibited. However, fires may be permitted for specific necessary activities in certain exceptional circumstances subject to authorization by PERU LNG.

Fires must not be lighted along the ROW or other work areas for burning waste.

Dust
CONTRACTOR shall ensure that all reasonable measures are taken to minimize dust impacts in sensitive habitats in accordance with the requirements of the Pollution Prevention CMP.

Noise
CONTRACTOR will maintain vehicles and machinery in good condition and furnish these with mufflers or other suitable abatement devices to minimize noise levels.

Electric pumps, generators and compressors will be routinely maintained and located as far as practicable from populated areas and fragile ecosystems containing noise sensitive species. They will be equipped with noise abatement mechanisms, which may include silencers, cladding or other noise absorbing or reflecting screens.

Engines should be switched off when the vehicle is not in use to avoid unnecessary noise from engine idling.

Electric generators and pumps will not be used by CONTRACTOR in sensitive habitat areas listed in Table 4.7.2 if they do not comply with World Bank/IFC noise standards (See Pipeline Compliance Monitoring CMP for applicable standards).

Maintenance and Repair Activities
All maintenance and repair activities will be confined to the ROW. No equipment or vehicle maintenance may be performed with 30 meters of any waterbody or wetland, unless the machine is broken down and it is impractical or unsafe to move it, in which case CONTRACTOR could repair the damaged equipment or vehicle in situ.

Signage
CONTRACTOR will place signs with environmental protection information in areas identified as environmentally sensitive such as camelids areas, bofedales/wetlands and other areas where sensitive flora and fauna species are situated immediately adjacent to the ROW and may be inadvertently disturbed or damaged during construction. Flagging of particular species or habitats will be undertaken where they are identified during the Preconstruction Survey as being immediately adjacent to the ROW.

Examples of other signs used for environmental protection would include the prohibition to hunt or capture animals, protection of plants, and the prohibition of lighting fires.

5.4 PROTECTION OF AQUATIC FAUNA

CONTRACTOR will implement mitigation procedures during trench excavation, installation, and pipe covering at river crossings to preserve aquatic habitats, minimize diversions, maintain uninterrupted water flow, avoid water use conflicts, and preserve the landscape in crossing areas.

All Project's personnel is prohibited from fishing in any inland waters (rivers, streams, lakes or ponds) in the Project area of influence, with the exception of authorized personnel for the purpose of hydrobiological monitoring and sampling activities.

CONTRACTOR will perform hydrostatic testing and the discharge of test water in compliance with the Pipeline Hydrostatic Testing CMP.
CONTRACTOR will install and maintain erosion and sedimentation control works wherever construction activities may affect waterbodies, in compliance with the Pipeline Erosion Control and Reinstatement CMP. CONTRACTOR will routinely monitor sediment in waterbodies.

5.5 PROTECTION OF TERRESTRIAL FAUNA

5.5.1 General Requirements

Hunting, Purchase, Capture, Possession, Disturbance, and Commercialization of Fauna

Hunting, capture, and possession of wild animals by CONTRACTOR are prohibited with the exception of rescue and relocation efforts.

It is forbidden for CONTRACTOR to buy or sell live wild animals.

It is prohibited for CONTRACTOR to hunt and/or fish within the Project area of influence.

If outsider hunters are found to be onsite, CONTRACTOR will notify PERU LNG who will report the problem to the appropriate authorities.

It is forbidden for CONTRACTOR to harass or disturb wild fauna, harm or destroy sensitive habitats (including nests, hideouts, burrows, etc), or otherwise interfere with their normal life in any way in areas not specifically approved by PERU LNG for clearing and grading activities.

CONTRACTOR will install chain-link or equivalent fencing around camps, pipe yards, valve stations, and other facilities to prevent the entry of wildlife and domesticated animals.

Meat from wild animals (bushmeat) should not be served by CONTRACTORS caterers in the camp canteens.

Pets

Pets are not permitted in any part of the Project area of influence including camps, ROW, yards and other worksites.

Project personnel may not capture, purchase, or otherwise obtain animals for pets in the Project area.

Exotic Fauna

The introduction of non-native fauna into ecosystems surrounding the ROW, camp facilities, or any other area is prohibited.

Injured Fauna

The following measures will be taken by CONTRACTOR in the event of an accident resulting in the injury of any individual fauna:

- Report the accident immediately to the Field Environmental Manager and Field Community Relations Manager who will determine the actions to be taken.
- All reasonable efforts will be made to take the animal to a local veterinary center to provide medical assistance. Where the animal is still alive, this decision should take into account the distance of the incident to the center and the safety of the PERU LNG or CONTRACTOR personnel. In this sense, the transport of the injured animal will be done in accordance with safety standards and without putting human life at risk.
- The recovery and release of the animal will be coordinated with a public (INRENA, CONACS, or others) and/or private (NGOs) institution.

CONTRACTOR will notify PERU LNG of any injuries and accidents involving fauna as soon as possible after the event.

Large individuals belonging to protected species and camelids will be transferred to a government-approved wildlife rehabilitation center or veterinary, if such exist within a reasonable distance from the incident.

Incidental mortalities identified in work areas and access roads will be reported to the Field Environmental Manager who will register information such as the species, size, time, habitat, etc.

Protection of Fauna during Clearing and Grading Activities

Prior to the start of clearing in a given work front CONTRACTOR needs to perform the ROW Preconstruction Survey described in Section 4.7 of this Plan.

CONTRACTOR personnel involved in clearing and grading activities need to be trained in Flora and Fauna protection and comply with the Code of Conduct using the training program described in Section 5.2 of this Plan.

CONTRACTOR Field Ecologist will verify the presence of fauna species in danger of harm or mortality or of other special concern when clearing vegetation within the ROW and will arrange for the setting of traps and collection and transfer of fauna where appropriate. The Field Ecologist will propose any other additional measures to the Clear and Grading Crew Supervisor.

Any animals caught in cleared material will be released by CONTRACTOR in a nearby suitable habitat away from work areas, provided it is safe for personnel.

Fauna Transit across the ROW

Pipeline construction from the clearing and grading to the backfill phase has the potential to restrict movements of wild or domestic fauna across the RoW. This will be especially important in high Andean areas used as grazing lands by camelids, either domesticated (llamas and alpacas) or wild and semi-wild (vicunas and guanaco).

Camelid activities are particularly important in the Ayavi District between approximately KP 220 and KP 280 (Ayavi District) and between KP 74 and KP 104 where there are herds of vicunas that roam wild across extensive areas. Other camelids, llamas and alpaca, are also observed in places between at least KP 120 and KP 220.

CONTRACTOR will ensure that pipeline trenches shall contain earthen ramps, plugs or crossovers at a spacing of not less than every 500 meters to permit the escape of any fauna that may enter the trench. In addition, these features shall enable fauna to safely cross the open trench and reach habitat outside the RoW.

CONTRACTOR will ensure that sufficient open space will be left between pipes at regular intervals to allow vehicular traffic and passage of domestic and wild animals along the ROW during stringing of pipe. These gaps between pipes will coincide with trench plugs or crossover locations.

In fauna transit areas, including the vicuna grazing area between approximately KP 74 to KP 104 and KP 220 and KP 280 CONTRACTOR will minimize to the greatest extent practicable, the time between pipe stringing and backfill in order to reduce the temporary barrier effect on wild and domestic fauna and any risk of injury caused by falling into the trench.
Excess material disposal areas will located such that they minimize any interruptions of fauna movements.

Trench Inspection and Rescue

CONTRACTOR will routinely inspect the trenches and facilitate the rescue of any trapped animal where safe to do so.

Project personnel shall notify the Field Ecologist or Field Environmental Officers upon encountering vertebrate fauna in the trenches. Such fauna shall be removed and released by authorized personnel.

Use of Existing Roads and Control of Vehicles and Machinery

Existing access roads will be used for the ROW to the extent practicable. In the event that additional accesses are required, CONTRACTOR will comply with the requirements of the Pipeline Project Footprint CMP and must receive PERU LNG approval prior to opening of new accesses.

Access road construction in areas defined by PERU LNG as containing sensitive habitats will be carried out in the shortest time possible and will consider the mitigation and prevention measures to avoid the alteration of these habitats.

Vehicles and machinery will only travel on authorized areas or roads.

Personnel, vehicles, and machinery will not be allowed to enter areas not authorized for the Project activities, especially in areas with sensitive habitats listed in Section 4.7-2.

CONTRACTOR should ensure that all vehicles are driven with caution and allow safe passage of wildlife across public roads, access roads and shooflies. Areas on the ROW known to have frequent occurrences of wildlife will be monitored routinely as part of daily inspections by CONTRACTOR's Environmental Officers.

Vehicle and heavy machinery operators will be provided with specific training in fauna protective measures and will be required to reduce speed in the presence of animals along the access roads. Training sessions will be provided in the form of toolbox talks. The toolbox talks will, among other items, address control of vehicle speeds and avoiding driving off the ROW or designated access roads and shooflies.

Camps and Yards

CONTRACTOR will install camps and yards only in areas that are not determined as environmentally or socially sensitive by PERU LNG, following the procedures described in this Plan and the Pipeline Footprint CMP for the case of areas not included in the ESIA.

Campsites will operate under the Code of Conduct and Remote Campsite Policies included in the ESMP Community Relations Plan.

No action is required in response to the presence of harmless invertebrates, amphibians, lizards, and small mammals or birds in areas where they are not exposed to risks or causing a nuisance.

In the event a reptile or mammal is encountered within camp and yard areas where they are at risk or pose a nuisance or hazard, the Field Environmental Manager will be advised for the determination of any required action.

CONTRACTOR will remove fauna by sensitive methods and will release the individual into nearby suitable habitats. Any snakes will be treated as venomous and shall only be handled by the Field Ecologist or another snake handling specialist and shall be relocated at least 1 km from any human settlement or actively cultivated area.
Birds should be encouraged to fly away from areas where they may be at risk.

Native vertebrate fauna shall not be harmed or exterminated unless such an action is justified by an imminent risk to human health and safety.

Noxious or toxic insects and other invertebrates such as ants, bees, wasps, spiders, and scorpions, and exotic vertebrate vermin such as house mice and roof rats may be exterminated by any lawful means as necessary to protect human health and safety.

5.5.2 Site-Specific Requirements

Pisco River (KP 334+500 – 335+000) – River Shrimp

CONTRACTOR will schedule construction of the Pisco River crossing (ELU 14) to avoid the major periods of river shrimp (*Cryphiops caementarius*) reproduction and migration (January to April) and other fish spawning periods. These periods correspond with the high water period when crossings should be avoided.

Pisco Sand Plains (KP 326+000 – KP 332+000)

No water may be extracted from the Bernal-Moron lagoons or channels habitat in the Pisco Sand Plains (ELU 13) for any purpose.

Camelids Management

Certain sections of the ROW between KP 70 and KP 280 are characterized by camelid farming, including vicuna, llamas and alpaca.

The high Andean scrubland (puna) areas of the pipeline ROW, particularly the districts of Ayavi, Tambo, Huaytara and Pilpichaca in Huancavelica Department between approximately KP 220 and KP 280 and the Huamanga and Vischongo area between approximately KP 74 and KP 104 in Ayacucho Department are especially important areas for vicuna farming where the animals are kept in a near wild state.

To minimize impacts on camelids, particularly the vicuna, CONTRACTOR will adopt the following general and activity specific good practice measures and ensure that all its staff are made aware and reminded of the requirements by general induction training, supervisor training, toolbox talks to general workers and on going site supervision by Environmental Officers:

- No feeding of camelids with workers food such as snacks and lunch packs
- Food garbage will not be left on the ROW and will be removed off site on a daily basis
- Ensure all construction waste, including welding rods, steel bevel shavings, coating resins and paints and oily rags are collected and not left on the ground surface or mixed with soil
- No driving off the RoW or authorized access roads will be strictly enforced

- No speeding on the RoW or along access roads will be strictly enforced
- No driving in darkness
- No hunting of animals
- No capture of animals for commercial gain or private use
- Where blasting activities are required along the ROW, CONTRACTOR will ensure that the surrounding predicted impact area is free of camelids prior to the blast to minimize the risk of harm caused by blast projectiles
- Warning Signs are to be installed and maintained at reasonable intervals along the RoW in camelid areas to the effect of '*Warning – Camelid Transit Area'* or equivalent
- Areas of open trench should be frequently inspected to determine if any camelids have fallen or are injured there. Where safe to do so, camelids will be assisted out of the trench
- Any evidence of illegal, third party hunting of camelids should be reported to the Works Supervisor and Community Affairs Manager
- CONTRACTOR should minimize as much as is reasonably practicable the time between pipe trenching and backfill to minimize the disruptive impacts on construction on camelid transit across the areas
- Trench plugs should be placed at regular intervals of approximately 500 meters and be designed to coincide with gaps left in the pipe either during stringing or after welding
- Trench plugs should also be placed on a site specific basis to coincide with prominent landscape and habitat features conducive to camelid gathering such as waterbodies, bofedales and grasslands
- During restoration and revegetation, only native and naturalized species representative of the habitat in the surrounding area will be used. There will be no use of invasive species including kikuyu grass (*Pennisetum clandestinum*).

CONTRACTOR will adopt the protocol for dealing with injured fauna in the event of an accident involving camelids on the ROW. The incident will be reported as soon as possible to CONTRACTOR Field Environmental Manager and Community Affairs Manager who in turn will notify PERU LNG immediately.

In the event that agreements are made between PERU LNG and the local communities to install camelid fencing in certain areas, CONTRACTOR will be required to work with the communities to install and maintain this fencing.

Access Roads and other facilities – Restricted Areas

Two specific areas were identified in the ESIA where no new permanent access roads should be developed as a means of providing access to the ROW, to minimize the risks of enhanced opportunities for third party hunting and poaching. Within these areas, new routes of access opened specifically for construction purposes will be temporary in nature, must be fully closed and reinstated after construction and must only occur where there is no other safe or practicable route of access to the work site along the ROW because of topographical or geotechnical constraints. Additionally, any upgrades and improvements of existing roads or shooflies proposed by CONTRACTOR will be agreed with COMPANY:

- Scrublands and other wooded areas around the Altomayo (Uras) River (near KP 30+000) in the District of Anco, Province of La Mar, Department of Ayacucho, where the white-tailed deer (*Odocoileus virginianus*) has been recorded and is considered particularly at risk because of hunting.
- Area corresponding to the community vicuña grazing lands in the grasslands located in Ayaví (Province of Huaytará, Department of Huancavelica), in the vicinity of KP 252+600.

Additionally, the Ecological Field Survey (2007) identified a number of high sensitivity habitats by Ecological Landscape Unit, as summarized in the table below where no new access roads will be

constructed if the routes traverse directly through this particular habitat to connect with the ROW (habitat in the EFS was defined along the narrow ROW corridor only and therefore a sensitive habitat described on the ROW does not necessarily imply the same sensitive habitat off the ROW where an access road may be under consideration) :

ECOLOGICAL LANDSCAPE UNIT (ELU)	DESCRIPTION	HABITAT TYPE (HIGH SENSITIVITY)	KP RANGE (INDICATIVE)
3	Torobamba River Valley (KP 25+115 - 44+350)	Cultivated Areas	28+055 – 29+993 30+931 – 32+180 34+712 – 36+523 37+178 – 38+278 38+851 – 40+053 41+766 – 42+367
		Thorny Scrub	29+993 – 30+931 32+180 – 32+620 33+133 – 34+712 36+523 – 37+178 38+278 – 38+851 25+905 – 28+055
5	Yucay River Valley (KP 56+783 – 74+199)	Resinous Scrub	61+318 – 61+675 62+478 – 63+582 73+786 – 73+915 73+960 – 74+199
11	Pisco Ica Watershed (KP 249+538 – 272+181)	Mixed Scrub	249+538– 253+385 254+301– 259+938 263+612 -272+000
		Thorny Scrub	253+385-254+301 259+938-263+612
12	Coastal Bat Hills (KP 272+181 – 308+000)	Desert Scrub	272+181-287+924
		Columnar Cacti and Scrub	287+924-308+000
13	Pisco Sand Plains (KP 308+000 – 332+940)	Hydromorphic Islands and Lagoons	330+582-330+640
14	Ica-Lima Coastal Plain (KP 332+940 – 408+000)	Riparian Corridors	334+697-335+083 362+463-362+615 364+345-364+563 389+341-389+459

CONTRACTOR shall avoid the routing of new access roads if these sensitive habitats are confirmed off ROW unless there are no practicable, safe or reasonable alternatives and in which case PERU LNG approval will be required.

In addition, no new camps and pipeyards, storage yards, borrow pits/quarries and spoil disposal sites will be developed within these high sensitivity habitat type areas unless CONTRACTOR can demonstrate to COMPANY that the exact sites it proposes are disturbed areas, degraded from their natural and original condition by previous human activities or there are no practicable, safe or reasonable alternatives.

Noise Avoidance and Monitoring at Sensitive Bird Habitats

To the extent practicable, CONTRACTOR will arrange its construction activities work programme, but especially with regards to drill and blast activities, to minimize noise levels and disturbance during the bird nesting season which coincides with the annual rainy period from December to April and with particular reference to the following bird sensitive areas defined in the ESIA:

- Andean peat bogs in the Apacheta High Sierras and Pampas-Palmitos River Basins
- Western Andean scrublands in the Pisco-Ica Watershed Divide west of Huaytará

- Fringing hydromorphic vegetation around the Morón and Bernal Lagoons in the Pisco River Sand Plains

Where construction activities occur in these areas during the breeding/nesting season CONTRACTOR should ensure it follows the good practice noise abatement measures set out in Section 5.3 of this Plan.

CONTRACTOR must perform noise monitoring at specific locations within the above areas as per Table 5-1. Noise monitoring will be undertaken by CONTRACTOR at the specified locations whenever any construction activities occur within this bird nesting period. No monitoring is required within these sensitive areas during the dry season from May to November.

TABLE 5-1. BIRD SENSITIVE AREA NOISE MONITORING POINTS (FROM ESIA)

ESIA SAMPLING SITE REF.	UTM COORDINATES		APPROX. NEAREST ROW KP	APPROX. DISTANCE TO ROW (M)	SENSITIVE BIRD SPECIES	HABITAT TYPE (AND ELU)
	NORTH	EAST				
A-57	8529302	521430	166+250	490	White-bellied cinclodes	Peat Bog (9)
A-59	8526536	502997	186+480	1,548	Pale-tailed canastero	Peat Bog (9)
A-72	8491888	458938	249+230	1,421	Rufous-breasted warbling finch	Mixed Scrub (11)
A-89 (Bernal Lagoon)	8477229	395829	327+200	616	Slender-billed Finch	Coastal Hydromorphic Vegetation (13)
A-91 (Morón Lagoon)	8478249	393208	329+828	963		

Noise monitoring points are to be located along the edge of the sensitive areas at the point closest to the ROW, as indicated in Table 5-1.

Minimum periods and frequency of noise monitoring at the nearest KP as identified in Table 5-1 and defined in the ESIA:

- Two weeks before the scheduled start of construction
- During clearing and grading
- During pipe stringing
- One month after completion of backfill

During construction, the specific monitoring frequency will be determined by CONTRACTOR and approved by PERU LNG at the time and will be representative of the activities occurring in the work area.

CONTRACTOR's Field Ecologist will review the noise monitoring data as it is collected and inspect the ROW and surrounding area to determine if there is any negative impact on nesting birds on the basis of noise levels, field observations and professional judgment.

If an impact is identified by CONTRACTOR Field Ecologist during the nesting season, additional noise mitigation measures will be agreed between CONTRACTOR AND COMPANY to eliminate or minimize the impact on the affected area. In addition to the bird sensitive areas requiring noise monitoring, as defined in the ESIA and listed in Table 5-1 above, the following areas listed in Table 5-2 were also defined in the Ecological Field Survey (2007) as containing certain bird species classified as being of Medium Sensitivity.

TABLE 5-2: BIRD SPECIES OF MEDIUM SENSITIVITY (FROM ECOLOGICAL FIELD SURVEY)				
ELU	DESCRIPTION	KP	SPECIES	COMMON NAME
1	Apurimac River Valley Montane Forest Ecotone	0+000 to 20+511	*Agriornis ardicola*	White-tailed shrike tyrant
			Theristicus melanopis	Black-faced Ibis
2	Campana Watershed	20+511 to 25+115	*Theristicus melanopis*	Black-faced Ibis
3	Torobamba River Valley	25+115 to 44+350	*Agriornis andicola*	White-tailed shrike tyrant
8	Apacheta High Sierras	117+388 to 162+137	*Asthenes dorbignyi (huancavelica)*	Pale-tailed Canastero
			Theristicus melanopis	Back-faced Ibis
9	Pampas-Palmitos River Basins	162+137 to 195+050	*Asthenes dorbignyi (huancavelica)*	Pale-tailed Canastero
10	Huaytara High Plains and Ridges	195+050 to 249+538	*Asthenes dorbignyi (huancavelica)*	Pale-tailed Canastero
13	Pisco Sand Plains	308+000 to 332+940	*Xenospingus concolor*	Slender-billed Finch

Within these areas, CONTRACTOR will adopt good working practices to ensure that noise is minimized as much as reasonably practicable by:

- ensure that noise generating equipment such as pumps, generators and compressors are routinely serviced to meet the design specification and performance
- careful sitting of pumps, generators and compressors where possible to minimize noise impacts off the ROW
- switching off vehicles when not in use to reduce noise from idling engines
- avoid unnecessary of revving of engines

5.6 PROTECTION OF FLORA AND VEGETATION

All CONTRACTOR personnel shall comply with the following general requirements relating to flora and vegetation:

Collection, Gathering, Purchase, and Possession of Plants

Any collection or gathering of wild plants and vegetation from the ROW, work areas or the Project area of influence is prohibited.

The purchase of wild plants, alive or byproducts, including fruit and forest products, from local communities along the ROW is not allowed.

The cutting of trees outside the ROW is prohibited. If there are any trees within the ROW that do not need to be cleared they will be clearly marked.

Plants marked and flagged for protection outside the ROW will not be cleared, removed or disturbed.

Dust Control

For the purpose of protecting sensitive flora, CONTRACTOR shall identify, prior to and during construction, areas at risk of significant impacts of dust on the ROW and on access roads in areas with protected plant species as listed in Table 4.7-1 and 4.7-2 of this Plan. CONTRACTOR shall apply dust management activities and monitoring as specified by the Pipeline Pollution Prevention CMP.

Introduction of Exotic Flora

The introduction of foreign or non adapted vegetation to ROW, camps, work areas and surroundings is not allowed.

Minimization of Land-take

CONTRACTOR will plan and design facilities and work areas to minimize the area to be cleared to that strictly necessary for the safe construction and operation of the pipeline Project, in compliance with the Pipeline Footprint CMP and Section 4 of this Plan.

Existing access roads will be used for the ROW and in the event of new accesses prior notice shall be given to the Work Supervisor, in compliance with the Pipeline Footprint CMP and Section 4.3 of this Plan.

