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Ref: 6266

**KEIRON MCKEE
CABLE STATION ROAD, SEDDON
WATER STORAGE DAM
RESOURCE CONSENT APPLICATION
Technical Report**

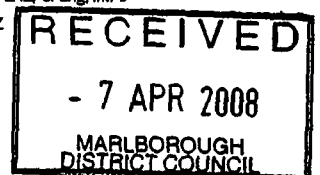
Prepared for:

13 March 2008

Keiron McKee
92 Cable Station Road
Seddon RD1
MARLBOROUGH



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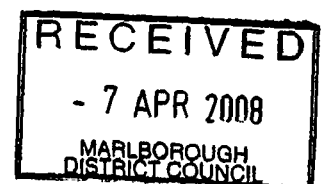
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1.0 INTRODUCTION

It is proposed to construct a water storage dam at the K McKee property located off Cable Station Road, Seddon for the purpose of storing water to irrigate grapes. The proposed dam forming the reservoir is located across a gully which is an unnamed tributary of Blind River. Construction of the dam is proposed to take place in 2008. This report describes the technical aspects of the proposed dam and is to support the application for Resource Consents. At this stage the principal design concepts have been established and feasibility design completed. Final design will be undertaken following application for Resource Consents.

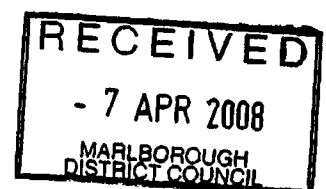
2.0 SITE DESCRIPTION

The proposed dam is located off Cable Station Road as shown on Figure 1. The dam is located on an unnamed tributary of Blind River. The location of the dam and the catchment area are shown on Figure 2.

The dam is located approximately 250m upstream of Cable Station Road. Runoff from the gully is piped under Cable Station Road via a concrete culvert 1100mm deep and 1400mm wide. The gully across which the dam is to be constructed is approximately 12m deep and typically 70m wide at the proposed reservoir water level with side slopes varying between about 16-22° (refer Figure 3). On the northern side of the gully the land rises up steeply at approximately 22° to approximately 7m above the proposed reservoir level and then levels off. The south bank rises up approximately 8m at an angle of 16° to a near level terrace. The gully will provide reasonable storage for water once it is dammed. The area is all in pasture. The catchment area is relatively small (approximately 100ha) and therefore flow in the gully is ephemeral and can be dry for prolonged periods over summer months.



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3.0 SITE GEOLOGY AND GEOTECHNICAL INVESTIGATION4S

Geotechnical investigations at the dam site comprised of 3 testpits (TP1-3) that were excavated in the proposed dam footprint as shown on Figure 3. Logs of the test pits are provided in Appendix A.

The soil profile at the dam site typically comprises a layer of topsoil underlain by stiff clayey silts and gravely clayey silts with mudstone (bedrock) present at shallow depths. The depths to mudstone measured in the pits are summarised in Table 1. The clayey silts that blanket much of the area to a shallow depth are believed to be windblown (loess) deposits. In places there are also gravely silts. These materials are inferred to be glacial outwash gravels (at higher elevations). Alluvium in the gully floor will be derived from erosion of the loess soils and glacial outwash gravels. The clayey silts are typically slightly moist. Mudstone underlies the site at relatively shallow depth (1.2m to 2.2m). The depth to mudstone is relatively shallow on the northern side and the centre of the gully (about 1.2m) but is deeper on the southern side of the gully which is typically deeper than 2m. Some of the alluvium materials in the gully overlying mudstone are weak and/or contain organic materials. Any materials that are low strength and highly compressible will need to be excavated from the footprint of the dam to avoid excessive settlement and to ensure the stability of the dam.

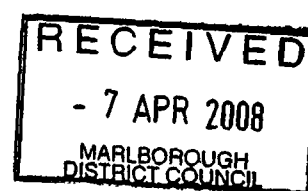
Mudstone is generally present at relatively shallow depths. It is of very low permeability and a cutoff can be constructed down to the mudstone beneath the dam to control seepage from the reservoir.

