Assessment of Soil and Water Impacts: Proposed Energy from Waste Facility, Eastern Creek.

Prepared for The Next Generation NSW Pty Ltd.

Report ID: E15002 DADI 001

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1. Introduction

The Next Generation NSW Pty Ltd (TNG NSW) proposes to construct and operate Energy from Waste (EfW) Electricity Generation Plant at Eastern Creek, approximately 36km west of the Sydney CBD. The EFW development will allow for unsalvageable and uneconomic residue waste from the Genesis Xero Material Processing Centre (MPC) and other residual waste fuel sources to be used to generate electricity. The plant will have the capacity to process up to 1.35 million tonnes per annum.

The site of the EFW Plant is located on Lots 1, 2 and 3, DP 1145808 and is accessed off Honeycomb Drive at Eastern Creek. The site and surrounding land are identified as part of the 'State Environmental Planning Policy (Western Sydney Employment Area) 2009 (WSEA SEPP)' to be redeveloped for industrial and employment uses over the next decade. The site has a total area of approximately 56 Ha including the Riparian Corridor, with a specific development area of 9 Ha. .

The project is identified as State Significant Development (SSD) under Schedule 1 of the State Environmental Planning Policy (State and Regional Development) 2011 (CL 20), being Electricity generating works and heat or co-generation with a capital investment value of greater than $30 million.

The proposed development will, in addition to the EfW facility, include the adoption of a plan of subdivision and the following ancillary works:

- Earthworks associated with the balance of the site;
- Internal roadways;
- Provision of a direct underpass connection (Precast Arch and Conveyor Culvert) between TNG Facility and the Genesis Xero Waste Facility;
- Staff amenities and ablutions;
- Staff car parking facilities;
- Water detention and treatment basins;
- Services (sewerage, water supply, communications, and power supply).

Further to the above physical works associated with the proposed EfW facility, this application seeks approval for the subdivision Lot 1, 2 and 3 in DP 1145805 in order to create a separate lot for the Transgrid Switching or Substation and additional lots to allow for future development of land not associated with the EfW facility and the Genesis Xero Material Processing Plant.

This report has been commissioned to address the requirements listed by the Director General of Planning NSW with respect to potential soil and water impacts of the proposed project as listed below and will form part of the Environmental Impact Statement (EIS) for the project:

- Description of the water demands and a breakdown of water supplies;
- Description of the measures to minimise water use;
- A detailed water balance;
- Description of the construction erosion and sediment controls;
- A description of the surface and stormwater management system, including on site detention, and measures to treat or reuse water;
- An assessment of potential surface and groundwater impacts associated with the development including the details of impact mitigation, management and monitoring measures; and an assessment of any potential existing soil contamination.

It should be noted that this report does not address issues directly related to stormwater management and Water Sensitive Urban Design (including compliance with Council policy requirements): these are dealt with in the Civil Infrastructure Report (AT&L, 2015). Assessment of flood risk is addressed in Section 15 of the EIS.

By way of disclosure, it is noted that this report is based on a draft document prepared by Ian Grey Groundwater Consulting (IGGC, 2015). The modelling and analysis contained herein have been adopted from the IGGC (2015) document.

2. Scope of Work

The scope of work undertaken is as follows:

- Undertake a walkover inspection of the site;
- Describe rainfall, climate, topography, soil, geological, hydrological and hydrogeological conditions at the site;
- Provide a description of the proposed development including a description of the cooling/process water system and measures for the separation of process water and waste-contact water;
- Review background documents, with particular reference to the IGGC (2015) draft report;
- Assess and incorporate the IGGC (2015) review of published and site-specific documents to establish the pre-development conditions;
- Provide an assessment of potential existing soil contamination including the potential for the presence of Acid Sulfate Soils (ASS);
- A detailed water balance for the plant has been prepared by the designers, Hitachi Zosen INOVA (HZI). This report makes reference to same and provides an assessment of the potential measures to minimise water use;
- A Construction Soil and Water Management Plan (CSWMP) has been prepared by AT&L. An overview of this SWMP is provided herein;
- Assess potential surface and groundwater impacts associated with the development including the details of impact mitigation, management and monitoring measures;
- Provide recommendations for specific measures required to minimise potential impacts arising from any acid sulphate soils and existing contamination of soil and/or groundwater that may be present.
- Specify requirements for monitoring of water quality and run-off volumes and recommendations for post–construction rehabilitation of disturbed areas will be provided.

Further to the above, the following comments from Blacktown City Council and NSW Department of Primary Industries are in hand and are addressed in the report:

- Blacktown City Council
  - Water conservation achieving a minimum of 80% of non-potable demand to be met through rainwater or equivalent; and,
  - Reduction of the Stream Erosion Index based on duration and rate of post-development stream flows.
- NSW Department of Primary Industries
  - Most of DPI's requirements can be addressed under the existing scope of work with the exception of the following:
  - Determination of any requirements for water access licence(s) to permit use of water from the OSD basin(s);
  - Assessment of the proposed development and associated water use in terms of the requirements of the Water Sharing Plan(s) for the area.

3. Site Description and Existing Environment

3.1 Site Setting, Topography and Geomorphology

The legal description of the site is Lots 1, 2 and 3 in DP 1145808 in the Blacktown City Council Local Government Area. The site is located approximately 8 km west-south-west from the Blacktown CBD and 36 km west of the Sydney CBD.

The site which is accessed off Honeycomb Drive at Eastern Creek is surrounded by land owned by ACN 114 843 453 Pty Ltd and ThaQuarry Pty Ltd, Australand, Hanson, Jacfin, the Department of Planning and Infrastructure and Sargents.

There is a substantial waste recycling facility (Genesis) and an associated landfill located within a former quarry void to the north and north east of the proposed development. These facilities are owned by companies associated with the project proponent and will provide some of the feedstock for the EfW plant. The landfill and recycling operations are operated under Licences 13426 and 20121 issued under the Protection of the Environment (Operations) Act, 1997.

Land to the east of the site is owned by Hanson and is used for the production of concrete and asphalt. It is noted that the asphalt plant is operated by Fulton Hogan. It is understood that Hanson currently have proposal on hand for the redevelopment of the facility.

Land to the south and west comprises undulating, cleared pasture. All the surrounding land is earmarked under the WSEA SEPP to be redeveloped for industrial and employment uses over the next decade.

The existing site comprises undulating, cleared pasture, generally sloping down to the south and west from a hill/ridge close to the northern site boundary at around 5º with localised slopes of up to 10º. Surface elevations vary from 79 mAHD in the north eastern area of the site to c.53 mAHD in the south western corner adjacent to the Ropes Creek tributary. The former quarry void to the northeast of the site has a basal level of -67 mAHD and has been converted into and engineered landfill.

A minor tributary of Ropes Creek runs through the southern part of the site from east to west and joins Ropes Creek approximately one kilometre north-west and downstream of the site boundary. Minor drainage lines are present in the northern-eastern and south-eastern areas of the site, generally draining to the south and south-west respectively.

Vegetation on the site comprises grasses with a few trees in the south-eastern part of the area.

Figure 3.1 shows the site setting and features.

3.2 Rainfall and Climate

3.2.1 Average Rainfall and Evaporation

The Bureau of Meteorology (http://www.bom.gov.au/climate/averages/tables/cw_067019.shtml) publish rainfall and evaporation data for Meteorological Station 067019 located at Prospect Reservoir, approximately 7 km east of the site for the period from 1887 to 1 April 2015. Monthly rainfall and evaporation statistics are summarised in Table 3.1. The mean and median annual rainfall at the station are 870.1 mm and 857.7 mm respectively. Maximum and minimum average monthly rainfall occurs in March (96.6 mm) and September (46.6 mm) respectively. Annual average evaporation is 1315 mm.

Rainfall is highest during the summer months peaking in January/February, and lowest in winter and early spring. Evaporation is highest in December and lowest in June and evaporation exceeds rainfall for all months except May, June and July.

3.3 Soils Types and Properties

Reference to the 1:100,000 scale soil landscape map of the Penrith area (Bannerman & Hazleton, 1990) indicates the following soil types:

- Moderately reactive, highly plastic clay soils up to 1m deep overlying Bringelly Shale;
- Moderately reactive, deep, layered fluvial soils around Ropes Creek.

Residual soils derived from weathering of the Bringelly Shale have the potential to be dispersive and results from laboratory testing of soil samples collected during earlier investigation of the area surrounding the site confirmed the presence of dispersive soils (J&K, 2004).

Erodibility (a soil's susceptibility to erosion) is determined by the physical properties of the soil including composition, texture, structure and dispersivity. The erodibility factor value based on the mapped soil landscape (Blacktown – bty) is 0.038 (Landcom, 2004) and this should be increased by 20% due to the presence of dispersive soils (Landcom, 2004), indicating high soil erodibility.

Reference to published Acid Sulfate Soil (ASS) maps shows that Actual or Potential ASS are not expected to occur in the area. This notion is supported by soil testing undertaken by PSM (2005) which did not indicate high soluble sulphate or low pH levels in site soils.

3.4 Geology and Hydrogeology

3.4.1 Geology

Reference to the published 1:100,000 Penrith area geology map (Clarke & Jones, 1991a) indicates that site is underlain by strata of the Wianamatta Group. The upper unit is the Bringelly Shale, a formation dominated by claystone and siltstone with thin laminite horizons and minor sandstone and with a thickness of at least 100m. This is underlain by the Minchinbury Sandstone, a 3m to 6m thick quartz-lithic sandstone; followed by the Ashfield Shale which comprises sandstone-siltstone laminite and sideritic claystone.

The Wianamatta Group is underlain by the Hawkesbury Sandstone, the top of which is expected to occur at below -80mAHD in the area of the site due to the presence of a palaeochannel (Jones and Clarke, 1991b), and is therefore likely to be below the base of the former quarry located immediately north-east of the proposed development.

The Minchinbury Diatreme occurs beneath the former quarry. This is considered to be the remnant of an explosive volcanic vent, and forms a steep-sided or vertical inverted conical structure approximately 850m by 300m and pear-shaped in plan. The diatreme comprises volcanic breccia made up of basaltic lapilli (4 to 32mm fragments) and blocks in a fine-grained matrix of tuff and siltstone. Vertically bedded sandstone/siltstone (Bringelly Shale) has been dragged down a ring fault surrounding the diatreme (Jones and Clarke, 1991b).

The edge of the diatreme is generally within the former quarry, with the upper benches excavated through weathered or un-weathered shale country rock. However, the diatreme extends beyond the south-western limit of the quarry, forming the low hill in the northern part of the cleared farmland which comprises the proposed development site. Volcanic strata are exposed in the road cuttings in this area.

Alluvial deposits of Quaternary age occur along Ropes Creek, located to the west of the site. Minor alluvium may occur along the course of a tributary creek which crosses the southern part of the site.

3.4.2 Hydrogeology

Background Information and Data

The hydrogeology of the site and surrounding area is largely controlled by the geology and the quarry void. The strata of the Wianamatta Shale group are generally of low permeability, and have a limited potential to transmit groundwater flow. The majority of groundwater flow occurs via fractures and bedding planes, with negligible flow through the rock mass.

The formation generally forms a layered aquifer system, with discrete aquifers occurring within horizontal fracture zones and with limited inter-connection between zones (IGGC, 2007). The groundwater pressure surface generally follows the topography, with groundwater flowing from recharge areas on high ground to discharge areas (generally creeks, rivers and wetland areas). Groundwater levels generally reflect the level of the nearest discharge zones and in the area of the site would be expected to be around 50 mAHD close to the creek lines. A slight downward hydraulic gradient typically exists between horizontal aquifer zones although this may be reversed in areas of groundwater discharge (IGGC, 2007).

The Minchinbury Diatreme would originally have formed a large, fractured rock mass within the Bringelly Shale. The permeability of the volcanic breccia relative to the surrounding shales and sandstone is not known, however the intrusion originally formed a low hill and the local high point, and would be expected to represent a groundwater recharge area, with groundwater flowing from high levels around the intrusion towards likely discharge areas associated with Ropes Creek to the west and Eastern Creek to the east. IGGC (2007) consider that the intrusion of the diatreme resulted in faulting and increased fracturing of the surrounding strata, and subsequent quarrying activities will have also increased local fracturing as a result of blasting and pressure relief. This is likely to have increased the permeability of the strata immediately surrounding the quarry (IGGC, 2007).

Regional groundwater quality is generally poor, with high salinity levels from connate salts within the formation or alternatively from leaching of accumulated salt from the lower soil profile (McNally, 2009) and the limited flushing due to low groundwater flow rates. Groundwater quality associated with igneous bodies such as the diatreme can be highly alkaline and high levels of inorganic nitrogen can also be present.

A weathered profile comprising soil and soil-like materials such as mottled clays and weathered shale generally overlies the shale. This reaches depths of 3 m to 12 m in the footslopes and valley floors but can be very thin or absent beneath hills. A perched shallow groundwater system can occur within this stratum with most groundwater flow taking place laterally through the upper, more permeable loamy soils.

Alluvial deposits occur around Ropes Creek, and limited alluvial material may occur immediately around the tributary. Such strata are highly variable, but are likely to comprise sands, silts and clays. Groundwater is likely to be hydraulically connected to the creek. Localised recharge from creek water is likely to result in relatively fresh groundwater, although discharge of more saline groundwater from the shale can occur through the alluvial material.

A search of the NSW Office of Water (NOW) database provided details of 18 registered bores located within 5 km of the site. The majority of these are test/monitoring bores, although there are also two shallow irrigation wells, an aquaculture waste disposal bore and a shallow domestic bore.

Bore details are summarised in Table 3.2 and locations are shown on Figure 3.2.

Information from the NOW records confirms the hydrogeological setting, with groundwater levels typically 10 to 25 metres below surface. Water quality data are limited, but the reported salinity levels are relatively low for the Bringelly Shale.

Groundwater use in the area is limited, with only three registered bores for abstraction of groundwater, all of which are shallow and exploit perched groundwater in residual clays or minor alluvium. There is also an aquaculture waste disposal bore. All other recorded bores in the area are monitoring or test bores. This low level of groundwater exploitation reflects the generally low yields and high salinity obtained from bores drilled into the shale.

Site-Specific Data

A groundwater monitoring network has been established as part of the development of the Genesis engineered landfill facility (IGGC, 2007) contained within the former quarry void. This network comprises seventeen bores of three types:

- Shallow bores targeting perched groundwater within the upper, weathered shale bedrock aquifer (18 m to 21 m deep);
- Intermediate bores targeting the mid-level aquifer zones within the fractured rock (50 m to 110 m deep); and D
- Deep bores targeting the aquifer zones close to or slightly below the base of the engineered landfill (115 m to 160 m deep) at -67 m AHD.

The presence of a deep quarry and associated dewatering for over 40 years followed by construction of an engineered landfill site and pumping of leachate from a basal drainage system has resulted in substantial depressurisation of the local groundwater systems. The invert of the present leachate drainage system is at an elevation of around -67 mAHD and leachate levels are required to be maintained at or below -45 mAHD; i.e. around 100m below the estimated natural groundwater level. This head difference represents a very high hydraulic gradient into the quarry from the surrounding aquifers (IGGC, 2007). Such a configuration is referred to as an hydraulic trap.

The low permeability of the strata in and around the quarry means that depressurisation results in a steep drawdown cone. The extent of depressurisation is likely to be fairly limited in the shallow aquifers within the soil zone/weathered profile and upper shale, but may extend to a kilometre or more from the quarry in the deep aquifers (IGGC, 2007). The conceptual groundwater regime around the quarry is illustrated in Figure 3.3 IGGC (2007).

Groundwater levels in bores intersecting bedrock near the north of the site (IGGC, 2015) occurs at 30 to 35 mAHD in the deep bores and around 40 mAHD in the intermediate bores. Groundwater levels in the bedrock are expected to increase with distance from the former quarry with elevations of around 50 mAHD or slightly greater likely to occur beneath the creek lines, including the Ropes Creek tributary.

Results of numerical modelling of groundwater flow provided by IGGC (2007) indicate likely groundwater levels in the fractured rock aquifer(s) beneath the site of 40 mAHD to 50 mAHD with groundwater flow generally from south to north towards the former quarry reflecting depressurisation due to long-term dewatering/leachate pumping. Simulation of conditions prior to development of the quarry indicated likely fractured rock groundwater levels of 60 to 62 mAHD; while recovered groundwater levels after the cessation of landfilling and leachate pumping are predicted to be around 63 to 68 mAHD beneath the proposed development site, slightly higher than those likely to have prevailed prior to quarrying. Critically it is noted in this regard that the operational licence for the landfill (Licence 13426) requires that levels be maintained at or below – 45 m AHD. Typically such a condition would remain in place until waste reaches "final storage quality", at which time "*the leachate from a landfill should be acceptable in the surrounding environment, allowing the site to be safely abandoned*" (Hjelmar & Hansen, 2005). On this basis it is expected that the landfill leachate pumping regime will be mandated under the licence for a period equivalent or longer than the operational life of the plant. As a result the groundwater levels are expected to remain around the current levels for the foreseeable future.

Pells Sullivan Meynink (PSM) carried out a geotechnical site investigation in July 2014 (PSM, 2015). This included drilling of 23 shallow boreholes (3.5 m to 5 m depth) and five deep, cored boreholes to depths of 14.85 m to 20.3 m. The latter had basal elevations of 40 mAHD to 61.7 mAHD and were drilled around the location of the proposed EfW plant, including the solid waste bunker which has a base level of 61 mAHD.

Five main geotechnical units were inferred based on the results of the site investigation and comprised: topsoil; existing fill; residual soil; Bedrock A (extremely weathered to moderately weather bedrock); and Bedrock B (moderately weather to fresh bedrock). The base of the residual soil/top of Bedrock A was encountered at 0.5 m to 4.6 m depth and the top of Bedrock B at 1.5 m to 9.1 m depth.

No groundwater was encountered during the site investigation other than in BH23, a shallow bore located close to the drainage line in the south-eastern area of the site. No wells or piezometers were installed; however the absence of noticeable groundwater inflows indicates that groundwater occurrence is limited and/or the strata encountered are of low hydraulic conductivity.

The shallow groundwater system is considered in more detail in Section 3.5.

3.5 Salinity

3.5.1 Background

Salinity is known to occur in shallow soils and groundwater seepages in Western Sydney, generally associated with the Wianamatta Group shales. Salinity impacts include damage to buildings or roads, vegetation dieback, erosion and waterlogging, and can be exacerbated by development or changes in surface, drainage and vegetation conditions if these are not carefully planned.

Reference to the published map of having salinity potential in Western Sydney (DIPNR, 2003) indicates that the majority of the site is classified as moderate salinity potential, with areas of high potential shown along Ropes Creek and along the tributary running through the southern part of the site.

