Veolia Environmental Services (Australia) Pty Ltd

Woodlawn Bioreactor

Modification to surface water and leachate management

11 December 2015

PARSONS BRINCKERHOFF

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Abbreviations

AEMR	Annual Environmental Management Review
AHD	Australian Height Datum
ARI	Average Recurrence Interval
Bioreactor	Woodlawn Bioreactor
Development Consent	Q91/00233
DP&E	NSW Department of Planning and Environment
EA	Environmental Assessment
ED	Evaporation Dam
ED1	Woodlawn Mine Evaporation Dam
ED2	Woodlawn Mine No. 2 Evaporation Dam
ED3	Woodlawn Mine No. 3 Evaporation Dam (overall)
ED3N	Woodlawn Mine No. 3 Evaporation Dam (southern portion)
ED3S	Woodlawn Mine No. 3 Evaporation Dam (northern portion)
EL	Exploration Licence
EPA	NSW Environment Protection Authority
EP&A Act	*NSW Environmental Planning and Assessment Act 1979*
EPBC Act	Commonwealth *Environmental Protection and Biodiversity Conservation Act 1999*
EPL	Environment Protection Licence
ESD	Ecologically Sustainable Development
FM Act	*Fisheries Management Act 1994*
GMLEP	Goulburn Mulwaree Local Environmental Plan 2009
Ha	Hectares
IMF	Intermodal Facility
Km	Kilometres
LEP	Local Environmental Plan
LGA	Local Government Area

MBT	Mechanical and Biological Treatment Facility
MNES	Matters of National Environmental Significance
NPW Act	*National Parks and Wildlife Act 1974*
NV Act	*Native Vegetation Act 2003*
OEH	Office of Environment and Heritage
OER	Odour Emission Rate
PCD	Plant Collection Dam
PoEO Act	*Protection of the Environment Operations Act 1997*
Project Approval	PA 10_0012
S(C&PL) 20	Special (Crown and Private) Lease 20
SEPP	State Environmental Planning Policy
SOER	Specific Odour Emission Rate
TD	Tailings Dam
TDN	Tailings Dam North
TDS	Tailings Dam South
TDW	Tailings Dam West
Veolia	Veolia Australia and New Zealand
WM Act	*Water Management Act 2000*
Woodlawn Site	Woodlawn Eco-precinct
WRD	Waste Rock Dam
WRP	Woodlawn Retreatment Project
WUP	Woodlawn Underground Project

1. Introduction

1.1 Background

The Woodlawn Eco-precinct (Woodlawn Site) is owned and operated by Veolia Australia and New Zealand (Veolia), located approximately 250 kilometres south west of Sydney in the NSW Southern Highlands. The Eco-precinct covers an area of 6000 hectares, comprises of the operating Pylara and Woodlawn pastoral properties and contains the existing Bioreactor, Wind Farm and Power Station and is constructing a mechanical and biological treatment facility (MBT) (refer to Figure 1.1).

An integral part of the Woodlawn Site is the Woodlawn Bioreactor (Bioreactor), where waste landfilling and landfill gas extraction occurs in the void of a remnant open cut mine, approximately 33 million cubic metres in capacity. The Bioreactor has been operating since September 2004, with the energy generation commencing in 2008. This occurs at the adjacent Woodlawn Bio Energy Power Station.

Municipal waste used at the Woodlawn Site is transported from Sydney in shipping containers via rail and unloaded onto road trucks at the Crisps Creek Intermodal Facility (IMF), owned and operated by Veolia and located approximately 8 km away in the township of Tarago. Local waste from neighbouring councils and businesses is transported directly via road.

The Woodlawn Site was previously a copper-zinc mine (1978 – 1998), operating both as an open pit and underground mining operation. Associated infrastructure included crushing and concentrating plants, evaporation dams and tailings storage facilities. In 1998, Denehurst Limited went into receivership, leaving the site with only minor rehabilitation completed. An active mineral exploration licence owned by Heron Resources Limited (Heron Resources) covers the site in addition to an active mining licence held by Tarago Resources Pty Ltd. Heron Resources hold a planning approval to undertake re-treatment of the tailings dams and further underground mining for base metals, gold and silver. A date for the commencement of mining or tailings reprocessing has not been set.

Veolia is constructing a Mechanical and Biological Treatment Facility (MBT) on the western side of the site. The purpose of the MBT is to separate the organic components from co-mingled waste for onsite composting to generate compost for land application to assist in achieving Veolia's rehabilitation objectives.

1.2 Need for the proposed modification

During the last few years, Veolia has improved the leachate treatment capacity at the Woodlawn Site and leachate volumes in the northern cell of evaporation dam 3 (ED3N) are now operating near capacity. As such, there is concern about the long-term adequacy, functioning and capacity of the site's ability to control leachate levels within the waste mass. If leachate builds up within the landfill, biogas capture will be reduced and the site's environmental performance will be compromised. Veolia is currently experiencing this as a result of scaling back leachate extraction rates to preserve the storage volume within the ED3N ponds until the required approvals have been obtained.

Veolia proposes to adjust the operational water management practices at the site to enable increased storage of leachate. The proposed amendment to Veolia's operations (the proposed modification) would use existing dams at the site to achieve this. Veolia proposes to use the southern portion of evaporation dam 3 (ED3S) for treated leachate storage. ED3S is currently used for storage of collected stormwater, this stormwater would be transferred to evaporation dam 2 (ED2). ED3S would need to be lined before it is used to store treated leachate. Pipes associated with treated leachate and stormwater transfer between the mine voids, ED3S, ED3N and ED2 would also need to be extended. The proposed modification is described further in Section 3.

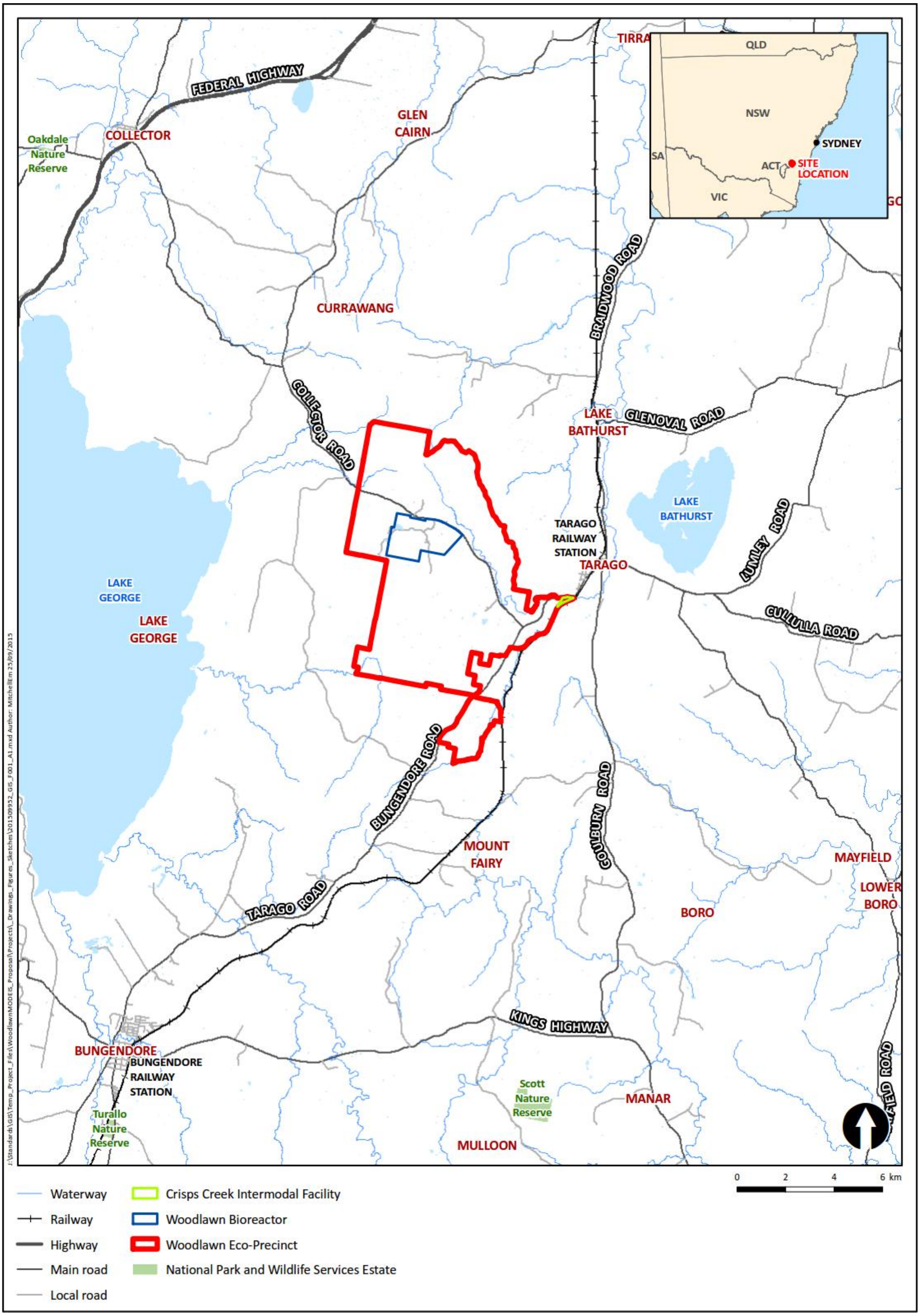

Figure 1.1 Location plan

Discussions with NSW Environment Protection Authority (EPA) and Department of Planning and Environment (DP&E) have highlighted the following key issues associated with the proposed modification:

- Water resources – changes to the site's water management scheme may create additional risks to local water resources. This could occur through overflows from the stormwater storage ponds and treated leachate ponds if adequate freeboards are not maintained. A water balance study (WSP | Parsons Brinckerhoff, 2015a) has been prepared for the proposed modification and is summarised in Section 5.4 and provided in Appendix B.
- Odour – use of ED3S for treated leachate storage will introduce a new odour source at the site, albeit a minor one that is localised around the dam (source). This has been addressed through an odour impact assessment which is summarised in Section 5.5 and provided in Appendix C.

This report presents the assessment of likely environmental effects resulting from the proposed modification to modify the approved operational water management at the Woodlawn site.

1.3 Purpose of this document

This Environmental Assessment (EA) has been prepared to support an application under Section 75W of the *Environmental Planning and Assessment Act 1979* (EP&A Act) to modify Development Consent Q91/00233 (the development consent) and Project Approval 10_0012 (the project approval) to include the proposed modification. Section 3 describes the proposed modification in more detail.

This EA has been prepared to consider the implications of the proposed modification in accordance with the requirements of the EP&A Act and Environmental Planning and Assessment Regulation 2000.

1.4 The proponent

The proponent for the proposed modification is Veolia Australia and New Zealand trading as Veolia Environmental Services (Australia) Pty Ltd (ABN: 20 051 316 584). Contact details for the proponent are:

Veolia Environmental Services	Phone: 132 955
Cnr Unwin & Shirley Streets	Email: nsw@veolia.com.au
Rosehill NSW 2142	

1.5 Document structure

This document is structured as follows:

- Section 1 (Introduction) – discusses the background to the proposed modification, describes the proponent and outlines the need for the proposed modification.
- Section 2 (Existing operations) – describes the current and approved operations at the Woodlawn Eco-precinct.
- Section 3 (Proposed modification) – describes the proposed modification.
- Section 4 (Regulatory framework) – considers the regulatory framework for the proposed modification, considers the applicability of Commonwealth and State legislation and relevant planning instruments, and provides an overview of consultation undertaken with stakeholders.

- Section 5 (Environmental impact assessment) – identifies and assesses the potential environmental impacts of the proposed modification and describes the measures that would be implemented to mitigate these.
- Section 6 (Conclusion) – provides a conclusion to the findings of the EA, including a justification for the proposed modification.

2. Existing operations

2.1 Current operations

The bioreactor and IMF form part of the Woodlawn Site, which is located approximately 7 kilometres (km) west of Tarago, New South Wales. The site primarily receives containerised municipal waste by rail from Sydney to the IMF facility which is then trucked to the bioreactor for treatment and disposal in the former mine void. Additionally, waste is received by road from local Council's and businesses (known as regional waste).

The bioreactor comprises of:

- a former mine void (converted to the Woodlawn Bioreactor for landfilling activities)
- the bioreactor leachate extraction and treatment infrastructure
- the bioreactor stormwater collection dams and associated infrastructure
- an evaporation dam (split into stormwater and treated leachate evaporation ponds)
- biogas extraction infrastructure
- an onsite power station with 6 landfill gas generators
- an access road, administration offices and workshop.

The bioreactor is located within the Special (Crown & Private Lands) Lease 20 (S(C&PL) 20).The boundary of S(C&PL) 20 is referred to as the Woodlawn Mine which was mined for gold, silver, copper, lead and zinc by Denehurst from 1978 to 1998.

The bioreactor co-exists with other mine infrastructure within the site. The former mining operation created three tailings storage dams (TDN, TDW and TDS), one waste dump, three evaporation dams (ED1, ED2 and ED3), one freshwater dam (Woodlawn Dam), one processing plant complex and administration block.

2.2 Water management

Veolia operates the Woodlawn Site as a zero contaminated water discharge site. In order to manage the water levels in dams utilised as part of Veolia's operations, water transfer volumes are monitored at regular intervals. Water quality data is also monitored in ED3 and Woodlawn Dam, as well as at surface water and groundwater monitoring sites within the Woodlawn Site.

The disturbed area within the Woodlawn Site has been progressively rehabilitated since mining ceased in 1998. Runoff from disturbed areas that are not yet rehabilitated are stored in water management ponds.

- The decant ponds developed within the tailings dams: West (TDW), North (TDN) and South (TDS) receive rainfall runoff from within the tailings dam surfaces. In the unlikely event when these dams would ever be near their freeboard level, water would be transferred to the evaporation dam 1 (ED1).
- ED1 is the final storage of majority of sources of runoffs from the disturbed areas. It receives stormwater from the disused plant complex and administration block, the dolerite stockpile and the waste dump seepage collected in the waste rock dam (WRD).
- The stormwater runoff from the disused plant complex and administration block are first collected in the plant collection dam (PCD). Stormwater is pumped out of PCD to ED1 based on water level triggers.
- Evaporation dam 2 (ED2) currently does not receive any runoff from external sources. This dam was constructed by Denehurst to increase storage capacity when ED1 was approaching its maximum allowable water storage during mining operations. Since mining operations ceased in 1998, the water level in ED2 as well as ED1 has been continuously declining.

- The northern part of evaporation dam 3 (ED3N) receives leachate that is pumped out from the mine void by Veolia and is split into 4 storage lagoons. A series of spray units are located on the western wall of ED3N to assist in volume reduction of leachate by promoting evaporation. These are only operated when winds are blowing in an easterly direction to minimise potential for spray drift outside the catchment of ED3N.
- The southern part of evaporation dam 3 (ED3S) receives stormwater that is pumped out from the mine void by Veolia. This pond also has 2 lagoons separated by a break wall.

Runoff from rehabilitated areas flows to nearby drainage lines, which drain to Crisps Creek. A portion of the western section of the former waste dump drain to Woodlawn Dam (also known as Fresh Water Dam or Raw Water Dam). Woodlawn Dam also receives groundwater from the Willeroo-Montrose bore field under an extraction licence. The raw water from Woodlawn Dam is used for dust suppression, ablution (after treatment). Drinking water is sourced from tankered water supplies.

Key water management features of the site are show on Figure 2.1.

2.2.1 Leachate management

Leachate from the bioreactor is constantly extracted from a combination of wells and sumps from within the waste mass in order to effectively access biogas for extraction to the onsite power station. The extracted leachate is either:

- required to optimise biogas generation and is recirculated back into the upper layers of the waste mass; or
- considered surplus and is extracted to the leachate treatment dam.

The extracted leachate is treated to remove organic loading and volatile compounds in order to minimise odour at the site. The treated leachate is then stored in the northern section of evaporation dam 3 (ED3N).

2.2.2 Stormwater management

The mine void also receives stormwater runoff down the sides of the void. This is captured by check dams and sumps that are strategically located within the mine void to keep this water separate from the waste and leachate. The stormwater is pumped out of the void to the southern portion of the evaporation dam 3 (ED3S).

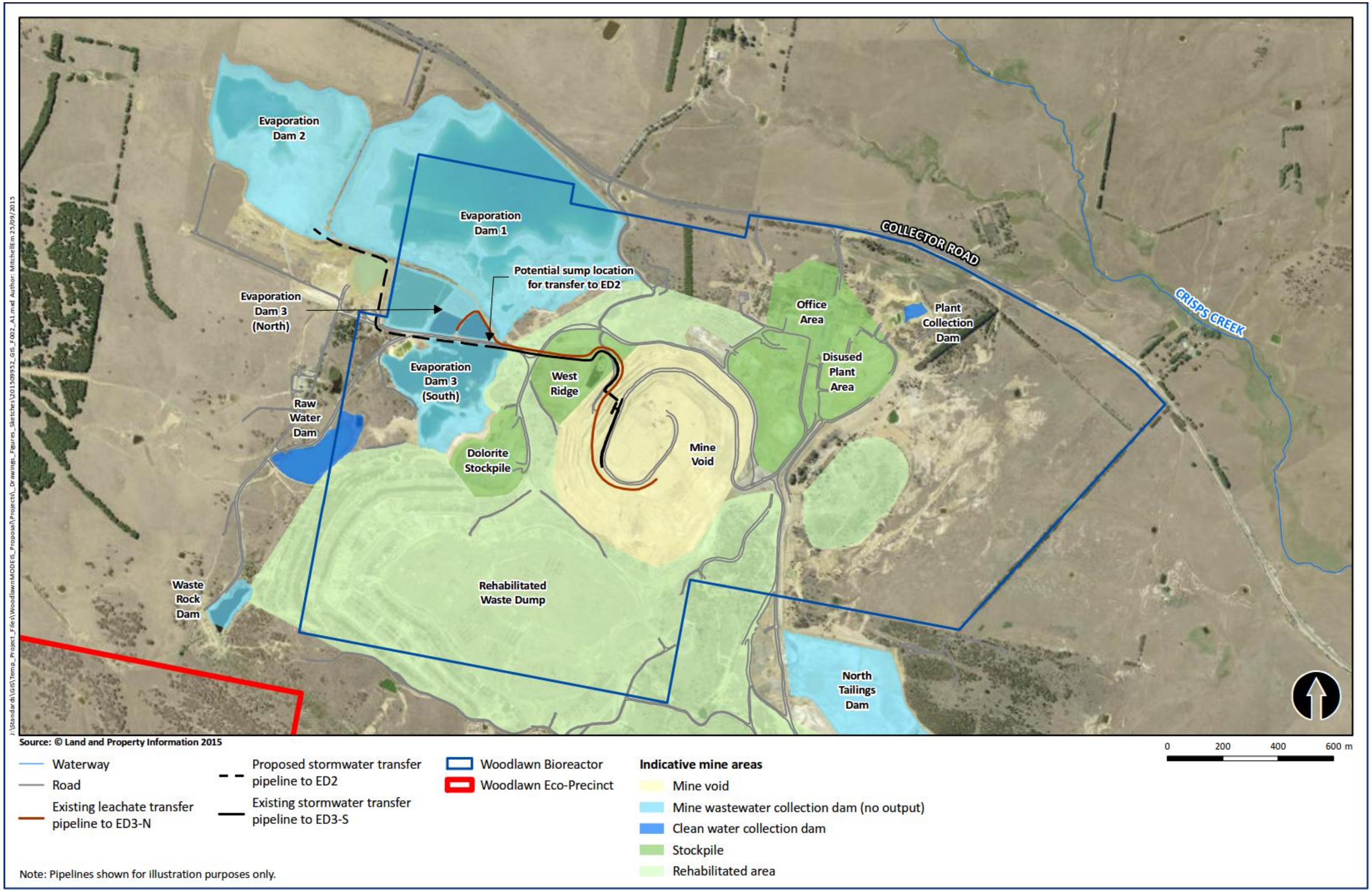

Figure 2.1 Water management within the site

2.3 Environmental management

The site is currently regulated by the EPA under the *Protection of the Environment Operations Act 1997* through Environment Protection Licence (EPL) 11436 and operates under a Landfill Environmental Management Plan which has been developed as required under the approvals discussed in Section 2.3.

The Landfill Environmental Management Plan includes a number of sub-plans which have been developed in consultation with relevant authorities as required by the project approval. These include:

- Air Quality and Greenhouse Gas Management Plan
- Soil and Water Management Plan
- Leachate Management Plan
- Noise Monitoring and Management Plan
- Vegetation Management Plan
- Fire and Emergency Management Plan
- Gas Management Plan
- Geotechnical Stability Management Plan
- Landscape and Vegetation Management Plan
- Landfill Closure and Rehabilitation Management Plan.

Veolia is required to prepare an Annual Environmental Management Review (AEMR) for the site which includes examines the environmental performance of the site. The AEMR is submitted to DP&E annually.

An independent environmental compliance audit is also undertaken at the site every three years by a suitably qualified auditor. These audits examine compliance of the site against the conditions of the project approval and the adequacy of any environmental plans and strategies implemented at the site.

2.4 Land ownership

The site is owned by Veolia and includes the properties “Woodlawn” and “Pylara”. The Woodlawn Bioreactor operational boundary is within the Special (Crown & Private Lands) Lease (S(C&PL)) 20 that was operated by Denehurst for mining until 1998.

Heron Resources (previously known as TriAusMin) Woodlawn Retreatment Project (WRP) and Woodlawn Underground Project (WUP) received approval July 2013 under Part 3A of the EP&A Act. Heron Resources is yet to commence these projects.

