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Reference No. 06623099-698-L-Rev1

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PASMINCO COCKLE CREEK SMELTER:

PROPOSED DESIGN CHANGES FOR CONTAINMENT CELL CAP

Dear Wayne

1.0 INTRODUCTION

This letter presents proposed revisions to the design of the cap for the containment cell at the Pasminco remediation site. The owner of the containment cell is Pasminco Cockle Creek Smelter, subject to Deed of Company Arrangement (PCCS), represented by Ferrier Hodgson as administrator. We understand that this letter will be provided to the NSW Department of Planning and Infrastructure (DoPI) in their role as project approval agency.

The proposed design revisions are summarised in Table 1 below. Further detail and discussion is provided in the remainder of this letter.

Table 1: Summary of Proposed Design Revisions

No.	Item	Proposed Design	Existing Design
A	Capping Detail- design revision applies to the portion of the Cell 1 area on the top deck of the cell where the capping system has not yet been constructed (approximate area 7.5 ha) (refer Note 1)		
	Barrier Layer	composite liner, i.e., a geomembrane combined with a 100mm thick layer of compacted clay	600mm thick layer of compacted clay
	Drainage Layer (above Barrier Layer)	geocomposite drain.	150mm thick layer of gravel
B	Playing fields	Regrade the top of the cell to create a landform suitable for construction of two AFL football fields	No provision for playing fields on the top of the cell
C	Slope on top deck of cell	Slope at 2%	Slope at 3%

Note: 1. No revisions are proposed to the Cell 1 capping system that has already been constructed, with the exception of replacement of a portion of the Cell 1 capping system as required for shaping of the cell. The area will have an approximate extent of 1 hectare, but will be determined during the detailed design.
No revisions are proposed for the capping system on the cell batters.
No revisions are proposed to the Cell 2 capping system.

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2.0 EXISTING DESIGN AND APPROVAL

2.1 Existing Design

The existing containment cell design is described in the two documents identified below.

- Golder Associates, Containment *Cell Detailed Design and Management Plan, Pasminco Cockle Creek Smelter*, Consultants Reference: 06623099-055, March 2007; and
- Golder Associates, *Addendum Report to Containment Cell Detailed Design and Management Plan, Pasminco Cockle Creek Smelter*, Consultants Reference: 06623099-079-RL2, 17 October 2007.

The large majority of the containment cell is designated as Cell 1, containing impacted soil from the remediation site, while a small portion is designated as Cell 2, containing specifically identified waste materials from the site. The containment cell landform comprises a relatively flat (3% gradient) upper portion, referred to as the top deck, with a total plan area of approximately 11.9 ha, and a batter portion (5H:1V slopes) with a total plan area of approximately 7.7 ha.

The containment cell footprint was extended to the west by 0m to 40 m in a 2010 design revision to increase cell volume (refer Section 3.3). This 2010 revision is reflected in the site Environment Protection Licence (No. 5042, clauses A4.4 and L5.2).

2.2 Existing Design Approval

The DoPI issued development conditions for the site remediation that included conditions relating to the containment cell design and construction (DOP File No: 9036299, Application No. 06_0184, February 2007). Of particular note are development conditions 3.2 and 3.3, which require review and approval of the cell design reports by the then Department of Environment and Conservation (DEC) (now the OEH) and the Contaminated Site Auditor (Auditor). In accordance with these conditions, the existing containment cell design was submitted to the then Auditor for the project, Mr William Ryall from ENSR/AECOM and the then DEC (now the OEH).

The DEC identified a list of design issues (dated June 2007) to be addressed. Golder addressed the issues raised by DEC and submitted the design reports to the Auditor for review.

The Auditor commented on the design outlined in the Golder design reports listed above (i.e. March 2007 and October 2007) and summarised his opinion in a summary site audit report:

- ENSR/AECOM, *Site Audit Report & Site Audit Statement Review of Final Containment Cell Design, Pasminco Cockle Creek Smelter, 13a Main Road, Boolaroo, NSW,* Consultants Reference: S40605_SAR_FinalCellDesign_27Feb08, *27 February 2008.*

This report is accompanied by the site audit statement WRR127/5.

