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Aus-10 Rhyolite Pty Ltd

ENVIRONMENTAL IMPACT STATEMENT

Proposed Expansion of Tinda Creek Sand Quarry

VOLUME 1: MAIN TEXT, APPENDICES 1 – 4

July 2014

Volume 1

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MAIN TEXT

July 2014

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Proposed Expansion of Tinda Creek Sand Quarry

July 2014

Prepared by
Umwelt (Australia) Pty Limited

on behalf of
Aus-10 Rhyolite Pty Ltd

Project Director:	**Peter Jamieson**
Report No.	**1731/R14/FINAL**
Date:	**July 2014**

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Executive Summary

Background

Aus-10 Rhyolite Pty Ltd t/a Hy-Tec Concrete and Aggregates (Hy-Tec) operates Tinda Creek Quarry, a sand quarry located approximately 67 kilometres north of Windsor along Putty Road, NSW. The existing quarry operations are currently located within Lot 2 DP 628806 with additional sand resources being located on the western part of Lot 2 and on the adjacent Lots 1 and 3 in DP 628806 which are to the north and south respectively. Lot 1, Lot 2 and Lot 3 are referred to collectively as the 'study area'.

The quarry is adjacent to the Greater Blue Mountains World Heritage Area and Yengo National Park and has been operating at the site for approximately 30 years with no measurable impact on these surrounding conservation areas.

The current development consent for the quarry was granted in 1996 by Hawkesbury City Council for extraction up to 2 million tonnes (Mt). At present there is approximately 300,000 tonnes of identified resource remaining within the approved extraction area, however, this resource is more difficult to extract and therefore less economically viable. Hy-Tec's preference is to extract from other resources identified on site.

Detailed assessment has been undertaken of sand resources on Lots 1, 2 and 3 with seven potential extraction domains (1 to 7) being identified. Geotechnical investigations have confirmed that the site contains in excess of 11.7 Mt of accessible high quality sand resources. Analysis of the available sand resource and potential environmental constraints indicate that approximately 7 Mt of the identified sand resource can be extracted whilst achieving a balance between maximising utilisation of the identified resource and minimising overall environmental impacts. Hy-Tec is seeking development consent to continue operation of the quarry for an additional 30 years to allow for extraction of these remaining identified resources.

The proposed expansion of Tinda Creek Quarry will constitute a significant change to the existing development and will require a new development application to be lodged. The potential for impacts on the adjacent Greater Blue Mountains World Heritage Area and Yengo/Wollemi National Parks associated with the proposed expansion of the quarry are limited to edge effects, which are proposed to be mitigated by the provision of buffers between the proposed disturbance area and site boundaries (ranging from a minimum of 237 metres to the World Heritage Area and 40 metres to the Yengo National Park). Following consultation with the National Parks and Wildlife Service (NPWS) two possible on-site biodiversity offset areas have been identified that would yield similar volumes of sand resource with extraction either occurring within Domain 3 or Domain 7. Quarrying within Domain 3 will result in the associated biodiversity area having an irregular boundary. Quarrying within Domain 7 would result in Domain 3 resource area forming part of the biodiversity offset area and being subsequently incorporated in to the National Park estate.

The official values of the Greater Blue Mountains World Heritage Area, as detailed on the Australian Heritage Database, relate to the diversity of examples of on-going ecological and biological processes significant in the evolution of Australia's highly diverse ecosystems and communities of plants and animals, particularly eucalypt-dominated ecosystems. These values will not be adversely affected by the proposed expansion of quarrying operations.

In addition, groundwater monitoring and modelling demonstrates that dredging will not adversely impact on groundwater levels on adjoining conservation lands, with drawdown around the extraction ponds being limited due to the relatively high clay content and consequent low permeability of the soils on the site. Further, groundwater dependent ecosystems on the site do not display any obvious signs of being adversely affected by

operations at the site over the past approximately 30 years and the results of aquatic ecology monitoring undertaken in Tinda Creek indicate no observable changes or adverse impacts.

As the proposed changes to the quarry will provide access to a resource of in excess of 5 Mt, the development application meets the criteria listed within Schedule 1 cl7(1)(b) of State Environmental Planning Policy (State and Regional Development) 2011 for assessment as 'state significant development' under Section 89C of the *Environmental Planning and Assessment Act 1979* (the EP&A Act). The Minister for Planning and Infrastructure will be the determining authority for this development application.

The Proposed Development

The Tinda Creek Sand Quarry Extension Project (the Project) involves extending the approved extraction area to provide access to additional sand resources at the site. The Project also proposes to extend hours of operation and increase production capacity from 125,000 tonnes per annum (tpa) to 300,000 tpa, to enable the quarry to cater for forecast increases in demand for sand from within the Sydney region.

The site has a long history of quarrying, having been in operation for approximately 30 years, and has well established buffers around the site. It is situated within a rural environment, surrounded predominantly by National Park, sharing a common boundary (eastern extent) with the Greater Blue Mountains World Heritage Area (Yengo National Park), while several small areas of agricultural landholdings are located to the immediate west of the site. The undulating topography and vegetation surrounding the Project area provide effective shielding from the nearby residences on the agricultural landholdings.

The sand resource being extracted contains typically 35 to 40% clay and as such exhibits low permeability in terms of groundwater movement. The low permeability of the sand resource significantly limits the lateral extent of dredging impacts on the groundwater table.

The Project will assist in meeting the strong, ongoing demand for construction sand driven primarily by development within the Sydney region, in particular the Northwest Subregion. It is estimated that the Sydney Planning Region consumes approximately 7 Mt of fine aggregate (i.e. construction sand) annually and that future fine aggregate demand within the Sydney region is estimated at around 75 Mt between 2010 and 2020 and 245 Mt by 2040. There are limited sources of suitable quality construction sand to meet this forecast demand, with supply of fine construction sand from Kurnell forecast to be exhausted within five years. Tinda Creek Sand Quarry is well positioned to help address this forecast supply deficit, given its strategic location close to a major regional road and future urban development areas of north-west Sydney.

The Project will provide for the continued employment of the existing six quarry staff and create an additional two staff positions, once operations reach the proposed maximum annual extraction limit. The continued and additional employment opportunities will create flow on effects to the local and regional economy. The Project will also continue to provide economic benefits through capital expenditure, ongoing operational expenditure and employee expenditure. The Project will also allow for the continued economic supply of quarry products in the region, the price of which are highly sensitive to transport costs.

The Project has been designed to balance resource utilisation and biodiversity conservation and minimise potential environmental and community impacts by:

- maximising the use of existing facilities;
- locating activities within existing disturbed areas of the site where possible;

- minimising the extent of disturbance in sensitive environmental areas;
- provision of on-site biodiversity offsets areas to compensate for areas disturbed through quarrying; and
- continuation of appropriate management measures.

The environmental impact assessment undertaken for the Project demonstrates that the site is suitable for the proposed Project and that the environmental impacts of the Project can be effectively managed. It is considered that the proposed Project environmental controls will mitigate potential environmental impacts to a level that will allow for the significant benefits of the Project for the local and regional communities to be realised in a sustainable manner.

Consultation

Consultation has been undertaken with government agencies, Transgrid and Aboriginal heritage groups. In addition, community consultation has been undertaken by the proponent throughout the preparation of the Environmental Impact Statement (EIS). The consultation process aimed to inform stakeholders about the project and identify key issues of concern to be investigated and assessed. These key issues have been considered in the EIS.

Key Environmental Issues

As detailed in **Section 4.0**, the environmental impacts of the proposal have been identified and subjected to a detailed environmental assessment based on:

- the nature of the proposed Project, including an assessment of the existing operations at the site;
- consultation with relevant government authorities;
- consultation with relevant community stakeholders; and
- expert technical analysis.

The key environmental issues identified through this process and the Director-General's Requirements (DGRs) were the subject of comprehensive specialist assessments of the potential impacts of the proposed Project on the surrounding environment and community. These are detailed in **Section 4.0** and the appendices of this document.

A general overview of the key environmental impacts associated with the proposed Project is outlined below.

Ecology

A detailed assessment of the potential ecological impacts associated with the proposed Project was undertaken. This included literature reviews and database searches which were used to inform targeted field surveys for both State and Commonwealth-listed threatened species, populations and communities. The assessment included evaluation of the habitat potential for these threatened species, populations and communities.

A total of 246 species were recorded within the Project area, of which 232 (94.3%) are native and 14 (5.7%) are introduced species. Five vegetation communities (with variants) were delineated across the Project area, being:

- Mellong Sandmass Dry Woodland:
  - Variation: Mellong Sandmass Dry Woodland Derived Native Grassland.

- Mellong Sandmass Swamp Woodland:
  - Variation: Mellong Sandmass Swamp Woodland (modified – overstorey absent).
- Hawkesbury Hornsby Plateau Exposed Woodland:
  - Variation: Hawkesbury Hornsby Plateau Exposed Woodland Derived Native Grassland.
- Stringybark – Ironbark Forest.
- Mellong Sandmass Sedgeland.

No endangered ecological communities (EECs) were identified within the Project area or the proposed disturbance area. One threatened flora species, small-flower grevillea (*Grevillea parviflora* subsp. *parviflora*) listed as vulnerable under the *Threatened Species Conservation Act 1995* (TSC Act) and *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), was recorded during the field surveys undertaken for this assessment. A total of 849 individuals of this species were recorded in the Project area, of which 3 occur within the proposed disturbance area if Domain 3 is quarried and 91 occur within the proposed disturbance area if Domain 7 is quarried and Domain 3 becomes part of the biodiversity offset area.

The results of the assessment concluded that the proposed Project would not have a significant impact for both State and Commonwealth-listed threatened species, populations and communities. In addition, the proposed Project was assessed as being unlikely to have an adverse impact on Groundwater Dependent Ecosystems (GDEs), the adjacent national parks and World Heritage Areas, or on corridors and connectivity between these areas. Notwithstanding the assessment of no significant impact, the Project has been referred to the Commonwealth Department of Environment for assessment of its potential as a 'controlled action' under the provisions of the EPBC Act. Following assessment of the referral documentation, a decision notice was issued by the Department of the Environment (DoE) in which the matter was determined to be a 'controlled action'. A response addressing the Commonwealth assessment requirements is provided in **Appendix 6**.

With respect to the GDEs, an inspection of the areas potentially affected by drawdown of groundwater (adjacent to the existing extraction area) was undertaken, in the context of extraction operations being on site for approximately 30 years. The inspection concluded that the condition and floristic/structural components of the vegetation communities adjacent to the extraction area was similar to vegetation occurring further away, with no apparent impacts from potential drawdown at the time of the field survey. The inspection also indicated that the vegetation communities appeared to be in good condition, with no physical signs of degradation or die back observed. These observations accord with measured groundwater levels in boreholes adjacent to the dredge pond, which show a limited horizontal extent of drawdown around the dredge pond due to the high clay content and consequent low permeability of soils on site.

The ecological assessment also addressed the following:

- development of appropriate impact mitigation and management options to minimise ecological impacts associated with the Project;
- provide data to inform rehabilitation of the site;
- requirements of the final landform to facilitate the re-establishment of existing vegetation communities and habitat;

- preparation of a comprehensive biodiversity offset strategy to compensate for the residual impacts of the Project that cannot otherwise be satisfactorily avoided, minimised or mitigated; and

- preparation of a detailed monitoring program to assess the success of the impact mitigation, rehabilitation and biodiversity offset strategies in reducing and compensating for the residual impacts of the Project.

Aboriginal Archaeology and Cultural Heritage

A detailed assessment of potential impacts of the Project on Aboriginal archaeology and cultural heritage has been undertaken. The assessment included consultation with Registered Aboriginal Parties (RAPs) throughout the course of the assessment process. This included participation in archaeological surveys and review of key documents, including the draft survey strategy and draft assessment report.

A search of the Office of Environment and Heritage (OEH) Aboriginal Heritage Information Management System (AHIMS) database revealed eight previously recorded archaeological sites located in an area of 10 kilometres by 10 kilometres surrounding the Project area. The only previous archaeological survey of the Tinda Park area was undertaken in August 1984, which concluded that two 'isolated finds' had resulted from the use of an access track and were only of 'possible' Aboriginal origin. No other artefactual material was located within the area assessed. Based on the environmental, ethnographic and archaeological context of the Project area, a predictive model was formulated. Amongst other findings, the model predicted a very low likelihood of archaeological material/sites reflecting intensive use by Aboriginal people being located in the Project area. Rather, the Project area was more likely to have been used as a resource gathering area as opposed to camping, an activity which does not often result in large amounts of artefact discard and making occupation/use difficult to discern.

Site surveys undertaken for the assessment indicated the location of a small artefact scatter consisting of a mudstone core and a quartzite flaked piece within a dam in Domain 3. The artefacts were in a secondary depositional context having washed in from upslope or upstream. The artefact scatter was assessed as having low archaeological significance due to its lack of complexity, lack of integrity and overall low research potential. The landforms incorporated in the proposed extraction domain areas were also assessed as having low potential for archaeological significance based on the results of the survey and the predictive model.

The majority of the proposed extraction domain areas (with the exception of Domain 2, Domain 3 and Domain 7) were found to be highly disturbed from past land clearance activities, historic quarrying and erosion. It was assessed that while it was possible that further stone artefacts may be located within the proposed extraction domain areas in a subsurface context, they were also likely to be of low complexity and low archaeological integrity.

The assessment of development impacts indicated the need to manage the artefact scatter, which is located in a disturbed context, in Domain 3. As the proposed works may if Domain 3 is quarried, impact the exposed Aboriginal artefacts, it was recommended that these be collected using the methodology set out in Aboriginal Cultural Heritage Assessment (**Appendix 9**) and under the protocols and procedures of the approved Aboriginal Cultural Heritage Management Plan (ACHMP) to be prepared for the Project. If Domain 7 is quarried rather than Domain 3, the artefact scatter in Domain 3 will not be disturbed by quarrying activities.

No comments were provided by the RAPs regarding any particular cultural significance associated with the Project area prior to or during the field surveys. Following review of the assessment report by the RAPs, one comment was received, requesting that should any artefact material be unearthed during extraction works, that this material be repatriated outside of the extraction area within undisturbed areas of the project site.

The assessment concluded that the proposed Project would not result in any significant impacts to Aboriginal archaeological items or places.

Traffic and Access

A comprehensive traffic impact assessment has been prepared for the proposal in accordance with the DGRs.

Site access is via Putty Road, a regional road that connects via Wilberforce Road and Windsor Road to north-western Sydney. Putty Road also provides connection with the Hunter Valley (near Singleton) and is the only road access route to and from Tinda Creek sand quarry.

Traffic generation from the proposed Project was assessed based on data from the existing operations and extrapolation of the data with respect to proposed maximum annual extraction, daily operating hours, days per year and estimates of average load. The proposed Project has the potential to yield an additional 18 outward bound loads spread over the day (being 36 total trips per day for 300,000 tpa, compared with the current average of 14 outward bound loads (28 total trips per day for 125,000 tpa). Projected Annual Average Daily Traffic (AADT) data for 2013 indicates that the addition of up to 36 daily trips would increase vehicle traffic flows on Putty Road by an additional 2.72%. In Year 10 of operations, this contribution to projected flows is estimated to be 2.38%, decreasing further to 1.82% in Year 30.

The proposed import of virgin excavated neutral material/excavated neutral material (VENM/ENM) to the quarry to assist in backfilling the extraction ponds will not increase traffic movements as this material will be back loaded using the same trucks that transport product from the site.

In terms of road network capacity and safety, the contribution of heavy vehicle movements over the life of the proposed expanded quarry operations (30 years) to overall flows and long-term growth rates on Putty Road is considered to be insignificant.

An intersection analysis at the site entrance on Putty Road showed that the potential volumes at the Putty Road/quarry access intersection will not exceed 100 vehicles per hour (vph) on Putty Road and 20 vph on the Quarry Access Road. These flows are well within the limits set by Austroads guidelines and therefore acceptable capacity conditions can be assumed at this intersection. Consequently, no upgrading of the intersection is required, however, it was recommended that the current site access be upgraded to comply with minor road access, in accordance with AS2890.2. In addition, to minimise the potential for tracking on to Putty Road, it was recommended that a shaker grid be installed on the quarry access road.

Noise

A detailed assessment of noise impacts associated with the proposed Project was undertaken, which included a review of noise levels from the existing quarry operations, in addition to consideration of construction noise, road traffic noise and the proposed operations at the site for a range of operating scenarios.

Assessment criteria were developed for intrusiveness, amenity, project-specific noise, sleep disturbance, construction and road traffic noise. The results of noise modelling demonstrated that predicted noise levels associated with operations at the site would be within relevant guidelines. Predicted noise levels also met the recommended sleep disturbance noise goals at all residential receivers, for the modelled worst-case operational and meteorological scenarios.

In addition, construction noise levels at all residential receivers was predicted to be at or below the construction noise management level of 40 dB(A). Road traffic noise levels from the increase in heavy vehicles travelling to or from the Project via Putty Road generally do not exceed the relevant day and night time road traffic noise criteria. Cumulative noise impacts were also determined to not exceed relevant criteria.

Air Quality

The extraction operations on site are primarily a 'wet' operation, via dredging of sand from extraction ponds. The expanded operations do propose small areas of 'dry' extraction, around the perimeters of extraction ponds, to assist in maintaining appropriate shaping of batter slopes to mesh in with the surrounding terrain.

A quantitative air quality impact assessment, however, was considered unwarranted for the proposal given the comparatively small components of dry extraction and the remote location of the extraction operations relative to the nearest sensitive receptor (residence). The nearest residence not associated with the quarry operation is located over 1.2 kilometres from the western extremity of the operations (separated by a ridge and dense bushland) and over 2 kilometres from the stockpile site.

In addition, the extractive material is sand with relatively high clay content (35–40%) and as such, it is unlikely to be susceptible to wind entrainment as the material is moist and strongly cohesive in an unprocessed state. Further the stockpile at the Project site is located over 2 kilometres from the nearest sensitive receptor (separated by a ridge and dense bushland).

Therefore, based on the low number and distance from sensitive receivers and remote nature of the operations, in addition to the majority of extraction operations being 'wet', the potential for adverse air quality impacts associated with the operations is considered negligible and hence quantitative assessment of air quality is considered unwarranted. Operations at the site (since the 1996 approval) demonstrate that dust emissions can be readily managed with the greatest potential source of dust being the haul road. This can be readily controlled with the appropriate use of a water cart. Mitigation measures to ensure that the potential for wind-blown sand is minimised on site have been developed for the Project, which essentially are a continuation of exiting approved work methods on site.

Surface Water

A detailed assessment of surface and groundwater issues was undertaken for the proposed Project. The site has a number of licensed groundwater production bores to provide for the water needs of the site, in particular, for top up of dredge ponds if required. Operations at the site are undertaken within a closed water management system with clean runoff from the upslope catchment diverted around the eastern and northern sides of the quarry area. The proposed expansion to the quarry will involve the staged augmentation of the existing closed water management system as quarrying progresses through extraction Domains 6 and 2 westward through Domain 1 towards Putty Road. Extension of the water management system will initially include establishment of a diversion drain around the western and southern perimeter of proposed extraction Domains 2, 6 and 1 to convey upslope runoff around the proposed extraction area. Parts of the existing dredge pond and the proposed dredge pond in Domain 6 will be progressively backfilled with tailings and imported VENM

and ENM to facilitate. This will be undertaken in accordance with Natural Regrade principles to provide a long-term stable landform.

Prior to extraction commencing in Domain 3, runoff from the area upslope of the eastern and southern boundaries of the existing extraction pond will be redirected to drain via the approved southern diversion along the southern and western perimeters of the existing extraction area. The southern diversion will rejoin Tinda Creek drainage system near the north-eastern corner of Domain 6. An additional diversion drain will be constructed around the northern perimeter of Domain 3 to convey upslope runoff away from the proposed dredge pond to Tinda Creek drainage system.

Domain 3 will also be progressively backfilled with the final landform providing a centralised drainage channel that drains to a pond within Domain 1. This pond will effectively replace the existing dredge pond and will provide an accessible water resource for ongoing fire-fighting purposes.

If Domain 7 is quarried rather than Domain 3, quarrying will commence in Domain 7 and progress to Domain 6, Domain 2 and Domain 1. Diversion drains will be constructed along the north-eastern boundary of Domain 7 to convey upslope runoff to the existing diversion drain that is located around the eastern and northern perimeter of the current dredge pond. An additional diversion drain will also be constructed along the south-western edge of Domain 7 to convey runoff around the south-western edge of the processing area to Tinda Creek.

The use of proposed diversion drains that will facilitate maintaining a closed water management system during the life of the quarry, will minimise impacts on catchment yield with the potential reduction in catchment runoff during quarry operations being limited to runoff from rainfall received within the perimeter of the quarry water management system.

The final landform has been designed to comprise a series of ponds and naturally graded drainage channels with the ultimate size of the ponds being approximately 16 hectares in area. The system has been designed to minimise the potential for sediment export off-site and to provide a stable landform in the long-term.

A detailed Soil and Water Management Plan will be prepared and submitted for approval prior to commencement of operations within the proposed extension areas. This plan will be based on Domain 3 or Domain 7 extraction areas depending on which is approved.

Groundwater

The proposed dredge ponds will be excavated into low permeability clayey sand material that is underlain by higher permeability sand. Assessment of geological logs from the exploration program undertaken for the Project indicates that the proposed 15 metre depth of extraction within the proposed extraction areas will not intersect the underlying higher permeability sand.

Groundwater monitoring undertaken for the Project indicates that groundwater levels are typically 3 to 8 metres below the surface in the area surrounding the existing and proposed quarry operations. Modelling of the proposed dredging operation within Domains 1, 2, 3, 4, 5 and 6 and the associated final landform indicates that groundwater levels in the surrounding National Park estate will not be significantly affected by proposed dredging operation with only small changes predicted in groundwater level and base flow contribution. Due to the similarity of hydrogeological characteristics and area to be quarried of Domain 3 and Domain 7, groundwater impacts of sand extraction from Domain 7 are likely to be similar to that if sand extraction is undertaken in Domain 7.

In addition, the proposed Project has been assessed against the relevant requirements of the Water Sharing Plan for the Greater Metropolitan Region Groundwater Sources 2011 (WSPGWS), the Water Sharing Plan for the Greater Metropolitan Region Unregulated River Water Sources (WSPURWS), and the NSW Aquifer Interference Policy (AIP). An analysis of the proposed Project with the WSPGWS rules for this groundwater source area indicated that the proposed Project is consistent with the rules. As the proposed Project is not seeking to extract water from Tinda Creek, the provisions of the WSPURWS are not applicable. Further, assessment of the proposed Project with respect to the minimal impact considerations specified under the AIP indicated Project compliance with these matters.

Hazards

A Preliminary Hazard Analysis (PHA) has been prepared in accordance with the guidelines published by the Hazardous Industry Planning Advisory Paper (HIPAP) No 6 (DP&I, 2011a). The PHA assessed the credible, potential hazardous events and corresponding risks associated with the proposed Project with the potential for off-site impacts.

The results of the PHA show that the risks associated with the proposed Project comply with the HIPAP guidelines for tolerable fatality, injury, irritation, propagation and societal risk. Also, risks to the biophysical environment from potential hazardous events are broadly acceptable. In addition, the proposed Project has no significant impact to the cumulative risk in the local area. As such, the proposed Project is not classified as a hazardous industry as defined under cl. 4(1) of SEPP 33.

Benefits of the Project

The continued and expanded operation of Tinda Creek Quarry will provide significant ongoing benefits as summarised below:

- The Project maximises the operating life of an existing quarry, thereby avoiding/delaying the need to develop a greenfield site to meet Sydney's need for quarry products and providing for the continued utilisation of existing equipment, facilities and environmental control measures. It also balances environmental and geological constraints with resource recovery from the quarry site.

- The Project will facilitate the continued supply of high quality construction sand into the Sydney regional markets to meet identified need for these materials, in particular, to meet forecast supply deficits of fine construction sand within five years. The quarry has convenient, economic access to its core market, which assists with reducing supply costs, greenhouse gas emissions and other environmental impacts per tonne kilometre transported. Sand from the quarry will also continue to be utilised by Hy-Tec to augment manufactured sand from other Hy-Tec quarries, further increasing construction sand supply for the Sydney market.

- The Project will support the rapid growth and development of the area, in particular in north-west Sydney, through supply of high quality construction materials. As such, the project will assist in achieving the aims and objectives of the various strategic and regional planning policies, including the Northwest Subregion, Draft Subregional Strategy (NSW Government, 2007).

- The quarry is positioned away from major population centres and incompatible land uses and has a substantial existing buffer zone for the two residences located to the west and the adjoining Greater Blue Mountains World Heritage Area and Yengo National Park.

- The Project will continue to provide six current full-time positions and a further two positions when the volume increases when fully operational. In addition, the proposed expansion of production will require approximately an additional 10 contract drivers for haulage, with flow on effects to the local and regional economy.

- The Project will provide direct economic benefits in the form of initial capital investment of approximately $0.3 million, however, the site will require ongoing capital expenditure of some $9 million to $10 million.

An ancillary benefit of the site and its dredge ponds is their utility during bushfire events. During the recent October/November 2013 Blue Mountains bushfire emergency, 82 fire tankers were stationed at Tinda Creek quarry, using the site as a staging area. In addition, the dredge ponds provided a critical source of water for replenishment of fire tankers and aerial water bombing craft. The Rural Fire Service (RFS) has indicated their desire to the proponent to be able to continue to have access to this important water supply for fighting fires in the surrounding National Parks and World Heritage Area. This is considered of great importance given the relatively undisturbed and inaccessible nature of the surrounding area and limited number of staging points along Putty Road.

In summary, the Project will have a positive socio-economic impact on the local and regional economy and community through the provision of long-term, permanent jobs, the need for services and the capital inflows, while having minimal adverse environmental impacts. The Project is therefore considered consistent with principles of ecologically sustainable development.

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APPENDICES

1.0 Introduction

1.1 Overview

Aus-10 Rhyolite Pty Ltd t/a Hy-Tec Concrete and Aggregates (Hy-Tec) operate Tinda Creek Quarry, a sand quarry located approximately 67 kilometres north of Windsor along Putty Road, NSW (**Figure 1.1**). Umwelt (Australia) Pty Limited (Umwelt) has been engaged by Hy-Tec to undertake the necessary impact assessments and assist in attaining approval for the proposal. Hy-Tec is seeking approval to increase production levels from Tinda Creek Quarry from approximately 125,000 tonnes per annum (tpa) to 300,000 tpa. Hy-Tec is also seeking to increase the area of the site subject to sand extraction to include additional resource, which has been identified through geotechnical assessment of the site. The existing quarry operations are currently located within Lot 2 DP 628806, though the proposed expansion would include extraction on the adjacent Lots 1 and 3 in DP 628806, to the north and south respectively. Lot 1, Lot 2 and Lot 3 are referred to collectively as the 'study area'.

Based on the details of the geotechnical investigation (Stitt, 2012), there is approximately 16.93 million tonnes (Mt) of raw sand resource accessible within the study area, which has the potential to yield approximately 11.71 Mt of product sand. Definition of the potential extent of the resource consisted of seven identified resource domains, as shown in **Figure 1.2**. Of these, five were selected for extraction following a detailed environmental constraints analysis, and are referred to hereafter as the 'Project area'. Each of these contains Joint Ore Reserves Committee (JORC) Code-complaint 'measured' and 'indicated' resource quantities, with approximately 7 Mt of product-sand proposed to be extracted under this proposal. It is noted that of this, 0.365 Mt of product sand in Domain 4 is located within the existing approved operations area (**Figure 1.3**).

The proposed expansion of Tinda Creek Quarry will constitute a significant change to the existing development and will require a new development application to be lodged. As the proposed changes to the quarry will provide access to a resource of in excess of 5 Mt, the development application meets the criteria listed within Schedule 1 cl7(1)(b) of State Environmental Planning Policy (State and Regional Development) 2011 for assessment as 'state significant development' under Section 89C of the *Environmental Planning and Assessment Act 1979* (the EP&A Act). The Minister for Planning and Infrastructure will be the determining authority for this development application.

Sand extraction in the proposed extension areas will be, effectively, a continuation of current operations. Current sand extraction operations are detailed in **Section 2.2**.

1.1.1 Background to the Proposal

The quarry expansion is proposed to be undertaken on the site as shown in **Figure 1.3**. The site comprises Lot 1, Lot 2 and Lot 3 in DP 628806, on Putty Road 23 kilometres north of Colo Heights, NSW (hereafter referred to as the 'study area'). Lot 1, Lot 2, and Lot 3 are 86 hectares, 86.67 hectares and 86 hectares respectively, with a total site area of 258.67 hectares. The proposed quarry expansion will result in disturbance of an additional approximately 50 hectares of the study area.

Quarrying activities have been undertaken on Lot 2 for approximately the last 30 years with the quarry currently producing up to 125,000 tonnes of product per year. The material quarried is comprised of clayey sand that contains typically 18% to 40% silt and clay.

The quarry operations involve the extraction of clayey sand from the quarry area using a cutter-suction dredge that floats on a dredge pond that has varied in size over the years

Source: LPI NSW, 2000

0 0.5 1.0 2km
1:35 000

Legend
Project Area

FIGURE 1.1

Locality Map

Source: Google Earth (2012), LMPA (2009)

0 250 500 750m
1:15 000

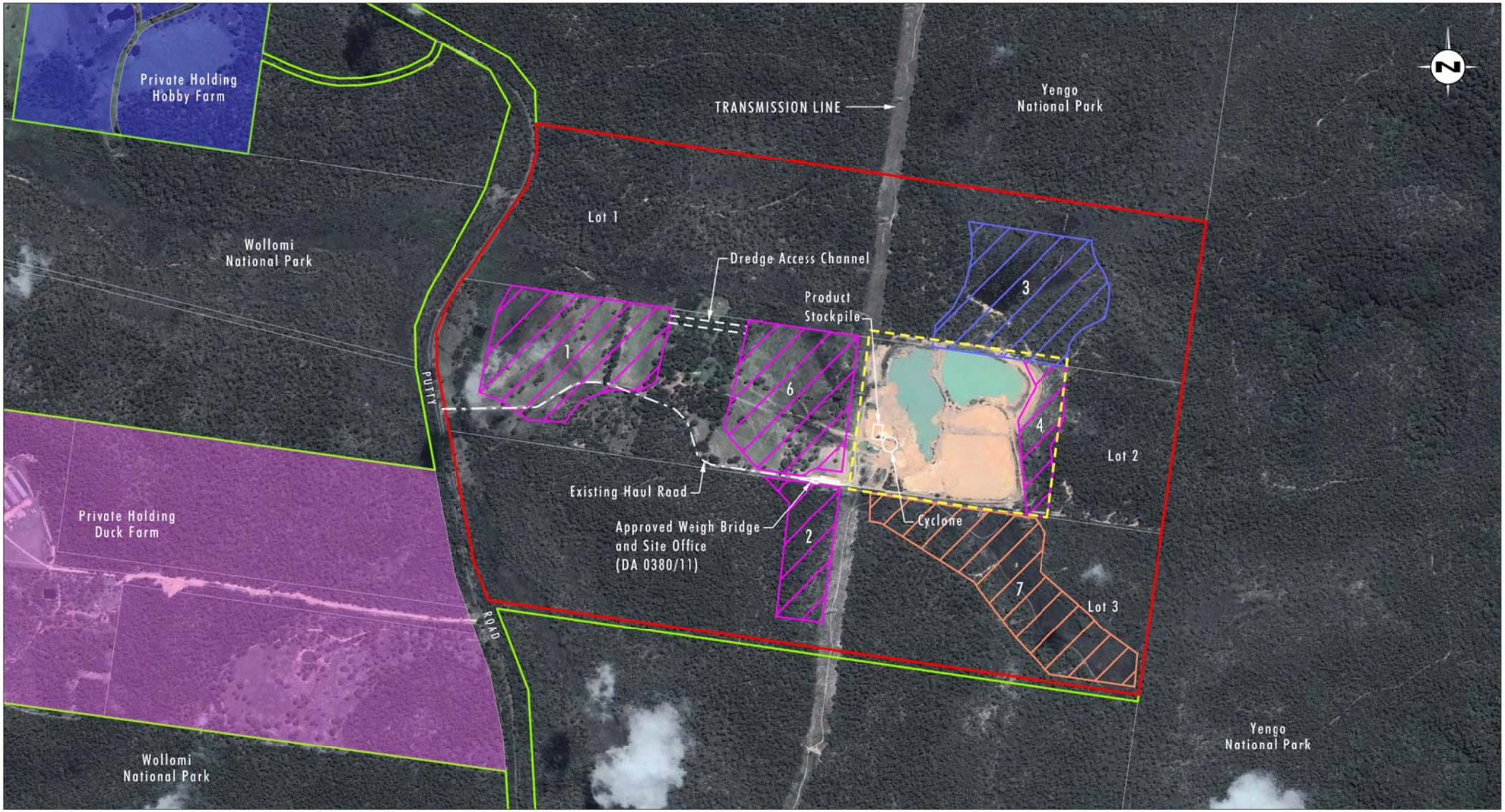
Legend

- Project Area
- Proposed Extraction Area
- Domain 3 Extraction Area
- Domain 7 Extraction Area
- National Park Boundary
- Identified Resource Domains (Stitt 2012)

File Name (A4): R14_V1/1731_372.dgn

FIGURE 1.2

Tinda Creek Sand Quarry Identified Resource Domains and Proposed Quarry Extension Areas



Source: Google Earth (2012), LPI NSW (2007)

Legend

- Project Area
- Limit of Approved Extraction (DA 134/95)
- Proposed Extraction Area
- Domain 3 Extraction Area
- Domain 7 Extraction Area
- Private Holding Duck Farm
- Private Holding Hobby Farm
- National Park Boundary

File Name (A4): R14_V1/1731_174.dgn

FIGURE 1.3

Project Area and Site Layout

between approximately 3 hectares to 6 hectares. The clayey sand is dredged from a depth of up to approximately 15 metres below the ground level. Sand, silt and clay is piped from the dredge pond to the sand processing plant where the sand is separated from the silt and clay. Product sand is stockpiled and subsequently transported off-site. Silt, clay and water are returned to tailings dams where the sediment is allowed to settle out. Water either drains back to the dredge pond via a short overland flow path or seeps from the processing area, sediment dams and tailings dams into the underlying unconfined aquifer as groundwater recharge in the area surrounding the quarry.

Tinda Creek was identified by the then Department of Mineral Resources (now Department of Resources and Energy (DRE)) as one of the long-term sources of sand for the Sydney market in 2001 (Pienmunne & Whitehouse, 2001). It is estimated that the Sydney Planning Region (SPR) consumes approximately 7 Mt of fine aggregate (i.e. construction sand) annually. Future fine aggregate demand within the SPR is estimated at around 75 Mt between 2010 and 2020 and 245 Mt by 2040 (Pienmunne & Whitehouse, 2001).

As existing quarries exhaust their supply, sand is being transported from further afield to meet this demand. Tinda Creek represents one of few remaining established sand resources within the SPR (Pienmunne & Whitehouse, 2001). In response to the growing demand for sand in the SPR, Hy-Tec is proposing to expand its existing operations at Tinda Creek to assist in meeting this demand. This Environmental Impact Statement (EIS) has been prepared to assess the potential impacts of the proposed quarry expansion and accompany Hy-Tec's application for Development Approval.

1.1.2 The Proponent

Tinda Creek quarry is operated by Hy-Tec Concrete & Aggregates Pty Ltd (NSW) (Hy-Tec), a wholly-owned subsidiary of Adelaide Brighton Limited. Hy-Tec is a quality assured supplier of premixed concrete, aggregates and sands to the commercial, industrial, civil and residential construction sectors and manages a number of quarries and extraction operations across NSW and Queensland. An average of approximately 68,500 tonnes of sand has been extracted annually at Tinda Creek since the commencement of the existing consent in 1996. The quarry currently produces up to 125,000 tonnes of product per year. It is proposed that Hy-Tec will use the facilities and infrastructure already located on site during the expansion of extraction operations, and upgrade mobile plant and equipment as extraction operations increase.

1.1.3 Location of the Proposal

The proposal will be undertaken within parcels of rural land described in cadastral terms as Lot 1, Lot 2 and Lot 3 in DP 628806, on Putty Road, approximately 23 kilometres north of Colo Heights, NSW. The proposal area is bounded on the north, east and south by Yengo National Park and on the west by Putty Road, several agricultural land holdings and Wollemi National Park (**Figure 1.3**).

1.1.4 Overview of the Proposal

The proposed extension to extraction operations will be for additional areas of development on site. The proposal is presented in more detail in **Section 2.3**, while the justification and alternatives considered are presented in **Section 2.4**.

The seven resource domains identified and described by Stitt (2012) as indicated in **Figure 1.2** are summarised below:

- Domain 1 – approximately 11.8 hectare area at the western extent of the site, predominantly located over Lot 2 (with minor extension into Lots 1 and 3) comprising an indicated product-sand resource of 2.1 Mt.

- Domain 2 – approximately 3.6 hectare area to the south-west of the current quarry site, adjacent to the western side of the electricity transmission line on Lot 3, comprising an indicated sand resource of 1.1 Mt.

- Domain 3 – approximately 11.9 hectare area to the north of the current quarry site on Lot 1, comprising an indicated sand resource of 2.3 Mt.

- Domain 4 – approximately 4.3 hectare area to the east of the current quarry site on Lot 2, comprising an indicated sand resource of 0.7 Mt.

- Domain 5 – approximately 5.85 hectare area to the south-east of the current quarry site, adjoins Domain 4 and Domain 7 and is predominantly located on Lot 3 (with a minor extension into Lot 2), comprising an indicated sand resource of 1.7 Mt.

- Domain 6 (referred to in Stitt (2012) as 'NW') – approximately 12.14 hectare area west of the current quarry site (downstream), adjacent to the electricity transmission line and is predominantly on Lot 2 of DP 628806 consisting of a measured sand resource of 1.17 Mt.

- Domain 7 (referred to in Stitt (2012) as 'SE') – approximately 17.54 hectare area to the south of the current quarry site (upstream), on Lot 3 in DP 628806, consisting of a measured sand resource of 2.64 Mt.

In total, Stitt (2012) identified 11.71 Mt of potentially extractable 'product sand' resource, comprising JORC Code-complaint indicated (7.9 Mt) and measured (3.81 Mt) sand resources.

As part of the preliminary environmental investigations for this Project, the definition of the final extraction footprint has been refined from the seven identified resource domains (outlined above), by taking into consideration potential environmental constraints, in particular those related to ecology and the consequent need to provide for an onsite biodiversity offset (refer **Section 4.2.4**). As part of the ecological constraints analysis, to enable biodiversity offset requirements to be met on-site, initially a decision was made to not quarry in the swamp woodland and sedgeland located in the south-east area of the site (Domain 7), despite the presence of high quality sand resources in that area with quarrying to be undertaken in Domain 3. In subsequent consultation, the National Parks and Wildlife Service (NPWS) indicated a preference for quarrying to occur in Domain 7 with Domain 3 to be left untouched and form part of the biodiversity offset area. In developing the quarry plan, Hy-Tec has sought to optimise the balance in developing the biodiversity offsetting package for the Project between economic viability of extraction quantities and preserving habitat on site. Analysis indicates that this can be achieved with the proposed quarry plan with quarrying occurring either in Domain 3 or in Domain 7.

To identify an operationally functional extraction footprint, the extents of the mapped domains were refined taking these constraints into consideration (**Figure 1.2**). It is noted that Stitt (2012) indicated that there was a very high probability of sand resources existing outside of the mapped domains, based on the known surficial geology of the site. Therefore, amendment to the boundaries of the resource domains to achieve a functional extraction footprint has been undertaken so that all of the footprint will contain recoverable sand resource, given the known surface geology/stratigraphy of the site.

The outcome of the preliminary environmental investigations and refinement of the extraction domains has resulted in the selection of the following resource domains (described below) for inclusion in the proposed extraction area, which are the subject of this assessment. It is noted that this process has involved three dimensional (3-D) modelling of the extraction areas, which incorporated internal batter design for the dredge ponds. As such, the results yield a more accurate measurement of extractable resource in each extraction domain compared to those stated in Stitt (2012), who applied a simpler approach (area x depth) to derive extraction quantities (along with bulk density and yield ratios, which have been applied here). The domains are described below as follows:

- Domain 1 – approximately 14.17 hectare area comprising an indicated product-sand resource of 1.89 Mt.
- Domain 2 – approximately 5.29 hectare area comprising an indicated product-sand resource of 0.35 Mt.
- Domain 3 – approximately 13.40 hectare area comprising an indicated product-sand resource of 1.95 Mt.
- Domain 4 – approximately 4.14 hectare area comprising an indicated product-sand resource of 0.40 Mt.
- Domain 6 – approximately 13.17 hectare area comprising an indicated product-sand resource of 2.26 Mt.

Alternatively, depending on which biodiversity offset area is adopted, quarrying may be undertaken within Domain 7 rather than Domain 3. Quarrying within Domain 7 would disturb approximately 14 hectares with an indicated resource of approximately 2 Mt.

The proposed Project is therefore seeking approval for extraction of a total product-sand resource of approximately 7 Mt within a proposed extraction area of 50 hectares, based on the results reported in Stitt (2012), the areas identified for extraction, a maximum extraction depth of 15.24 metres below ground level and design internal batters.

Each extraction stage will involve the removal and stockpiling of topsoil followed by the extraction of available resource via cutter suction dredge. A summary of the extraction sequence is described as follows:

- Following completion of the existing, approved extraction operations (which includes the majority of the Domain 4 area), commence extraction operations in Domain 6. A short trench (approximately 60 metres) will be constructed beneath the overhead powerline to allow movement of the dredge into the Domain 6 starter pond. Following repositioning of the dredge, a pipe will be placed in the trench to provide water to Domain 6 and the trench backfilled.
- While the dredge is located within Domain 6, undertake extraction operations within Domain 2 as a dry extraction operation. Material will be hauled to the edge of Domain 6 and fed to the dredge.
- After completion of extraction operations in Domain 6 and Domain 2, commence in Domain 1. The dredge will be moved into the Domain 1 extraction area via a trench to be constructed on the northern side of Lot 2. This trench will remain open to facilitate movement of water into Domain 1 from Domain 6.

- Once extraction is completed in Domain 1 the dredge will be dissembled and transported back to the existing dredge pond from where the sand resource within Domain 3 will be initially accessed.

If extraction is approved for Domain 7 rather than Domain 3, quarrying would commence in Domain 7 and then progress to Domains 6, 2 and 1 as outlined above. No extraction would occur in Domain 3.

An extraction plan for the operation is described in **Section 2.3**. The duration of extraction operations and rehabilitation of the site is expected to be completed over a period of approximately 30 years.

The ongoing rehabilitation of the current quarry site is proposed to continue within the extraction extension areas. Further detail regarding the rehabilitation of the site is provided in **Section 2.3.8**.

1.2 Approvals Required

1.2.1 Development Approval

The proposed development is listed as type consistent with the provisions of Schedule 1 cl.7(1)(b) of State Environmental Planning Policy (State and Regional Development) 2011 as follows:

> **7 Extractive Industries**
>
> (1) Development for the purpose of extractive industry that:
>
> (a) extracts more than 500,000 tonnes of extractive materials per year, or
>
> (b) extracts from a total resource (the subject of the development application) of more than 5 million tonnes, or
>
> (c) extracts from an environmentally sensitive area of State significance.

The proposed extension to the Tinda Creek sand quarry has a proposed annual extraction limit of 300,000 tonnes of sand, however, it has a potential to extract approximately 7 Mt of product-sand resource over the life of the Project. As such the Project has been defined by the Director-General as a State Significant Development. Therefore the proposal requires consent in accordance with Section 89E of the EP&A Act. The Minister for Planning and Infrastructure is the determining authority for any project assessed under Division 4.1 of the EP&A Act.

This EIS has been prepared to address the requirements of Section 89H of the EP&A Act, the requirements of the Environmental Planning and Assessment Regulation 2000 and specific requirements issued by the Director-General of the Department of Planning and Infrastructure (DP&I), now known as the Department of Planning and Environment (DP&E), (provided in **Appendix 1**).

The proposal will not require a variation to Environmental Protection Licence (EPL) 12007, as this licence provides for extraction of up to 500,000 tonnes per year.

Section 3.0 provides further details on the approvals process and legislation that applies to the proposal.

1.3 Consultation

1.3.1 Agency Consultation

Initial consultation with Government Agencies was undertaken through the Preliminary Environmental Assessment (PEA) and Director-General's Requirements (DGRs) process. Agencies that provided a response to DP&I (now DP&E) included:

- Roads and Maritime Services (RMS). In addition, a meeting was held with RMS Sydney Region;
- Office of Environment and Heritage (OEH). Given the relatively straightforward nature of the proposal and impact assessment with respect to biodiversity and Aboriginal archaeological issues, no further consultation has been undertaken with OEH in regard to the Project. Notwithstanding, the comprehensive requirements for fieldwork and survey methodologies, consultation and reporting for these two issues, as detailed by OEH in the DGRs for the Project, have been addressed by the studies;
- Hawkesbury City Council; and
- Department of Primary Industries (DPI) (including NSW Office of Water; Crown Lands; and Fisheries NSW).

A request for review of the DGRs was made to DP&I (now DP&E) in relation to the proposed methodology for assessment of air quality. A copy of this correspondence and the Department's response is provided in **Appendix 2**.

Consultation was also undertaken with Transgrid in relation to the existing double circuit 330 kV transmission line that traverses the quarry area. A copy of comments received is provided in **Appendix 2**. In summary, Transgrid indicated that there were no objections to the Project, providing that access could be maintained to the tower structures and that various safety procedures would be enacted. Notwithstanding this advice, a copy of the EIS will be sent to Transgrid for comment during the exhibition period.