Soil landscapes in Western Sydney commonly comprise poorly drained duplex soils, with relatively permeable loamy topsoil over a low permeability clay subsoil, and this situation is likely to prevail across most of the site. Soil water moves more easily through the loamy topsoil (often flowing across the underlying clay), and salt can accumulate in the subsoil. Surface expression of salinity occurs where soil water accumulates and seeps to the surface, and evaporation concentrates the salts; typically on lower slopes or flats (Nicholson, 2003). This situation is shown in Figure 3.4.

Salinity can also arise in areas of saline groundwater discharge from deeper aquifers. Groundwater in the Bringelly shale is typically brackish to saline, and this water discharges naturally along creeks and gullies. Salinity expressions occur in discharge zones and when groundwater is sufficiently shallow for capillary action to bring water and salt to the surface. These effects are exacerbated should groundwater levels rise due to increased recharge accompanying vegetation removal and landuse changes etc. This situation is shown in Figure 3.5.

3.5.2 Site Conditions

The previous investigation has been undertaken into salinity on the site (PSM, 2005) included a review of published information, site inspection, drilling of boreholes (nine in total, three of which are on the current site), soil sampling, piezometer installation (four in total, one of which was on the current site) and measurement of groundwater levels.

No significant salinity impacts was reported. Results of the analysis of soil samples collected from the boreholes located on the site showed the following:

- Sulphate levels were all well below those considered potentially aggressive to concrete piles;
- Chloride levels were all below those considered potentially aggressive to steel piles;
- Soil electrical conductivity (EC) levels generally indicated non-saline topsoil, moderately saline residual soils, and very saline shale bedrock.

The report concluded that soils on site are moderately saline, but that with appropriate site drainage, redevelopment would probably improve the salinity situation.

Salinity investigation of neighbouring land to the east has also been undertaken (SMEC, 2002). This also identified moderately saline soils accompanied by elevated electrical conductivity in surface water features. The need for appropriate salinity management procedures was identified, and the potential for an improved salinity situation with appropriate management was again identified.

Piezometers installed in previous investigations and identified on site by IGGC in May 2014 are shown on Figure 3.6, and details are provided in Table 3.3. The IGGC site inspection (2015) reported no evidence of serious salinity impacts was observed: there were no indications of salt scalds; salt crystals; vegetation dieback; or other salinity effects. Areas of waterlogging were observed as follows:

- The minor gully that runs from the north-east corner of the site in a south-south-westerly direction shows evidence of minor shallow groundwater discharge through vegetation and minor to substantial waterlogging depending on the preceding rainfall condition;
- A swampy area and associated minor drainage line running from midway along the eastern site boundary towards the south-west then south to join the main tributary. This drainage feature pre-dates quarrying and processing activities on the adjacent sites based on the historical aerial photograph from 1947 (DP, 2006) although leakage and/or overflow from Hanson's sediment dams is likely to have increased waterlogging since quarrying and associated activity commenced;
- Swampy and/or waterlogged areas associated with the creek (tributary of Ropes Creek, mostly limited to the south-eastern area of the site).

Water level and salinity data from the shallow piezometers indicates groundwater flow in the shallow formations following the topography, with recharge occurring on the higher ground and discharge taking place along the minor drainage lines and the tributary of Ropes Creek. The groundwater level in MW4 appears anomalous, and likely reflects leakage from the nearby dam on Hanson's property. Salinity of the shallow groundwater is low on the higher ground and mid-slopes, increasing with proximity to the creek. IGGC (2015) suggest that this reflects the discharge of saline groundwater from deeper fractured rock aquifer(s) hosted by the Bringelly Shale is occurring in these areas in addition to shallow groundwater discharge, as the increase is too great to be explained by evaporative concentration alone.

3.6 Groundwater Dependent Ecosystems

The NSW State Groundwater Dependant Ecosystem Policy (DLWC, 2002) is a component policy of the NSW State Groundwater Policy Framework. Groundwater Dependent Ecosystems (GDEs) are ecosystems which have their species composition and their natural ecological processes determined by groundwater (ARMCANZ & ANZECC, 1996).

The shallow groundwater system present beneath the site is likely to be providing some support to terrestrial vegetation (predominately non-native grasses) and a limited contribution to base flow in the tributary. The groundwater system is limited to that hosted by the weathered profile overlying the shale bedrock with low hydraulic conductivity likely to prevail except in the upper ~1 m of the soil profile. The available groundwater storage in the system is low; this, together with the low hydraulic conductivity of the lower soil profile and underlying strata greatly limit the potential for the shallow groundwater system to sustain terrestrial ecosystems or surface water base flow during extended dry periods. The limited contribution of shallow groundwater to surface water base flow is supported by the salinity levels noted in monitoring bore MW2.

The site and the tributary of Ropes Creek have been substantially altered from the original natural state by historical clearing of native vegetation to allow establishment of pasture and by maintenance of a highly artificial surface water flow regime over a prolonged period due to discharge of water pumped from the quarry and by leakage from the settlement dams located immediately adjacent to the south-eastern boundary on Hanson's site.

In view of these factors, no GDEs are considered to be present on the site

3.7 Potential for Existing Contamination of Soil and/or Groundwater

3.7.1 Previous Site Investigation and Assessment

Stage 1 Environmental Site Assessments (ESA) have been undertaken on broader parcels of land which encompassed the site by ADI (1995) and CH2M HILL (2004), neither of which reported any indication of past industrial activity on the site. Both assessments identified the asphalt manufacturing plant on land immediately adjacent to the eastern site boundary and topographically upgradient as having the potential to have impacted the site.

A Stage 2 site investigation and assessment was undertaken by ADI in (1998). The investigation involved the collection and laboratory analysis of soil/sediment samples from dams, drainage lines and creeks that were identified in the Stage 1 assessment as having the potential to be impacted by the asphalt plant and/or quarry operations. (Note that most of the samples were located outside the boundary of the study site.) In addition, samples were collected on a grid pattern on the site close to the common boundary with the asphalt plant. A number of 'background' soil samples were collected from the western area of the site, farthest from the potential source of contamination. Five shallow groundwater monitoring wells were installed to assess groundwater quality. Surface-water samples were also collected from two dams and from the tributary. The approximate location of the sampling points are shown on Figure 3.6. Results of the investigation were compared to the guideline values current at the time (ANZECC Australian and New Zealand Guidelines for the Assessment and Management of Contaminated Sites, 1992).

The ADI (1995 and 1998) refer to soil samples collected on the subject site as 'background samples'. The location of these samples cannot be ascertained from the information at hand. The CH2M Hill (2004) report does not provide further data on site conditions.

Four groundwater wells were monitored by ADI (1998) on or adjacent to the subject site (MW2-5). The 1998 report makes reference to groundwater sampling undertaken in 1995. It is noted that the reports on hand do not provide sufficient detail on the method of groundwater sample collection and handling, specifically whether samples were filtered prior to analysis. Furthermore field data sheets and observations are not included in the documents on hand. Key indicators of potential impact from the asphalt plant are Total Petroleum Hydrocarbons (TPH), monocyclic aromatic hydrocarbons (BTEX) and Polycyclic Aromatic Hydrocarbons (PAH). Importantly, all of these analyses were below the laboratory limits of reporting in all samples in the 1998 investigation. It is noted that some minor detections of PAHs were reported in the ADI (1995) study. In the absence of information on field and sampling methods, specifically the solids content (or turbidity) of the groundwater samples the writer is of the view that the 1995 results are most likely an anomaly attributable to poor well development or purging resulting in the inclusion of solid particles in the samples. It is further noted that low-levels of both TPH and PAH can occur naturally in samples of bedrock in the Wianamatta Group rocks. On this basis the writer concludes that, on the basis of the information at hand, there is no evidence that groundwater on the development site has been impacted by the asphalt plant on the adjacent land to the east.

ADI (1998) analysed a sample of water from a dam and drainage line on the site and reported that concentrations of heavy metals detected were attributable to the presence of suspended sediment in the samples. The report did not suggest any impact of surface water from the asphalt plant.

The ADI (1998) investigation reported the results of sediment sampling in drainage lines however the document on hand does not show the location of the samples. No further comment can be provided on these results.

3.7.2 Recent Investigation and Assessment

Further assessment was undertaken by A.D. Envirotech Australia Pty Ltd (ADE) in July/August 2014 (ADE, 2014). Conclusions of the assessment are as follows:

- Soil and sediment samples were collected from twenty five points across the site including boreholes, stockpiles and creek beds (excluding QA/QC samples). Four surface-water samples were collected from four sample points along the creek;
- Criteria applied included the NEPM Schedule B(1) Health Based Investigation Levels (HIL) D, Ecological Screening Levels (commercial/industrial); NSW EPA Waste Classification Guidelines Part 1: Classifying Waste for off-site disposal; and ANZECC Guidelines for Fresh and Marine Water Quality. It is the opinion of ADE that no contamination of the site from potential contaminating practices undertaken both on and off site, had occurred prior to the time the investigation took place;
- The concentrations of the potential contaminants within the soil, sediment and surface water samples collected were below the NEPM Schedule B (1) Health Based Investigation Levels (HIL) D, Ecological Screening Levels (commercial/industrial) and ANZECC Guidelines for Fresh and Marine Water Quality assessment criteria;
- Based on the findings of the investigation, ADE (2014) concluded that “no contamination of the site from potential contaminating practices undertaken both on and off site, had occurred prior to the time the investigation took place”. ADE further concluded that the site is deemed suitable for commercial/industrial land use and the proposed development.

3.8 Surface Water and Drainage

3.8.1 Surface Water Features

The main surface water feature in the area is Ropes Creek, located approximately 400 metres west of the site boundary at its closest point. Ropes Creek forms part of the South Creek sub-catchment of the Hawkesbury Nepean catchment and joins South Creek approximately 10 km downstream (north-north-west) of the site. A tributary of Ropes Creek runs from east to west through the southern area of the site and joins Ropes Creek approximately one kilometre north-west and downstream of the site boundary. The catchment of the tributary extends up to 750 m upstream from the site boundary and has a total area from the top of the catchment to the confluence with Ropes Creek of 119 ha.

Two minor drainage lines are present on the site. The first comprises a swampy area draining from the southern end of the eastern boundary, joining the tributary approximately 150 m from the eastern boundary. The second is a minor gully which runs in a south-south-westerly direction from the north-east corner of the site before forming an indistinct, minor and at time swampy channel which runs parallel to the tributary before joining it c.200 m downstream of the site boundary.

The catchments areas and drainage features on and around the site are shown on plans in Appendix A.

The proposed development site has an area of 9 ha and excludes the riparian zone which extends 20 m each side of the creek. Most of the area comprising the development site, lay-down pads and substation (21.4 ha) currently drains to the tributary within this area by overland flow or minor drainage channels. A small part of the western part of the overall area (2 ha) drains to the tributary downstream of the site boundary via overland flow and the area close to the northern site boundary currently drains to Ropes Creek via overland flow or other, more minor tributaries, of which c.0.8 ha will lie within the site drainage system after development.

The former quarry was in operation from the early 1960s until c.2008. During most of this period, runoff and groundwater seepage from the quarry sub-catchment drained to a basal quarry pond, from where it was pumped to settlement dams located on the Hanson processing site immediately east of the proposed development site prior to re-use or discharge to the tributary of Ropes Creek. Discharge of pumped water over many years is likely to have altered the nature of the tributary substantially, both in terms of the flow regime and water quality. The watercourse is presently in a fairly degraded condition, with erosion features evident along the banks.

Blacktown City Council carried out visual inspection of locations throughout the catchment as part of the development of the State of the Waterways Management Plan (WMP) for Ropes Creek (BCC, 2005, adopted 10 May 2006). This included sites T2 4, T2 5 and T2 6 located downstream of the south-western site boundary, mid-site and on the site close to the upstream boundary respectively. Sites were assessed for attributes relating to riparian vegetation, in-stream conditions, geomorphology, disturbance and community. The upstream site showed the highest scores and met catchment targets for riparian vegetation and disturbance, reflecting its setting within a lightly wooded area. The downstream site showed the lowest overall score largely due to a very low score for riparian vegetation. T2 5 showed a low score for geomorphology probably reflecting erosion due to increased wet-weather flows from discharge of water from the quarry.

The WMP identified establishment of a 40 m (or to the 1% AEP flood extent) or greater setback for future development as an action for the relevant waterway management zone. Implementation of WSUD was identified as the highest priority action for the catchment and a minimum 100 m riparian buffer recommended.

Flood modelling and assessment of flood risk was carried out by Brown Consulting in March 2010 for Blacktown City and is discussed in Section 22.2 of the EIS.

3.8.2 Existing Surface Water Runoff and Ambient Water Quality

Pre-development peak flows for the area comprising the development site, lay-down pads and substation (21.4 ha) have been provided (AT&L, 2015) and are as follows:

- 20 Year ARI: 5.9 m3/s;
- 100 Year ARI: 7.95 m3/s.

NSW Office of Water (NOW) operates a gauging station on Ropes Creek at Debrincat Avenue, St Marys, located approximately 6.5 km downstream of the site. The specific mean discharge for the gauging station is 0.807 ML/d/km2, indicating that the contribution to creek flow is equivalent to average run-off of approximately 34% of annual average rainfall. This will include creek base flow due to groundwater discharge from alluvial strata associated with Ropes Creek. Applying this factor to the development site area of 9 ha suggests approximate average run-off of 0.07 ML/d (0.8 L/s), equivalent to 26.5 ML/a; and of 0.17 ML/d (2.0 L/s, 63 ML/a) for the 21.4 ha area including the lay-down pads and substation. Total average flow in the tributary at the point approximately 130 m downstream of the site boundary is expected to be of the order of 1 ML/d (9.2 L/s; 963 m3/d). These values are likely to over-estimate actual average flow due to the limited groundwater base flow in the area of the site compared to Ropes Creek.

The only laboratory water quality data available for the tributary other than field readings collected on 1st December 2005 as part of salinity assessment (see Section 3.5.2) are as follows:

- A single sample collected by ADI as part of the Stage 2 Environmental Assessment. This indicated reasonable water quality, fresh to slightly brackish with no heavy metals or organic compounds detected but with an elevated nitrate concentration of 15 mg/L and pH of 8.2. This is likely to reflect discharge of pumped water from the quarry;
- Four samples collected during the recent Phase II detailed site investigation (ADE, 2014). These all showed very low levels of heavy metals and organic compounds with most results being below limits of resolution. No other analysis was undertaken.

The field readings collected by IGGC on 1st December 2005 and reported in IGGC (2015) also indicated fresh to slightly brackish water (electrical conductivity of 1,241 µS/cm) and very high pH of 9.85. Discharge of pumped water from the quarry formerly operated by Hanson was taking place when these readings were taken, via the sediment ponds located immediately east of the south-eastern corner of the site. The high pH noted on both occasions is considered to be indicative of water that has been in contact with basic igneous geological material for some time, and is similar to readings for water from the quarry pond collected on the same time.

3.8.3 Water Quality and River Flow Objectives

Water Quality Objectives (WQOs)

Environmental objectives for most river catchments in NSW were approved by Government in 1999. At that time, the Healthy Rivers Commission (HRC) had completed or substantially completed public inquiries for a small number of catchments, including the Hawkesbury-Nepean, and environmental objectives were therefore not provided for those catchments. The HRC recommended interim Water Quality Objectives (WQOs) in its Final Reports for these catchments and these were subsequently confirmed by Government (DLG, 2001). In essence, ANZECC guidelines apply other than for nutrients for which catchment-specific WQOs were recommended. All WQOs are for mean concentrations.

Blacktown City Council identified protection of aquatic ecosystems and visual amenity as the key values for both the Hawkesbury Nepean and Catchment and Parramatta River catchment areas within the Blacktown LGA during development of the Water Quality and Quantity Monitoring Program 2008-2012 (BCC, 2008). The key adopted WQOs for the proposed development are summarised in Table 3.4.

River Flow Objectives (RFO)

The RFO are agreed high level goals for surface water flow management. Those identified by BCC are based around maintaining or restoring natural water level and flow regimes, including the following:

- Maintain low flows, pools and wetlands;
- Protect or restore a proportion of moderate and high flows and natural floodplain inundation patterns while preventing increased height or rate of high flows;
- Maintain or restore natural variability and rates of change in water levels; and,
- Manage groundwater for ecosystems to maintain groundwater levels and natural variability around potential Groundwater Dependent Ecosystems or to minimise risks to ecosystems and surface water quality in areas of rising (particularly saline) groundwater.

4. Proposed Development, Water Balance and Water Management

4.1 Description of Proposed Development

The proposed development includes construction of the Energy from Waste Plant for electricity generation and ancillary works including earthworks; internal roadways; a direct underpass connection beneath the estate road (Precast Arch and Conveyor Culvert) between TNG Facility and the Genesis Xero Waste Facility; staff amenities and ablutions; staff car parking facilities; the water detention and treatment basin and services (sewerage, water supply, communications, power supply).

Construction of the EfW plant and associated facilities (including lay-down pads and substation) will involve extensive excavation and filling on the site. Excavation to depths of up to 15 metres will be required in small areas (mostly for the solid fuel bunker) with excavation taking place over approximately one third of the site area to typical depths of 5 to 6 metres. Filling will take place over much of the remainder, with a maximum thickness of c.7 metres and a typical thickness of 3 to 4 metres of material being placed. Calculated volumes indicate approximately 323,000 m3 of excavated material (including stripping for stockpiling and reuse) and 429,000 m3 of fill, with a net balance of 147,000 m3 of additional fill material required (AT&L, 2015).

The completed facility will include the following major features:

- The main EfW building. This will house the following infrastructure:
  - The tipping hall for deposition of waste from trucks;
  - The solid fuel bunker (either one divided bunker serving four combustion lines or two bunkers serving two lines each) to allow mixing of waste and to accept direct deposition from the conveyor;
  - The combustion/boiler system (four combustion lines);
  - The flue gas treatment systems;
  - The energy recovery plant; and,
  - The residue handling and treatment areas;
- The turbine buildings and air-cooled condensers;
- Internal roadways, weighbridges and staff car parking;
- The substation; and,
- The bio-retention basin.

Three temporary lay-down pads will also be formed to facilitate construction of the EFW plant.

The General Arrangement Plan and Bulk earthworks Cut and Fill Plan provided by AT&L are included in Appendix A, together with a number of cross sections. A schematic cross-section running north-north-east from the south-western corner of the site is provided in Figure 4.1.

4.2 Construction Water Demand

A construction programme has been prepared by HZI (Appendix B). It is estimated that construction will be completed within 43 months, with civil works being undertaken between months five and thirteen. The plan includes an estimate of town water use by month during the construction period. The average monthly water use is estimated to be 546 m^3, with a maximum of 1836 m^3 and minimum of 12 m^3 . The total water demand for the construction phase is 23,464 m^3 or 23.4 ML.