In summary, the Auditor considered that the design allowed the Auditor to issue a site audit statement certifying "*the suitability of the proposed containment cell(s) and associated infrastructure to meet remediation objectives for the site*". Amongst others, the auditor placed the condition on the site audit statement WRR127/5 that "*any changes to the design of the containment cell and/or associated infrastructure that differ significantly from the design in Management Plans 1 to 6, be documented and submitted to NSW DECC for their approval at the earliest practicable time and in any case before implementation of the change.*" The management plans referred to by the Auditor include the Golder design reports listed above (i.e. March 2007 and October 2007) and define the proposed land use of the containment cell as 'passive (non-development use)'.

The Auditor further stated that it was his opinion that the issues raised by DEC had been "*addressed satisfactorily so that they have either been resolved or can be addressed as compliance requirements on the variation to EPL No. 5042.*"

3.0 CURRENT CIRCUMSTANCES RELEVANT TO CELL CAP DESIGN

3.1 Status of Cell Construction

Overview

As of 30 November 2011, the progress of containment cell filling and capping is summarised below. The summary refers to Unit 21 "Contaminated Material", which is the material placed to fill Cell 1 of the containment cell, and to Unit 2 "Clay Liner Material", which is the material used to construct the barrier layer in the capping system.

- Quantity of Unit 21 Contaminated Material placed = approximately 1,000,000 cu.m;
- Area of Cell 1 capping system completed = 65,000 m^2;
- Quantity of Unit 2 Clay placed in Cell 1 cap = 36,432 cu.m; and
- Area where Cell 1 filling completed and awaiting Unit 2 Clay placement for cap = approximately 13,000 m^2.

The material filling the containment cell (Cell 1) is referred to in the design as Unit 21 "Contaminated Material". The maximum thickness of this material in the cell will be approximately 15 m. This material is placed and compacted in a controlled manner, in accordance with the technical specifications, with moisture and density requirements for compaction and maximum 300mm thick lifts. The minimum required compaction density is 95% of standard maximum dry density (SMDD).

The actual compaction density achieved during cell construction is measured at a specific frequency by the geotechnical inspection and testing authority (GITA) for the project. The GITA is engaged to independently (Level 1, AS 3798) monitor compliance with the specification. Approximately 750 compaction density tests have been conducted by the GITA in the Unit 21 fill that has been placed to date, with the average density achieved being approximately 103% SMDD.

This data indicates that the material filling the containment cell has generally been placed at a significantly higher density than required by the design, similar to that achieved in an engineered structural fill. This means that the cell material is generally significantly stronger, stiffer, and less compressible than anticipated at the time of the design. Therefore, the likelihood of significant differential settlements developing at the completed cell surface is less than anticipated.

3.2 Local Need for Additional Playing Fields

The following factors are relevant for consideration of the development of playing fields on the containment cell (based on discussion with PCCS):

- Anecdotal information from local sporting clubs indicates that there is a local shortage of playing fields, particularly for certain sporting codes including AFL;
- Provision of public playing fields by Lake Macquarie City Council (LMCC) is generally constrained by the availability of suitable, flat land and by funding requirements (e.g., LMCC Development Contributions Plan, 2004); and
- PCCS considers that development of playing fields on top of the containment cell could provide a productive end use for the local community at a potentially lower overall cost to LMCC than other options.

Golder understands that changes in local development and community needs since the time of the existing design approval have resulted in both PCCS and LMCC viewing the use of the top of the containment cell for playing fields as increasingly desirable.

Golder notes that the reduced likelihood of significant differential settlements developing at the cell surface due to the high level of cell compaction being achieved during construction (refer Section 3.1) makes the playing field option more feasible from a serviceability and maintenance viewpoint.

The reduced differential settlement likelihood also makes it feasible to consider reducing the slope of the top of the cell from the existing design value of 3%, too steep for playing field use, to a smaller value that is more consistent with appropriate playing field slopes (refer Section 4.2). A reduced slope for the top of the cell would also provide additional contingency for cell volume (refer Section 3.3).