Before clearing of the ROW, camps, yards, and other work areas begins, CONTRACTOR will clearly delimit all areas to be cleared with visible markers to ensure that clearance does not take place outside designated areas.

Additional temporary access roads will have a maximum disturbance width of 15 meters apart from in exceptional cases where extra width may be required for safety or construction considerations, subject to approval of COMPANY.

CONTRACTOR is not permitted to clear trees outside the ROW or other approved work areas.

5.6.1 Bofedales / Wetlands

High Andean wetlands (bofedales) are important sources of water and support sensitive ecological habitats and grazing areas for camelids. Bofedales are crossed by the ROW in ELU's 1, 2, 4, 5, 6, 8, 9 and 10

The measures used to avoid, minimize and control impacts to bofedales are set out in the Erosion Control and Reinstatement CMP.

5.6.2 Bromeliads – Tillandsias

Tillandsia mats (belonging to the Bromeliad family of plants) are found in patches within the coastal desert section of the Pipeline ROW in ELU 13, Pisco Sand Plains (KP 308+400 – 332+940) and ELU 14, Ica-Lima Coastal Plain (KP 332+940 – 408+000).

CONTRACTOR shall ensure that impacts on these plant communities adjacent to and immediately outside the ROW are minimized by the following measures:

- No driving off the ROW except on approved access roads and shooflies
- Avoid stockpiling of ROW trench spoil or grading material directly adjacent to tillandsia patches, where practicable
- Flagging of tillandsia patches for protection where directly adjacent to/outside the ROW
- CONTRACTOR Field Ecologist or another Field Environmental Officer to be present during any ROW clear and grade and earth moving activities
- Collection and removal of plants by Project workers is prohibited
- Training and toolbox talks to assist workers with the identification of tillandsias, its sensitivity and the importance of the above measures

5.7 WATERBODY PROTECTION

5.7.1 Pollution Prevention

Sensitive aquatic habitats such as rivers, streams, wetlands, bofedales and lagoons are at risk of contamination by hydrocarbon discharges caused by spills, drips and leaks from mobile or static equipment during construction.

CONTRACTOR should refer to the Pollution Prevention CMP which outlines the Project commitments in relation to pollution prevention and control and the measures to be adopted by CONTRACTOR to manage these risks.

5.7.2 Sediment Control

Sensitive aquatic habitats are also at risk of contamination by sediment caused by erosion along the ROW.

CONTRACTOR should refer to the Erosion Control and Reinstatement CMP which outlines the Project commitments in relation to the control of sediment by the use of temporary and permanent erosion control measures.

CONTRACTOR will define and agree with COMPANY the location and nature of temporary erosion controls to be installed and maintained along the ROW until final, permanent reinstatement, as part of the Pre-Construction Survey. CONTRACTOR will prepare area-specific Erosion Control Plan as a result of this survey.

CONTRACTOR Clear and Grade Work Crew will avoid the removal of soil stabilizing ground level vegetation along the edges of watercourses where practicable and these buffer zones on the trench side of the ROW will be retained until immediately prior to installation of the pipe crossing to protect the watercourses from contamination by sediment runoff from erosion of the ROW and the banks. Tree trunks, branches and other vegetation occurring above ground level are permitted to be removed by the Clear and Grade Crew but shall not use methods that will disturb tree roots and destabilize the banks.

The exact width of the buffer zones will be agreed on a site-by-site basis by PERU LNG and CONTRACTOR but should be a minimum width of 2 to 3 meters. Within the ROW, vegetation can be removed along the watercourse by the Clear and Grade Crew at the position where preparation and installation of a watercourse crossing is required.

CONTRACTOR should also ensure that turbid trench water is not allowed to enter sensitive bofedales by employing good practice measures during dewatering operations including pump set-up, operation and discharge monitoring.

5.7.3 Acid Rock Drainage

The ESIA identified a number of areas along the Pipeline ROW which were considered to have a high or medium risk of generation of acid rock drainage (ARD).

When entering waterbodies such as rivers, streams, lakes, wetlands and bofedales, ARD has the potential to harmfully affect the aquatic habitat by increasing water acidity, lowering pH, reducing dissolved oxygen levels and increasing the dissolved metals and sulphate content of the water to possibly toxic levels either by a progressive or by intensive pulse loading of acid runoff especially during the rainy season or isolated rainfall events.

CONTRACTOR should refer to the Pollution Prevention CMP and Compliance Monitoring CMP for full details of the ARD areas defined along the ROW and access roads, and the Project commitments and mitigation measures for minimizing and monitoring potential impacts from ARD.

5.7.4 Pipeline Crossing Installation

Pipeline construction across major rivers and streams will be carried out where practicable during the dry season (April – November) avoiding the rainy periods (December – March). The crossing of the Pisco River (KP 335) must be carried out outside of the January – April period.

CONTRACTOR will ensure that crossing techniques are used which maintain downstream flows at all times or that if flows are interrupted (e.g. flume pipe method of pipe installation where the flume is temporarily removed to allow pipe string to be lowered into the trench) it is for as short a time as possible.

The EFS and this Plan identifies a number of watercourses which contain ecologically or commercially sensitive aquatic species including fish and shrimps. Where dam and overpump techniques are used to carry channel flowing water around the ROW crossing during pipe installation, CONTRACTOR shall ensure that protection meshes are installed upstream and downstream of the works area to prevent pump entrainment or other harm to fish, fry, shrimps and other aquatic organisms and that any remaining aquatic life trapped within the work area is removed by the Field Ecologist, where practicable.

5.8 TOPSOIL PROTECTION

Topsoil protection measures during stripping, handling, storage is addressed in the Erosion Control and Reinstatement CMP to ensure that this resource is preserved in its original quality and quantity to facilitate reinstatement, revegetation, return of original biodiversity, soil stabilization and erosion control and waterbody protection.

5.9 HYDROSTATIC TESTING

Hydrostatic testing will require the abstraction of large volumes of water from rivers or lakes and the subsequent discharge and disposal of hydrotest waters to land or waterbodies after the completion of the hydrotest.

CONTRACTOR will perform hydrostatic testing of the Pipeline in full compliance with the ESIA standards set out in the Pipeline Hydrostatic Test Plan and Compliance Monitoring Plan in order to ensure there are no significant impacts on ecological resources and ESIA commitments are met.

No hydrotest dewatering will be permitted directly into wetlands/bofedales.

If corrosion inhibitor oxygen scavenger additives are used during hydrotesting (subject to approval by COMPANY), CONTRACTOR should ensure careful location selection and design details for the dewatering site in order to avoid or minimize as far as is reasonably practicable the impacts of introducing lower levels of dissolved oxygen within the hydrotest water discharge into receiving waterbodies.

5.10 ENVIRONMENTAL AUDIT, MONITORING AND REPORTING

CONTRACTOR will implement the construction phase monitoring procedures described by the Pipeline Compliance Monitoring CMP.

Monitoring is integral to the Project activities at all levels. For the purposes of this Plan, the term monitoring applies to the empirical environmental monitoring of physical, chemical, biological or

ecological parameters (such as noise, biological water) and qualitative monitoring through inspection and audit and monitoring of performance against Project requirements and commitments. Monitoring includes the monitoring, review and verification of the implementation and effectiveness of mitigation measures.

A large proportion of PERU LNG's environmental and social role during the construction phase will be related to monitoring and, more specifically, assuring that CONTRACTOR is implementing environmental and social commitments related to their respective activities in a manner consistent with the ECOMP, the Pipeline Restoration Plan (PRP), and the CMPs. As part of the ESMS, both PERU LNG and CONTRACTOR shall establish assurance plans and processes for ensuring all the requirements of the ECOMP are being implemented.

Where monitoring identifies non-compliances against Project standards, requirements and commitments, PERU LNG may issue Work improvement Notices (WIN), Corrective Action Requests (CAR), Non-Compliance Reports (NCR) and Temporary Work Suspension Notices (TWS) to the CONTRACTOR which must be addressed in a timely manner.

CONTRACTOR shall submit a Monitoring Report to PERU LNG on a monthly basis for review and approval.

In addition to internal monitoring and audits conducted by CONTRACTOR and PERU LNG, external audits will also be carried out on a systematic, periodic basis by a number of accepted third parties including:

- Regulatory governmental agencies, including OSINERGMIN who will inspect, supervise and audit the pipeline Project on a monthly basis and may issue Observations against non-compliances, and
- International Finance Institutions (Lenders) and their auditors, providing financial support to the Project and who will undertake visits including audits on a quarterly basis throughout the duration of the Project.

The principal objective of verification and monitoring is to provide assurance that CONTRACTOR is adhering to the requirements and commitments contained in the ECOMP.

Verification and Monitoring by CONTRACTOR will be in accordance with the Pipeline Compliance Monitoring CMP.

5.11 BIOLOGICAL MONITORING PROGRAM

COMPANY will be responsible for developing a Biological Monitoring Program for ecologically sensitive habitats, including but not limited to aquatic ecosystems. COMPANY will implement this program prior to construction and maintain it throughout the construction period and into reinstatement and operation.

Among other things, the Biological Monitoring Program will address the larger mobile mammal species listed in Section 4.7 (spectacled bear, puma, mountain lion, Andean cat, and condor) which although unlikely to be directly impacted by construction activities could be indirectly impacted.

APPENDIX 1: CONTRACTOR ECOLOGICAL ACTION PLAN / CHECKLIST

ELU 1: APURIMAC RIVER VALLEY MONTANE FOREST ECOTONE, KP 0+000 – 20+511					
Item	Action	How	When	Who	Reference
Bofedales/ Wetlands*	• Definition and delineation (validation of ESIA and EFS)	• Pre-Construction Survey	Before Construction	Construction /Engineering/ Environmental	4.7.1
	• Development of good practice construction measures	• Bofedales Method Statement/Procedure	Before Construction	Construction/Engineering/ Environmental	5.6.1
	• Implementation of good practice construction measures	• Method Statement/Procedure and Toolbox Talks	During Construction	Construction	5.6.1
	• Compliance Monitoring	• Site inspection and supervision	During Construction	Environmental	5.12
Waterbodies (Rivers, Streams)* Key Sites: River Alfarpampa, KP 0+196 River Qollpa, KP 0+475 River Sachapampa, KP 9+884 ROW also crosses an arroyo and several quebradas of intermittent or ephemeral flow	• Definition and delineation of temporary erosion control measures	• Pre-Construction Survey	Before Construction	Construction/Engineering/ Environmental	4.6.1
	• Install and maintain temporary erosion control measures	• Erosion Control Plan	During Construction	Construction	5.8.1
	• Compliance Monitoring	• Site inspection and supervision	During Construction	Geotechnical /Environmental	5.12
	• Pollution prevention and control during crossing installation	• Generic or site-specific Method Statements	Before Construction	Construction/Engineering/ Environmental	5.8.1
	• Implementation	• Method Statement and Toolbox Talks	During Construction	Construction	5.8.1
	• Compliance Monitoring	• Site inspection and supervision	During Construction	Environmental	5.12
	• Minimise sediment discharge into watercourse	• Retain vegetative buffer zone along watercourse edge during site clearance, and only to be stripped later, prior to crossing installation • Good practice crossing techniques used during installation	During Construction	Construction	5.8.1
Medium Sensitivity Species	• Definition and delineation	• Pre-Construction Survey	Before Construction	Construction/Engineering/ Environmental	4.6
	• Restrict clearance to ROW	• Demarcation / flagging of	Before and During	Construction	4.6

ELU 1: APURIMAC RIVER VALLEY MONTANE FOREST ECOTONE, KP 0+000 – 20+511					
Item	Action	How	When	Who	Reference
Polylepis pauta (Quenual tree)	limits	areas and species outside ROW • Pre-works awareness training, toolbox talks • Site monitoring by Works Supervisor and Environmental Officer	Construction		
Reptiles – frogs (*Eleutherodactylus discoidalis*, *Phrynopus sp)*, and Lizards (*Proctoporus*)	• Protection and removal to 'safe areas' before clearance works begin	• Identification during Pre-Construction Survey • Trapping, capture and removal just before/during clearance	Before/During Construction	Environmental	4.6
Birds – Tyrant (*Agriornis ardicola*) and Ibis (*Theristicus melanopis*)	• Minimize disturbance during construction	• Noise abatement measures	During Construction	Construction	5.5.2
Acid Rock Drainage – High Risk: Access Roads, KP 4+255 (access to V182)	• Develop special construction practices to avoid aquatic habitat degradation from acid runoff from working areas	• Acid Rock Drainage Method Statement	Before Construction	Construction/Environmental	5.8.2
	• Implement special construction practices to avoid aquatic habitat degradation from acid runoff from working areas	• Acid Rock Drainage Method Statement • Training and Toolbox Talks	During construction	Construction	5.8.2
	• Compliance monitoring	• Site inspection, supervision and water quality monitoring	During Construction	Environmental	5.12

* Refer EFS for KP details

ELU 2: CAMPANA WATERSHED, KP 20+511 – 25+115					
Item	Action	How	When	Who	Reference
Bofedales/ Wetlands*	• Definition and delineation (validation of ESIA and EFS)	• Pre-Construction Survey	Before Construction	Construction /Engineering/ Environmental	4.6.1
	• Development of good practice construction measures	• Bofedales Method Statement/Procedure	Before Construction	Construction/Engineering/ Environmental	5.6.1
	• Implementation of good practice construction measures	• Method Statement/Procedure and Toolbox Talks	During Construction	Construction	5.6.1
	• Compliance Monitoring	• Site inspection and supervision	During Construction	Environmental	5.12
Waterbodies (Rivers, Streams)* Key Sites: River Huayco, KP 26+100 ROW also crosses several arroyos and quebradas of intermittent or ephemeral flow	• Definition and delineation of temporary erosion control measures	• Pre-Construction Survey	Before Construction	Construction/Engineering/ Environmental	4.6.1
	• Install and maintain temporary erosion control measures	• Erosion Control Plan	During Construction	Construction	5.8.1
	• Compliance Monitoring	• Site inspection and supervision	During Construction	Geotechnical /Environmental	5.12
	• Pollution prevention and control during crossing installation	• Generic or site-specific Method Statements	Before Construction	Construction/Engineering/ Environmental	5.8.1
	• Implementation	• Method Statement and Toolbox Talks	During Construction	Construction	5.8.1
	• Compliance Monitoring	• Site inspection and supervision	During Construction	Environmental	5.12
	• Minimise sediment discharge into watercourse	• Retain vegetative buffer zone along watercourse edge during site clearance, and only to be stripped later, prior to crossing installation • Good practice crossing techniques used during installation	During Construction	Construction	5.8.1
<u>Medium Sensitivity Species</u> Shrubs - *Escallonia resinosa* and *Tecoma sambuxifolia*	• Definition and delineation	• Pre-Construction Survey	Before Construction	Construction/Engineering/ Environmental	4.6
	• Restrict clearance to ROW limits	• Demarcation / flagging of areas and species outside ROW • Pre-works awareness training, toolbox talks • Site monitoring by Works Supervisor and Environmental Officer	Before and During Construction	Construction	4.6
Bog Orchid – *Myrosmodes sp.*	• Verify none-existence (i.e prior	• Pre-Construction Survey	Before Construction	Environmental	4.6.3

ELU 2: CAMPANA WATERSHED, KP 20+511 – 25+115					
Item	Action	How	When	Who	Reference
	translocation by COMPANY). Notify COMPANY if observed.				
Lizards – *Proctoporus sp.*	• Protection and removal to 'safe areas' before clearance works begin	• Identification during Pre-Construction Survey • Trapping, capture and removal from ROW just before/during clearance	Before/During Construction	Environmental	4.6.3, 5.5.1
Birds – Ibis (*Theristicus melanopis)*	• Minimize disturbance during construction	• Noise abatement measures	During construction	Construction	5.5.2

* Refer EFS for KP details

ELU 3: TOROBAMBA RIVER VALLEY, KP 25+115 – 44+350					
Item	Action	How	When	Who	Reference
Waterbodies (Rivers, Streams)* Key Sites: River Altomayo, KP 30+042 River Torobamba, KP 38+824 ROW also crosses several arroyos and quebradas with intermittent or ephemeral flows	• Definition and delineation of temporary erosion control measures	• Pre-Construction Survey	Before Construction	Construction/Engineering/ Environmental	4.6.1
	• Install and maintain temporary erosion control measures	• Erosion Control Plan	During Construction	Construction	5.8.1
	• Compliance Monitoring	• Site inspection and supervision	During Construction	Geotechnical /Environmental	5.12
	• Pollution prevention and control during crossing installation	• Generic or site-specific Method Statements	Before Construction	Construction/Engineering/ Environmental	5.8.1
	• Implementation	• Method Statement and Toolbox Talks	During Construction	Construction	5.8.1
	• Compliance Monitoring	• Site inspection and supervision	During Construction	Environmental	5.12
	• Minimise sediment discharge into watercourse	• Retain vegetative buffer zone along watercourse edge during site clearance, and only to be stripped later, prior to crossing installation • Good practice crossing techniques used during installation	During Construction	Construction	5.8.1
<u>High Sensitivity Species</u> • Cactus *(Corryocactus quadrangularis)* • Shrub *(Kageneckia lanceeolota*)	• Definition and delineation	• Pre-Construction Survey	Before Construction	Construction/Engineering/ Environmental	4.6
	• Restrict clearance to within ROW limits	• Demarcation / flagging of areas and species outside ROW • Pre-works awareness training, toolbox talks • Site monitoring by Works Supervisor and Environmental Officer	Before and During Construction	Construction/Engineering/ Environmental	
<u>Medium Sensitivity Species</u>	• Definition and	• Pre-Construction Survey	Before Construction	Construction/Engineering/	4.6

ELU 3: TOROBAMBA RIVER VALLEY, KP 25+115 – 44+350					
Item	Action	How	When	Who	Reference
• Tree (*Acacia macracantha)*	delineation			Environmental	
• Shrubs – *Ariestiguieta discolor, berberis flexuosa, echinopsos peruviana puquiensis, eriotheca vargasii, escallonia myrtilloides, escallonia resinosa, tecoma arequipensis, tecoma sumbucifolia)* • Cactus *(Echinopsos peruviana puquiensis)*	• Restrict clearance to within ROW limits	• Demarcation / flagging of areas and species outside ROW • Pre-works awareness training, toolbox talks • Site monitoring by Works Supervisor and Environmental Officer	Before and During Construction	Construction	4.6
• Reptiles – toads (Chanus spinulosis) and lizard *(Stenocercus aff. apurimacus)*	• Protection and removal to 'safe areas' before clearance works begin	• Identification during Pre-Construction Survey • Trapping, capture and removal from ROW just before clearance	Before/During Construction	Environmental	4.6.3, 5.5.1
• Birds – Tyrant (*Agriornis andicola)*	• Minimize disturbance during construction	• Noise abatement measures	During construction	Construction	5.5.2
<u>Permanent New Access Roads</u> • Altomayo River (KP 30)	• Avoid permanent new access roads/shooflies	• Utilize existing roads/shooflies and improvements/upgrade where necessary. • Close and reinstate new access roads/shooflies	During and after construction	Construction	5.5.2

* Refer EFS for KP details

ELU 4: SILICCASA SIERRA, KP 44+350 – 56+738					
Item	Action	How	When	Who	Reference
Bofedales/ Wetlands*	• Definition and delineation (validation of ESIA and EFS)	• Pre-Construction Survey	Before Construction	Construction /Engineering/ Environmental	4.6.1
	• Development of good practice construction measures	• Bofedales Method Statement/Procedure	Before Construction	Construction/Engineering/ Environmental	5.6.1
	• Implementation of good practice construction measures	• Method Statement/Procedure, Training and Toolbox Talks	During Construction	Construction	5.6.1
	• Compliance Monitoring	• Site inspection and supervision	During Construction	Environmental	5.12
Waterbodies (Rivers, Streams)* Key Sites: ROW crosses several quebradas with intermittent or ephemeral flows. Also passes close to Yanacocha Lagoon	• Definition and delineation of temporary erosion control measures	• Pre-Construction Survey	Before Construction	Construction/Engineering/ Environmental	4.6.1
	• Install and maintain temporary erosion control measures	• Erosion Control Plan	During Construction	Construction	5.8.1
	• Compliance Monitoring	• Site inspection and supervision	During Construction	Geotechnical /Environmental	5.12
	• Pollution prevention and control during crossing installation	• Generic or site-specific Method Statements	Before Construction	Construction/Engineering/ Environmental	5.8.1
	• Implementation	• Method Statement and Toolbox Talks	During Construction	Construction	5.8.1
	• Compliance Monitoring	• Site inspection and supervision	During Construction	Environmental	5.12
	• Minimise sediment discharge into watercourse	• Retain vegetative buffer zone along watercourse edge during site clearance, and only to be stripped later, prior to crossing installation	During Construction	Construction	4.6

ELU 4: SILICCASA SIERRA, KP 44+350 – 56+738					
Item	Action	How	When	Who	Reference
		• Good practice crossing techniques used during installation			
Medium Sensitivity Species • Shrub (*Escallonia myrtilloides)*	• Definition and delineation	• Pre-Construction Survey	Before Construction	Construction/Engineering/ Environmental	4.6
	• Restrict clearance to within ROW limits	• Demarcation / flagging of areas and species outside ROW • Pre-works awareness training, toolbox talks • Site monitoring by Works Supervisor and Environmental Officer	Before and During Construction	Construction	4.6
• Orchids *(Aa Sp.*), Bog Moss *(Distichia muscoides)*, Bog Orchids *(Myrosmodes sp.)* and Herbs *(Perezia coerulescens)*	• Verify none-existence (i.e prior translocation by COMPANY). Notify COMPANY if observed.	• Pre-Construction Survey	Before Construction	Environmental	4.6

* Refer EFS for KP details

ELU 5: YUCAY RIVER VALLEY, KP 56+738 – 74+199					
Item	Action	How	When	Who	Reference
Bofedales/ Wetlands*	• Definition and delineation (validation of ESIA and EFS)	• Pre-Construction Survey	Before Construction	Construction /Engineering/ Environmental	4.6.1
	• Development of good practice construction measures	• Bofedales Method Statement/Procedure	Before Construction	Construction/Engineering/ Environmental	5.6.1
	• Implementation of good practice construction measures	• Method Statement/Procedure, Training and Toolbox Talks	During Construction	Construction	5.6.1
	• Compliance Monitoring	• Site inspection and supervision	During Construction	Environmental	5.12
Waterbodies (Rivers, Streams)* Key Sites: Yucay River, KP 62+380 ROW also crosses several quebradas with intermittent or ephemeral flows	• Definition and delineation of temporary erosion control measures	• Pre-Construction Survey	Before Construction	Construction/Engineering/ Environmental	4.6.1
	• Install and maintain temporary erosion control measures	• Erosion Control Plan	During Construction	Construction	5.8.1
	• Compliance Monitoring	• Site inspection and supervision	During Construction	Geotechnical /Environmental	5.12
	• Pollution prevention and control during crossing installation	• Generic or site-specific Method Statements	Before Construction	Construction/Engineering/ Environmental	5.8.1
	• Implementation	• Method Statement and Toolbox Talks	During Construction	Construction	5.8.1
	• Compliance Monitoring	• Site inspection and supervision	During Construction	Environmental	5.12
	• Minimise sediment discharge into watercourse	• Retain vegetative buffer zone along watercourse edge during site clearance, and only to be stripped later, prior to crossing installation • Good practice crossing techniques used during installation	During Construction	Construction	5.8.1
<u>High Sensitivity Species</u> • Cactus *(Corryocactus quadrangularis)*	• Definition and delineation	• Pre-Construction Survey	Before Construction	Construction/Engineering/ Environmental	4.6
	• Restrict clearance to within ROW limits	• Demarcation / flagging of areas and species outside ROW	Before and During Construction	Construction/Engineering/ Environmental	4.6

