13.0 Soil and Water

13.1 Introduction

This section provides an assessment of the potential impacts of the development on soil and water (including surface water, ground water, contaminated lands and landform). This assessment has focused on construction related impacts as this phase of the development is considered to be the most pertinent to soil and water related impacts. The Hydrology section of this EIS (**Section 8**) has provided an assessment of potential impacts of the operational water requirements of the development on the Nepean River (including its ecology and other water users). The assessment of potential operational soil and water impacts of the development in this section is confined to consideration of potential ongoing risks of erosion and sediment runoff to the Nepean River during the operational maintenance phase of the development.

13.2 Director-General's Requirements

The Director-General's hydrological assessment requirements for the development have been addressed in 2 separate sections of this EIS: Section 8, Hydrology and Section 13, Soil and Water. This soil and water section addresses the following requirements:

- impacts and risks to surface water and groundwater characteristics, flows, quality and quantity;
- proposed construction water quality objectives and management measures for the Nepean River;
- hydrological and geomorphic impacts to the riparian zone, during construction and operation, including those causing destabilisation and erosion to the riverbank and bed;
- impacts to and from the groundwater contamination plume adjacent to the proposal;
- adequate mitigating and monitoring requirements to address surface water and groundwater impacts, with particular reference to:
    - how construction within the Nepean River on steep gradients or highly erosive soil types would be managed during construction and operation;
    - how the erosion control measures on site would be maintained including a conceptual erosion and sediment control plan; and
    - stormwater management.

The remaining hydrology DGR requirements have been addressed in Section 8.

13.3 Existing Environment

13.3.1 Soils

Geology and Soil Type

The 1:100,000 scale geological map of Penrith (Geological Survey NSW, 1991) indicates that the site is situated on the Cranbrook Formation, a quaternary deposit comprising gravel, sand, silt and clay. The development site is underlain by Ashfield and Bringelly shales of the Wianamatta group and alluvium from the quaternary period (see **Figure 13-1**).

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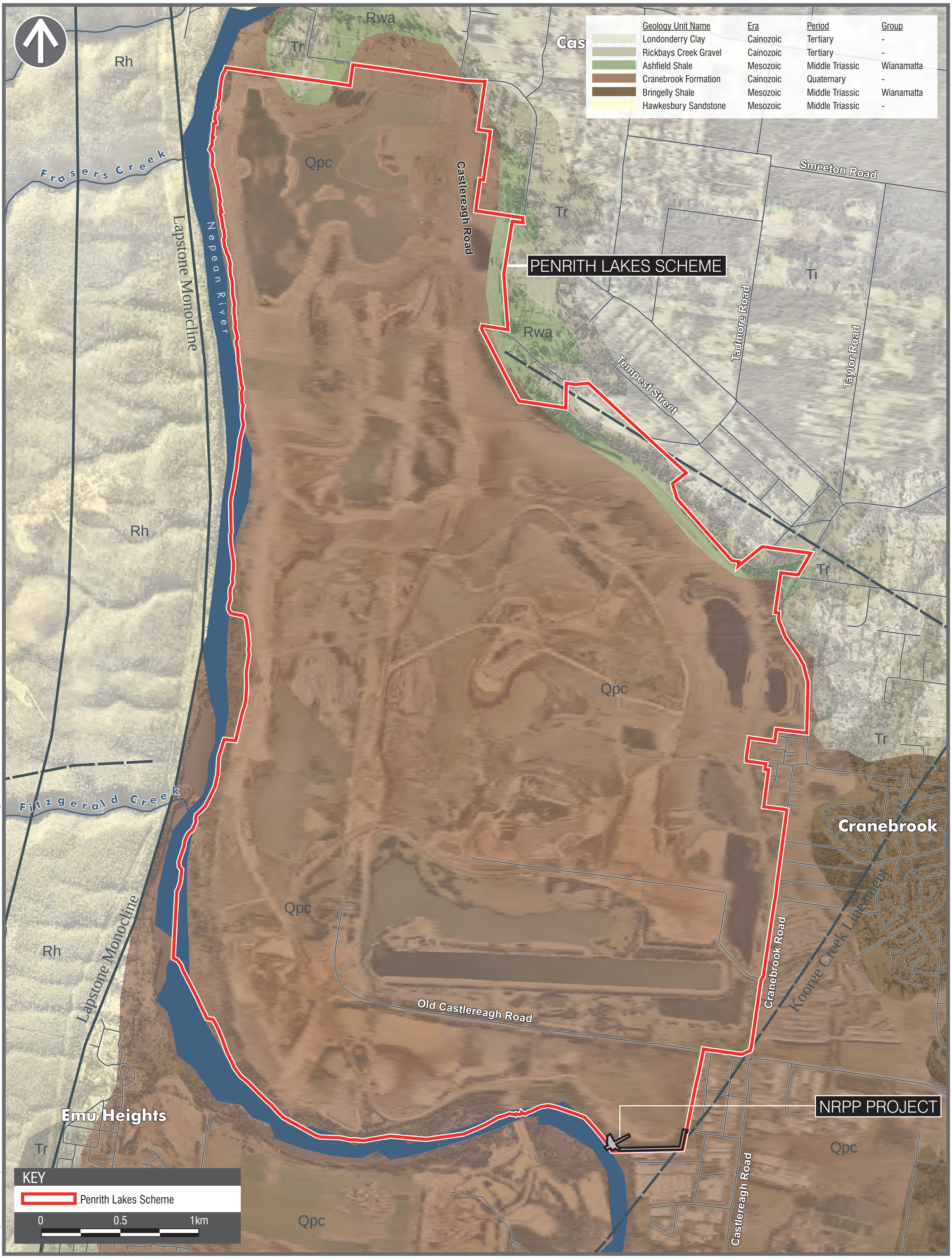

