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Project: Support for the Implementation and maintenance of the Algoa Reconciliation Strategy

Evaluation of the Raising of Kouga Dam

Reference: 107210

Prepared for:
Department of Water Affairs

Revision: 1

26 March 2013

Document Control Record

Aurecon South Africa (Pty) Ltd
PO Box 494
Cape Town
8000

T +21 526 5790
F +27 526 9500
E erik.vanderberg@aurecongroup.com
W www.aurecongroup.com

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Document control	aurecon					
Report Title	Evaluation of the Raising of Kouga Dam					
Document ID			**Project Number**		107210	
File Path	"p:\Projects\107210 Support for Implem & Maint - Algoa Recon Strategy\3 Delivery\06 Technical Support\Interventions\Dam in the Kouga River\Kouga Dam Raising Evaluation Draft Report.docx"					
Client	Department of Water Affairs		**Client Contact**		Ms Isa Thompson	
Rev	**Date**	**Revision Details/Status**	**Prepared by**	**Author**	**Verifier**	**Approver**
0	26 March 2013	Draft Report	Aurecon	Diane Erasmus, Frank Denys Patsy Scherman Erik van der Berg	Erik van der Berg	Erik van der Berg
Current Revision	1					

Approval			
Author Signature		Approver Signature	
Name	Erik van der Berg	Name	Erik van der Berg
Title	Ms	Title	Mr

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List of Acronyms

AWSS	Algoa Water Supply System
BAR	Basic assessment report
C.A.P.E	Cape Action for People and the Environment
CapeNature	Western Cape Nature Conservation Board
CBA	Critical Biodiversity Areas
DEA	Department of Environmental Affairs
DWA	Department of Water Affairs
DSO	Dam Safety Office
EIA	Environmental impact assessment
EWR	Ecological water requirements
ha	Hectares
IDZ	Industrial development zone
MAR	Mean annual runoff
m^3/a	cubic metres per annum
NEMA	National Environmental Management Act
NHRA	National Heritage Resources Act
NMBM	Nelson Mandela Bay Municipality
NWA	National Water Act
SANParks	South African National Parks
UNFCCC	United Nations Framework Convention on Climate Change
URV	Unit reference value
WRSM	Water Resources Systems Model
WRYM	Water Resources Yield Model

1 Introduction

1.1 The Algoa Water Supply System

The Algoa Water Supply System (AWSS) extends from the Kouga River system in the west to the Sundays River system in the east. The AWSS provides water to the Gamtoos Irrigation Board, domestic water to 1.1 million people in the Nelson Mandela Bay Municipality (NMBM), more than 373 industries, as well as the Coega Industrial Development Zone (IDZ) and several smaller towns within the Kouga Municipality area.

The water requirements of the NMBM have increased steadily over the past few years, due to in-migration, increased service levels and industrial activity. In 2011/2012, the total water usage from the AWSS was 149.7 million cubic metres per annum (million m^3/a). The combined yield of the AWSS sources at an assurance of supply of 98% (1:50 year assurance of supply) is 164.4 million m^3/a. Although there is still some surplus water in the system, the system will be put at risk by any significant increase in water use or reduction in supply brought about by drought. Taking into consideration that the water requirements will continue to steadily increase and that intensive water users are yet to be established at the Coega IDZ, the Department of Water Affairs (DWA) together with the NMBM commissioned a study to investigate the current and future water requirements and supply of water (Aurecon, 2002a); (Aurecon, 2002b). This study identified interventions which can potentially be developed to increase the supply of the AWSS.

1.2 Kouga Dam

The Kouga Dam, located in the western part of the AWSS, currently has a capacity of about 133 million m^3. Currently, the ratio of the full supply capacity of Kouga Dam to the mean annual runoff (MAR) of the Kouga River catchment is smaller than the optimum ratio (approximately 200%) for runoff utilisation for the area (Aurecon, 2002a). One of the options under consideration to increase water supply to the NMBM area is to increase the capacity of the Kouga Dam, thereby allowing for capture of available run-off.

1.3 Dam rehabilitation

The Kouga Dam is currently under investigation as there are some concerns that the current safety risk of the dam is higher than normally acceptable. The precise details and extent of the problems are currently unknown. The DWA: Dam Safety Office (DSO) is still conducting an examination of the dam, although it is clear that the dam in its current state cannot be raised, despite it having been designed to do so. Once the DSO has determined the magnitude of the problems, the dam will be rehabilitated.

There is therefore potential for this rehabilitation work to go hand in hand with a new dam directly downstream of the old structure and so increase the storage capacity in the reservoir as desired.

1.4 Objective of this Evaluation

In light of the updated yield values that became available from the Algoa Water Resources Bridging Study: Water Resources and System Modelling Report (Oct 2010), of which a final report copy was recently made available, it was evident that the feasibility of this intervention needed revisiting.

The aims of this desktop-level investigation, with very limited fieldwork, are the following:

- Revisit the potential yield associated with the option of raising the Kouga Dam wall and increasing water storage capacity.
- Update the cost estimate at a desktop level.
- Undertake a high level environmental and social screening exercise to better understand the impacts of the potential dam raising.
- Review the feasibility (benefits and impacts) of the potential scheme and provide a recommendation on how this may impact on the rehabilitation programme.

1.5 Methodology

1.5.1 Hydrology and Yield Analysis

The water resources of the region were calibrated in the rainfall-runoff, Water Resources Systems Model (WRSM2000) and the natural flow sequences so generated subsequently used in the Water Resources Yield Model (WRYM) to determine the total yield that the system can supply. Both these models are monthly time step models which incorporate rainfall, evaporation, runoff, land use, reservoir operations, river diversions, etc. to model the movement and use of water at a regional level. The consequential increase in yield from this raised dam was analysed by WRP (Pty) Ltd in 2012 as part of an analysis of the entire Algoa Water Supply System (Department of Water Affairs, 2010).

There was a focus on the acquisition of accurate land use in the catchment, especially with regards to irrigation. A satellite census was conducted to define the growth in irrigation and farm dam development. Historical & stochastic yield analyses were performed with the Kouga Dam (both existing and raised options) in conjunction with the Loerie Dam further downstream. The AWSS was modelled as a whole. The entire supply system to the NMBM1 was modelled as a whole, including the contributions from the Kromme sub-system with its Churchill and Mpofu Dams as well as the Groendal sub-system with its “Old Dams”. The predicted yields from the dam were estimated for the options of raising the dam by 10,5m, 16,5m and 19,8m.

1.5.2 Cost estimates

Updated cost estimates were made for the options of raising the dam by 10,5m, 16,5m and 19,8m respectively. The cost model is a first-order model based on measured quantities and rates of concrete, formwork and excavation multiplied by an all-in factor. Quantities were estimated using a cross section of the valley downstream of the existing dam and typical dimensions for a concrete gravity dam.

[1] Nelson Mandela Bay Municipality

Potential cost savings due to the foreseen synergy between the dam raising and the dam safety construction activities have not yet been factored in. The costs of purchasing land and replacing infrastructure has not yet been included.

1.5.3 Environmental Aspects

This study has been undertaken at a desktop level to identify potential environmental and social impacts which will guide the future planning of the raising of Kouga Dam, should this alternative be taken further. The following methodology was adopted:

- Additional areas that will be inundated as associated with potential engineering solutions to increase dam capacity were mapped spatially;
- Vegetation types that will be affected were mapped and the conservation status of affected areas and the potential impact of the loss in terms of the vegetation remaining was identified;
- There was liaison with key stakeholders in the field to issues of concern; and
- Aspects requiring additional study were identified.

2 Background

2.1 The Baviaanskloof

The Baviaanskloof conservation area was established in 1923 with the declaration of the Baviaanskloof Forest Reserve, which was managed by the Department of Forestry (Boshoff A. , 2008). Today, the reserve, which has increased to an estimated 180,000ha, is managed by the Eastern Cape Parks Board. The reserve is located within a mega-reserve (Figure 2.1), proposed by the Cape Action for People and the Environment (C.A.P.E.), which includes both formally protected areas and privately owned land (Boshoff, 2005). The Baviaanskloof area encompasses a diversity of landscapes supporting an even greater diversity of ecosystems.

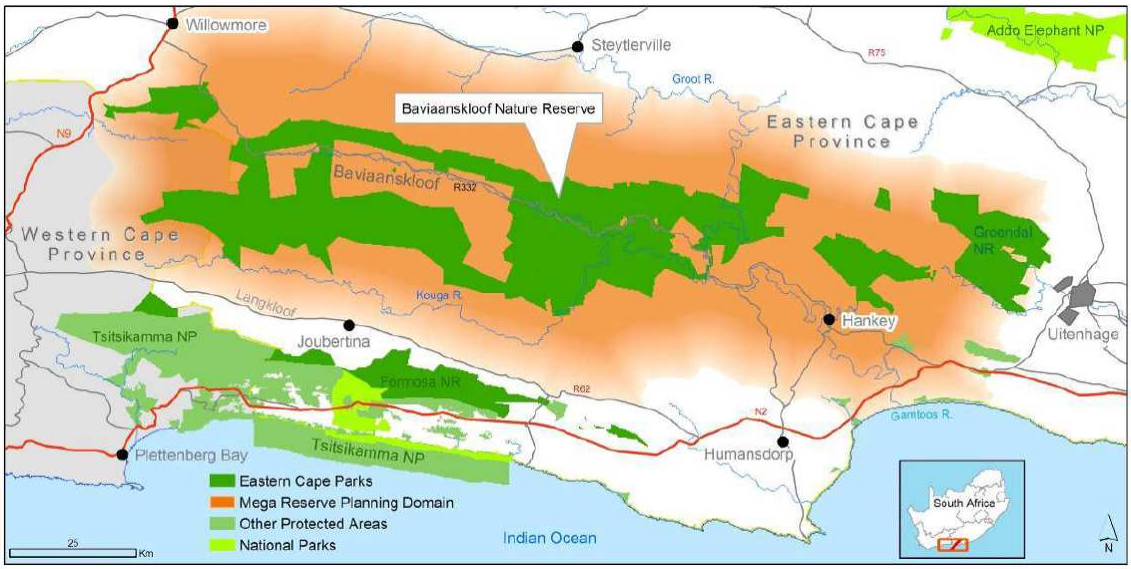

Figure 2.1: Map of the Baviaanskloof Mega-Reserve (C.A.P.E., 2011)

The Baviaanskloof Reserve is one of the eight protected areas within the Cape Floral Region Protected Area, the latter covering 553,000ha and representing one of the richest areas for plants in the world. It covers a conservation landscape of over 400,000ha and includes both protected areas and agricultural lands. As such, it provides a habitat for more than 50 mammal species, over 300 bird species, and a host of other faunal species, such as reptiles and amphibians (EC Parks, 2009). This region has representatives of all seven of South Africa's biomes and is one of the most bio-diverse areas within southern Africa, being located at the convergence of three of the world's top 34 biodiversity hotspots (Cape Floristic, Succulent Karoo and Maputaland-Pondoland-Albany Regions).

The Baviaanskloof Nature Reserve was proclaimed a World Heritage Site in 2004, based on its exceptional natural beauty and its culturally important sites and artefacts as well as its biodiversity significance and important ecological processes. Protection of this area is thus afforded in terms of the following key legislation:

- World Heritage Convention Act (Act No. 49 of 1999);

- The National Environmental Management Act (Act No. 107 of 1998), as amended;
- The Physical Planning Act (Act No. 88 of 1967);
- The National Environmental Management Biodiversity Act (Act No 10 of 2004) (NEMA); and
- The National Environmental Management: Protected Areas (Act 57 of 2003).
- The National Water Act 36 of 1998.
- The National Forest Act 84 of 1998.
- The National Environmental Management: Protected Areas Act 57 of 2003.
- National Heritage Resources Act 25 of 1999.

Overarching international and national obligations that apply include the following:

- The Convention on Biological Diversity.
- The Local Agenda 21.
- The Ramsar Convention.
- The United Nations Framework Convention on Climate Change (UNFCCC).
- Constitution of the Republic of South Africa, 1996.
- The National Biodiversity Framework, 2007.
- South Africa's National Framework for Sustainable Development, 2008.
- The National Spatial Development Perspective, 2003.

Mining or prospecting is completely prohibited in a World Heritage Site and all developments must be subjected to environmental impact assessments (UNESCO, 2012), and the South African legislation noted above will be applicable.

The Baviaanskloof Nature Reserve already plays a vital role in the provision of good quality water for downstream consumption by local communities as well as agriculture. Almost the entire catchment of the Baviaanskloof River and a substantial part of the catchment of the Kouga River are located within the existing Baviaanskloof Nature Reserve. A satellite census conducted to define the growth in irrigation and farm dam development indicated that large areas of the Kouga Dam catchment are covered by alien invasive plants of which a fair amount had already been cleared through Working for Water (Department of Water Affairs, 2010). Large scale irrigation is also prevalent in the catchment. Despite this, water supplied by the mega-reserve is of very high quality and this reduces the need for expensive treatment downstream. The Baviaanskloof area is thus vital as a sustainable source of good quality water for human, agricultural, industrial and environmental consumption downstream.

The mega-reserve also offers an opportunity to increase the supply of potable water to agriculture and human consumers. This can be achieved by increasing water security from the Kouga Dam to above the present level of 75%, by including as much as possible of the catchments of the Baviaanskloof and Kouga rivers, as well as increasing the storage capacity of the dam (Boshoff A. , 2008). Extending the southern boundary of the existing Baviaanskloof Nature Reserve to the Kouga River will ensure that 75% of the Kouga-Baviaanskloof catchment will be under conservation management. This will permit the effective application of sound catchment management practices and improve the supply of water (Boshoff, 2005).

The Loerie Dam is situated south of the Kouga River and together with the Kouga Dam forms part of the Gamtoos River System (Anon, Gamtoos System Report).

2.2 Kouga Dam

The Kouga Dam is a 69m high concrete arch dam 69m high with a full storage capacity of 126 million m^3. It is situated on the Kouga River approximately 5km upstream of its confluence with the Groot River (33° 44' 27"S, 24° 35' 15"E), with a catchment area of 388,700ha. Its full supply level is 149.36m (masl) above sea level, with a full supply capacity (2008) of 126 million m^3. The length of the dam basin is approximately 34km and the surface area of the impoundment at full storage capacity is 555ha.

Geologically, the gorge within which the dam is located is comprised of strata of the Table Mountain sandstone series in which layers of shale and tillite are included. The upper reaches of the Kouga Dam is located within the protected area, while the lower reaches are surrounded by agricultural land (Aurecon, 2002b).

The dam was originally designed to be raised to increase its capacity, however, due to problematic foundation conditions on the right flank this can no longer occur. As an alternative it was proposed to construct a new mass gravity rollcrete dam immediately downstream of the existing wall. The current proposal would raise the full supply level to roughly 160masl giving it a storage capacity of 200 million m^3.