Figure 2.2 illustrates the spatial relationship between the operational area of the bioreactor and Heron Resource’s proposed operational area. Note that the studied area for Heron Resources in Figure 2.1 is referred to as TriAusMin operational area with ownership yet to be formally agreed between Veolia and Heron.

Heron Resources has recently completed an exploration program as part of commencing its approved project. Veolia and Heron Resources are finalising agreements regarding ownership of land at the Woodlawn Site. If Heron Resources proceeds with its project, it is expected to utilise all stored water in evaporation and tailings dams in mineral processing, including the ED3S dam where Veolia has been storing stormwater collected from the mine void.

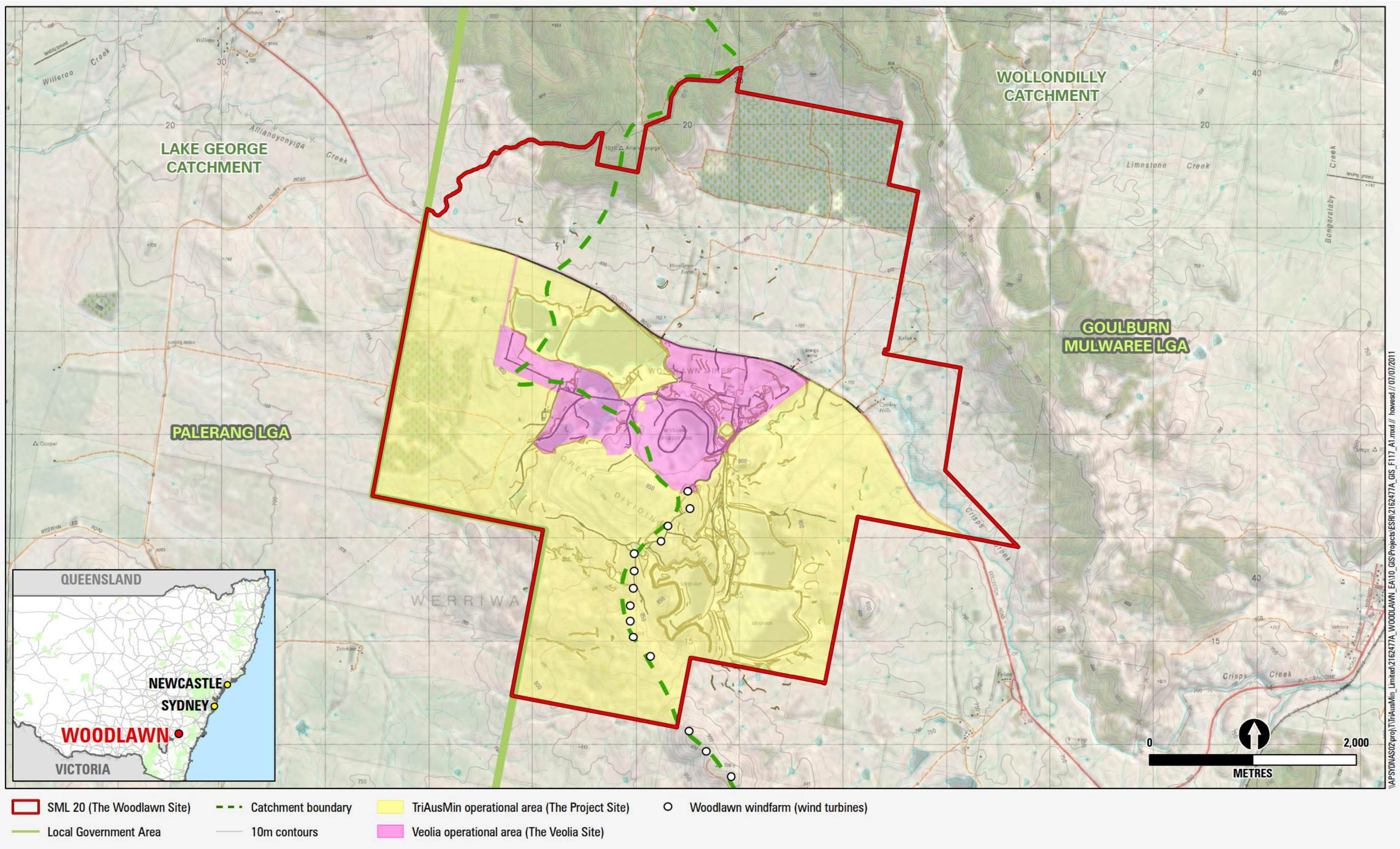

Figure 2.2 **Land uses within the site**

3. Proposed modification

3.1 The proposed modification

As described in Section 1.2, Veolia has improved the leachate treatment capacity at the site and leachate volumes in the northern cell of evaporation dam 3 (ED3N) are now operating near capacity. As such, there is concern about the long-term adequacy, functioning and capacity of the site's ability to control leachate levels within the waste mass. If leachate builds up within the landfill, biogas capture will be reduced and the site's environmental performance will be compromised. Veolia is currently experiencing this as a result of scaling back leachate extraction rates to preserve the storage volume within the ED3N ponds until the required approvals have been obtained.

Veolia proposes to adjust the operational water management practices at the site to gain additional volume for the storage of treated leachate. The proposed amendment to Veolia's operations (the proposed modification) would allow for this by using existing dams at the site that have capacity for increased storage.

The northern half of ED3 has four lagoons (ED3N1, 2, 3 & 4). Water level monitoring of these lagoons shows that ED3N1, ED3N2 and ED3N3 are operating at their maximum allowable water levels. The water level in ED3N4 is operating at approximately 0.8m below its maximum allowable level. Veolia has reduced the leachate extraction rate from the waste to preserve volume within the ED3N system until the required approvals are obtained.

The southern half of ED3 (ED3S) has two lagoons and only water extracted from the mine void is stored and evaporated in this dam.

Veolia proposes to use ED2 to store and evaporate stormwater from the mine void and ED3S lagoons for treated leachate from the bioreactor in addition to ED3N lagoons. The stored water currently within ED3S will be transferred to ED2. ED3S will be lined before its use as leachate storage facility. About 10% of the storage area from the northern lagoon of ED3S will be used as a sump to facilitate water transfer from the mine void to ED2. The remainder of ED3S will store leachate from the mine void.

The proposed modification will require the realignment and extension of above ground pipes associated with leachate and stormwater transfers between dams. The pipes may be installed underneath existing site roads where crossings occurring. In these areas, the pipes would be installed under the road through trenching.

Figure 2.1 provides an overview of the proposed modification.

4. Regulatory framework

This Section of the EA provides a description of the regulatory framework under which the Woodlawn Bioreactor operates and statutory considerations applicable to the proposed modification.

4.1 Existing approvals

The site operates under the following approvals that are the subject of this EA:

- Project Approval PA 10_0012 (the project approval) – issued under Part 3A of the EP&A Act on 16 March 2012. This approval allowed for an increase in the maximum input rate for the bioreactor from 500,000 tpa to 1.13 million tpa.
- Development Consent Q91/00233 (the development consent) – issued under Part 4 of the EP&A Act on 30 November 2000. This approval provided for the establishment of the Woodlawn Bioreactor to receive up to 500,000 tpa of general solid waste.

Relevant clauses of these approvals that relate to operation of ED3 and leachate management would need to be amended to allow for the proposed modification. These are outlined in Table 4.1.

Table 4.1 Approval conditions relevant to the proposed modification

Reference	Requirement	Requested change
Project Approval PA 10_0012		
Schedule 4, Clause 16	*The proponent shall prepare and implement a Soil & Water Management Plan for the Landfill to the satisfaction of the Director-General. This plan must:* *(c) must specifically consider soil and water management (including leachate management) at the Landfill and ED3.*	▪ Add a requirement to update the plan to reflect changes in use of ED2 and ED3.
Development Consent Q91/00233		
Schedule 2, Clause 58	*There must be no discharge of waters from the area subject to the Development Application, unless more than 210mm of rain falls within a 72 hour time period (1 in 100 year ARI of 72 hours duration).*	▪ The development consent boundary does not include ED2 and this clause needs to be amended to allow controlled discharges to ED2.
Schedule 2, Clause 64	*Stormwater in the mine void must only be discharged into ED3, or otherwise used for operational purposes within the landfill, as approved in writing by the EPA.*	▪ This clause needs to be amended to allow for stormwater to be discharged to ED2.
Schedule 2, Clause 65	*Stormwater in the mine void may only be transferred into ED3 provided that:* *(a) The Applicant can always comply with condition 58* *(b) The concentration of ammonia in the stormwater to be transferred does not exceed 0.03 mg/L and the concentration of total organic carbon in the stormwater does not exceed 1 mg/L; and* *(c) The stormwater to be transferred contains no leachate.* *Unless otherwise approved in writing by the EPA.*	▪ This clause needs to be amended to include the use of ED2 for stormwater storage.

Reference	Requirement	Requested change
Schedule 2, Clause 132	*The Applicant shall prepare and implement a surface water-monitoring program to monitor the environmental performance of the construction, operation and rehabilitation of the development on surface water. The surface water-monitoring.* …	▪ This clause needs to be amended to include requirements for recording volumes of stormwater transferred to ED2.

The following approvals also apply to the site, but are not relevant to the proposed modification and therefore are not the subject of this EA:

- MP 05_0158 – approved on 11 August 2010 under Part 3A of the EP&A Act. This approval allowed for the IMF to receive waste by road from surrounding municipal Councils.
- PA 06_0239 – approved on 6 November 2007 under Part 3A of the EP&A Act. This approval provided for the 'Woodlawn Alternative Waste Technology Project'.
- PA 07_0143 – approved on 4 July 2013 under Part 3A of the EP&A Act. This approval allowed for mineral extraction and processing of extracted or and existing tailings stored at the site. The proponent for this approval is TriAusMin (now known as Heron Resources) and this project has not commenced.

4.2 Commonwealth legislation

An approval under the EPBC Act is required for any action that is likely to have a significant impact on Matters of National Environmental Significance (MNES). Nine MNES are listed under Part 3 of the EPBC Act of which the following may be relevant to the Woodlawn Site:

- listed threatened species and ecological communities
- migratory species.

If a proposed action is likely to have a significant impact on MNES, the action is deemed to be a *controlled action*. A controlled action can only be carried out with the approval of the Minister under Section 133 of the EPBC Act.

A search of the 'protected matters search tool' which maps MNES, was undertaken on 7 December 2015. This indicated that there are a number of threatened flora and fauna protected by this Act have been recorded in a 10 km area around the site, however; as the proposed modification would not involve the clearing of any vegetation or destruction of fauna habitat, impacts to these matters are considered negligible. Therefore further consideration of this Act is not required.

4.3 State legislation

4.3.1 Environment Planning and Assessment Act 1979

As discussed above, the site operates under approvals issued under Parts 3A and Part 4 of the EP&A Act.

Part 3A was repealed on 1 October 2011 by the *Environmental Planning and Assessment Amendment Act 2011* (the Repeal Act). Schedule 6A of the EP&A Act defines certain projects as 'transitional Part 3A projects'. These include '*an approved project (whether approved before or after the repeal of Part 3A).*

The proposed modification is therefore a transitional Part 3A project as it is an approved project to which Part 3A applies. Clause 3 of Schedule 6A of the EP&A Act provides that Part 3A continues to apply to transitional Part 3A projects following its repeal.

Approval for the proposed modification is therefore sought under Section 75W of the EP&A Act. Section 75W states:

75W Modification of Minister's Approval:

> *"1. The proponent may request the Minister to modify the Minister's approval for a project. The Minister's approval for a modification is not required if the project as modified will be consistent with the existing approval under the Part.*
>
> *2. The request for the Minister's approval is to be lodged with the Director-General. The Director-General may notify the proponent of environmental assessment requirements with respect to the proposed modification that the proponent must comply with before the matter will be considered by the Minister.*
>
> *3. The Minister may modify the approval (with or without conditions) or disapprove of the modification."*

Section 75W(2) states that the Minister's approval is not required where the modified project will be consistent with the approved project. DP&E does not consider the proposed modification to be entirely consistent with the project approval and development consent. Accordingly, a modification to both Q91/00233 and PA 10_0012 is sought under Section 75W of the EP&A Act.

The proposed modification does not represent a substantial change to the existing approvals, consequently it is considered that the Minister is able to modify the approval under Section 75W of the EP&A Act.

As a transitional Part 3A project, Section 75U of the EP&A Act (now repealed) continues to apply to the site and proposed modification. Section 75U specifies a number of authorisations and approvals that are not required for projects approved under Part 3A. Pursuant to Section 75U, the following authorisations are not required for the proposed modification:

- a permit under Section 20, 205 or 2019 of the *Fisheries Management Act 1994* (FM Act)
- an approval under Part 4, or an excavation permit under Section 139, of the *Heritage Act 1977* (Heritage Act)
- an Aboriginal heritage impact permit under Section 90 of the *National Parks and Wildlife Act 1974* (NPW Act)
- an authorisation referred to in Section 12 of the *Native Vegetation Act 2003* (NV Act) (or under any Act to be repealed by that Act) to clear native vegetation or State protected land
- a bushfire safety authority under Section 100B of the *Rural Fires Act 1997*
- a water use approval under Section 89, a water management work approval under Section 90 or an activity approved under Section 91 of the *Water Management Act 2000* (WM Act).

The matters that will ordinarily be considered in these applications for these authorities have been addressed in this EA and previous environmental impact assessments applicable to the site.

4.3.2 Other NSW legislation

Consideration of other legislation that is considered applicable to the proposed modification is outlined in Table 4.2.

Table 4.2 NSW Legislation

Legislation	Key requirements	Relevance to the proposed modification
Dams Safety Act 1978	▪ This act establishes a committee for the surveillance and protection of prescribed dams and surrounding areas. ▪ The committee requires owners of prescribed dams to undertake monitoring to ensure the safety of their dams. This includes periodic assessments and reviews of their dams by appropriately qualified personnel.	▪ Schedule 1 of this Act lists the following dams within the site as being prescribed dams: ‣ Woodlawn Mine Evaporation (ED1) ‣ Woodlawn Mine No.2 Evaporation (ED2) ‣ Woodlawn North Tailings (TDN) ‣ Woodlawn South Tailings (TDS) ‣ Woodlawn West Tailings (TDW). ▪ The proposed modification would not alter the capacity of any of these dams or affect their structure and therefore the modification will not affect dam safety. ▪ Consultation will be undertaken with the Dam Safety Committee regarding the proposed modification if it is approved, as part of its routine reporting requirements.
Mining Act 1992	▪ This act establishes a framework for the regulation of exploration and mineral extraction, including: ‣ Compensation of landholders for loss or damage ‣ Means for an appropriate return to the state from mineral resources ‣ Measures to ensure the appropriate rehabilitation of mine sites. ▪ Under this act, exploration and mining must be undertaken under an authorisation or lease.	▪ Exploration Licence (EL) 7257 and Special (Crown & Private Lands) Lease (S(C&PL)) 20 were issued under this Act and apply to the site. ▪ As discussed in Section 2.4, Heron Resources are currently conducting mineral exploration activities within the site under EL 7257. ▪ Veolia and Heron Resources are finalising agreements regarding land ownership of certain areas so that the operation of the bioreactor and potential mining and mineral processing activities occur simultaneously at the Woodlawn Site. ▪ S(C&PL)L 20 is currently held by Tarago Operations Pty Ltd and expires on 16 November 2029. This licence allows for the mining of a range of minerals within the site, however; mining has not been undertaken since 1998.
Protection of the Environment Operations Act 1997 (PoEO Act)	▪ This act establishes a regime for the prevention of pollution and a regulatory framework for environmental protection. ▪ An environmental protection licence (EPL) is required from the NSW Office of Environment and Heritage (OEH) under this Act for 'scheduled activities' and 'scheduled development work'. ▪ The bioreactor and IMF meet the definition of a scheduled activity under this Act and Veolia operates these facilities under EPL 11436.	▪ The NSW Environmental Protection Authority (EPA) licences the operation of the site, covering the following scheduled activity: ‣ Waste disposal (application to land) ▪ Veolia has undertaken consultation with the EPA regarding the proposed modification and will lodge an application to modify the EPL to account for the proposed modification, if it is approved.

Legislation	Key requirements	Relevance to the proposed modification
Water Management Act 2000 (WM Act)	▪ This Act governs access to, and the use of, water in NSW where water sharing plans (WSP) have commenced. ▪ The following WSPs apply to water sources in the vicinity of the site: ‣ Water Sharing Plan for the Murray-Darling Basin Fractured Rock Groundwater Sources (2012) ‣ Water Sharing Plan for the Murrumbidgee Unregulated and Alluvial Water Sources (2012) ‣ Aquifer Interference Policy (2012) ▪ The following approvals are required under this Act for certain developments: ‣ Water Access Licence (WAL), which approves access to a share of a water source. ‣ Works Approval, which applies to water supply, drainage or flood mitigation works. ‣ Water Use Approval, which applies to specific uses of extracted water. ‣ Controlled Activity Approval, which applies to works in, on or under waterfront land (40 m from the upper bank). ▪ If groundwater extraction is required for the proposed modification, an Aquifer Interference Approval may be required for the work under clause 91F of the WM Act. ▪ A Flood Work Approval is required under this Act for 'flood works' located on a floodplain that may have an effect on the flow of water during a flood event.	▪ The proposed modification will not involve the extraction or capture of any additional water at the site and therefore a WAL is not required. ▪ A Works Approval is not for activities subject to approval under Part 3A of EP&A Act are exempt. ▪ A Water Use Approval for activities subject to approval under Part 3A of EP&A Act are exempt. ▪ A Controlled Activity Approval is not required as no works are being undertaken on waterfront land. ▪ The proposed modification will not involve any additional extraction of groundwater at the site and therefore an Aquifer Interference Approval is not required. ▪ The proposed modification is not being undertaken on a floodplain and therefore a Flood Work Approval is not required.

4.4 State environmental planning policies

Under Section 75R(2)(b) of the EP&A Act, State Environmental Planning Policies (SEPPs) apply to projects which Part 3A applies.

Given this, various SEPPs potentially of relevance to the proposed modification have been identified and discussed.

4.4.1 SEPP 33 – Hazardous and Offensive Development

State Environmental Planning Policy No. 33 – Hazardous and Offensive Development (SEPP33) requires the consent authority to consider the merits of proposed activities, such as its location, measures implemented to minimise its impacts including and the way in which it is to be carried out. A review of the relevant components of the proposed modification has determined that it is not considered to be potentially hazardous or offensive when implemented as described in this EA. As such, a detailed preliminary hazard analysis is not required under SEPP 33.

Further, as per SEPP 33 applies only to developments that are potentially dangerous or offensive and the proposed development does not constitute a potentially hazardous or offensive industry under clause 3, SEPP 33 does not apply to the proposed modification.

4.4.2 State Environmental Planning Policy (Sydney Drinking Water Catchment) 2011

State Environmental Planning Policy (Sydney Drinking Water Catchment) 2011 (SDWC SEPP) seeks to ensure that a proposed development has a neutral or beneficial effect on water quality, thereby preserving Sydney's drinking water catchments. The SDWC is administered by Water NSW.

The site drains to tributaries of Crisps Creek, which eventually drains to a Sydney Drinking Water Catchment (Lake Burragorang). As described in Section 2.2, the site currently operates as a zero contaminated water discharge site and the proposed modification would not alter this.

The 'Neutral or Beneficial Effect on Water Quality Assessment Guideline 2011' (SCA 2011) has been developed to assist with the implementation of the SDWC. Under the guideline, a project is considered to have a neutral or beneficial effect on water quality as long as it:

- has no identifiable potential impact on water quality
- will contain any water quality impact on the development site and prevent it from reaching any watercourse, waterbody or drainage depression on site
- will transfer any water quality impact outside the site where it is treated and disposed of, to standards approved by the consent authority.

Table 4.3 provides an assessment of the proposed works against the 'neutral or beneficial effect test' outlined in Section 3.2 of the guideline, and the requirements for 'no identifiable potential impacts on water quality' outlined in Section 4.4.1 of the guideline.

Table 4.3 Neutral or beneficial effect test for the proposed works

No.	Details	Comparison against the proposed works
Section 3.2 *A proposed development or activity will be found to have a neutral or beneficial effect on water quality if it complies with and demonstrates any of the following:*		
1	*There are no factors involved that have any potential to impact on water quality.* *There will be no changes to site conditions and/or the nature and location of development that could:*	▪ The site will continue to operate as a zero contaminated water discharge site and therefore there will be no potential impacts to water quality in surrounding environments or any changes to the nature of the bioreactor operation.
1a.	*directly change pollutant loads by introducing or increasing substances into the water cycle (such as waste flows, increased erosion, nutrients and sediments) or*	▪ As above.
1b.	*Indirectly change the quality of water in the hydrological system by changing the bio-physical characteristics of the site in any way that reduces or significantly threatens to reduce, the capacity of the site and related hydrological/ecological components to assimilate, treat and otherwise produce water of at least equal quality to the existing systems. Changes relate to the environmental values of the system, and may include:* - *significant changes to water flows (reductions or increases to flows)* - *clearing or degradation of watercourses of riparian corridors* - *changing the path of water flows through these assimilative systems.*	▪ The proposed works will not alter any drainage patterns or local hydrology. ▪ No clearing of riparian vegetation would be required.