4.0 CONSTRUCTION MATERIALS

Suitable materials for constructing the dam are available on site. It is proposed to obtain most fill from within the reservoir with some from excavations from the foundation of the dam and the auxiliary spillway. This will increase the storage volume of the reservoir. The low permeability core of the dam can be constructed from selected clayey silt that blankets the site and mudstone. Such material, when compacted, has very low permeability, low compressibility and high strength. The upstream and downstream shoulders of the dam will be constructed from gravely silt. The more gravely material will be used in the upstream shoulder. Laboratory testing of the proposed fill materials for the dams will be undertaken to determine the soils strength and compaction characteristics.

5.0 SEISMIC HAZARD

The site is located in an area of high seismic hazard with three known active faults (Awatere, Clarence and Wairau) within 30km of the site. The closest fault is the Awatere which is 13km north. This fault is considered capable of generating up to magnitude 7.5 earthquakes and has an estimated average recurrence interval of movement of 1,000 years (Ref 2). The proposed embankment (zoned earth/rockfill structure) is capable of withstanding very high levels of earthquake shaking.



6.0 GENERAL DESCRIPTION OF DAM AND STORAGE CAPACITY

The dam will form a reservoir to provide a storage capacity of up to 20,000m³. Approximately 7,000m³ of this storage is obtained by excavation of material from within the reservoir footprint to construct the dam. The height-storage curve for the reservoir is shown on Figure 5.

The dam is approximately 6.2m high beneath the crest and will impound water to a depth of 5m. The area of the reservoir at normal maximum operating water level (RL18.1) is close to 1ha. The footprint area of the dam, including the auxiliary spillway, is approximately 0.3ha.

The dam incorporates primary and secondary spillways. The primary spillway design has the capacity to pass a 10 year return period flood on its own. For larger floods, water will be discharged over the auxiliary spillway.

The layout plan of the proposed dam, including the reservoir area, is shown on Figure 3. A typical cross-section and long-section of the dam are shown on Figure 4. The levels shown on these figure are heights above mean sea level. The co-ordinates are in terms of the Marlborough Circuit co-ordinates.

7.0 DAM DESIGN

7.1. Design Standards and Potential Impact Classification

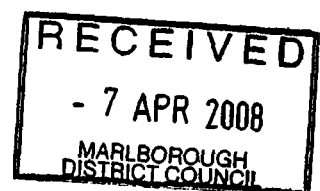
The dam will be designed in accordance with the New Zealand Society on Large Dams (NZSOLD) Dam Safety Guidelines (Ref.1) and relevant International Commission on Large Dams (ICOLD) Design Guidelines. The NZSOLD design requirements are dependent on the potential impact classification (PIC) of the dam. For the proposed dam we assess the PIC to be low.

The proposed dam site is located 250m upstream of Cable Station Road and Blind River. At the interception of the gully and Cable Station Road, there is a concrete culvert with a depth and width of 1100mm and 1400mm, respectively. Some buildings are located downstream of the dam site, but they are located above the flood plain. The nearest structure downstream of the proposed dam is a farm house that is located on a bank about 4m above the river bed.

Failure of the dam would result in water flowing down the gully and possibly overtopping Cable Station Road before it enters into Blind River. The volume of stored water is relatively small (20,000m³) and therefore it is anticipated that flood flows from a breach will be attenuated within a very short period of time.

We consider the risk of any fatalities from a dam break to be low because:

- i) the risk of dam failure is extremely low for a dam designed and constructed in accordance with current practice.
- ii) Vehicles driving along Cable Station Road would see flood flows across the road and have time to stop.



- iii) the likelihood of people being present within the flood plain and not moving away from a rising water level is very low.
- iv) the time for breach development is short (estimated to be less than 20 minutes).
- v) the time to empty the reservoir will be very short because of the small volume of water in the reservoir.
- vi) there are no habitable buildings in the flood plain.

7.2. Embankment Design

The embankment is approximately 6m high and is a zoned structure. A typical cross-section is shown on Figure 4. The crest is at RL19.3. The embankment has upstream and downstream shoulder slopes of 2.5:1 (H:V), with a 4m wide crest. The embankment has a low permeability central core (Zone A) constructed from mudstone and selected clayey silt. The low permeability core is extended as a cutoff down to mudstone bedrock. The upstream shoulder (Zone B) will consist of more gravely material capable of draining under drawdown conditions. The downstream shoulder of the embankment can consist of less gravely material than the upstream side. Both the upstream and downstream shoulders of the embankment will generally be founded on mudstone bedrock.

