

Stornoway Quarrying

Raeburn Quarry

Development Proposal and Environmental
Management Plan

APPENDIX E

LMRS Soils and Rehabilitation Report

Stornoway Quarries

Raeburn Quarry Rehabilitation Guidelines

March 2009



INTRODUCTION

Rehabilitation guidelines for the Stornoway Raeburn basalt quarry (refer plate 1) are based on the creation of a stable landform and the preparation of a growing medium suitable for the establishment of pasture species. The proposed end land use will be to re-establish a pasture cover suitable for grazing, similar to the current surrounding land use (refer plate 2).



Plate 1 : Operating quarry



Plate 2 : Surrounding land use looking south from the quarry



These rehabilitation guidelines address:

- stockpiling all weathered overburden for future use in rehabilitation
- separate stockpiling of topsoil
- battering of pit side to form a continuous slope and the creation of a stable landform suitable for grazing
- preparing a suitable growing medium through replacement of the subsoil and clays (overburden) followed by topsoil capping
- erosion control and drainage management through controlling catchment discharge
- establishment of a cover crop followed by the establishment of a self-sustaining pasture cover
- repeated nutrient application until a nutrient pool develops
- broad-leaf weed control during pasture establishment
- declared weed control
- appropriate seasonal timing
- monitoring and maintaining stability, nutrient levels, weed control and vegetation establishment

Stripping and Stockpiling

Overburden (weathered profiles), historically, have been stockpiled to the northern end of the quarry (refer plate 3). The northern stockpiles may also contain topsoil and clay from off-site.

Recent stockpiling and stripping has also occurred on to the eastern side (refer plate 4). The eastern stockpiles require reshaping and stabilisation to prevent ongoing erosion.





Plate 3 : Northern stockpiles



Plate 4 : Eastern stockpile



Plate 5: East facing batter erosion as a result of concentrated discharge





Plate 6 : East facing batter erosion as a result of concentrated discharge

Future Stockpiles

As a component of the development programme, additional stockpiling will take place to both the western and eastern perimeter of the operation. Historically overburden and topsoil appear to have been mixed. This is not ideal. Future stockpiling should involve stripping the top 200-250 mm of topsoil (refer plate 9) to the new eastern and western boundaries of the proposed development. The remaining overburden (refer plate 8), up to 1 m in depth should then be stripped to the inside of the topsoil into a separate windrow. The topsoil and remaining overburden must not be mixed. (Refer staged development plans for Proposed Stockpiling locations).

Eastern Stockpile Batter Stabilisation

The eastern stockpile will need to be re-shaped in order to control surface discharge and to prevent slope erosion. The surface formed following recent stripping and stockpiling has resulted in a concentration of run-off down the length of the depressions created by a bull-dozer, while moving the overburden. Consequently, batter slope erosion has occurred on the east facing slope (refer plates 5 and 6). The top surface of the recent stockpiles will need to be re-constructed, directing discharge to stable vegetated outlets.



The discharge from the eroding batter passes through grass over 1 m in height. The grass is acting as an excellent filter preventing any off-site sediment deposition damage.

In addition to reshaping the stockpile and control drainage, the whole stockpile should be sown to

- Ryecorn 50 kg/ha
- Ryegrass var Victorian 10 kg/ha
- Ryegrass var Tama 10 kg/ha

Sowing should take place immediately following reshaping and drainage control. Sowing should be undertaken by hand immediately after reshaping. (Preferably in April/May 2009)

Landform Creation (refer Figure 1)

As the pit is relatively shallow, the suggested final landform will be to create a graded batter at the pit perimeter, suitable for the establishment of grazing pasture. The current slope at the north-western corner (refer plate 7) is ideal.

Benching of the quarry face is proposed during operation, ultimately finishing at 10 metres horizontal to 5 metres vertical slopes. The stockpiled overburden should be pushed over the benches and any graded and battered fill slopes, to create a continuous slope suitable for the establishment of pasture. The proposed slope will be a maximum of 2h:1v.

The landform must be created out of a mixture of rock and clay. Rock alone as a fill material will be too free draining and will not be suitable for pasture establishment and persistence.