A copy of the draft EIS was also forwarded to the following government bodies during adequacy review and the comments received subsequently addressed in this document:

- Crown Lands;
- NSW Fisheries;
- NSW Office of Water;
- Office of Environment and Heritage;
- NSW Planning and Infrastructure;
- Hawkesbury City Council;
- Division of Resources and Energy; and
- Environment Protection Authority.

1.3.2 Community Consultation

Consultation has been undertaken to date with the proponent liaising with the owners of the two private properties located to the west of the study area prior to the commencement of the public exhibition period. The consultation consisted of telephone discussions regarding the proposed Project, including provision of information regarding proposed extraction quantities, traffic movements, extent of disturbance and duration of operations. No objections were raised during this consultation process. As detailed in **Section 4.4**, extensive consultation has been undertaken with relevant Aboriginal stakeholder groups.

1.4 Environmental Assessment Team

This EIS was prepared by Umwelt (Australia) Pty Limited on behalf of Hy-Tec with specialist input provided by the following organisations/specialists:

- Geotechnical Assessment Peter H Stitt & Associates Pty Ltd;
- Ecological Assessment Umwelt (Australia) Pty Limited;
- Archaeological Assessment Umwelt (Australia) Pty Limited;
- Groundwater Assessment Umwelt (Australia) Pty Limited;
- Noise Assessment Umwelt (Australia) Pty Limited; and
- Traffic Assessment TPK & Associates Pty Ltd.

A Statement of Authorship and a full listing of the project team members and their respective roles is provided in **Appendix 3**.

1.5 Structure of the Environmental Assessment

An overview of the structure of this EIS is provided below.

- **Executive Summary** provides a brief overview of the proposal, the major outcomes of the environmental impact assessment, and an outline of key commitments that will be made to mitigate any potential impacts;
- **Section 1.0** introduces the proposal, outlines the background to the proposal, provides a summary of key details, and outlines the structure of the EIS;
- **Section 2.0** contains a detailed description of the proposal, available sand resources, the study area and the availability of alternatives;
- **Section 3.0** describes the planning context and environmental context for the proposal, including the applicability of Commonwealth and State legislation;
- **Section 4.0** contains a description of the existing environment and a comprehensive analysis and assessment of the key environmental issues relevant to the proposal, including direct and cumulative impacts;
- **Section 5.0** details the draft Statement of Commitments proposed to be adopted throughout the life of the proposal in order to mitigate any potential impacts;

- **Section 6.0** contains a conclusion as required by the DGRs;
- **Section 7.0** provides a checklist of how the DGRs have been addressed in the EIS;
- **Section 8.0** provides a list of references referred to in the EIS; and
- **Section 9.0** provides a list of abbreviations referred to in the EIS.

2.0 Description of the Proposal

2.1 Site Description

The quarry site consists of Lot 1, Lot 2 and Lot 3 of DP 628806, located in the Parish of Ivory, Hunter County, Hawkesbury City Council Local Government Area (LGA), approximately 23 kilometres north of Colo Heights, or 67 kilometres north of Windsor, along Putty Road in NSW. The three lots are referred to collectively as the 'study area'. A gravel road connects the study area to Putty Road. An existing high voltage electricity transmission line runs north-south through all three lots.

The study area is located at the confluence of two small ephemeral creeks in the upper reaches of Tinda Creek Catchment. Tinda Creek is a tributary of Wollemi Creek which joins the Colo River approximately 16 kilometres to the west of the study area. The valley in which the quarry is located is approximately 500 metres wide and is bounded to the east by the Mellong Range and to the north and south by a series of unnamed ridges.

Tinda Creek flows ephemerally to the north-west from the existing quarry, and has been diverted around the eastern and northern boundaries of the current operations via a small earthen drainage channel (refer **Figure 2.1**). Tinda Creek joins with other ephemeral second order streams on the northern boundary of the existing quarry. These drainage lines convey water during and immediately following rainfall, but do not hold water during periods of dry weather, due to the proximity of the site to the top of the Tinda Creek catchment.

2.1.1 Land Use within the Study Area

Quarrying activities have been undertaken on Lot 2 for approximately 30 years, with the quarry currently producing up to 125,000 tonnes of product sand per year. The majority of Lot 2 has been cleared of vegetation and prior to commencement of sand quarrying operations on the site, was utilised for low intensity grazing. Lot 1 and Lot 3 are predominantly vegetated and contain several internal access tracks, in addition to an easement for a 330 kV transmission line. The study area also contains a manager's residence on Lot 2 that is currently occupied.

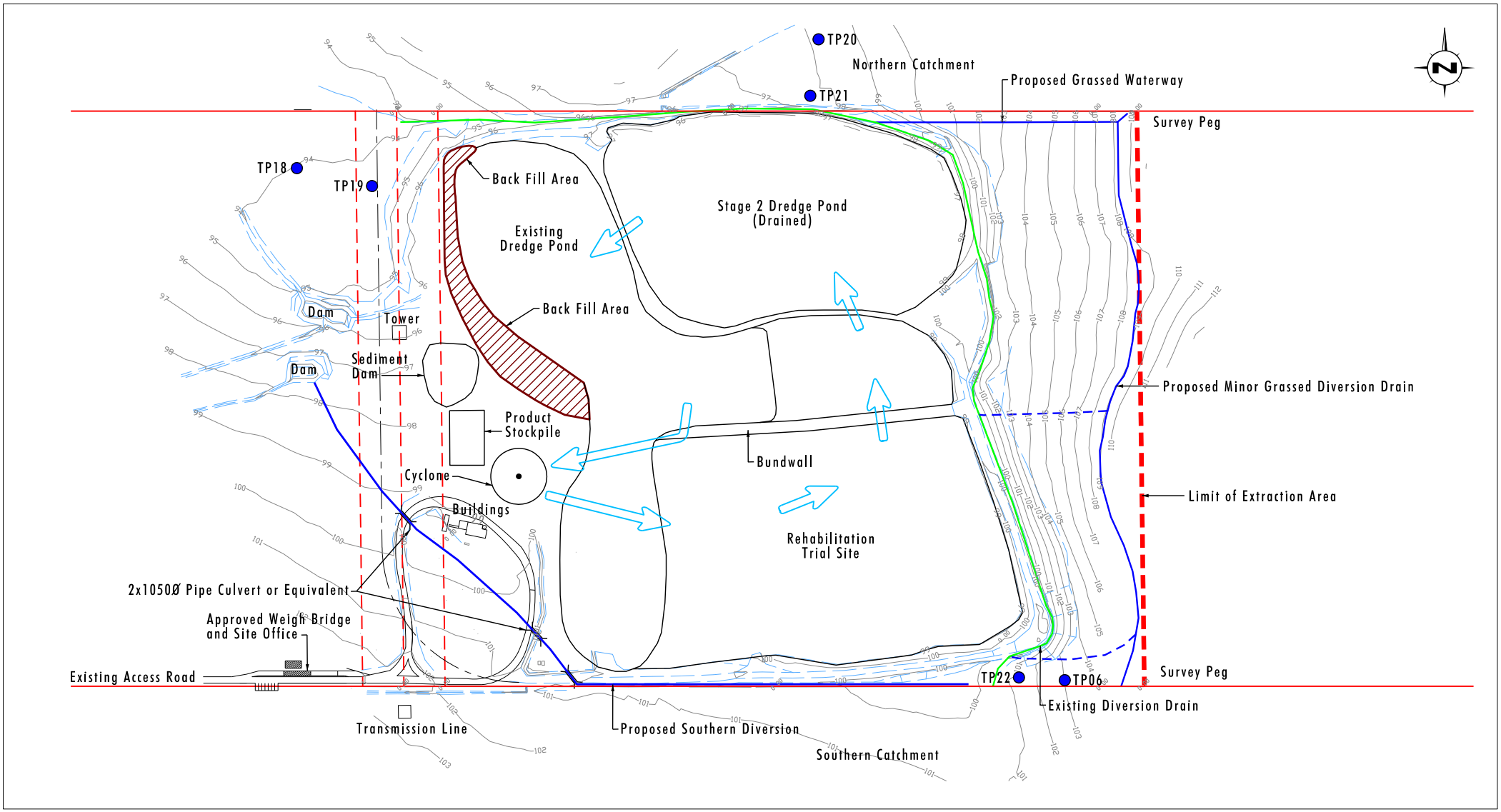
2.1.2 Services

A 60.96 metre wide electricity transmission easement containing an overhead dual circuit 330 kV transmission line crosses Lot 1, Lot 2 and Lot 3 in a north-south direction as shown in **Figure 1.3**. A sand and gravel access road connects the current extraction site with Putty Road, which is designated as State Route 69 and connects Windsor in the south to Singleton in the north. There are no other known services in the area.

2.1.3 Surrounding Land Uses

While there are a few isolated landholdings nearby zoned as Rural (Mixed Agriculture), the majority of the surrounding land as shown in **Figure 1.1** is reserved as National Park under the *National Parks and Wildlife Act 1974.* Wollomi National Park (to the west of the site) and Yengo National Park (to the east of the site) form part of the Greater Blue Mountains World Heritage Area. Land uses in the area include:

- recreational uses of both Wollemi and Yengo National Parks for bushwalking, mountain biking and other associated activities;
- agricultural uses such as duck farming;



Source: Freeburn Surveyors

0 50 100 200m
1:4000

Legend

- Groundwater Monitoring Bores
- Direction of Water Flow

FIGURE 2.1

Quarry Layout and Water Management System

- rural residential properties; and
- Putty Road, which is a popular road for motorcyclists and other tourists due to its scenic and historic values. A detailed analysis of the traffic along Putty Road is provided in **Section 4.6**.

2.1.4 Regional Geology

Tinda Creek Quarry is located in the Sydney Basin, which generally consists of lower rock strata belonging to the Narrabeen Group (sandstone, mudstone, shale) overlain by Hawkesbury Sandstone (sandstone with some shale lenses). Formations of Tertiary basalt occur as mountains (e.g. Yengo and Wareng) and as plugs in the bottom of some valleys. Hawkesbury Sandstone is the predominant sandstone unit outcropping in the region surrounding Sydney. The basement to the sand resources is the unweathered Hawkesbury Sandstone deposited during the Triassic Period (195 to 225 million years ago) (Stitt, 2010). This unit is overlain by weathered rock, clay and sand (refer **Section 2.1.4.1**).

The Hawkesbury Sandstone in the study area comprises variously coloured sands and clayey sands, white and pale coloured clay, and some grey-dark grey shale. Near the surface it is very soft and intensely weathered, while the sandstone becomes harder and more competent with depth, ranging from approximately 5 metres to 20–30 metres below the surface. Brown and reddish coloured, generally soft, ironstone concretions are observed near the top of the friable sandstone in many locations. Bedding is typical of the Hawkesbury Sandstone as observed elsewhere, variable in thickness, horizontal to sub-horizontal, and cross bedding is common (Stitt, 2010).

2.1.4.1 Geomorphic Model of Tinda Creek

Tinda Creek drains westward from the sandstone Mellong Range. For part of its course, the present day creek flows over an area of sediments deposited into a shallow lake formed in the palaeo-valley of Tinda Creek, during the Tertiary Period (2 to 60 million years ago). In other parts of the study area it flows over the friable Hawkesbury Sandstone into which the palaeo-valley was incised. The Tertiary sediments comprise a sequence of lacustrine and fluvial sands, sandy clays, silty clays, and minor thin peaty clays (Stitt, 2010).

A geological investigation of the site was undertaken by Coffey (1992) who reported that the geological sequence within the study area consists of a colluvial layer of sands and silty sands to a depth of 0.5 metres to 2 metres, underlain by residual clayey sands to a depth of 10 metres to 27 metres. The clayey sands are derived from in-situ weathering of the underlying Hawkesbury Sandstone.

Geological strata from driller's logs (Golders Associates, 2005) for a borehole that was drilled to 90 metres on site for a groundwater supply bore is provided in **Table 2.1.**

Table 2.1 – Driller's Log for Groundwater Bore at Tinda Creek Quarry

Depth Below Ground Level (m)	Material Encountered
0 to 23 m	sandy clay
23 to 51 m	sandstone yellow
51 to 54 m	sandstone white
54 to 63 m	sandstone yellow
63 to 67 m	sandstone white
67 to 68 m	clay grey
69 to 90 m	sandstone, quartzite

As shown in **Table 2.1** sand clay that is currently being quarried on-site was encountered to a depth of 23 metres. This was underlain by 44 metres of sandstone which in turn was underlain by 1 metre of clay shale at a depth of 67 metres. Below 68 metres sandstone quartzite was encountered to the base of the drill hole at 90 metres below ground level.

An assessment of sand resources at the site was undertaken (Stitt, 2010; 2012), which included a detailed drilling program. The location of boreholes that informed the resource assessment is shown in **Figure 2.2**, which also details the footprint of the resource domains mapped from the drilling program and the final extraction domains. A conceptual model of the lithology of the study area is shown in **Figure 2.3**, based on the results of the Coffey (1992) and more recent Stitt (2010; 2012) investigations.

Figure 2.4 shows a series of cross sections developed from the results of the drill logs (refer **Figure 2.2** for cross section locations). Where drill holes are not located immediately adjacent to a cross section, the lithology shown on the cross section has been inferred from drill logs of the nearest borehole and surface topography. The depth of clayey sand shown in **Figure 2.4** is limited to the extent of the borehole, however, in all cases shown the borehole was terminated in clayey sand. The depth shown for the clayey sand layer is therefore conservative. The cross sections indicate that the proposed extraction domains are located primarily within the depositional layer of relatively impermeable, lacustrine/colluvial clayey sands.

The extraction domains (and resultant dredge ponds) are therefore effectively contained within the relatively impermeable clayey sand material. As such, extraction operations are not expected to significantly affect groundwater flows or downstream flows in Tinda Creek (via drawdown), which is supported by measured and modelled groundwater levels on site (refer **Section 4.9.3**).

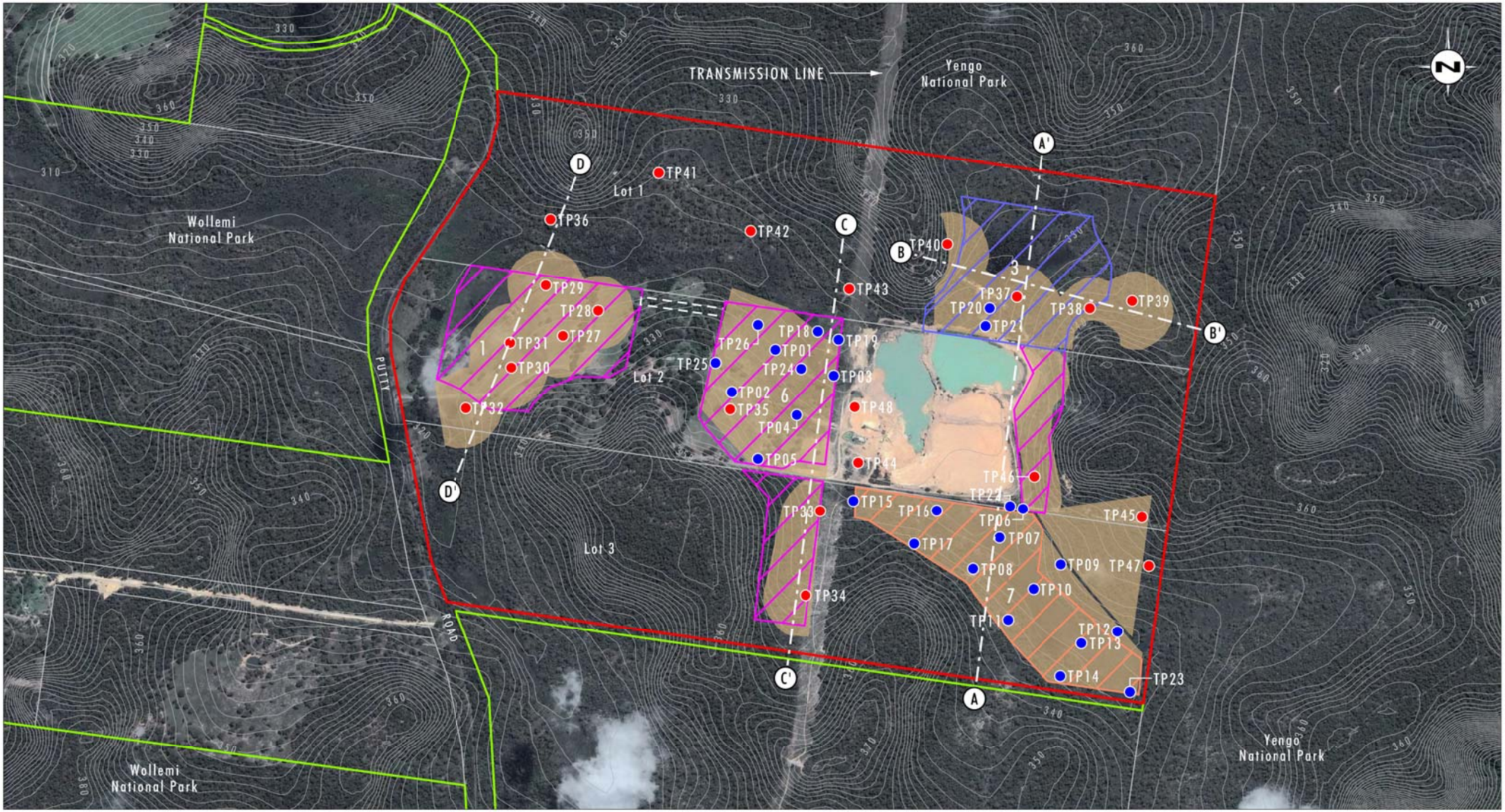
2.1.4.2 Acid Sulfate Soils

In NSW, acid sulfate soils occur along the coastal margin, in estuarine floodplains and coastal lowlands. The study area is located in an inland, elevated upper catchment valley situated at approximately 330 metres Australian Height Datum (mAHD), 70 metres below the catchment divide. The site does not support the physical environmental conditions conducive to the formation of acid sulfate soils. Accordingly, the site and surrounding area has not been mapped as containing the potential for acid sulphate soils.

2.1.5 Surface and Groundwater

The dredging ponds contain a combination of intersected groundwater and runoff from rainfall that falls on the extraction area. Groundwater bore licences are held for the site with a total approved extraction capacity of 55 million litres (ML) per year, comprising Licence 10WA112523 (WAL24381) (40 ML) and Licence 10WA112531 (WAL 24367) (15 ML). In addition Licence 10BL603495 has been granted for the establishment of 11 additional groundwater monitoring bores. Information was submitted in July 2013 to the NSW Office of Water (NOW) for conversion of this licence (yet to be completed). Further detailed analysis of groundwater conditions at the site is provided in **Section 4.9**.

The quarry operates a closed water management system. Slurry comprising water, sand, silt and clay is pumped from the dredge pond to the processing plant. Once the sand is separated, sediment laden discharge from the processing plant is conveyed to tailings dams and sediment dams which are located within the quarry water management system. There is no water discharged off-site from the water management system. Water discharged to the tailings dams and sediment dams is stored on-site and contributes to groundwater recharge in the area.



Source: Google Earth (2012), LPI NSW (2007)
Note: Contour Interval 2mAHD. For section details refer to Figure 2.4

0 200 400 600m
1:14 000

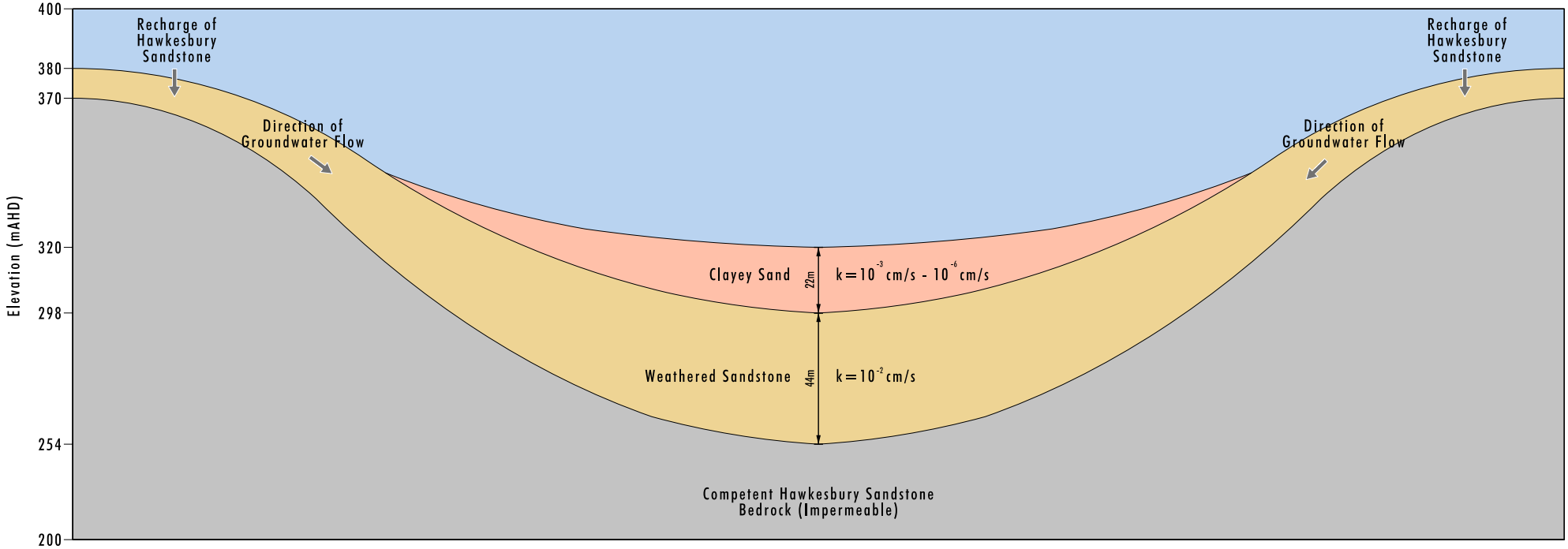
Legend

- Project Area
- Proposed Extraction Area
- Domain 3 Extraction Area
- Domain 7 Extraction Area
- National Park Boundary
- Mapped Resource Domains Footprint
- 2010 Drilling Programme
- 2012 Drilling Programme

File Name (A4): R14_V1/1731_374.dgn

FIGURE 2.2

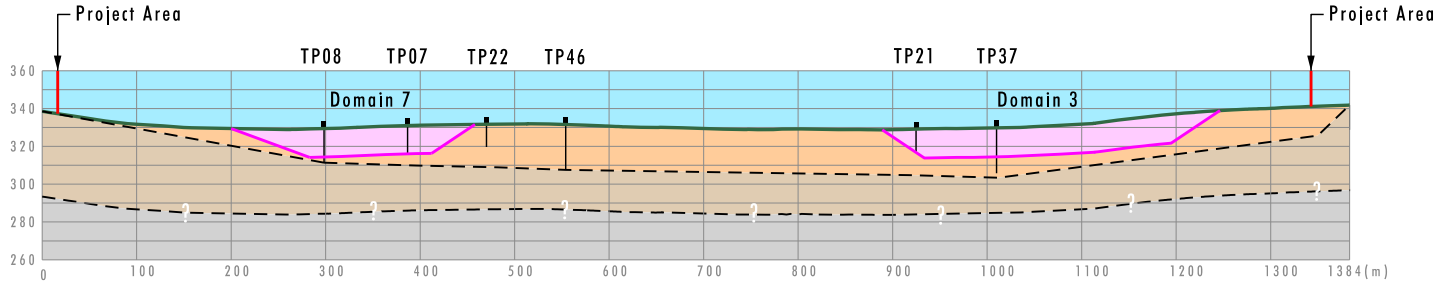
Borehole Locations and Mapped Resource Domains



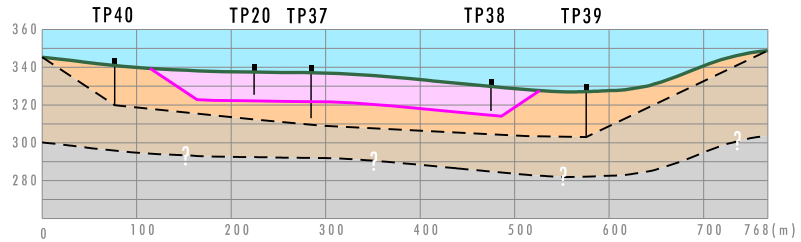
0 25 50 100m
1:20 (vertical scale)

FIGURE 2.3

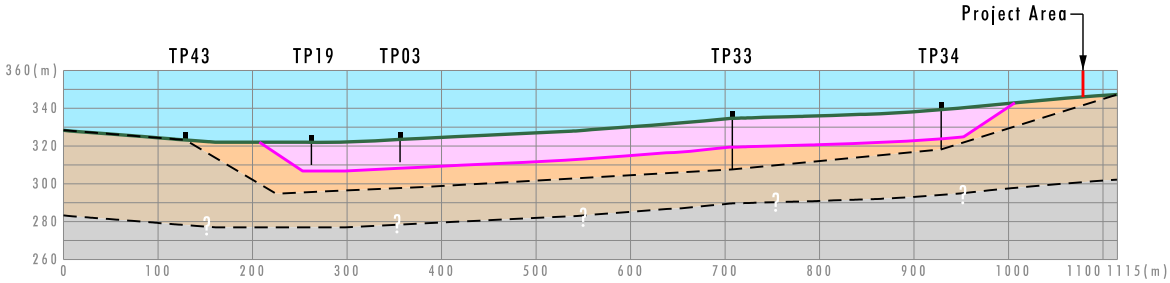
Conceptual Groundwater Model of Tinda Creek Catchment



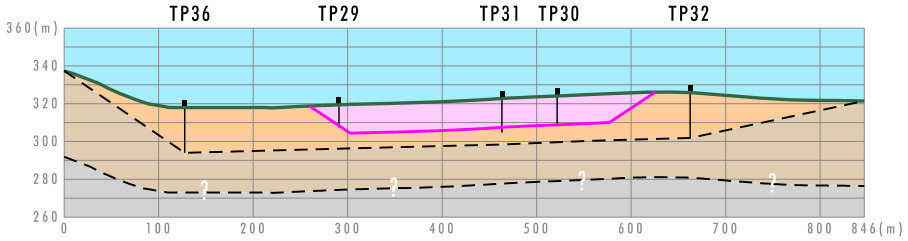
Section A-A'



Section B-B'



Section C-C'



Section D-D'

Legend

- Natural Surface
- Extracion Area
- Clayey Sand
- Weathered Sandstone
- Hawkesbury Sandstone Bedrock
- Borehole location

0 50 100 200m
Vertical Scale 1:4000

0 100 200 400m
Horizontal Scale 1:8000

FIGURE 2.4

Borehole Cross Sections

At the location of the existing quarry the valley floor is approximately 500 metres wide. Underlying the quarry is an unconfined aquifer that is comprised of approximately 20 metres to 30 metres of sandy clay, which is further underlain by approximately 40 metres of weathered sandstone. The sandy clay material has a significantly lower permeability than the underlying weathered sandstone which is the main regional groundwater conduit in the area.

The ground elevation at the quarry is approximately 330 mAHD (i.e. approximately 70 metres below catchment divide 800 metres to the east). Average ground slope between the eastern catchment divide and the quarry is approximately 9%. Ground elevation where Tinda Creek flows under Putty Road approximately 1.5 kilometres west of the quarry is approximately 15 metres lower (i.e. 315 mAHD). The stream gradient of Tinda Creek between the quarry and Putty Road is approximately 1%.

A detailed groundwater assessment has been undertaken and is discussed in **Section 4.9**, while the outcomes of the modelling are presented in **Appendix 4**.

2.2 Sand Resources

2.2.1 Current Sand Mining Operations

Stitt (2010; 2012) reports that the -75 µm clay/fines content in the proposed extraction domains varies from around 27% to 59% (average 37%) and that the Tinda Creek sand resources are well suited to the production of medium to fine grained concrete aggregates as defined by AS-2758.1.

At present, the quarry operation involves the extraction of clayey sand from the quarry area using a cutter–suction dredge, floating on an approximately 3 hectare dredge pond. The clayey sand is dredged from a depth of up to approximately 15 metres below the ground surface and typically 5 metres below the surface of the dredge pond. Extracted silt and clay sand is pumped via a pipeline to a screening and washing plant where the sand is separated from the silt and clay. The sand is then passed through a cyclone for dewatering before being stockpiled on site for subsequent despatch to market. Silt, clay and water are returned to tailings dams where the sediment is allowed to settle out. Clay is also stockpiled for subsequent use in site rehabilitation works. Water that seeps from the processing area is directed to a sediment dam where it is allowed to settle prior to being returned to the active dredge pond.

Sand is loaded from the stockpiles into trucks using a front-end loader and transported approximately 250 metres to a weighbridge, before exiting the site via a sand and gravel surfaced road at the Putty Road access (part of the Main Road system), approximately 1.2 kilometres to the west of the weighbridge. The existing quarry layout is shown in **Figure 2.1**.

The sand quarry operates a closed water management system with all water used in the dredging and washing process being recycled. Water from the current dredge pond is used to transport the dredged sand and clay to the screening and washing plant. Water used for washing sand is then used to transport tailings back to the current dredge pond as it is currently large enough for the simultaneous sedimentation of silts and clays near the processing area, and the extraction of sand and process water at the extraction face. In doing so, water is recycled to minimise water usage and assist in maintaining water levels in the dredge pond.

2.2.2 Potential Extractable Sand Reserves

As at the end of December 2013 there was approximately 500,000 tonnes of identified sand resource that could still be extracted from within the currently approved extraction area pursuant to Condition 34 of the existing consent (DA134/95) (refer **Figure 1.3**).

Available sand resources have been calculated by Stitt (2012) for the study area (refer **Figure 1.2**) based on the results of two drilling programs (**Figure 2.2**) and are summarised in **Table 2.2**, which provides estimates of raw sand and product sand.

Table 2.2 – Total Sand Resources within Identified Extraction

Resource Domain	Area (ha)	Average thickness (m)	Raw Sand Resource (Mt)	Expected Yield (%)	Product Sand (Mt)	Residual Silt & Clay (Mt)
Domain 1	11.8	16	3.32	63.0	2.1	1.22
Domain 2	3.6	24	1.53	72.0	1.1	0.43
Domain 3	11.9	16	3.29	70.0	2.3	0.99
Domain 4	4.3	15	1.11	63.0	0.7	0.41
Domain 5	5.85	24	2.50	68.0	1.7	0.80
Domain 6	12.14	7.7	1.67	70.2	1.17	0.50
Domain 7	17.54	11.1	3.51	75.2	2.64	0.87
Total	**67.13**		**16.93**		**11.71**	**5.22**

NB: Domains 1–5 based on JORC 'indicated' resource estimates (Stitt, 2012). 6 and 7 comprise JORC 'measured' resource estimates (Stitt, 2010).

The majority of Domain 4 (approximately 3.8 hectares) is located within the existing approved operations area as per DA 134/95 (**Figure 1.3**). As detailed in **Table 2.2**, an additional (to that available in Domain 4) approximately 15.82 Mt of raw sand resource has been identified in the remaining extraction domains, which would be expected to yield approximately 11 Mt of product sand.

The average grading of extractable sand resources (Stitt 2010; 2012) is shown in **Table 2.3**.

Table 2.3 – Average Grading of Identified Extractable Sand Resources

Aperture Size (mm)	4.75	2.36	1.18	0.600	0.425	0.300	0.150	0.075
Domain 6 (NW) *	**Percentage Passing**							
Raw	99.2	98.4	97.2	91.1	79.6	58.2	33.7	27
Product (all <75µm removed)	98.9	97.8	96.1	87.7	71.9	42.6	9.1	0
Domain 7 (SE) *								
Raw	99.8	99.3	97.7	89.9	75	53	29.6	22.5
Product (all <75µm removed)	99.7	99	96.9	86.9	68	40.1	9.4	0
Domains 1–5 **								
Raw	98	97	95	92	85	70	44	37
Product (all <75µm removed)	96	95	93	88	77	55	17	5

NB: * Stitt (2010) ** Stitt (2012)

As can be seen from **Table 2.3,** approximately 93–97% of the product sand resource is sized less than 1.18 millimetres in diameter (coarse sand) while approximately 40–55% of the product-sand resource is sized less than 0.3 millimetres in diameter (fine sand).

2.2.3 Sand Resources Planned for Extraction

As discussed in **Section 1.1.4**, the quantity of sand resource proposed to be extracted has been refined based on the following constraints:

- detailed assessment of ecological constraints across the site;
- adjustment of the of the boundaries of each extraction domain to account for identified constraints;
- a limit to extraction depth of 15.0 metres below ground surface; and
- final internal batters of 3:1.

This process of refinement has resulted in the final extraction plan proposing extraction as detailed in **Table 2.4**. Domains 2 and 6 and Domains 3 and 4 have been combined in **Table 2.4**, given that they will effectively operate as a single dredge pond during operations. In summary, a total of approximately 7 Mt of sand is proposed for extraction, at a maximum rate of 300,000 tpa. Assuming a long-term average of 275,000 tpa, this would result in a quarry life of approximately 25 years. Given the potential for variation in market demand and supply over this time scale, and time required for rehabilitation once the resource has been extracted, Hy-Tec is seeking an approval for 30 years of quarry operations.

Table 2.4 – Sand Resource Proposed for Extraction

Resource Domain	Area (ha)	Depth Limit (m)	Raw Sand Resource # (Mt)	Yield (%)	Product Sand (Mt)	Residual Silt & Clay (Mt)
Domain 1	14.17	15.24	2.99	63	1.89	1.10
2 & 6	18.46		3.67	71	2.61	1.06
3 & 4	17.54		3.52	67	2.34	1.18
Total	**50.17**		**10.18**		**6.84**	**3.34**

Domains 1–4 based on JORC 'indicated' resource estimates (Stitt, 2012). Domain 6 comprises JORC 'measured' resource estimates (Stitt, 2010).

As previously discussed, after taking ecological constraints into account, Domain 7 has a potential extraction area of approximately 14 hectares and contains approximately 2 Mt of product-sand that would be quarried if approval is granted and Domain 3 is included as part of a biodiversity offset area. Quarrying within Domain 7 rather than Domain 3 would result in approximately 7 Mt of product-sand being produced.

2.2.4 Future Demand for Tinda Creek Sand Products

Apart from satisfying customer demand for producing a range of sand suitable for the production of fine concrete aggregate, sand extracted at Tinda Creek will also be mixed with manufactured sand from other Hy-Tec quarry operations (refer **Section 2.4.2**). This will enable what is otherwise a waste product from hard rock quarries to be effectively utilised as construction sand.

2.3 The Proposal

The proposal involves an expansion of existing quarry operations within the study area. There are no proposed changes to the existing:

- extraction and haulage methods; and
- sand processing methods.

Back loading of virgin excavated neutral material/excavated neutral material (VENM/ENM) may increase above existing annual quantities, while at full operations, an additional two full-time staff will be required.

2.3.1 Site Access

The existing site access is via the gravel haul road that connects the processing plant to Putty Road as shown on **Figure 1.3**. The haul road is watered as necessary during hours of operation to minimise dust generation. The haul road will need to be diverted to allow completion of extraction operations in Domain 1 (refer to **Figure 1.3**). The impact assessment has taken this future diversion into account.

Traffic considerations are discussed in more detail in **Section 4.6**, which in summary, recommends the upgrade of the haul road intersection with Putty Road to comply with AS 2890.2. The recommendation is based on traffic volumes on Putty Road.

2.3.2 Site Preparation

Initial development of the proposed extraction areas will involve:

- removal and stockpiling of topsoil progressively over proposed extraction areas;
- establishing a suitably sized dredge pond or (for adjacent domains) progressively extending the existing dredge pond into the proposed extraction areas;
- bulldozing and/or hydraulically excavating peripheral sand into the dredge pond for extraction in areas where dredging alone is not feasible; and
- proceeding with extraction within the domain in accordance with the quarry extraction plan.

2.3.2.1 Topsoil Stripping

Vegetation clearing and topsoil stripping in each extraction domain will be undertaken in accordance with procedures outlined in the existing approved Environmental Management Plan (EMP). This will be updated prior to commencement of operations associated with a consent issued for the current application.

Vegetation will be removed with a bulldozer or similar equipment, any timber will be mulched and the material placed in stockpiles on rehabilitated areas as required. Topsoil and subsoil will be stripped to its full depth using a combination of bulldozer/front-end loader/excavator and haul truck. Topsoil and subsoil will then be placed on areas undergoing rehabilitation or placed in stockpile areas for future rehabilitation works. Material stripped from sedgelands will where possible be directly reused on suitably reshaped areas.

2.3.3 Extraction and Haulage

Extraction of sand from the quarry area is achieved using a cutter-suction dredge that floats on the active dredge pond. The sand is dredged from a depth of up to approximately 15 metres below the natural ground surface and piped from the dredge pond to the sand processing plant where the sand is separated from the silt and clay. Product sand is stockpiled and subsequently transported off-site via the existing haul road. Typically, extracted sand will be transported by 50 tonne trucks with a 'truck and dog' arrangement, each with a maximum payload of approximately 33 tonnes. Approximately 10,000 tonnes of product-sand may be stockpiled in the extraction area at any one time.

2.3.4 Sand Processing

It is proposed that extracted sand will be processed using the same method and infrastructure as the existing operation as described in **Section 2.2.2**.

2.3.5 Site Equipment and Infrastructure

The following equipment or similar is currently used on site:

- 10/8 Cutter Suction Dredge;
- Hyundai HI 760-7 Excavator;
- Hyundai Loader;
- D7R Caterpillar Dozer;
- 500 kVA Cummins C500 D5 Generator;
- Volvo A35 Haulage Units;
- road trucks; and
- water cart.

It is also proposed that the following site equipment and infrastructure may be replaced or purchased within normal capital expenditure cycles over the life of the project to maintain and/or increase extraction to the required level as necessary:

- upgrades to cutter suction head on the existing dredge;
- replacement dredge;
- upgrades to wash tank and cyclone tower;
- upgraded loader; and
- new additional dump truck.

Further changes to infrastructure and equipment may be required due to scheduled maintenance and ongoing operational efficiency during the 30 year project timeframe.

Existing infrastructure on site consists of administration and site offices, weighbridge, screening and wash plant, cyclone, sand tower, dredge and various water/slurry pumps.

2.3.6 Workforce and Hours of Operation

The proposed Project will require an additional two staff to the existing workforce of six if the quarry attains the additional volume. An additional 10 to 15 contract truck drivers will be required for product haulage.

It is proposed that normal hours of operation would be 5.00 am to 10.00 pm Monday to Friday and 5.00 am to 3.00 pm on Saturdays, in order to enable the quarry to service variable product demand. Extraction operations, however, would be undertaken primarily during daylight hours. Normal operations would not be undertaken on Sundays and public holidays, although it is proposed that operations such as repair and maintenance of plant/equipment and vehicles may occur during these times.

2.3.7 Proposed Extension Plan and Schedule

The proposed extraction schedule is summarised in **Table 2.5** and detailed below, based on an assumed average extraction quantity of 275,000 tpa. Following completion of dredging in Domain 4 (the majority of which is within the existing approved extraction area), extraction will either continue in a westerly direction into Domain 6 (**Figure 1.3**) or move into Domain 7 which is directly to the south-east of Domain 4 before progressing to Domain 6. To access Domain 6, a short trench (approximately 60 metres) will be constructed beneath the overhead powerline to allow movement of the dredge into the Domain 6 starter pond. Following repositioning of the dredge, a pipe will be laid in the trench to enable return flow from the existing water management system to Domain 6 and the trench will be backfilled.

While the dredge is located within Domain 6, extraction operations will also be undertaken in Domain 2 as a dry extraction operation, from which sand will be 'pushed' into the Domain 6 dredge pond (e.g. via dozer, excavator and haulage truck) and then dredged to the processing plant.

Dredging will then be focussed on Domain 1. Access to this area of the site will require excavating a cut through from Domain 6 to provide the dredge 'wet' access, preventing the need to dismantle the plant and equipment. This trench will remain open to facilitate movement of water into Domain 1 from Domain 6 and the existing water management system.

Following completion of operations in Domain 1 quarrying will either cease or the dredge will be dismantled and moved back upstream to the Domain 3 area if Domain 3 is not to be incorporated into a biodiversity offset area. Within Domain 3, extraction if it occurs is anticipated to progress upstream to the east, before returning downstream, with the dredge completing extraction in the south-west corner of Domain 3. While dredge operations are anticipated to progress as described above, the actual dredge path may vary to ensure maximised efficiency of extraction operations and minimal environmental impact.

Table 2.5 – Indicative Extraction Schedule for Average Extraction of 275,000 tpa

Operational Year	Resource Domain	Area (ha)	Product Sand (Mt)	Annual Average (t)	Estimated Completion (years)
1–10	4 & 6	17.32	2.65	275,000	9.7
11–18	2 & 1	19.45	2.24		8.1
19–26	3	13.40	1.95		7.1
Total		**50.17**	**6.84**		**24.9**

Domain 1–4 based on JORC 'indicated' resource estimates (Stitt, 2012). Domain 6 comprises JORC 'measured' resource estimates (Stitt, 2010).

It is estimated that, if Domain 7 is quarried, extraction would occur within the first approximately seven years of quarrying under the new consent with the indicative extraction schedule in **Table 2.5** being moved back approximately seven years. No extraction would occur in Domain 3 if Domain 7 is quarried.

The timeframes for the operation (approximately 25 years) are based on a long-term average annual extraction rate of 275,000 tpa. Approval is being sought however, for a 30 year quarry lifespan, to allow for potential unforeseen production delays that may occur over a three decade production horizon and to enable rehabilitation of the site to be undertaken.

2.3.8 Backfilling

Backfilling with VENM and ENM is part of the current operations. This material is brought to site opportunistically as back loads and is managed in accordance with relevant legislative requirements and strict protocols that include production of appropriate chain of custody documentation to identify that it has been appropriately certified prior to entry to the site. Hy-Tec does not accept any material that has not been certified as VENM/ENM. It is considered that the VENM/ENM brought to the site will comprise materials derived from sandstone, siltstone and clay shales from across the Sydney Basin and in aggregate would have a similar particle size and hydrogeological properties to the sandy clay material that is being extracted from the site. The material brought to site is generally backfilled upon arrival or may be stockpiled for a short period of time depending on operational needs at the time. All stockpiles of material are appropriately managed in accordance with the site's erosion and sediment control procedures as detailed in the approved EMP (Umwelt, 2013).

The backfilling is undertaken to reduce the surface area of ponds in the final landform, which minimises water loss through evaporation and reduces the potential groundwater impacts on the surrounding National Park estate. Backfilling also enables a more contiguous natural landform to be created between the extraction ponds and the site boundary.

As extraction progresses, the dredge ponds will be progressively backfilled with (initially) a mixture of spoil return (35–40% of dredge volume) and imported VENM and ENM. The amount of VENM/ENM imported to the site will be governed by availability of material and the logistics associated with haulage as backload to the site. It is estimated that a minimum of 1.4 Mt of VENM/ENM will be backloaded to the site over the life of the quarry operations. This equates to approximately 15% of the dredged volume.

It is estimated that through the return of silt and clay and through backfilling a minimum of 50% of the extraction void will be filled upon completion of extraction operations. Under this scenario, the area of open water on site would be approximately 16 hectares, which is consistent with the approved pond extents under the existing approval. Should greater quantities of VENM/ENM be available and it is logistically/financially feasible to import this material, the areal pond extents or the depth of the resultant ponds would be decreased.

Assessment of potential groundwater impacts of the proposed development (refer **Section 4.9.3**) has included consideration of the minimum backfilling scenario resulting in 16 hectares areal extent of the dredge ponds. Results of the groundwater modelling indicated no significant impacts to the regional groundwater aquifer under this scenario, or significant adverse impacts on the surrounding National Park and World Heritage estate lands with respect to lateral extents of groundwater drawdown.

2.3.9 Rehabilitation and Final Land Use

The rehabilitation of the proposed extension to the extraction area will be a continuation of ongoing rehabilitation practices at the site. Rehabilitation will consist of stabilising and

returning the quarried ecological landscape to a condition consistent with the currently approved final landform characteristics for the site. To do so, two interrelated measures are proposed: the rehabilitation of the quarried landform, and a biodiversity offset package. Natural Regrade™ software has been used to model final landforms for the quarried site to ensure that the final landform is consistent with the surrounding landforms and is free draining. The Natural Regrade™ software was developed to facilitate the design of landforms based on natural landform principles. The principles of the proposed rehabilitation of the site have informed the objectives of the landform design process and parameterisation of the model set up.

2.3.9.1 Quarry Site Rehabilitation

As described in **Section 2.3.8**, consistent with current ongoing rehabilitation measures, it is proposed that VENM and ENM will continue to be used to partially backfill extracted areas. Doing so will minimise the volume and size of open water bodies both during and after operations. Though it is recognised that there is a need in the local area to maintain a viable water source for bush fire-fighting requirements, in order to minimise the impact of current sand extraction operations on the final landform, VENM/ENM is currently being used to restore the impacted areas to a state where:

- groundwater flows are the same or similar to their state pre-extraction; and
- suitable native vegetation such as the Mellong Sandmass Sedgeland can be seeded or otherwise emplaced after the reshaping of the landform to restore the ecological profile to a state consistent with the surrounding area. Further detail regarding post-quarry land use is provided in **Section 4.2**.

It is planned that this rehabilitation work will coincide with the completion of dredging and the ongoing rehabilitation of the north-western corner of the existing quarry area. This will allow for the connection of the Mellong Sandmass Sedgeland with the Mellong Sandmass Swamp Woodland located along the gully of Tinda Creek to the west of the quarry site in Lot 1 and Lot 2. Further details on site rehabilitation and closure planning are provided in **Section 4.15**.