There is no estimate in the programme of the quantity of water to be retained for reuse on site during the construction phase. It is likely that the reuse of retained stormwater will be concentrated during the civil works for uses such as dust suppression.

4.3 EfW Plant Operational Water Demand

Predicted water demand for the developed site has two main components:

- EfW plant process water; and,
- General use for staff facilities, including potable supply.

4.3.1 EfW Plant Process Water Requirements

A detailed water balance for the EfW plant has been prepared by HZI and is provided in Appendix B. The water balance provides water consumption data per hour of operation. We are advised by HZI that the plant will operate for 8000 hours per annum. On the basis of a water input of 20.10 m3/h of operation, the total water demand is estimated to be 160.8 megalitres per annum. It is noted that the water balance prepared by HZI assumes 'average' operating conditions denoted as "LP N".

The proposed EfW plant comprises a total of four lines, constructed and operated as two blocks each with two lines. The water management system is complicated somewhat by the fact that some parts of the system serve a single line while others serve either both lines in a block or the entire facility. This is shown in the diagram provided in Appendix B (Water Balance – Process).

The EfW process includes three main stages as follows:

- Water/Steam Cycle;
- Flue Gas Treatment and Boiler Cleaning; and,
- Bottom Ash Handling.

Water/Steam Cycle (W/SC)

- A closed-loop boiler system is proposed. The combustion grate will use an air-cooled and partly water-cooled design. Total average water demand (LP N) will be 20.1 m^3/hr, which equates to 160.8 ML/yr based on 8000 hours of operation per annum. The cycle loss for the water/steam cycle is calculated to be 11.6 ML/yr.;
- Air-cooled condenser. Steam from the turbines will be condensed using an air-cooled condenser which eliminates water consumption from this stage of the process. The condensed water is returned to the boilers.

Flue Gas Treatment and Boiler Cleaning (FGT)

- A semi-dry scrubbing flue gas treatment system is proposed. The average water consumption requirement with boiler cleaning and flue gas treatment is estimated to be 3.4 m3/hr for each of the four lines. A total of 117.2 ML/yr is expected to be lost from this stage with the flue gas.

Bottom Ash Handling

- Wet handling of combustion residue (bottom ash) will be employed with a total average gross water requirement of approximately 40.6 ML/yr which will be met by re-use of demineralisation plant effluent with the remainder of the water demand being met from re-use of process water effluent from the other stages.

- It is calculated that, under average conditions, 32.08 ML/yr is expected to be lost with the bottom ash.

4.3.2 Use for Staff Facilities

The facility will employ up to 55 staff working three, 8-hour shifts per day. The Australian Government Department of Environment & Heritage (2006) suggest an average water use for offices of 1.125 kL/m^2/yr. Warren (2003) provides an office space allocation per person is 23 m^2 for owner-occupied properties. Based on these values the water use is estimated to be 1.43 ML/yr. The split between potable and non-potable water use is not known at this time.

There is limited data available to divide the staff use between potable and non-potable sources. For the purpose of this report, a split of 70%/30% respectively has been adopted. On this basis the potable versus non-potable water use for staff facilities is estimated to be 1.00 ML/yr and 0.43 ML/yr respectively.

4.4 Water Supply Requirements

The plant designers, HZI, advise that only high-quality water is to be used in the Water/Steam Cycle. As such there is no potential for the use of stormwater runoff in the EfW plant without treatment. No such treatment is contemplated in the current design and the use of stormwater in the plant has not been considered in this report. In summary, the total water supply requirements are as follows:

- Plant water: 160.8 ML/yr plus staff amenities of 1.0 ML/yr)r;
- Staff amenities potable water: 1.00 ML/yr
- Staff amenities non-potable water: 0.43 ML/yr;
- Total water use: 162.23 ML/yr.

4.5 Water Re-Use

4.5.1 Process Water Re-use within the EfW Plant

The proposed EfW process is designed to allow the maximum practicable level of re-use of water within the plant. This includes: use of demineralisation plant effluent for bottom ash handling; return of boiler blow-down water for re-use in the Water/Steam Cycle and use for flue gas treatment; and re-use of water from the sampling stations.

4.5.2 Re-Use of Roof Run-Off (non-potable)

Blacktown City Council DCP Part R requires that industrial and commercial developments supply 80% of their non-potable demand using non-potable sources. Where the 80% threshold cannot be met, use of non-potable sources should be maximised.

A plan of roof areas is included in Appendix A. The total available main roof area for rainwater collection is 17,570 m^2, excluding the turbine hall roof areas located topographically downgradient of the rain water holding tank. An Excel spreadsheet-based daily water balance model was developed by IGGC (2015) to allow estimation of the available volume of roof run-off and to assist in determining optimum sizing of storage tank(s) The model used actual daily rainfall data from the Prospect Reservoir BoM Station for a 35-year period (1980 to 2014). This period was selected as the overall annual average rainfall is close to the long-term average and a good range of rainfall conditions are represented, including years close to the 5th, 10th, 80th and 97th percentile annual rainfall. The model methodology, assumptions and a selection of model results in graphical form are provided in Appendix C.

The IGGC (2015) model assumes that no first flush diverters will be installed and that 100% of rainfall on roof areas will be converted to run-off.

A series of simulations was run by IGGC (2015)to determine the optimum storage tank size and 1000 kL was selected. This allows average re-use of 95% of the total inflow to the tank(s). The relationship between tank size and re-use rate is shown in Figure 4.2.

Predicted average rainwater yield for the full model period is:

- 9.15 ML/yr or 5.63% of water demand in the driest year (1980);
- 10.26 ML/yr or 6.20% of water demand in the 1 in 10 dry year (2006);
- 15.54 ML/yr or 9.285% of water demand in the median year (2014);
- 18.57 ML/y or 10.72% of water demand in the 1 in 5 wet year (1998);
- 25.37 ML/yr or 12.81% of water demand in the wettest year (1988).

Further to the above, the writer is advised that rain water holding tanks will be installed adjacent to the turbine halls and that water will be used on site as required.

4.5.3 Potential for Re-use of Stormwater Run-off

Re-use of stormwater run-off collected in the bio-retention basis was proposed in the original EIS submission. Further consultation with the plant design engineers has indicated that water quality is unsuitable and stormwater re-use other than that from roof areas has been ruled out.

4.6 Proposed Stormwater Drainage and Control Measures

4.6.1 Construction Soil and Water Management

Soil and water management during construction has been addressed in the Construction Management Plan (Brookfield Multiplex Constructions, undated). A detailed Soil and Water Management Plan is to be developed for the construction stage, with reference to relevant guidelines, namely Landcom (2004).

4.6.2 General Stormwater Management

Stormwater management has been broadly addressed in the Civil Infrastructure Report (AT&L, 2015). Site plans showing the proposed drainage and stormwater management systems are included in Appendix A.

The main features are as follows:

- Most of site surfaces will be impervious. Stormwater drainage from the entire site will be conveyed from north to south via open gutters, stormwater pits and underground pipes to an on-site detention (OSD)/bio-retention basin to be located in the south-western corner of the development area;
- The main areas of the site, i.e. the EfW plant, each of the lay-down pans, the substation and the roadways, will effectively each form their own sub-catchment for stormwater control.

These will be linked by the piped stormwater drainage systems with four entry points to the bio-retention basin;

- The bio-retention basin and outlet structure will provide mitigation of peak flows for 20 year and 100 year ARI events and with target annual pollutant load reductions to meet Council requirements.

Stormwater drainage from the estate road will be directed to the existing Genesis Facility swale and South-Western OSD (western end) or to the stormwater system of the proposed Hanson Asphalt and Concrete Facility (eastern end).

5. Assessment of Potential Impacts – Construction Phase

5.1 Erosion and Sediment Control Plan

The soils present on the site are expected to exhibit high erodibility. The presence of dispersive soils is also likely. These characteristics will require that particular attention be paid to erosion and sediment control during the construction phase and careful planning should be undertaken with regard to control and mitigation requirements, monitoring of run-off water quality and volume, and to phasing of the excavation, filling, construction and rehabilitation stages across the site. Acid Sulphate Soils (ASS) are not expected to be present on site.

Erosion and Sediment Control have been addressed in the Civil Infrastructure Report (AT&L, 2015). Options for the removal of sediment and other pollutants are outlined briefly and include sediment fences, cut-off drains and sediment basins.

Temporary sediment basin(s) will be required due to the scale of excavation, filling and other works involved; particularly as dispersive soils are expected. Design, sizing and location of basin(s) will need to be determined based on the proposed phasing of site works. The final Erosion and Sediment Control Plan (ESCP or a Soil and Water Management Plan, if required) to be submitted prior to issue of the Construction Certificate should include detailed description of the proposed overall approach and specific erosion and sediment control measures including the following:

- Proposed phasing of works (it is suggested that this be based upon the final stormwater catchments for the completed development; with excavation, filling and surfacing carried out area by area from north to south).
- Requirements for, and design sizing of sediment basins and associated catch drains;
- Detailed erosion control measures;
- Proposed systems for management of inflows and pumping of accumulated rainfall (and any minor groundwater seepage from excavations;
- Proposed monitoring of volumes of run-off, pumped water from excavations and discharge from the site during construction; and,
- Details of the approach and methods to be employed in post-construction rehabilitation of the site.

5.2 Construction Phase Water-Quality Monitoring Programme

Monitoring is required to demonstrate the effectiveness of erosion control and sediment control measures, assist with construction site management and identify any impacts. A surface-water monitoring programme including background, routine and event-based (wet weather) monitoring is provided in Table 5.1. At least one sampling round is to be undertaken prior to the commencement of works to provide additional background data (pre-development characterisation).

The following analytical suites and field measurements are recommended:

- Suite A: Routine Monitoring. Field measurements and observations (pH, electrical conductivity (EC), dissolved oxygen (DO), turbidity and description of flow conditions). Laboratory analysis for total suspended solids (TSS), total heavy metals, nutrients (ammonia, total oxidised nitrogen (NO¬¬x), total nitrogen (TN) and total phosphorus (TP)), total organic carbon (TOC);

- Suite B: Wet weather monitoring. Field measurements and observations. Ammonia, TN, TP, TOC, TSS;
- Suite C: Field monitoring of surface water conditions during construction. Field measurements and observations with particular attention to visual appearance (surface sheen, visually turbid, *etc*), odour and flow conditions.

5.3 Additional Matters [SPR1]Arising from Site Specific Soil and/or Groundwater Conditions

Assessment of site-specific soil and groundwater conditions has not indicated the likely existence of any major problems or potential hazards although attention should be paid to the following issues and requirements that have been identified.

5.3.1 Dispersive Soils

Dispersive soils are expected to occur on the site and will be encountered during the excavation and construction program. Sedimentation basins in the ESCP are to be designed to account for the presence of dispersive soils and the ability to use of coagulants and/or flocculants.

5.3.2 Saline Soils

Salt accumulation can occur in the low permeability clay subsoil layer as a result of the low permeability of this stratum limiting downward percolation. This can give rise to a highly saline soil horizon. Excavation has the potential to mobilise this salt and allow it to enter the construction stormwater drainage system.

Visual observation should be maintained during excavation of the subsoil profile and soils showing clear evidence of high salinity (visible salt crystals etc.) should be removed and stored in covered stockpiles. Reuse of site as backfill material is considered acceptable although blending with less saline soils is recommended.

5.3.3 Groundwater Seepage into Excavations and Dewatering Requirements

Excavation to a depth of up to 15 metres will be required in the area of the solid fuel bunker with two further areas requiring 10 m+ excavation. Overall, excavation is proposed over approximately one third of the site area to typical depths of 5 to 6 metres.

Groundwater was not encountered during the geotechnical investigation carried out in July 2014 (PSM, 2015) other than a shallow water table recorded in one, low-lying location. It should be noted that no wells/piezometers were installed as part of the investigation; nevertheless the results indicate groundwater occurrence is likely to be limited and/or the strata encountered of low hydraulic conductivity.

Some shallow groundwater is expected in the deeper excavations. Inflow rates are expected to be low and will, in all likelihood, reduce further within a few days of the water-bearing strata being exposed. The volume of water generated by groundwater inflow is expect to be considerably less than that due to rainfall and it is considered unlikely that a formal groundwater dewatering system will be required.

It is expected that seepage water will be suitable for transfer to the construction-phase stormwater management systems. Poor quality groundwater may be encountered in some areas, such as elevated salinity associated with saline soils or highly alkaline water perhaps with elevated ammonia levels associated with the volcanic breccia present beneath the hill in the northern part of the site. On-site treatment, blending with stormwater or transfer off-site to a suitable, licensed disposal site may be necessary as a last resort.

A licence for temporary construction dewatering issued by the NSW Office of Water (NOW) is unlikely to be required as the total groundwater inflow is expected to be less than 3 ML/yr.

5.3.4 Soil Contamination

The investigations undertaken do not indicate the presence of residual shallow contamination sources with the potential to have impacted groundwater beneath the site. The Construction Environmental Management Plan (Brookfield Multiplex Constructions, undated) contains a protocol for dealing with ‘unexpected finds’ during the works.

6. Assessment of Potential Impacts - EfW Facility Operation

6.1 EfW Process Water Systems

The EfW process is described in Sections 4.1 and 4.2. Total average net water demand for the EfW plant (160.8 ML/yr) and staff amenities (1.43 ML/yr) is expected to be 162.23 ML/yr. The quantity of potable-quality water required is 161.8 ML/yr (160.8 plus 1.0 ML/yr) and the quantity of non-potable water is 0.43 ML/yr. Details are provided in Section 4.4.

6.2 Pollution Prevention Design Measures

The entire EfW process will take place within roofed buildings, greatly limiting the potential for of leaching of contaminants from the incoming waste or process residue and the resulting risk of impacts on surface water or groundwater systems. Some potential for the EfW process to result in contamination of the stormwater drainage system does exist if effective separation of stormwater drainage from potentially contaminated areas is not provided. These areas comprise the following:

- Tipping hall ;
- Flue gas treatment and energy recovery system ;
- Residue handling and treatment area ;
- Areas/systems used for handling, treatment and disposal of contaminated process water, including any leachate generated in the tipping hall.

The tipping hall design floor level is slightly higher than the surrounding roadway levels. Pram ramps, grated drains or similar will be provided across the full width of entry and exit ways to ensure that any liquid generated within the tipping hall will be contained. It is noted that the tipping hall hs been designed with a 1:100 fall towards the waste bunkers. Any leachate or waste-contact water that may be produced will be evaporated during the thermal treatment process.

The residue handling/treatment and flue gas treatment/energy recovery areas also have design floor levels slightly higher than surrounding roadways. These areas have little potential for generation of contaminated liquid but an internal drainage system and grated drains or similar across the entry/exit ways will be provided to allow wash-down etc.

Any volumes of leachate and/or contaminated process water generated as part of the EfW process are expected to be small and will be collected and evaporated via the thermal treatment process.

6.3 Stormwater Management Strategy

Details of the proposed stormwater management system and the Erosion and Sediment Control Plan for the development have been provided by AT&L as part of their Civil Infrastructure Report (AT&L, 2015). Blacktown City Council requires that the stormwater management strategy for the site include assessment and reduction of the Stream Erosion Index (SEI). Councils “Developer Handbook for Water Sensitive Urban Design” includes draft guidance on the modelling of stormwater quality and quantity using the Model for Urban Stormwater Improvement Conceptualisation (MUSIC) and a method for estimation of the SEI based on pre- and post-development stream flow regimes. There are four steps to the method as follows:

- Estimate the critical flow for the receiving waterway;

- Develop and run a MUSIC model for pre-development conditions to estimate the mean annual runoff volume above the critical flow;
- Develop and run a MUSIC model for post-development conditions to estimate the mean annual runoff volume above the critical flow;
- Calculate the SEI using the results obtained.

MUSIC modelling contained herein has been conducted by IGGC (2015) and is presented in Appendix D.

6.3.1 Estimation of the Critical Flow

This is defined as the flow threshold below which no erosion is expected to occur for a particular waterway and is estimated as a percentage of the pre-development two year ARI peak flow at the location in question. 25% is used in the Blacktown area based on the presence of dispersive soils. The critical flow for the site has been estimated in accordance with the guidance provided as follows (taken from IGGC, 2015):

1. Time of Concentration calculated from the site area using the probabilistic rational method from AR&R (EA, 2007): $t_c = 0.76 \times A^{0.38} = 0.42$ hours;
2. Rainfall Intensity or I_2 of 49.5 mm/hr selected from the rainfall intensity chart for Blacktown;
3. Two year ARI runoff coefficient (C2) calculated using the following equation from AR&R: $C_2 = C_{10} \times FF_2 = 0.6 \times 0.74 = 0.444$ where C_{10} is the 10 year runoff coefficient and FF2 the 2 year frequency factor (both from AR&R);
4. Two year ARI peak flow calculated using the rational method: $Q_2 = 0.278 \times C_2 \times I_2 \times A = 1.308\ m^3/s$
5. $Q_{critical} = Q_2 \times 25\% = 0.327\ m^3/s$

6.3.2 Estimation of the Pre- and Post-Development Mean Annual Flow

Two MUSIC models were prepared by IGGC (2015) for flow estimation purposes only (i.e. water quality was not simulated). Blacktown City Council's MUSIC-link was used to import the most appropriate climate data and default parameter values.

The pre-development model was assumed to be 100% pervious and was represented by a single Agricultural Source Node with a catchment area of 21.4 ha draining to a Receiving Node via a Generic Treatment Node. The flow transfer function in the generic node was set up to convert all inflows at or below the critical flow to zero outflows, with inflows exceeding the critical flow converted to outflows equal to the inflow minus the critical flow.

The post-development model comprises two source nodes: one for roof areas (2.735 ha, 100% impervious), the other for the remainder of the site (18.665 ha, 80% impervious). These both drain to an OSD Node (surface area 6,193 m^2, extended detention depth 1.5 m, volume 9290 m^3) followed by a Bio-retention Basin Node (surface area 2,400 m^2, extended detention depth 0.3 m, volume 720 m^3) which represent the site bio-retention basin. Drainage to the Receiving Node is via a Generic Treatment Node with a flow transfer function set up as for the pre-development model.

Both models were run and the mean annual load flow output value for the Generic Treatment Nodes recorded. These were 8.08 ML/a for the pre-development model and 1.62 ML/a for the post development model. The input value was substantially higher for the post-development model, demonstrating the effectiveness of the detention basin in attenuating high flows. It should be noted that additional reduction in post-development flow will occur due to re-use of roof water as this process was not included in the simulation.

