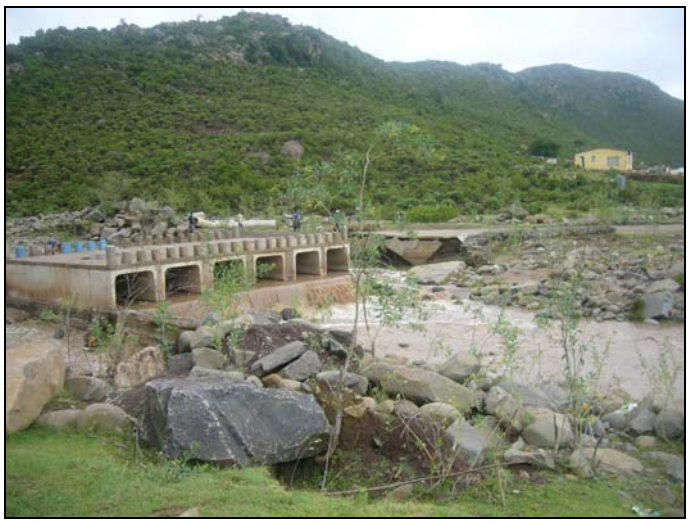
PROPOSED CONSTRUCTION OF NEW BRIDGE CROSSING, DUBENI NEAR QUEENSTOWN

BASIC ASSESSMENT REPORT

Completed in terms of the National Environmental Management Act, 1998 (Act No.107 of 1998), as amended, and the Environmental Impact Assessment Regulations, 2010 (Version 1).



August 2010

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August 2010

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EXECUTIVE SUMMARY

Chris Hani District Municipality (CHDM), in association with Eyethu Engineers are developing proposals to construct a new bridge crossing at Dubeni, near Queenstown to replace existing crossing structures which have been damaged and are largely ineffective. Terreco Environmental cc were appointed by Eyethu Engineers to undertake the statutory environmental authorisation process required for the Project as per Section 24 of the National Environmental Management Act 107 of 1998 (as amended). The application process includes the preparation of a Basic Assessment Report in accordance with the EIA Regulations 2006.

These proposals will provide for the minor realignment of the existing gravel road (T576) either side of the crossing and the construction of a 76m long, 4 span single span bridge immediately downstream of the existing structures over the Silver Stream River, a tributary of the White Kei River. The existing structures will then be demolished.

Key features of the existing environment include the ridgeline bounded White Kei River valley, the Silver Stream and White Kei Rivers, which are important local water bodies and receptors, an irrigation project utilising water abstracted upstream of the existing bridge structure, two grave sites adjacent to the Silver Stream and a few homesteads at least 95m from the crossing on either side of the Silver Stream. Debris from the original crossing is present within the river course along with sections of broken pipeline and spoil heaps from recent road maintenance activities. Otherwise, the setting of the general area is rural and traffic volumes on the existing gravel roads are low.

The likely biophysical and human impacts associated with the construction of the Project are not atypical of construction activities, are generally temporary and can be adequately managed by implementing a comprehensive Environmental Management Plan (EMPR). Negative impacts include, changes to the landscape, noise and dust generation, terrestrial and aquatic ecosystem impacts, alternation of river dynamics, risk of public nuisance and conflict with existing, adjacent land uses and pollution risk (soil and water). Some positive construction impacts will result through the employment and income generation opportunities associated with the acquisition of construction materials and the requirement for a workforce and all its related needs.

The subsequent use of the new bridge crossing will have significant positive impacts for vehicle and pedestrian access and safety across the Silver Stream in particular as well as some biophysical benefits associated with restoring the flow dynamics of the Silver Stream. Some negative impacts may be associated with the inherent risk of accidents on the approach roads and crossing which could lead to aquatic system impacts at worse but this risk should be low due to low traffic volumes and speeds (and was already of feature of the existing environment). However, the negative benefits that may result from the use of the new bridge are expected to be far outweighed by the local community and aquatic system benefits that should occur.

Specialist aquatic studies were undertaken at the request of Department of Water Affairs in connection with a separate authorisation application process in terms of the National Water Act 36 of 1998. The conclusions of these studies were *'the building of a new river crossing provides an opportunity to mitigate a number of the current riverine impacts, through the careful design and rigorous implementation of the mitigation measures and recommendations provided in this report..in the event this occurs, the construction of the new bridge crossing over the Silver Streams River represents a LOW potential impact, both from a sociological and an aquatic ecosystem perspective'.*

The No-Go alternative to the Project would be to allow the status quo to remain where vehicles and pedestrians would continue to traverse the Silver Stream via informal crossing points, weather and river levels permitting. Such a scenario is deemed unsafe by the community and contrary to specific objectives described in the Emalahleni Municipality strategic planning documentation. It was concluded that the No-Go alternative to the Project is not a feasible option.

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SECTION A: INTRODUCTION AND METHODOLOGY

1. Introduction and Overview

Chris Hani Municipality are developing proposals for the construction of a new bridge crossing over the Silver Stream River, a tributary of the White Kei River, at Dubeni near Queenstown. The proposed new bridge crossing will provide a much needed link between the communities to the north of the Silver Stream and the R396/N6 corridor which is currently hampered by the absence of a formal crossing.

Terreco Environmental cc were appointed by Eyethu Engineers (Pty) Ltd, the Project Managers, to undertake the Basic Environmental Assessment for the Project as required under Section 24 of the National Environmental Management Act, Act No 107 of 1998 (as amended). This report presents the findings of the Basic Environmental Assessment which has been completed in accordance with Regulations 22 and 23 of the EIA Regulations (Government Notice No. R. 385, 21 April 2006).

2. Structure of the Report

The Basic Assessment Report has been structured to reflect the requirements of the EIA Regulations, specifically Regulation 23 (1) and (2). As per Regulation 23 (1), the Basic Assessment Report follows the format provided by the relevant authority, in this instance the provincial Department of Economic Development and Environmental Affairs (DEDEA) (Queenstown). The DEDEA prescribed Basic Assessment Report, included in Section B, is supported by supplementary information on the Project and the EIA process, presented in Section A of the report (this section). The findings of the Basic Assessment Process are summarised in Section C: Conclusions. Appendices A – G follows the format reflected in DEDEA's standard Basic Assessment Report as follows:

APPENDIX A: Site plan(s).

APPENDIX B: Photographs.

APPENDIX C: Facility illustration(s).

APPENDIX D: Specialist reports, including the Geotechnical Report and Aquatic Specialist Study Report.

APPENDIX E: Comments and responses report.

APPENDIX F: Environmental Management Programme.

APPENDIX G: Other information, including the following:

- Preliminary Design Report.
- Detailed Need and Desirability Assessment.
- Impact Assessment Criteria.
- Proof of application to Department of Water Affairs for Water Use authorisation.

The Impact Assessment covered in the DEDEA standard Basic Assessment Form (Section B) has been expanded in Section A.10 of this document.

3. Details of the Environmental Assessment Practitioner (EAP)

Regulation 23 (2) (a) of the EIA Regulations, 2006, indicates that the Basic Assessment Report must contain details of the EAP who prepared the report and the expertise of the EAP to carry out basic assessment procedures. The general requirements for EAP's are outlined in Regulation 18 of the EIA Regulations, specifying that the EAP must be independent[1], must have the necessary expertise in conducting environmental assessments and must perform the work in an objective manner.

The Basic Assessment was undertaken by Louise Jupp and Nenekazi Songxaba of Terreco Environmental cc. Terreco Environmental cc is an East London-based environmental and geotechnical consulting firm with extensive experience in a variety of development projects through the Eastern Cape Province.

Louise Jupp has a BSc (Honours) in Earth Science and an MSc in Environmental Science. She is a Director of Terreco Environmental cc and has been operating as an Environmental Practitioner in the UK and South Africa for over 17 years. She has undertaken environmental impact assessments for a variety of infrastructure projects in urban and rural settings including new road schemes, transmission lines, runway extensions, rail lines and bulk sewer mains in accordance with South African and major funding requirements and frameworks. Other related environmental experience includes preparing chapters on the principles of and methodology for undertaking EIA for road schemes and air transport for the European Union and the Cypriot Government. She is therefore familiar with the environmental impact assessment process and its application on a variety of related infrastructure projects.

Nene Songxaba is an environmental scientist at Terreco Environmental cc. She has a BSc (Honours) in Botany and Zoology degree awarded by the University of Transkei. She is currently registered for Masters Degree in Environmental Management in the University of the Free State. Ms Songxaba worked

[1] The EAP must have no business, financial, personal or other interest in the in respect of the application or activity other than fair remuneration for work performed in connection with the activity. Furthermore, there must be no circumstances which may compromise the objectivity of the EAP.

as a full time Environmental Control Officer at the Ugie – Langeni Phase II road construction site for just over two years. She has also been involved in other road upgrading projects in the Eastern Cape, including a new access road and bridge across the Cumakala River between Stutterheim and Mlungisi.

Terreco Environmental cc, nor any of its members have any business, financial or personal interest in respect of the proposed construction of the new bridge crossing at Dubeni, other than fair remuneration for work performed in undertaking the Basic Assessment. A declaration of independence, signed in the presence of a commissioner of oaths, is included in the associated Application Form.

The Terreco Environmental's Company Profile and CV's for any of the parties involved in the Basic Assessment process are available on request.

4. Basic Environmental Assessment Process

At a minimum, the construction of a new bridge is a listed activity as described in Government Notice R544 in terms of Section 24(2)(a) and (d) of the National Environmental Management Act, 1998 (NEMA). As such, a Basic Environmental Assessment is required in support of the application for environmental authorisation which must be submitted to DEDEA.

The listed activities applied for this Project are outlined in full in the table below:

Table 1: Listed Activities which forms part of this Application for Environmental Authorisation.

REF	ITEM	ACTIVITY	RELEVANCE
Government Notice No R. 544 (June 2010)	11	The construction of (i) bridges and (xi) infrastructure or structures covering 50 square metres or more where such construction occurs within a watercourse or within 32 metres of a watercourse, measured from the edge of a watercourse, excluding where such construction will occur behind the development setback line	The construction of the new bridge over the Silver Stream River, a tributary of the White Kei River, and the realignment of the approach roads will trigger this threshold.
	18	The infilling or depositing of any material of more than 5 cubic metres into, or the dredging, excavation, removal or moving of soil, sand, shells, shell grit, pebbles or rock from (i) watercourse.	Foundations for and on either side of the new bridge across the Silver Stream River will trigger this threshold at a minimum.

REF	ITEM	ACTIVITY	RELEVANCE
Government Notice No R. 544 (June 2010)	22	The construction of a road outside urban areas, (ii) where no reserve exists where the road is wider than 8 metres.	The minor realignment of both ends of the existing gravel road adjoining the new bridge cross will comprise ±300m on each side. This may exceed the threshold depending on the definition of road work vs. maintenance.

The Basic Environmental Assessment has been undertaken in accordance with Regulations 21 – 23 of the Environmental Impact Assessment Regulations, 2010[2], promulgated in terms of Section 24(5) of NEMA. Other than the EIA Regulations, cognisance was taken of the DEAT Guideline documents published in support of the previous 2006 EIA Regulations[3] [4]. The Basic Assessment Report, which is contained within Section B of this document, follows the format supplied by DEDEA, i.e. the Basic Assessment Report in terms of National Environmental Management Act, 1998 (Act No 107 of 1998) as amended and the Environmental Impact Assessment Regulations, 2010 (Version 1).

The methodology employed in the Basic Assessment for this Project is outlined as follows:

- The appointment of Terreco Environmental cc as an independent Environmental Assessment Practitioner (EAP) for the completion of the Basic Assessment.
- The Public Participation Process (PPP) was initiated in January 2010 with the publishing of notices in the newspaper and the placement of a signboard (in English and Xhosa) on location. The targeted distribution of leaflets, the notification of key stakeholders, and holding a stakeholder and public meeting for the affected communities in February 2009 after receiving design information. The detailed approach to the PPP and the key issues and concerns which were raised by stakeholders and interested and affected parties (IAPs) during the process are provided in the 'Comments and Response Report', APPENDIX E.
- One response to the advertisements was received and the details recorded on the stakeholder database (see APPENDIX E).
- Site visits were undertaken during January 2010 and February 2010, and all relevant documents, plans and aerial photos were gathered from the Project Team, public and private sources and reviewed (refer to footnotes throughout this document).

2 Government Notice No. R. 543 (June 2010)

3 DEAT (2005) *Guideline 3: General Guide to the Environmental Impact Assessment Regulations, 2005, Integrated Environmental Management Guideline Series,* Department of Environmental Affairs and Tourism (DEAT), Pretoria.

4 DEAT (2005) *Guideline 4: Public Participation in Support of the EIA Regulations, 2005, Integrated Environmental Management Guideline Series,* Department of Environmental Affairs and Tourism, (DEAT), Pretoria.

- Specialists inputs on water quality and river health were requested by the Department of Water Affairs (DWA) in support of water use authorisation processes as described in the National Water Act 36 of 1998. The aquatic studies were coordinated by Dr Mandy Uys of Laughing Waters and the report has been summarised below with the full report included in APPENDIX D.

- The draft Basic Environmental Assessment Report was initially compiled in March 2010 and completed June 2010. The report was made available to all registered IAPs and key stakeholders for review for a two week comment period 29 July – 12 August 2010.

- Inputs received from stakeholders and IAPs during the comment period will be reviewed and integrated, where appropriate, into the final Basic Assessment Report prior to submission to the DEDEA. No comments were received.

- DEDEA's decision regarding the application for environmental authorisation will be communicated to the Applicant and IAPs in due course. Should any party wish to appeal the outcome of DEDEA's deliberations, then the appeal process will be activated as per the EIA regulations.

5. Assumptions and Limitations

The following information gaps, assumptions or limitations have been applied and/or noted for this assessment, respectively:

- There is no traffic data for the affected gravel road however it is expected traffic volumes will be low. It is assumed there will be no significant traffic generation with the implementation of the Project.

- There was no Spatial Development Framework for Emalahleni Municipality.

- It is assumed DME will issue permits for the use of borrow pits in terms of the Mineral and Petroleum Resources Development Act 28 of 2002.

- It is assumed DWA will issue authorisation to proceed with the Project in terms of Section 21 (c) and (i) of the National Water Act 36 of 1998.

- There are currently no details regarding the disposal of material generated from the demolition of the existing bridge structures.

- There are no details regarding the materials to be used for any temporary crossing that may be required or whether there will be an actual need for a coffer dam during construction.

6. Description of the Affected Environment

This section provides a brief overview of the general environment which will be affected by the construction and use of the Project. It is supported by Figures A1 – A8 which describe the biophysical characteristics and Figures B1 – B6 which contain photographs of the site and study area.

6.1 Regional Context and Locality

(Refer to Figure A1: General Location Plan in APPENDIX A.)

The affected area lies within the jurisdiction of Emalahleni Municipality (EC136), Chris Hani District Municipality (DC13).

The proposed Project is located in northern Dubeni which is located approximately 22km north east from Queenstown (as the crow flies). Specifically Dubeni is located approximately 9.2km on a 5m wide gravel road (T576) from its junction with the R396, via the R392 from Queenstown. The existing gravel road passes through a number of rural settlements and extends both north and eastwards beyond Dubeni to connect other rural settlements located adjacent to and within the White Kei River valley.

The gravel road crosses the Silver Stream River, a small tributary of the White Kei River via a temporary 100m long concrete causeway for vehicles which has been established with the collapse of the bridge crossing at S31° 44' 34.7", E22° 00' 54.9". A concrete pathway has also been constructed immediately upstream of the causeway for pedestrians. The crossing is approximately 130m downstream of a natural dam-like feature which is used to supply an irrigation project on the northern bank of the Silver Stream and approximately 195m upstream of the confluence between the Silver Stream and White Kei River. An existing water pipeline is located at the existing crossing.

6.2 Natural Features

a) Climatic conditions

Queenstown has a relatively dry climate with an average rainfall of 540mm per annum. Precipitation occurs mostly during the summer months and predominantly in the form of thunderstorms. Temperatures range between a maximum of 35°C during the summer to below 0°C during winter. The prevailing wind direction is from the northwest. The wettest months of the year fall between October and March. Monthly average rainfall and evaporation figures range from a high of 80mm to less than 20mm (rainfall) and a high of 140mm to a low of 58mm for evaporation.

Broad-scale climatic conditions are described for each of the major vegetation units present in the general study area (see below, Section 6.2d), namely the Tsomo Grassland and Tarkastad Montane Grasslands.

The characteristics of these vegetation units have been summarised overleaf:

Table 2 Broad-scale Climatic Conditions for the General Study Area[5].

	Tsomo Grassland	Tarkastad Montane Grassland
Mean annual precipitation	609mm	470mm
Mean annual temperature	15.2°C	14.3°C
Mean frost days	28 days	39 days
Mean annual potential evaporation	1792mm	1994mm
Mean annual soil moisture stress (days when evaporative demand was more than double the soil moisture supply)	76%	78%

It is noted in the Specialist Aquatic Studies Report that *'a known feature of Eastern Cape rainfall is that the highest precipitation can occur in virtually any month of the year. This results in reasonably unseasonal rainfall (year round) and a variable somewhat unpredictable runoff regime'* (refer to APPENDIX D for a full copy of the report).

b) Topography

(Refer to Figure A2 (APPENDIX A) and Figure C1, (APPENDIX C) which illustrates the contours for general area and specific to the proposed new bridge, respectively.)

The topography of the Project focus area is dominated by the White Kei River valley which is bounded by roughly north-south orientated ridge lines on both sides of the valley. The western ridge line rises to approximately 1200+m above mean sea level whereas the eastern ridge rises steeply to 1500+m above mean sea level. The base of the river valley generally lies at 1050m above mean sea level (refer to Figure C1, APPENDIX C).

c) Drainage

(*Refer to Figure A3 (APPENDIX A) illustrates the relevant quaternary catchment for the study area AND Figure C1 (APPENDIX C) illustrates the 1:50 or 1:100 year flood line for the Silver Stream River.)*

DWA specifically requested tests be undertaken on the Silver Stream River to provide a background to the catchment and hydrology of the river including water quality parameters, geomorphological and riparian vegetation characteristics and fish and invertebrate assemblages present. These studies were undertaken by Dr Mandy Uys, Dr Anton Bok, Dr Pete Illgner and James Mackenzie, the results of which

[5] Extracted from Mucina, L & Rutherford, MC (eds) 2006. The vegetation of South Africa, Lesotho and Swaziland. *Strelitzia* 19. South African National Biodiversity Institute, Pretoria for the respective vegetation units present.

have been included in full in APPENDIX D. To summarise, and taking into account the assumptions made, the results of the studies indicate the following[6]:

- The Silver Stream River is a tributary of the White Kei which flows into the Great Kei River in the Eastern Cape. The river is located in the quaternary catchment S10D in the Mzimvubu to Keiskamma Water Management Area (WMA 12). The Xonxa Dam is situated approximately 21km downstream of the confluence between the Silver Stream and White Kei Rivers.

- A desktop Ecological Reserve was completed and approved for the White Kei (S10D) in January 2005. *'This Reserve set the Present Ecological State (PES) of the White Kei in this section as a 'B' category, the Recommended Ecological Category (REC) as a 'B' (inferring that the PES must be maintained) and the Ecological Importance and Sensitivity (EIS) as 'Moderate'*.

- Water quality is measured at a station upstream of the Xonxa Dam – refer to Table 3 below.

- From the perspective of river geomorphology (which can affect on the associated river habitats and ecosystems) the PES of the Silver Stream River was deemed to be D (largely modified) on account of the current river crossing and water abstraction at the rock outcrop upstream from the crossing. *'Modifications to the catchment that may have had a potential impact on the geomorphic state of the study site include extensive gully erosion, scattered housing, cultivated fields and a limited number of roads and tracks.'* These modifications are important in terms of runoff, the shape of the channel (incised and eroded) and sediment delivery to and sedimentation of the rivers. There are indications a large flood(s) has taken place.