2.3.9.2 Biodiversity Offset Package

Two possible biodiversity offset packages have been considered and analysed as part of the proposal. A direct, like-for-like biodiversity offset is proposed as part of the Project to compensate for the residual impacts of the Project. The Biodiversity Offset Area is proposed to be located adjacent to Yengo National Park, on the northern boundary of the Project area and may possibly extend along sections of the eastern boundary if quarrying is undertaken in Domain 7 rather than Domain 3. The proximity of the National Park and the high conservation values of the Biodiversity Offset Areas suggest donation of the offset to the NPWS estate as the most effective mechanism to ensure the long-term protection of the offset area. Further consultation with NPWS and OEH will be undertaken to determine the preferred biodiversity offset area and the approach to long-term management of the biodiversity offset site.

Details of the potential offset packages are provided in **Section 4.2** and **Appendix 7**.

2.4 Alternatives to the Proposal

2.4.1 Alternative Extraction Design

An alternative considered by the proponent was to expand the quarry to fully access the identified approximately 11 Mt of resource on the site, with biodiversity offset areas to be provided offsite. This option, however, would likely have resulted in a relatively larger impact on site, in particular with respect to adversely affecting connectivity through the site. The option of providing for biodiversity offsets on site was considered to provide a more optimal balance for the Project between access to the resource and achieving conservation objectives in the locality, in particular given the proximity of the site to conservation lands. This approach has resulted in approximately 4.7 Mt of product-sand that has been identified on-site not being included in the Project.

2.4.2 Alternative Sites

Alternative sites were considered as part of the EIS process. Most land with similar topographic and soil characteristics in the region that may support suitable sand resources is conserved in perpetuity within the National Park estate. While there are other small private land holdings in the local area, in general, they do not possess suitable soil or geological features to indicate the presence of construction-quality sand.

The option of considering suitable sites outside of the region was considered, however, all sites located were considered not viable at the present time due to a combination of planning, logistical and operational constraints and proximity to existing infrastructure.

Given the availability of the resource within the existing land holdings and operations area and the fact that quarrying has been undertaken at the site for over 30 years with no adverse impacts on the surrounding ecosystem, an extension of the quarry operations was considered the most feasible option.

2.4.3 Alternative Materials

Currently, there are no alternative materials available that can replace natural terrestrially-derived sand for processes requiring industrial grade or fine construction sand. Alternatives to natural terrestrially-derived sand are available for use in some construction and fill applications and are summarised below:

- Slag sand, which is a by-product of steelmaking and can be used as a substitute for construction sand or fill and is classified as ‘coarse’ sand, whereas the Tinda Creek sand is classified as ‘fine’ sand. The availability of slag sand is limited and would not assist Hy-Tec to meet ongoing demand.

- Quarry sand (rock fines) is a by-product of the crushing process used to produce coarse aggregate in hard rock quarries. This process produces large angular shaped sand grains, which are either used in applications that require such types of sand, or where grain shape does not matter. The availability of this type of sand is considered to be low and diminishing due to improvements in hard rock processing techniques.

- Manufactured sand, which is produced through additional processing of hard rock fines or by directly crushing hard rock to sand size particles. Manufactured sand cannot be processed to fine or medium sized grains and must be blended with such sand to make it suitable for construction purposes. Currently, fine or medium grained sand can only be sourced from natural sand supplies. Manufactured sand may be available in moderate

quantities, although its availability is constrained by the expense of processing high quality hard rock that could be used to produce coarse aggregate at a lower cost.

- Recycled building and demolition materials, such as crushed concrete and brick can be used to replace coarse sand for low-strength concrete in some cases. This type of sand is often used as fill, paving sand or aggregate for road pavements and is available in small quantities.

- Excavated rock, or spoil from large scale excavation projects can be processed into sand products if the excavated rock has suitable physical properties. The production of quality sand through this process is uncommon as it is usually dependent on selective extraction of rocks during excavation or extensive reprocessing. This type of sand is often used for fill.

- Fly ash is produced by coal fired power stations and is a potential substitute for sand as it is lightweight and has self-cementing properties. It is often used as a cement extender in concrete, although its use is constrained by reprocessing and transport costs.

The potential for alternative materials to be used to replace some or all of the natural sand produced by the proposal is considered to be limited at this time, due to the limited available quantities of alternative materials and high processing costs. This is particularly evident for high quality applications such as concrete and industrial applications which require fine or very fine grade sand. Typically, the use of alternative sand products is constrained by the cost of production and transport, limited availability and inconsistent quality.

2.4.4 Alternative of Not Proceeding

As described in **Section 1.1.1**, the high demand and lack of potential future sand resources for the Sydney market was identified by Pienmunne & Whitehouse (2001). While there have been several recent approvals relating to sand extraction to service the greater Sydney and Newcastle market, notably in the Port Stephens/Stockton Bight area and near Maroota, south of Wiseman's Ferry, it is considered that there is still insufficient secure supply of sand to meet the projected demand over the next two decades.

If the proposal does not proceed, and other sources of sand suitable for the construction needs of the Sydney basin are not met, it is likely that there would be an increased shortage of supply, leading to increased prices and a consequent potential reduction in construction activity. Further, should the proposal not proceed or consent not be granted to extend the life of the operations, the financial viability of the Tinda Creek Sand Quarry will be jeopardised due to the less economically viable nature of the remaining resources under the existing consent.

3.0 Planning Context

3.1 Approval Process

As described in **Section 1.2.1**, the Project meets the criteria listed within Schedule 1 cl7(1)(b) of State Environmental Planning Policy (State and Regional Development) 2011 for assessment as State Significant Development under Section 89C of the EP&A Act. The Minister for Planning will be the determining authority for this development application.

The process for seeking approval for the proposal under Section 89C of the EP&A Act is outlined below:

- Hy-Tec submitted a Project Application to DP&I (now DP&E) supported by a PEA, seeking confirmation regarding the appropriate approval pathway. The PEA outlined the proposal and identified key environmental issues.

- After further confirmation with DP&E regarding the availability of product-sand and proposed quarry footprint, the Director-General of DP&E issued Hy-Tec with the DGRs to be addressed as part of the detailed EIS for the proposal (this document).

- Hy-Tec prepares the EIS (this document) and a draft Statement of Commitments and lodges it with DP&E. The Director-General, together with other relevant agencies and authorities, assess the adequacy of the EIS prior to its public exhibition.

- The EIS is publicly exhibited for at least 30 days. During this time, submissions are invited from the public and the Director-General consults with relevant public agencies regarding the issues raised (if any). The Director-General, in consultation with relevant agencies, produces a preliminary set of recommendations, including measures to mitigate or manage potential environmental impacts.

- The Director-General provides Hy-Tec with draft recommendations and any public submissions received. Hy-Tec responds to any issues raised and may modify the proposal and Statement of Commitments. Hy-Tec may produce a Submissions Report outlining responses to issues raised by the public, for review by the Director-General.

- If any significant modification to the proposal or Statement of Commitments is made at this stage, a Preferred Project Report is prepared to clearly define the revised proposal, commitments and predications of environmental impacts. That report will be publicly exhibited for a period of no less than 30 days for community information only (no submissions would be accepted during this period).

- NSW DP&E evaluates the EIS, any Submissions Report and Preferred Project Report (if necessary), giving consideration to submissions received during the exhibition period. NSW DP&E's draft Assessment Report is provided to the Director-General, who consults with relevant agencies prior to finalising the Assessment Report and approving or refusing approval for the proposal, or referring the Project to the Planning Assessment Commission for approval if deemed appropriate in accordance with the guidelines. If approved, the Conditions of Approval and the Statement of Commitments are finalised and provided to Hy-Tec with confirmation of the approval.

3.2 Commonwealth Legislation

3.2.1 *Environment Protection and Biodiversity Conservation Act 1999*

The Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) requires any action that has, or is likely to have, a significant impact on Commonwealth land or Matters of National Environmental Significance (MNES) to obtain approval of the Commonwealth Minister for the Environment.

The relevance of each MNES when considering the works area and environs is summarised in **Section 4.3**. A search of the Commonwealth Government's Protected Matters Search Tool was undertaken on 5 July 2013. The assessment was undertaken with reference to an Environment Protection and Biodiversity Conservation Act Online Database search, with a buffer area of 10 kilometres. A copy of the results of the database search is provided in **Appendix 5**.

The assessment indicates that there are no MNES that would be significantly impacted by the proposed development. Notwithstanding, the Proposal was referred for further assessment under the EPBC Act in relation to several listed Threatened and Migratory species (refer **Section 4.2.4** and **Table 4.3**).

Following assessment of the referral documentation, a decision notice was issued by the Department of the Environment (DoE) pursuant to section 75 and section 87 of the EPBC Act in which the matter was determined to be a 'controlled action'. A copy of the assessment requirements issued by DoE is provided in **Appendix 1**, while a response addressing the Commonwealth assessment requirements is provided in **Appendix 6**.

3.2.2 *Native Title Act 1993*

The Commonwealth *Native Title Act 1993* provides for determinations of native title in Australia. The main objects of the Act are:

- to provide for the recognition and protection of native title;
- to establish ways in which future dealings affecting native title may proceed and to set standards for those dealings;
- to establish a mechanism for determining claims to native title; and
- to provide for, or permit that validation of past acts, and intermediate period acts, invalidated because of the existence of native title.

Native Title claims are investigated by the National Native Title Tribunal and determined by the Federal Court of Australia.

As Lots 1–3 in DP 628806 are under freehold title, Native Title does not apply under the *Native Title Act 1993*.

3.3 State Legislation

3.3.1 *Environmental Planning and Assessment Act 1979*

As discussed in **Section 3.1** the process of obtaining approval for the proposal is established by the EP&A Act.

Developments that extract more than 500,000 tonnes of material per year or extract from a total resource of more than 5 Mt are listed in Schedule 1 of State Environmental Planning Policy (State and Regional Development) 2011 (refer to **Section 3.3.3.5**) and therefore require approval under Section 89C of the EP&A Act.

The Minister for Planning has confirmed that Section 89C of the EP&A Act is applicable to the proposal (refer to **Appendix 1**) and the Minister or their delegate will therefore be the determining authority for the proposal.

3.3.2 Other Legislation

Table 3.1 discusses the application of other NSW legislation to the proposal.

Table 3.1 – NSW Legislation

Legislation	Key Requirements	Relevance to the Proposal
Fisheries Management Act 1994	Listings of endangered species populations and ecological communities, critically endangered species and ecological communities, vulnerable species and ecological communities and key threatening processes.	A ministerial order to permit harm to threatened species is required if harm to listed species is identified within the proposal. No threatened species listed within the *Fisheries Management Act 1994* were recorded or are considered to be likely to be impacted by the project.
Heritage Act 1977	Approval is required from the Heritage Council of NSW to disturb or excavate land where this will or is likely to result in a relic being discovered, exposed, moved, damaged or destroyed.	No approval is required under this legislation for projects assessed as State Significant Development under Part 4 of the EP&A Act.
National Parks and Wildlife Act 1974	Approval is required from NPWS to knowingly destroy, deface or damage; or knowingly cause or permit the destruction of or damage to an Aboriginal object or Aboriginal Place. The Colo River and its tributaries are declared as Wild Rivers under this Act.	No approval is required under this legislation for projects assessed as State Significant Development under Part 4 of the EP&A Act. The proposed project area is outside of the geographic limits of the Wild Rivers regulations as described within this Act.
Native Vegetation Act 2003	Approval is required under this Act from the relevant Catchment Management Authority to clear native vegetation in certain circumstances.	No approval is required under this legislation for projects assessed as State Significant Development under Part 4 of the EP&A Act.
Protection of the Environment Operations Act 1997	Environment Protection Licences are required from the EPA for 'scheduled activities' and 'scheduled development work'.	The proposal will extract more than 30,000 t of extractive material per year and therefore meets the definition of a scheduled activity under Schedule 1 of this Act. No variation to the existing licence will be required under this Act.

Table 3.1 – NSW Legislation (cont)

Legislation	Key Requirements	Relevance to the Proposal
Roads Act 1993	Development that affects a public road, Crown road, highway, main road, freeway or tollway requires approval from the NSW Roads and Maritime Services (RMS) or the local Council under this Act.	As detailed in **Section 4.6.3.2**, an upgrade to the site intersection at Putty Road is not recommended. Compliance of the site access entrance road with AS2890.2 is required (**Section 4.6.3.3**). Should compliance require any works in the road reserve of Putty Road, an approval under the Act will be sought from RMS.
Threatened Species Conservation Act 1995 (TSC Act)	Approval is required to: (a) harm any animal that is of, or is part of, a threatened species, population or ecological community; (b) pick any plant that is of, or is part of, a threatened species, population or ecological community; (c) damage critical habitat; or (d) damage habitat of a threatened species, population or ecological community.	A comprehensive ecological assessment has been prepared for the proposal and is presented in **Appendix 7**. Impact assessments prepared for the proposal in accordance with this Act concluded that approval is not required under this legislation.
Water Management Act 2000	Identification of licensing requirements of the Act. The Water Sharing Plan for the Greater Metropolitan Region Groundwater Sources and the Water Sharing Plan for the Greater Metropolitan Region Unregulated River Water Sources both commenced during 2011. In addition, an assessment against minimal impact considerations of the Aquifer Interference Policy is required.	No new licences are required for the Project. An assessment against the provisions of the Water Sharing Plans and Aquifer Interference Policy has been undertaken in **Sections 3.4.4**, **3.4.5** and **3.5**. In addition, surface and groundwater impacts of the Project are addressed in **Section 4.9**.

3.3.3 State And Regional Environmental Planning Policies

3.3.3.1 State Environmental Planning Policy No. 33 – Hazardous and Offensive Development

SEPP 33 – Hazardous and Offensive Development (SEPP 33) requires a preliminary risk screening of a proposed development to determine the need for a preliminary hazard analysis (PHA) to assess the potential hazard associated with a proposed development. The preliminary screening involves identification and assessment of the storage of specific dangerous goods classes that have the potential for significant off-site effects. A preliminary risk screen is presented in **Section 4.12**.

3.3.3.2 State Environmental Planning Policy No. 44 – Koala Habitat Protection

State Environmental Planning Policy No. 44 – Koala Habitat Protection (SEPP 44) requires a plan of management to be approved by the NSW OEH for any impacts to 'potential' or 'core' koala habitat. Hawkesbury City Council does not have a koala habitat plan of management for the Council area. None of the 10 koala feed tree species listed on Schedule Two of SEPP 44 were recorded in excess of 15% of the canopy cover, however some areas of grey gum (*Eucalyptus punctata*) were recorded and comprised up to 10% of the canopy species.

The identification of koalas within the Project area triggered the requirement to determine whether or not the Project area provides 'core koala habitat' in accordance with SEPP 44. Core koala habitat is determined by assessing the presence of a breeding population, particularly the presence of breeding females with back-young.

A single koala was heard but could not be located during the November 2010 survey period. This was within the typical period (July to December) in which koala mothers are carrying their young on their backs. The single koala was likely a male, as females rarely bellow. In addition, a koala was identified during the February 2011 survey. The koala was a young male of approximately 4 to 6 kg. Following a period of being on their mothers' backs, young koalas are forced to begin a stage of independence around the months of December and January. During this period young koalas typically remain within their mother's home range and often in trees close to their mother. During the first half of the subsequent calendar year young koalas will typically disperse out of their mother's home range area in search of a home range area of their own. It is most likely that the young male koala identified during February was still within his mother's home range, although he may have already started the dispersal process.

The presence of a young male koala during February and the resulting likely presence of his mother's home range area within or near the Project area indicate that the woodland areas in proximity to the Project area could be 'core koala habitat'. To be conservative the Project area has been considered as most likely forming 'core koala habitat' as defined under SEPP 44.

In accordance with the requirements of this SEPP, a plan of management has been prepared to manage any potential impacts to koala habitat caused by the proposed Project. Further detail is provided in **Section 4.2.2** and **Appendix 7**.

3.3.3.3 State Environmental Planning Policy (Infrastructure) 2007

An existing dual circuit 330 kV electricity transmission easement (Transgrid) is located along the western edge of the existing quarry. Clause 45(1)(b) of State Environmental Planning Policy (SEPP) (Infrastructure) 2007 (the 'Infrastructure SEPP') states that:

> **45 Determination of development applications—other development**
>
> (1) This clause applies to a development application (or an application for modification of a consent) for development comprising or involving any of the following: ……
>
> (b) development carried out:
>
> (i) within or immediately adjacent to an easement for electricity purposes (whether or not the electricity infrastructure exists), or.....
>
> (2) Before determining a development application ... for development to which this clause applies, the consent authority must:
>
> (a) give written notice to the electricity supply authority for the area in which the development is to be carried out, inviting comments about potential safety risks, and
>
> (b) take into consideration any response to the notice that is received within 21 days after the notice is given.

In accordance with cl.45(2)(a) and (b) of the Infrastructure SEPP, written notice of the project has been provided to Transgrid (refer to **Section 1.3.1**), while comment on the proposal from Transgrid has been considered and is included in **Appendix 2**. A summary of Transgrid's response is provided in **Section 1.3.1**.

The proposal also meets the definition of a traffic generating development under cl.104 of the Infrastructure SEPP as it meets the criteria listed in Schedule 3 of that SEPP of 'commercial premises and industry more than 15,000 m^2 in area'.

In accordance with the requirements of cl.104(3) of the Infrastructure SEPP:

> (3) Before determining a development application for development to which this clause applies, the consent authority must:
>
> (a) give written notice of the application to the RTA within 7 days after the application is made, and
>
> (b) take into consideration:
>
> (i) any submission that the RTA provides in response to that notice within 21 days after the notice was given (unless, before the 21 days have passed, the RTA advises that it will not be making a submission), and
>
> (ii) the accessibility of the site concerned, including:
>
> (A) the efficiency of movement of people and freight to and from the site and the extent of multi-purpose trips, and
>
> (B) the potential to minimise the need for travel by car and to maximise movement of freight in containers or bulk freight by rail, and
>
> (iii) any potential traffic safety, road congestion or parking implications of the development.

Written notice of the Project and the PEA was provided to the RTA (now Roads and Maritime Services – RMS) by NSW DP&E (refer to **Section 1.3.1**). RMS was provided with the opportunity to provide input into the DGRs for the Project (refer to **Appendix 1**). In addition, as part of the traffic impact assessment, a meeting was held with RMS regarding the potential impacts of the Project and proposed assessment methodology. The matters to be taken into consideration in accordance with cl.104 of the Infrastructure SEPP and matters raised by RMS are addressed in **Section 4.6** and **Appendix 8**.

3.3.3.4 State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007

Clause 2 of State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007 (the 'Mining SEPP') details the aims of the SEPP as follows:

> a) provide for the proper management and development of mineral, petroleum and extractive material resources for the purpose of promoting the social and economic welfare of the State, and
>
> b) facilitate the orderly and economic use and development of land containing mineral, petroleum and extractive material resources, and
>
> c) establish appropriate planning controls to encourage ecological sustainable development (ESD) through the environmental assessment, and sustainable management, of development of mineral, petroleum and extractive material resources.

The Mining, Petroleum Production and Extractive Industries SEPP outlines where various activities are permissible both with and without development consent and defines developments that are prohibited, exempt or complying developments. These provisions do not affect the requirement for approval under Section 89 of the EP&A Act for the current project.

Clause 7(3)(a) of the Mining SEPP states that development for *'extractive industry on land on which development for the purposes of agriculture or industry may be carried out (with or without development consent)'* is permissible only with development consent. As the proposal is for development on land zoned 1 – Rural (Mixed Agriculture), the proposed development is permissible with consent.

3.3.3.5 State Environmental Planning Policy (State and Regional Development) 2011

Developments that extract more than 500,000 tonnes of material per year or extract from a total resource of more than 5 Mt are listed in Schedule 1 of State Environmental Planning Policy (State and Regional Development) 2011 and therefore require approval under Section 89 of the EP&A Act (refer to **Section 3.3.1**). As the proposal is for extraction of up to 6.84 Mt of material, approval is required in accordance with the provisions of this SEPP and Act.

3.3.4 Sydney Regional Environmental Plan No 20—Hawkesbury–Nepean River (No 2—1997)

Sydney Regional Environmental Plan No 20—Hawkesbury–Nepean River (No 2—1997) (SREP 20) provides for the regulation of development within the Hawkesbury/Nepean area. The Project site is not listed within Schedule 2 of SREP 20 as a place where extractive industries are prohibited and as such, is not prohibited under SREP 20.

3.3.5 Sydney Regional Environmental Plan No 9—Extractive Industry (No 2—1995)

Sydney Regional Environmental Plan No 9—Extractive Industry (No 2—1995) (SREP 9) provides for the regulation of extractive industries within the Sydney Region. The project site is not listed within Schedule 1, Schedule 2 or Schedule 3 of SREP 9 and consequently, is neither regarded as a site of regional extractive significance nor prohibited under SREP 9.

3.3.6 Section 117(2) Direction 1.3

Direction 1.3 was issued by the Minister under Section 117(2) of the EP&A Act in relation to Mining, Petroleum Production and Extractive Industries. Direction 1.3 requires Councils to (amongst other things) consult with the Director-General of the Department of Primary Industries (during the preparation of a draft Local Environmental Plan – LEP) to identify any resources of State or regional significance and existing extractive industries occurring in the area.

During consultation for the draft LEP, a submission was provided to Council on behalf of the landowner regarding a proposed E2 conservation zoning of sections of Lot 1, Lot 2 and Lot 3 DP 628806 (letter dated 12 April 2010). The submission indicated that (at the time) an existing Section 117 Direction applied to sand resources at the site.

Notwithstanding, it is unclear whether Hawkesbury City Council complied with this Direction during preparation of the Hawkesbury Local Environmental Plan 2012. A review of the mapping associated with the Hawkesbury Local Environmental Plan 2012 indicates no specific mapping or identification of the quarry as an extractive industry site, nor is there any specific reference in the LEP to the quarry site.

3.4 Local and Regional Planning Instruments

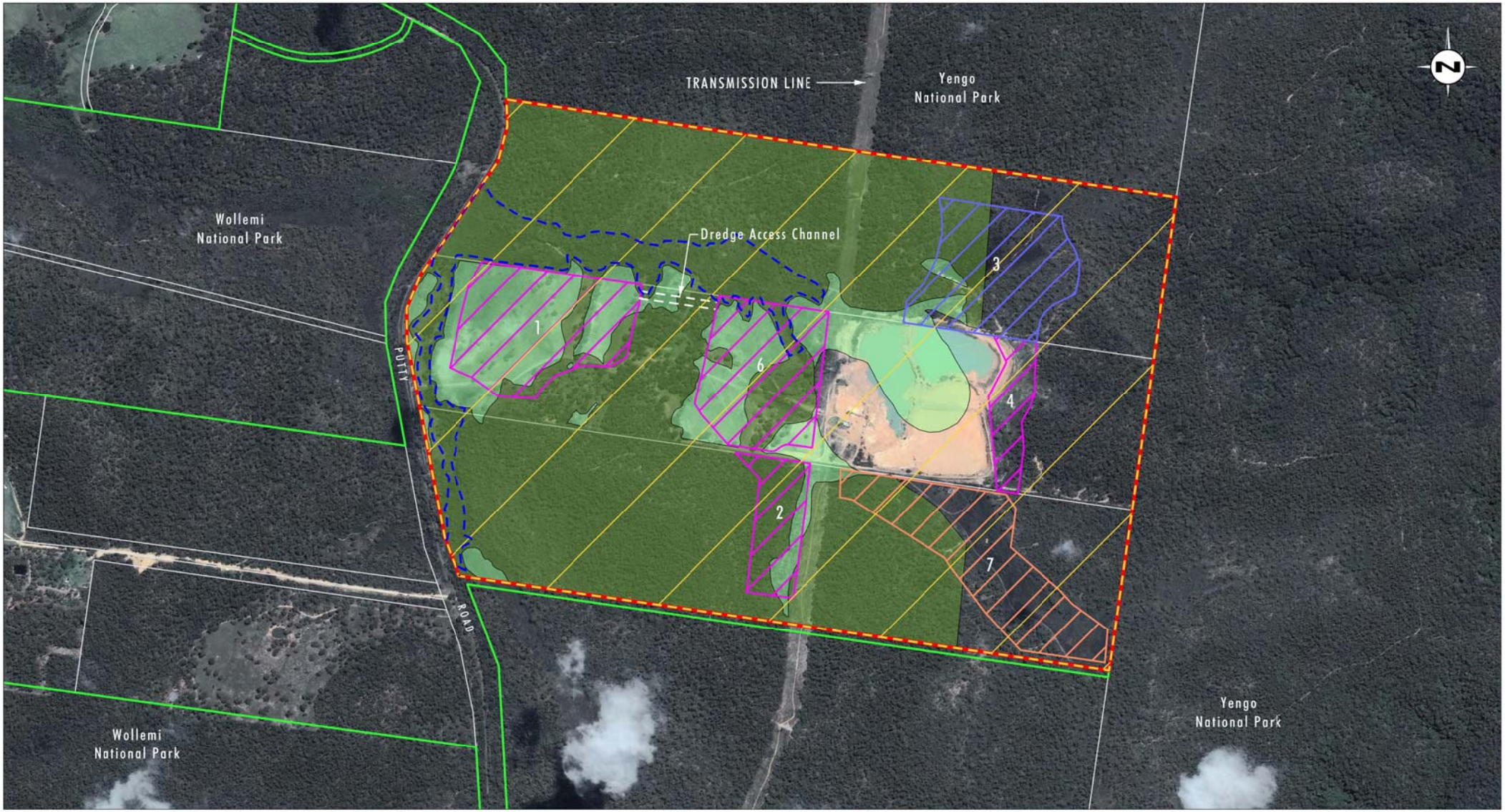
3.4.1 Hawkesbury Local Environment Plan 2012

The proposal is subject to the provisions of the Hawkesbury Local Environment Plan 2012. This plan sets the broad planning framework for development in the Hawkesbury area. The proposed operations are located within Zone RU1 – Primary Production (**Figure 3.1**). The objectives of this zone are as follows:

- To encourage sustainable primary industry production by maintaining and enhancing the natural resource base.
- To encourage diversity in primary industry enterprises and systems appropriate for the area.
- To minimise the fragmentation and alienation of resource lands.
- To minimise conflict between land uses within this zone and land uses within adjoining zones.
- To encourage agricultural activities that do not rely on highly fertile land.
- To ensure that development occurs in a way that does not have a significant adverse effect on water catchments, including surface and groundwater quality and flows, land surface conditions and important ecosystems such as waterways.
- To promote the conservation and enhancement of local native vegetation including the habitat of threatened species, populations and ecological communities by encouraging development to occur in areas already cleared of vegetation.
- To ensure that development retains or enhances existing landscape values including a distinctive agricultural component.
- To ensure that development does not detract from the existing rural character or create unreasonable demands for the provision or extension of public amenities and services.

Extractive industries are permitted within zones designated as RU1. In addition, the proposal is permissible in this zoning in accordance with the Mining, Petroleum Production and Extractive Industries SEPP (refer to **Section 3.3.3.4**). The proposal is in general, consistent with the objectives of the LEP as follows:

- While not being a primary industry, the proposed development does not affect any existing or potential primary industries.
- Assessment of potential issues related to surface and groundwater quality and flows, land surface conditions and ecosystems are addressed in **Section 4.0** of the EIS.
- Clearing of native vegetation has been minimised and where it does occur, mitigation measures are recommended to offset impacts associated with the clearing. Detailed assessment of this issue is provided in **Appendix 7** and summarised in **Section 4.2**.
- The proposal is an expansion of an existing industry on the site. As such it will not detract from the existing character of the site.
- The proposal will not create demand for the provision or extension of public amenities and services.



Source: Google Earth (2012), LMPA (2009), Hawkesbury Local Environmental Plan (2012)

0 250 500 750m
1:15 000

Legend

- Project Area
- Proposed Extraction Area
- Domain 3 Extraction Area
- Domain 7 Extraction Area
- National Park Boundary
- Zone RU1 (Primary Production)
- Wetlands (Hawkesbury LEP 2012 mapping)
- Significant Vegetation
- Connectivity between Significant Vegetation

FIGURE 3.1

Hawkesbury LEP 2012
Zoning and Constraints
Mapping for the Study Area

File Name (A4): R14_V1/1731_392.dgn

In addition, **Figure 3.1**, shows that a small portion of extraction Domain 6 is within an area designated as 'Wetland' under the Hawkesbury LEP 2012, and that all extraction Domains (except Domain 4) are located within areas designated as either 'Significant Vegetation' or 'Connectivity between Significant Vegetation'.

The additional local provisions have been included by Council in the Hawkesbury LEP 2012 in order to ensure that development avoids, minimises or mitigates potential impacts to wetlands, or to terrestrial biodiversity values respectively. These provisions are addressed in the assessments reported in **Section 4.2** and **Appendix 7**.

3.4.2 Hawkesbury Development Control Plan 2002

The Hawkesbury Development Control Plan 2002 (DCP, 2002) provides guidelines for development within the Hawkesbury LGA. The general guidelines (Part C of DCP, 2002) provide details on design and control for a range of development issues. Issues that are of relevance to the Project are summarised below with reference provided as to where they are addressed in more detail in this report:

- car parking (**Section 4.6.4**);
- erosion and sediment control (**Section 4.1.1**);
- bushfire control (**Section 4.13.1**);
- energy efficiency (**Section 4.11.8**); and
- waste management (**Section 4.13**).

3.4.3 Hawkesbury City Council Section 94 Development Contributions Plan 2008

The Hawkesbury City Council Section 94 Development Contributions Plan 2008 operates in conjunction with the Hawkesbury City Council Section 94A Development Contributions Plan 2002 and provides a framework for Council to obtain contributions from developers towards the provision of public amenities, services and infrastructure required as a consequence their development.

The plan recognises the substantial costs associated with maintaining a road network for road haulage from extractive and other industrial sources by regulating the per-tonne cost of haulage in relation to the Consumer Price Index (CPI). The rate applicable to quarries as detailed in the contribution formula in the Plan is $0.543 per tonne of material extracted. However, under Condition 8 of the existing consent (DA134/95), Hy-Tec currently pay $0.71 per tonne of material extracted. As of 24 July 2013, the standard contribution rate for quarries was increased by Hawkesbury Council to $0.74 per tonne of material extracted.

3.4.4 Water Sharing Plan for the Greater Metropolitan Region Groundwater Sources

The Water Sharing Plan for the Greater Metropolitan Region Groundwater Sources 2011 (WSPGWS) was made on 2 March 2011 and commenced on 1 July 2011. The Plan is due for extension/replacement in July 2021.

The Study Area is located in the Sydney Basin North Groundwater Source area.

3.4.4.1 Consistency of Proposed Project with and Analysis of WSPGWS Rules

An analysis of the consistency or otherwise of the proposal with the WSPGWS rules for this groundwater source area is provided in **Table 3.2**. The analysis indicates that the proposal is consistent with the rules. Further details regarding assessment of potential groundwater impacts are provided in **Section 4.9**.

Table 3.2 – Analysis of Proposal Consistency with Water Sharing Plan Rules

Water Sharing Plan Rules		Analysis
Access Rules		
Rules for granting of access licences		
Granting of access licences may be considered for the following	• Local water utility, major water utility, domestic and stock, and town water supply. *These are specific purpose access licences in clause 19 of the Water Management (General) Regulation 2004.*	• Not relevant.
	• Aquifer (Aboriginal cultural), up to 10 ML/yr.	• Not relevant.
	• Commercial access licences under a controlled allocation order made in relation to any unassigned water in this water source.	• Relevant. Hy-Tec currently holds bore licences for its existing operations and these are adequate to supply future needs of the quarry.
Rules for managing water allocation accounts		
Carryover	• Up to 10% entitlement allowed. *Carryover is not allowed for domestic and stock, major utility, local water utility or specific purpose access licences.*	• Not relevant. Commercial access licence sought.
Rules for managing access licences		
Managing surface and groundwater connectivity	• From year 7 of the plan, for areas adjoining unregulated water sources (i.e. rivers and creeks), existing works within 40 m of the top of the high bank of a river or creek, except existing works for, local water utility, town water supply, food safety or essential dairy care purposes, will have conditions which establish: ▪ the flow class of the river established under the water sharing plan for the corresponding unregulated water source, or ▪ in the absence of a flow class, visible flow in the river at the closest point of the water supply works to the river. • These distances and rules may be varied for an applicant if the work is drilled into the underlying parent material and the slotted intervals of the works commences deeper than 30 m or no minimal impact on base flows in the stream can be demonstrated. • For major utility and local water utility access licences these rules apply to new water supply works from plan commencement.	• Not relevant. Application for Project approval pre-dates year 7 of the plan (i.e. 1 July 2017).

Table 3.2 – Analysis of Proposal Consistency with Water Sharing Plan Rules (cont)

Water Sharing Plan Rules		Analysis
Rules for granting and amending water supply works approvals		
To minimise interference between neighbouring water supply works	No water supply works (bores) to be granted or amended within the following distances of existing bores: • 400 m from an aquifer access licence bore on another landholding, or • 100 m from a basic landholder rights bore on another landholding, or • 50 m from a property boundary (unless written consent from neighbour), or • 1,000 m from a local or major water utility bore, or • 200 m from a NSW Office of Water monitoring bore (unless written consent from NSW Office of Water). *The plan lists circumstances in which these distance rules may be varied and exemptions from these rules.*	• Existing bore licences for the operations are in place and the location of each bore is consistent with the rules.
To protect bores located near contamination	No water supply works (bores) are not (sic) to be granted or amended within: • 250 m of contamination as identified within the plan, or • 250 m to 500 m of contamination as identified within the plan unless no drawdown of water will occur within 250 m of the contamination source, • a distance greater than 500 m of contamination as identified within the plan if necessary to protect the water source, the environment or public health and safety. *The plan lists circumstances in which these distance rules may be varied and exemptions from these rules.*	• The existing water supply bores on the site are located >500 m from the approved septic tank on the site. In addition, modelled drawdown from the bores is approximately 50 m.
To protect water quality	To minimise the impact on water quality from saline interception in the shale aquifers overlying Sydney basin sandstone, the bore being used to take groundwater must be constructed with pressure cement to seal off the shale aquifer as specified by the Minister.	• The site does not draw water from the shale aquifers.

Table 3.2 – Analysis of Proposal Consistency with Water Sharing Plan Rules (cont)

Water Sharing Plan Rules		Analysis
To protect bores located near sensitive environmental areas	No water supply works (bores) to be granted or amended within the following distances of high priority Groundwater Dependent Ecosystems (GDEs) (non Karst) as identified within the plan: • 100 m for bores used solely for extracting basic landholder rights, or • 200 m for bores used for all other access licences. The above distance restrictions for the location of works from high priority GDEs do not apply where the GDE is a high priority endangered ecological vegetation community and the work is constructed and maintained using an impermeable pressure cement plug from the surface of the land to a minimum depth of 30 m. No water supply works (bores) to be granted or amended within the following distances from these identified features: • 500 m of high priority karst environment GDEs, or • a distance greater than 500 m of a high priority karst environment GDE if the Minister is satisfied that the work is likely to cause drawdown at the perimeter of the high priority karst GDE, or • 40 m of a river or stream or lagoon (3rd order or above), • 40 m of a 1st or 2nd order stream, unless drilled into underlying parent material and slotted intervals commence deeper than 30 m (30 m may be amended if demonstrate minimal impact on base flows in the stream), or • 100 m from the top of an escarpment. *The plan lists circumstances in which these distance rules may be varied and exemptions from these rules.*	• One high priority Groundwater Dependent Ecosystem within the Sydney Basin North Groundwater Source area as identified in the plan is located at Capertree Valley. This GDE is not located within proximity to the project area. • There are existing approved bores located within the Study Area associated with the existing operations (**Section 2.1.4**). No new bores are proposed.
To protect groundwater dependent culturally significant sites	No water supply works (bores) to be granted or amended within the following distances of groundwater dependent cultural significant sites as identified within the plan: • 100 m for bores used for extracting for basic landholder rights, or • 200 m for bores used for all other aquifer access licences. *The plan lists circumstances in which these distance rules may be varied and exemptions from these rules.*	• The results of the Aboriginal archaeological and cultural heritage assessment (**Section 4.4**) indicated that there are no culturally significant sites within the Study Area. Further, the existing licensed bores are located > 200 m from the boundary of the Study Area with the surrounding Yengo and Wollemi National Parks.

Table 3.2 – Analysis of Proposal Consistency with Water Sharing Plan Rules (cont)

Water Sharing Plan Rules		Analysis
Rules for replacement groundwater works	A replacement groundwater work must be constructed to take water from the same water source as the existing bore and to a depth specified by the Minister. A replacement work must be located within: • 20 m of the existing bore; or • If the existing bore is located within 40 m of the high bank of a river the replacement bore must be located within: ▪ 20 m of the existing bore but no closer to the high bank of the river or a distance greater if the Minister is satisfied that it will result in no greater impact. Replacement works may be at a greater distance than 20 m if the Minister is satisfied that doing so will result in no greater impact on the groundwater source and its dependent ecosystem. The replacement work must not have a greater internal diameter or excavation footprint than the existing work unless it is no longer manufactured. If no longer manufactured the internal diameter of the replacement work must be no greater than 110% of the existing work.	• The Project does not propose any replacement groundwater works.
Rules for the use of water supply works approvals		
To manage bores located near contaminated sites	Maximum amount of water that can be taken in any one year from an existing work within 500 m of a contamination source is equal to the sum of the share component of the access licence nominating that work at commencement of the plan.	There are no bores located in the Study Area < 500 m from a contamination source.
To manage the use of bores within restricted distances	The maximum amount of water that can be taken in any one year from an existing work within the restricted distances to minimise interference between works, protect sensitive environmental areas and groundwater dependant culturally significant sites is equal to the sum of the share component of the access licence nominating that work at commencement of the plan.	There are no bores located in the Study Area that are situated within the restricted distances.
To manage the impacts of extraction	The Minister may impose restrictions on the rate and timing of extraction of water from a water supply work to mitigate the impacts of extraction.	There are existing approved bores located within the Study Area associated with the existing operations (**Section 2.1.4**). No new bores are proposed.

Table 3.2 – Analysis of Proposal Consistency with Water Sharing Plan Rules (cont)

Water Sharing Plan Rules		Analysis
Limits to the availability of water		
Available Water Determinations (AWDs)	• 100% stock and domestic, local and major utilities and specific purpose access licences • 1 ML/unit of share aquifer access licences *AWD for aquifer access licences may be reduced in response to a growth in use.*	There are existing approved bores located within the Study Area associated with the existing operations (**Section 2.1.4**). No new bores are proposed.
Trading Rules		
INTO groundwater source	Not permitted.	Relevant. No trading proposed.
WITHIN groundwater source	Permitted subject to local impact assessment.	Relevant. No trading proposed.
Conversion to another category of access licence	Not permitted.	Relevant. No trading proposed.

3.4.4.2 Description of Site Water Use

As detailed in **Section 2.1.5**, the quarry has licensed groundwater bores with a total approved extraction of 55 ML/year. This water is used as top up water as required, with the dredging and processing being operated as a closed management system. In addition, a licence is held for 11 groundwater monitoring bores. It is estimated that current operations use less than 0.3 ML/year of the 55 ML/year licensed groundwater bore allocation for the site with the water being used to intermittently fill the water cart for dust suppression purposes. In addition, at current production levels of approximately 115,000 to 125,000 tpa, assuming a conservation upper limit moisture content of 8%, approximately 9 ML/year of water is exported from the site in product sand. This water is comprised of surface runoff from the closed water management system catchment and groundwater. At proposed maximum production level of 300,000 tpa, water exported from the site in product will increase to a maximum of approximately 24 ML/year which is less than 50% 0f the current licensed allocation.

At present, one sediment dam is located adjacent to the stockpile area, which receives runoff from this area of the site (site stockpile and cyclone area). The sediment dam is approximately 20 by 30 metres and up to 1 metre deep (approx. volume 0.6 ML).

A clean water diversion of Tinda Creek is located around the eastern and northern side of the current extraction operations, as shown in **Figure 2.1**. Further details on this diversion are provided below in **Section 3.4.5.1**.

3.4.5 Water Sharing Plan for the Greater Metropolitan Region Unregulated River Water Sources

The Water Sharing Plan for the Greater Metropolitan Region Unregulated River Water Sources 2011 (WSPURWS) was made on 2 March 2011 and commenced on 1 July 2011. The Plan is due for extension/replacement in July 2021.

The Study Area is located in the Sydney Basin North Groundwater Source area. At present, under the existing approval, flow from the upper reaches of Tinda Creek (a first order ephemeral stream) has been directed around the extraction area in an earthen channel to

maintain a clean water diversion (**Figure 2.1**). The channel dimensions are approximately 3 metres (wide) by 0.8 metres (deep) by 850 metres (long).

No water is currently, or proposed to be, extracted from Tinda Creek for the site operations. The rehabilitation and closure concept for the quarry (**Section 4.15**) proposes reinstating flow of Tinda Creek through the site.

Monitoring and modelling of groundwater indicates that extraction operations at the site over the last approximately 30 years have not had any significant adverse effect on groundwater levels or GDEs in the surrounding area. This is discussed further in **Section 4.9**.

Therefore, given that there is currently no surface water extraction, nor is there any proposed for the future, it is considered that the WSPURWS is in general, not applicable to the proposal.

3.5 Aquifer Interference Policy

The Aquifer Interference Policy (AIP) provides details of the role and requirements of the Minister administering the *Water Management Act 2000* in the water licensing and assessment processes for aquifer interference activities under *the Water Management Act 2000* and other relevant legislative frameworks.

The AIP applies to all activities that either penetrate, interfere, obstruct, take or dispose with/of water in an aquifer. The existing sand extraction operations at Tinda Creek penetrates the local aquifer, while water is also taken from the aquifer through pumping from the licensed water supply bores (**Section 2.1.4**).

3.5.1 Minimal Impact Considerations

The AIP requires that proponents demonstrate that minimal impact considerations specified under the AIP can be met.

The assessment provided here is based on the results of the groundwater modelling reported in **Section 4.9**.

The groundwater source category at Tinda Creek is defined as being ‘less productive’, given the yield data from production bores is less than 5 L/s (**Section 4.9**). Groundwater sampling has not included data for total dissolved solids.

An assessment of the minimal impact considerations based on the ‘less productive’ groundwater source category is provided in **Table 3.3**. For the purposes of the assessment, the groundwater source at Tinda Creek is categorised as ‘porous rock’.

Table 3.3 – Assessment of Minimal Impact Considerations for Less Productive Porous Rock Groundwater Source at Tinda Creek

Minimal Impact Consideration	Assessment
Water Table	
1. Less than or equal to 10% cumulative variation in the water table, allowing for typical climatic 'post-water sharing plan' variations, 40 m from any: (a) high priority groundwater dependent ecosystem; or (b) high priority culturally significant site; listed in the schedule of the relevant water sharing plan. A maximum of a 2 m decline cumulatively at any water supply work.	There is one high priority Groundwater Dependent Ecosystem within the Sydney Basin North Groundwater Source area as identified in the plan and it is located at Capertree Valley. This GDE is not located within proximity to the project area. There are no listed high priority culturally significant sites within proximity to the proposed extraction areas. Further, groundwater modelling (**Section 4.9**) indicates that there will be no impacts to any offsite water supply works.
2. If more than 10% cumulative variation in the water table, allowing for typical climatic 'post-water sharing plan' variations, 40 m from any: (a) high priority groundwater dependent ecosystem; or (b) high priority culturally significant site; listed in the schedule of the relevant water sharing plan if appropriate studies demonstrate to the Minister's satisfaction that the variation will not prevent the long-term viability of the dependent ecosystem or significant site. If more than a 2 m decline cumulatively at any water supply work then make good provisions should apply.	There are no listed high priority GDEs or high priority culturally significant sites within proximity to the proposed extraction areas that could be affected by drawdown from the quarry. Groundwater modelling (**Section 4.9**) indicates the variation in water table as a result of the proposed quarry development would be less than 10% at any high priority site.
Water Pressure	
1. A cumulative pressure head decline of not more than a 2 m decline, at any water supply work.	Groundwater monitoring and modelling (**Section 4.9**) indicates that the drawdown in the water table will not extend to or impact adversely on any surrounding groundwater supply bores.
2. If the predicted pressure head decline is greater than requirement 1. above, then appropriate studies are required to demonstrate to the Minister's satisfaction that the decline will not prevent the long-term viability of the affected water supply works unless make good provisions apply.	Predicted pressure head decline is less than requirement 1 (refer above).

Table 3.3 – Assessment of Minimal Impact Considerations for Less Productive Porous Rock Groundwater Source at Tinda Creek (cont)

Minimal Impact Consideration	Assessment
Water Quality	
1. Any change in the groundwater quality should not lower the beneficial use category of the groundwater source beyond 40 m from the activity.	The use of groundwater on the site is for the purposes of dust control and if required during dry times, to augment water levels in the dredge pond (i.e. to facilitate slurry pumping for transport in dredge pipes). Therefore, its use is highly unlikely to affect groundwater quality or the beneficial use category of the Sydney Basin North Groundwater Source area.
2. If condition 1 is not met then appropriate studies will need to demonstrate to the Minister's satisfaction that the change in groundwater quality will not prevent the long-term viability of the dependent ecosystem, significant site or affected water supply works.	Condition 1 has been met.

In summary, the assessment of the Project against the minimal impact considerations of the AIP indicates that the Project will meet all conditions and as such have a minimal impact on the aquifer at the site, which forms part of the Sydney Basin North Groundwater Source.

4.0 Environmental Assessment

4.1 Environmental Risk Analysis

A preliminary environmental risk analysis, summarised in **Table 4.1**, identified issues considered as requiring detailed investigation in the EIS.

