



Griffith City Council

Tharbogang Landfill and Quarry Expansion Project:

Preliminary Environmental Assessment - Modification

June 2014

Final for Submission



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1. Introduction

Griffith City Council (Council or GCC) is progressing with the design development phase and post-approval compliance requirements associated with the expansion of the Tharbogang Waste Management Centre in Griffith, New South Wales. This project was approved by the Department of Planning and Infrastructure (DoP&I) on 8 July 2010 (ref 06_0334).

CPE Associates (CPEa) Pty Ltd is assisting Council with the development of the Project in relation to the design development process and preparing documentation required to meet key conditions of consent. During this process, it has been highlighted that Council could change the approach to provide additional landfill and quarry resources within the approved area by re-prioritising the expansion program through focussing on the landfill capacity, rather than extraction of the quarry resource.

In addition a refined approach has been developed to managing the new landfill and quarry and to address the costly requirements to deliver what is an essentially generic concept design approach. This refined approach has also taken into consideration and is considered to satisfy the requirements of the EPA's *Environmental Guidelines: Solid Waste Landfills* (1996).

1.1 Purpose of Report

The purpose of this report is to provide strategic and technical information to the Department of Planning and Environment (DP&E) about a number of proposed modifications to the Tharbogang Landfill and Quarry Expansion Project, and to seek approval for these changes. The proposed design revisions are outlined below:

- Design changes to the existing quarry pit which will become the new landfill
- Change in the sequencing of the new quarry pits
- Removal of green waste from the waste stream.

1.2 Disclaimer

This document has been prepared for a particular purpose, using information made available by the client in accordance with the client's instructions. Users of this document should note the assumptions and approximations used. Any use of the document outside of the stated purpose is at the user's risk.

2. Existing Design and Approval

Project Approval was granted on 8 July 2010 for the Tharbogang Quarry and Landfill Expansion Project (Reference 06_0334) under Part 3A Major Projects of the *Environmental Planning and Assessment Act 1979* (EP&A Act). The approval is for a new landfill to be developed in the existing quarry area and for two new quarries to be developed within the existing site (see **Figure 2-1**). A subsequent Modification (06_0334 MOD 1) was approved on 9 May 2012 associated with changes to the Biobanking Offset Strategy.

The existing Project Approval is based on the following documentation:

- Concept Design Report: *Operational and Development Plan for Tharbogang Quarry and Landfill*, by Coffey Mining, December 2008.
- Environmental Assessment: *Tharbogang Quarry and Landfill Expansion. Volume 1 Environmental Assessment Report* by Balance Consulting Australia, July 2009.

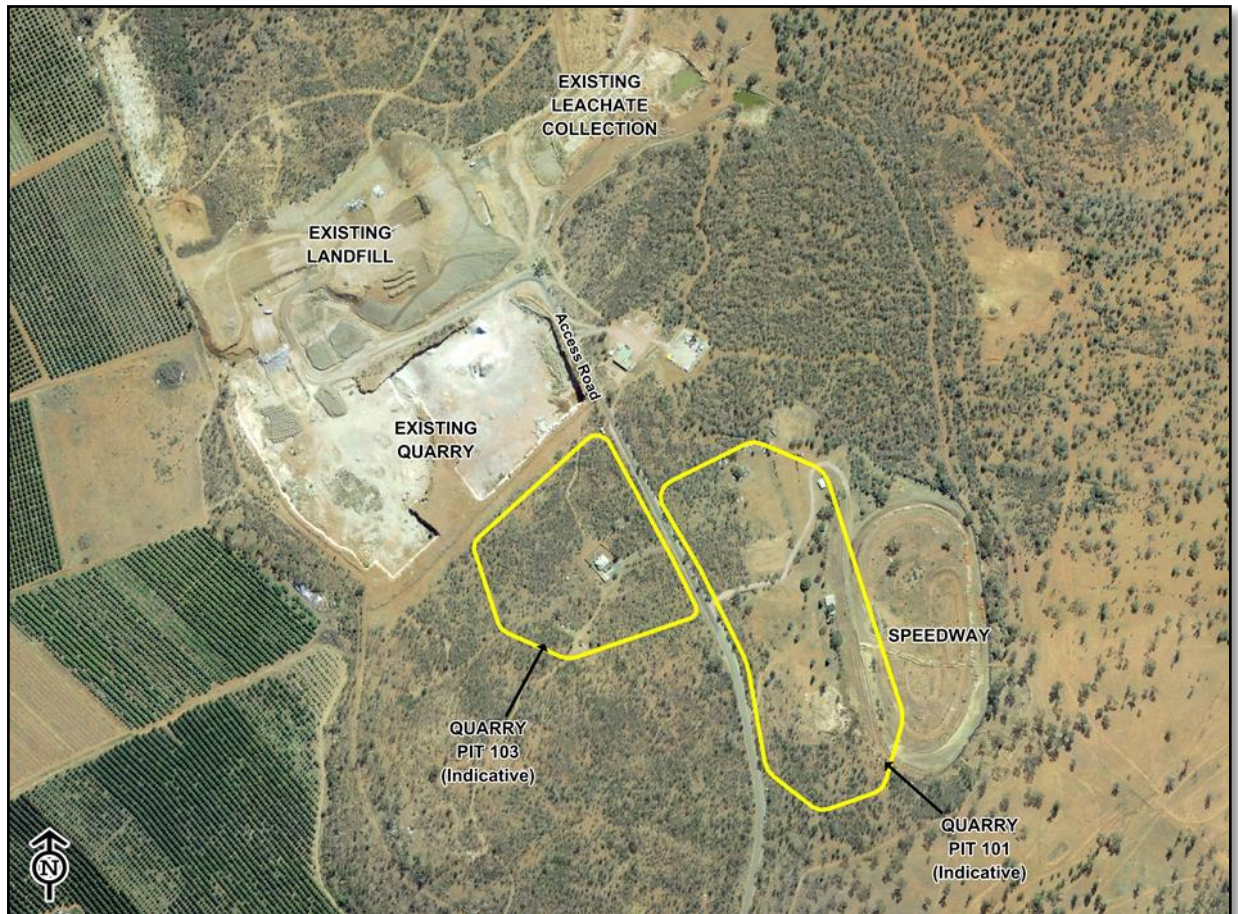
Many of the current generic design parameters outlined in the Coffey Mining concept (2008) appear to have been incorporated into the new landfill cell conceptual design. However, this concept appears to reflect those standards a major metropolitan coastal landfill must meet, which may not necessarily be relevant or required for a smaller rural landfill that is in a semi-arid climate, such as the Tharbogang Waste Management Facility. Factors such as local climatic conditions, low waste disposal rates, maximising landfill capacity generated for the lowest investment; a relatively low domestic rates base of a rural city and most importantly affordability of the proposed design by Council and the community, do not appear to have been given adequate consideration at the concept development stage. The preliminary generic design principles that were proposed in the Environmental Assessment (Balance, 2009) have now been included in all documentation that forms the current Planning Approval for the new landfill cell development and the current landfill rehabilitation.