- The PES of the riparian vegetation is B/C indicating 'largely natural with few modifications' to 'moderately modified' on account of vegetation clearance, grazing and the presence of exotic vegetation. The expected trend for the PES is negative and trending towards C due to exotic invasive species present. No rare or endangered riparian plant species were recorded (or expected) at the site. The riparian habitats present include wetland/marsh areas with sedges, rocky pools, cobble beds with woody vegetation, cobble bank with hydrophilic grasses, steep mixed bank and vertical woody structures. The riparian zone forms a patchy tree in otherwise shrub landscape – refer to Figure 6.1 in the Specialist Report (APPENDIX D). The wetland and pools are in a fairly natural condition.

- From the perspective of invertebrate present, the PES of the Silver Stream River is deemed to be B/C on account of upstream water abstraction and the effects of erosion and land-use activities. The expected trend for PES is downward due to catchment-related activities. Invertebrates identified during sampling included mayflies, damselflies and stoneflies. *'There are no known endangered unique or endemic invertebrate taxa in Silver Streams…the river site is not*

[6] The potential impacts have been assessed on the basis of Figure C1 and that the new crossing is likely to be a four pier bridge only.

considered to be a close-to-natural example of a river in this ecoregion [and] *the instream invertebrate habitat is neither highly diverse, nor abundant or of high quality.'*

- From the perspective of the fish species present two of three expected fish species in the Silver Stream River were sampled including the Chubbyhead barb and Sharptooth catfish. The PES is currently considered to be a 'C' category with an expected negative trend due to increased demand for water and increased stock numbers with population growth. *'There are no rare, endangered or unique fish species expected and the natural fish biodiversity in this region of Southern Africa is very low.'* However, under 'natural, undisturbed conditions' the Silver Stream River would be an important spawning stream for the former fish species on account of the unsuitable breeding conditions associated with the White Kei River. The importance of the Silver Stream River as a migration corridor is low due to the dolerite sill/rock waterfall upstream of the crossing.

- Overall, the EIS of the Silver Stream River is considered to be 'Moderate' and the REC is considered to be 'B/C' which generally requires maintaining the existing condition or PES of the river. *'The construction of the road crossing represents either a threat to this management requirements* [viz the REC]*, or an opportunity, contingent on the extent to which those involved in the design and construction of the crossing (and demolition and removal of the disused bridge) adhere to mitigation measures, recommendations and standard BMPs within the EMPR.'*

In terms of the Eastern Cape Biodiversity Conservation Plan, which includes the identification of Aquatic Critical Biodiversity Areas, the study area and surrounds do not fall within or lie close to any such designated areas.

A summary of the results is provided in Table 3 below.

Table 3: Summary of Silver Stream River Survey (geomorphology, riparian vegetation, invertebrates, fish and water quality only) (refer to APPENDIX D).

COMPONENT ASSESSED	PES	EIS	REC	ECO STATUS	REC	WATER QUALITY	
Geomorphology	D	MODERATE	C/D	B/C	B/C	Temperature pH	23.8 ˚C 7.9
Riparian vegetation	B/C		B/C			Total dissolved solids	22 mS/m
Invertebrates	B/C		B/C			Clarity Turbidity	12 Cm High
Fish	C		C			Colour	Brown

d) Vegetation and Wildlife [7]

(Refer to Figure A4 and Figure A5, APPENDIX A.)

The riparian vegetation has been described in Section 6.2c) above.

From a general perspective, the study area lies within the Grassland Biome which incorporates much of the Eastern Cape and extends northwards covering much of eastern South Africa inland of the coast and savannah biomes. The major vegetation types associated with this biome and found within the study area are associated with the Sub-Escarpment Grassland sub-group of the Grassland Biome and include the Tsomo Grassland (Gs15) and Tarkastad Montane Shrubland (Gs17) – refer to Figure A4, APPENDIX A.

The Tsomo Grassland (Gs15) vegetation typically occurs within the Eastern Cape in the region to the east of the Queenstown basin. This vegetation type occurs within the plains between the mountain peaks and ridges and typically occurs at altitudes of 760 – 1580m, and specific to the study area equates to the White Kei River valley. Tsomo Grassland 'is a grassland or open thronveld, often grazed short or replaced by dwarf shrubland dominated by species of *Euryops*.' This vegetation type *'shows various stages of overutilization and also a gradient from grassland to thornveld'* and *'mountain ridges within this unit are often wooded'*. In terms of conservation status, Tsomo Grassland is described as Vulnerable and is under generally threat from cultivation, the dense concentration of rural settlements, alien infestation and due to serious soil erosion. The Tarkastad Montane Shrubland (Gs17) is at its eastern most extent in the vicinity of Queenstown. It is typically associated with ridges, hills and isolated mountain slopes. 'The vegetation is low, semi-open, mixed Shrubland with 'white' grasses and dwarf shrubs forming a prominent component of the vegetation.' The conservation status of this vegetation type is Least Threatened.

There are no known protected areas in the proximity of the Project.

In terms of the Eastern Cape Biodiversity Conservation Plan[8], the Project area appears to lie outside, but adjacent to an area designated as Critical Biodiversity Area 3 or 'Other Natural Area' (ONA) (Figure A5). This area is largely associated with the White Kei River valley. ONAs are described as 'functional

[7] Mucina, L & Rutherford, MC (eds) 2006. The vegetation of South Africa, Lesotho and Swaziland. *Strelitzia* 19. South African National Biodiversity Institute, Pretoria.

[8] The Eastern Cape Biodiversity Conservation Plan (ECBCP) has been developed in response to the requirements of the Biodiversity Act 10 of 2004 with a view to mapping existing protected areas, identifying critical biodiversity (terrestrial and aquatic) areas, other natural habitat and areas where no natural habitat remains for the Eastern Cape region and developing associated land use guidelines. These guidelines aim to set a desired ecological state for the given land types identified. The ECBCP effectively integrates existing biodiversity plans for the Province (e.g. STEP) and fills in the gaps using mainly national data: that is, no additional fine-scale Eastern Cape specific data was generated. It is intended this broad-scale information be use in spatial planning and land-use decision making whether for the preparation of IDPs, SDF, State of the Environment Reports, Strategic Environmental Assessments or even EIAs.

landscapes' as opposed to natural or near natural landscapes thus reflecting a degree of transformation or human use. Associated recommended land use objectives for these 'functional landscapes' include keeping the natural habitat intact in wetlands (including wetland buffers) and riparian zones and for environmental authorisations for proposed land uses to support ecosystem integrity. In terms of recommended 'permissible land uses' for an ONA, settlements (and presumably associated infrastructure) are 'conditional' subject to environmental authorisation.

Site observations confirmed the presence of invasive alien vegetation within the river channel and immediately adjacent river banks, viz within generally disturbed areas, including a spoil heap adjacent to the right hand bank of the Silver Stream.[9]

In terms of wildlife, it is expected the diversity in the proposed project area will be limited on account of the level of habitat disturbance and human activity in the area, including hunting. Those species present are likely to be more tolerant of human activities but no signs of wildlife or their existence were observed during the site visit, other than avifauna.

e) Geology and Soils [10] [11] [12]
(Refer to Figure A6: Regional Geology and Figures A7a and A7b for soils: APPENDIX A)

The geology of the broader area comprises the Beaufort Group of deposits which are part of the Karoo Supergroup sequence and were deposited around 250 million years ago (Lower Permian to Triassic period). The Beaufort Group deposits present specifically include the mudstones and sandstones of the Burgersdorp Formation of the Tarkastad Subgroup. The deposits of this group were originally deposited by meandering river systems which eventually formed 1000m thick deposits which mark the end of sedimentation of the Beaufort Group. The Burgersdorp deposits are important as they record the recovery of life following the devastating mass extinction with occurred 251 million years ago at the end of the Permian Period. Karoo dolerite intrusions occurred extensively around 206 million years ago (Jurassic period) and are evident either side of the White Kei River valley as ridge lines. Quaternary alluvium deposits are present, as would be expected, in the White Kei River valley itself.

The general soil types and classes are shown on Figure A7a and A7b. DWA have specifically requested information regarding soil characteristics for a given study area and especially reference to erosion risk where this may result in silt loading in adjacent water courses/water bodies. In short, the immediate study area contains general soil classes that are either shallow and associated with hard or weathered rock (i.e.

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9 The right hand bank of a river lies on the right hand side when facing downstream.

10 Based on a review of 1:250 000 Geological Series, Sheet 3226 King Williams Town and Mc Carthy T & Rubidge B (2005) The Story of Earth and Life: A Southern African Perspective.

11 Mucina, L & Rutherford, MC (eds) 2006. The vegetation of South Africa, Lesotho and Swaziland. *Strelitzia* 19. South African National Biodiversity Institute, Pretoria.

12 AGIS Comprehensive Atlas (www.agis.agric.co.za). Soils and Land Cover mapping.

to the west of the confluence between the Silver Stream and the White Kei Rivers) and are of high clay content, poorly drained and structured as found within direct proximity to the White Kei River. These general classifications appear to be borne out by observations as shown in the photographs, APPENDIX B. Additional information regarding soil types is provided with the description of the vegetation mapping of South Africa. The land types associated with the vegetation units present in the study area are described in Table 4 below:

Table 4: Soils/Land Types for the General Study Area – refer also to Figure A4. [13] [14]

Land Type associated with Vegetation Unit	Tsomo Grassland	Tarkastad Montane Grassland
Db	Refers to land where duplex soils with red B horizons comprise more than half of the area covered by duplex soils.	-
Fb	Indicates land where lime occurs regularly (though possibly in small quantities) in one or more valley bottom soils.	Indicates land where lime occurs regularly (though possibly in small quantities) in one or more valley bottom soils.
Fc	-	Refer to land where lime is generally present throughout the entire landscape.
Ib	-	Indicates land types with exposed rock (country rock, stones or boulders) covering 60-80% of the area.

In terms of erodibility (Figure 7b, APPENDIX A), the area incorporating the bridge site comprises soils likely to have a low to very high susceptibility to water erosion and a moderate susceptibility to wind erosion at most. This is assumed to be a product of the terrain, associated runoff and the presence of the watercourses, and presence of the shallow, poorly structured soils. The potential for soil regeneration, if badly eroded, is categorised as low to very low. Other information collated and presented on the AGIS Comprehensive Atlas indicated there are no areas of degraded land or areas comprising soils requiring special management requirements such as swelling clays or poor/impeded drainage.

It is reported in the Specialist Aquatic Study Report (APPENDIX D) that the *'lithostratigraphy of the area indicates intercalated arenaceous and argillaceous strata* [and] *soils are moderate to deep, with a sandy loam texture* [and] *the erodibility index is 14 with a quaternary sub-catchment sediment yield of 59 000 tons/annum.'*

[13] Extracted from Mucina, L & Rutherford, MC (eds) 2006. The vegetation of South Africa, Lesotho and Swaziland. *Strelitzia* 19. South African National Biodiversity Institute, Pretoria for the respective vegetation units present.

[14] Du Plessis (1987)

f) Environmental Quality

Air quality within and incorporating the Project is expected to be typical of a rural area where emissions are likely to be characterised by wood or paraffin burning (heating, lighting and cooking) and dust generation. The gravel road is expected to be a relatively important source of dust within the adjacent settlements during dry conditions although traffic volumes are low. In terms of potentially sensitive receptors to air quality change, such as schools and clinics, there are no such receptors immediately adjacent to the bridge site: the nearest residential properties are located approximately 95m and 148m from the existing bridge crossing. A school was observed further south of the site and adjacent to the gravel road which leads to the bridge crossing approximately 1.7km to the south of the existing bridge crossing. The low volume of traffic using the gravel road, including the general absence of heavy goods vehicles, will mean the effect of vehicle emissions will be of little importance in local air quality.

The noise environment observed for the Project focus area during the site visit is not atypical of a rural area. Vehicles are expected to be a noticeable noise source as and when vehicles pass along the road – none were encountered during the site visit (3 hours). Otherwise background noise components include natural sounds and those associated with village activities.

The landscape and visual character of the area to be affected by the Project, has been described in terms of the specific area incorporating the new bridge and minor road realignments. The following landscape and visual characteristics were noted (refer also to Figure B1 – B3, APPENDIX B):

- The landscape character of the study area is rural consisting of low density residential development arranged in 'traditional' patterns. The general area centring on the bridge comprises a shallow boulder strewn stream situated within a ridge-bounded moderately wide river valley linked to the White Kei River. The ridge lines are distinctive natural features of the landscape. Another settlement (or extension of Dubeni) is visible north of the site and on the adjacent bank of the White Kei River situated on the slopes of the eastern ridge. Vegetation cover predominantly comprises short to medium height vegetation at most with the latter found within the riparian zone of the White Kei River in particular. Vegetation cover is essentially continuous excluding where rocky outcrops and ridge lines occur. The bridge is a distinctive man-made feature in the landscape as much because it is clearly a defunct structure as well as being a distinctly utilitarian structure, the scale of which appears out of context with the water level of the Silver Stream observed at the time. Minor detractions include the slabs of concrete and sections of concrete pipeline which lie strewn within the watercourse and the spoil heap at the southern entry to the existing crossing. Interestingly there is minimal evidence of litter within the Silver Stream and White Kei River.

- Views of the current bridge crossing are limited to two or three homesteads but these are expected to be oblique given the orientation of the properties relative to the bridge. Views of the

bridge crossing from the settlement across the valley are likely to be distant and/or partially screened by the riparian vegetation, and therefore of little intrusion. The visual quality of this section, on a scale of very poor, poor, ordinary, attractive to very attractive, is deemed to be ordinary to attractive overall on account of the rural setting and distinctive natural features present.

g) Cultural Heritage

(Refer to Photograph 13, Figure B5, APPENDIX B)

Two graves sites were observed on the left bank of the Silver Stream adjacent to the gravel road and opposite the closest homestead to the existing bridge on the left bank of the watercourse. The Project Engineers are aware of these two graves and have made appropriate allowances in their design for the bridge and minor road realignments to avoid these sites.

There are no other sites of known cultural or historical significance in the vicinity of the area to be affected by the Project.

6.3 Existing Land Use and Zoning

The general study area lies within a rural landscape. Key land uses noted within the route corridor include, (refer to Figure A1, APPENDIX A and the photographs in Figures B1-B6, APPENDIX B):

- Roughly north-south orientated gravel road.
- Remnants of former bridge structure, temporary concrete causeway and concrete pathway for pedestrians.
- Spoil site, concrete slabs and broken pipes (dumped or damaged) within or adjacent to the Silver Stream.
- Irrigated fields adjacent to the White Kei River, apparently part of a local project.
- Scattered homesteads at the bridge site but a largely extended, ribbon style settlement of Dubeni further south of the bridge, incorporating a police station and school.
- Rural settlement on the slopes of the right side of the White Kei River valley.
- Informal pathways.
- Open undeveloped areas within the river valley and ridge lines used for grazing.

- A power line passes alongside the gravel road on the right bank of the Silver Stream travelling in an east-west orientation over the western ridge adjacent to the ponded area.
- An existing water supply pipeline is located upstream and parallel to the existing crossing (refer to Figure C1, APPENDIX C)

It is understood the area to be directly affected by the new bridge is zoned 'communal farming'.

The categorisation of land cover for the study area (Figure A8, APPENDIX A) reflects the observed land uses with reference to thicket, bushland, shrubland and unimproved grasslands, settlements and degraded grasslands (assumed to be in connection with general grazing activities).

6.4 Land Ownership

The study area is Communal State Land.

6.5 Planning Framework

The study area lies within Ward 7 of Emalahleni Municipality (EM) (EC136), Chris Hani District Municipality (CHDM) (DC13). Selected community statistics for the municipality are summarised below:

Selected Social Parameters	Emalahleni Municipality.
Employment and access to income	The major employment sector is government/social service with the agricultural sector contributing only 3%. 98% of households have no access to regular monthly income. 79% of households have no formal income.
Key demographic features	There is a higher percentage of women to men. Men generally leave the municipality in search of jobs and education.
Access to services	44% of the population do not have electricity. 38% of the population use paraffin for lighting and heating. 11% of the population have access to refuse collection with rural communities left to dump waste within their yards or illegally dump waste. 47% of the population are awaiting household access to water. 12% of the population have access to basic level sanitation
Road network	There are 313km of access or minor roads in the municipality, 65km of trunk roads, 90km of main roads and 658km of district roads.

As is required by law, it is essential to measure all proposed developments within an area of jurisdiction of a local municipality against the principles and the development proposals as contained in the Municipal

Integrated Development Plan (IDP), Spatial Development Framework (SDF) and associated policy and sector development plans.

Specific to EM, the following core framework issues apply or are pertinent as listed in the IDP:

IDP (2009/2010)

Chapter 2: As part of its problem analysis process, the municipality invited communities to identify their issues and needs. It is noted there was no direct reference to the need for a new bridge at Dubeni, however the need for bridges (new or improved) are listed requirements for other wards.

Current Situation: it is acknowledged in the IDP that the gravel road network is in poor condition and specifically 'access across streams and watercourses is generally poor during rainstorms. There is a municipality-wide need for the construction of appropriate causeways and bridges.' Roads and stormwater are included under the Infrastructure Development Cluster which is one of the agreed key priority areas.

Infrastructure Development Cluster: The objective is 'to ensure provision of effective and sustainable access roads network and stormwater service' and to provide 'good quality transport infrastructure'. One of three strategies includes lobbying for funding for maintenance and upgrading of local access roads (which is assumed to include bridges).

Infrastructure Development Cluster Projects: There is no specific reference to bridge construction/re-construction in general or specific to the Dubeni area. Similarly, there are no specific projects listed in the IDP.

The SDF is under preparation and is not available for review.

In conclusion, the local planning framework directly promotes and supports the development and implementation of the Project, and vice versa, the Project clearly complements the focus of the Municipal planning frameworks for road infrastructure.

Further discussion of the suitability of the Project relative to current planning frameworks is also provided in Section A8 below in connection with the assessment of need and desirability.

7. Project Proposals

The Project is described below and includes reference to the motivation for and history of the Project. This section is based on information presented in the Bridge Design Report produced by Eyethu Engineers (Pty) Ltd (May 2010). Refer to APPENDIX G for a copy of the design report.

(Refer to Figures C1 - C2, APPENDIX C)

7.1 Motivation for and objectives of the Project

a) Project Motivation

The primary motivation for the Project is the absence of a formal crossing structure at Dubeni which was damaged during flood conditions. The gravel road (T576) is an important link to rural settlements within the White Kei River valley and the loss of the formal bridge can present crossing problems for pedestrians and vehicles where poor weather or high water levels occur. Vehicles currently cross Silver Stream River via a concrete causeway directly through the watercourse and a concrete footpath has been provided upstream of the causeway for pedestrians.

There was a clear community backing for the new crossing as demonstrated during the public meeting (February 2010).

b) Project Objectives

The primary objective of the Project is to: provide a formal bridge crossing for pedestrians and vehicles and to enable the removal of the defunct crossing structures; and to provide a quality permanent replacement structure across Silver Stream River.

From a hydraulic and hydrological perspective, the bridge will be design above the estimated 1:50 year return period and due to its preferred vertical alignment will not be overtopped by a 1:100 year return period flood peak water level. The peak flows and average flow velocities for the 1:50 and 1:100 year floods are 563m^3 and 1.9m/s and 445m^3 and 1.5m/s respectively.

Geometric and traffic requirements take into account the very low traffic volumes, other similar structures in place and the minor status of the road in the road network. The approach roads to the structure on either side of the river and the layerworks are to be to Eastern Cape Department of Road and Public Works standards. The maximum design speed of the road approaches on the northern and southern approach roads will be 40 and 30 km/h respectively.

7.2 Project Design

Taking into account the objective of the Project, the design comprises the following features:

- Existing road adjustment:
  - The gravel road will be effectively shortened by approximately 68m on the southern or right hand side of the river and by approximately 22m on the northern or left hand side of the Silver Stream River to connect with the new position of the bridge.

- The combined length of the two approaches to the bridge will be 300m in length.

- New 76m long single lane bridge crossing over the Silver Stream River comprising:

  - The new bridge will comprise no.4 equal concrete spans 19m long and 200mm thick. The deck will be 4.5m wide and will incorporate a single 1.0m wide pedestrian sidewalk which will also house service ducts. The parapets consist of a reinforced concrete traffic barrier with pre-cast concrete hand-rails.

  - The bridge will be positioned approximately 50m downstream of the existing crossing structure.

  - The bridge will be set on no. three wall type piers with semi-circular ends to facilitate easy flow of water around each pier and to divert rolling debris and boulders away from the piers.