Table 4.1 – Summary of Issues Analysis

Issue	Development Action	Further Assessment Required?
Ecology	Vegetation clearing	Yes. Potential flora and fauna impacts.
Aboriginal Heritage	Vegetation clearing and landform modification	Yes. Potential archaeological impacts.
Historic Heritage	Landform modification no historic heritage items identified	No. No historic heritage items on site. No further assessment warranted.
Traffic and Transport	Increase in truck movements	Yes. Potential noise and road safety impacts.
Noise	Increase in extraction operations	Yes, potential site and road traffic noise impacts.
Air Quality	Increase in extraction operations	Yes. Potential dust and diesel emissions impacts.
Water Management	Increase in surface area disturbance and intersection of water table	Yes. Potential for groundwater and surface water impacts.
Rehabilitation	Increase in surface area disturbance	Yes. Ground stabilisation and return to existing conditions (where possible) required.
Greenhouse Gas	Increase in extraction operations	Yes. Potential increase in carbon emissions.

A PEA for the proposal was provided to NSW DP&I (now DP&E) with the Project Application for consideration in issuing the DGRs for the proposal (provided in **Appendix 1**).

NSW DP&E provided the PEA to other relevant government agencies for consultation regarding the DGRs. The DGRs identified the key environmental assessment issues for the project as:

- land resources;
- biodiversity;
- water resources;
- heritage;
- traffic and transport;
- waste;
- air quality;

- greenhouse gases;
- noise;
- visual;
- hazards;
- social and economic; and
- rehabilitation.

Detailed assessment of these key issues has been undertaken and is documented in this section of the EIS, in addition to including the consideration of management and mitigation methods, as outlined in **Section 5.0** as the Statement of Commitments. A checklist of EIS requirements is provided in **Section 7.0**.

4.1.1 Other Issues

The Hawkesbury Development Control Plan 2002 (DCP, 2002) identifies several issues of relevance to this proposal. Some of these issues are addressed within the wider framework of the assessment report (**Section 3.4.2**).

4.1.1.1 Erosion and Sediment Control

Drainage off all disturbance areas is currently directed back to the dredge and settling ponds. Clean water flow from upslope of the quarry is diverted around the site. The access road has existing drainage structures in place to control potential for erosion and sediment discharge, while a water cart is used to control dust on the access road as required.

The proposed expansion of operations will continue the implementation of existing site erosion and sedimentation controls as detailed in the approved EMP for the site.

4.1.1.2 Effluent

There will be only minor changes to the existing staffing levels on the site as a result of the proposed development. As such, the existing approved effluent disposal system will not require upgrading and will operate in accordance with the existing Council approval.

4.2 Ecology

A comprehensive assessment of potential ecological impacts has been undertaken for the Project by Umwelt and is provided in **Appendix 7**. The assessment was prepared in accordance with relevant guidelines and legislation. This section provides a summary of the key findings of the ecological assessment.

4.2.1 Flora

4.2.1.1 Flora Survey Methods

A detailed flora survey methodology was designed and completed in order to gain a thorough understanding of the floristics and vegetations of the Project area. The methods included a detailed literature review of relevant reports and vegetation mapping and aerial photography interpretation. This information was then used to design a field survey program to map and survey vegetation communities and to target threatened species, endangered populations, Threatened Ecological Communities (TECs), and their habitats. The flora surveys were undertaken with consideration of the relevant OEH flora survey guidelines (DEC, 2004).

Flora surveys were undertaken on 18 June 2010, 17 and 18 November 2010, 7 to 10 February 2011, 11 and 12 August 2011 and 26 to 28 November 2012. A total of 25 systematic vegetation quadrats (20 metres by 20 metres) were sampled in the study area during the field surveys. The quadrats were positioned at sites that were selected by considering a range of attributes that influence or determine the type of vegetation community present, particularly topographic position, slope, aspect and soil type. Rapid assessments were completed at 21 locations across the Project area during June 2010. The data collected during the rapid assessment surveys was primarily used to provide assistance in the delineation and refinement of vegetation mapping and also to target threatened flora species and endangered populations. Extensive meandering transects were walked throughout the study area targeting potentially occurring threatened flora species across the site particularly the small-flower grevillea (*Grevillea parviflora* subsp. *parviflora*), Bynoes wattle (*Acacia bynoeana*), *Dillwynia tenuifolia* and *Olearia cordata*.

Vegetation communities were delineated through the identification of repeating patterns of plant species assemblages in each of the identified strata. Communities were then compared to those vegetation communities identified in the Wollemi National Park Vegetation Survey (Bell, 1998) and the Yengo National Park and Parr State Recreation Area Vegetation Survey (Bell et al., 1993). All vascular plants were identified using keys and nomenclature in Harden (1992, 1993, 2000 and 2002), and Wheeler et al. (2002). Where known, changes to nomenclature and classification have been incorporated into the results, as derived from *PlantNET* (Botanic Gardens Trust, 2013), the online plant name database maintained by the National Herbarium of New South Wales.

Further detail regarding the flora survey methodology is outlined in Section 3.3 of the Ecological Assessment provided in **Appendix 7** of this report.

4.2.1.2 Flora Survey Results

A total of 246 species were recorded within the Project area, of which 232 (94.3%) are native and 14 (5.7%) are introduced species. Five vegetation communities (with variants) were delineated across the Project area, being:

- Mellong Sandmass Dry Woodland:
  - Variation: Mellong Sandmass Dry Woodland Derived Native Grassland.
- Mellong Sandmass Swamp Woodland:
  - Variation: Mellong Sandmass Swamp Woodland (modified – overstorey absent).

- Hawkesbury Hornsby Plateau Exposed Woodland:
  - Variation: Hawkesbury Hornsby Plateau Exposed Woodland Derived Native Grassland.
- Stringybark – Ironbark Forest.
- Mellong Sandmass Sedgeland.

No endangered ecological communities (EECs) were identified within the Project area or the proposed disturbance area. One threatened flora species, small-flower grevillea (*Grevillea parviflora* subsp. *parviflora*) listed as vulnerable under the TSC and EPBC Acts, was recorded during the field surveys undertaken for this assessment. A total of 849 individuals of this species were recorded in the Project area, of which 3 occur within the proposed Domain 3 disturbance area and 91 occur within the proposed Domain 7 disturbance area.

Further detail regarding the flora survey results is outlined in Section 4.1 of the Ecological Assessment provided in **Appendix 7** of this report.

4.2.2 Fauna

4.2.2.1 Fauna Survey Methods

A detailed flora survey methodology was designed and completed in order to gain a thorough understanding of the fauna assemblage and fauna habitats of the Project area. The methods included a detailed review of relevant reports and searches of databases which was then used to design a field survey program to map and survey the fauna on the site targeting threatened species, endangered populations and their habitats. The fauna surveys were undertaken with reference to the relevant OEH fauna survey guidelines (DEC, 2004).

Four fauna survey periods were sampled within the Project area during spring and summer 2010, summer 2011, winter 2011 and spring 2012. During each of the fauna survey periods, a variety of survey techniques were employed. This included trapping surveys that targeted mammal, reptile and amphibian species including terrestrial Elliott A and B traps, arboreal Elliott B traps, terrestrial cage traps, terrestrial and arboreal hair funnels, harp traps and pitfall traps. Area searches targeted a range of species using nocturnal spotlighting, call playback sessions, diurnal and nocturnal reptile and amphibian searches, bird surveys and micro-bat echolocation recording. Targeted surveys for winter bird species, particularly regent honeyeater (*Anthochaera phrygia*) and swift parrot (*Lathamus discolor*), and Rosensbergs goanna (*Varanus rosenbergi*) were also undertaken across the Project area.

Targeted habitat assessments were also undertaken across the Project area, with particular focus on SEPP 44 – Koala Habitat Protection assessments to determine the presence of potential koala (*Phascolarctos cinereus*) habitat. An assessment of the presence of koala feed tree species was made opportunistically across the Project area as well as formally at each flora quadrat. Where koala feed species were present in the Project area, an assessment of the proportion of feed species (compared to non-feed species) within the canopy was undertaken. General habitat assessments assessing the habitat features of the three broad habitat types occurring in the Project area; being woodland/forest, sedgeland and derived native grassland habitat were undertaken. Habitat characteristics were noted and recorded including landscape slope, fire history, cut stump density, weed infestation levels, signs of feral animals, tree dieback levels, number of fallen logs, rock cover and loose bark on trees.

Further detail regarding the fauna survey methodology is outlined in Section 3.4 of the Ecological Assessment provided in **Appendix 7** of this report.

4.2.2.2 Fauna Survey Results

A total of 121 fauna species were recorded during surveys of the Project area. The 121 species comprised 69 bird, 9 reptile, 11 frog and 32 mammal species. Frequently observed species included noisy friarbird (*Philemon corniculatus*), white-checked honeyeater (*Phylidonyris niger*) the banjo frog (*Limnodynastes dumerilii*), common brushtail possum (*Trichosurus vulpecula*) and eastern grey kangaroo (*Macropus giganteus*).

A total of 15 threatened fauna species were recorded within the Project area comprising 4 birds, 1 reptile and 10 mammals (including 6 bat species). Fourteen of these species are listed as Vulnerable under the TSC Act, with two of these species, and one additional species, also listed as Vulnerable under the EPBC Act. In addition, the grey-headed flying fox (*Pteropus poliocephalus*) was recorded during surveys via its characteristic call in habitats adjacent to the Project area.

The broad habitat types recorded within the Project area comprised sedgeland, woodland/forest, derived native grassland and farm dams. Two SEPP 44 tree species, grey gum (*Eucalyptus punctata*) and forest red gum (*Eucalyptus tereticornis*) were recorded within the Project area but neither comprised 15% or more of the total number of trees in the upper or lower strata of the tree component. However the Project area was identified as potential core koala habitat by the identification of two koalas during spotlighting surveys.

Further detail regarding the fauna survey results is outlined in Section 4.2 of the Ecological Assessment provided in **Appendix 7** of this report.

4.2.3 Aquatic Habitat

Surveys of the aquatic habitat within the Project area were undertaken by Umwelt in 2007 (Umwelt, 2008) and involved condition assessments across eight monitoring sites, sampling of macroinvertebrates and water quality and photo monitoring points. Only sites 1 to 5 occur within the Project area. This monitoring was undertaken in August 2007 shortly after a period of relatively high precipitation and runoff that occurred during and following the June 2007 storm event.

Aquatic habitats in the Project area include Tinda Creek, a tributary of Wollemi Creek which joins the Colo River approximately 16 kilometres to the west of the Project area, artificial diversion channels and dam sites. Tinda Creek flows ephemerally to the north-west from the existing quarry, and has been diverted around the eastern and northern boundaries of the current operations via a small earthen drainage channel. Tinda Creek joins with other ephemeral second order streams on the northern boundary of the existing quarry. These drainage lines convey water during and immediately following rainfall, but do not pond water during periods of dry weather.

During field surveys for the Project, aquatic ecology reference sites assessed in 2007 (Umwelt, 2008) were inspected to determine whether there had been any observable changes to habitat condition. The results of the assessment reported in Umwelt (2008) supported the conclusion that there were no indications that suggested that the quarry had resulted in any adverse impacts on the ecology of Tinda Creek.

Inspection of these areas during the field work for the Project indicated no observable changes to habitat condition. This is consistent with the findings of the baseline ecological study of Tinda Creek reported in Umwelt (2008) and demonstrates that the quarry operations are not having an adverse impact on the ecology of Tinda Creek and as a result would not impact on areas of the creek further downstream in the National Park and World Heritage Area.

NSW Fisheries threatened and protected species – records viewer was also accessed to determine if any species had been newly listed or had potential to occur in the Project area (see **Appendix 7**). No threatened aquatic species listed on the *Fisheries Management Act 1994* (FM Act) or the EPBC Act were recorded or are expected to occur in the Project area. Species listed within the FM Act or the EPBC Act are considered in further detail within **Appendix 7**.

4.2.4 Potential Impacts

The ecological values identified in the Project area that were considered in determining the impact of the Project and the development of impact mitigation and biodiversity offsetting requirements include:

- the loss of native vegetation communities and fauna habitats;
- known threatened species habitat, including:
  - identified habitat for one threatened terrestrial mammal species, the New Holland mouse, listed as Vulnerable on the EPBC Act;
  - potential core habitat for the koala (*Phascolartus cinereus*), as described by SEPP 44 Koala Habitat Protection;
  - identified habitat of one threatened reptile species, Rosenberg's Goanna, listed as Vulnerable on the TSC Act;
  - identified habitat for two forest owl species, the powerful owl and masked owl, both listed as Vulnerable on the TSC Act;
  - a large population of the TSC Act and EPBC Act listed *Grevillea parviflora* subsp. *parviflora*, with approximately 849 plants recorded during surveys;
  - an area of woodland habitat for threatened woodland birds and micro-bats including (but not limited to) the varied sittella (*Daphoenositta chrysoptera*), scarlet robin (*Petroica boodang*), east coast freetail-bat (*Mormopterus norfolkensis*) and large-eared pied bat (*Chalinolobus dwyeri*); and
  - potential winter flowering woodland foraging habitat for the endangered swift parrot (*Lathamus discolor*) and for the critically endangered regent honeyeater (*Anthochaera phrygia*);
- the presence of GDEs Mellong Sandmass Swamp Woodland and Mellong Sandmass Sedgeland; and
- the presence of hollow-dependent fauna habitat, including known habitat of the squirrel glider (*Petaurus norfolcensis*) and the eastern pygmy possum (*Cercartetus nanus*) both listed under the TSC Act.

The Project will result in the clearing of a small area of habitat for a range of woodland-dependent threatened fauna species recorded in the proposed disturbance area and wider Project area. The clearing of 18.7 hectares of woodland/forest, 5.4 hectares of swamp forest and sedgeland habitat and 20.7 hectares of derived native grassland is not considered likely to result in the reduction in the local population of the threatened species recorded in the proposed disturbance area and wider Project area.

As part of the field surveys, an inspection of the areas potentially affected by drawdown of groundwater (adjacent to the existing extraction area) was undertaken, in the context of extraction operations being on-site for approximately 30 years. This assessment related to GDEs present in Domain 7 (located in the south-east corner of the study area), Domain 3

(located in the north-east corner of the study area) (refer Figure 4.1 in **Appendix 7**) and is also relevant to the area identified by Council LEP 2012 mapping as 'Wetland' (located in the western portion of the site, near the boundary of Lot 1 and Lot 2 and along the boundary with Putty Road) (refer **Figure 3.1**). It is worth noting that not all of the area designated by Council's LEP mapping is occupied by GDEs (refer Figure 4.1 in **Appendix 7**) and consequently, Council's mapping overstates the area of the site that supports 'wetland' habitat. This is presumably due to the scale at which Council mapping was undertaken and the lack of field verification.

The inspection concluded that the condition and floristic and structural components of the vegetation community adjacent to the extraction area was similar to vegetation occurring further away, with no apparent impacts from potential drawdown at the time of the field survey. The inspection also indicated that the vegetation communities adjacent to the current dredge area appeared to be in good condition, with no physical signs of degradation or die back observed. These observations accord with modelled drawdown effects of the existing dredge pond (based on measured groundwater levels in boreholes), which shows a limit of horizontal extent of drawdown, attributed to the high clay content (35–40%) and consequent low permeability of soils on site (refer **Section 4.9**). The Project is not expected to adversely impact GDEs.

Based on the threatened species assessment undertaken under the EP&A Act and EPBC Act (refer to **Appendix 7** of this report), the Project is not considered likely to result in significant impacts on threatened flora and fauna species recorded or considered likely to occur in the proposed disturbance area.

4.2.5 EPBC Referral

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) requires an Assessment of Significance relating to the potential impacts of an Action (the Project) on listed MNES (**Section 3.2.1**). This assessment has been undertaken and is summarised in **Section 4.3**, with a detailed assessment provided in **Appendix 7**.

The assessment concluded that there are no MNES that would be significantly impacted by the proposed development. Notwithstanding, the proposal was referred for further assessment under the EPBC Act in relation to several listed Threatened and Migratory species (refer **Section 4.2.4** and **Table 4.3**) and a referral report prepared and submitted to the Commonwealth DoE for consideration of whether the Project constitutes a 'controlled action'.

Following assessment of the referral documentation, a decision notice was issued by DoE pursuant to section 75 and section 87 of the EPBC Act in which the matter was determined to be a 'controlled action'. A copy of the assessment requirements issued is provided in **Appendix 1**, while a response addressing the Commonwealth assessment requirements is provided in **Appendix 6**.

4.2.6 Proposed Management, Mitigation and Offseting

Hy-Tec has sought to avoid and minimise potential impacts on the ecological values of the Project area throughout the project planning process. This has included avoidance and minimisation of disturbance of key vegetation communities and fauna habitats. Hy-Tec has also committed to the design and implementation of a comprehensive strategy to mitigate the adverse impacts of the Project which includes the rehabilitation of disturbed areas, weed control, sediment and erosion control, implementation of a robust tree felling procedure, nest box establishment in retained vegetation, and pre-clearance surveys in Rosenberg's goanna and threatened arboreal mammal habitat.

In addition, a direct, like-for-like biodiversity offset is proposed as part of the Project to compensate for the residual impacts of the Project. The Biodiversity Offset Area is located adjacent to Yengo National Park, on the northern boundary of the Project area. The proximity of the National Park and the high conservation values of the Biodiversity Offset Area suggest donation of the offset to the NPWS estate as the most effective mechanism to ensure the long-term protection of the offset site. Further consultation with NPWS will be undertaken to determine the preferred requirements for long-term management of the Biodiversity Offset Area.

Further detail regarding the proposed management, mitigation and offsetting strategy is outlined in Sections 6.0 and 7.0 of the Ecological Assessment provided in **Appendix 7** of this report.

4.3 Environment Protection and Biodiversity Conservation Act 1999 Assessment

4.3.1 Background

The EPBC Act requires that assessment must be made to determine if an activity is likely to impact upon nine identified MNES. A relatively new MNES relating to protection of water resources from impacts of coal seam gas and large coal mining projects is not applicable to this Project. Activities considered likely to cause a significant impact to MNES require Commonwealth approval under the provisions of the EPBC Act. In summary, the nine MNES listed under the EPBC Act are:

- World Heritage Properties;
- National Heritage Places;
- Wetlands of International Importance;
- Threatened Species and Ecological Communities;
- Migratory Species;
- Nuclear actions;
- Commonwealth Marine Areas;
- Great Barrier Reef Marine Park; and
- Water Resources.

4.3.2 Assessment

The relevance of each MNES when considering the proposed development is summarised in **Table 4.2**. This assessment was undertaken with reference to an EPBC Act Online Database search in July 2013, with a buffer area (locality) of 10 kilometres. A copy of the EPBC search results is provided in **Appendix 5**. It is noted that, as per 'nuclear actions', reference to the 'water resources' MNES is not included in the results of the EPBC Protected Matters Report, as its consideration relates to the type of activity rather than its location.

A detailed assessment for significance of the relevant MNES is provided in **Appendix 7**.

Table 4.2 – Consideration of EPBC Act MNES

Consideration	Assessment
World Heritage Properties	The subject site is located adjacent to the Greater Blue Mountains World Heritage Area (GBMWHA) which is a declared property with World Heritage Area status. The extraction operations are setback a minimum of 237 m (eastern boundary, refer **Figure 4.1**) from the boundary with Yengo National Park if Domain 3 is quarried and 40 m if Domain 7 is quarried. Yengo National Park forms part of the GBMWHA. Wollemi National Park, which also forms part of the GBMWHA, is located across Putty Road and downstream of the subject site. The quarry operates a closed water management system, with clean water drainage diverted around the site. This water management approach will continue for the proposed expanded operations. The proposed expanded extraction operations will not adversely affect any of the official values of the GBMWHA, which relate to the diversity of examples of ongoing ecological and biological processes significant in the evolution of Australia's highly diverse ecosystems and communities of plants and animals, particularly eucalypt-dominated ecosystems.
National Heritage Places	The subject site is located adjacent to the GBMWHA which is listed as a National Heritage Place. The extraction operations are setback a minimum of 237 m (eastern boundary, refer **Figure 4.1**) from the boundary with Yengo National Park if Domain 3 is quarried and 40 m if Domain 7 is quarried. Yengo National Park forms part of the GBMWHA. Wollemi National Park, which also forms part of the GBMWHA, is located across Putty Road and downstream of the subject site. The quarry operates a closed water management system, with clean water drainage diverted around the site. This water management approach will continue for the proposed expanded operations. The proposed expanded extraction operations will not adversely affect any of the official values of the GBMWHA, which relate to the diversity of examples of on-going ecological and biological processes significant in the evolution of Australia's highly diverse ecosystems and communities of plants and animals, particularly eucalypt-dominated ecosystems.
Wetlands of International Significance (RAMSAR Wetlands)	There are no RAMSAR wetlands listed in the locality.
Great Barrier Reef Marine Park	The Great Barrier Reef Marine Park is not in the locality.
Commonwealth Marine Areas	There are no Commonwealth marine areas listed in the locality.
Threatened Ecological Communities	One critically endangered and one endangered community listed on the EPBC Act were identified as having potential to occur within a 10 km radius of the proposed disturbance area based on the results of the Protected Matters search. Neither of these communities, however, is located on the subject site.

Table 4.2 – Consideration of EPBC Act MNES (cont)

Consideration	Assessment
Threatened Species	A total of 36 EPBC-listed threatened species are recorded as being in the locality. One flora species listed as Vulnerable under the EPBC Act was recorded on the site, namely small flower grevillea (*Grevillea parviflora* subsp. *parviflora*). Four fauna species listed as Vulnerable under the EPBC Act were recorded on the site, namely large-eared pied bat (*Chalinolobus dwyeri*), koala (*Phascolarctos cinereus*), new holland mouse (*Pseudomys novaehollandiae*) and grey-headed flying-fox (*Pteropus poliocephalus*). A detailed assessment of significance with respect to these species (**Appendix 7**) indicates that the proposed development is considered unlikely to cause a significant impact on any Threatened species listed under the EPBC Act.
Migratory Species	A total of 13 EPBC-listed migratory species were recorded as being in the locality. Only one listed migratory species has been recorded within the Project area, the white-bellied sea-eagle (*Haliaeetus leucogaster*). A detailed assessment of significance with respect to this species (**Appendix 7**) indicates that the proposed development is considered unlikely to cause a significant impact on any Migratory species listed under the EPBC Act.

4.3.3 Other Matters Protected by the EPBC Act

In addition to MNES, consideration must be given to other matters protected by the EPBC Act when assessing proposals. These matters are summarised in **Table 4.3**.

Table 4.3 – Consideration of Other EPBC Act MNES

Consideration	Assessment
Commonwealth Lands	One (1) EPBC-listed Commonwealth Lands is recorded in the locality. This land is not located within the subject site. The proposed development will not impact upon any Commonwealth Lands.
Commonwealth Heritage Places	There are no Commonwealth Heritage Places listed in the locality. No Commonwealth Heritage Places will be affected by the proposed activity.

Table 4.3 – Consideration of Other EPBC Act MNES (cont)

Consideration	Assessment
Listed Marine Species	A total of 12 listed marine species are recorded as potentially occurring in the locality. The proposed development is located approximately 35 km inland from the nearest estuarine environment (Hawkesbury River at Wisemans Ferry) and 75 km inland from the nearest marine environment (Tasman Sea). Further, the site is at approximately 330 m AHD elevation. In general, the site therefore does not contain any habitat for the listed Marine Species. One species (also listed as migratory), however, was recorded flying over the site during field surveys (white-bellied sea-eagle *Haliaeetus leucogaster*). A detailed assessment of significance with respect to this species (**Appendix 7**) indicates that the proposed development is considered unlikely to cause a significant impact on any Marine species listed under the EPBC Act.
Whales and Other Cetaceans	There are no whales or other cetaceans recorded in the locality. As such, the proposed development will not impact upon any habitat for whales and other cetaceans.
Critical Habitats	No critical habitats listed under the EPBC Act have been identified within the locality.
Commonwealth Reserves	No Commonwealth Reserves occur within the locality.

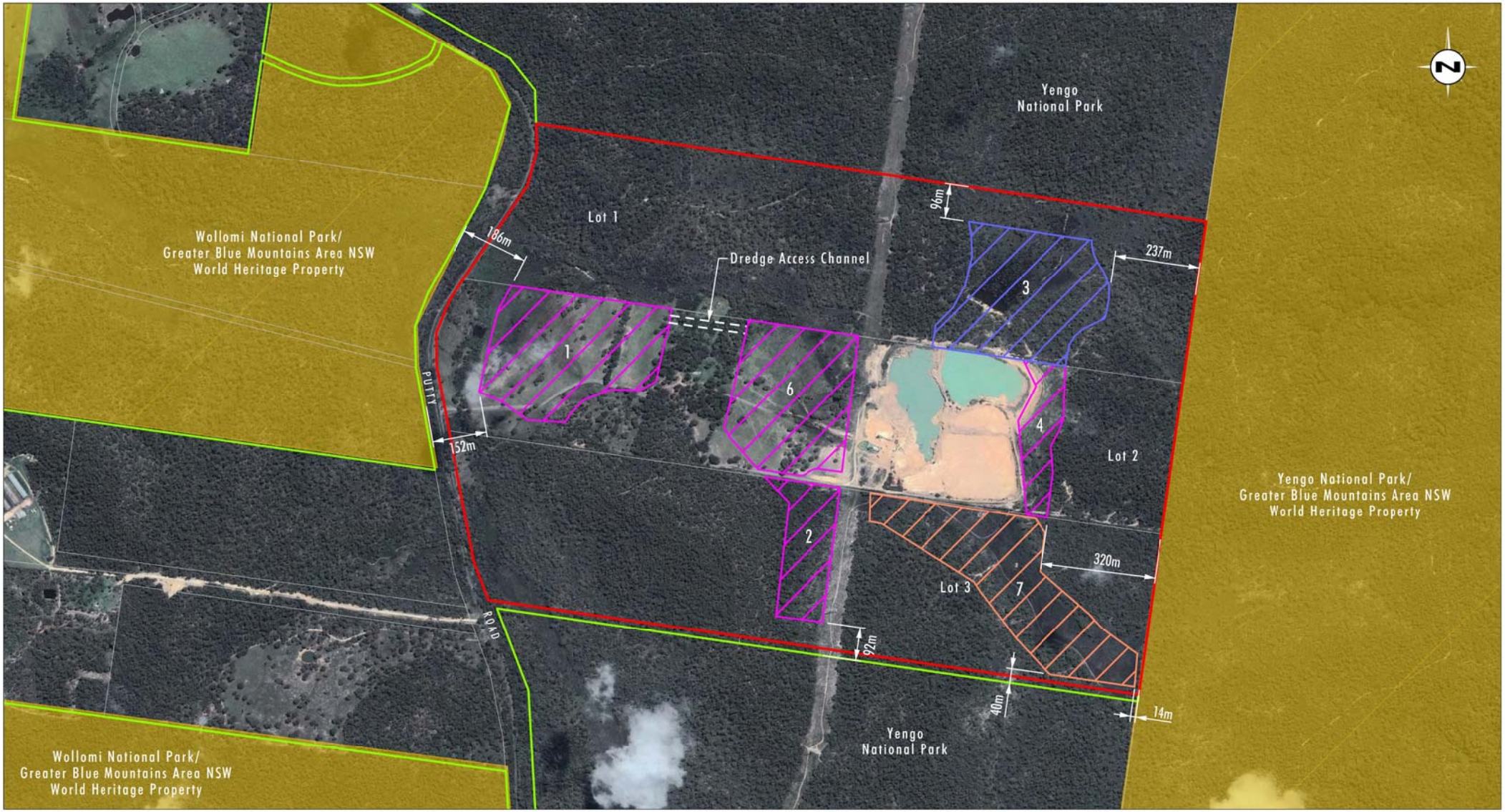
4.3.4 Assessment Conclusion

The assessment of significance concludes that the proposed development will not result in the potential for a significant effect on Threatened Species and Threatened Ecological Communities listed under the EPBC Act.

There are no Wetlands of International Significance, Migratory Species, EPBC-listed threatened species or any other matters protected by the EPBC Act that will be significantly affected by the proposed development. It is therefore considered that the proposed development would not require Commonwealth approval under the provisions of the EPBC Act.

Notwithstanding, the proposal was referred for further assessment under the EPBC Act in relation to listed Threatened and Migratory species (refer **Section 4.2.4** and **Table 4.3**).

Following assessment of the referral documentation, a decision notice was issued by the DoE pursuant to section 75 and section 87 of the EPBC Act in which the matter was determined to be a 'controlled action'. A copy of the assessment requirements issued by DoE is provided in **Appendix 1**, while a response addressing the Commonwealth assessment requirements is provided in **Appendix 6**.



Source: Google Earth (2012), LPI NSW (2007), Australian Government Department of the Environment - Water - Heritage and the Arts (2007)

Legend

- Project Area
- Proposed Extraction Area
- Domain 3 Extraction Area
- Domain 7 Extraction Area
- National Park Boundary
- Greater Blue Mountains Area NSW World Heritage Property

FIGURE 4.1

Proximity of Project Area to World Heritage Area and National Park

File Name (A4): R14_V1/1731_393.dgn

4.4 Aboriginal Archaeology and Cultural Heritage

4.4.1 Aboriginal Party Consultation and Involvement

Aboriginal party identification and consultation for this assessment has been undertaken in accordance with DoE, Climate Change and Water (DECCW[1], 2010) *Aboriginal Cultural Heritage Consultation Requirements for Proponents* (ACHCRs). Through the notification process required by the ACHCRs the following Aboriginal parties were identified as having an interest in the Project area:

- Darug Aboriginal Cultural Heritage Assessments (DACHA).
- Darug Aboriginal Land Care (DALC).
- Darug Custodial Aboriginal Corporation (DCAC).
- Darug Land Observations (DLO).
- Darug Tribal Aboriginal Corporation (DTAC).
- Gunjeewong Cultural Heritage Aboriginal Corporation (GCHAC).
- Hawkesbury–Nepean CMA Catchment Officer (Aboriginal Communities) (HMCA).
- Metropolitan Local Aboriginal Land Council (MLALC).
- Yarrawalk (Y).

All Registered Aboriginal Parties were consulted throughout the course of the Aboriginal heritage assessment process from the time of their registration. In summary, this involved the opportunity to attend meetings, provide cultural input throughout the assessment process and participate in archaeological surveys and review of key documents, including the draft survey strategy and draft assessment report. Copies of correspondence to and from registered Aboriginal parties are provided in **Appendix 9**.

4.4.2 Aboriginal History of the Study Area

The Yengo and Wollemi NP areas were not opened up to European settlers until the Putty Road was completed and opened for traffic in 1823. The first recorded instances of Europeans in the Wollemi and Yengo National Park areas were three expeditions, undertaken by William Parr, Benjamin Singleton and John Howe (1817–1820) attempting to find an overland route from Sydney to the Hunter Valley (O'Rourke, 2009).

After an overland route to the Hunter Valley had been established, survey and settlement began, however, this was focused on the more hospitable Hunter Valley area. The Putty Road was not heavily travelled after it was officially opened, as it was a dangerous road and soon became known for the bushrangers who attacked travellers. In 1942 the road was reconstructed as a defence route south as a result of the vulnerability of the Hawkesbury River ferry crossings and the threat of Australia being invaded from the north, and the road was fully sealed in 1964 (PRTDM, 2010).

[1] Now the Office of Environment and Heritage.

The 1938 Ivory Parish Map (refer to **Appendix 9**), indicates the land to the east of Putty Road, including the Project area, as having been granted to V C R & M I Meyer by that time. The earliest confirmed use of the land within the Project area is the use of the sedge swamp area for pumpkin cultivation (Ray Bygraves pers. comm.).

Disturbance factors within the Project area arising from historic use include ground disturbance caused by the existing quarry, the construction of earthen dams and levees for the diversion of water around the existing quarry, surface and subsurface disturbance caused by the installation of a 330 kV transmission line which runs north to south across the assessment area, cleared gravel vehicle tracks and general disturbance caused by vegetation clearance, agricultural practices and the movement of vehicles through the area.

All of these impacts have the potential to have disturbed and/or destroyed any Aboriginal sites that may have occurred within the parts of the Project area affected by the proposed quarry expansion.

4.4.3 Context

4.4.3.1 Environmental

The Project area is located on the edge of the Macdonald Ranges. The Project area is a private land holding, bordered by the Yengo National Park to the north, east and south and the Putty Road to the west, with the Wollemi National Park on the western side of Putty Road. The two National Parks surrounding the Project area form part of the Greater Blue Mountains World Heritage area which was gazetted in 2000. The World Heritage area is comprised of eight protected areas (including the Yengo and Wollemi National Parks) and is noted for its representation of eucalypt habitats as well as localised swamps, wetlands and grassland (UNESCO, 2000).

The Project area is located in the Sydney Basin, which is generally composed of Narrabeen and Hawkesbury sandstones and shales (NPWS, 2001). The Project area is underlain by Hawkesbury Sandstone and overlain by Quaternary Alluvium consisting of gravel, sand, silt and clay layers.

The Project area is located within two soil landscapes, the Gymea soil landscape and the Oxford Falls Variant A soil landscape. The proposed extraction domain areas are almost entirely within the Oxford Falls soil landscape. The soil profile integrity, and thus integrity of possible archaeological deposits is low in both soil landscapes, as a result of historic land clearance, quarrying activities and agricultural practices. The sandy nature of the soils also suggests that if artefact material was discarded in the area that it would be likely to move down through the soil profile through bioturbation.

The Project area is part of the Mellong Swamp system and reflects the general topography of the Mellong Range, which is characterised by rounded broad crests and wide valley floors (DECC, 2008), with elevations ranging from 320 metres to 380 metres. In the swampy areas the slopes are generally gently inclined (McInnes, 1997). Spur crests define the north, east and western edges of the Project area while the central and eastern areas are comprised of low gradient slopes, creeklines and sedge swamp.

Tinda Creek is a tributary of Wollemi Creek which joins the Colo River approximately 16 kilometres to the south-west of the Project area. From its start in the Project area, Tinda Creek flows intermittently to the north-west, and has been diverted around the eastern and northern boundaries of the existing quarry via a small earthen drainage channel. Tinda Creek joins with other intermittent second order streams at the northern boundary of the existing quarry. These drainage lines contain water during and immediately following rainfall, but do not hold water during periods of dry weather.

A review of the flora and fauna species recorded in and immediately around the Project area identified the presence of species with known Aboriginal uses but suggested that the larger Mellong Swamp may have been the focus of Aboriginal resource gathering activities.

Ethnographic recordings indicate that Aboriginal pathways and trade routes existed throughout the broader Yengo and Wollemi National Park areas and that specific areas within Yengo National Park were regularly used for ceremonial purposes.

4.4.3.2 Aboriginal Cultural

No specific information was provided by the registered Aboriginal parties in relation to the Aboriginal cultural context of the Project area. However, information in relation to Aboriginal cultural significance of the area was provided by relevant stakeholders as part of the consultation process. This is detailed further in **Section 4.4.10**.

4.4.3.3 Archaeological

A search of the OEH Aboriginal Heritage Information Management System (AHIMS) database conducted on 3 April 2013 revealed eight previously recorded archaeological sites located in an area of 10 by 10 kilometres surrounding the Project area (AMG coordinates E281000-291000/N6323000-6333000) (refer to **Table 4.4**). The site locations are shown in Figure 5.1 of **Appendix 9**.

Table 4.4 – Registered Sites within 5 kilometres of the Project Area

Site ID	Site Name	Datum	Easting	Northing	Site Type	Distance and Direction from the Project Area
45-2-0346	Yengo NP	AGD	287970	6331630	Axe Grinding Groove, Rock Engraving	3.75 km north-north-east
45-2-0390	Yengo NP	AGD	287620	6328010	Shelter with Art	850 m east
45-2-2404	C806	AGD	283800	6332790	Shelter with Art	4.7 km north-north-west
45-2-2430	Caloul Swamp Shelter	GDA	283357	6326785	Shelter with Artefact Scatter, Grinding Grooves, Archaeological Deposit	1.9 km south-west
45-2-2467	Fern Bank Shelter	GDA	281732	6326188	Shelter with Artefact Scatter and Axe Grinding Grooves	3.6 km
45-2-2468	Attic Shelter	GDA	281750	6326208	Shelter with Axe Grinding Grooves	3.7 km south-west
45-2-2493	Tari Valley Shelter	GDA	281560	6323328	Shelter with Art and Artefact scatter	5.75 km south-south-west
45-3-2257	Yengo NP	AGD	287850	6328100	Axe Grinding Grooves	1.1 km east

A site search of a broader area (20 kilometres by 30 kilometres) identified 107 sites. The majority of these sites were rockshelters with art, engraving sites and grinding groove sites. There were a very low number of artefact scatter sites recorded.

The only previous archaeological survey of the Tinda Park area was undertaken by Bonhomme and McDonald for Brayshaw and Associates in August 1984. This inspection related to a dam that was located immediately north of the extraction operations at the time (and is now part of the current extraction area). As part of the survey, all eroded/exposed areas were inspected and rock outcrops were examined for engravings, art and possible shelter habitation. During the survey a piece of rhyolite/silcrete with no obvious evidence of flaking and a quartz flake with a definite bulb of percussion were identified within a metre of each other. The silcrete/rhyolite was uncommon enough in the region to warrant inspection, however, all of the breakages were deemed to be fresh. It was concluded that both 'isolated finds' had resulted from the use of an access track and were only of 'possible' Aboriginal origin. No other artefactual material was located within the area assessed. The two pieces of stone were outside the then proposed dam impact area.

In relation to the broader Yengo and Wollemi National Parks, previous archaeological investigations and the OEH AHIMS register indicate that:

- occupation sites are rare – this may be a reflection of past investigation biases rather than what is actually present;
- engraving sites are relatively common where suitable sandstone is exposed on ridgelines;
- grinding groove sites are relatively common where suitable sandstone is located in association with creeklines or a water source such as a pothole within a sandstone platform;
- stone arrangements, while not common, do occur in the area;
- rockshelters with evidence of use are relatively common in areas with suitable geology/topography. These may contain a mix of art, artefacts, grinding grooves and/or potential archaeological deposit (PAD); and
- scarred trees have been recorded in the adjoining National Parks but are not common.

4.4.4 Predictive Modelling

Based on the environmental, ethnographic and archaeological (refer to **Sections 4.0** and **5.0**) context of the Project area the following predictive model was formulated:

- there is a very low likelihood that archaeological material/sites reflecting intensive use by Aboriginal people will be located in the Project area;
- if sites are located within the Project area they are likely to be small artefact scatters and isolated finds resulting from transient use of the area by Aboriginal people;
- small artefact scatter sites and isolated finds if present are most likely to be situated on the slightly elevated, low gradient, spur crests within 50 metres of Tinda Creek;
- if small artefact scatter sites and isolated finds are present they are most likely to be identified in areas with high levels of exposure in proximity to creek banks or in areas of prior disturbance;
- if artefacts are located they are likely to have been manufactured from quartz, fine grained siliceous materials, quartzite or basalt. Flakes, broken flakes and flaked pieces are the most likely artefact types;

- the nature of the sandy soil within the Project area and surrounds mean that sites containing stone artefacts are likely to have been affected by ongoing taphonomic processes which may have acted to destroy sites through erosion or to bury the artefacts through soil aggradation at the base of slopes or through bioturbation[2];

- within the area of the sedge swamp and unmodified slopes visibility is expected to be low. Vegetation cover is expected to be moderate to high based on reasonable rainfall experienced prior to survey;

- if any mature trees remain, scarred trees may be present;

- grinding grooves and rock engraving sites are not likely to occur/to have been preserved in the Project area due to the unsuitable highly weathered nature of the sandstone and the limited area in which it outcrops;

- due to the low gradient topography rockshelters will not occur in the Project area;

- the spur crest and ridge crests surrounding the Project area were likely used as travel ways through the landscape. There are low-lying, low gradient spurs extending into the edges of the Project area from the surrounding ridges. It is possible that Aboriginal people passed through the Project area and used these spurs to access the ridges. Based on ethnographic information it is also possible that the Putty Road, passing to the west of the Project area was used by Aboriginal people as a travel way;

- the swampy portions of the Project area would have been attractive for aquatic resource gathering but would not have been a favourable location for Aboriginal people to camp in the past, as it would have been wet or damp, especially after periods of rainfall. The western portion of the Project area is likely to have contained more swamp land in the past, also making it unattractive for camping; and

- the Project area is more likely to have been used as a resource gathering area rather than for camping. Resource gathering is an activity that does not often result in large amounts of artefact discard and making occupation/use difficult to discern.

4.4.5 Previous Archaeological Research

As only a limited amount of research has been undertaken in the vicinity of the Project area, this section of the report will look at a wider range of studies, including the previous study undertaken in the Project area, some of the larger studies within the Yengo National Park and a wider reaching study in the Sugarloaf Range that will assist in informing the current assessment.

4.4.5.1 Sim (1966)

Sim (1966) located and recorded 22 groups of rock engravings in the MacDonald River Valley. Within these 22 groups of engravings there were 44 clusters of engravings, with emu tracks represented in a large number of sites. In the discussion of the engravings and the region, Sim notes that the southern section of the MacDonald River region is rugged and infertile, with the ridge tops almost devoid of water, apart from after heavy rains. Sim notes that the engravings are situated along the main ridges, with the majority being on the two ridges that provide routes between the more fertile valley areas in the region.

[2] Bioturbation refers to activities of animals and insects that act to move artefacts through the soil profile through activities such as burrowing or trampling.

It was also highlighted that the engravings are limited to the area south of Putty and Wollombi, despite (painted) rockshelter art continuing north and west from the region. Sim avoided interpreting the engravings, apart from noting that many of the engraving sites were probably sacred sites.

Observations about the environment at the time were made, including a note that the MacDonald River had at one stage been a deep, permanent reliable source well stocked with fish, but by 1966 it was silted and shallow. It was also noted that within then living memory a number of reliable water holes at the heads of gullies had been destroyed by silting and scouring.

4.4.5.2 Smith (1983)

As part of her Honours research, Smith (1983) investigated rock art in the Mangrove Creek and Macdonald River valleys to see if a tribal boundary between the Kuringai and Darkingjung could be seen – being the Macdonald River itself, or a distinguishable boundary buffer zone that would have been used by both groups.

Smith (1983) looked at the spatial distribution of variations in form and techniques in the rock art of 108 shelters and 71 open engraving sites with macropods and anthropomorphic figures. In her study she did not look at the artefacts located at any of the shelters, therefore these cannot be used to inform the current Project.

In addressing what figures to compare, Smith observed all of the motifs and found that open engraving sites east of Mangrove Creek tend to have a predominance of lizards and implements and a low emphasis on tracks, while those on the west of Mangrove Creek appear to emphasise tracks rather than figures. On both sides of Mangrove Creek, fish and tracks are more likely to be found in valleys than ridge tops. This observation suggests that differences in sites were tied in with function, different functions carried out on ridge tops and in valleys, and between specific ridge tops. Areas which, from the ethnography, were traditionally trade and/or access routes were shown to have had a high level of variation in style and composition. Interestingly stylistic differences were observed at the engraving sites, however were not seen at the rockshelter sites.

The macropod engravings on the ridge tops in the Peats Ridge area and near the Boree Track tended to be more varied, in size, technique and style. The engraved macropods appeared to increase in size as you travel west. The change in macropods from east to west also appeared to have a zone around the Boree Track and MacDonald River area where the form of the macropods began to change. Smith concluded that macropods in engraving sites and whole panels at engraving sites had variations that correlated to a probable ethnic boundary at Mangrove Creek. Variations of form and size, rather than technique produced the correlation to a tribal boundary, however social constructs were seen as only one of the factors affecting these variations. Purpose, technique, topography also appeared to explain variations in the motifs, while some variations were unexplained.

4.4.5.3 Bonhomme and McDonald (1984)

The only previous archaeological survey of the Tinda Park area was undertaken by Bonhomme and McDonald for Brayshaw and Associates in August 1984. This inspection related to a dam that was located immediately north of the extraction operations at the time (and is now part of the current extraction area). As part of the survey, all eroded/exposed areas were inspected and rock outcrops were examined for engravings, art and possible shelter habitation.

During survey a piece of rhyolite/silcrete with no obvious evidence of flaking and a quartz flake with a definite bulb of percussion were identified within a metre of each other approximately 1.5 kilometres east of the power-line easement[3]. The silcrete/rhyolite was uncommon enough in the region to warrant inspection, however all of the breakages were deemed to be fresh. It was concluded that both 'isolated finds' had resulted from the use of an access track and were only of 'possible' Aboriginal origin. No other artefactual material was located within the area assessed. The two pieces of stone were outside the proposed dam impact area.

The report concluded that the isolated 'finds' in the upslope area probably resulted from farm use of the access track and were not of Aboriginal origin and that while the swamps may have been a focus for food producing activities, occupation sites are more likely to occur in drier upslope areas.

4.4.5.4 Attenbrow (2006)

In 2006, Attenbrow undertook a number of years of research of the Upper Mangrove Creek catchment to look at cultural and demographic change that may (or may not) have occurred in the catchment over time. A variety of site types were recorded in the Upper Mangrove Creek catchment – archaeological deposits, pigment and engraved images, grinding grooves and scarred trees. From excavations undertaken by Attenbrow it was found that stratified rockshelter deposits containing Aboriginal artefactual material dated back to 11,000 years before present (BP) with varying lengths of habitation at various sites.

With detailed chronological material, Attenbrow was able to observe changes in artefact types and numbers over the past 4000 years. Open sites were divided into base or habitation camps, where groups of people would establish a more long term, or recurring campsite and activity or location camps, which were created more opportunistically for an activity based purpose. In the fourth millennium BP an increase in the number of base camps was observed along with the first appearance of ground edge implements.

In the third millennium BP a significant increase in the number of base camps was observed, however, this increase was observed alongside an increase in the number of activity camps, suggesting increased use of the catchment. In the first millennium BP, a decrease in the local artefact accumulation was observed.

