

Moorebank Precinct West Intermodal Terminal Facility - Modification

Geotechnical and Contamination Memorandum



SIMTA

SYDNEY INTERMODAL TERMINAL ALLIANCE

Part 4, Division 4.1, State Significant
Development

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TO Nathan Cairney

CC Greg Stratton

FROM Nathan Steggles

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**GEOTECHNICAL AND CONTAMINATION MEMORANDUM SUPPORTING MPW CONCEPT
PLAN/EARLY WORKS MODIFICATION FOR FILL IMPORTATION**

1.0 INTRODUCTION

The Moorebank Intermodal Company (MIC) has received Concept Plan Approval, under Part 4, Division 4.1 of the *Environmental Planning and Assessment Act 1979* (EP&A Act), to develop the Moorebank Precinct West Intermodal Terminal Project (MPW Project) on the western side of Moorebank Avenue, Moorebank, in south-western Sydney (the MPW site).

On 4 June 2015, the MIC, with the approval of the Commonwealth Government, entered an agreement with the Sydney Intermodal Terminal Alliance (SIMTA) under which SIMTA will obtain approvals, build and operate all stages of the MPW Project at Moorebank. SIMTA is seeking approval to modify the MPW Concept Proposal and Stage 1 (Early Works) approval (SSD_5066) (MPW Concept Plan Approval).

The Environmental Impact Assessment (EIS) prepared for the Concept Plan Approval identified that fill material required for the development of the MPW site would be largely sourced from excavations within the MPW site and hence imported fill volumes for the project would be relatively minor. Subsequent civil design development for the MPW Project has identified that fill required to be imported to the MPW site is estimated at 1,600,000 cubic metres (m³). It is proposed to undertake additional site preparatory works, including the import, placement and stockpiling of clean fill, as a modification to the approved Stage 1 (Early Works).

This Geotechnical and Contamination Memorandum has been prepared to support an application made under section (s) 96(2) of the EP&A Act to modify the MPW Concept Plan Approval (SSD_5066) to allow for the Modification Proposal. The Modification Proposal includes the importation, direct placement, compaction and stockpiling of a total of 1,600,000m³ of fill to the primary earthworks area. Figure 1 shows the location of the proposed Modification Proposal, including the area of impact and the primary earthworks area, where direct placement and stockpiling of material would be undertaken.

This memorandum has been prepared in accordance with the request (received from Nathan Cairney of Tactical, 20th April 2016) and our proposal of 22nd April 2016 (Ref: 1416224-026-P-Rev0).



Figure 1: Proposed earthworks (MPW Concept Plan Modification)

1.1 Purpose of this memorandum

This Geotechnical and Contamination Memo assessment report has been prepared to provide further information on, and environmental assessment of, the Modification Proposal. The Modification Proposal has been reviewed against the Secretary's Environmental Assessment Requirements (SEARs, SSD 5066) and documentation prepared for the MPW Concept Plan Approval and applicable legislation and guidelines to determine whether the works and associated impacts of the Modification Proposal are 'substantially the same development' as that proposed under the MPW Concept Plan Approval.

This memorandum highlights the geotechnical and contamination issues pertaining to the area of the proposed imported fill stockpile (primary earthworks area) and the anticipated impact of the proposed stockpile on the existing site conditions. The memorandum also addresses the development of the detail design of the stockpile material and arrangement.

2.0 EXISTING SITE CONDITIONS

The MPW Concept Plan Approval ([SSD 5066](#)¹), includes conceptual approval to use the land held by MIC as an intermodal terminal, and to undertake "Early Works (Stage 1)". The NSW Department of Planning and Environment draft conditions of consent, defined the Early Works (Stage 1) as:

- removal of existing hardstand/roads/pavements and infrastructure associated with existing buildings including services termination and diversion
- rehabilitation of the excavation / earthmoving training area;
- remediation of contaminated land;
- removal of underground storage tanks;
- minor clearing and grubbing of the temporary stockpiling area
- heritage impact remediation works; and
- the establishment of construction facilities and access, including site security.

The primary earthworks area that is the area of proposed filling covers a variety of previous land-use. A large part of the area is grassed with scattered trees, occupied by low rise warehouses, administration and training buildings, and residential housing associated with the former Army School of Engineering (SME). Paved access roads, along with paved and unpaved open space and landscaped sporting fields occupy a large proportion of the site. A number of ponds are present in the north eastern corner of the proposed stockpile area. An existing stormwater system comprising pits, pipes and open channels runs through the area. However it is anticipated that these features will be removed, redirected and remediated as appropriate as part of the approved Early Works.

A summary of the geology, soils and contamination of the area and key geotechnical and contamination aspects of subsurface conditions, relating to the Modification Proposal are discussed below.

2.1 Geology

The published 1:100,000 Penrith Geological Map (NSW Department of Minerals, 1991) indicates that the area of impact is characterised by Tertiary alluvial deposits (Ta) of Pliocene age with terraces of more recent Quaternary (Holocene) age (<10,000 years) alluvial deposits (Qha) adjacent to the Georges River. The geological map indicates that the underlying rock conditions in the area are either Triassic Hawkesbury Sandstone (Rh) or Ashfield Shale (Rwa). A brief overview of the ground conditions encountered within the area of impact is provided below. Geological conditions at the MPW site are discussed in further detail in the Golder Geotechnical Interpretive Report (Ref. 147623070-011).

¹ http://www.majorprojects.planning.nsw.gov.au/index.pl?action=view_job&job_id=5066

2.2 Soils

Outside of existing structures, a variety of paved and unpaved surfaces are present across the area of impact. In unpaved areas, the site is characterised by a relatively thin layer of predominantly granular topsoil, underlain by alluvial soils over bedrock. The topsoil thickness encountered during investigation varies up to approximately 0.2 m thickness but is typically 0.1 m thickness or less. The organic content varies but is typically minor. At selected investigation locations evidence of prior topsoil layers being filled over was observed. Locally thicker and more humic topsoil is to be expected in the immediate proximity of established vegetation (e.g. stands of trees and bushes). In some areas locally deep anthropogenic fill has been encountered up to 4 metres (m) deep (for detail reference can be made to the Golder Post Phase 2 ESA, Ref: 147623070-019, 2015).

In the primary earthworks areas, the natural alluvial material is a mixture of granular/sand (typically medium dense or denser) and cohesive/clay material (typically of very stiff consistency or harder). Cohesive alluvial material predominates over granular alluvial material, which is typically present as sand seams or bands within a clay profile. The depth to bedrock varies across the area typically in the range of 10m below ground surface to 25m below ground surface.

Following site preparation, in accordance with activities noted as being part of Early Works above, the foundation for filling is anticipated to typically include sand fill, clay fill, alluvial clay and alluvial sand. As discussed in the Golder Geotechnical Interpretive Report (Ref: 147623070-11), significantly different performance can be expected between the granular (i.e. sand) and cohesive (i.e. clay) material as a subgrade/stockpile foundation (i.e. differing soaked CBR values and swell potential). Differing performance is also likely between the alluvial and fill material of similar grain size (e.g. both clay or both sand), although to a lesser degree.

The exception to this is the anthropogenic fill which due to the nature of its placement (inferred to be uncontrolled) and inclusions (such as timber, steel and concrete building debris and general rubbish) will typically not be suitable as a foundation in its current condition.

Due to historic site use, the lateral extent of fill will vary at similar elevations. Likewise sand seams and bands within the dominantly clay alluvium will be laterally discontinuous. Delineation of zones of granular versus cohesive subgrade may prove difficult, even with relatively extensive investigation, prior to stripping and exposure of subgrade.

Foundation preparation requirements will be addressed in the site specific Earthworks Specification (the Earthworks Specification) as discussed further in Section 3.0 of this memorandum.

2.3 Groundwater

Groundwater beneath the primary earthworks areas has been recorded as typically between 9 to 12m below existing ground surface (i.e. approximately RL 2m to RL 6m) and flowing towards the Georges River (west). This was broadly corroborated by the recent Stage 2, 2016 investigation undertaken by Golder Associates except at GA-TP-3112 which recorded groundwater inflow at 2.9m below ground surface. This was inferred to be a local effect resulting from the proximity of an existing pond.

The impact of the proposed stockpile on groundwater levels will be dependent on numerous factors including the manner in which the foundation of the stockpile is prepared, the nature of the stockpile material and surface drainage provided within and around the stockpile. We note that ongoing groundwater monitoring is expected as part of the long term environmental management plan. More detailed assessment of groundwater impacts may be appropriate dependent on the duration of the proposed temporary stockpiling and the level of sensitivity of the management measures for groundwater risk to fluctuations in groundwater level.

2.4 Contamination

The contamination on the site has been subject to numerous investigations with the most current investigation documents included in the MPW Concept Plan EIS. These included the Phase 1 and Phase 2 Environmental Site Assessment Reports and the provisional Remediation Action Plan (RAP), prepared by PB in 2014, and the Post Phase 2 Environmental Site Assessment Report and Validation Plan - Principals prepared by Golder Associates in 2015.

Subsequently as part of the Early Works, the site will be remediated to the extent permissible under the MPW Concept Plan Approval (SSD - 5066). These remediation works will be audited by an accredited contaminated land Auditor, and that the Auditor will prepare a section A, Site Audit Statement at the completion of the remediation works. The Site Audit Statement will be provided to the consent authority to satisfy the obligations under Clause 7(1) of State Environmental Planning Policy 55 and the MPW Concept Plan Approval Minister's Conditions of Approval (MCoA) B1 to B3.

2.4.1 Early Works Remediation

The remediation to be completed under the Early Works will include:

- the demolition, excavation and remediation of known underground storage infrastructure and associated contaminated soils impacted with petroleum hydrocarbons;
- the excavation and remediation of known stockpiles of building demolition waste and/or asbestos contaminated soils;
- the excavation and remediation of known areas of soil contamination ('hotspots') including soils impacted with lead, and petroleum hydrocarbons at concentrations which present an unacceptable risk to the future use of the site;
- the assessment and if required remediation of materials suspected of being contaminated with polychlorinated bi-phenols (PCBs), organochlorine pesticides (OCP) and per- and poly-fluorinated alkyl substances (PFAS); and
- the assessment and if required remediation of underground utilities suspected as either being made of or suspected of containing hazardous or contaminated materials.

The remediation and validation works will be completed in accordance with the guidelines endorsed by the NSW Environmental Protection Authority (EPA) under Section 105 of the *Contamination Land Management Act 1997* (CLM Act).

The NSW EPA's preferred position on the selection of remediation options, as stated in the DEC, NSW (2006) *Auditor Guidelines*, is to preference on-site treatment of the soil so that the level of contaminant is either destroyed or the associated hazard is reduced to an acceptable level ahead other remediation options. Onsite treatment is applicable for the identified hydrocarbon contaminants which are amenable to onsite biological treatment through land farming. However, recalcitrant contaminants such as heavy metals and asbestos are often not amenable to onsite treatment, and alternative options such as excavation and isolation, excavation and disposal, or leaving contaminated material in situ with management controls are appropriate options for consideration. This prioritisation is supported by the NSW EPA Waste Avoidance and Resource Recovery Strategy [WARR] (EPA 2014), which adopts the waste minimisation hierarchy and is aimed at avoiding and reducing the generation of waste.

The remediation works will include the preparation of documents expected to be required to facilitate the progression of the remediation and ensure appropriate mitigation measures are implemented during the future development of the site:

- *Stage specific Remediation Action Plans (RAPs)* – a RAP specific to each stage of development will be required to accommodate the detailed engineering design within the adopted remedial approaches, as well as to align with the staged development approval process. The stage specific RAPs are to refer to the Preliminary RAP (PB, 2014b), and the Site Validation Principles (Golder, 2015c) and are to include validation plans appropriate for each proposed stage of development which includes remediation actions.
- *Stage specific Remediation and Validation Reports (RVR)* – at the appropriate time and where required, a RVR will be prepared for each development area. These reports will document the remediation and validation activities completed within a specific area. These reports will facilitate the Auditor's review of the remediation and validation activities;
- *Construction Environmental Management Plan (CEMP)* – a CEMP will be developed specific to each stage of development, and where required the CEMP will draw on the requirements of MCoA D19, the

processes described in the Preliminary RAP (PB, 2014a), the Validation Plan - Principles and the Remediation Specification (Golder 2015c), as well as the Stage Specific RAP developed for that stage of the MPW Project. The CEMP will also stipulate the actions to be taken should additional contamination be identified during the development of the site (i.e. an unexpected finds protocol).