  - The foundations for the piers are to comprise spread footings dowelled into the founding rock. The founding depths vary from 3m to 6m below stream bed level (see Figure C2, APPENDIX C).

  - The abutments will be ear-wing type abutments to minimise possible scour effects of a 1:100 year flood.

  - The remaining features of the existing bridge and crossing structures will be demolished and removed. It is assumed the gravel road to either side of the existing bridge will also be decommissioned and the area rehabilitated.

- Protection measures comprising gabions or stone pitching will be placed on the river banks and the approach road earthworks. 300mm thick rhino mattresses will be supported on the 1m x 1m gabion foundations from the abutments up to a maximum length of 50m on both approaches.

- Construction materials:

  Construction materials will be required for the main structure, protection works and road works.

  - Bridge structure materials – to be commercially sourced from Queenstown or East London.

  - Mass earthworks – to be sourced from nearby quarry.

  - Protection works - materials are expected to be source locally on site for the gabions or stone pitching. If this recommendation relates to utilising the cobbles in the river channel this is not an option.

- Road works – to be sourced from borrow pits to the south/south west of the crossing once approved by Department of Minerals and Energy (see below).

- Borrow pits:
  - Two potential borrow pits have been identified for use during the construction of the new bridge and road alignments. These are located at S31 45 38.5, E27 01 12.5 and S31 45 6.8, E27 00 22.6 to the S and SW of Dubeni respectively.

- Relocation of existing services:
  - Approximately 80m of the existing canal will be relocated and replaced with 70m of 900mm diameter class 50D concrete pipes.

It is noted that a diversion may be in operation during the construction of the new bridge and is proposed to be situated immediately upstream of the existing crossing. The nature of this temporary crossing is unknown at this stage. The need for a coffer dam will depend on the timing of construction.

7.3 Additional Permitting Requirements

It is important to note the use of borrow pits and quarries for the sourcing of road building materials is regulated by the Department of Minerals and Energy via the Minerals and Resources Petroleum Development Act, Act No 28 of 2002, and Regulations. Prior to commencing with the extraction of materials from any of the sources, authorisation in the way of a mining permit or right is required from the DME. This process is being run in parallel to the DEDEA application for authorisation of the Project. A separate Environmental Management Programme Report is currently being prepared by the EAP for submission to DME.

In addition, the establishment of a new crossing structure and removal of existing structures will be subject to the requirements of the National Water Act 36 of 1998 for which a separate permitting process will be undertaken subject to the guidance of DWA. This process is dependent on a positive environmental authorisation for the Project from DEDEA.

8. Project Need and Desirability

The national Department of Environmental Affairs and Tourism (DEAT) has produced draft guidelines regarding requirements for the 'need and desirability of a Project to be more clearly considered and discussed during an EIA process[15]. Such a discussion is made relative to the IDP and SDF of the relevant affected local municipality to *'…determine whether or not the development is 'justified'* [and] *in other words to ensure that the development will be socially, economically and environmental sustainable'.*

15 DEDEA (2008). Draft Guideline on the Information Requirements to Describe Need and Desirability in the Environmental Impact Assessment Process.

The guidelines require that a series of questions be answered in detail. These questions have been listed in APPENDIX G and responses provided accordingly. In short, the Project is considered to be in line with the objectives and strategies of the IDPs for Chris Hani District Municipality and Emalahleni Municipality. It was also noted that there was strong community support for the Project during the public meeting (February 2010) as demonstrated by the Comments Forms received (a total of 98).

9. Alternatives

The EIA Regulations require that alternatives to a proposed activity be considered. Alternatives are different means of meeting the general purpose and need of a proposed activity. Alternatives may include location or site alternatives, activity alternatives, process or technology alternatives, temporal alternatives or the No-Go alternatives, with the 'No-Go' alternative as the option of not undertaking the proposed activity or any of its alternatives. The 'No-Go alternative provides a baseline against which the impacts of other alternatives should be compared. Even if the 'No-Go' alternative is not feasible or reasonable, it is compulsory to assess the implications of this course of action.

9.1 No-Go Alternative

The 'No-Go' option for the Project will involve simply maintaining the status quo, i.e. the community will continue to use informal crossing points through the river, weather and/or river level permitting with an inherent risk of drowning. Such a status quo will invariably continue to restrict vehicular and pedestrian access for certain sectors of the community in general and especially during poor weather conditions or high water levels in the river. The 'No-Go' option would also continue to promote poor community safety as well as lead to the degradation of the Silver Stream.

The No-Go alternative is discussed in the Impact Assessment outlined below and included in the DEDEA prescribed Basic Assessment form in SECTION B.

9.2 Bridge Position Alternatives

Major bridge position alternatives for the Project are limited on account of the existing gravel road infrastructure and geographical constraints. Three alternative positions for the new bridge have been considered by the Project Engineers, viz the existing position, 50m downstream and 150m downstream of the existing position (see Figure C1, APPENDIX C). It was recommended in the Bridge Design Report that the proposed crossing 50m downstream of the existing crossing be the preferred option on account of suitability and providing the most smooth approach from each road access.

Further to the above, an exemption from considering alternatives has been made in the Section A1 of the DEDEA prescribed Basic Assessment Report format.

9.3 Bridge Design Alternatives

There are no bridge design alternatives. The length of the bridge precludes any option for using less spans/piers.

10. Description and Assessment of Potential Impacts

This section presents the findings of the impact identification and assessment exercise as required in terms of the EIA Regulations. It is provided in support of Section D: Impact Assessment of the DEDEA prescribed Basic Assessment Form and should be read in conjunction with this.

The methodology adopted for this Basic Assessment has been based the guidance provided in DEAT Guideline 5[16].

10.1 Impact Identification

An 'aspects' based approach has largely been used in the identification of potential impacts during the construction and the operation phases. 'Environmental Aspects' are the mechanisms by which an activity interacts with the environment. Environmental aspects refer to an element of an activity, product or service which can have a beneficial or adverse impact on the environment. For example, it could involve a discharge, an emission, the consumption or re-use of a material, or noise. On this basis, a number of environmental aspects have been determined for the construction and use of the proposed new road and road upgrade. These are presented in Table 5 below.

Table 5: Environmental Aspects

Main Category		Sub-Categories	Examples as relevant to this project
INPUTS	Resource Consumption	Raw Materials Manufactured Products Energy	Sand, gravel, rock. Materials for construction and road upgrade. Diesel and petrol.
		Water	Water for construction works and maintenance purposes. Water for domestic purposes.
OUTPUTS	Releases to Water	Diffuse sources (seepage/run-off)	Stormwater runoff. Spillages from construction works.
	Releases to Air	Dust Gases and fumes	Dust generated from transport and construction activities. Gases and fumes associated with exhaust emissions.

[16] DEAT (2006) Guideline 5: Assessment of Alternatives and Impacts in support of the Environmental Impact Assessment Regulations, 2006. Integrated Environmental Management Guideline Series, DEAT Pretoria.

Main Category		Sub-Categories	Examples as relevant to this project
	Other Releases or Emissions	Noise and vibration Solid waste Accidental spillages Light	Construction noise and vibration associated with traffic generation and plant use. Solid waste from construction and maintenance activities. Spillages. Use of construction lights during any night time activities.
Land Transformation		Surface disturbance Topographical change Land use change	Removal of vegetation. Foundation excavations. Addition of new man-made structure into landscape.
Social Aspects		Employment and income generation.	Construction staff. Subcontractors.
		Access disruption	Temporary disruption to property/resource access. Permanent disruption to property/resource access.
		Changes in land-use / zoning	Loss of grazing land.
		Provision of service	Provision of river crossing.

Environmental 'aspects' (or mechanisms) provide the link between activities and impacts. Significant impacts will only result where there is a significant 'aspect'. Potential impacts associated with the proposed activities have been identified using an activity/aspect/impact matrix (Figure 1). The matrix illustrates the specific activities associated with the construction and use of the Project, the range of aspects that may be collectively linked to these activities and the resulting impacts.

Figure 1: Aspect and Impact Identification Matrix

ACTIVITY			⇨ INTERACTION BETWEEN THE ENVIRONMENTAL ASPECT AND POTENTIAL IMPACT ILLUSTRATED BELOW ⇩														
PHASE OF OCCURRENCE	CONSTRUCTION (C)	Establishment & use of construction camp and offices – including provision for any fuel and vehicle/plant storage and workshops.	C		C	C	C		C	C	C	C		C	C	C	C	
		Procuring and transferring of materials, plant and/or equipment to and from the site.		C						C	C				C	C	C	
		Storage of construction materials and/or waste on site.				C	C	C		C	C					C		
		Site preparation, including vegetation clearance and grubbing.						C	C	C		C	C		C	C		
		Cement batching.	C	C	C	C	C	C	C	C	C				C	C	C	
		Earthworks and spoiling of existing bridge structures to be demolished.	C			C	C	C	C	C		C	C	C	C	C		
		Bridge construction, including temporary crossing structures.	C	C		C	C	C	C	C	C	C	C	C	C	C	C	
		Existing bridge demolition.	C			C	C	C	C	C	C	C	C		C	C		
		Temporary road closures and accommodation of traffic and pedestrians.												C	C	C		
		Site rehabilitation (incorporating the construction areas, camp and temporary crossing).			C			C	C	C		C	C			C	C	
	OPERATION (O)	Use of the new replacement bridge.									O							O
ASPECT Element of an activity that can interact with the environment and lead to environmental impacts, or the cause of a given impact.			Energy Demand	Materials Consumption	Water Consumption	Releases to water, incl stormwater	Releases to air (gaseous. Incl odours)	Releases to air (dust)	Noise Emissions & Vibrations	Waste generation, storage & disposal	Accidental spillages	Ground disturbance & vegetation clearance	Change in land form &/or channel form	Change in land use and/or accessibility	Traffic Generation (on, off and to the site)	Employment Opportunities	Procurement of services and goods	Provision of Service
			INTERACTION BETWEEN THE ENVIRONMENTAL ASPECT AND POTENTIAL ENVIRONMENTAL IMPACTS ⇩															
AFFECTED ENVIRONMENT – POTENTIAL IMPACTS	PHYSICAL	Air Pollution.	C				C	C							C			
		Soil compaction / erosion / pollution.									C	C	C					
		Landscape change and visual impacts.						C				C	C	C				
		Surface water pollution.				C				C	C O							O
		Groundwater pollution.								C	C							
		Alteration of drainage systems.			C	C					C O	C O	C O	C				O
	BIOLOGICAL	Terrestrial ecosystem and biodiversity impacts						C	C	C	C	C						
		Aquatic ecosystem and biodiversity impact				C				C	C O	C O	C O					O
		Spread of invasive alien species.										C						
	SOCIO-ECONOMIC	Compatibility / incompatibility with existing land uses.						C	C	C	C O	C			C	C		O
		Public nuisance – disruption to traffic, access and severance, dust generation, noise and vibration and light 'pollution'.						C	C	C	C O				C	C		
		Public health and safety, including security.								C	C O				C	C		O

		ASPECT Element of an activity that can interact with the environment and lead to environmental impacts, or the cause of a given impact.	Energy Demand	Materials Consumption	Water Consumption	Releases to water, incl stormwater	Releases to air (gaseous. Incl odours)	Releases to air (dust)	Noise Emissions & Vibrations	Waste generation, storage & disposal	Accidental spillages	Ground disturbance & vegetation clearance	Change in land form	Change in land use and/or accessibility	Traffic Generation (on, off and to the site)	Employment Opportunities	Procurement of services and goods	Provision of Service
		INTERACTION BETWEEN THE ENVIRONMENTAL ASPECT AND POTENTIAL ENVIRONMENTAL IMPACTS ⇩																
AFFECTED ENVIRONMENT – POTENTIAL IMPACTS	SOCIO-ECONOMIC	Aesthetic impacts.						C		C			C	C				O
		Socio-economic impacts.		C										C	C	C	C	O
		Compatibility / incompatibility with municipal service provision.	C		C	C				C					C			
		Heritage resource impacts.													C			
		Compatibility / incompatibility with sustainable or responsible resource use (e.g. allowing for recycling).	C	C	C					C							C	

10.2 Impact Prediction

Impact prediction involves describing the nature, characteristics and parameters of the impacts/issues identified for the Project on the basis of an understanding of the existing biophysical and human environment within which each impact/issue will take place. This in turn provides for the foundation of assigning significance to each impact. The following criteria are considered (refer to Table G1, APPENDIX G which provides a more detailed description of the criteria categories):

- The nature of the impact (positive or negative).
- The type of impact (primary, secondary or cumulative).
- The extent and location of the impact (site, local, regional or national).
- The timing of the impact (pre-construction, construction, operation and decommissioning).
- The duration of the impact (short-term, long-term, intermittent or continuous).
- The severity or magnitude of the impact (low, medium, high; negative or positive) – refer to Table G2, APPENDIX G.
- The reversibility of the impact.
- Probability of occurrence (unlikely, possible, likely or definite).
- The mitigation potential (high, medium or low) – refer to Table G3, APPENDIX G.

Collectively, the prediction criteria describe the nature and scale of change to the existing environment with the construction and use of the Project. The determination of the criteria categories per impact/issue is based on a number of qualitative and/or quantitative assessment techniques ranging from applying professional judgement and experience through to detailed modelling and intrusive/non-intrusive investigations. The final assessment technique used largely depends on the nature and scale of the activity, the sensitivity of the receiving environment, the level of concern expressed by the public/stakeholders and the specific requirements expressed by key authorities such as DEDEA, DWA and local government.

The assessment process for this Project largely comprises a qualitative assessment.

10.3 Mitigation Measures

The EIA process provides an opportunity to identify the potential for, and range of, mitigation measures that may be introduced into the design, construction and/or operation of a given project. Such mitigation measures will serve to avoid or reduce adverse impacts as well as to enhance the benefits, thereby providing for a more environmentally acceptable activity or project.

10.4 Significance Evaluation

The significance evaluation process defines an overall significance rating for each identified impact WITH mitigation and WITHOUT mitigation. The significance rating (negligible, low, moderate or substantial) is based on the prediction criteria assigned for each impact as well as the level of public or stakeholder comments raised. The significance evaluation also takes into account the potential for residual impacts which may result despite the proposed mitigation measures.

It should be noted that a low mitigation potential does not necessarily imply that the impact is highly significant. An impact with a low significance rating may be extremely difficult to mitigate such as noise generated by earth moving equipment during construction, while a highly significant impact may be relatively simple to mitigate with the implementation of the correct mitigation measures. Concern naturally arises when an impact with a high significance has a low mitigation potential. In some instances this may present a fatal flaw and motivation for rejecting the development.

Tables outlining the significance of the potential impacts associated with the construction and use of the new bridge are provided below. A discussion of the impact of the No-Go alternative is provided, as required, thereafter.

10.4 Construction Phase Impacts

Table 6: Impact Assessment Table: Construction

POTENTIAL CONSTRUCTION IMPACT (in order of impact as described in Figure 1)	ASPECT (refer to Figure 1)	Nature	Type	Extent	Duration	Severity	Reversibility	Probability	MITIGATION POTENTIAL	SIGNIFICANCE		MITIGATION MEASURES
										Without Mitigation	With Mitigation	
PHYSICAL ENVIRONMENT												
Air Pollution (gaseous and dust) Gaseous emissions will be associated with the use of construction vehicles and plant and/or the storage of fuels and other volatiles on site. Dust generation will result from ground disturbing activities, any cement batching, the stockpiling of soils and materials, demolition activities and from vehicle movements on the construction site.	Energy demand, releases to air & traffic generation.	–	Primary	Site	Short term, intermittent	Low –	Yes & No	Probable to Definite	Moderate (emissions) High (dust)	MOD	LOW	Measures will be described in the EMPR to help reduce air quality impacts (dust and emissions) during construction. These include ensuring regular vehicle and plant maintenance, use of appropriate storage systems for fuels and construction vehicle speed controls. Dust control measures include spraying exposed ground surfaces and stockpiles with water. Provided the EMPR is implemented appropriately there should be no significant adverse impacts or residual impacts resulting from air emissions.
Soil compaction / erosion / pollution The risk of soil compaction and erosion is common to construction sites. Excavations and localised changes to the slope and landform will also potentially impact on erosion and pollution risks. Erosion risks will be exacerbated by any failure to control stormwater runoff across exposed surfaces and/or compacted surfaces. The storage and use of machinery and hazardous substances (e.g. bitumen, cement and fuels) and/or waste may lead to soil contamination through incorrect storage, handling spillage, leaks and/or poor preparation for emergencies. The Silver Stream and White Kei Rivers are potential receptors of any such construction related pollution or silt loaded stormwater/runoff, at a minimum, and will be sensitive to any such changes in water quality.	Accidental spillage, ground disturbance & change in landform.	–	Primary & secondary	Site	Short term, intermittent	Low –	Yes	Probable	High to Moderate	MOD	LOW	The EMPR will include measures to restrict the construction 'footprint', reduce the risk of soil erosion, managing stormwater and reducing the risk of potentially contaminating accidents. A plan for the management of any contaminated ground generated during the construction phase will be required. Provided the EMPR is implemented appropriately there should be no significant adverse impacts or residual impacts resulting from ground disturbing activities. Construction of the bridge should be phased to take place during the dry season and be completed as soon as possible. Bank protection and/or stabilisation measures must be put in place and stop-boards used to control loose soil entering the water course. In addition, runoff from the construction areas must not be channelled directly into the Silver Stream River. In the event a coffer dam is used during construction of the bridge, this must not be constructed using sand bags on account of the risk of silt loading.
Landscape change and visual impacts The physical changes to the landscape, starting with the construction activities, will permanently change the appearance and aesthetic quality of a given area. Specific to the Project, the construction of the bridge, with embankments and minor road realignment will re-introduce a significant feature into the landscape alone. Excessive dust generation can also have a visual impact.	Releases to air, ground disturbance, change in landform & change in land use.	–	Primary	Site to Local	Medium term, continuous	Low –	No	Definite	Low	LOW	LOW	Mitigation options are limited on account of the bridge structure, the design of which will be defined by the river characteristics and road speed. A rehabilitation plan will be required to redress those areas affected by the construction activities. Only indigenous plants should be used. The dust control measures described above will help reduce the scale of any visual impacts that may otherwise result during construction.
Surface water and groundwater pollution Construction activities may result in water pollution events through the incorrect dumping of spoil, waste or materials near watercourses, the inappropriate siting of toilets, poor stormwater management, poor storage, handling or spillage of hazardous materials on site and accidents. The need for a temporary river crossing for plant during the construction of the new bridge (including the embankments) is unknown at this stage. The demolition of the existing bridge will be a particularly risky activity in terms of potential silt loading alone. The Silver Stream and White Kei River are potential receptors of any water pollution event. The presence and sensitivity of any borehole supplies is unknown at this stage.	Releases to water, waste generation & accidental spillage.	–	Primary & secondary	Site to Local	Short term, intermittent	Low –	Yes	Possible to Probable	High	MOD	LOW	The REC for the Silver Stream River is B/C: this is an indication that the current ecological state of the system should be maintained, if not upgraded. No water pollution event during the construction phase will be tolerated. Cement or concrete, in particular, should be set or cured before any river water comes into contact with it as wet cement or concrete is lethal to aquatic biota. The EMPR will describe good housekeeping and pollution prevention specific measures to reduce the significance of construction activities on the water environment. This will include limiting the proximity of potentially polluting activities to the Silver Stream and White Kei River, such as cement use. No water abstraction from the Silver Stream and White Kei River will be allowed without consultation with and/or a permit from DWA. No alteration to the river bank or river bed may take place for temporary or permanent structures without authorisation from DWA: to do so will be illegal and potentially subject to a fine. Construction of the bridge should be phased to take place during the dry season and be completed as soon as possible. Bank protection and/or stabilisation measures must be put in place and stop-boards used to control loose soil entering the water course. In addition, runoff from the construction areas must not be channelled directly into the Silver Stream River. In the event a coffer dam is used during construction of the bridge, this must not be constructed using sand bags on account of the risk of silt loading The conditions of the DWA authorisation will apply.