The artefact types recorded included retouched flakes, cores, ground implements, hammerstones/manuports, fractured pieces and waste. The waste category in the analysis included flakes, broken flakes and flaked pieces. The raw materials recorded include quartz, fine grained siliceous (FGS), chert, silcrete, quartzite and igneous. The quartz, FGS, chert (excluding tuff) and quartzite were described as having eroded out of the sandstone conglomerate layers. The chert category included jasper, chalcedony, indurated mudstone and volcanic tuff, exposed in the Grose Valley which drains into the Hawkesbury River.

The 'waste' category was by far the most common artefact class from the sites sampled, comprising over 90% of the artefacts recovered. Approximately half (51%) of the artefacts from the Upper Mangrove Creek sites were manufactured from quartz, while FGS (33%) was also prominent. Other raw materials that could be sourced locally were chert (8%) quartzite (4%) and igneous (3%). Silcrete (2%) was probably imported to the area. Some of the chert was probably imported to the area as well, but was combined into the locally available category for Attenbrow's study.

[3] A distance of 1.5 km east of the power easement is outside the Project area, approximately 300 m east of Putty Road.

4.4.5.5 Umwelt (2010)

Umwelt (2010) undertook survey and assessment of an area within the Sugarloaf State Conservation Area. The topography of the Sugarloaf Range is similar to the Yengo and Wollemi National Parks, with steep narrow ridges and deep valleys. The ridge and spur crests in the Sugarloaf Range were the Aboriginal pathways through and across the mountains, similar to the main ridgelines through the Yengo and Wollemi National Parks.

The geology of the Sugarloaf Range is similar to that of the Yengo and Wollemi National Parks, consisting of Narrabeen Group sandstones and conglomerates. Grinding groove sites were the dominant site type in the areas of steep terrain, with artefact sites most often located on spur crests that have access tracks with higher levels of visibility and soils prone to erosion. The ridgelines and gentle spurs in the Sugarloaf Range are known to have been the traditional Aboriginal pathways through the range, with most artefact sites being small scatters, likely to be indicative of transient use rather than prolonged camping.

The Sugarloaf Range differs from the Yengo and Wollemi National Park area, in that there are very few rockshelters with evidence of occupation in the Sugarloaf, as most shelters or overhangs are small with sloping floors and no deposit. There is also only one recorded art site, an engraving site associated with grinding grooves in a creek. Prior to systematic survey being undertaken in the Sugarloaf Range, a similar overall open site distribution to the Yengo and Wollemi National Parks could be seen, with previously recorded sites predominantly large numbers of grinding grooves in the upper reaches of the creeklines, where sandstone platforms in the creeks were suitable for grinding, with low numbers of other site types, including artefact scatters, isolated finds and scarred trees. The grinding grooves that were recorded were largely recorded by one person, whose activities targeted locating and recording grinding groove sites.

During the Umwelt (2010) survey 62 additional sites were recorded including 20 grinding groove sites, one site that had grinding grooves associated with a rockshelter and isolated artefact, one rockshelter with artefacts and deposit, 36 artefact scatter and isolated finds, three scarred trees and two stone arrangements.

After the systematic survey, that assessed all landforms, including ridges, spur crests, slopes and valleys, the number of recorded artefact sites within the Sugarloaf Range itself increased greatly. The artefacts in the Sugarloaf Range were all recorded on four wheel drive access tracks and motorbike trails on low gradient ridge and spur crests. A pattern of recurring artefact location on crests/benches between the upper tributary water courses rather than beside the water courses was noted. This was suggested to have three potential reasons: the steep gradient of the landforms associated with the watercourses making them unsuitable for camping, the gentle gradient of the spur crests were more suitable for camping and there was poor visibility next to the watercourses.

The artefacts were manufactured from Nobbys tuff and silcrete, with lower numbers of quartz, petrified wood, quartzite and indurated mudstone. Nobbys tuff, quartz and quartzite were locally available, while silcrete was also available nearby. The indurated mudstone was thought to have either been obtained through trade, or that prior to the silting up of the lower reaches of the Hunter River that mudstone cobbles may have been available in the cobble beds in the river (as they are currently further upriver).

4.4.5.6 Implications

Apart from the study by Bonhomme and McDonald (1984) in the Project area, there has been minimal mention or discussion of artefact sites that have been located in the Wollemi and Yengo National Parks. Little attention has been paid to considering the potential for artefactual material to be present in the landscape. Attenbrow (1997) notes the artefacts that

were excavated during her studies, however, she has combined artefact classes and raw materials in such a way that it is difficult to compare with other work.

Bonhomme and McDonald (1984) identified silcrete and quartz in their assessment, however concluded that both isolated pieces they located may not have been of Aboriginal origin. Attenbrow's work identified that quartz was the most common raw material used in the Mangrove Creek basin. This is likely to be the case across the Yengo National Park, as quartz is available in the local conglomerates.

The Project area does not have the suitable topography for rockshelters, having gradual elevation changes, as opposed to steep ridges with sandstone overhangs. Sandstone outcrops and boulders have been identified outside of the proposed Project impact area. In Domain Area 3, these were observed in the far east of the property boundary outside of the proposed impact area and were observed to be weathered with rough uneven surfaces and unsuitable for grinding unlike the platforms and benches that were more commonly used for engraving and grinding in the wider area.

While artefact class and raw materials located in the Sugarloaf Range are not comparable to what is identified in the Yengo National Park, the topography provides a potential model for artefact distribution. Artefact sites are most likely to consist of isolated artefacts or small artefact scatters located on low gradient ridge and spur crests.

In summary, in relation to the broader Yengo and Wollemi National Parks, previous archaeological investigations and the OEH AHIMS register indicate that:

- occupation sites are rare. This is highly likely to be a reflection of past investigation biases rather than what is actually present;
- engraving sites are relatively common where suitable sandstone is exposed on ridgelines;
- grinding groove sites are relatively common where suitable sandstone is located in association with creeklines or a water source such as a pothole within a sandstone platform;
- stone arrangements, while not common, do occur in the area;
- rockshelters with evidence of use are relatively common. These may contain a mix of art, artefacts, grinding grooves and/or PAD; and
- scarred trees have been recorded in the National Parks but are not common.

As noted in **Section 4.4.3.3**, there are over 650 registered Aboriginal sites in the Yengo National Park, and there are 107 registered sites within 20 kilometres of the Project area. Most (59%) of the registered sites in the search area are closed sites/rockshelters, with evidence of use/occupation. Most of the open sites registered in the search area (74%) are art sites and/or grinding grooves. Only four of the sites are artefact sites, which, without any additional systematic survey, supports the suggestions made that the wider area was not used for camping/occupation. This conclusion, however, is highly likely to have been biased by the focus of all earlier research on the location of art sites and rockshelters. Prior research in areas of similarly geology and topography have noted that spur and ridge crests were often used for travel routes by Aboriginal people and that small artefact scatter sites reflecting transient use by were found were these landforms occurred.

4.4.6 Archaeological Surveys

The survey methodology approved by the registered Aboriginal parties included 100% survey of the proposed extraction domain areas. Two periods of survey were undertaken, the first in February 2011 and the later in May 2013. The survey resulted in the location of a small artefact scatter (Tinda Creek Artefact Scatter 1) consisting of a mudstone core and a quartzite flaked piece within a dam in Domain 3. The artefacts were in a secondary depositional context having washed in from upslope or upstream.

The proposed extraction domain areas were found to be highly disturbed from past land clearance activities, historic quarrying and erosion. It was assessed that while it was possible that further stone artefact may be located within the proposed extraction domain areas in a subsurface context it was assessed that they were also likely to be of low complexity and low archaeological integrity.

4.4.7 Potential Archaeological Deposits

One very small artefact scatter was located in a disturbed context in Domain 3 (refer to Figure 7.1 of **Appendix 9**). The artefact scatter comprised a mudstone core and quartz flaked piece located at MGA 286312E 6328413N. The artefacts were located within 7 metres of each other on the inside edge of a dam and had presumably spent some time under water before the dam wall was breached. They were currently located on disturbed sands subject to sheet wash erosion. Each artefact was found on a pedestal of sand indicating active erosion was still occurring. The artefacts were clearly in a secondary depositional context presumably having washed into the dam from the adjacent slope or from upstream. The site was called Tinda Creek Artefact Scatter 1 and a site card has been completed and forwarded to the OEH for inclusion on the AHIMS register in compliance with Section 89A of the NPW Act (1974).

No sandstone outcrops were observed in the proposed extraction domain areas.

The decomposed bedrock in the proposed extraction domain areas was compact and a uniform bleached white. In the previously modified areas the sand was a darker orange colour and also formed of decomposed sandstone bedrock. High levels of disturbance due to infrastructure, landscape clearing and the existing quarrying operations had affected the soil profile integrity of the Project area as a whole. Observation of soil profiles in existing drainage ditches in Domain 3 identified high levels of bioturbation within the loose sandy soils.

The nature of the Project area, especially the sedge swamp in the south-east corner and creek line to the north-west indicated that it was likely to have had some Aboriginal food resource potential in the past and that it would have attracted transient hunters and gatherers. The ephemeral nature of these activities, however, is unlikely to have resulted in archaeologically visible artefact material. The larger Mellong Swamp north of the Project area, however, would have been a more bountiful resource area and more suitable for occupation events which may be more visible archaeologically.

While the low spurs on the periphery of Project area may possibly have been used to access the more elevated ridges to the east it was also assessed as unlikely that this use would have resulted in the discard of sufficient artefact material to make it archaeologically visible.

Overall, the survey indicated that while further Aboriginal artefacts could possibly occur in a subsurface context within the Project area, they will typically be at relatively low densities and of low complexity. Furthermore prior impacts to the Project area are high to very high suggesting that artefacts within areas subject to disturbance will be in a secondary

depositional context and lack any spatial association and therefore will be of low archaeological value in terms of understanding the Aboriginal behaviour that resulted in their discard. This, however, does not reduce their Aboriginal cultural value.

4.4.8 Aboriginal Cultural Significance

As Aboriginal cultural significance relates to the values of a site, place or landscape to Aboriginal people, it must be determined by Aboriginal people. The Aboriginal parties participating in the project therefore have the right and obligation for assessing the significance of their cultural heritage. In assessing this significance a range of factors may be considered and this can extend beyond the physical presence of a site and its contents. Archaeological material, cultural knowledge, natural resources and landscape may all be considered.

Leanne Watson (DCAC) made the following comments in relation to Aboriginal cultural significance of the project area prior to the 2013 survey.

> This area is highly significant to the Darug people due to the evidence of continued occupation, within close proximity to this project site there is a complex of highly significant sites. Sites are significant to us for the information that they hold and the connection to Darug people. Aboriginal people (Darug) had a complex lifestyle that was based on respect and belonging to the land, all aspects of life and survival did not impact on the land but helped to care for and conserve land and the sustenance that the land provided. As Darug people moved through the land there were no impacts left, although there was evidence of movement and lifestyle, the people moved through areas with knowledge of their areas and followed signs that were left in the landscape. Darug people knew which areas were not to be entered and respected the areas that were sacred. Yengo – Wollemi National parks are of extremely high significance due to the sites and dreaming that this area holds, our group has spent time in these areas documenting sites and stories and the significance is all over this area.

After the survey in 2011, Gordon Workman (Darug Land Observations) indicated that he was interested in the hills surrounding the Project area and if the proposed impacts were to extend to those areas he would like to be involved. In 2013 Phil Khan (Yarrawalk) indicated that the entire landscape was of cultural significance to Aboriginal people and the soils closer to the creek would have greater potential for providing evidence of Aboriginal occupation of the landscape.

4.4.9 Archaeological Significance

Tinda Creek Artefact Scatter 1 was assessed as having low archaeological significance due to its lack of complexity, lack of integrity and overall low research potential. The landforms incorporated in the proposed extraction domain were also area assessed as having low potential for archaeological significance based on the results of the survey and the predictive model.

4.4.10 Potential Impacts

The current proposal involves the removal and stockpiling of topsoil progressively over proposed extraction domains and the establishment of (or progressively extending) dredge ponds the existing dredge pond into the proposed extraction domain areas and bulldozing and/or hydraulically excavating peripheral sand into the dredge pond for extraction in areas where dredging alone is not feasible.

The principal concern regarding the management of these development impacts is in respect to the management of Tinda Creek Artefact Scatter 1 which is located in a disturbed context in Domain 3. As the proposed works may impact the exposed Aboriginal artefacts (depending on whether Domain 3 or Domain 7 is quarried), the impact will need to either be avoided or an approval obtained for their impact.

4.4.11 Proposed Management and Mitigation Measures

4.4.11.1 Management Options

There are a number of management options possible:

1. Change the quarry extraction plans to avoid Tinda Creek Artefact Scatter 1 and provide for its protection during quarrying activities.

2. Undertake further archaeological investigation in the area of Tinda Creek Artefact Scatter 1 to better understand the archaeological character of any subsurface deposits.

3. Allow for the collection of the two artefacts from Tinda Creek Artefact Scatter 1 without the requirement for further archaeological investigation.

4. Allow for the destruction of the Tinda Creek Artefact Scatter 1 site without further archaeological investigation.

Option 1 could impact on the future feasibility of the sand quarry operation if Domain 3 is to be quarried which is an outcome that is not assessed as warranted as the area has already undergone substantial historic impact.

As the artefact scatter is in a highly disturbed context and does not retain any archaeological integrity – Option 2 – further archaeological investigation is also not warranted. As the artefacts are of significance to the registered Aboriginal parties for this Project Option 4 is not assessed as appropriate, resulting in Option 3 being assessed as the most appropriate management outcome. It is noted that as this is a State Significant development it will be necessary for the artefact collection to be undertaken (if the site is not avoided) in compliance with a stand-alone Aboriginal Cultural Heritage Management Plan (ACHMP) or as part of a broader EMP.

4.4.11.2 Management Recommendations

The following recommendations apply to the proposed extraction domain. Based on the outcomes of the assessment it is recommended that:

- archaeological subsurface investigation is not necessary within the proposed extraction domains, prior to the quarry expansion proceeding;

- Hy-Tec in consultation with the registered Aboriginal parties prepare an ACHMP/Section of an EMP for the proposed quarry extension area which will allow for management (collection) of the artefacts located in the Tinda Creek Artefact Scatter 1 site in Domain 3 if Domain 3 is to be quarried, and to provide for future management of Aboriginal cultural heritage issues should they arise across the broader Project area;

- if Domain 3 is to be quarried, the artefacts located within the Tinda Creek Artefact Scatter 1 site are collected using the methodology set out in **Appendix 9** and under the protocols and procedures of the approved ACHMP;

- in the unlikely event that previously unrecorded artefact material is exposed during ground disturbance works within the quarry extension area, work must cease in the vicinity of the artefact material and the registered Aboriginal parties contacted and the artefact material managed in accordance with the ACHMP using the methodology set out in **Appendix 9**;

- in the highly unlikely event that human/possible human skeletal material is uncovered during quarry works associated with the proposed extraction domain areas or by natural erosion processes within any part of the Project area, all work likely to affect the human skeletal material shall cease immediately. Hy-Tec must notify the NSW Police Department (Police Coroner) in the first instance. The area then becomes a crime scene and is under the control of the NSW Police Department until the Police have declared otherwise. If the Police determine the skeletal remains are not of a criminal nature then Hy-Tec must notify OEH (Enviroline 131555), a suitably qualified forensic archaeologist/anthropologist and the relevant Aboriginal parties to determine an appropriate course of action prior to the recommencement of work in the area;

- in the highly unlikely event that sandstone with evidence of Aboriginal engravings or grinding grooves is exposed during ground disturbance works within the proposed extraction domains, work should cease in the immediate area and the registered Aboriginal parties and the OEH should be contacted immediately to discuss an appropriate course of action prior to the recommencement of work in the area;

- to mitigate the impact to the Aboriginal cultural values of the area, remediation of the existing quarry and proposed impact areas should be undertaken following cessation of quarrying activities; and

- in order that Hy-Tec employees/contractors working on the project have the skills to identify the above-mentioned site types an Aboriginal Cultural Heritage Training Package should be prepared in consultation with the registered Aboriginal parties to be provided as part of the quarry induction process.

4.4.11.3 Care and Control of Artefacts

Further consultation was undertaken with the registered Aboriginal parties as part of the preparation of the ACHMP/EMP to determine appropriate Care and Control arrangements for the two artefacts located within the Tinda Creek Artefact Scatter 1 site in Domain 3 and any other artefacts that may be recovered during quarry operations (if any) under the protocols of the ACHMP/EMP.

Only one response was provided in relation to Care and Control of any artefacts recovered from the Tinda Creek Artefact Scatter 1 site or during works in the quarry extension area. Gordon Morton of Darug Aboriginal Cultural Heritage Assessments requested that any artefacts recovered from the quarry extension area be reburied within country and outside the proposed impact areas. The artefacts to be collected using the methodology set out in Section 9.5.1 of **Appendix 9** and under the protocols and procedures of an approved ACHMP. This recommendation will be incorporated into the ACHMP.

4.4.11.4 Aboriginal Cultural Heritage Management Plan (ACHMP)

As the Tinda Creek project is defined as a State Significant project there is no requirement to apply to OEH for an Aboriginal Heritage Impact Permit (AHIP) for impact to Aboriginal archaeological sites, instead management and impacts to known and unknown sites/artefacts are usually managed in compliance with an ACHMP approved by the DP&E.

The ACHMP will be required to detail management strategies for the Tinda Creek Artefact Scatter 1 site (if Domain 3 is to be quarried) and for any future Aboriginal objects encountered during quarry works (if any). The ACHMP will be prepared in consultation with the registered Aboriginal Parties and clearly identify the responsibilities of all parties involved – Hy-Tec, registered Aboriginal parties, archaeologists – and designate timeframes for required heritage management processes.

4.5 Historic Heritage

4.5.1 Heritage Listings

In order to identify if any known historical heritage items or sites are located within the project area, desktop searches were conducted of NSW State Heritage Register and State Heritage Inventory, the Australian Heritage Database (including Commonwealth and National Heritage lists and the Register of the National Estate), and local planning instruments (Hawkesbury Local Environmental Plan (HLEP), 2012).

These searches identified no known State Heritage Listed sites or other items subject to any form of statutory heritage listing within the Project area.

4.5.2 Historic Heritage Overview

The 1903 Ivory Parish Map shows no land grants as existing in the area at that time. The 1938 Ivory Parish Map, the next available parish map, indicates the land to the east of Putty Road, including the project area, as having been granted by that time. These grants were likely made in the early 1930s.

The Putty Road was completed and opened for traffic in 1823. However, it was known to be treacherous and a difficult journey. It wasn't until 1942 that the Department of Main Roads (DMR) reconstructed the road as a defence route south as a result of the vulnerability of the Hawkesbury River ferry crossings and the threat of Australia being invaded from the north (Oz Roads, n.d.). Following the end of the World War II, the DMR took ownership of Putty Road and the sealing of the road was subsequently complete by 1964 (Oz Roads, n.d.).

There are no identified historical heritage items or potential historical archaeological sites within the proposed extraction domains. Pastoral infrastructure such as fence lines extant across the Project area indicate the enclosing of the landscape to make paddocks and delineate lot boundaries and are typical of fences found throughout the area and rural NSW. Any extant fence lines or other rural infrastructure within the project area are likely to be of no significance and have no research potential.

4.5.3 Historic Heritage Management Recommendations

In the unlikely event that unexpected archaeological remains or potential heritage items not identified as part of this assessment are discovered during the project, all works in the immediate area should cease, the remains and potential impacts should be assessed by a qualified archaeologist or heritage consultant and, if necessary, the Heritage Branch, DP&E notified.

4.6 Traffic and Access

4.6.1 Existing Traffic Environment

A detailed traffic impact assessment was undertaken by TPK & Associates Pty Ltd (refer **Appendix 8** for detailed report). Putty Road is the only road access route to and from Tinda Creek sand quarry. The RTA Annual Average Daily Traffic (AADT) data for station 06.122 report an annual average of 1218 axle pairs/day along the Putty Road between 1989 and 2005, at a location 1.6 kilometres south of Colo Heights (**Table 4.5**). A light vehicle/heavy vehicle split of 90:10 was recorded based on surveys reported for the site (**Appendix 8**), however, a conservative split of 80:20 has been applied for the purposes of the assessment. In addition, three axel pairs have been assumed for heavy vehicles.

There are no through roads between this location and Tinda Creek quarry by which heavy vehicles could access the Sydney market. While the data displays both positive and negative growth rates between surveys, the overall long term average growth rate of AADT is 1.35%.

To the north AADT data report an average of 6115 axle pairs along the Golden Highway at Mt Thorley, a key intersection with the Putty Road. As this data is intended to capture the traffic travelling the Golden Highway, as opposed to vehicles entering and exiting the Putty Road, and significant intersections with through roads exist between this point and Tinda Creek, it cannot be used to reliably indicate passing heavy vehicle traffic at the quarry.

Table 4.5 – AADT Data Station # 06.122

Year	1989	1991	1993	1996	1999	2002	2005	Mean
Axle Pairs	1129	1230	1088	1105	1172	1428	1373	1218
Light Vehicles [#]	903	984	870	884	938	1142	1098	974
Heavy Vehicles [##]	75	82	73	74	78	95	92	81
Growth Change (%) over Period		8.95	-11.54	1.56	6.06	21.84	-3.85	
Long Term Growth Rate (%)		1.35						

[#] 80:20 split light/heavy vehicles based on site survey data; 1 axel pairs assumed for light vehicles)

[##] 80:20 split light/heavy vehicles based on site survey data; 3 axel pairs assumed for heavy vehicles)

Assumptions for determination of current traffic generation from the quarry operations is summarised as follows:

- annual extraction of 125,000 tonnes;
- operations occurring 300 days a year;
- average load 33 tonnes;
- heavy vehicle trips vary from 12 to16 per day (outward bound); and
- staff (light vehicles) trips vary from 6 to 8 per day (inward bound).

Extrapolating the long term annual AADT growth rate of 1.35% on Putty Road gives an estimated 102 heavy vehicles for 2013 (1325 vehicles in total). Therefore, assuming a maximum of 32 (two-way) daily heavy vehicle trips being generated by the existing quarry operations, the existing quarry operations currently contribute approximately 31% to existing heavy vehicle flows on Putty Road and 2% to overall traffic flows on Putty Road.

4.6.1.1 Crash Data

In mid 2007 the RTA's Road Safety and Traffic Management Branch in Newcastle undertook analysis of an 82 kilometres section of the Putty Road to determine options to reduce motorcycle crashes. The results of this analysis were reported by Thomas et al. (2011). The southern extent of the section of Putty Road terminated approximately 10 kilometres to the north of Tinda Creek Quarry and didn't consider the section of Putty Road used by trucks accessing the quarry. The section of Putty Road north of the quarry travels through Wollemi and Yengo National Parks and includes approximately 60 kilometres of winding road with many tight curves which are not exhibited on the section of Putty Road south of the quarry to Windsor.

A crash analysis was undertaken as part of the safety review. The crash rate was found to be relatively high for a low volume road, with 165 crashes recorded between January 2002 and December 2007. There was also a corresponding high rate of casualty crashes, with 68% of crashes resulting in injury (105) or a fatality (8). Other pertinent information from the study is summarised below:

- Crashes were generally dispersed over the study area. However, several crash clusters were identified for further analysis with the intention of implementing specific road safety treatments in these areas.
- Fifty-five per cent of crashes are related to motorcyclists, while motorcyclists make up only approx 5% of vehicles across an average week.
- Most motorcycle crashes occurred on a weekend, where motorcycles represent nearly 14% of vehicles on the road.
- Seventy-one per cent of motorcycle crashes were coded as 'speed' related.
- An action plan was developed to identify a range of treatments that could be implemented in a short timeframe by December 2007. The key road safety issues that were implemented included:
    - changes to speed zones;
    - provisions for police enforcement of speeding;
    - improvements to signage, linemarking and delineation;
    - campaigns to improve driver/rider awareness of road safety issues; and
    - change driver/rider behaviour.

Following implementation of the aforementioned actions, there was a noticeable drop in non-motor cycle and motorcycle accidents on this section of Putty Road. An analysis of three year moving average of crash data from 1996–2010 indicated a break in trend following works undertaken in late 2007.

In summary, the results of the study showed that the strategy implemented to reduce the number and severity of motorcycle crashes on Putty Road was proven to be effective.

An analysis of the safety of the existing intersection in the context of potential increases in truck movements associated with the proposed expanded quarry operations is provided in **Section 4.6.3**.

4.6.2 Traffic Generation

The traffic produced by the proposed quarry expansion was estimated using the following assumptions:

- maximum annual extraction of 300,000 tonnes;
- operating hours may occur from 5.00 am to 10.00 pm on weekdays and 5.00 am to 3.00 pm Saturday;
- operations occurring 300 days a year;
- average load 33 tonnes;
- heavy vehicle trips vary from 30 to 34 per day (inward); and
- staff (light vehicles) trips vary from 6 to 8 per day (inward). An additional 1 to 2 trips per day (inward) may be generated with employment of 1 to 2 staff at maximum annual extraction capacity.

In summary, the potential increase in truck flow at a production level of 300,000 tpa is 18 (one way) trips spread over the day, which equates to an additional 36 daily trips.

A comparison of the contribution of the additional heavy vehicle movements from the proposed expansion of Tinda Creek to the projected AADT data for 2013 (refer **Section 4.6.1**), indicates that the addition of up to 36 daily trips would increase vehicle traffic flows on Putty Road by an additional 2.72% (**Table 4.6**). In Year 10 of operations, this contribution to projected flows is estimated to be 2.38%, decreasing further to 1.82% in Year 30.

The projected increase in flows (compared to the existing contribution from the quarry) for 2013 AADT heavy vehicle projections represents an increase of 1.37% above the long term average growth rate (1.35%) for vehicles on Putty Road. In Year 10 of operations, this increase is estimated to be 1.03% above the long term average growth rate, decreasing further to 0.47% in Year 30 (**Table 4.6**).

Table 4.6 – Comparison of Projected Heavy Vehicle Trips to Projected AADT Data

		Projected Volumes ^			
Year	**2005**	**2013**	**2023**	**2033**	**2043**
Axle Pairs	1373	1529	1748	1999	2286
Total Vehicle Trips on Putty Road	1190	1325	1515	1733	1981
Current Contribution to Total Vehicle Trips (%) ^^		2.42	2.11	1.85	1.62
Additional Contribution to Total Vehicle Trips (%) ^^^		2.72	2.38	2.08	1.82
Additional Above Long Term Growth Rate (%)		1.37	1.03	0.73	0.47

^ Based on Long term annual growth rate 1.35%

^^ Based on current 32 two way daily movements

^^^ Based on maximum additional 36 two way daily movements

In terms of road network capacity and safety, the contribution of additional heavy vehicle movements over the life of the proposed expanded quarry operations (30 years) to overall flows (2.72–1.82%) and long term growth rates (1.37–0.47%) on Putty Road is considered to be insignificant.

The proposed import of VENM/ENM to the quarry to assist in backfilling the extraction ponds will not increase traffic movements as this material will be back loaded using the same trucks that transport product from the site.

4.6.3 Intersection Analysis

For the purposes of determining the efficacy of the existing intersection of the quarry entrance and Putty Road, peak hour traffic survey data was utilised from a more recent survey undertaken at Howes Valley, approximately 32 kilometres to the north of the site (by BJ Bradley & Associates in April 2009). There are no significant influences between this survey site and the quarry entrance that would impact on peak hour indications.

In addition, traffic survey of the Putty Road/quarry access road intersection was undertaken on 13 May 2013. Further details are provided in **Appendix 8**.

4.6.3.1 Sight Distance

At the intersection with the quarry access road, Putty Road is zoned 100 km/h. The RMS Supplement to Austroads Guide to Road Design Part 4A indicates that between 282 metres and 304 metres is the required Safe Intersection Sight Distance (SISD) to be available at intersections within a 100 km/h speed zone.

The sight distance from the intersection to both the north and south exceeds 304 metres.

4.6.3.2 Intersection Layout

The volumes for the Putty Road/quarry access road intersection indicate that the intersection is classified as a BAR/BAL type in accordance with Austroads Part 4A (**Appendix 8**). The traffic assessment concludes that the current alignment of Putty Road is acceptable for prevailing conditions and that widening of the shoulders to BAR layout standard is not essential.

4.6.3.3 Quarry Road

The traffic impact assessment (**Appendix 8**) recommends that the entrance to the quarry access road comply with the minor road standard access (AS2890.2) as shown in **Appendix 8**). Should augmentation of the entrance road require any works in the road reserve of Putty Road, an approval under the *Roads Act 1993* will be sought from RMS.

4.6.3.4 Intersection Capacity

Analysis of the intersection capacity shows that:

- the low growth rates on Putty Road indicate that it is not a factor in considering intersection layout;
- the current intersection arrangement provides adequate traffic management for potential traffic volumes; and
- traffic volumes are below the threshold levels that require modelling as proof of intersection capacity.

The traffic report concludes that as the potential volumes at the Putty Road/quarry access intersection will not exceed 100 vph on Putty Road and 20 vph on the quarry access road; these flows are within the limits of the Austroads guide and therefore acceptable capacity

conditions can be assumed at this intersection. Consequently, no upgrading of the intersection is recommended.

4.6.4 Car Parking

Chapter 2 of Hawkesbury City Council's DCP 2002 refers to car parking and access requirements for a range of developments within the LGA. The DCP does not specify car parking requirements for extractive industry developments. Notwithstanding, a designated car parking area is provided opposite the site office/weighbridge with sufficient parking for all staff and site visitors. Site access requirements were considered in **Section 4.6.3**, which recommended upgrading the access to comply with the minor road standard access as detailed in AS2890.2.

4.6.5 Windsor Bridge

The primary haul route for sand extracted from Tinda Creek Quarry passes over Windsor Bridge at Windsor. Windsor Bridge was opened in 1874 and is the oldest bridge across the Hawkesbury River. In addition to quarry traffic, it provides an important local vehicle and pedestrian link and contributes to the regional road network between Western Sydney, the Blue Mountains and the Hunter region. Current usage of the bridge is approximately 19,000 vpd, of which 1130 (7%) are heavy vehicles (DP&I, 2013 – Windsor Bridge determination report). The 12 to 16 outward trips, or 24 to 32 return trips, modelled by TPK is equivalent to approximately 2.8% of all heavy vehicles passing over Windsor Bridge.

A replacement Windsor Bridge was approved in 2013, and construction is anticipated to be completed during 2015 (DP&I, 2013 – Windsor Bridge Determination Report). It is considered by RMS that there is minimal risk of bridge failure before the completion of the new bridge. RMS predicts an increase of 7000 vehicles to 24,000 vehicles by 2026.

It is considered that the contribution of heavy vehicles from Tinda Creek Quarry to total traffic flow across the current and approved new Windsor Bridges will be marginal. It is anticipated that quarry vehicles will comply with all directions from RMS during the construction of the bridge, including reduced speed limits, traffic controls and other directions.

4.6.6 Mitigation

The following mitigation measures are recommended in relation to managing traffic and access issues associated with the proposed Project:

- Upgrade the current site access to ensure compliance with minor road access, in accordance with AS2890.2, as shown in **Appendix 8**.

4.6.7 Summary

The proposed expansion of extraction operations at Tinda Creek will generate up to an additional 36 two-way heavy vehicle trips per day. The traffic assessment indicates that the additional traffic generated will increase traffic movements on Putty Road initially by 2.72%, decreasing to 1.82% in the last year of quarry operations. This represents an initial increase to the overall long term growth rate by 1.37%, decreasing to 0.47% in the last year of quarry operations. In terms of traffic generation, this contribution is considered to be negligible and well within the safe operating capacity of Putty Road.

Analysis of the intersection layout and capacity indicates that proposed traffic volumes are well within the BAR/BAL limits set by Austroads guidelines and that no upgrade is considered

warranted. The site access (i.e. on Lot 2), however, was determined to require minor upgrading to comply with the minor road standard access as detailed in AS 2890.2.

4.7 Noise

A detailed noise impact assessment (NIA) was prepared for the Project and is provided in **Appendix 10**. This section of the EIS provides a summary of the NIA, including an assessment of potential impacts and description of proposed mitigation measures.

4.7.1 Existing Noise Environment

The existing background noise environment in the area surrounding the Project was measured using a continuous noise logger. Details of the monitoring program (**Table 4.7**) are provided in **Appendix 10**. The monitoring results were used to assess the background (L_{A90}) and amenity (L_{Aeq}) noise levels within the nearest residential receiving areas to the site.

Table 4.7 – Noise Monitoring Program Details

Title	Location	Logger Serial No.	Measurement Started	Measurement Stopped
N1	Lot 2, DP 628806 MGA56 E285298 N6327945	194625	10:00 17/11/10	10:45 26/11/10

Monitoring location N1 is located to the west of the existing sand quarry on Lot 2, DP 628806 (refer **Figure 4.2**). The monitoring location represents an undeveloped rural area, nearby to the existing sand quarry, that is considered representative of the of the background noise environment at the potentially affected noise sensitive locations.

Based on the background monitoring results it can be reasonably assumed that, due to the rural nature of the area surrounding the Project, the existing background level is at or below 30 dB(A). In addition to this, there are no other industrial noise sources in the area surrounding the Project. Therefore the existing industrial $L_{Aeq, period}$ (where period is day, evening or night) noise levels is more than 10 dB below the Acceptable Noise Level as defined by the Industrial Noise Policy (INP) (EPA, 2000) (refer **Table 4.8**).

Details of consideration of meteorological conditions in the modelling are provided in **Appendix 10**.

4.7.2 Assessment Criteria

4.7.2.1 Intrusiveness Criteria

Where the existing background level in the region surrounding the Project is at or below 30 dB(A) the corresponding Intrusiveness Criteria would be 35 dB(A). This is the minimum possible Intrusiveness Criterion under the INP (EPA, 2000).

4.7.2.2 Amenity Criteria

To limit continuing increases in noise levels due to industrial development, the INP (EPA, 2000) has identified maximum ambient noise levels for typical receiver areas and land uses. The recommended acceptable and maximum ambient noise levels for a rural environment are provided in **Table 4.8**.

Source: Google Earth (2012), LPI NSW (2007)

0 250 500 750m
1:15 000

Legend

- Project Area
- Proposed Extraction Area
- Domain 3 Extraction Area
- Domain 7 Extraction Area
- Private Holding Duck Farm
- Private Holding Hobby Farm
- National Park Boundary
- Noise Monitoring Location
- Nosie Receiver Location

FIGURE 4.2

Noise Monitoring and Noise Sensitive Receiver Locations

File Name (A4): R14_V1/1731_394.dgn

Table 4.8 – Amenity Criteria – Recommended L_{Aeq} Noise Levels from Industrial Noise Sources, dB(A)

Type of Receiver	Indicative Noise Amenity Area	Time of Day[1] (Period)	Recommended LAeq Noise Level	
			Acceptable	Recommended Maximum
Residence	Rural	Day	50	55
		Evening	45	50
		Night	40	45

Note: 1. For Monday to Saturday, Day-time 7.00 am–6.00 pm; Evening 6.00 pm–10.00 pm; Night-time 10.00 pm–7.00 am. On Sundays and Public Holidays, Day-time 8.00 am–6.00 pm; Evening 6.00 pm–10.00 pm; Night-time 10.00 pm–8.00 am.

Where the existing industrial $L_{Aeq, period}$ (where period is day, evening or night) noise level is more than 10 dB below the Acceptable Noise Level referred to in **Table 4.8**, the Amenity Criteria is set at the Acceptable Noise Level nominated in **Table 4.8**.

4.7.2.3 Project-specific Noise Levels

The project-specific noise level (PSNL) reflects the most stringent noise levels derived from both the Intrusiveness and Amenity Criteria and would be 35 dB(A) $L_{Aeq,15minute}$ for the day-time, evening and night-time periods.

4.7.2.4 Sleep Disturbance

The Sleep Disturbance Criteria are based on the criteria from the INP Application Notes which reference the review of research on sleep disturbance published in the NSW Road Noise Policy (DECCW, 2011). The INP Application Notes suggests that to prevent sleep disturbance, the $L_{A1,1minute}$ or L_{Amax} level of a noise source should not exceed the L_{A90} background noise level by more than 15 dB when measured outside the bedroom window. The Sleep Disturbance Criteria for all identified noise sensitive locations was therefore determined to be 45 dB(A).

4.7.2.5 Construction Noise

The OEH recognises that construction activities could potentially generate higher noise levels than those of an industrial operation. DECC's (now OEH's) *Interim Construction Noise Guideline* (DECC, 2009) provides criteria for construction activities for representative residential receivers surrounding the Project.

The construction phase of the Project is limited to the realignment of the quarry access road to the south of Domain 1, which will occur once extraction commences in Domain 1, and for the minor entrance upgrade works (refer **Section 4.6.3.3**). The realignment of the access road and upgrade of the quarry entrance road is only anticipated to occur within recommended standard construction hours. The construction noise management level for all residential receivers surrounding the Project was therefore determined to be 40 dB(A).

4.7.2.6 Road Traffic Noise

The DECCW's (now OEH's) NSW Road Noise Policy (DECCW, 2011) sets out criteria for road traffic noise through the provision of a framework that addresses traffic noise issues associated with new developments, new or upgraded road developments or planned building developments.

Table 4.9 outlines the criteria relevant for the two way traffic volumes due to the Project on Putty Road.

Table 4.9 – Road Noise Criteria, dB(A)

Road Category	Type of Project/Land Use	Assessment Criteria	
		Day (7.00 am–10.00 pm)	**Night (10.00 pm–7.00 am)**
Freeway/arterial/sub-arterial roads	3. Existing residences affected by additional traffic on existing freeways/arterial/sub-arterial roads generated by land use developments	$L_{Aeq(15\ hour)}$ 60 (external)	$L_{Aeq(9\ hour)}$ 55 (external)

Source: Table 3 NSW Road Noise Policy (DECCW, 2011)

As the Project is not seeking to operate throughout the entire night time period, it is appropriate to assess the impact of road traffic noise during the times when noise sensitive receivers may be subject to additional traffic generated noise due to the Project.

The approach taken was to assess the $L_{Aeq(1\ hour)}$ road traffic noise contribution of the project and compare this result to the $L_{Aeq(9\ hour)}$ criterion. This presents a conservative approach to preserving the amenity of noise sensitive receivers due to increases in road traffic noise associated with the Project.

4.7.3 Potential Sources of Noise Emissions

The potential noise sources from the project are detailed in **Appendix 10** and summarised as follows:

- Operational Noise – includes all machinery equipment typically used on site in day to day operations.
- Construction Noise – includes a range of typical construction equipment likely to be utilised on the site in association with the upgrade/re alignment of the quarry access road and its connection to Putty Road.
- Road traffic noise – traffic volumes from NSW Roads and Maritime Service (formally the NSW RTA) AADT stations 06.122 and 06.113 have been used to determine daily existing two-way traffic volumes on Putty Road. The noise sources modelled were based on increases in heavy vehicle traffic volumes, which expected to increase from the existing average 12 to 16 loads per day to an average of 30 to 34 loads per day, in association with the increased rate of production due to the Project.

4.7.4 Receiver Locations

Three residential receivers were identified surrounding the Project area, the locations of which are shown in **Figure 4.2**.

4.7.5 Potential Noise Impacts

The proposal does not have any vibration generating components and hence the potential for vibration impacts such as structural damage or regenerated noise is negligible.

4.7.5.1 Operational Noise Levels

No potential exceedances of the PSNL of 35 dB(A) for the Project were identified. While no exceedances of noise goals for the Project were predicted, Hy-Tec will need to ensure that the control measures identified for the Project (refer **Appendix 10**) are implemented and that operations are appropriately managed to minimise noise generating activities during extraction of sand from the areas located closest to the identified receivers (i.e. Domain 1).

4.7.5.2 Sleep Disturbance

Noise sources that could lead to sleep disturbance are typically transient noises and often have tonal characteristics. Activities occurring within the night-time that could lead to sleep disturbance include:

- air horns used to control truck movement;
- reversing beepers; and
- track clatter from bulldozers.

The predicted received $L_{A1,1minute}$ noise levels (< 30 dB(A)) meet the recommended sleep disturbance noise goals outlined in **Section 4.7.2.4** at all residential receivers, for the modelled worst-case operational and meteorological scenarios.

4.7.5.3 Construction Noise

A source to receiver noise model was used to determine construction noise impacts at the nearest residential receiver to the construction activities during standard hours. The results of the modelling indicated that construction noise levels at all residential receivers was predicted to be at or below the construction noise management level 40 dB(A) as described in **Section 4.7.2.5**.

4.7.5.4 Road Traffic Noise

Assessment of the road traffic noise impact of the Project has been conducted at three setback distances representative of the residential receivers likely to be influenced by movement of product trucks travelling to or from the Project along Putty Road to Western Sydney. The road traffic noise impacts were modelled at setback distances of 25 metres, 50 metres and 100 metres from the centre line of Putty Road. Impacts on the remainder of the transport route to Western Sydney would be lower due to greater existing traffic volumes on this route. Predictions were based on:

- a maximum of 54 heavy vehicle movements during the day time period; and
- a maximum of 4 heavy vehicle movements per hour during the night time period.

The results of traffic noise modelling are presented in **Table 4.10**.

Table 4.10 – Predicted Day and Night Road Traffic Noise Levels on Putty Road, dB(A)

Receiver	Year of Project	Setback Distance, m	Period	Assessment Criteria, Day $L_{Aeq,15\ hour}$ Night $L_{Aeq,9\ hour}$	Existing Predicted Traffic Noise Levels, Day $L_{Aeq,15\ hour}$ Night $L_{Aeq,1\ hour}$	Predicted Traffic Noise Levels, Day $L_{Aeq,15\ hour}$ Night $L_{Aeq,1\ hour}$	Increase in Predicted Traffic Noise Levels dB(A)
Putty Road, north of Wilberforce through to Mellong Based on NSW RTA AADT Station 06.122	Year 1	20	Day	60	58.9	59.9	1
			Night	55	52.6	54.4	1.8
	Year 30		Day	60	60.6	61.4	0.8
			Night	55	54.4	55.6	1.2
	Year 1	50	Day	60	53.4	54.6	1.2
			Night	55	47.2	49.2	2
	Year 30		Day	60	55.1	56.0	0.9
			Night	55	48.9	50.4	1.5
	Year 1	100	Day	60	47.5	49.0	1.5
			Night	55	41.3	43.7	2.4
	Year 30		Day	60	49.2	50.3	1.1
			Night	55	43.0	44.8	1.8
Putty Road in the vicinity of Wilberforce Based on NSW RTA AADT Station 06.113	Year 1 to Year 30	20	Day	60	61.6	62.0	0.4
			Night	55	53.0	54.1	1.1
	Year 1 to Year 30	50	Day	60	54.4	54.9	0.5
			Night	55	45.8	47.1	1.3
	Year 1 to Year 30	100	Day	60	49.4	49.9	0.5
			Night	55	40.7	42.2	1.5

Notes: 1. Criteria for existing residences affected by noise from redevelopment of existing freeways/arterial/sub-arterial roads.

2. Day (7.00 am–10.00 pm) and Night (10.00 pm–7.00 am).

3. Existing predicted traffic noise levels include existing traffic due to Tinda Creek Quarry.

The results presented in **Table 4.10** indicate that the predicted road traffic noise levels from the increase in heavy vehicles travelling to or from the Project via Putty Road generally do not exceed the day and night time road traffic noise criteria outlined in the NSW Road Noise Policy (DECCW, 2011).

However, noise sensitive receivers located on Putty Road in the vicinity of Wilberforce that have a setback distance of less than 20 metres may currently experience noise levels higher than the 60 dB(A) day time noise criteria due to existing high levels of light vehicle traffic on Putty Road. The same situation may also occur if traffic numbers continue to grow on Putty road north of Wilberforce through to Mellong for noise sensitive receivers with a setback distance of less than 20 metres.

The NSW Road Noise Policy (DECCW, 2011) states that 'an increase of up to 2 dB represents a minor impact that is considered barely perceptible to the average person'. The predicted increase in traffic noise due to the Project at these locations is less than 0.8 dB(A). As the modelling approach taken in this assessment does not consider the attenuation effects of terrain and is considered conservative and the predicted increase in noise levels are considered minor, it is unlikely that a noise sensitive receiver will perceive an increase in traffic noise due to the Project.

4.7.5.5 Cumulative Noise

To limit continuing increases in noise levels due to industrial development, the INP (EPA, 2000) has identified maximum ambient noise levels for typical receiver areas and land uses. The recommended acceptable ambient noise levels are used as the cumulative noise impact assessment criteria. There are no other industrial noise sources in the region surrounding the Project. As outlined in **Sections 4.7.2.3**, the limiting criterion for the Project will be the Intrusiveness Criteria, which has been adopted as the PSNL for the Project.

4.7.5.6 Impacts Summary

Umwelt has undertaken a NIA of the Project in accordance with Section 10 of the INP (EPA, 2000). Noise modelling of the Project's operations indicated the following:

- Operational noise – operational noise levels from the Project are predicted to meet or be less than the PSNL at all residential receivers.

- Sleep disturbance – the calculated $L_{A1,1minute}$ noise levels from the operation are expected to comply with the recommended sleep disturbance noise goals at all residential receiver locations.

- Construction noise – the predicted construction noise levels at the nearest residential receiver to the construction activities has the potential to reach the construction noise management level of 40 dB(A). As a result Hy-Tec should apply all feasible and reasonable work practices to manage the construction noise levels. Hy-Tec should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as provided contact details as outlined in the *Interim Construction Noise Guidelines* (DECC, 2009).