Water from the Kouga Dam is distributed to water users by a system of canals and pipelines. The main canal starts at the dam and ends at the Loerie Balancing Dam. The canal system consists of canals, siphons, balancing dams, and pipelines. The total length of the main canal is 97km (72km canal, 17km siphons, and 8km tunnels). The total length of the branch canals is 30km and of the pipelines is 91km. In addition to the Loerie Balancing Dam, a further two balancing dams were constructed along the route of the main canal to prevent the wasting of water due to fluctuations of demand. The Kouga Dam and the main canal supply water for both irrigation and urban use; the branch canals are used mainly for irrigation and the Loerie Dam for urban water supply only. Water is supplied to the NMBM's purification works at the Loerie Dam site by means of an outlet control tower and tunnel (Gamtoos Tourism, 2008).

3 Updated Yield and Costing

The Algoa Water Supply System was modelled in its entirety using the Water Resources Yield Model, during the *Algoa Water Resources Bridging Study* (Department of Water Affairs, 2010). The availability of the information from this study initiated the present investigation.

The Kouga Dam, located upstream of the confluence of the Gamtoos and Groot rivers, is fed by the Baviaanskloof and Kouga Rivers. The Baviaanskloof River contributes about 10% of flow and the Kouga River most of the water for the Kouga Dam, which in turn delivers 100% of the water requirements of the Gamtoos River Valley irrigation area and up to 20% of the requirements for the NMBM (Department of Water Affairs, 2010).

A number of options from the Kouga-Loerie sub-system have been considered as part of the *Algoa Water Resources Bridging Study* to increase the yield of the AWSS (Department of Water Affairs, 2010), outlined below:

- Raise Kouga Dam, according to the following three scenarios:
  - to 200 million m^3 (raised by 10.5m)
  - to 255 million m^3 (raised by 16.5m)
  - to 293 million m^3 (raised by19.8m);
- Clear invasive alien plants in the Kouga Dam catchment areas;
- Reduce opportunistic irrigation in the catchment;
- Include the supplementary Guernakop Dam.
- Improve operational aspects relating to Loerie Dam (note that this option has already been implemented).

The Guernakop Dam, at a site approximately 15km upstream of the upper end of Kouga Dam on the Kouga River, was evaluated as part of the Algoa Prefeasibility Study (Aurecon, 2002b) as an option to increase system water yield. As indicated above, raising the wall of the Kouga Dam was another option considered to increase the water storage capacity. However, due to problematic foundation conditions on the right flank, and the type of dam, this has been ruled out. As an alternative a new mass gravity rollcrete dam immediately downstream of the existing wall was considered, using the existing dam as an upstream shutter. The increase in yield from the various options for raising the dam is indicated in Table 3.1.

Table 3.1. Increase in yield from various options for increasing water yield

Scenario	Dam volume (million m^3/a)	Firm Yield (million m^3/a)	Incremental yield (million m^3/a)
Existing Kouga Dam	126	66.7	-
Raising of Kouga Dam:			
Kouga raised by 10.5m	200 (+74)	74.4	+ 7.7
Kouga raised by 16.5m	255 (+129)	79.0	+ 12.3
Kouga raised by 19.8m	293 (+167)	84.0	+ 17.3
Construct new Guernakop Dam:			
Kouga + Guernakop (200 million m^3)		87.9	+ 21.2
Operating rule: Kouga supports Loerie[2]			
When Loerie Dam's capacity is at 45%		75.5	+ 8.8
Clear alien vegetation		76.3	+ 0.8
Continued alien growth		73.2	- 2.3
When Loerie Dam's capacity is at 30%		75.7	+ 0.2
No opportunistic irrigation in upstream catchment		80.5	+ 4.8

The increase in yield obtained from these options is not regarded as significant. The increase in yield will however improve marginally when upstream opportunistic irrigation is reduced and further removal of alien invasive plants takes place.

3.1 Cost Estimates

3.1.1 Dam Wall Raising

A first-order cost estimate (Table 3.2) of capital costs of the dam wall for the option of raising the Kouga Dam was prepared based on a number of assumptions, with and without taking the dam rehabilitation work into account, namely:

- The existing dam wall will be incorporated into the new structure by using it as an upstream shutter or coffer dam. The total area of formwork needed is therefore less than if the existing dam were not incorporated into the structure.
- Due to the foundation concerns at the existing dam, the new dam will most likely be a concrete gravity dam which acquires most of its stability from its weight rather than its foundation.
- Due to its proximity to the existing dam, all roads, pipelines, power supply etc. will be available to service the new dam during operations and during construction allowing lower rates to be utilised.
- All mechanical and electrical items at the dam are to be replaced.
- The bulk of the dam will be constructed using roller compacted concrete.

[2] The adoption of an operating rule where Loerie Dam is kept at a higher level was one of the first recommendations of the Algoa Water Supply Strategy, which has subsequently been implemented. This increase in yield has therefore already been realised.

- No other infrastructure such as larger transfer pipelines or the upgrading of the water treatment works was included. The Loerie Water Treatment Works may however need upgrading to increase treatment capacity.
- Potential cost savings due to the foreseen synergy between the dam raising and the dam safety construction activities have not yet been factored in, due to the current lack of clarity regarding this aspect.
- The costs of purchasing land and replacing infrastructure has not yet been included. There is little development in and around the Kouga Dam reservoir, as this area forms part of the Baviaanskloof Nature Reserve. However, the raised water level would inundate a number of camp sites as well as sections of the historically significant Baviaanskloof Road (R332). Relocating the road may prove difficult due to the limitations imposed by the terrain.
- The cost model is a first-order model based on measured quantities and rates of concrete, formwork and excavation multiplied by an all-in factor. Quantities were estimated using a cross section of the valley downstream of the existing dam and typical dimensions for a concrete gravity dam.
- Incremental capital costs were also estimated based on the assumption that a new structure constructed up to the existing full supply level would be the most cost effective solution to the dam's current dam safety problems.

Table 3.2: Dam raising capital cost estimate (dam wall only)

Description	0.0m Raising[3]	10.5m Raising	16.5m Raising	19.8m Raising
Civil works	R 474	R 656	R 784	R 869
Mechanical works	R 60	R 100	R 100	R 100
Preliminary & General (25%)	R 133	R 189	R 221	R 242
Contingencies (15%)	R 100	R 142	R 166	R 182
Engineering (15%)	R 115	R 163	R 190	R 209
TOTAL CAPITAL COST	R 882	R 1 250	R 1 461	R 1 602
Incremental Capital Cost	-	R 368	R 579	R 720

All values in R million

The yields associated with the various raising levels and the associated unit reference values (URVs) are shown in Table 3.3.

[3] This option considers the case where the dam is not raised but a new dam is still built to the existing full supply level. This represents a scenario where the Dam Safety Office decides that a new structure downstream of the existing one would be less costly than the rehabilitation of the old structure.

Table 3.3: Yields and Unit Reference Values

Description	10.5m Raising	16.5m Raising	19.8m Raising
Yield (million m^3/a)	74.4	79.0	84.0
Incremental Yield (million m^3/a)	7.7	12.3	17.3
Unit Reference Value @ 6% (R/m^3)	R 12.14	R 8.84	R 6.89
Incremental Unit Reference Value @ 6% (R/m^3)	R 3.61	R 3.50	R 3.09

4 Ecological Water Requirements

According to DWA policy and the National Water Act (NWA), no water-using development may be initiated or use of water may be allocated until the basic human needs Reserve and water for aquatic ecosystems, i.e. the ecological Reserve or ecological water requirements (EWR), have been allocated. The DWA Reserve database of July 2012 only contains one Reserve template for water use in the Kouga River catchment, and that is in quaternary catchment L82A far upstream of Kouga Dam and on the Groot tributary to the Kouga River. The template was signed off in 2003 – results are shown in Table 4.1. Reserve results for the Gamtoos River are also shown, with the L90B template re-signed in 2011 and the L90C template in 2000.

Table 4.1: Reserve results for the Kouga and Gamtoos rivers

River + quaternary catchment	Level of assessment	Present Ecological State (PES)	Ecological Importance + Sensitivity (EIS)	Recommended Ecological Category (REC)
Groot River (trib of the Kouga River); L82A	Desktop: quantity only	D	High	C
Gamtoos River, L90B		D	Moderate	D
Gamtoos River, L90C		D	Moderate	D

Should further work now be conducted at Kouga Dam, whether it is a new dam being built below the current dam, or the dam wall being raised, none of these activities should proceed without a proper estimate of the EWR and impact on the downstream users and aquatic environment. It is recommended that the following steps should be undertaken.

- Liaison with the Chief Directorate: Resource Directed Measures (contacts: Y Atwaru and B Weston) regarding the requirements of an EWR study for this activity.
- The level at which the EWR study would be undertaken. It is envisaged that a Rapid (III) study with a high flow component, would be undertaken. It is unlikely that a higher confidence study will be required, due to the present state of the system and impact of the existing dam.
- The selection of localities for EWR site(s): Due to the short stretch of the Kouga River below the Kouga Dam, and the existing impacts related to the current dam, it is anticipated that an EWR site should be placed on the Gamtoos River downstream of the dam. Due to the requirements for suitable habitat, a second less impacted site may be required as well.
- The evaluation by the Reserve team will have to consider the impact of reduced high flows due to an increase in dam wall height.
- The Scenario step of the 8-step Reserve process must consider the impact of increased water use from the dam, due to its increased capacity.
- Detailed information regarding outlet capacities and operation of the dam will be needed, as well as how the allocation of water to users downstream of the dam takes place, e.g. off-take points.
- It is strongly recommended that the EIA and EWR study be undertaken concurrently.
- It is presumed that a determination of potential impacts on the Gamtoos Estuary will need to be undertaken as well; possibly at a scoping level in the first instance.

5 Biophysical and Social Environment

5.1 Biodiversity

Seven of the country's eight biomes are found in the broader Baviaanskloof area. These are the Fynbos, Subtropical Thicket, Nama-karroo, Succulent Karoo, Grassland, Savanna, and Forest biomes. There is thus extremely high habitat diversity, with 53 vegetation types in the mega-reserve area and 27 in the Baviaanskloof Reserve.

The mega-reserve area falls in the eastern section of the Cape Floristic Region which is predominantly fynbos. The Baviaanskloof Nature Reserve supports approximately 138 families, 570 genera, and 1,199 species. The vegetation is a complex mix of relatively uniform composition of plant species within a geographic area, which changes rapidly over short distances (Boshoff 2005). In terms of global standards, there is an exceptionally high incidence of rare and endemic species found within the reserve. At least 20 species are currently known to be endemic to the region and 52 species in the Baviaanskloof Nature Reserve itself are considered to be threatened with extinction (Boshoff A. , 2005).

Critical Biodiversity Areas (CBA) are areas formally identified as the highest priority areas whose conservation is important for maintaining biodiversity throughout the region. Their selection is based on scientific assessments of conservation targets (such as key species and ecological communities) and conservation goals (the number and location of targets). There are a number of CBAs within the area that would be affected by the proposed development. Maps showing CBAs for the affected area are included in Appendix 1.

In terms of NEMA, it is required to assess biodiversity impacts in terms of the concept of CBAs (SANBI, 2007). Specific guidelines for land use decision making have not yet been developed for the Baviaanskloof area. Development of specific guidelines for the Baviaanskloof Mega-Reserve will take place as part of a bioregional planning process that will use the Baviaanskloof Mega-Reserve biodiversity assessment and neighbouring plans (SANBI, 2007). However, development will be required to be in keeping with the principle of maintaining the biodiversity in as near a natural state as possible or with no loss of biodiversity for CBA Classes 1 and 2. Management should be for sustainable development, keeping natural habitat intact in wetlands (including buffers) and riparian zones for areas identified as CBA Class 3, with environmental authorisations supporting ecosystem integrity. This aspect will require detailed assessment in an EIA.

The higher full supply level could extend the length of river inundated from 3km to 4km downstream of the confluence of the Baviaanskloof and Kouga Rivers to about 2km upstream of the confluence into both rivers. This additional inundated area would be situated mainly in the Baviaanskloof Wilderness Area and would also extend a short distance into the Guerna Wilderness Area (Aurecon, 2002a). Based on the mapped vegetation for the Baviaanskloof Mega-Reserve (Euston-Brown, 2006), the vegetation types potentially affected by the projected inundation resulting from increasing the dam capacity include Baviaanskloof Subtropical Forest, Kouga Grassy Fynbos, Baviaanskloof Thicket Savanna, Baviaanskloof Thicket Savanna, Groot Woodland and Baviaanskloof Spekboom Thicket. The maps indicating the vegetation types affected are included in Appendix 2.

All vegetation types potentially affected other than Kouga Grassy Fynbos are endemic or Near Endemic (i.e. being found in this area only). All of these vegetation types, other than Baviaanskloof

Thicket Savanna, which has a conservation status of Vulnerable, are still relatively intact. Baviaanskloof Thicket Savanna has less than 50% of its vegetation intact. Both the Baviaanskloof Subtropical Forest and the Baviaanskloof Thicket Savanna have not met the target area for conservation and the impact of loss of such vegetation types required more detailed assessment. Maps of the Ecosystem Status of the affected area are included in Appendix 3. Preliminary assessment of the status of the vegetation shows that in places, the Baviaanskloof Savanna Thicket is heavily degraded (Euston-Brown, 2006).

Land cover and land use changes often indicate major impacts on biodiversity (SANBI, 2007). The land use and land cover of the area, based on the National Land Cover database of 2010 (SANBI, 2007), is shown on the maps in Appendix 4. There is no cultivated area that will be affected by the inundation resulting from the increase in capacity, although cultivated land may be affected by construction of the new dam below the existing dam. The land cover types affected are mainly water bodies, wetlands (which are protected vegetation types), thicket and small areas of shrubland and low fynbos.

While Rocky Refugia and Cliff habitat is well represented in the protected area it is regarded as unique and sensitive, rich in endemic plants especially succulent species. These habitats are often host to rare and threatened plants. For example, the near vertical cliffs located within the Kouga Dam area form a unique environment in which a succulent-rich community thrive (Dr Ernst van Jaarsveld, pers. com.). This succulent community includes *Gasteria ellaphieae*) which grows in lichen-rich crevices in the Kouga Dam area (SANBI b, 2011).

There would also be a loss of wetland habitat along the river banks, which would impact on the biotic communities supported by the wetland habitats. Loss of any wetland requires detailed assessment prior to development applications being approved by the environmental authorities.

5.2 Ecosystem Services

Terrestrial ecosystems provide a number of vital services, such as food, fibre, water, and recreation, for people and society (Erlank, 2010). Effective management is essential to maintain ecosystems to deliver ecosystem services sustainably, as change from landuse practices, climate and biodiversity etc. can affect the functionality of the ecosystem. In addition, significant change may compromise the delivery of such ecosystem services. It is critical that there are sufficient resources available to ensure the maintenance of the integrity of the Baviaanskloof World Heritage Site.

The Kouga Dam is located within a protected area and the water produced is of high quality, reducing the need for expensive treatment downstream. Any risk to the ecosystems that support this service would impact on water delivery downstream.