3.3 Cell Volume and Contingency

The containment cell footprint was enlarged in 2010 to provide additional cell airspace (i.e., storage volume) for an unanticipated increase in the volume of waste requiring containment (refer Section 2.1). The 2010 modification involved an extension of the footprint by between approximately 0 m to and 40 m to the west, along a boundary of approximately 500 metres. PCCS indicates that any further expansions of the containment cell will impinge on planned development areas within the site and are not likely to be viewed favourably by the local community. Additionally, further expansion would require a redesign and approval of the cell and associated infrastructure such as the downgradient groundwater cut-off drain, likely causing delays to cell completion.

Currently, there is an available contingency of approximately 40,000 cu.m in the cell design, equivalent to only 3% of the total design volume of the cell. There is a risk that further unanticipated increases in the volume of Unit 21 material needing to be placed within the cell could exceed this contingency. Therefore, there is a general need to develop further volume contingency options that have minimal potential to cause environmental and community impacts, are not likely to delay cell completion, and that are practicable with respect to site development constraints.

3.4 Clay Shortage

Clay Sources for Cell Cap

The existing capping system design for Cell 1 includes a barrier layer comprising a 600 mm thick layer of Unit 2 “Clay Liner Material”. The specification for this soil material is relatively strict, in particular requiring the material to have a very low permeability and a limited amount and size range of gravel/rock particles. The existing capping system design for Cell 2 includes a composite cap where the layer of Unit 2 Clay is augmented with a geomembrane layer.

The total quantity of Unit 2 Clay required for the cell cap with the existing design is 133,000 cu.m. Considering the quantity placed to date, 36,432 cu.m. (refer Section 3.1), and PCCS’ expectation that an additional 48,000 cu.m. can be locally sourced during cell construction, a significant shortfall of more than 48,000 cu.m. of Unit 2 Clay is anticipated for the cell.

Unit 2 Clay has proven difficult to source locally, and there are a number of issues associated with its supply, as indicated below (based on discussion with PCCS).

- There are no known quarries or other commercial sources that can reliably supply material in large quantities that meets the Unit 2 Clay specification. Clay permeability characteristics are subject to variation with small changes in local geology.
- The primary source of Unit 2 Clay is through excavation for urban development. In recent years, the slowdown in the housing and development market, exacerbated by the *Global Financial Crisis*, has seen a reduction in potential clay sources. PCCS has attempted to identify development sites through ongoing contacts in the development industry and subscription to the Building and Construction Information (BCI) Australia newsletter.
- Suitable Unit 2 Clay at urban development sites is typically found in relatively small quantities and is excavated by development contractors who are not focussed on careful segregation of suitable and unsuitable materials. Consequently, suitable materials can be rendered unsuitable due to inadvertent mixing during excavation.
- Large-scale excavations in the Newcastle vicinity typically produce clayey soil materials that contain gravel/rock particles in excess of that allowed by the Unit 2 Clay specification. For example, materials

from large excavation works at the Summerhill landfill in Wallsend were considered as Unit 2 Clay in 2009 but subsequently found to be excessively rocky and non-conforming.

In Golder's role as technical reviewer of Unit 2 Clay sources for compliance with specification requirements, we have formally considered 11 possible sources submitted by PCCS and the former cell construction contractor. Golder has informally considered and rejected a number of other potential sources. Golder has approved eight sources for Unit 2 Clay. The relatively large number of source that have been considered is consistent with a shortage of suitable materials in the project vicinity.

Options and Implications

Golder considers that the general options available to PCCS to address the shortage of Unit 2 Clay are as identified and discussed below.

a) treat or process available clay sources to manufacture a material that meets specification requirements (e.g. bentonite addition and/or screening to remove rock.

b) source clay from distant locations.

c) revise the specification to allow use of lower quality clay materials in the cap.

d) revise the cap design to reduce the required quantity of Unit 2 Clay by including geosynthetic material layers.

Option (a): This option would achieve a conforming capping layer with no design changes required, However, this option would require the manufacturing of a large amount of Unit 2 Clay material which would likely require bench and/or pilot-scale studies for each potential material source regarding acceptable treatment procedures and materials, processing procedures, equipment, and quality control requirements. The need for such studies would likely lead to delays that extend the time required to complete the cell capping. In general, delays in capping the containment cell are environmentally undesirable because uncapped cell materials have a higher risk of environmental impact than fully capped cell materials (eg., risk of generating contaminated dust, runoff, leachate). Further, as indicated by PCCS, delays may be undesirable for the local economy because an unfinished appearance of the site (i.e., without completed capping and revegetation in place) may continue to provide a disincentive to local investment in housing and other urban development.