The design shown on Figure 4 includes a chimney drain. However, the inclusion of a chimney drain in the design will be subject to the results of the testing on the borrow material that is currently underway to whether the borrow materials are resistant to erosion. The function of a chimney drain is to intercept seepage through the embankment and to maintain the downstream shoulder in a dry state. It also acts as a filter to prevent internal erosion developing along cracks that might develop in the dam. The chimney drain is extended down into the cutoff.

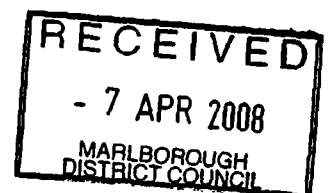
The volume of fill associated with the dam is approximately 2,800m³ of Zone A and 3,000m³ of Zone B. Construction materials will be mainly obtained from within the reservoir and excavations from the foundations of the dam. Additional fill will be sourced from excavations for the auxiliary spillway.

Topsoil will be stripped and temporarily stockpiled. It will be used to rehabilitate the downstream shoulder of the dam and for topsoiling the auxiliary spillway channel.

Unsuitables from the foundation and spillway excavations will be placed downstream of the embankment.

7.3. Spillways

The dam includes primary and secondary spillways as shown on Figures 3 and 4. It is proposed that the design flood be taken as 1,000 years. This corresponds to the upper limit for low PIC dams.



The primary spillway for the dam is located on the south abutment and is proposed to consist of a manhole entry structure with a pipe outlet. The pipe is buried at shallow depth in the downstream shoulder or abutment of the dam. It discharges into the gully downstream of the dam. The auxiliary spillway associated with the dam is situated on the same abutment as the primary spillway. It has a 5m wide inlet and is a grassed channel. A grassed spillway will be satisfactory because flood durations are short. The auxiliary spillway has a reinforced concrete sill at the entry to provide accurate level control and to ensure that flow is spread uniformly across the grassed spillway channel. Earthworks required to construct the auxiliary spillway for the dam involve approximately 1100m³ of cut. The side slopes of the spillway channel are 2:1 (H:V). The slopes will be topsoiled and grassed. Some changes to the auxiliary spillway design may occur at the final design stage, but we would expect such changes to be relatively minor.

Detailed modelling will be undertaken to optimise the design of the spillways and to ensure their performance will meet design objectives. The primary spillway associated with the dam will have the capacity to pass at least 10 year return period flood flows. For greater floods excess water will flow over the auxiliary spillway. The auxiliary spillway will be designed to pass the 1,000 year flood with 0.5m freeboard at the dam crest.

7.4. Seepage Control

Seepage control beneath the dam will be provided primarily by a cutoff extending down to mudstone which underlies the site at relatively shallow depths. This will ensure potential seepage losses will be very low. The depth to mudstone beneath the dam varies from approximately 1.2m in the gully floor to a maximum of 2.2m on the southern abutment.

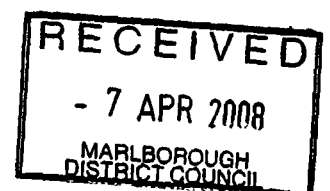
8.0 CONSTRUCTION

It is recommended that construction be undertaken by an experienced earthworks Contractor. Construction is planned to commence in 2008 and is expected to take approximately 2 months.

Construction drawings and a Technical Specification will be prepared. They will detail the requirements for construction including standards for foundation preparation, earthfill compaction, drainage materials and spillways as well as quality assurance requirements. The Designer will undertake inspections at times to confirm critical details and to ensure design requirements are being achieved. The Contractor will be required to undertake control testing to confirm fill standards have been achieved. Independent tests will also be undertaken if necessary.

The Contractor will be required to provide means of controlling any flood flows during construction of the dam. Diversion is required during construction of the dam to divert any possible flood flows to downstream of the dam.

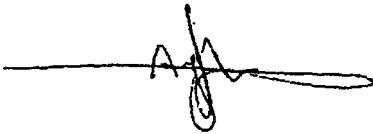
The Contractor will be required to provide a sediment control plan prior to construction commencing. This will set out the proposed works and construction methods that will be implemented to minimise and control sediment that could enter the watercourse downstream.