- *EOW and UXO Management Plan* – a site wide, and/or stage specific EOW/UXO Management Plan will need to be developed as part of the CEMP to ensure a safe working environment is established during earthworks.
- *Asbestos in Soils Management Plan (AMP)* - the AMP will be prepared to specifically address the management of asbestos in or on soils during the remediation and staged development of the site. The AMP will define the actions, roles and responsibilities associated with the management of asbestos in or on soils during the proposed development works. Any management or remediation actions undertaken in relation to asbestos in soils will be undertaken in accordance with the Safe Work NSW requirements, including but not limited to the guidelines for *Managing asbestos in or on soil* (2014), and *Codes of Practice - How to Safely Remove Asbestos* (2011) and *How to Manage and Control Asbestos in the Workplace* (2011). Asbestos works will also be undertaken by appropriately trained persons including those with Class A licences for the removal of friable asbestos and / or Class B licences for the removal of non-friable asbestos. The remediation and/or management actions will include:
 - Onsite in-situ containment through the direct placement of cover fill materials to prevent future disturbance of the impacted materials and therefore minimise the potential for the materials to generate airborne fibres. The cover will be nominally minimum 0.5 meters (m) depth. However, in areas where the final design require less than 0.5m of cover, visible ACM fragments will be removed and the area nominated for closer management within the Long Term Environmental Management Plan;
 - Onsite excavation and containment through the excavation and replacement of asbestos impacted soils in a nominated containment area. The onsite containment areas will be nominated in consultation with the appointed Site Auditor, will consider positions on the site which present minimal impact to the proposed development and minimise the potential for disturbance during the future operation of the site. Containment will include the placement of materials at depths generally greater than 1.5m, and will include a minimum of 0.5 m cover to minimise the potential for the materials to generate air borne fibres. Onsite containment locations will be mapped and noted for closer management within the Long Term Environmental Plan;
 - Excavation and offsite *disposal* through the excavation, transport and offsite disposal of soils impacted with asbestos. Excavation works will be completed at areas where impacted soils are not considered suitable or onsite insitu containment, or are unsuitable for inclusion within an onsite containment area. Excavated materials will be disposed of in accordance with the requirements of the Waste Management Plan, and will be disposed at a facility appropriately licenced by the NSW EPA for the receipt of friable asbestos wastes.

The AMP will include general requirements for the management of asbestos works including consultation requirements, licencing requirements, health monitoring and air monitoring requirements. The AMP will also include protocols for un-expected finds of asbestos during future development earth works. It is expected that where warranted the AMP will be updated and reissued at the completion of the Early Works remediation activities, and as each stage of development is completed.

- Long Term Environmental Management Plan (LTEMP), a site wide LTEMP will be developed at the completion of the remediation works and will prescribe the protocols for the ongoing maintenance and /or monitoring or any long term remedial or mitigation measures implemented during the remediation. The LTEMP will include the roles and responsibilities for implementation, the consultation requirements, and licencing requirements. The LTEMP will stipulate the actions to be taken should additional contamination be identified during the post development occupation of the site (i.e. an unexpected finds protocol, an asbestos in soils response plan and UXO/EOW response plan). It is expected that where warranted the LTEMP will be updated and reissued as each stage of development is completed.

3.0 MODIFICATION WORKS

It is proposed to undertake additional site preparatory works, including the import, placement and stockpiling of clean fill, as a modification to the approved Early Works. The proposed modification would result in an intensification of activity associated with the approved Early Works. The works, for which a modification is sought (the Modification Proposal), include the following:

- Minor vegetation removal (not Endangered Ecological Communities, slightly above that provided within Early Works)
- Import, by truck, of approximately 1,600,000m³ of fill (from offsite locations)
- Stripping and stockpiling of topsoil within the area of impact, cut and fill (within the primary earthworks areas) and stockpiling of clean fill within the primary earthworks areas (see Figure 1)
- Temporary sediment and erosion control works, including onsite detention basins (greater than those envisaged within the Early Works)
- Establishment of temporary internal haulage routes, construction compounds (including, but not limited to, a materials crusher and other plant and equipment) (additional to those included within Early Works).

Figure 1, above, shows the location and extent of the Modification Proposal, which would occur largely within the footprint of the approved Early Works.

3.1 Earthworks

The nature of the fill to be imported for permanent placement and stockpiling is understood to be a clean, non-expansive, sandstone fill, in general accordance with a material derived from the sandstone bedrock indicated in borehole logs LDS-BH-1042 and LDS-BH-1050 (Attachment 1). The stockpile layout is shown in the Earthworks Plan (Drawing No. MCPN-ARC-CV-DWG-0111, Issue 01), provided as Attachment 2.

The materials are likely to be sourced from a local Sydney tunnel that is to be excavated with road headers, producing a spoil mix comprising sands, gravels and cobbles. Some fine grained materials will also be present but are expected to make up less than 10% by weight. Dependent on the grading of the as received material some processing (possibly screening only or crushing and screening) will be required to provide a material suitable for permanent placement in accordance with the Earthworks Specification.

In general the material would also need to be equivalent to Class 1 or 2 materials (i.e. compliant with the NSW EPA definitions of Virgin Excavated Natural Materials or Excavated Natural Materials) as discussed in the in the Validation Plan – Principles (Golder, 2015) and as included in the MPW Concept Plan application. To be compliant with the above mentioned definitions, consideration will also be given to the potential for acid rock conditions within potential fill sources and dependent on the material source (and its variability) laboratory testing for acid rock conditions will be completed.

Furthermore, the importation and placement of permanent fill will need to conform to the project Earthworks Specification, which is yet to be developed. The Earthworks Specification will include details on earthworks material criteria, handling and placement requirements, embankment and cutting formation (including foundation, batter and benching requirements), unsuitable material and bridging layer requirements, conformance testing methods and acceptance criteria (e.g. for material acceptance and compaction control). It is noted that for the upper zone of the permanently placed fill (which may form subgrade to pavement or foundation to structures) particular requirements will exist to mitigate against, for example, stress concentrations around cobble sized material underlying pad footings.

Permanent fill and the overlying temporary stockpile will be derived from material which performs as an earthfill rather than a rockfill. Meaning, the fill should be constructed such that its strength and stability are obtained from compaction of finer material (dominantly sand grain size), embedding larger rock pieces (to the maximum particle size and in proportions satisfying the requirements of the project Earthworks Specification) rather than mechanical interlock (as might apply in a rock fill embankment). The material

grading adopted within the Earthworks Specification for imported sandstone should be such that validation testing of compaction is possible by conventional methods. This will require that rock material is sufficiently broken down and evenly distributed through the fill material, with sufficient finer material surrounding to produce, dense, compact fill layer to the project Earthwork Specification requirements.

Laboratory testing of proposed imported fill material should be undertaken to confirm suitability in accordance with the project Earthworks Specification. In view of the sandstone fill proposed for importation such testing, for material intended for permanent placement will include:

- Laboratory compaction testing
- Soaked CBR testing (with prior pre-treatment in accordance with RMS T102 and T103)
- Particle Size Distribution (as received and post pre-treatment in accordance with RMS T102 and T103)
- Atterberg Limit Testing.

3.2 Direct placement of fill

Direct placement of fill will require foundation preparation in accordance with the project Earthworks Specification. In general foundation preparation will typically involve clearing and grubbing, grading, levelling, moisture conditioning and compaction of an upper zone of the subgrade. General clearing should include removal of everything on or above the site surface, including rubbish, vegetable matter and organic debris, scrub, trees, timber, stumps, boulders and rubble, slabs, foundations, retaining walls, paving, abandoned services and the like. Before commencing foundation preparation any infrastructure (e.g. relocated services) will be located, marked and documented in the areas that will be affected by the earthworks operations. It is noted that poorly documented infrastructure locations could present a significant risk to future development, particularly should deep foundations be required.

Due to the variable nature and depth of 'topsoil', assessment will be made in accordance with the Earthworks specification as to the appropriate depth of topsoil stripping at specific locations. Scalping of vegetation (e.g. grass cover) will be necessary as part of general grading and preparation for filling. Some localised areas free of topsoil will likely be encountered based on the proposed footprint of stockpiling. In other areas locally deeper topsoil will be encountered (e.g. within zones of established vegetation). Final depths of topsoil stripping will be determined in accordance with the Earthworks Specification. However, for planning purposes an average allowance of 0.1 m of topsoil stripping is made.

Provision for addressing unforeseen zones of 'unsuitable' material will be addressed within the Earthworks Specification. It is noted that higher compaction requirements are likely to be required for the foundation and direct placed fill itself than may be acceptable for the temporary fill stockpile. There is potential for ACM and EOW /UXO to be encountered during topsoil stripping and this will be managed in accordance with the Asbestos in Soil Management Plan and EOW/UXO Management Plan.

The height of areas of direct placed fill is understood to vary, general comments on management of surface water, potential scour, slope stability and protection from fouling with vegetation provided in Section 3.3 apply also to the lower portion of placed fill intended to be left in place permanently.

3.3 Stockpiling of fill

Stockpiles will be placed and compacted in accordance with the Earthworks Specification. Adequate compaction will be required to achieve necessary stability, mitigate against erosion and provide a sufficiently trafficable surface to enable maintenance and inspection. However, compaction requirements for the stockpile material will likely be less than that for permanent fill placement.

Compaction requirements adopted in the Earthworks Specification should be developed in consideration of the intended life of the stockpile (i.e. how long it will be in place) and performance requirements including accessibility. As a preliminary guide, a relative compaction of 90% Standard Maximum Dry Density (SMDD) will likely be acceptable for temporary stockpiles. A higher level of compaction will be considered if proposed batter slope angles or vehicle loading necessitate it. Consideration will also be given to the allowable proximity of plant and equipment to the crest/edge of the temporary stockpile.

The Earthworks Plan, (Drawing No. MCPN-ARC-CV-DWG-0111, Issue 01), provided as Attachment 2, indicates a stockpile height of 6m with batter slopes of 1V:3H. Adequate stability is likely to be readily achievable for an imported sandstone product such as could be produced from the sandstone bedrock shown on the provided borehole logs, when adequately compacted. Maximum batter slope limits should be provided in the Earthworks Specification but would likely be limited to 1V:2H for temporary stockpiles. This steeper slope angle (than the 1V:3H indicated in the provided drawing) should be readily achievable for an adequately compacted sandstone fill. However, it is noted that shallower slopes may be suitable in consideration of potential maintenance and access requirements (particularly so for the base of the stockpile which will be left as a permanent feature).

For heights greater than 4m, benching will be implemented. A bench will also be incorporated at the top of the permanent fill placement such that some flexibility exists in the maximum height of the temporary fill batter above. This may also present an advantage in installation of erosion protection and drainage measures as discussed below. The bench height will be set above finished level for permanent placement, such that "fouling" of the near surface of the bench, during operation of the temporary stockpile, could be addressed by stripping an upper zone (say 1 to 2 lifts up to 500mm) off the zone of the perimeter bench at the time of removal of the overlying stockpile.

To maintain trafficability and manage surface water, the temporary stockpile will be graded and potentially provided with a temporary surfacing in some or all areas dependent on access requirements and usage. The surfacing appropriate will be dependent on the nature of the imported fill adopted and the access and usage requirements of the stockpile. In view of this, surfacing may be restricted to provision of (zones) of spray polymer or durable inert crushed rock (e.g. 'blue metal'). If high quality imported fill is obtained and/or frequent access to and usage of the surface of the stockpile is not required it may not be necessary to provide any surfacing.

The potential for fouling of the upper lifts(s) of the stockpile with vegetation will be addressed in the Earthworks Specification and in consideration of appropriate surfacing. It is noted that, given the large areal extent of the stockpile, unintended spread of vegetation (e.g. grasses) within unprotected surfaces could result in the need for treatment of a large volume of otherwise 'ready to place' material.