5.3 Hydrology and Aquatic Services

Rivers are natural corridors for the flows of energy, matter and species and are often key elements in the regulation and maintenance of landscape biodiversity (McCartney, Sullivan, & Acreman, 2001). River ecosystems are adapted to the natural hydrological regime and many components of those systems rely on the natural flood cycle for survival (McCartney, Sullivan, & Acreman, 2001). Damming a river to create a dam has significant impacts, apart from that of permanent destruction of terrestrial ecosystems upstream of the dam through inundation. The most common downstream effect of large dams is that variability in water discharge over the year is reduced, as there is controlled

discharge of water from dams and the magnitude and timing of flood peaks may be reduced (McCartney, Sullivan, & Acreman, 2001).

The increase in the dam capacity would result in an overflow (and range of floods) that is less frequent than before (Aurecon, 2002b). The reduction in frequency of overflows would not affect the existing low and high flows in the relatively unregulated Gamtoos River, since no base flows are currently released from the dam. However, the frequency of flood flows in the Gamtoos River and estuary would be reduced. There is also concern that further impoundment of the Kouga River could negatively impact the diluting effect of water from this river on the high salinity levels of the Groot River (Aurecon, 2002b). This could have potential ecological impacts downstream;

When dams are created, terrestrial ecosystems are replaced by aquatic habitats and large water bodies replace riverine flow patterns (McCartney, Sullivan, & Acreman, 2001). Traditionally, there is a period of dissolved oxygen exhaustion as the dam levels rise, resulting from decomposition of newly submerged vegetation. Although a stable state establishes eventually becomes established, the period of trophic upsurge and anoxia may last for a number of years (Thornton, Kimmel, & Payne, 1990). The significance thereof would need to be determined by a water quality specialist.

There is also a potential for disruption of riverine fisheries and sedimentation of the reservoir, with consequent backwater effects (Sadler, Verocai, & Vanclay, 2000).

It is not anticipated that the potential new Kouga Dam and additional inundation areas would create an additional barrier to flow in the river channel nor to faunal migration routes. However, this aspect would require more detailed assessment in future studies.

5.4 Topography, Geology and Geomorphology

The Kouga and Baviaanskloof Mountains, part of the Cape Folded Mountains, run parallel to each other in an east-west direction, with the highest peak in the Baviaanskloof Mountains being Scholtzberg at 1625m above sea level. The landscape of the area has been created by erosion, along with repeated subsidence and upliftment events over millions of years. The slopes fall steeply from the peaks to the north and south to a plateau level (the Mica land surface) of 650 to 900 m above sea level. Only a few ridges of this formation survive, the rest carved away by deep ravines reaching valleys (Kouga, Baviaanskloof and Groot River valleys) at an altitude of between 550 and 320 m above sea level. (EWISA, 2013).

The existing topography in the area will constrain the development of alternative areas for infrastructure to replace that which will be inundated, especially in terms of relocating parts of the road through the reserve.

5.5 Historical context

Artefacts found in rock shelters in the Baviaanskloof date back to the Middle Stone Age (100,000 to 30,000 years ago) (Boshoff A., 2005). The Baviaanskloof Mega-reserve is considered an important meeting place of the diverse cultures of the Late Stone Age communities, the hunter-gatherer San, the Khoekhoen (or Khoikhoi) and the Khoisan who have inhabited the area over time and is highly significant for Stone Age archaeology (Boshoff A., 2008). About 1700 years ago, Bantu-speaking Iron Age agro-pastoralists migrated from central and eastern Africa with crops such as sorghum and millet and domesticated sheep, goats and cattle.

Rock paintings and other heritage resources have been found close to the Kouga Dam, with rock paintings observed about 2m above the present water level which have possibly already been inundated in floods with the present dam level. It is presumed that there would have been a number of rock paintings and relics that must have been lost when the present dam was built as it is assumed that there would have been more human activity near the original river level than there was at the present level (pers. comm. Stephen Mullineux).

This aspect will require further assessment to ensure that no archaeological and heritage resources are affected by the increased dam capacity and that there is no further loss of significant heritage resources.

5.6 Infrastructure

The headlands of the Kouga Dam lie within the Baviaanskloof Nature Reserve, which is an Eastern Cape provincial nature reserve. The reserve itself has limited infrastructure, namely two bush camps located at the bottom of the Holgat Pass at the headwaters of Kouga Dam, a hut accessed by a 4 by 4 route, a picnic site at Smitskraal and the road between the gates at either side of the reserve.

The Baviaanskloof Road (R332) is a major tourist route through the area and was built between 1880 and 1890 by Thomas Bain, South Africa's most famous road engineer. This road is the longest of the roads and mountain passes built by him. The Baviaanskloof Road stretches from Patensie in the east to Willowmore in the west (197km) (Anon, 2012). It is still gravel and traverses valleys and river beds as well as high mountain peaks (Figure 5.1) The Baviaanskloof Road makes a 7km detour to the Kouga Dam and offers the only access point to the Rooihoek and Doodsklip campsites (Figure 5.2).

The increase in areas of inundation will result in the need to relocate the Doodsklip and Rooihoek wilderness campsites, as well the Smitskraal picnic area. It will also require the relocation of parts of the road winding through the valley floor (Figure 5.3). This will be difficult to achieve because of the limitations of the available terrain. It will also have implications in terms of the National Heritage Resources Act, as the road is older than 60 years and is regarded as an important historical resource.

Figure 5.1: The Baviaanskloof Road

In , the photo to the left shows the road running along the valley floor close to Doodsklip. The photo to right shows the road in relation to Doodsklip campsite.

Figure 5.2: View of the Doodsklip Wilderness Camp at the headlands of the Kouga Dam

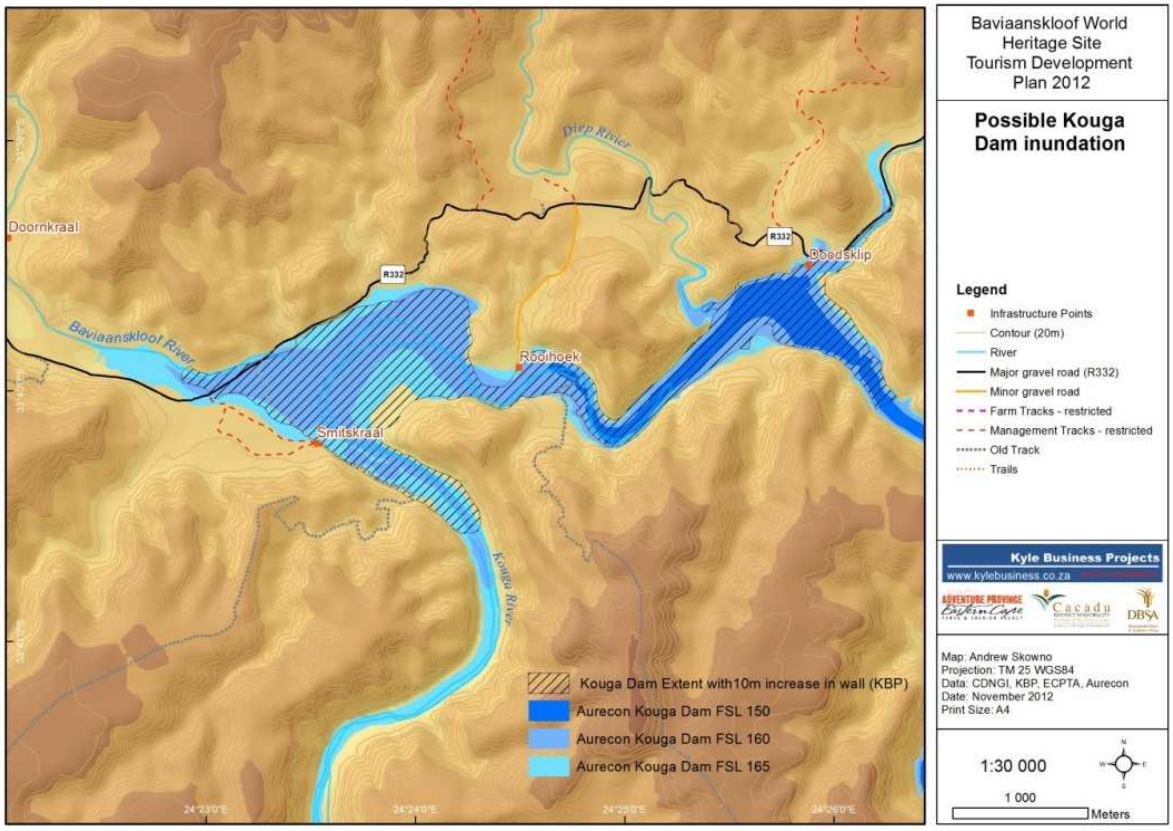

Figure 5.3: Inundation of a raised Kouga Dam

5.7 Landuse in the Kouga/Gamtoos area

The land use in the affected area is predominantly nature conservation (Baviaanskloof Nature Reserve). The landuse in the greater Baviaanskloof Mega-Reserve is predominantly grazing for livestock with intensive cultivation or irrigated land along the main rivers. There may also be an impact on agriculture and other activities downstream of the existing with the construction of the new dam. This aspect was not addressed in any detail in this study but will require detailed investigation in future studies.

5.8 Tourism

Due to the constraints related to agriculture in the area, many farmers outside of the Baviaanskloof Nature Reserve have developed ecotourism as a parallel activity. The awarding of World Heritage Site status to the Baviaanskloof Nature Reserve has stimulated the growth of the local tourism industry, based on the spectacular biodiversity of the area (Boshoff A. , 2008). By the end of 2004, at least nine properties in the western sector of the Baviaanskloof were offering ecotourism activities such as accommodation, hiking trails, birding, 4x4 trails, horse riding and rock art visits, with similar trends in the areas to the immediate east and south of the reserve (Boshoff A. , 2008). Tourism-related economic development has also occurred in and around local rural towns such as Willowmore and Steytlerville, boosted by conservation initiatives associated with the Baviaanskloof Nature Reserve and World Heritage Site. The appropriate development of tourism potential of the area will result in a number of socio-economic benefits at the local, regional and national levels.

The road through the Baviaanskloof Nature Reserve is an important tourism resource and provides the only access from one side of Baviaanskloof to the other. Limitations to use of this through road may have significant implications in terms of tourism and will need to be addressed further in a detailed environmental and social assessment.

There is currently a study underway to compile a Baviaanskloof World Heritage Site Tourism Development Plan. The report is not yet available and this study will need to be updated to include the findings of this study when available.

5.9 Baviaanskloof Development and Management Plan

The Wilderness Foundation has developed a vision and 5 Year Development and Management Plan for the Baviaanskloof Mega-Reserve, with the stated long-term goal “of conserving the biodiversity of the Baviaanskloof Mega-Reserve with the delivery of benefits and the full support of local communities, endorsement by government and international recognition.” As the overriding aim of the area is to conserve biodiversity, to protect ecosystem process and to ensure the status of the World Heritage Site, it is imperative that all development activities within the area are assessed in terms of these strategic documents and that early and continuous engagement occurs with relevant stakeholders.

5.10 Risks to the biophysical and social environment

There are a number of potential impacts that could arise from the raising of the Kouga Dam. The areas potentially affected with the various options considered are summarised in

Table 5.1.

Table 5.1: Areas of land and road inundated with the various alternatives considered

Dam wall height (m)	Raising height (m)	Full Supply Level (masl)	Dam Volume (million m^3)	Area inundated (ha)	Increase in inundated area (ha)	Road length affected (km)
69	-	150	126	548	-	-
79.5	10.5	160	200	853	305	0.8
85.5	16.5	165	255	1,045	497	1.5
88.8	19.8	170	293	1,186	638	4.4

The initial screening process indicated that there is a potential for negative biodiversity, heritage, social and tourism impacts. The preliminary identification of potential impacts is detailed below:

- Inundation of significant areas of indigenous vegetation will occur. This includes areas identified as CBAs, which are areas identified in bioregional planning studies as areas critical for conservation.
- It also includes the loss of Baviaanskloof Thicket Savanna, listed as a vulnerable vegetation type.
- There is a potential loss of Rocky Refugia and Cliff habitat, supporting rare and endemic plant species.
- There will be a loss of wetland habitat along the river banks, which provides a valuable ecosystem service.
- The higher full level supply will inundate up to 3km to 4km downstream of confluence to 2km upstream of confluence of the Kouga and Groot Rivers.
- There will potentially be less frequent overflow and range of floods, with potential ecological impacts downstream.
- There will potentially be less dilution of saline water in the Groot River.
- There will be inundation of parts of the road built by Thomas Bain. This road is a heritage resource and also the only access through the valley. It will it be very difficult to realign the affected parts of the road because of the topography. This aspect will need to be part of a Heritage Impact Assessment.
- There may be a need to relocation of some hiking trails and the Smitskraal picnic site.
- The Rooihoek and Doodsklip wilderness campsites will be inundated and need to be relocated.
- The implications for tourism should the campsites and road need to be relocated must be investigated further.
- The area is rich in archaeological history and an assessment of the areas to be inundated will need to be undertaken to ensure no resources are lost.
- The implications of low oxygen levels and water quality once the dam is filled must be investigated by a specialist, with special reference to the implications for systems dependent on the water.
- The impact of the new dam on the area immediately below the existing dam wall will need further assessment in terms of the impact on the land users in the area. There may be a need for relocation and compensation of lost farming land or dwellings.
- There will be earthworks and permanent change to the area immediately below the existing dam wall.

- A construction camp will need to be established to accommodate construction staff either in the vicinity of the proposed dam or in established towns, which has significant social impacts on the area. This aspect will need to be addressed in a social assessment as part of ongoing studies.
- The social assessment would also need to address the impact of in-migration into the area, as there are high rates of unemployment in the Eastern Cape and people will be attracted to the area looking for work.
- Development of borrow areas will be required from which materials required will be sourced and such areas will also need environmental assessment.
- Other aspects to be addressed in the study would include the risks to biodiversity associated with construction activities, such as increase in dust and noise, poaching, spread of aliens and increased risk of fire from increased activity in the area and the presence of construction workers.
- The implications of a change in the biodiversity status in terms of the World Heritage status must be assessed.
- The impacts on the local economy in terms of tourism, agriculture and other services.

The construction of a dam wall immediately against, or downstream of the existing dam to increase the capacity of the Kouga Dam, will require authorisations in terms of the National Environmental Management Act (Act 107 of 1998), as amended (NEMA) and the National Water Act (Act 36 of 1998) (NWA), as well as the National Heritage Resources Act (NHRA) No. 25 of 1999. Details of such legislation are attached in Appendix 5.

The environmental process required for the proposed activity is a full environmental impact assessment (EIA), which is a lengthy process and is likely to delay the rehabilitation of the dam wall.

6 Recommendations

The following recommendations are made:

6.1 Yield

The raising of Kouga Dam by 19.8m will increase the firm yield of the Kouga system by approximately 17.3 million m^3/a (26% increase in yield), which is relatively small. It does not seem worthwhile to consider raising the dam by a lesser height, as the lessor raisings are more expensive.

The areas in the Kouga Catchment already cleared from alien invasive plants need to be maintained as such. Continued clearing will improve the yield advantage but will also improve the supply to irrigation and significantly adds to spills from Kouga Dam that will most probably improve the supply to the environmental requirement downstream of the dam.

The option to curtail irrigation water use in the Kouga Catchment when the users from Kouga Dam are under restrictions will have minimal improvement on the water available from Kouga Dam. This is as result of the large areas in the Kouga catchment under opportunistic irrigation.