No.	Details	Comparison against the proposed works
2	*The development will not adversely affect water quality off-site because:*	
2a.	*pollutant loads from the development/activity can be transported to acceptable downstream treatment and disposal facilities without adverse off-site water quality impacts, or*	▪ Pollutants from the site will continue to be contained with the site's water management system and no-offsite water quality effects would be expected.
2b.	*any water quality issues can be effectively managed on-site so that there are no adverse water quality impacts off-site, or*	▪ The site will continue to operate as a zero contaminated water discharge site and therefore there will be no potential impacts to water quality in surrounding environments or any changes to the nature of the bioreactor operation.
2c.	*there are no indirect adverse impacts on water quality caused, or likely to be caused, by changes to factors that currently affect water quality off-site such as treatment, assimilation of pollutants, or the hydrological cycle (such as changes to flow or flow-paths, water courses or riparian corridors).*	▪ No indirect off-site water quality impacts would be expected to result from the proposed works as no clearing of riparian vegetation, assimilation of nutrients or changes to hydrological patterns would occur.
Section 4.4.1 *It is safe to assume that a development will have no identifiable potential impact on water quality if the development is unlikely to result in:*		
▪ *a change in surface imperviousness (or result in an impervious area less than 50 square metres)*		▪ The proposed modification would not result in the creation of any hardstand areas.
▪ *a concentration of flow of water*		▪ The proposed modification would not concentrate the flow of any waters (such as drainage lines).
▪ *the impedance of flow of water*		▪ The proposed modification would not impede the flow of water of any drainage lines during construction or operation.
▪ *a substantial disturbance of soil (more than 50 square metres)*		▪ The proposed modification would not result in the disturbance of more than 50 square metres of soil. Minor soil disturbance may occur when ED3S is lined, however, this dam is considered to already be disturbed.
▪ *discharge of effluent, dust pollutants or stormwater*		▪ The proposed works would not result in the discharge of effluent, dust pollutants or stormwater.

As shown in Table 4.1, the proposed works meet the requirements for having a neutral or beneficial water quality impact as required by the SDWC.

4.5 Local environmental plans

Under Section 75R of the EP&A Act environmental planning instruments, other than SEPPs, do not apply to Part 3A projects. Notwithstanding this, local environmental plans (LEPs) are relevant for consideration of the permissibility of the proposed modification.

The site is located in the Goulburn-Mulwarree Local Government Area (LGA) and is therefore subject to the Goulburn Mulwarree Local Environmental Plan 2009 (GMLEP). Under this plan, the site is located within the following land-use zones:

- IN3 Heavy Industrial
- RU2 Rural Landscape.

The proposed modification would occur in parts of the site zoned IN3 Heavy Industrial. The current use of the site as a bioreactor and waste management facility is not listed as a prohibited activity in the GMLEP and is therefore considered permissible with consent in this zone. As approval for the proposed modification is being sought under Part 3A of the EP&A Act, development consent is not required. Notwithstanding this, the proposed modification is considered to be generally consistent with the GMLEP.

4.6 Consultation

In preparing for the proposed modification and undertaking this EA, Veolia has undertaken the consultation activities described in Table 4.4.

Table 4.4 Stakeholder consultation

Stakeholder	Summary of consultation	Issues raised	How addressed in this EA
NSW Department of Planning and Environment (DP&E)	▪ Initial discussion meeting on 16 September 2015 ▪ Letter sent to briefing of the proposed modification on 25 September 2015. ▪ Phone conversations between October 2015 and November 2015.	▪ Whether modification would be required ▪ Approvals relevant to the site. ▪ Potential for water discharges and water related issues.	▪ Section 4.1 ▪ Section 5.3.
NSW Environmental Protection Authority (EPA)	▪ Site meeting with EPA to discuss requirements on 20 August 2015 ▪ Phone conversation to clarify odour assessment approach in September 2015	▪ Potential for odour issues and odour assessment would be required ▪ EPL licence modification requirements. ▪ Potential for water management issues ▪ Stormwater discharge criteria likely to be required	▪ Section 5.5. ▪ Section 4.3.2. ▪ Section 5.4.

5. Environmental impact assessment

5.1 Environmental risk assessment

To assist in identifying key issues and potential impacts associated with the proposed modification, a preliminary risk analysis has been completed and is included in Appendix A.

The key impacts identified through this process and through consultation with relevant regulators (refer to Section 4.6) were found to be:

- Potential for erosion and land management issues during the draining and lining of ED3S (addressed in Section 5.3).
- The ability of the proposed modification to provide sufficient water and treated leachate storage to enable efficient operation of the site, and to maintain the zero contaminated water discharge requirements of the site (addressed in Section 5.4).
- Potential for additional odour generation due to the use of a new treated leachate storage (addressed in Section 5.5).

These issues are investigated further in the following sections.

Other issues, such as the potential for air and noise impacts during the construction period, requirements for clearing of vegetation and other issues were considered in the environmental risk assessment. These issues were found to be either not required for the proposed modification or not applicable as they would not create any additional impacts above those already occurring from normal operation of the site.

As described in Section 2.3, the site operates under a Landfill Environmental Management Plan and this would be implemented during construction and operation of the proposed modification to ensure any unexpected environmental impacts are identified and adequately managed.

5.2 Mitigation of impacts

Due to the limited impacts associated with the proposed modification and Veolia's implementation of an existing environmental management program across the Woodlawn Site (refer to Section 2.3), the environmental risk assessment and more detailed impact assessments provided in the following sections have not identified the need for any additional mitigation measures.

Veolia would continue to implement its operational environmental management systems during construction and operation of the proposed modification. These include system to manage environmental impacts and respond to any incidents. Veolia would also be bound by its statutory obligations under its EPL and general environmental protection requirements of relevant legislation such as the PoEO Act.

5.3 Soils and land management

5.3.1 Features of the proposed modification area

The average elevation of the Woodlawn Site is approximately 800 metres above Australian Height Datum (mAHD), with a range in elevation from 760 mAHD in the north-east corner of the Site to 1,000 mAHD along the ridgeline of the Great Dividing Range. The region generally comprises rolling undulating pastoral plains with the Great Dividing Range running through the Site in a north–south direction. The western side of the Great Dividing Range (roughly one-third of the Woodlawn Site) forms part of the Lake George Catchment, an ephemeral lake, while the remainder on the eastern side of the Great Dividing Range is part of the Wollondilly Catchment.

Sections of the Woodlawn Site such as the mining void and various remnant embankments have steep slopes although many of these are either excavated in in-situ rock or are constructed from waste rock and generally erosion resistant.

The proposed modification will affect dams ED2 and ED3, and pipes associated with leachate and stormwater transfer (shown on Figure 2.1). This part of the Woodlawn Site is generally flat, with the former mine void and waste dump located immediately to the south. Collector Road (a local public road) is located immediately to the north. The Woodlawn Site office facilities are located approximately 1 km to the north east of ED3S.

The area surrounding the Woodlawn Site consists of undulating plains used for sheep and cattle grazing. Lake George is a large ephemeral fresh water lake located approximately 8 km west of the Woodlawn Site. Lake Bathurst, is located 9 km to the east. A network of ephemeral fresh water drainage channels exist on the Woodlawn Site, draining into the Wollondilly and Lake George Catchments. Water within operational areas is captured and diverted to the stormwater dams described in Section 2.2.2.

5.3.2 Soil landscapes

The soil landscapes of the Woodlawn Site are mapped in the *Soil Landscapes of the Braidwood* (Jenkins, 1996). This shows the entire area is covered by anthropogenic soils which are soils that are disturbed by human activities.

The Woodlawn Site has been substantially disturbed and modified by mining activities. Large areas of exposed rock (mining void, cut batters) and dumped waste rock exist on site. There is essentially no topsoil and any previous topsoil resources would appear to be have either lost during mining activities or used for site rehabilitation works.

Extrapolation of the soil landscape maps undertaken for previous assessments at the site indicates that the soils that existed on site prior to mining were either the Duckfield Hut Soil Landscape or the Kalbili (Variant) Soil Landscape (WSP | Parsons Brinckerhoff, 2015b).

The properties and constraints of the three soil landscapes are listed in Table 5.1.

Table 5.1 Soil landscapes properties and constraints

Soil Landscape	Soils	Properties
Duckfield Hut	Shallow, well drained Lithosols on crests, moderately deep Red Podzolic Soils on well drained side slopes and upper slopes. Moderately deep, moderately well to imperfectly drained Yellow Podzolic Soils on mid to lower slopes. Moderately deep to deep, poorly drained Soloths, Solodic Soils and Solodised Solonetz on lower slopes and drainage lines.	Seasonal waterlogging with localised rock outcrop, foundation hazard, saline seepage and waterlogging. Soils are infertile and locally shallow and topsoils are hard-setting. Subsoils are highly erodible, sodic, hard-setting, have low wet bearing strength and shrink-swell properties.
Kalbili (Variant)	Shallow, moderately well drained Earthy Sands/Loams on upper slopes. Moderately deep to deep, poorly drained Yellow Podzolic Soils and Solodic Soils on lower slopes.	Seasonal waterlogging, water erosion hazard, foundation hazard and run-on. Infertile soils, topsoils are acid. Subsoils are sodic, erodible, hard-setting and have low permeability.
Disturbed Terrain	Varies from level plains to undulating terrain and has been disturbed by human activity to a depth of at least 1 m. The original soil has been removed, greatly disturbed or buried. Most of these areas have been levelled to slopes of <5%. Landfill includes a wide variety of soil, rock building and waste material. The original vegetation has been completely cleared.	Dependent on the nature of the fill material and may include mass movement hazard, soil impermeability leading to poor drainage, low fertility and toxic material.

5.3.3 Impact assessment

The proposed modification will result in the following minor disturbance to the Woodlawn Site:

- Extension and realignment of stormwater and leachate transfer pipes (as shown on Figure 2.1)
- Change in use of ED2 to a stormwater storage dam
- Change in use of ED3 to a treated leachate management dam (including draining and lining of the dam with an impervious material before its use for leachate storage)
- Excavation of trenches across existing roadways and access tracks, where pipeline crossings are required.

These disturbances will occur in a part of the site that has previously been extensively disturbed by mining activities and is maintained as operational areas within the Woodlawn Site. During the construction activities described above, there is the risk that erosion could occur to disturbed areas (such as ED3S during lining activities or pipeline trenches). If this did occur, any sediment would be caught in the site's stormwater management system and would not flow off-site. Eroded areas would be rehabilitated to address any issues. There would be no additional erosion risk once construction is complete and ED3S is used for treated leachate storage.

5.4 Surface water

5.4.1 Existing environment

Lake George is a large ephemeral fresh water lake located approximately 8 km west of the Woodlawn Site. Lake Bathurst, is located 9 km to the east. A network of ephemeral fresh water drainage channels exist on the Woodlawn Site, draining into the Wollondilly and Lake George Catchments.

The headwaters and three tributaries of Crisps Creek originate within the Woodlawn Site and flow in a south-easterly direction before discharging to the Mulwaree River in the Wollondilly River Catchment. This catchment forms part of the Warragamba Dam catchment, which contributes to Sydney's drinking water supply. The catchment of Crisps Creek has an area of approximately 3,200 hectares (ha), which represents 0.3% of the Wollondilly River Catchment.

Surface water monitoring has been undertaken on site since prior to the commencement of construction in accordance with the requirement of EPL 11436. The results of the monitoring program have been reported each year in the *Annual Return* and *Annual Environmental Management Report*.

Surface water monitoring is undertaken upstream and downstream of the Woodlawn Site on Crisps Creek, downstream on Allianoyonyige Creek and within all the water storage dams on site.

Upstream surface water on Crisps Creek is strongly acidic with low electrical conductivity. Downstream surface water on Crisps Creek is slightly alkaline with higher conductivity than upstream that is reflective of the sodic subsoils and salt scalds evident on the agricultural land upstream of the monitoring location.

Surface water downstream of Evaporation Dam 1 (ED1) and Evaporation Dam 2 (ED2) on Allianoyonyige Creek has moderate alkalinity and low electrical conductivity.

Surface water quality with the various dams on site generally demonstrates extreme acidity with elevated electrical conductivity and heavy metals that is a function of water management during mining operations and management of stormwater and leachate from the mine void.

5.4.2 Impact assessment

WSP | Parsons Brinckerhoff prepared a water balance study for current activities and those planned under the proposed modification for the bioreactor.

The 2015 water balance is included as Appendix B and concluded that:

- ED2 will be able to safely store stormwater from the mine void without exceeding its maximum allowable water level subject to model parameters adopted in the water balance model.
- No changes in water balance for ED1, TDS, TDN and TDW are expected by the proposed modification.
- Leachate discharge from the mine void is expected to vary between 0.5 L/s and 3.0 L/s. Time estimates for ED3S pond to fill up to maximum levels depend on future climate sequences and rates of leachate transfer. Simulated estimates for the historic wettest, the driest and the average climate sequences show that the proposed modification will provide for a minimum of 248 days of treated leachate storage at the maximum pumping rate (under wet weather conditions).
- Once ED3S fills up to the freeboard level, the daily average rate of leachate transfer from the bioreactor will need to be reduced to contain the leachate and direct rainfall and runoff volumes within the leachate management ponds. Under this scenario, pumping of leachate could continue to EDS3 at the following rates
  - 1.2 L/s under average weather conditions
  - 0.15 L/s under wet weather conditions.
- Future climatic conditions are difficult to predict and therefore a risk based approach to leachate management is required. If prolonged wet conditions occur, leachate extraction from the bioreactor may need to be reduced or suspended unless alternative storage pond is developed or the leachate treatment system is upgraded sufficiently to facilitate offsite discharge.

5.5 Air quality – odour

5.5.1 Existing environment

Veolia has commissioned specialist odour consultancy The Odour Unit Pty Ltd to undertake annual odour audits of the Woodlawn Bioreactor site. Previous audits in 2012 and 2013 identified elevated odour emissions from ponds ED3N-1 and ED3N-2 respectively as a result of insufficient treatment in the Leachate Aeration Dam system. Improvements to this system resulted in a large decrease in odour emissions from all four ED3N ponds in 2014 to extremely low levels. These results and the 2015 Audit results are presented in Table 5.2.

The 2015 audit results show a slightly higher rate of odour emission from all four ED3N ponds when compared with 2014, but still very low rates of odour emission for treated wastewater systems. These elevated odour emissions are being investigated by Veolia and will be reported in the 2015 Odour Audit Formal Report.

Table 5.2 Measured odour emissions for ED3N between 2012 and 2015

	2012				2013		2014		2015	
Location	Dam Surface Area[1] (m^2)[1]	SOER[2] ($ou.m^3/m^2/s$)	OER[3] ($ou.m^3/s$)	Dam Surface Area (m^2)	SOER ($ou.m^3/m^2/s$)	OER ($ou.m^3/s$)	SOER ($ou.m^3/m^2/s$)	OER ($ou.m^3/s$)	SOER ($ou.m^3/m^2/s$)	OER ($ou.m^3/s$)
ED3N-1	7000	394	2,760,000	6000	0.3	1,800	0.017	104	0.132	794
ED3N-2	6500	0.21	1,350	5500	20.1	111,000	0.066	365	0.145	797
ED3N-3	6500	0.37	2,430	5500	0.2	852	0.032	178	0.091	500
ED3N-4	16000	0.41	6,600	25000	0.0603	1,510	0.023	575	0.269	6,724

Notes:
[1]The dam surface area changed between 2012 and 2013
[2]SOER = Specific Odour Emission Rate. This represents the measured rates of odour emission per square metre of exposed pond area.
[3]OER = Odour Emission Rate. This represents the total odour emission rate determined for each source.

5.5.2 Impact assessment

The measured results from the ED3N ponds have been used to project emissions from pond E3DS as shown in Table 5.3. The mean SOER result for the four ponds has been calculated and used in the projection.

Table 5.3 Project odour emission rates for ED3S

Source ID	Dam surface area (m^2)	SOER (ou.m3/m2/s)	OER (ou.m3/s)
ED3N System 2015			
ED3N-1	6000	0.132	794
ED3N-2	5500	0.145	797
ED3N-3	5500	0.091	500
ED3N-4	25000	0.269	6,724
ED3N Total	42,000	0.159 (mean)	8,810
Projected ED3S System			
ED3S	89,435	0.159	14,200
ED3S-S	23,330		4,510
ED3S Total	118,000		18,700

The projected odour emission increase from the conversion of ED3S-S to leachate storage and evaporation duties would increase the pond systems odour emission rate by 4,510 ou.m3/s (51%). With the combined ED3S system projected surface areas, the overall odour emission rate would increase by 18,700 ou.m3/s, equivalent to a twofold increase in odour emissions from the evaporation dam system. This increase is considered to be insignificant in given the distance of this odour source from potential receptors (the closest receptor being approximately 1.6km from the Woodlawn site). Furthermore, as the odour character of the pond emissions is relatively neutral (described as earthy/mildly ammoniacal), it is considered that this source is benign and will not cause problems off-site provided the site's Leachate Aeration Dam system continues to be managed and operated effectively.

The relative magnitude of the proposed ED3S system emissions compared to overall site odour emissions is difficult to address quantitatively, given the disparate Bioreactor odour sources and the inherent difficulties in quantifying odour emissions. The 2015 Odour Audit (The Odour Unit, 2015) was able to determine that the odour emission rate from the active tipping face inside the Bioreactor was 45,100 ou.m3/s – well below the estimate in the original Environmental Assessment projection (292,000 ou.m3/s). This reduction is largely due to a decrease in the active tipping area – minimising the active tipping face is one of the key performance indicators at the Woodlawn site. It is considered that fugitive odour emissions are likely to be comparable to the active tipping face emissions to the overall Bioreactor emissions.

Given the above, and assuming a Bioreactor emission rate of at least 100,000 m3/s, it is calculated that the proposed utilisation of the ED3S system will add a maximum of 17% to overall site odour emissions, at full dam capacity.

On this basis, it is expected that the conversion of ED3S for treated leachate management will not result in any increase in odour impacts from the Woodlawn site.

6. Conclusion

6.1 Alternatives and options considered

Alternatives and options to the proposed modification were considered as part of planning for the proposed modification. Alternatives considered included:

- Developing new storage pond(s) to increase stormwater and leachate capacities available at the site – this was not considered feasible as it would result in significant costs and environmental impacts compared to the proposed modification, which would utilise available capacity within the existing system.
- Implementing leachate treatment system that would enable leachate to be treated to a quality that would allow for off-site discharge – this was not considered feasible due to the long timeframes associated with developing and implementing such as system. Veolia is currently investigating options for upgrading the site's leachate treatment systems with a view to minimising requirements for storage of treated leachate.
- Reduction to leachate extraction rates – Veolia have noted that attempting to reduce the extraction rate to maintain a sustainable level with the current leachate storage system has had a negative impact on our environmental performance at the site due to the functioning of the bioreactor. This is not considered a viable long term solution for the site.
- Utilising other leachate and stormwater storages within the Woodlawn Site – other storages that may be available for storage include other dams and former underground mine workings. A preliminary review of these options found that none would provide sufficient capacity required and in some cases (such as use of underground mine workings), may conflict with other land uses at the site.
- The 'do nothing option'. This option involves operating the site as it currently is, with leachate storages operating at near full capacity. This was not considered feasible as it operating at near capacity presents an unacceptable risk that an unplanned discharge of leachate may occur to the surrounding environment.

Overall, the proposed modification was identified as having the least environmental impacts of all viable options considered and was therefore considered to be the preferable option.

6.2 Ecologically sustainable development

The four principles of ESD are outlined in Section 6(2) of the Protection of Environmental Operations Act 1979 (PoEO Act), and in Schedule 2 of the EP&A Regulations. In summary, the principles are:

- **The precautionary principle** – if there are threats of serious or irreversible damage, a lack of full scientific uncertainty should not be used as a reason for postponing measures to prevent environmental degradation.
- **Intergenerational equity** – the present generation should ensure that the health, diversity and productivity of the environment are maintained or enhanced for the benefit of future generations.
- **Conservation of biological diversity and ecological integrity** – the diversity of genes, species, populations and their communities, as well, as the ecosystems and habitats they belong to, should be maintained or improved to ensure their survival.
- **Improved valuation, pricing and incentive mechanisms** – environmental factors should be included in the valuation of assets and services.

Table 6.1 provides an assessment of how these principles apply to the proposed modification.

Table 6.1 Adherence of the proposed modification to the principles of ESD

Principle	How addressed by the proposed modification
The precautionary principal	▪ The proposed modification is not anticipated to cause serious or irreversible environmental damage that will result in impacts of a permanent nature. ▪ Impact assessments have been undertaken for this EA, to predict as far as possible, potential impacts associated with the proposed modification. ▪ All measures considered to be necessary to safeguard environmental values have been identified and included in preparation of this assessment.
Intergenerational equity	▪ Environmental investigations have been undertaken for the proposed modification during the preparation of this EA and mitigation measures have been developed where necessary to minimise the impacts on the health, diversity and productivity of the environment and therefore maintain benefits for future generations. ▪ The proposed modification will contribute towards the ongoing employment of staff and operation of the Woodlawn Site, providing benefits for local, regional and state wide communities through direct and indirect employment and providing for the beneficial use of a large portion of the state's municipal waste. ▪ The proposed modification will not sterilise any land from future development or affect the beneficial uses of the area following closure of the bioreactor.
Conservation of biological diversity and ecological integrity	▪ The proposed modification would not cause any impacts to biodiversity.
Improved valuation, pricing and incentive mechanisms	▪ The proposed modification will use existing equipment; infrastructure and staff associated with the Woodlawn Site and will therefore provide for efficient resource use. ▪ The proposed modification will result in improved operational efficiencies at the Woodlawn Site increasing the long-term productivity of the bioreactor.

6.3 Conclusion

The proposed modification consists of a minor change to on-site leachate and stormwater management at the Woodlawn Site and is not predicted to cause any substantial additional impacts to those previously approved under the project approval and development consent.