POTENTIAL CONSTRUCTION IMPACT (in order of impact as described in Figure 1)	ASPECT (refer to Figure 1)	Nature	Type	Extent	Duration	Severity	Reversibility	Probability	MITIGATION POTENTIAL	SIGNIFICANCE		MITIGATION MEASURES
										Without Mitigation	With Mitigation	
Alteration of drainage systems The construction of a temporary river crossing or the use of a coffer dam and the change in landform associated with construction activities can affect drainage patterns and/or the relationship between runoff and infiltration at a minimum leading to changes in turbidity, sedimentation and habitat impacts (see below). The use of the coffer dam and also lead to dewatering of the river downstream and/or the backing up of water on the upstream side of the dam. A similar effect can result from the use of a temporary crossing where the crossing is too high. In the event sand bags are used to construct the coffer dam there is a risk of coarse sediment being added to the Silver Stream River with associated habitat impacts (see below). The demolition of the existing bridge will be a particularly risky activity in terms of changes to the river bank and bed characteristics. There is also a risk of accelerated erosion (scour) of the channel bank and increased turbidity downstream, the establishment of a step in the channel bed and/or a discontinuity in channel substrate types resulting from construction activities at, on or in the Silver Stream River.	Water consumption, releases to water, accidental spillage, ground disturbance, change in landform & change in land use.	–	Primary & secondary	Site to Local	Short term, continuous	Med –	Yes	Possible to Probable	Moderate	MOD	LOW	The REC for the Silver Stream River is B/C: this is an indication that the current ecological state of the system should be maintained, if not upgraded. Construction must take place in the dry season and be completed as soon as possible. The use of a coffer dam could help limit the physical extent over which any downstream impacts on the river bed may occur. However, the coffer dam must be fail safe and not constructed with sand bags (see above). All materials used to construct the coffer dam or temporary crossing must be removed off site once there is no further need for these structures. The height of the coffer dam and/or temporary crossing must not cause damming of water upstream of the coffer dam which will cause the inundation of the in-channel wetland area upstream. In addition, 25% of the normal flow of the Silver Stream River must be maintained within the 'low flow channel' using a pipe in the coffer dam. Bank protection and/or stabilisation measures must be put in place and stop-boards used to control loose soil entering the water course. In addition, runoff from the construction areas must not be channelled directly into the Silver Stream River. A rehabilitation plan will be required to redress those sections of the Silver Stream and/or White Kei River banks which have been affected by the construction activities. This will also provide an opportunity to repair the banks that have been affected by the temporary crossings and to remove debris from the existing structure which has been washed downstream, including concrete, gabion baskets and materials, and other material previously used for the existing crossing. Material for gabions or similar structures must not be sourced from the river course. The conditions of the DWA authorisation will apply.
BIOLOGICAL ENVIRONMENT												
Terrestrial ecosystem and biodiversity impacts. It is inevitable the construction phase will result in the loss of some vegetation (including riparian vegetation) and habitat through ground clearance for the construction of Project structures, at a minimum. The risk of pollution from accidents, poor construction practices and dust deposition may result in further terrestrial and/or riparian habitat degradation. Light pollution and noise generation may disturb any wildlife present in the immediate area.	Releases to air, noise and vibration, waste generation, accidental spillage, and ground disturbance.	–	Primary	Site	Short term or permanent	Low –	No	Definite	High	MOD	LOW TO NEGLIGIBLE	The footprint of construction activities must be kept to a minimum. Vegetation outside the construction areas must be protected from creep of activities and the in-channel wetland must be declared a 'No-Go' area. No firewood is to be collected from the area by construction workers. Consider transplanting endemic trees and shrubs rather than clearing. Good housekeeping and pollution prevention specific measures described in the EMPR should help reduce construction impacts on the terrestrial biological environment through pollution. A rehabilitation plan will be required to redress those areas affected by the construction activities: only indigenous plants should be used. Disturbed areas can be reseeded using grasses from the area. The conditions of the DWA authorisation will apply.
Aquatic ecosystem and biodiversity impacts. The risk of pollution from accidents, poor construction practices and silt loading may result in further aquatic habitat degradation at and downstream of the site. The construction of a temporary river crossing, the use of a coffer dam, any riparian vegetation clearance and/or the demolition of the existing bridge may also lead to aquatic habitat degradation and pollution or silt loading risks as described above. Changes in turbidity and sedimentation are key potential impacts which can affect the aquatic habitats of both river systems. There is also a risk of a channel step and/or a discontinuity of substrate occurring due to scouring which in turn can present barriers to biota movement upstream of the affected areas. The use of sand bags for any coffer dam or exposure to wet/unset cement or concrete can also affect aquatic habitats and biota. Other impacts on aquatic habitats and biota may result where dewatering occurs due to damming effects (intentional or unintentional) or where inundation occurs upstream potentially affecting the in-channel wetland upstream of the existing crossing.	Release to water, waste generation and accidental spillage.	–	Primary and secondary	Site to Local	Short term, continuous	Med –	Yes	Unlikely	High	MOD	LOW TO NEGLIGIBLE	The REC for the Silver Stream River is B/C: this is an indication that the current ecological state of the system should be maintained, if not upgraded. Refer to the mitigation measures described above for 'surface water and groundwater pollution' and 'alteration of drainage systems'. The conditions of the DWA authorisation will apply.

POTENTIAL CONSTRUCTION IMPACT (in order of impact as described in Figure 1)	ASPECT (refer to Figure 1)	Nature	Type	Extent	Duration	Severity	Reversibility	Probability	MITIGATION POTENTIAL	SIGNIFICANCE		MITIGATION MEASURES
										Without Mitigation	With Mitigation	
Spread of invasive alien species The clearance of vegetation and ground disturbance can provide opportunities for the spread of invasive alien species from within or from outside the Project site. As there is already a presence of invasive alien plant species in the riparian zone, there is a risk of spreading invasive alien species beyond the construction site.	Ground disturbance with vegetation clearance.	–	Secondary	Site to Local	Short term, continuous	Mod –	Yes	Definite	Moderate	MOD	LOW	Measures will be described in the EMPR to help reduce the spread of invasive alien plant species directly and through the dust control measures and the early implementation of the landscape rehabilitation plan. Provided the EMPR is implemented appropriately the risk of spreading invasive alien plants should be reduced.
HUMAN ENVIRONMENT												
Compatibility / incompatibility with existing land uses. The single access road leading to and beyond the bridge is an important access for the surrounding communities and is therefore sensitive to access disruption. The properties and community facilities adjacent to this access road are also sensitive to disruption, noise and dust generation, traffic volumes and/or exposure to pollution, accidents and security risks. Two graves are located on the northern bank of the Silver Stream and are potentially sensitive sites to construction activities (see below).	Releases to air, noise emissions, waste generation, accidental spillage, ground disturbance, change in land use & traffic generation.	–	Primary and secondary	Site to Local	Short term, intermittent	Low –	Yes	Probable to Definite	High	MOD	LOW	Provided the EMPR is implemented as described, the construction of the new bridge should not result in significant conflicts with or cause severe disruption to existing land users. Some element of disruption may remain despite the EMPR, but good proactive communications with adjacent land users and Ward Councillors/Committees should help reduce the significance of any such residual impact.
Public nuisance – disruption to traffic, access and severance, dust generation and noise and vibration. Access to the construction site can be made via the existing gravel road network off the R396. It is inevitable that some disruption to existing traffic flows and access to properties will result from the construction phase given the focus of the Project. Earthworks, excavations, vegetation clearance topsoil/materials stockpiling and demolition activities may, with high wind conditions, lead to dust generation. Construction vehicles, earth moving plant and other plant on site will generate noise, and possibly vibration, during the construction period.	Releases to air, noise emissions, waste generation accidental spillage, change in land use &traffic generation.	–	Primary & secondary	Site to Local	Short term, intermittent	Low to Mod –	Yes	Probable to Definite	High	MOD	LOW	The EMPR includes specifications for setting out designated haul routes and providing traffic controls to help minimise traffic disruption in general. Access to existing property entrances and community facilities must be maintained at all times. The EMPR will also include basic controls to limit dust and noise generation as described above. Provided the EMPR is implemented appropriately there should be no significant adverse impacts or residual impacts resulting from air emissions (dust).
Public health and safety and security. There is a potential risk to public health and safety from general exposure to construction activities on site, construction traffic and where, for example, travel routes are disrupted and exposure to any accidents or pollution events that may occur on or off site. A change in criminal activity may also result during the construction phase – either targeting the construction site or adjacent properties.	Waste generation, accidental spillage, change in land use & traffic generation.	–	Primary and secondary	Site to Local	Short term, continuous	Low –	Yes	Probable to definite	High	MOD	LOW	The EMPR will include specifications to manage site security, restrict unauthorised access and to prevent and respond to accidents that may occur. A plan for the management of contaminated ground generated will be required to help reduce any public exposure to health risks.
Aesthetic impacts. Poor management of construction waste may lead to aesthetic impacts through windblown litter. Construction activities generally have a negative aesthetic impact on account of the scarred appearance of the landscape. Site security lighting or any night working may result in light pollution particularly for residents overlooking the crossing point.	Releases to air, waste generation, change in landform & change in land use.	–	Primary and secondary	Site	Short term to medium term	Low –	Yes & No	Probable	Moderate	MOD	LOW	The EMPR will include specifications for waste management including litter patrols. The implementation of a rehabilitation plan will help to improve the aesthetic quality of the site. Any night time working will be subject to controls and lighting systems will be required not to cause undue 'light pollution'.
Socio-economic impacts. The local community and businesses in the general area including Queenstown and Lady Frere stand to benefit through the employment opportunities and through the procurement of supplies, materials and plant during construction. The provision of employment and training opportunities during construction may serve to uplift the local community where unemployment levels are high. Some revenue to the municipality may also follow through the use of services, e.g. waste disposal.	Materials consumption, change in land use, traffic generation, employment opportunities, procurement of services & goods.	+	Primary and secondary	Local	Short term, continuous	Med +	Yes	Probable to definite	High	LOW	MOD	The use of local labour and the sourcing of construction materials from local suppliers, where practical, can be promoted through the EMPR and/or contract documentation for the construction phase.
Compatibility / incompatibility with municipal service provision. The construction activities will consume water and will generate wastewater and solid waste (including rubble from the demolition of the existing structures) that will need to be treated / disposed at municipal facilities. There are no hazardous waste landfill sites in the municipality.	Energy demand, water consumption, releases to water, waste generation & traffic generation.	–	Primary	Local	Short term, intermittent	Low –	No	Definite	Low	MOD	LOW	Promoting responsible resource use and waste minimisation, recycling or reuse will be incorporated into the EMPR. Any hazardous waste generated or encountered will need to be removed to an appropriately permitted landfill site.

POTENTIAL CONSTRUCTION IMPACT (in order of impact as described in Figure 1)	ASPECT (refer to Figure 1)	Nature	Type	Extent	Duration	Severity	Reversibility	Probability	MITIGATION POTENTIAL	SIGNIFICANCE		MITIGATION MEASURES
										Without Mitigation	With Mitigation	
Heritage resource impacts. Ground disturbance during the construction phase can lead to the discovery of unrecorded graves, artefacts and other features of cultural, historical or archaeological interest. Two graves have been identified on the northern bank of the Silver Stream adjacent to the bridge. The design of the new crossing and road realignment has been made in cognisance of these graves.	Traffic generation.	–	Primary	Site	Short term, intermittent	Low –	Yes	Possible	High	MOD	LOW	The EMPR will include specifications to provide for the discovery and protection of any features of potential interest. The use of the northern bank of the Silver Stream for construction activities should be limited to reduce the risk of grave desecration. A buffer zone must be established to prevent the 'creep' of activities towards the graves.
Compatibility / incompatibility with sustainable or responsible resource use. The construction phase will require materials and resources that are renewable and non-renewable – e.g. fuels, waste, slurry and concrete/cement. Construction will also generate wastes, effluent and emissions.	Energy demand, materials consumption, water consumption, waste generation & procurement of services and goods.	–	Primary	Local	Short term, intermittent	Low –	No	Probable to definite	Moderate	MOD	LOW	The EMPR will include specifications to promote the responsible and conservative use of materials and to promote waste minimisation, recycling and reuse where possible and practicable.

10.5 Operation Phase Impacts

Table 7: Impact Assessment Table: Operation

POTENTIAL OPERATIONAL IMPACT (in order of impact as described in Figure 1)	ASPECT	Nature	Type	Extent	Duration	Severity	Reversibility	Probability	MITIGATION POTENTIAL	SIGNIFICANCE		MITIGATION MEASURES
										Without Mitigation	With Mitigation	
PHYSICAL ENVIRONMENT												
Surface water pollution and alteration of drainage systems. There is a risk of localised pollution from any accidents on or approaching the new bridge, however such a risk would have also been associated with the previous bridge. The significance of any pollution event would depend on the severity of the accident and/or the nature of materials spilled. The presence of the new bridge should represent a benefit to the current situation in terms of redirecting pedestrian and vehicle movements away from direct contact with the river. The demolition of the existing bridge will also remove an existing barrier to water flow and aquatic fauna. However, there is a risk the new structure can affect the flow and inundation regime of the Silver Stream River with associated impacts on turbidity, sedimentation and aquatic habitats and biota (see below) depending on the design and position of the bridge.	Accidental spillage	–	Primary	Site to local	Short term, intermittent	Low –	Yes	Possible	High	LOW	LOW	The risk of road traffic accidents should be low given the low volumes of traffic and speeds. However the use of signage announcing the presence of the bridge can help reduce risk of accidents especially at night. The ability to bypass the bridge by vehicle in particular must be prevented through the demolition of the existing features and foundations and by the appropriate design of the adjoining road.
	Provision of service	+	Primary	Site to Local	Long term, continuous	Low +	Yes	Definite	None	LOW	LOW	The design of the new bridge should minimise the following: • The risk of impeding flow and any associated risk of affecting the inundation regime. • The risk of scour occurring downstream of the bridge structures by using scour protection measures on the downstream side of the structures using for example a combination of geotextiles and planting, reno mattresses or gabion baskets etc. • Affecting the low-flow channel of the Silver Stream River • The risk of a channel step developing and/or a change in substrate between the piers. In addition, the river banks immediately up and downstream of the bridge and/or approach roads must be protected from erosion. Roadside drainage should not be channelled directly to the river but should be directly onto adjacent slopes. Regular maintenance of the bridge must be undertaken to ensure trapped debris is removed in general and especially after large storm events. Bank integrity/stabilisation should also be checked after large storm events and any rehabilitation measures repaired.

POTENTIAL OPERATIONAL IMPACT (in order of impact as described in Figure 1)	ASPECT	Nature	Type	Extent	Duration	Severity	Reversibility	Probability	MITIGATION POTENTIAL	SIGNIFICANCE		MITIGATION MEASURES
										Without Mitigation	With Mitigation	
BIOLOGICAL ENVIRONMENT												
Aquatic ecosystem and biodiversity. There is a risk of localised pollution from any accidents on the road especially where these are on or close to the bridge. The significance of any pollution event would depend on the severity of the accident and/or the nature of materials spilled. However, the risk of accidents should be low given the low volumes of traffic on the road. The new bridge should represent a benefit relative to the existing situation through the removal of barriers to water flow and movement of fauna at a minimum. However, there is a risk the new structure can affect the flow and inundation regime of the Silver Stream River with associated impacts on turbidity, sedimentation and aquatic habitats and biota depending on the design and position of the bridge.	Accidental spillage	–	Primary	Site to local	Short term, intermittent	Low –	Yes	Possible	High	LOW	LOW	The risk of road traffic accidents should be low given the low volumes of traffic and speeds. However the use of signage announcing the presence of the bridge can help reduce risk of accidents especially at night. The ability to bypass the bridge by vehicle in particular must be prevented through the demolition of the existing features and foundations and by the appropriate design of the adjoining road.
	Provision of service	+	Primary	Site to local	Long term, continuous	Low +	Yes	Definite	None	LOW	LOW	Refer to the mitigation measures described above for 'surface water and alteration of drainage systems'. Ongoing maintenance of new approach road and bridge is required, particularly after heavy rains and floods, to repair any erosion and flood damage and re-stabilise any disturbed areas.
HUMAN ENVIRONMENT												
Compatibility / incompatibility with existing land uses The new bridge will be compatible with the existing land uses insofar as it will replace a defunct feature which is critical to the effective use of the access road. There is an inherent risk of pollution from any vehicle accidents on the bridge. The significance of any pollution event would depend on the severity of the accident and/or the nature of the materials spilled. As noted above, the risk of accidents should be low given the low volumes of traffic using the road network. Benefits may result through improved access between villages and especially for those north of Dubeni.	Accidental spillage	–	Primary & secondary	Site to Local	Short term, intermittent	Low –	No	Definite	Low to moderate	LOW	LOW	The risk of road traffic accidents should be low given the low volumes of traffic and speeds. However the use of signage announcing the presence of the bridge can help reduce risk of accidents especially at night. The ability to bypass the bridge by vehicle in particular must be prevented through the demolition of the existing features and foundations and by the appropriate design of the adjoining road.
	Provision of service	+	Primary & secondary	Site to Local	Long term, continuous	Med +	No	Definite	High	MOD	MOD	-
Public health and safety, including security. There is an inherent risk of exposure to road accidents and any associated pollution events by definition of the existence of the river crossing. The significance of any pollution event and the public health risk would depend on the severity of the accident and/or the nature of materials spilled, however this should be reduced with the provision of a better quality crossing structures. The new crossing should be a significant improvement to the current situation by isolating pedestrians and vehicles from direct contact with the river enabling year round access.	Accidental spillage	–	Primary & secondary	Site	Short term, intermittent	Low –	Yes	Probable	Moderate	LOW	LOW	The risk of road traffic accidents should be low provided sufficient road signage and lighting is maintained. Timeous road maintenance will also be important for promoting safer journeys. The need for any speed control measures should be monitored by the Municipality depending on complaints and/or accidents recorded.
	Provision of service	+	Primary & secondary	Site	Long term, continuous	Med +	Yes	Definite	Moderate	MOD	MOD	-
Aesthetic impacts. The bridge will form a permanent and prominent feature in the landscape with little option for mitigation however views of the bridge are generally oblique and/or distant. Views are also likely to be partially screened by intervening vegetation and topography. Visual quality is unlikely to be a key concern for villagers and has certainly not been raised to date. the new bridge could be a marked improvement especially with the removal of defunct features and slabs of concrete etc.	Provision of service	–	Primary	Site to Local	Medium term - continuous	Med – to Low –	No	Definite	Low to moderate	MOD	LOW	It is inevitable that with time the visual significance of the bridge in the landscape will diminish as residents become accustomed to the physical changes in the landscape.
Socio-economic impacts. The provision of the new bridge should provide socio-economic benefits through all year/all weather access as well as benefits resulting from improved access to community facilities in the immediate and general area.	Provision of service	+	Secondary	Local to regional	Long term, continuous	Med +	No	Probable to Definite	Moderate	MOD	MOD	-

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10.6 Cumulative Impacts

Cumulative impacts are impacts which result from the incremental impact of the proposed activity on a common resource when added to the impacts of other past, present or reasonably foreseen future activities. Cumulative impacts can occur from the collective impacts of individual minor actions over a period of time and can include both direct and indirect impacts[17]. Considering the complexity of assessing the nature and significance of cumulative impacts a detailed assessment has not been undertaken, nor is one required in terms of the Basic Environmental Assessment. The primary potential cumulative impacts which may arise from the Project are expected to be associated with improved access to community facilities, such as clinics, hospitals and schools and improved access to employment. There is a possibility this may in turn result in community enhancement, the significance of which is unknown and beyond the scope of this assessment.

10.7 The "No-Go" Alternative

The "No-Go" alternative would comprise maintaining the status quo where communities would continue to use the informal crossing point, as available, and in so doing be exposed to difficult and unsafe travel conditions. The potential environmental aspects that may be associated with the status quo could include:

- Exposure to drowning risks for pedestrian and vehicle passengers.
- Exposure to accidents with vehicles leading to possible river pollution risks.
- Disruption to access and/or associated severance associated with restricted crossing during poor weather and/or high water level conditions which will in turn affect access to basic facilities, government, educational and financial institutions and employment opportunities. This perceived and real severance will be particularly significant for the young, low income, elderly and disabled members of the community who rely on these community facilities.
- Continued disruption to the flow regime of the Silver Stream through the presence of the improvised crossing structures and/or the remains of the existing bridge.
- Risks of river bank erosion and/or silt loading from informal crossings and/or through the change in flow dynamics particularly during high water levels.