ELU 5: YUCAY RIVER VALLEY, KP 56+738 – 74+199					
Item	Action	How	When	Who	Reference
		• Pre-works awareness training, toolbox talks • Site monitoring by Works Supervisor and Environmental Officer			
Medium Sensitivity Species • Shrubs (*Berberis flexuosa and Escallonia myrtilloides)* • Cactus *(Cleistocactus morawetzianus* and *Echinopsis peruviana spp. Puquiensis)*	• Definition and delineation	• Pre-Construction Survey	Before Construction	Construction/Engineering/ Environmental	4.6
	• Restrict clearance to within ROW limits	• Demarcation / flagging of areas and species outside ROW • Pre-works awareness training, toolbox talks • Site monitoring by Works Supervisor and Environmental Officer	Before and During Construction	Construction	4.6
• Reptiles – toads *(Chanus spinulosis*), frogs *(Telmatobbius sp.)* and lizards *(Stenocercus frittsi and Liolamus sp.)*	• Protection and removal to 'safe areas' before clearance works begin	• Identification during Pre-Construction Survey • Trapping, capture and removal from ROW just before clearance	Before/During Construction	Environmental	4.6.3, 5.5.1
• Fish – Killifish (*Orestias sp.)* and Andean catfish *(Trichomycterus rivulatus)*	• Protection of species and habitat during construction	• Installation of temporary erosion controls to minimize sediment runoff from ROW near waterbodies • Good practice techniques for waterbody crossing to minimize turbidity, interruption of flows and entrainment • Good practice pollution prevention and control to avoid hydrocarbon discharges	During construction	Construction	5.8.1, 5.8.3

* Refer EFS for KP details

ELU 6: HUAMANGA-VISCONGO WATERSHED DIVIDE, KP 74+199 – 103+970					
Item	Action	How	When	Who	Reference
Bofedales/ Wetlands*	• Definition and delineation (validation of ESIA and EFS)	• Pre-Construction Survey	Before Construction	Construction /Engineering/ Environmental	4.6.1
	• Development of good practice construction measures	• Bofedales Method Statement/Procedure	Before Construction	Construction/Engineering/ Environmental	5.6.1
	• Implementation of good practice construction measures	• Method Statement/Procedure, Training and Toolbox Talks	During Construction	Construction	5.6.1
	• Compliance Monitoring	• Site inspection and supervision	During Construction	Environmental	5.12
Waterbodies (Rivers, Streams)* Key Sites: ROW crosses several arroyos (streams) and quebradas with ephemeral or intermittent flows	• Definition and delineation of temporary erosion control measures	• Pre-Construction Survey	Before Construction	Construction/Engineering/ Environmental	4.6.1
	• Install and maintain temporary erosion control measures	• Erosion Control Plan	During Construction	Construction	5.8.1
	• Compliance Monitoring	• Site inspection and supervision	During Construction	Geotechnical /Environmental	5.12
	• Pollution prevention and control during crossing installation	• Generic or site-specific Method Statements	Before Construction	Construction/Engineering/ Environmental	5.8.1
	• Implementation	• Method Statement and Toolbox Talks	During Construction	Construction	5.8.1
	• Compliance Monitoring	• Site inspection and supervision	During Construction	Environmental	5.12
	• Minimise sediment discharge into watercourse	• Retain vegetative buffer zone along watercourse edge during site clearance, and only to be stripped later, prior to crossing installation • Good practice crossing techniques used during installation	During Construction	Construction	5.8.1
<u>Medium Sensitivity Species</u> • Shrubs – *Escallonia myrtilloides, Oreomyrrhis andicola* and *Parastrephia*	• Definition and delineation	• Pre-Construction Survey	Before Construction	Construction/Engineering/ Environmental	4.6
	• Restrict clearance to within ROW limits	• Demarcation / flagging of areas and species outside ROW	During Construction	Construction	4.6

ELU 6: HUAMANGA-VISCONGO WATERSHED DIVIDE, KP 74+199 – 103+970					
Item	Action	How	When	Who	Reference
quadrangularis		• Pre-works awareness training, toolbox talks • Site monitoring by Works Supervisor and Environmental Officer			
• Reptiles – frogs (*Telmatobius sp.*) and lizards *(Liolamus sp.)*	• Protection and removal to 'safe areas' before clearance works begin	• Identification during Pre-Construction Survey • Trapping, capture and removal from ROW just before clearance	Before/During Construction	Environmental	4.6
• Fish – Killifish (*Orestias sp.)*	• Protection of species and habitat during construction	• Installation of temporary erosion controls to minimize sediment runoff from ROW near waterbodies • Good practice techniques for waterbody crossing to minimize turbidity, interruption of flows and entrainment • Good practice pollution prevention and control to avoid hydrocarbon discharges	During construction	Construction	5.8.1, 5.8.3
• Camelids – Vicuna (*Vicugna vicugna)*	• Develop camelid protection measures	• Camelids Method Statement/Procedure	Before construction	Environmental	5.5.2
	• Implement camelid protection measures	• Method Statement/Procedure, Training and Toolbox Talks	During construction	Construction	5.5.2
	• Compliance monitoring	• Site inspection and supervision	During construction	Environmental	5.5.2

* Refer EFS for KP details

ELU 7: VINCHOS RIVER VALLEY, KP 103+970 – 117+388					
Item	Action	How	When	Who	Reference
Waterbodies (Rivers, Streams)* Key Sites: Vinchos River, KP 110+680 ROW also crosses several arroyos (streams) and quebradas with ephemeral or intermittent flows	• Definition and delineation of temporary erosion control measures	• Pre-Construction Survey	Before Construction	Construction/Engineering/ Environmental	4.6.1
	• Install and maintain temporary erosion control measures	• Erosion Control Plan	During Construction	Construction	5.8.1
	• Compliance Monitoring	• Site inspection and supervision	During Construction	Geotechnical /Environmental	5.12
	• Pollution prevention and control during crossing installation	• Generic or site-specific Method Statements	Before Construction	Construction/Engineering/ Environmental	5.8.1
	• Implementation	• Method Statement and Toolbox Talks	During Construction	Construction	5.8.1
	• Compliance Monitoring	• Site inspection and supervision	During Construction	Environmental	5.12
	• Minimise sediment discharge into watercourse	• Retain vegetative buffer zone along watercourse edge during site clearance, and only to be stripped later, prior to crossing installation • Good practice crossing techniques used during installation	During Construction	Construction	5.8.1
Medium Sensitivity Species • Shrubs – *Escallonia myrtilloides* • Cactus – *Echinopsis peruviana ssp. Puquiensis* and *Oroya peruviana*	• Definition and delineation	• Pre-Construction Survey	Before Construction	Construction/Engineering/ Environmental	4.6
	• Restrict clearance to within ROW limits	• Demarcation / flagging of areas and species outside ROW • Pre-works awareness training, toolbox talks • Site monitoring by Works Supervisor and Environmental Officer	During Construction	Construction	4.6
• Fish – Andean catfish *(Trichomycterus rivulatus)*	• Protection of species and habitat during construction	• Installation of temporary erosion controls to minimize sediment runoff from ROW near waterbodies	During construction	Construction	5.8.1, 5.8.3

ELU 7: VINCHOS RIVER VALLEY, KP 103+970 – 117+388					
Item	Action	How	When	Who	Reference
		• Good practice techniques for waterbody crossing to minimize turbidity, interruption of flows and entrainment • Good practice pollution prevention and control to avoid hydrocarbon discharges			

* Refer EFS for KP details

ELU 8: APACHETA HIGH SIERRAS, KP 117+388 – 162+137					
Item	Action	How	When	Who	Reference
Bofedales/ Wetlands*	• Definition and delineation (validation of ESIA and EFS)	• Pre-Construction Survey	Before Construction	Construction /Engineering/ Environmental	4.6.1
	• Development of good practice construction measures	• Bofedales Method Statement/Procedure	Before Construction	Construction/Engineering/ Environmental	5.6.1
	• Implementation of good practice construction measures	• Method Statement/Procedure, Training and Toolbox Talks	During Construction	Construction	5.6.1
	• Compliance Monitoring	• Site inspection and supervision	During Construction	Environmental	5.12
Waterbodies (Rivers, Streams)* Key Sites: Churiac River, KP147+500 ROW also crosses several lagoons, arroyos (streams) and quebradas with ephemeral or intermittent flows	• Definition and delineation of temporary erosion control measures	• Pre-Construction Survey	Before Construction	Construction/Engineering/ Environmental	4.6.1
	• Install and maintain temporary erosion control measures	• Erosion Control Plan	During Construction	Construction	5.8.1
	• Compliance Monitoring	• Site inspection and supervision	During Construction	Geotechnical /Environmental	5.12
	• Pollution prevention and control during crossing installation	• Generic or site-specific Method Statements	Before Construction	Construction/Engineering/ Environmental	5.8.1
	• Implementation	• Method Statement and Toolbox Talks	During Construction	Construction	5.8.1
	• Compliance Monitoring	• Site inspection and supervision	During Construction	Environmental	5.12
	• Minimise sediment discharge into watercourse	• Retain vegetative buffer zone along watercourse edge during site clearance, and only to be stripped later, prior to crossing installation • Good practice crossing techniques used during installation	During Construction	Construction	5.8.1
Medium Sensitivity Species • Shrubs – *Escallonia myrtilloides* • Cactus – *Oroya peruviana* • Bushes – *Berberis sp.* and *Ephedra Americana*	• Definition and delineation	• Pre-Construction Survey	Before Construction	Construction/Engineering/ Environmental	4.6
	• Restrict clearance to within ROW limits	• Demarcation / flagging of areas and species outside ROW • Pre-works awareness training, toolbox talks	During Construction	Construction	4.6

ELU 8: APACHETA HIGH SIERRAS, KP 117+388 – 162+137					
Item	Action	How	When	Who	Reference
		• Site monitoring by Works Supervisor and Environmental Officer			
• Herbs (*Perezia coerulensis* and *Perezia pinnatifida)* and Plants *(Ribes sp.)*	• Verify none-existence (i.e prior translocation by COMPANY). Notify COMPANY if observed.	• Pre-Construction Survey	Before Construction	Environmental	4.6
• Reptiles – Lizards *(Liolaemus cf. melanogaster and Liolaemus melanogaster.)*	• Protection and removal to 'safe areas' before clearance works begin	• Identification during Pre-Construction Survey • Trapping, capture and removal from ROW just before clearance	Before/During Construction	Environmental	4.6
• Camelids – Vicuna (*Vicugna vicugna)*	• Develop camelid protection measures	• Camelids Method Statement/Procedure	Before construction	Environmental	5.5.2
	• Implement camelid protection measures	• Method Statement/Procedure, Training and Toolbox Talks	During construction	Construction	5.5.2
	• Compliance monitoring	• Site inspection and supervision	During construction	Environmental	5.5.2
• Birds – Ibis (*Theristicus melanopis)*, Canastero (*Asthenes dorbignyi huancavelica)* and White Bellied Cinclodes *(Cinclodes palliatus)*	• Minimize disturbance during construction	• Noise abatement measures	During construction	Construction	5.5.2
Acid Rock Drainage – High Risk ROW (KP 145+000 – 162+137) Access Roads, Medium Risk KP 152+325 (access to ROW via Posas Pampas)	• Develop special construction practices to avoid aquatic habitat degradation from acid runoff from working areas	• Acid Rock Drainage Method Statement	Before construction	Construction/Environmental	5.8.2
	• Implement special construction practices to avoid aquatic habitat degradation from acid runoff from working areas	• Acid Rock Drainage Method Statement • Training and toolbox Talks	During construction	Construction	5.8.2
	• Compliance monitoring	• Site inspection and supervision and water quality monitoring	During Construction	Environmental	5.8.2

* Refer EFS for KP details

ELU 9: PAMPAS-PALMITOS RIVER BASINS, KP 162+137 – 195+050					
Item	Action	How	When	Who	Reference
Bofedales/ Wetlands*	• Definition and delineation (validation of ESIA and EFS)	• Pre-Construction Survey	Before Construction	Construction /Engineering/ Environmental	4.6.1
	• Development of good practice construction measures	• Bofedales Method Statement/Procedure	Before Construction	Construction/Engineering/ Environmental	5.6.1
	• Implementation of good practice construction measures	• Method Statement/Procedure, Training and Toolbox Talks	During Construction	Construction	5.6.1
	• Compliance Monitoring	• Site inspection and supervision	During Construction	Environmental	5.12
Waterbodies (Rivers, Streams)* Key Sites: Palmitos River,KP 175+216 Pampas River, KP186+700 ROW also crosses several arroyos (streams) and quebradas with ephemeral or intermittent flows	• Definition and delineation of temporary erosion control measures	• Pre-Construction Survey	Before Construction	Construction/Engineering/ Environmental	4.6.1
	• Install and maintain temporary erosion control measures	• Erosion Control Plan	During Construction	Construction	5.8.1
	• Compliance Monitoring	• Site inspection and supervision	During Construction	Geotechnical /Environmental	5.12
	• Pollution prevention and control during crossing installation	• Generic or site-specific Method Statements	Before Construction	Construction/Engineering/ Environmental	5.8.1
	• Implementation	• Method Statement and Toolbox Talks	During Construction	Construction	5.8.1
	• Compliance Monitoring	• Site inspection and supervision	During Construction	Environmental	5.12
	• Minimise sediment discharge into watercourse	• Retain vegetative buffer zone along watercourse edge during site clearance, and only to be stripped later, prior to crossing installation • Good practice crossing techniques used during installation	During Construction	Construction	5.8.1
<u>Medium Sensitivity Species</u> • Herbs (*Perezia coerulescens* and *Perezia pinnatifida)*	• Verify none-existence (i.e prior translocation by COMPANY). Notify	• Pre-Construction Survey	Before Construction	Environmental	4.6

ELU 9: PAMPAS-PALMITOS RIVER BASINS, KP 162+137 – 195+050					
Item	Action	How	When	Who	Reference
	COMPANY if observed				
• Reptiles – Lizards *(Liolaemus sp..)*	• Protection and removal to 'safe areas' before clearance works begin	• Identification during Pre-Construction Survey • Trapping, capture and removal from ROW just before clearance	Before/During Construction	Environmental	4.6
• Camelids – Vicuna (*Vicugna vicugna)*	• Develop camelid protection measures	• Camelids Method Statement/Procedure	Before construction	Environmental	5.5.2
	• Implement camelid protection measures	• Method Statement/Procedure, Training and Toolbox Talks	During construction	Construction	5.5.2
	• Compliance monitoring	• Site inspection and supervision	During construction	Environmental	5.5.2
• Birds – Canastero (*Asthenes dorbignyi Huancavelica) and* White-bellied Cinclodes (*Cinclodes palliatus*)	• Minimize disturbance during construction	• Noise abatement measures • Noise monitoring at ESIA sampling sites A-57 and A-59	During construction	Construction	5.5.2
Acid Rock Drainage High Risk: ROW (KP 162+137 – 175+000 & KP 190+000 – 195+000)	• Develop special construction practices to avoid aquatic habitat degradation from acid runoff from working areas	• Acid Rock Drainage Method Statement	Before construction	Construction/Environmental	5.8.2
	• Implement special construction practices to avoid aquatic habitat degradation from acid runoff from working areas	• Acid Rock Drainage Method Statement • Training and toolbox Talks	During construction	Construction	5.8.2
	• Compliance monitoring	• Site inspection and supervision	During Construction	Environmental	5.8.2

* Refer EFS for KP details

ELU 10: HUAYTARA HIGH PLAÍNS AND RIDGES, KP 195+050 – 249+538					
Item	Action	How	When	Who	Reference
Bofedales/ Wetlands*	• Definition and delineation (validation of ESIA and EFS)	• Pre-Construction Survey	Before Construction	Construction /Engineering/ Environmental	4.6.1
	• Development of good practice construction measures	• Bofedales Method Statement/Procedure	Before Construction	Construction/Engineering/ Environmental	5.6.1
	• Implementation of good practice construction measures	• Method Statement/Procedure, Training and Toolbox Talks	During Construction	Construction	5.6.1
	• Compliance Monitoring	• Site inspection and supervision	During Construction	Environmental	5.12
Waterbodies (Rivers, Streams)* Key Sites: River Leche Leche, KP 209+500 River Canya, KP212+200 ROW also crosses several arroyos(streams) and quebradas with ephemeral or intermittent flows	• Definition and delineation of temporary erosion control measures	• Pre-Construction Survey	Before Construction	Construction/Engineering/ Environmental	4.6.1
	• Install and maintain temporary erosion control measures	• Erosion Control Plan	During Construction	Construction	5.8.1
	• Compliance Monitoring	• Site inspection and supervision	During Construction	Geotechnical /Environmental	5.12
	• Pollution prevention and control during crossing installation	• Generic or site-specific Method Statements	Before Construction	Construction/Engineering/ Environmental	5.8.1
	• Implementation	• Method Statement and Toolbox Talks	During Construction	Construction	5.8.1
	• Compliance Monitoring	• Site inspection and supervision	During Construction	Environmental	5.12
	• Minimise sediment discharge into watercourse	• Retain vegetative buffer zone along watercourse edge during site clearance, and only to be stripped later, prior to crossing installation	During Construction	Construction	5.8.1

ELU 10: HUAYTARA HIGH PLAÍNS AND RIDGES, KP 195+050 – 249+538					
Item	Action	How	When	Who	Reference
		• Good practice crossing techniques used during installation			
Medium Sensitivity Species • Herbs (*Perezia coerulescens)*	• Verify none-existence (i.e prior translocation by COMPANY). Notify COMPANY if observed.	• Pre-Construction Survey	Before Construction	Environmental	4.6
• Reptiles – Lizards *(Liolaemus spramirez and Liolaemus cf. polystictus.)*	• Protection and removal to 'safe areas' before clearance works begin	• Identification during Pre-Construction Survey • Trapping, capture and removal from ROW just before clearance	Before/During Construction	Environmental	4.6
• Camelids – Vicuna (*Vicugna vicugna)*	• Develop camelid protection measures	• Camelids Method Statement/Procedure	Before construction	Environmental	5.5.2
	• Implement camelid protection measures	• Method Statement/Procedure, Training and Toolbox Talks	During construction	Construction	5.5.2
	• Compliance monitoring	• Site inspection and supervision	During construction	Environmental	5.5.2
• Birds – Canastero (*Asthenes dorbignyi Huancavelica),* rufous-breasted warbling finch *(Poospiza rubecula)*	• Minimize disturbance during construction	• Noise abatement measures • Noise monitoring at ESIA sampling sites A-72	During construction	Construction	5.5.2

* Refer EFS for KP details

ELU 11: PISCO-ICA WATERSHED DIVIDE, KP 249+538 – 272+181					
Item	Action	How	When	Who	Reference
Waterbodies (Rivers, Streams) Key Sites: Arroyos (streams) at KP 255+870, 256+353, 257+789 Several quebradas with ephemeral or intermittent flows	• Definition and delineation of temporary erosion control measures	• Pre-Construction Survey	Before Construction	Construction/Engineering/ Environmental	4.6.1
	• Install and maintain temporary erosion control measures	• Erosion Control Plan	During Construction	Construction	5.8.1
	• Compliance Monitoring	• Site inspection and supervision	During Construction	Geotechnical /Environmental	5.12
	• Pollution prevention and control during crossing installation	• Generic or site-specific Method Statements	Before Construction	Construction/Engineering/ Environmental	5.8.1
	• Implementation	• Method Statement and Toolbox Talks	During Construction	Construction	5.8.1
	• Compliance Monitoring	• Site inspection and supervision	During Construction	Environmental	5.12
	• Minimise sediment discharge into watercourse	• Retain vegetative buffer zone along watercourse edge during site clearance, and only to be stripped later, prior to crossing installation • Good practice crossing techniques used during installation	During Construction	Construction	5.8.1
<u>High Sensitivity Species</u> • Shrub (*Chersodoma arequipensis)*	• Verify none-existence (i.e prior translocation by COMPANY). Notify COMPANY if observed.	• Pre-Construction Survey	Before Construction	Environmental	4.6
<u>Medium Sensitivity Species</u> • Cactus *(Senocio tovari)*	• Definition and delineation	• Pre-Construction Survey	Before Construction	Construction/Engineering/ Environmental	4.6
	• Restrict clearance to within ROW limits	• Demarcation / flagging of areas and species outside ROW • Pre-works awareness training, toolbox talks • Site monitoring by Works Supervisor and Environmental Officer	During Construction	Construction	4.6
• Reptiles – Lizards	• Protection and removal to	• Identification during Pre-Construction	Before/During	Environmental	4.6

ELU 11: PISCO-ICA WATERSHED DIVIDE, KP 249+538 – 272+181					
Item	Action	How	When	Who	Reference
(Liolaemus sp. Microlophus affitigris)	'safe areas' before clearance works begin	Survey • Trapping, capture and removal from ROW just before clearance	Construction		
• Camelids – Vicuna (*Vicugna vicugna)*	• Develop camelid protection measures	• Camelids Method Statement/Procedure	Before construction	Environmental	5.5.2
	• Implement camelid protection measures	• Method Statement/Procedure, Training and Toolbox Talks	During construction	Construction	5.5.2
	• Compliance monitoring	• Site inspection and supervision	During construction	Environmental	5.5.2
• Birds – Rufous-breasted warbling finch *(Poospiza rubecula)*	• Minimize disturbance during construction	• Noise abatement measures • Noise monitoring at ESIA sampling sites A-72 (refer ELU 10)	During construction	Construction	5.5.2
Acid Rock Drainage Medium Risk: ROW (KP 255+000 – 265+000)	• Develop special construction practices to avoid aquatic habitat degradation from acid runoff from working areas	• Acid Rock Drainage Method Statement	Before construction	Construction/Environmental	5.8.2
	• Implement special construction practices to avoid aquatic habitat degradation from acid runoff from working areas	• Acid Rock Drainage Method Statement • Training and Toolbox Talks	During construction	Construction	5.8.2
	• Compliance monitoring	• Site inspection and supervision	During Construction	Environmental	5.8.2
<u>Permanent New Access Roads</u> • KP 252+600, Ayavi community vicuna grazing lands	• Avoid permanent new access roads/shooflies	• Utilize existing roads/shooflies and improvements/upgrade where necessary. • Close and reinstate new access roads/shooflies	During and after construction	Construction	