- Road noise – the predicted road traffic noise levels from light and heavy vehicles travelling to or from the Project via Putty Road do not exceed the day and night time road traffic noise criteria outlined in the NSW Road Noise Policy (DECCW, 2011), except where existing traffic noise levels are already above the criteria.

4.7.6 Proposed Management and Mitigation Measures

4.7.6.1 Noise Monitoring Program

It is recommended that Hy-Tec undertake an attended noise monitoring in order to assess ongoing compliance with relevant noise impact assessment. The noise monitoring program should:

- be undertaken to confirm operational noise levels after extraction operations are established within extraction Domain 6 and 1 (being closer to sensitive receptors compared to existing operations) within six months of commencing in that Domain;

- make provision for a review of any noise complaint (after the complaint has been investigated and substantiated by the proponent) regarding the Project from a nearby residence or OEH and undertake additional monitoring if warranted;

- specifically assess operational performance against the Intrusiveness criteria using a $L_{Aeq,\ 15\ minute}$ descriptor; and

- if noise impacts are identified during the night time period, measure and assesses the transient noise levels due to industrial noise sources using the sleep disturbance criteria descriptor of $L_{A1, 1 minute}$.

The noise monitoring program should also measure and assess the environmental noise levels due to industrial noise sources using the amenity assessment descriptor of $L_{Aeq, Period}$. However, as the Project is the only industrial noise source in the region, the noise monitoring program could be based on unattended monitoring.

As the predicted noise impacts for the Project are minor, it is recommended that the frequency of the noise monitoring program be based on the confirmation of operational noise levels after extraction operations are established within Domain 6 and 1, within six months of commencing in that Domain.

Further targeted noise monitoring should be conducted as warranted to respond to any noise complaints received from nearby residents in consultation with OEH and DP&E. Justification for the scope and methodology of any targeted monitoring program should be documented in the EPL Annual Return.

The detailed procedures that will be employed by Hy-Tec for assessing noise compliance by the Project will be documented in a Noise Management Plan. The Noise Management Plan will also identify and prioritise the operational constraints that could be implemented in order to maintain compliance with the requirement of the Project consent and EPL.

The use of the continuous real-time noise monitoring or predictive meteorological forecasting is not necessary for the assessment of normal operations of the Project given the low risk to the noise amenity of the nearby residences. However, temporary noise logging combined with audio recording could be used in noise compliance assessment activities.

4.7.6.2 Compliance Assessment

The methodology for assessing compliance with the requirement of the Project approval and EPL would be based on the noise monitoring program detailed in **Section 4.7.6.1** and would utilise the following components:

- Undertake noise monitoring surveys to measure ambient noise levels in the region surrounding the Project and determine the Project's contribution to measured noise levels.

- Compare the noise monitoring results with predicted noise impacts for the similar meteorological conditions and operating/mining conditions and with the relevant noise impact assessment criteria to assess compliance of the Project with the relevant development consent and EPL criteria.

4.7.6.3 Reporting

The monitoring results should be reviewed by the Hy-Tec environmental representative to assess compliance with the NIA predictions and with the relevant noise impact assessment criteria. The results will be reported in accordance with the requirements of the Project approval and EPL.

4.8 Air Quality

Air quality, in reference to quarry operations, generally refers to the level of particulate matter (or dust) carried by the air. Sources of particulate matter may be naturally occurring or caused by human activities, such as burning fossil fuels in cars or power plants, generating industrial emissions or mining/extractive industries.

Material to be extracted is comprised of unconsolidated sands. No crushing or grinding is proposed. The extraction operations on site are primarily a 'wet' operation, with a cutter suction dredge used to remove sand from the extraction ponds. Sand is extracted in a 2:1 ratio (water to solids) slurry and conveyed via pipeline to a central cyclone unit where it is dewatered and stockpiled, ready for loading and transport off site. The expanded operations propose to undertake small areas of 'dry' extraction around the perimeters of the extraction ponds, to assist in maximising resource utilisation and extraction efficiency, in addition to the process of maintaining appropriate shaping of batter slopes to mesh in with the surrounding terrain.

A quantitative air quality impact assessment was considered unwarranted for the proposal due to the extraction operations being primarily 'wet,' the comparatively small components of dry extraction and the remote location of the extraction operations relative to the nearest sensitive receptor (residence), as the dust emissions from the operations can be readily controlled through the use of a water cart for dust suppression. The nearest residence not associated with the quarry operation is located over 1.2 kilometres from the western extremity of the proposed operations (separated by ridges and dense bushland) and over 2 kilometres from the stockpile site.

In addition, the extractive material is moist sand with relatively high clay content (35 to 40%) and as such, it is unlikely to be susceptible to wind entrainment as the material is moist and strongly cohesive in an unprocessed state. Further as discussed, the stockpile at the Project site is located over 2 kilometres from the nearest sensitive receptor (separated by a ridge and dense bushland).

Therefore, based on the low number of sensitive receivers (three), distance to receivers and relatively remote nature of the operations, in addition to the majority of extraction operations being 'wet', the potential for adverse air quality impacts associated with the operations is considered negligible and hence quantitative assessment of air quality is considered unwarranted.

Operations at the site (since the 1996 approval) demonstrate that dust emissions can be readily managed with the greatest potential source of dust being the haul road. This issue is currently controlled with the use of a water cart as required. In addition, the stockpile maintains a moisture content of approximately 5%, given its limited residence time from dewatering to dispatch. The moisture also assists in loading and (notwithstanding load covers) preventing potential losses during transport.

Mitigation measures to ensure that the potential for wind-blown sand is minimised on site have been developed for the project, which essentially are a continuation of existing approved work methods on site. These include:

- checking to ensure that appropriate stockpile moisture content is maintained;
- use of a water cart on the access road as required;
- minimising the areas and duration of exposed soils; and

- prompt commencement of stabilisation/rehabilitation in accordance with the existing approved Environmental Management Plan (Umwelt, 2012).

4.9 Water Management

4.9.1 Surface Water Management

Prior to the quarry being established, Tinda Creek drained from the south-east of the quarry in a north-westerly direction through the centre of the current extraction area and then flowed, as it does today in a westerly direction (see **Figure 4.3a**) towards Putty Road. This flow path has subsequently been diverted around the eastern and northern boundaries of the current extraction area. As shown on **Figure 2.1**, another intermittent flow path drains in a southerly direction towards the current extraction area and is also diverted along the northern boundary of the area. The existing sand extraction operation is located at the confluence of these two flow paths and their respective catchments. To the west of existing quarry operations another tributary of the Tinda Creek system flows in a northerly direction along the eastern side of Putty Road and joins Tinda Creek prior to it passing under Putty Road via a multi-cell culvert (see **Figure 4.3a**). Collectively these three drainage lines receive and convey runoff from the study area and upslope catchments to the Tinda Creek system. Tinda Creek drains to the Colo River approximately 16 kilometres west of the site.

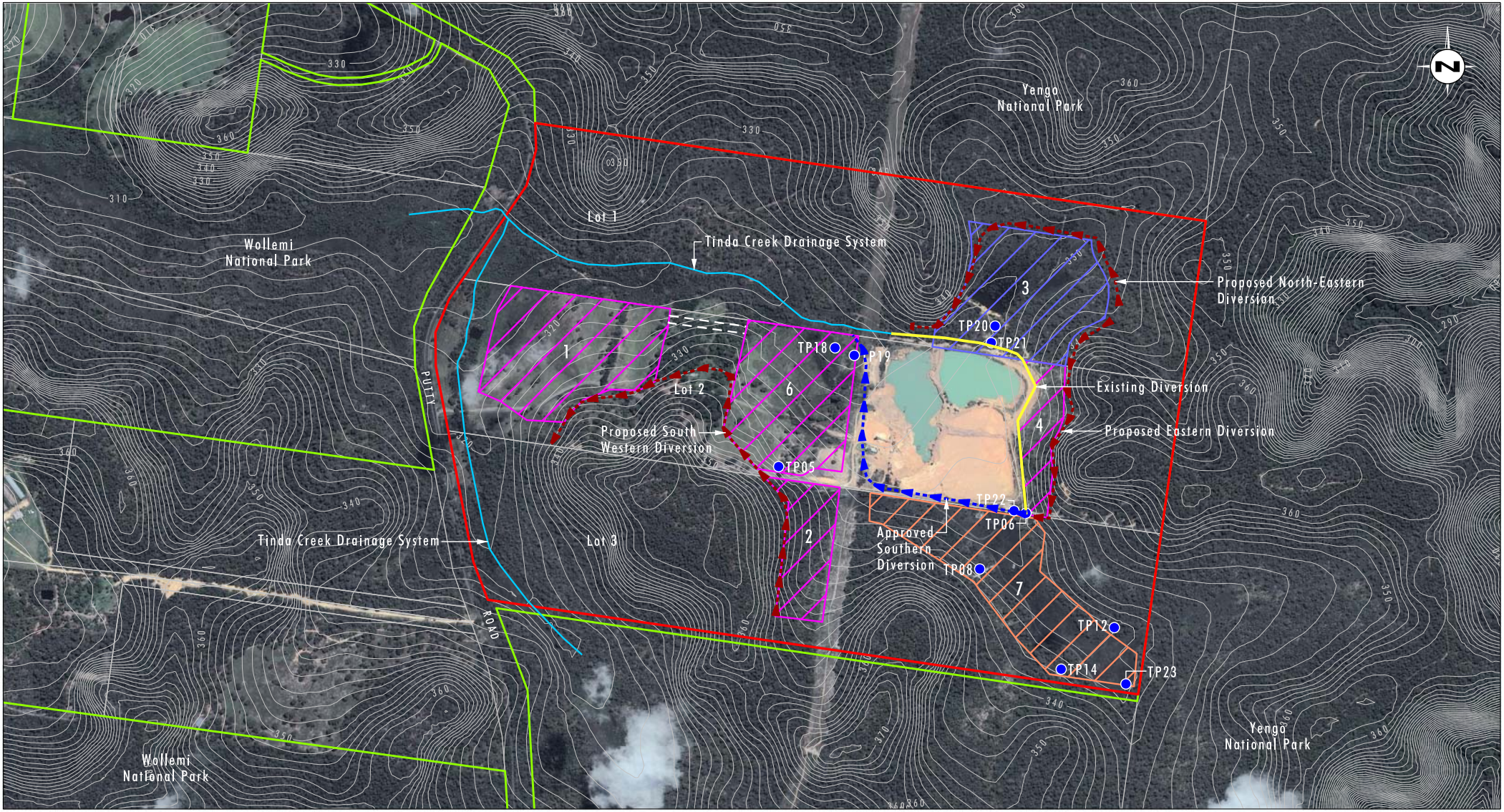
As discussed in **Section 2.1**, quarry operations at the site are undertaken within a closed water management system with clean runoff from the upslope catchment diverted around the eastern and northern sides of the quarry area via the Existing Diversion drain as shown on **Figure 4.3a**.

The proposed expansion to the quarry will disturb (in stages) approximately 50 hectares of land over a 30 year period. It will involve the staged augmentation of the existing closed water management system as quarrying progresses from the existing dredge pond through extraction Domains 6 and 2 (central pond) and then further westward to Domain 1 (western pond) which will be located to the east of Putty Road. Subsequently the extraction operation will be moved to Domain 3 to the north of the existing dredge pond. Alternatively, if it is decided to include Domain 3 within the biodiversity offset area and not be quarried, then quarrying will progress from the existing dredge pond to Domain 7 to the south-east and then progress into Domain 6 through to Domain1 in the same manner as above.

Extension of the existing water management system to include the proposed quarry extension areas will involve the establishment of clean water diversion drains around the perimeters of the proposed disturbance areas.

If Domain 3 is quarried, quarrying will initially be undertaken in the central (Domains 6 and 2) and western (Domain 1) ponds and will initially require the establishment of the South Western Diversion drain (see **Figure 4.3a**) around the western and southern perimeter of proposed extraction Domains 2, 6 and 1 to convey upslope runoff to the north flowing tributary of Tinda Creek adjacent to Putty Road. While extraction is being undertaken in Domains 2, 6 and 1, water from upslope of the existing quarry will continue to be diverted around the quarry via the Existing Diversion drain as shown on **Figure 4.3a**.

To enable the dredge to be relocated into Domain 6 and to provide for return water flow from the tailings dams to the dredge pond, a narrow trench will be dredged through the transmission line easement between the existing dredge pond and Domain 6. Once sufficient material has been removed to establish a dredge pond in Domain 6, a return water pipe will be placed at the base of the narrow trench and the trench will be backfilled to facilitate continued access along the transmission line easement. While the narrow trench is



Source: Google Earth (2012), LPI NSW (2007)
Note: Contour Interval 2mAHD

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Legend

- Project Area
- Proposed Extraction Area
- Domain 3 Extraction Area
- Domain 7 Extraction Area
- National Park Boundary
- Groundwater Monitoring Bores

FIGURE 4.3a

Existing and Proposed Water Management System Domain 3 Extraction

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open, access along the easement will be achieved by driving east, then north and then west around the existing dredge pond on the existing road system or by driving overland around the western edge of the dredge pond to be established in Domain 6. It is envisaged that the trench will be open for a period of approximately 1 to 2 months.

Parts of the existing dredge pond and the central dredge pond in Domain 6 will be progressively backfilled with tailings and imported VENM and ENM to facilitate the construction of a broad overland flow path in this area. This will be done to enable the Southern Diversion to be established. The Southern Diversion which was approved as part of modifications to the quarry in 2010 will be constructed to convey flows around the southern and western sides of the existing dredge pond and processing area prior to extraction commencing in Domain 3 (northern dredge pond). Runoff from the area upslope of the eastern and southern boundaries of the existing extraction pond will be redirected to drain via the approved Southern Diversion along the southern and western perimeters of the existing extraction area. The Southern Diversion will rejoin Tinda Creek drainage system near the north-eastern corner of Domain 6.

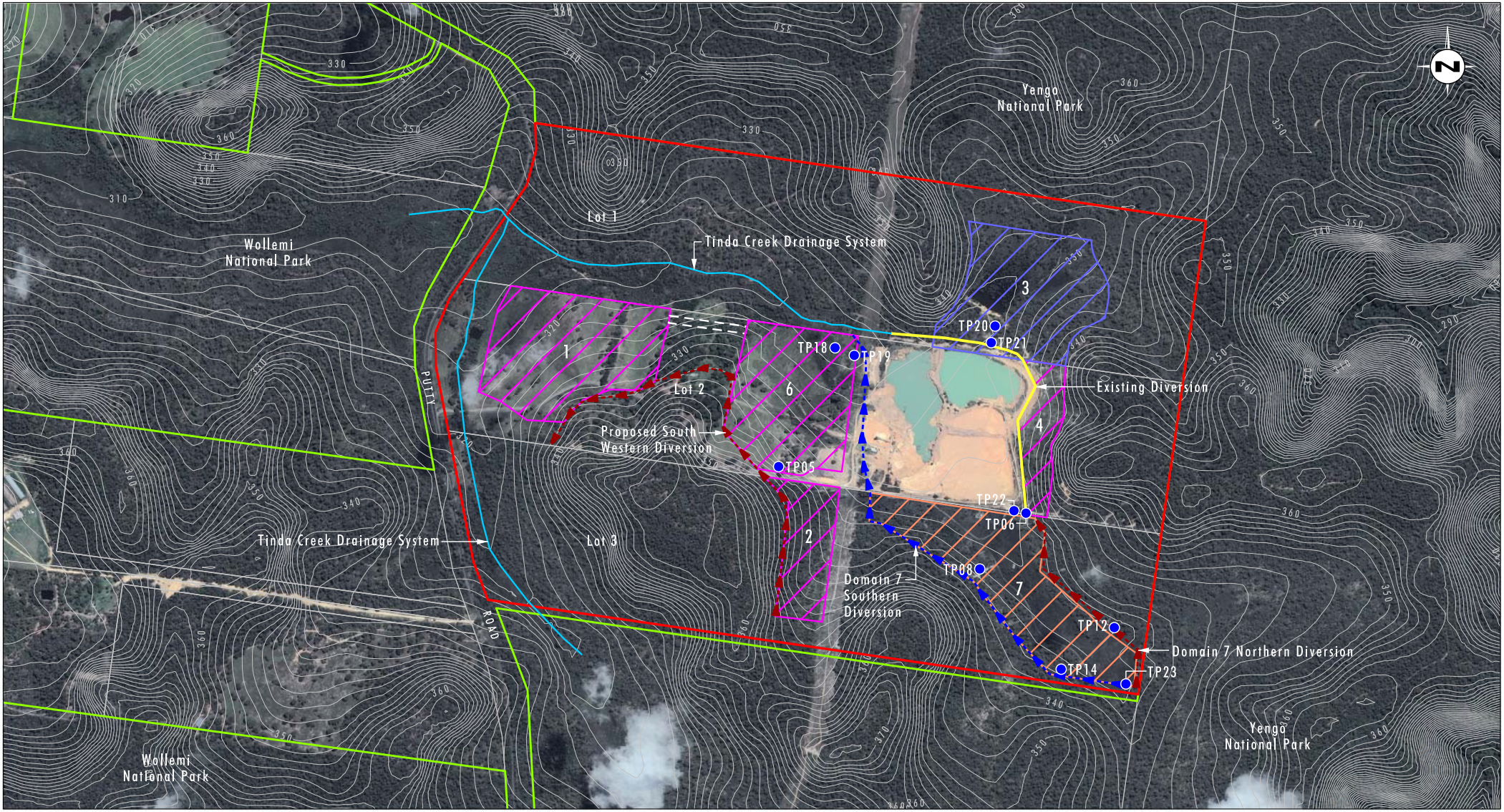
Once extraction is completed in the western pond, the dredge will be disassembled and transported back to the existing dredge pond from where dredging will progress into Domain 3. Prior to extraction commencing in Domain 3, an additional diversion drain will be constructed around the northern perimeter of the northern pond to convey upslope runoff away from the proposed dredge pond to Tinda Creek drainage system.

Upslope runoff will continue to be diverted around the central and western dredge ponds until such time as the ponds have been shaped to the final landform and rehabilitated to the extent that the landform is stable and capable of receiving runoff. Until this time the central and western dredge ponds will be maintained as off-line storages and will assist in reducing sediment export from the site. The use of proposed diversion drains that will facilitate maintaining a closed water management system during the life of the quarry, will minimise impacts on catchment yield with the potential reduction in catchment runoff during quarry operations being limited to runoff from rainfall received within the perimeter of the quarry water management system.

If quarrying is undertaken in Domain 7, the South Diversion drain will be extended (see **Figure 4.3b**) along the southern boundary of the Domain 7 extraction area to connect to the proposed Domain 7 Southern Diversion drain. In addition, a vegetated bund will be constructed along the northern edge of the Domain 7 extraction area to convey runoff to the Existing Diversion drain that is located around the eastern and northern perimeters of the current extraction area. The proposed Eastern and North Eastern Diversion drains (see **Figure 4.3a**) would not be constructed. The proposed South Western Diversion drain would be constructed prior to quarrying commencing quarrying in Domain 2 and 6.

Silt and clay material separated as part of sand processing will continue to be placed back in the base of the dredge ponds. In addition it is proposed that a minimum of 1.4 Mt of ENM and VENM material will be backloaded to the site over the life of the quarry. This material will also be used to backfill the dredge ponds with the focus over the life of the quarry being to backfill the existing dredge pond and either the Domain 3 or Domain 7 dredge ponds depending on which one is quarried. Backloaded material in excess of this requirement will be used to backfill the central dredge pond. It is intended that the western dredge pond (Domain 1) will be left open to provide an accessible water resource for ongoing fire-fighting purposes. This pond will effectively replace the existing dredge pond.

The final landform has been designed to comprise a series of ponds and naturally graded drainage channels. The system has also been designed to minimise the potential for sediment export off-site and to provide a stable landform in the long term.



Source: Google Earth (2012), LPI NSW (2007)
Note: Contour Interval 2mAHD

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Legend

- Project Area
- Proposed Extraction Area
- Domain 3 Extraction Area
- Domain 7 Extraction Area
- National Park Boundary
- Groundwater Monitoring Bores

FIGURE 4.3b

Existing and Proposed Domain 3 Water Management System Domain 7 Extraction

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It is intended that the final landform will have an open water pond area of approximately 16 hectares or less with the ultimate size of the ponds depending on the volume of ENM/VENM that is backloaded to the site. The landform has been designed to provide flexibility in the amount of material that can be backloaded to the site. This has been achieved through the design enabling the degree to which the ponds are backfilled to be determined by the amount of ENM and VENM that is imported to the site with the design having sufficient flexibility to enable between 1.4 Mt to approximately 4 Mt of VENM and ENM to be backloaded to the site if the material is available. Backfilling and reshaping of the site will be undertaken in accordance with Natural Regrade principles to provide a long-term stable landform. This is discussed further in **Section 4.15**.

It is proposed that the final alignment of Tinda Creek will follow the alignment of the Southern Diversion and then follow the existing alignment of Tinda Creek from the Southern Diversion west leaving those parts of the central and western ponds that have not been backfilled as off line storages. Provision has also been made in the landform design if sufficient material is available for backloading to the site, for the final alignment of Tinda Creek to flow through the central and western dredge ponds once the site is rehabilitated and stabilised.

The proposed Project has been assessed against the relevant requirements of the Water Sharing Plan for the Greater Metropolitan Region Groundwater Sources 2011 (WSPGWS), the Water Sharing Plan for the Greater Metropolitan Region Unregulated River Water Sources (WSPURWS), and the NSW AIP. An analysis of the proposed Project with the WSPGWS rules for this groundwater source area indicated that the proposed Project is consistent with the rules. As the proposed Project is not seeking to extract water from Tinda Creek, the provisions of the WSPURWS are not applicable. Further, assessment of the proposed Project with respect to the minimal impact considerations specified under the AIP indicated Project compliance with these matters.

4.9.2 Water Usage

As discussed in **Section 3.4.4.2**, water is used on site to transport sand silt and clay slurry from the dredge pond to the processing plant and is then used to separate sand from the silt and clay (see **Figure 2.1**). Water within the dredge pond comprises surface runoff from the closed water management system catchment and groundwater. Apart from water that is exported from site in product sand and water that is used on-site for dust suppression (i.e. on the haul road), the remainder of the water pumped from the dredge pond is re-circulated back to the dredge pond via the on-site closed water system.

It is estimated that annual dust suppression needs for the approximately 1 hectare of haul road is approximately 8 to 10 ML/year. The majority of this water is drawn from the washing plant water supply (i.e. dredging operations) with less than 0.3 ML/year of this being supplied from on-site groundwater bores. In early 2014 Hy-Tec installed meters on the groundwater bores to enable better tracking of groundwater usage.

Product sand typically contains between approximately 4% and 8% moisture. At current production levels of approximately 115,000 to 125,000 tpa, assuming a conservation upper limit moisture content in product sand of 8%, approximately 9 ML/year of water is exported from the site in product sand.

At the proposed maximum production level of 300,000 tpa, water exported from the site in product will increase to a maximum of approximately 24 ML/year making the total water usage for dust suppression and export in product up to approximately 34 ML/year.

4.9.3 Groundwater Management

4.9.3.1 Groundwater Characteristics

Groundwater quality at the site has been monitored at six monthly intervals since October 2010 with the following parameters recorded at 11 monitoring bores (see **Figure 4.3a**):

- pH;
- conductivity;
- nitrate;
- ammonia; and
- TPH.

Table 4.11 – Groundwater Quality for Period October 2010 to November 2013

	pH			Conductivity (µS/cm)		
Bore	**Max**	**Average**	**Min**	**Max**	**Average**	**Min**
TP22	5.4	5.2	4.6	74	60	50
TP06	6.6	5.9	5.3	1320	321	65
TP12	5.5	5.3	5.0	73	63	55
TP23	5.5	5.4	5.2	77	59	50
TP14	5.9	5.2	4.8	170	112	65
TP08	6.7	5.5	5.0	200	120	68
TP05	5.5	5.2	4.9	170	128	80
TP18	5.3	5.2	4.9	130	123	115
TP19	5.6	5.3	4.9	95	88	80
TP20	5.5	5.3	5.0	97	85	75
TP21	5.7	5.5	5.3	73	56	45

As shown in **Table 4.11** groundwater pH tends to be slightly acid due to the generation of organic acid from the breakdown of plant material with pH levels up to 6.7 being recorded at the start of the monitoring period after a prolonged dry period. Conductivity is generally very low except for monitoring bore TP 06 at the start of the monitoring period again after a prolonged dry period. By May 2013 after an above average rainfall period, conductivity in TP 06 has reduced to 55 µS/cm. Available monitoring data indicates that quarry activities are not adversely impacting on groundwater quality which is generally very good and tends to fluctuate in response to changes in rainfall conditions.

As shown in **Figures 2.3** and **2.4**, the proposed dredge ponds will be excavated into low permeability clayey sand material that is underlain by higher permeability sand. Assessment of geological logs from the exploration program undertaken for the project indicates that the proposed 15 metre depth of extraction within the proposed extraction areas will not intersect the underlying higher permeability sand.

Groundwater level monitoring has been undertaken at 11 monitoring bores across the site on a monthly basis since October 2010. Monitoring bore locations are shown on **Figure 4.3a** and recorded ground levels and monthly rainfall for the period October 2010 to November 2013 are shown on **Figure 4.4**. As shown on **Figure 4.4**, groundwater levels fluctuate

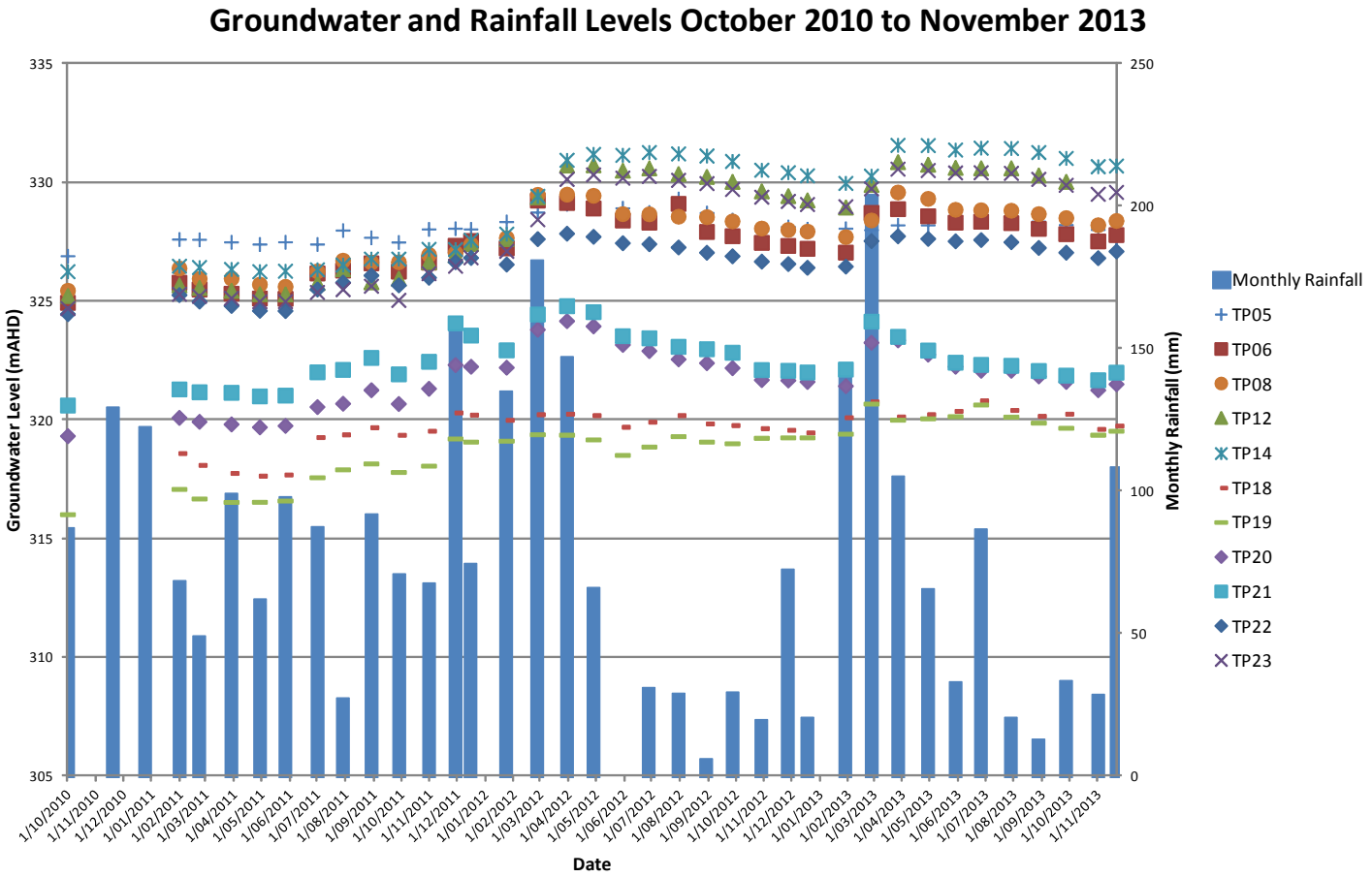


FIGURE 4.4

Groundwater Levels (October 2010 to November 2013)

reasonably quickly in response to rainfall with variations in groundwater level of up to 4 metres being observed over the October 2010 to November 2013 monitoring period.

The range of groundwater levels recorded for each of the monitoring bores for the period October 2010 to November 2013 is summarised in **Table 4.12**.

Table 4.12 – Recorded Groundwater Levels

Monitoring Bore Location	Ground Level (mAHD)	Minimum Groundwater Level (mAHD)	Maximum Groundwater Level (mAHD)	Range (m)
TP22	328.572	324.5	327.9	3.4
TP06	330.527	324.9	329.2	4.3
TP12	332.026	325.2	330.9	5.6
TP23	331.613	324.7	330.6	5.9
TP14	335.064	326.3	331.6	5.3
TP08	332.071	325.5	329.6	4.1
TP05	334.613	326.9	329.3	2.4
TP18	320.93	317.6	320.8	3.2
TP19	320.965	316.0	320.7	4.7
TP20	325.649	319.3	324.2	4.8
TP21	326.378	320.6	324.8	4.2

As shown in **Table 4.12**, recorded groundwater levels range from approximately 316.0 mAHD at Monitoring Bore TP19 adjacent to the southern boundary of the existing dredge pond to approximately 331.6 mAHD at Monitoring Bore TP14 at the south-eastern corner of the site adjacent to Yengo National Park with variation in groundwater levels over the monitoring period ranging from 2.4 metres at TP05 to 5.9 metres at TP 23. Average rainfall over the period October 2010 to November 2013 was 885 mm/year, reflecting above average rainfall for the period of groundwater record. This followed on from a slightly below average rainfall year in 2009 when 672 mm was received.

Groundwater level monitoring undertaken for the project (see **Table 4.12**) indicates that groundwater levels are typically 1 to 9 metres below the surface in the area surrounding the existing and proposed quarry operations.

As shown on **Figure 4.3a**, a series of three paired monitoring bores each approximately 50 metres apart have been established around the perimeter of the existing quarry operation those being:

- Monitoring Bores 19 and 18 immediately to the north-west;
- Monitoring Bores 21 and 20 immediately to the north-east; and
- Monitoring Bores 22 and 6 immediately to the south-east.

As can be seen from **Figure 4.4**, groundwater levels in the bores closest to the dredge pond are typically 1 to 2 metres lower than in the adjoining paired bore during dry periods with the difference in water levels reducing during prolonged wet periods. As shown on **Figure 4.4**, groundwater levels rose during the 2010 to 2013 monitoring period which received above average rainfall following on from the below average rainfall received in 2009.

Analysis of the available monitoring data for monitoring bores TP22 (adjacent to the south-eastern corner of the dredging area), TP 6 approximately 50 metres further from the

dredge pond to the east of TP 22 and TP 14 approximately 500 metres south-east of TP 14 shows that groundwater levels in all the bores respond similarly to rainfall. Monitoring indicates that groundwater levels in TP 14 are approximately 1 metre higher than those in TP 22 and TP 06 in dry periods (i.e. up to approximately March 2012) with the difference in groundwater level increasing to approximately 4 to 5 metres after prolonged high rainfall events.

4.9.3.2 Groundwater Modelling

A steady state groundwater model of Tinda Creek catchment for the existing quarry operation was developed using Visual MODFLOW Pro Version 2011.1. This model was based on the Visual MODFLOW model that was developed for the quarry in February 2008 (Umwelt, 2008) and was updated to take into consideration additional geological information and groundwater level information that has been obtained since that time.

Visual MODFLOW is a computer program that simulates three-dimensional groundwater flow through a porous medium. The model is capable of simulating groundwater flow under the influence of recharge, evapotranspiration, flow to wells, flow to drains and flow through riverbeds. Visual MODFLOW is the most widely used groundwater flow model for applications such as the assessment of the impact of mining and quarrying projects on unconfined groundwater systems. In Visual MODFLOW, catchments are broken up into a grid of blocks known as 'cells', the locations of which are described in terms of rows, columns and layers. A number of layers can be defined in Visual MODFLOW to reflect vertical changes in aquifer properties.

The major aquifer properties required by Visual MODFLOW include:

- surface topography and layer thickness;
- hydraulic conductivity;
- aquifer storage parameters;
- recharge;
- evapotranspiration; and
- flow boundary conditions including no flow boundaries, rivers and areas of constant head.

4.9.3.3 Groundwater Model Properties and Calibration

In developing the MODFLOW model for the site, are a range of hydraulic conductivity, specific storage, specific yield and porosity values were explored with those that provide closest calibration to observed groundwater levels during the period October 2010 to December 2011 which was an average rainfall period set out in **Table 4.13**.

Table 4.13 – Hydraulic Conductivity and Storage Parameters used in Tinda Creek Groundwater Model

	Conductivity (cm/s)	Specific Storage (m^3/m^3)	Specific Yield (%)	Porosity (%)
Layer 1 – Clayey sand	5×10^{-6}	1×10^{-5}	8	48
Layer 1 – sand	1×10^{-2}	1×10^{-5}	28	39
Layer 2 – sand (lower catchment)	1×10^{-2}	1×10^{-5}	28	39
Layer 2 – sand (upper catchment)*	1.5×10^{-3}	1×10^{-5}	28	39
Layer 3 – Bedrock	No flow	No flow	No flow	No flow

Boundary conditions applied in the model are the same as used in 2008 model developed for the site (Umwelt, 2008) and include:

- no flow boundaries along Tinda Creek catchment divide;
- river boundary condition along the main arm of Tinda Creek using a combination of available site survey information combined with heights derived from 1:25,000 topographic maps; and
- river boundary conditions along the southern and northern unnamed tributaries of Tinda Creek in the vicinity of Putty Road and along Rising Fast Gully using elevation data estimated from the 1:25,000 topographic map.

All scenarios have assumed evaporation from the catchment 600 mm/year with an extinction depth 5 metres for forest areas and 2.5 metres for grass and sedges areas. Evaporation of 1050 mm/year has been assumed for dredge ponds with an extinction depth of 5 metres.

The recharge parameters used in the modelling are provided in **Table 4.14**.

Table 4.14 – Recharge Parameters used in the Modelling

Rainfall Scenario	Recharge Over Catchment (mm/year)	Recharge Over Dredge Ponds (mm/year)
Above Average (900 mm/year)	100	900
Average (700 mm/year)	70	700
Below Average (400 mm/year)	40	400

4.9.3.4 Modelled Scenarios and Predicted Impacts

A series of groundwater models have been developed using Visual MODFLOW to explore the comparative impacts that quarrying could have on groundwater levels and groundwater contributions to flows in the Tinda Creek system. Visual MODFLOW models that have been developed for Tinda Creek model the following landform configurations:

- Tinda Creek catchment with current (2013) quarrying operations;
- Tinda Creek catchment with existing dredge pond and the northern dredge pond (Domain 3) backfilled with silt, clay and ENM/VENM; and

- Tinda Creek catchment with existing dredge pond, the central dredge pond (Domain 6) and the northern dredge pond (Domain 3) backfilled with silt, clay and ENM/VENM.

Modelled groundwater head equipotentials for steady state average rainfall conditions for existing quarry operations (2013) are shown on **Figure 4.5**. As can be seen from **Figure 4.5** modelled groundwater levels range from:

- approximately 313 mAHD near the north-western extent of the site where Tinda Creek flows under Putty Road;
- to approximately 316 mAHD at the southern boundary of the site adjacent Putty Road;
- to approximately 328 mAHD at the south-eastern corner of the site adjacent to Yengo National Park; and
- to approximately 322 mAHD at the north-eastern corner of the site adjacent to Yengo National Park.

Ground level at each of these locations ranges from approximately 3 metres to 12 metres above predicted groundwater levels.

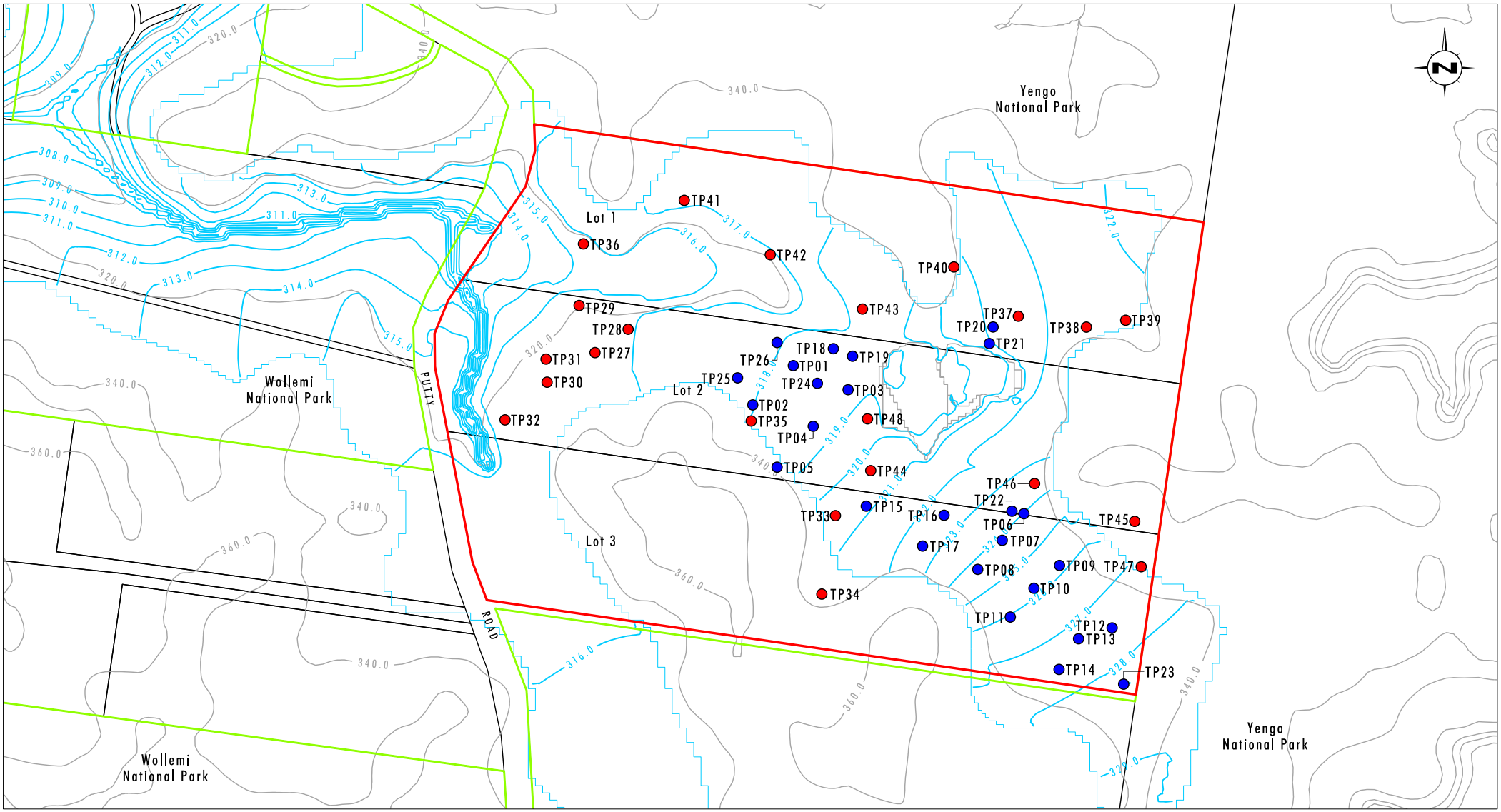
Modelled groundwater head equipotentials for steady state average rainfall conditions for the proposed dredging operation with existing quarry and northern dredge pond (Domain 3) backfilled to approximately 3 metres below existing ground level are shown on **Figure 4.6**. As can be seen from **Figure 4.6** modelled groundwater levels range from:

- approximately 312 mAHD near the north-western extent of the site where Tinda Creek flows under Putty Road;
- to approximately 316 mAHD at the southern boundary of the site adjacent Putty Road;
- to approximately 327 mAHD at the south-eastern corner of the site adjacent to Yengo National Park; and
- to approximately 321 mAHD at the north-eastern corner of the site adjacent to Yengo National Park.

As shown on **Figure 4.6**, predicted groundwater levels under this scenario have dropped by approximately 0 metres and 1 metre when compared to predictions for the existing quarry operation.

Modelled groundwater head equipotentials for steady state average rainfall conditions for the proposed dredging operation with existing quarry, northern dredge pond and central dredge pond (Domain 6) backfilled to approximately 3 metres below existing ground level are shown on **Figure 4.7**. As can be seen from **Figure 4.7** modelled groundwater levels range from:

- approximately 313 mAHD near the north-western extent of the site where Tinda Creek flows under Putty Road;
- to approximately 316 mAHD at the southern boundary of the site adjacent Putty Road;
- to approximately 327 mAHD at the south-eastern corner of the site adjacent to Yengo National Park; and
- to approximately 322 mAHD at the north-eastern corner of the site adjacent to Yengo National Park.