6.2 Costing

It is evident that the raising of Kouga Dam would be relatively costly due to the reduced yield (R 1 602 million for a 19.8m raising), but there are still significant uncertainties regarding the overall cost.

Dam safety requirements and cost, and how it relates to the potential raising, is not yet known. If dam safety work can contribute to a reduction of the capital cost of the raising of Kouga Dam, it would become a more viable option to consider. In this instance, the increased yield above could be obtained at a cost of R 720 million. This equates to a significantly reduced URV (which decreased from R 6.89/m^3 to R 3.09/m^3).

Environmental flows have not been taken into account in the yield determination, which could influence the viability and feasibility of the scheme.

6.3 Environmental

The option of increasing the capacity Kouga Dam will have significant environmental and social impacts. The proposed activities will trigger environmental and other legislative processes. These will require detailed specialist input, stakeholder consultation and a full EIA, which is a lengthy process.

Should this option be investigated further, the risks identified in Section 5 should be addressed in detail in further studies of the dam raising. The stakeholder engagement process must begin as early as possible in the process to ensure that issues are incorporated into the study at the earliest opportunity. Stakeholder engagement must include the key stakeholders identified in Table 6.1.

Table 6.1: List of key stakeholders

Name	Organisation	Tel:	Email
Tracey Potts	Manager: Biodiversity Stewardship Programme, Eastern Cape Parks and Tourism Agency	+27 42 2920245	Tracey.Potts@ecpta.co.za
Wayne Erlank	Manager: Regional, Routes and Reserves (West), Eastern Cape Parks & Tourism Agency	+27 41 364 2570	wayne.erlank@ecpta.co.za
Andrew Skowno	ECOSOL GIS	27 82 7744613	drew@sa.wild.org
Tony Albers	Kyle Business Projects	+27 41 5825289	tony.albers@kylebusiness.co.za
Pierre Joubert	Director of Gamtoos Irrigation		pjoubert@lantic.net
Ernst van Jaarsveld	SANBI		e.vanjaarsveld@sanbi.org.za

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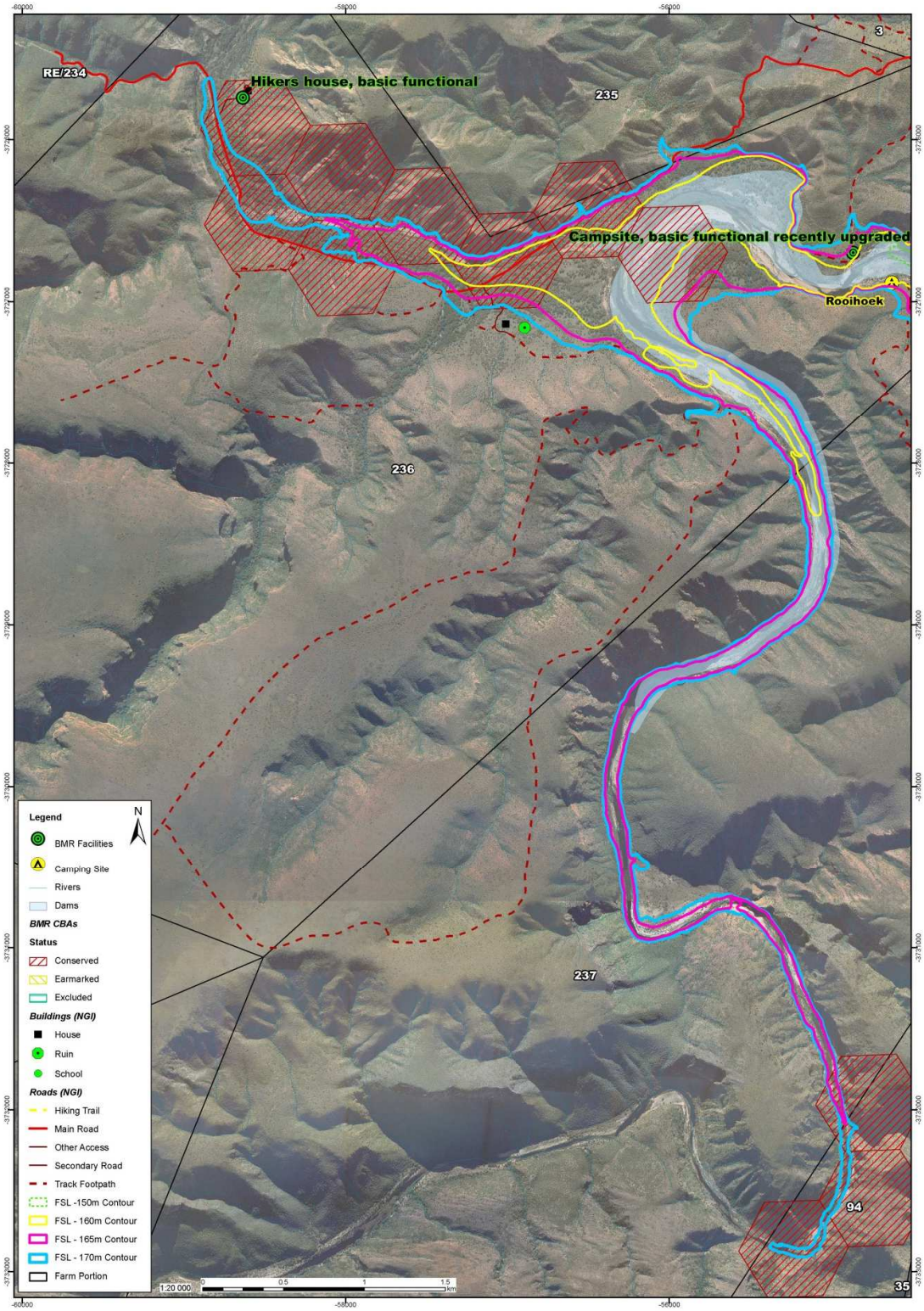
Personal Communications:

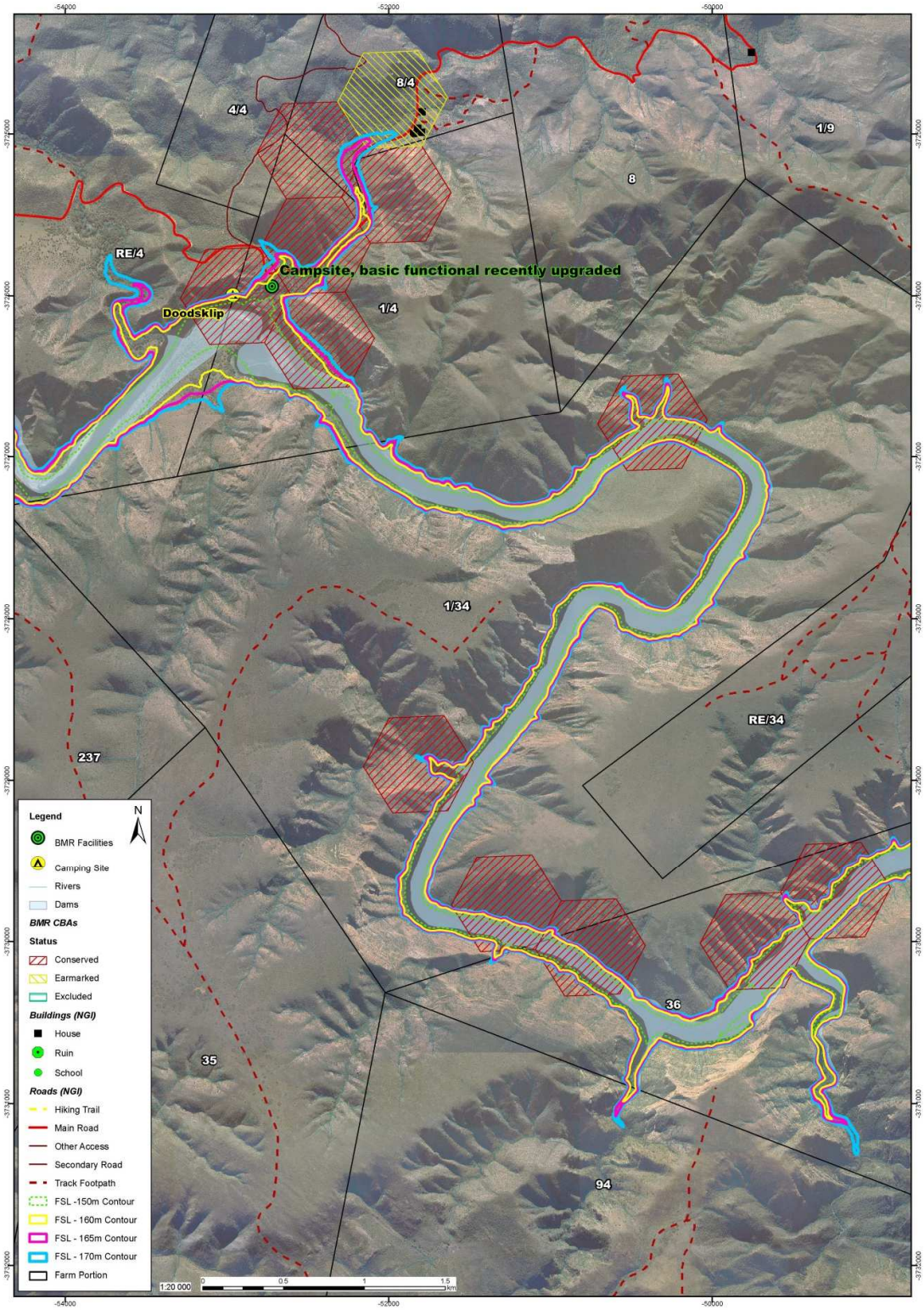
Ernst Van Jaarsveld – SANBI (e.vanjaarsveld@sanbi.org.za)

Stephen Mullineux – Department of Water Affairs (MullineuxS@dwa.gov.za)