An additional consideration is that Option (a) does not provide any additional contingency for cell volume (refer Section 3.3).

Option (b): This option would achieve construction of the cap with no design changes required, and without the need for material treatment/processing studies in Option (a). However, this option may significantly increase the "transport footprint" of containment cell construction with associated environmental and amenity impacts. Construction delays are also possible depending on the difficulty experienced in identifying and arranging supply and transportation from distant sources. As with the previous option, Option (b) does not provide any additional contingency for cell volume.

Option (c): This option would result in a higher permeability cap material and overall cap performance would likely be poorer. Specifically, the rate of leachate generation from the containment cell would be expected to be higher than for the current capping design. As with the previous options, Option (c) does not provide any additional contingency for cell volume.

Option (d): This option would likely result in equivalent or improved cap performance and is considered to be practically achievable without construction delays. This option would require appropriate design, specification, installation and long-term maintenance of geomembrane and other geosynthetic materials (refer Section 5.0). Significantly, this option provides additional contingency for cell volume because the use of geosynthetic materials will result in a reduction in the total thickness of the capping system (refer Section 4.1).

We note that Golder has previously considered Option (d) to be a generally acceptable capping approach for this project, as well as for numerous other waste containment projects. Specifically, the March 2007 Design Report by Golder states regarding the cap: *'Geosynthetics are usually included where available materials do not meet the performance requirements of a low permeability liner, or where a composite liner is required.'*

At the time of the cell design, it was thought that available soil materials would meet the performance requirements for Unit 2 Clay and therefore a geosynthetic capping system was not part of the capping design for Cell 1. A geomembrane material was, however, specified for the Cell 2 capping system because Cell 2 required a cap with a composite liner (i.e. combination of geomembrane and clay liner).

The proposed design of an Option (d) cap for Cell 1, incorporating a geomembrane and other geosynthetic materials, is further discussed in Section 4.0.

3.5 Summary

Golder has considered the project circumstances, as described above, and we consider that a redesign of the cell cap can effectively address current project needs and retain the environmental integrity of the cell design.

The proposed design revisions are summarised in Table 1 and are as follows:

- revise the design of the barrier layer and drainage layer within the Cell 1 capping system to incorporate geosynthetic materials and to reduce the thickness of the Unit 2 Clay layer as well as the overall thickness of the capping system; and
- revise the cell landform to facilitate construction of two AFL football fields, including overall flattening of the slope of the top of the cell.

We consider that these revisions provide an appropriate balance between maintaining cell integrity, minimising delays to cell completion, and addressing current project needs for reduced Unit 2 Clay volume, playing field development, and additional cell volume contingency. These revisions are also considered practicable from a cost-benefit and constructability perspective.

The following section of this letter provides additional detail of the proposed design revisions

4.0 PROPOSED DESIGN REVISIONS – TECHNICAL DISCUSSION

4.1 Replacement of Cell 1 clay/gravel capping system with a geosynthetic capping system

Overview

The current capping system design for Cell 1 and proposed design revisions are identified in Table 2 below and discussed subsequently. Revisions are proposed for the drainage layer and barrier layer components. The proposed design revisions apply primarily to the portions of the capping system on the top deck of Cell 1 that have not yet been constructed.

Table 2: Capping System and Proposed Design Revisions – Top Deck of Cell 1

Component (listed from top to bottom)	Existing Design	Proposed Design
Topsoil Layer	150 mm thick; Topsoil specification (Unit 20)	No change proposed
Subsoil Layer	600 mm thick; Subsoil specification (Unit 19)	No change proposed
Drainage Layer	150mm thick; Subsoil gravel drainage layer specification (Unit 18); Overlain by filter geotextile (Unit 13)	Geocomposite drain (geonet drain core with geotextile filter bonded to both sides); thickness 5-10 mm.
	Subsoil drainage collection pipes (Unit 17) within subsoils drainage layer	No change proposed to pipe material; revised pipe layout and spacing
Barrier Layer	no geomembrane	LLDPE geomembrane (overlying clay liner); thickness 1 mm
	600 mm thick: Clay liner material (Unit 2)	100 mm thick: Clay liner material (Unit 2)