9.0 OPERATION, MAINTENANCE AND SURVEILLANCE

An Operation, Maintenance and Surveillance Manual will be prepared. This will set out operational, maintenance and surveillance requirements necessary to ensure the ongoing safety of the dam. Monitoring and inspections are a fundamental part of the dam safety process. Specific requirements for the dam will be prepared. The NZSOLD Guidelines recommend for low PIC dams that routine regular inspections by the owner be undertaken at 1-4 monthly intervals, intermediate review by an Engineer every 1-2 years with a comprehensive review every 10 years.

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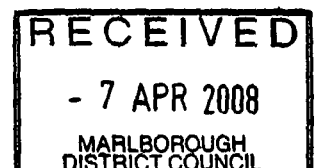
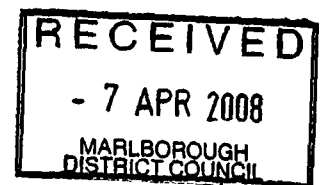


TABLE 1. SUMMARY OF DEPTHS TO MUDSTONE

Test Pit	Depth to Mudstone (m)
1	1.2
2	1.2
3	2.2



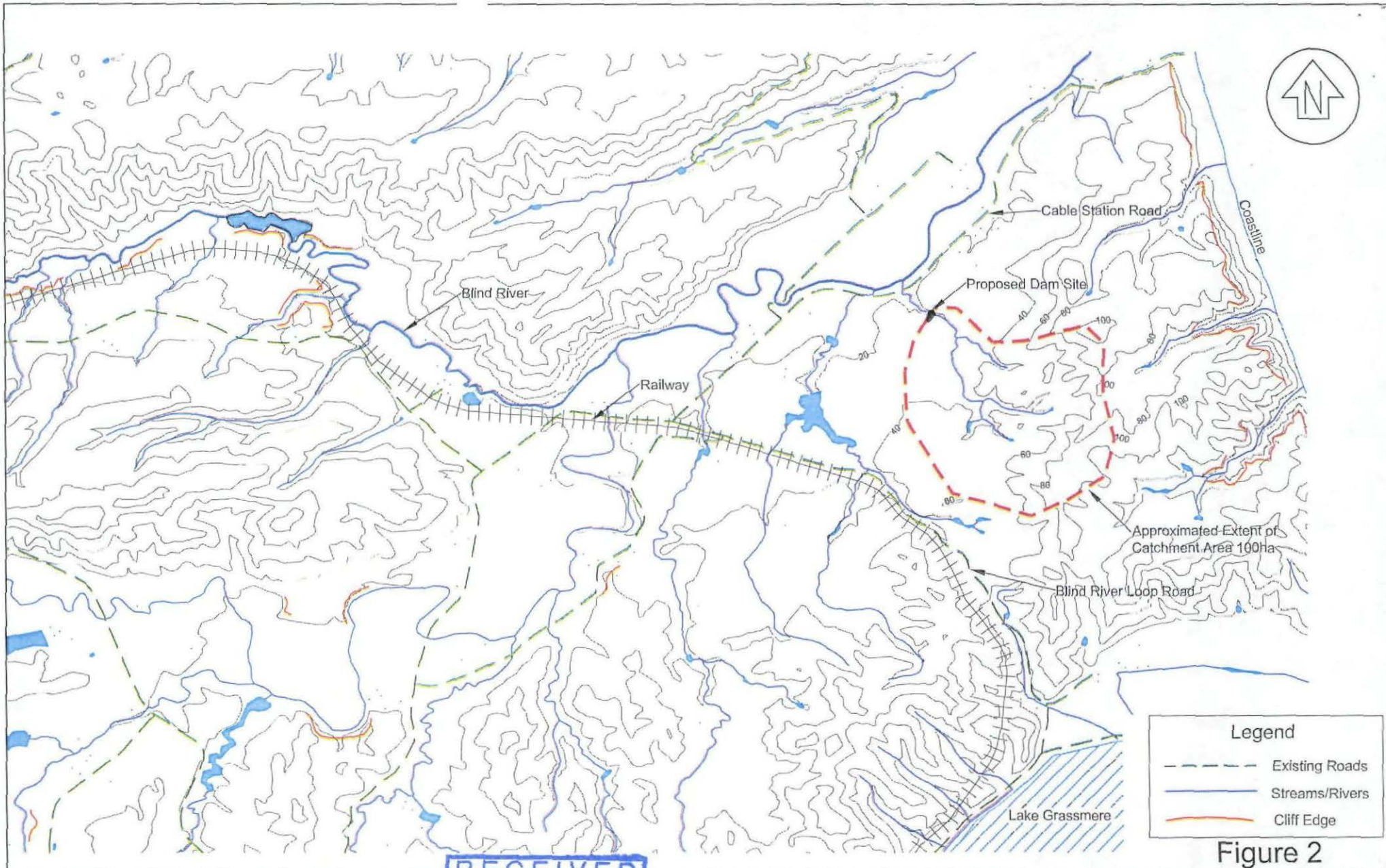


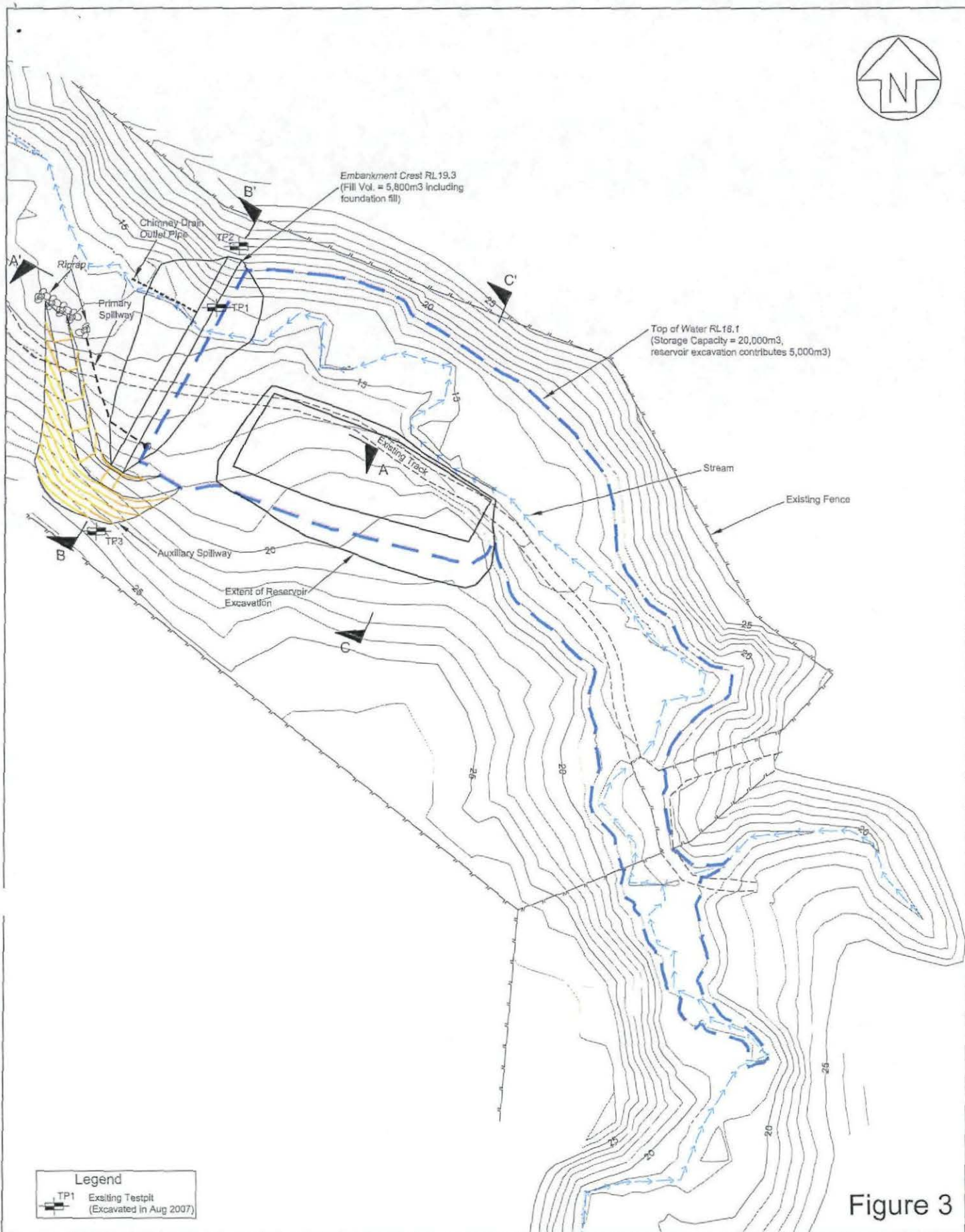
Figure 2

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K. MACKEE Water Storage Dam
Dam Site and Catchment Area Plan