In short, there are expected to be no benefits associated with the No-Go alternative. It is concluded the Project is a preferred option to the No-Go Alternative and it is highly recommended that the No-Go Alternative not receive any further consideration.

[17] DEAT (2005) *Guideline 5: Assessment of Alternatives and Impacts in support of the Environmental Impact Regulations, 2006. Integrated Environmental Management Guideline Series*, Department of Environmental Affairs and Tourism (DEAT), Pretoria.

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SECTION B: DEDEA BASIC ASSESSMENT REPORT

This section presents the Basic Environmental Assessment in the format prescribed by DEDEA (version 1).

Exemption is being sought from the consideration of project alternatives (site and activity) other than the mandatory 'No-Go' alternative.

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SECTION C: CONCLUSIONS

1. Environmental Impact Statement

There is a clear 'need and desirability' for the Project as supported by community inputs during the PPP and as described in the current suite of municipal strategic planning frameworks.

On balance, it is anticipated that the construction of the Project will have a low negative impact on the biophysical environment provided an Environmental Management Programme (EMPR) is rigorously implemented and monitored by an independent Environmental Control Officer (ECO). A low positive impact on the human environment will result from the short term construction phase employment and training opportunities as well as the acquisition of construction materials from local suppliers and other workforce needs.

The operation or use of the Project is likely to have a low negative impact on the biophysical environment with the main impacts most likely to be associated with any accidents and spills which could arise, albeit infrequently: these would be especially important in proximity to the Silver Stream. Conversely, the removal of people and vehicles from passing directly through the river and the removal of the existing bridge structures should have a moderate positive impact on the aquatic systems.

The operation or use of the new bridge crossing is expected to have a low negative impact at most, on the human environment given the relatively isolated position of the bridge crossing to existing dwellings. Visual impacts may result from the physical presence of the bridge which will form a prominent feature in the landscape until such time as a degree of acclimatisation to the change occurs. However, views of the crossing point are either oblique or distant and no specific concerns have been raised by the community about any loss of quality of views. Low negative impacts on the aquatic environment or for public health and safety may result from any accidents on or at the new bridge where these lead to spills, however this is expected to be the exception rather than the norm. Low aquatic related impacts are dependent on the design of the bridge insofar as it must prevent any channel changes resulting from scouring or changes in flow and reduce the long term risk of bank destabilisation at a minimum (see 'Recommendations' below).

Overall, the localised negative impacts linked to the use of the Project are considered to be significantly outweighed by the moderate positive impacts that will result from the new bridge crossing and the removal of the existing structure.

These biophysical and human benefits will include:

- Removing the risk of pedestrians (and/or vehicles) being washed away and/or drowning during high water flow at the crossing (or other informal crossings) specifically but providing generally safer and easier access across the Silver Stream for all ages.
- Reducing the effects of severance for communities further upstream when it is not possible to cross the Silver Stream on foot or by vehicle by providing an all weather crossing.
- Reducing the risk of further riparian habitat and physical degradation of the river banks and beds by removing human activity (and inherent pollution risks) directly from the river course and river banks.
- Restoring 'normal' flows in the Silver Stream (and White Kei River) by removing the remnants of the existing bridge which are clearly affecting water flow, and promoting further bank damage and flood risk.
- Removing barriers to fish and other aquatic fauna which currently exist.

It is concluded in the Aquatic Specialist Study Report that *'the building of a river crossing provides an opportunity to mitigate a number of the current riverine impacts through careful design and rigorous implementation of the mitigation measures and recommendations provided'*.

The primary potential cumulative impacts which may arise from the Project are expected to be associated with improved access to community facilities, such as clinics, hospitals and schools and improved access to employment. There is a possibility this may in turn result in community enhancement through income generation and/or access to services.

There is clear motivation for the Project as demonstrated by the community during the public participation process and supported by the results of the need and desirability assessment. Rather, the absence of the Project, i.e. the No-Go Alternative, would represent a conflict with Emalahleni Municipality's strategic planning focus as well as the community requirements. There are perceived to be no biophysical or human benefits associated with the No-Go situation.

Attached, in APPENDIX F, is an Environmental Management Programme which is to be applied during the construction phase in order to mitigate any negative impacts which may otherwise arise. Additional recommendations are outlined below.

2. Recommendations/Conditions for Authorisation

1. The final design of the Project must consider the following recommendations:

   - The design of the bridge should be informed wherever possible by the Massachusetts Stream Crossing Guidelines (refer to Appendix F of the Aquatic Specialist Study Report, APPENDIX D).

   - The active channel width, water flow and substrate continuity must be maintained through the design of the bridge including the provision of stabilisation measures on the bridge structures and on the banks and ensuring the piers are located outside the low-flow active channel. No step must be allowed to form in the channel due to scour over time.

   - The stabilisation measures should be planned and implemented with larger floods in mind (viz larger than 1:50 year).

   - Where possible, bioengineering solutions should be considered for the stabilisation measures, e.g. using rooting and vegetation cover in combination with geotextiles and 'hard' engineering.

2. The relevant prior DWA authorisation (a General Authorisation or License) must be obtained for the construction of a new bridge, as required under Section 21 of the National Water Act 36 of 1998.[18] Construction cannot commence until the authorisation has been received from DWA.

3. The construction of the new bridge should not be allowed to proceed without the approval and implementation of a detailed Environmental Management Plan (EMPR) for the Construction Phase. The EMPR is included in APPENDIX F.

4. The EMPR must be legally binding on all contractor and subcontractors operating on site. Contractors and subcontractors must accept responsibility for abiding by the environmental specifications and penalty clauses (e.g. fines) must be included in the contract documentation and applied in event of non-conformance.

5. An external independent Environmental Control Officer must be appointed to undertake site inspections for the duration is of the construction phase (from site preparation through to handover): the frequency of the site inspections described in the EMPR.

[18] This process is currently underway – refer to APPENDIX G.

6. All construction staff must undergo environmental awareness training and must be made aware of the consequences should the specifications of the EMPR and the conditions of the DEDEA authorisation be contravened.

7. Construction work should be limited to the immediate area only. Everything outside of the construction area must be regarded as no-go, particularly where private property is involved.

8. Especial care must be taken during the construction of the new bridge and removal of the existing bridge, in particular, to protect the Silver Stream (and White Kei River) from physical, chemical or biological degradation.

9. The Present Ecological State (PES) for the Silver Stream (B/C) must be maintained (or improved) during the construction (and operation) of the new bridge and approach roads.

10. Construction activities should take place during low flow months and should be completed as quickly as possible.

11. In the event coffer dams are to be used, these must not be constructed with sand bags. The coffer dam must facilitate at least 25% of the 'normal' flow and must not be too high to cause damming of the Silver Stream River upstream of the crossing.

12. Any temporary crossing structure or access must not cause damming of the Silver Stream River upstream of the crossing.

13. It is critical sediment loading and/or pollution is limited to an absolute minimum during construction – see also Recommendation 9 above.

14. Material (cobbles) for gabions is not to be removed from the river channels.

15. Should borrow pits be required for the Project the prescribed process described in the Minerals and Petroleum Resources Development Act 28 of 2002 must be followed and a permit obtained from Department of Minerals and Energy (DME) in advance of materials being extracted.

16. An attempt must be made to use local contractors and suppliers where possible. Labour intensive construction measures should be employed if possible as long as this approach does not result in a greater impact on the environment. A labour desk or similar structure may be required to assist with the fair recruitment of local labour.

17. A Community Liaison Officer must be appointed as a community representative and an ongoing communication with the public must be maintained during construction.

18. Sign boards should be erected and a complaints register maintained.

19. The construction works area must be fenced during the construction phase to maintain site security and to restrict access to the site by grazing animals and pedestrians.

20. Safe access across the Silver Stream must be maintained during construction.

21. The existing bridge and associated structures (e.g. concrete slabs and remaining gabion structures) must be demolished and removed off site. Care must be taken to replace gaps left in the Silver Stream River channel with material that is similar to the channel substrate

22. Exotic vegetation to be cleared from the area.

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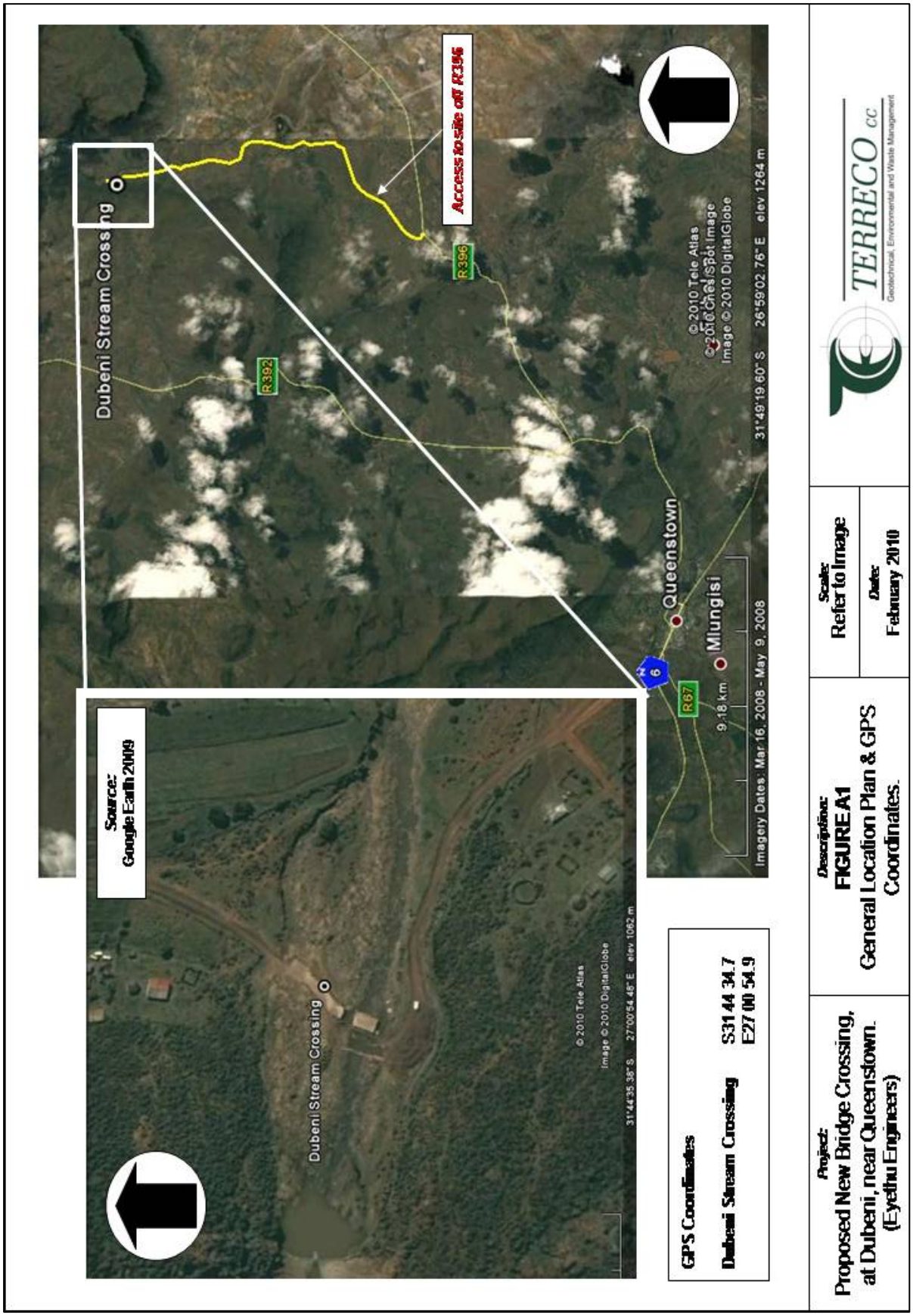
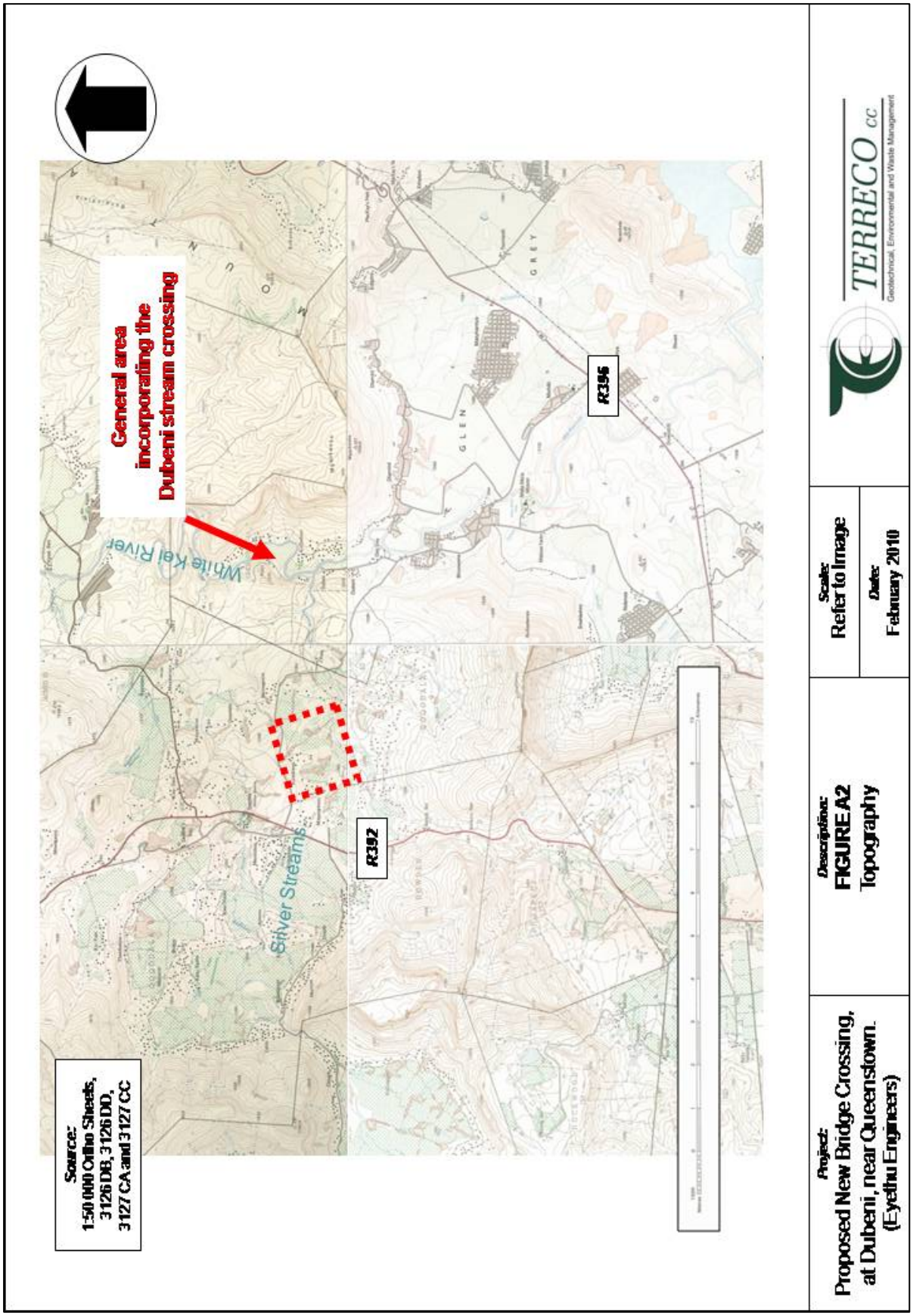
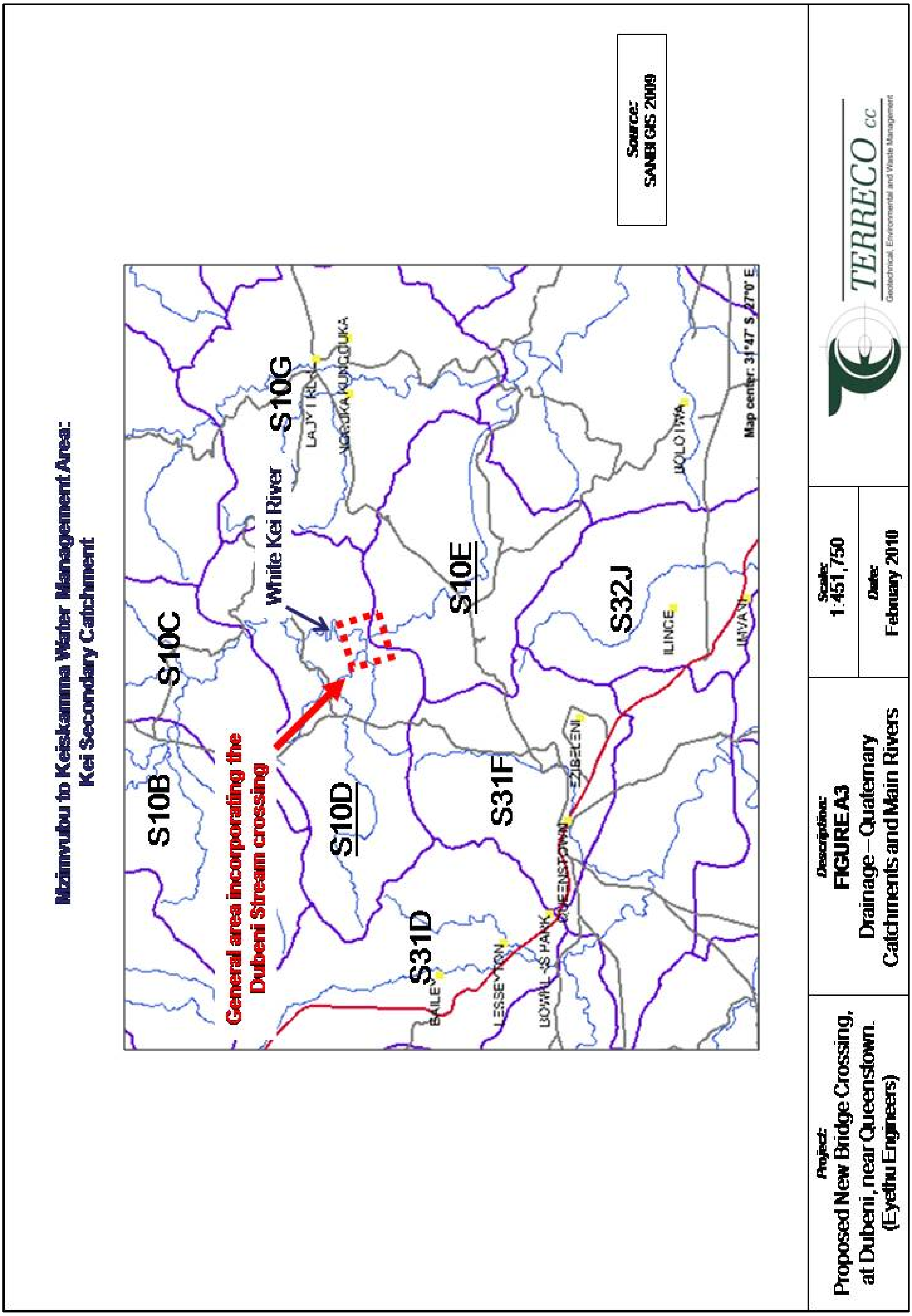
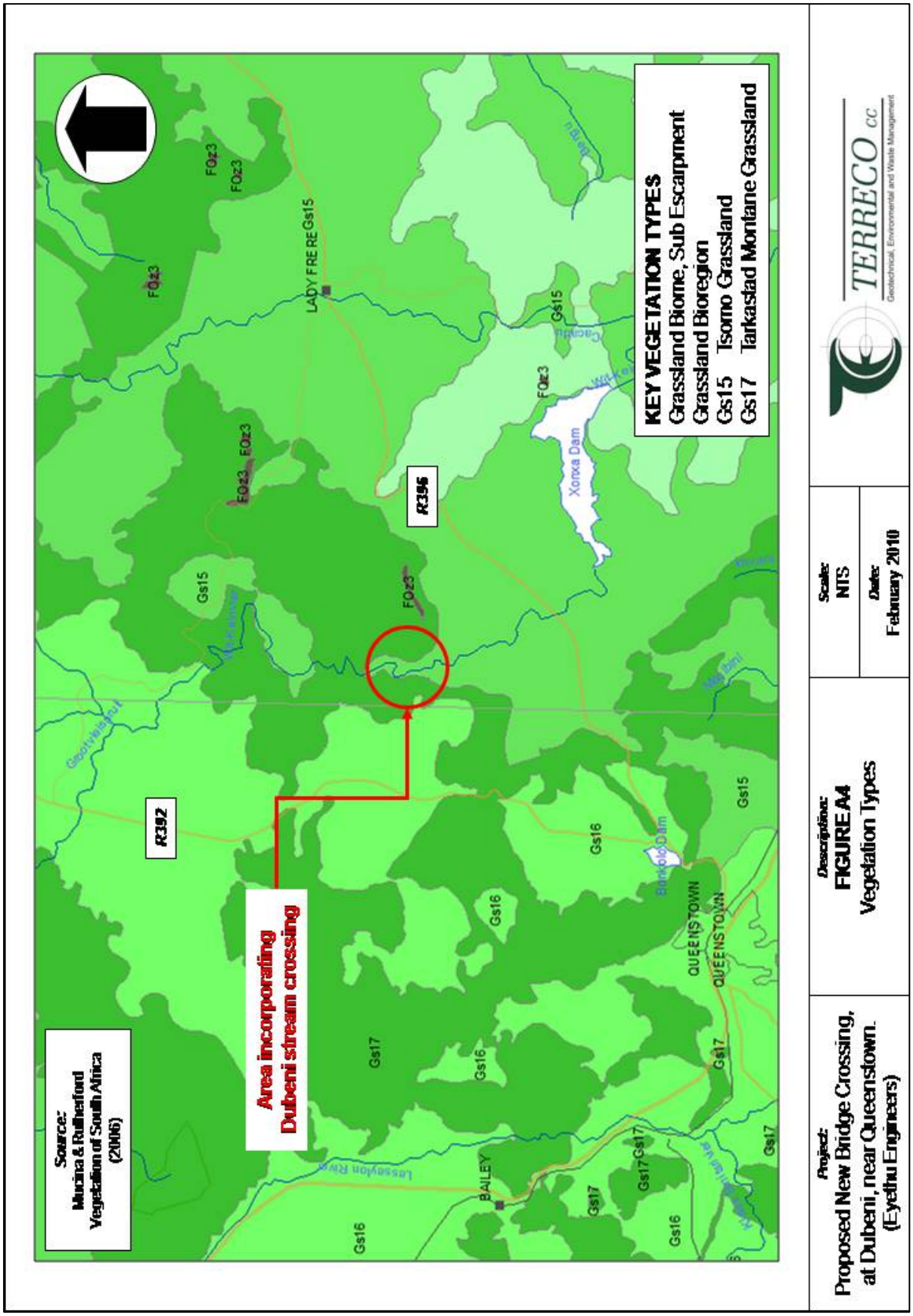
APPENDIX A: SITE PLAN(S)