The *Staged Operational and Development Plan for the Tharbogang Quarry and Landfill* (Coffey Mining, 2008, Appendix J; p. 2) states that the design parameters for the new landfill cell were to be considered as generic in nature only and that further design work would be required. It appears that Coffey Mining has essentially utilised the *NSW EPA Environmental Guidelines: Solid Waste Landfills* (1996) as an absolute standard for the basis for the new cell conceptual design.

The EPA Guidelines are not prescriptive and they utilise a performance-based approach where proponents are advised to consider local and in-situ conditions and adopt design parameters accordingly. A design review has identified that opportunities exist to apply

approaches consistent with the Guidelines that are more suitable for the circumstances of this site.

Figure 2-1 Site Layout



2.1 Consultation with EPA (Griffith)

Council and CPEa representatives met with EPA (Griffith) officers, Darren Wallett and Jason Price, on Tuesday 17 September 2013 to discuss the revised approach to the proposed Landfill and Quarry Expansion. The overall principle of the revisions GCC wishes to proceed with are well understood and supported in-principle.

3. Refined Concept Design

This Modification Assessment is based on a refined concept design *Tharbogang Landfill and Quarry Expansion Project: Preliminary Environmental Assessment - Modification* prepared by CPEa Associates for Griffith City Council (September, 2013). This Section provides a strategic justification for the proposed consent modifications, with further technical detail provided in in **Section 4**.

The over-arching Project is still the same in terms of the development of a new landfill and two quarry pits, and the Limits on Approval (Schedule 2, Conditions 7 and 8) do not need to be changed.

During the concept design refinement stage, a number of aspects of the approved landfill design and operations have been found not to be based be on a site specific approach, nor represent best practice. The design parameters of concern included:

- Not fully utilising existing landfill and quarry assets and resources before moving to costly new asset creation approaches;
- Not maximising the landfill capacity generated by the new cell base and the removal of the existing high sided landfill cell (that exists in the current quarry);
- Disposal of organic/garden waste to landfill as a day cover rather than adopting a resource recovery approach. There are adequate quantities of virgin excavated natural material (VENM) received at the Tharbogang Facility to provide for interim cover requirements;
- Creating a semi-bioreactor landfill cell to encourage maximum landfill gas generation and waste stabilisation in a climate where minimal leachate is generated and where organics should be diverted for resource recovery purposes and landfill gas generation avoided in the first place. Leachate that is constantly recirculated through a waste mass would increase in toxicity over time and such an approach would also maintain a head of leachate on the HDPE liner/barrier floor. It is better practice to collect and remove any leachate to avoid a head of leachate on a liner/barrier; and
- Leachate collection using pickup sumps on the floor of each cell, submersible pumps and rising mains through the waste body that are typically subject to damage and pose an unnecessary operational risk and high maintenance requirement.

3.1 New Landfill – Design Revisions

As per the approved concept, it is proposed to use the existing quarry void as a new landfill cell once the existing landfill space is exhausted and the required final landform shape is developed. There is potential to significantly lower the unit cost of providing landfill space and to increase the overall amount of landfill space that is developed within the new cell area. The revised approach includes a number of design aspects:

- Extraction of additional remaining quarry resource to create a more fit for purpose landfill base design;
- A revised new landfill floor and wall base design to better utilise the proposed existing quarry final landform;
- Improving the depth and capacity of the landfill liner system to the top of the revised new cell batters;
- Rearrangement of the landfill cell staging and sequencing plan;
- Maximising potential landfill capacity over the landfill base design;
- Simplifying and reducing operational risk of the leachate collection system; and
- Minimising organic inputs to the new landfill through improved organics recycling and resource recovery activities.

3.1.1 Improved capacity

The approved landfill has been designed to have eight putrescible HDPE lined cells that will be situated across two split-levels, with a subsurface drainage system to be constructed sequentially. Each landfill cell comprises a purpose-built bund and in some sections infill batter stabilisation works to construct a landfill base shape to hold and contain the waste and leachate. A number of bunds will be required within the current approved design to structurally hold back the waste mass on the top level and sides of the new landfill where the existing high quarry walls are removed. This approach consumes a significant quantity of the potential airspace that could be generated within the current quarry void for a new landfill. It also greatly restricts the height that each landfill cell can be formed up to due to the removal of the existing high quarry walls in critical areas. The height of the waste body has been maintained to a low level to minimise any risks associated with using the lower structural bunding system.

3.1.2 Purpose-shaped Landfill Cell

Calculations have shown that the existing quarry has approximately eight years of quarry resource available and this quarry resource should be fully utilised before commencing extraction from a new quarry pit. The adopted concept design was based on using the existing quarry on an “as is” basis leaving the remaining quarry resource in place. Such an approach results in a sub-optimal landfill base shape being created for the new landfill development.

The remaining quarry resource has been calculated to include the bench area, the two rock spur areas and laying back the existing quarry vertical walls in selected areas as

detailed in **Appendix A (Sheet C)**. Removing this remaining quarry material would allow for a more “fit for purpose” landfill specific bowl shape to be developed for the new landfill cell, creating additional landfill capacity, improved landfill liner arrangements and allowing leachate to be gravity drained rather than pumped.

Calculations for the remaining quarry resource have assumed 150,000t of processed quarry resource is required per year (as per Balance, 2009), using a conversion factor of 2.6t/m³ of unblasted rock. As at early 2013 there is approximately 482,000m³ of unblasted rock available in the combined top benched area, rock spurs and from material removed to lay back the existing vertical quarry walls in selected locations. That is, there is sufficient material available for 8.35 years based on the above assumptions, i.e. the current quarry won't be exhausted until around 2021.

The current approved design for the landfill and quarry expansion (Coffey Mining, 2008) focusses on the provision of future quarry resources involving two approved isolated extraction pits to be mined in stages. The expanded landfill would use the existing quarry void once the quarry activities are transitioned to the new Quarry Pit 103.

Under this approach there remains significant unused quarry resource and landfill capacity in Council's existing asset and the construction of and transition to these new quarry and landfill assets is considered premature, sterilising valuable quarry asset resources.