The proposed modification is likely to result in minor environmental impacts, including increased localised odour around the treated leachate storage sources, potential for erosion of disturbed areas during construction. Impact assessments prepared for the proposed modification has determined that these impacts can be effectively managed by Veolia's existing environmental management system implanted across the Woodlawn Site.

The proposed modification will reduce the risk of unplanned discharges of leachate and thereby provide a benefit to the surrounding environment by reducing the potential for water quality impacts.

The Woodlawn Bioreactor provides for the beneficial use of a large portion of the state's municipal waste. The proposed modification to this approval will enable Veolia to continue the high operational and environmental performance standards at the Woodlawn Bioreactor and ensure its long-term operational security, thereby providing benefits for local, regional and state-wide communities. The proposed modification is not predicted to generate significant changes to the overall environmental impacts of the Woodlawn Site and is therefore considered to be justified.

7. References

Jenkins B.R 1996, *Soil Landscapes of the Braidwood 1:100,000 Sheet map and report*, Department of Land and Water Conservation, Sydney.

The Odour Unit 2015, *Woodlawn Bioreactor Facility Odour Assessment Study – Addition of ED3S to Leachate Management System.* Report prepared for Veolia, October 2015.

WSP | Parsons Brinckerhoff 2015a, *Veolia Woodlawn Bioreactor Water Balance for Proposed Amendment to Surface Water Management*. Report prepared for Veolia, November 2015.

WSP | Parsons Brinckerhoff 2015b, *Woodlawn Bioreactor Soil and Water Management Plan*. Report prepared for Veolia.

Appendix A

Environmental risk analysis

Table A.1 Risk Assessment Matrix

Potential Consequences					Probability				
Maximum Reasonable Consequence (MRC) Score	MRC Score Description				A ALMOST CERTAIN to happen	B LIKELY to happen at some point	C MODERATE possible, it might happen	D UNLIKELY not likely to happen	E RARE practically impossible
	Environment	Public Safety	Social	Property/Assets					
1 Catastrophic	Irreversible impacts either on-site or off-site; prosecution	Fatality or multiple serious injuries or illness	Widespread social impacts relating to project	Destruction of, or serious damage to major equipment, plant, buildings etc.	1	2	4	7	11
2 Major	Serious impacts; significant cost to remediate; prosecution	Incapacitating injury or long term health problems	Significant damage to reputation of operator	Serious damage to major equipment, plant, buildings etc.; low potential for repair	3	5	8	12	16
3 Moderate	Moderate impact; can be remediated; not likely to result in prosecution	Serious injury or health impacts	Organised opposition to project; significant impact on local community	Damage to major equipment, plant, buildings etc.; potentially repairable at substantial cost	6	9	13	17	20
4 Minor	Minor on-site impact; non reportable incident; can be remediated	Injury or illness requiring medical treatment	Inconvenience to community/ landowners	Damage to equipment, plant, buildings etc.; repairable at significant cost	10	14	18	21	23
5 Insignificant	Negligible on-site impact, small area on-site; easily remediated	First aid injury	Isolated inconvenience to individuals	Minor, easily repaired damage to equipment, plant, buildings etc.	15	19	22	24	25

Table A.2 Environmental Risk Assessment

Issue	Proposed activity	Potential impacts	Risk Assessment*			Discussion
			C	L	R	
Aboriginal archaeology	Soil disturbance for construction activities.	The only construction activities that have potential to result in soil disturbance is the lining of ED3S, which may require minor reshaping. Trenching across existing roadways and tracks may be required where pipeline crossings occur.	4	D	**L(21)**	ED3S is a disturbed area and will only require minor disturbance to allow for it to be lined. Any road crossings would be short and would result in short-term excavations of short trenches. Previous archaeological studies across the site have found Aboriginal heritage sites, although those located in the area of the proposed modification have been salvaged or destroyed in accordance with Section 90 of the *National Parks and Wildlife Act 1974.* If unexpected Aboriginal site(s) are found during construction, they would be managed in accordance with Veolia's Environmental Management Plans.
Air quality	Use of ED3S for leachate storage.	Generation of additional odour causing odour impacts to nearby sensitive receivers.	4	C	**L(18)**	A detailed odour assessment has been prepared for the proposed modification and is discussed further in Section 5.5 and provided in Appendix C. It is concluded that the proposed modification is unlikely to cause odour impacts to the nearest sensitive receivers.
	Construction activities (lining of ED3S, movement or extension of above ground transfer pipes)	Generation of dust, causing impacts to nearby residents.	4	D	**L(18)**	The nearest sensitive receiver to the site is located over 1.6 km away. Due to the minor nature of the works associated with the proposed modification, it is not considered to have the potential to cause dust impacts to this receiver. The construction activities for the proposed modification will be subject to the site's Landfill Environmental Management Plan and therefore will be subject to dust mitigation, which further minimises the potential for impacts to occur to sensitive receivers.

Issue	Proposed activity	Potential impacts	Risk Assessment*			Discussion
			C	L	R	
Ecology	Vegetation clearing for construction purposes	Impacts to native flora and fauna, impacts to threatened species and communities, loss of habitat.	4	D	**L(21)**	The proposed modification would only require works within parts of the site that have already been cleared and are operated without vegetation cover. Therefore no vegetation clearing is required and no impacts to ecology are expected.
Greenhouse gas emissions	Construction activities (lining of ED3S, movement or extension of above ground transfer pipes)	Greenhouse gas emissions.	5	B	**L(19)**	The proposed modification will use existing plant and equipment at the site during the construction period and will not result in any changes to site operations that would cause additional greenhouse gas emissions. The proposed modification is therefore not considered to have the potential to cause additional greenhouse gas emissions from the site.
Groundwater	Use of ED2 for stormwater storage	The storage of stormwater in ED2 may result in increased infiltration of water from the dam to the water table.	4	D	**L(24)**	ED2 is lined with an impervious material and therefore minimal infiltration of stored stormwater to groundwater is expected.
	Construction activities	Excavations may fill with groundwater during construction.	5	D	**L(24)**	Previous groundwater studies and monitoring undertaken at the site indicate that the previous mining activities at the site have lowered groundwater table levels and shallow groundwater would not be expected The proposed modification would only require shallow excavations for the installation of pipelines across roadways. Groundwater infiltration to these excavations would not be expected.

Issue	Proposed activity	Potential impacts	Risk Assessment*			Discussion
			C	L	R	
Hazardous materials	Storage and use of dangerous or hazardous goods.	Soil or water contamination from spills or leaks.	4	D	L(21)	The only hazardous materials that would be used for the proposed modification would be fuel used to power plant and equipment used during the construction period. This equipment would be in use as part of normal site operations and would be subject to Veolia's existing environmental management systems. Therefore this activity presents no additional risk to the environment above normal site operations.
Historic heritage	Soil disturbance for construction activities.	The only construction activity that has potential to result in soil disturbance is the lining of ED3S, which may require minor reshaping.	4	D	L(21)	ED3S is a disturbed area and will only require minor disturbance to allow for it to be lined. There are no known heritage sites or relics in the vicinity of ED3S. In the unlikely event that a heritage objects is found during construction, it would be managed in accordance with Veolia's Landfill Environmental Management Plan.
Land Management	Construction activities (lining of ED3S, movement or extension of above ground transfer pipes)	Erosion and sedimentation from soil disturbance.	4	C	L(18)	Erosion and sedimentation may occur during the construction works in disturbed areas such as trenches constructed for road crossings. This is considered further in Section 5.3 of the EA.
		Invasion of weeds in disturbed areas.	4	C	L(18)	Given the small amount of disturbance that would occur for the proposed modification, it is unlikely that it would result in weed establishment. Once operational, ED3S would not provide any additional habitat for weeds. Veolia would continue to implement its existing weed management program across the site, thereby removing any weeds that may occur.
Noise impacts	Construction activities (lining of ED3S, movement or extension of above ground transfer pipes)	Generation of noise, causing impacts to nearby residents.	4	D	L(18)	The nearest sensitive receiver to the site is located over 1.6 km away. Due to the minor nature of the works associated with the proposed modification, it is not considered to have the potential to cause additional noise impacts to this receiver above those that would already occur from the site.

Issue	Proposed activity	Potential impacts	Risk Assessment*			Discussion
			C	L	R	
						The construction activities for the proposed modification will be subject to the site's Landfill Environmental Management Plan and therefore will be subject to noise mitigation, which further minimises the potential for impacts to occur to sensitive receivers.
Socio-economic impacts	Construction activities (lining of ED3S, movement or extension of above ground transfer pipes)	Unforeseen, unmanaged or undesired changes to local population. Unforeseen, unmanaged or undesired economic impacts.	5	D	**L(24)**	Given the minor nature of the works and that the modification will not require the employment of any additional staff or engagement of contractors above that already undertaken for operation of the site, it is not anticipated to result in any socio-economic impacts to nearby communities.
Surface water	Use of ED2 for stormwater storage Use of ED3S for leachate storage	Changes to the sites water management practices may result in insufficient storage being available for leachate and stormwater. This could result in discharge of contaminated water to the surrounding environment.	2	D	**M(12)**	A detailed site water balance study was prepared for the proposed modification and it is concluded that the proposed changes would not increase the risk of discharge of contaminated water from the site. Refer to Section 5.4 and Appendix B for more detail.
Road transport	Construction activities Operational activities	Increased road traffic reducing level of service of road network. Creation of safety hazards on public roads.	4	D	**L(21)**	The proposed modification will not require the transport of any equipment or materials on a public road, or require works within a public road.
Visual impacts	Construction activities (lining of ED3S, movement or extension of above ground transfer pipes) Use of ED2 for stormwater storage Use of ED3S for leachate storage	Visual impacts to nearby sensitive receivers or users of nearby areas.	4	D	**L(21)**	The proposed modification is unlikely to cause visual impacts above those that are already associated with the site as it will not change the site's overall appearance. The construction period is the only part of the modification with the potential, during which time ED3S will be drained and lined. The draining of this dam would be undertaken routinely to remove sediment build up and therefore the modification would not result in any additional visual impacts. None of these works are visible to the public due to the existing topography.

Issue	Proposed activity	Potential impacts	Risk Assessment*			Discussion
			C	L	R	
						Previous assessments undertaken for the site identified few sensitive viewpoints around the site and therefore visual impacts are not considered to be an issue.
Waste Management	construction activities operational activities	Poor management of waste, resulting in contamination, pollution, or poor resource efficiency.	4	C	**L(18)**	The proposed modification will not generate any additional waste above the waste that would normally be generated at the site. Minor quantities of construction waste may be generated during construction and this would be disposed of as part of the site's operational maintenance waste stream.

Appendix B

Water balance

VEOLIA

WOODLAWN BIOREACTOR

WATER BALANCE FOR PROPOSED AMENDMENT TO SURFACE WATER MANAGEMENT

NOVEMBER 2015

WSP | PARSONS BRINCKERHOFF

WOODLAWN BIOREACTOR

WATER BALANCE FOR PROPOSED AMENDMENT TO SURFACE WATER MANAGEMENT

Veolia

Final

Project no: 2269623A-WAT-REP-001 RevA
Date: November 2015

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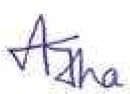
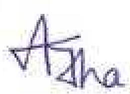
QUALITY MANAGEMENT

ISSUE/REVISION	FIRST ISSUE	REVISION 1	REVISION 2	REVISION 3
Date	3 November 2015	16 November 2015		
Prepared by	Dr Aditya Jha	Dr Aditya Jha		
Signature				
Authorised by	Steven Crick	Steven Crick		
Signature				
Project number	2269623A	2269623A		

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EXECUTIVE SUMMARY

BACKGROUND

WSP | Parsons Brinckerhoff prepared a surface water assessment as a part of an environmental assessment for the Heron Resources Limited (previously known as TriAusMin) Woodlawn Retreatment Project (WRP) and Woodlawn Underground Project (WUP). Heron Resources Limited received approval to proceed with these projects in July 2013 from the NSW Department of Planning and Infrastructure (DPI) under part 3A of the NSW Environmental Planning and Assessment Act 1979. Heron Resources Limited is yet to commence these projects.

The Woodlawn Bioreactor (Figure 1.1) within the Woodlawn Eco-Precinct is owned by Veolia. The Woodlawn Bioreactor co-exists with other mine infrastructure that were created during mining by Denehurst from 1978 to 1998 surrounding the Woodlawn Bioreactor boundary. The Woodlawn Site in this report refers to the extent of the historic footprints of Denehurst mining that surrounds the Woodlawn Bioreactor operational boundary. The mining operation created three tailings storage dams (TDN, TDW and TDS), one waste dump, three evaporation dams (ED1, ED2 and ED3), one freshwater dam (Woodlawn Dam), one processing plant complex and administration block.

The site set up works for the Woodlawn Bioreactor occurred in 2002. Since 2004, Veolia has been utilising (Figure 1.2):

- → the historic mine void for storing putrescible waste and a bioreactor that produces gas for a 3 MW power station
- → the evaporation dam 3 (ED3) for containment of contaminated water and surface runoffs within the mine void.

PROPOSED CHANGES

Veolia proposes to utilise ED2 in addition to ED3S and ED3N for the mine void water management as follows (Figure 1.2):

- → Current storage of stormwater in ED3S will be emptied into ED2.
- → Future stormwater collected within the mine void will be pumped to ED2 for storage and evaporation. A smaller portion of ED3S (referred to as ED3S Sump in this report) will be isolated and utilised as stormwater sump to facilitate pumping to ED2 from the mine void.
- → Emptied ED3S will be lined before commencement of future leachate discharge to the remainder of ED3S lagoons (referred to as ED3SL in this report). This will allow leachate stored in lagoons of ED3N to gradually evaporate.
- → Veolia will continue to use lagoons of ED3N for storage of leachate from the mine void in addition to the proposed ED3SL.
- → Should Heron Resources Limited commences mining, Veolia proposes to continue using ED2 for its mine void stormwater storage and evaporation.

CURRENT WATER MANAGEMENT

The disturbed area within the Woodlawn Site has been progressively rehabilitated since mining ceased in 1998.

Runoff from disturbed areas that are not yet rehabilitated are stored in water management ponds:

- The decant ponds developed within the tailings dams: West (TDW), North (TDN) and South (TDS) receive rainfall runoff from within the tailings dam surfaces. In the unlikely event when these dams would ever be near their freeboard level, water would be transferred to the evaporation dam 1 (ED1).
- ED1 is the final storage of majority of sources of runoffs from the disturbed areas. It receives stormwater from the disused plant complex and administration block, the dolerite stockpile and the waste dump seepage collected in the waste rock dam (WRD).
- The stormwater runoff from the disused plant complex and administration block are first collected in the plant collection dam (PCD). Stormwater is pumped out of PCD to ED1 automatically based on water level triggers.
- The evaporation dam 2 (ED2) currently does not receive any runoff from external sources. This dam was constructed by Denehurst to increase storage capacity when ED1 was approaching its maximum allowable water storage. Since 1998, the water level in ED2 as well as ED1 had been continuously declining.
- The northern part of evaporation dam 3 (ED3N) receives leachate that is pumped out from the mine void by Veolia and is split into 4 storage lagoons.
- The southern part of evaporation dam 3 (ED3S) receives stormwater that is pumped out from the mine void by Veolia. This pond also has 2 lagoons.

Note that the water management ponds also receives direct rainfall captured within the perimeter of their embankment. Water levels in these dams are controlled by evaporation, rainfall and any diverted runoffs.

Majority of runoffs from the rehabilitated area flows out of the Woodlawn Site to natural environment except for the portion that drains to Woodlawn Dam (also known as Fresh Water Dam or Raw Water Dam). Woodlawn Dam also receives groundwater from the Willeroo-Montrose bore field. The raw water from Woodlawn Dam is used for dust suppression, ablution (after treatment). Drinking water is sourced from bottled water supplies.

WATER BALANCE ASSESSMENTS

Veolia's proposed amendments to the void water management will affect ED2 and ED3S primarily as follows:

- Stormwater from the mine void will be pumped regularly to ED2. This will increase the water storage and levels in ED2 from its storage as of 2015.
- The lined and emptied ED3L lagoons will start receiving future leachate discharges from the mine void. This will increase water storage in ED3SL over time.

Water balance simulations were undertaken to:

- Test adequacy of the current freeboard level of ED3S if adopted for ED3SL that will define the upper limit for storing leachate in ED3SL. Additional leachate will be diverted to lagoons of ED3N.
- Identify the wettest, driest and average climate sequences for further assessments.
- Estimate a range of timeframe for the empty lagoons of ED3SL to fill up to the adopted freeboard level of 790.5 mAHD for the first time under the wettest, the driest and the average climate sequences when the daily average leachate discharge is varied between 1 L/s and 4 L/s.
- Estimate feasible rates of leachate transfer once ED3SL fills up to the adopted freeboard level of 790.5 mAHD.

- Assess a likelihood of ED2 overtopping if the future climate sequence are similar to the historical climate.

METHODOLOGY

Water balance assessments presented in this report are based on the same GOLDSIM based water balance model that WSP | Parsons Brinckerhoff developed for Heron Resources Limited in 2012 (Parsons Brinckerhoff, 2012).

For the water balance assessment results presented in this report, all mining related water demands were set to zero. Changes in the model related to water transfers for mining were reverted to reflect current condition.

Before applying the water balance model for water balance assessments, the following parameter set from Parsons Brinckerhoff (2012) model were tested for validity in light of recent data made available by Veolia:

- pan evaporation coefficient = 0.85
- volumetric runoff coefficient for area between water surface and dam embankment = 10%
- volumetric runoff coefficient from catchments of the ponds = 10% and
- seepage loss from the ponds = 0 mm/day.

Data provided by Veolia for historic measurements of pond levels, leachate extraction rates and stormwater transfer rates were used in water balance model validation and recalibration.

Parsons Brinckerhoff (2012) water balance model's climate data were extended based on the most recent information from the Bureau of Meteorology and the Woodlawn Site gauges. A climate sequence from 1944 to 2014 was used in the assessments.

Water balances for ED3SL, ED2, ED1, TDS, TDN and TDW were undertaken for the historic climate sequence from 1944 to 2014.

RESULTS

EXTRACTED BIOREACTOR LEACHATE MANAGEMENT USING ED3SL AND ED3N LAGOONS

- The current freeboard level of 790.5 mAHD for ED3S is also suitable for ED3SL. It is assumed that Veolia will actively empty any storage of water above this freeboard level to either ED3N lagoons or the mine void or future storage ponds that might be developed.
- Veolia intends to extract leachate from the bioreactor in the first year at much higher rate. The likely hood of ED3SL filling up within the first 2 years is high if the average daily leachate extraction rates are kept greater than 3 L/s and it depends on the expected climate sequences.
- Leachate discharge from the mine void is expected to vary between 0.5 L/s and 3.0 L/s. Time estimates for ED3SL pond to fill up to freeboard level depend on future climate sequences and rates of leachate transfer to ED3SL. Simulated estimates for the historic wettest, the driest and the average climate sequences are as follows:

Table ES.1 Summary of modelled outcomes for ED3SL as a result of leachate rates and climate conditions

CLIMATE SEQUENCE	LEACHATE DISCHARGE (L/S)	DAYS TO REACH FREEBOARD LEVEL	DURATION (MONTHS)	DURATION (YEAR)
The wettest (1974 to 1979)	4	248	8.3	0.7
	3	471	15.7	1.3
	2	587	19.6	1.6
	1	1244	41.5	3.5
The driest (1979 to 1984)	4	615	20.5	1.7
	3	1257	41.9	3.5
	2	1953	65.1	5.4
	1	>1953	>65	>5.4
The average (1992 to 1999)	4	339	11.3	0.9
	3	511	17.0	1.4
	2	683	22.8	1.9
	1	2104	70.1	5.8

- Once ED3SL fills up to the freeboard level, the daily average rate of leachate transfer from the bioreactor will need to be reduced to contain the leachate and direct rainfall and runoff volumes within the leachate management ponds, ED3N and ED3SL as the following:
  - The simulated results presented for the average climate sequence indicates that the system can keep receiving the leachate from the bioreactor at 1.2 L/s.
  - The simulated results presented for the wettest climate sequence indicates that the system can keep receiving the leachate from the bioreactor at 0.15 L/s.
- Future climatic sequence is difficult to predict therefore a risk based approach to leachate management is required. Depending on whether the wettest sequence returns, there will be a period during the bioreactor operation that leachate extraction may need to be completely stopped unless alternative storage pond is developed or the leachate treatment system is upgraded sufficiently to facilitate offsite discharge.
- From and empty state, ED3SL is unlikely to fill up to its freeboard level if leachate from the bioreactor is transferred at a constant rate of 0.36 L/s under the range of climatic conditions recorded by BOM from 1944 to 2014.

EXTRACTED MINE VOID STORMWATER MANAGEMENT USING ED2

- ED2 will be able to safely store stormwater from the mine void without exceeding its maximum allowable water level subject to model parameters adopted in the water balance model.
- No changes in water balance for ED1, TDS, TDN and TDW are expected by the proposed amendment to the mine void water management (refer to Appendix A).

1 WOODLAWN BIOREACTOR

Veolia owns and operates the Woodlawn Bioreactor (the Project) and Crisps Creek Intermodal Facility (IMF). They form an integral part of the Woodlawn Eco-Precinct site, which is located approximately 7 kilometres (km) west of Tarago, New South Wales. The site is situated approximately 250 km south west of Sydney, between Goulburn and Canberra (refer to Figure 1.1). The site primarily receives containerised municipal waste by rail from Sydney to the IMF facility which is then trucked to the bioreactor for treatment and disposal in the former mine void. Additionally, waste is received by road from local Council's and businesses.