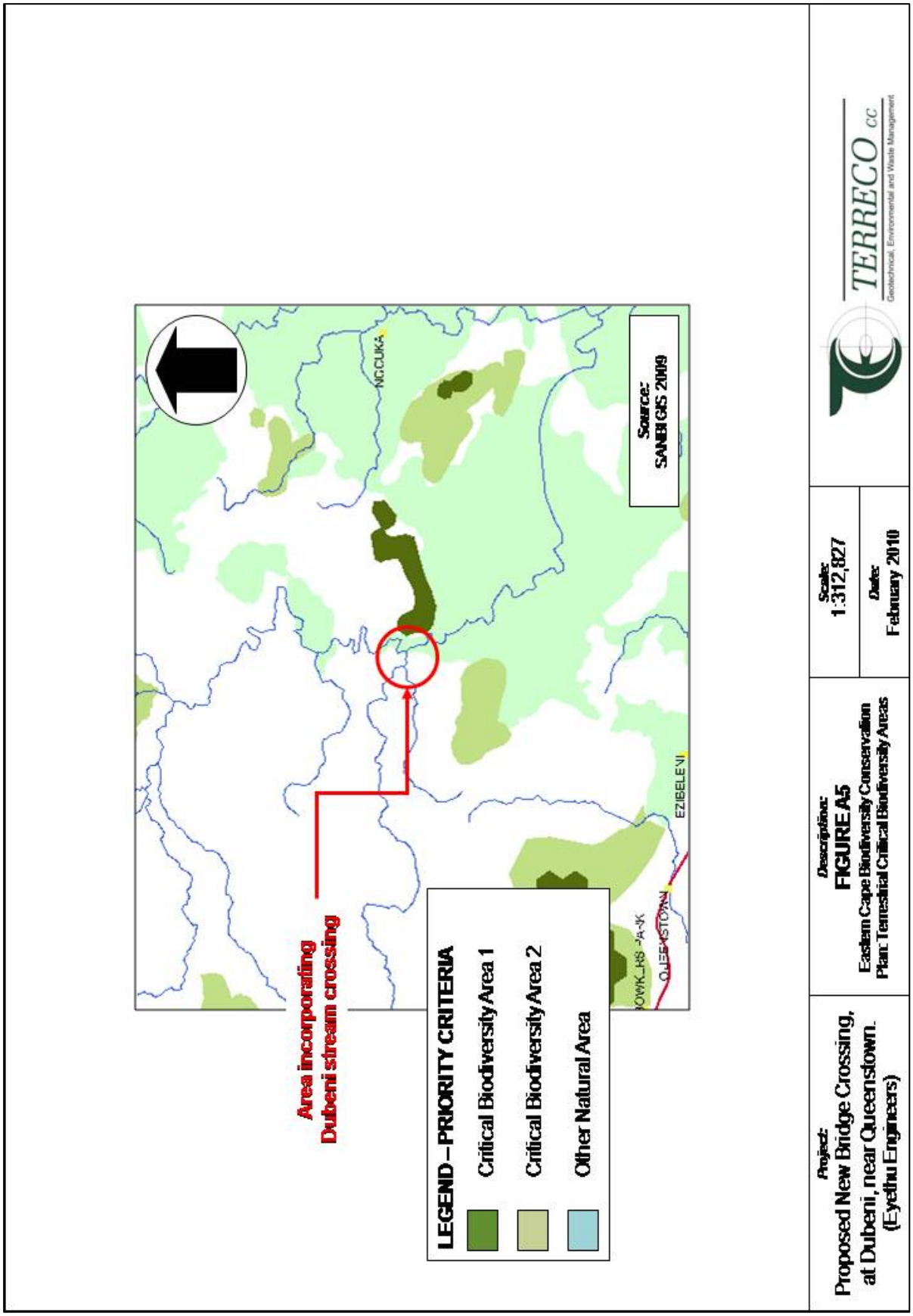
Figure A1	General Location Plan & GPS Coordinates.
Figure A2	Topography.
Figure A3	Drainage – Quaternary Catchments and Main Rivers.
Figure A4	Vegetation Types.
Figure A5	Eastern Cape Biodiversity Conservation Plan: Terrestrial Critical Biodiversity Areas.
Figure A6	Regional Geology.
Figure A7a	Soils.
Figure A7b	Soil Erodibility.
Figure A8	Land Cover.

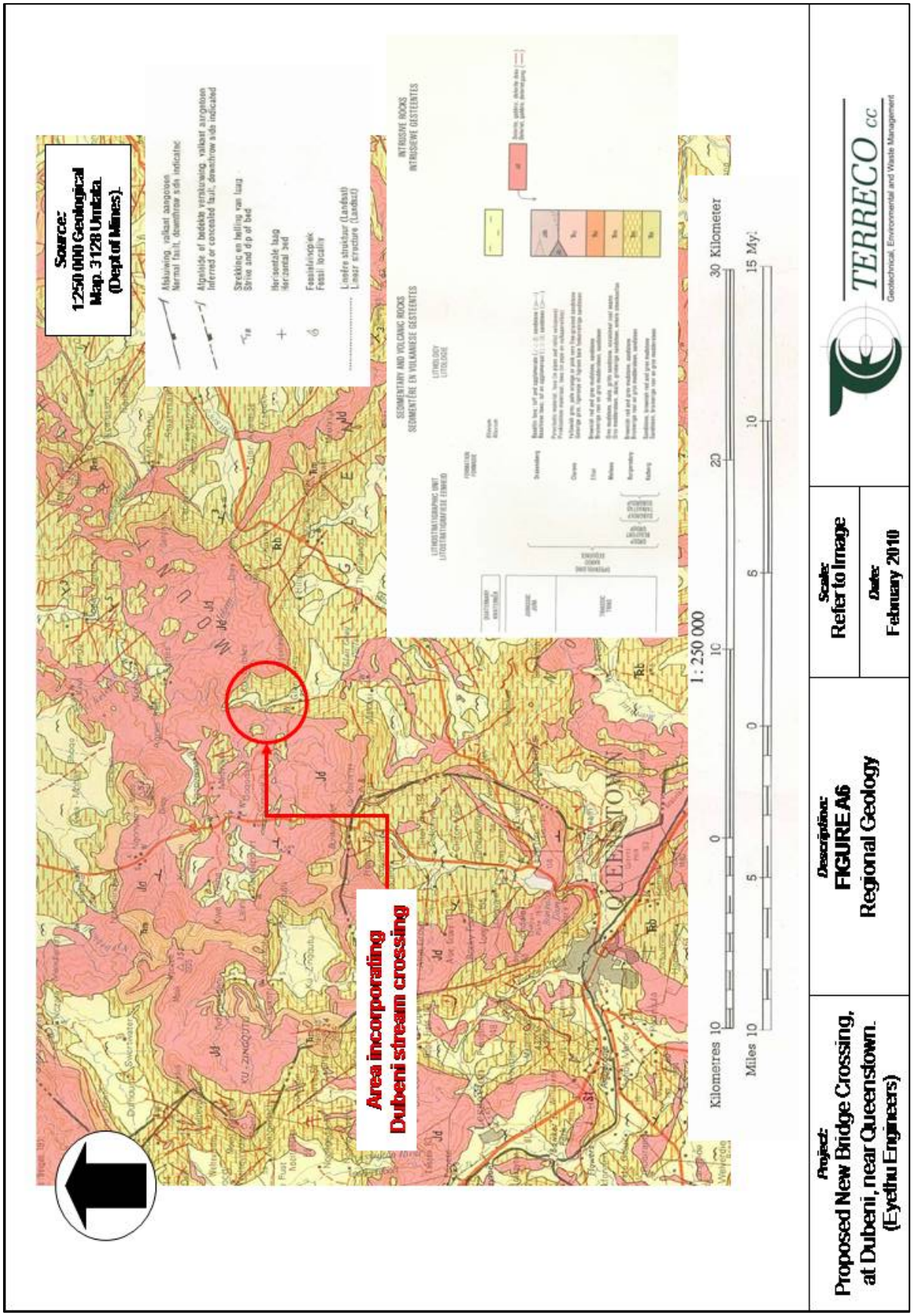

Source: Google Earth 2009
Dubeni Stream Crossing
© 2010 Tele Atlas
Image © 2010 DigitalGlobe
31°44'35.38" S 27°00'54.48" E elev 1062 m
Dubeni Stream Crossing
Access to site off R396
R392
R396
R67
Queenstown
Mlungisi
9.18 km
© 2010 Tele Atlas
© 2010 CNES / Spot Image
Image © 2010 DigitalGlobe
Imagery Dates: Mar 16, 2008 - May 9, 2008
31°49'19.60" S 26°59'02.76" E elev 1264 m
GPS Coordinates
Dubeni Stream Crossing S31 44 34.7
E27 00 54.9
Project:
Proposed New Bridge Crossing, at Dubeni, near Queenstown. (Eyethu Engineers)
Description:
FIGURE A1
General Location Plan & GPS Coordinates.
Scale:
Refer to Image
Date:
February 2010
TERRECO cc
Geotechnical, Environmental and Waste Management

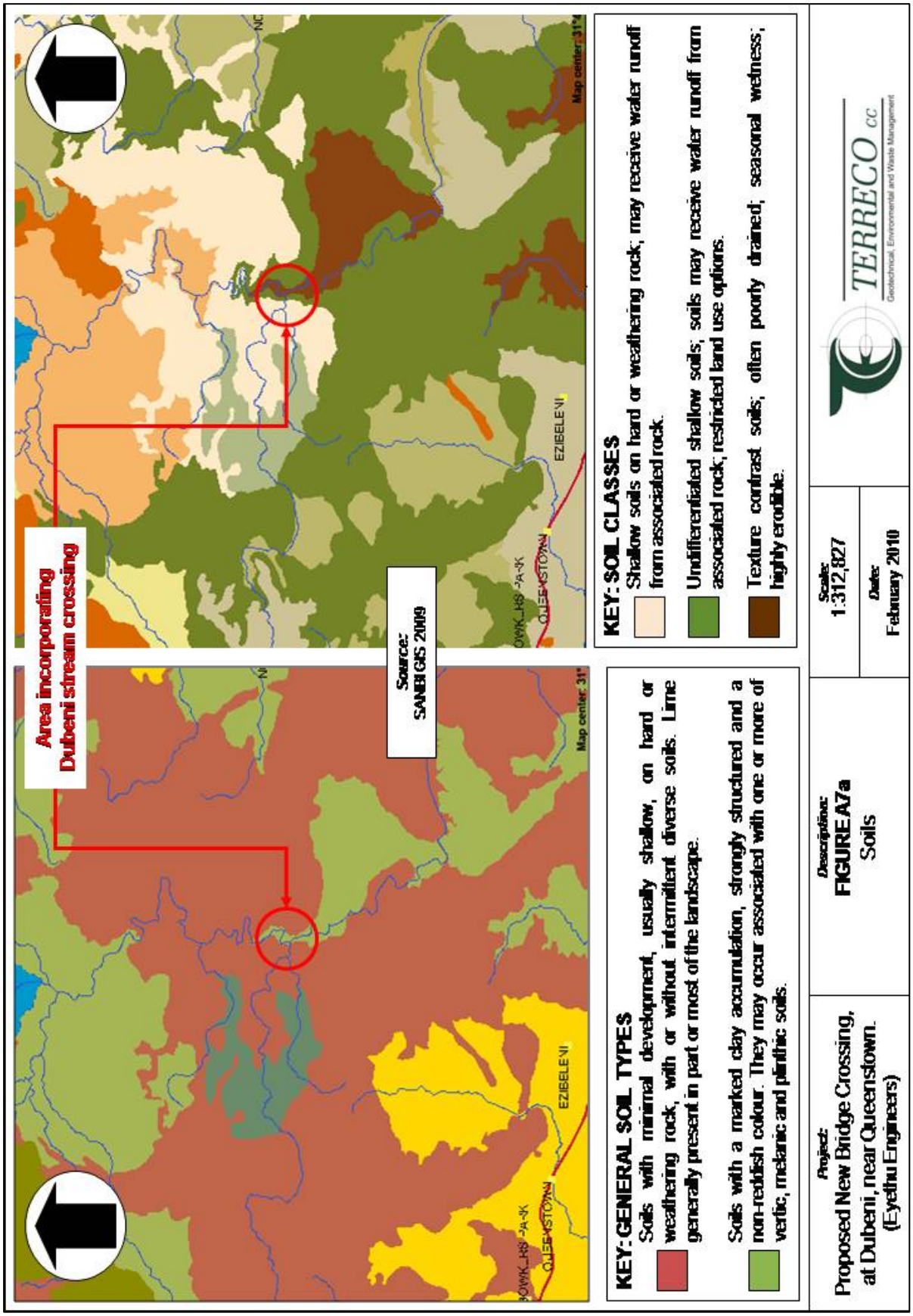

General area incorporating the Dubeni stream crossing
White Kei River
Silver Streams
R392
R396
GLEN GREY
Source: 1:50 000 Ortho Sheets, 3126DB, 3126DD, 3127CA and 3127CC
Project: Proposed New Bridge Crossing, at Dubeni, near Queenstown. (Eyethu Engineers)
Description: FIGURE A2 Topography
Scale: Refer to Image
Date: February 2010
TERRECO cc
Geotechnical, Environmental and Waste Management

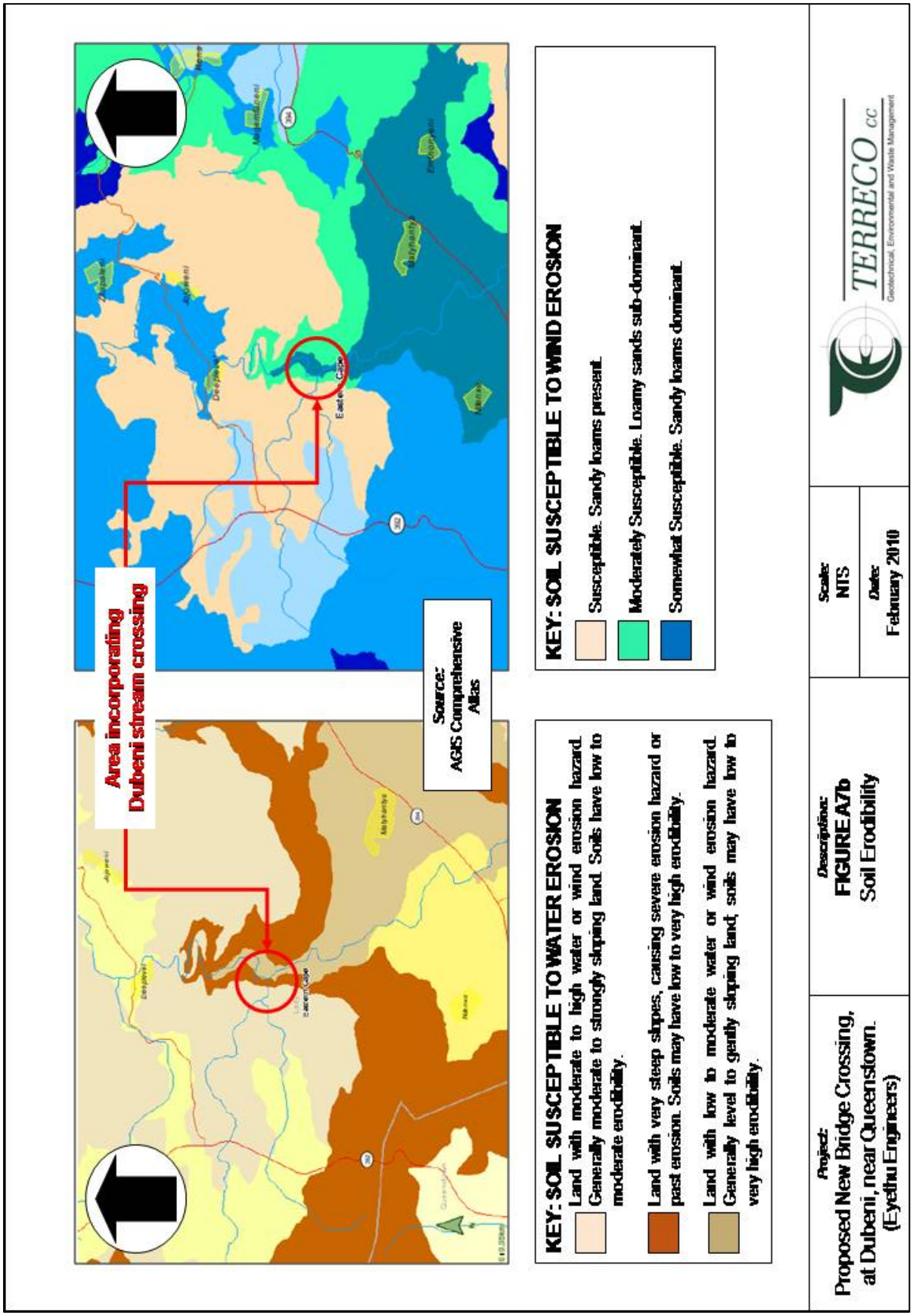

Mzimvubu to Keiskamma Water Management Area:
Kei Secondary Catchment
Source:
SANBI GIS 2009
General area incorporating the
Dubeni Stream crossing
White Kei River
S10B
S10C
S10D
S10E
S10G
S31D
S31F
S32J
QUEENSTOWN
EZIBELENI
ILINGE
LESSEYTON
BAILEY
BOWKER'S PARK
Map center: 31°47' S, 27°0' E
Project:
Proposed New Bridge Crossing,
at Dubeni, near Queenstown.
(Eyethu Engineers)
Description:
FIGURE A3
Drainage – Quaternary
Catchments and Main Rivers
Scale:
1:451,750
Date:
February 2010
TERRECO cc