G:\Projects\602 Projects\60221206 Penrith Lakes\FIGURES\EIS\60221206 F13.1 Penrith 1 to 100000 Geological Map 01 09 2014 TO Rev B

AECOM

PENRITH 1:100,000 GEOLOGICAL MAP

Environmental Impact Statement
Nepean River Pump and Pipeline Project

Source: Penrith 1:100,000 Geological Map (Geological Survey NSW, 1991)

FIGURE 13.1

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Topography and Geomorphology

The topography and geomorphology at the development site comprises the following environments:

- narrow bench running along the Nepean River and likely acting as the top of bank for the low flow channel of the Nepean River;
- an embankment which rises steeply from the eastern edge of the Nepean River which is at an elevation of 7m AHD to approximately 27 m AHD at the top of the riverbank. The pumping station would be located along this embankment with the MCC and transformer located at the top of the embankment; and
- Nepean River floodplain which is generally flat, extending eastwards from the top of the embankment with an elevation of approximately 26-27 m AHD. The pipeline and power line would be located at this elevation.

Soil Landscape

The Penrith 1:100,000 soil landscape map (Hazelton and Bannerman, 1989) identifies the soils at the development site as being Richmond soils. The soils are likely to be poorly structured orange to red clay loams, clays and sands. Main soil types within this profile include a loose reddish brown loamy sand, brown mottled light clay and brown mottled stiff medium to heavy clay.

Limitations of these soils include high erodibility with a high erosion hazard, particularly on terrace edges. The soils generally also have a very high level of aluminium toxicity, localised salinity, very low fertility, low to moderate shrink swell and sodic properties. With low available water capacity, the soils can experience minor localised flooding. The surface soils are moderately erodible with a high fine sand fraction and low organic matter content. Subsoils in this area generally have very high erodibility due to very low organic matter, and a high fine sand and silt content.

In relation to the development site, it is expected that the soil profile in areas along the Nepean Riverbank would be relatively intact, however, the soil profile of areas within the PLS are considered unlikely to have been retained, due to historically high levels of disturbance (e.g. quarrying).

Salinity

Known and potential salinity for the study area was identified using the then Department of Infrastructure, Planning and Natural Resources (DIPNR) Western Sydney map and guidelines (2002) (as shown in **Figure 13-2**). The map shows that parts of Cranebrook Creek and its floodplain within the PLS have been identified as having known soil salinity. The development is situated in an area of moderate salinity potential (DIPNR, 2002).

Acid Sulfate Soils

The Australian Soil Resource Information System indicates that there is low probability and very low confidence in the potential for or presence of acid sulfate soils (ASS) in and around the development site (ASRIS, 2012). Similarly, the Penrith LEP 2010 does not list the development area as containing ASS or as having potential to contain ASS.

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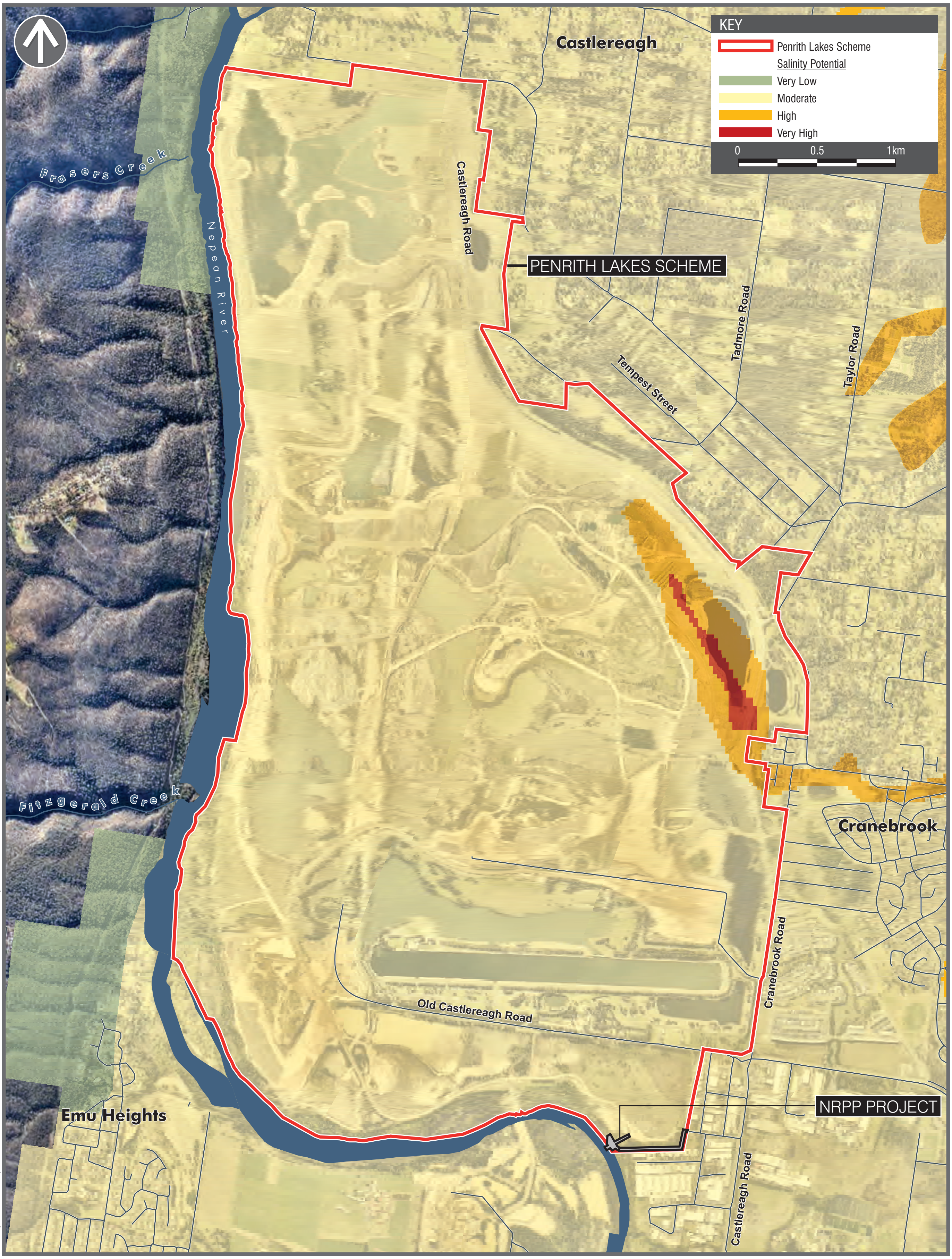