The licensed area of the Project comprises of:

- a mine void (converted to the Woodlawn Bioreactor for landfilling activities)
- the bioreactor leachate extraction and treatment infrastructure
- the bioreactor stormwater collection dams and associated infrastructure
- an evaporation dam (split into stormwater and leachate evaporation ponds)
- the bioreactor biogas extraction and power generating infrastructure
- an access road, administration offices and workshop.

The licensed area of the Project is located within the Special Mining Lease 20 (SML20). The boundary of SML20 is referred to as the Woodlawn Site which was mined by Denehurst from 1978 to 1998.

The Project co-exists with other mine infrastructure within the Woodlawn Site. The former mining operation created three tailings storage dams (TDN, TDW and TDS), one waste dump, three evaporation dams (ED1, ED2 and ED3), one freshwater dam (Woodlawn Dam), one processing plant complex and administration block.

1.1 LEACHATE MANAGEMENT

Leachate from the bioreactor is constantly extracted from a combination of wells and sumps from within the waste mass in order to effectively access biogas for extraction to the onsite power station. The extracted leachate is either:

- required to optimise biogas generation and is recirculated back into the upper layers of the waste mass; or
- considered surplus and is extracted to the leachate treatment dam.

The extracted leachate is treated to remove organics and volatile compounds in order to minimise odour at the site. The treated leachate is then stored in the northern section of evaporation dam 3 (ED3N).

Due to progressive percolation of the irrigation water, incidental rainfall and ongoing compaction and degrading of the landfill material, the lower portions of the landfill material become saturated with leachate and local groundwater. The leachate is pumped-out of the pit regularly via the associated dams and transported to the northern cell of evaporation pond 3 (ED3N) so that methane production is maximised.

1.2 STORMWATER MANAGEMENT

The mine void also receives stormwater runoff down the sides of the void. This is captured by check dams and sumps that are strategically located within the mine void to keep this water separate from the waste and leachate. The stormwater is pumped out of the void to the southern portion of the evaporation dam 3 (ED3S).

1.3 PROPOSED AMENDMENT TO LEACHATE AND STORMWATER MANAGEMENT

During the last few years, Veolia has improved the leachate treatment capacity at the site and leachate volumes in the ED3N are now operating near capacity. As such, there is concern about the long-term adequacy, functioning and capacity of the site's ability to control leachate levels within the waste mass. If leachate builds up within the landfill, biogas capture will be reduced and the site's environmental performance will be compromised.

It is therefore proposed to use the southern portion of ED3S for storage of treated leachate and the existing evaporation dam 2 (ED2) to be used as a stormwater storage facility. This would require the existing volume of stormwater to be emptied from ED3S into ED2. ED3S would then be lined before it is used to store treated leachate. A pump and pipe system would also need to be installed to regulate and handle the leachate flow and stormwater transfer between the mine voids, ED3S, ED3N and ED2 (refer to Figure 1.2).

1.4 ENVIRONMENTAL ASPECTS

It is not anticipated that the amended operations have the potential for substantial environmental impacts. Discussions with NSW EPA have highlighted the following key areas for investigation:

1. Odour – use of ED3S for leachate storage will introduce a new odour source at the site, albeit a minor one. This has been addressed through an odour impact assessment prepared by the Odour Unit.
2. Water resources – changes to the site's water management scheme may create additional risks to local water resources. This could occur through overflows from the stormwater storage ponds and leachate ponds if adequate freeboards are not maintained. This issue has been addressed by this report.
3. Stormwater piped to ED2 would need to meet specific discharge criteria that would be specified on the site EPL. Storages in ED2 has been steadily declining since 1998 after mining activity ceased in the Woodlawn Site. ED2 has not filled up to date (Veolia, 2014).

WSP | Parsons Brinckerhoff and The Odour Unit was engaged by Veolia to assist with identifying and assessing these potential issues.

This report summarises hydrological characteristics of the Woodlawn Site and provides simulated results to quantify water balances for the evaporation dams: ED2 and ED3S that will be affected by the proposed amendment to the bioreactor leachate and the mine void stormwater management by Veolia.

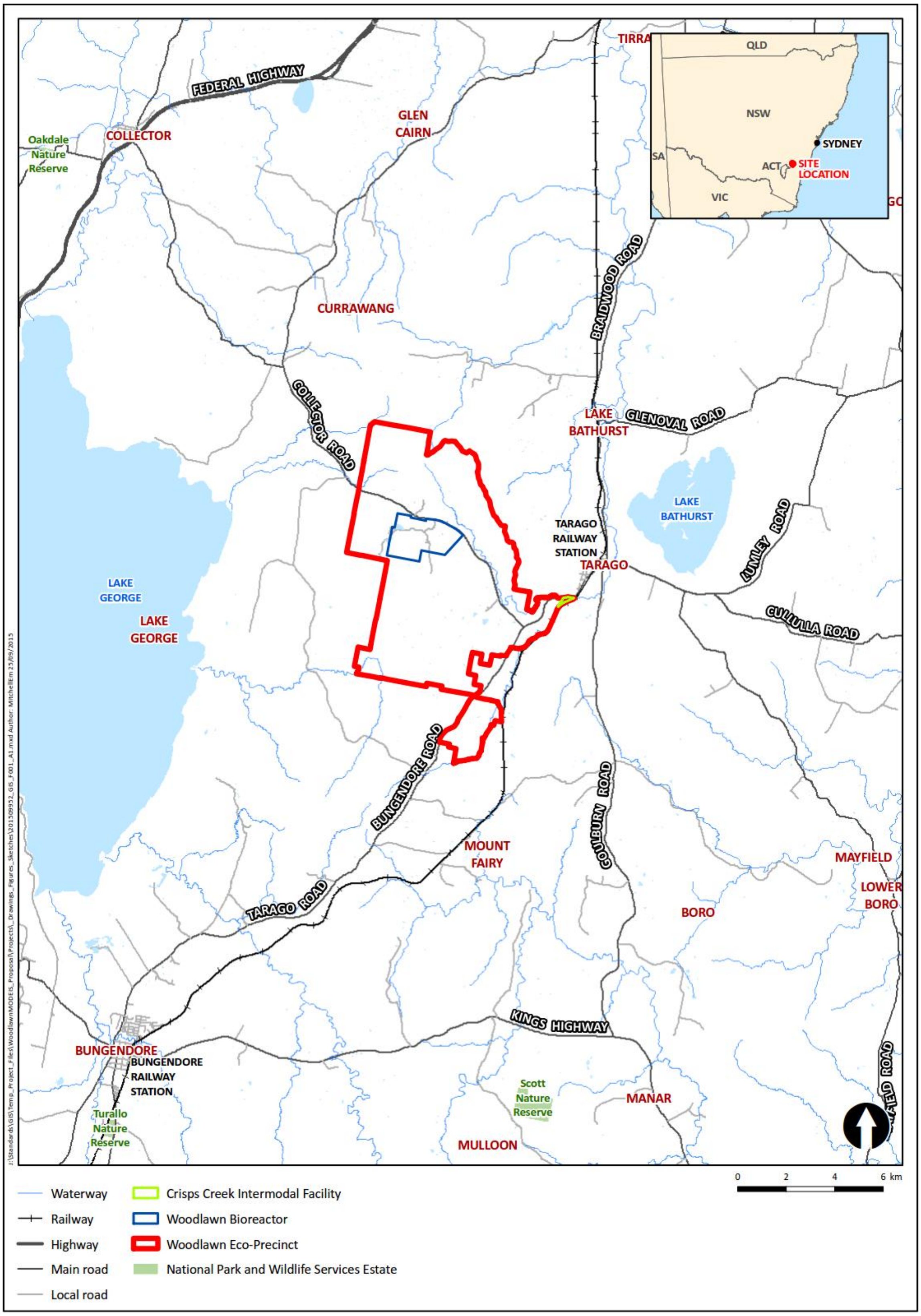


Figure 1.1 Location plan

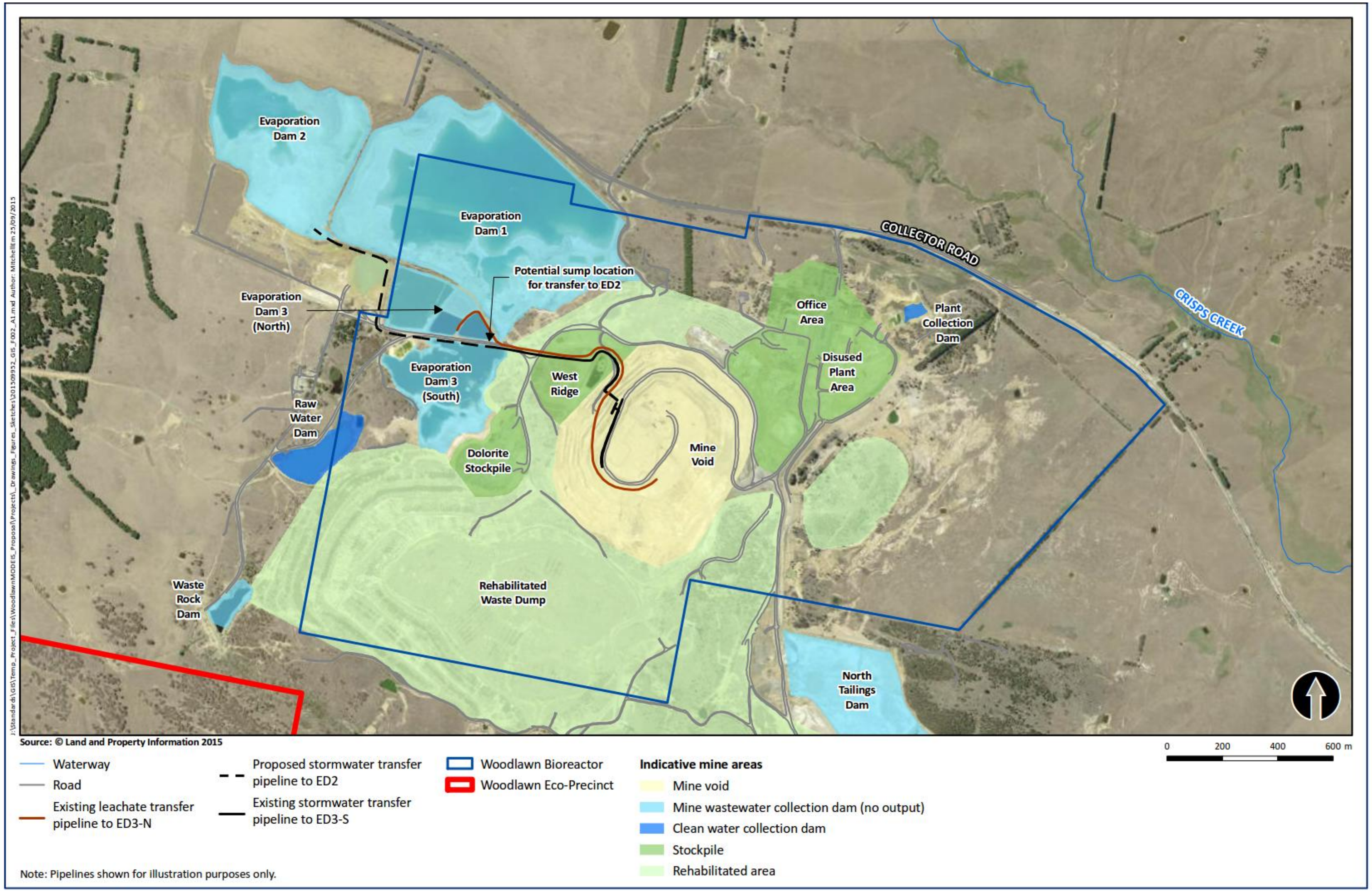


Figure 1.2 Modification area site plan

2 THE WOODLAWN SITE

The Woodlawn Eco-Precinct (Figure 1.1) is owned by Veolia and includes the properties "Woodlawn" and "Pylara". The Woodlawn Bioreactor operational boundary (EPL11436) is within the Special Mining Lease (SML20) that was once operated by Denehurst for mining until 1998.

WSP | Parsons Brinckerhoff prepared a surface water assessment as a part of an environmental assessment for the Heron Resources Limited (previously known as TriAusMin) Woodlawn Retreatment Project (WRP) and Woodlawn Underground Project (WUP). Heron Resources Limited received approval to proceed with these projects in July 2013 from the NSW Department of Planning and Infrastructure (DPI) under part 3A of the NSW Environmental Planning and Assessment Act 1979. Heron Resources Limited is yet to commence these projects.

Figure 2.1 has been reproduced from Parsons Brinckerhoff (2012) report, which illustrates the spatial relationship between Veolia's Bioreactor operational area and the studied extent of the area for Heron Resources Limited. Note that the studied area for Heron Resources Ltd in Figure 2.1 is referred to as TriAusMin operational area.

There are currently two independent entities on adjacent sites operating within the Woodlawn Site: Veolia and Infigen.

Heron Resources Limited is currently exploring as part of planned recommencement of mining operations. Veolia and Heron Resources Limited are finalising agreements regarding ownership of land at the Woodlawn Site.

If the Heron Resources Limited project proceeds, it is expected to utilise all stored water in evaporation and tailings dams in mineral processing, including the ED3S dam where Veolia has been storing stormwater collected from the mine void.

The modelled water balance assessment from 2012 (Parsons Brinckerhoff, 2012) indicated that water levels in all dams would be maintained well below freeboard levels since any surface water collected in the dams will be used in mineral processing as the first source of water. The only other source of water that was considered in the assessment for Heron Resources Limited was abstracted groundwater from Willeroo-Montrose borefield.

The proposed changes of stormwater transfer from the mine void to ED2 is not expected to change water balance should Heron Resources Limited recommence mining within the Woodlawn Site.

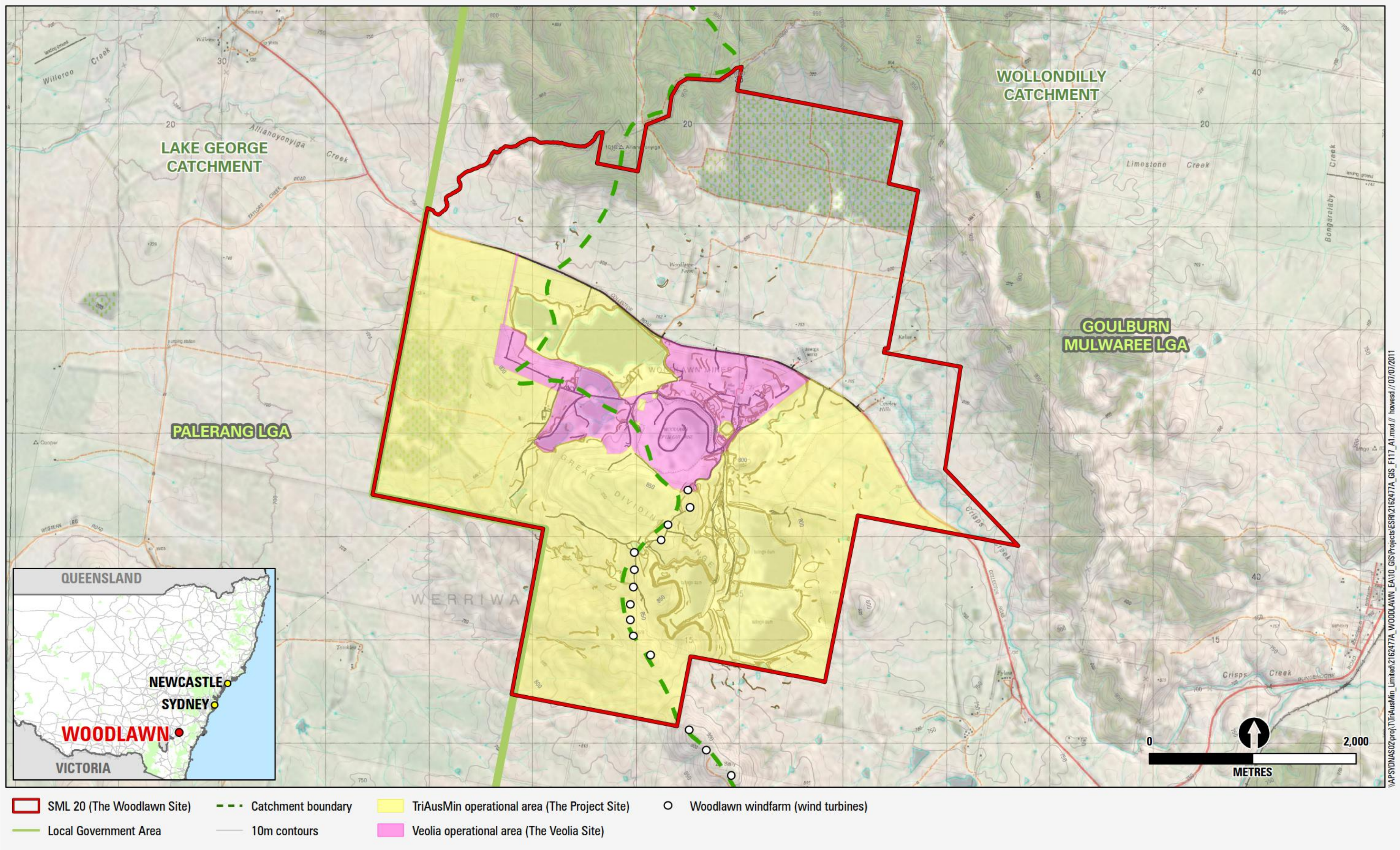


Figure 2.1 Definition of Veolia and potential Heron Resources Limited activities

2.1 EXISTING ENVIRONMENT

The Veolia's Bioreactor Operation co-exists with other mine infrastructures within the Woodlawn Site (SML 20), which was historically mined by Denehurst from 1978 to 1998. The mining operation created three tailings storage dams (TDN, TDW and TDS), one waste dump, three evaporation dams (ED1, ED2 and ED3), one freshwater dam (Woodlawn Dam), one processing plant complex and administration block (Figure 2.2).

The Woodlawn Bioreactor site setup work commenced in 2002. Since 2004 Veolia has utilised (Figure 1.2):

- the historic mine void for storing putrescible waste and a bioreactor that produces gas for a 3 MW power station
- the evaporation dam 3 for containment of contaminated water and surface runoffs within the mine void.

2.2 CURRENT WATER MANAGEMENT

Figure 2.2 summarises inferred surface water flow pathways and catchment areas. The disturbed area within the Woodlawn Site has been progressively rehabilitated since mining ceased in 1998.

Runoffs from disturbed areas that are not yet rehabilitated are stored in water management ponds:

- The decant ponds developed within the tailings dams: West (TDW), North (TDN) and South (TDS) receive rainfall runoff from within the tailings dam surfaces. In the unlikely event when these dams would ever be near their freeboard level, water would be transferred to the evaporation dam 1 (ED1).
- ED1 is the final storage of majority of sources of runoffs from the disturbed areas. It receives stormwater from the disused plant complex and administration block, the dolerite stockpile and the waste dump seepage collected in the waste rock dam (WRD).
- The stormwater runoff from the disused plant complex and administration block are first collected in the plant collection dam (PCD). Stormwater is pumped out of PCD to ED1 automatically based on water level triggers.
- The evaporation dam 2 (ED2) currently does not receive any runoff from external sources. This dam was constructed by Denehurst to increase storage capacity when ED1 was approaching its maximum allowable water storage. Since 1998, the water level in ED2 as well as ED1 had been continuously declining.
- The northern part of evaporation dam 3 (ED3N) receives leachate that is pumped out from the mine void by Veolia and is split into 4 storage lagoons.
- The southern part of evaporation dam 3 (ED3S) receives stormwater that is pumped out from the mine void by Veolia. This pond also has 2 lagoons.

Note that the water management ponds also receives direct rainfall captured within the perimeter of their embankment. Water levels in these dams are controlled by evaporation, rainfall and any diverted runoffs.

Majority of runoffs from the rehabilitated area flows out of the Woodlawn Site to natural environment except for the portion that drains to Woodlawn Dam (also known as Fresh Water Dam or Raw Water Dam). Woodlawn Dam also receives groundwater from the Willeroo-Montrose bore field. The raw water from Woodlawn Dam is used for dust suppression, ablution (after treatment). Drinking water is sourced from bottled water supplies.

Veolia operates the Woodlawn Site as zero contaminated water discharge site. In order to manage the water dam levels and water transfer volumes are monitored at regular intervals. Water quality data are also monitored in the dams as well as at surface water and groundwater monitoring sites within the Woodlawn Site.

The state of water is reported every year in the Annual Environmental Management Report (AEMR) for SML20 that is circulated to:

- NSW Trade & Investment, Resources & Energy – Minerals & Petroleum;
- NSW Environment Protection Authority;
- Goulburn Mulwaree Council
- Community Liaison Committee
- Sydney Catchment Authority.

Veolia has advised that the AEMR from 2014/2015 onwards will be prepared by Heron Resources Ltd.

The AEMR reports for 2006, 2012, 2013 and, 2014 were provided by Veolia. The information from the AEMR reports related to water usage, dam water levels and water transfers between dams were used in the water balance assessments.

Discussion and interpretation of water quality data are beyond the scope of this report.