3.1.3 Leachate Collection and Management

Leachate recirculation and landfill disposal of green/organic waste has been recommended by Coffey (2009) to create a semi-bioreactor landfill that is stated to promote bioremediation of any pollutants contained in the leachate. The leachate is to be isolated from other sources of runoff through the use of well pumps and the landfill liner. This includes the removal of leachate via pumping to the leachate dam, fed by a network of HDPE pipes risers throughout the waste body which would be progressively raised as the waste body is developed. The current approved design is a mechanical/electrical leachate collection approach, which represents a higher risk and operational cost than a simpler traditional gravity based leachate drainage approach.

This process has a number of design elements that are recommended to be specifically removed as they are unsuitable for the site and may create long term operational issues.

The current design includes rising pipes from sumps in each of the eight landfill cell floors. These pipes will have to be progressively raised as the landfill is developed in height. At the base of these rising pipes are stainless steel submersible pumps designed to pump leachate from the collection sump in each landfill cell. The leachate is transferred to a leachate holding tank where it is intended to be reused to operate the

landfill as a semi-bioreactor landfill. This uses the principle of recirculating leachate within the landfill to assist speedup of the decomposition of organic materials in the landfill. There are a number of potential problems with this approach:

- Such approaches are better suited to coastal landfills that generate large quantities of leachate and are mostly used to avoid constructing excessively large leachate storage dams and to provide greater leachate containment potential. The Tharbogang combined old and new landfills will generate relatively low levels of leachate due to the low rainfall. The existing leachate dam has historically been dry most years. As a result, using the leachate to stimulate the bio-reactor process will be difficult to maintain.
- The reliance on a mechanical pumped approach represents an avoidable operational risk should the power source to the pumps be lost or mechanical failure or blockage occur.
- Riser pipes are subject to damage from landfill plant, site users and the differential settlement of the waste body over time.
- Landfilling organic/garden waste is best avoided and this material should be recovered for recycling and resource recovery purposes (the majority of recovered green waste will be required for the capping layers). Landfilling organics will greatly contribute to future landfill gas generation, which is best avoided in the first place by minimising the organic content of a landfill. Organic waste is also the primary contributor to leachate toxicity through generation of organic acids and nutrients. If leachate is continuously recirculated through a waste mass its toxicity will also increase over time creating future operational issues.
- It is strategically more effective to remove the green/organic waste from the landfilling process to assist with the overall reduction of gas production from the new landfill cell. This green/organic waste, in turn, can be used for rehabilitation in the capping layers.
- A leachate recirculation system will still ultimately require a method of leachate disposal, such as an evaporation pond or costly disposal to sewer, to prevent the excessive build-up of leachate quantities over time. Leachate continuously reinjected back into a landfill cell will increase in toxicity with each passage through the waste mass, making it more difficult to ultimately safely dispose.

The revised approach would reshape the landfill floor (see **Section 3.1.2**) to allow leachate to flow out of the landfill base by gravity to an enhanced and enlarged leachate storage dam. In the unlikely event that the combined volume of leachate from the landfill and greenwaste storage areas can't be managed through natural evaporation, then the revised approach to leachate disposal would be by way of spray irrigation over the storage pond to further encourage evaporation.

An assessment for the need for a “fail-safe” will be made at the detail design stage of this project. If required, the “failsafe” will consist of a pump to allow leachate to be pumped to a storage tank adjacent to the highest point of the landfill. The pump would only operate during times of extreme rainfall when there is a risk of the leachate storage pond overflowing. The leachate pumped to the tank will be injected back into the landfill and absorbed into the waste mass for later recovery once it has percolated back to the landfill base over time.

Under the revised design, the leachate barrier liner system would still be an HDPE liner with a subsurface drainage system as per the approved design and EPA Benchmark Techniques. However, the revised liner design would extend to the top of the landfill base batters and be secured in an engineered anchor trench. This will create a significantly improved lined landfill area for the containment of the waste body and with significantly higher liner levels compared to the approved design.

The benefits of a gravity-fed leachate collection system include:

- no external energy input, and hence operational cost savings
- greater reliability as there would be no mechanical parts to fail
- a cheaper system to construct and maintain.

3.2 Quarry Pit Sequencing Change

The new landfill was planned to be developed within the floor of the existing quarry and over the remaining significant in-situ quarry resource materials as a two-tiered landfill. The first new quarry, Pit 103 (see **Figure 2-1**), was planned to be an extension of the existing quarry area and was to commence by blasting through and removing the south-eastern quarry wall and leaving an access corridor in front of the new landfill.

The proposed new landfill conceptual design will require a 20 metre buffer zone area between the new landfill and Quarry Pit 103; with the Quarry Pit 103 access being relocated south-east back towards the weighbridge (see **Appendix A, Sheet A**). This buffer area will result in the Quarry Pit 103 surface area and resource being reduced by around 34% with approximately 637,000 m³ of quarry resource being available. It was proposed to utilise material won from the next quarry cell to construct the new landfill internal batters and bunds. If the 140,000 m³ of new landfill construction material is sourced from Pit 103 then the available quarry resource material will reduce to around 500,000 m³ or 3.3 years.

Quarry Pit 103 will only yield around 90,000 m³ of overburden, which is insufficient to supply the capping material required for the current landfill rehabilitation. The availability of sufficient top soil is also highly unlikely due to the site having been previously scalped.

Rather than open up Pit 103, it is proposed to now commence with Quarry Pit 101 which has around 250,000 m³ of overburden and which would provide the 175,000 m³ of capping material required for the rehabilitation of the current landfill. Being lower down the slope, Quarry Pit 101 is also likely to yield a better quantity and quality of top soil material that is required (around 76,000m³). Similarly, Quarry Pit 101 has a larger resource base and there is minimal impact on the quarry life from sourcing and producing the 140,000 m³ of various aggregates and construction materials required for the new landfill cell.

3.3 Removal of green waste from the waste stream

Garden waste has been diverted from the existing landfill into a recycling and resource recovery program for several years, which has significantly lowered the organic composition of the waste going to landfill at the site in line with State Government Resource Recovery targets. VENM received at the site has been used instead. The approved design appears to require that garden waste is shredded and used as day cover. This process will unnecessarily increase the organic composition of the waste in the new landfill cell and work against resource recovery objectives. If this approach was adopted in an effort to develop a use or market for the shredded garden waste, it is not considered an appropriate order of resource reuse against the Waste Hierarchy. There is significant need and opportunity to utilise processed organic materials within the progressive rehabilitation activities that are required at the site.

Green waste would be removed from the landfill to assist landfill remediation. This approach is consistent with the EPA's *Reducing Waste: Implementation Strategy 2011-2015*, reduces the rate of landfill space consumption and generates less landfill gas.

4. Proposed Design Revisions – Technical Discussion

This section provides more technical detail for the proposed consent modifications, outlined in Section 3.