Appendices

Appendix 1: Maps showing Critical Biodiversity Areas

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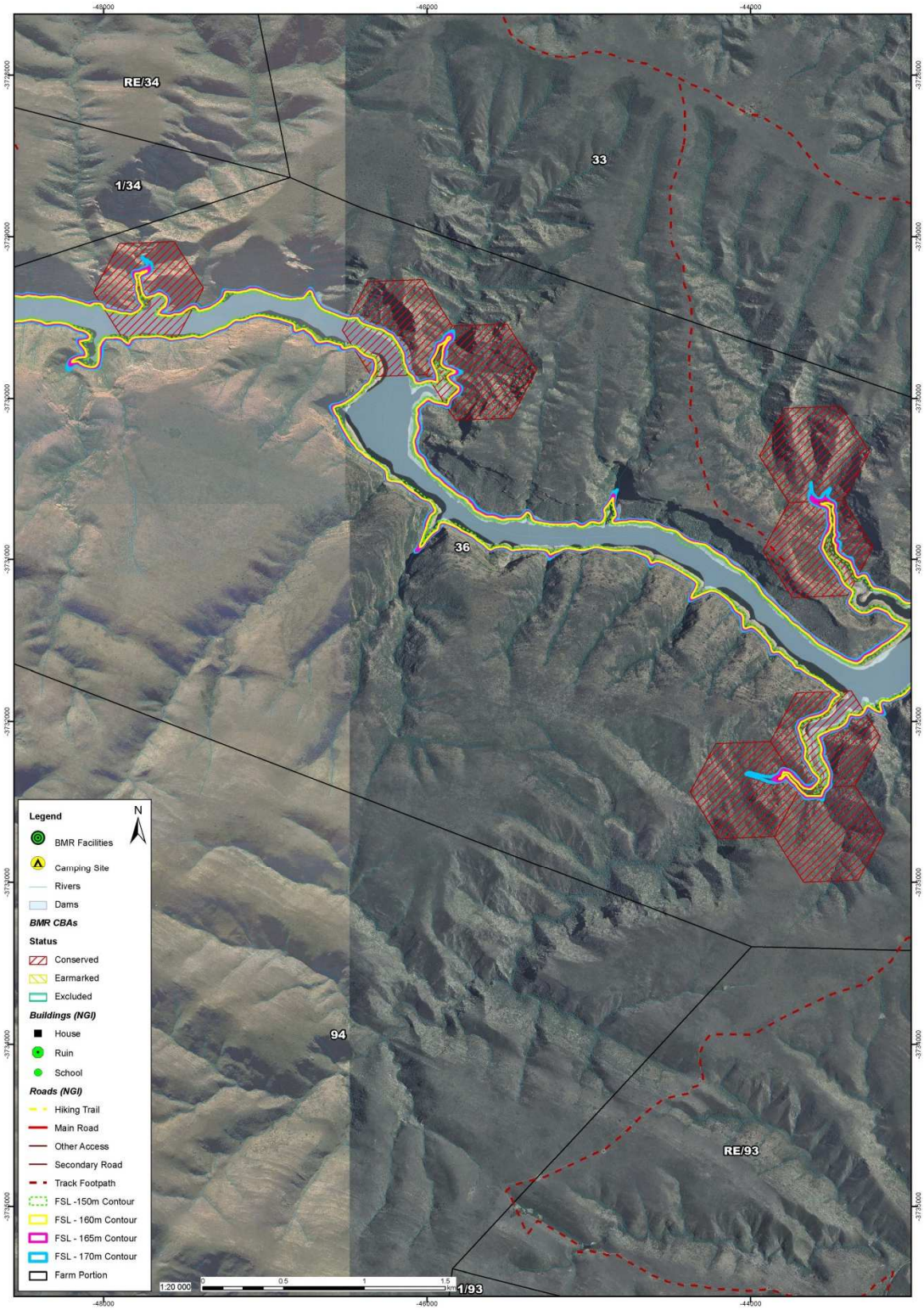
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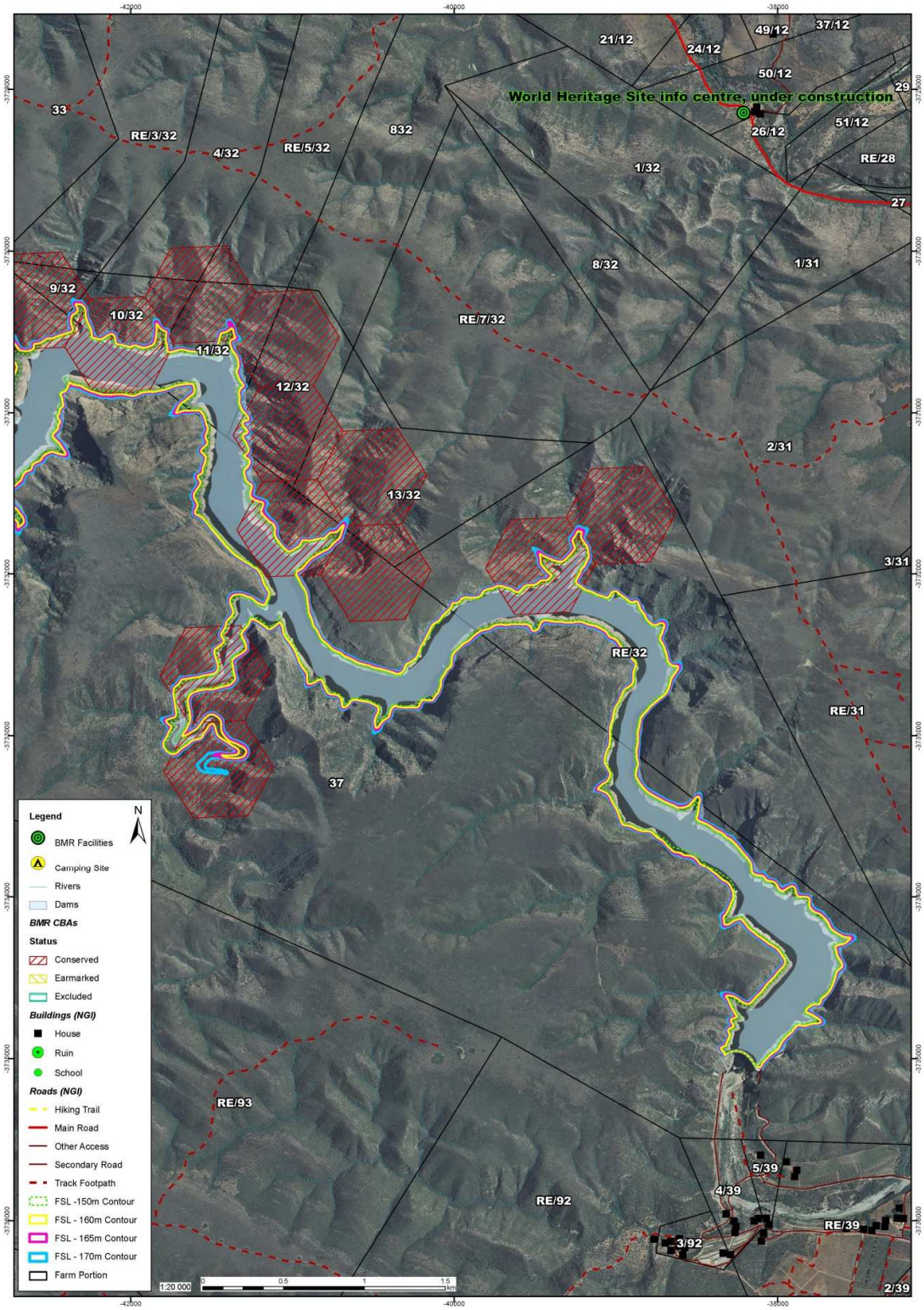
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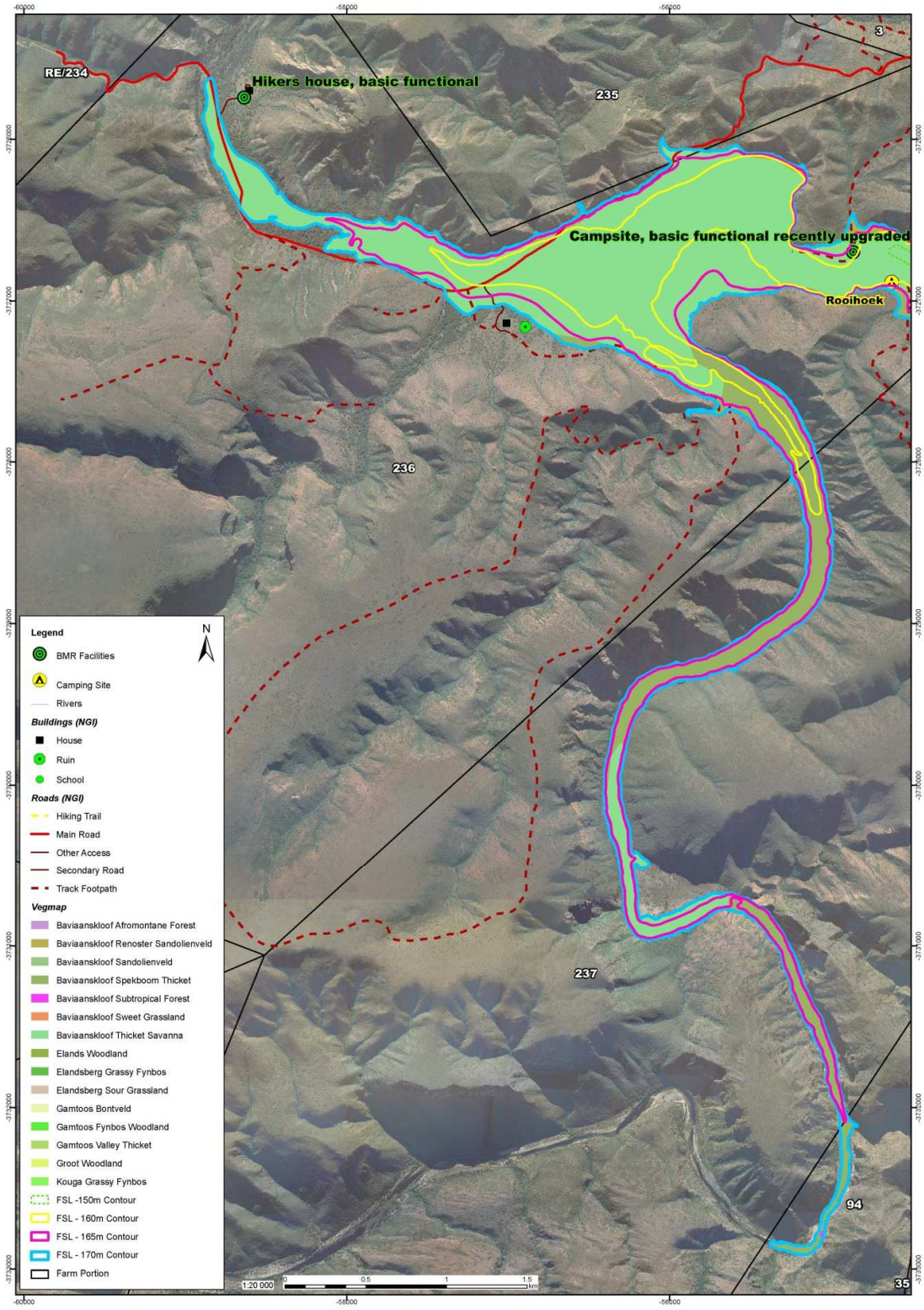
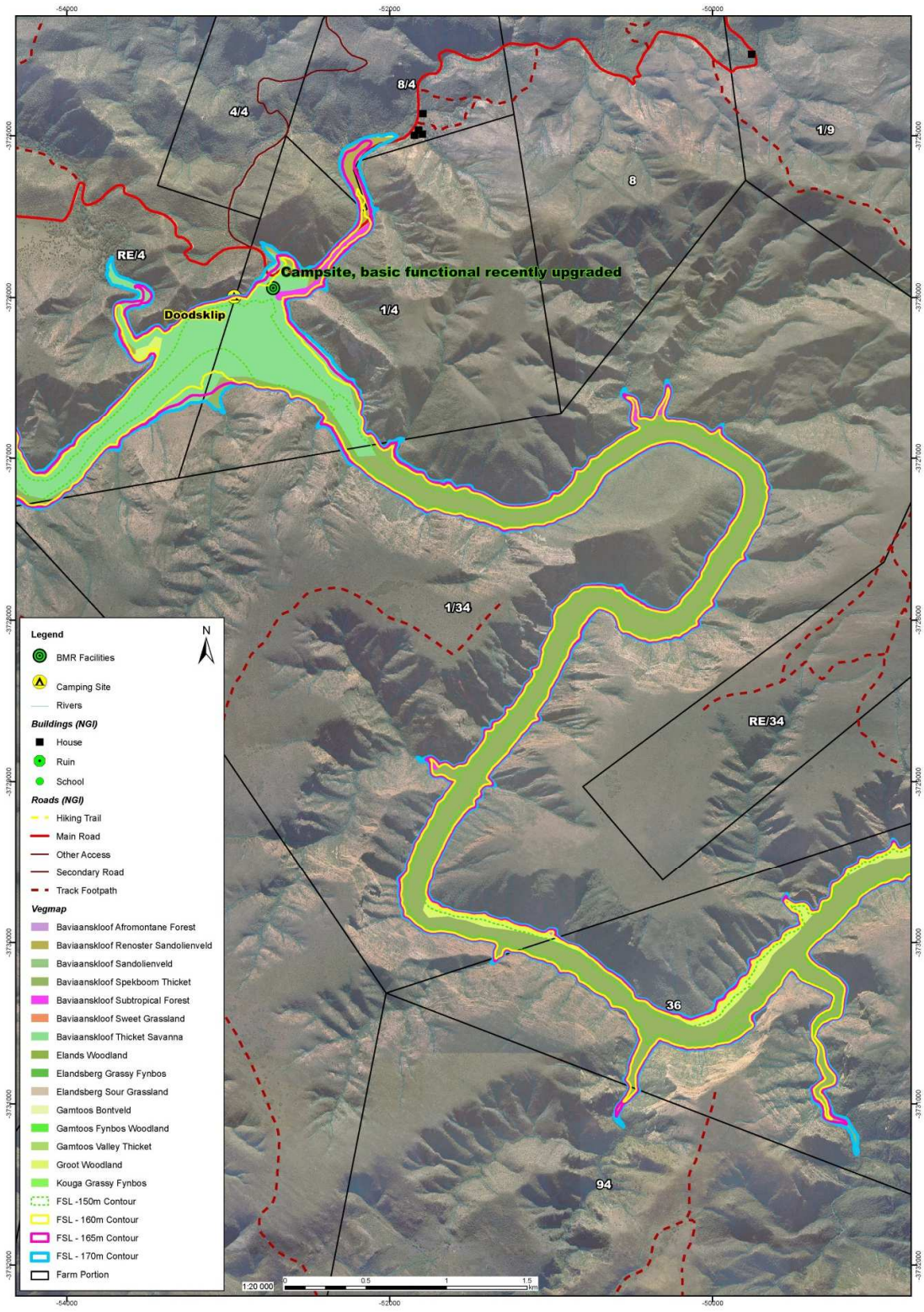
Appendix 2: Maps showing Vegetation Types