Figure 1. Proposed rehabilitation profiles (east-west and north-south)

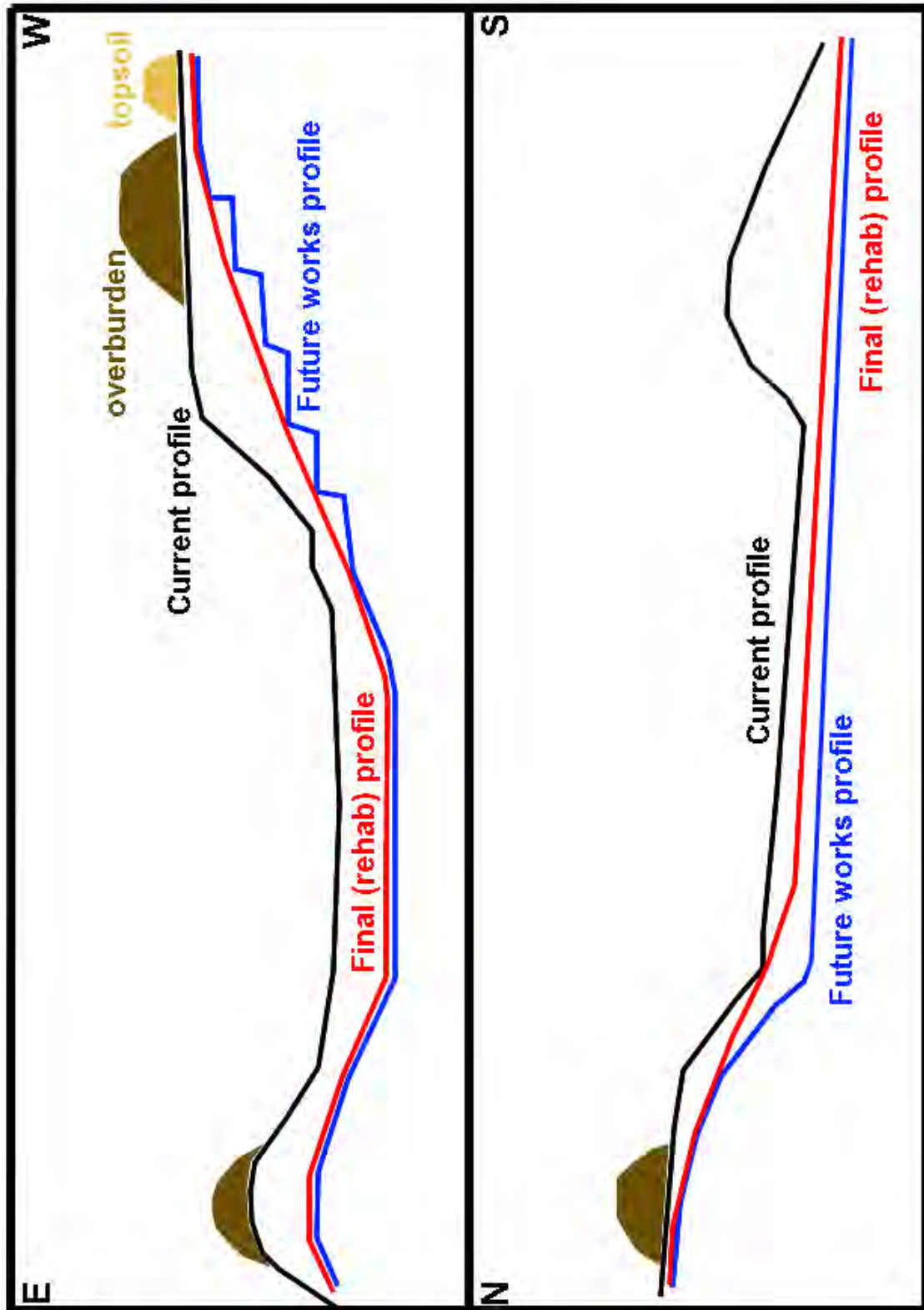




Plate 7 : Current graded slope (foreground) in the northwestern corner is ideal for rehabilitation

Topsoil Replacement

Historically the overburden and topsoil were stockpiled to the north of the existing pit (refer plate 3). More recently stockpiling has occurred to the east (refer plate 4). Future development will result in additional stockpiling and windrowing to the eastern and western perimeters where topsoil and overburden will be windrowed separately.

The stockpiled overburden should be respread as a subsoil and to help create a sloping landform. Once the landform has been created the topsoil will be respread over the embankments to a minimum depth of 150 mm.

The topsoil will be left in a loose friable condition suitable for pasture establishment.

Erosion Control and Drainage

Sediment control ponds are located to the north-east of the existing quarry. Catchment discharge also drains through the fractured rock within the quarry floor.



The final landform created should drain towards the south into a clay lined dam that will initially act as a sediment pond and once pasture has been established it will serve as a farm dam.