Drawing No. 6266-Figure 2
 Date: 10 March 2008
 Drawn: BL
 Scale: 1:20000 (©A3)
 Filename: 6266-Fig 2

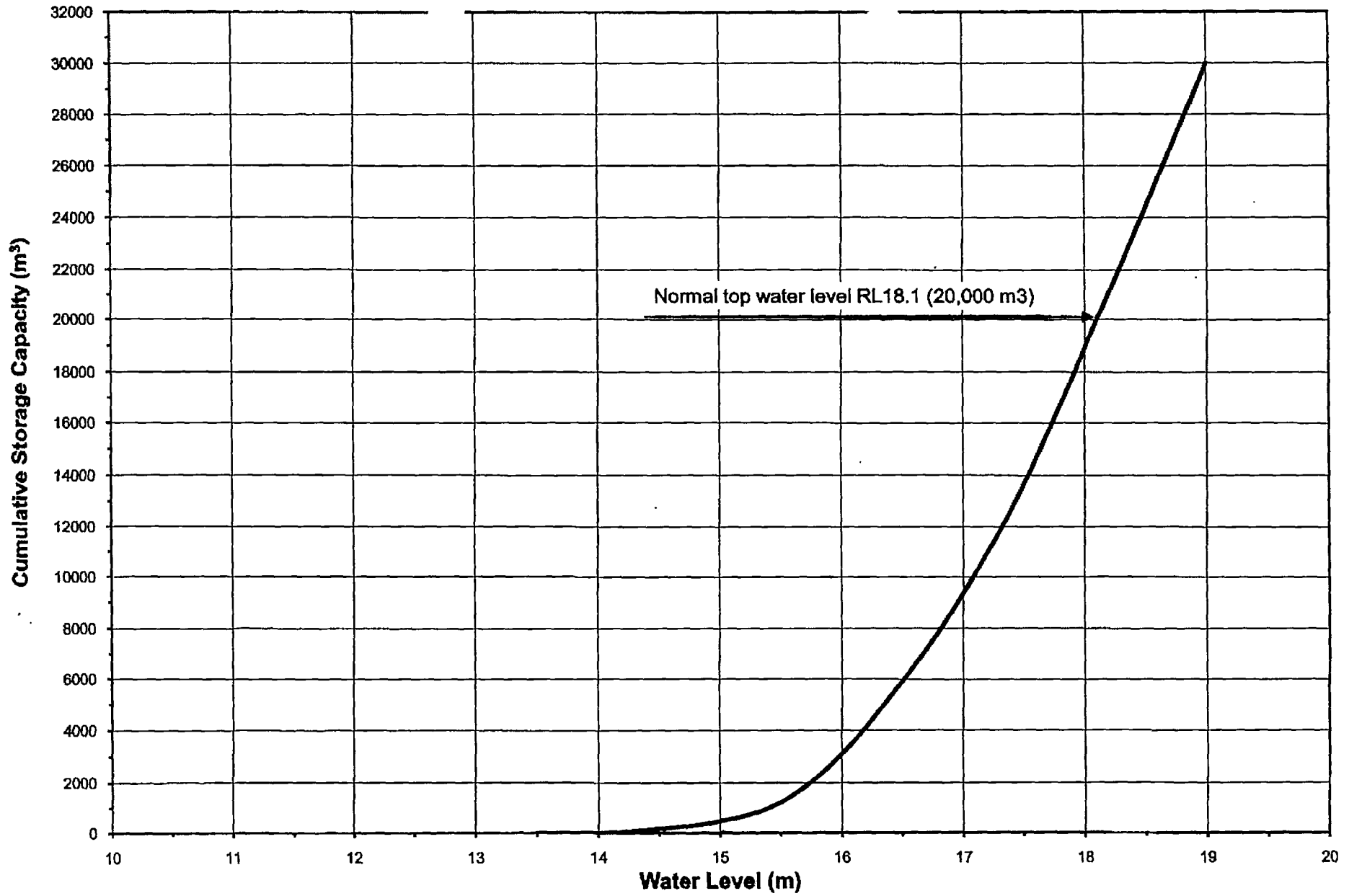


Legend
 TP1 Existing Testpit
 (Excavated in Aug 2007)