6.3.3 Calculation of the Stream Erosion Index (SEI)

The SEI is calculated as the ratio of the output mean annual flow from the generic node for the post-development model over that for the pre-development model as follows:

SEI= $\sum$ (Q_post-Q_crit) $\div$ $\sum$(Q_pre- Q_crit)

The SEI calculated by IGGC (2015) is 0.167, well below the upper limit of 3.5 and the stretch target of 1 and potential for stream erosion is expected to be reduced as a result of the proposed development.

6.4 Potential Groundwater Impacts

Redevelopment and land use changes can potentially impact on groundwater quality or on the availability of groundwater resources. The former generally occurs due to intentional or accidental discharge of polluting substances to soils or groundwater, as a result of poorly designed drainage systems, leaking underground storage tanks, discharges from septic tanks, inadequate pollution prevention measures around fuel storage areas etc. Impacts on groundwater resource availability can occur if land use changes result in a substantial reduction in rainfall recharge to productive aquifers.

The site setting is one of low sensitivity with respect to potential groundwater impacts. The underlying Bringelly Shale has a low resource potential, with water bores generally having low yields of high salinity groundwater. Groundwater usage in the area of the site is very low. The low permeability of the shale and the overlying residual clays greatly limits the potential for near-surface pollution to reach groundwater.

The proposed development does not include any activities that pose a particular risk to groundwater quality. The development will be sewered, and stormwater drainage will be directed to the local surface water system. The development therefore does not pose an unacceptable risk to groundwater quality, subject to standard pollution prevention measures for fuel storage etc.

Development will result in a reduction in groundwater recharge. IGGC (2015) estimated the reduction in recharge to the fractured rock aquifer for the development site and the lay-down pan and substation areas to be in the order of 1,570 m^3/year most of which would be contributing to inflow to the former quarry under existing conditions. The reduction in recharge to the shallow groundwater system is estimated by IGGC (2015)to be in the order of 10,000 to 20,000 m^3/year. Under current conditions much of this water is likely to be lost through evapo-transpiration with the remainder emerging at the surface in the areas subject to waterlogging or discharging directly to the creek; and will instead form part of the balanced discharge that will take place from the bio-retention basin. These changes will not affect the resource value of the local groundwater systems, and has potential benefits in terms of salinity as discussed in Section 6.5.

The waste bunker, some 15 m deep, has the potential to intercept and possibly obstruct shallow groundwater flow. As no significant groundwater is expected to be encountered at the proposed excavation depths, the potential impacts are considered to be negligible. As a precaution, it is understood that a groundwater drainage system around the entirety of the waste bunkers will be installed to assist groundwater re-entering the strata. To monitor groundwater surrounding the waste bunkers, the aforementioned groundwater drainage system will also be connected to an inspection manhole which will enable periodic inspection of groundwater levels surrounding the waste bunkers. No disposal of intercepted groundwater is expected to be required under normal operating conditions for the lifetime of the facility.

In the long-term, water levels within the landfill are expected to be maintained at -45 m AHD as required under the site licence. As such, no significant change is expected in the intermediate and deep groundwater levels that would impact on the EfW facility.

6.5 Potential Salinity Impacts

Published guidance on the management of salinity in Western Sydney for redevelopment sites (Nicholson, 2003) provides planning and investigation requirements for large redevelopment/rezoning applications.

Firstly, the salinity potential of the site locality (the site and surrounding area) should be identified. In this case, because an area of high salinity risk is present close by, there is a high salinity potential for the locality. Based on the scale of the proposed development and the salinity potential of the locality, the guidance then requires salinity management responses along the following lines:

- Identify and review existing reports;
- Understand salinity processes on the site and determine requirements for site specific investigation;
- Consider salinity management options and requirements;
- Develop a site-specific Salinity Management Plan;
- Address salinity management requirements in the Development Control Plan for the site.

The first three of these requirements should be addressed at this stage; with the last two addressed during the detailed design process once the DA has been granted. The first two items have been addressed in Section 3.

6.5.1 Existing Salinity Impacts

Review of published information and previous reports together with inspection of the site indicate that existing salinity impacts are limited. There are no visible signs of salt scalds, vegetation dieback or other indicators of serious salinity effects. Existing salinity impacts are limited to the following:

- Waterlogging along minor drainage lines, some probably due to leakage from dams or poor existing drainage;
- Increased salinity close to the tributary of Ropes Creek, probably reflecting discharge of deep groundwater from the Bringelly Shale.

6.5.2 Salinity Implications and Potential Impacts – Proposed Land use

The proposed development involves the construction of large areas of impervious surfaces, and provision of a formal stormwater drainage system for the site.

Potential for the proposed development and land use to cause or exacerbate salinity impacts is therefore very limited. Moderately to highly saline soils may be present on the site, particularly close to drainage lines, and excavation of these could release additional salt into the environment. Construction in areas of high water tables and elevated salinity (i.e. close to drainage lines) could result in salinity damage to roads or buildings, although the potential for such impacts is limited.

6.5.3 Salinity Implications of Deep Groundwater Level Changes

Re-pressurisation of the deep shale aquifer will not occur in the timeframes relevant to the EfW plan operation due to a requirement to maintain water levels within the former quarry at -45 M AHD under the site licence. This issue therefore does not warrant further consideration at this time.

6.6 Potential Constraints on Development and Mitigation Requirements

The site is in a low risk area with respect to potential groundwater impacts, and there are no constraints on development or mitigation requirements other than standard pollution prevention measures.

The risk associated with salinity is also low, and the development is expected to reduce existing salinity impacts as a result of reduced recharge and improved drainage.

There is some risk of salinity damage to buildings, roads or infrastructure associated with development. Results from previous investigation (PSM, 2005) show sulphate and chloride levels in all soil samples below those considered potentially aggressive to foundations, indicating that standard construction materials should be suitable in most parts of the site. Occurrence of shallow groundwater appears to be limited; however, there is some risk that excavation and construction close to drainage lines or in low-lying areas may encounter saline groundwater at shallow depth. The presence of building foundations or roadways in contact with or in the capillary zone of a saline water table can result in salinity damage to susceptible materials.

Inflow rates to excavations are expected to be negligible to low, and are not likely to cause problems during excavation and construction.

In general, development should be planned in accordance with salinity guidance (Nicholson, 2003). The main aspects relevant to the site are as follows:

- Avoid/minimise exposure of saline subsoils, minimise cut and fill;
- Avoid disturbance in riparian zones and poorly drained areas;
- Establish vegetation is areas subject to erosion and disturbance;
- Consider salt-resistant construction materials in areas of shallow saline water tables;
- Monitor perched water tables.

Landscaped areas should be planned with salt-tolerant vegetation, and any irrigation should be minimal and based on requirements of vegetation.

Detailed mitigation and monitoring requirements should be covered in a Salinity Management Plan for the site, to be submitted to Council for approval.

6.7 Requirements for Further Investigation

Further investigation of salinity conditions in soils and any shallow groundwater present may be advisable during the detailed design process and/or the initial stages of construction to ensure suitability of materials used for construction of hardstand, buildings, roadways and the drainage system. Particular attention should be paid to areas close to existing drainage lines where there is a greater likelihood of salinity occurrence and measurements of soil salinity and shallow groundwater levels in these areas should be considered.

The Precinct Plan for the development area requires submission of a Salinity Management Plan (SMP) with any development application: however it is proposed that the SMP be prepared as part of the detailed design process once the DA has been granted, and submitted for Council approval. The requirement for an SMP can be conditioned in the DA. Existing information is sufficient to demonstrate that salinity risks do not pose an obstacle to the proposed development, and the proposed approach allows the SMP to be developed based on the detailed design of the site drainage system and other features.

A monitoring program should be implemented prior to development, continuing until a reasonable period after development. This should include water level and salinity monitoring of shallow groundwater, and requirements should be detailed in the Salinity Management Plan for the site.

6.8 Additional Approval and Policy Requirements

6.8.1 Water Sharing Plans

Surface Water

The proposed development is within the area covered by the Water Sharing Plan (WSP) for the Greater Metropolitan Region Unregulated River Water Sources (commenced on 1 July 2011) Use of stormwater run-off from the site for water supply for the EfW process is not proposed nor is it currently under consideration. Should this situation change, such use of stormwater run-off is considered to be consistent with the provisions of the WSP subject to the following:

- A Water Access Licence and suitable allocation being obtained through NOW and/or the water dealings process provided under the Water Management Act 2000;
- Approval from NOW of the water supply works (OSD/bio-retention basin and associated pumping system) and of the water use.

Groundwater: Licensing Requirements for Potential Water Supply from Deep Aquifers

The proposed development is within the area of the Water Sharing Plan (WSP) for the Greater Metropolitan Region Groundwater Sources – Sydney Basin Central Groundwater Source which commenced on 1 July 2011. There is potential for groundwater supply from the fractured rock aquifers (Hawkesbury Sandstone) present at depth beneath the site (c.200 m depth or greater). This groundwater source is currently poorly understood in terms of potential bore yields and groundwater quality due to its depth and a consequent lack of exploration. Investigation may be considered and if a suitable supply can be obtained unassigned water is expected to be available for commercial use under the WSP. Test bore licences would be required for investigation.

6.8.2 Aquifer Interference Policy and Approval Requirements for Dewatering

The NSW Aquifer Interference Policy was released in September 2012 and applies across the State. It explains the water licensing and impact assessment processes for aquifer interference activities under the Water Management Act 2000 and other relevant legislation.

The Water Management Act 2000 defines an aquifer interference activity as that which involves any of the following:

- The penetration of an aquifer;
- The interference with water in an aquifer;
- The obstruction of the flow of water in an aquifer;
- The taking of water from an aquifer in the course of carrying out mining or any other activity prescribed by the regulations; and,
- The disposal of water taken from an aquifer in the course of carrying out mining or any other activity prescribed by the regulations.

The legislation and associated regulation regarding Aquifer Interference Approvals are in place but have yet to be "proclaimed" and have therefore not been implemented. No timeframe is available for implementation at the time of writing. Activities such as construction dewatering currently continue to be regulated by NSW Office of Water (NOW) through issuing of temporary licences under the Water Act 1912, where required.

~~NSW Office of Water (~~NOW~~)~~ generally applies an informal exemption to dewatering from a water table aquifer where the pump rate is less than 10 L/s and the total quantity of groundwater pumped is less than 25,000 kilolitres. Construction dewatering requirements for the proposed development are expected to meet these criteria and a licence is not expected to be required.

The permanent bypass drainage system around the waste bunker is not expected to result in any net removal of groundwater and a water access licence is not expected to be required. The system will ensure that the development will meet the “minimal impact considerations” define in the Aquifer Interference Policy and an Aquifer Interference Approval is not expected to be required after full implementation of the policy.

7. Conclusions

The findings of this report are provided below with reference to the DG requirements and scope of works.

7.1 Site Characterisation

The site is characterised as follows:

- Legal description is Lots 1, 2 and 3 in DP 1145808 in the Blacktown LGA;
- Soils are classified as moderately reactive, dispersive and of high erodibility;
- Acid Sulfate Soils (ASS) are not expected to occur on the site;
- The site is underlain by rocks belonging to the Wianamatta Group, specifically the Bringelly Shale which consists of claystone and siltstone with minor sandstone horizons. The quarry void to the northeast of the site was developed to exploit the volcanic breccia and is currently being rehabilitated by means of engineered landfill;
- Regional groundwater in the Wianamatta Group is of poor quality, high salinity and low yield, with limited potential as a resource. Due to long-term dewatering of the former quarry void, has depressurised the local groundwater system. The depressed groundwater levels and inward-flowing hydraulic gradients form an hydraulic trap which is expected to be maintained for the foreseeable future. The maintenance of depressed water levels within the landfill is mandated under the operational licence;
- The site is assessed as having moderately saline soils although no evidence of 'serious' salinity has been reported in past investigations;
- No Groundwater Dependent Ecosystems (GDEs) are considered to be present on the site;
- Soil contamination has been assessed in a number of past reports. The most recent report (ADE, 2014), incorporating the results of preceding investigations concluded that "no contamination of the site from potential contamination practices undertaken both on and off site" has occurred;
- The site drains into a tributary of Ropes Creek. The Creek in the vicinity of the site has been assessed by Blacktown Council as being in generally degraded condition. Importantly, the development does not include any work within the riparian zone;
- The limited water-quality data available indicates that the Creek water is fresh to slightly brackish with a pH of 9.85.

7.2 Water Balance

The entire EfW process will take place within roofed buildings, greatly limiting the potential for of leaching of contaminants from the incoming waste or process residue and the resulting risk of impacts on surface water or groundwater systems.

The EfW facility has been designed as a closed loop. The total water supply requirements are as follows:

- Potable-quality water: 161.8 ML/yr (160.8 ML/yr for plant and 1.00 ML/yr for staff amenities);
- Non-potable water: 0.43 ML/yr;
- Total water use: 162.23 ML/yr.

Rain water will be collected from the roof of the EfW plant for reuse in the plant. Predicted average rainwater reuse is summarised below:

- 9.15 ML/yr or 5.63% of water demand in the driest year (1980);
- 10.26 ML/yr or 6.20% of water demand in the 1 in 10 dry year (2006);
- 15.54 ML/yr or 9.285% of water demand in the median year (2014);
- 18.57 ML/y or 10.72% of water demand in the 1 in 5 wet year (1998);
- 25.37 ML/yr or 12.81% of water demand in the wettest year (1988).

Further to the above, the writer is advised that rain water holding tanks will be installed adjacent to the turbine halls and that water will be used on site as required.

The remaining water required for the project will be obtained form Sydney Water main supply.

It is noted that the plant designer, HZI, has advised that stormwater from hardstand areas will not be suitable for use in the EfW plant.

7.3 Soil and Water Management and Impacts

A detailed Erosion and Sediment Control Plan (ESCP) is to be developed for the construction phase of the project. The plan is to be developed with reference to Landcom (2004) guidelines and must account for the dispersive and erodible nature of the site soils.

Stormwater management for the completed facility has been addressed in detailed by AT&L.

The development is not expected to intersect groundwater levels, with the possible exception of the waste bunker excavation. To mitigate possible groundwater issues, it is understood that a drainage and pump out system will be incorporated into the construction of the waste bunker. In the unlikely event that shallow seepage accumulates in the excavation, it is expected that the water will be suitable for transfer to the construction-phase or post-construction phase stormwater management systems.

As there will be extensive structures and pavements built on the site, the area available for groundwater recharge will be substantially reduced. IGGC (2015) estimate a reduction in recharge to the shallow groundwater system of 10,000 to 20,000 m^3/yr. However, under current conditions much of this water would be lost through evapotranspiration, with the remainder emerging at the surface in waterlogged areas or discharging to the creek. As a result, little or no impact is expected on the resource value of the local groundwater system.

Modelling of pre- (8.08 ML/yr) and post-development (1.62 ML/yr) mean annual flows shows an overall reduction in flow volumes following completion of the EfW facility construction, demonstrating the effectiveness of the detention basin in attenuation flows. The Stream Erosion Index (SEI) following completion of the facility is calculated to be 0.16, which is below the upper limit of 3.5 and stretch target of 1.

In relation to salinity, the placement of impervious surfaces over the site is expected to reduce the potential salinity impacts.

7.4 Overall Assessment

In broad terms it is considered that potential soil and water impacts can be adequately managed during the construction and operational phase. It is critical that soil and water management infrastructure be carefully designed and operated.

The EfW plant will be almost exclusively operated using potable quality water due to the stringent water-quality standards required for successful and safe operation of the facility.

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Figures

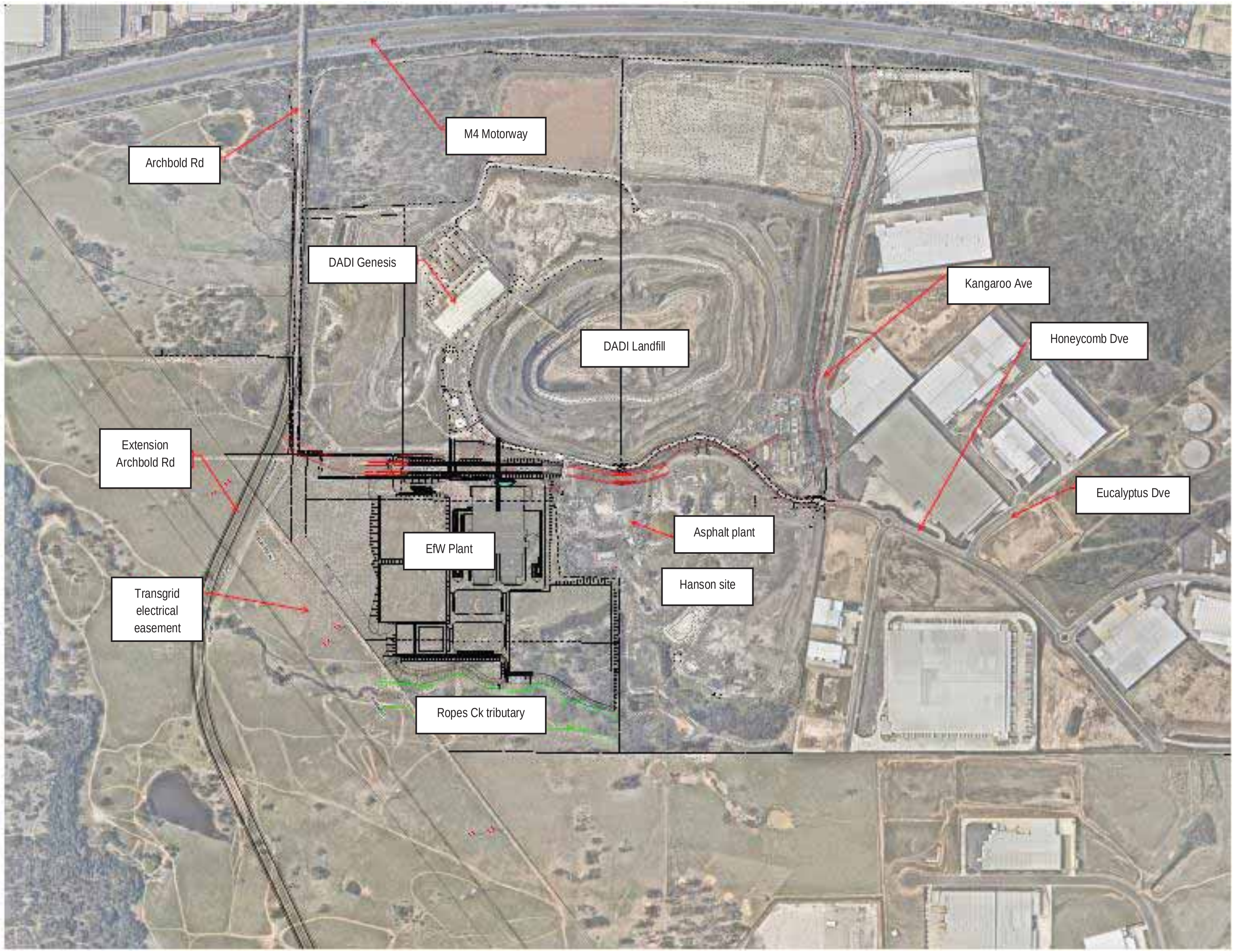


Figure 3.1:

Site setting and features

NOT TO SCALE

Image source: google earth

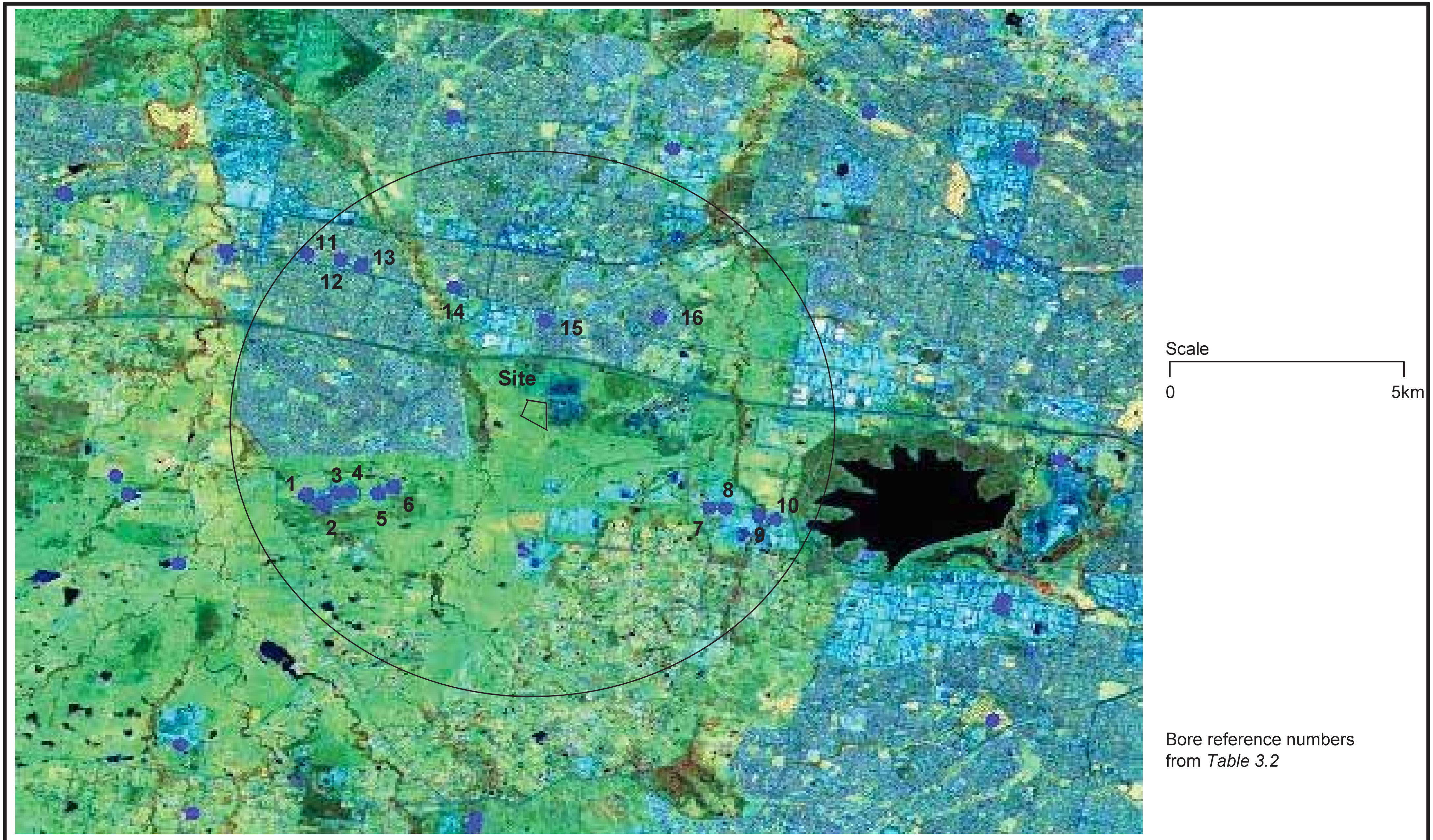


Figure 3.2

Location of Registered Bores

Project: Environmental Impact Assessment, Proposed Energy from Waste Facility, Soil and Water
Location: Eastern Creek
Client: TNG (NSW) Pty Ltd
Project No: BJ07

Figure 3.6

Approximate Stage 2 ESA Sample Locations (ADI, 1995)

Project: Environmental Impact Assessment, Proposed Energy from Waste Facility, Soil and Water
Location: Eastern Creek
Client: TNG (NSW) Pty Ltd
Project No: BJ07

IGGC

Figure 3.3: Conceptual groundwater regime (Simplified, Not to Scale). Source (IGGC (2005)

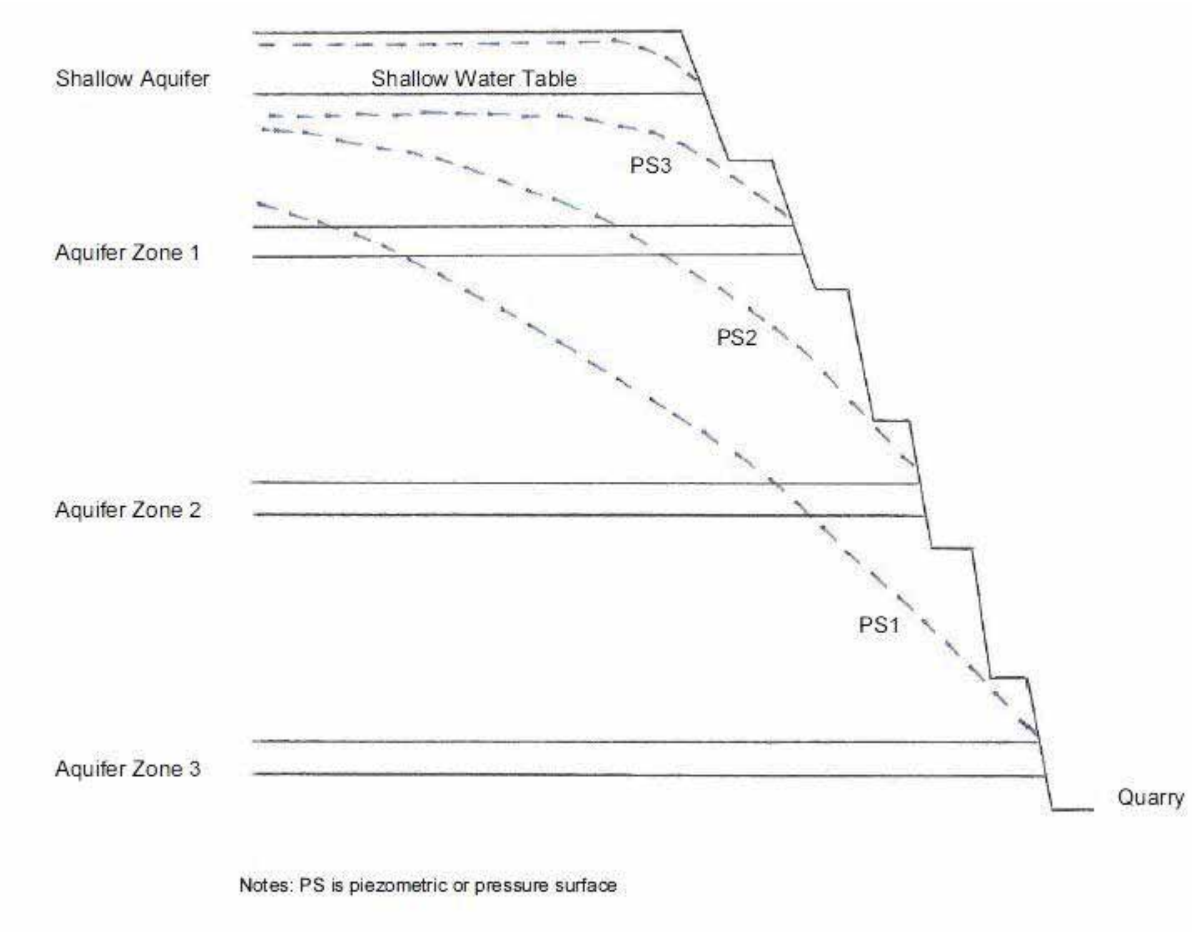


Figure 3.4: Salinity associated with shale soil landscape (Mitchell, 2000)

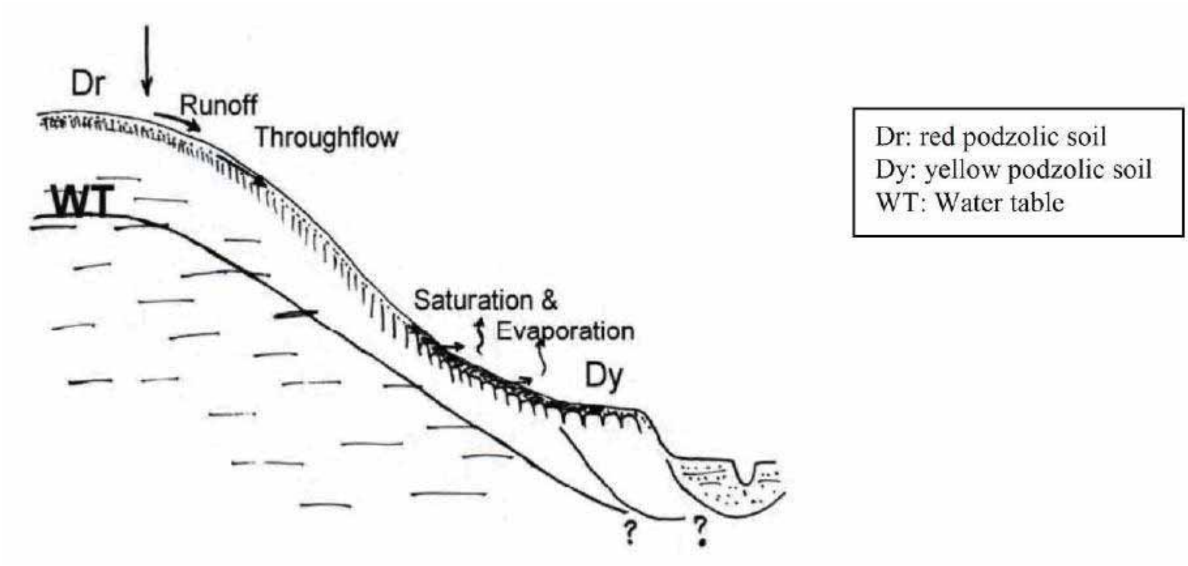


Figure 3.5: Salinity associated with deep groundwater discharge (Mitchell, 2000)

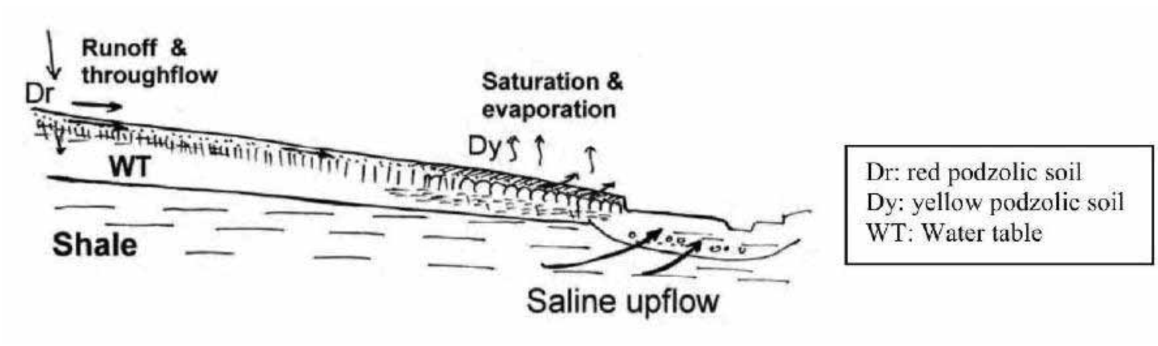


Figure 4.2: Roof water tank size vs re-use rate. (IGGC, 2015)

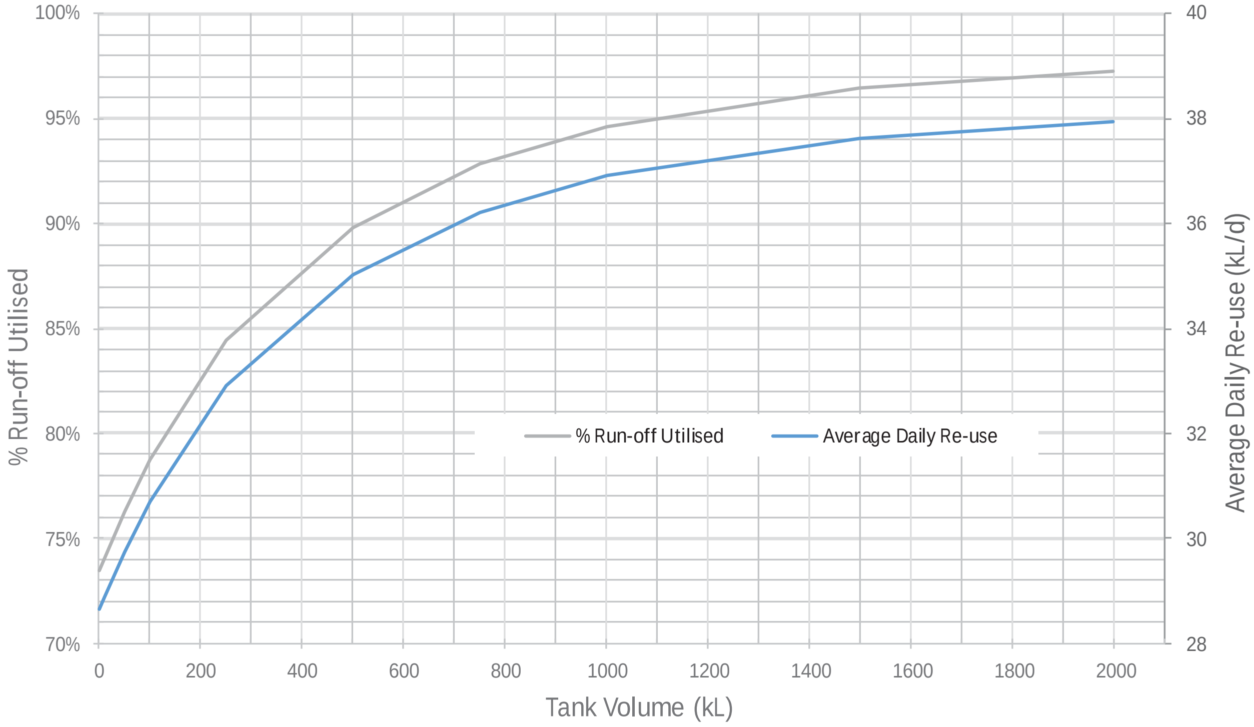
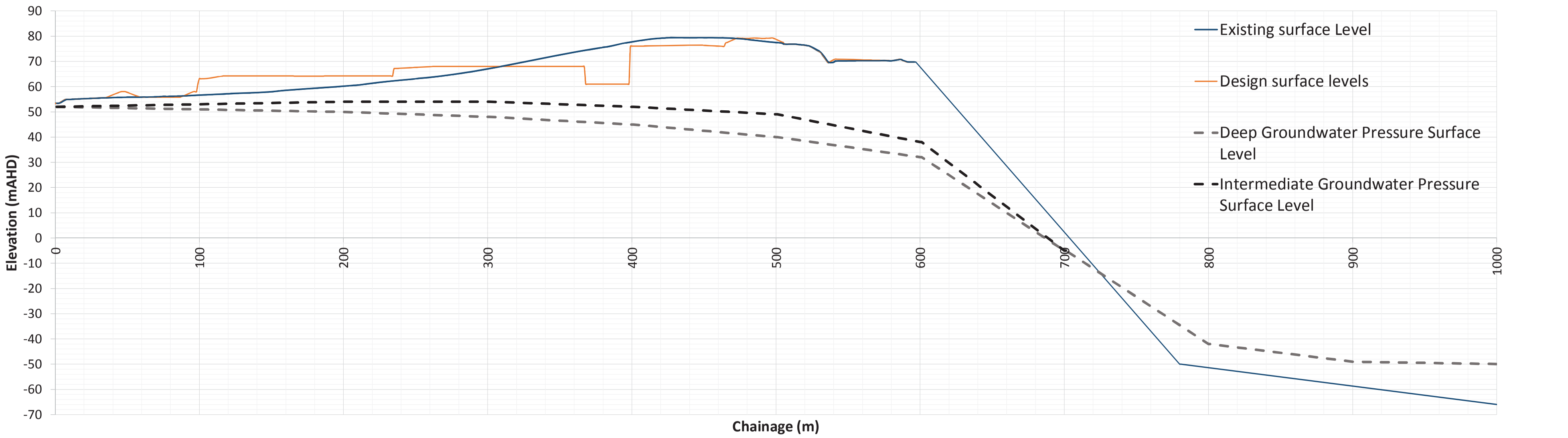


Figure 4.1: Schematic Cross Section with Existing and Predicted Groundwater Pressure Surfaces



Tables

Table 3.1: Summary of Monthly Rainfall and Evaporation (millimetres)

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Mean Rainfall (mm)	94.6	96.5	96.6	74.4	70.9	75.5	56.3	50.3	46.6	58.9	73.3	75.9	870.1
Decile 1 Rainfall (mm)	22.2	12.4	20.6	15.6	10.4	8.7	6.5	5.8	7.8	12.6	15.3	19.5	570
Median rainfall (mm)	73.2	73.1	78.3	56.2	39.2	49.7	32.7	30.2	40.4	43.3	60.1	57.5	857.7
Decile 9 (mm)	192.4	198.1	199.5	161.7	171.1	177.8	128.6	130.7	100.9	130.8	142.3	160.1	1178.2
Mean Rain Days[1]	10.7	10.7	11.0	9.4	8.9	9.5	7.8	7.9	8.4	9.3	9.6	9.9	113.1
Mean Evaporation (mm)	171	133	121	87	62	48	53	78	108	136	147	177	1315

Notes.

1. Mean no. days with rainfall >1mm.
2. Data source www.bom.gov.au climatic averages for Prospect Reservoir meteorological station #067019
Latitude: 33.82 °S, Longitude: 150.91 °E, Elevation: 61 m, Commenced: 1887, Status: Open, Latest available data: 01 Apr 2015
3. Mean evaporation calculated by multiplying mean daily evaporation by number of days in respective month (28.25 days for February).