G:\Projects\602 Projects\60221206 Penrith Lakes\FIGURES\EIS\60221206 F13.2 Salinity Potential 01 09 2014 TO Rev A

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SALINITY POTENTIAL
Environmental Impact Statement
Nepean River Pump and Pipeline Project

Source: Department of Infrastructure, Planning and Natural Resources (2003)

FIGURE 13.2

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13.3.2 Surface Water

Surface water quality data for the Nepean River was sourced from the PLS Stage 1 Water Management Plan. This data was collected by Sydney Water over a period of up to 5 years. **Table 48** provides a summary of nitrogen and phosphorus levels in the Nepean River from a collection point at Boral Bridge, located downstream of the Penrith Weir and Boundary Creek between January 2010 and March 2012.

Table 48 Nepean River Surface Water Quality Data - Boral Bridge - January 2010-March 2012 (Data from Sydney Water)

Total Nitrogen		Total Phosphorus	
Number of samples	39	Number of samples	39
Min (MG/L)	0.210	Min (MG/L)	0.013
Max (MG/L)	0.880	Max (MG/L)	0.045
Median (MG/L)	0.430	Median (MG/L)	0.023
Average (MG/L)	0.430	Average (MG/L)	0.023
95^{th} Percentile (MG/L)	0.680	95^{th} Percentile(MG/L)	0.037
Number above 1987 Deed	1	Number above 1987 Deed	14
1987 Deed Guideline for the Main Lakes	0.700	1987 Deed Guideline for the Main Lakes	0.025

Given that intake from the Nepean River would be used to supplement water levels within the PLS, the water quality of the river is important to the water quality of the PLS. As the monitoring results in **Table 48** indicate, water quality of the Nepean River was compliant with PLDC's Total Nitrogen guideline for the Main Lakes of the PLS, with only 1 exceedance. Total phosphorus levels exceeded the 1987 Deed Guideline for the Main Lakes on 14 occasions (working out to be 36 % of the time) (PLDC, 2012b).

These results show the potential for the Nepean River to produce nutrient rich water (PLDC, 2012b). It is important to note that this water quality is significantly better than recorded pre-2010, suggesting that the Western Sydney Replacement Flows project (outlined in **Section 1.0**) upstream of the sample site is having a positive impact on water quality (PLDC, 2012b).

Faecal pollution is measured by collection data for the enterococci bacteria level in a river. **Table 49** provides a summary of the enterococci data for the Nepean River from the aforementioned collection point at the Boral Bridge. The table shows that the requirements for Primary Contact as per the ANZECC Guidelines were exceeded 59 % of the time, and those for Secondary Contact 19 % of the time (PLDC, 2012b).

Table 49 Enterococci data from the Nepean River - January 2007- March 2012 (Data from Sydney Water)

Faecal Indicator – Enterococci (CFU/100ML)	
Number of samples	28
Min	10
Max	590
Median	45
Average	105
95^{th} Percentile	338
Number above Primary Contact	16
% Time out of Primary Contact	59.19 %
Number above Secondary Contact	5
% Time out of Secondary Contact	18.55 %

The water quality data in **Table 49** indicate that at the collection point, the Nepean River is frequently affected by moderate levels of bacterial pollution (PLDC, 2012b).

13.3.3 Groundwater

The IEP Report included a review of ground water conditions at the PLS. The IEP Report identified that the south western portion of the PLS is situated on an alluvial terrace at around RL 20-27m AHD, and is underlain by about 15 m of permeable gravel, sand and silt. A higher terrace (RL 40-50m AHD) composed of similar but more cemented older sediments, lies on the north east portion of the PLS (IEP, 2005). The groundwater system within the lower terrace is essentially a self-contained aquifer, which is characterised by high permeability and storage capacity and by water of generally less than 500 mg/L Total Dissolved Solids (TDS). The groundwater depth within the lower terrace is estimated by the IEP Report to be between approximately RL 12-20 m AHD. Most of the water stored within this system is obtained from direct precipitation or from infiltrating lake water, although a small proportion may originate from leakage around Penrith Weir. The IEP Report indicates that during low water levels, the PLS lakes act as groundwater sumps, with water flowing into the lakes from bank storage where this is not restricted by clay seals. Most groundwater discharge from the system is thought to enter the Nepean River downstream from the PLS.

A conceptual model for groundwater movement to and from subsurface storage at the PLS was developed by Coffey Partners (1980), which was reviewed as part of the IEP Report. The Coffey Partners' model estimated that inflow roughly balanced outflow, at around 3,500 ML per year, and that total groundwater storage at the time of assessment was about 17,000 ML. The key elements of the groundwater balance were:

- rainwater directly infiltrates the sands and gravels of the Cranebrook Formation on the lower terrace. This is by far the largest source of groundwater, making up about 77% of the aquifer recharge in the vicinity of the PLS;
- the second main source of recharge at the time of the study was return water from irrigation (from agricultural activities outside of the PLS), which made up about 15%. This source has now largely disappeared;
- stormwater runoff to the lakes was estimated by Coffey Partners to be about 8 % of inflow to the groundwater system. It is derived primarily from weathered shale bedrock areas to the south-east and is expected to be slightly saline as a result; and
- a much smaller flux of presumed saline groundwater, discounted as negligible by Coffey Partners, enters the lakes from the east via the Rickabys Creek Gravels in the upper terrace.