If considered appropriate, a grass cover will be established over the lower portion of the fill, intended as permanent placement early on, to manage erosion and surface flow issues associated with the overlying temporary stockpile. A bench at the approximate interface between the permanent and temporary filling (as described above) would also have the advantage of separating these zones with different batter slope protection measures.

Temporary erosion and sediment control measures will be required for the stockpile and will include the installation of crest drains and batter chute drains, as required. These will be detailed within a Sediment and Erosion Control Plan prepared in accordance with the requirements of the Landcom, Soils and Construction, Managing Urban Stormwater Volume 1 4th Edition, March 2004.

The magnitude of surface drainage measures will be developed based upon suitable hydrological assumptions pertinent to the site. The sophistication and durability of the drainage measures will be developed in consideration of the intended life of the stockpile. However, the impact of the surface drainage elements adopted on the permanent fill placement below will also be considered. For example, appropriate frequency of chute drains and what level of energy dissipation might be appropriate. Seeding of a lower permanent batter should provide protection against scour and erosion. Mitigation of the grass spreading into the overlying temporary batter and (potentially fouling the materials) would be aided by physical separation with a bench at the approximate boundary of the permanent fill materials and temporary stockpiles materials and might be addressed by spraying with an acceptable herbicides.

4.0 CONCLUSION

Importation of sandstone fill presents a number of benefits for the management of asbestos contamination, potential UXO/EOW and subgrade performance issues. Management of quality control aspects of the permanent fill and risks associated with temporary stockpiling should be addressed by a site specific earthworks specification (the Earthworks Specification) developed in consideration of the final design layout adopted and operational requirements relating to the stockpiling during construction stage.

Key geotechnical and contamination benefits resulting from the importation of non-expansive sandstone fill meeting the Earthworks Specification requirements are:

- Provision of a more consistent less moisture sensitive working platform
- Provision of a laterally consistent layer for which pavement design can be developed consistently over large areal extents (where appropriate to design loads and operational requirements), with possible economy in pavement design
- Possible economy in pavement design due to potentially higher CBR values being achievable for the imported fill than existing site material (dependent on the actual level of subgrade, resulting from design fill heights and pavement thicknesses)
- Potential improvement of foundation performance via “pre-loading” effect of the temporary stockpile

In summary, impacts on geotechnical considerations within the area of impact associated with the Modification Proposal constitute a small change from those assessed for the Early Works under the MPW Concept Plan EIS, Response to Submissions (RtS) and Supplementary Response to Submissions (SRtS). Through the implementation of the mitigation measures approved for the MPW Concept Plan and the RMCoA, impacts associated with the Modification Proposal are expected to be consistent with the impacts predicted within the MPW Concept Plan EIS.

The recommended mitigation measures include the development and implementation of the following, in accordance with the MPW Concept Plan Approval and supporting documentation:

- *Earthworks Specification*
- *Sediment and Erosion Control Plan*
- *Construction Environmental Management Plan (CEMP)*
- *EOW and UXO Management Plan*
- *Asbestos in Soils Management Plan (AMP); and*
- *Long Term Environmental Management Plan (LTEMP).*

5.0 CLOSURE

We trust this memorandum provides sufficient input to your supporting memorandum as requested. If you have any questions, please do not hesitate to contact the undersigned in our Sydney Office.

Attachments:

Attachment 1 – Borehole Logs provided by client

Attachment 2 – Earthworks Plan, Drawing No. MCPN-ARC-CV-DWG-0111, Issue 01, Arcadis

Nathan Steggles
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Greg Stratton
Principal Environmental Engineer

NRS/GVS:BJF/nrs

Limitations

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This Document has been prepared for the particular purpose outlined in Golder’s proposal and no responsibility is accepted for the use of this Document, in whole or in part, in other contexts or for any other purpose. The current issue of this document is Draft for discussion only and is subject to finalisation which may include alteration of the comments provided herein.

The scope and the period of Golder’s Services are as described in Golder’s proposal, and are subject to restrictions and limitations. Golder did not perform a complete assessment of all possible conditions or circumstances that may exist at the site referenced in the Document. If a service is not expressly indicated, do not assume it has been provided. If a matter is not addressed, do not assume that any determination has been made by Golder in regards to it.

Conditions may exist which were undetectable given the limited nature of the enquiry Golder was retained to undertake with respect to the site. Variations in conditions may occur between investigatory locations, and there may be special conditions pertaining to the site which have not been revealed by the investigation and which have not therefore been taken into account in the Document. Accordingly, additional studies and actions may be required.

In addition, it is recognised that the passage of time affects the information and assessment provided in this Document. Golder’s opinions are based upon information that existed at the time of the production of the Document. It is understood that the Services provided allowed Golder to form no more than an opinion of the actual conditions of the site at the time the site was visited and cannot be used to assess the effect of any subsequent changes in the quality of the site, or its surroundings, or any laws or regulations.

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Where data supplied by the client or other external sources, including previous site investigation data, have been used, it has been assumed that the information is correct unless otherwise stated. No responsibility is accepted by Golder for incomplete or inaccurate data supplied by others.

Golder may have retained subconsultants affiliated with Golder to provide Services for the benefit of Golder. To the maximum extent allowed by law, the Client acknowledges and agrees it will not have any direct legal recourse to, and waives any claim, demand, or cause of action against, Golder’s affiliated companies, and their employees, officers and directors.

Attachment 1 – Borehole Logs



REVISION C REPORT OF BOREHOLE: LDS-BH-1042

SHEET: 2 OF 10 REV: C
 DRILL RIG: Hydrapower Scout
 CONTRACTOR: Hagstrom Drilling Pty Ltd
 LOGGED: MHA/JN DATE: 23/12/15
 CHECKED: GMcN DATE: 8/1/16

CLIENT: CDSJV COORDS: 329653.0 m E 6243541.0 m N MGA94 56
 PROJECT: WestConnex - The New M5 SURFACE RL: 1.4 m DATUM: AHD
 LOCATION: M5 East Motorway INCLINATION: -90°
 JOB NO: 1524285 HOLE DEPTH: 90.00 m

Drilling			Sampling		Field Material Description										
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS	UNIT			
L			10	-8.60			SM	Silty SAND medium to coarse grained, with some clay, with some quartz, fine grained, sub-angular gravel		L - MD					
			11	11.00									CI-CH	CLAY medium to high plasticity	St - VSt
				-9.60											
M			11.30	-9.90			SP	SAND							
L			12							L - MD					
			13												
			14												
			15												
			16												
			17												
			18												
			19												
			20										20.00		

REVISION C

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WB

Quaternary



REVISION C REPORT OF BOREHOLE: LDS-BH-1042

SHEET: 3 OF 10 REV: C
 DRILL RIG: Hydrapower Scout
 CONTRACTOR: Hagstrom Drilling Pty Ltd
 LOGGED: MHA/JN DATE: 23/12/15
 CHECKED: GMcN DATE: 8/1/16

CLIENT: CDSJV
 PROJECT: WestConnex - The New M5
 LOCATION: M5 East Motorway
 JOB NO: 1524285

COORDS: 329653.0 m E 6243541.0 m N MGA94 56
 SURFACE RL: 1.4 m DATUM: AHD
 INCLINATION: -90°
 HOLE DEPTH: 90.00 m

Drilling				Sampling		Field Material Description						
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS	UNIT
WB	▲		20	20.20			Cl-CH	CLAY medium to high plasticity		S - F		
				-18.80			SP-SC	SAND		L - MD		
L			21	21.50			Cl-CH	CLAY medium to high plasticity		S - F		Quaternary
				-20.30			SP-SC	SAND		L - MD		
			22	22.00			Cl-CH	CLAY medium to high plasticity		S - F		
				-20.80			SP	SAND		L - MD		
H			24	24.00			Cl-CH	Sandy CLAY medium to high plasticity, brown, fine grained sand		St - VST		Residual
				-22.60								
			28				For Continuation Refer to Sheet 4					
			29									
			30									

REVISION C

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REVISION C REPORT OF BOREHOLE: LDS-BH-1042

SHEET: 4 OF 10 REV: C
 DRILL RIG: Hydrapower Scout
 CONTRACTOR: Hagstrom Drilling Pty Ltd
 LOGGED: MHA/JN DATE: 23/12/15
 CHECKED: GMcN DATE: 8/1/16

CLIENT: CDSJV COORDS: 329653.0 m E 6243541.0 m N MGA94 56
 PROJECT: WestConnex - The New M5 SURFACE RL: 1.4 m DATUM: AHD
 LOCATION: M5 East Motorway INCLINATION: -90°
 JOB NO: 1524285 HOLE DEPTH: 90.00 m

Drilling					Field Material Description				Defect Information			
METHOD	WATER	TCR	RQD (SCR)	DEPTH (metres)	DEPTH RL	GRAPHIC LOG	ROCK / SOIL MATERIAL DESCRIPTION	WEATHERING	INFERRED STRENGTH $I_{s(50)}$ MPa	DEFECT DESCRIPTION & Additional Observations	AVERAGE DEFECT SPACING (mm)	UNIT
								EL 0.03 VL 0.03 L 0.1 M 0.3 H 1 VH 3 EH 10			10 30 100 300 1000	
				20								
				21								
				22								
				23								
				24								
				25								
				26								
				27								
				28	28.09		Continuation of Sheet 3					
					26.69		SANDSTONE WITH 5% SILTSTONE LAMINATIONS medium to coarse grained, pale grey, indistinctly bedded at 0-20°, slight iron staining on bedding	MW				
				29						28.91 m: B, 7°, Un, Ro, Ct, clayey sand		
										29.41 m: B, 7°, Un, Ro, Cn		
				30	29.95							

REVISION C

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REVISION C REPORT OF BOREHOLE: LDS-BH-1042

SHEET: 5 OF 10 REV: C
 DRILL RIG: Hydrapower Scout
 CONTRACTOR: Hagstrom Drilling Pty Ltd
 LOGGED: MHA/JN DATE: 23/12/15
 CHECKED: GMcN DATE: 8/1/16

CLIENT: CDSJV COORDS: 329653.0 m E 6243541.0 m N MGA94 56
 PROJECT: WestConnex - The New M5 SURFACE RL: 1.4 m DATUM: AHD
 LOCATION: M5 East Motorway INCLINATION: -90°
 JOB NO: 1524285 HOLE DEPTH: 90.00 m

Drilling				Field Material Description				Defect Information				
METHOD	WATER	TCR	RQD (SCR)	DEPTH (metres)	DEPTH RL	GRAPHIC LOG	ROCK / SOIL MATERIAL DESCRIPTION	WEATHERING	INFERRED STRENGTH Is(50) MPa	DEFECT DESCRIPTION & Additional Observations	AVERAGE DEFECT SPACING (mm)	UNIT
									EL 0.03 VL 0.01 L 0.1 M 0.3 H 1 VH 10 EH		10 30 100 300 1000	
			100	85 (90)	30	-28.60	very coarse grained from 29.95 to 32.27m, with some fine grained clasts SANDSTONE WITH 1-5% SILTSTONE LAMINATIONS medium to coarse grained, pale grey, indistinctly bedded at 0-22°	MW		30.72 m: B, 0°, Un, Ro, Cn 30.74 m: B, 17°, Un, Ro, Cn 30.79 m: B, 25°, Un, Ro, Cn 31.25 m: B, 3°, Un, Ro, clayey sand Ct		
					32	32.25 -30.85	fine to medium grained			32.55 m: B, 10°, Un, Ro, clayey sand Ct 32.63 m: DS, 0°, sandy clay, =23 mm 32.95 m: B, 5°, Un, Ro, Cn		
					33	33.41 -32.01	dark brown, with irregularly structured clay seams from 33.41 to 33.55m	EW SW		33.46 m: SZ, high plasticity clay, width = 130 mm, possibly de-cemented		
			100	95 (100)	34					34.57 m: B, 18°, Pl, Ro, Cn 34.94 m: DS, 13°, clayey sand, =12 mm 35.33 m: DS, =50 mm 35.73 m: B, 14°, Pl-Un, Ro, Cn 35.82 m: B, 8°, sand, blue grey Sn, =13 mm		
					36	36.00 -34.60 -34.80	CORE LOSS -200 mm					
					37		SANDSTONE WITH 3% SILTSTONE LAMINATIONS fine to medium grained, pale grey, indistinctly bedded at 0-21°, with trace fine to medium grained clasts	SW		36.38 m: B, 16°, Pl, Ro, Cn 37.26 m: B, 18°, Un, Ro, Cn 37.46 m: B, 7°, Pl, Ro, Cn 37.58 m: J, 33°, =22 mm 37.78 m: B, 0°, Un, Ro, Cn 37.83 m: B, 15°, Un, Ro, clayey sand Ct 37.87 m: DS, 0°, clayey sand, =2 mm		
			95	85 (90)	38							
			100	95 (100)	39							
					40	40.00						