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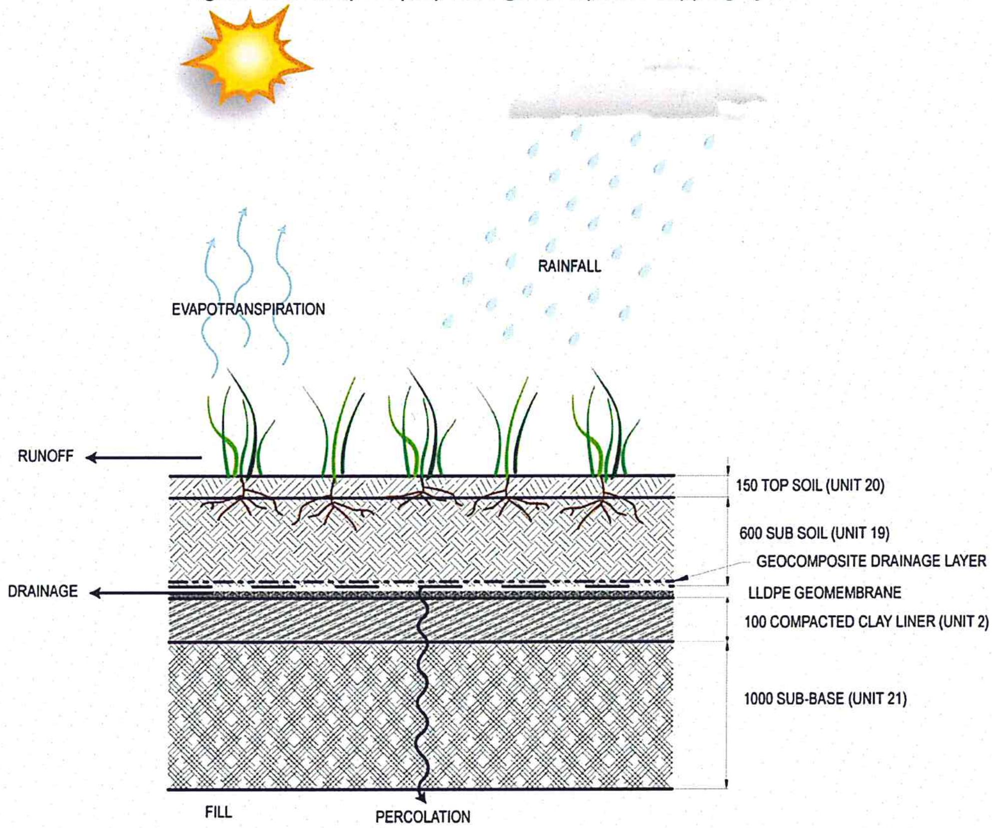
Component (listed from top to bottom)	Existing Design	Proposed Design
Sub Base	1000 mm thick: Sub base material (*select Unit 21)	No change proposed
Total System Thickness	2500 mm	1860 mm

The following figure shows the revised design proposed for the capping system for the top deck of Cell 1.

Figure 1: Concept of proposed geocomposite capping system



Barrier Layer and Composite Liner Effect

The proposed design revision replaces a relatively thick layer of Unit 2 Clay with a thin layer of Unit 2 Clay overlain by a geomembrane. In the proposed design the thin layer of Unit 2 clay provides a bedding layer for the geomembrane that serves two functions as follows: (i) clay layer will protect the geomembrane because it will not contain any gravel or rock particles that could puncture or penetrate the geomembrane; and (ii) clay layer in contact with the geomembrane provides a composite liner effect whereby the rate of water leakage through any defects in the geomembrane is likely to be significantly less than if the geomembrane was placed on more permeable soil. Because the development of a full composite liner effect (i.e., an order of magnitude or more reduction in leakage rate) is typically documented for clay layers that are substantially thicker than 100 mm, we consider that only a partial composite effect will likely be achieved with the proposed design. However, even a partial composite effect would result in leakage rates several times lower than for a single clay liner or single geomembrane. On this basis alone, it can be demonstrated that environmental impacts caused by infiltration through the proposed cap are likely reduced from the cap design which is currently approved, assuming that the cap is maintained suitably as per the maintenance requirements.