The IEP Report identified that 5 groundwater monitoring bores were installed in 1988 along the eastern boundary of the PLS and 2 additional bores installed in 1991 to monitor groundwater conditions within the PLS. The findings of the annual monitoring reports from 1988-93 included the following:

- water levels correlated well with rainfall, with an approximately 1-month time lag between major precipitation events and bore level rises. This supports the Coffey Partners' conclusion that most of the recharge to lower terrace gravels in the PLS was by direct rainfall infiltration, rather than from the Nepean River near Penrith;
- this also implies that water levels in the observation bores were not greatly affected by inflows from the Rickabys Creek Gravel aquifer, to the east of the PLS. Salinity, however, may have increased relative to bores further west; and
- extraction activities within the PLS, including the construction of the SIRC Lake at the time, caused drops in water levels. This included a general decline in the water table of about 2 m, from RL19.5 m AHD to RL17.5 m AHD over the 4 years of monitoring (1989-93). The maximum declines were 1.4 m over 6 months and 2 m over 12 months.

In addition to the presence of an alluvial terrace, the IEP Report identified that Hawkesbury Sandstone is expected to be present at a depth of about 30m below the level of the lower terrace, at about RL –10 m AHD, capped by nearly impermeable shale. The IEP Report indicated that this formation has a thickness of about 200 m and that compared to the alluvial terrace gravels above, the sandstone is a low-yielding, anisotropic and inhomogeneous aquifer. The IEP Report also indicated that based on very limited water quality data available (a single deep bore installed at 200 m) the water quality in this deep Sandstone aquifer is typically in the range of 500-1500mg/L TDS, tending to improve with depth. The top 20-30m was identified to be the most saline.

13.3.4 Contaminated Land

Past land use in and around the area now referred to as the PLS has comprised over 200 years of agriculture and 6 decades of mining (PLDC, 2010). European land grants were first issued in the Penrith Lakes area in the early 1800’s, with the area subsequently farmed for wheat and cattle, then orchards, market gardening and dairying. In the 1950’s, sand and gravel quarrying developed into the key land use at the site (PLDC, 2010).

Based on its land use history, potentially contaminating activities that are likely to have been previously carried out in the Penrith Lakes area would be those associated with agriculture and quarrying. Potential agricultural contaminants from activities such as dairy and other farming would be generally confined to specific locations and activities including storage and use of pesticides and hydrocarbons, machinery and vehicle maintenance areas and the use of asbestos cement pipes for irrigation (Maunsell, 2006). Asbestos cement pipes have previously been removed from the PLS to licensed waste disposal areas. However, additional pipes may still be present within the proposal site (Maunsell, 2006).

Quarrying and earthmoving activities previously conducted in the Penrith Lakes area may have produced contaminants such as hydrocarbons from fuel storage and vehicle maintenance. However these would be confined to specific areas and the potential for residual contamination is likely to be low due to the shallow depth of penetration of contamination and the homogenisation and mixing of the soils during quarrying activities. All hydrocarbon contaminated areas within the PLS attributable to PLDC quarrying and earth moving activities would be suitably remediated and independently audited by an EPA Accredited Site Auditor prior to final handover of the PLS to the NSW Government.

A search of the EPA Record of Notices for contaminated lands was undertaken on 25 March 2013 to establish whether any written notices had been issued or action taken for land the subject of the development site under Section 58 of the *Contaminated Land Management Act 1997*. The search results showed no records on the development site, with the closest record being for a contaminated groundwater plume from Crane Enfield Metals, 2115 Castlereagh Road, approximately 600 m to the east of the development. The plume is understood to be located to the east of the development site in the vicinity of Cassola Place at a depth of approximately 6 m below surface. Further details of this contamination site are provided in **Sections 13.4.3** and **13.4.4** below.

13.4 Potential Impacts

Existing site conditions including proximity to the Nepean River, steep embankment terrain and highly erodible soils means that unless adequate controls are in place, there is a high potential for soil and water impacts during the construction phase of the development which would involve ground exposure and works close to and within the Nepean River itself. Operational soil and water impacts of the development would be confined to potential erosion and sedimentation risks from ongoing operational maintenance activities. Key soil and water risks that are likely to be posed by the construction phase of the development are identified below and discussed further in subsequent sections.

- bank destabilisation and erosion and sediment runoff into the Nepean River has the potential to occur from clearing and top soil stripping and general construction activities in close proximity to the Nepean River, in particular within the steep terrain of the embankment itself for the construction of the pumping station within the embankment and the construction of an access track to the river;
- water quality impacts to the river are likely to occur during the creation of a temporary ‘spit’ from the riverbank extending out into the water, using excavated soil and rock gabions, to provide temporary access to the river to enable construction of the intake structure. Sedimentation of the Nepean River is likely to be caused by the direct emplacement of material within the river;
- water quality impacts to the river also have the potential to occur during the construction of the intake structure within the Nepean River due to the requirement for the minor detailed excavation of the river bed to allow placement of the intake structure and anchor blocks;
- the temporary ‘spit’ also has the potential to temporarily alter stream flow conditions, by posing a partial barrier to stream flow. Altered flows could affect bank erosion and cause a temporary bottle necking effect in this location of the river in high flow conditions. Notwithstanding, the potential for impact is expected to be minor due to the minimal width of the spit compared with the width of the river in this location and is further discussed below;

- earthworks during construction have the potential to uncover contaminated soils, acid sulfate soils and/ or saline soils, which if not properly managed have the potential to cause contaminated runoff into the Nepean River;
- temporary changes to river flow and water quality conditions during construction and ultimate changes to embankment morphology at the location of the intake structure have the potential to impact on river flora and fauna, including available in-stream habitat.