* Refer EFS for KP details

ELU 12: COASTAL BAT HILLS, KP 272+181 – 308+000					
Item	Action	How	When	Who	Reference
Waterbodies (Rivers, Streams)* Key Sites: No permanent flowing channels but several quebradas with ephemeral or intermittent flows	• Definition and delineation of temporary erosion control measures	• Pre-Construction Survey	Before Construction	Construction/Engineering/ Environmental	4.6.1
	• Install and maintain temporary erosion control measures	• Erosion Control Plan	During Construction	Construction	5.8.1
	• Compliance Monitoring	• Site inspection and supervision	During Construction	Geotechnical /Environmental	5.12
	• Pollution prevention and control during crossing installation	• Generic or site-specific Method Statements	Before Construction	Construction/Engineering/ Environmental	5.8.1
	• Implementation	• Method Statement and Toolbox Talks	During Construction	Construction	5.8.1
	• Compliance Monitoring	• Site inspection and supervision	During Construction	Environmental	5.12
	• Minimise sediment discharge into watercourse	• Retain vegetative buffer zone along watercourse edge during site clearance, and only to be stripped later, prior to crossing installation • Good practice crossing techniques used during installation	During Construction	Construction	5.8.1
<u>High Sensitivity Species</u> • Cactus (*Cleistocactus acanthurus)*	• Definition and delineation	• Pre-Construction Survey	Before Construction	Construction/Engineering/ Environmental	4.6
	• Restrict clearance to within ROW limits	• Demarcation / flagging of areas and species outside ROW • Pre-works awareness training, toolbox talks • Site monitoring by Works Supervisor and Environmental Officer	Before and During Construction	Construction/Engineering/ Environmental	4.6
<u>Medium Sensitivity Species</u> • Cactus *(Browningra candelaris* and *Neoralmondia arequipensis)* • Tree *(Orthopterygium*	• Definition and delineation	• Pre-Construction Survey	Before Construction	Construction/Engineering/ Environmental	4.6
	• Restrict clearance to within ROW limits	• Demarcation / flagging of areas and species outside ROW • Pre-works awareness training,	During Construction	Construction	4.6

ELU 12: COASTAL BAT HILLS, KP 272+181 – 308+000					
Item	Action	How	When	Who	Reference
huaucui) • *Shrubs (Ephedra Americana* and *Loasa incana)*		toolbox talks • Site monitoring by Works Supervisor and Environmental Officer			
• Herbs *(Cridoscolus basiacanthus)*	• Verify none-existence (i.e prior translocation by COMPANY). Notify COMPANY if observed.	• Pre-Construction Survey	Before Construction	Environmental	4.6
• Reptiles – Lizards *(Microlophus tigris* and *Phyllodactylus lepidopygus)*	• Protection and removal to 'safe areas' before clearance works begin	• Identification during Pre-Construction Survey • Trapping, capture and removal from ROW just before clearance	Before/During Construction	Environmental	4.6
• Camelids – Vicuna (*Vicugna vicugna)*	• Develop camelid protection measures	• Camelids Method Statement/Procedure	Before construction	Environmental	5.5.2
	• Implement camelid protection measures	• Method Statement/Procedure, Training and Toolbox Talks	During construction	Construction	5.5.2
	• Compliance monitoring	• Site inspection and supervision	During construction	Environmental	5.5.2
Acid Rock Drainage Medium Risk: ROW (KP 285+000 – 300+000) Access Roads – Medium Risk, KP 289+088 (access to right bank of San Juan Creek)	• Develop special construction practices to avoid aquatic habitat degradation from acid runoff from working areas	• Acid Rock Drainage Method Statement	Before construction	Construction/Environmental	5.8.2
	• Implement special construction practices to avoid aquatic habitat degradation from acid runoff from working areas	• Acid Rock Drainage Method Statement • Training and Toolbox Talks	During construction	Construction	5.8.2
	• Compliance monitoring	• Site inspection and supervision and water quality monitoring	During Construction	Environmental	5.12

* Refer EFS for KP details

ELU 13: PISCO SAND PLAINS, KP 308+000 – 332+940					
Item	Action	How	When	Who	Reference
Humedales/ Wetlands* (coastal/desert bofedales or hydromorphic islands)	• Definition and delineation (validation of ESIA and EFS)	• Pre-Construction Survey	Before Construction	Construction /Engineering/ Environmental	4.6.1
	• Development of good practice construction measures	• Bofedales Method Statement/Procedure	Before Construction	Construction/Engineering/ Environmental	5.6.1
	• Implementation of good practice construction measures	• Method Statement/Procedure, Training and Toolbox Talks	During Construction	Construction	5.6.1
	• Compliance Monitoring	• Site inspection and supervision	During Construction	Environmental	5.12
Waterbodies (Rivers, Streams) Key Sites: Moron, Bernal and Lagunillas Lagoons (KP 326+000 – KP 332+000)	• Definition and delineation of temporary erosion control measures	• Pre-Construction Survey	Before Construction	Construction/Engineering/Environmental	4.6.1
	• Install and maintain temporary erosion control measures	• Erosion Control Plan	During Construction	Construction	5.8.1
	• Compliance Monitoring	• Site inspection and supervision	During Construction	Geotechnical /Environmental	5.12
	• Pollution prevention and control during crossing installation	• Generic or site-specific Method Statements	Before Construction	Construction/Engineering/Environmental	5.8.1
	• Implementation	• Method Statement and Toolbox Talks	During Construction	Construction	5.8.1
	• Compliance Monitoring	• Site inspection and supervision	During Construction	Environmental	5.12
	• Minimise sediment discharge into watercourse	• Retain vegetative buffer zone along watercourse edge during site clearance, and only to be stripped later, prior to crossing installation • Good practice crossing techniques	During Construction	Construction	5.8.1

ELU 13: PISCO SAND PLAINS, KP 308+000 – 332+940					
Item	Action	How	When	Who	Reference
		used during installation			
Medium Sensitivity Species • Reptiles – Lizards *(Dicrodoa heterolepis, Microlophus thoracicusicae, Phyllodactylus lepidopygus)*	• Protection and removal to 'safe areas' before clearance works begin	• Identification during Pre-Construction Survey • Trapping, capture and removal from ROW just before clearance	Before/During Construction	Environmental	4.6
• Birds – Slender-billed finch (*Xenospingus concolor)*	• Minimize disturbance during construction	• Noise abatement measures • Noise monitoring at ESIA sampling sites A-89 (Bernal Lagoon) and A-91 (Moron Lagoon)	During construction	Construction	5.5.2
Medium Sensitivity Species • Bromeliads - *Tillandsia sp. – latifolia and paleacea*	• Minimise disturbance and loss of plants and habitat outside ROW corridor	• No driving off ROW or unauthorized access roads • Avoid stockpiling of ROW spoil directly to adjacent tillandsia patches, where practicable • Flagging of tillandsia patches for protection where directly adjacent to/outside ROW • Environmental Officer present during ROW clearing and grading activities • Training and toolbox talks	During construction	Construction and Environmental	5.6.2

* Refer EFS for KP details

ELU 14: ICA-LIMA COASTAL PLAIN, KP 332+940 – 408+000					
Item	Action	How	When	Who	Reference
Waterbodies (Rivers, Streams) Key Sites: Pisco River (KP 334+800) Magtente River (KP362+500) Chico River (KP 364+500)	• Definition and delineation of temporary erosion control measures	• Pre-Construction Survey	Before Construction	Construction/ Engineering/Environmental	4.6.1
	• Install and maintain temporary erosion control measures	• Erosion Control Plan	During Construction	Construction	5.8.1
	• Compliance Monitoring	• Site inspection and supervision	During Construction	Geotechnical /Environmental	5.12
	• Pollution prevention and control during crossing installation	• Generic or site-specific Method Statements	Before Construction	Construction/Engineering/ Environmental	5.8.1
	• Implementation	• Method Statement and Toolbox Talks	During Construction	Construction	5.8.1
	• Compliance Monitoring	• Site inspection and supervision	During Construction	Environmental	5.12
	• Minimise sediment discharge into watercourse	• Retain vegetative buffer zone along watercourse edge during site clearance, and only to be stripped later, prior to crossing installation • Good practice crossing techniques used during installation	During Construction	Construction	5.8.1
	• Protection of river shrimp *(Cryphiops caementarius*) in Pisco River	• Construction of river crossing outside sensitive January – April period	During Construction	Construction	5.8.3
Medium Sensitivity Species • Tree, Huarango (*Acacia macracantha)*	• Definition and delineation	• Pre-Construction Survey	Before Construction	Construction/Engineering/ Environmental	4.6
	• Restrict clearance to ROW limits	• Demarcation / flagging of areas and species outside ROW • Pre-works awareness training, toolbox talks • Site monitoring by Works Supervisor and Environmental Officer	During Construction	Construction	4.6
• Reptiles – Lizards	• Protection and	• Identification during Pre-Construction	Before/During	Environmental	4.6

ELU 14: ICA-LIMA COASTAL PLAIN, KP 332+940 – 408+000					
Item	Action	How	When	Who	Reference
(Ctenblepharys adspersa, Dicrodon heterolepis, Microlophus tigris, Toads *(Chaunus limensis),* Snakes *(Alsopphis sp.)*	removal to 'safe areas' before clearance works begin	Survey • Trapping, capture and removal from ROW just before clearance	Construction		
High Sensitivity Species • Fish – Shrimps (*Cryphiops caementarius)* *Medium Sensitiivty Dpecies* • Andean catfish *(Trichomycterus rivulatus)*	• Protection of species and habitat during construction	• Installation of temporary erosion controls to minimize sediment runoff from ROW near waterbodies • Good practice techniques for waterbody crossing to minimize turbidity, interruption of flows and entrainment • Good practice pollution prevention and control to avoid hydrocarbon discharges	During construction	Construction	5.8.1, 5.8.3
Medium Sensitivity Species • Bromeliads - *Tillandsia sp.- latifolia and paleacea*	• Minimise disturbance and loss of plants and habitat outside ROW corridor	• No driving off ROW or unauthorized access roads • Avoid stockpiling of ROW spoil directly to adjacent tillandsia patches, where practicable • Flagging of tillandsia patches for protection where directly adjacent to/outside ROW • Environmental Officer present during ROW clearing and grading activities • Training and toolbox talks	During construction	Construction and Environment	5.6.2

APPENDIX 7: PIPELINE BIORESTORATION CONTRACTOR MANAGEMENT PLAN

Environment, Social, Health and Safety Management System (ESHS MS)

Pipeline Biorestoration Contractor Management Plan

Document Number:
02/ES/PL/PN/012/A02

TABLE OF CONTENTS

TABLE OF CONTENTS 2
1.0 INTRODUCTION 4
2.0 POLICY AND LEGISLATIVE REQUIREMENTS 5
2.1 CORPORATE OBJECTIVES 5
2.2 PERUVIAN LEGISLATIVE REQUIREMENTS 6
2.3 INTERNATIONAL STANDARDS AND GUIDELINES 6
3.0 ROLES AND RESPONSIBILITIES 8
3.1 PLANS 8
3.2 RESPONSIBILITIES 8
3.3 ENVIRONMENTAL AND SOCIAL MANAGEMENT ORGANIZATION 9
3.4 METHOD STATEMENTS 10
3.5 VERIFICATION AND MONITORING PLAN 10
3.5.1 CONTRACTOR MONITORING 10
3.5.2 PERU LNG MONITORING 11
3.6 REPORTING 12
3.7 TRAINING 12
4.0 SENSITIVE SPECIES AND HABITATS 13
5.0 BIORESTORATION 18
5.1 GENERAL 18
5.2 DESCRIPTION OF THE BIORESTORATION PROGRAM 19
5.3 SPECIES FOR REVEGETATION 22
5.4 HABITAT-SPECIFIC REQUIREMENTS 22
5.4.1 ANDEAN GRASSLANDS (ELUS 1 TO 10) 22
5.4.2 UPPER MONTANE FOREST 22
5.4.3 DRY ANDEAN SCRUB, LOW BROADLEAF EVERGREEN FOREST, AND DRY DECIDUOUS FOREST 23
5.4.4 DESERT SCRUB AND COLUMNAR CACTI 23
5.4.5 COASTAL PLAIN RIPARIAN VEGETATION 23
5.4.6 CULTIVATED AREAS 23
5.4.7 ANDEAN WETLAND REVEGETATION 24
5.5 GRASS SEEDING 24
5.5.1 AREAS SUBJECT TO SEEDING 24
5.5.2 PROPOSED SPECIES 25
5.5.3 NATIVE SEED COLLECTION 25
5.5.4 BROADCAST SEEDING 25
5.5.5 HYDROSEEDING 26

5.5.6 TUSSOCK GRASS TRANSPLANTS 26
5.6 TREE AND SHRUB CUTTINGS AND TRANSPLANTS 26
5.7 FERTILIZER APPLICATION 27
5.8 PESTICIDE USE AND MANAGEMENT 27
5.9 MAINTENANCE 27

LIST OF TABLES

Table 3 Roles and Responsibilities for PERU LNG and Contractor
Table 5.2a Approximate Area for Revegetation in the ROW
Table 5.2b Approximate Area Subject to Revegetation at Camps
Table 5.7.1 ROW, Camp and Yard Areas Requiring Revegetation
Table 5.7.2a Proposed Herbaceous (Grass) Species
Table 5.7.2b General Seed Mix 1 (4.200 – 4.900 m)
Table 5.7.2c General Seed Mix 2 (3.500 – 4.200 m)
Table 5.7.2d General Seed Mix 3 (2.000 – 3.500 m)
Table 5.9a Proposed Shrub and Tree Species
Table 5.9b Tree and Shrub Mix 1 (4.200 – 4.900 m)
Table 5.9c Tree and Shrub Mix 2 (3.500 – 4.200 m)
Table 5.9d Tree and Shrub Mix 3 (2.000 – 3.500 m)
Table 5.9e Tree and Shrub Mix 4 (0 – 2.000 m)

LIST OF APPENDICES

APPENDIX 1: PROPOSED SEED MIXES BY SPECIES 28
APPENDIX 2: PROPOSED SPECIES MIXES BY ECOLOGICAL LANDSCAPE UNIT..... 32
APPENDIX 3: IFC PERFORMANCE STANDARD 5 REQUIREMENTS FOR PESTICIDE USE AND MANAGEMENT 46

1.0 INTRODUCTION

PERU LNG S.R.L. (hereafter PERU LNG) is developing a liquefied natural gas (LNG) export project (the Project) that includes the construction of a 408 km pipeline (hereafter the Pipeline) from near the city of Ayacucho to a natural gas liquefaction facility at Pampa Melchorita south of Lima. The construction of the Pipeline is the subject of various environmental and social commitments that have been identified in the Environmental and Social Impact Assessment (ESIA), Peruvian legislation requirements and international standards and guidelines adopted by International Finance Institutions (IFIs).

These requirements are being managed by PERU LNG through the development of an Environmental and Social Management Plan (ESMP) which comprises a number of Contractor Management Plans (CMPs) including this Pipeline Biorestoration Contractor Management Plan (hereafter referred to as the Plan).

This Plan has been developed based on the findings of the approved ESIA (2006) and a subsequent Ecological Field Survey (EFS) of the Pipeline corridor completed in 2007 by *Domus Consultoria Ambiental* (a Peruvian environmental consultancy firm) on behalf of PERU LNG. Together with the ESIA, the EFS formed an important source document that was used as a basis for developing and informing this Plan and should be referred to by CONTRACTOR for more detailed reference information about species, habitats and their sensitivity.

This Plan specifically identifies the commitments made by the Project which are the responsibility of CONTRACTOR in relation to the biorestoration and revegetation of all disturbed areas and habitats which have been affected by construction including the Pipeline Right of Way (ROW) and off-ROW sites, including access roads, shooflies, camps, pipeyards, borrow pits and spoil (excess material) disposal sites. The scope of this Plan extends from after the completion of physical reinstatement works (i.e. clean-up) by CONTRACTOR, which are described in detail in the Erosion Control and Reinstatement CMP, to the final handover of Project occupied lands required for construction back to PERU LNG or third parties.

Other Project biorestoration commitments which are the direct responsibility of PERU LNG including the definition, collection and procurement of seed mixes, management of translocated sensitive plant species, propagation of new plants and execution of a long-term biological/biodiversity monitoring program. These activities are covered in a separate PERU LNG document.

This Plan addresses only those commitments and requirements related to construction of the Pipeline between Ayacucho and the LNG Plant at Pampa Melchorita, and does not address commitments relating specifically to either the LNG Plant itself or associated works such as the GNL-2 Quarry and marine works which are the subject of a separate contract between PERU LNG and others.

Due to the large number of commitments made in the Pipeline ESIA relating to biorestoration and revegetation (numbering approximately 160), this Plan has not copied them verbatim. To ensure this document is usable and workable, a number of commitments have been combined and the intent of other commitments captured. However, CONTRACTOR shall be aware of all related commitments made in the ESIA (see Appendix 1). If a commitment or its intent has not been directly or explicitly captured within the text of this Plan, CONTRACTOR shall still be expected to comply with the ESIA requirements.

Because of the close link between biorestoration and other key environmental issues including ecology, erosion and sediment control, pollution prevention, physical reinstatement and clean-up and waste management, this Plan should be used in conjunction with other CMPs developed by PERU LNG and issued to CONTRACTOR, including but not limited to:

- Environmental and Social Management Plan (Framework Document)
- Footprint CMP
- Ecological CMP
- Erosion Control and Reinstatement CMP
- Pollution Prevention CMP
- Waste Management CMP
- Compliance Monitoring CMP

In particular, the Erosion Control and Reinstatement CMP addresses the physical aspects of reinstatement and clean-up (ground reinstatement, river/stream bank and channel and Andean wetland/bofedales restoration, recontouring, topsoiling, drainage, excess rock disposal, permanent erosion control measures, slash management, etc.) which are necessary prior to biorestoration. The Ecological CMP in turn references the translocation of sensitive plant species by PERU LNG prior to construction and management of sensitive ecological habitats by CONTRACTOR during construction.

This Plan should also be read in association with the PERU LNG Land Acquisition and Compensation Plan in relation to the Project's approach to reinstatement of disturbed anthropogenic (human influenced) habitats including Cultivated Areas and Eucalyptus Plantations.

As part of its planning and readiness for construction, CONTRACTOR is required to prepare its own specific Environmental and Social Implementation Plans (ESIPs) setting out how it intends to meet and comply with the specific Project commitments set out in each CMP developed by PERU LNG. In this regard and with reference to this Plan, CONTRACTOR shall prepare a Biorestoration ESIP.

The PERU LNG Environmental and Social Management Plan (Framework Document) provides an explanation of the linkage between the CMPs and ESIPs.

2.0 POLICY AND LEGISLATIVE REQUIREMENTS

PERU LNG intends that its corporate objectives, Peruvian legislative requirements, applicable IFI international standards and guidelines, as well as Project ESIA commitments, all of which are identified and described in this Plan, will guide the Project's biorestoration activities and performance.

2.1 CORPORATE OBJECTIVES

PERU LNG 's corporate objectives of are set out in the Environment, Health and Safety (EHS) and Community Relations Policies and Guidelines section of the Environmental Impact Assessment, Peru LNG Export Project, 2003. A PERU LNG objective, as set out in the Pipeline ESIA Restoration and Revegetation Plan, is to adequately manage biorestoration and revegetation of the areas impacted by Pipeline construction activities. This will be done according to policies and procedures established by PERU LNG.

The specific objectives are:

- Restore the land affected by project activities along the ROW, campsites, surplus material depots, access roads and other works areas.
- Protect the topsoil and restore vegetation cover as quickly as possible after construction in order to stabilize the ground surface, avoid soil erosion and mass wasting and protect pipeline integrity.
- Return the ground to its original preconstruction condition to reestablish original biodiversity, natural habitats or human influenced landscape activities such as agriculture, forest, pasture and husbandry.
- Promote revegetation as quickly as possible to protect the soil against erosion and safeguard sensitive ecological habitats such as waterbodies and wetlands against sediment inundation.

2.2 PERUVIAN LEGISLATIVE REQUIREMENTS

The following Peruvian legislative instruments are relevant to biorestoration management during Pipeline construction. This summary is not a legal opinion and should be interpreted as guidance only.

- Political Constitution of Peru
- Law 28611, Environmental General Law, dated October 15, 2005.
- Law 26834, Law of Natural Protected Areas, dated June 30, 1997
- Law 27308, Forestry and Wildlife Law, dated July 15, 2000.
- Law 26821, Organic Law for the Sustainable Use of Natural Resources, dated June 26, 1997
- Law 26839, Law for Conservation and Sustainable Use of Biological Diversity, dated July 8, 1997
- Law 17752, General Law of Water Resources, dated July 24, 1969
- Law for Public Investment in Development of Economic Activities in National Lands and Native and Peasant Farmer Community Lands
- Participation Rights Law and Civilian Control
- Supreme Decree 041-99-EM, Regulation for the Transportation of Hydrocarbons through Pipelines, dated September 15, 1999
- Supreme Decree 15-2006-EM, Environmental Protection Regulations for Hydrocarbon Activities, dated March 3, 2006
- Supreme Decree N° 034-2004-AG, Fauna threatened species categorization, dated September 17, 2004

2.3 INTERNATIONAL STANDARDS AND GUIDELINES

PERU LNG will ensure that Project biorestoration will fulfill the applicable requirements of the IFIs . The applicable IFIs Performance Standards on Environmental and Social Sustainability are:

- IFC Performance Standard 1: Social and Environmental Assessment and Management System, which establishes requirements for assessment, management, organizational capability, training, community engagement, monitoring, and reporting.
- IFC Performance Standard 4: Community Health, Safety and Security, which requires projects to avoid or minimize adverse impacts due to project activities on soil, water, and other natural resources in use by affected communities.
- IFC Performance Standard 6: Biodiversity Conservation and Sustainable Natural Resource Management.

Of particular reference to this Plan, IFC Performance Standard 6 sets out the following requirements:

i. Assess the significance of Project impacts on all levels of biodiversity as an integral part of the Social and Environmental Assessment process
ii. Minimize any conversion or degradation of modified habitat, and, depending on the nature and scale of the Project, identify opportunities to enhance habitat and protect and conserve biodiversity as part of the Project's operations
iii. Do not significantly convert or degrade such habitat, unless the following conditions are met:
   - There are no technically and financially feasible alternatives.
   - The overall benefits of the Project outweigh the costs, including those to the environment and biodiversity.
   - Any conversion or degradation is appropriately mitigated.
iv. Design natural habitat mitigation measures to achieve no net loss of biodiversity where feasible, which may include a combination of actions, such as:
   - Post-operation restoration of habitats.
   - Offset of losses through the creation of ecologically comparable area(s) that is managed for biodiversity.
   - Compensation to direct users of biodiversity.
v. In areas of critical habitat, no Project activities will be implemented unless the following requirements are met:
   - There are no measurable adverse impacts on the ability of the critical habitat to support the established population of species or the functions of the critical habitat.
   - There is no reduction in the population of any recognized critically endangered or endangered species.
   - Any lesser impacts are mitigated in accordance with point *IV* above.
vi. The client will not intentionally introduce any new alien species (not currently established in the country or region of the Project) unless this is carried out in accordance with the existing regulatory framework for such introduction, if such framework is present, or is subject to a risk assessment (as part of the client's Social and Environmental Assessment) to determine the potential for invasive behavior. The client will not deliberately introduce any alien species with a high risk of invasive behavior or any known invasive species, and will exercise diligence to prevent accidental or unintended introductions

The IFC defines "*significant conversion or degradation*" as: *(i) the elimination or severe diminution of the integrity of a habitat caused by a major, long-term change in land or water use; or (ii) modification of a habitat that substantially reduces the habitat's ability to maintain viable population of its native species.*

This Plan also will assure compliance with the IDB's Environment and Safeguards Compliance Policy in regards to the protection of natural habitats by avoiding the significant conversion or degradation of such and prohibiting the introduction of invasive species.