4.1 New Landfill – Design Changes

As outlined in Section 3, the concept design of the new landfill cell would benefit from a range of revisions to the cell floor design, batter shape and leachate collection but will remain within the same footprint as the approval apart from a marginal increase in the south-east corner (see Appendix A - Figure D2).

The new landfill would be comprised of five cells (see Appendix A - Sheets D2 and G1). The capacity of these cells is shown in Table 4-1.

Table 4-1 Calculation Summary of Landfill Cells 1-5

	Cell 1	Cell 2	Cell 3	Cell 4	Cell 5	TOTAL
Capacity (m ³)	131,634	124,781	119,121	142,096	142,497	660,129
Life (yrs)	4	4	4	5	5	22

Based on a current filling rate of filling rate averages of 24,000 m³ per annum the design life would be 22 years to fill Cells 1-5 at approximately 30,000 tonnes per annum. As a result, no change to the Project Approval limits of approval is required.

The Project Approval limits of approval are:

7. *The Proponent may undertake quarrying and landfilling operations on the site until 31 December 2035.*
8. *The Proponent shall not:*
 - (a) *extract more than 315,000 tonnes per year of gravel materials from the site: or*
 - (b) *receive more than 35,000 tonnes per year of general solid waste (putrescible and non-putrescible) to the site.*

There is additional capacity and a concept design prepared for another two cells to be placed on top of the new landfill (Cells 1-5), but consent for these additional cells is not sought as part of this Modification.

4.1.1 Final quarry landform floor and batter levels

Reshaping the final quarry landform would create a more fit for purpose landfill base shape that has a continuous 1% slope graded floor from the back (south-western wall) of the quarry down to the front (north-east) of the quarry and create 1:3 sloped batter walls as quarry resource is removed during the existing operations. This approach does not consume large amounts of landfill capacity before the asset is operational. The floor level would remain generally at 135m AHD; with a gradient running from 133m AHD in the front northern corner to 137m AHD in the back southern corner creating the required 1% floor gradient for a gravity-based leachate collection system.

The revised approach leaves the existing high quarry wall to the south-east of the existing quarry area as this will allow the generation of additional landfill capacity in the new cell and provide a safe ultimate design interface between the new landfill and future quarrying operations (**Appendix A, Sheet D2**).

The revised design comprises five new landfill expansion cells. There would be no impact on the surrounding visual amenity as the landfill will mostly be filling the existing quarry void. The void screened by the north-eastern wall.

A structural bund with appropriately engineered anchoring will be required in the lower northern corner. However, this structural bund will not be required to be constructed until development of Cell 5 which is the last base layer cell to be developed.

The footprint of the proposed final landform would be designed to meet the EPA's *Environmental Guidelines: Solid Waste Landfills*. This would include gentle grading towards the south-east corner towards Quarry Pit No 103. Vegetation in this area comprises White Cypress Pine – Shrubby Currawang woodland regrowth (EcoLogical, 2011; Figure 5).

The revised landfill cell design could provide 660,000 m³ or 22 years life at an asset development cost of approx. \$5/m³ compared to an estimated cost of approx. \$17/m³ for the design as currently approved.

4.1.2 Leachate collection and management

Each landfill cell will have an internal bund constructed which will either be removed later as the next adjacent cell is constructed to form a continuous landfill liner system or the internal bund will be maintained with gravity fed leachate collection pipes being trenched through the bund wall to connect to existing leachate collection pipes.

The leachate will drain from the landfill cell under gravity where the leachate trunk line will discharge leachate into a concrete pit that overflows into a double lined HDPE leachate storage dam from where it will naturally evaporate due to the high pan-

evaporation force in this locality and the high area for evaporation to occur. The construction of a “fail-safe” will be determined at the detailed design stage of the Landfill/Quarry development. In the event a “fail-safe is installed the process will occur as follows; the accessible leachate concrete pit will have a submersible pump capable of pumping the leachate to the top south-western batter where a tank capable of storing leachate will be installed. This leachate return line is to serve as a leachate management fail-safe system only and not a regular leachate reinjection or recirculation system. It will only allow leachate to be reinjected back into the new landfill cell should the level of leachate stored in the new lined leachate dam reach a level that threatens available dam freeboard such that an uncontrolled discharge of leachate to the environment may potentially occur.

In the unlikely event that the pan-force evaporation proves inadequate, then a spray irrigation leachate evaporation system would be installed over the leachate dam surface. The leachate would be sprayed onto the surface of the pond to enhance evaporative disposal of leachate.

(**Appendix A, Sheet D1**) shows a number of design aspects including the proposed cell bunding, leachate gravity drainage system, flushing points, and subsurface drainage. Leachate flushing points would be installed on the south-western side of the landfill, whilst the leachate drainage system would be collected from the north-eastern side.

It is proposed as part of the development to construct new leachate ponds with a minimum capacity of 620kL.

4.1.3 Environmental Considerations

The following environmental aspects have been considered during the development of the revised concept for the revised landfill cell design.

Table 4-2 Environmental Considerations – Revised Landfill Cell Design

Environmental Aspect	Response
Visual Amenity – ultimate landform - final quarry landform and batter levels	The finished level of landfill will not affect the ridgeline in the background. The final landform would be addressed during detailed design ensuring that the final landform is meets the EPA’s capping performance requirements.
Ecology – impact on native vegetation from final quarry landform and batter levels	<i>Outlined below</i>
Noise – additional quarrying to	The blasting frequency associated with the revised landfill base landform design will not change. That is, once per month.
Groundwater	No change to the potential to impact on groundwater is expected as the revised concept maintains a liner and leachate collection system.

Environmental Aspect	Response
Air Quality	If spraying the leachate is required then, it would be undertaken in an area remote from the public and if necessary, the activity would be stopped in adverse (windy) conditions. It will only be sprayed back over the ponds, and not in proximity of any residential receptors.

Ecological considerations

The footprint of the proposed final landform would marginally increase in the south-east corner towards Quarry Pit No 103 (**Section 4.1; Appendix A, Sheet C**). Vegetation in this area comprises White Cypress Pine – Shrubby Currawang woodland regrowth (EcoLogical, 2011; Figure 5), which is of lower value than other vegetation communities on the Site.

The design criteria (Balance 2009 applied to the selection of quarry pits for the Site (Lot 202) included:

- Maintaining a minimum 100m corridor along the eastern and western boundary of the site to ensure the vegetation of McPhersons Range remains connected:
 - Anticipated at 0 to 300m;
 - Revegetation and enhancement measures to be implemented to create contiguous corridors connecting with Lot 201;
- Not encroaching on the Bimble Box woodland at the southern end of the site; and
- Maintaining a minimum 40 meter riparian buffer zone on either side of the ephemeral drainage lines.