13.4.1 Soils

Erodibility and Terrain and River Morphology

Based on the key risk scenarios described above, potential soil erosion and terrain/ river morphology impacts of the construction of the development are summarised as being:

- erosion from areas disturbed by construction work and vegetation clearance, and potential sedimentation within the Nepean River;
- erosion of the river bank due to changed flow patterns brought about by in-stream construction.
- alteration of the river banks, benches and other physical features of the Nepean River. These changes to local geomorphology may have repercussions for in-stream habitat features utilised by flora and fauna;
- impacts to bank stability as a result of riparian vegetation clearance; and
- erosion and sedimentation impacts during rehabilitation works particularly related to disturbance of stockpiles and respreading of stockpiles.

Careful management of construction activities would be required to ensure that the potential for erosion from exposed areas is minimised as far as possible. This would include minimising the areas of exposure to the minimum practicable and stabilisation of exposed areas as soon as possible, particularly in areas of high risk such as the steep embankment of the Nepean River. In particular vegetation clearing would be undertaken with consideration to maintaining bank stability including retaining tree stumps where possible. With the implementation of appropriate controls it is considered that the erosion risks of the development can be managed to avoid significant impacts to the river during the construction phase.

Whilst some changes to river morphology are likely to be unavoidable (such as the permanent alteration of some riverbank features of the Nepean River to locate the intake structure and pumping station), it is considered unlikely that the these changes would significantly alter river flow conditions, hydrology or associated aquatic ecology in the long term and that over time, habitat features would re-establish in the area. It is also noted that changes to the river bank morphology would be confined to the immediate vicinity of the development footprint and not affect a significant stretch of the river.

The temporary 'spit' proposed to be installed during construction, whilst having the potential to alter river flows in the short term, is necessary to protect the water quality of the Nepean River during construction, which is considered to be at more risk if construction was undertaken without such a measure in place. The spit would be confined to the minimum space required for construction works and is expected to be limited to a small section of the width of the river. As the spit would not extend the entire width of the river channel, it is not expected to pose a significant barrier to river flows (including associated fish passage and high flow conditions) during the construction phase. Further to this, the spit would be in place for a relatively short term only (only for the duration of the intake structure construction) reducing the risk of exposure to impacts, as far as possible.

The temporary spit will be constructed from gabion style rock material to allow the construction of the intake structure. The gabion style rock is consistent with the existing river bed materials in this area and will reduce sedimentation in the river compared with materials such as earthen fill. When construction of the intake structure has been completed the temporary spit will be removed from the river. A small excavator will be used to excavate the spit back to the original river bed formation by working from the farthest point of the spit and excavating back toward the river bank until completely removed.

The proposed post-construction rehabilitation for the development is comprehensive, and has been developed in part to ensure the bank does not pose an ongoing risk of erosion. All disturbed areas of the bank would be fully stabilised and rehabilitated using local indigenous species to mitigate ongoing potential for sedimentation into the river at the completion of construction works. The access track would be initially rehabilitated but maintained at a reduced operational width (approximately 3.5 m). Consequently, once rehabilitation of the construction disturbance has occurred, there would not be any ongoing potential for erosion or destabilisation.

Salinity

The development is situated in an area mapped as being of moderate salinity potential (DIPNR, 2002). The only known salinity in the study area is within the PLS, on parts of Cranebrook Creek and its floodplain. These areas are relatively isolated and approximately 3 km north of the development site. It is not anticipated that the development would disturb these identified areas of salinity.

Given that the development site is not identified as an area of high salinity hazard or potential, soil excavation as part of construction is not anticipated to uncover highly saline soils which have the potential to generate saline runoff from the development site. Saline soils, if uncovered could exacerbate the erodibility of soils on site and therefore increase sedimentation potential. Erosion and sedimentation has been identified as a key risk during the construction stage of the development and detailed measures recommended to minimise and control impacts are identified in **Section13.5**.

It is noted that existing drainage into the river would naturally mobilise salts within the soil profile should saline soils naturally occur in the area. Consequently, earth works associated with the development should it uncover saline soils is unlikely to significantly change existing drainage of salts into the river. All excavation works would be managed to minimise soil exposure to the minimum period necessary and disturbed areas would be rehabilitated as soon as possible to provide for long-term soil stabilisation and re-establishment of indigenous vegetation (which would provide a long-term control for minimising and controlling soil salinity).

Acid Sulfate Soils

Both the Australian Soil Resource Information System and the Penrith LEP 2010 show the development site as having no identified ASS, and a low potential to contain ASS. Notwithstanding, should ground testing during future geotechnical assessments for the development (as part of detailed design), identify the potential for ASS within the development site, management measures would be including in the CEMP for the development to identify, manage and dispose of excavated ASS.

13.4.2 Surface Water

As previously identified, the key water quality risks posed by the construction of the development on the water quality of the Nepean River relate to potential sedimentation from construction activities undertaken in close proximity to or within the Nepean River itself. As construction within the Nepean River is required for the installation of the water intake structure, installation of a temporary ‘spit’ using gabion style rock is proposed to ensure that works can be undertaken safely and efficiently. The spit would allow detailed trimming and installation of the water intake structure and associated anchor blocks.