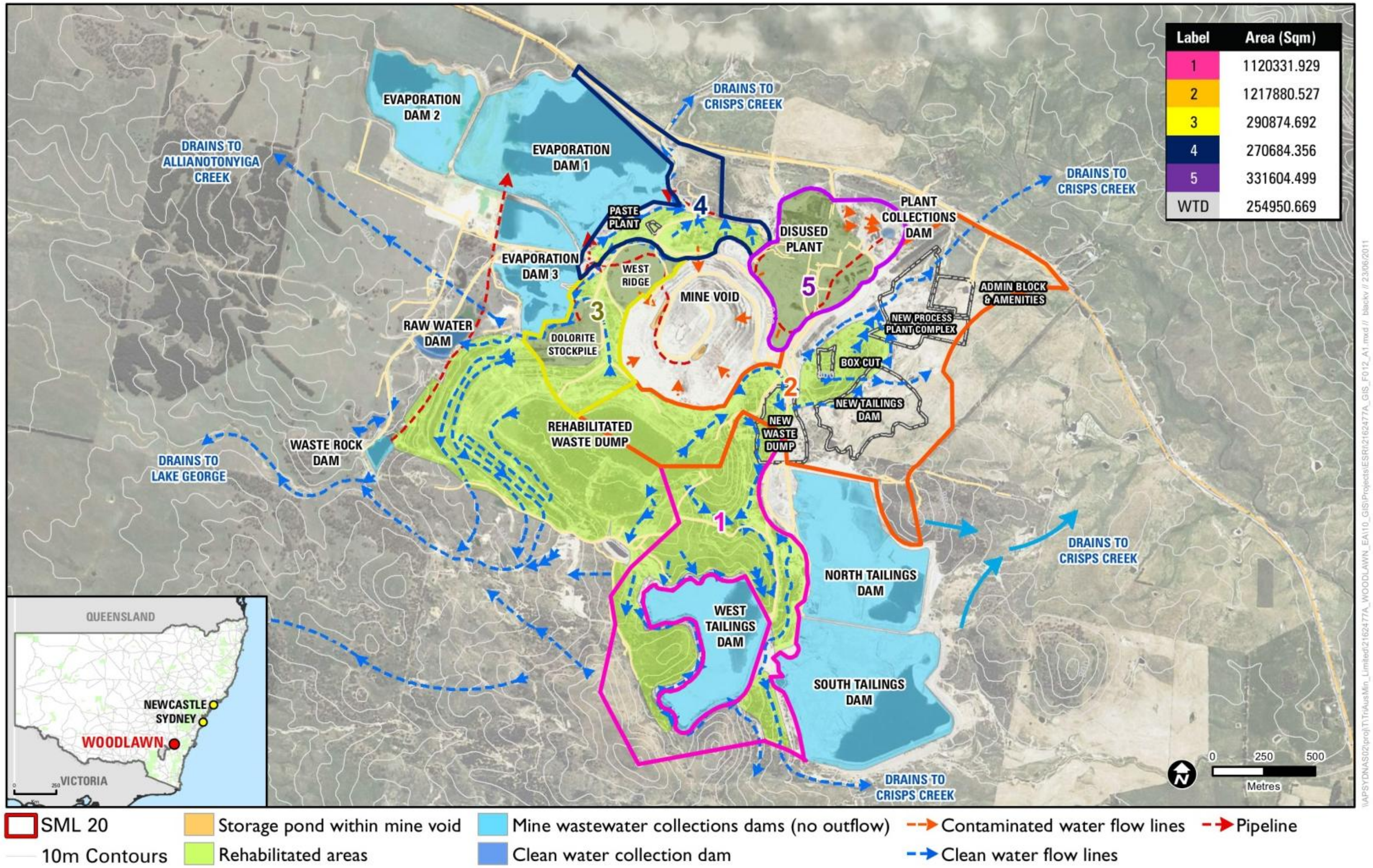


Figure 2.2 Local surface water features within the Woodlawn Site

3 CLIMATE

Figure 3.1 shows the locations of the Bureau of Meteorology (BOM) rainfall and pan evaporation gauging sites that are located in the vicinity of the Woodlawn Site. The station details are provided in Table 3.1. Although rainfall data are available at three of the BOM sites: Goulburn TAFE (BOM70263), Lake Bathurst, Somerton (BOM 70036) and Bungendore Post Office (BOM70011), Pan Evaporation data is only available from Goulburn TAFE (BOM70263). Lake Bathurst (BOM70036 – Somerton) is the nearest site which is approximately 10 km north east of the Woodlawn Site. Goulburn TAFE (BOM70263) and Bungendore Post Office (BOM70011) are roughly 20 km from the Woodlawn Site to the north-east and south-east respectively. Rainfall and Pan Evaporation are also measured at the Woodlawn Site. The rainfall data from the Woodlawn Site are available from 1986 but the Pan Evaporation record start from May 2007.

3.1 RAINFALL DATA

Annual rainfall time series from the BOM sites are compared with the time series from Woodlawn Site rainfall station in Figure 3.2. The Woodlawn Site rainfall is well correlated with the Lake Bathurst Somerton rainfall (Figure 3.3) with the coefficient of determination greater than 0.7. Annual rainfall and pan evaporation data are summarised in Table 3.2.

The annual rainfalls in 1944 and 1982 were the lowest and the 2nd lowest on record at Lake Bathurst, Somerton (BOM 70036) and Bungendore Post Office (BOM70011). Between these two years, the highest and the second highest annual rainfalls were recorded in 1950 and 1974. With respect to the annual average rainfall of 642mm from the Woodlawn Site rainfall station, 1947 to 1952 and 1987 to 1993 are the second and the first longest consecutive period of above average rainfalls. Similarly the rainfalls were below annual average from 2000 to 2004 for five consecutive years.

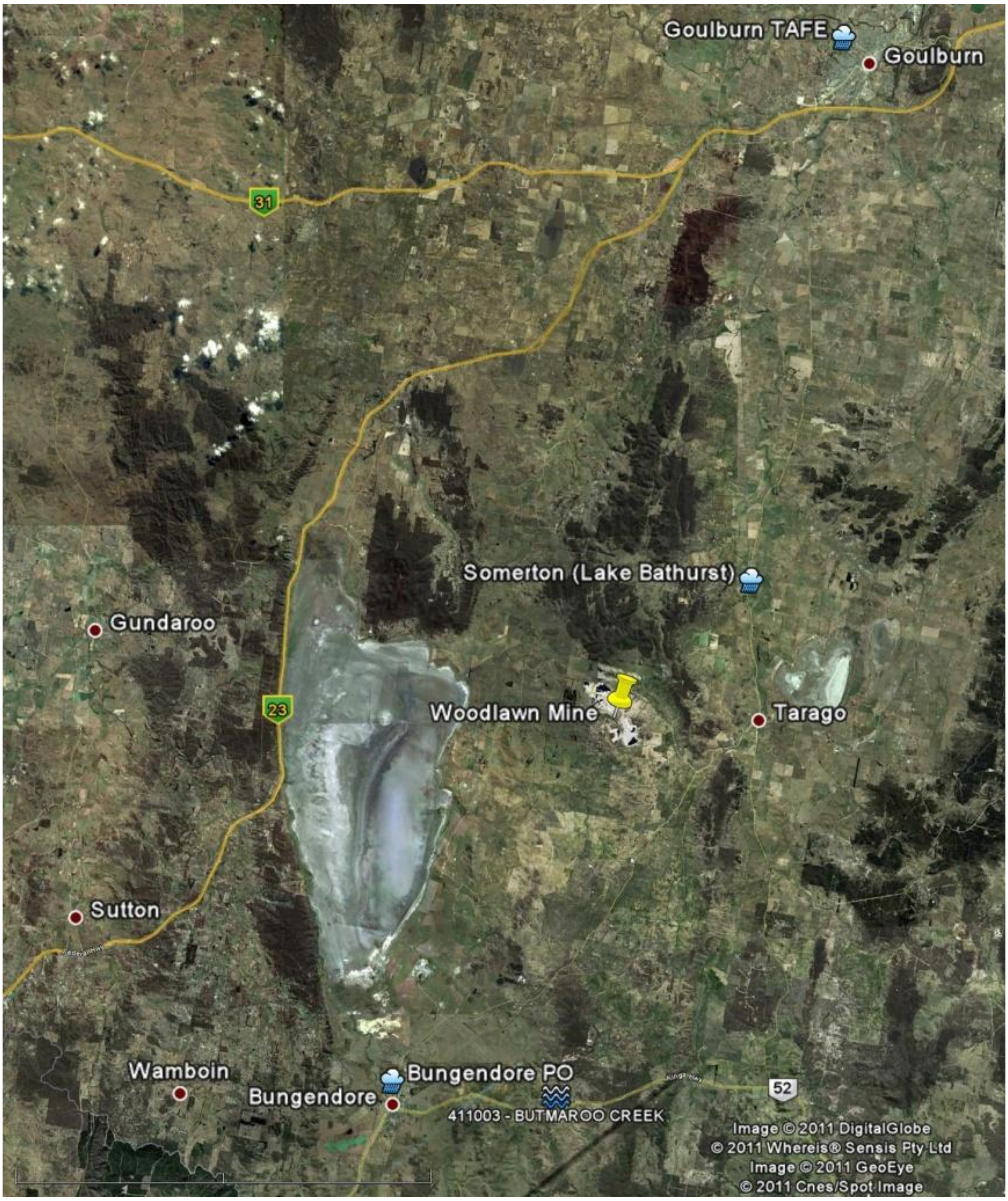


Figure 3.1 BOM rain and evaporation gauges

Table 3.1 Summary of BOM stations

STATION	BUNGENDORE POST OFFICE	GOULBURN TAFE	LAKE BATHURST (SOMERTON)
Number	70011	70263	70036
Opened	1890	1971	1931
Status	Open	Open	Open
Latitude	35.25° S	34.75° S	35.01° S
Longitude	149.44° E	149.70° E	149.65° E
Elevation	698 m	670 m	668 m

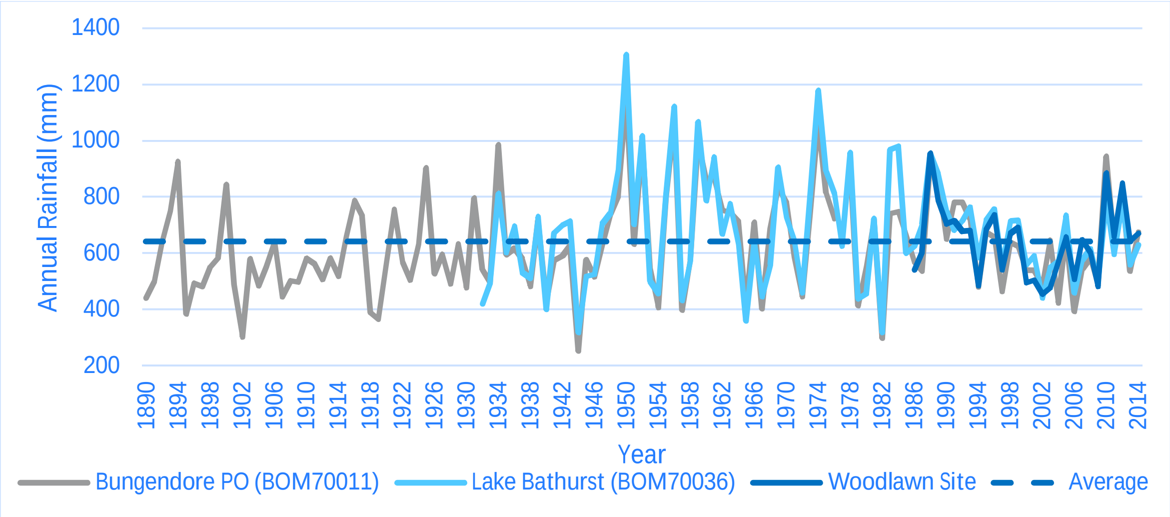


Figure 3.2 Annual variation of rainfalls in the vicinity of the Woodlawn Site

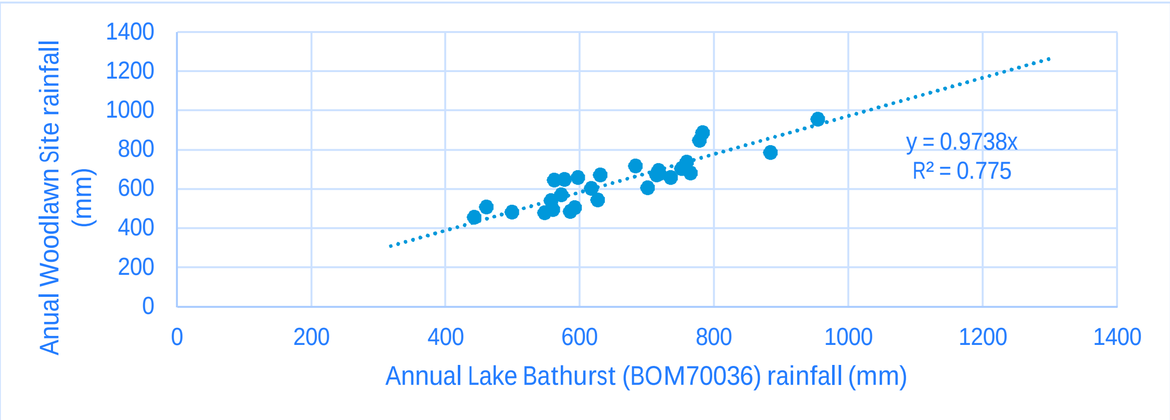


Figure 3.3 Regression relationship between annual rainfalls from the Woodlawn Site and Lake Bathurst

Table 3.2 Summary of annual rainfall and pan evaporation data

YEAR	BUNGENDORE PO (BOM70011) RAINFALL (MM)	GOULBURN TAFE (BOM70263) RAINFALL (MM)	LAKE BATHURST (BOM70036) RAINFALL (MM)	WOODLAWN SITE RAINFALL (MM)	GOULBURN TAFE (BOM70263) PAN EVAPORATION (MM)
1986-2014 (Average)	632	634	658	642	1,146
1944	253		318		
1950	1,158		1,305		
1974	1,072	1,049	1,178		
1982	299	362	318		1,846
1988	930	889	954	957	1,147
2002	488	374	442	456	1,324
2010	944	915	782	886	1,084
2012	826	739	778	848	1,091

3.1.1 DAILY RAINFALLS

Table 3.3 lists rainfall events with daily rainfall total > 100 mm. For the tabulated rainfall events a three-day rainfall total was also calculated. The table indicates that the highest daily rainfall of 161 mm occurred in 1989 and was recorded at the Lake Bathurst station. The highest three-day rainfall of 224 mm occurred in 1925 and was recorded at the Bungendore PO station.

The last rainfall event with a daily total of more than 100 mm occurred in 1989. Over the last 16 years daily rainfall total has not exceeded 100 mm at any of the rainfall stations.

Table 3.3 Summary of rainfall events with daily rainfall > 100 mm

STATION	DATE FROM	DATE TO	THREE-DAY TOTAL RAINFALL (MM)	DAILY MAXIMUM RAINFALL (MM)
70011 (Bungadore PO)	06/1/1894	08/01/1894	138.0	111.5
	10/05/1925	12/05/1925	122.4	121.4
	26/05/1925	28/05/1925	224.0	152.4
	21/06/1925	23/06/1925	100.6	100.6
	07/01/1934	09/01/1934	116.3	108.7
	20/10/1959	22/10/1959	180.1	143.3
	30/10/1969	01/11/1969	141.3	130.6

STATION	DATE FROM	DATE TO	THREE-DAY TOTAL RAINFALL (MM)	DAILY MAXIMUM RAINFALL (MM)
	17/10/1976	19/10/1976	135.6	135.6
	20/03/1978	22/03/1978	119.5	105.2
	30/04/1988	02/05/1988	120.0	117.8
	14/03/1989	16/03/1989	147.0	129.0
70036 (Lake Bathurst, Somerton)	02/01/1941	04/01/1941	152.4	101.6
	02/05/1948	04/05/1948	129.8	101.6
	20/10/1959	22/10/1959	179.1	115.6
	05/09/1967	07/09/1967	114.3	104.1
	30/10/1969	01/11/1969	157.0	150.9
	14/03/1989	16/03/1989	193.1	161.1
70263 (Goulburn TAFE)	26/06/1997	28/06/1997	173.2	114.0
	16/01/2006	18/01/2006	157.6	148.2

3.2 PAN EVAPORATION DATA

The Pan Evaporation data from the Woodlawn Site and Goulburn TAFE appear identical from 2007 to 2014 (Figure 3.4). The annual average pan evaporation from Goulburn TAFE from 1986 to 2014 is 1,146 mm. The annual pan evaporation was found to be lower in wet years and higher in dry years. The annual pan evaporation were less than 1,100 mm in 2010 and 2012 when the annual rainfalls were greater than 840 mm. The annual pan evaporation was 1,846 mm when the annual rainfall was 318 mm at Lake Bathurst, Somerton in 1982.

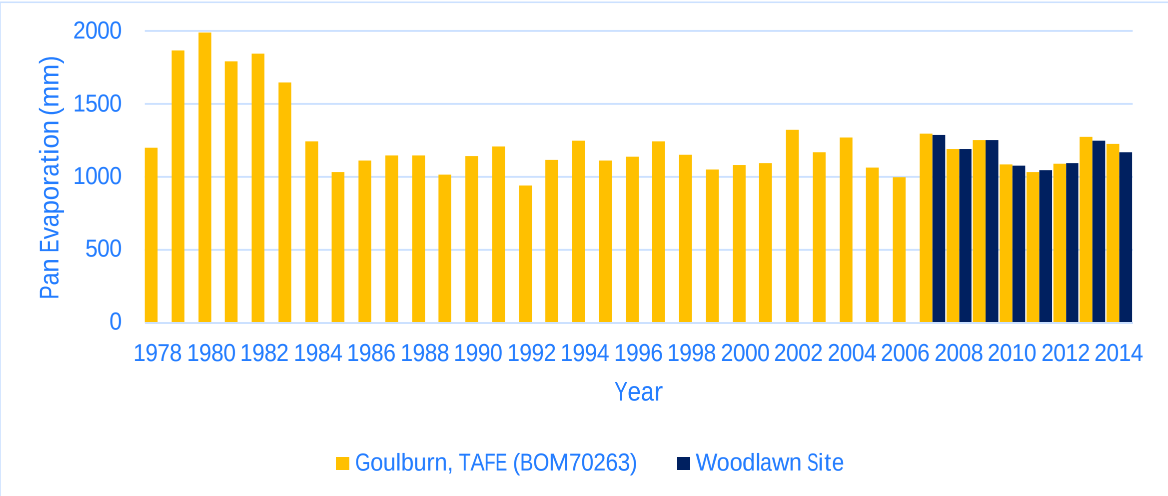


Figure 3.4 Pan Evaporation data from Goulburn, TAFE and the Woodlawn Site

4 STREAMFLOW

The Woodlawn Site on the western side of the Great Dividing Range (roughly 1/3rd) forms part of the Lake George catchment while the remainder is a part of the Wollondilly Catchment (Figure 4.1).

Lake George is a large ephemeral fresh water lake which experiences cycles of dry and flooded conditions. It is located approximately 8 kilometres west of the Woodlawn Site, while a smaller lake, Lake Bathurst, is located 9 kilometres to the east. A network of intermittent fresh water drainages traverse the Woodlawn site, draining into both the Wollondilly and Lake George Catchments.

Crisps creek originates within the Woodlawn SML20 lease boundary, north of the Collector Road. Crips creek has multiple tributaries that originate west of the Collector Road from within the Woodlawn Site, the prominent watercourse being the one that originates from the bases of TDS and TDN.

Crisps Creek has a catchment area of approximately 3,200 hectares and flows in a south-easterly direction to the Mulwaree River. The Mulwaree River is part of the Wollondilly River catchment. The Wollondilly River has a catchment area of approximately 10,030 km^2 and forms part of the Warragamba Dam catchment, which contributes to Sydney's drinking water supply. The catchment of Crisps Creek is only 0.3% of the Wollondilly River catchment.

Allionoyonyiga Creek has a catchment area of approximately 1,300 hectares and flows in a westerly direction to its confluence with Willeroo Creek before flowing into Lake George. There are two other ephemeral creeks located south of Allionoyonyiga Creek that flow into Lake George.

4.1 GAUGED STREAMFLOW

Neither Crisps Creek nor Allionoyonyiga Creek is gauged for streamflow. The nearest flow gauging site operated by the NSW Office of Water is at Butmaroo Creek, about 20 km south of the Woodlawn Site. This gauging site measures flow in Butmaroo Creek that flows west of the Great Dividing Range into Lake George. The total catchment area of this gauging site is 65 km^2 (Figure 4.2). Daily discharge data from 1979 to 2011 were obtained from the Office of Water website.

Using the daily rainfall data from the BOM site 070011 at the Bungendore PO, volumetric runoff coefficients for Butmaroo Creek were estimated. Table 4.1 summarises the estimated runoff coefficients for the top 5 runoff events from the data set from 1979 to 2011.

The analysed runoff events consisted of rainy days ranging from 1 to 6 days. The total rainfall depths ranged from 71 mm (1-day rain event) to 147 mm (3-day rain event). The volumetric runoff coefficients ranged from 18% (event number 3) to 66% (event number 5).

Figure 4.3 presents a scatter plot between annual rainfalls and calculated volumetric runoff coefficients from the entire available data set. A power function is fitted through the data to develop a non-linear relationship. The data indicates non-linear increase in annual runoff from as low as 1% in 1982 (rainfall = 299 mm) to as high as 35% in 1989 (rainfall = 867 mm).

The Butamaroo Creek data suggest that event based runoffs are expected to be between 15% and 70%, depending on the antecedent moisture condition but on an annual scale the runoffs are expected to vary from 1% to 35% depending on total annual rainfalls.