The IDB will not support operations that, in its opinion, significantly convert or degrade critical natural habitats. Whenever feasible, IDB-financed operations and activities will be sited on lands already converted. In addition, the IDB will not support operations involving the significant conversion or degradation of natural habitats as defined in this policy, unless: (i) there are no feasible alternatives acceptable to the Bank; (ii) comprehensive analysis demonstrates that overall benefits from the operation substantially outweigh the environmental costs and; (iii) mitigation and compensation measures acceptable to the IDB – including, as appropriate, minimizing habitat loss and establishing and maintaining an

ecologically similar protected area that is adequately funded, implemented and monitored. The IDB will not support operations that introduce invasive species.

3.0 ROLES AND RESPONSIBILITIES

3.1 PLANS

PERU LNG has the ultimate responsibility for performing biorestoration management and assuring biorestoration commitment compliance in respect to the Project as a whole.

CONTRACTOR is responsible for complying with the content of this Plan including the policy and legislative requirements and other specific commitments related to biorestoration. CONTRACTOR shall prepare a corresponding Biorestoration Environmental and Social Implementation Plan (ESIP) which shall include:

- Roles and responsibilities of all senior project personnel employed by CONTRACTOR for biorestoration activities
- Description and delimitation of areas to be revegetated
- Method Statements to be applied for seeding and planting, including application of fertilizers, mulching, hydroseeding or other soil preparations
- Schedule of revegetation activities
- Procedures and requirements for reporting to PERU LNG

The Biorestoration ESIP shall be submitted to PERU LNG for review and approval. The ESIP will not be considered as 'Approved for Construction' until all comments raised by PERU LNG have been addressed by CONTRACTOR to the satisfaction of PERU LNG. The Biorestoration ESIP must be completed before the commencement of any biorestoration work.

CONTRACTOR may elect to sub-contract certain elements of its biorestoration activities to other parties, subject to review and approval by PERU LNG. Sub-contractors shall fully comply with the commitments set out in this Plan and CONTRACTOR shall allocate sufficient monitoring and supervision from its own resources to assure compliance with this requirement.

3.2 RESPONSIBILITIES

Table 3 below summarizes the roles and responsibilities of CONTRACTOR including a reference to PERU LNG responsibilities where there is a close or dependent link between the two organizations.

TABLE 3 - ROLES AND RESPONSIBILITIES FOR PERU LNG AND CONTRACTOR

ACTIVITY	PERU LNG	CONTRACTOR
Preparation of Biorestoration ESIP	Review and approval	Before commencement of biorestoration
Definition of seed mixes	Developed in consultation with local specialists organizations and communities*	-
Preparation/Collection/Procurement of grass seed mixes (Native and Naturalized species)	Working with local specialist organizations and communities*	-
Seeding of disturbed areas including ROW, access roads, camps, yards, borrow pits, and others	Provision of seed mixtures*	Seeding undertaken after completion of physical reinstatement of disturbed areas. CONTRACTOR to provide supervision, labour, equipment, machinery

TABLE 3 - ROLES AND RESPONSIBILITIES FOR PERU LNG AND CONTRACTOR		
ACTIVITY	PERU LNG	CONTRACTOR
Geotextile/Jute	Areas to be defined jointly by PERU LNG / CONTRACTOR	Supplied and installed by CONTRACTOR as per PERU LNG specification
Hydroseeding	Areas to be defined jointly by PERU LNG / CONTRACTOR	Hydroseeding undertaken after completion of physical reinstatement of disturbed areas. CONTRACTOR to provide supervision, labour, equipment, machinery
Fertilizer (Inorganic/Chemical)	Areas to be defined jointly by PERU LNG / CONTRACTOR. Fertilizer supplied by PERU LNG	Applied by CONTRACTOR as per PERU LNG specification
Preparation of shrubs, plants propagated from seeds and cuttings, procurement of other plants and management of translocated sensitive plant species	Working with local specialist organizations and communities*	
Replanting of disturbed areas with shrubs and plants		Supplied by PERU LNG with CONTRACTOR undertaking collection from nursery and physical planting
Replanting of translocated plant species		Supplied by PERU LNG with CONTRACTOR undertaking collection from nursery and physical planting
Biological/Biodiversity (including Revegetation) Monitoring	Undertaken by PERU LNG with the participation of stakeholders (participative monitoring)*	-

* PERU LNG biorestoration responsibilities addressed by separate document

3.3 ENVIRONMENTAL AND SOCIAL MANAGEMENT ORGANIZATION

The framework for the Project's ESHS Management System is provided by the Pipeline Environmental and Social Management Plan (Framework Document).

Environment, Social and Cultural Heritage Department
PERU LNG, as part of its environmental conservation and natural resource sustainable use policies, has established an Environment, Social and Cultural Heritage Department that, amongst other duties, will be responsible for management of biorestoration and revegetation issues and verifying CONTRACTOR's compliance with this Plan.

Commitment Register Document
A Commitment Register Document is formulated to contain all biorestoration and revegetation commitments from the ESIA. A number of these commitments will be addressed directly by PERU LNG and are the subject of a separate document. However the majority of the ESIA commitments are the responsibility of CONTRACTOR and are addressed by the CMPs including this Plan.

Contractor Management Plans
The CMPs developed by PERU LNG describe the minimum environmental standards to be met by the Project in complying with conditions and commitments set out in the ESIA. Among that set of Plans is this Plan.

Environmental and Social Implementation Plans
CONTRACTOR shall develop its own Environmental and Social Implementation Plans (ESIPs) in response to PERU LNG's CMPs including a Biorestoration ESIP.

Full details of the Environment and Social Management Organization between PERU LNG and CONTRACTOR is set out in the Environmental and Social Management Plan (Framework Document).

Environmental Team
With particular reference to this Plan, CONTRACTOR shall appoint a Biorestoration Specialist with the appropriate practical experience to be able to fully understand and implement the biorestoration and revegetation commitments of this Plan together with an understanding of the requirements for physical reinstatement set out in the Erosion Control and Reinstatement CMP. CONTRACTOR shall ensure that the Biorestoration Specialist is mobilized to the Project in a timely manner in order to participate effectively in early Project preparation works including preparation and review of relevant plans, procedures, method statements and the Pre-Construction Survey where sensitive habitats, reinstatement and biorestoration issues will be identified.

The Biorestoration Specialist shall report to the Field Environmental Manager. Other resources may be allocated by CONTRACTOR to assist the Biorestoration Specialist where necessary. The roles of the Biorestoration Specialist and Field Ecologist (refer to the PERU LNG Ecological CMP) can be combined into one role if CONTRACTOR can demonstrate to PERU LNG that the proposed candidate has the appropriate technical and practical experience and capability to successfully perform both roles.

3.4 METHOD STATEMENTS

CONTRACTOR shall prepare Biorestoration Method Statements for the following tasks:

- Seeding and Ground Preparation
- Planting of Propagated Shrubs and Plants
- Biorestoration of Ecologically Sensitive Habitats
- Replanting of Translocated Sensitive Plant Species
- Fertilizer Application
- Mulch (straw) Application
- Hydroseeding
- Control of noxious/invasive weeds

These topics are addressed in more detail in Sections 4 and 5 of this Plan. The Method Statements shall be issued to Peru LNG for review and approval prior to the start of any biorestoration related activity. Also, no biorestoration-related work will be performed before the appropriate Method Statements have been approved by Peru LNG.

3.5 VERIFICATION AND MONITORING PLAN

3.5.1 Contractor Monitoring

CONTRACTOR shall undertake monitoring of the revegetation of disturbed areas until such time as these areas are effectively handed over to PERU LNG.

CONTRACTOR shall carry out periodic evaluations of revegetated areas to track plant development, survival, damage, species mortality rates, and the presence of noxious weeds and invasive species.

Revegetation monitoring shall document the recovery of the vegetation cover of the ROW and shall identify any deficiencies and notify these to the Field Environmental Manager, who will prepare an action plan to remediate these deficiencies and achieve revegetation goals.

Verification and monitoring by CONTRACTOR shall be performed in accordance with the Compliance Monitoring CMP.

CONTRACTOR shall appoint environmental field officers to carry out all inspection and monitoring activities required to verify and document the level of performance and success of activities specified in this Plan.

CONTRACTOR shall report weekly to PERU LNG on environmental management issues including any key details on biorestoration activities as defined in this Plan. The report shall provide documentation and indicators that will allow PERU LNG to track compliance and identify areas where improvements are required.

In addition, a comprehensive monthly report shall be prepared by CONTRACTOR and submitted to PERU LNG, detailing all the biorestoration activities carried out during the previous month and the work plan for next month.

The Compliance Monitoring CMP identifies CONTRACTOR's commitments made for the Project in relation to compliance monitoring for the following aspects:

- Water (including sedimentation at river crossings)
- Erosion and Sedimentation Control
- Air
- Noise
- Pollution Prevention
- Waste Management

3.5.2 Peru LNG Monitoring

PERU LNG will ensure that CONTRACTOR fulfills Project commitments with regards to biorestoration and revegetation identified in this Plan. PERU LNG will also develop a strategy for each applicable environmental component related to the Project so that the monitoring plan is integrated for the different internal audits scheduled to be carried out.

PERU LNG will assign Environmental Field Supervisors to the Project reporting directly to PERU LNG's Environmental Manager. These supervisors will be responsible for checking the CONTRACTOR's compliance with the requirements of this Plan, the requirements of the ESIA and the Commitment Register Document, any other environmental conditions and mitigation measures specified by PERU LNG and requirements of environmental permits and approvals.

The PERU LNG's Supervisor's biorestoration responsibilities shall include, but are not necessarily limited to:

- Verifying the proper application of plant materials during revegetation activities, including density, distribution pattern, and species.
- Verifying that revegetation achieves vegetative coverage goals.
- Verifying that noxious weeds and invasive species are being controlled..
- Reviewing relevant records of compliance with the Project biorestoration commitments and applicable permits..
- Establishing a program to monitor the success of physical restoration and revegetation and ensuring its implementation.

3.6 REPORTING

CONTRACTOR shall report to PERU LNG on the biorestoration issues included in this Plan on a weekly basis as part of its Weekly Progress Meeting, based on information provided by the Biorestoration Specialist. This information shall address (at least) the following aspects:

- Seeding or planting undertaken including but not limited to dates, locations, species and quantities
- Hydroseeding undertaken including but not limited to dates, locations and quantities
- Application of fertilizer and mulch including but not limited to dates, locations and quantities
- Reports of noxious/invasive weeds including any measures taken to control these species
- Reporting of other environmental aspects relating to air quality, noise, water quality, waste management and soil and erosion control and which are directly or indirectly linked to biorestoration management are addressed in the other CMPs as listed in Section 1 (Introduction) of this Plan

CONTRACTOR's Field Environmental Manager, Biorestoration Specialist and other Environmental Field Officers shall discuss the findings of the Weekly Progress Meeting to plan compliance strategies for the following week.

In addition, CONTRACTOR shall prepare a comprehensive Monthly Environmental Report for submittal to PERU LNG, detailing all activities carried out during the previous month and the working plan for next month. This report shall contain all relevant issues relating to biorestoration management.

3.7 TRAINING

All CONTRACTOR's personnel shall receive a General Environmental Induction prior to admittance to the ROW and other work areas. This Induction will include, among others, biorestoration and revegetation issues as part of a general awareness of ecological sensitivity, biodiversity, topsoil management, sediment and erosion control and waterbody protection.

In addition, CONTRACTOR shall arrange specialized and more detailed environmental training courses in general or specific topics of biorestoration and revegetation for certain staff such as Managers and Supervisors who will be directly involved in biorestoration. Individual Supervisors will also receive training from the Field Environmental Manager or Biorestoration Specialist on key environmental issues that affect or could be affected by their specific work activity such as pollution prevention and waste management.

The information acquired by Supervisors during training shall be cascaded to the rest of the biorestoration work crew, including laborers and machine operators, by routine toolbox talks and other appropriate communication measures. The requirements of CONTRACTOR's Method Statements must also be explained to Supervisors and summarized to their crews where they relate specifically to their activities.

The biorestoration-specific training subjects shall include:

- Protection of Permanent Erosion Control measures
- Protection of reinstated and topsoiled areas
- Routes of Access and egress
- Identification of sensitive species for translocation replanting

- Handling of shrubs, plants and saplings
- Ground preparation and methods for seeding and planting
- Watering of ground
- Identification and control of noxious/invasive weeds
- Application of fertilizers and mulches
- Hydroseeding in restricted areas
- Hydroseeding

Other general environmental subjects applicable to the workforce shall include:

- Pollution prevention and control for water and soil protection
- Fuel and lubricants handling and refueling
- Waste management
- Flora and fauna protection
- Working in wetlands/bofedales
- Bird Sensitive areas
- Protection of third party property
- Environmental incidents and emergencies response

4.0 SENSITIVE SPECIES AND HABITATS

The Ecological Field Survey (EFS) completed by Peru LNG in 2007 verified, consolidated and refined the ecological and biological findings of the approved ESIA (2006) which was based on a broad 3 to 7km corridor, and defined a number of sensitive habitats and species specific to the ROW using a much narrower 50 metre corridor centred on the ROW alignment.

A description of the methodology for habitat and species sensitivity classification is set out in the Ecological CMP and full details are provided in the EFS Source Document. However, the key details relevant to biorestoration and revegetation requirements for this Plan are summarized in tabulated form below.

- Table 4.1 presents a summary of each of the 14 ELUs including name, KP range, elevation and precipitation;
- Table 4.2 presents each of the 18 main habitats along the ROW and the ELU they have been observed in;
- Table 4.3 presents High and Medium Sensitivity plant species for each ELU;
- Table 4.4 presents High and Medium Sensitivity habitats for each ELU; and,
- Table 4.5 presents Protected Plant species for each ELU.

TABLE 4.1 – ECOLOGICAL LANDSCAPE UNITS (ELUs) ALONG THE ROW

NO.	ELU	KP	ELEVATION (METERS)		WET SEASON PRECIPITATION RANGE
			MIN.	MAX.	
1	Apurimac River Valley Montane Forest ecotone	0+000 – 20+511	2,966	4,066	600-2000
2	Campana Watershed	20+511 – 25+115	3,414	4,066	500-700
3	Torobamba River Valley	25+115 – 44+300	2,400	3,674	300-600
4	Silicassa Sierra	44+300 – 56+783	3,566	4,222	500-700
5	Yucay River Valley	56+783 – 74+199	2,850	3,864	500-700
6	Huamanga-Vischongo Watershed Divide	74+199 - 103+970	3,864	4,250	600-700
7	Vinchos River Valley	103+970 – 117+388	3,200	4,000	600-800
8	Apacheta High Sierras	117+388 – 162+137	3,841	4,864	700-1000
9	Pampas-Palmitos River Basins	162+137 – 195+050	4,000	4,700	700-1000

TABLE 4.1 – ECOLOGICAL LANDSCAPE UNITS (ELUs) ALONG THE ROW					
NO.	ELU	KP	ELEVATION (METERS)		WET SEASON PRECIPITATION RANGE
			MIN.	MAX.	
10	Huaytara High Plains and Ridges	195+050 – 249+538	4,000	4,650	400-800
11	Pisco-Ica Watershed Divide	249+538 – 272+181	2,850	4,000	300-500
12	Coastal Bat Hills	272+181 – 308+000	750	3,100	10-400
13	Pisco Sand Plains	308+000 – 332+940	256	750	0-50
14	Ica-Lima Coastal Plain	332+940 – 402+000	125	368	0-10

Source: Ecological Field Survey (EFS), 2007

TABLE 4.2 – HABITAT TYPES ALONG THE ROW BY ELU	
HABITAT TYPE	ELU's WHERE PRESENT
Wetland and Riparian Areas	
Riparian Vegetation	14
Coastal Hydromorphic Islands	13
Peat Bogs (Bofedales)	1, 2, 4, 5, 6, 8, 9, 10
Grasslands	
Sward-forming Grassland	1, 2,4, 6, 8, 9, 10
Tussock Grassland	1, 2, 3, 4, 5, 6, 7, 8, 9, 10
Other Herbacaeous Formations	
Tillandsia Mats	13, 14
Scrublands	
Resinous Scrub	3, 4, 5, 7, 8
Thorny Scrub	3, 5, 11
Mixed Scrub	10, 11
Desert Scrub	11, 12
Forests	
Upper Montane Forest	1
Dry Deciduous Forest	3
Low Broadleaf Evergreen Forest	3
Cactus-dominated Formations	
Columnar Cacti and Scrub	12
Anthropogenic Areas	
Eucalyptus Plantations	5
Cultivated Areas	1, 2, 3, 5, 6, 7, 8, 13, 14
Natural Unvegetated Areas	
Scarcely Vegetated High-Andean Areas	8, 9, 10
Coastal Desert Barrens	13, 14

Source: Ecological Field Survey (EFS), 2007

TABLE 4.3 - HIGH AND MEDIUM SENSITVITY PLANT SPECIES BY ELU		
SPECIES	DESCRIPTION	LEVEL OF SENSITIVITY
1. Apurimac River Valley Montane Forest Ecotone, KP 0+000 – 20+511		
Polylepis pauta	Quenual Tree	Medium
2. Campana Watershed, KP 20+511 – 25+115		
Escallonia resinosa	Shrub	Medium
Myrosmodes sp.	Bog Orchid	Medium
Tecoma sambuxifolia	Shrub	Medium
3. Torobamba River Valley, KP 25+115 – 44+350		
Corryocactus quadrangularis	Cactus	HIGH
Kageneckia lanceolota	Shrub	HIGH
Acacia macracantha	Tree	Medium

TABLE 4.3 - HIGH AND MEDIUM SENSITVITY PLANT SPECIES BY ELU		
SPECIES	DESCRIPTION	LEVEL OF SENSITIVITY
Ariestiguieta discolor	Shrub	Medium
Berberis flexuosa	Shrub	Medium
Echinopsos peruviana puquiensis	Cactus	Medium
Eriotheca vargasii	Shrub	Medium
Escallonia myrtilloides	Shrub	Medium
Escallonia resinosa	Shrub	Medium
Tecoma arequipensis	Shrub	Medium
Tecoma sumbuxifolia	Shrub	Medium
4. Siliccasa Sierra, KP 44+350 – 56+738		
Aaa Sp.	Orchid	Medium
Distichia muscoides	Bog Moss	Medium
Escallonia myrtilloides	Shrub	Medium
Myrosmodes sp.	Bog Orchid	Medium
Perezia coerulescens	Herb	Medium
5. Yucay River Valley, KP 56+783 – 74+199		
Corryocactus quadrangularis	Cactus	HIGH
Berberis flexuosa	Shrub	Medium
Cleistocactus morawetzianus	Cactus	Medium
Echinopsis peruviana spp. Puquiensis	Cactus	Medium
Escallonia myrtilloides	Shrub	Medium
6. Huamanga-Viscongo Watershed Divide, KP 74+199 – 103+970		
Escallonia myrtilloides	Shrub	Medium
Oreomyrrhis andicola	Shrub	Medium
Parastrephia quadrangularis	Shrub	Medium
7.Vinchos River Valley, KP 103+970 – 117+388		
Echinopsis peruviana ssp. Puquiensis	Cactus	Medium
Escallonia myrtilloides	Shrub	Medium
Oroya peruviana	Cactus	Medium
8. Apacheta High Sierras, KP 117+388 – 162+137		
Berberis sp.	Bush	Medium
Ephedra Americana	Bush	Medium
Escallonia myrtilloides	Shrub	Medium
Oroya peruviana	Cactus	Medium
Perezia coerulescens	Herb	Medium
Perezia pinnatifida	Herb	Medium
Ribes sp.	Plant	Medium
9. Pampas-Palmitos River Basins, KP 162+137 – 195+050		
Perezia coerulescens	Herb	Medium
Perezia pinnatifida	Herb	Medium
10. Huaytara High Plains and Ridges, KP 195+050 – 249+538		
Perezia coerulescens	Herb	Medium
11. Pisco-Ica Watershed Divide, KP 249+538 – 272+181		
Chersodoma arequipensis	Shrub	HIGH
Senocio/Aequarorium tovari	Cactus	Medium
12. Coastal Bat Hills, KP 272+181 – 308+000		
Cleistocactus acanthurus	Cactus	HIGH
Browningra candelaris	Cactus	Medium
Cridoscolus basiacanthus	Herb	Medium
Ephedra Americana	Shrub	Medium
Loasa incana	Shrub	Medium
Neoralmondia arequipensis	Cactus	Medium
Orthopterygium huaucui	Tree	Medium
13. Pisco Sand Plains, KP 308+000 – 332+940		

TABLE 4.3 - HIGH AND MEDIUM SENSITVITY PLANT SPECIES BY ELU		
SPECIES	DESCRIPTION	LEVEL OF SENSITIVITY
Tillandsia latifolia	Plant	Medium
Tillandsia paleacea	Plant	Medium
14. Ica-Lima Coastal Plain, KP 332+940 – 408+000		
Acacia macracantha	Tree	Medium
Tillandsia latifolia	Plant	Medium
Tillandsia paleacea	Plant	Medium

TABLE 4.4 - HIGH AND MEDIUM SENSITIVITY HABITATS BY ELU			
ECOLOGICAL LANDSCAPE UNIT (ELU)	HABITAT TYPE	HABITAT SENSITIVITY	APPROX. ROW LENGTH (m)
1. Apurimac River Valley Montane Forest Ecotone	Upper Montane Forest	Medium	4,821
	Tussock Grassland	Medium	6,280
	Sward-forming Grassland	Medium	5,675
2. Campana Watershed	Peat Bog	Medium	956
3. Torobamba River Valley	Cultivated Areas	High	7,901
	Dry Deciduous Forest	Medium	651
	Thorny Scrub	High	6,335
4. Sillaccasa Sierra	Tussock Grassland	Medium	10,316
5. Yucay River Valley	Resinous Scrub	High	1,829
	Riparian Corridors	Medium	26
6. Huamanga-Vischongo Watershed Divide	Tussock Grassland	Medium	27,184
7. Vinchos River Valley	Cultivated Areas	Medium	12,062
8. Apacheta High Sierras	Scarcely Vegetated High Andean Areas	Medium	17,568
	Sward-forming Grassland	Medium	14,920
	Tussock Grassland	Medium	6,419
9. Pampas-Palmitos River Basins	Tussock Grassland	Medium	12,222
10. Huaytará High Plains and Ridges	Scarcely Vegetated High Andean Areas	Medium	3,549
	Sward-forming Grassland	Medium	16,127
	Tussock Grassland	Medium	33,616
11. Pisco-Ica Watershed Divide	Mixed Scrub	High	17,872
	Thorny Scrub	High	4,598
12. Coastal Bat Hills	Desert Scrub	High	15,743
	Columnar Cacti and Scrub	High	20,076
13. Pisco Sand Plains	Hydromorphic Islands and Lagoons	High	58
14. Ica-Lima Coastal Plain	Cultivated Areas	Medium	17,758
	Coastal Desert Barrens	Medium	46,430
	Riparian Corridors	High	874

Notes:

- The precise locations (KP points) where each of the sensitive habitats occurs in each ELU is set out in the Ecological Field Survey document which also sets out the methodology and criteria for classification and definition of habitat sensitivity and should be read in conjunction with this Plan.