A series of small check dams up to 400 mm in height should be constructed perpendicular to the main pit drainage line. Ryecorn should also be established as a cover crop over exposed surfaces to assist in erosion prevention.

Revegetation

Once the topsoil has been re-spread it will need to be cultivated preferably with agricultural tines, particularly if it has been left fallow for an extended period of time. Cultivation should occur in autumn, (two weeks following knock-down herbicide application) and immediately prior to sowing. Rocks will be present and seed application will be best completed using an agricultural spinner (also used for fertilizer application). Basalt soils, particularly sub-soils are acidic. Ag-Lime application will be required at the rate of 10 tonne /ha. Ag-Lime is best applied by spreader trucks (e.g. Altrac Spreading).

Once the lime, seed and fertilizer have been applied, the surface should be harrowed.

Follow up weed control in the pasture will be required.

The recommended pasture species to cope with freer draining basalt topsoil and subsoils mix is as follows :

Cover Crop of Cereal Rye (ryecorn)	40 kg/ha
Ryegrass var Victorian	12 kg/ha
Ryegrass var Tama	08 kg/ha
Cocksfoot var Porto	05 kg/ha



White Clover var Huia	03 kg/ha
Sub-Clover var Trikkala	02 kg/ha

The recommended fertilizer is 14:16:11 at 500 kg/ha initially. The fertilizer should be applied by tractor and spinner.

Follow-up maintenance lime and fertilizer requirements will be based on future soil analysis.

Weed Management

Declared weeds

Fennel (*Foeniculum vulgare*) is present in the north-eastern corner adjacent to the sediment ponds. This species will invade disturbed areas and will potentially establish on any rehabilitated surface. Annual control is recommended in late spring of each year. Initial control should commence in 2009.

Control of fennel is best achieved via the foliar application of a glyphosate based herbicide (e.g. Round-Up). All herbicide application should be implemented by a suitably qualified and experienced weed control contractor. The quarry is adjacent to a vineyard, therefore, herbicide use around vineyards will be limited and must be carefully controlled. The use of some herbicides is restricted at certain times of year in the vicinity of vines. Treatment is best completed in autumn–winter. (By always using a professionally certified weed control contractor the risk of off-site damage is minimised).

Any other declared weeds that are deemed a threat to pasture establishment will be identified in the monitoring inspection and will be dealt with based on the Statutory Weed Management Plans for those species.



Weeds in Pasture

A variety of thistle species are present on-site and on surrounding properties. Other minor agricultural weeds such as wire weed and fat hen have also establishing on the disturbed perimeter of the quarry, particularly in the soil stockpiles.

The recommended treatment will be to ignore the agricultural weeds until the topsoils and overburden are respread. The re-spread topsoil remains fallow allowing the weeds to germinate. The germinating weeds should then be treated with a complete knock-down herbicide. Two weeks after the initial herbicide application the surface will be prepared for cultivated and sown. Agricultural weeds will continue to establish at the site. Further selective herbicide applications may be required and will be based on inspection.

Initial agricultural weed control, prior to cultivation and sowing, will be best achieved via a combination of non-selective 'knock-down' herbicides (glyphosate based) and broad-leaf selective herbicides (e.g. MCPA, Kamba M). The most appropriate herbicide selection will depend on the weed species present at the time of quarry closure and rehabilitation (many years from now). Weed control following cultivation and sowing needs to target weed species without damaging desirable species. The use of broad-leaf selective herbicides will be required which do not adversely affect grass and clover species. Again, all herbicide application should be implemented by a suitably qualified and experienced weed control contractor.

Timing

Pasture establishment is seasonally dependant. The recommended timing is as follows :

- Prepared landform for rehabilitation in summer of any one year
- Respread topsoil in late summer/early autumn
- Allow topsoil to sit fallow until agricultural weeds germinate.
- Spray weeds



- Two weeks after herbicide application apply lime and fertilizer, then cultivate
- Apply seed and harrow in
- Monitor
- Implement follow up weed spraying.

Maintenance and Monitoring

A monitoring inspection should be conducted annually in November. The inspection will aim to identify any issues associated with weed colonisation, surface stability and vegetation establishment success. If any of these issues are identified remedial measures will be undertaken.



Soil Description

The soils are derived from Tertiary basalt and are described as stony gradational clays reddish/brown ranging from 5YR4/2 at the surface to 5YR 4/6 at lower levels (refer plates 8 and 9).

Weathered profile depth varies from 1 m to 1.5 m



Plate 8 : Typical soil profile





Plate 9 : Typical depth of topsoil at between 150-300 mm