Table 3.2 Summary Details of Registered Bores

Ref	Bore No	Easting (mMGA)	Northing (mMGA)	Depth (m)	Purpose	Standing Water Level (m)	Salinity (mg/L TDS)	Date Drilled	Screen (m)	Geology
1	GW101087	294624	6255732	90.3	Monitoring			1996	70.5 to 88.3	
2	GW101083	294912	6255522	78	Monitoring			1996	58.2 to76	
3	GW102673	295163	6255774	78	Monitoring	9.68	4750	1993	Multiple	Siltstone/sandstone/shale
4	GW102674	295369	6255779	71.9	Monitoring		4400	1993	Multiple	Shale/siltstone/sandstone
5	GW101085	295857	6255789	99.3	Monitoring/test			1996	79.5 to 97.3	
6	GW101082	296112	6255918	40.3	Monitoring/test	12.43		1996	30.4 to 39.3	
7	GW104060	301538	6255572	24.6	Monitoring			2001	8.6 to 23.6	5m clay over shale
8	GW104061	301820	6255566	24.5	Monitoring			2001	8.5 to 23.5	siltstone/shale
9	GW104062	302387	6255420	24.4	Monitoring	17	2800	2001	5.4 to 23.4	4m clay over shale
10	GW104063	302689	6255343	27.4	Monitoring			2001	8.4 to 26.4	5m clay over shale
11	GW075076	294522	6261087	13.5	Monitoring (DWR)	7		1999	10.5 to 13.5	clay
12	GW075077	295109	6260936	12.5	Monitoring (DWR)	12.5		1999	9.5 to 12.5	12.5m clay over shale
13	GW075078	295501	6260807	8	Monitoring (DWR)			1999	1 to 8	7.8m clay over shale
14	GW028415	297090	6260390	7.6	Irrigation			1966		3m clay, 1.8m gravel over shale
15	GW028414	298655	6259660	6.1	Irrigation	3.9		1966		clay over shale
16	GW018361	300615	6259765	217.9	Aquaculture Waste Disposal			1961	OH from 12.1	14m clay over basalt/shale/sandstone

Notes:

1. MGA is Map Grid of Australia;
2. mg/L is milligrams per litre;
3. TDS is total dissolved solids;
4. OH is open hole.

Table 3.3 Summary of Shallow Piezometers and Groundwater Levels

Bore	Elevation mAHD	Bore Depth M	GW Depth 14/5/14 m	GWL 14/2/95 mAHD	GWL 1/12/05 mAHD	GWL 14/5/14 mAHD	EC 1/12/05 µS/cm	pH 1/12/05
BH4	54	5	nm	na	51.75	Nm	30,410	6.73
BH8	c.58	4.3	4.64	dry (<52.8)	dry	53.36	na	na
MW2	55.69	8	2.57	51.6	51.37	53.12	18,830	6.76
MW3	66.99	8	1.7	64.27	63.18	65.29	1,400	7.14
MW4	71.62	8	broken	68.03	68.85	Nm	937	7.1
MW5	72.31	8	5.25	66.26	66.95	67.06	1,384	6.92
Creek							1,241	9.85

Notes.

1. GW is groundwater.
2. GWL is groundwater level.
3. mAHD is metres Australian Height Datum.
4. EC is electrical conductivity measured in microSeimens per centimetre.
5. Nm is not measured;
6. NA is not applicable.

Table 3.4 Summary WQOs: Nutrients, Urban Areas, Tributary Stream

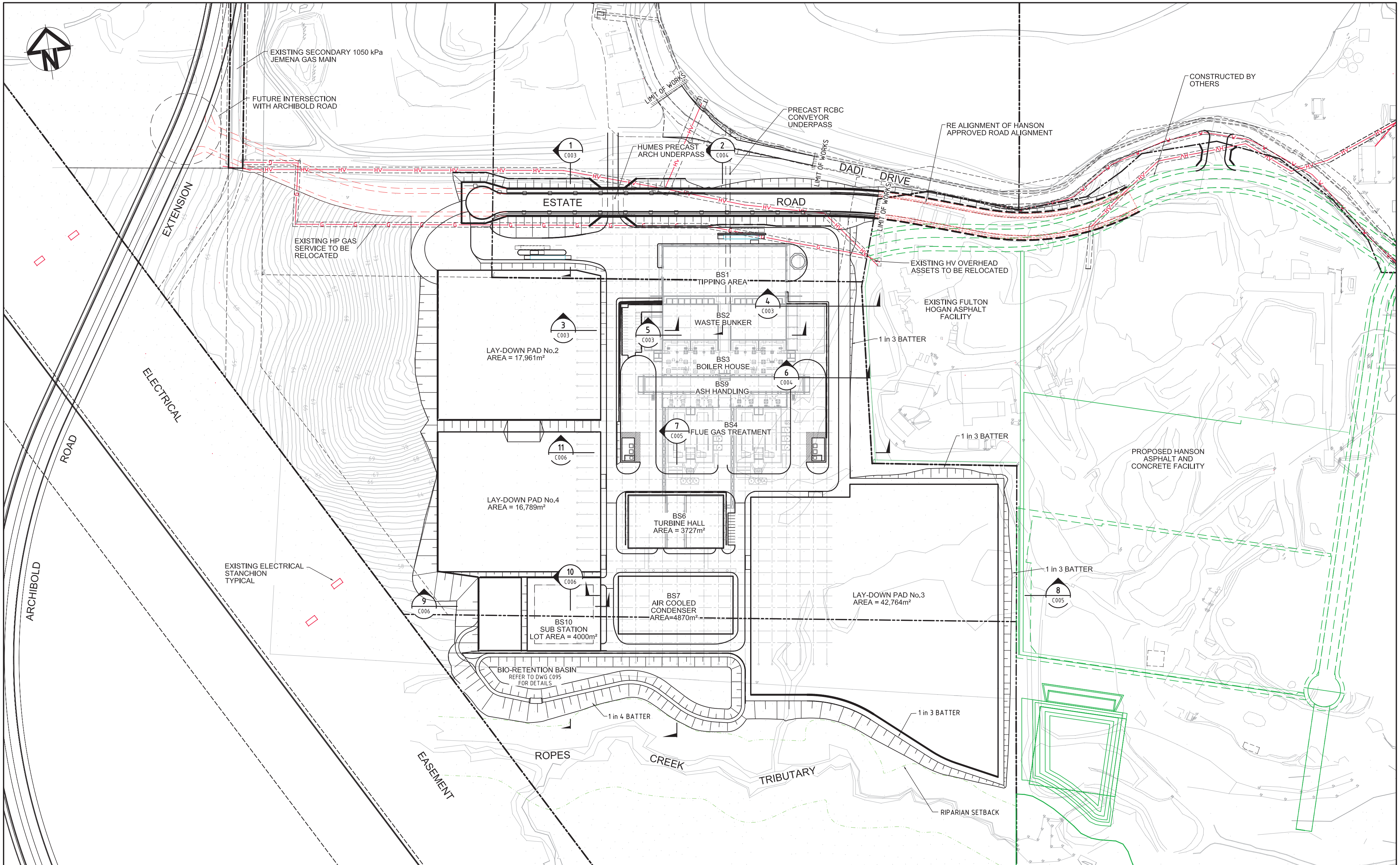
WQOs and Indicators	WQO	
	HRC	ANZECC/BCC
Healthy Aquatic Ecosystems		
Total Phosphorus (µg/L)	~50	25
Total Nitrogen (µg/L)	~1,000	350
Chlorophyll-a (µg/L)		5
Turbidity (NTU)		6 to 50
Dissolved Oxygen		85% to 110%
pH		6.5 to 8
Salinity (EC as µS/cm)		125 to 2,200
Biological Assessment		AusRivAS and SIGNAL
Visual Amenity		
Visual Clarity & Colour		<20% reduction in clarity from natural <10 point Munsell Scale change in natural hue <50% change in natural reflectance
Surface Films and Debris		No visible oil; free from floating debris & litter
Nuisance Organisms		None present in unsightly amounts

Notes. µg/L is micrograms per litre. EC as µS/cm is electrical conductivity as microSeimens per centimetre. NTU is Nephelometric Turbidity Units.

Table 5.1: Outline Surface Water Quality Monitoring Plan

Type of Monitoring	Monitoring Frequency	Sampling Locations	Analytical Suite
Pre-Development Characterisation			
Routine	Quarterly	1, 3,4	A
Wet Weather	Target 4 time per year	1, 3, 4	B
Construction Period			
Sediment Basin Discharge	Daily field readings & observations	5, 6	C
	Weekly (monthly after 3 months)	2, 3, 5, 6	B
No Discharge	Monthly	1 to 5	A
Construction Dewatering			
No Discharge	Characterisation prior to discharge as required	7	A
During Discharge	First day of discharge then weekly	2, 3, 5/7	A then B
Post-Construction			
Bio-Retention Basin Discharge	Target of 4 per year for first two years then twice yearly	2, 3, 6	B
Routine	Quarterly for the first two years then six-monthly	1 to 5	A

Appendix A



Issue	Description	Date
E	RE-ISSUED FOR SSDA	20-02-15
D	ISSUED FOR SSDA	18-06-14
C	ISSUED FOR INFORMATION	16-06-14
B	ISSUED FOR CLIENT REVIEW	14-05-14
A	ISSUED FOR COORDINATION	06-05-14

Bar Scales

0 30 60 90 120 150m

1 : 1500 @ A1 1 : 3000 @ A3

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Client: THE NEXT GENERATION

Scales	1 : 1500 @ A1	Drawn	TS
		Designed	TS
Grid	MGA	Checked	MM
Height Datum	AHD	Approved	

Project: ENERGY FROM WASTE ELECTRICITY GENERATION PLANT, EASTERN CREEK

Title: GENERAL ARRANGEMENT PLAN

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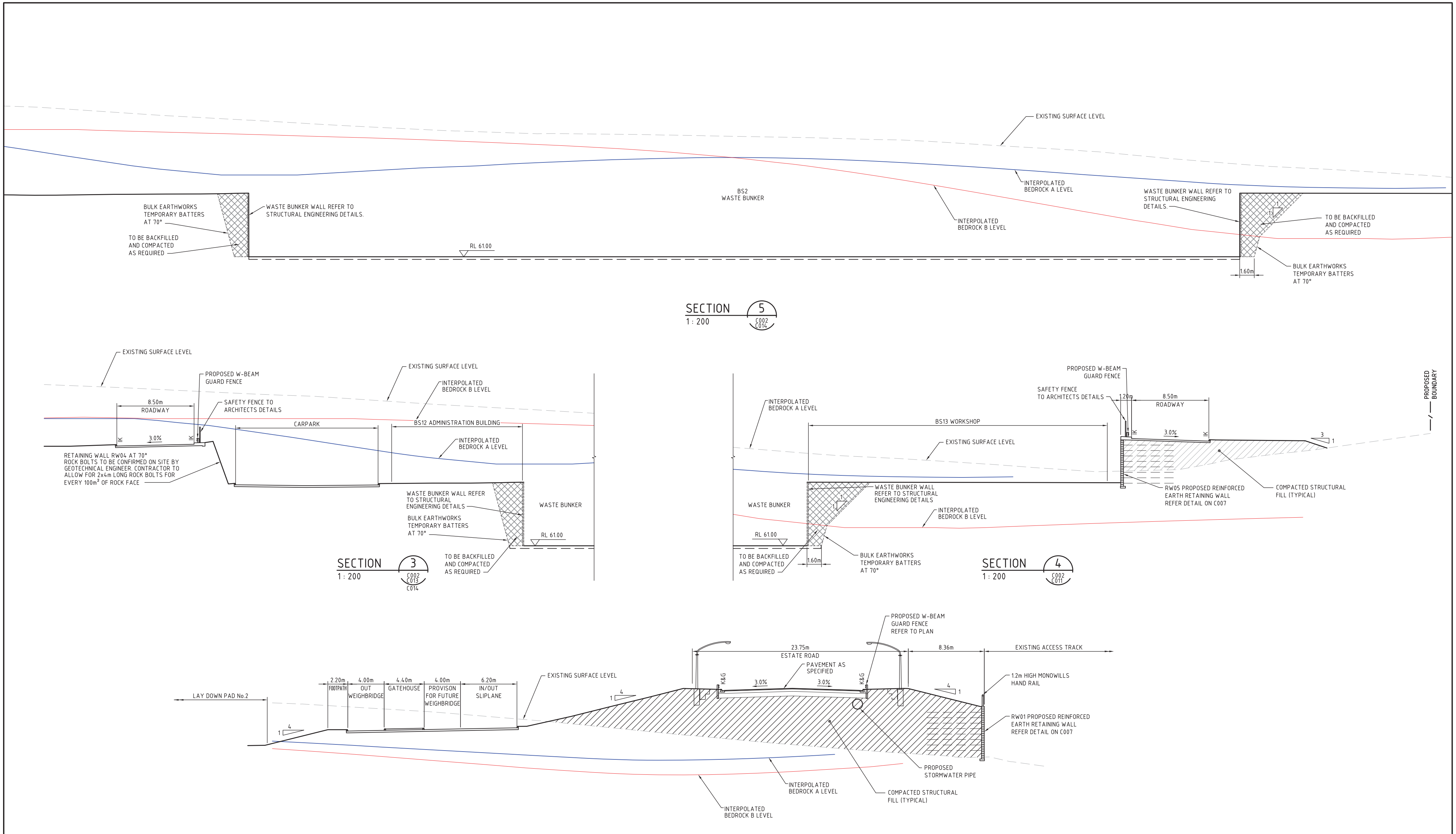
A1

Drawing No.	Project No.	Issue
C002	14-187	E

100mm on Original

Date Plotted: 20 Feb 2015 – 05:09PM File Name: F:\14-187 TNG\Drgs\Civil\DA-Drawings\C002.dwg



NOTE: RETAINING WALL TYPE SUBJECT TO DETAILED DESIGN.

Issue	Description	Date
C	RE-ISSUED FOR SSDA	20-02-15
B	ISSUED FOR SSDA	18-06-14
A	ISSUED FOR CLIENT REVIEW	14-05-14

Bar Scales

0 5 10 15 20m

1 : 200 @ A1 1 : 400 @ A3

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Client

THE NEXT GENERATION

Scales: 1 : 200 @ A1

Grid

Height Datum: AHD

Drawn	TS
Designed	TS
Checked	MM
Approved	

Project

ENERGY FROM WASTE ELECTRICITY GENERATION PLANT, EASTERN CREEK

Title

TYPICAL SECTIONS SHEET 1

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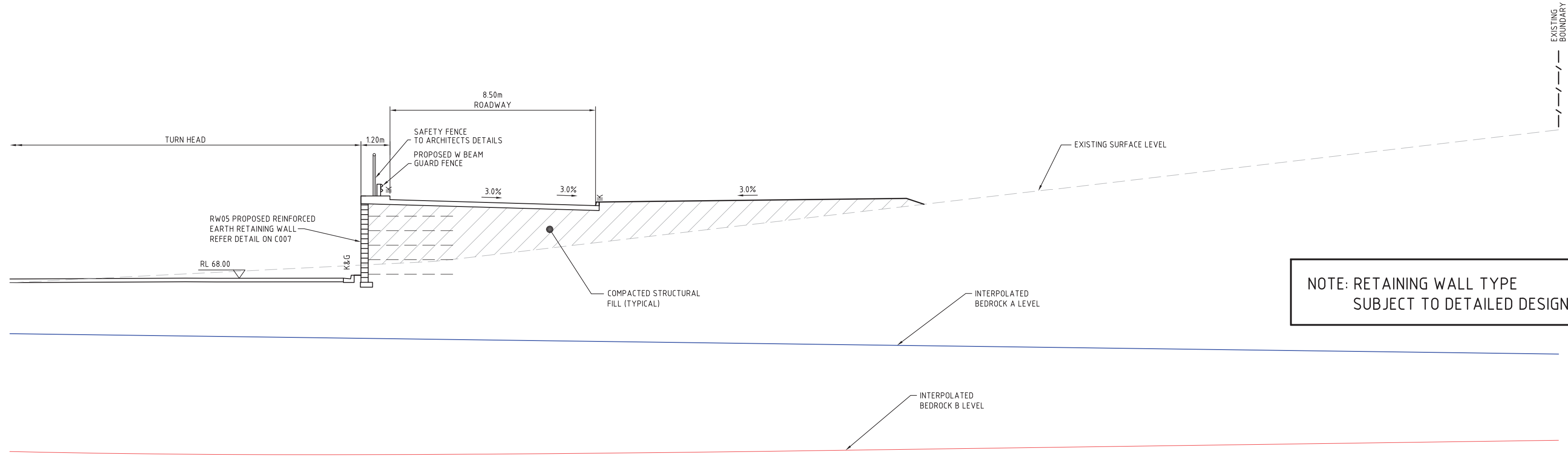
A1

Drawing No.	Project No.	Issue
C003	14-187	C

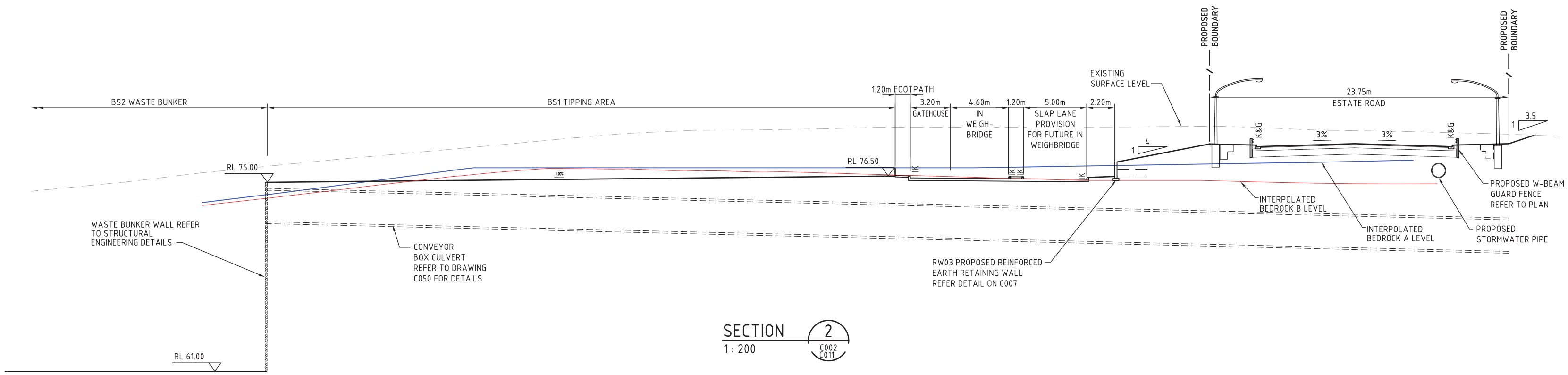
100mm on Original

Date Plotted: 20 Feb 2015 - 05:09PM File Name: F:\14-187 TNG\Drgs\Civil\DA-Drawings\C003.dwg



NOTE: RETAINING WALL TYPE SUBJECT TO DETAILED DESIGN.