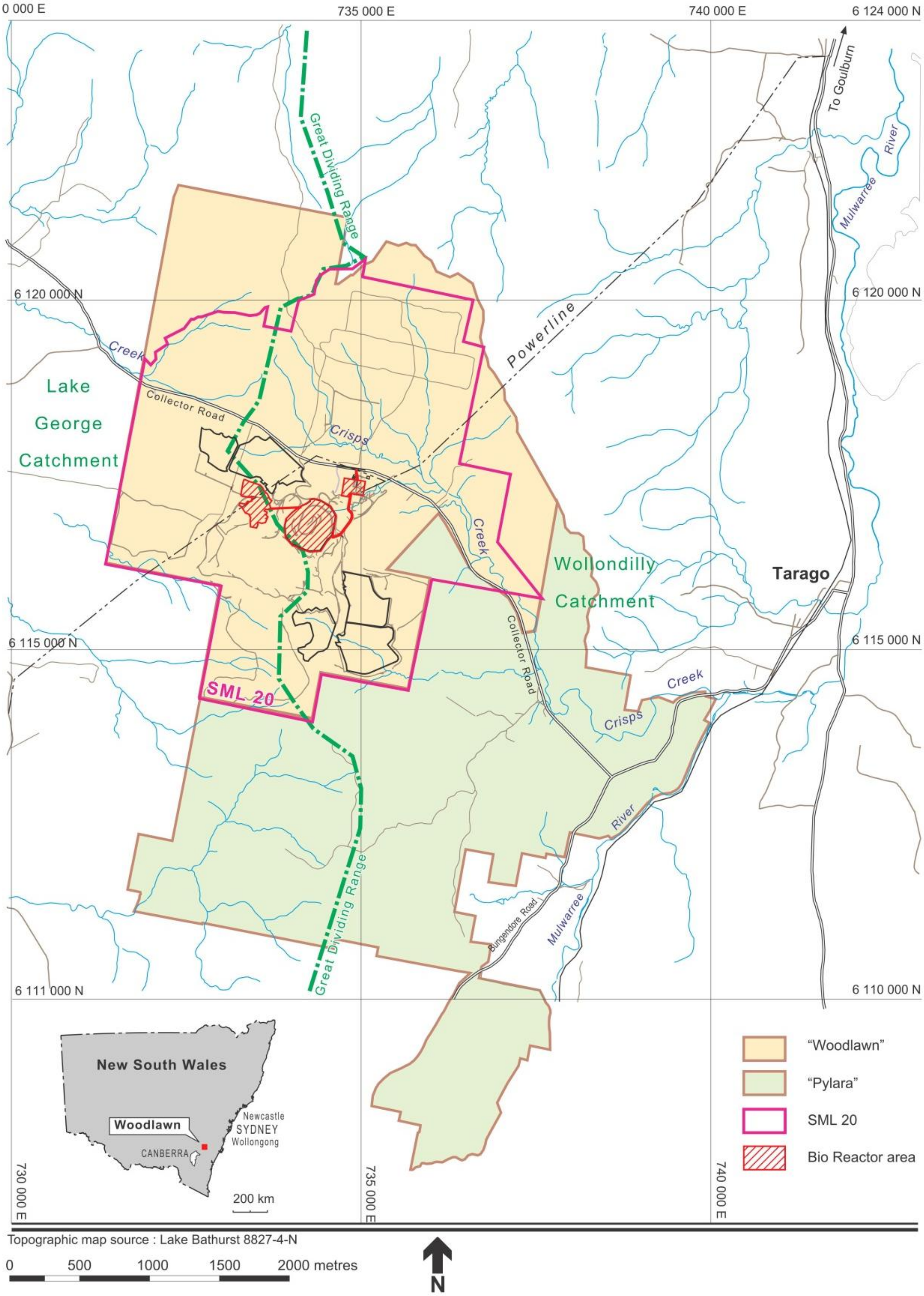


Figure 4.1 Location of local creeks in the vicinity of the Woodlawn Site

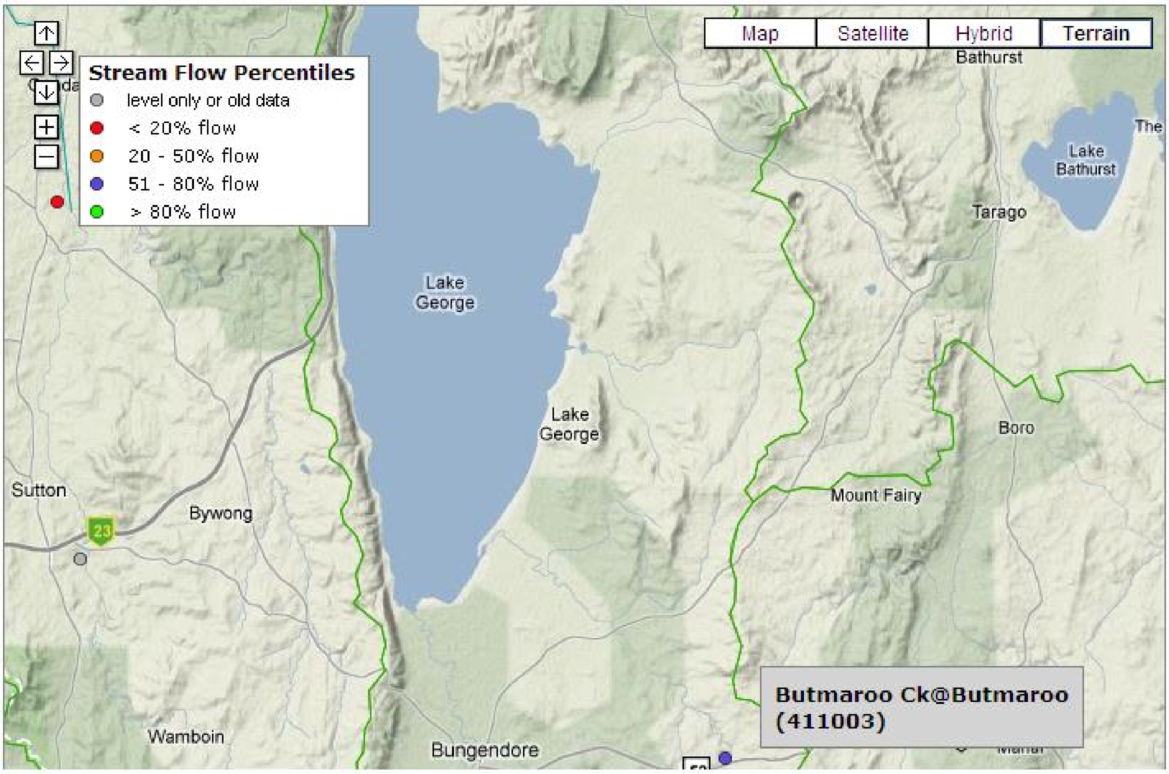


Figure 4.2 Location of the Butmaroo Creek gauging site (source: Office of Water)

Table 4.1 Estimated volumetric runoff coefficients for Butmaroo Creek

EVENT NUMBER	DATE FROM	DATE TO	BUNGADORE RAIN (MM)	NUMBER OF RAINY DAYS	BUTMAROO CREEK RUNOFF (MM)	VOLUMETRIC RUNOFF COEFFICIENT
1	27/04/1988	08/05/1988	133	4	65	0.49
2	25/12/1988	30/12/1988	71	1	30	0.43
3	14/03/1989	19/03/1989	147	3	26	0.18
4	01/04/1989	06/04/1989	101	3	52	0.51
5	08/07/1991	22/07/1991	120	6	79	0.66

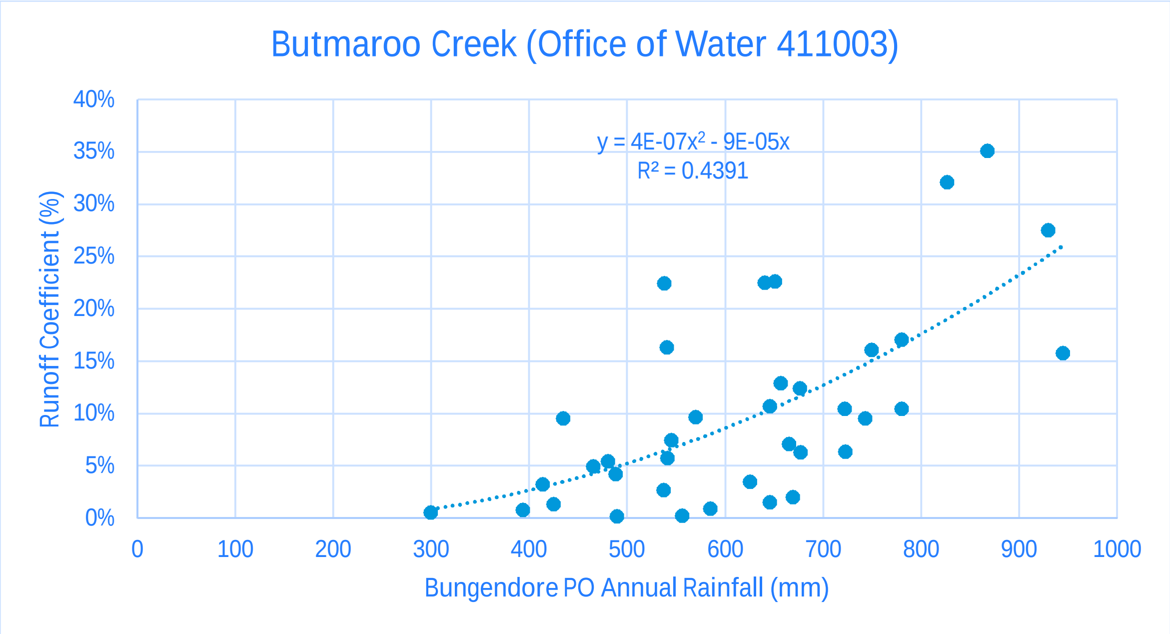


Figure 4.3 A regression relationship between annual rainfalls and volumetric runoff coefficients for Butmaroo Creek

5 THE WOODLAWN SITE MONITORING DATA PROVIDED BY VEOLIA

5.1 DISTURBED AREA RUNOFF

Surface water runoff generated from rainfalls over the disused plant complex, workshop and office blocks within the catchment 5 (refer to Figure 2.2) are collected in the Plant Collection Dam (PCD). An automated pumping system transfers the stormwater collected in PCD to ED1 based on level triggered switches. Veolia records volume transferred as pump hours.

Figure 5.1 shows the average daily rate of pumped water transferred from PCD to ED1. The daily rate was calculated from accumulated volumes between reported dates.

5.2 ED1 AND ED2 WATER LEVEL

Veolia provided records of historic water depth measurements for ED1 and ED2. The water depths were referenced to the top of a marker peg. Note that the top of the peg is a visual marker for the spillway in each pond or lagoon. The RL of the marker peg was not supplied. The data file provided by Veolia indicates that water levels in both ponds were below the base of the pegs from February 2007 to date. There appears to be gap in recording from February 2003 and February 2007, potentially due to water levels remaining below the peg levels.

Review of Veolia (2006) report suggest 788.8 mAHD may be the level of the marker. A paragraph in the report states "*The current water level has dropped below the marker peg and is conservatively estimated at 785.5 RL or 3.3 m below the embankment crest RL (788.8 RL) for ED1*". This statement indicates that the water depths might have been referenced to 788.8 mAHD.

The top of the peg was assumed to be 788.8 mAHD and historic water levels were calculated. The estimated water levels for ED1 and ED2 are presented in Figure 5.2. Refer to Table 5.1 for basic characteristics of ED1 and ED2 dams.

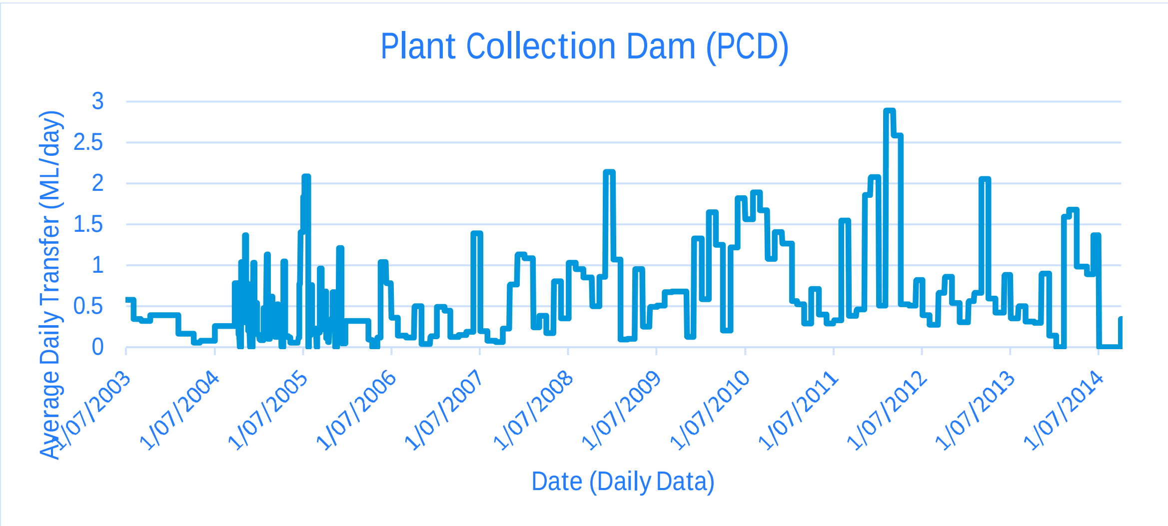


Figure 5.1 Pumped transfer from PCD to ED1 (Source: Veolia)

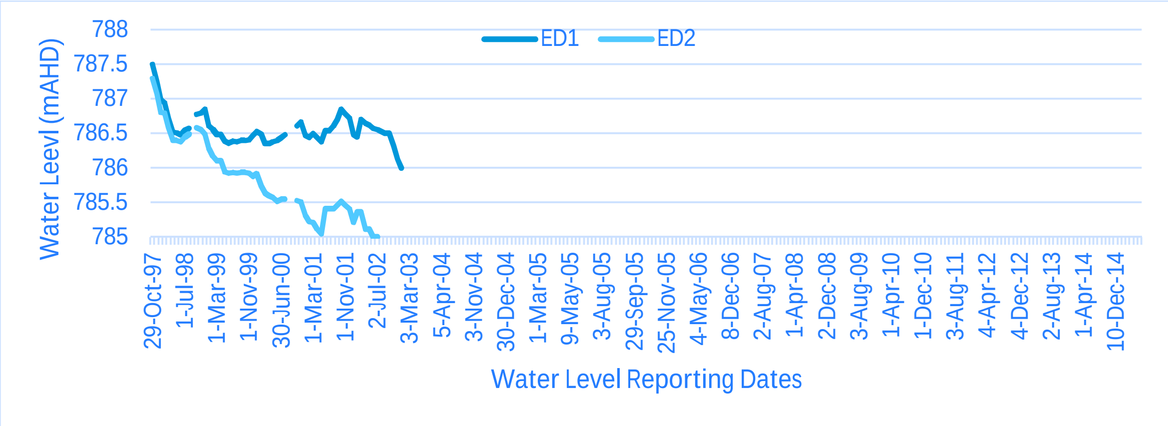


Figure 5.2 Monitored water levels for ED1 and ED2 (Source: Veolia)

Table 5.1 Summary of key bathymetric characteristics for ED1 and ED2

LOCATION	ELEVATION (MAHD)	ED1 VOLUME (ML)	ED1 AREA (HA)	ED2 VOLUME (ML)	ED2 AREA (HA)
Base	782.0	0.0	2.9	0.0	3.9
	785.0	188.3	24.0	153.9	9.1
Spillway	788.8	1345.3	52.5	846.2	23.5

5.3 BIOREACTOR LEACHATE RECOVERY

Veolia manages leachate within the waste mass in the void. Batches of extracted leachate are treated in an aeration pond and pumped to ED3N for evaporation (Veolia, 2012).

Metered rates of leachate transfer from the mine void to ED3N is presented in Figure 5.3. The figure also provides annual average for 2013, 2014 and 2015. The annual average rates of leachate transfer has been on the rise from 0.97 L/s in 2013 to 1.79 L/s in 2014 and 2.5 L/s in 2015. Veolia expects to continue to extract leachate at a rate between 0.5 L/s to 2 L/s when ED3S is approved to be used as a leachate storage pond.

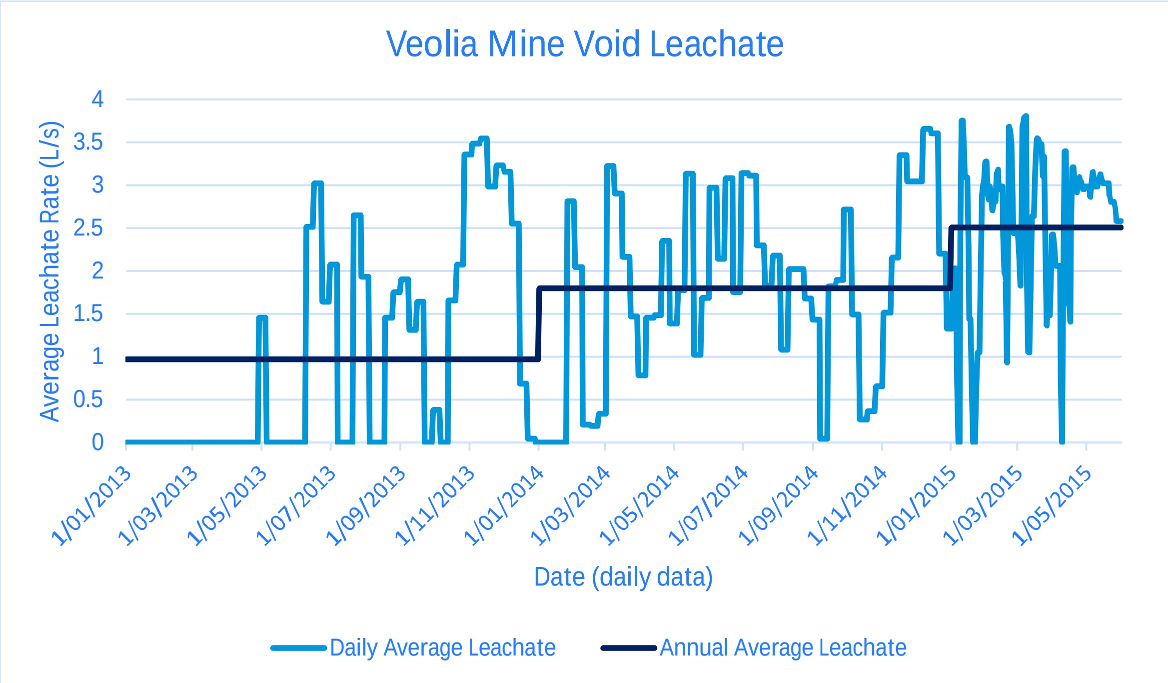


Figure 5.3 Metered rates of leachate transfer from Mine Void to ED3N

5.4 LEACHATE DAM (ED3N) WATER LEVELS

Monitored water levels for lagoons in ED3N are presented in Figure 5.4. Except for ED3N Lagoon4, all other lagoons are near the allowable freeboard levels. Table 5.2 summarises key characteristics of bathymetric data for ED3N Lagoons.

The last data point on 27 August 2015 indicates that water levels in Lagoons 2 and 3 were close to their minimum wall levels 791.60 mAHD and 791.50 mAHD respectively. The water level in ED3N4 (Lagoon4) was 0.80 m below the maximum allowable water level (FSL = 791.30 mAHD) with an empty space of 30 ML on 27 August 2015.

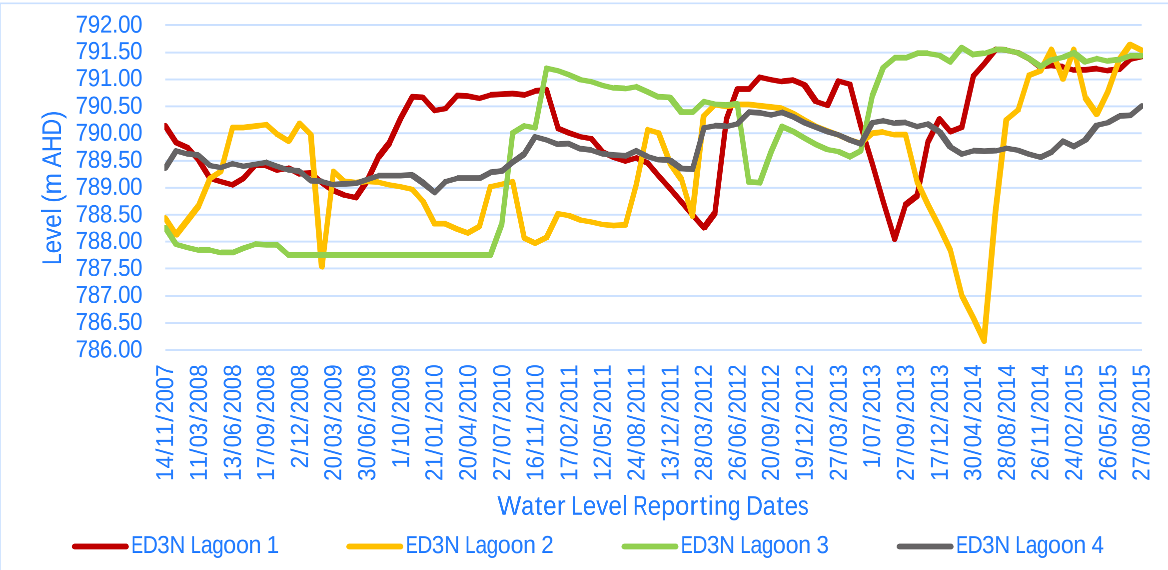


Figure 5.4 Metered water levels in ED3N leachate dam lagoons

Table 5.2 Basic characteristics of ED3N Lagoons

ED3N LAGOONS	LOCATION	WATER LEVEL	VOLUME (ML)	AREA (HA)
ED3N Lagoon1	Wall	**791.80**	26.74	0.91
	FSL	791.30	22.59	0.86
	Base	787.40	0.00	0.00
ED3N Lagoon2	Wall	**791.60**	21.48	0.75
	FSL	791.10	18.08	0.71
	Base	787.50	0.00	0.00
ED3N Lagoon3	Wall	**791.50**	17.79	0.68
	FSL	791.00	14.80	0.63
	Base	787.80	0.00	0.00
ED3N Lagoon4	Wall	**791.80**	123.54	4.13
	FSL	791.30	104.21	3.97
	Base	786.20	0.00	0.00

5.5 MINE VOID STORMWATER AND STORAGE POND (ED3S) LEVEL

Measured water levels for ED3S dam where the mine void stormwater is stored and evaporated are shown in Figure 5.5. Note that Veolia does not accurately measure water levels when it is below the bottom of the peg (except for the water levels shown between 18 May 2006 and 7 May 2007). Table 5.3 summarises key characteristics of ED3S pond bathymetry.