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Track Footpath
Vegmap
Baviaanskloof Afromontane Forest
Baviaanskloof Renoster Sandolienveld
Baviaanskloof Sandolienveld
Baviaanskloof Spekboom Thicket
Baviaanskloof Subtropical Forest
Baviaanskloof Sweet Grassland
Baviaanskloof Thicket Savanna
Elands Woodland
Elandsberg Grassy Fynbos
Elandsberg Sour Grassland
Gamtoos Bontveld
Gamtoos Fynbos Woodland
Gamtoos Valley Thicket
Groot Woodland
Kouga Grassy Fynbos
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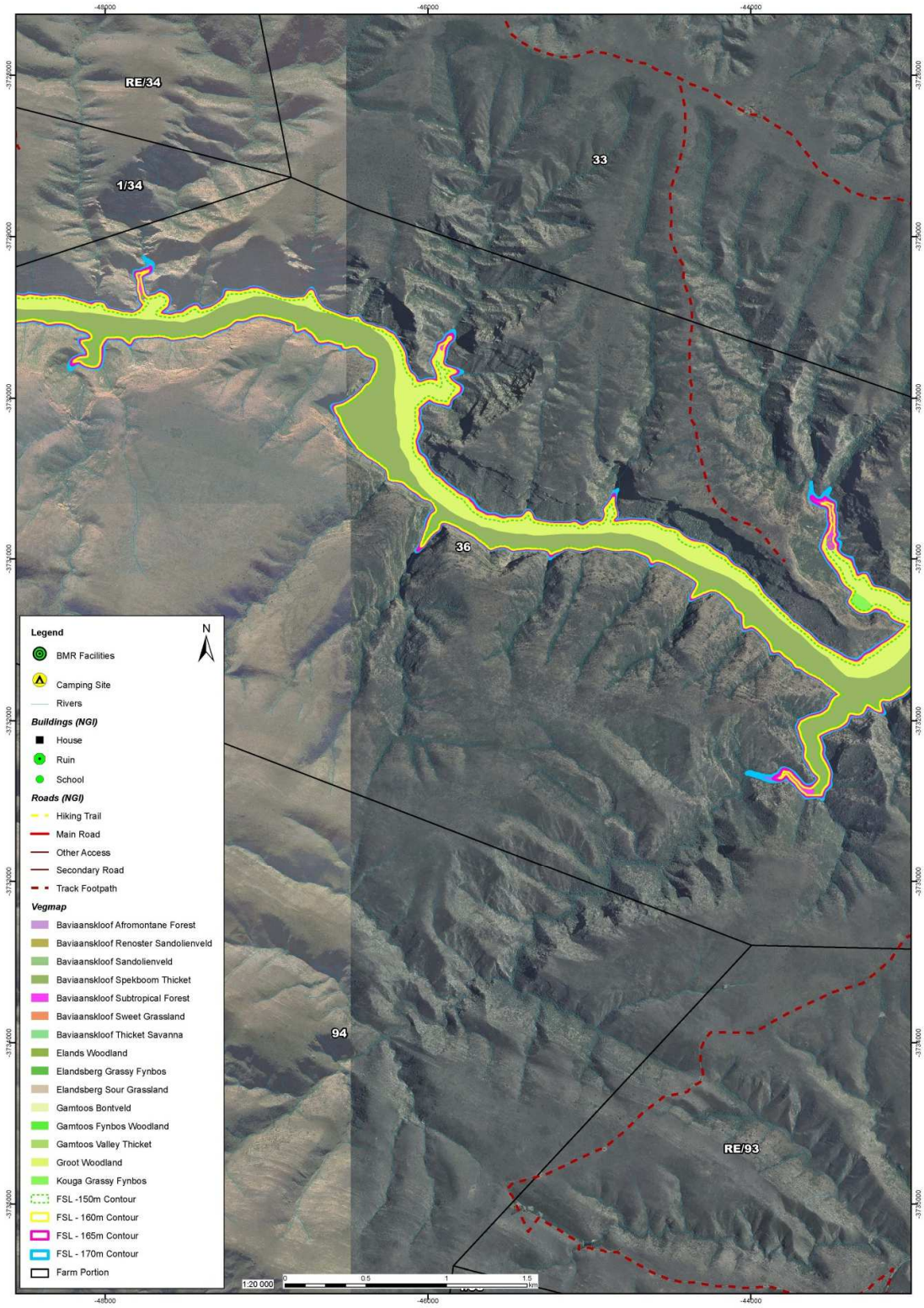
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Baviaanskloof Subtropical Forest
Baviaanskloof Sweet Grassland
Baviaanskloof Thicket Savanna
Elands Woodland
Elandsberg Grassy Fynbos
Elandsberg Sour Grassland
Gamtoos Bontveld
Gamtoos Fynbos Woodland
Gamtoos Valley Thicket
Groot Woodland
Kouga Grassy Fynbos
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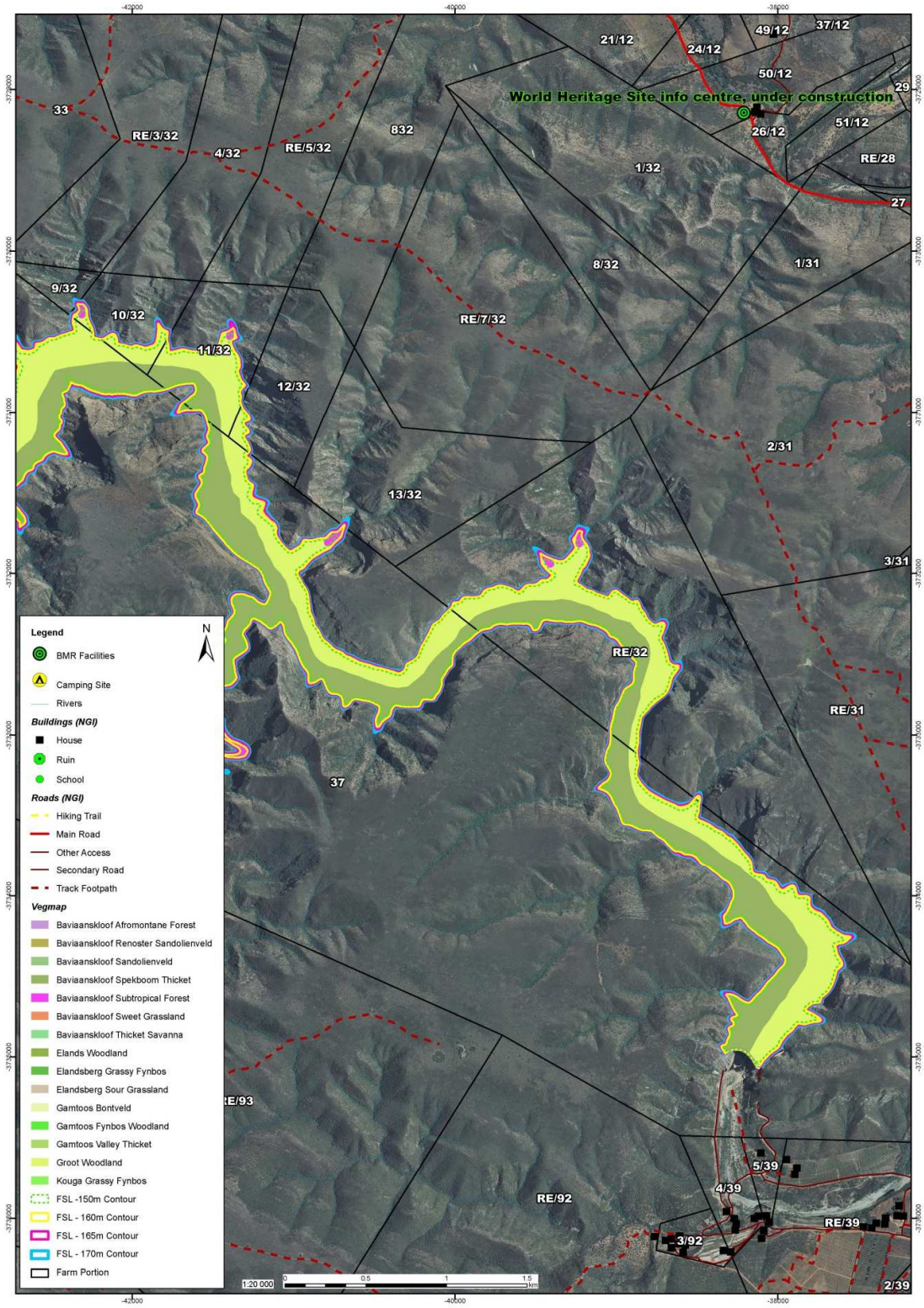
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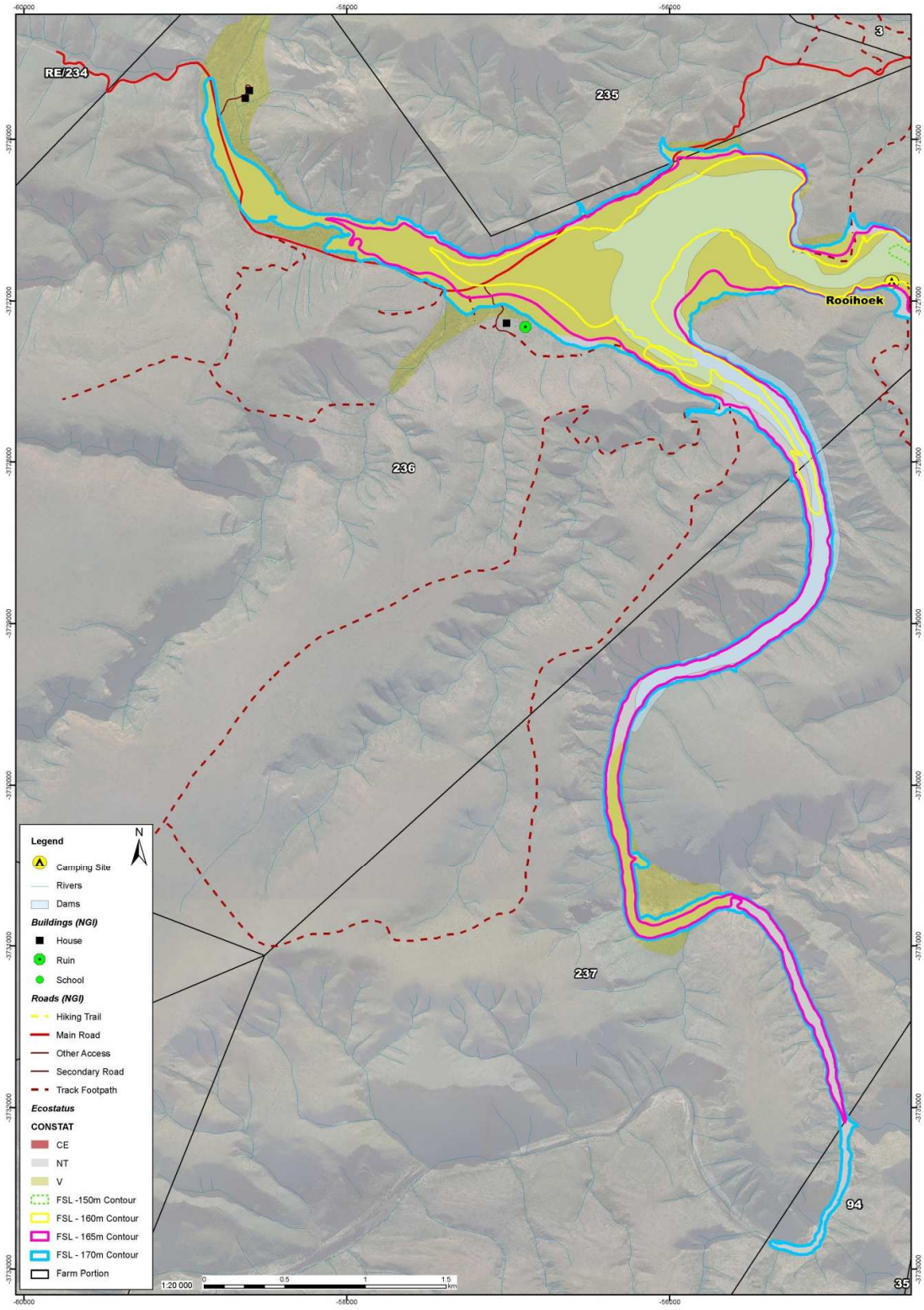
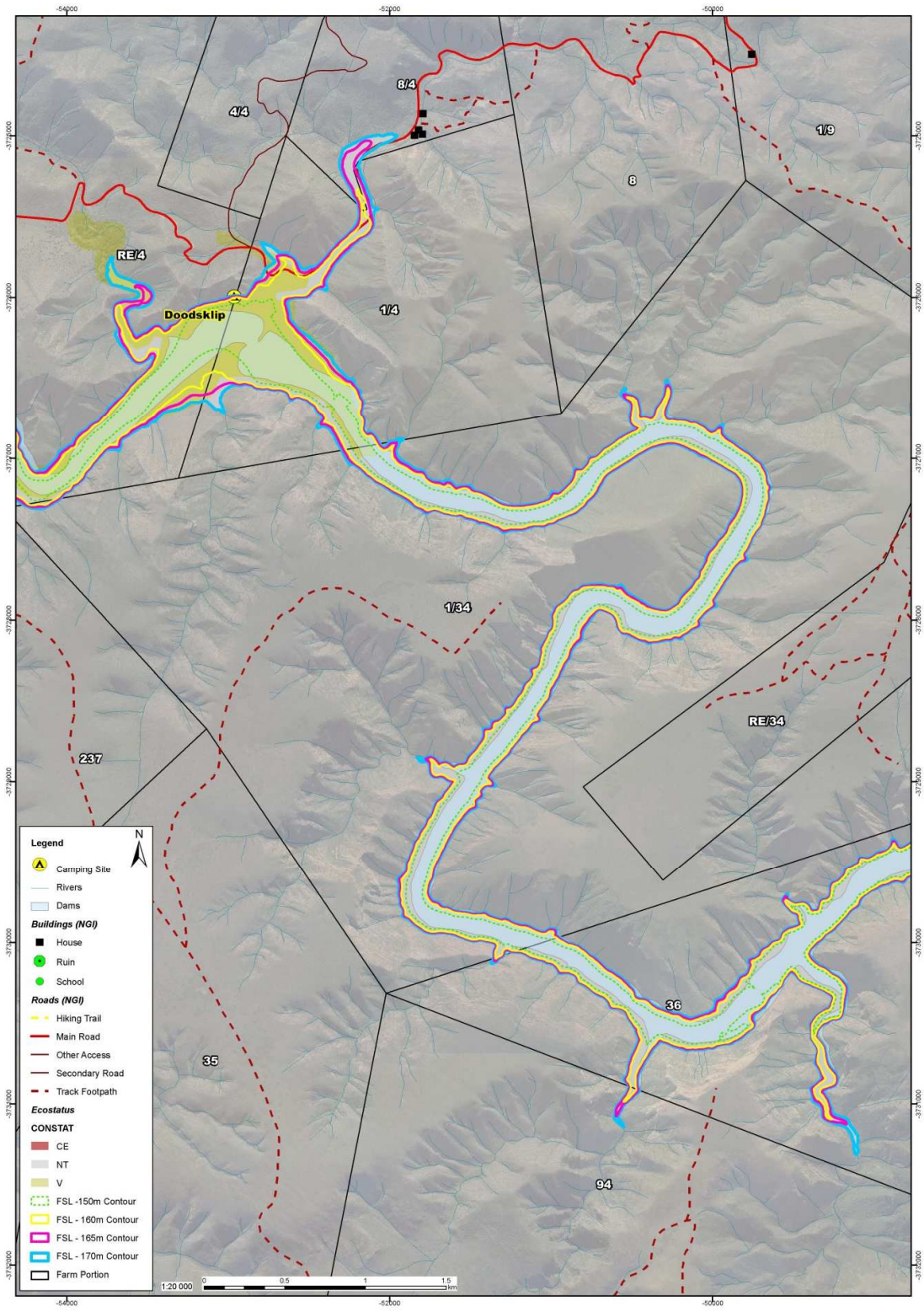
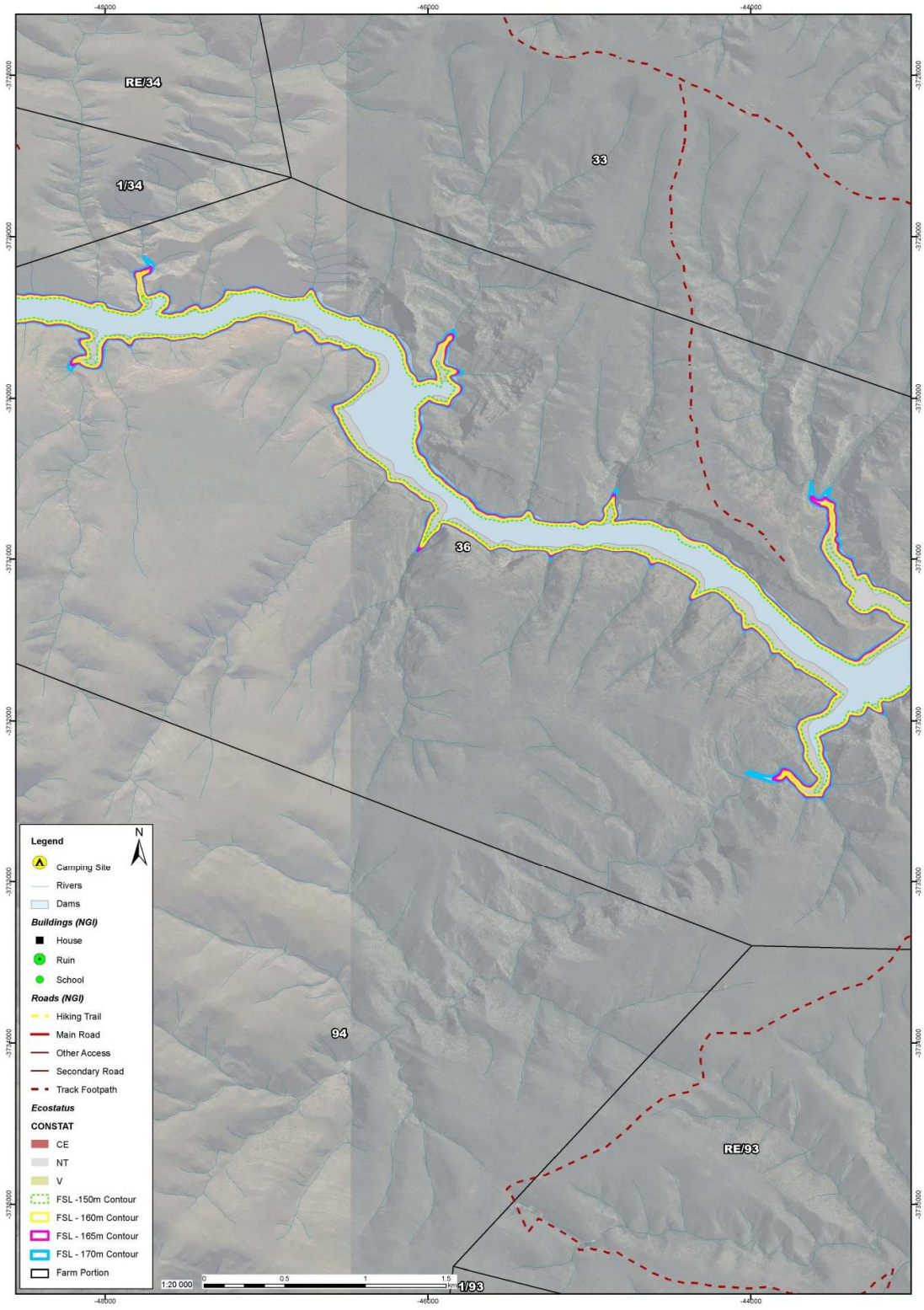
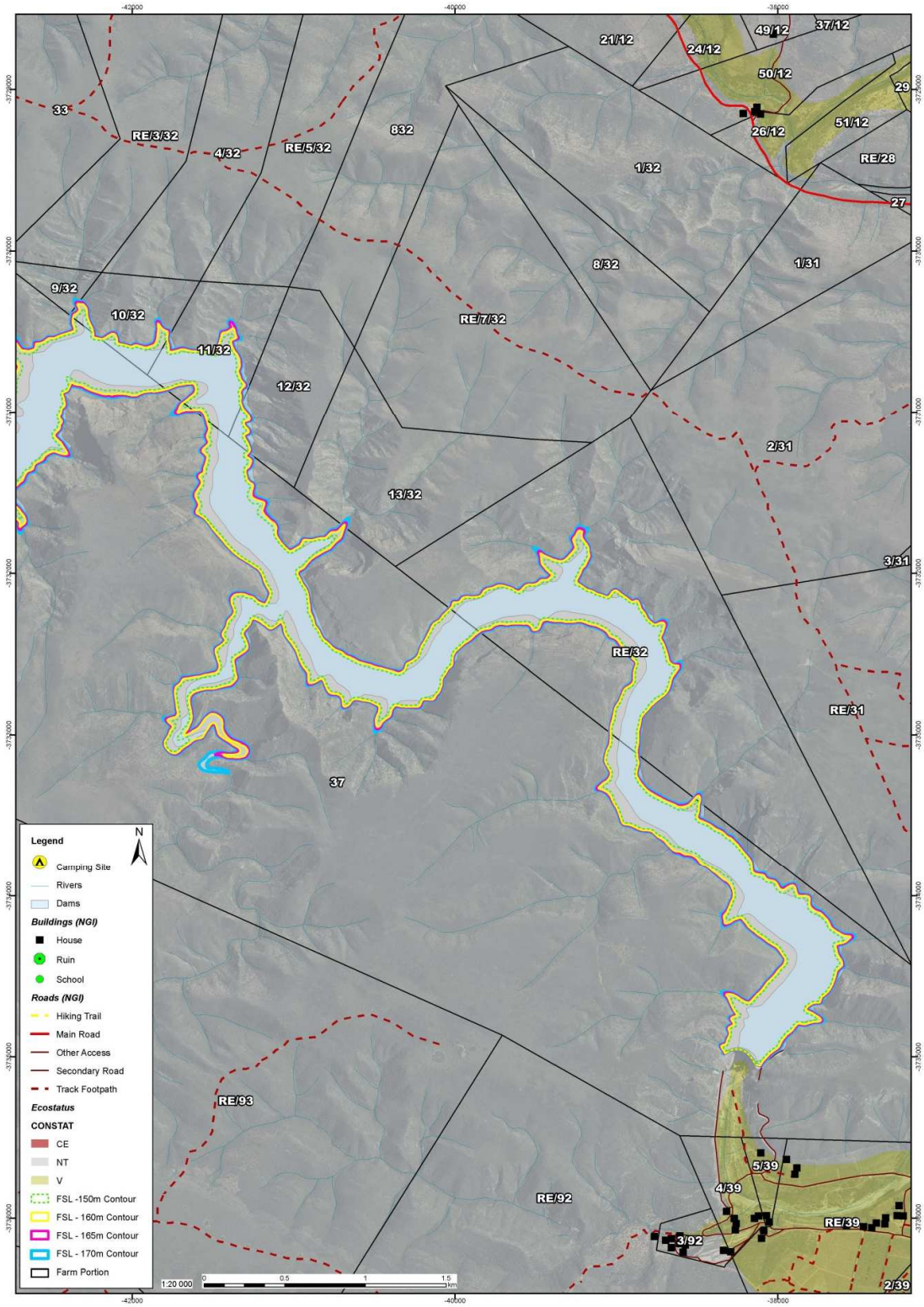
Rivers
Buildings (NGI)
House
Ruin
School
Roads (NGI)
Hiking Trail
Main Road
Other Access
Secondary Road
Track Footpath
Vegmap
Baviaanskloof Afromontane Forest
Baviaanskloof Renoster Sandolienveld
Baviaanskloof Sandolienveld
Baviaanskloof Spekboom Thicket
Baviaanskloof Subtropical Forest
Baviaanskloof Sweet Grassland
Baviaanskloof Thicket Savanna
Elands Woodland
Elandsberg Grassy Fynbos
Elandsberg Sour Grassland
Gamtoos Bontveld
Gamtoos Fynbos Woodland
Gamtoos Valley Thicket
Groot Woodland
Kouga Grassy Fynbos
FSL -150m Contour
FSL - 160m Contour
FSL - 165m Contour
FSL - 170m Contour
Farm Portion
1:20 000
0
0.5
1
1.5
km
-42000
-40000
-38000
-3732000
-3734000
-3736000
-3738000