None of these aspects of high value would be affected by this small section of additional clearing, which are adjacent to the existing quarry. It also noted that the clearing of vegetation will be progressive over 50 years.

The refined concept will not impact the approved on any land set aside in the Landscape and Biodiversity Management Plan - Rehabilitation and Biodiversity Offset Strategy Management Plan (EcoLogical, 2011) and the approved Offset Modification No 1.

4.1.4 Monitoring Considerations

The following activities would be considered in further detail during the detailed design stage, and may require monitoring as part of the ongoing maintenance of the Tharbogang Waste Management Facility:

- Management of spray irrigation system;
- Leachate collection;
- Landfill gas generation.

The monitoring requirements associated with these activities are shown in the table below.

Table 4-3 Potential monitoring requirements – Revised Landfill Cell Design

Monitoring	Environmental Aspect	Reporting
Leachate	Groundwater Quality	LO&EMP
Landfill Gas generation	Air Quality	LO&EMP
Spray Management	Air Quality	LO&EMP

Monitoring requirements associated with other environmental aspects are adequately covered in in the existing Project Approval (Appendix 2 – Table E1). In addition, there are requirements in the existing Environment Protection License (EPL) to monitor the stormwater sedimentation pond as well as a number of boreholes around the Site. These requirements are likely to be maintained as part of a revised EPL for the expansion activities.

4.2 Quarry Pit Sequencing Change

As outlined in **Section 3.2**, the revised concept would commence new quarrying operations with Pit 101 and then Pit 103 (see **Figure 2-1**). Prior to the commencement of quarrying Pit 101, a number a steps would occur:

1. Native seed collection
2. Top soil stripping and stockpiling
3. Excavation and transport of overburden to existing landfill rehabilitation project.

Native seeds would be collected from the Bimble Box-Pine Woodland- Lower Slopes species. These seeds would be germinated and grown in accordance with revegetation/planting schedules.

After seed collection, all suitable top soil material would be stripped. It is estimated that this would yield 80,00m³ of material. Grade A and lesser quality materials would be separated into identified stockpiles. Overburden would be then excavated from Quarry Pit 101 in stages to match the rehabilitation stages associated with the existing landfill.

4.2.1 Environmental Considerations

Quarry Pit 101 is located further away from the nearest residential property (receptor) than Quarry Pit 103 (Balance EA; Appendix C – Noise and Vibration Statement), thus the impact of a change in sequencing of the quarry operations on the surrounding residential receivers would not change any adverse effects on local residents. The commencement of quarry operations will be delayed by approximately eight years under this revised concept.

4.2.2 Monitoring Considerations

No additional monitoring would be required for the proposed change in quarry pit sequencing.

4.3 Removal of green waste from the waste stream

To assist with ongoing landfill and quarry rehabilitation projects, it is proposed to divert and process onsite all available garden, wood, food and organic waste into mulch, compost and soil products and stockpile this material for future reuse within landfill and quarry rehabilitation projects. It is understood that there are relatively substantial quantities of locally sourced compostable agricultural wastes such as grape marc that are currently unrecovered and which, subject to further investigation in the context of the waste strategy, could be ideal for incorporation into the proposed landfill capping and gas management systems.

There is a disturbed area to the northwest of the existing stormwater pond that will be suitable prepared for greenwaste storage. The area will drain to a sump that will be pumped to the leachate pond or other approved containment as it is unlikely that the site levels will allow it to drain by gravity (see **Figure 4-1**).

4.3.1 Environmental Considerations

The following environmental aspects associated with the removal of the green waste stream from landfill have been considered during the development of the revised concept.