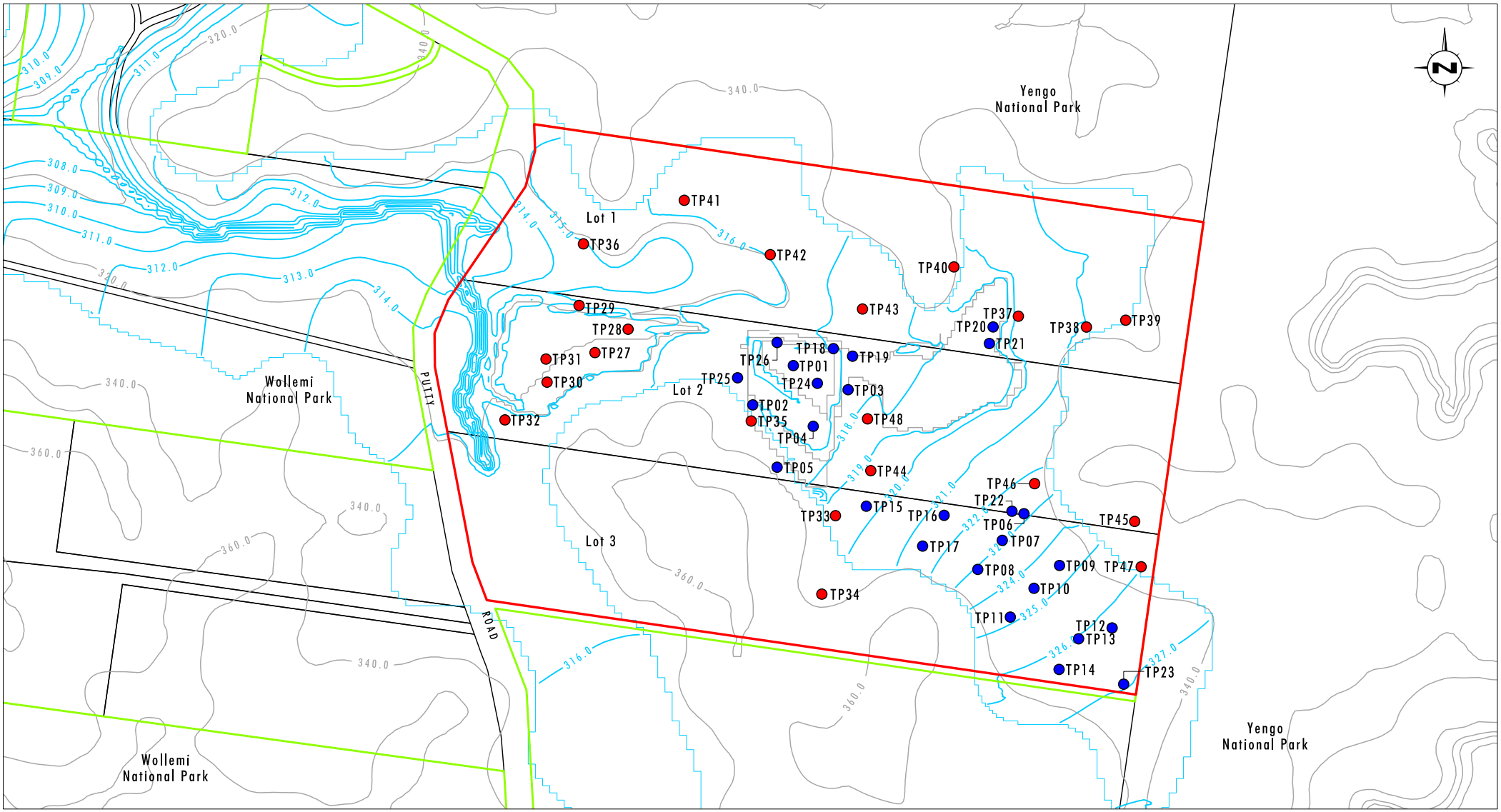
Source: Google Earth (2012), LPI NSW (2007)

Legend

- Project Area
- National Park Boundary
- 2010 Groundwater Bores
- 2012 Groundwater Bores

FIGURE 4.5

Modelled Groundwater Head Equipotentials (mAHD) - Existing Quarry



Source: Google Earth (2012), LPI NSW (2007)

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1:15 000

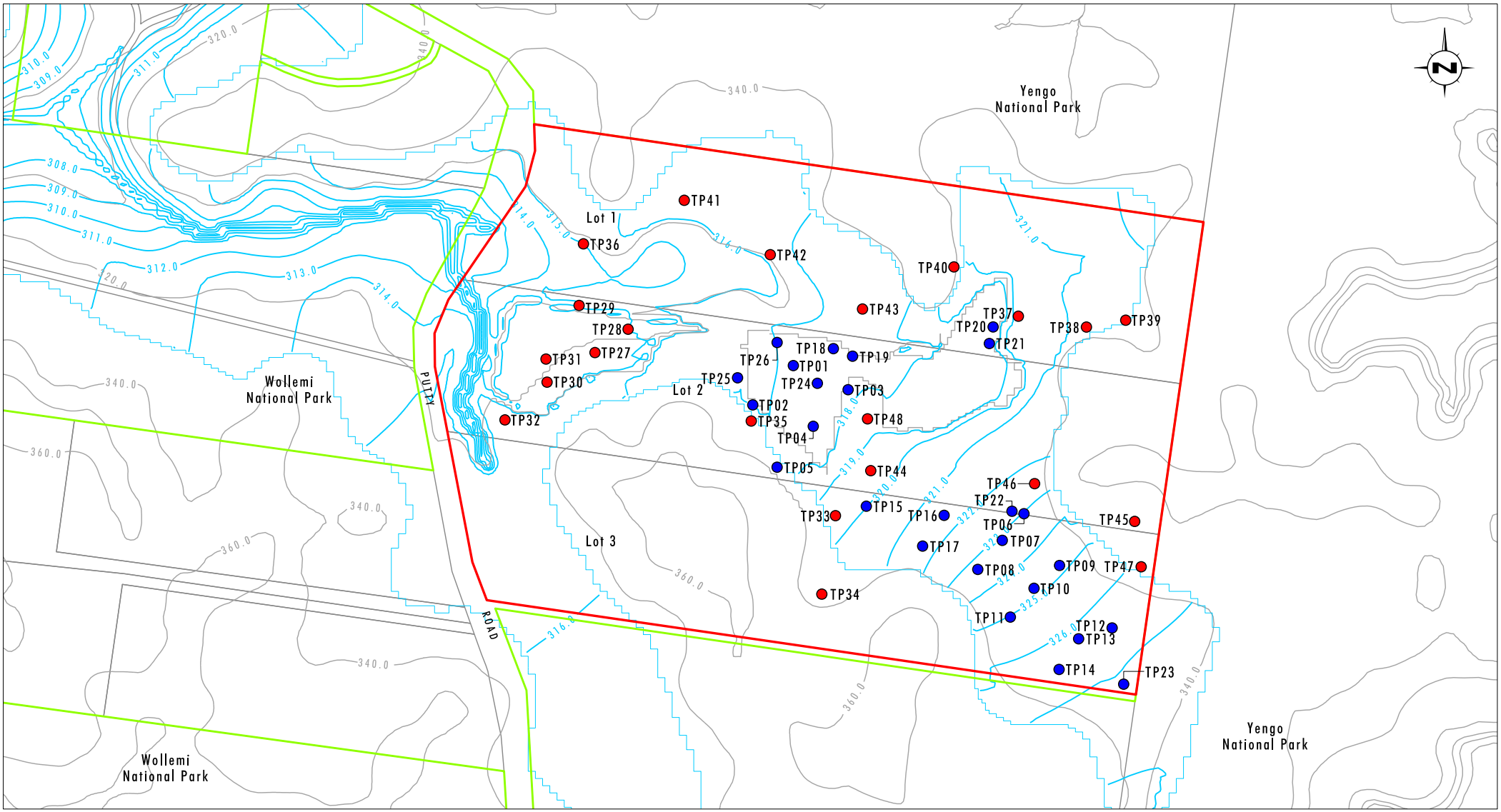
Legend

- Project Area
- National Park Boundary
- 2010 Groundwater Bores
- 2012 Groundwater Bores

FIGURE 4.6

Modelled Groundwater Head Equipotentials (mAHD) - Final Landform with infilled Existing and Northern Pits

File Name (A4): R14_V1/1731_406.dgn



Legend

- Project Area
- National Park Boundary
- 2010 Groundwater Bores
- 2012 Groundwater Bores

FIGURE 4.7

Modelled Groundwater Head Equipotentials (mAHD) - Final Landform with infilled Existing, Northern and Central Pits

File Name (A4): R14_V1/1731_407.dgn

As shown on **Figure 4.7**, predicted groundwater levels under this scenario have dropped by approximately 0 metres and 1 metre when compared to predictions for the existing quarry operation.

Modelling of the proposed dredging operation and final landform as discussed above indicates that groundwater levels in the surrounding National Park estate will not be significantly affected by proposed dredging operation with only small changes predicted in groundwater level.

The calibrated MODFLOW model was used to explore potential changes in baseflow to Tinda Creek catchment as a result of the various modelled quarrying scenarios. The results of this analysis are summarised in **Table 4.15**.

Table 4.15 – Predicted Baseflow Contributions to Tinda Creek System

	Wet Rainfall Scenario			Average Rainfall Scenario			Dry Rainfall Scenario		
	Upper Catchment Outflow (m^3/day)	Total Catchment Outflow (m^3/day)	Total Catchment Outflow (ML/year)	Upper Catchment Outflow (m^3/day)	Total Catchment Outflow (m^3/day)	Total Catchment Outflow (ML/year)	Upper Catchment Outflow (m^3/day)	Total Catchment Outflow (m^3/day)	Total Catchment Outflow (ML/year)
Existing Quarry Scenario									
Recharge	-1640.6	-3315.7	-1210.2	-1112.7	-2235.1	-815.8	-597.32	-1208.31	-441.0
Evapotranspiration	733.28	2849.38	1040.0	386.38	1947.88	711.0	152.02	1140.67	416.3
Tinda Creek (inflow)	0	-5.426	-2.0	0	-38.859	-14.2	0	-93.049	-34.0
Tinda Creek (outflow)	90.8	472.31	172.4	70.289	325.889	118.9	35.916	160.816	58.7
Final Landform Infill Existing and North Pits									
Recharge	-1859	-3522.7	-1285.8	-1271	-2382.8	-869.7	-688.51	-1290.5	-471.0
Evapotranspiration	1073.3	3088.5	1127.3	662.83	2130.03	777.5	365.81	1266.42	462.2
Tinda Creek (inflow)	0	-8.1607	-3.0	0	-43.82	-16.0	0	-101.23	-36.9
Tinda Creek (outflow)	83.432	442.392	161.5	61.44	297.3	108.5	24.53	124.92	45.6
Final Landform Infill Existing, North and Central Pits									
Recharge	-1667.2	-3325.6	-1213.8	-1122.1	-2231.8	-814.6	-606.69	-1209.91	-441.6
Evapotranspiration	886.23	2892.63	1055.8	493.94	1974.34	720.6	259.34	1178.42	430.1
Tinda Creek (inflow)	0	-8.699	-3.2	0	-43.308	-15.8	0	-99.384	-36.3
Tinda Creek (outflow)	83.217	440.347	160.7	62.909	301.669	110.1	26.92	132.64	48.4

As show in **Table 4.15**, during average rainfall conditions total catchment outflow at the western edge of the groundwater model which is approximately 2 kilometres downstream from Putty Road is expected to reduce from approximately 118.9 ML/year to approximately 108 ML/year if only the existing and north pits are backfilled and to 110.1 ML/year if the central pit is also backfilled. All of these predicted reductions in groundwater yield are less than the 55 ML/year that Hy-Tec is currently licensed to extract from groundwater resources on-site.

4.9.3.5 Groundwater Management Controls

Groundwater modelling indicates that the proposed quarry operation is unlikely to have a significant adverse impact on surrounding groundwater levels or the availability of groundwater to groundwater dependent ecosystem in the surrounding area.

It is proposed that groundwater level monitoring will continue to be undertaken on a monthly to quarterly basis with additional monitoring bores to be established towards the western boundary of the site and in the north-east corner over the site.

Groundwater level information will be regularly reviewed and reassessed against model predictions with the groundwater model being revised if monitoring results indicate this is required.

4.10 Visual Impacts

4.10.1 Existing Environment

The existing quarry is located on land previously cleared for farming. Land to the north of the existing quarry on Lot 1 has been partially cleared, though has since regrown. On the eastern side of the quarry are rock outcrops with primarily dense native vegetation. To the south and south-east of the existing quarry, within Lot 3, is a large, low-lying sedgelands, surrounded by densely vegetated gentle slopes. From the site west towards Putty Road is a disturbed area, now grassed with some trees present.

4.10.2 Visual Impact Assessment

With the exception of Domain 1 (**Figure 1.3**), the current operations are not visible from the nearest public road (Putty Road), or from off site in any direction, given the distance of the quarry to the edge of the site, the density of vegetation and topographic characteristics of the landscape. The proposed extension to the extraction areas will not involve the relocation or construction of any infrastructure and has minimal potential for significant visual impact to any vantage points beyond the property boundary.

Operations in Domain 1 may be partly visible to passing traffic through the existing vegetation located between the western end of Domain 1 and Putty Road (**Figure 1.3**). However, given the linear extent of this vegetation, which runs parallel to the western extent of Domain 1, it is unlikely that any significant viewpoint could be established, notwithstanding that the viewers would be motorists passing in a 100 km/h zone. Therefore, it is concluded that there is a very low potential for visual impact from operations in Domain 1 and as such, no mitigation measures recommended.

4.11 Greenhouse Gas and Energy

This section of the report provides details regarding a quantitative assessment of the potential Scope 1, 2 and 3 emissions of the Project, a qualitative assessment of the potential impact these emissions have on the environment; and an assessment of reasonable and feasible measures to minimise greenhouse gas emissions as a result of the proposed expanded extractive operations.

4.11.1 Greenhouse Assessment Framework

The GHGEA assessment framework is based on the methodologies and emission factors contained in the National Greenhouse Accounts (NGA) Factors 2012 (DCCEE, 2012a). The assessment framework also incorporates the principles of The Greenhouse Gas Protocol.

The NGA Factors draw on the National Greenhouse Gas and Energy Reporting System (Measurement) Determination (2008) (DIICCSRTE (2013)), however, the NGA Factors have a general application to the estimation of a broader range of greenhouse gas inventories (DCCEE, 2012b) that are more suited to environmental impact assessment.

The Greenhouse Gas Protocol (World Resources Institute/World Business Council Sustainable Development, 2004) (GHG Protocol) provides an internationally accepted approach to greenhouse gas accounting. The GHG Protocol provides guidance on setting reporting boundaries, defining emission sources and dealing with issues such as data quality and materiality. The GHG Protocol also defines three distinct reporting scopes, to eliminate the possibility of double counting. The reporting scopes are outlined briefly below.

Scope 1 emissions are direct emissions which occur from sources owned or controlled by the reporting entity, over which they have a high level of control (such as fuel use).

Scope 2 emissions are those generated from purchased electricity consumed by the reporting entity, which can be easily measured and can be influenced through energy efficiency measures. Scope 2 emissions physically occur at the facility where electricity is generated (i.e. the power station).

Scope 3 emissions are indirect emissions that are a consequence of the activities of the reporting entity, but occur at sources owned or controlled by another reporting entity (e.g. outsourced services).

4.11.2 Assessment Methodology

Scope 1, 2 and 3 emissions were calculated based on the methodologies and emission factors contained in the NGA Factors 2012. Diesel use activity data associated with product transport was estimated using diesel use efficiency factors developed by the Australian Greenhouse Office (AGO, 2006).

4.11.2.1 Data Sources and Exclusions

The calculations in this report are based on activity data projections provided by Hy-Tec. Transport energy use was estimated based on fuel consumption and distance assumptions for specific markets.

Table 4.16 includes activity data which was excluded from the assessment boundary.

Table 4.16 – Data Exclusions

Emissions Source	Scope	Description	Reason for Exclusion
Combustion of fuel for energy	Scope 1	Small qualities of fuels such as petrol	Emissions likely to lack relevance to project stakeholders
Business travel	Scope 3	Employees travelling for business purposes	Emissions likely to lack relevance to project stakeholders
Employee travel	Scope 3	Employees travelling between their place of residence and the quarry site	Emissions likely to lack relevance to project stakeholders

Petrol use was excluded from the greenhouse gas assessment as it is not forecast to be a major source of energy or greenhouse gas emissions. Greenhouse gas emissions from petrol use are unlikely to be considered relevant by internal or external stakeholders.

Employee travel and business travel were excluded from the greenhouse gas assessment as they are not forecast to be a major source of greenhouse gas emissions. Greenhouse gas emissions from employee travel and business travel are unlikely to be considered relevant by internal or external stakeholders.

4.11.3 Predicted Energy Consumption

The Project's energy consumption is based on the following assumptions:

- The quarry will extract and transport 300,000 tpa.
- On-site diesel use will average 1.6 l per product tonne of product.
- All product is delivered 100 kilometres. This assumption may over estimate product transport, as products are currently delivered within a 100 kilometres radius of the quarry.
- All on-site diesel is delivered 100 kilometres from Western Sydney.
- Transport diesel use will average 0.546 L/km (AGO, 2006).

The Project's primary energy source is diesel. The operation of the quarry is forecast to require approximately 19,000 GJ of energy per annum.

4.11.4 Predicted Greenhouse Gas Emissions

Total annual emissions associated with the Project, at maximum production, are forecast at approximately 4300 t CO_2-e per annum. **Table 4.17** provides a breakdown of the Project's greenhouse gas emission sources. Details of calculations are provided in **Appendix 11**.

Table 4.17 – Greenhouse Gas Emissions

Emissions Source	Scope	Operations at 300,000 tpa
		t CO_2-e
Stationary diesel use	1	1,288
Electricity use	2	0
Energy extraction/transmission	3	98
Outsourced transport	3	2,887
TOTAL		**4,273**

Annual Scope 1 emissions generated by the quarry operations are forecast at approximately 1,300 t CO_2-e per annum. Scope 1 emissions are generated from the combustion of diesel.

The Project is not forecast to consume grid electricity and will not be associated with the production of Scope 2 emissions.

Annual Scope 3 emissions associated with the quarry operations are forecast at approximately 3,000 t CO_2-e per annum. Scope 3 emissions are indirect emissions associated with outsourced transport services and the production of diesel.

4.11.5 Impact of Emissions on the Environment

The Project's greenhouse gas emissions will have a disperse impact, as they are highly mobile and are generated up and down the supply chain. Greenhouse gas emissions primarily alter the atmospheric concentration of carbon dioxide and methane. The secondary impacts of greenhouse gas emissions may include global warming, ocean acidification and carbon fertilisation of flora. The tertiary impacts of greenhouse gas emissions (i.e. climate change) may have many ramifications for the natural and built environment.

The Project's direct emissions are forecast to be approximately 1,300 t CO_2 -e per annum.

To put the Project's emissions into perspective, global greenhouse gas emissions are forecast to be 46,000,000,000 t CO_2-e by 2020 (Sheehan et al., 2008). During operation, the quarry will contribute approximately 0.000003% to the global emissions per annum (based on its projected Scope 1 emissions). The Scope 2 and 3 emissions associated with the quarry should not be considered in a global context, as global projections only represent Scope 1 emissions (i.e. the sum of all individual emission sources).

4.11.6 Impact on Climate Change

The Intergovernmental Panel on Climate Change (IPCC) define climate change as a change in the state of the climate that can be identified by changes in the mean and/or variability of its properties, and which persists for an extended period, typically decades or longer (IPCC, 2007).

Climate change is caused by changes to the energy balance of the climate system. The energy balance of the climate system is driven by atmospheric concentrations of greenhouse gases and aerosols, land cover and solar radiation (IPCC, 2007). There is strong evidence to suggest that observations of global warming are directly correlated to increased concentrations of atmospheric greenhouse gases (IPCC, 2007). The extent to which global emissions and atmospheric concentrations of greenhouse gases have a demonstrable impact on climate change will be largely driven by the global response to reducing total global emissions.

The Project, like all activities that generate greenhouse gas emissions, will alter atmospheric concentrations of greenhouse gases and provide a driver for future climate change. It would be misleading to assess the climate change impacts of the Project by simply applying a radiative forcing coefficient to the greenhouse gases generated by the Project. Carbon emitted to the atmosphere is exchanged between carbon reservoirs such as oceans and ecosystems over a wide range of timescales (IPCC, 2007). It would therefore be erroneous to assume that the greenhouse gases generated by the Project will materially shift the atmospheric concentration of greenhouse gases in a linear way.

Given the almost insignificant levels of greenhouse gas emissions forecast for the Project, the Project's contribution to future climate change will almost certainly be overshadowed by emerging greenhouse gas sources and sinks.

4.11.7 Current Mitigation Measures

Hy-Tec is a subsidiary of (or controlled by) Adelaide Brighton Pty Ltd. Controlling corporations that use more than 0.5 petajoules (PJ) of energy per year must participate in the Energy Efficiency Opportunities (EEO) Program. Adelaide Brighton triggers the energy use thresholds of the EEO Program and as such is therefore required to undertake energy efficiency assessments and report the progress of energy efficiency projects. Hy-Tec currently complete energy efficiency assessments, undertake energy efficiency planning and assist Adelaide Brighton to report on the progress of nominated energy efficiency projections. Hy-Tec will continue to participate in the EEO Program and undertake the following activities to improve energy use efficiency:

- develop an energy efficiency opportunities project and communication plan;
- evaluate energy use for the Project;
- identify and investigate potential energy efficiency opportunities; and
- implement, track, communicate and report on energy efficiency opportunities.

4.11.8 Assessment of Proposed Management and Mitigation Measures

Figure 4.8 demonstrates that approximately 30% of the Project's emissions are under the operational control of Hy-Tec.

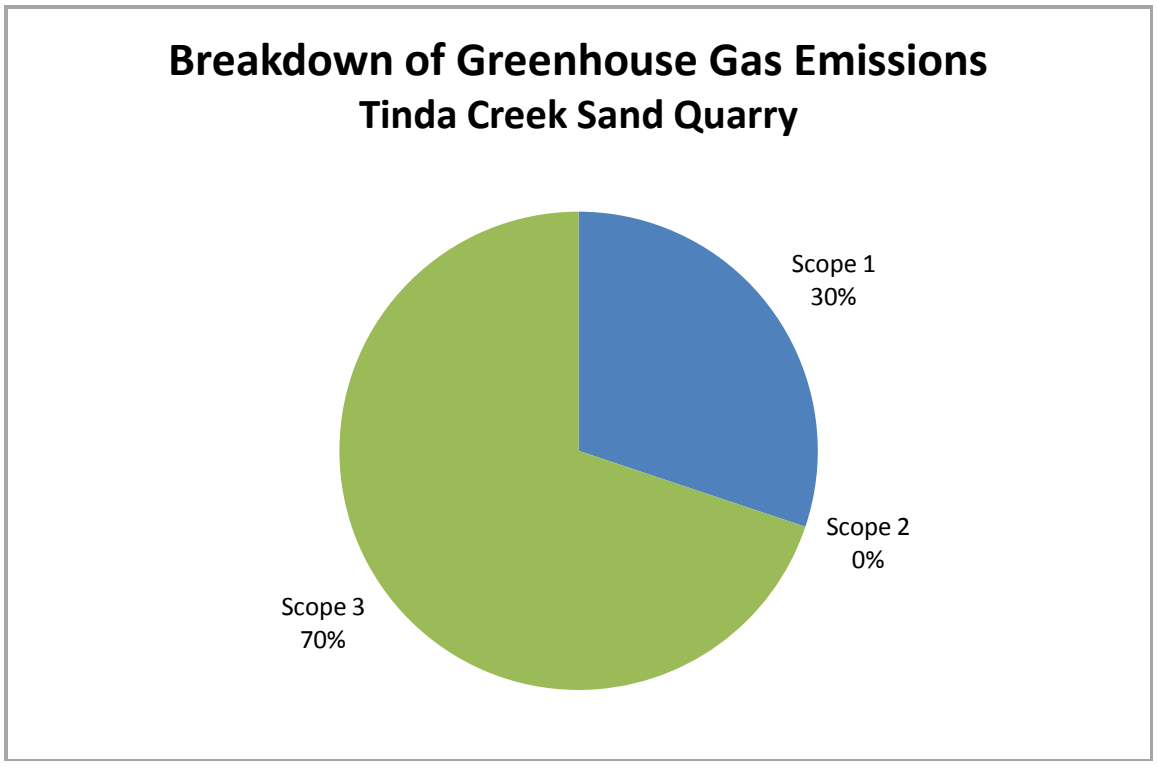


Figure 4.8 – Proportion of Greenhouse Gas Emissions by Source

The Project's Scope 1 emissions are generated through the operation of the dredge, earthmoving equipment, a haul truck, pumps and an electricity generator.

Effective mitigation measures could include improving diesel use efficiency of on-site plant and equipment; and switching from diesel to alternative fuel sources.

In accordance with the requirements of the DGRs, the following sections assess a range of greenhouse gas mitigation measures against common mitigation practice that have been discussed and evaluated by the proponent for the Project.

4.11.8.1 Improving On-site Diesel Use Efficiency

Table 4.18 provides an assessment of a range of potential mitigation measures that may result in a reduction of greenhouse gas emissions from on-site diesel use.

Table 4.18 – Options Assessed for On-site Diesel Use

Energy Use During Extraction		
Potential Mitigation Measure	**Planned for Project**	**Reason for Inclusion/Exclusion**
1. Upgrading the haul truck	Yes	Occurs as part of the operational equipment replacement program
2. Upgrading the front-end loader	Yes	Occurs as part of the operational equipment replacement program
3. Upgrading the dredge cutter and suction head	Yes	Is required to handle proposed increased production from 125,000 tpa to 300,000 tpa and improve efficiency of operations

Table 4.18 – Options Assessed for On-site Diesel Use (cont)

Energy Use During Extraction		
Potential Mitigation Measure	**Planned for Project**	**Reason for Inclusion/Exclusion**
4. Optimising the efficiency of the operation (e.g. review haul routes to minimise travel; reducing dredge downtime;)	Yes	Operations subject to regular review to maximise efficiency
5. Regular maintenance and replacement of equipment to optimise efficiency (e.g. pump impellors)	Yes	Part of ongoing plant and equipment maintenance program as required under the detailed Mine safety Management Plan for the site
6. Matching extraction capacity to processing capacity	Yes	The cyclone configuration is currently rated to 150TPH and is capable of the producing 300,000 tpa without further upgrade
7. Reducing re-handling of tailings, clay and product	Yes	Operations subject to regular review to maximise efficiency
8. Variable Speed Drives (VSD) on suitable electric motors	Yes	Reviewed as part of the operational equipment replacement program

4.11.8.2 Switching to Lower Emission Energy Sources

Table 4.19 provides an assessment of a range of potential mitigation measures that may result in a reduction of greenhouse gas emissions from switching energy sources.

Table 4.19 – Options Assessed for Switching Energy Sources

Energy Use During Processing		
Potential Mitigation Measure	**Planned for Project**	**Reason for Inclusion/Exclusion**
1. Solar water pumps to transfer water from the tailings dam to the dredge pond	Possible	A review of options regarding the use of solar powered equipment as part of the operations is currently in progress.
2. Solar panels for the administration building	Possible	A review of options regarding the use of solar powered equipment as part of the operations is currently in progress.
3. Alternate sources of electricity generation	Possible	A review of options regarding the use of alternative powered equipment as part of the operations is currently in progress.
4. Bio-gas/bio-diesel for on-site equipment	Possible	Part of forward program to investigate options for use

4.11.9 Conclusion

The operation of the quarry is expected to generate approximately 1,300 t CO_2-e Scope 1 emissions per annum, at maximum production. The Project's emissions may be reported under the National Greenhouse and Energy Reporting System as Adelaide Brighton Pty Ltd triggers legislative reporting thresholds, however, as an individual facility, the Project's emissions are forecast to be relatively small.

The greenhouse gas emissions associated with the Project are unlikely to generate a demonstrable adverse impact on the environment. The Project is also unlikely to impact national greenhouse gas policy objectives due to its relatively small annual emissions.

The proponent has identified a number of mitigation measures that will be implemented over the life of the Project in addition to others that are actively under consideration for determination of feasibility. The proponent will continue to monitor diesel usage and assess the associated efficiencies. Through this process, the proponent will identify opportunities and subsequently implement reasonable and feasible measures, which will result in improved energy efficiencies.

4.12 Hazards

4.12.1 Safety, Health and Environment

Hazards onsite are managed in accordance with the Hy-Tec Health, Safety and Environment (HSE) Management System and Mine Safety Management Plan (MSMP) (comprising Group Policy, Standards and Site Specific Procedures) and in accordance with the New South Wales *Work Health and Safety Act 2011* (WH&S Act), the Work Health and Safety Regulation 2011 and relevant Australian Standards.

Hy-Tec aims to eliminate all injuries, occupational illnesses and preventable vehicular incidents. The company seeks to achieve this by:

- identifying and reducing the risks of all types of work activities that have the potential to produce personal injury or occupational illness;
- ensuring that everyone (including visitors and contractors) complies with appropriate legal and workplace requirements relating to safety and health;
- establishing measurable objectives and targets for HSE to ensure continuous improvement aimed at elimination of work related illness and injury;
- providing instruction, training and supervision to improve individual's understanding of workplace hazards, including safe work practices and emergency procedures;
- involving individuals in safety and health matters within the workplace, and consulting with them in ways to recognise, evaluate and control workplace hazards via the risk management process;
- communicating safety and health information to all employees, contractors, labour hire employees and visitors to the workplace; and
- effectively implementing the HSE Policy and Mine Safety Management Plan.

4.12.2 Preliminary Hazard Assessment

SEPP 33 – Hazardous and Offensive Development (SEPP 33) requires a preliminary risk screening of a proposed development to determine the need for a preliminary hazard analysis (PHA) to assess the potential hazard associated with a proposed development. The preliminary screening involves identification and assessment of the storage of specific dangerous goods classes that have the potential for significant off-site effects. If, at the proposed location, and in the presence of controls, the risk level exceeds the acceptable

criteria for impacts on the surrounding land use, the development is classified as 'hazardous' or 'offensive' industry and may not be permissible within most land use zones in NSW.

A 'hazardous industry' under SEPP 33 is one which, when all locational, technical, operational and organisational safeguards are employed continues to pose a significant risk. An 'offensive industry' is one which, even when controls are used, has emissions which result in a significant level of offence e.g. odour or noise emissions. A proposal cannot be considered either hazardous or offensive until it is firstly identified as potentially hazardous or potentially offensive, and is subjected to the assessment requirements of SEPP 33. A PHA is required if a proposed development is potentially hazardous.

A proposed development may also be potentially hazardous if the number of traffic movements for the transport of hazardous materials exceeds the annual or weekly criteria outlined in Table 2 of Applying SEPP 33 (DoP, 2011). If these thresholds are exceeded a route evaluation study is likely to be required.

HIPAP No. 6 – Guidelines for Hazard Analysis (DoP, 2011a) notes that a PHA should identify and assess all hazards that have the potential for off-site impact. The expectation is that the hazards would be analysed to determine the consequence to people, property and the environment and the potential for hazards to occur. It is noted also that Hy-Tec's Mine Safety Management Plan (element 17 – Hazardous Substances and Dangerous Goods) meets the requirements.

4.12.2.1 Preliminary Risk Screening

Preliminary risk screening is undertaken to determine the requirement for a PHA. SEPP 33 contains a number of criteria for hazardous material storage quantities that have the potential to create off site impacts.

Table 4.20 contains a list of hazardous materials to be stored and used at Tinda Creek Quarry and the SEPP 33 screening criteria.

Table 4.20 – Hazardous Materials Inventory

Material	ADG Code Class (PG)	Estimated Project Storage Capacity (kg)	Screening Threshold (kg)	Trigger SEPP 33
Aerosols	2.1	(WD 40) 12 x 521 ml cans	100	No
LPG (Handigas)	2.1	2 x 45kg	10,000	No
Thinners	3(II)	1 x 20L	5,000	No
Kerosene	3(III)	1 x 20L	5,000	No

ADG Code – Australian Dangerous Goods Code.

The aggregate quantity of Class 2.1 flammable gases (excluding LPG) to be stored on site is below the SEPP 33 screening threshold of 100 kg, while the stored quantity of LPG is below the screening threshold of 10,000 kg.

The aggregate quantity of Class 3 flammable liquids to be stored on site is also below the SEPP 33 screening threshold of 5000 kg. Based on the information in **Table 4.20** the development is not considered potentially hazardous with respect to the storage of hazardous materials. Diesel fuel is also stored on site, however, is not subject to SEPP 33 screening as it is not stored with Class 3 flammable liquids. The proponent will continue existing work practices of storing all dangerous goods in accordance with dangerous goods storage requirements and relevant Australian Standards.

4.12.2.2 Transport Quantity Screening

Table 4.21 contains details of the anticipated dangerous good related traffic movements associated with the proposed development. Traffic movements associated with all classes of hazardous materials do not trigger the need for a transport safety study based on the estimated number and frequency of movements for these materials.

Table 4.21 – Estimated Vehicle Movements of Dangerous Goods

Material	ADG Code Class	Delivery Quantity (t)	No. of Deliveries/Despatches		Minimum Quantity (t)		Screening Threshold		Trigger SEPP 33
			Weekly	p.a.	Bulk	Packages	Weekly	p.a.	
Aggregate flammable gases	2.1	<2*	<30*	<500*	2	5	>30	>500	No
Aggregate Flammable liquids	3 (II)	<2*	<30*	<500*	3	10	>30	>500	No

* Delivery quantities and frequencies estimated by Umwelt.

4.12.2.3 Conclusion

The Project is not considered to be a potentially hazardous development with respect to the storage, use or transportation of hazardous substances. Therefore, in accordance with SEPP 33, a PHA is not required and no further risk analysis and assessment is required.

4.12.3 Bushfire Hazard

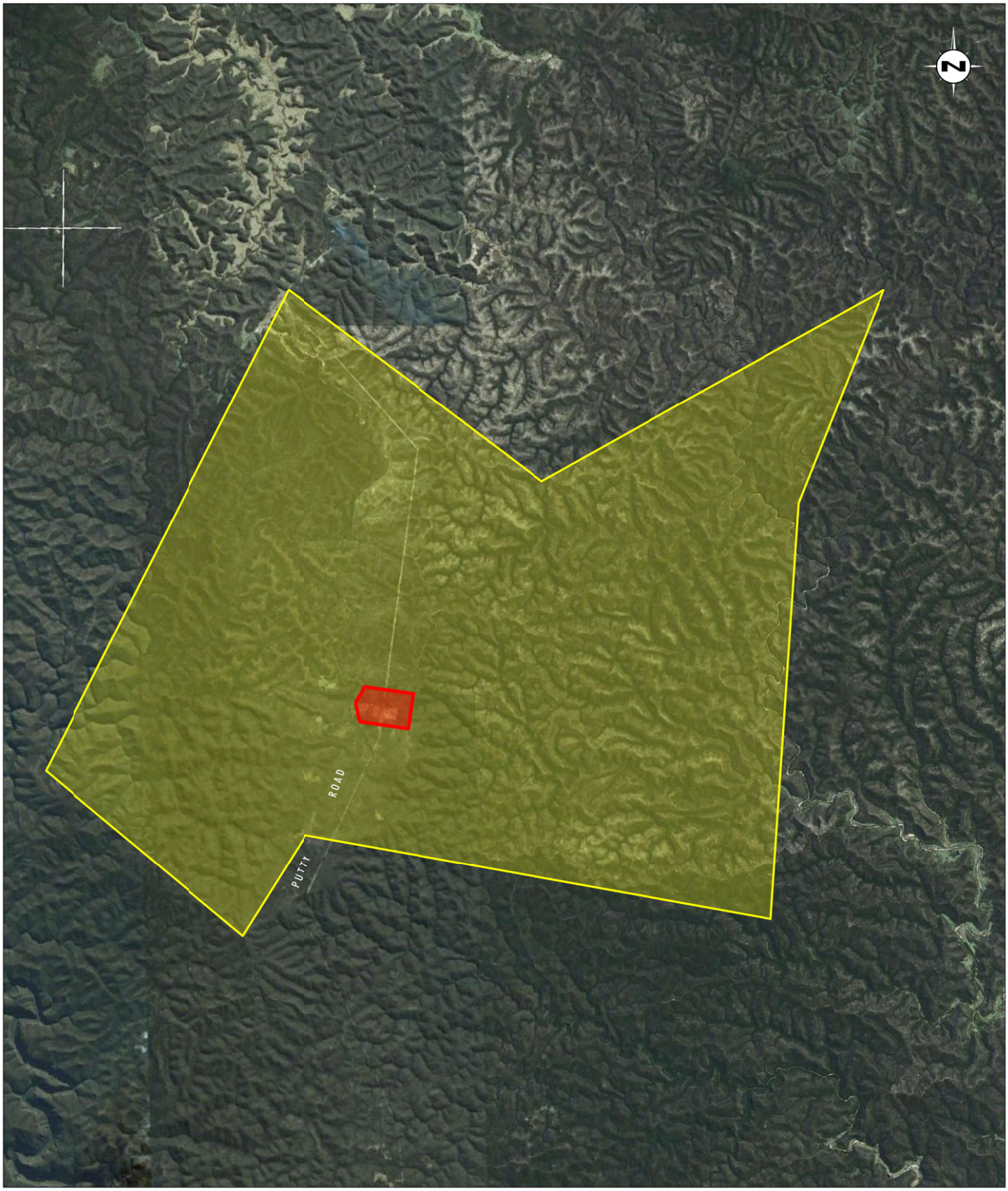
The proposed expansion of extraction operations on the site is not a type of development that is covered by the Planning for Bushfire Protection guidelines (RFS, 2006). The proposed expanded operations are for increased disturbance areas and extraction volumes only. An existing approved administration building and weighbridge (development consent 749298 for DA0380/11, approved 18/10/11) is located on site adjacent to the weighbridge (refer **Figure 2.1**). No new buildings are proposed as part of the proposed development.

As such, the potential risk to the extraction operations from bushfire attack are assessed from the point of view of emergency evacuation and management in the case of a bushfire emergency and the potential for the operations to cause a bushfire for example, from the operation of machinery.

4.12.3.1 October/November 2013 Blue Mountains Fires

During late October to early November 2013, the Blue Mountains area experienced a series of very large, uncontrolled bushfires. During this bushfire emergency, 82 fire tankers were stationed at Tinda Creek quarry, using the site as a staging area. In addition, the dredge ponds provided a critical source of water for replenishment of fire tankers and aerial water bombing craft. RFS has indicated its desire to the proponent to be able to continue to have access to this important water supply for fighting fires in the surrounding National Parks and World Heritage Area.

One of these fires, the 'Howes Swamp' fire, burnt through all vegetated areas on Lots 1, 2 and 3, which are located at the centre of the extensive area affected by the fire. A map showing the extent of the fire and location of the site is provided in **Figure 4.9**. Despite the



Source: Google Earth (2013), NSW RFS (2013)

0 2.5 5.0 10.0km
1:200 000

Legend
Project Area
Mapped Extent of Howes Swamp Fire

FIGURE 4.9

Mapped Extent of 2013 Howes Swamp Fire

extensive nature of the fire, none of the site infrastructure was adversely affected, which supports the efficacy of the current approach to bushfire management on site.

4.12.3.2 Bushfire Management

The majority of the Project area is cleared of vegetation, with existing extraction operations located in the eastern portion of Lot 2. Lot 1 and 3 are vegetated, while the entire site (Lot 1, Lot 2 and Lot 3) are surrounded by intact (predominantly remnant) vegetation of the Yengo and Wollemi National Parks. This land is identified as being bushfire prone by Hawkesbury City Council Bushfire Prone Land Mapping System and represents a potentially significant fuel load capable of sustaining and promoting the spread of bushfire and is the most significant bushfire threat to the site.

The Project represents the continuation of existing quarry operations and expansion into the vegetated eastern portion of Lot 1, possible expansion into the vegetated central portion of Lot 3 and expansion west in Lot 2 (predominantly cleared) and a minor expansion into the central portion of Lot 3 adjacent to the existing 330 kV powerline and easement (**Figure 1.3**). It is not proposed to relocate the existing infrastructure on the site.

The existing bushfire management measures on site include:

- maintained access road (for haul trucks);
- water cart; and
- fire extinguishers on all machinery and in site office and sheds.

The proponent is currently in the process of updating a bushfire emergency response plan as part of an update of the Mine Safety Management Plan prepared for the operation. The updated plan will be prepared in consultation with the local Rural Fire Service brigade and details of the plan will be provided in the updated EMP to be prepared for the project.

The proponent intends to continue to implement existing bushfire management measures currently in place at the site in consultation with the local Rural Fire Service (RFS). In the past, the RFS has on several occasions drawn water from the dredge pond for aerial fire fighting purposes in the region. The area and volume of the current (and proposed future) pond/s provides a readily accessible and abundant water source for this purpose and is a critical component for the operations of bush fire fighting in the local region.

4.12.3.3 Bushfire Threat Assessment

A bushfire threat assessment involves assessing the vegetation formations and the slope of the land to determine the appropriate Asset Protection Zone's (APZs) required in accordance with the methods in *Planning for Bushfire Protection* (PBP) (RFS, 2006). It is noted that PBP was developed to provide a guide to the necessary planning considerations when developing areas for residential use which are likely to be affected by bushfire. While the requirements do not specifically apply to a Project of this nature, the methods provided for calculating APZs from PBP have been used as a general guide in this assessment.

Vegetation formations play a key role in bushfire behaviour, woodland and forest vegetation formations represent large fuel loads due to the presence of understory vegetation, leaf litter and for forest vegetation, the connection of the trees within the canopy.

The majority of the existing active quarry areas within the site are surrounded by open areas (settling ponds) and forest vegetation formations. The existing infrastructure area (comprising workshed, stockpiles and loading area) is located in the central portion of the site on Lot 2

and is greater than 150 metres from any significant vegetation formation. The existing approved office and weighbridge facility are located on the boundary of Lot 2 and Lot 3, adjacent to the access road and are surrounded by cleared land to the north, east and west, and some areas of cleared land to the south (which forms the transmission easement). The office building is located approximately 40 metres for the nearest forest vegetation formation to the south which forms part of the proposed Domain 2 extraction area (refer **Figure 1.3**).

Based on the location of the infrastructure on site and its distance to forest vegetation formations, as well as existing infrastructure having already being recently approved, an assessment of relevant slope and calculation of Asset Protection Zones and BALs is considered unwarranted. In summary, sufficient defendable space exists around the site infrastructure and facilities. Therefore, the bushfire threat assessment has not been taken any further.

Notwithstanding, bushfire management measures for the existing and proposed expanded operations are discussed below.

4.12.3.4 Ongoing Bushfire Management

The haul road on the site provides access across the site for fire fighting vehicles. Water for use in fire fighting is provided for by the main dredge pond, in addition to licensed groundwater bores that can also be accessed to provide supply if needed. These supplies ensure that there is sufficient water available on site for bushfire fighting purposes. Fire fighting equipment including fire hydrants, extinguishers and hose reels will continue to be provided at all infrastructure areas and mobile equipment will be maintained in accordance with Australian Standards and WH&S guidelines.

Hy-Tec and the previous operators of the quarry have a history of safe operation of Tinda Creek Quarry and implementation of appropriate measures on site for managing bushfire risk. Hy-Tec will continue to implement the appropriate measures to reduce the risk of fire ignition and the spread of bushfire across the site in consultation with the RFS.

Given the design and location of infrastructure areas on the site and the implementation of ongoing bushfire management measures, Hy-Tec considers that any potential bushfire risk would be appropriately managed. In the event of a bushfire emergency, internal WH&S procedures would be implemented to ensure the safety of all staff and visitors/contractors on the site.

4.13 Waste Management

The DGRs for the Project identify waste management as a key issue to be assessed.

This section focuses on the identification and management of waste material produced as part of ongoing operations.

4.13.1 Predicted Waste Streams

Wastes that will require management in association with the quarry activities include:

- construction waste;
- workshop wastes, including waste oil into 1000 L container, filters, grease cartridges, oily rags and scrap metal;

- office paper and general rubbish;
- wastewater from amenities and office; and
- tyres.

Tinda Creek Quarry currently generates less than 20 m^3 of general waste per annum. It is anticipated that the Project will not significantly increase the level of waste generated from existing quarry operations. Steel and aluminium are also recycled from the quarry operations, with the quantities generally between 1 to 2 tonnes annually.

4.13.2 Waste Management

Hy-Tec is committed to the management of waste streams in accordance with the principles of waste hierarchy, where emphasis is placed upon reduce, re-use, recycle prior to disposal of its wastes. In order to minimise the generation of waste and maximise re-use of waste products, where practicable, the following practices are adopted:

- Any construction waste generated is recycled wherever possible, or where recycling is not possible, disposed of to an appropriately licensed waste management facility.
- All waste oil is collected and stored in containers within a covered and bunded area, and removed from the site by an appropriately licensed contractor with all relevant waste tracking documentation completed.
- All oil filters are separately stored and returned to the manufacturer for re-use.
- Any scrap metal is deposited into a dedicated skip bin for periodic collection and recycling.
- All office paper and general waste originating from the office, amenities building, and packaging from routine equipment and vehicle maintenance consumables is incinerated on site, in accordance with an existing approval from Hawkesbury City Council.
- Waste water from the amenities is treated and disposed of via an approved, registered septic system that is periodically inspected by Hawkesbury City Council.
- All waste tyres are removed by the supplier of replacement tyres.

With these proposed controls in place, it is expected that the impacts associated with waste generation and disposal resulting from the Project can continue to be managed effectively.

4.14 Socio-economic Considerations

4.14.1 Study Area Overview

Tinda Creek Sand Quarry is located 23 kilometres north of Colo Heights on Putty Road, within the Hawkesbury City Council LGA. Over 80% of the LGA is National Park, which also accounts for the majority of land surrounding the quarry site. The Hawkesbury LGA has the lowest population density of all LGAs within the Sydney basin. The Colo Macdonald locality to the south of Tinda Creek is sparsely populated, with a population density of between 0 to 10 people per square kilometre.

The top employment industries within the LGA are Retail Trade, Manufacturing and Government Administration and Defence (#hawkesbury.pdf). As described in **Section 2.1.3**,

surrounding land uses in the local area, aside from National Park, include hobby farms and a duck farm.

4.14.2 Demographic Profile

Due to the relative isolation of Tinda Creek within the LGA, the demographics of Colo Heights, as the closest developed area, are presented in relation to the Hawkesbury City Council LGA within **Table 4.22** (HCC, 2009; HCC, 2013).

Table 4.22 – Comparison of Demographic Profiles

	Colo Heights		Hawkesbury LGA	
	Total	**Population Change (%)**	**Total**	**Population Change (%)**
Population1996	362		57,381	
Population 2006	342	-5.5	60,561	5.5
Population 2011	328	-4.1	62,353	3.0
Demographic Indicators 2011 Data				
Indicator	**Total**	**% Population**	**Total**	**% Population**
0–14 years	67	20.4	13,372	21.5
15–39 years	82	25.0	20,613	33.1
40–64 years	143	43.6	21,120	33.9
65 years and over	36	11.0	7,248	11.5
Born Overseas	66	20.1	11,113	17.8
Indigenous	7	2.1	1,609	2.6
Top Five Employment Industries 2011 Data				
Industry	**Total**	**% Active Workforce**	**Total**	**% Active Workforce**
Manufacturing	26	30.2	3,368	10.8
Construction	20	23.3	3,925	12.6
Other services	9	10.5	1,509	4.8
Retail trade	6	7.0	3,253	10.4
Wholesale trade	5	5.8	1,523	4.9

4.14.3 Future Expansion in Proximity to the Study Area

Future expansion within the North Western district of the Sydney Metropolitan Area is planned, with an increase of 140,000 dwellings to a total of 391,000 dwellings by 2031, and an increase of employment capacity of 130,000 jobs to 367,000 jobs by 2031 (NSW Government, 2007). This includes expansion within regional centres such as Penrith, the Norwest Business Park, Blacktown and Rouse Hill. There is, however, minimal development planned in the LGA and expansion within the Hawkesbury LGA is limited for the following reasons:

- The majority of land is reserved within National Parks.
- Residential development is limited due to the risks of bushfire and flooding on the Hawkesbury/Nepean floodplain.
- Remaining agricultural land within the Sydney basin, much of which is within the Hawkesbury LGA, is being protected from encroaching development.

4.14.4 Community and Economic Effects

The initial capital investment value of the project is approximately $0.3 million, however, it is recognised that the site will require ongoing capital expenditure of some $9 million to $10 million over the 25 to 30 year life of the operation to replace the dredge, loader, excavator, dump trucks and other items during the life of the project. The gross (gate) value (in current terms) of the resource proposed for extraction (7 Mt) is approximately $140 million.

In regard to the immediate local community, there will be the continued employment of existing Hy-Tec staff. However, due to the potentially uneconomic nature of the resources remaining under the existing consent, it is possible that there may need to be a reduction in the workforce if the proposed Project (to access more economically viable resources) is not implemented. The Project, if approved, will continue to provide six current full time positions and a further two positions when the volume increases when fully operational. In addition, the proposed expansion of production will require approximately an additional 10 contract drivers for haulage.

The proposal is unlikely to cause negative effects on the local economy. Hy-Tec and its employees will benefit the local and regional economies through direct spending of wages and employing the services of contractors, consultants, trades people, transport operators and other associated service providers.