Appendix 3: Maps showing Ecosystem Status




8/4
4/4
1/9
8
RE/4
Doodsklip
1/4
1/34
RE/34
237
36
35
94
Legend
N
Camping Site
Rivers
Dams
Buildings (NGI)
House
Ruin
School
Roads (NGI)
Hiking Trail
Main Road
Other Access
Secondary Road
Track Footpath
Ecostatus
CONSTAT
CE
NT
V
FSL -150m Contour
FSL - 160m Contour
FSL - 165m Contour
FSL - 170m Contour
Farm Portion
1:20 000
0
0.5
1
1.5
km


RE/34
1/34
33
36
94
RE/93
1/93
Legend
N
Camping Site
Rivers
Dams
Buildings (NGI)
House
Ruin
School
Roads (NGI)
Hiking Trail
Main Road
Other Access
Secondary Road
Track Footpath
Ecostatus
CONSTAT
CE
NT
V
FSL -150m Contour
FSL - 160m Contour
FSL - 165m Contour
FSL - 170m Contour
Farm Portion
1:20 000
0
0.5
1
1.5
km


-42000
-40000
-38000
-3720000
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-3740000
-3750000
21/12
49/12
37/12
24/12
50/12
29
33
RE/3/32
4/32
RE/5/32
832
26/12
51/12
1/32
RE/28
27
8/32
1/31
9/32
10/32
RE/7/32
11/32
12/32
2/31
13/32
3/31
RE/32
RE/31
37
RE/93
RE/92
5/39
4/39
RE/39
3/92
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Legend
N
Camping Site
Rivers
Dams
Buildings (NGI)
House
Ruin
School
Roads (NGI)
Hiking Trail
Main Road
Other Access
Secondary Road
Track Footpath
Ecostatus
CONSTAT
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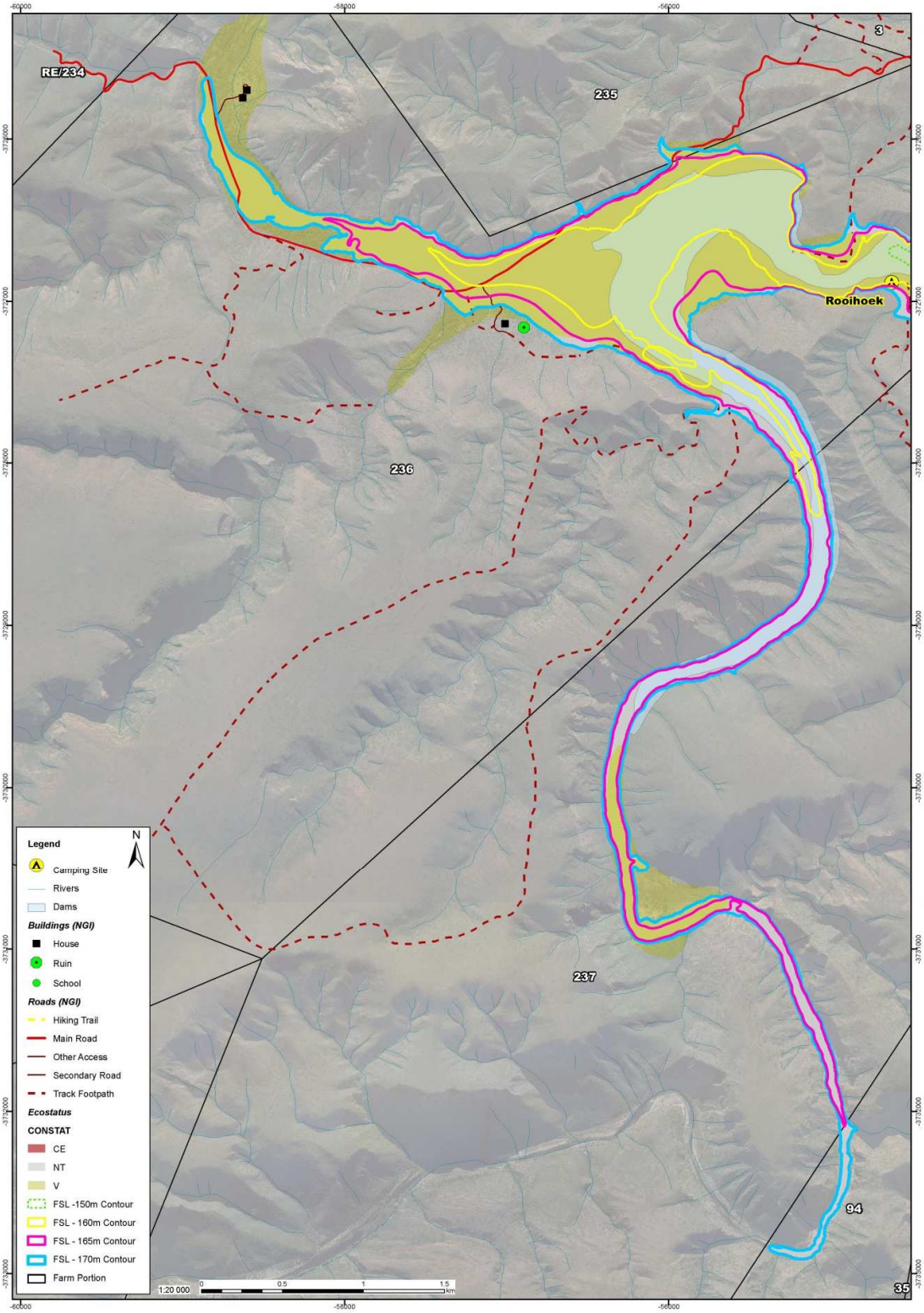
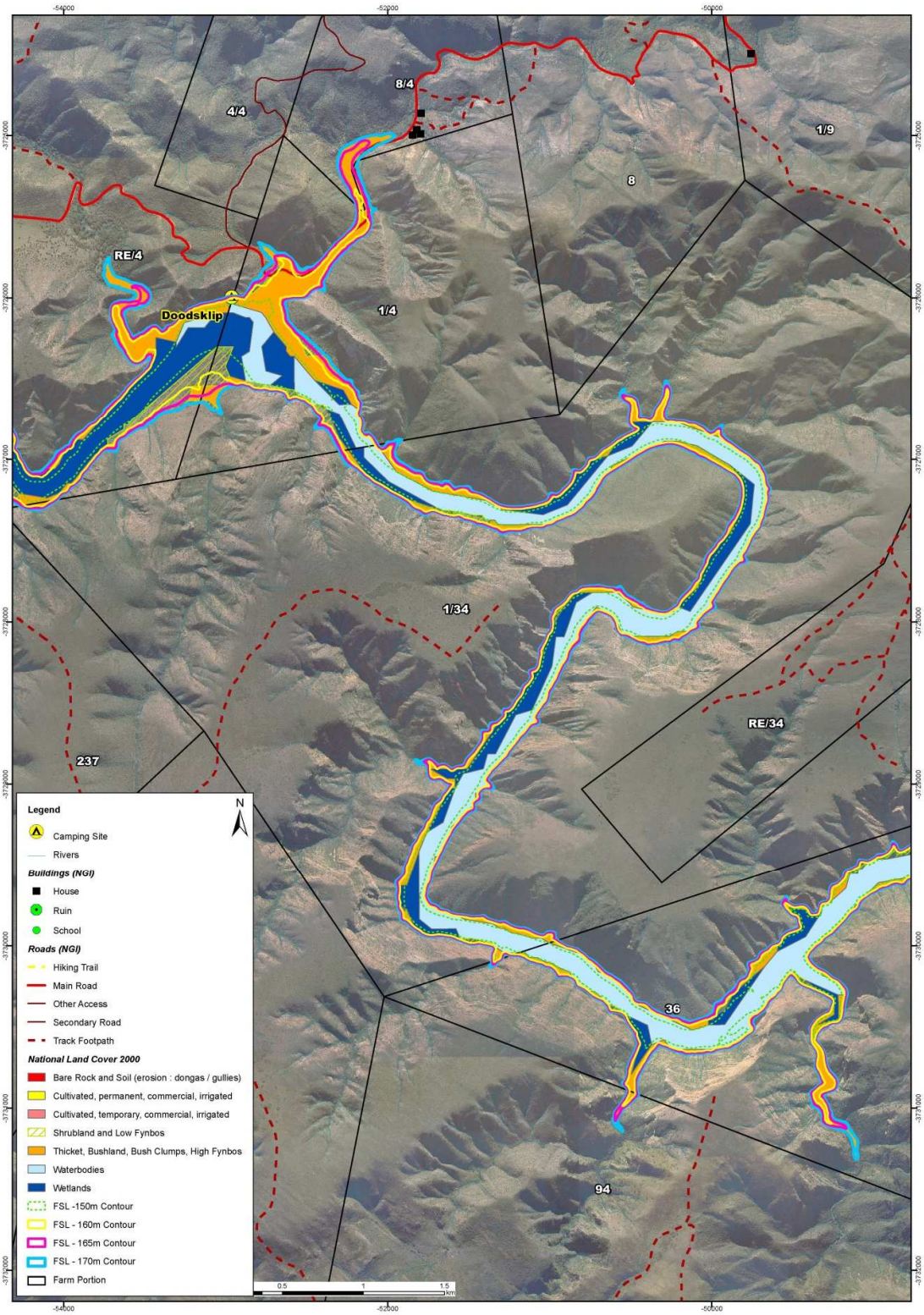
V
FSL -150m Contour
FSL - 160m Contour
FSL - 165m Contour
FSL - 170m Contour
Farm Portion
1:20 000
0
0.5
1
1.5
km