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REVISION C REPORT OF BOREHOLE: LDS-BH-1042

CLIENT: CDSJV
 PROJECT: WestConnex - The New M5
 LOCATION: M5 East Motorway
 JOB NO: 1524285

COORDS: 329653.0 m E 6243541.0 m N MGA94 56
 SURFACE RL: 1.4 m DATUM: AHD
 INCLINATION: -90°
 HOLE DEPTH: 90.00 m

SHEET: 6 OF 10 REV: C
 DRILL RIG: Hydrapower Scout
 CONTRACTOR: Hagstrom Drilling Pty Ltd
 LOGGED: MHA/JN DATE: 23/12/15
 CHECKED: GMcN DATE: 8/1/16

Drilling				Field Material Description				Defect Information				
METHOD	WATER	TCR	RQD (SCR)	DEPTH (metres)	DEPTH RL	GRAPHIC LOG	ROCK / SOIL MATERIAL DESCRIPTION	WEATHERING	INFERRED STRENGTH $I_{s(50)}$ MPa	DEFECT DESCRIPTION & Additional Observations	AVERAGE DEFECT SPACING (mm)	UNIT
									EL 0.03 VL 0.01 J 0.1 M 0.3 H 1 V _H 10 EH		10 30 100 300 1000	
			100	95 (100)	40		SANDSTONE WITH 5% SILTSTONE LAMINATIONS fine to medium grained, pale grey, indistinctly bedded at 0-21°, with trace fine to medium grained clasts	SW - FR				
			100	85 (95)	41					41.50 m: J, 70°, Un, Ro, Cn, =84 mm 41.53 m: DS, 18°, Un, Ro, sand, =5 mm 41.59 m: B, 3°, Un, Ro, sand, =2 mm 41.68 m: J, 7°, Un, Ro, Cn 41.96 m: DS, clayey sand, =80 mm 42.05 m: B, 28°, Pl-Un, Ro, clayey sand Ct		
			100	85 (95)	42					43.16 m: DS, 17°, sand, =18 mm 43.28 m: B, 12°, Un, Ro, sand Ct 43.51 m: J, 59°, =50 mm 43.66 m: B, 10°, Un, Ro, Cn 43.72 m: B, 5°, Un, Ro, Cn		
			100	90 (95)	43					44.10 m: J, 75-90°, Un, Ro, Cn, =202 mm 44.17 m: DS, 12°, gravelly sand		
					44.60		dark grey, clayey	HW		44.80 m: DS, sandy clay, =120 mm, iron stained		
					45.06		SANDSTONE fine to medium grained, massive, pale grey	FR		45.58 m: B, 13°, Un, Ro, Cn		
					45.62		SANDSTONE WITH 1-5% SILTSTONE LAMINATIONS fine to medium grained, pale grey, indistinctly bedded at 0-17°, with trace fine to medium grained clasts			45.85 m: B, 16°, Pl, Ro, clayey sand Vr		
					46.59		increased siltstone laminations from 46.59m to 46.95m			46.70 m: B, 9°, Pl-Un, Ro, clayey silty sand Vr 46.71 m: B, 11°, Un, Ro, clayey sand Vr 46.79 m: DS, 15-0°, Un, Ro, sandy clay		
					47.40		bedding indistinct to massive	HW		47.16 m: B, 9°, Pl, Ro, clayey sand Vr 47.23 m: DS, 25-12°, clayey sand gravel, =80 mm 47.31 m: DS, 0°, clayey sand, =10 mm 47.36 m: J, 0-72°, St, Ro, Cn, =30 mm, possibly drilling induced		
					48			FR		47.91 m: CS, clayey sandy gravel, =70 mm, possible bedding shear		
			100	100 (100)	49					49.41 m: DS, 0°, Pl, sandy clay, =15 mm		
					50							

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REVISION C REPORT OF BOREHOLE: LDS-BH-1042

SHEET: 7 OF 10 REV: C
 DRILL RIG: Hydrapower Scout
 CONTRACTOR: Hagstrom Drilling Pty Ltd
 LOGGED: MHA/JN DATE: 23/12/15
 CHECKED: GMcN DATE: 8/1/16

CLIENT: CDSJV COORDS: 329653.0 m E 6243541.0 m N MGA94 56
 PROJECT: WestConnex - The New M5 SURFACE RL: 1.4 m DATUM: AHD
 LOCATION: M5 East Motorway INCLINATION: -90°
 JOB NO: 1524285 HOLE DEPTH: 90.00 m

Drilling				Field Material Description				Defect Information				
METHOD	WATER	TCR	RQD (SCR)	DEPTH (metres)	DEPTH RL	GRAPHIC LOG	ROCK / SOIL MATERIAL DESCRIPTION	WEATHERING	INFERRED STRENGTH Is(50) MPa	DEFECT DESCRIPTION & Additional Observations	AVERAGE DEFECT SPACING (mm)	UNIT
									EL 0.03 VL 0.01 L 0.1 M 0.3 H 1 VH 10 EH		10 30 100 300 1000	
			100 (100)	50	-48.60	[Dotted pattern]	SANDSTONE WITH 3% SILTSTONE LAMINATIONS fine to medium grained, pale grey, massive to indistinctly bedded at 0-17°	FR				
				51						51.20 m: DS, 15°, Pl, Sl, sand Vr		
				51.48	-50.08	[Dotted pattern]	SANDSTONE fine to medium grained, massive, pale grey, with trace clasts					
			100 (100)	52								
				52.27	-50.87	[Dotted pattern]	SANDSTONE WITH 10% SILTSTONE LAMINATIONS fine to medium grained, pale grey, distinctly bedded at 0-22°					
				53						53.25 m: B, 0°, Pl, Ro, sand Vr		
				54								
				54.06	-52.66	[Dotted pattern]	SANDSTONE WITH SILTSTONE FLECKS fine to medium grained, massive, pale grey					
				55								
			100 (100)	55								
				54.81	-53.41	[Dotted pattern]	SANDSTONE WITH 1% SILTSTONE LAMINATIONS fine to medium grained, pale grey, indistinctly bedded at 0-23°					
				56								
			100 (100)	56				SW				
				56.94	-55.54	[Dotted pattern]	SANDSTONE medium to coarse grained, massive, pale grey	FR				
				57						57.42 m: J, 42°, Un, Ro, Cn		
				57.57	-56.17	[Dotted pattern]	brown staining on sandstone from 57.57m to 57.86m (possibly siderite nodules)	SW				
				58				FR				
			100 (100)	59								
				60						59.85 m: B, 9°, Pl, Ro, sandy silty clay Ct		

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REVISION C REPORT OF BOREHOLE: LDS-BH-1042

SHEET: 8 OF 10 REV: C
 DRILL RIG: Hydrapower Scout
 CONTRACTOR: Hagstrom Drilling Pty Ltd
 LOGGED: MHA/JN DATE: 23/12/15
 CHECKED: GMcN DATE: 8/1/16

CLIENT: CDSJV COORDS: 329653.0 m E 6243541.0 m N MGA94 56
 PROJECT: WestConnex - The New M5 SURFACE RL: 1.4 m DATUM: AHD
 LOCATION: M5 East Motorway INCLINATION: -90°
 JOB NO: 1524285 HOLE DEPTH: 90.00 m

Drilling				Field Material Description				Defect Information				
METHOD	WATER	TCR	RQD (SCR)	DEPTH (metres)	DEPTH RL	GRAPHIC LOG	ROCK / SOIL MATERIAL DESCRIPTION	WEATHERING	INFERRED STRENGTH $I_{s(50)}$ MPa	DEFECT DESCRIPTION & Additional Observations	AVERAGE DEFECT SPACING (mm)	UNIT
									EL 0.03 VL 0.01 L 0.1 M 0.3 H 1 VH 3 EH 10		10 30 100 300 1000	
			100 (100)	60			SANDSTONE medium to coarse grained, massive, pale grey	FR				
				61								
				61.71	-60.31		SANDSTONE WITH 5% SILTSTONE LAMINATIONS fine to medium grained, pale grey, distinctly bedded at 0-27°			61.63 m: B, 23°, Pl, Ro, Cn		
				62								
				62.47	-61.07		SANDSTONE WITH SILTSTONE FLECKS fine to medium grained, massive, pale grey, with trace fine to medium grained clasts and siltstone fragments					
				63								
				63.50	-62.10		63.5 to 63.6 m: minor iron staining					
				63.80	-62.40		63.8 to 63.9 m: iron staining			63.77 m: B, 13°, Pl, Ro, clayey sand Vr		
			100 (100)	64								
				65			siltstone flecks becoming more conspicuous					
				65.00	-63.60					65.92 m: CS, 16°, Pl-St, clayey sandy gravel, =12 mm		
				66								
				67								
			100 (100)	68						67.95 m: B, 14°, Un, Ro, Cn		
				69								
			100 (100)	69.70								
			80 (75)	70	-68.36		CORE LOSS - 60 mm	FR				

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GAP gINT FN. F02a
RL3



REVISION C REPORT OF BOREHOLE: LDS-BH-1042

SHEET: 9 OF 10 REV: C
 DRILL RIG: Hydrapower Scout
 CONTRACTOR: Hagstrom Drilling Pty Ltd
 LOGGED: MHA/JN DATE: 23/12/15
 CHECKED: GMcN DATE: 8/1/16

CLIENT: CDSJV COORDS: 329653.0 m E 6243541.0 m N MGA94 56
 PROJECT: WestConnex - The New M5 SURFACE RL: 1.4 m DATUM: AHD
 LOCATION: M5 East Motorway INCLINATION: -90°
 JOB NO: 1524285 HOLE DEPTH: 90.00 m