Figure 4-1 Proposed Green Waste Storage Location

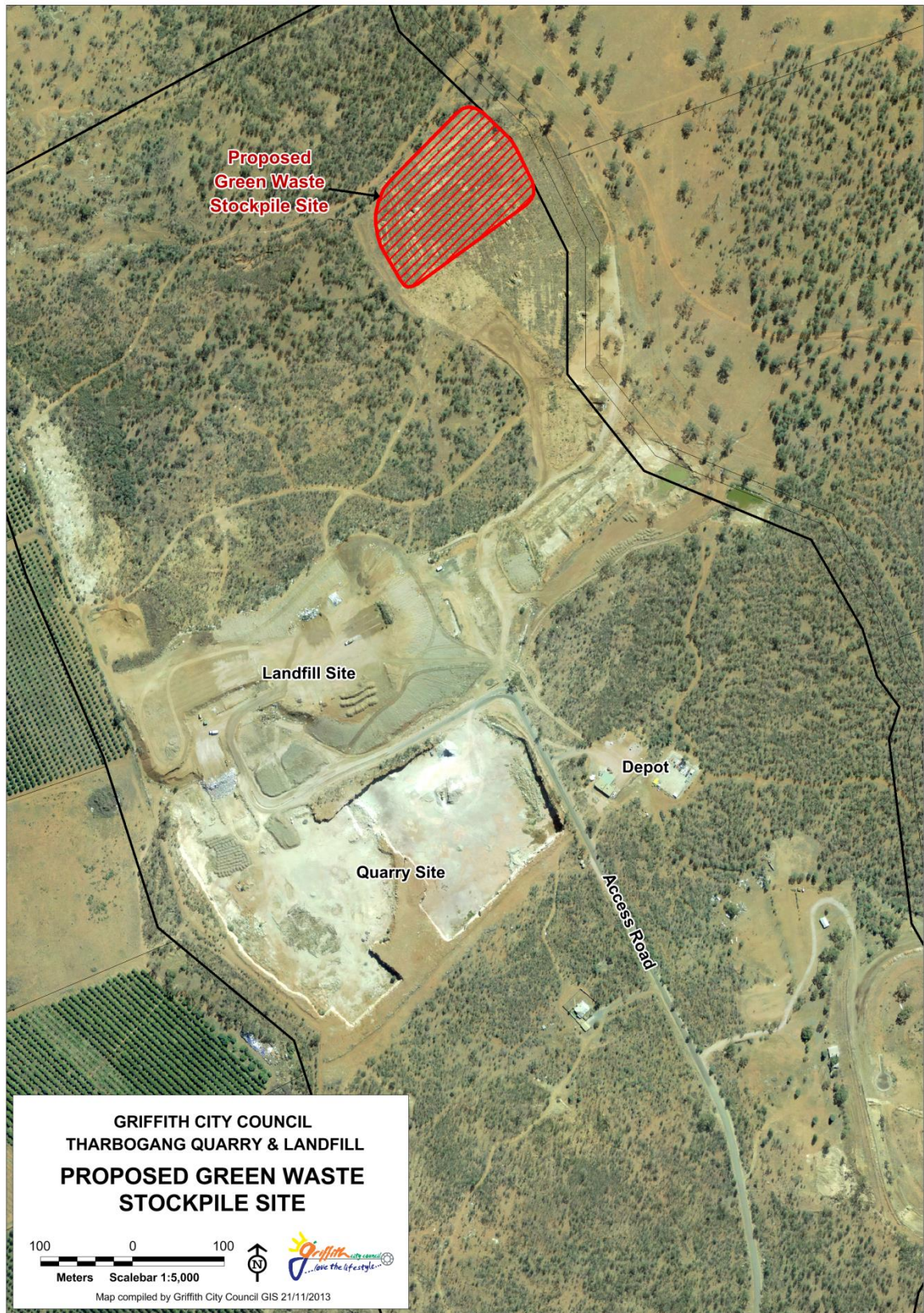


Table 4-4 Removal of Green Waste Stream – Environmental Considerations

Environmental Aspect	Modification
Surface water/ Leachate	Potential to generate minor amounts of surface water and leachate from the containment of stockpiled green waste stockpiling. The runoff from the greenwaste stockpile area will be treated as leachate and conveyed to the leachate pond for evaporation
Social	Indirect reduced landfill management costs to rate payers owing to additional landfill capacity created by removing green waste stream and reduced landfill capping costs
	Reduced landfill gas generated from on-site operations (Eg WH&S)
	Encourage the community to recover valuable material that would otherwise be landfilled
Landfill gas	Reduced gas owing to less organic waste landfilled

4.3.2 Monitoring Considerations

The following activities associated with a separated green waste stream would be considered in further detail during the detailed design stage, and may require monitoring as part of the ongoing maintenance of the Tharbogang Waste Management Facility:

- management of any liquid (including tannins) from the storage of green waste
- Green waste removed from landfill and used in cover operations.

The monitoring requirements associated with these activities are shown in the table below.

Table 4-5 Potential monitoring requirements – Separated Green Waste Stream

Monitoring	Environmental Aspect	Reporting
Leachate from green waste storage	Surface water/Groundwater	LO&EMP
Green waste removed from landfill and used in cover operations	Air Quality/Landfill Gas	LO&EMP

5. References

Balance Consulting Australia (2009) *Tharbogang Quarry and Landfill Expansion. Volume 1 Environmental Assessment Report*. Prepared for Griffith City Council, July 2009.

Coffey Mining (2008) *Staged Operational and Development Plan for Tharbogang Quarry and Landfill*. Prepared for Griffith City Council. December 2008.

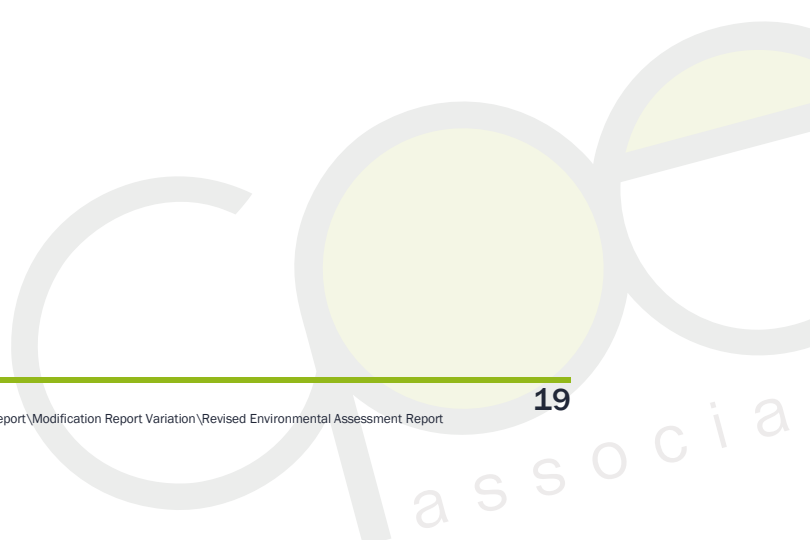
CPEa Associates (2013) *Tharbogang Landfill and Quarry Expansion Project: Preliminary Environmental Assessment - Modification*. Prepared for Griffith City Council, September, 2013.

Department of Environment, Climate Change and Water [DECCW], (2010). “*Handbook for the design, construction, operation, monitoring and maintenance of a passive landfill gas drainage and biofiltration system*”.

Environmental Protection Authority [EPA], NSW (1996). “*Environmental Guidelines: Solid Waste Landfills.*”

EcoLogical Australia (2011) *Tharbogang Landfill and Quarry, Landscape and Biodiversity Management Plan, Rehabilitation and Biodiversity Offset Strategy Management Plan*. Prepared for Griffith City Council, December 2011.