A temporary spit using gabion style rock is the preferred construction option as it would enable construction works to proceed in the most efficient manner and for construction duration within the river to be minimised. Whilst short term sedimentation impacts into the Nepean River water column are expected during the installation of the temporary spit, it is necessary to ensure the intake structure can be constructed within a contained environment to minimise the potential for sedimentation impacts on the river during the bulk of these construction works. To ensure protection of water quality, a sediment curtain would be fitted outside of the construction works footprint to minimise sedimentation from works being released into the river.

In flood conditions, there would be the risk of the spit being overtopped and sedimentation being released into the river. However, the likelihood of this occurring is considered to be low and in such conditions water quality in the river would be expected to be highly turbid and unlikely to be significantly affected by development impacts.

The use of a temporary spit using gabion style rock is the preferred option however should conditions not be suitable for its installation, other construction options (including excavation from the bank within the intact water channel of the river or installation of an earthen coffer dam would be pursued). The latter 2 options would have the potential for greater disturbance and water quality impacts to the river and would be less efficient involving a longer construction time and would be pursued as a last resort only. Sedimentation and turbidity impacts associated with these alternative methodologies would also be controlled and minimised via the implementation of a sediment curtain around the work area. The final methodology for construction within the river would be determined during detailed design and submitted as part of the Construction Certificate approval process.

As construction related impacts of the development would be temporary, significant and long-term water quality related changes to aquatic health and habitats are not expected as a result of the development. Notwithstanding, a construction water quality monitoring program would be implemented to monitor the effectiveness of construction measures put in place to protect river water quality. In addition, appropriate measures would be implemented to contain potential ASS or contaminated (if uncovered) to ensure no uncontrolled runoff into the river. Refer **Section 13.4.4** for further details on contaminated land.

13.4.3 Groundwater

The IEP Report concluded that the majority of groundwater discharge from the groundwater system related to the PLS would enter the Nepean River downstream of the PLS, and that the main source of groundwater would be from rainfall infiltrating the lower terrace.

Excavation works for the development would include excavation within the Nepean River embankment for the construction of the pumping station, excavation within the river channel for the installation of the intake structure and trenching along a 160 m section of the embankment for the installation of the underground pipeline to the outlet structure. Excavation for the intake channel would be at the river water level, at approximately 10 m AHD. Construction of the pumping station in the river embankment would require earth works along the full height of the embankment from river level to the top of the embankment (approximately 10 m to 27 m AHD). The underground pipeline would extend from the top of the pumping wet well structure up the embankment and would discharge at the outlet structure in the PLS wetlands. The pipeline would be trenched to depth of approximately 1 m depth below the surface AHD. Based on identified groundwater depths in the IEP Report of between 12-20 m AHD, the embankment works are considered to be at most risk of intercepting the shallow alluvial groundwater system along the lower terrace of the Nepean floodplain, which characterise the development site. However, no interception of the deep Sandstone aquifer (>30m below the lower terrace level) is expected.

Whilst development excavation works may temporarily intercept and draw down a limited area of this groundwater (in the immediate vicinity of the development), it is considered unlikely that the development construction would have significant long-term impacts on the prevailing groundwater system. Any drawdown is expected to recover with rainfall recharge in the medium term. Upon the completion of construction works and rehabilitation and restoration of landform, the development is not expected to pose an ongoing risk of groundwater draw down on site. In addition, given that groundwater from this existing alluvial system already discharges into the Nepean River (and into the lakes system of the PLS), any groundwater that discharges into the river during the construction of the pumping station is considered unlikely to significantly change the water quality of the river compared to the existing situation. As identified in **Section 6.3.3**, the proposed works are consistent with activities identified to be 'defined minimal impact aquifer interference activities' under the *NSW Aquifer Interference Policy* and therefore can be licences under the *Water Management Act 2000*.

It is considered that groundwater quality impacts could arise, if development excavation works result in the interception of contaminated leachate which has been identified by the EPA to be flowing west and leaching into the Nepean River from the contaminated ground water plume located to the east of the site at the Crane Enfield Metals site. In addition to water quality implications, interception of contaminated groundwater could pose occupational health risks to onsite workers.

To address this matter, as a precautionary measure a groundwater and soil sampling program would be implemented prior to the commencement of construction at the development site. The program would be developed and implemented with reference to the known location and migration direction of the Crane Enfield Metals contamination plume (based on a review of the contamination and remediation assessments undertaken at that site). The program would include consideration of the risk of uncovering contaminated groundwater and/ or soils during construction works. Should the risk of uncovering contaminated groundwater be identified on site, detailed measures would be developed in consultation with the EPA and NOW and would be put in place to control occupation and health risks to workers. The detailed measures would also ensure that the development through its construction works does not exacerbate the risks to river water quality (e.g. by increasing leachate volumes through soil disturbance/ runoff) significantly more than the existing case, acknowledging that there already is leachate flow into the river.

13.4.4 Contaminated Land

As discussed in **Sections 13.3.4** and **13.4.3**, the closest known contaminated land to the site is a groundwater plume from Crane Enfield Metals, 2115 Castlereagh Road, approximately 600 m to the east. The plume is located to the east of the pipeline alignment in the vicinity of Cassola Place at a depth of approximately 6 m below the surface.

Investigations undertaken by the EPA indicate that the Crane Enfield Metals site is contaminated with a range of volatile chlorinated hydrocarbons including trichloroethylene and its degradation products. In particular, the contaminants are present in soil and groundwater on Lot 2 DP787827 (the Crane Enfield Metals site) and the contaminated groundwater has migrated south from Lot 2 onto the neighbouring property at Lot 11 DP518287. Further, this groundwater was found to be leaching into the Nepean River. The Crane Enfield Metals site is subject to a remediation order with interim remediation required by 30 Sept 2015 and long term remediation by 30 Sept 2039, through the implementation of a soil vapour extraction system.