Figure 3

K. MCKEE WATER STORAGE DAM CABLE STATION ROAD SEDDON, MARLBOROUGH		PREPARED BY: ENGINEERING GEOLOGY LTD Unit 70, 331 Rosedale Rd, PO Box 301054, Albany, NZ Ph +64-9-4862548, Fax +64-9-4852556		PROJECT APRIL BY DATE DESIGN APRIL DESIGNED TM Mar 08 CHECKED RA Mar 08 DRAWN BL Mar 08		PROJECT: Water Storage Dam AREA: Seddon CONSULTANT DRAWING No. 6266-01.dwg JOB NUMBER: 6266 ORIGINAL SCALE: 1:1000		TITLE Site Plan DRAWING No. 6266-01 SIZE A3		REV. No. A
No.	BY	DATE	REVISION	DESIGNED	APPROX	DRAWN	DATE	SCALE	NO.	REV. No.
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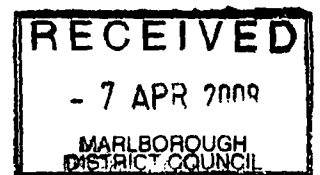


Height Storage Curve for K McKee Dam

Figure 5

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APPENDIX A
TEST PIT LOGS



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SITE: 92 Cable Station Road, SEDDON

TESTPIT No. 1

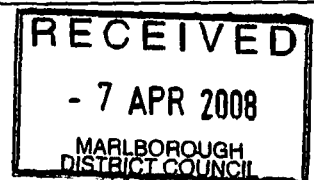
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Sheet 1 of 1

REDUCED LEVEL STRATA	DESCRIPTION OF SOIL	SOIL SYMBOL	DEPTH (m)	SAMPLE TYPE	WATER CONTENT (%)	WATER LEVEL	CORRECTED VANE SHEAR STRENGTH (kPa)		
							● Field vane (BS 1377)	○ Remoulded Field vane	
							50	100	150
	TOPSOIL								
Alluvium	SILT, clayey, gravelly		1			Dry 8/8/07			
	MUDSTONE								
	E.O.P. @ 1.4m		2						
			3						
			4						
			5						

NOTES

LOGGED BY: RA
 DATE DRILLED: 8-Aug-07
 DRILL METHOD: Excavator



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TESTPIT No. 2

SITE: 92 Cable Station Road, SEDDON

REF: 6266

Sheet 1 of 1

REDUCED LEVEL STRATA	DESCRIPTION OF SOIL	SOIL SYMBOL	DEPTH (m)	SAMPLE TYPE	WATER CONTENT (%)	WATER LEVEL	CORRECTED VANE SHEAR STRENGTH (kPa)		
							50	100	150
	TOPSOIL	~ ~ ~							
Loess	SILT, clayey, slightly moist, brown, orange		1			Dry 8/8/07			
	MUDSTONE								
	E.O.P. @ 1.4m		2						
			3						
			4						
			5						

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TESTPIT No. 3

SITE: 92 Cable Station Road, SEDDON

REF: 6266

Sheet 1 of 1

REDUCED LEVEL STRATA	DESCRIPTION OF SOIL	SOIL SYMBOL	DEPTH (m)	SAMPLE TYPE	WATER CONTENT (%)	WATER LEVEL	CORRECTED VANE SHEAR STRENGTH (kPa)
							● Field vane (BS 1377) ○ Remoulded Field vane 50 100 150
	TOPSOIL	~ ~ ~					
Loess	SILT, clayey, dry, light grey						
Glacial Out	SILT, gravelly, dense	○ ○ ○	1			Dry 8/807	
	MUDSTONE		2				
	E.O.P. @ 2.4m		3				
			4				
			5				

NOTES

LOGGED BY: RA
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 DRILL METHOD: Excavator

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