Appendix A. Drawings



CURRENT LANDFILL AND QUARRY LANDFORM - NOVEMBER 2012

SCALE 1:2000

CPEa PROPOSED
PIT 103 ENTRANCE



- SURVEY DATA PROVIDED BY GRIFFITH CITY COUNCIL
NOVEMBER 2012.
- SITE CONTOURS_SOURCE

D	ISSUE FOR REVIEW	04.03.2013	SGY	CH
C	ISSUE FOR REVIEW	21.02.2013	SGY	CH
B	ISSUE FOR REVIEW	18.12.2012	SGY	CH
A	ISSUE FOR REVIEW	11.12.2012	SGY	CH
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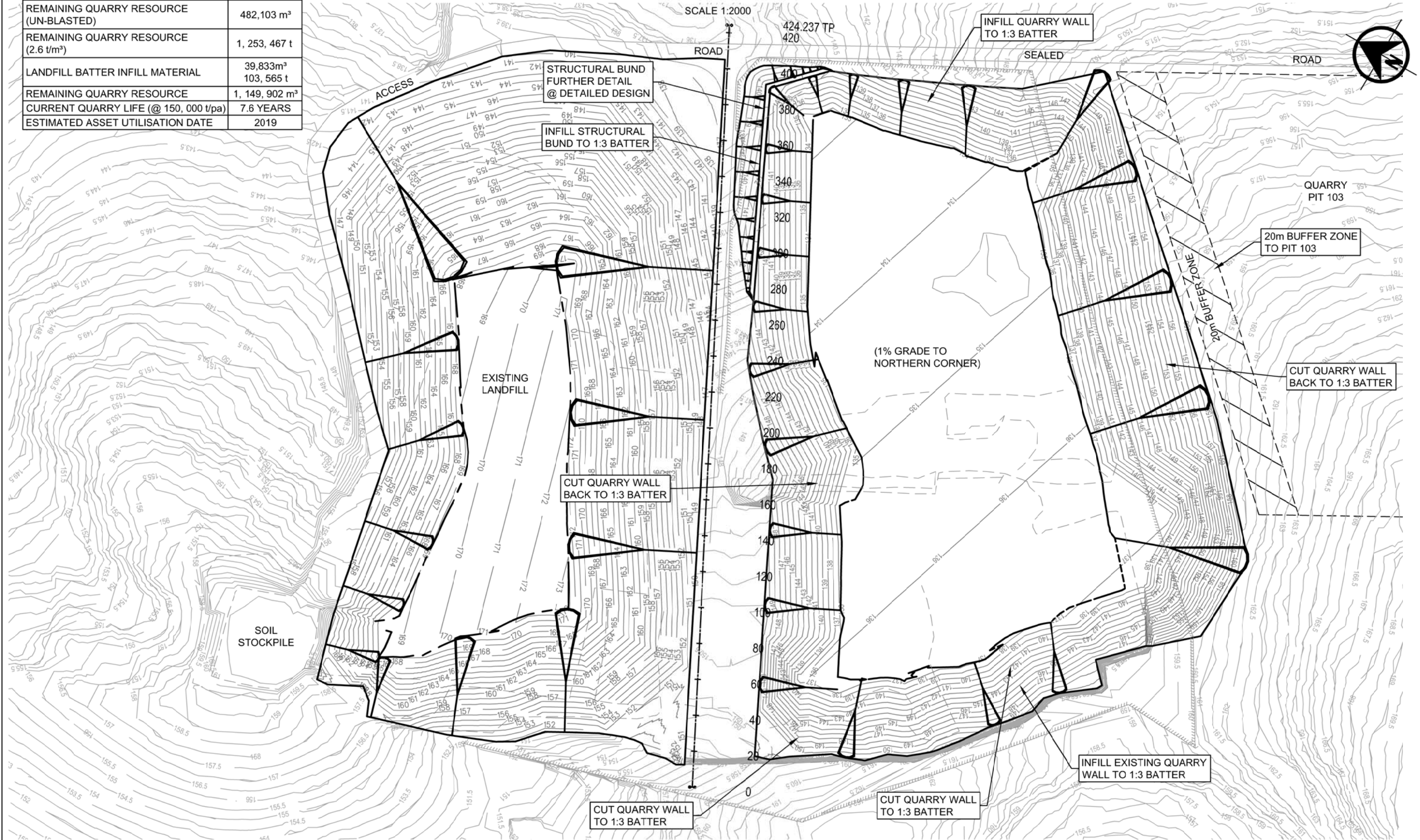
associates
PO Box 3009 Phone 02 4402 9392
Nowra North NSW 2541 Fax. 02 4446 0511

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CHECK:	C.H
APPR.	P.H
REV:	D

SHEET	A	SCALE	AS NOTED
THARBOGANG LANDFILL PROJECT CURRENT LANDFILL AND QUARRY LANDFORM - NOVEMBER 2012			

FINAL QUARRY LANDFORM FOR CURRENT QUARRY

CALCULATION SUMMARY	
REMAINING QUARRY RESOURCE (UN-BLASTED)	482,103 m ³
REMAINING QUARRY RESOURCE (2.6 t/m ³)	1,253,467 t
LANDFILL BATTER INFILL MATERIAL	39,833m ³ 103,565 t
REMAINING QUARRY RESOURCE	1,149,902 m ³
CURRENT QUARRY LIFE (@ 150,000 t/yr)	7.6 YEARS
ESTIMATED ASSET UTILISATION DATE	2019



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A	ISSUE FOR REVIEW	11.12.2012	SGY	CH		REV: D		
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NEW LANDFILL CELL FLOOR AND WALL CONCEPT DESIGN

SCALE 1:2000



SUMMARY CALCULATIONS				
	BUND MATERIAL QUANTITY m ³	LINER AREA m ²	LEACHATE PIPE m	SUBSURFACE DRAINAGE PIPE m
C1	3,683.8	18,523	834.8	309.2
C2	3,757.5	19,361	789.9	300.8
C3	2,228.8	20,103	873.4	418.6
C4	1,138.8	22,252	417.9	171.7
C5	-	19,491	287.2	139.1
TOTAL	10,808.9	99,730	3,203.2	1,339.4



- LEGEND**
- SUBSURFACE DRAINAGE PIPE
 - LEACHATE DRAINAGE PIPE
 - - - 20m BUFFER ZONE TO PIT 103
 - INTERNAL BUNDING
 - LINER BOUNDARY

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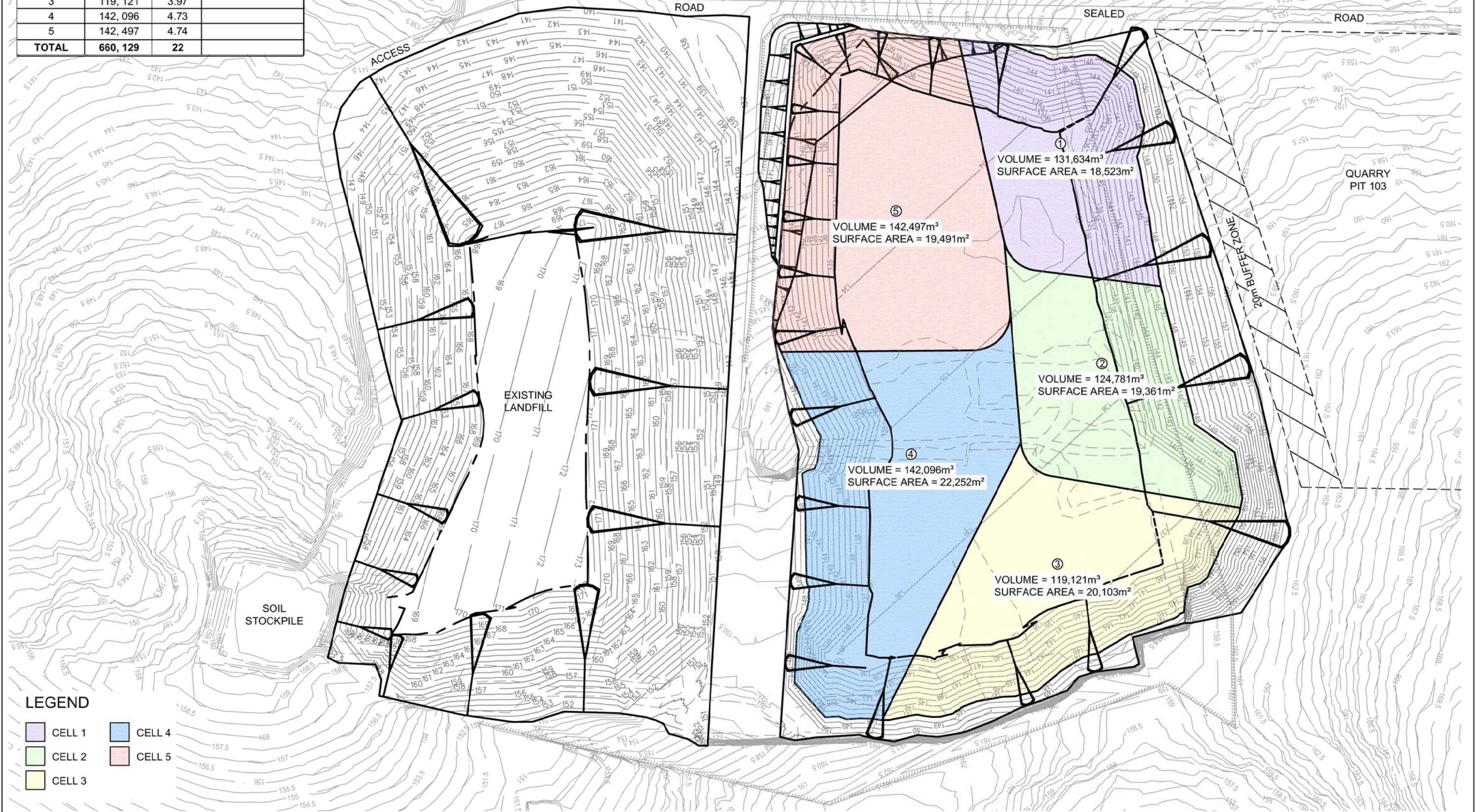
SHEET D1	SCALE AS NOTED
THARBOGANG LANDFILL PROJECT NEW LANDFILL CELL FLOOR AND WALL CONCEPT DESIGN	