TABLE 4.5 - PROTECTED PLANTS IDENTIFIED ALONG ROW BY ELU & HABITAT				
FAMILY	SCIENTIFIC NAME	TYPE OF PLANT	CATEGORY	ELU (*HABITAT*)
Asteraceae	*Aristeguietia discolor*	Shrub	NT	Torobamba River Valley ELU *(Cultivated Areas)*
	Chersodoma arequipensis	Subshrub	CR	Pisco-Ica Watershed Divide ELU *(Mixed and Thorny Scrub)*
	Parastrephia quadrangularis	Shrub	VU	Huamanga-Vischongo Watershed Divide ELU *(Tussock Grassland)*
	Perezia coerulescens	Herb	VU	Sillaccasa Sierra ELU *(Sward-forming Grassland)* Apacheta High Sierras ELU *(Sward-forming Grassland)* Huaytará High Plains and Ridges ELU *(Sward-forming Grassland)*
	Perezia pinnatifida	Herb	VU	Apacheta High Sierras ELU *(Sward-forming Grassland)* Pampas-Palmitos River Basins ELU *(Sward-forming Grassland)*
Bignoniaceae	*Tecoma arequipensis*	Shrub	VU	Torobamba River Valley ELU *(Dry Deciduous Forest)* *(Resinous Scrub)*
	Tecoma sambucifolia	Shrub	NT	Torobamba River Valley ELU *(Thorny Scrub)* *(Cultivated Areas)*
Cactaceae	*Browningia candelaris*	Cactus	VU	Coastal Bat Hills ELU *(Desert Scrub)* *(Columnar Cacti and Scrub)*
	Cleistocactus acanthurus	Cactus	EN	Coastal Bat Hills ELU *(Desert Scrub)* Coastal Bat Hills ELU *(Columnar Cacti and Scrub)*
	Corryocactus quadrangularis	Cactus	EN	Torobamba River Valley ELU *(Cultivated Areas)* *Yucay River Valley* *(Resinous Scrub)*
	Echinopsis peruviana puquiensis	Cactus	VU	Yucay River Valley ELU *(Resinous Scrub)* Vinchos River Valley ELU *(Cultivated Areas)*
Euphorbiaceae	*Cnidoscolus basiacanthus*	Herb	VU	Coastal Bat Hills ELU *(Columnar Cacti and Scrub)*
Ephedraceae	*Ephedra americana*	Subshrub	NT	Apacheta High Sierra ELU *(Sward-forming Grassland)* Coastal Bat Hills ELU *(Columnar Cacti and Scrub)*
Fabaceae	*Acacia macracantha*	Tree	NT	Ica-Lima Coastal Plain ELU *(Cultivated Areas)* *(Riparian Vegetation)* Torobamba River Valley ELU *(Cultivated Areas)*
Glossuraliaceae	*Escallonia myrtilloides*	Shrub	EN	Yucay River Valley ELU *(Thorny Scrub)* Huamanga-Vischongo Watershed Divide ELU *(Tussock Grassland)* Vinchos River Valley ELU *(Tussock Grassland)*

TABLE 4.5 - PROTECTED PLANTS IDENTIFIED ALONG ROW BY ELU & HABITAT				
FAMILY	SCIENTIFIC NAME	TYPE OF PLANT	CATEGORY	ELU (*HABITAT*)
				(Resinous Scrub) Apacheta High Sierra ELU *(Tussock Grassland)*
	Escallonia resinosa	Shrub	VU	Torobamba River Valley ELU *(Thorny Scrub)* Torobamba River Valley ELU *(Cultivated Areas)*
Orchidaceae	*Myrosmodes* sp.	Bog Orchid	NT	Campana Watershed ELU *(Peat Bogs)* Sillaccasa Sierra ELU *(Peat Bogs)*
Rosaceae	*Kageneckia lanceolata*	Shrub	CR	Torobamba River Valley ELU *(Thorny Scrub)*
	Polylepis pauta	Tree	NT	Apurimac Valley Montane Forest Ecotone ELU *(Upper Montane Forest)*

Notes:
- CR – Critically Endangered
- EN – Endangered
- VU - Vulnerable
- NT – Near Threatened

Although biorestoration and revegetation will be required along the entire ROW (excepting most areas within the coastal desert habitats), the habitats and plant species defined as High and Medium sensitivity in Tables 4.3 and 4.4 will be considered as special biorestoration areas which will be prioritized with respect to:

- Development of seed mixtures by PERU LNG with as much use of native species as practicable
- Use of naturalized species where not invasive and as erosion control
- Application of organic or chemical fertilizers, mulching and other means of soil improvement to promote revegetation
- Monitoring for weed control

5.0 BIORESTORATION

5.1 GENERAL

The Project ESIA includes a Restoration and Revegetation Plan setting out the requirements for biorestoration along the ROW and other disturbed work areas after the completion of construction. This Plan incorporates the requirements of the ESIA and provides additional requirements designed to facilitate biorestoration and revegetation and return disturbed areas as close and as quickly as possible to their pre-construction condition. Revegetation will result in enhanced ground stability, erosion and sediment control and highest potential for reestablishment of the original habitat and biodiversity.

Revegetation of the ROW will comprise natural revegetation and regeneration based on the seed-bank preserved within the topsoil stockpile that was prepared during the preliminary clearing and grading activities of construction and also assisted revegetation using a combination of naturalized species from commercial sources and native species collected from the Pipeline route and surrounding area. Assisted revegetation will aim to be representative of the natural and original biodiversity of the area prior to construction.

PERU LNG will define, source and provide the seed supply to CONTRACTOR including a Seeding Schedule for its distribution. The Seeding Schedule will be defined by the vegetative condition of natural habitats as they exist prior to construction. The seeding mixtures will comprise native species where possible and naturalized (commercially available), the specific details of which as identified in Section 4.6.2 of this Plan, are subject to verification and finalization by PERU LNG during the course of the Project.

Where revegetation involves the re-introduction of shrubs by planting in addition to seeding, PERU LNG will make arrangements with local communities to procure existing or propagate new shrubs from seeds or cuttings prior to CONTRACTOR's entry and commencement of works on the ROW.

CONTRACTOR shall apply jute matting, mulch (straw), fertilizer and hydroseeding as directed by PERU LNG following joint inspections of the ROW and off-ROW disturbed areas.

During the hiring of local labor when executing its biorestoration program, CONTRACTOR shall give preference to laborers with ecological or agricultural experience.

Slash material management, including the re-spreading across reinstated areas of natural organic matter containing soil enhancing mulch, nutrients and seed, such as roots, leaves, branches and tree trunks that was originally cut and stockpiled along the ROW during the site clearance phase, is addressed in the Erosion Control and Reinstatement CMP as this process is an immediate follow up activity to topsoil re-spreading which is covered as part of physical reinstatement works.

5.2 DESCRIPTION OF THE BIORESTORATION PROGRAM

The biorestoration program, which effectively comprises the high Andean region from KP 0 (ELU 1, Apurimac River Valley Montane Forest Ecotone) to approximately KP 272 (ELU 11, Pisco-Ica Watershed Divide) will take place during the rainy season, generally from November to March when the availability of water and soil moisture is most likely to be at its highest annual level and the temperatures are highest and therefore maximizing the survivability rate for seeds and plants.

Revegetation will not be required in certain areas defined between KP 0 and KP 272 in naturally rocky areas or other areas comprising outcropping bedrock, broken superficial rock, talus, or other soil conditions where a vegetative cover does not naturally occur. These areas will be identified during CONTRACTOR's Pre Construction Survey (refer to Ecological CMP).

In addition to seeding, planting of shrubs and trees will also be required in certain areas. PERU LNG will supply the plant materials ready for planting to CONTRACTOR from nurseries or other sources. These plants may originate from seeds, cuttings or sensitive plant species translocated from the ROW or other work areas by PERU LNG prior to CONTRACTOR's site clearance works in accordance with the Ecological CMP.

Between KP 272 and the end of the Pipeline at KP 408 (Pampa Melchorita), the ROW crosses predominantly desert habitats with no or sparse natural vegetation cover and revegetation will only be undertaken in very limited areas including desert scrub and riparian habitats. These will be identified during the Pre Construction Survey.

CONTRACTOR shall revegetate the ROW as close as possible to its original pre-construction habitat conditions with the following habitat exceptions as defined in the Ecological Field Survey:

- Cultivated Areas
- Eucalyptus Plantations

In Cultivated Areas and Eucalyptus Plantations any revegetation will be carried out by appropriate third parties such as private landowners or community groups and determined by agreements reached by PERU LNG in accordance with the PERU LNG Land Acquisition and Compensation Management Plan.

Table 5.2a and 5.2b show approximate areas to be revegetated along the ROW and camps based on figures that have been extracted from the ESIA Restoration and Revegetation Plan. These figures are subject to change following further studies by PERU LNG, the Pre Construction Survey undertaken by CONTRACTOR and CONTRACTOR's detailed Program of Works including its proposals for camps and other facilities.

TABLE 5.2a - APPROXIMATE AREAS FOR REVEGETATION IN THE ROW

ELU	KP Range	Area (Ha)	Habitat Type	Length (m)	Area (Ha)
Apurimac River Valley Montane Forest Ecotone (1)	0+000- 20+511	46.52	Upper Montane Forest	4,821	12.05
			Peat bogs	1,830	4.58
			Sward-forming grassland	5,675	14.19
			Tussock grassland	6,280	15.70
Campana Watershed (2)	20+511-25+115	10.80	Peat Bog Wetlands	956	2.39
			Sward-forming Grassland	1,970	4.93
			Tussock Grassland	1,392	3.48
Torobamba River Valley (3)	25+115-44+448	28.21	Tussock grassland	790	1.98
			Low Broadleaf Evergreen Forest	513	1.28
			Dry Deciduous Forest	651	1.63
			Thorny Scrub	6,335	15.84
			Resinous Scrub	2,995	7.49
Sillaccasa Sierra (4)	44+448-56+783	31.21	Peat bog wetlands	440	1.10
			Sward-forming grassland	1,554	3.89
			Resinous Scrub	173	0.43
			Tussock grassland	10,316	25.79
Yucay River Valley (5)	56+783-74+199	5.16	Peat bog wetlands	45	0.11
			Thorny scrub	171	0.43
			Resinous Scrub	1,797	4.49
			Tussock grassland	49	0.12
Huamanga-Vischongo Watershed Divide (6)	74+199-103+970	74.03	Tussock grassland	27,184	67.96
			Sward-forming grassland	754	1.89
			Peat Bogs	1,672	4.18
Vinchos River Valley (7)	103+970-117+388	3.39	Resinous scrub	1,158	2.90
			Tussock grassland	198	0.50
			Sward-forming grassland	14,920	37.30
			Tussock grassland	6,419	16.05
			Peat Bogs	5,215	13.04
			Resinous Scrub	150	0.38
Pampas-Palmitos River Basins (9)	162+137-195+050	82.28	Tussock Grassland	12,222	30.56
			Sward-forming Grassland	10,517	26.29
			Peat Bog	2,118	5.30
			Peat Bogs	1,158	2.90
			Sward-forming grassland	16,127	40.32
			Tussock grassland	33,616	84.04

TABLE 5.2a - APPROXIMATE AREAS FOR REVEGETATION IN THE ROW					
ELU	KP Range	Area (Ha)	Habitat Type	Length (m)	Area (Ha)
			Mixed Scrub	38	0.10
Pisco-Ica Watershed Divide (11)	249+538-272+181	56.61	Thorny scrub	4,590	11.48
			Mixed scrub	17,872	44.68
			Desert Scrub	181	0.45
Coastal Bat Hills (12)	272+181-308+000	39.36	Desert Scrub	15,743	39.36
Pisco Sand Plains (13)	308+000-332+940	0.00	None	0	0.00
Ica-Lima Coastal Plain (14)	332+940-402+000	2.19	Riparian Vegetation	874	2.19
Total		626.63		250,652	626.63

- Not every section of ROW within each Ecological Landscape Unit requires revegetation. Revegetation is determined by the type of natural habitat and topographical features. Where no natural vegetation cover occurs (e.g. rocky areas and desert habitats, no revegetation is proposed)

TABLE 5.2b - APPROXIMATE AREAS SUBJECT TO REVEGETATION AT CAMPS						
CAMP	UTM LOCATION		KP	HABITAT TYPE	W X L (m)	AREA (Ha)
	East	North				
Chiquintirca PS3	640,667	8,556,464	0+500	Cultivated Area	150 x 150	2.25
Jolpas	638,424	8,559,845	5+330	Sward-forming Grassland	150 x 75	1.12
Anchihuay	632,658	8,562,220	12+594	Degraded Upper Montane Forest	150 x 150	2.25
Campana	624,624	8,561,048	23+173	Sward-forming Grassland	350 x 100	3.50
Patibamba	613,385	8,556,477	38+928	Thorny Scrub	150 x 150	2.25
Las Nubes	607,770	8,550,078	50+836	Tussock Grassland	100 x 150	1.50
Huaychao	603,105	8,544,413	60+020	Resinous Scrub	200 x 300	6.00
Acocro	602,522	8,533,316	70+623	Cultivated Area	150 x 300	4.50
Vinchos	571,762	8,529,230	106+803	Cultivated Area	400 x 700	12.00
Ocollo	557,585	8,524,051	127+248	Sward-forming Grassland	200 x 300	6.00
Rumichaca	505,991	8,522,600	188+063	Tussock Grassland	150 x 150	2.25
Huaytará	473,804	8,494,469	233+797	Tussock Grassland	150 x 150	2.25
Huancaccasa	444,982	8,486,642	266+369	Mixed Scrub	100 x 150	1.50
Total						47.37

Biorestoration will take place along the specified areas of ROW and other off-ROW sites including camps, access roads, shooflies, pipeyards, borrow pits and spoil (excess rock) disposal sites.

Exceptions will be made where access roads opened and used by CONTRACTOR during construction are converted into permanent service roads used for pipeline maintenance by PERU LNG during the operation phase. However, the sides of these roads including any cut slopes will be revegetated with seed mixtures consistent with the surrounding habitat. Where CONTRACTOR uses existing brownfield sites with no vegetation cover no revegetation will be required.

5.3 SPECIES FOR REVEGETATION

The use of native or naturalized species favorably adapted to the local environment without being invasive or intrusive is a principal objective of the revegetation program. Species mix selection by area along the Pipeline will take into consideration the vegetation data collected for the biological baseline component of the ESIA which identified recommended species for seeding and planting together with the observations from the Ecological Field Survey, 2007.

Naturalized species constitute those species which have been introduced by human activity or have moved naturally into new habitats. PERU LNG will ensure that seed mixtures will only comprise those naturalized species that occur along the ROW and within the surrounding areas and are not considered invasive and to the long-term detriment of native species and natural biodiversity. Naturalized species will form an important element in the revegetation and soil stabilization of several habitats in the Andean region where native species are difficult or impossible to source at a practicable level for the quantities required for ROW revegetation and where, because of erosion risk on thin infertile soils on steep slopes, a faster growing cover crop is initially required. Over a long-term period the more rapidly colonizing naturalized species will progressively be replaced by slower establishing native species as part of the natural plant succession process. In this regard, there will be no use by in any reinstated areas of non-native, invasive species such as kikuyu grass (*Pennisetum clandestinum*).

PERU LNG will define the final selection of species for revegetation before each specific activity including provision of the seed supply to CONTRACTOR.

5.4 HABITAT-SPECIFIC REQUIREMENTS

The following habitat-specific revegetation requirements are set out in the ESIA. PERU LNG will define the final species inventory on the basis of the availability and practicality of collection and propagation of the various species.

5.4.1 Andean Grasslands (ELUs 1 to 10)

Andean grasslands, comprising sward-forming grassland habitat and tussock grassland habitat occur in patches throughout ELUs 1 to 10 (KP 0 to KP 249). Revegetation in these habitats will be performed by sowing seeds of commercially available naturalized grasses such as *Festuca arundinacea, Dactylis glomerata, Avena strigosa, Trifolium repens,Trifolium pretense* and *Lolium perenne*.

Seeds of native grasses including *Calamagrostis vicunarum, Calamagrostis rigida, Calamagrostis antoniana, Festuca dolichophylla, Stipa obtusa, Trifolium amabile, Agrostis breviculmis* and *Jarava ichu* will be collected where practicable. Plugs of *Jarava* spp. (ichu tussock grasses) will also be planted.

5.4.2 Upper Montane Forest

Upper montane forest habitat is found in ELU 1, Apurimac River Valley Montane Forest Ecotone (KP 0+000 to KP 20+511).

Revegetation in these areas will be performed by sowing seeds of commercially available naturalized grasses such as *Festuca arundinacea, Dactylis glomerata, Avena strigosa, Trifolium repens* and *Trifolium pretense*. Native species will also be used where available such as *Agrostis breviculmis, Calamagrostis antoniana, Calamagrostis rigida, Festuca dolichophylla and Stipa obtuse.*

Shrubs such as *Gynoxys oleifolia, Hesperomeles lanuginosa, Lupinus aff. mutabilis, Oreocallis grandiflora, Senna versicolor, Spartium junceum, Tessaria integrifolia* and *Oreocallis grandiflora* will be planted on the ROW.

Tree species that will be considered for planting within the ROW but outside the 8-m wide restricted area of planting around the pipeline include *Alnus acuminata, Clusia* sp., *Escallonia myrtilloides, Escallonia resinosa, Oreopanax oroyanus* and *Vallea stipularis*.

5.4.3 Dry Andean Scrub, Low Broadleaf Evergreen Forest, and Dry Deciduous Forest

Low Broadleaf Evergreen Forest and Dry Deciduous Forest occurs in ELU 3 (Torobamba River Valley, KP 25+115 to KP 44+350).

Scrubland is observed in the following areas:

- Resinous Scrub – ELUs 3, 4, 5, 7, 8
- Thorny Scrub – ELUs 3, 5, 11
- Mixed Scrub – ELUs 10, 11

Depending on soil quality, the following shrub species, among others, will be considered: *Baccharis latifolia, Baccharis tricuneata, Dodonaea viscosa, Gynoxys oleifolia, Hesperomeles lanuginosa, Lupinus* aff. *mutabilis, Oreocallis grandiflora, Senna versicolor, Spartium junceum, Tecoma sambucifolia,* and *Tessaria integrifolia.*

Potential trees include *Acacia macracantha, Alnus acuminata, Buddleja coriacea, Caesalpinia spinosa, Clusia* sp., *Eriotheca vargasii, Escallonia myrtilloides, Escallonia resinosa, Oreopanax oroyanus, Polylepis* spp.,, *Schinus molle,* and *Vallea stipularis.*

In habitats identified as Thorny Scrub, natural regeneration from the soil seed bank will be promoted with no assisted seeding by native or naturalized species.

5.4.4 Desert Scrub and Columnar Cacti

There will be no revegetation by CONTRACTOR in these areas.

5.4.5 Coastal Plain Riparian Vegetation

Tree and shrub species, such as *Acacia macracantha, Tessaria integrifolia* and *Baccharis latifolia*, which promote slope stabilization, will be used in the revegetation of disturbed riparian areas. Seeding of grasses is not required in these habitats due to the near absence of rainfall.

5.4.6 Cultivated Areas

Cultivated areas affected by construction activities will not be replanted with crops or other vegetation. CONTRACTOR is responsible only for the physical restoration of affected cultivated areas; including recontouring and reinstatement of topsoil in its original condition and restoration of any affected irrigation systems (refer to Erosion Control and Reinstatement CMP).

5.4.7 Andean Wetland Revegetation

Sod, turf cuttings and other plant materials comprising the surface vegetative and root layer of the soil within the wetland habitat will be removed by CONTRACTOR during clearing and prior to the topsoil stripping process, if and where feasible and practicable to do so, depending on the localized ROW ground conditions. If it is possible to salvage the turf separately, it will be temporarily stored and placed on the surface of the topsoil stockpile after stripping to form a cap to facilitate its preservation during the construction phase.

During topsoil reinstatement after ROW re-grading within the wetland, the turf cap will again be removed and separated from the rest of the topsoil stockpile. The topsoil will be re-spread across the ROW surface and the turf cap will be carefully re-spread on the surface to enhance the likelihood of reestablishment. Where it was not previously practicable to readily separate the turf layer from the topsoil during site clearing and stripping because of ground conditions then all the material will be re-spread together across the ROW surface.

Turf revegetation will be supplemented by seeds sourced from the wetland prior to construction or by planting of native species propagated from seeds or cuttings obtained from sources in the local community under arrangements developed by PERU LNG. Herbaceous species such as *Hypochaeris taraxacoides, Luzula racemosa, Distichia muscoides* and *Pycnophyllum molle* will be used.

Non wetland species shall not be introduced into wetland areas either by seed or plants as part of the revegetation program.

Further details on protection measures to be used by CONTRACTOR when working in and reinstating bofedales are set out in the Erosion Control and Reinstatement CMP.

5.5 GRASS SEEDING

5.5.1 Areas Subject To Seeding

Grass seeding will not be applied in areas where the pre-existing native vegetation cover does not include a significant herbaceous layer, such as the Scarcely Vegetated High Andean habitats, the Desert Scrub habitats, and all other areas west of KP 272 which forms the edge of the Andes Mountains in the region of the Coastal Bat Hills.

Estimates of areas to be revegetated with grass and legumes along access roads and shooflies and in spoil disposal areas are not included in this Plan and will be dependent on details developed by CONTRACTOR. Table 5.7.1 summarizes areas that will be seeded with grass and forb mix.