Drilling				Field Material Description				Defect Information				
METHOD	WATER	TCR	RQD (SCR)	DEPTH (metres)	DEPTH RL	GRAPHIC LOG	ROCK / SOIL MATERIAL DESCRIPTION	WEATHERING	INFERRED STRENGTH Is(50) MPa	DEFECT DESCRIPTION & Additional Observations	AVERAGE DEFECT SPACING (mm)	UNIT
									EL 0.03 VL 0.01 J 0.1 M 0.3 H 1 V 10 EH		10 30 100 300 1000	
				70			SANDSTONE WITH SILTSTONE FLECKS fine to medium grained, massive, pale grey, with trace fine to medium grained clasts and siltstone fragments	FR				
				70.48				HW		70.35 m: J, 38-90°, Un, Ro, Cn, =175 mm		
				-69.08			CORE LOSS - 400 mm					
				70.88			SANDSTONE WITH SILTSTONE FLECKS fine to medium grained, massive, pale grey, with trace fine to medium grained clasts and siltstone fragments	SW				
		80	25 (75)	-69.48						70.91 m: CS, 0°, clayey sandy gravel 70.94 m: DS, 8°, silty clayey sand, =7 mm 71.09 m: J, 63°, Un, Ro, Cn 71.14 m: B, 0°, Un, Ro, sand Vr 71.31 m: J, 18°, Un, Ro, Cn, =20 mm 71.35 m: B, 9°, Un, Ro, Cn 71.41 m: B, 4°, Un, Ro, sand Cn 71.57 m: J, 34°, Un, Ro, Cn 71.63 m: CS, 3-22°, sandy gravel, =35 mm 71.69 m: B, 23°, Un, Ro, Cn 71.86 m: J, 90°, Un, Ro, Cn, =280 mm		
				71.35			SANDSTONE WITH SILTSTONE LAMINATIONS fine to medium grained, pale grey, indistinctly bedded at 32°					
				-69.95								
				71.70			SANDSTONE WITH SILTSTONE FLECKS fine to medium grained, massive, pale grey, with trace fine to medium grained clasts and siltstone fragments					
				-70.30								
				72.00			CORE LOSS - 360 mm					
				-70.60								
				72.36			SANDSTONE WITH 5% SILTSTONE LAMINATIONS fine to medium grained, pale grey, indistinctly bedded at 0-24°, iron stained adjacent to joints	HW				
				-70.96						72.44 m: J, 80°, Un, Ro, Cn 72.46 m: J, 35°, Un, Ro, Cn 72.50 m: J, 35°, Un, Ro, Cn 72.77 m: DS, 18°, gravelly sand, =4 mm		
		85	30 (85)							72.96 m: J, 59°, Un, Ro, Cn, =40 mm 73.01 m: DS, sandy clay, =50 mm 73.07 m: B, 27°, Un, Ro, Cn 73.13 m: J, 75°, Un, Ro, Cn, =90 mm 73.46 m: B, 29°, Un, Ro, clayey sand Ct 73.61 m: J, 48°, Un, Ro, Cn 73.65 m: B, 15°, Pl, Ro, clayey sand Vr 73.70 m: J, 50°, Un, Ro, Cn 73.72-73.82 m: SZ, Un, Ro, Cn		
				74.26			with fine to medium grained clasts, heavy iron staining below 74.50 m					
				-72.86						74.17 m: J, 56°, Un, Ro, Cn, =56 mm 74.33 m: DS, gravelly sandy clay, =20 mm 74.43 m: B, 21°, Un, Ro, Cn 74.46 m: B, 15°, Un, Ro, Cn 74.50 m: J, 34°, Un, Ro, sand Vr, =35 mm 74.52 m: B, 14°, Un, Ro, Cn 74.74 m: DS, silty clayey gravel, 30 mm		
				74.66			CORE LOSS - 50 mm	HW				
				-73.31				MW				
				75.66			SANDSTONE WITH SILTSTONE LAMINATIONS medium to coarse grained, pale grey, indistinctly bedded at 0-24°, with fine to medium grained clasts, heavily iron stained at top					
				-74.26						75.19 m: B, 24°, Pl, Ro, clayey sand Vr 75.27 m: B, 21°, Un, Ro, clayey sand Vr 75.38 m: J, 69°, Un, Ro, Cn 75.51 m: B, 6°, Un, Ro, clayey gravel Vr 75.65 m: C, 17°, Un, Ro, silty clay Vr 75.70 m: C, 33°, Un, Ro, silty clay Vr		
				75.66			with fine to coarse grained siltstone gravel from 75.66 to 75.75m					
				-74.35				SW				
				76.00			fine to medium grained, no clasts					
		100	60 (100)							76.38 m: SS, 7°, Un, Ro, clayey sand Ct 76.43 m: B, 11°, Un, Ro, clayey sand Vr 76.45 m: B, 7°, Pl, Ro, sandy clay Ct 76.56 m: DS, 12°, gravelly sandy clay, =70 mm, iron stained 76.75 m: B, 10°, Pl, Ro, sandy clay Vr		
				77.22						77.22 m: DS, 0-17°, sandy clay, =15 mm 77.25 m: J, 90°, Pl, Ro, Cn, =60 mm		
				-76.90								
				78.30			medium to coarse grained, with trace fine to medium grained clasts					
				-76.90						77.93 m: B, 19°, Pl, Ro, Cn 77.95 m: B, 13°, Pl, Ro, Cn		
		100	95 (100)							78.30 m: DS, 12°, sandy clay, =10 mm		
				80.00								

GAP 8_10.0 LIB FOR NSW.GLB Log GAP CORED BOREHOLE 1524285 MASTER.GPJ <-DrawingFiles> 04/03/2016 16:14 8:30:04 Datgel Tools

HQ3

Hawkesbury

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GAP gINT FN. F02a
RL3



REVISION C REPORT OF BOREHOLE: LDS-BH-1042

SHEET: 10 OF 10 REV: C
 DRILL RIG: Hydrapower Scout
 CONTRACTOR: Hagstrom Drilling Pty Ltd
 LOGGED: MHA/JN DATE: 23/12/15
 CHECKED: GMcN DATE: 8/1/16

CLIENT: CDSJV COORDS: 329653.0 m E 6243541.0 m N MGA94 56
 PROJECT: WestConnex - The New M5 SURFACE RL: 1.4 m DATUM: AHD
 LOCATION: M5 East Motorway INCLINATION: -90°
 JOB NO: 1524285 HOLE DEPTH: 90.00 m

Drilling				Field Material Description				Defect Information				
METHOD	WATER	TCR	RQD (SCR)	DEPTH (metres)	DEPTH RL	GRAPHIC LOG	ROCK / SOIL MATERIAL DESCRIPTION	WEATHERING	INFERRED STRENGTH $I_{s(50)}$ MPa	DEFECT DESCRIPTION & Additional Observations	AVERAGE DEFECT SPACING (mm)	UNIT
									EL 0.03 VL 0.01 L 0.03 M 0.3 H 3 VH 10 EH		10 30 100 300 1000	
			100 (100)	80	-78.60		SANDSTONE WITH 5-10% SILTSTONE LAMINATIONS medium to coarse grained, pale grey, indistinctly bedded at 0-24°, with trace fine to medium grained clasts	SW - FR				
				81	-80.95		indistinctly bedded at 0-10°					
			100 (100)	82	-82.28		indistinctly bedded at 0-24°, becoming very coarse grained, with 5-10% fine quartz gravel			82.08 m: B, 8°, Un, Ro, Cn		
				83	-80.88							
				84								
			100 (100)	85	-85.51		fine to medium grained, with trace medium to coarse grained siltstone gravel			84.49 m: J, 61°, Pl, Ro, Cn, =100 mm 84.78 m: B, 11°, Un, Ro, Cn		
				86	-84.11					85.33 m: J, 63°, Pl-Un, Ro, Cn, =115 mm 85.49 m: C, 7°, Un, Ro, Cn 85.51 m: C, 5°, Un, Ro, Cn 85.71 m: B, 6°, Pl, Ro, Cn 85.86 m: CS, 26°, sandy clayey gravel, =68 mm		
				87	-86.56		SANDSTONE WITH SILTSTONE FLECKS fine to medium grained, massive, pale grey	FR		86.22 m: CS, 0-15°, Pl-Un, Ro, sandy clayey gravel		
				88	-85.16							
			100 (100)	89	-87.07		SANDSTONE WITH 20-30% SILTSTONE LAMINATIONS medium grained, pale grey, distinctly bedded at 0-13°, with trace fine to medium grained clasts			88.04 m: B, 18°, Un, Ro, Cn		
				90	-85.67							
				90	-90.00		END OF BOREHOLE @ 90.00 m TARGET DEPTH GROUNDWATER NOT OBSERVED GROUTED					

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REVISION C REPORT OF CORE PHOTOGRAPHS: LDS-BH-1042

SHEET: 1 OF 8 REV: C
 DRILL RIG: Hydrapower Scout
 CONTRACTOR: Hagstrom Drilling Pty Ltd
 LOGGED: MHA/JN DATE: 23/12/15
 CHECKED: GMcN DATE: 8/1/16

CLIENT: CDSJV
 PROJECT: WestConnex - The New M5
 LOCATION: M5 East Motorway
 JOB NO: 1524285

COORDS: 329653.0 m E 6243541.0 m N MGA94 56
 SURFACE RL: 1.4 m DATUM: AHD
 INCLINATION: -90°
 HOLE DEPTH: 90.00 m



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CLIENT: CDSJV COORDS: 329653.0 m E 6243541.0 m N MGA94 56
 PROJECT: WestConnex - The New M5 SURFACE RL: 1.4 m DATUM: AHD
 LOCATION: M5 East Motorway INCLINATION: -90°
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REVISION C REPORT OF CORE PHOTOGRAPHS: LDS-BH-1042

SHEET: 3 OF 8 REV: C
 DRILL RIG: Hydrapower Scout
 CONTRACTOR: Hagstrom Drilling Pty Ltd
 LOGGED: MHA/JN DATE: 23/12/15
 CHECKED: GMcN DATE: 8/1/16

CLIENT: CDSJV
 PROJECT: WestConnex - The New M5
 LOCATION: M5 East Motorway
 JOB NO: 1524285

COORDS: 329653.0 m E 6243541.0 m N MGA94 56
 SURFACE RL: 1.4 m DATUM: AHD
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CLIENT: CDSJV COORDS: 329653.0 m E 6243541.0 m N MGA94 56
 PROJECT: WestConnex - The New M5 SURFACE RL: 1.4 m DATUM: AHD
 LOCATION: M5 East Motorway INCLINATION: -90°
 JOB NO: 1524285 HOLE DEPTH: 90.00 m



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REVISION C REPORT OF CORE PHOTOGRAPHS: LDS-BH-1042

SHEET: 5 OF 8 REV: C
 DRILL RIG: Hydrapower Scout
 CONTRACTOR: Hagstrom Drilling Pty Ltd
 LOGGED: MHA/JN DATE: 23/12/15
 CHECKED: GMcN DATE: 8/1/16

CLIENT: CDSJV
 PROJECT: WestConnex - The New M5
 LOCATION: M5 East Motorway
 JOB NO: 1524285

COORDS: 329653.0 m E 6243541.0 m N MGA94 56
 SURFACE RL: 1.4 m DATUM: AHD
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CLIENT: CDSJV COORDS: 329653.0 m E 6243541.0 m N MGA94 56
 PROJECT: WestConnex - The New M5 SURFACE RL: 1.4 m DATUM: AHD
 LOCATION: M5 East Motorway INCLINATION: -90°
 JOB NO: 1524285 HOLE DEPTH: 90.00 m


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REVISION C REPORT OF CORE PHOTOGRAPHS: LDS-BH-1042

SHEET: 7 OF 8 REV: C
 DRILL RIG: Hydrapower Scout
 CONTRACTOR: Hagstrom Drilling Pty Ltd
 LOGGED: MHA/JN DATE: 23/12/15
 CHECKED: GMcN DATE: 8/1/16

CLIENT: CDSJV COORDS: 329653.0 m E 6243541.0 m N MGA94 56
 PROJECT: WestConnex - The New M5 SURFACE RL: 1.4 m DATUM: AHD
 LOCATION: M5 East Motorway INCLINATION: -90°
 JOB NO: 1524285 HOLE DEPTH: 90.00 m



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REVISION C REPORT OF CORE PHOTOGRAPHS: LDS-BH-1042

SHEET: 8 OF 8 REV: C
DRILL RIG: Hydrapower Scout
CONTRACTOR: Hagstrom Drilling Pty Ltd
LOGGED: MHA/JN DATE: 23/12/15
CHECKED: GMcN DATE: 8/1/16

CLIENT: CDSJV COORDS: 329653.0 m E 6243541.0 m N MGA94 56
PROJECT: WestConnex - The New M5 SURFACE RL: 1.4 m DATUM: AHD
LOCATION: M5 East Motorway INCLINATION: -90°
JOB NO: 1524285 HOLE DEPTH: 90.00 m



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REVISION C REPORT OF BOREHOLE: LDS-BH-1050

SHEET: 1 OF 10 REV: C
 DRILL RIG: Hydropower
 CONTRACTOR: Hagstrom Drilling Pty Ltd
 LOGGED: MBB DATE: 7/1/16
 CHECKED: GMcN DATE: 20/1/16

CLIENT: CDSJV
 PROJECT: WestConnex - The New M5
 LOCATION: M5 East Motorway
 JOB NO: 1524285