Due to its distance from the development, no direct interception of the main plume is expected during earthworks. However as discussed in **Section 13.4.3**, there is the potential for the development to uncover soil and /or groundwater which has been contaminated by leachate migrating in a westerly direction from this plume. As a precautionary measures additional soil and groundwater testing and further assessment as detailed in **Section 13.4.3** would be carried out to manage construction impacts.

Although remediation target dates set for the contamination plume (i.e. interim remediation by 2015) would likely coincide with the operational commencement date for the development (also expected in 2015), there is a residual risk that contaminants may still be present in the Nepean River in the intake water to the PLS, which could pose a water quality risk to the recreational usages of the lakes. PLDC would in consultation with the EPA ensure that pumping of water for the PLS only commences, after the EPA is satisfied the remediation works undertaken at the Crane Metals Site has sufficiently addressed leachate issues to the Nepean River, such that water quality at the Nepean does not pose a health risk to the PLS.

13.5 Mitigation Measures

The following mitigation measures are proposed to minimise and manage soil and water impacts from the development.

13.5.1 Construction

A CEMP would be developed, and all construction works for the development undertaken in accordance with it. To mitigate erosion and sediment issues associated with construction, an Erosion and Sediment Control Plan (ESCP) would be prepared as part of the CEMP, in accordance with guidelines *Managing Urban Stormwater Guidelines* (2004) ‘Blue Book’ (herein referred to as Blue Book) produced by the Department of Housing. The ESCP would be prepared as part of the CEMP prior to the commencement of construction and implemented for the duration of construction works. A conceptual ESCP has been developed, identifying the broad areas that would be covered by the plan, as shown in **Section 13.5.2**.

Mitigation measures related to soil and water that would be detailed within the ESCP and CEMP would include:

- confining works within the Nepean River bed within a sediment curtain including construction of a temporary ‘spit’. This temporary spit would be designed to minimise the disruption to the flow regime of the water course corridor and ensure that adequate flow is maintained for fish passage;
- Any dewatering required from within the construction area would be pumped out to a detention basin within the development site to allow for settlement of sediments prior to discharging back to the river or stored within existing detention ponds within the PLS. If the water is proposed to be discharged back into the river, the water would be discharged as the water quality within the river improves following initial disturbance of the riverbed. A variation to the existing PLDC EPL would be sought to enable discharge of this dewatering back into the Nepean River (if required). Appropriate water quality testing would be undertaken prior to its discharge to ensure it meets EPL water quality criteria prior to discharge;
- installation of a sediment curtain around the construction footprint in the river (including around the temporary ‘spit’) to control and manage the release of runoff generated during construction works associated with the intake structure;
- minimising the extent of disturbance and duration of exposure of disturbed areas to the practicable minimum extent to enable construction, especially in high risk construction areas (river embankment), with temporary or final stabilisation of surfaces occurring (where practicable) immediately after completion of works in a specific area.
- installation of temporary geofabric sediment fences down slope of disturbed areas where there is the potential for runoff to enter the Nepean River, in particular during construction works for the wet well within the embankment;

- diversion of clean stormwater away from exposed areas including from open pipeline trenches using straw bales or other similar temporary barriers where practicable;
- not locating stockpiled topsoil or subsoil within 40 m of watercourses to prevent migration of soils;
- keeping active work areas tidy and well maintained to minimise potential for construction materials (such as sand and concrete) to mobilise into the river; and
- implementation of a water quality monitoring program to monitor the effectiveness of mitigation measures on the water quality of the Nepean River and undertaking regular inspections of the site to ensure appropriate implementation of measures.

To monitor construction related impacts on surface water quality of the Nepean River, surface water monitoring would be undertaken upstream and downstream of works, for the duration of the construction phase. In the absence of specific water quality guidelines which can be applied to the assessment and monitoring of water quality in a construction context, water quality downstream would be monitored against daily base line water quality conditions upstream of the development. It is considered that such an approach would enable immediate recognition of changes to water quality resulting from the development against day to day base line conditions of the development and would enable the distinction of development related impacts relative to upstream water quality. Note that as the ANZECC Guidelines are designed for use for whole of catchment monitoring, these guidelines are deemed inappropriate for use in the point source, construction monitoring context proposed for the development.

Should any chemicals or fuel be required for construction purposes, these substances would be stored in a manner that satisfies *Storing and Handling Liquids: Environmental Protection (Participant's Manual)* (DECC, 2007). Emergency spill kits would also be provided at the site, with construction vehicles regularly inspected and maintained to reduce the risk of any fuel or oil spills.

In the event that unexpected ASS is disturbed during earthworks, an ASS Management Plan would be developed. The plan would include controls to divert stormwater surface runoff away from the area. Potential ASS material would be classified with respect to the *Waste Classification Guidelines* (DECCW, 2009), removed from the development site and disposed of at a licensed waste facility.

As a precautionary measure a groundwater and soil sampling program would be implemented prior to the commencement of construction at the development site. The program would be developed and implemented with reference to the known location and migration direction of the Crane Enfield Metals contamination plume (based on a review of the contamination and remediation assessments undertaken at that site). The program would include consideration of the risk of uncovering contaminated groundwater and/ or soils during construction works. Should the risk of uncovering contaminated groundwater be identified on site, detailed measures would be developed in consultation with the EPA and NOW and would be put in place to control occupational health risks to workers. The detailed measures would also ensure that the development through its construction works does not exacerbate the risks to river water quality (e.g. by increasing leachate volumes through soil disturbance/ runoff) significantly more than the existing case, acknowledging that there already is leachate flow into the river.