Geomembranes

Geomembrane liners, primarily high-density polyethylene (HDPE) and linear low-density polyethylene (LLDPE), are widely used in capping applications for landfills and containment cells as an alternative to compacted clay liners. Both compacted clay and geomembrane materials are considered technically feasible options which are able to provide effective hydraulic barriers if adequate design and construction quality assurance (CQA) programs are implemented.

The general advantages and disadvantages of both materials based on industry literature (Mitchell (2008), Qian et al. (2002)) and our previous experience have been summarised in **Table 3**.

Table 3: Advantages and Disadvantages of Compacted Clay and Geomembrane Liners

Component	Compacted Clay	Geomembrane (HDPE or LLDPE)
Advantages		
Manufacture/ Construction	■ Well established methods of construction and quality control	■ Manufactured product with generally less variability in quality than clay
Performance	■ Effective low permeability barrier layer when properly installed ■ Longer diffusion path than geomembrane ■ High resistance to UV, heat and energy exposure (compared to geomembrane)	■ Effective low permeability barrier layer when properly installed ■ Lower water infiltration rates than compacted clay, thereby reducing leachate generation in the long-term ■ Lower gas emission rates than compacted clay ■ High differential settlement tolerance
Airspace	■ N/A	■ Increased airspace available for placement of waste material compared to compacted clay
Timing (Specific to PCCS site)	■ Refer section 3.4.	■ More readily available than clay. Reduced likelihood of delays to the project.
Disadvantages		
Manufacture/ Construction	■ Requires significantly larger volume of liner material than geomembrane ■ Requires Construction Quality Assurance (CQA) due to material variability, compaction moisture content, and desiccation potential	■ Requires more stringent CQA and increased site supervision compared to compacted clay. Particular concerns are welding and seam control, wrinkle control, puncture protection and protection during placement of overlying materials.
Performance concerns	■ Desiccation cracking ■ Internal shear due to differential settlement ■ Root penetration	■ Long-term durability of geomembrane materials related to UV, heat and energy exposure (e.g., a 10°C temperature increase can halve the service life). Exposures must be minimised with adequate installation protection and depth of burial. ■ Susceptible to defects such as faulty seams, punctures, and wrinkles (CQA required) ■ Limited resistance to diffusive migration (pertinent to volatile organics, which are not a significant contaminant at the PCCS site)

Design concerns	■ May require thicker soil cover layers than geomembrane to provide protection from desiccation cracking and root penetration and to provide confining stress for increased resistance to internal shear	■ Limited interface shear strength. Detailed consideration of slope stability required. ■ Puncture protection required ■ Wind uplift (when uncovered) ■ Separation distance between waste material and final surface smaller than with compacted clay
Timing (Site specific)	■ Shortage of clay locally may result in project delays. Refer section 3.4.	■ N/A

Of the general advantages described in **Table 3** above, the main advantages of geomembrane capping systems over the traditional compacted clay for the PCCS site are as follows:

1) Geomembranes can provide a lower permeability barrier than compacted clay liners which can lead to lower water infiltration rates; this is particularly true for geomembranes used in combination with underlying clay layers (i.e., composite liner effect as described earlier);
2) Geomembranes are considerably thinner than compacted clay liners which leads to increased airspace availability for waste placement (i.e., cell volume contingency); and
3) Geomembranes are advantageous if a suitable source of high-quality clay is not available.

In general, the main disadvantages of geomembranes are:

1) Susceptibility to defects, such as seam faults and wrinkles, and to construction damage, such as punctures and tears, which can reduce their performance as a hydraulic barrier; this disadvantage can be managed for most sites, including the PCCS site, by the selection and testing of appropriate materials and the implementation of a comprehensive CQA program, which has already been done at the PCCS site for the geomembrane components in the Cell 2 base liner and cap; and
2) The potential for instability on slopes due to the limited shear strength on the interfaces between the geomembrane and surrounding materials; this disadvantage is not relevant to the proposed design revision at the PCCS site which does not include use of geomembrane on the Cell 1 slopes (i.e., on top deck only).