TABLE 5.7.1 - ROW, CAMP AND YARD AREAS REQUIRING REVEGETATION

WORKS ELEMENT	QUANTITY	AREA TO BE AFFECTED (HA)	AREA TO BE SEEDED WITH GRASS / FORB MIX (HA)	GRASSLANDS	ASSOCIATED GRASS IN SHRUBLANDS AND FORESTS
Pipeline ROW	N/A	1,005.00	478.12	374.96	103.16
Camps/Pipe Yards	13	47.37	45.26	16.63	28.63
Total		1,052.37	523.38	391.59	131.79

Notes

- N/A: Not applicable
- This information is based on assumptions set out in the ESIA and is subject to change depending on CONTRACTOR's detailed proposals for camps, yards and other supporting facilities

5.5.2 Proposed Species

PERU LNG will provide CONTRACTOR with seed mixtures necessary for the establishment of grass and other herbaceous cover. Species composition will be determined by the combination of native and naturalized species that were observed along the Pipeline ROW during ESIA studies and the subsequent Ecological Field Survey and by any other species that are subsequently observed where CONTRACTOR identifies additional work areas that will require reinstatement and revegetation (Refer Table 1, Appendix 1).

Where possible, different species mixes will be defined by the unique characteristics of each habitat type within each Ecological Landscape Unit (ELU) as observed in the Ecological Field Survey. Proposed species mixes by ELU habitat are set out in Appendix 1. The key species in each habitat based on dominance and importance within the habitat and likely sourcing and availability are highlighted.

However, where a unique species mix reasonably copying the original environment cannot adequately be assembled for a particular habitat because of difficulties of collection of native species, a general species seed mix will be used. This general seed mix has been defined on the basis of a number of natural and native species set out in Appendix 1 (Tables 2,3,4).. A separate section specific for wetland areas (bofedales) is also defined.

The general seed mixes form an indicative representation of a habitat rather than a perfect replica. A return to original conditions will be expected with time as any native species which are unable to be collected during the Project will naturally gradually recolonize the disturbed areas. PERU LNG will provide CONTRACTOR with a definitive list of species mixes, per area and density application rates, when it is finalized.

5.5.3 Native Seed Collection

Seeds of non-domesticated native plant species are generally not commercially available.

PERU LNG will ensure that the production or collection of native grass seeds is planned and coordinated with local communities in order to have seed material available for CONTRACTOR in the appropriate time.

An additional source of native seed will be the harvesting of native hay (straw) from areas at the seed stage. This will be obtained from local communities by PERU LNG and provided to CONTRACTOR to spread over the ROW where specified at a rate of 1.1 to 2.0 tons/ha (50-80 bales of 22-25 kg each). If hay is baled, it should not be stored more than 2-3 days to prevent spoilage. All hay will be stored in a dry area prior to application. The straw will also serve as a source of mulch and organic matter to apply to the ROW surface to promote the binding and enrichment of the soil and as a further means of erosion control.

Wherever practicable, native seed applied to disturbed areas will be sourced from the same habitat type as the surrounding area.

5.5.4 Broadcast Seeding

In most areas requiring grass and legume seeding, broadcast seeding will be performed by CONTRACTOR using standard low-impact mechanical or manual methods directly upon restored and graded topsoil. The seed shall be covered by raking the soil. Seed sprinkling machines may also be used to carry out the task much more efficiently.

5.5.5 Hydroseeding

Hydroseeding may be required to achieve a more rapid and dense vegetative cover in the most sensitive areas of thin, infertile erodable soils on steep slopes in areas where seasonal rainfall presents a high risk of erosion or instability with a slow and restricted growing season posed by temperature constraints at high elevations.

Hydroseeding will be undertaken by CONTRACTOR in areas specified by PERU LNG. It will be based on the established method of spraying from a tank or truck a water based substance typically composed of seeds, fertilizer, cellulose fibers and a tackifier/glue adhesive that allows the seeds to stick to the application surface. The tank has an evacuation mechanism operating by pressure using a connected hose that allows carrying out a controlled dispersion onto ground surfaces.

Prior to commencement of restoration activities CONTRACTOR must prepare a Method Statement to PERU LNG for review and approval, identifying proposed areas for hydroseeding and an outline method of work.

5.5.6 Tussock Grass Transplants

PERU LNG will provide CONTRACTOR with native tussock grasses, such as Peruvian needlegrass or feathergrass (*Jarava ichu*) for planting on the steeper sections of the ROW in tussock grassland habitats (ELUs 1, 2, 3, 4, 5, 6, 7, 8, 9, 10) subject to soil erosion.

PERU LNG will arrange for these grasses to be salvaged from the ROW and other proposed work areas if practicable prior to clearing activities by CONTRACTOR. The plants will be developed by local communities and PERU LNG's third party consultants in fields or nurseries under the overall management of PERU LNG and provided to CONTRACTOR for replanting during its biorestoration work programme.

5.6 TREE AND SHRUB CUTTINGS AND TRANSPLANTS

PERU LNG will coordinate with local communities and its third party consultants to obtain seeds, cuttings or transplants of all appropriate shrubs and trees prior to CONTRACTOR commencing clearing activities along the ROW or other off-ROW areas required.

The quantity of seedlings acquired from the local communities will be based on an evaluation of the quantity they can realistically provide.

Plants will not be taken from the wild except as authorized by the Peruvian authorities and in agreement with the local communities. Native plants grown from seed, cuttings and temporary transplants obtained during the preconstruction phase will be used in the revegetation activities and planted in their source areas.

CONTRACTOR shall use the following guidelines to develop their method statements as per Section 3.4 of this Plan:

- The planting of tree and shrub species with deep roots that may compromise the integrity of the buried pipe will not be allowed within 4 meters of each side of the pipe alignment (total width of exclusion zone is therefore 8 meters).
- To the extent possible, planting should occur in the rainy season (November – March). Where this is not practicable, CONTRACTOR should water the trees and shrubs immediately after planting to facilitate establishment.

- To the extent possible, planting should be performed on cloudy, cool, humid days to avoid exposure of plants and roots to harsh micro climatic conditions such as excessive heat and drought.
- Unhealthy plants should be culled and discarded and the material used as mulch.
- Spacing and arrangement of plants should provide a natural appearance (i.e., plants not regularly spaced) and provide the required planting density of each species as indicated by prevailing conditions in the natural habitat surrounding the disturbed area of ROW or other work areas
- Planting holes should be approximately two times wider and only slightly deeper than the plant's root mass.
- Planting holes backfill must be adequately compacted to remove voids and allow good root contact with soil.
- Plants shall be watered immediately after planting and as needed to promote establishment.
- Any waste associated with planting will be collected and removed offsite by CONTRACTOR as per requirements of the Waste Management CMP.

Tables 5 (Appendix 2) shows the possible shrub and tree species that may be used during revegetation as identified in the ESIA and Table 6 identifies those particular species observed along the ROW. The specific inventory for planting of shrubs and trees will be finalized by PERU LNG as a Schedule/Line List and provided to CONTRACTOR prior to commencement of biorestoration.

5.7 FERTILIZER APPLICATION

Fertilizer application shall be limited to areas where it is necessary to establish a rapid vegetative cover for erosion control purposes in areas of high risk. Any fertilizer applications must be formulated and performed such that the natural nutrient balances in the adjacent ecosystems are not altered, in particular where there are wetlands or nearby waterbodies.

Fertilizer, if and where required, shall be specified and provided by PERU LNG.

CONTRACTOR shall prepare a Fertilizer Application Method Statement for review and approval by PERU LNG setting out the method of application.

5.8 PESTICIDE USE AND MANAGEMENT

If CONTRACTOR proposes the use of pesticides or other means for pest management and control, such use shall be consistent with the pesticide use and management guidelines of the IFC's Social and Environmental Performance Standard 5 on Pollution Prevention and Abatement (See Appendix 2 for these guidelines). Pesticide application by CONTRACTOR shall require review and approval by PERU LNG.

5.9 MAINTENANCE

CONTRACTOR shall perform routine maintenance of revegetated areas until such time that occupation of the land is officially handed back to PERU LNG.

CONTRACTOR shall control noxious weeds and invasive species within revegetated areas that reduce the forage quality of Andean lands. These activities shall be scheduled and performed in consideration of prevailing weather conditions and seasonality of plant development. The use of fires by CONTRACTOR to destroy stockpiles of noxious weeds that have gathered together shall require prior approval from PERU LNG.

APPENDIX 1: Proposed Seed Mixes by Species

TABLE 1 - PROPOSED GRASS SPECIES (ESIA)						
COMMON NAME	SCIENTIFIC NAME	FAMILY	CLIMATE	SOIL REQUIREMENTS	SOWING DENSITY (KG/HA)	ELEVATION RANGE (m)
Section 1: Naturalized (Commercially Available)						
Bristle oats	Avena strigosa	Poaceae	Temperate-cold	Drained	30	2,500 – 4,200
Tall fescue	Festuca arundinacea	Poaceae	Temperate-cold	Slightly drained	20	2,000 – 4,200
Orchard grass	Dactylis glomerata	Poaceae	Temperate-cold	Well-drained	20	2,500 – 4,200
White clover	Trifolium repens	Fabaceae	Temperate-cold	Slightly drained	5	3,000 – 4,200
Red clover	Trifolium pratense	Fabaceae	Temperate-cold	Drained	8	3,000 – 4,200
Rye grass	Lolium perenne	Poaceae	Temperate-cold	Drained	10	2,000 – 4,200
Section 2: Native (Sourced under arrangement with local community)						
Vicuña reedgrass	Calamagrostis vicunarum	Poaceae	Temperate-cold	Well-drained	6-8	3,900 – 4,600
Rigid reedgrass	Calamagrostis rigida	Poaceae	Temperate-cold	Slightly drained	6-8	3,900 – 4,400
Reedgrass	Calamagrostis antoniana	Poaceae	Temperate-cold	Slightly drained	6-8	3,800 – 4,200
Fescue	Festuca dolichophylla	Poaceae	Temperate-cold	Slightly drained	6-8	3,800 – 4,500
Needlegrass	Stipa obtusa	Poaceae	Temperate-cold	Slightly drained	6-8	3,800 – 4,200
White Clover	Trifolium amabile	Fabaceae	Temperate-cold	Poorly-drained	6-8	3,100 – 4,500
Short-stem bentgrass	Agrostis breviculmis	Poaceae	Temperate-cold	Well-drained	6-8	3,500 – 4,500
Peruvian needlegrass or feathergrass (ichu)	Jarava ichu	Poaceae	Temperate-cold	Moderately to Well drained	6-8	3,000 – 4,200
Lupine	Lupinus mutabilis	Poaceae	Temperate-cold	Moderately drained	10	3,500 – 4,200
Section 3: Wetland (Bofedales) Species						
Dandelion cat's-ear	Hypochaeris taraxacoides	Asteraceae	Temperate-cold	Poorly drained	6-8	3,100 – 4,300
Racemose woodrush	Luzula racemosa	Juncaceae	Temperate-cold	Poorly drained	6-8	3,500 – 4,250
Kunkuna	Distichia muscoides	Juncaceae	Temperate-cold	Poorly drained	6-8	3,500 – 4,550
White clover	Trifolium amabile	Fabaceae	Temperate - cold	Poorly drained	6-8	3,100 – 4,500

Notes

- Source: Adapted from ESIA, Volume IV, Chapter 7.
- Sowing Density: 1 Hectare = 10,000 m^2 = equivalent of 400m length of ROW (assuming a 25 m standard working width)
- The target relative cover will be 70% grass and 30% legume.
-

The three general seed mixes defined in Tables 2, 3 and 4 are defined on the basis of altitude, with different species adapted to different climatic regimes at different altitudes from 2,000 meters to 4,900 meters. No seed mix is proposed for altitudes less than 2.000 m (edge of the Andes, west of KP 272) where there is a predominant absence of vegetation.

TABLE 2 - GENERAL SEED MIX 1 (4,200–4,900 m)			
SCIENTIFIC NAME	COMMON NAME	RATE	SEEDING TECHNIQUE
Calamagrostis rigida	Ichu	6-8 kg/ha	Broadcast
Trifolium amabile	White Clover	6-8 kg/ha	Broadcast
Agrostis breviculmis	Chiji	6-8 kg/ha	Broadcast
Calamagrostis vicunanum	Reed bent grass	6-8 kg/ha	Broadcast
Festuca dolichopphylla	Fescue, chillihua	6-8 kg/ha	Broadcast

TABLE 3 - GENERAL SEED MIX 2 (3,500–4,200 m)			
SCIENTIFIC NAME	COMMON NAME	RATE	SEEDING TECHNIQUE
*Avena strigosa**	Bristle oat	30 kg/ha	Broadcast
*Festuca arundinacea**	Tall fescue	20 kg/ha	Broadcast
Lupinus mutabilis	Lupine or tarwi	10 kg /ha	Broadcast
*Lolium perenne**	Rye grass	10 kg/ha	Broadcast
*Dactylis glomerata**	Orchard grass	20 kg/ha	Broadcast
*Trifolium repens**	White clover	5 kg/ha	Broadcast
*Trifolium pratense**	Red clover	8 kg/ha	Broadcast
Calamagrostis vicunamum	Vicuna reedgrass	6-8 kg/ha	Broadcast
Calamagrostis rigida	Rigid reedgrass	6-8 kg/ha	Broadcast
Calamagrostis antoniana	Reedgrass	6-8 kg/ha	Broadcast
Festuca dolichophylla	Fescue	6-8 kg/ha	Broadcast
Stipa obtuse	Needlegrass	6-8 kg/ha	Broadcast
Trifolium amabile	White Clover	6-8 kg/ha	Broadcast
Agrostis breviculmis	Short-stem bentgrass	6-8 kg/ha	Broadcast
Jarava ichu	Peruvian needlegrass	6-8 kg/ha	Broadcast

TABLE 4 GENERAL SEED MIX 3 (2,000–3,500 m)			
SCIENTIFIC NAME	COMMON NAME	RATE	SEEDING TECHNIQUE
Jarava ichu	Peruvian needlegrass	6-8 kg/ha	Broadcast
*Avena strigosa**	Bristle oat	30 kg/ha	Broadcast
*Lolium perenne**	Rye grass	10 kg/ha	Broadcast
*Festuca arundinacea**	Tall fescue	20kg/ha	Broadcast
*Dactylis glomerata**	Orchard grass	20kg/ha	Broadcast
*Trifolium repens**	White clover	5kg/ha	Broadcast
*Trifolium pratense**	Red clover	8kg/ha	Broadcast

* Naturalized Species

TABLE 5 - PROPOSED SHRUB AND TREE SPECIES (ESIA)					
SCIENTIFIC NAME	COMMON NAME	TYPE	ELEVATION RANGE (m)	SOIL REQUIREMENTS	GROWTH RATE
Acacia macracantha	Huarango	Shrub to small tree, 3 – 10m	100 – 3,100	Shallow and rocky soil	NI
Alnus acuminata	Aliso	Tree	1,200 – 3,600	Deep soil	Medium Fast
Baccharis latifolia	Chilca	Shrub	0 – 3,800	Shallow and rocky soil	Medium
Baccharis tricuneata	Taya	Shrub	NI	NI	NI
Buddleja coriacea	Colle	Tree 8m	3,400 – 4,500	Deep soil, can grow in rocky soil, tolerates alkaline pH	Slow
Caesalpinia spinosa	Tara	Tree 5m	1,200 – 2,800	Shallow and rocky soil	Medium
Clusia sp.	Chojal	Tree	2,300 – 2,500	NI	NI
Dodonaea viscosa	Chamana	Shrub	1,000 – 3,200	Shallow and rocky soil	Fast
Eriotheca vargasii	Pati	Tree 6m	2,000 - 3,200	Shallow and rocky soil	NI
Escallonia myrtilloides	Tasta	Tree	3,600 – 3,900	NI	NI
Escallonia resinosa	Chachacomo	Shrub to small tree, 5 to 7m	3,300 – 4,500	Shallow and rocky soil	Slow
Gynoxys oleifolia	Japru	Shrub	3,300 – 4,500	Shallow and rocky soil, tolerates alkaline pH	Medium
Hesperomeles lanuginosa	Manzanillo	Tree	2,300 – 2,700	Shallow and rocky soil	Slow
Lupinus aff. *mutabilis*	Tarwi silvestre	Shrub	2,500 – 4,200	Shallow and rocky soil	Medium
Opuntia ficus-indica	Prickly pear	Cactus	0 – 3,300	Shallow and rocky soil, tolerates alkaline pH	Slow
Oreocallis grandiflora	Chakpá	Shrub to small tree, 2 –	2,200 – 3,600	Deep soil, and can grow in rocky soil	Slow

TABLE 5 - PROPOSED SHRUB AND TREE SPECIES (ESIA)					
SCIENTIFIC NAME	COMMON NAME	TYPE	ELEVATION RANGE (m)	SOIL REQUIREMENTS	GROWTH RATE
		4m			
Oreopanax oroyanus	Yaquil	Tree	800 – 3,000	Shallow and rocky soil, tolerates alkaline pH	Slow
Polylepis sp.	Quinual	Tree 5m	2,800 – 5,000	Shallow/rocky soil	Slow
Schinus molle	Peppertree, molle serrano	Tree 8m	0 – 3,200	Deep soil, and tolerates alkaline pH	Slow
Senna versicolor	Mutuy	Shrub to small tree, 3m	2,600 – 3,900	Shallow and rocky soil, tolerates alkaline pH	Medium
Tecoma sambucifolia	Haranhuay	Tree	2,200 – 3,400	Shallow soil and tolerates alkaline pH	Slow
Tessaria integrifolia	Pájaro bobo	Shrub to small tree	0 – 2,500	Floodplain, stream bank, and hydromorphic soils.	Fast
Vallea stipularis	Gilquemsa	Tree	2,200 – 3,200	Shallow and rocky soil	Fast

Notes:

- Source: Adapted and augmented from ESIA Volume IV, Chapter 7.
- NI = No Information

TABLE 6 – ESIA LISTED SPECIES THAT ARE HIGH AND MEDIUM SENSITIVITY SPECIES IDENTIFIED BY THE 2007 ECOLOGICAL FIELD SURVEY		
SCIENTIFIC NAME	**COMMON NAME**	**ELU & KP**
Acacia macracantha	Huarango Tree	3 (KP 40), 14 (KP 334+900, 336, 391)
Eriotheca vargasii	Pati	3 (KP 40)
Escallonia myrtilloides	Tasta	3 (KP 37), 4 (KP 55), 6 (KP 88+400), 7 (KP 116+100, 116+300), 8 (KP 118+700)
Escallonia resinosa	Chachacomo	3 (KP 28 & 35)
Polylepis	Quenual Tree	1 (KP 4, 9)
Tecoma sambucifolia	Pajaro bobo	3 (KP 29, 35, 36+700)

Appendix 2: Proposed Species Mixes by Ecological Landscape Unit

Proposed Plant Species for Revegetation - ELU 1

Apurimac River Valley Montane Forest Ecotone (KP 00+000 - 05+500 and 07+000 – 13+500) (2,966-3,810 metres; 3,200-3,688 metres)

Habitat Type	Species	
	Native	Naturalized
Peat bogs	***Distichia muscoides, Luzula racemosa, Trifolium amabile, Hypochaeris taraxacoides***	
Sward-forming grassland	*Crotalaria striata, Distichia muscoides, Senna birostris, Senna versicolor,* ***Trifolium amabile*** *,*	*Centrosema macrocarpum,* ***Dactylis glomerata*** *,* ***Lupinus mutabilis*** *, Medicago hispida, Spartium junceum,* ***Trifolium pratense, Trifolium repens***
Tussock grassland	*Aciachne pulvinata, Aciahne cf. acicularis,* ***Agrostis breviculmis*** *, Agrostis tolucensis, Bromus catharticus, Bromus lanatus, Calamagrostis amoena,* ***Calamagrostis antoniana*** *, Calamagrostis macrophylla, Calamagrostis rigescens,* ***Calamagrostis rigida, Calamagrostis vicunarum*** *, Festuca breviaristata,* ***Festuca dolichophylla*** *, Nassella inconspicua, Paspalum bonplandianum, Pennisetum purpureum, Poa annua, Stipa brachyphylla,* ***Stipa ichu*** **(*Jarava ichu*), *Stipa obtusa*** *, Stipa* sp. (*Jarava* sp.)*, Vetiveria zizanioides*	***Avena sativa/Avena strigosa*** *,* ***Dactylis glomerata, Trifolium pratense, Trifolium repens*** *,* ***Lolium perenne, Lupinus mutabilis***
Upper montane forest	*Ageratina sternbergiana, Clethra* sp., *Clusia* sp.*, Hedyosmum* cf. *scabrum, Hesperomeles lanuginosa, Morus insignis, Oreocallis grandiflora, Polylepis incana, Polylepis pauta, Polylepis racemosa, Polylepis subsericans, Polylepis tomentella, Vallea stipularis, Weinmannia* sp.	***Festuca arundinacea*** *,* ***Lupinus mutabilis*** *, Trifolium repens,* ***Lolium perenne***

Proposed Plant Species for Revegetation - ELU 2

Campana Sierra (KP 05+500-07+000 y 13+500 - 26+000) (3,670-3,868 metres; 3,414-4,066 metres)

Habitat Type	Species	
	Native	Naturalized
Peat bogs	***Distichia muscoides, Luzula racemosa***, ***Trifolium amabile***	
Sward-forming grassland	*Crotalaria striata, Distichia muscoides, Senna birostris, Senna versicolor,* ***Trifolium amabile,***	*Centrosema macrocarpum,* ***Dactylis glomerata***, ***Lupinus mutabilis***, *Medicago hispida, Spartium junceum,* ***Trifolium pratense, Trifolium repens***
Tussock grassland	*Aciachne pulvinata, Aciahne cf. acicularis,* ***Agrostis breviculmis***, *Agrostis tolucensis, Bromus catharticus, Bromus lanatus, Calamagrostis amoena,* ***Calamagrostis antoniana,*** *Calamagrostis macrophylla, Calamagrostis rigescens,* ***Calamagrostis rigida, Calamagrostis vicunarum***, *Festuca breviaristata,* ***Festuca dolichophylla***, *Nassella inconspicua, Paspalum bonplandianum, Pennisetum purpureum, Poa annua, Stipa brachyphylla,* ***Stipa ichu (Jarava ichu), Stipa obtusa***, *Stipa sp. (Jarava sp.), Vetiveria zizanioides*	***Avena sativa/Avena strigosa***, ***Dactylis glomerata, Trifolium pratense, Trifolium repens***, ***Lolium perenne, Lupinus mutabilis***

Proposed Plant Species for Revegetation - ELU 3
Torobamba River Valley (KP 26+000 - 44+250) (2,400-3,674 metres)

Habitat Type	Species	
	Native	Naturalized
Dry Deciduous Forest	*Acacia macracantha, Erythrina edulis, Eriotheca vargasii, Prunus serotina*	***Trifolium pratense, Trifolium repens*** , ***Lolium perenne***
Low Evergreen Broadleaf Forest	*Aristeguietia discolor, Escallonia resinosa, Tecoma arequipensis, Tecoma sambucifolia*	
Resinous Scrub	*Baccharis glutinosa, Baccharis latifolia, Baccharis odorata, Baccharis salicifolia, Baccharis tricuneata, Columellia obovata, Dodonaea viscosa, Gynoxys oleifolia, Schinus molle, Tecoma arequipensis, Tecoma sambucifolia*	
Thorny Scrub	*Berberis lutea, Dasyphyllum ferox, Dunalia spinosa*	