Appendix 4: Maps showing National Land Cover

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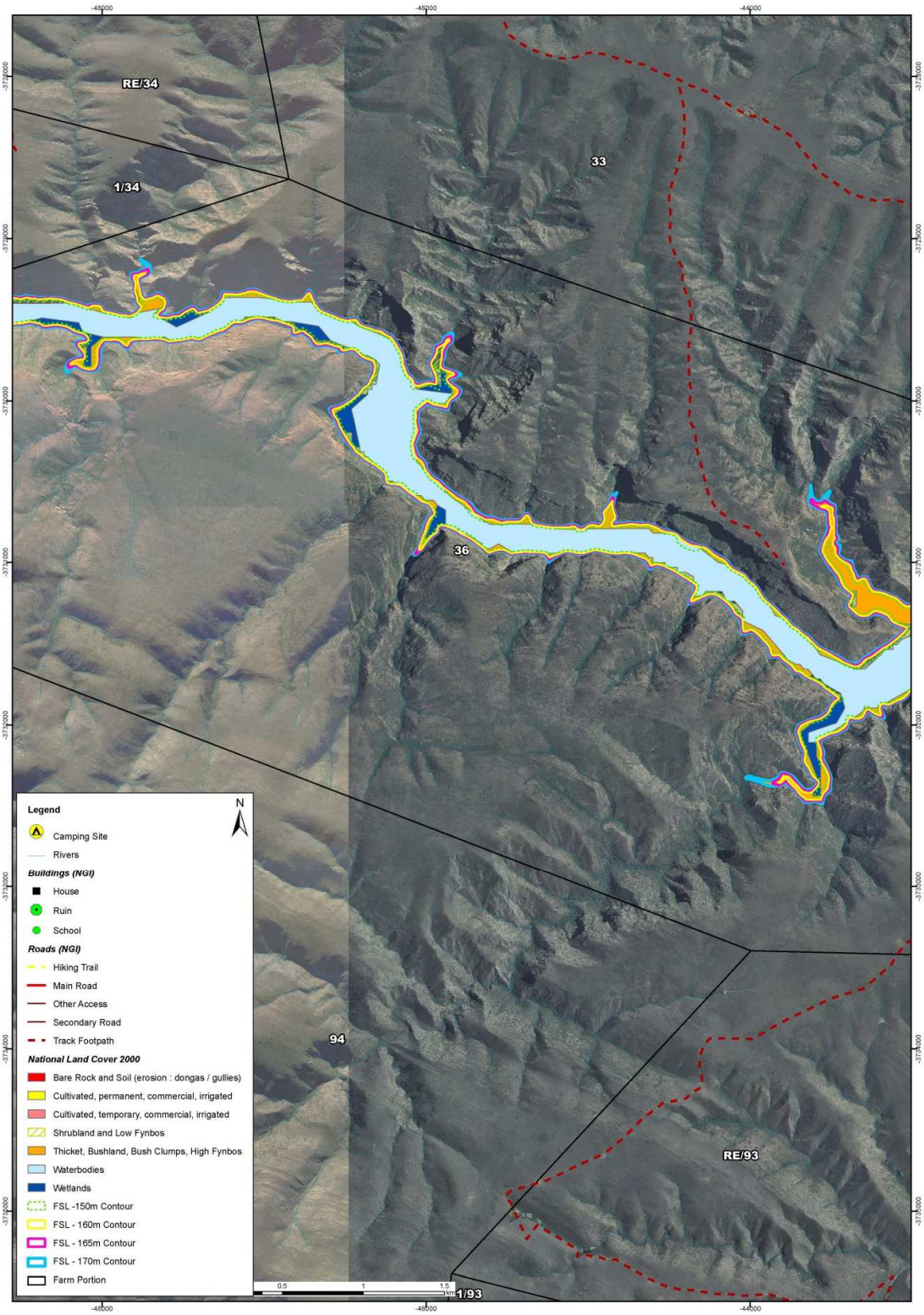
-52000
-50000
-3724000
-3726000
-3728000
-3730000
-3732000
8/4
4/4
1/9
8
RE/4
Doodsklip
1/4
1/34
RE/34
237
36
94
Legend
N
Camping Site
Rivers
Buildings (NGI)
House
Ruin
School
Roads (NGI)
Hiking Trail
Main Road
Other Access
Secondary Road
Track Footpath
National Land Cover 2000
Bare Rock and Soil (erosion : dongas / gullies)
Cultivated, permanent, commercial, irrigated
Cultivated, temporary, commercial, irrigated
Shrubland and Low Fynbos
Thicket, Bushland, Bush Clumps, High Fynbos
Waterbodies
Wetlands
FSL -150m Contour
FSL - 160m Contour
FSL - 165m Contour
FSL - 170m Contour
Farm Portion
0.5
1
1.5
km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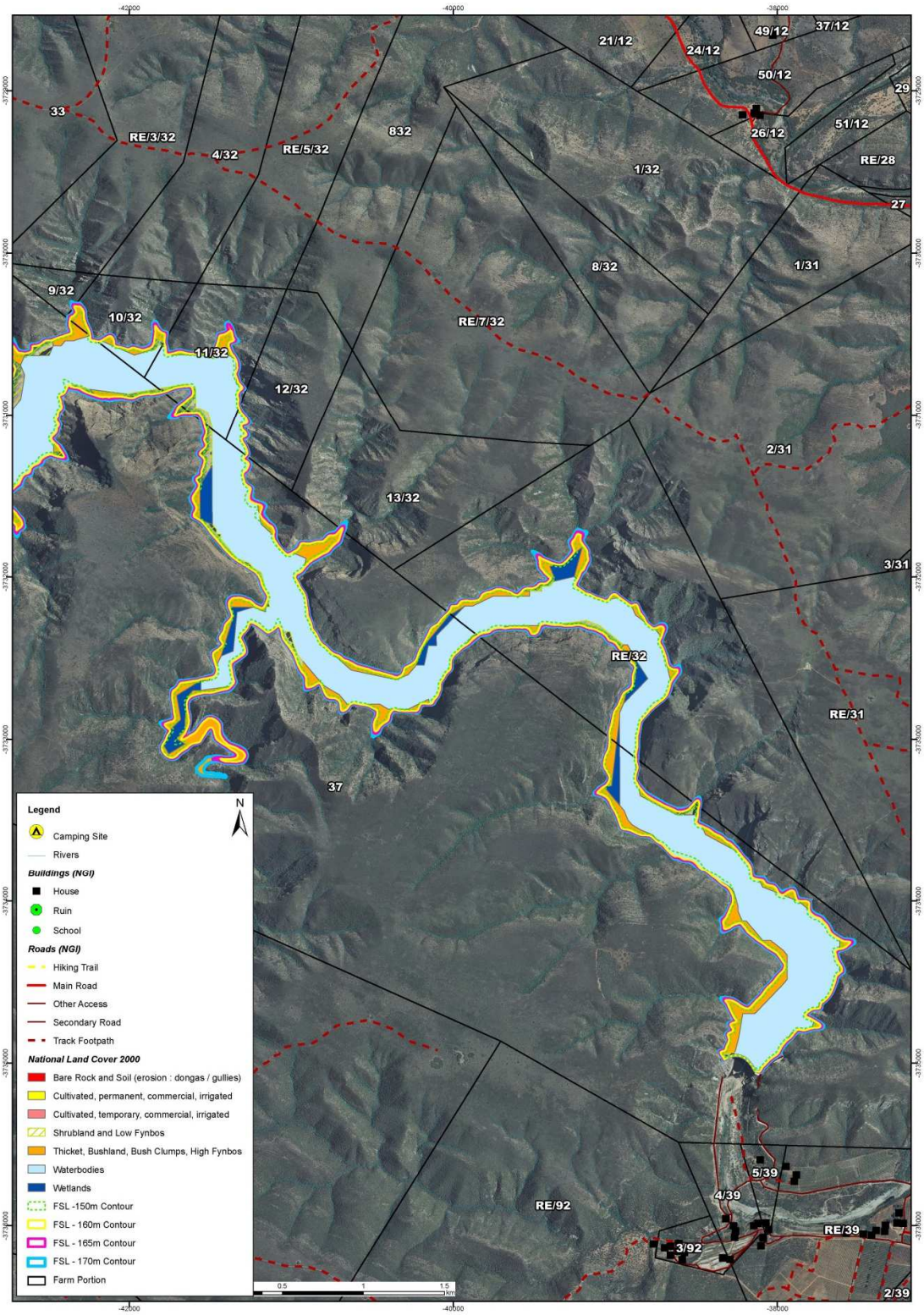
-46000
-44000
-3734000
-3736000
-3738000
-3740000
-3742000
-3744000
-3746000
RE/34
1/34
33
36
94
RE/93
1/93
N
Legend
Camping Site
Rivers
Buildings (NGI)
House
Ruin
School
Roads (NGI)
Hiking Trail
Main Road
Other Access
Secondary Road
Track Footpath
National Land Cover 2000
Bare Rock and Soil (erosion : dongas / gullies)
Cultivated, permanent, commercial, irrigated
Cultivated, temporary, commercial, irrigated
Shrubland and Low Fynbos
Thicket, Bushland, Bush Clumps, High Fynbos
Waterbodies
Wetlands
FSL -150m Contour
FSL - 160m Contour
FSL - 165m Contour
FSL - 170m Contour
Farm Portion
0.5
1
1.5
km


-42000
-40000
-38000
-3729000
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-3738000
21/12
24/12
49/12
37/12
50/12
29
33
RE/3/32
4/32
RE/5/32
832
26/12
51/12
RE/28
1/32
27
8/32
1/31
9/32
10/32
11/32
12/32
RE/7/32
2/31
13/32
3/31
RE/32
RE/31
37
Legend
N
Camping Site
Rivers
Buildings (NGI)
House
Ruin
School
Roads (NGI)
Hiking Trail
Main Road
Other Access
Secondary Road
Track Footpath
National Land Cover 2000
Bare Rock and Soil (erosion : dongas / gullies)
Cultivated, permanent, commercial, irrigated
Cultivated, temporary, commercial, irrigated
Shrubland and Low Fynbos
Thicket, Bushland, Bush Clumps, High Fynbos
Waterbodies
Wetlands
FSL -150m Contour
FSL - 160m Contour
FSL - 165m Contour
FSL - 170m Contour
Farm Portion
0.5
1
1.5
km
5/39
4/39
RE/92
RE/39
3/92
2/39

Appendix 5: Legal Context

Process to be followed for environmental authorisation

The construction of a dam wall immediately against, or downstream of the existing dam to increase the capacity of the Kouga Dam, will require authorisations in terms of the National Environmental Management Act (Act 107 of 1998), as amended (NEMA) and the National Water Act (Act 36 of 1998) (NWA), as well as the National Heritage Resources Act (NHRA) No. 25 of 1999.

It is envisaged that the proposed construction may trigger the following activities Table 1)[4]:

Table 1. Listed activities in terms of NEMA

Listing notice one (Government Notice No. R. 544)	Listing notice two (Government Notice No. R. 545)	Listing notice three (Government Notice No. R. 546)
Activity 11(iv): The construction of dams where such construction occurs within a watercourse or within 32 meters of a watercourse.	Activity 19: The construction of a dam, where the highest part of the dam wall, as measured from the outside toe of the wall to the highest part of the wall, is 5 metres or higher or where the high-water mark of the dam covers an area of 10 hectares or more.	Activity 4(ii): The construction of a road wider than 4 metres with a reserve less than 13,5 metres.
Activity 13: The construction of facilities or infrastructure for the storage, or for the storage and handling, of a dangerous good, where such storage occurs in containers with a combined capacity of 80 but not exceeding 500 cubic metres.		Activity 12: Clearance of 300m^2 or more for CBAs recognized in bioregional plans.
Activity 22: The construction of a road, outside urban areas, (i) with a reserve wider than 13.5 meters or, where (ii) where no reserve exists where the road is wider than 8 metres, or (iii) for which an environmental authorisation was obtained for the route determination in terms of activity 5 in Government Notice 387 of 2006 or activity 18 in Notice 545 of 2010.		Activity 13: Clearance of 1ha or more for CBS recognized in Systematic Biodiversity Plans (SBP) adopted by the competent authority.
Activity 41: The expansion of facilities or infrastructure for the off-stream storage of water, including dams and reservoirs, where the combined capacity will be increased by 50000 cubic metres or more.		Activity 14: The clearance of an area of 5 hectares or more of vegetation where 75% or more of the vegetative cover constitutes indigenous vegetation.
Activity 55: The expansion of a dam where: (i) the highest part of the dam wall, as measured from the outside toe of the wall to the highest part of the wall, was originally 5 metres or higher and where the height of the wall is increased by 2,5 metres or more; or (ii) where the high-water mark of the dam will be increased with 10 hectares or more.		Activity 17: The expansion of reservoirs for bulk water supply where the capacity will be increased by more than 250 cubic metres.

[4] NOTE: This is not a complete list of activities which will be triggered. Additional activities relating to the construction phase and / or associated infrastructure may trigger further activities.

As this proposed project triggers activities listed in all three listing notices, the proponent will need to undertake an EIA. In terms of section 24C of the NEMA, the authorising authority will be the Department of Environmental Affairs (DEA), as the project will takes place in a World Heritage Site and the applicant would be a government department (DWA).

In terms of the National Heritage Resources Act (Act 25 of 1999), heritage resources, including archaeological or palaeontological sites over 100 years old, graves and structures older than 60 years, are protected. Heritage resources may not be disturbed without a permit from the relevant heritage resources authority. This means that before such sites, such as the Baviaanskloof Road, are disturbed by development, it is incumbent on the developer to ensure that a Heritage Impact Assessment is undertaken.

In terms of the NWA, the construction of the dam wall will trigger a section 21(b) {storage of water} water use, as well as section 21(a) {taking water from a water resource} as the additional yield to be used will require an increased abstraction licence. Obtaining a water abstraction licence can be problematic and in this instance would more than likely require an update of the Ecological Water Requirement in the Kouga and Groot Rivers and possibly even in the estuary further downstream, as well as a census of all water use downstream of the dam to ensure there is no over-allocation of the resource. It is also possible that section 21(c)&(i) may also be triggered due to the increased inundation area.

The NWA allows for two types of authorisations, a General Authorisation and a Water Use Licence. General Authorisations apply to activities which tend to have a reduced impact on a water resource, while Water Use Licences apply to activities which have a higher impact on a water resource. For a section 21(b) water use, the General Authorisation would only apply for the storage of water up to 50,000m^3 of water. As the construction of the dam wall will create a storage facility of 246m^3, a Water Use Licence will be required from the Department of Water Affairs.

Furthermore the DWA: Dam Safety Office will not issue a Licence to Construct unless all the relevant NWA water use licences have been issued.

In addition to the above requisite authorisations, the following authorisations and permits may be required prior to the activity commencing:

- **Blasting** - Blasting permits are required from the Department of Mineral Resources in accordance with the Explosives Act (Act No 26 of 1956).
- **Waste disposal** - All wastes (general and hazardous) generated during the construction may only be disposed of at appropriately licensed sites.
- **Storage of hazardous substances** - Hazardous substances must be stored and handled in accordance with the appropriate legislation and standards, which may include the Hazardous Substances Act, the Occupational Health and Safety Act, and relevant associated Regulations.
- **Health and safety** of work teams - Construction Regulations (2003) published under the Occupational Health and Safety Act (Act No 85 of 1993) apply to construction activities including “the moving of earth, clearing of land, the making of an excavation, piling, or any similar type of work”. A “health and safety plan” which addresses hazards, and includes safe working procedures to mitigate, reduce or control the hazards identified, is required under this Act. A risk assessment must also be undertaken by an appropriately qualified person(s) and the Contractor shall ensure that all employees under his or her control are informed, instructed and trained by a competent person regarding any hazard and the related work procedures before any work commences, and thereafter at such times as may be determined in the risk assessment.
- **Removal of trees** – The removal of trees from the dam basin requires a permit in terms of the National Forest Act (No 84 of 1998).
- **Removal and transportation of endangered fauna and flora** - The removal and transportation of indigenous and endangered species to nurseries or green houses require permits in terms of the National Biodiversity Act (No10 of 2004), Section 30.