Drainage Layer

The proposed design revision for the top deck of Cell 1 includes replacement of a 150 mm thick gravel drainage layer with a 5 to 10 mm thick geocomposite drain (i.e., a geonet drain core with geotextile filter bonded to both sides). Geocomposite drains are often used in conjunction with geomembranes in geosynthetic capping systems. Advantages and disadvantages of geocomposite drains are discussed in the table below.

Table 4: Advantages and Disadvantages of Geocomposite Drains

Performance Factor	Discussion
Permeability and Flow Capacity	Geocomposite drain is purpose made to perform as a drainage plane and the drainage core has open drainage paths and higher inherent permeability than gravel. However, as the material is substantially thinner than the existing gravel layer design (i.e., 5 to 10 mm versus 150 mm), its overall flow capacity is similar to that of the gravel layer. Site-specific flow capacity calculations will be required for detailed design of the geocomposite drain, accounting for the overall slope of the capping system.
Clogging Potential	Geocomposite drain incorporates a geotextile filter layer to minimise fines migration into the drainage core. The existing gravel layer design also incorporates such a geotextile filter layer. In general, though geocomposite drains will have higher internal flow velocities that reduce the potential for internal sedimentation of fine particles, they are considered to have a higher risk of clogging than gravel layers due to their inherent thinness. The higher risk of

Performance Factor	Discussion
	clogging is typically managed with an observation and maintenance approach. One of the major potential consequences of clogging, instability of capping system slopes, is not relevant to the proposed use at the PCCS site because the use of geocomposite drain is not proposed for Cell 1 slopes (i.e. top deck only).
Protection of Underlying Geomembrane	The geocomposite drain will provide effective protection to the underlying geomembrane from puncture from overlying capping system materials. It will be, in essence, a thick puncture protection layer. Conversely, a gravel drainage layer is a puncture risk for the underlying geomembrane. A relatively thick cushion geotextile would typically be required between a geomembrane and drainage gravel to reduce puncture risk.
Durability and Survivability	The long-term durability of geocomposite drain materials is generally considered acceptable for waste containment capping systems provided that UV, heat and energy exposure is minimised with adequate installation protection and depth of burial. Survivability of geocomposite drains is typically more of a concern than for gravel drainage layers, due to their thinness, and is typically addressed through observation and maintenance procedures.

Overall, the use of a geocomposite drain is considered technically acceptable as long as flow capacity, depth of burial, and maintenance requirements are addressed during detailed design.

Summary

The proposed design revisions to the barrier layer and the drainage layer on the top deck of Cell 1 are considered technically acceptable and will require appropriate detailed design and CQA implementation. In addition, the current Cell Operation and Maintenance Plan (COMP) will require revisions to address the presence of a geomembrane and overall thinner capping system.

4.2 Flattening of Cell Surface

It is proposed to flatten the cell top deck from a gradient of currently 3% to a value of 2% while batter areas will retain their current design of 5H:1V and stormwater drop structures will remain in their current location. Areas with playing fields will have a surface gradient of approximately 1%, beneath which the underlying cap and subsoil drainage layer will generally maintain a gradient of 2% or be modified depending on the subsurface drainage measures incorporated into the playing field turf system . The change in cell surface grade is undertaken to facilitate playing field development and to gain further cell airspace (i.e., cell volume contingency).

Technical Feasibility

Potential technical issues to be addressed for flattening of the cell surface are:

1) grade reversal of the surface due to differential settlement, resulting in ponding of surface water runoff; this could potentially cause reduced amenity to site users, negative impacts on revegetation and increased infiltration through the cap;

2) grade reversal of the subsurface drainage layer, resulting in increased infiltration through the cap; and

3) effects on landfill gas collection system performance.

While the risk of grade reversal occurring is considered low, additional contingency measures will be incorporated in the design. These may include:

- more frequent subsoil drainage pipes; and
- adjustments to the COMP to incorporate appropriate inspection and maintenance measures.

Based on the available knowledge of material compaction in the cell (refer Section 3.1) and a more detailed cell settlement analysis carried out, we consider that a flatter cell surface grade is warranted. We have undertaken an updated settlement analysis of the cell, which indicates that a 2% cell surface grade has a low risk of causing grade reversal.