COORDS: 329791.2 m E 6243654.9 m N MGA94 56
 SURFACE RL: 1.7 m DATUM: AHD
 INCLINATION: -90°
 HOLE DEPTH: 87.00 m

Drilling			Sampling		Field Material Description									
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY	DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS	UNIT	
HA	L-M		0	1.73			CI	TOPSOIL: CLAY medium plasticity, dark brown		S			Fill	
				0.20			CH	FILL: Sandy CLAY high plasticity, orange red, fine to medium grained, sub-angular sand		F				
				1.53			SM	FILL: Silty SAND medium grained, sub-rounded, dark grey, trace silt		M				
				0.60			SP	FILL: Gravelly SAND medium grained, dark grey, trace sub-rounded gravel		L				
				1.13			SP	FILL: SAND medium grained, sub-rounded to sub-angular, pale grey		L				
				1.10		SPT 1.50-1.95 m 2, 3, 3 N=6		SP	SAND medium grained, sub-rounded, pale brown, trace sub-angular gravel, with some shell fragments		L			
				0.63										
				1.30										
				0.43										
				1.50										
L			2	0.23									Quaternary	
				1.75										
				-0.02										
			3	3.00		SPT 3.00-3.45 m HW/450mm								
WB			4	-1.27									Quaternary	
				4.50										
				-2.77		SPT 4.50-4.95 m 5, 10, 15 N=25								
M			5										Quaternary	
				6		SPT 6.00-6.45 m 12, 15, 13 N=28								
L			7										Quaternary	
				7.70		SPT 7.50-7.95 m 2, 1, 2 N=3								
				-5.97			SC	Clayey SAND fine to medium grained, dark grey, low plasticity clay		L				
L			8										Quaternary	
				9.30		U75 9.00-9.40 m PP = 50 kPa								
			9	-7.57			CH	Sandy CLAY high plasticity, pale grey, fine to medium grained sand		F				
			10											

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REVISION C REPORT OF BOREHOLE: LDS-BH-1050

SHEET: 2 OF 10 REV: C
 DRILL RIG: Hydropower
 CONTRACTOR: Hagstrom Drilling Pty Ltd
 LOGGED: MBB DATE: 7/1/16
 CHECKED: GMcN DATE: 20/1/16

CLIENT: CDSJV
 PROJECT: WestConnex - The New M5
 LOCATION: M5 East Motorway
 JOB NO: 1524285

COORDS: 329791.2 m E 6243654.9 m N MGA94 56
 SURFACE RL: 1.7 m DATUM: AHD
 INCLINATION: -90°
 HOLE DEPTH: 87.00 m

Drilling			Sampling		Field Material Description							
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS	UNIT	
M			10				CH	Sandy CLAY high plasticity, pale grey, fine to medium grained sand				
					SPT 10.50-10.95 m 3, 5, 12 N=17							
					U75 11.00-11.40 m				VSt	Casing dropped @ 10.80 m		
			12	12.00 -10.27	SPT 12.00-12.45 m 2, 3, 8 N=11			dark grey to black	St	Organic material throughout, peat inferred		
				12.35 -10.62			SC	Clayey SAND medium to coarse grained, sub-rounded to sub-angular, pale grey, with dark grey to black clay nodules				
				13					MD			
					SPT 13.50-13.95 m 3, 4, 4 N=8							
				14	13.89 -12.16			ML	Interbedded Clayey SILT and SAND medium plasticity, dark grey to black, clayey silt with trace fine grained gravel/charcoal, medium to coarse grained, sub-rounded, pale grey sand	F		
					14.50 -12.77			SP	SAND medium to coarse grained, sub-rounded, pale grey	L		
				15	15.00 -13.27	SPT 15.00-15.45 m 0, 0, 9 N=9		CH	Interbedded CLAY and SAND high plasticity, grey, medium to coarse grained sand, apel grey	St		
M					SPT 16.50-16.95 m 9, 15, 18 N=33				H			
			17	17.00 -15.27			SW	SAND medium to coarse grained, sub-rounded, pale grey				
					SPT 18.00-18.45 m 2, 1, 6 N=7				L			
					SPT 19.50-19.95 m 1, 2, 11 N=13				MD			

Quaternary

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REVISION C REPORT OF BOREHOLE: LDS-BH-1050

SHEET: 3 OF 10 REV: C
 DRILL RIG: Hydropower
 CONTRACTOR: Hagstrom Drilling Pty Ltd
 LOGGED: MBB DATE: 7/1/16
 CHECKED: GMcN DATE: 20/1/16

CLIENT: CDSJV COORDS: 329791.2 m E 6243654.9 m N MGA94 56
 PROJECT: WestConnex - The New M5 SURFACE RL: 1.7 m DATUM: AHD
 LOCATION: M5 East Motorway INCLINATION: -90°
 JOB NO: 1524285 HOLE DEPTH: 87.00 m

Drilling			Sampling		Field Material Description								
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS	UNIT	
L			20.20	-18.47			SW	SAND medium to coarse grained, sub-rounded, pale grey coarse grained					
	M		21.20	-19.47	SPT 21.00-21.45 m 5, 3, 6 N=9 U75 21.45-21.85 m PP = 250 kPa		CH	CLAY high plasticity, brown-grey, with some fine to medium grained sand, with some black silts (possibly peat bands)					
			22.50	-20.77	SPT 22.50-22.95 m 3, 6, 8 N=14 U75 22.95-23.35 m PP = 300 kPa		CL	Sandy CLAY low plasticity, brown grey, fine to medium grained sand			VSt		
	H		23.55	-21.82			SP	SAND medium to coarse grained, rounded to sub-angular, grey.				Only pushed 0.19 m due to ground being too hard to continue for SPT	
			24.00	-24.45	SPT 24.00-24.45 m 9, 10, 13 N=23								
			25.50	-25.95	SPT 25.50-25.95 m 8, 11, 14 N=25								
		27.45	-25.72	SPT 27.00-27.45 m 9, 13, 9 N=22		CL	Sandy CLAY low plasticity, pale grey, fine to medium grained sand, trace coarse grained sub-angular gravel						
		28.50	-28.95	SPT 28.50-28.95 m 8, 16, 22 N=38		SP	SAND coarse grained, rounded to sub-angular, grey, trace clay, with some coarse grained gravel						

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WB

Quaternary

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REVISION C REPORT OF BOREHOLE: LDS-BH-1050

SHEET: 4 OF 10 REV: C
 DRILL RIG: Hydropower
 CONTRACTOR: Hagstrom Drilling Pty Ltd
 LOGGED: MBB DATE: 7/1/16
 CHECKED: GMcN DATE: 20/1/16

CLIENT: CDSJV
 PROJECT: WestConnex - The New M5
 LOCATION: M5 East Motorway
 JOB NO: 1524285

COORDS: 329791.2 m E 6243654.9 m N MGA94 56
 SURFACE RL: 1.7 m DATUM: AHD
 INCLINATION: -90°
 HOLE DEPTH: 87.00 m

Drilling			Sampling			Field Material Description							
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS	UNIT	
WB	H		30		SPT 30.00-30.17 m 10, 34/20mm N>34		SP	SAND coarse grained, rounded to sub-angular, grey, trace clay, with some coarse grained gravel			Refusal of SPT in second interval	Quaternary	
			31		SPT 31.50-31.95 m 7, 8, 10 N=18				VD				
			32	31.88 -30.15			SPT 33.00-33.45 m 13, 9, 8 N=17	SM	Silty SAND fine to medium grained, rounded to sub-rounded, dark grey-black				Groundwater flowing under pressure
			33							MD			
			34	34.00 -32.27			SPT 34.50-34.95 m 5, 11, 9 N=20	CI	CLAY medium plasticity, dark grey, with some medium grained sand				
H	M		35		SPT 36.00-36.45 m 9, 12, 14 N=26					VST			
			36										
			37	37.00 -35.27		SPT 37.50-37.80 m 30 N=R	SP	SAND fine to medium grained, rounded, pale grey			VD		
			38										
			39										
			40										

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REVISION C REPORT OF BOREHOLE: LDS-BH-1050

SHEET: 5 OF 10 REV: C
 DRILL RIG: Hydropower
 CONTRACTOR: Hagstrom Drilling Pty Ltd
 LOGGED: MBB DATE: 7/1/16
 CHECKED: GMcN DATE: 20/1/16

CLIENT: CDSJV COORDS: 329791.2 m E 6243654.9 m N MGA94 56
 PROJECT: WestConnex - The New M5 SURFACE RL: 1.7 m DATUM: AHD
 LOCATION: M5 East Motorway INCLINATION: -90°
 JOB NO: 1524285 HOLE DEPTH: 87.00 m

Drilling					Field Material Description					Defect Information				
METHOD	WATER	TCR	RQD (SCR)	DEPTH (metres)	DEPTH RL	GRAPHIC LOG	ROCK / SOIL MATERIAL DESCRIPTION	WEATHERING	INFERRED STRENGTH $I_{s(50)}$ MPa	DEFECT DESCRIPTION & Additional Observations	AVERAGE DEFECT SPACING (mm)	UNIT		
											10 30 100 300 1000			
				30										
				31										
				32										
				33										
				34										
				35										
				36										
				37										
				38	38.00 -36.27		Continuation of Sheet 4 SANDSTONE fine to medium grained, yellow-brown, rounded, with some clays in bands, very dense	EW HW		38.24 m: DS, 8°, Un, Ro, Cn, 50 mm		Residual		
		100	95 (100)	39	39.00 -37.27		SANDSTONE medium grained, massive, pale grey, indistinct laminations dip 5-10°, trace lithic fragments	SW		38.90 m: B, 9°, Un, Ro, clay Ct		Hawkesbury		
		100	95 (100)	40	40.00					39.87 m: B, 10°, Un, Sm, clay Ct				

REVISION C

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REVISION C REPORT OF BOREHOLE: LDS-BH-1050

SHEET: 6 OF 10 REV: C

CLIENT: CDSJV
 PROJECT: WestConnex - The New M5
 LOCATION: M5 East Motorway
 JOB NO: 1524285

COORDS: 329791.2 m E 6243654.9 m N MGA94 56
 SURFACE RL: 1.7 m DATUM: AHD
 INCLINATION: -90°
 HOLE DEPTH: 87.00 m

DRILL RIG: Hydropower
 CONTRACTOR: Hagstrom Drilling Pty Ltd
 LOGGED: MBB DATE: 7/1/16
 CHECKED: GMcN DATE: 20/1/16

Drilling				Field Material Description				Defect Information					
METHOD	WATER	TCR	RQD (SCR)	DEPTH (metres)	DEPTH RL	GRAPHIC LOG	ROCK / SOIL MATERIAL DESCRIPTION	WEATHERING	INFERRED STRENGTH $I_{s(50)}$ MPa	DEFECT DESCRIPTION & Additional Observations	AVERAGE DEFECT SPACING (mm)	UNIT	
									EL 0.03 VL 0.01 J 0.1 M 0.3 H 1 VH 10 EH		10 30 100 300 1000		
				40	-38.27	[Dotted pattern]	SANDSTONE WITH 10% CARBONACEOUS LENSES	SW		40.14 m: DS, 3°, Pl, clay, 20 mm			
				40.25	-38.52		SANDSTONE WITH 10-15% SILTSTONE LAMINATIONS						
				41			medium grained, pale grey, 5-7° bedding				41.09 m: B, 8°, Pl, Ro, Cn		
			100	95 (100)			medium grained, pale grey, 5-20° bedding dip, minor iron staining			41.75 m: B, 5°, Pl, Ro, sandy clay Ct			
				42	42.32	[Dotted pattern]	SANDSTONE			42.30 m: CZ, 12°, Pl, Vr, silcrete			
				42.59	-40.59		medium to coarse grained, massive, red-grey, iron stained				42.67 m: B, 8°, St, Ro, carbonaceous material Ct		
				42.54	-40.81		SANDSTONE WITH 15% CARBONACEOUS LAMINATIONS						
				43			medium grained, grey, 10° dip, minor carbonaceous flecks				43.45 m: B, 10°, Pl, Ro, sandy clay Ct		
			100	95 (100)									
				44	44.49	[Dotted pattern]	SANDSTONE WITH 15-20% SILTSTONE LAMINATIONS			44.75 m: B, 20°, Pl, Ro, clayey sand Ct			
				45	-42.76		medium grained, grey, 10° dip				45.37 m: B, 20°, Pl, Ro, clay Ct		
				46	46.00	[Dotted pattern]	SANDSTONE WITH 5% SILTSTONE LAMINATIONS			45.52 m: B, 5°, Pl, Ro, Cn			
				46	-44.27		medium grained, grey, 10° dip, planar bedding						
			100	95 (100)									
				47									
				48	48.00	[Dotted pattern]	SANDSTONE WITH 30% SILTSTONE LAMINATIONS			48.56 m: B, 10°, Pl, Ro, Cn			
				48	-46.27		medium grained, grey, 8° dip				48.82 m: B, 3°, Pl, Ro, Cn		
				48	48.32		LAMINITE						
				49	-46.63		SANDSTONE WITH 10-15% SILTSTONE LAMINATIONS			49.17-49.25 m: SZ, Pl-Un, intact sand infill			
			100	90 (100)			medium grained, grey, 8° dip, distinct cross bedding, 5% carbonaceous laminations			49.17 m: J, 10°, Pl, Ro, Cn			
				50						49.17-49.25 m: SZ, Pl-Un, intact sand infill			
								FR		49.30 m: B, 6°, Pl, Ro, Cn			