In addition, the Project will supply up to 300,000 tpa of fine construction sand for the Sydney market. In the context of the impending closure of supply from Kurnell, (which currently supplies approximately 1 Mtpa of the 7 Mt Sydney market), the uptake of this demand by Tinda Creek is significant (approximately 20–30%) of the impending loss of annual supply from Kurnell.

Local and State government will also continue to receive economic benefits, including revenue from taxes and levies.

The Federal government will continue to receive revenue from Tinda Creek quarry through means including company tax, excise on imported equipment and goods, fuel excise and other taxes such as the goods and services tax and income tax.

4.14.5 Cumulative Impacts

The proposal will have very limited cumulative interaction with surrounding developments and activities, other than through the use of the public road network, given that there are no proposed changes to the infrastructure on site and all extraction will take place within property owned and/or managed by Hy-Tec.

The proposal will result in up to 300,000 tpa of fine sand being available to the Sydney market over the next 25 to 30 years, which is equivalent to approximately 4% of the (current) annual demand for fine sand in the Sydney Planning Region (**Section 1.1.1**). As discussed, it will partially fill the supply deficit of fine grade construction sand created when resource is exhausted at Kurnell in approximately 5 years. There are no known proposed or approved fine aggregate extractive developments within the vicinity of Tinda Creek, and the extent of National Park prevents the extraction of most nearby resources, thereby limiting the potential for future development of this resource in the area. In addition, there are no other producers in the Sydney region at present capable of producing this fine grade construction sand. Production from Tinda Creek has the potential to replace approximately 20–30% of the current Kurnell market supply.

Therefore, the Project will act to off-set a significant decline in construction and industrial grade sand supplies sourced from within the Sydney regional market, which is being caused by diminishing availability to sand resources in the Sydney region (refer to **Section 1.1.1**).

If the proposal were not to proceed, the lack of access to sand resources at Tinda Creek would add to the decline of available construction and industrial grade sand resources for the Sydney market and add significant costs to the construction industry with the need to import fine sand from areas outside of the Greater Sydney region. The limitation of sand supplies would have significant economic flow-on effects to the wider communities of the Sydney and Hunter regions, which are dependent on sand products for a number of essential uses including construction and industrial products and processes.

4.15 Closure and Rehabilitation

4.15.1 Current Practice

In accordance with Condition 10 of the existing approval (DA134/95), Hy-Tec has commenced rehabilitation of the quarry site through backfilling of the existing dredge pond with silt and suitably approved VENM and ENM material. However due to a lack of ready supply, no VENM/ENM was brought onto site during the 2012 or 2013 calendar years.

VENM and ENM material is brought to site when available as back loads and is managed in accordance with relevant legislative requirements and strict internal protocols that include production of appropriate chain of custody documentation to identify that it has been appropriately certified, prior to acceptance at the site. Hy-Tec does not accept any material that has not been certified as VENM/ENM. The material brought to site is generally backfilled upon arrival or may be stockpiled for a short period of time depending on operational needs at the time. All stockpiles of material are appropriately managed in accordance with the site's erosion and sediment control plan as detailed in the approved Environmental Management Plan (Umwelt, 2013).

The emplacement of sediment and tailings from the extraction process has continued along the south-western boundary of the active dredge pond. Some material has been emplaced next to the operational area to ensure continued safety of operations. Material emplacement has continued along the south-western boundary, as anticipated within the rehabilitation plan in the Environmental Management Plan (EMP) (Umwelt, 2013).

The EMP envisaged additional emplacement also along the northern boundary of the dredge pond however access to Domain 3 if approved will be via the northern boundary of the dredge pond. The EMP will be updated to reflect this if approval to extract material from Domain 3 is granted.

It is anticipated that the active emplacement of VENM and ENM as well as onsite sediment and tailings materials will continue along the western boundary of the current dredge pond, progressively regrading the slope of the pond boundary.

4.15.2 Final Landform Design

4.15.2.1 Background

Approximately 10.2 Mt of raw sand resource is proposed to be extracted. Of this, approximately 3.4 Mt will be returned to the site as residual silt and clay, the balance being product sand (refer **Table 2.4**).

The sensitive nature of the surrounding area requires a closure plan that is both sustainable in the long term, as well as enabling the final landform to blend with the environment.

The main objectives of the design process are described as follows:

- Increase the final extracted volume from 2 Mt currently approved to approximately 9 Mt in total without substantially altering the approved void size.
- To generate an acceptable final landform is a key component of the design. This will involve establishing a final landform that blends with the surrounding natural topography and is sustainable in the long term.
- Develop a final landform that will facilitate the ecological and hydrological objectives of no significant impact.
- Provide flexibility in terms of the extraction and backfill operations, particularly in terms of the quantities of imported VENM and ENM required for the landform.

In planning the final landform, the following aspects were considered:

- The overall gradient from the lower (western) end of the proposed extraction area up to the north-eastern corner (Domain 3) or south-eastern corner (Domain 7) of the proposed quarry area is approximately 1%, that is, 1 metre vertical fall for every 100 metres measured horizontally. However, the overall slope is typically concave with flatter gradients of 0.5% just upslope of where Tinda Creek flows under Putty Road.
- Slopes over the area proposed for extraction are typically around 5%, but with some localised steeper slopes of up to 20%. The steeper slopes are typically found on the weathered residual sandstone material.
- It was noted that there are no well defined natural creek lines over the proposed extraction area, with wide and flat profiles in the clayey sand alluvium and very natural limited channel development over the weathered residual material.
- Excavated faces within the extraction area are inherently stable, with vertical faces remaining intact for extended periods of time. The stability of the excavated faces is due to the clayey content of the materials, and competent nature of the weathered residual material.

In order to design a stable final landform, the following constraints were identified:

- The need to import VENM/ENM fill material to achieve a void space consistent with the existing approved approximately 16 hectare pond extent.
- The residual silt and clay material from the dredging process that is placed back into the extraction areas has a fine grading, and is likely to be most stable if placed well below the ground surface or into a relatively flat profile rather than on steep slopes.
- As discussed, the existing approval includes provision for ponds within the final landform of up to approximately 16 hectare in extent. A landform without ponds was considered, however, the required volume of material needed to be imported as backfill is significant, and may not be achievable due to the uncertainties regarding the market availability of certified material suitable for use as backfill.
- The final design should take account of the impact of topography on the hydrogeology and ecology of the surrounding landscapes so as to assist in the regeneration of vegetation communities. It was considered that achieving a naturally shaped landform and viable ecological communities would be best achieved by using key characteristics of local drainage systems in the design of the rehabilitated landscape.

4.15.2.2 Design Methodology

As discussed in **Section 4.15.1**, the site currently imports certified VENM and ENM. The design process assessed the required minimum volumes of VENM and ENM to ensure that the environmental impacts associated with the current approved operations would not be increased by the proposed increase in extraction quantity.

An initial final landform being a free draining landform was designed using a commercially available software package (Natural Regrade™). The software was developed to allow the design of landforms based on stable alluvial slopes within the same climatic zone and within similar soils that have proven to be stable in the long term. This is to ensure the stability of slopes created by rehabilitation post the extraction operations. The principles of the proposed rehabilitation of the site have informed the objectives of the landform design process and parameterisation of the model set up.

Characteristics of the natural landform that are assessed as part of the design process include the drainage density, the sinuosity of creek lines, typical distances from ridge lines to the start of creek lines, and various other parameters. An initial final landform was then designed using a free-draining profile. The initial landform was then modified to allow for ponds within the final landform, ensuring that the pond extents were consistent with the parameters of the existing approval.

From the above, a final landform which includes the ponds of a size consistent with the current development consent, was compiled and is shown in **Figure 4.10a**. The suitability of the landform to ensure limited impacts on soils, groundwater, surface water and consequently ecology was then assessed. An alternative design based on similar parameters was also derived to reflect quarrying in Domain 7 rather than Domain 3 and is shown on **Figure 4.10b**.

4.15.2.3 Design Assessment

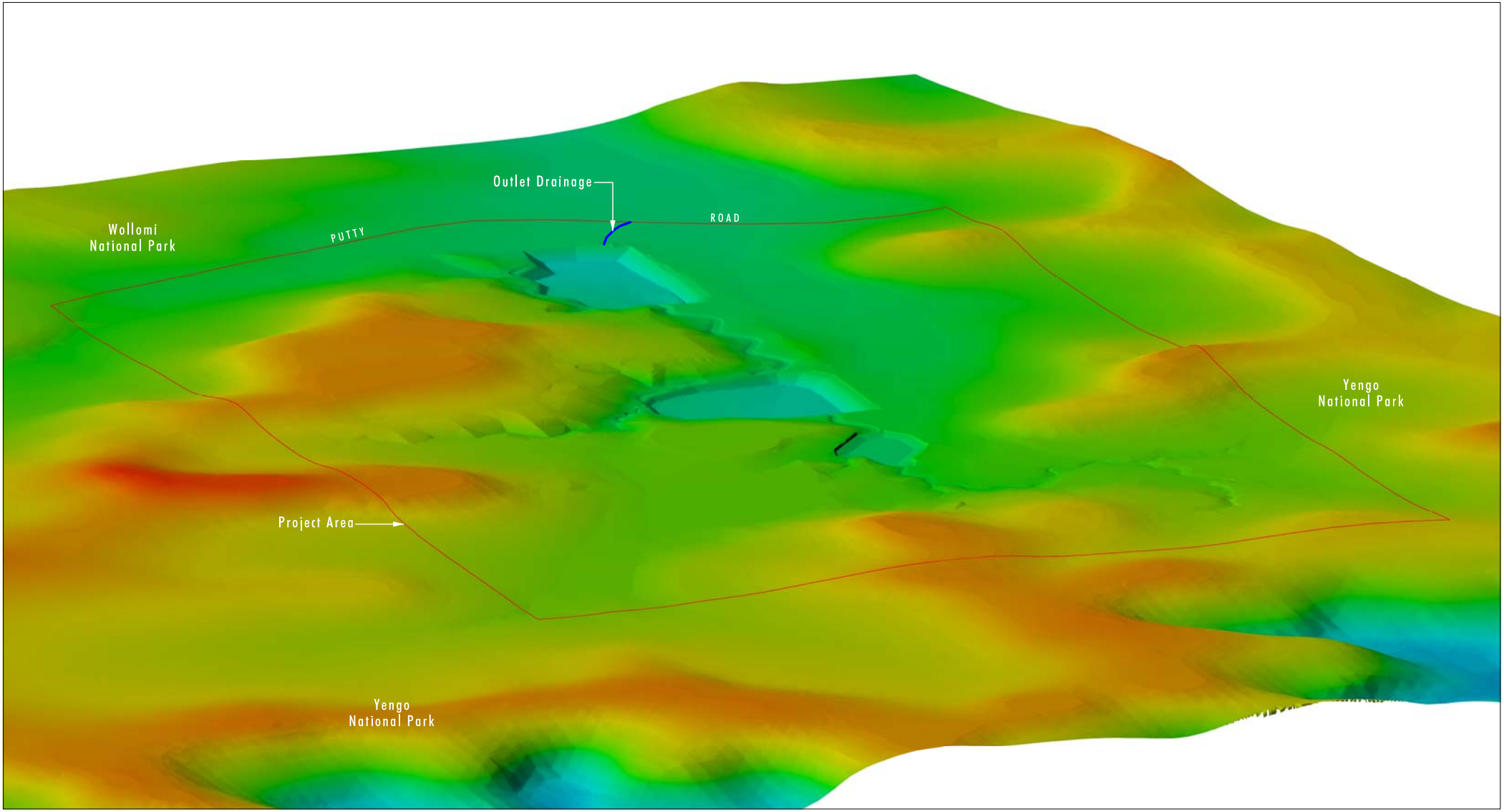
In terms of the landform design, key points are noted below as follows:

- The design is flexible, in response to the variability of the final voids, which is dependent on the final quantity of material imported to the site over the life of the Project.

- As far as is practical, the transitions on to the rehabilitated area will be smooth, using similar slopes to those upslope of the landform. The exception to this will be on the southern side of the existing extraction area which has already been backfilled with silt and clay and is characterised by a wide flat area. This area will be used to reduce the peak flow rates entering the landform. Some additional erosion protection may be required on the transition in this area.

- The rehabilitated landform has a gradual transition on the main drainage line involving slopes not exceeding 3%, flattening out to very flat slopes of 0.2% just upslope of the road. The use of convex profiles that become flatter with increasing catchment area is a key component of the design.

- Although designed to limit the risk of erosion within alluvial materials, the transitions into and out of the ponds within the rehabilitated landform will involve a change in grade and may require some additional erosion protection where the ponds are not flooded.



Legend

Project Area

Outlet Drainage

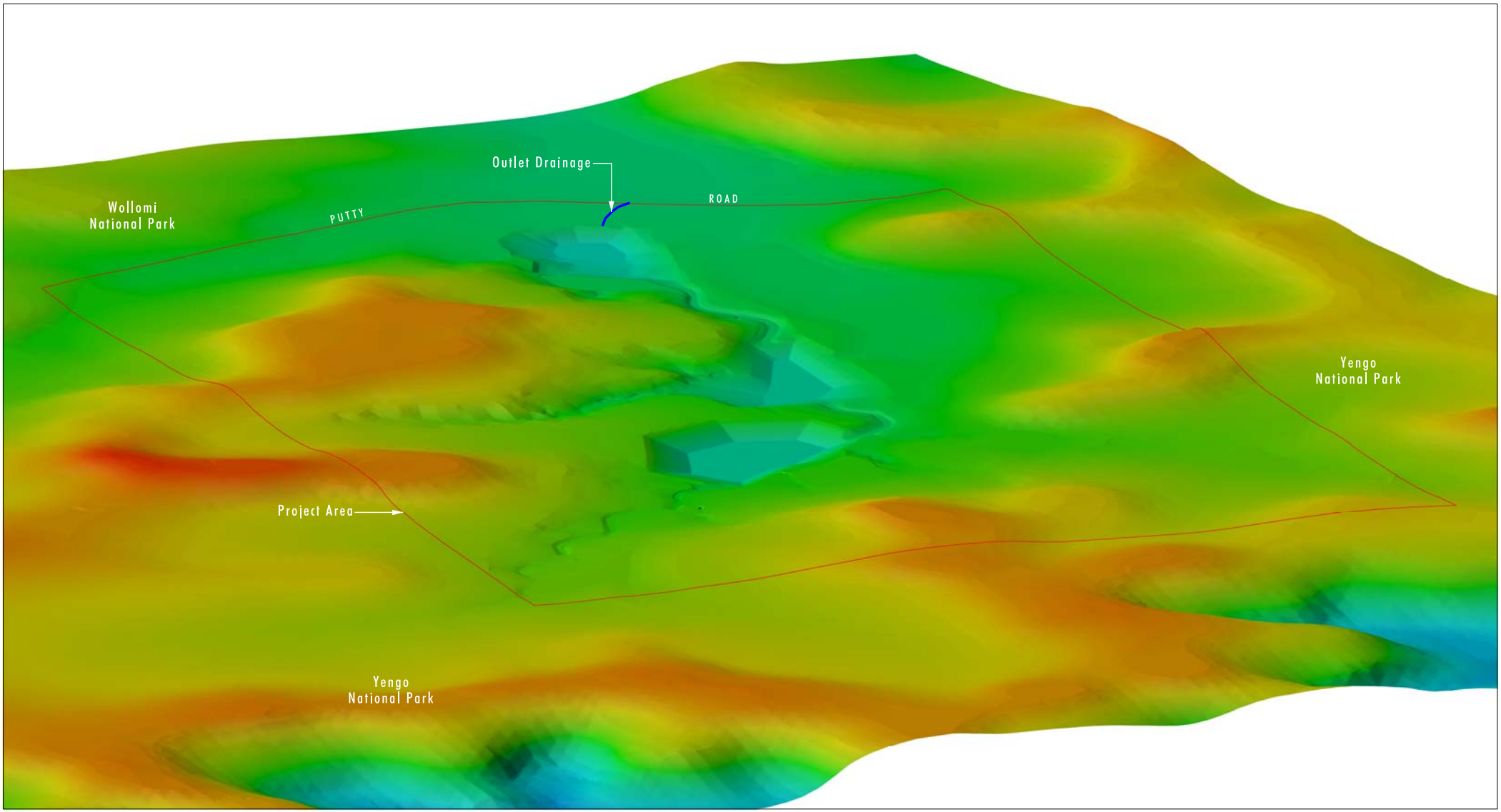
Height:

273m
283m
293m
303m
313m
323m
333m
343m
353m
363m
374m

FIGURE 4.10a

Perspective View Looking West Showing
Example Modelled Final Landform
Domain 3 Extraction

File Name (A4): R14_V1/1731_408.dgn



Legend

Project Area

Outlet Drainage

Height:

273m
283m
293m
303m
313m
323m
333m
343m
353m
363m
374m

FIGURE 4.10b

Perspective View Looking West Showing Example Modelled Final Landform Domain 7 Extraction

File Name (A4): R14_V1/1731_437.dgn

- Two options exist for the voids remaining within the rehabilitated landscape within Domain 6 and Domain 1. These are either:
    - off channel voids or impoundments, with the primary drainage line connecting to the existing natural watercourse to the west of the voids, thus reducing the catchment to the voids; or
    - in channel voids or impoundments, which would overspill back to Tinda Creek just upslope of the Tinda Creek road crossing.
- It should be noted that the flat profile of the rehabilitated landscape is intended to cater for the scenario where only the minimum volume of VENM and ENM imported to the site. Some localised ponding and sediment collection can be expected on these lower gradients, however, they correspond to the areas targeted for the main ponds.
- If substantial amounts of ENM/VENM are available during the life of the quarry, the landform can be reshaped to a free draining system with limited ponds along the alignment of drainage system.

The extraction of sand is a highly dynamic and variable activity, and the actual rate of production and the availability of VENM and ENM over the life of the Project will be influenced by several factors ranging from the actual geology to market conditions. It is likely, therefore, that the final landform design will need to be reviewed throughout the life of the quarry and revisited ahead of closure. This process will need to be adaptively managed to allow for changes that may be required. However, the principles involved in the final landform design are not expected to deviate significantly from the concepts detailed above.

4.15.3 Ongoing Rehabilitation

The rehabilitation of the proposed extension to the extraction area will be a continuation of ongoing rehabilitation practices at the site. Rehabilitation will consist of stabilising and returning the quarried landscape to a condition consistent with its current state. To do so, two interrelated measures are proposed; the rehabilitation of the quarried landform, and a biodiversity offset package that will provide an endemic seed store for the rehabilitated landform.

A series of rehabilitation measures have been implemented at the quarry to maximise the stability of the rehabilitated landscape and thereby minimise sediment export and erosion from the site, as detailed in the most recent EMP (Umwelt, 2013). These include the use of VENM/ENM as cover material to be placed over the residual silt and clay to provide a stable landform surface. The VENM/ENM material will in aggregate have larger grain size, have a more cohesive nature and lower moisture content than the residual silts and clays that it will be placed over). The VENM/ENM will also have better suitability for sustaining vegetation which will increase the long term stability of the final landform through providing greater protection against erosive forces.

Rehabilitation will also include the use of native seed mix that has been recommended for use at the quarry by NPWS. Rehabilitation works will continue to be undertaken on an ongoing basis as the quarry develops and extraction in areas is completed. To minimise the potential for ongoing erosion and sediment generation, all new diversion drains and flow paths will be vegetated with grass species and maintained as a stable vegetative cover.

As extraction progresses, the site will be progressively rehabilitated with the base of the dredge ponds continuing to be backfilled with silt and clay that is discharged from the sand washing process. Residual silt and clay material from the sand washing process can be directed via pipes to any part of the quarry to facilitate backfilling.

As sections of the quarry are progressively shaped to achieve the final landform, dewatered silt and clay from extractive operations will be incorporated into the surface to provide a growing medium and increase the moisture holding capacity of the upper part of the soil profile. It is envisaged that approximately 100 mm of silt and clay from previously quarried areas will be incorporated into the upper 300 mm of the soil profile.

The diversion drains surrounding the existing extraction pond will be left in place to divert surface flows around the pond and maintain flows in Tinda Creek while extraction is being undertaken in Domains 6, 2 and 1. As discussed in **Section 4.9**, additional clean water diversions will be established around these extraction areas and Domain 7 if it is quarried to convey upslope runoff around the disturbance area to Tinda Creek. The diversions around Domains 6, 2 and 1 will remain in place until the final landform has been rehabilitated and stabilised to a sufficient level to be capable of conveying runoff at non-erosive velocities. As a result each of the ponds created will be effectively sediment dams and off line storages until such times as the diversion drains are removed.

Water in the pond that will form part of the final landform will be derived from both limited groundwater inflow and from rainfall that either lands on the pond surface or drains from the catchment area of the closed quarry water management system. All exposed external batters of the pond will be grassed and will have a batter slope of no steeper than 1V:3H.

4.15.4 Closure and Decommissioning

At the completion of extraction operations all equipment, materials, hardstand areas and infrastructure other than roads and dams will be removed. The area from which the material has been removed will then be ripped to a depth of approximately 0.5 metres to reduce compaction and increase infiltration capacity. The area will then be planted with either pasture or native tree and shrub species depending on what the intended ongoing land use will be at the time of quarry closure. A detailed Vegetation Management Plan outlining the species to be planted and the planting and maintenance regime will be submitted as the final land use is determined, six months prior to the planned closure of the quarry.

It is envisaged that reshaping and replanting of the final landform will take approximately two years to complete after extraction has ceased. The reshaped quarry will be maintained for a further period of five years to ensure that a stable and self sustaining native vegetation cover is achieved.

5.0 Draft Statement of Commitments

The DGRs for the proposal (**Appendix 1**) require that the EIS include a Draft Statement of Commitments which details the measures proposed by Hy-Tec for environmental mitigation, management and monitoring.

If approval is granted under the EP&A Act for the proposal, Hy-Tec will commit to the controls detailed below.

5.1 Compliance with the EIS

5.1.1 To carry out the development for the Project generally in accordance with the Development Application and this EIS.

5.2 Life of Operation, Production and Hours of Operations

Project Life

5.2.1 The Project approval life will be for an additional 30 years from the date of commencement of operations under the Project Approval. Closure and rehabilitation activities will be undertaken in accordance with a detailed Quarry Closure Plan, at the time of closure. These works may extend beyond the 30 year operational approval period.

Production Limits

5.2.2 A maximum of 300,000 tonnes per year of sand products will be transported from the quarry.

Hours of Operation

5.2.3 Quarry operations will be undertaken between the hours of 5.00 am and 10.00 pm Monday to Friday and 5.00 am and 3.00 pm on Saturdays.

5.2.4 The following activities may occur on Sundays and public holidays:

- maintenance of fixed plant and mobile plant;
- product stockpile management;
- water cart operations for stockpile area and plant area; and
- pumping for dewatering activities.

5.3 Environmental Management, Monitoring and Reporting

Environmental Management Plan

5.3.1 Within six months of development consent, Hy-Tec will revise its existing Environmental Management Plan (EMP) as part of the implementation of the Project. The EMP will include details of all of the management and monitoring

commitments outlined in the EIS (specifically those outlined in this Statement of Commitments).

Annual Review

5.3.2 Hy-Tec will prepare an Annual Review of the environmental performance of the Project and will make this available to the public, Hawkesbury City Council and relevant government agencies as required.

5.4 Ecology

A range of mitigation measures are proposed to ameliorate potential adverse ecological impacts associated with the Project. These include:

5.4.1 Implement a robust weed management program to be documented in the revised EMP.

5.4.2 Conduct rehabilitation progressively over the life of the quarry. All rehabilitation works will be scheduled to commence as soon as practicable after disturbance and reformation of the landscape.

5.4.3 A robust tree felling procedure will be implemented at Tinda Creek Quarry to minimise the potential for impacts on native fauna species (including threatened species) as a result of the clearing of hollow-bearing trees.

5.4.4 Nest boxes will be established in retained vegetation in proximity to area impacted as a result of the Project to mitigate the loss of hollow-bearing trees. An assessment of the number of tree hollows lost during clearing will be made as part of the tree felling activities and nest boxes will be established to compensate for this loss, where appropriate. Suitably designed nest boxes will be established for the range of hollow-dependent species that are known to occur in the Project area.

5.4.5 A pre-clearance survey of the proposed disturbance areas will be undertaken prior to ground disturbance (within seven days of the planned disturbance) to ensure that no Rosenberg's Goanna burrows are present. The assessment should be undertaken by a suitably qualified and licensed ecologist. If burrows are present, the ecologist will provide advice on how to ensure that no goannas remain within the burrows during the clearing process.

5.4.6 A pre-clearance survey of all areas to be cleared will be undertaken (within seven days of the planned clearing time) to ensure that no termite mounds used by Rosenberg's Goannas are present. The assessment should be undertaken by a suitably qualified and licensed ecologist. If termite mounds are present, the ecologist will provide advice on how to ensure that no goanna eggs or juveniles remain within the mounds during the clearing process.

5.4.7 A comprehensive biodiversity offset strategy is to be implemented for the Project as described in **Appendix 7** to ensure the development maintains or improves the terrestrial and aquatic biodiversity values of the region in the medium to long-term.

5.5 Aboriginal Heritage

It is noted that archaeological subsurface investigation is not necessary within the proposed extraction domains, prior to the quarry expansion proceeding. However, a range of mitigation measures are proposed to ameliorate potential adverse archaeological impacts associate with the Project. These include:

5.5.1 In consultation with the registered Aboriginal parties, prepare an Aboriginal Cultural Heritage Management Plan (ACHMP) for the proposed Project. The ACHMP will allow for management (collection) of the artefacts located in the Tinda Creek Artefact Scatter 1 site in Domain 3 (if Domain 3 is to be quarried) and to provide for future management of Aboriginal cultural heritage issues should they arise across the broader Project area. The ACHMP will form part of the revised EMP for the project.

5.5.2 If Domain 3 is to be quarried, the artefacts located within the Tinda Creek Artefact Scatter 1 site are collected using the methodology set out in the protocols and procedures of the approved ACHMP.

5.5.3 The EMP is to be updated to contain provisions to address management of the following issues, as detailed in the Aboriginal Cultural Heritage and Archaeological Assessment (**Appendix 9**):

- exposure of previously unrecorded artefactual material during ground disturbance works within the Project area;
- exposure of human/possible human skeletal material during ground disturbance works within the Project area;
- exposure of sandstone with evidence of Aboriginal engravings or grinding grooves; and
- development of an Aboriginal Cultural Heritage Training Package for all Hy-Tec employees/contractors working on the Project to be provided as part of the quarry induction process.

5.6 Historic Heritage

5.6.1 In the unlikely event that unexpected archaeological remains or potential heritage items not identified as part of this assessment are discovered during the Project and are likely to be disturbed by the Project, all works in the immediate area should cease, the remains and potential impacts should be assessed by a qualified archaeologist or heritage consultant and, if necessary, the Heritage Branch, Department of Planning notified.

5.7 Traffic and Access

5.7.1 The site access will be upgraded to comply with the minor road standard access as detailed in AS2890.2.

5.8 Noise

5.8.1 Hy-Tec will undertake an attended noise monitoring program (as detailed in **Section 4.7.6.1**) in order to assess ongoing compliance with relevant noise impact assessment criteria over the life of the Project. Details of the Noise Management Plan will be provided in the revised EMP.

5.8.2 The monitoring results will be reviewed by the Hy-Tec environmental representative to assess compliance with the Noise Impact Assessment (NIA) predictions and with the relevant NIA criteria. The results will be reported in accordance with the requirements of the Project approval and EPL.

5.9 Air Quality

5.9.1 The existing dust control measures will continue to be implemented on site, including:

- minimisation of the total disturbed/working areas at any one time; and
- watering of unsealed roads, working areas and stockpiles as required.

5.10 Surface Water and Groundwater

5.10.1 Hy-Tec will continue to undertake monitoring of groundwater bores in accordance with existing licence conditions.

5.10.2 All diversion drains will continue to be maintained in good condition.

5.10.3 The water management system will remain as a closed system.

5.11 Greenhouse Gas and Energy

5.11.1 Hy-Tec will continue to participate in the Energy Efficiency Opportunities (EEO) Program and undertake the following activities to improve energy use efficiency:

- develop an EEO project and communication plan;
- evaluate energy use for the Project;
- identify and investigate potential EEO; and
- implement, track, communicate and report on EEO.

5.11.2 Hy-Tec will continue to improve on-site diesel use efficiency based on the range of measures outlined in **Section 4.11.8.1**

5.11.3 Hy-Tec will explore the use of lower GHG emission energy sources as soon as practical based on the range of measures outlined in **Section 4.11.8.2.**

5.12 Hazards

5.12.1 Hy-Tec will store all dangerous goods in accordance with dangerous goods storage requirements and relevant Australian Standards.

5.12.2 Hy-Tec will continue to implement the appropriate measures to reduce the risk of fire ignition and the spread of bushfire across the site in consultation with the Rural Fire Services (RFS).

5.13 Rehabilitation and Closure

5.13.1 The revised EMP will detail the approach to rehabilitation of the Project, including the species to be used in revegetation works.

5.13.2 Wherever possible, rehabilitation will be completed progressively as part of the ongoing development of the quarry.

5.13.3 A detailed Quarry Closure Plan will be developed approximately three years prior to cessation of quarrying activities.

6.0 Conclusion and Justification

6.1 Overview of Environmental Impacts

The potential environmental impacts of the Project have been identified through a process involving:

- assessment of the site characteristics;
- consultation with government agencies;
- consultation with surrounding landowners, the Aboriginal community and other stakeholders; and
- expert technical assessments.

The key issues identified in the DGRs were the subject of comprehensive technical assessment to identify and assess the potential impacts of the Project on the existing environment and community. The results of these assessments are detailed in **Section 4.0** and the appendices of this EIS.

The environmental and social impacts of the Project have been minimised through maximising the use of existing and approved disturbance areas, refining the Project design in consideration of environmental constraints and stakeholder input, maximising the use of the existing quarry resources and infrastructure, and implementation of appropriate control measures as part of an iterative Project design process.

With the proposed measures to avoid, minimise or manage impacts associated with the Project, it is anticipated that the Project can proceed without significantly changing the extent of impact on the surrounding environment or local community.

6.2 Suitability of the Site

The Project area is located within a rural environment approximately 23 kilometres north of Colo Heights. While there are small landholdings to the immediate west of the quarry zoned as Rural (Mixed Agriculture), the majority of land surrounding the site is reserved as National Park which provides both topographic and vegetative shielding for the quarry.

Quarrying activities have been undertaken on Lot 2 for approximately the last 30 years with the quarry currently producing up to 125,000 tonnes of product per year. Tinda Creek Quarry is a well established quarry operation, being located adjacent to a direct regional transport route and with existing infrastructure and facilities to support quarrying activities. The site is also strategically placed to provide a continuing supply of sand to the Sydney market, having been identified for the then Department of Mineral Resources (now Division of Resources and Energy (DRE)) as one of the long-term sources of sand for the Sydney market in 2001 (Pienmunne & Whitehouse, 2001). A detailed resource evaluation was undertaken (Stitt, 2010; 2012) which identified up to an additional 11.7 Mt of available 'product-sand' resource at the site, of which approximately 7 Mt has been identified for extraction via the analysis of a range of constraints as presented in this EIS.

The Project will result in the extension and continuation of the existing quarry operation, maximising the use of existing facilities. The majority of proposed new extraction areas within the site are located in existing cleared areas, while those areas that require clearing are able to be offset by the retention of existing intact vegetation communities within the site.

The existing land uses of the Project area and surrounding areas are described in **Section 2.1.3**. A detailed analysis of potential on-site and off-site impacts is provided in **Section 4.0**. The comprehensive environmental impact assessment demonstrates that the site is suitable for the proposed Project and that the environmental impacts of the Project can be effectively managed.

6.3 Benefits of the Proposal

The continued operation of Tinda Creek Quarry will provide significant ongoing benefits. The key benefits associated with the quarry are summarised below:

- The Project will facilitate the continued supply of high quality construction sand into the Sydney region markets to meet identified need for these materials.
- The Project will support the rapid growth and development of the area, in particular in north-west Sydney, through supply of high quality construction materials and assist in achieving the aims and objectives of the various strategic and regional planning policies, including the Northwest Subregion, Draft Subregional Strategy (NSW Government, 2007).
- The Project is well positioned to cater for the predicted growth in demand for quarry products given its strategic location adjacent to the regional road network and the north-west subregion of Sydney, and the limited number of major resources within the Sydney region that can serve these markets over the next 20 to 30 years.
- The quarry has convenient, economic access to its core market, which assists with reducing supply costs, greenhouse gas emissions and other environmental impacts per tonne kilometre transported.
- The Project maximises, within environmental and geological constraints, the resource recovery from the quarry site while utilising existing infrastructure.
- The Project maximises the operating life of an existing facility, thereby delaying the need to develop a greenfield site to meet the regional need for quarry products.
- The quarry is positioned away from major population centres and incompatible land uses and has a substantial existing buffer zone for residences to the west.
- The Project will allow for continued employment of the existing six quarry personnel and numerous road transport drivers, with flow on effects to the local and regional economy.
- The Project will provide direct economic benefits in the form of capital expenditure (approximately $0.3 million), ongoing capital expenditure of some $9 million to $10 million over the life of the quarry and ongoing operational expenditure and employee expenditure.
- Flow-on economic benefits of the direct expenditure is estimated to generate a further $9.8 million benefit within the local and State economies.

- Continued payment of significant s94 development contributions to Hawkesbury City Council based on a cents per tonne rate of product transported from the site. At the proposed peak production rate of 300,000 tpa, this will amount to approximately $213,000 per annum (based on Council's 2013 s94 contribution rate of $0.71 per tonne).

- The Project will continue to contribute to the Commonwealth and State governments through taxes.

An ancillary benefit of the dredge ponds on site is their utility during bushfire events. During the October/November 2013 Blue Mountains bushfire emergency, 82 fire tankers were stationed at Tinda Creek Quarry and used the dredge ponds to draw water for replenishment of tankers and aerial water bombing craft. The RFS has indicated its desire to be able to continue to have access to this important water supply for fighting fires in the surrounding National Parks and World Heritage Area.

6.4 Ecologically Sustainable Development

The EP&A Act aims to encourage ecologically sustainable development (ESD) within NSW. As outlined in **Section 3.3**, the Project requires approval from the Minister for Planning, or delegate, under Part 4 of the EP&A Act. As such, the Minister needs to be satisfied that the Project is consistent with the principles of ESD. This section provides an assessment of the Project in relation to the principles of ESD.

To justify the Project with regard to ESD principles, the benefits of the Project in an environmental and socio-economic context should outweigh any negative impacts. The ESD principles encompass:

- the precautionary principle;

- inter-generational equity;

- conservation of biological diversity; and

- valuation and pricing of resources.

Essentially, ESD requires that current and future generations should live in an environment that is of the same or improved quality compared to the one that is inherited by the current generation.

6.4.1 The Precautionary Principle

Schedule 2 Clause 7(4)(a) of the Environmental Planning and Assessment Regulation 2000 (EP&A Reg) defines the precautionary principle as follows:

> ....if there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation. In the application of the precautionary principle, public and private decisions should be guided by:
>
> (i) careful evaluation to avoid, wherever practicable, serious or irreversible damage to the environment, and
>
> (ii) an assessment of the risk-weighted consequences of various options.

In order to achieve a level of scientific certainty in relation to potential impacts associated with the Project, this EIS has undertaken an extensive evaluation of all the key components. Detailed assessment of all key issues and necessary management procedures has been conducted and is documented in this EIS.

The assessment process has involved a detailed study of the existing environment and the use of engineering and scientific modelling and study to assess and determine potential impacts as a result of the Project. To this end, there has been careful evaluation to avoid, where possible, irreversible damage to the environment.

The decision-making process for the design, impact assessment and development of management processes has been transparent in the following respects:

1. Relevant government authorities, community members and other stakeholders were consulted during EIS preparation (**Section 1.3**). This enabled comment and discussion regarding potential environmental impacts and proposed environmental management procedures.

2. Hy-Tec has an established Health, Safety and Environmental (HSE) Management System. In addition, the existing quarry operates in accordance with an approved EMP, Mine Safety Management Plan and environmental monitoring, which will be revised prior to commencement, should this application be approved.

3. The assessments presented in this EIS have been undertaken based on the best available scientific information about the Project area. Where uncertainty in the data used in the assessment has been identified, a conservative worst case analysis has been undertaken and contingency measures have been identified to manage that uncertainty. A validation program has also been proposed to measure predicted against actual impacts of the Project (refer to **Section 5.0**), so that contingency measures, if required, can be implemented in a timely and pro-active manner.

4. An auditing and review process is an integral component of Hy-Tec's existing HSE management system for the quarry, providing for verification of future quarry performance by independent auditors and relevant government agencies. Hy-Tec will continue this auditing and verification process for the Project.

6.4.2 Inter-generational Equity

Schedule 2 Clause 7(4)(b) of the EP&A Reg defines inter-generational equity as follows:

> Inter-generational equity namely, that the present generation should ensure that the health, diversity and productivity of the environment are maintained or enhanced for the benefit of future generations.

Inter-generational equity refers to equality between generations. It requires that the needs and requirements of present-day generations do not compromise the needs and requirements of future generations in terms of the health, diversity and productivity of the environment.

The key objective of the Project is to maximise the effective use of existing resources and meet the needs of the community for quarry products, whilst minimising environmental and social impacts. As part of quarrying operations to recover a substantial, fine aggregate resource, a comprehensive rehabilitation strategy will be developed for the Project area.

As detailed in **Section 4.0**, the Project can be undertaken without having a significant adverse impact on the local environment or community. The environmental management

measures discussed in **Section 5.0** have been developed to minimise the impact of the Project on the environment and community to the greatest extent reasonably possible.

The management of environmental issues as outlined in this EIS will maintain the health, diversity and productivity of the environment for future generations.

6.4.3 Conservation of Biological Diversity and Ecological Integrity

Schedule 2 Clause 7(4)(c) of the EP&A Reg defines conservation of biological diversity and ecological integrity as follows:

> conservation of biological diversity and ecological integrity namely, that conservation of biological diversity and ecological integrity should be a fundamental consideration.

This refers to the maintenance of species richness, ecosystem diversity and health and the links and processes between them. All environmental components, ecosystems and habitat values potentially affected by the Project are described in this EIS. Potential impacts are also outlined and measures to ameliorate any negative impact are outlined in the statement of commitments (**Section 5.0**).

The ecological assessment completed for the Project (**Section 4.2**) concluded that the Project will not have a significant impact on biodiversity.

6.4.4 Valuation and Pricing of Resources

The goal of improved valuation of natural capital has been included in Agenda 21 of Australia's Intergovernmental Agreement on the Environment. The principle of improved valuation and pricing refers to the need to determine proper values of services provided by the natural environment. The objective is to apply economic terms and values to the elements of the natural environment. This is a difficult task largely due to the intangible comparisons that need to be drawn in order to apply the values.

The Project optimises the valuation and pricing of the fine aggregate resource with minimal impact by:

- ensuring the long-term viability of the quarry by optimising the remaining viable quarry resources, maximising the use of existing infrastructure and maximising operational and economic efficiencies; and
- maximising the efficient extraction of the resource through detailed design and planning.

Project feasibility considerations have included the costs of integration of effective management measures to minimise potential environmental and social impacts as well as design of the Project to limit the impact on other natural resources including water and native vegetation.

6.5 Conclusion

The Project will allow for the ongoing supply of fine construction sand to the local and regional markets for up to an additional 30 years, providing a valuable and necessary resource to the local economy. Identified supply constraints of construction sand for the Sydney region market underpin a strong ongoing demand for the products produced by Tinda Creek Quarry and the quarry is well placed to effectively and economically meet this demand. The Project will provide significant economic benefit to the local area and region

through secure supply of high quality quarry products, ongoing and increased employment, capital expenditure and ongoing operational expenditure. These benefits will have flow on effects within the local and regional economies.

The Project has been designed with consideration of the environmental values of the Project area and potential impacts of the Project have been minimised through appropriate Project design and control measures. The potential environmental impacts of the Project have been thoroughly assessed and, where potential impacts have been identified, mitigation measures and environmental safeguards have been recommended and incorporated into Project design and operational management. Where possible, these mitigation measures have been built into the design of the Project to minimise the need for ongoing management throughout the life of the Project.

It is considered that the Project has identified and mitigated potential environmental impacts to a level that will allow for the significant benefits of the Project for the local and regional communities to be realised in a sustainable manner.

7.0 Director–General's Requirements Checklist

A consolidated list of Director-General's Requirements (DGRs) issued for the Project is provided in **Appendix 1**. A checklist of where the matters raised in the DGRs are addressed in the EIS is provided in **Table 7.1**.

Table 7.1 – DGRs Checklist

Director-General's Requirement	**Section in EIS**
Detailed description of development	**Section 2.0**
Planning considerations	**Section 3.0**
Risk assessment	**Section 4.1**
Description of existing environment	**Section 4.0**
Assessment of impacts of all stages of development	**Section 4.0**
Description of environmental controls	**Section 4.0**
Consolidated summary of environmental management and monitoring	**Section 5.0**
Estimate of Capital Investment Value	**Executive Summary**
Estimate of jobs created	**Section 2.3.6**
Certification that information provided is accurate	**Appendix 2**
Land resources	**Sections 2.0** and **4.15**
Biodiversity	**Sections 4.2** and **4.3**
Water resources	**Section 4.9**
Heritage	**Sections 4.4** and **4.5**
Traffic and transport	**Section 4.6**
Waste	**Section 4.13**
Air quality	**Section 4.8**
Greenhouse gases	**Section 4.11**
Noise	**Section 4.7**
Visual	**Section 4.10**
Hazards	**Section 4.12**
Socio-economic	**Section 4.14**
Rehabilitation	**Section 4.15**
Consultation	**Section 1.3**

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9.0 Abbreviations and Glossary

3D	three dimensional
AADT	Annual Average Daily Traffic
ACHMP	Aboriginal Cultural Heritage Management Plan
ADG Code	Australian Dangerous Goods Code
AHIMS	Aboriginal Heritage Information Management System
AHIP	Aboriginal Heritage Impact Permit
AIP	Aquifer Interference Policy
APZs	Asset Protection Zones
AWD	available water determination
BP	before present
CPI	Consumer Price Index
DACHA	Darug Aboriginal Cultural Heritage Assessments
DALC	Darug Aboriginal Land Care
dB(A)	Decibels A-weighting
DCAC	Darug Custodial Aboriginal Corporation
DCP	Development Control Plan
DGRs	Director-General's Requirements
DLO	Darug Land Observations
DMR	Department of Main Roads (now Roads & Maritime Services)
DoE	Department of Environment
DP&E	Department of Environment and Planning
DP&I	Department of Planning & Infrastructure (now the Department of Planning and Environment)
DPI	Department of Primary Industries
DRE	Department of Resources & Energy
DTAC	Darug Tribal Aboriginal Corporation
EECs	Endangered Ecological Communities
EEO	Energy Efficiency Opportunities

EIS	Environmental Impact Statement
EMP	Environmental Management Plan
ENM	excavated neutral material
EP&A Act	Environmental Planning & Assessment Act 1979
EPBC Act	Environment Protection & Biodiversity Conservation Act 1999
EPL	Environment Protection Licence
ESD	Ecologically Sustainable Development
FGS	fine grained siliceous
FM Act	Fisheries Management Act 1994
GBMWHA	Greater Blue Mountains World Heritage Area
GCHAC	Gunjeewong Cultural Heritage Aboriginal Corporation
GDEs	Groundwater Dependent Ecosystems
GHG	greenhouse gas
GHGEA	Greenhouse Gas and Energy Assessment
GJ	gigajoules
HCC	Hawkesbury City Council
HIPAP	Hazardous Industry Planning Advisory Paper
HMCA	Hawkesbury–Nepean CMA Catchment Officer (Aboriginal Communities)
HSE	Health, Safety and Environment
Hy-Tec	Aus-10 Rhyolite Pty Ltd t/a Hy-Tec Concrete and Aggregates
INP	Industrial Noise Policy
IPCC	Intergovernmental Panel on Climate Change
JORC	Joint Ore Reserves Committee
kg	kilogram(s)
km/h	kilometres per hour
kV	kilovolt
LEP	Local Environmental Plan
L	litre(s)

L/s	litres per second
LGA	Local Government Area
mAHD	metres Australian Height Datum
ML	million litres
ML/year	million litres per year
MLALC	Metropolitan Local Aboriginal Land Council
mm/year	millimetres per year
MNES	Matters of National Environmental Significance
MSMP	Mine Safety Management Plan
Mt	million tonnes
Mtpa	million tonnes per annum
NGA	National Greenhouse Accounts
NIA	Noise Impact Assessment
NOW	NSW Office of Water
NPWS	National Parks & Wildlife Service
OEH	Office of Environment & Heritage
PAD	Potential archaeological deposit
PEA	Preliminary Environmental Assessment
PHA	Preliminary Hazard Analysis
PJ	petajoules
PSNL	project-specific noise level
RAPs	Registered Aboriginal Parties
RFS	Rural Fire Service
RMS	Roads and Maritime Services
RTA	Roads and Traffic Authority (now Roads and Maritime Services)
SEPP	State Environmental Planning Policy
SISD	Safe Intersection Sight Distance
SPR	Sydney Planning Region

SREP 20	Sydney Regional Environmental Plan No 20—Hawkesbury–Nepean River
TECs	Threatened Ecological Communities
tpa	tonnes per annum
TSC Act	Threatened Species Conservation Act 1995
Umwelt	Umwelt (Australia) Pty Limited
vph	vehicles per hour
VENM	virgin excavated neutral material
WH&S Act	*Work Health and Safety Act 2011*
WSPGWS	Water Sharing Plan for the Greater Metropolitan Region Groundwater Sources
WSPURWS	Water Sharing Plan for the Greater Metropolitan Region Unregulated River Water Sources
Y	Yarrawalk