Proposed Plant Species for Revegetation - ELU 4
Sillaccasa Sierra (KP 44+250 - 56+800) (3,566-4,222 metres)

Habitat Type	Species	
	Native	Naturalized
Peat bogs	***Distichia muscoides, Luzula racemosa, Trifolium amabile***	
Sward-forming grassland	*Crotalaria striata, Distichia muscoides, Senna birostris, Senna versicolor,* ***Trifolium amabile***	***Trifolium pratense, Trifolium repens*** , ***Lolium perenne***
Resinous Scrub	*Baccharis glutinosa, Baccharis latifolia, Baccharis odorata, Baccharis salicifolia, Baccharis tricuneata, Columellia obovata, Dodonaea viscosa, Gynoxys oleifolia, Schinus molle, Tecoma arequipensis, Tecoma sambucifolia*	
Tussock grassland	*Aciachne pulvinata, Aciahne* cf. *acicularis,* ***Agrostis breviculmis,*** *Agrostis tolucensis, Bromus catharticus, Bromus lanatus, Calamagrostis amoena,* ***Calamagrostis antoniana*** , *Calamagrostis macrophylla, Calamagrostis rigescens,* ***Calamagrostis rigida, Calamagrostis vicunarum,*** *Festuca breviaristata,* ***Festuca dolichophylla*** , *Nassella inconspicua, Paspalum bonplandianum, Pennisetum purpureum, Poa annua, Stipa brachyphylla,* ***Stipa ichu*** **(*Jarava ichu*),** ***Stipa obtusa*** , *Stipa* sp. (*Jarava* sp.), *Vetiveria zizanioides*	***Avena sativa/Avena strigosa, Dactylis glomerata, Trifolium pratense, Trifolium repens, Lolium perenne, Lupinus mutabilis***

Proposed Plant Species for Revegetation - ELU 5
Yucay River Valley (KP 56+800 – 74+000) (2,850-3,864 metres)

Habitat Type	Species	
	Native	Naturalized
Thorny scrub	*Atriplex peruviana, Berberis lutea, Dasyphyllum ferox, Dunalia spinosa*	***Trifolium pratense, Trifolium repens*** , ***Lolium perenne***
Resinous Scrub	*Baccharis glutinosa, Baccharis latifolia, Baccharis odorata, Baccharis salicifolia, Baccharis tricuneata, Columellia obovata, Dodonaea viscosa, ynoxys oleifolia, Schinus molle, Tecoma arequipensis, Tecoma sambucifolia*	

Proposed Plant Species for Revegetation - ELU 6
Huamanga-Vischongo Watershed Divide (KP 74+000 - 104+000) (3,864-4,250 metres)

Habitat Type	Species	
	Native	Naturalized
Peat bogs	***Distichia muscoides, Trifolium amabile***	
Sward-forming grassland	*Crotalaria striata, Distichia muscoides, Senna birostris, Senna versicolor,* ***Trifolium amabile,***	***Trifolium pratense, Trifolium repens*** *,* ***Lolium perenne***
Resinous Scrub	*Baccharis glutinosa, Baccharis latifolia, Baccharis odorata, Baccharis salicifolia, Baccharis tricuneata, Columellia obovata, Dodonaea viscosa, Gynoxys oleifolia, Schinus molle, Tecoma arequipensis, Tecoma sambucifolia*	
Tussock grassland	*Aciachne pulvinata, Aciahne cf. acicularis,* ***Agrostis breviculmis*** *, Agrostis tolucensis, Brachiaria* sp. (*Naturalized*)*, Bromus catharticus, Bromus lanatus, Calamagrostis amoena,* ***Calamagrostis antoniana*** *, Calamagrostis macrophylla, Calamagrostis rigescens,* ***Calamagrostis rigida, Calamagrostis vicunarum,*** *Festuca breviaristata,* ***Festuca dolichophylla*** *, Nassella inconspicua, Paspalum bonplandianum, Pennisetum purpureum, Poa annua, Stipa brachyphylla,* ***Stipa ichu (Jarava ichu), Stipa obtusa,*** *Stipa* sp. (*Jarava* sp.)*, Vetiveria zizanioides*	*Avena sativa/Avena strigosa,* ***Dactylis glomerata, Trifolium pratense, Trifolium repens*** *,* ***Lolium perenne, Lupinus mutabilis***

Proposed Plant Species for Revegetation - ELU 7
Vinchos River Valley (KP 104+000 - 117+400) (3,200-4,000 metres)

Habitat Type	Species	
	Native	**Naturalized**
Resinous Scrub	*Baccharis glutinosa, Baccharis latifolia, Baccharis odorata, Baccharis salicifolia, Baccharis tricuneata, Columellia obovata, Dodonaea viscosa, Gynoxys oleifolia, Schinus molle, Tecoma arequipensis, Tecoma sambucifolia*	***Trifolium pratense, Trifolium repens*** *,* ***Lolium perenne***
Tussock grassland	*Aciachne pulvinata, Aciahne* cf. *acicularis,* ***Agrostis breviculmis,*** *Agrostis tolucensis, Bromus catharticus, Bromus lanatus, Calamagrostis amoena,* ***Calamagrostis antoniana*** *, Calamagrostis macrophylla, Calamagrostis rigescens,* ***Calamagrostis rigida, Calamagrostis vicunarum,*** *Festuca breviaristata,* ***Festuca dolichophylla,*** *Nassella inconspicua, Paspalum bonplandianum, Pennisetum purpureum, Poa annua, Stipa brachyphylla,* ***Stipa ichu*** **(*Jarava ichu*),** ***Stipa obtusa*** *, Stipa* sp. (*Jarava sp.*), *Vetiveria zizanioides*	*Avena sativa/Avena strigosa, Dactylis glomerata, Trifolium pratense, Trifolium repens,* ***Lolium perenne, Lupinus mutabilis***

Proposed Plant Species for Revegetation - ELU 8
Apacheta High Sierras (KP 117+400 - 170+000) (3,841-4,900 metres)

Habitat Type	Species	
	Native	**Naturalized**
Scarcely Vegetated High Andean Areas	No seeding or planting required.	
Peat Bogs	***Distichia muscoides, Trifolium amabile***	
Sward-forming grassland	*Crotalaria striata, Distichia muscoides, Senna birostris, Senna versicolor,* ***Trifolium amabile***	*Centrosema macrocarpum,* ***Dactylis glomerata****,* ***Lupinus mutabilis****, Medicago hispida, Spartium junceum,* ***Trifolium pratense, Trifolium repens***
Resinous Scrub	*Baccharis glutinosa, Baccharis latifolia, Baccharis odorata, Baccharis salicifolia, Baccharis tricuneata, Columellia obovata, Dodonaea viscosa, Gynoxys oleifolia, Schinus molle, Tecoma arequipensis, Tecoma sambucifolia*	
Tussock grassland	*Aciachne pulvinata, Aciahne* cf. *acicularis,* ***Agrostis breviculmis****, Agrostis tolucensis, Bromus catharticus, Bromus lanatus, Calamagrostis amoena,* ***Calamagrostis antoniana****, Calamagrostis macrophylla, Calamagrostis rigescens,* ***Calamagrostis rigida, Calamagrostis vicunarum,*** *Festuca breviaristata,* ***Festuca dolichophylla****, Nassella inconspicua, Paspalum bonplandianum, Pennisetum purpureum, Poa annua, Stipa brachyphylla,* ***Stipa ichu*** **(*Jarava ichu*),** ***Stipa obtusa****, Stipa* sp. (*Jarava sp.*), *Vetiveria zizanioides*	*Avena sativa/Avena strigosa,* ***Dactylis glomerata, Trifolium pratense, Trifolium repens****,* ***Lolium perenne, Lupinus mutabilis***

Proposed Plant Species for Revegetation - ELU 9
Pampas-Palmitos River Basins (KP 170+000 - 195+000) (4,000-4,700 metres)

Habitat Type	Species	
	Native	Naturalized
Scarcely Vegetated High Andean Areas	No seeding or planting required.	
Peat Bogs	***Distichia muscoides, Trifolium amabile***	
Sward-forming grassland	*Crotalaria striata, Distichia muscoides, Senna birostris, Senna versicolor,* ***Trifolium amabile***	*Centrosema macrocarpum,* ***Dactylis glomerata, Lupinus mutabilis,*** *Medicago hispida, Spartium junceum,* ***Trifolium pratense, Trifolium repens***
Tussock grassland	*Aciachne pulvinata, Aciahne* cf. *acicularis,* ***Agrostis breviculmis****, Agrostis tolucensis, Bromus catharticus, Bromus lanatus, Calamagrostis amoena,* ***Calamagrostis antoniana****, Calamagrostis macrophylla, Calamagrostis rigescens,* ***Calamagrostis rigida, Calamagrostis vicunarum****, Festuca breviaristata,* ***Festuca dolichophylla,*** *Nassella inconspicua, Paspalum bonplandianum, Pennisetum purpureum, Poa annua, Stipa brachyphylla,* ***Stipa ichu*** **(*Jarava ichu*), *Stipa obtusa***, *Stipa* sp. *(Jarava sp.), Vetiveria zizanioides*	*Avena sativa/Avena strigosa,* ***Dactylis glomerata, Trifolium pratense, Trifolium repens****,* ***Lolium perenne, Lupinus mutabilis***

Proposed Plant Species for Revegetation - ELU 10
Huaytará High Plains and Ridges (KP 195+000 - 249+500) (4,000-4,650 metres)

Habitat Type	Species	
	Native	Naturalized
Scarcely Vegetated High Andean Areas	No seeding or planting required.	
Peat Bogs	***Distichia muscoides, Trifolium amabile***	
Sward-forming grassland	*Crotalaria striata, Distichia muscoides, Senna birostris, Senna versicolor,* ***Trifolium amabile***	*Centrosema macrocarpum,* ***Dactylis glomerata*** *,* ***Lupinus mutabilis*** *, Medicago hispida, Spartium junceum,* ***Trifolium pratense, Trifolium repens***
Tussock grassland	*Aciachne pulvinata, Aciahne* cf. *acicularis,* ***Agrostis breviculmis*** *, Agrostis tolucensis, Bromus catharticus, Bromus lanatus, Calamagrostis amoena,* ***Calamagrostis antoniana*** *, Calamagrostis macrophylla, Calamagrostis rigescens,* ***Calamagrostis rigida, Calamagrostis vicunarum*** *, Festuca breviaristata,* ***Festuca dolichophylla*** *, Nassella inconspicua, Paspalum bonplandianum, Pennisetum purpureum, Poa annua, Stipa brachyphylla,* ***Stipa ichu*** **(*Jarava ichu*),** ***Stipa obtusa*** *, Stipa* sp. (*Jarava sp.*), *Vetiveria zizanioides*	*Avena sativa/Avena strigosa,* ***Dactylis glomerata, Trifolium pratense, Trifolium repens*** *,* ***Lolium perenne, Lupinus mutabilis***

Proposed Plant Species for Revegetation - ELU 11
Pisco-Ica Watershed Divide (KP 249+500 - 272+000) (2900-4,050 metres)

Habitat Type	Species	
	Native	Naturalized
Thorny scrub	*Atriplex peruviana, Berberis lutea, Chersodoma arequipensis, Dasyphyllum ferox, Dunalia spinosa*	
Mixed scrub	*Senna birostris, Senna versicolor*	***Trifolium pratense, Trifolium repens*** , ***Lolium perenne***

Proposed Plant Species for Revegetation - ELU 12
Coastal Bat Hills (KP 272+000 to 308+000) (750-2,900 metres)

Habitat Type	Species	
	Native	Naturalized
Desert Scrub	No seeding or planting required.	
Columnar cacti formations		

Proposed Plant Species for Revegetation - ELU 13
Pisco Sand Plains (KP 308+000 to 332+500) (236-750 metres)

Habitat Type	Species	
	Native	Naturalized
Tillandsia Mats	No seeding or planting required.	
Desert Barrens		
Coastal Hydro-morphic formations		

Proposed Plant Species for Revegetation - ELU 14

Ica-Lima Coastal Plain (KP 332+500 – 408+000) (125-368 metres)

Habitat Type	Species	
	Native	Naturalized
Tillandsia Mats	No seeding or planting required	
Riparian Vegetation		
Desert Barrens		

APPENDIX 3: IFC Performance Standard 5 Requirements for Pesticide Use and Management

- **12.** The client will formulate and implement an integrated pest management (IPM) and/or integrated vector management (IVM) approach for pest management activities. The client's IPM and IVM program will entail coordinated use of pest and environmental information along with available pest control methods, including cultural practices, biological, genetic and, as a last resort, chemical means to prevent unacceptable levels of pest damage.

- **13.** When pest management activities include the use of pesticides, the client will select pesticides that are low in human toxicity, known to be effective against the target species, and have minimal effects on non-target species and the environment. When the client selects pesticides, the selection will be based on whether the pesticides are packaged in safe containers, are clearly labeled for safe and proper use, and have been manufactured by an entity currently licensed by relevant regulatory agencies.

- **14.** The client will design its pesticide application regime to minimize damage to natural enemies and prevent the development of resistance in pests. In addition, pesticides will be handled, stored, applied, and disposed of in accordance with the Food and Agriculture Organization's International Code of Conduct on the Distribution and Use of Pesticides or other good international industry practice.

- **15.** The client will not use products that fall in World Health Organization Recommended Classification of Pesticides by Hazard Classes I-a (extremely hazardous) and I-b (highly hazardous); or Class II (moderately hazardous), if the project host country lacks restrictions on distribution and use of these chemicals, or if they are likely to be accessible to personnel without proper training, equipment, and facilities to handle, store, apply, and dispose of these products properly.

APPENDIX 8: PERU LNG BAP PRIORITIZATION RESULTS 2006

Extract from PERU LNG BAP (2006)

SELECTION PROCESS OF SPECIES AND ECOSYSTEMS FOR THE BAP BY PERU LNG

The selection process of species and ecosystems for the BAP has been conducted considering the participation of the different stakeholders, based on selection criteria that lead to the identification of the important species and ecosystems of the region. The list of species and ecosystems shown in *Table A6-2* below considers those selected by the communities, those of interest for the NGOs and those under national and international conservation categories. For the commencement of the BAP activities, it is required to select seven species (four of which will be fauna species and three flora species) and three ecosystems. It is contemplated to increase the number of species and ecosystems progressively as the BAP develops and the initial project become sustainable.

Selection criteria

The selection criteria applied are described below:

- ✓ Registration of species in the ESIA, which are presented as field observation and/or survey
- ✓ Validation of species prioritized by the communities
- ✓ Validation of species of interest for the NGOs
- ✓ Conservation category of flora and/or fauna species protected by the national legislation (for flora: Ministerial Resolution No. 01710-77-AG/DGFF and for fauna: Supreme Decree 034-2004-AG) and international legislation (CITES and IUCN) that promote local development. Map 1-2 shows the sites where fauna species were registered, including: vicuñas, Andean condors, Peruvian long-snouted bats, spectacled bears, woolly monkeys, pudus, pumas, and *Telmatobius* frogs, and also plant species such as *Polylepis* trees and *Puya raimondi*.

A weight has been assigned to each criterion, as shown in *Table A8-1*.

The ESIA has allowed for the identification of the most important ecosystems based on the determination of the sensitivity of the ecosystems along the proposed gas pipeline (See ESIA, Chapter 6.0 Ecological synthesis, Vol. IIB) and fragile ecosystems (See ESIA, Chapter 2.0 Socio-environmental impacts, Vol. III).

Table A8-1 Weight of selection criteria of species and ecosystems

Criterion		Weight	Justification
Type of registration in the EIAS	By Observation	2	Direct registration
	By Interview	1	Indirect registration
Validation by the communities		2	The communities (larger number of people) are in direct contact with natural resources
Validation by the NGOs		1	Most of the NGOs are established in the capitals of districts, far from direct contact with natural resources
National protection		3	Compliance with the Peruvian legislation
International protection		2	Extension to good practices through the compliance with the international legislation

Selection of species and ecosystems for the BAP.

The summation of the weights of the total criteria has allowed for the identification of the species and ecosystems with the highest scores (*Table A8-2*), which correspond to seven species (four fauna species with the highest scores and three flora species with the highest scores) and three ecosystems. Among the fauna species are: camelids, Andean condor, Peruvian long-snouted bat and spectacled bear; and the flora includes: medicinal plants, quenual and *puya*. Cactus (columnar cactus, etc.) will be described within the activities for the conservation of the Peruvian long-snouted bat, since it is its source of feeding and both species share related habitats.

It is highlighted that the communities and the NGOs have identified the need of increasing the awareness of the population on issues of conservation and sustainable use of biodiversity resources.

Table A8-2 Selection process of species and ecosystems to be considered in the BAP

Criteria / Species and Ecosystems	ESIA		Communities (2)	NGOs (1)	National Protection (3)	International Protection (2)	Total
	O (2)	E (1)					
Fauna							
1. Camelids	X		X	X	X[2*]	X[3* y 4*]	10
2. Trout	X		X	X			5
3. Vizcacha	X		X	X			5
4. Aquatic Frog	X		X			X[4]	6
5. Cattle	X		X				4
6. Guinea Pig	X		X	X			5
7. River Shrimp	X						2
8. Cochinilla	X						2
9. Andean Condor	X		X		X[2]	X[3 y 4]	9
10. Peruvian Long Snouted	X				X[2]	X[3]	7

Criteria / Species and Ecosystems	ESIA		Communities (2)	NGOs (1)	National Protection (3)	International Protection (2)	Total
	O (2)	E (1)					
Bat							
11. Spectacle Bear		X	X	X	X[2]	X[3 y 4]	9
12. Wholly Monkey		X			X[2]	X[3 y 4]	6
13. Sacha cabra (Pudu)		X			X[2]	X[3 y 4]	6
14. Andean Puma		X			X[2]	X[3 y 4]	6
15. Andean Cat		X				X[3]	3
Flora							
16. Plants for Word	X		X				4
17. Natural Pasture	X		X				4
18. Potato (native crops)	X		X				4
19. Medicinal Plants	X		X	X			5
20. Aromatic Plant (Muña)	X		X				4
21. Cactus	X		X	X		X[4]	7’
22. Orchids	X			X		X[4]	5
23. Queñual	X		X	X	X[1]		8
24. Puya raimondi	X			X	X[1]		6
25. Pati	X						2
Sensitive Ecosystems							
27. Area of the Bernal and Morón Lagoons	X		X	X			5
28. Area of the Bolívar Mine	X						2
29. Area of the Eastern Slope	X		X	X			5
30. Área of Cropland (Vinchos y Yucay)	X		X				4
31. High Andean Area 4 (between the Llasac y Chihuiri mountains)	X		X	X			5

Note: Information source based on which the species and ecosystems were included (X).
National and international protection: [1]Ministerial Resolution N° 01710-77-AG/DGFF, [2]Supreme Decree N° 034-2004-AG, [3]IUCN, [4]CITES and [*]Vicuña.
Type of registration in the EIAS: O (observed) and E (survey).
Weight of the selection criterion: number in parenthesis. Total: Summation of the weight of each criterion (final column)
(‘) Cactus (columnar cactus) will be described within the activities for the conservation of the Peruvian long-snouted bat.

Selected species/Ecosystem

APPENDIX 9: OUTLINE REQUEST FOR PROPOSALS (RFP) AND LOG FRAME MATRIX

Table A9-1 Draft Outline RFP Format

Section Number	Title	Content
1	Information for applicants	How to use the document
2	The PERU LNG BAP	Outlines the background information on PERU LNG and the BAP covering such issues as: • Who PERU LNG is; • The rationale for a BAP; • BAP Objectives; • BAP Implementation Principles; • BAP Development Process; • Priority Themes for Investment; • Funding Strategy.
3	BAP Project Guidelines	Outlines the contractual issues and includes: • Communication details; • Details of the Priority Themes for the RFP round; • Terms and conditions; • Eligibility criteria, • Available funds for the RFP round; • The application phases (if a two staged approach is used) • Proposal evaluation process; • The RFP time schedule.
4	Project Conceptual Proposal (this section is relevant only if a two phased approach is applied)	Provides: • Format and guidance for the Conceptual Summary for a Phase 1 Application; • Guidance for applicants on preparing the Conceptual Summary; • Phase 1 proposal evaluation criteria and scoring system.
5	Detailed Proposal	Provides: • Format and guidance for the Detailed Proposal for a Phase 2 Application; • Guidance for applicants on preparing the Detailed Proposal; • Phase 2 proposal evaluation criteria and scoring system.
6	Theme Background Information	Provides baseline information regarding the Priority Themes of the RFP for applicants to take into account in analyses and project design.
7	PERU LNG HSE Policies	To include copies of PERU LNG requirements.

Applicants will be asked to use a complete logical framework matrix approach to develop their detailed proposals. An example is shown below:

Table A9-2: Example Log Frame

Intervention Logic/ Project Strategy	Objectively Verifiable Indicators	Means of Verification (MOV)	Assumptions & Risks
Main Goal: What is the wider programme goal? What overall need or problem is The project trying to address? (A group of projects may share this same goal)	Measures the extent to which a contribution to the overall objective has been made. Used during evaluation.	What data sources are to be used to verify the indicators e.g. reports, minutes, surveys, accounts, government statistics etc. If a survey is needed is the relevant activity listed in the activity column and in the budget? How will the **goal** Indicators be verified?	
Project Objective(s): The environmental and development outcome at the end of the project – more specifically the expected benefits to the target group(s).	Helps answer the question "How will we know if the purpose has been achieved?" Should include appropriate details of quantity, quality and time.	How will the **objective** Indicators be verified? Is there a need for baseline measurement? Who will collect the information and at what cost and over what period?	(Project Objective to Main Goal) Assumptions (factors outside project management's control) that may impact on the purpose-objective linkage
Outputs: The direct/tangible results (goods and services) that the project delivers, and which are largely under project management's control.	Helps answer the question "How will we know if the results have been delivered?" Should include appropriate details of quantity, quality and time.	How will the **output** Indicators be verified? Is there a need for baseline measurement? Is the information already available or will it have to be specifically gathered?	(Outputs to Project Objective) Assumptions (factors outside project management's control) that may impact on the purpose-objective linkage
Activities: The activities (work programme) that need to be carried out to deliver the planned outputs. Summarize individual activities and sub-activities. Number the activities in order to link them to the Indicators and also to the Gantt Chart.	Costs: Activity based project budget sheets to be developed showing resources, types, units, number of units, unit rates and costs on an activity by activity basis.	Costs: Activity based project budget sheets to be developed showing resources, types, units, number of units, unit rates and costs on an activity by activity basis.	(Activities to Outputs) Assumptions (factors outside project management's control) that may impact on the purpose-objective linkage

Intervention Logic/ Project Strategy	Objectively Verifiable Indicators	Means of Verification (MOV)	Assumptions & Risks
			What are the preconditions that must be satisfied prior to start of activities? Which conditions that are beyond the control of the beneficiaries must be fulfilled?