NEW LANDFILL STAGING PLAN CELLS 1 - 5

SCALE 1:2000



CALCULATION SUMMARY			
CELL	CAPACITY	LIFE YEARS	CAPITAL ESTABLISHMENT COST
1	131,634	4.38	
2	124,781	4.16	
3	119,121	3.97	
4	142,096	4.73	
5	142,497	4.74	
TOTAL	660,129	22	



LEGEND

 CELL 1	 CELL 4
 CELL 2	 CELL 5
 CELL 3	

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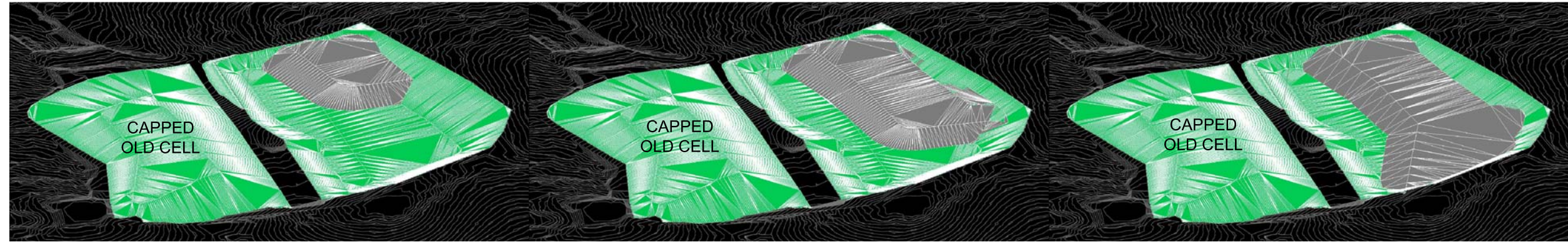
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SHEET D2	SCALE AS NOTED
THARBOGANG LANDFILL PROJECT NEW LANDFILL STAGING PLAN CELLS 1 - 5	

3D NEW LANDFILL STAGING PLAN

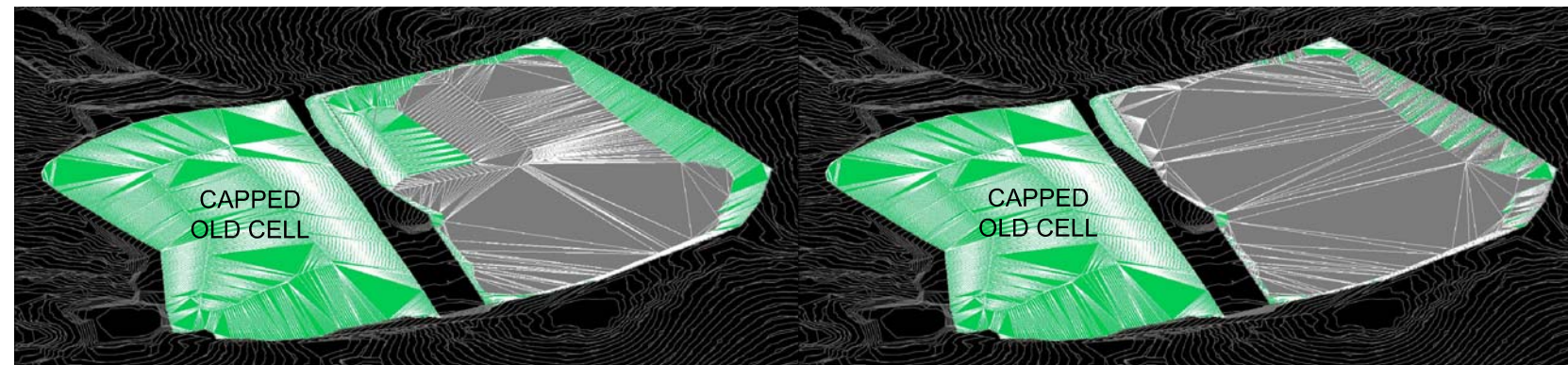
SCALE 1:2000



CELL 1
CAPACITY = 131,634m³
LIFE = 4.38 YEARS
COST =

CELL 2
CAPACITY = 124,781m³
LIFE = 4.16 YEARS
COST =

CELL 3
CAPACITY = 119,121m³
LIFE = 3.97 YEARS
COST =



CELL 4
CAPACITY = 142,096m³
LIFE = 4.73 YEARS
COST =

CELL 5
CAPACITY = 142,497m³
LIFE = 4.74 YEARS
COST =

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B	ISSUE FOR REVIEW	18.12.2012	SGY	CH		APPR. P.H	THARBOGANG LANDFILL PROJECT 3D LANDFILL STAGED DEVELOPMENT SEQUENCE PLANS - SHEET 1	
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