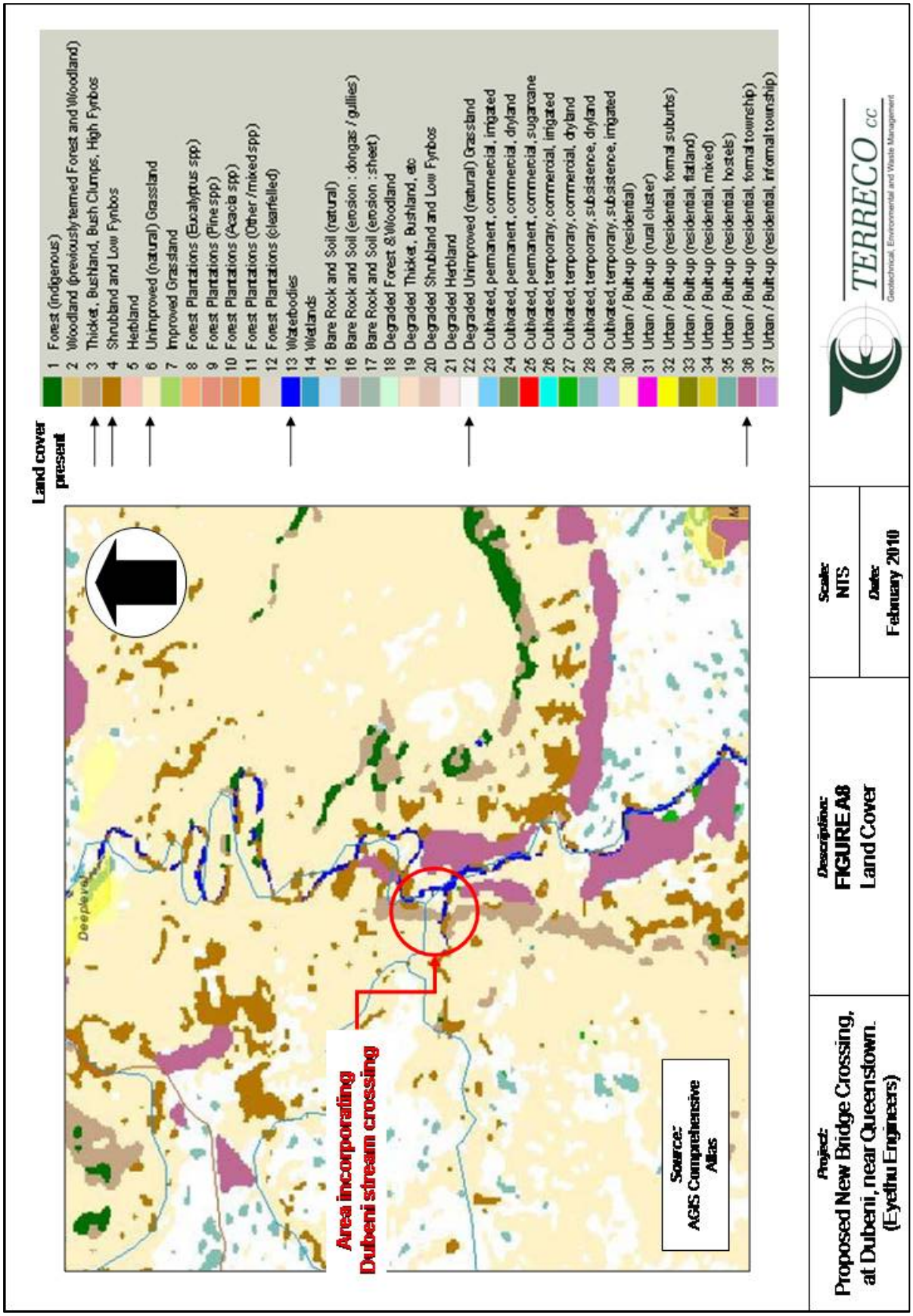

KEY VEGETATION TYPES
Grassland Biome, Sub Escarpment Grassland Bioregion
Gs15 Tsomo Grassland
Gs17 Tarkastad Montane Grassland
Area incorporating Dubeni stream crossing
Source: Mucina & Rutherford Vegetation of South Africa (2006)
R392
R396
LADY FRE RE
BAILEY
QUEENSTOWN
Xonxa Dam
Project: Proposed New Bridge Crossing, at Dubeni, near Queenstown. (Eyethu Engineers)
Description: FIGURE A4 Vegetation Types
Scale: NTS
Date: February 2010
TERRECO cc
Geotechnical, Environmental and Waste Management


Area incorporating
Dubeni stream crossing
LEGEND – PRIORITY CRITERIA
Critical Biodiversity Area 1
Critical Biodiversity Area 2
Other Natural Area
Source:
SANBI GIS 2009
NGCUKA
EZIBELENI
Project:
Proposed New Bridge Crossing,
at Dubeni, near Queenstown.
(Eyethu Engineers)
Description:
FIGURE A5
Eastern Cape Biodiversity Conservation
Plan: Terrestrial Critical Biodiversity Areas
Scale:
1:312,827
Date:
February 2010
TERRECO cc
Geotechnical, Environmental and Waste Management


Source:
1:250 000 Geological
Map. 3128 Umtata.
(Dept of Mines).
Area incorporating
Dubeni stream crossing
1 : 250 000
Kilometres 10 0 10 20 30 Kilometer
Miles 10 5 0 5 10 15 My.
Project:
Proposed New Bridge Crossing,
at Dubeni, near Queenstown.
(Eyethu Engineers)
Description:
FIGURE A6
Regional Geology
Scale:
Refer to Image
Date:
February 2010
TERRECO cc
Geotechnical, Environmental and Waste Management

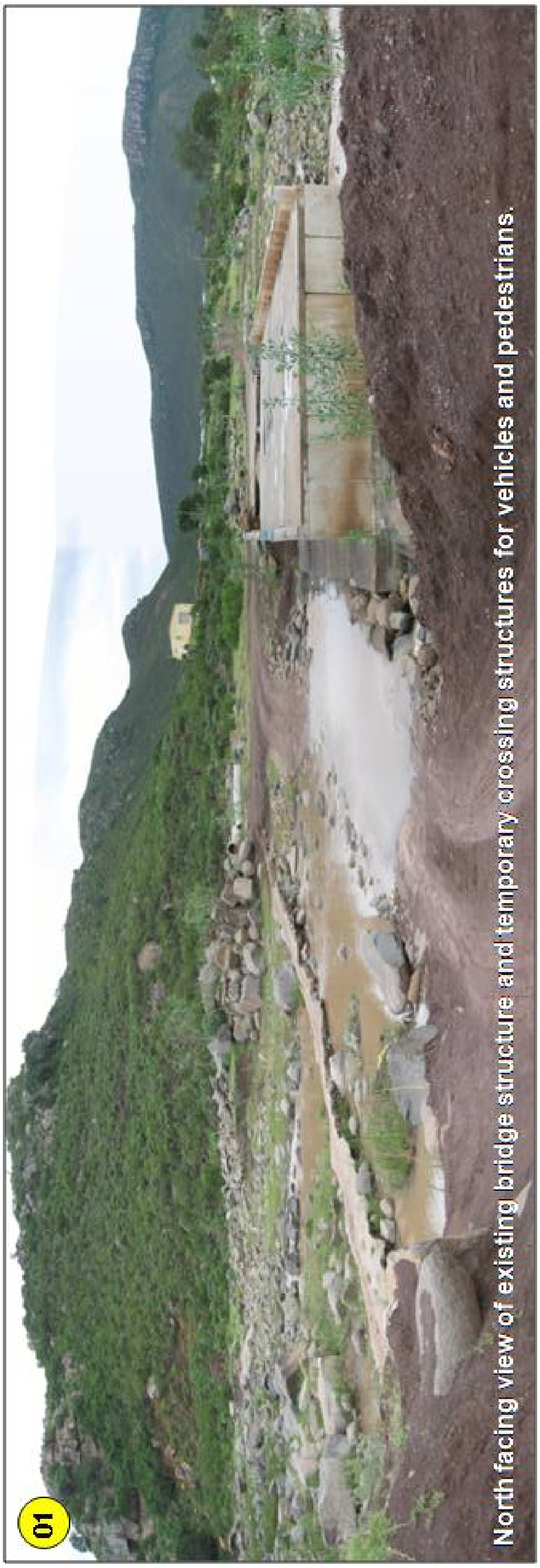

Area incorporating Dubeni stream crossing
Source: SANBI GIS 2009
KEY: GENERAL SOIL TYPES
Soils with minimal development, usually shallow, on hard or weathering rock, with or without intermittent diverse soils. Lime generally present in part or most of the landscape.
Soils with a marked clay accumulation, strongly structured and a non-reddish colour. They may occur associated with one or more of vertic, melanic and plinthic soils.
KEY: SOIL CLASSES
Shallow soils on hard or weathering rock; may receive water rundf from associated rock.
Undifferentiated shallow soils; soils may receive water rundf from associated rock; restricted land use options.
Texture contrast soils; often poorly drained; seasonal wetness; highly erodible.
Project:
Proposed New Bridge Crossing, at Dubeni, near Queenstown. (Eyethu Engineers)
Description:
FIGURE A7a
Soils
Scale:
1:312,827
Date:
February 2010
TERRECO cc
Geotechnical, Environmental and Waste Management


Area incorporating Dubeni stream crossing
Source: AGIS Comprehensive Atlas
KEY: SOIL SUSCEPTIBLE TO WATER EROSION
Land with moderate to high water or wind erosion hazard. Generally moderate to strongly sloping land. Soils have low to moderate erodibility.
Land with very steep slopes, causing severe erosion hazard or past erosion. Soils may have low to very high erodibility.
Land with low to moderate water or wind erosion hazard. Generally level to gently sloping land, soils may have low to very high erodibility.
KEY: SOIL SUSCEPTIBLE TO WIND EROSION
Susceptible. Sandy loams present.
Moderately Susceptible. Loamy sands sub-dominant.
Somewhat Susceptible. Sandy loams dominant.
Project:
Proposed New Bridge Crossing, at Dubeni, near Queenstown. (Eyethu Engineers)
Description:
FIGURE A7b
Soil Erodibility
Scale:
NTS
Date:
February 2010
TERRECO cc
Geotechnical, Environmental and Waste Management


Land cover present
1 Forest (indigenous)
2 Woodland (previously termed Forest and Woodland)
3 Thicket, Bushland, Bush Clumps, High Fynbos
4 Shrubland and Low Fynbos
5 Herbland
6 Unimproved (natural) Grassland
7 Improved Grassland
8 Forest Plantations (Eucalyptus spp)
9 Forest Plantations (Pine spp)
10 Forest Plantations (Acacia spp)
11 Forest Plantations (Other /mixed spp)
12 Forest Plantations (clearfelled)
13 Waterbodies
14 Wetlands
15 Bare Rock and Soil (natural)
16 Bare Rock and Soil (erosion : dongas / gullies)
17 Bare Rock and Soil (erosion : sheet)
18 Degraded Forest &Woodland
19 Degraded Thicket, Bushland, etc
20 Degraded Shrubland and Low Fynbos
21 Degraded Herbland
22 Degraded Unimproved (natural) Grassland
23 Cultivated, permanent, commercial, irrigated
24 Cultivated, permanent, commercial, dryland
25 Cultivated, permanent, commercial, sugarcane
26 Cultivated, temporary, commercial, irrigated
27 Cultivated, temporary, commercial, dryland
28 Cultivated, temporary, subsistence, dryland
29 Cultivated, temporary, subsistence, irrigated
30 Urban / Built-up (residential)
31 Urban / Built-up (rural cluster)
32 Urban / Built-up (residential, formal suburbs)
33 Urban / Built-up (residential, flatland)
34 Urban / Built-up (residential, mixed)
35 Urban / Built-up (residential, hostels)
36 Urban / Built-up (residential, formal township)
37 Urban / Built-up (residential, informal township)
Deepleve
Area incorporating Dubeni stream crossing
Source: AGIS Comprehensive Atlas
TERRECO cc
Geotechnical, Environmental and Waste Management
Project: Proposed New Bridge Crossing, at Dubeni, near Queenstown. (Eyethu Engineers)
Description: FIGURE A8 Land Cover
Scale: NTS
Date: February 2010

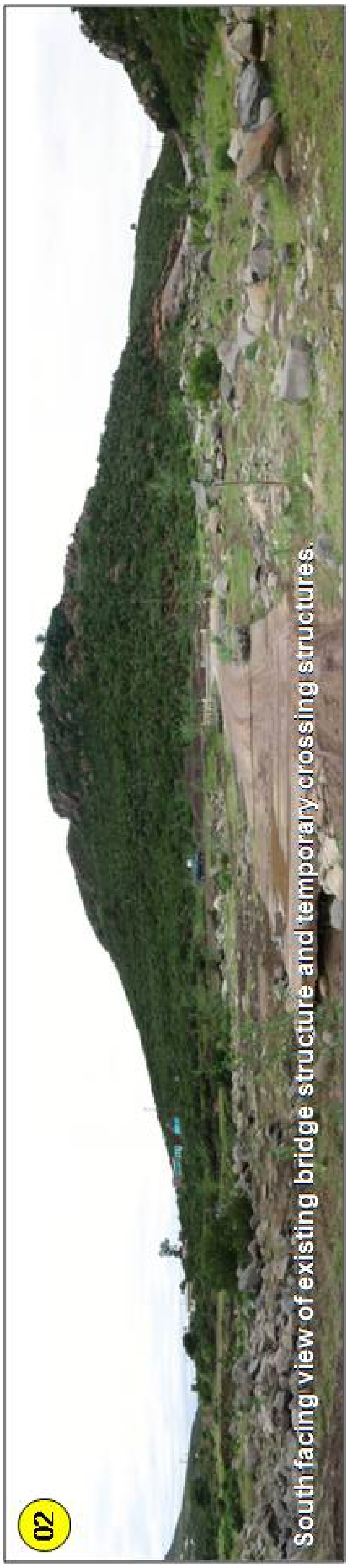
APPENDIX B: PHOTOGRAPHS

01



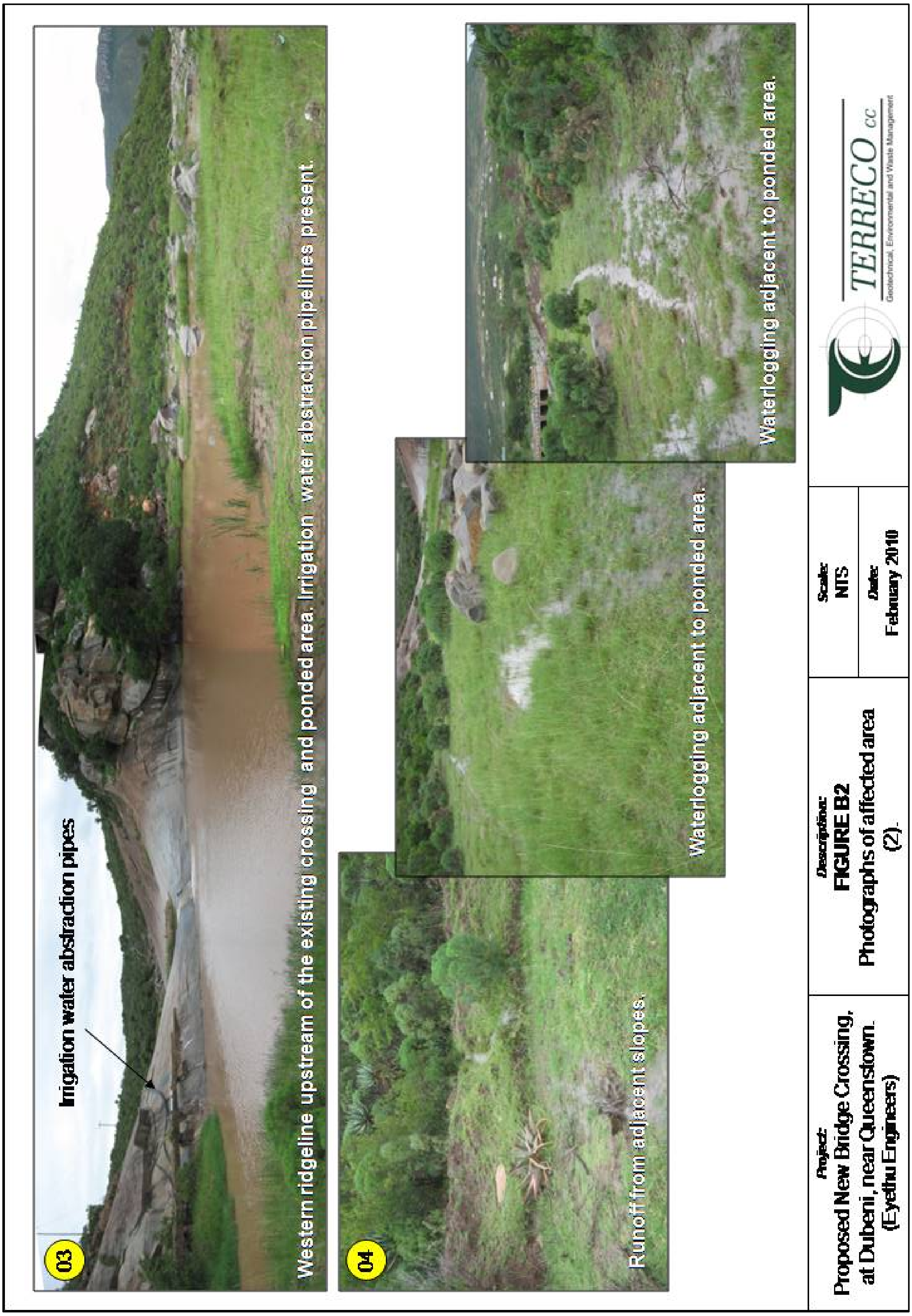
North facing view of existing bridge structure and temporary crossing structures for vehicles and pedestrians.

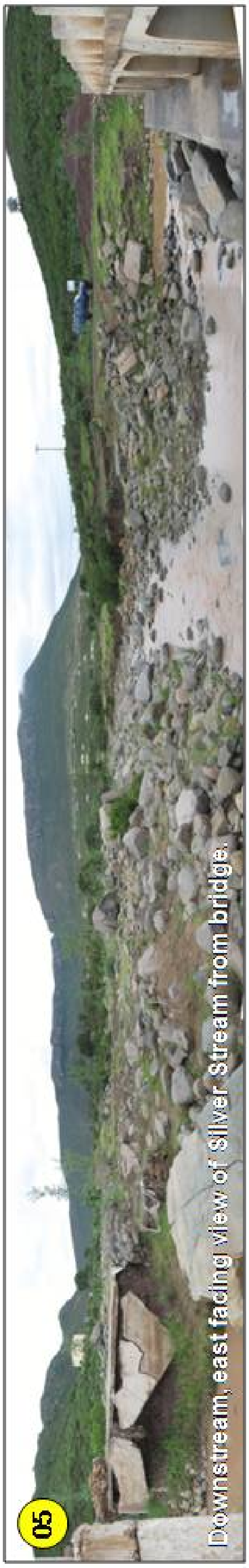
02



South facing view of existing bridge structure and temporary crossing structures.