Upon completion of construction, all areas subject to temporary construction disturbance would be rehabilitated to ensure ground stabilisation. The following rehabilitation measures would be applied:

- areas that would be retained as cleared easements into the operational phase (the pipeline and overhead power line easements) and the compound site would be vegetated with grass species (hydro-seeding) only;
- all remaining disturbed areas would be revegetated to a standard equal to or better than existing and to aid in the visual screening of built element of the development, consistent with the *Land Rehabilitation Manual* (Soil Conservation Service of NSW and PLDC, 1986);
- rehabilitation would be undertaken using indigenous species consistent with existing ecological communities and to provide a low risk of ongoing conflict with adjacent easements (e.g. low risk of overhanging into the power line easement and associated conflict with safety clearance requirements); and
- revegetation measures would be supplemented by other ground stabilisation measures (including the ongoing use of erosion and sediment control) to ensure appropriate site stabilisation until the vegetation is established.

Prior to the completion of construction, a maintenance and monitoring program would be developed and implemented to monitor the effectiveness of revegetation and ground stabilisation measures implemented. This would include regular inspection and maintenance of rehabilitation measures (including watering and replanting of dying plants) to ensure no risk of sedimentation to the Nepean River. Monitoring and maintenance measures would continue until the rehabilitated vegetation has been established and no longer requiring any supplementary erosion and sediment control to prevent sedimentation into the Nepean River.

PLDC and/ or the future management authority of the PLS would in consultation with the EPA ensure that pumping of water for the PLS only commences, after the EPA is satisfied the remediation works undertaken at the Crane Metals Site has sufficiently addressed leachate issues to the Nepean River, such that water quality at the Nepean does not pose a health risk to the PLS.

13.5.2 Conceptual Erosion and Sediment Control Plan (ESCP)

As discussed in **Section 13.5.1** a detailed ESCP would be developed as part of the CEMP for the development prior to the commencement of construction and implemented for the duration of construction works. It is expected that the ESCP would include (but not necessarily be limited to) details of the following:

- identification of locations within the development site and/or site specific activities which are likely to pose the highest risk of erosion and sedimentation (e.g. embankment works, works within the river, stockpiling, trenching etc);
- Identification of a standard list of practices that would apply to the site as a whole and identification of location and activity specific measures that would apply to manage specific areas of erosion and sedimentation risk;
- include location and/ or activity specific site plans identifying the location and type of mitigation measures to be implemented for that location/ activity to guide day to day construction management on site;
- monitoring and review protocols to identify the frequency of inspection of site measures and review of measures to determine their effectiveness and appropriateness as construction progresses; and
- responsibilities of site personnel, outlining who is responsible for implementing, monitoring, reviewing and maintaining the measures on site.

Details of the ESCP would be finalised as part of the CEMP for the development.

13.5.3 Operation

Following the implementation of rehabilitation measures at the completion of construction (as discussed above), the development is not expected to pose an ongoing risk of erosion and sedimentation to the Nepean River. Ongoing inspection and maintenance requirements for the development (including vegetation maintenance within the pipeline easement) would be incorporated into the maintenance requirements for the PLS as a whole and would become the responsibility of the relevant authority that would take over the management and operation of the PLS. The ongoing operation and maintenance of the power line component of the development would be taken over by Endeavour Energy, as the new power line would become part of Endeavour Energy’s electricity asset.

The DGRs issued for the development have required consideration of storm water management for the development including a stormwater management plan. As noted previously, the development is not expected to pose an ongoing risk of erosion and sedimentation in the operational phase. Clean stormwater runoff from the development site which does not infiltrate into the soil is expected to drain via overland flow into the Nepean River (from the pumping station and development elements on the river bank – MCC and transformer) and/ or across the PLS into the southern wetlands (from the pipeline easement). Clean runoff from the power line easement would most likely drain into Council stormwater drains along Lugard Street. A Stormwater Management Plan for the PLS is being developed as part of the Stage 2 Water Management Plan. This Plan details how stormwater runoff from within the PLS catchment would be directed and used to maintain lake water levels within the PLS. Stormwater flow from the NRPP development site would be consistent with the provisions of this plan.

13.6 Conclusion

The main potential for impacts to soil and water from the development would occur during construction works. Construction works have the potential to impact on soils, water and local topography.

The primary potential impacts from the development are related to erosion and sediment. The construction phase would involve clearance of vegetation, in-stream works, alteration of river banks and other features of the Nepean River, which pose a high risk of erosion and sedimentation into the Nepean River. The location of the current NRRP development in a steeper section of the river bank would pose additional challenges with respect to mitigation and control measures. However, in general the soil and water risks of the current development are expected to be similar and comparable to the previously approved project which also involved works within the Nepean River. The current development would however involve an overall smaller disturbance footprint along the banks of the Nepean River compared to the previously approved project and consequently less potential for erosion and sediment potential in this regard. In order to minimise the potential for impact, a detailed CEMP including ESCP would be prepared and implemented for the development. A conceptual ESCP has been developed for this EIS.

There is a contaminated groundwater plume approximately 600 m to the east of the development site. Due to its distance from the development, no direct interception of this plume is expected during earthworks. However, as leachate associated with this plume has been identified to be migrating west and already leaching into the Nepean River, there is the potential for excavation works associated with the development to uncover contaminated soils and/ or groundwater associated with this plume. As a precautionary measure, a detailed soil and groundwater testing program is proposed to be implemented prior to the commencement of construction to determine the presence of any contaminated leachate within the development area and to determine development-specific construction mitigation measures to be implemented on site should the presence of these contaminants be identified.

The site and surround has been identified to pose a low risk of containing ASS or salinity, and as such there is considered little risk of encountering either during construction.

Overall the soils and water impacts of the proposed development are considered to be temporary and manageable and unlikely to result in long-term adverse impacts to the Nepean River or its surrounds.