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REVISION C REPORT OF BOREHOLE: LDS-BH-1050

SHEET: 7 OF 10 REV: C
 DRILL RIG: Hydropower
 CONTRACTOR: Hagstrom Drilling Pty Ltd
 LOGGED: MBB DATE: 7/1/16
 CHECKED: GMcN DATE: 20/1/16

CLIENT: CDSJV COORDS: 329791.2 m E 6243654.9 m N MGA94 56
 PROJECT: WestConnex - The New M5 SURFACE RL: 1.7 m DATUM: AHD
 LOCATION: M5 East Motorway INCLINATION: -90°
 JOB NO: 1524285 HOLE DEPTH: 87.00 m

Drilling					Field Material Description				Defect Information			
METHOD	WATER	TCR	RQD (SCR)	DEPTH (metres)	DEPTH RL	GRAPHIC LOG	ROCK / SOIL MATERIAL DESCRIPTION	WEATHERING	INFERRED STRENGTH $I_{s(50)}$ MPa	DEFECT DESCRIPTION & Additional Observations	AVERAGE DEFECT SPACING (mm)	UNIT
											10 30 100 300 1000	
			100 (100)	50			SANDSTONE WITH 10-15% SILTSTONE LAMINATIONS medium grained, grey, 8° dip, distinct cross bedding, 5% carbonaceous laminations	FR		49.93 m: B, 6°, Pl, Sm, clay Ct		
				51						51.42 m: B, 3°, Pl, Ro, clay Ct		
			100 (100)	52						52.48 m: B, 7°, Pl, Ro, Cn		
				53						53.06 m: B, 10°, Pl, Ro, Cn 53.15 m: J, 30°, St, Ro, Cn 53.29 m: B, 10°, Pl, Sm, Cn, iron stained 53.39 m: SS, 60°, Pl, Ro, Ct		
				54								
			100 (100)	55								
				56						56.08 m: B, 6°, Pl, Ro, Cn 56.20 m: B, 4°, Pl, Ro, Cn		
				57						56.53 m: B, 7°, Pl, Ro, Cn		
				57.07								
				55.34			40% siltstone laminations			57.10 m: B, 8°, Pl, Ro, clayey sand Ct		
				55.42			10-15% siltstone cross laminations			57.26 m: B, 5°, Pl, Ro, clayey sand Ct		
				58								
			100 (100)	59			SANDSTONE medium grained, massive, grey					
				58.38								
				56.65								
				60			SANDSTONE WITH 20-25% SILTSTONE LAMINATIONS medium grained, grey, cross bedding, 10° dip					
				59.34								
				57.61								
				60.00								

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REVISION C REPORT OF BOREHOLE: LDS-BH-1050

SHEET: 8 OF 10 REV: C
 DRILL RIG: Hydropower
 CONTRACTOR: Hagstrom Drilling Pty Ltd
 LOGGED: MBB DATE: 7/1/16
 CHECKED: GMcN DATE: 20/1/16

CLIENT: CDSJV COORDS: 329791.2 m E 6243654.9 m N MGA94 56
 PROJECT: WestConnex - The New M5 SURFACE RL: 1.7 m DATUM: AHD
 LOCATION: M5 East Motorway INCLINATION: -90°
 JOB NO: 1524285 HOLE DEPTH: 87.00 m

Drilling				Field Material Description				Defect Information				
METHOD	WATER	TCR	RQD (SCR)	DEPTH (metres)	DEPTH RL	GRAPHIC LOG	ROCK / SOIL MATERIAL DESCRIPTION	WEATHERING	INFERRED STRENGTH $I_{s(50)}$ MPa	DEFECT DESCRIPTION & Additional Observations	AVERAGE DEFECT SPACING (mm)	UNIT
											10 30 100 300 1000	
				60	-58.27		SANDSTONE medium grained, massive, grey, bedding indistinct, dips 0-20°, with trace siltstone lenses	FR				
			100 (100)	61								
				62								
				63								
				64								
			100 (100)	65								
				66								
				66.14	-64.41		SANDSTONE WITH 10% SILTSTONE LAMINATIONS fine to medium grained, pale grey, cross bedding 10°			66.24 m: B, 5°, Pl, Ro, Cn		
				66.46	-64.73		SANDSTONE medium to coarse grained, massive, grey					
				67								
				68								
				68.20	-66.47		becoming indistinctly laminated, dip 0-10°			68.42 m: B, 5°, Pl, Ro, Cn 68.55 m: B, 18°, Pl, Ro, Cn 68.63 m: J, 21°, Pl, Ro, Cn		
				68.86	-67.13		CONGLOMERATE coarse grained, massive, grey, poorly sorted, with sub-rounded quartz and lithics to 5 mm			68.97 m: J, 50°, St, Ro, Cn		
				69.24	-67.51		CONGLOMERATIC SANDSTONE medium grained, pale and dark grey			69.24-69.38 m: CZ, 6°, Un, Sm, clay Ct		
			100 (100)	69.46	-67.73		SILTSTONE fine grained, dark grey, thinly laminated			69.41 m: B, 2°, Pl, Ro, Cn 69.56 m: B, 5°, Pl, Ro, Cn 69.65 m: J, 20°, Pl, Sm, Cn		
				70	70.00							

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REVISION C REPORT OF BOREHOLE: LDS-BH-1050

SHEET: 9 OF 10 REV: C
 DRILL RIG: Hydropower
 CONTRACTOR: Hagstrom Drilling Pty Ltd
 LOGGED: MBB DATE: 7/1/16
 CHECKED: GMcN DATE: 20/1/16

CLIENT: CDSJV COORDS: 329791.2 m E 6243654.9 m N MGA94 56
 PROJECT: WestConnex - The New M5 SURFACE RL: 1.7 m DATUM: AHD
 LOCATION: M5 East Motorway INCLINATION: -90°
 JOB NO: 1524285 HOLE DEPTH: 87.00 m

Drilling				Field Material Description				Defect Information				
METHOD	WATER	TCR	RQD (SCR)	DEPTH (metres)	DEPTH RL	GRAPHIC LOG	ROCK / SOIL MATERIAL DESCRIPTION	WEATHERING	INFERRED STRENGTH $I_s(50)$ MPa	DEFECT DESCRIPTION & Additional Observations	AVERAGE DEFECT SPACING (mm)	UNIT
											10 30 100 300 1000	
			100	85 (100)	70		SANDSTONE WITH 10% SILTSTONE FLECKS medium grained, massive, pale grey, sparse laminations, dip 0-10°	FR		69.93 m: B, 2°, Pl, Sm, Cn		
					71							
					72		becoming darker grey					
			100	100 (100)	73		SANDSTONE WITH 25% CARBONACEOUS FLECKS coarse grained, massive, pale grey SANDSTONE medium grained, massive, pale grey					
					74							
					75							
			100	100 (100)	76		SANDSTONE WITH 15-20% SILTSTONE LAMINATIONS medium to coarse grained, grey, cross bedded, 0-30° dip			76.84 m: B, 2°, Pl, Sm, clay Ct		
					77							
			100	100 (100)	78							
					79					78.91 m: J, 68°, Pl, Ro, Cn 79.15 m: B, 40°, Pl, Ro, clay Ct		
					80		5-10% siltstone laminations					

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REVISION C REPORT OF BOREHOLE: LDS-BH-1050

SHEET: 10 OF 10 REV: C
 DRILL RIG: Hydropower
 CONTRACTOR: Hagstrom Drilling Pty Ltd
 LOGGED: MBB DATE: 7/1/16
 CHECKED: GMcN DATE: 20/1/16

CLIENT: CDSJV COORDS: 329791.2 m E 6243654.9 m N MGA94 56
 PROJECT: WestConnex - The New M5 SURFACE RL: 1.7 m DATUM: AHD
 LOCATION: M5 East Motorway INCLINATION: -90°
 JOB NO: 1524285 HOLE DEPTH: 87.00 m

Drilling					Field Material Description					Defect Information				
METHOD	WATER	TCR	RQD (SCR)	DEPTH (metres)	DEPTH RL	GRAPHIC LOG	ROCK / SOIL MATERIAL DESCRIPTION	WEATHERING	INFERRED STRENGTH Is(50) MPa	DEFECT DESCRIPTION & Additional Observations		AVERAGE DEFECT SPACING (mm)		UNIT
			100	100 (100)	80		SANDSTONE WITH 15-20% SILTSTONE LAMINATIONS medium to coarse grained, grey, cross bedded, 0-30° dip	FR						
			100	100 (100)	81									
			100	100 (100)	82						81.71 m: B, 10°, St, Ro, Cn 81.80 m: B, 2°, Un, Ro, carbonaceous material Vr			
					83									
					83.66									
					-81.93		SANDSTONE WITH 5% CARBONACEOUS LAMINATIONS coarse grained, pale grey, 15° dip, planar, with trace siltstone fragments							
					84									
					84.71									
					-82.98		SANDSTONE WITH 10% SILTSTONE LAMINATIONS medium to coarse grained, grey, 10° dip, cross-bedded				84.58 m: B, 12°, Pl, Ro, Cn 84.95 m: B, 5°, Pl, Ro, Cn			
					85									
					85.31									
			100	85 (100)	-83.58		SANDSTONE WITH 5% SILTSTONE FLECKS medium grained, massive, grey, sparse laminations dip 5-20°							
					86									
					85.97						85.97 m: B, 15°, Pl, Ro, clay Ct			
					87									
					87.00									
					-85.27		END OF BOREHOLE @ 87.00 m TARGET DEPTH GROUNDWATER NOT OBSERVED GROUTED TELEVIEWER IMAGING COMPLETED DOWNHOLE GEOPHYSICS COMPLETED							
					88									
					89									
					90									

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REVISION C REPORT OF CORE PHOTOGRAPHS: LDS-BH-1050

SHEET: 1 OF 7 REV: C
 DRILL RIG: Hydropower
 CONTRACTOR: Hagstrom Drilling Pty Ltd
 LOGGED: MBB DATE: 7/1/16
 CHECKED: GMcN DATE: 20/1/16

CLIENT: CDSJV COORDS: 329791.2 m E 6243654.9 m N MGA94 56
 PROJECT: WestConnex - The New M5 SURFACE RL: 1.7 m DATUM: AHD
 LOCATION: M5 East Motorway INCLINATION: -90°
 JOB NO: 1524285 HOLE DEPTH: 87.00 m



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REVISION C REPORT OF CORE PHOTOGRAPHS: LDS-BH-1050

SHEET: 2 OF 7 REV: C
 DRILL RIG: Hydropower
 CONTRACTOR: Hagstrom Drilling Pty Ltd
 LOGGED: MBB DATE: 7/1/16
 CHECKED: GMcN DATE: 20/1/16

CLIENT: CDSJV COORDS: 329791.2 m E 6243654.9 m N MGA94 56
 PROJECT: WestConnex - The New M5 SURFACE RL: 1.7 m DATUM: AHD
 LOCATION: M5 East Motorway INCLINATION: -90°
 JOB NO: 1524285 HOLE DEPTH: 87.00 m



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REVISION C REPORT OF CORE PHOTOGRAPHS: LDS-BH-1050

SHEET: 3 OF 7 REV: C
 DRILL RIG: Hydropower
 CONTRACTOR: Hagstrom Drilling Pty Ltd
 LOGGED: MBB DATE: 7/1/16
 CHECKED: GMcN DATE: 20/1/16