Project:	Description:	Scale:	
Proposed New Bridge Crossing, at Dubeni, near Queenstown. (Eyethu Engineers)	FIGURE B1 Photographs of affected area (1).	NTS Date: February 2010	TERRECO cc Geotechnical, Environmental and Waste Management

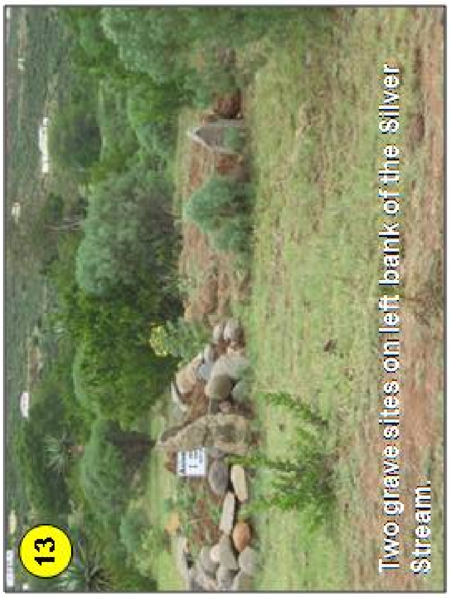

03
Irrigation water abstraction pipes
Western ridgeline upstream of the existing crossing and ponded area. Irrigation water abstraction pipelines present.
04
Runoff from adjacent slopes.
Waterlogging adjacent to ponded area.
Waterlogging adjacent to ponded area.
Project:
Proposed New Bridge Crossing, at Dubeni, near Queenstown. (Eyethu Engineers)
Description:
FIGURE B2
Photographs of affected area (2).
Scale:
NTS
Date:
February 2010
TERRECO cc
Geotechnical, Environmental and Waste Management



Project: **Proposed New Bridge Crossing, at Dubeni, near Queenstown. (Eyethu Engineers)**	*Description:* **FIGURE B3** Photographs of affected area (3).	*Scale:* NTS *Date:* February 2010	TERRECO cc Geotechnical, Environmental and Waste Management

Project: **Proposed New Bridge Crossing, at Dubeni, near Queenstown. (Eyethu Engineers)**	***Description:*** **FIGURE B4** Photographs of affected area (4).	***Scale:*** NTS ***Date:*** February 2010	TERRECO cc Geotechnical, Environmental and Waste Management

12 Spoil heaps on right bank of Silver Stream.



13 Two grave sites on left bank of the Silver Stream.

14 Stormwater structure.

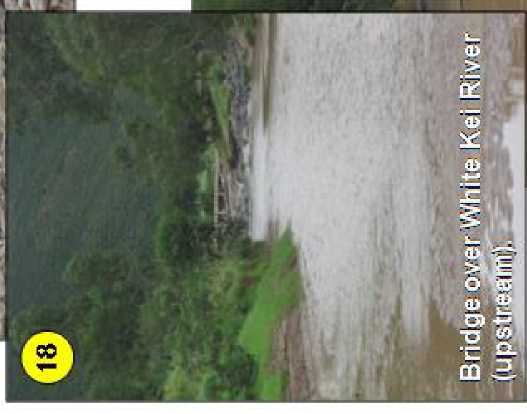
15 Flood channel or donga.

16a Alternative crossing for Silver Stream (1).

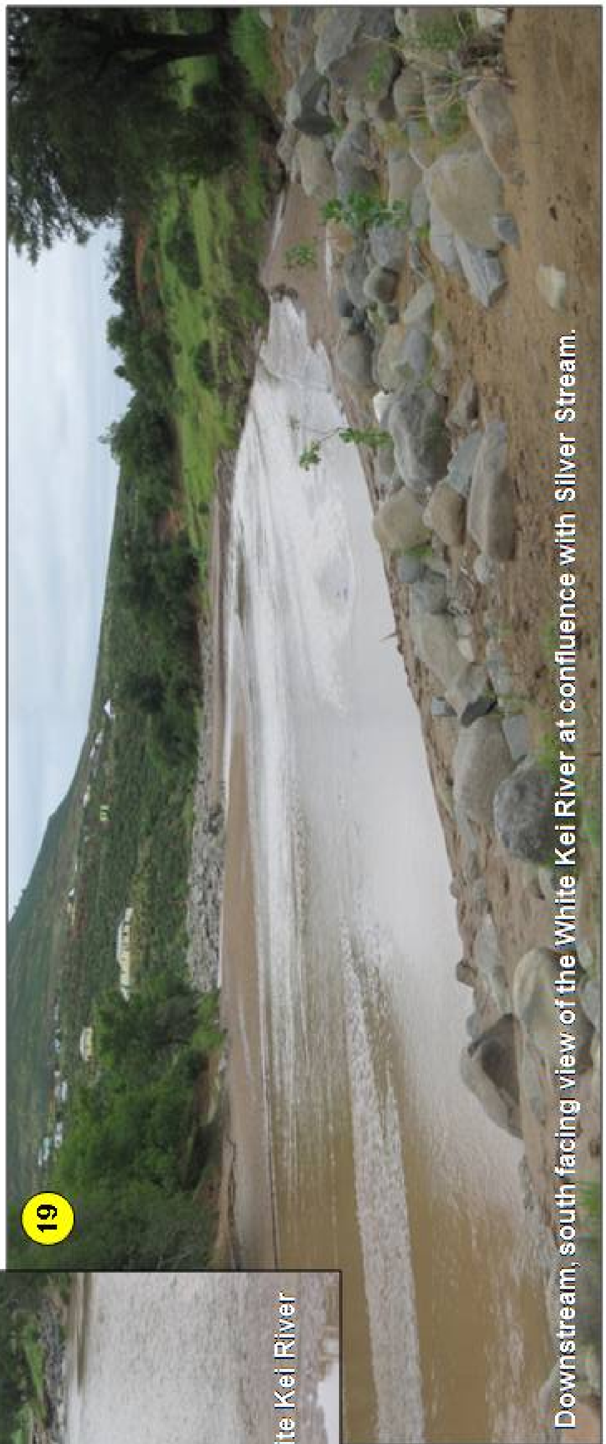
16b Alternative crossing for Silver Stream (2).

Project:	Description:	Scale:	
Proposed New Bridge Crossing, at Dubeni, near Queenstown. (Eyethu Engineers)	FIGURE B5 Photographs of affected area (5).	NTS	TERRECO cc Geotechnical, Environmental and Waste Management
		Date: February 2010	

17 Downstream, northerly facing view of the confluence between the Silver Stream and White Kei River.

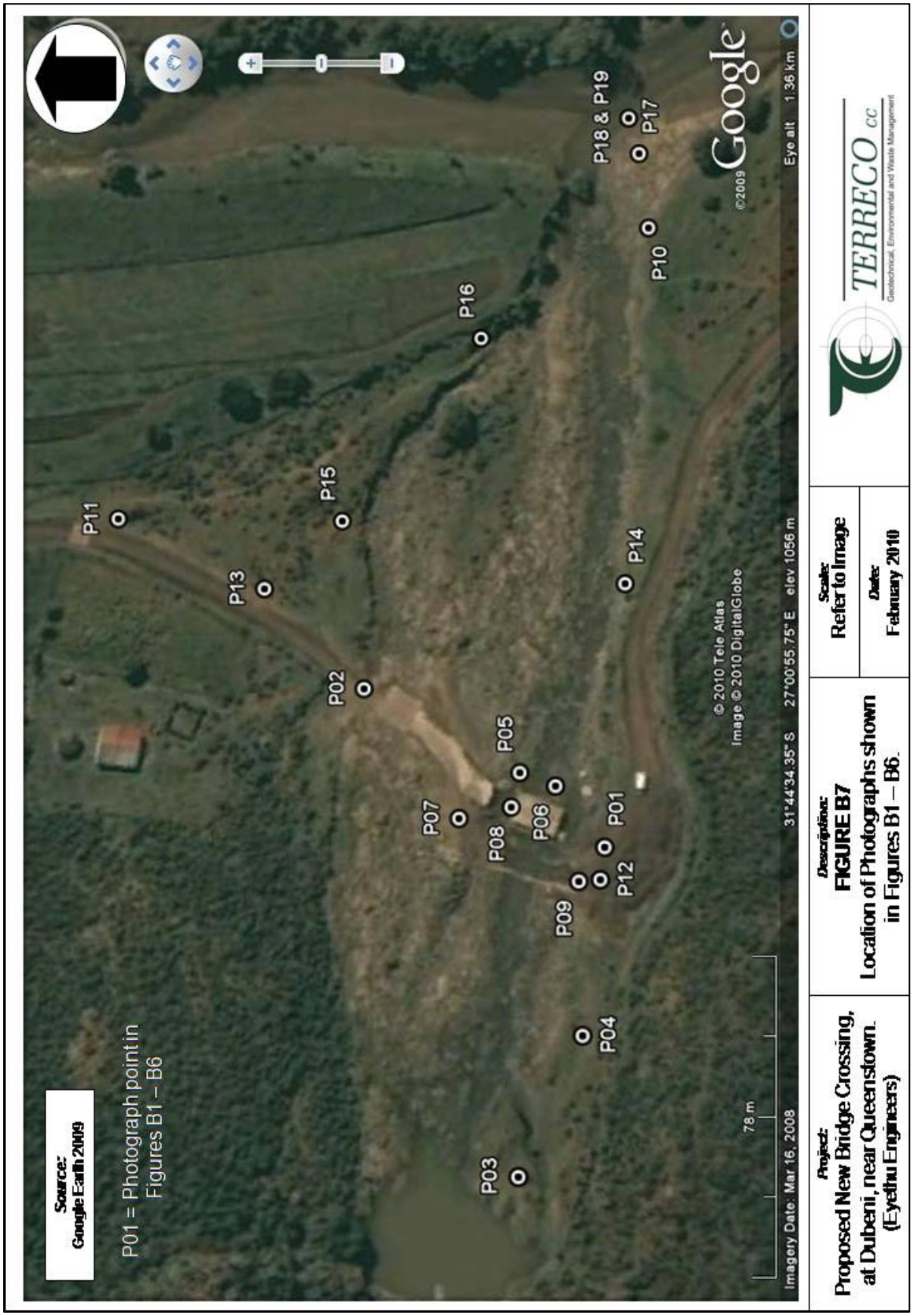


18 Bridge over White Kei River (upstream).



19 Downstream, south facing view of the White Kei River at confluence with Silver Stream.

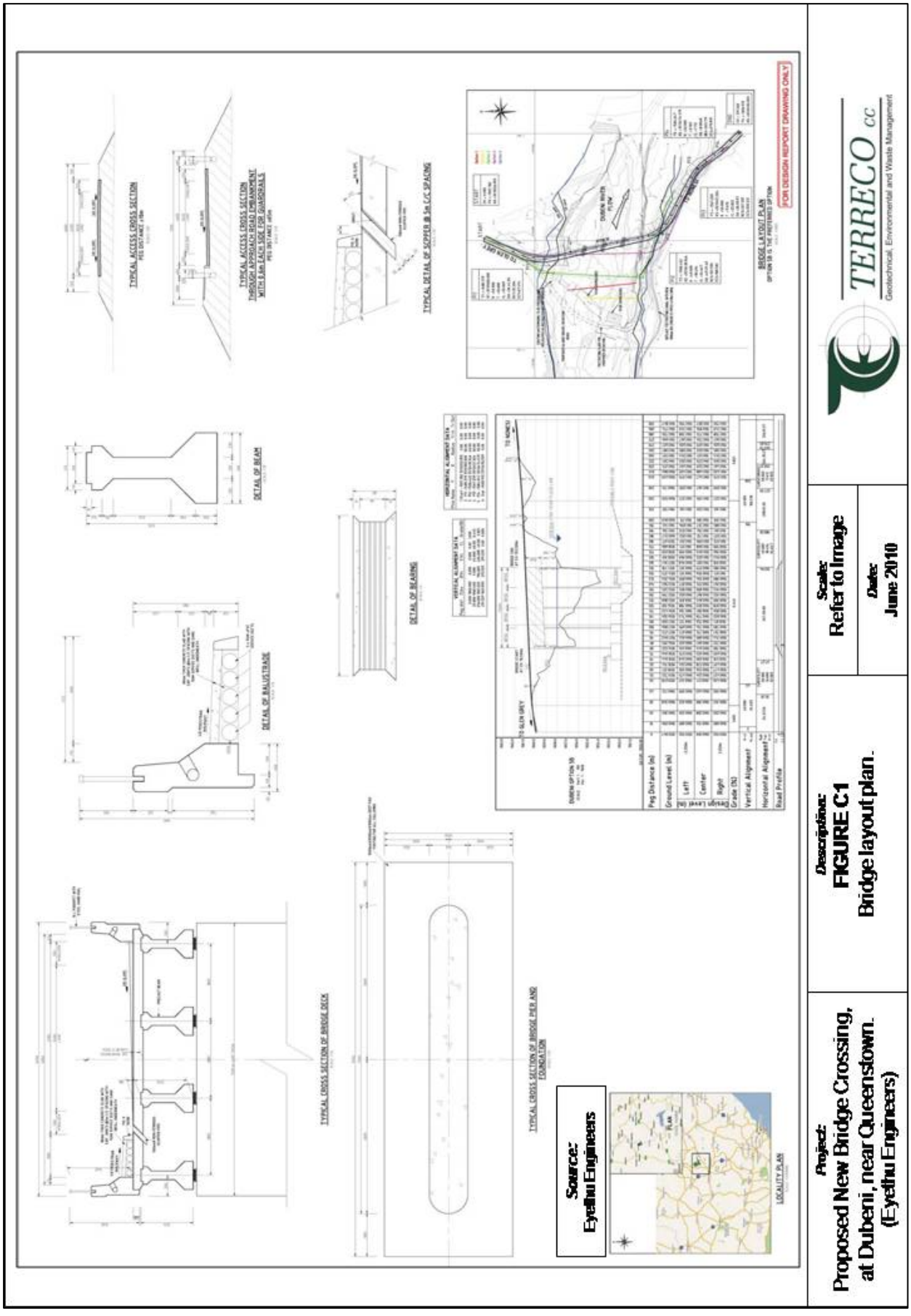
Project: Proposed New Bridge Crossing, at Dubeni, near Queenstown. (Eyethu Engineers)	**Description:** FIGURE B6 Photographs of affected area (6).	**Scale:** NTS **Date:** February 2010	TERRECO cc Geotechnical, Environmental and Waste Management

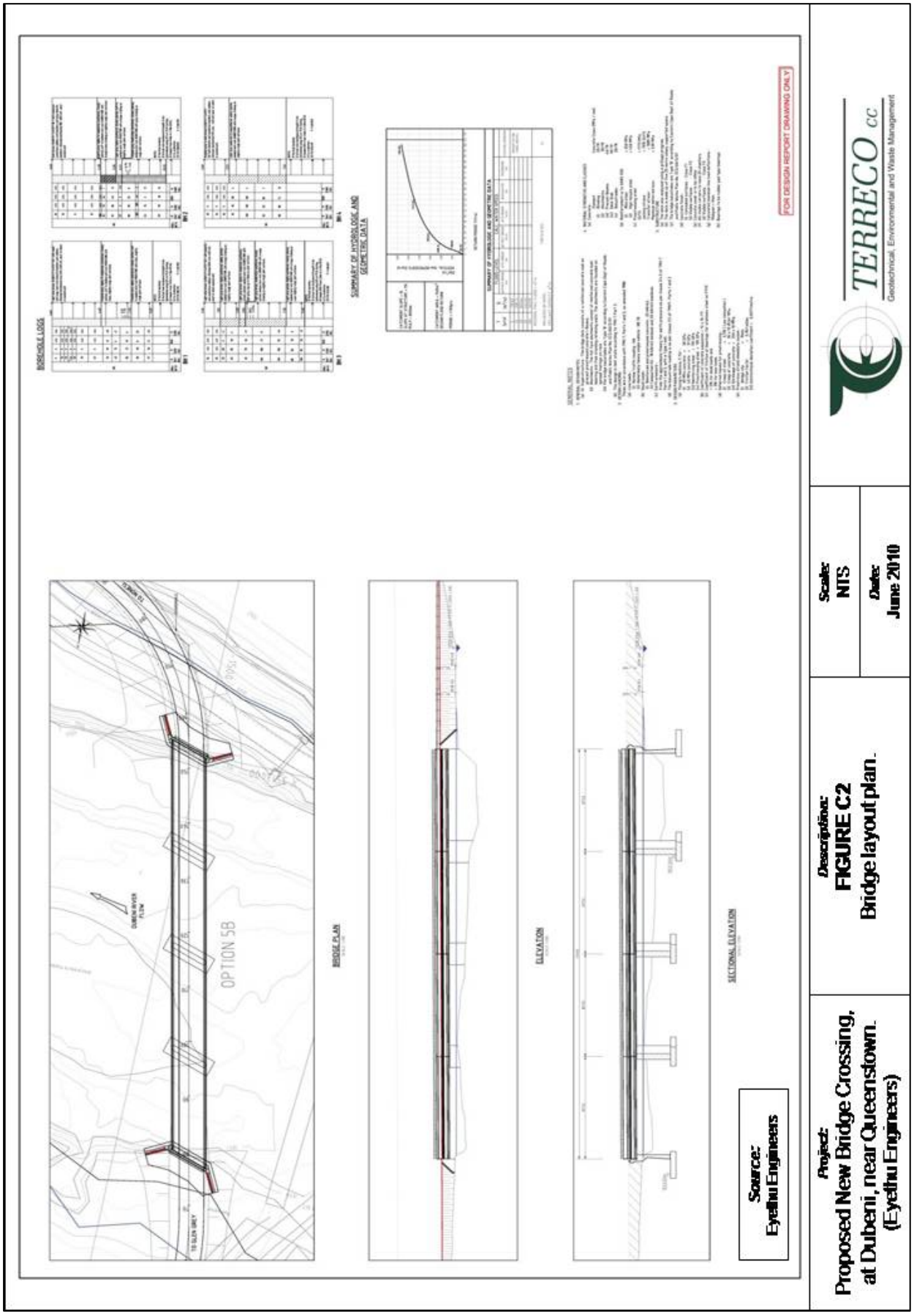

Source:
Google Earth 2009
P01 = Photograph point in Figures B1 – B6
P01
P02
P03
P04
P05
P06
P07
P08
P09
P10
P11
P12
P13
P14
P15
P16
P17
P18 & P19
78 m
Imagery Date: Mar 16, 2008
31°44'34.35" S 27°00'55.75" E elev 1056 m
Eye alt 1.36 km
© 2010 Tele Atlas
Image © 2010 DigitalGlobe
©2009 Google
Project:
Proposed New Bridge Crossing, at Dubeni, near Queenstown. (Eyethu Engineers)
Description:
FIGURE B7
Location of Photographs shown in Figures B1 – B6.
Scale:
Refer to Image
Date:
February 2010
TERRECO cc
Geotechnical, Environmental and Waste Management

APPENDIX C: FACILITY ILLUSTRATION(S)

Figure C1 General Arrangement for Bridge, Sheet 1 of 2.

Figure C2 General Arrangement for Bridge, Sheet 2 of 2.


TERRECO CC
Geotechnical, Environmental and Waste Management
Project:
Proposed New Bridge Crossing, at Dubeni, near Queenstown. (Eyethu Engineers)
Description:
FIGURE C1
Bridge layout plan.
Scale:
Refer to Image
Date:
June 2010
Source:
Eyethu Engineers
FOR DESIGN REPORT DRAWING ONLY
TYPICAL ACCESS CROSS SECTION
TYPICAL ACCESS CROSS SECTION
TYPICAL DETAIL OF SCOUR @ 3m C/C SPACING
BRIDGE LAYOUT PLAN
DETAIL OF BEAM
DETAIL OF BEARING
DETAIL OF BALUSTRADE
TYPICAL CROSS SECTION OF BRIDGE DECK
TYPICAL CROSS SECTION OF BRIDGE PIER AND FOUNDATION
LOCALITY PLAN


BOREHOLE LOGS
SUMMARY OF HYDROLOGIC AND GEOMETRIC DATA
FOR DESIGN REPORT DRAWING ONLY
OPTION 5B
BRIDGE PLAN
ELEVATION
SECTIONAL ELEVATION
Source:
Eyethu Engineers
Project:
Proposed New Bridge Crossing, at Dubeni, near Queenstown. (Eyethu Engineers)
Description:
FIGURE C2
Bridge layout plan.
Scale:
NTS
Date:
June 2010
TERRECO cc
Geotechnical, Environmental and Waste Management

APPENDIX D: SPECIALIST REPORTS

Appendix D1 Geotechnical Study by Terreco Geotech.

Appendix D2 Aquatic Specialist Study Report.

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APPENDIX E: COMMENTS AND RESPONSES REPORT

APPENDIX F: ENVIRONMENTAL MANAGEMENT PROGRAMME

APPENDIX G: OTHER INFORMATION

Appendix G1	Bridge Design Report (May 2010).
Appendix G2	Need and Desirability Assessment.
Appendix G3	Environmental Impact Assessment Criteria.
Appendix G4	Proof of application to DWA for Water Use (Section 21 (c) and (i))