A cell with a 2% surface grade would result in additional airspace for placement of contaminated materials in the cell, which would reduce the likelihood of further cell footprint expansions being required. Avoiding a further increase in cell footprint is considered to be an overall environmental benefit for the site (refer Section 3.4) and would also maintain the land area available for potential future contingency measures relating to the downgradient groundwater cutoff drain (refer Section 3.3).

Summary

The flattening of the cell surface is technically feasible as cell compaction is higher than previously specified. Additional design and maintenance measures will be incorporated.

4.3 Construction of Playing Fields on Cell Surface

It is proposed to design the cell to allow the construction of two AFL football fields on the containment cell surface in the future. The fields will be sloped at 1% and will be constructed by additional earthworks on top of the 2% subgrade. The previously approved land use for the cell is defined as 'passive use, no development', in the cell design report.

Land use

The previously approved land use for the cell is defined as 'passive use, no development', in the cell design report. We understand that this land use definition originated to provide a contrast with an initial plan to develop the surface of the cell for commercial / industrial land use. The currently proposed land use of football fields would classify as 'park, recreational open space, playing field', as defined in the Guidelines for the NSW Site Auditor Scheme (DEC 2006). Subject to further consultation with relevant parties, this does not appear to constitute a significant change from the original land use.

Technical Feasibility

Sportsgrounds are frequently constructed on former landfills, with ground conditions often less favourable for such developments than the Pasminco containment cell. The waste placed in the containment cell comprises controlled fill and the ground underlying the containment cell has been improved with high energy impact compaction. As outlined in Section 3.1, compaction of material in the cell is higher than initially specified (103% of SMDD vs. 95% of SMDD as required in the Technical Specification).

The flattening of the containment cell cap (Refer Section 4.2) will assist in the construction of football fields on the containment cell surface. A number of items such as cap penetrations for lighting / goal posts, diversion of landfill gas collection points, football field drainage/irrigation, and other football field infrastructure. will require detailed design.

The following issues will need to be considered for the design of the playing fields:

1) grade reversal of the surface due to differential settlement, resulting in ponding of surface water runoff, which may result in reduced amenity to site users, negative impacts on revegetation and increased infiltration through the cap; this issue is, however, routinely addressed for many playing field designs;

2) grade reversal of the subsurface drainage layer, resulting in increased infiltration through the cap;

3) design of local surface water drainage around the football fields.

It should be noted that the subsurface drainage layer graded at 2% may be retained, however it may be possible to combine the football field turf drainage layer and the subsurface drainage layer.

While the risk of grade reversal occurring is considered low for a 2% surface grade and moderate for a 1% surface grade, additional contingency measures will be incorporated in the design. These may include:

- more frequent subsurface drainage pipes; and
- adjustments to the COMP to incorporate appropriate inspection and maintenance measures.

The football fields may require additional maintenance, especially in regards to areas of differential settlement, when compared to a football field on a Greenfield site. It should be noted that the active recreational use of the site as football fields may be beneficial to capping system performance in that it may result in an increased level of inspection of the cell surface, i.e. surficial erosion features may be noticed and repaired more rapidly due to community use of the site.

Summary

The design of football fields on the cell surface is considered technically feasible and does not appear to constitute a major change of land use. However, turf, football field drainage, surface and subsurface drainage and cap penetrations require detailed design. The containment cell maintenance program presented in the COMP will require updating.

A more active use of the site by the community may indirectly result in more active inspection than for a passive site without active landuse.

5.0 RELEVANT DOCUMENTATION IN PREPARATION

Golder is currently preparing additional documentation to support the design changes, which will be submitted to OEH for consideration. These documents include:

- Revised containment cell design drawings: Approximately 36 drawings from the current set will require revision;
- Specifications for new materials such as geomembranes and geocomposite drains;
- Design Revisions Report to include detailed design calculations and provide further technical justification for the design changes; and
- Revised cell operation and maintenance plan (COMP) to include specific maintenance for a geosynthetic cap with playing fields.

6.0 CLOSURE

We are looking forward to discussing this letter with you.

GOLDER ASSOCIATES PTY LTD

Daniel Dohle
Senior Engineer

Dr Gary Schmertmann
Associate

DD/GRS,JLM/gl

CC: Mark Elliott, Ferrier Hodgson
Richard Bastow, Ferrier Hodgson

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