CLIENT: CDSJV COORDS: 329791.2 m E 6243654.9 m N MGA94 56
 PROJECT: WestConnex - The New M5 SURFACE RL: 1.7 m DATUM: AHD
 LOCATION: M5 East Motorway INCLINATION: -90°
 JOB NO: 1524285 HOLE DEPTH: 87.00 m



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REVISION C REPORT OF CORE PHOTOGRAPHS: LDS-BH-1050

CLIENT: CDSJV
 PROJECT: WestConnex - The New M5
 LOCATION: M5 East Motorway
 JOB NO: 1524285

COORDS: 329791.2 m E 6243654.9 m N MGA94 56
 SURFACE RL: 1.7 m DATUM: AHD
 INCLINATION: -90°
 HOLE DEPTH: 87.00 m

SHEET: 4 OF 7 REV: C
 DRILL RIG: Hydropower
 CONTRACTOR: Hagstrom Drilling Pty Ltd
 LOGGED: MBB DATE: 7/1/16
 CHECKED: GMcN DATE: 20/1/16



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REVISION C REPORT OF CORE PHOTOGRAPHS: LDS-BH-1050

SHEET: 5 OF 7 REV: C
 DRILL RIG: Hydropower
 CONTRACTOR: Hagstrom Drilling Pty Ltd
 LOGGED: MBB DATE: 7/1/16
 CHECKED: GMcN DATE: 20/1/16

CLIENT: CDSJV
 PROJECT: WestConnex - The New M5
 LOCATION: M5 East Motorway
 JOB NO: 1524285

COORDS: 329791.2 m E 6243654.9 m N MGA94 56
 SURFACE RL: 1.7 m DATUM: AHD
 INCLINATION: -90°
 HOLE DEPTH: 87.00 m



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REVISION C REPORT OF CORE PHOTOGRAPHS: LDS-BH-1050

SHEET: 6 OF 7 REV: C
 DRILL RIG: Hydropower
 CONTRACTOR: Hagstrom Drilling Pty Ltd
 LOGGED: MBB DATE: 7/1/16
 CHECKED: GMcN DATE: 20/1/16

CLIENT: CDSJV COORDS: 329791.2 m E 6243654.9 m N MGA94 56
 PROJECT: WestConnex - The New M5 SURFACE RL: 1.7 m DATUM: AHD
 LOCATION: M5 East Motorway INCLINATION: -90°
 JOB NO: 1524285 HOLE DEPTH: 87.00 m



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REVISION C REPORT OF CORE PHOTOGRAPHS: LDS-BH-1050

SHEET: 7 OF 7 REV: C
 DRILL RIG: Hydropower
 CONTRACTOR: Hagstrom Drilling Pty Ltd
 LOGGED: MBB DATE: 7/1/16
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CLIENT: CDSJV COORDS: 329791.2 m E 6243654.9 m N MGA94 56
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 JOB NO: 1524285 HOLE DEPTH: 87.00 m



GAP 8_10.0 LIB FOR NSW.GLB Grfctbl GAP CORE PHOTO 2 PER PAGE 1524285 MASTER.GPJ <<DrawingFile>> 04/03/2016 16:25 8.30.004 Datgel Tools

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GAP gINT FN. F28
RL1

Attachment 2 – Drawing No. MCPN-ARC-CV-DWG-0111, Issue 01, Arcadis



LEGEND

EXTENT OF WORK FOR APPROVALS

NOTES

FILL VOLUMES

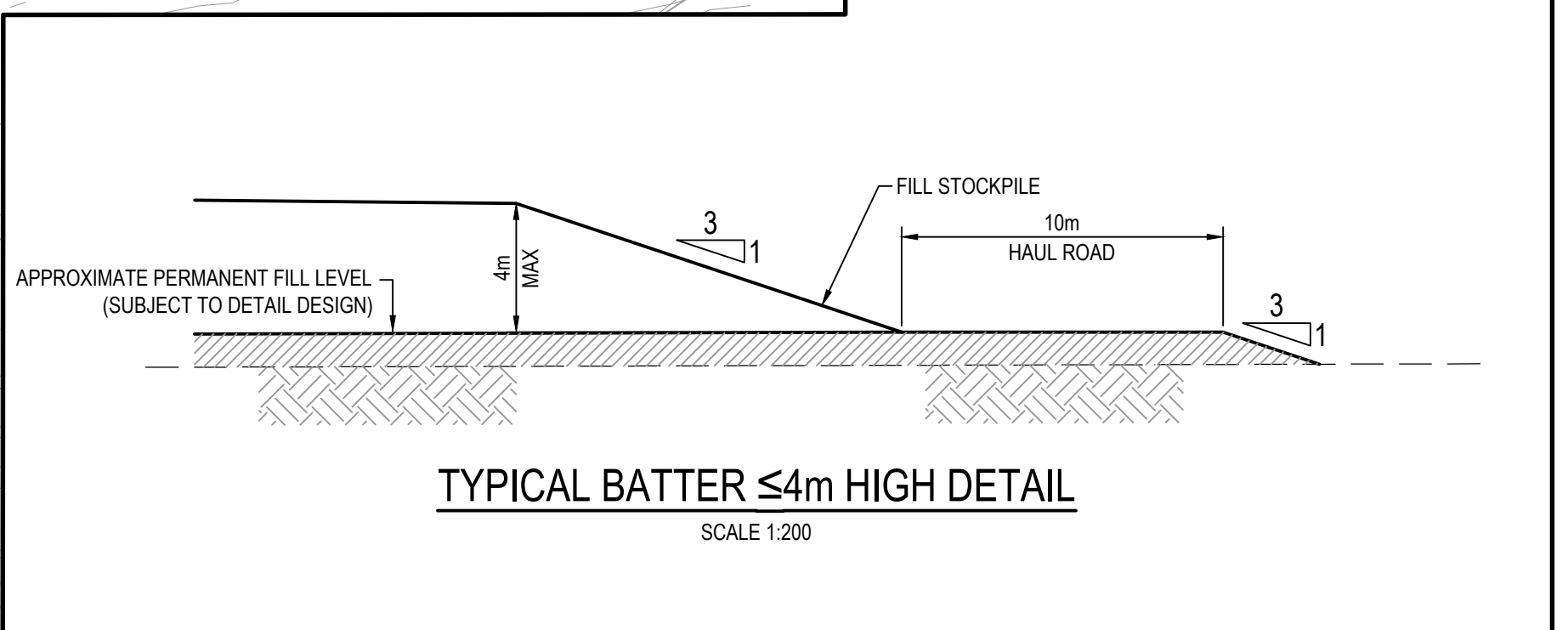
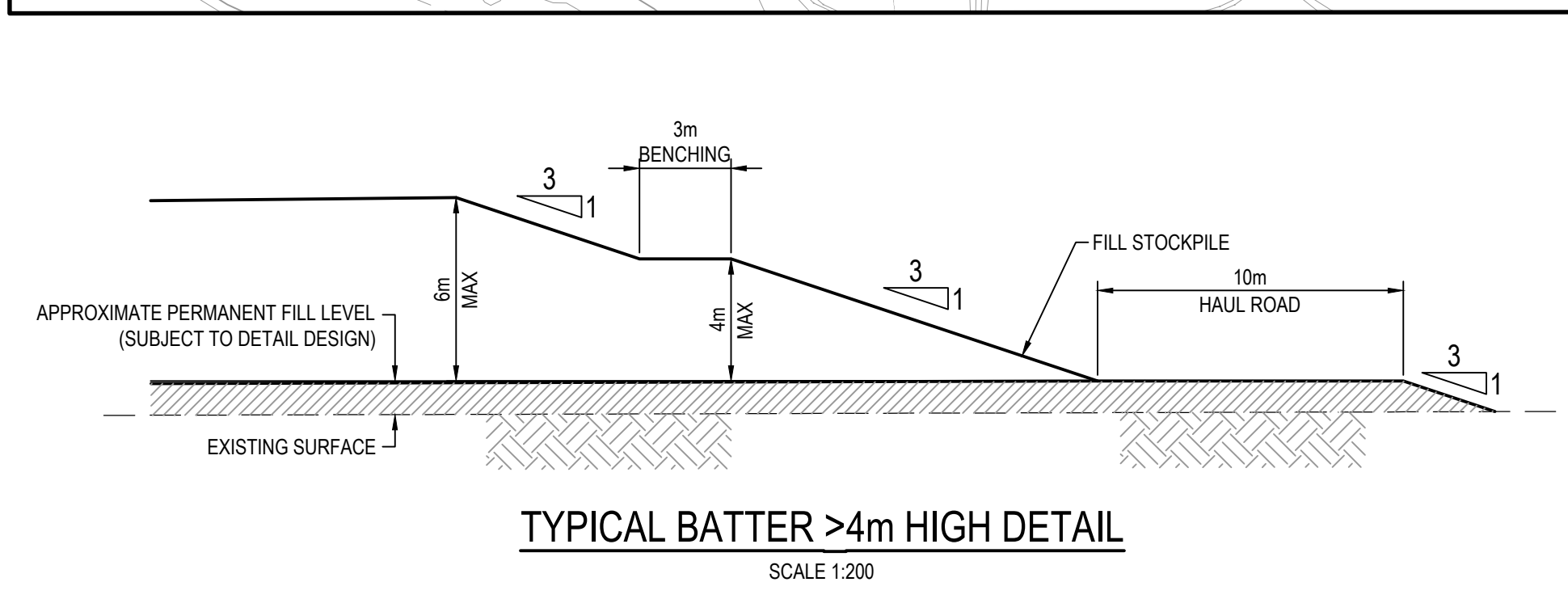
APPROXIMATE VOLUME OF PERMANENT FILL 400,000m³

APPROXIMATE VOLUME OF STOCKPILE FILL 1,200,000m³

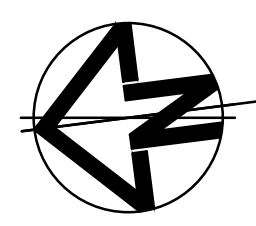
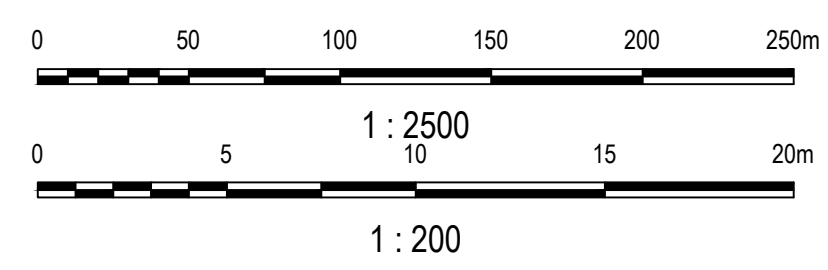
EARTHWORKS NOTES/ASSUMPTIONS

1. THE CUT/FILL VOLUMES ASSUME THE EXISTING SURFACE HAS BEEN STRIPPED OF 300mm OF TOPSOIL AND THE EXISTING SURCHARGE MOUND HAS BEEN REMOVED WITHIN THE DEVELOPMENT AREA.
2. THE CUT/FILL VOLUMES ARE TO THE FINISHED SURFACE LEVEL.
3. NO ALLOWANCE FOR BULKING FACTORS.
4. NO ALLOWANCE FOR TRENCH EXCAVATION.
5. CONTOURS SHOWN ON THIS PLAN ARE FINISHED SURFACE CONTOURS.

DEPTH RANGE LEGEND



Issue	Description	Date
02	DRAWING TITLE CHANGED	20.06.2016
01	ISSUE FOR INFORMATION	23.05.2016



Client

SIMTA SYDNEY INTERMODAL TERMINAL ALLIANCE

TACTICAL GROUP

Status: **PRELIMINARY ONLY**
NOT TO BE USED FOR CONSTRUCTION

Scales: 1:2500

Original Size: **A1**

Height Datum: AHD

Grid: MGA

Filename: MCPN-ARC-CV-DWG-0111-EarthworksPlan.dwg

Project: **MPW INTERMODAL TERMINAL FACILITY**
MPW CONCEPT PLAN MODIFICATION

Title: **EARTHWORKS PLAN**

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Fax No: +61 2 8907 9001
arcadis.com

Project No: **AA009335**

Drawing No: **MCPN-ARC-CV-DWG-0111- 02**