SECTION 6
1 : 100
C002 C014



SECTION 2
1 : 200
C002 C011

NOTE: RETAINING WALL TYPE SUBJECT TO DETAILED DESIGN.

Issue	Description	Date
C	RE-ISSUED FOR SSDA	20-02-15
B	ISSUED FOR SSDA	18-06-14
A	ISSUED FOR CLIENT REVIEW	14-05-14

Bar Scales

0 2 4 6 8 10m
1 : 100 @ A1 1 : 200 @ A3

0 5 10 15 20m
1 : 200 @ A1 1 : 400 @ A3

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Client

THE NEXT GENERATION
Energise Your Future

Scales	AS SHOWN	Drawn	TS
		Designed	TS
Grid		Checked	MM
Height Datum	AHD	Approved	

Project
ENERGY FROM WASTE ELECTRICITY GENERATION PLANT, EASTERN CREEK

Title
TYPICAL SECTIONS SHEET 2

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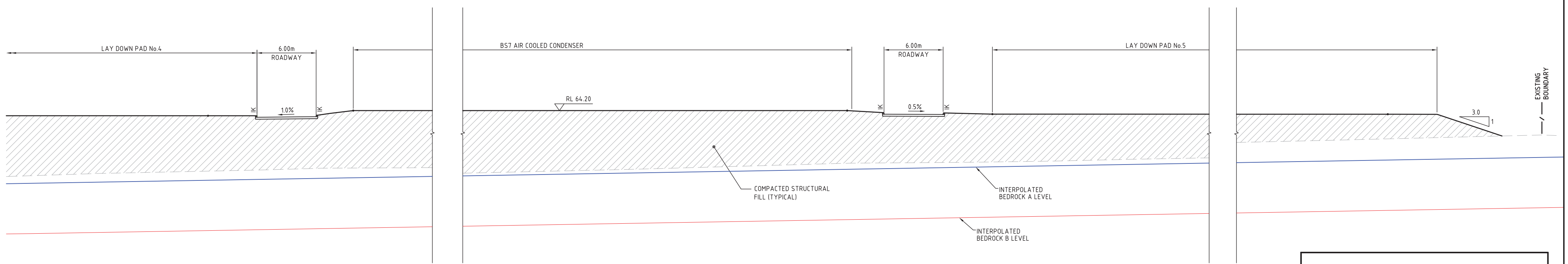
A1

Drawing No.	Project No.	Issue
C004	14-187	C

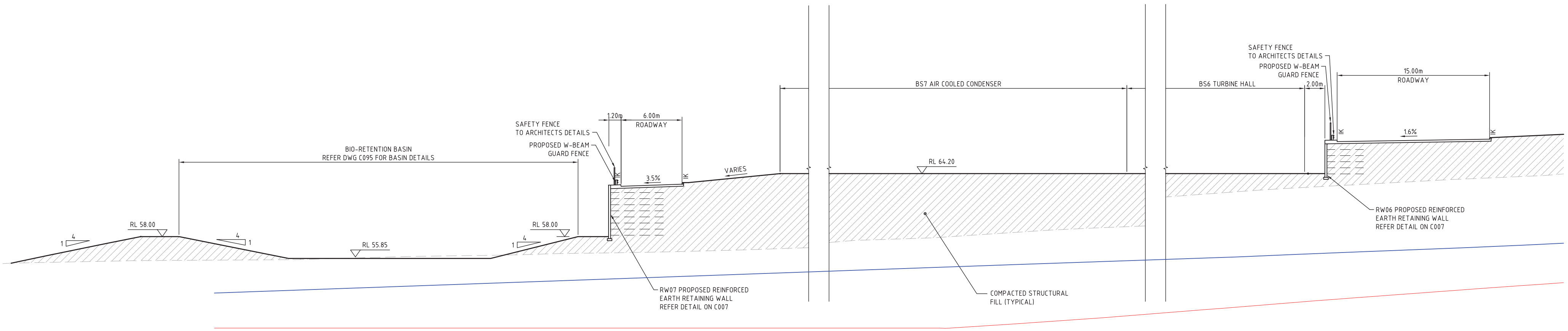
100mm on Original

Date Plotted: 20 Feb 2015 - 05:09PM File Name: F:\14-187 TNG\Drgs\Civil\DA-Drawings\C004.dwg



SECTION 8
1 : 200
C002 C014

NOTE: RETAINING WALL TYPE SUBJECT TO DETAILED DESIGN.



SECTION 7
1 : 200
C002 C014 C016

Issue	Description	Date
C	RE-ISSUED FOR SSDA	20-02-15
B	ISSUED FOR SSDA	18-06-14
A	ISSUED FOR CLIENT REVIEW	14-05-14

Bar Scales
0 5 10 15 20m
1 : 200 @ A1 1 : 400 @ A3

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Client: THE NEXT GENERATION — Energise Your Future

Scales	1 : 200 @ A1	Drawn	TS
		Designed	TS
Grid		Checked	MM
Height Datum	AHD	Approved	

Project: ENERGY FROM WASTE ELECTRICITY GENERATION PLANT, EASTERN CREEK

Title: TYPICAL SECTIONS SHEET 3

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Status: FOR APPROVAL
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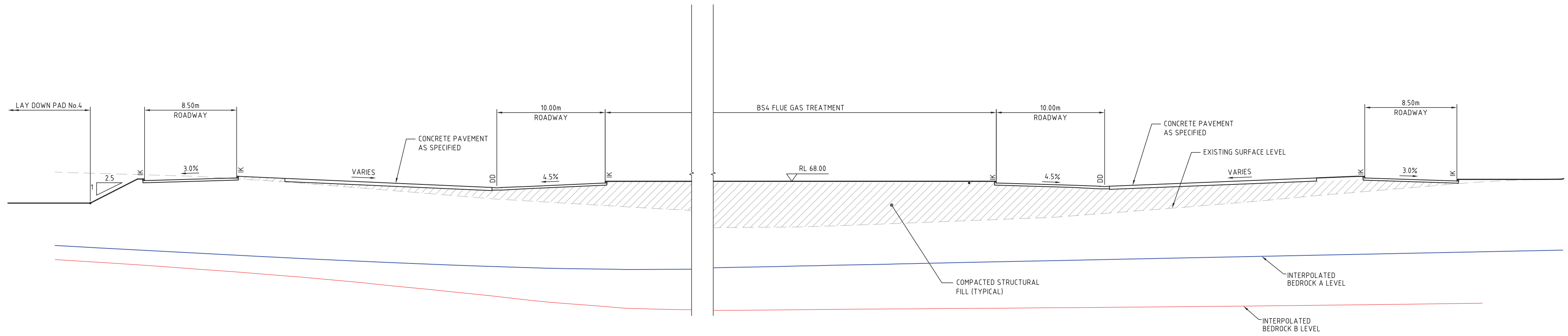
A1

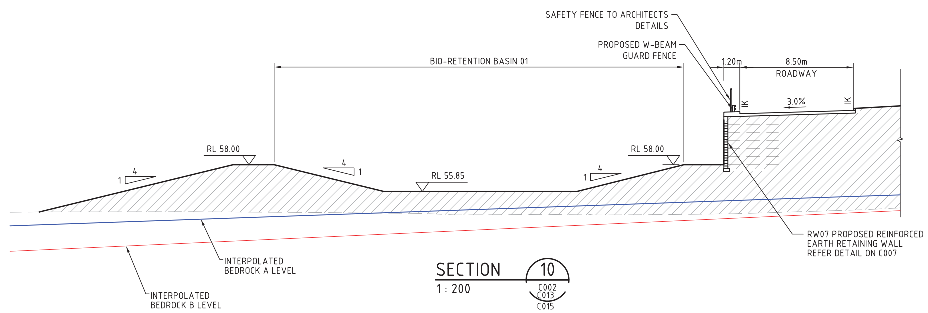
Drawing No.	Project No.	Issue
C005	14-187	C

100mm on Original

Date Plotted: 20 Feb 2015 - 05:09PM File Name: F:\14-187 TNG\Drgs\Civil\DA-Drawings\C005.dwg



SECTION 11
1 : 200
C002
C013



SECTION 10
1 : 200
C002
C013
C015

SECTION 9
1 : 200
C002
C015

Issue	Description	Date
C	RE-ISSUED FOR SSDA	20-02-15
B	ISSUED FOR SSDA	18-06-14
A	ISSUED FOR CLIENT REVIEW	14-05-14

Bar Scales

0 5 10 15 20m

1 : 200 @ A1 1 : 400 @ A3

Client

THE NEXT GENERATION

Energise Your Future

Scales	1 : 200 @ A1	Drawn	TS
		Designed	TS
Grid		Checked	MM
Height Datum	AHD	Approved	

Project

ENERGY FROM WASTE ELECTRICITY GENERATION PLANT, EASTERN CREEK

Title

TYPICAL SECTIONS SHEET 4

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FOR APPROVAL

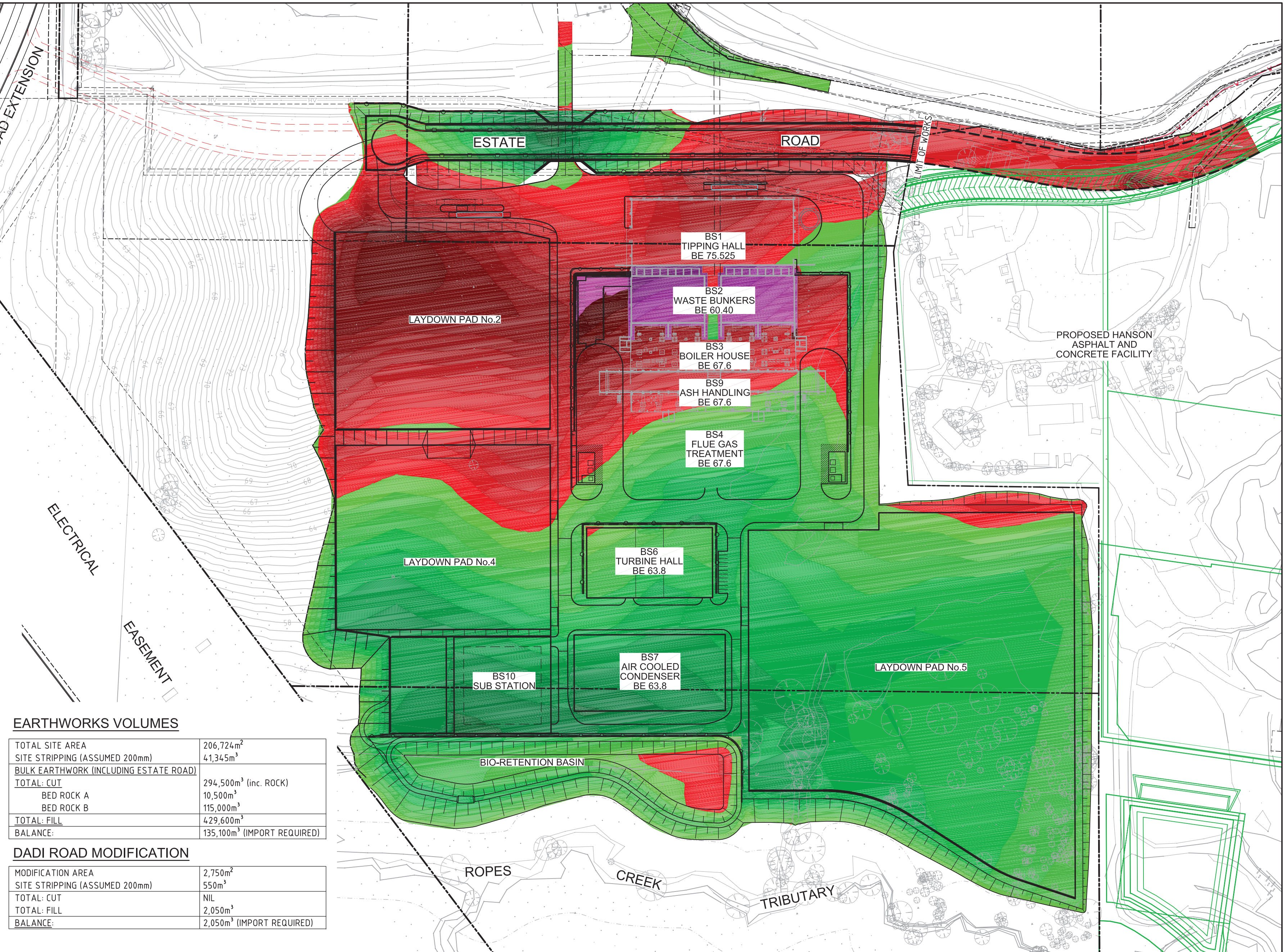
NOT TO BE USED FOR CONSTRUCTION

A1

Drawing No.	Project No.	Issue
C006	14-187	C

100mm on Original

Date Plotted: 20 Feb 2015 - 05:09PM File Name: F:\14-187 TNG\Drgs\Civil\DA-Drawings\C006.dwg



NOTES

EARTHWORKS VOLUMES DENOTED ARE APPROXIMATE ONLY AND HAVE BEEN CALCULATED BETWEEN THE EARTHWORKS SURFACE LEVEL (DEPTH BELOW FINISHED SURFACE LEVELS VARIES) AND THE EXISTING SURFACE LEVEL MINUS 200mm. THE VOLUMES DO NOT TAKE INTO ACCOUNT :-

1. BULKING FACTORS OF REMOVED CUT
2. REMOVAL OF EXISTING BUILDING SLABS AND PAVEMENTS
3. REMOVAL AND\OR REMEDIATION OF ANY EXISTING UNCONTROLLED FILL
4. PROPOSED LANDSCAPING
5. STORMWATER AND UTILITIES TRENCHING
6. EXISTING DAMS OR WATER BODIES WHERE BY THE BASE HAS NOT BEEN SURVEYED DUE TO THE PRESENCE OF WATER AT TIME OF SURVEY

BEDROCK A AND B VOLUMES HAVE BEEN CALCULATED USING THE APPROXIMATE INFERRED GEOTECHNICAL STRATA WITHIN PSM GEOTECHNICAL REPORT PSM2407-005 REV 2 JANUARY 2015

REFER TO STRUCTURAL ENGINEERS DRAWINGS FOR STRUCTURAL SLAB THICKNESS. STRUCTURAL SLAB AND SUBGRADE THICKNESS SHOWN ON STRUCTURAL DRAWINGS WILL TAKE PRECEDENT AND DETERMINE THE BULK EARTHWORKS LEVELS DENOTED ON THIS DRAWING.

CUT\FILL DEPTH RANGE LEGEND

Lower value		Upper value	Colour	Lower value		Upper value	Colour
-19m	to	-18m		-4m	to	-3m	
-18m	to	-17m		-3m	to	-2m	
-17m	to	-16m		-2m	to	-1m	
-16m	to	-15m		-1m	to	0m	
-15m	to	-14m		0m	to	1m	
-14m	to	-13m		1m	to	2m	
-13m	to	-12m		2m	to	3m	
-12m	to	-11m		3m	to	4m	
-11m	to	-10m		4m	to	5m	
-10m	to	-9m		5m	to	6m	
-9m	to	-8m		6m	to	7m	
-8m	to	-7m		7m	to	8m	
-7m	to	-6m		8m	to	9m	
-6m	to	-5m		9m	to	10m	
-5m	to	-4m		10m	to	11m	

EARTHWORKS VOLUMES

TOTAL SITE AREA	206,724m²
SITE STRIPPING (ASSUMED 200mm)	41,345m³
BULK EARTHWORK (INCLUDING ESTATE ROAD)	
TOTAL: CUT	294,500m³ (inc. ROCK)
BED ROCK A	10,500m³
BED ROCK B	115,000m³
TOTAL: FILL	429,600m³
BALANCE:	135,100m³ (IMPORT REQUIRED)

DADI ROAD MODIFICATION

MODIFICATION AREA	2,750m²
SITE STRIPPING (ASSUMED 200mm)	550m³
TOTAL: CUT	NIL
TOTAL: FILL	2,050m³
BALANCE:	2,050m³ (IMPORT REQUIRED)

Issue	Description	Date
C	RE-ISSUED FOR SSDA	20-02-15
B	ISSUED FOR SSDA	18-06-14
A	ISSUED FOR CLIENT REVIEW	14-05-14

100mm on Original

Bar Scales

0 25 50 75 100 125m

1 : 1250 @ A1 1 : 2500 @ A3

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Client

THE NEXT GENERATION

Scales: 1 : 1250 @ A1
Grid: MGA
Height Datum: AHD

Drawn: TS
Designed: TS
Checked: MM
Approved:

Project: ENERGY FROM WASTE ELECTRICITY GENERATION PLANT, EASTERN CREEK

Title: BULK EARTHWORKS CUT AND FILL PLAN

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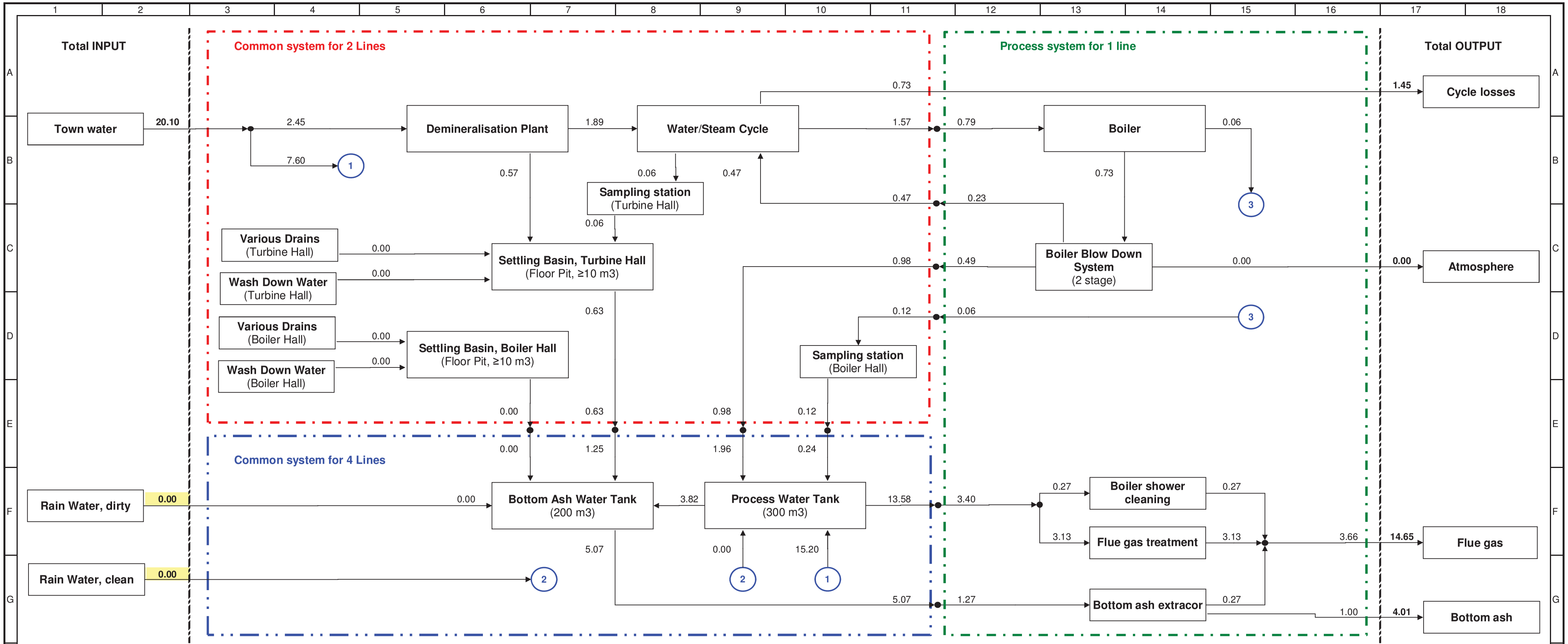
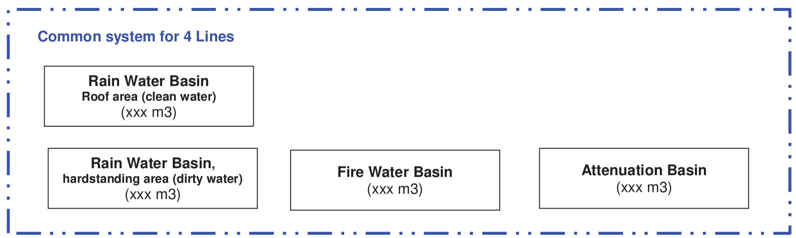
A1

Drawing No.: C009
Project No.: 14-187
Issue: C

Date Plotted: 20 Feb 2015 - 05:26PM File Name: F:\14-187 TNG\Drgs\Civil\DA-Drawings\C009.dwg

Appendix B





Total water consumption at different load points with 4 Lines running on 100% load:

LP N: 20.10 m3/h
LP 1: 24.80 m3/h
Max * : 36.50 m3/h

Remarks
* : Calculated with
- all boiler with high boiler fouling (FG temp exit boiler 185°C)
- high ash content in the waste (24.0% of 42.3 t/h waste)

To be clarified:
- Size of rain water basin/tanks, fire water basin/tank and possible storage basin/tank for other type of water used (attenuation basin)
- Which basin/tanks are actually needed/wanted
- Scope of delivery between HZI and Civil
- Number of floor pits needed within the turbine and boiler building (one for all lines or 1 per 2 Lines?), a question of layout planning and therefore cost evaluation between civil costs and costs for additional piping.
- Possible water treatment plant for dirty water and in who's scope of supply

Operating condition
- Normal operation at load point: LPN
- No. of Lines in operation: 4
- Rain water not considered

Mass Balance, status: i.o.
- Total water input 20.10 t/h
- Total water output 20.10 t/h

Design Data

Thermal power waste	per line	117.4 MW
Waste throughput	per line	31.3 t/h
Ash content waste		12.8%
Flue gas temp. inlet FGT		170 °C

Remarks
- The unit of all values is t/h (1'000 kg/h) except indicated otherwise.
- The purpose of this mass balance calculation is to determine the overall process water consumption of the plant. The values are mean expected/assumed operating values. Most of the flows are intermitted and not continuous flows.
- Note: the actual water consuption at a specific time depends strongly on two factors:
  1): fouling of the boiler (this influences the flue gas temperature at the exit of the boiler hence the water consumption of the flue gas treatment system)
  2): the ash content of the waste and the composition of the ash (this influences the water consumption of the bottom ash extractor)
- Water steam cycle losses are counted fully as losses despite partly being recovered in bottom ash and process water tanks.
- In this document not all all internal connections are shown and no pumps are displayed.
- The given values shall not be used for pipe sizing purposes since it may not correspond to the design value of it.

Rev.	Date	Description
2		
1		
0		First Issue

UNDER PROGRESS

Project Name: **Eastern Creek TNG**
Project No: **YE-3267**
Load point: **LPN**

Hitachi Zosen INOVA

	Date	Name
Prepared	19/01/15	Kunz
Checked		
Approved		

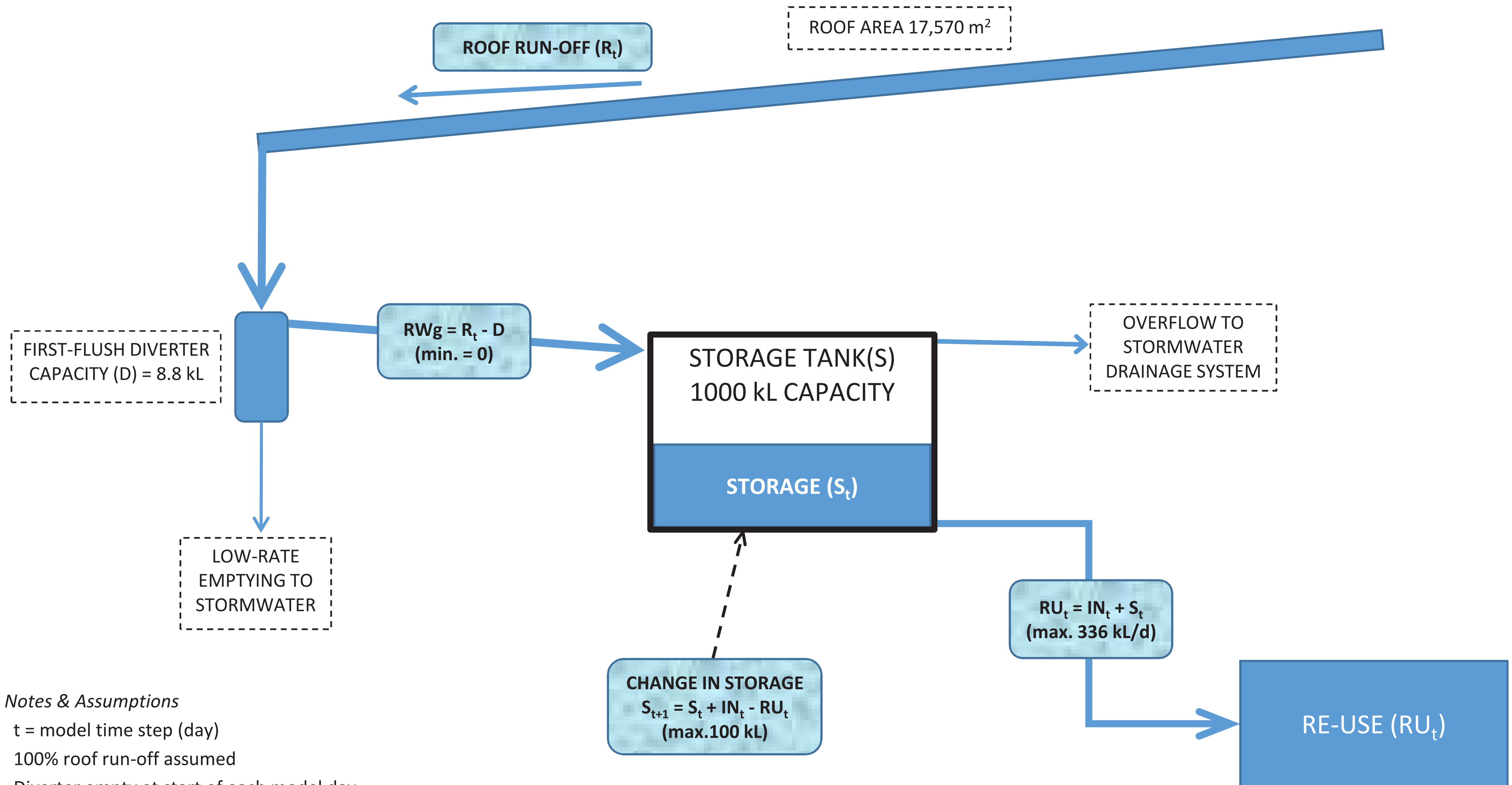
Water Balance - Process
Bloc Diagram

HZI doc. N° : - Revision: 0

Prog. No. : CSP-104 / V4.2
Print date : 16/04/15 Page : 1/1

H:\Professional services\Edison Project Files\E15002 DADI\E15002 DADI Background Documents\[Eastern Creek TNG_Water Balance_Process_Rev0-WorkInProgress.xlsm]Diagram

Appendix C



Notes & Assumptions

t = model time step (day)

100% roof run-off assumed

Diverter empty at start of each model day

Re-use takes place on all rain days

Roof Water Re-use Conceptual Model & Assumptions

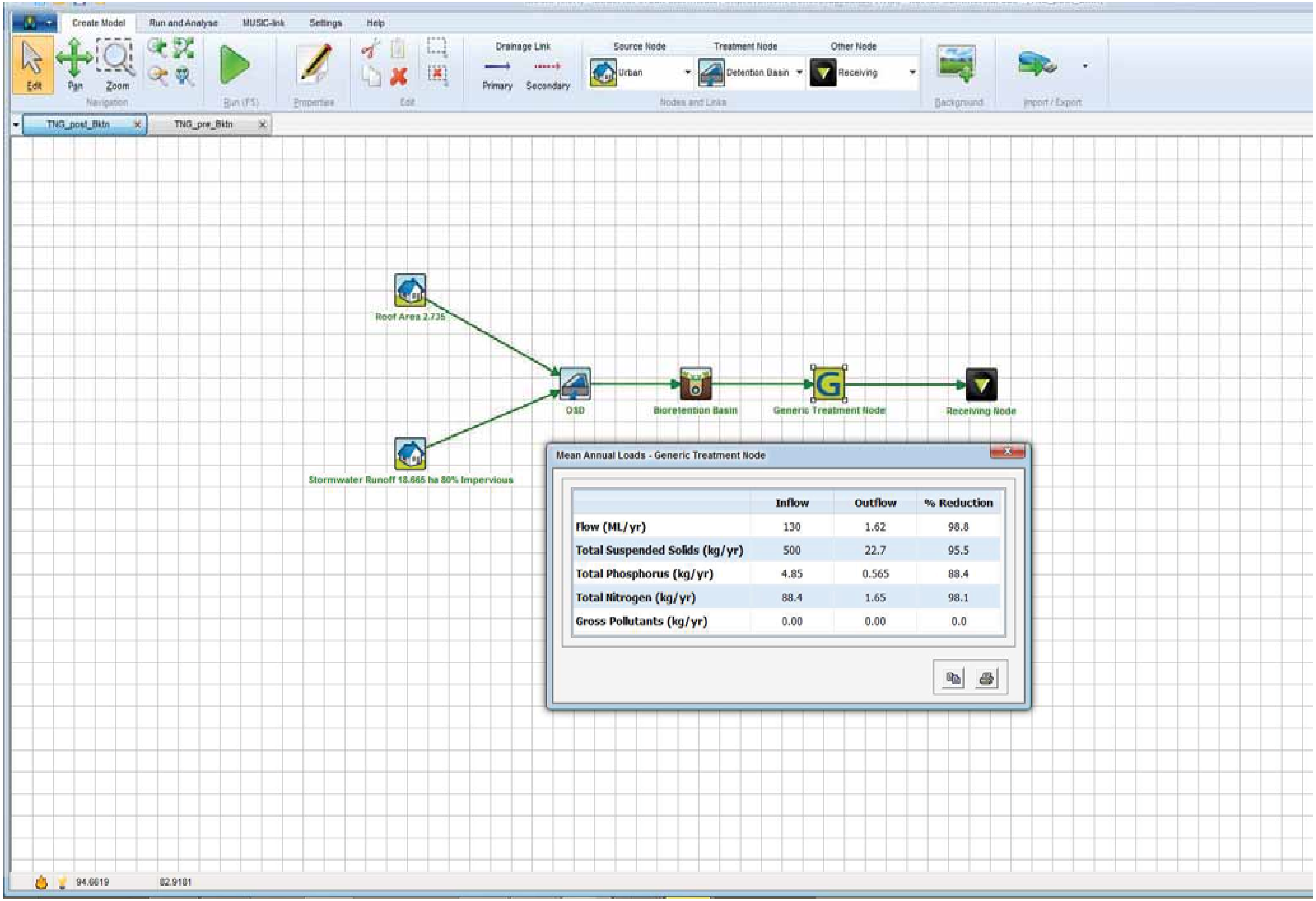
Project: EIA, Proposed Energy from Waste Facility, Soil and Water

Location: Eastern Creek

Client: TNG (NSW) Pty Ltd

Project No: BJ07

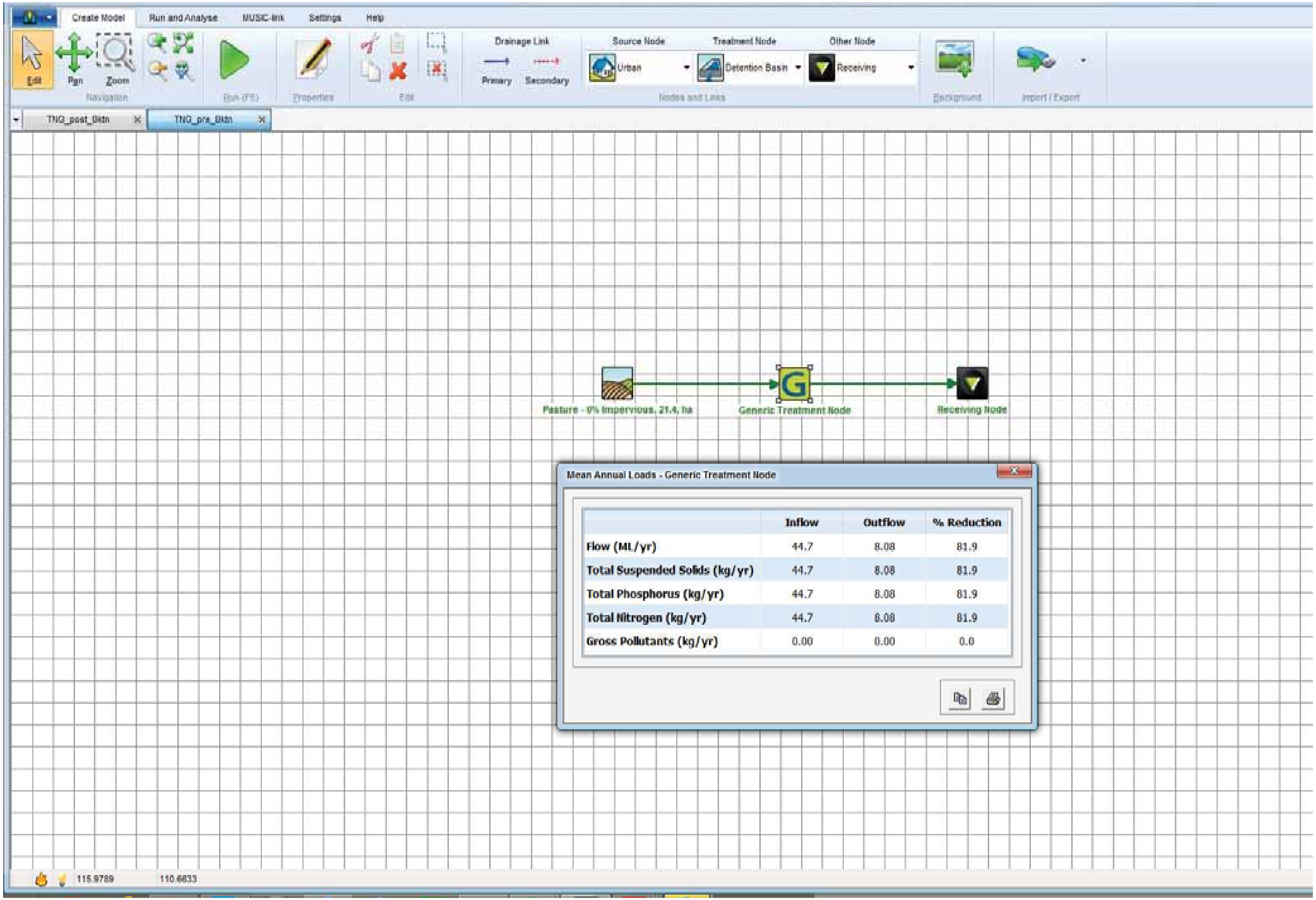
Appendix D



Create Model
Run and Analyse
MUSIC-link
Settings
Help
Edit
Pan
Zoom
Navigation
Run (F5)
Properties
Edit
Drainage Link
Primary
Secondary
Source Node
Urban
Treatment Node
Detention Basin
Other Node
Receiving
Nodes and Links
Background
Import / Export
TNG_post_Bktn
TNG_pre_Bktn
Roof Area 2.735
Stormwater Runoff 18.665 ha 80% Impervious
OSD
Bioretention Basin
Generic Treatment Node
Receiving Node
Mean Annual Loads - Generic Treatment Node

	Inflow	Outflow	% Reduction
Flow (ML/yr)	130	1.62	98.8
Total Suspended Solids (kg/yr)	500	22.7	95.5
Total Phosphorus (kg/yr)	4.85	0.565	88.4
Total Nitrogen (kg/yr)	88.4	1.65	98.1
Gross Pollutants (kg/yr)	0.00	0.00	0.0

94.6619
82.9181


Create Model
Run and Analyse
MUSIC-link
Settings
Help
Edit
Pan
Zoom
Navigation
Run (F5)
Properties
Edit
Drainage Link
Primary
Secondary
Source Node
Urban
Treatment Node
Detention Basin
Other Node
Receiving
Nodes and Links
Background
Import / Export
TNG_post_Bktn
TNG_pre_Bktn
Pasture - 0% Impervious, 21.4, ha
Generic Treatment Node
Receiving Node
Mean Annual Loads - Generic Treatment Node
Inflow
Outflow
% Reduction
Flow (ML/yr) 44.7 8.08 81.9
Total Suspended Solids (kg/yr) 44.7 8.08 81.9
Total Phosphorus (kg/yr) 44.7 8.08 81.9
Total Nitrogen (kg/yr) 44.7 8.08 81.9
Gross Pollutants (kg/yr) 0.00 0.00 0.0
115.9789
110.6833