The water level in ED3S has been above the bottom of the peg since August 2010 to date. The last recorded level of 790.22 on 1 June 2015 was well within the maximum allowable water level (spillway level or FSL) of 790.5 mAHD.

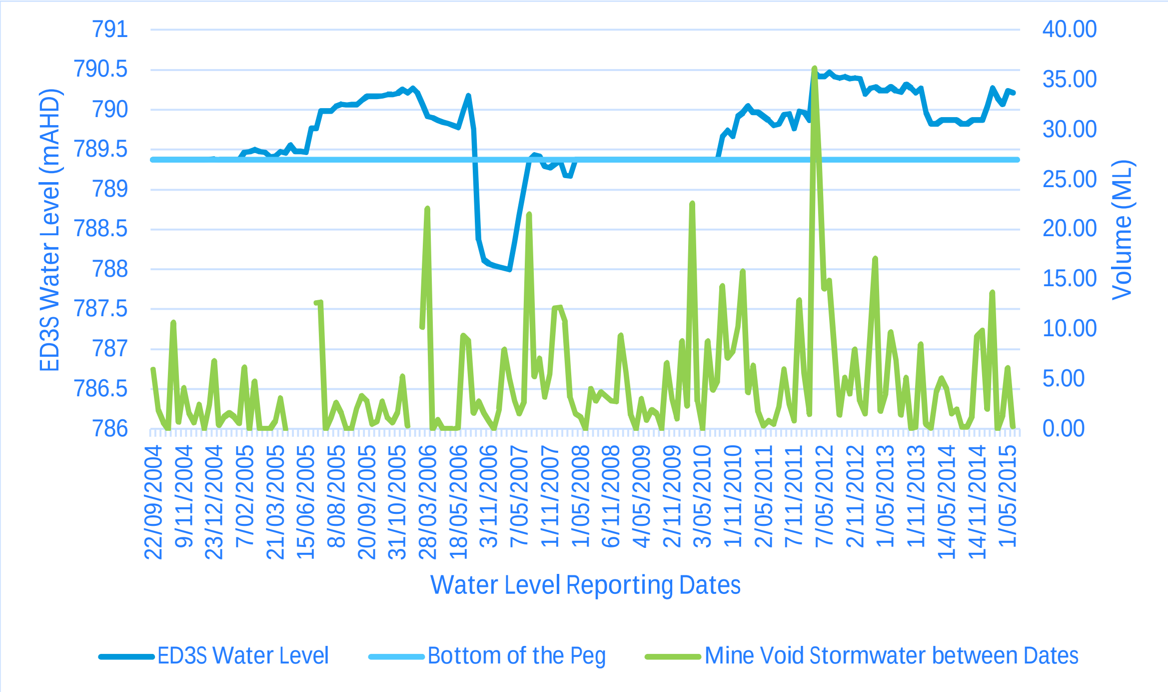


Figure 5.5 ED3S water level and the mine void stormwater (Source: Veolia)

Table 5.3 Basic characteristics of ED3S

POND	LOCATION	WATER LEVEL (MAHD)	VOLUME (ML)	AREA (HA)
ED3S	Wall	791.00	178.94	9.51
	FSL	790.50	134.28	8.94
	Top of Peg	790.37	122.83	8.71
	Base of Peg	789.37	48.70	5.49
	Base of Pond	786.40	0.00	0.00

6 OBSERVATIONS/FINDINGS

6.1 MINE VOID STORMWATER

Pumping hour based volumes of stormwater transferred from the mine void to ED3S are compared with the rainfall volume from the mine void catchment of 44.93 ha in Figure 6.1. Total stormwater volume pumped from the mine void to ED3S pond is estimated to be 23% of the total rainfall volume captured within the rim of the mine void.

ED3S pond receives stormwater runoff from the mine void and direct rainfall-runoff within the bound of its dam wall. Water balance modelling was undertaken for ED3S pond with the Veolia's estimated stormwater runoff data to simulate observed water levels for ED3S shown in Figure 5.5. The simulated results indicate that the pumping hour based estimation of the stormwater may be an over estimation. Refer to Section8.1 for the water balance modelling results.

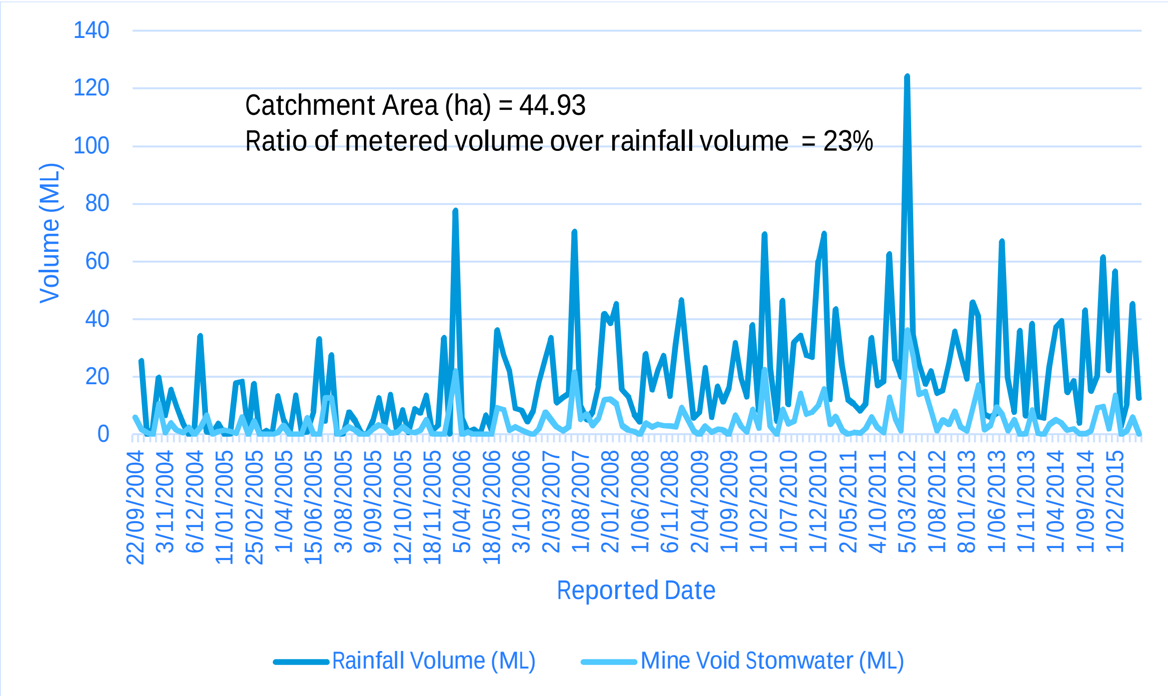


Figure 6.1 Comparison of rainfall volume from the mine void catchment with Veolia's pumping record

6.2 PCD DAM CATCHMENT RUNOFF

Veolia records hours of pumping, which is then multiplied with pump capacity to estimate runoff volumes. The Veolia's estimates of pumped volumes from PCD as presented in Figure 5.1 are compared with rainfall volumes from the PCD catchment of 33 ha in Figure 6.2. The sum of pumped volume from 1 August 2003 to 1 Aug 2014 was found to be 110% of the total rainfall volume from 33 ha. It appears that volume estimated from pumping hours may not be accurate.

Note that PCD runoffs are transferred to ED1, which also receives runoffs from the dolerite deposit area as well as seepage from the waste dump that is collected in WRD. Water balance simulation for ED1 was undertaken from a known water level and various %runoffs from PCD catchment. The simulation indicates that the realistic runoff from PCD dam may be less than 15% of the total rainfall volume. The calibration results for ED1 are presented in Appendix A.

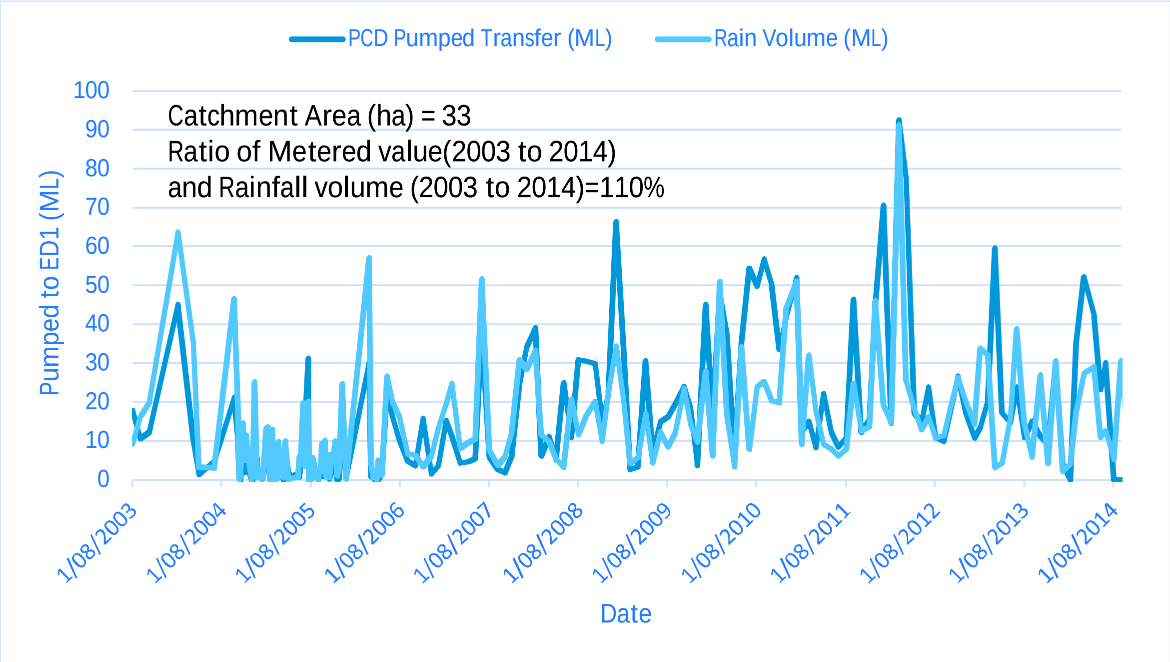


Figure 6.2 Comparison of rainfall volume from the PCD catchment with Veolia's pumping record

7 ASSUMPTIONS MADE

The following assumptions were made for the water balance analyses presented in this report:

- Veolia’s pumping hour based estimates of stormwater volumes from the mine void may be an over estimation.
- Veolia’s pumping hour based estimates of stormwater volumes from PCD to ED1 may be in error.
- A pan factor of 0.85 is suitable for water surface evaporation.
- Seepage from evaporation dams ED1 and ED2 are occurring. Veolia is currently updating the Soil and Water Management Plan (schedule 4 condition 17) of the Project Approval 10_0012 that outlines seepage management.
- The proposed leachate storage in ED3SL will be lined prior to transferring leachate from the bioreactor.
- Use of constant rate of the bioreactor leachate transfer to ED3SL in the modelled assessments would not dampen daily water level variation significantly.

8 WATER BALANCE ASSESSMENTS

Veolia's proposal is to transfer stormwater that is currently stored in ED3S to ED2 and continue using ED2 to store stormwater collected from the mine void over the life of the bioreactor operation. This will change the recent regime for ED2, which was only storing and evaporating direct rainfall and runoff generated within its footprint since 1998 to-date.

Veolia's proposal is to line the emptied ED3S pond before storing leachate collected from the mine void over the life of the bioreactor. ED3S will continue to collect direct rainfall and runoff from within its footprint.

ED1 is the main evaporation pond that receives stormwater generated from the PCD catchment, the dolerite stockpile, WRD and may receive potential transfers from TDS, TDN and TDW. This pond will not be affected by Veolia's operation directly.

Water balance simulations were undertaken to assess:

- conservative limits for leachate discharge to ED3S leachate storage (ED3SL) without overtopping under historical climate
- likelihood of ED2 overtopping under historical climate.

Water balance assessments presented in this report are based on the same GOLDSIM based water balance model that Parsons Brinckerhoff developed for Heron Resources Limited in 2012 (Parsons Brinckerhoff, 2012). In the current assessment all mining related water demands were set to zero. Changes in the model related to water transfers for mining were reverted to reflect current condition.

8.1 ED3S

ED3S refers to full pond prior to implementation of the proposed amendment by Veolia.

ED3S is an isolated evaporation pond that only receives stormwater from mine void. Water can also enter from rainfalls and its associated runoff generated between the pond water surface and the pond embankment (refer to Figure 8.1).

The water balance model that was developed by Parsons Brinckerhoff (2012) for the proposed Heron Resources Limited mining operation was tested for its validation for ED3S based on measured data provided by Veolia. The model test revealed that the stormwater volumes data provided by Veolia could be an over-estimation. Note that Veolia estimates water volumes based on pumping hours multiplied by pump capacity.

8.1.1 MODEL VALIDATION AND RECALIBRATION

The water balance model was run from a known water level of 789.47 m AHD on 7 Feb 2005 (refer to Figure 5.5). Metered stormwater volume data provided by Veolia was used as the mine void stormwater input to the pond (refer to Figure 5.5). Daily time step climate data from the Woodlawn Site station was used in the simulation.

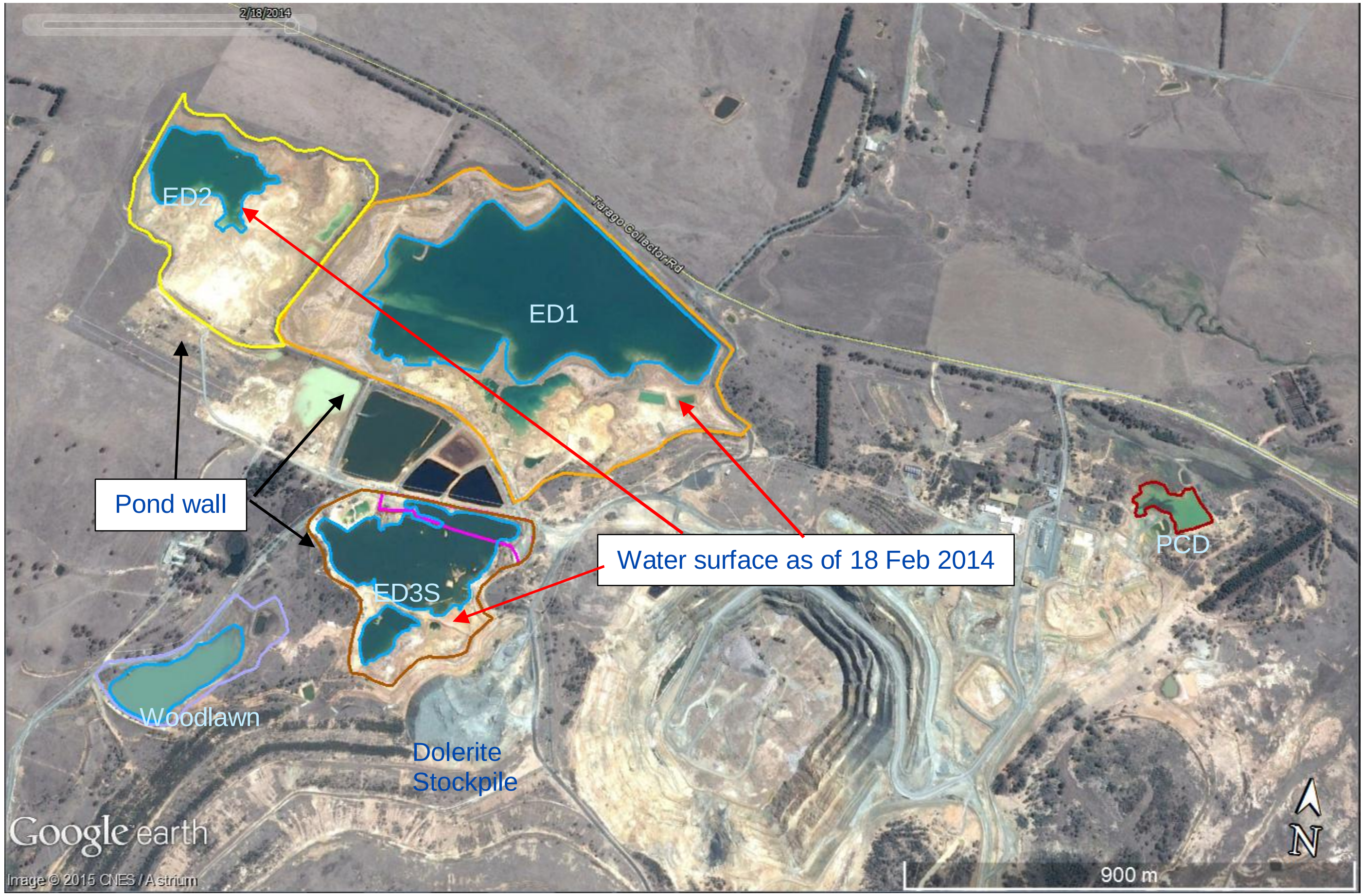


Figure 8.1 Google Earth imagery dated 18 Feb 2014 for the Woodlawn Site

Two sets of results are presented:

- Figure 8.2 shows the simulated water levels in ED3S without any reduction to the mine void stormwater volume. The early part of simulated water levels mimics the observed water levels in ED3S in 2005. The water level exceeds the top of peg level but remains below the dam crest until 2010. The simulation indicates that the pond should have spilled from 2010 till 2014. Veolia confirmed that this pond has never spilled. Veolia also stated that stormwater from ED3S gets transferred to ED1 whenever the water levels are close to the top of the marker peg level.
- Figure 8.3 shows simulated water levels for ED3S under reduced stormwater volume. In this simulation the mine void stormwater volumes were reduced by 60%. The simulated water levels mimic the observed levels quite closely till 2012 after which the level exceed the observed water levels. This simulation suggested that Veolia's estimated volumes of the mine void stormwater from pumped hours may be an over-estimation.

Veolia was requested for confirmation on data related issue. Veolia confirmed that the stormwater measurements are based on pumped hours and pump capacity therefore the volume estimates may not be accurate for the water balance.

It was, therefore, concluded that the mine void stormwater volumes data provided by Veolia are over-estimation. WSP | Parsons Brinckerhoff reduced the stormwater volumes by 60% based on water balance simulation results for ED3S. The reduced stormwater volume time series was used in ED2 water balance assessment.

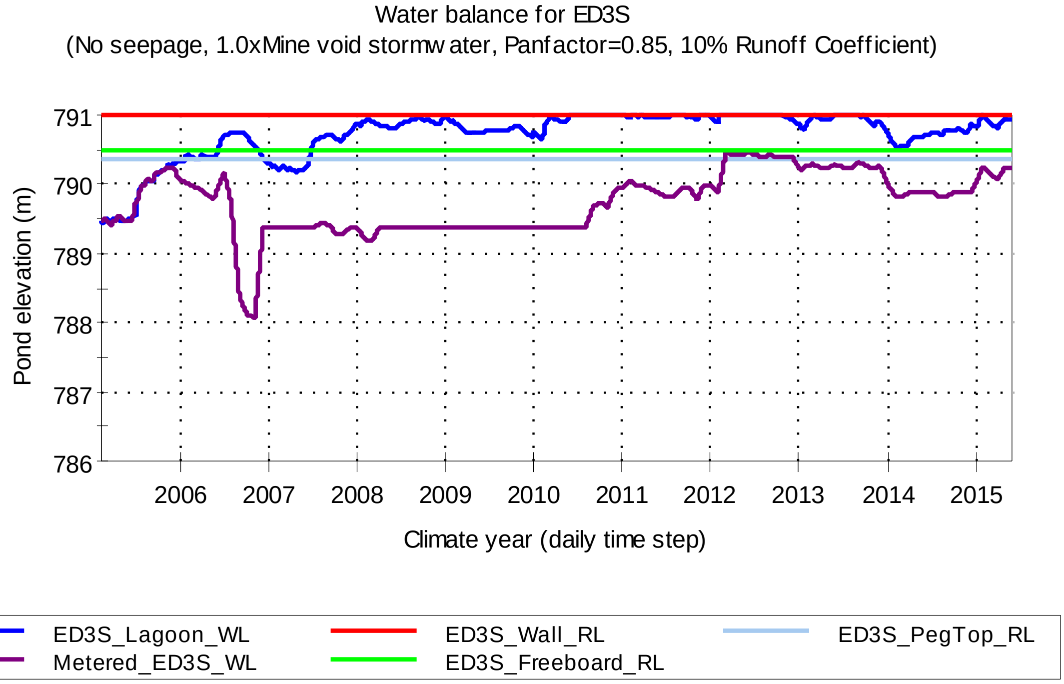


Figure 8.2 Water balance simulation result for ED3S with Veolia's mine void stormwater

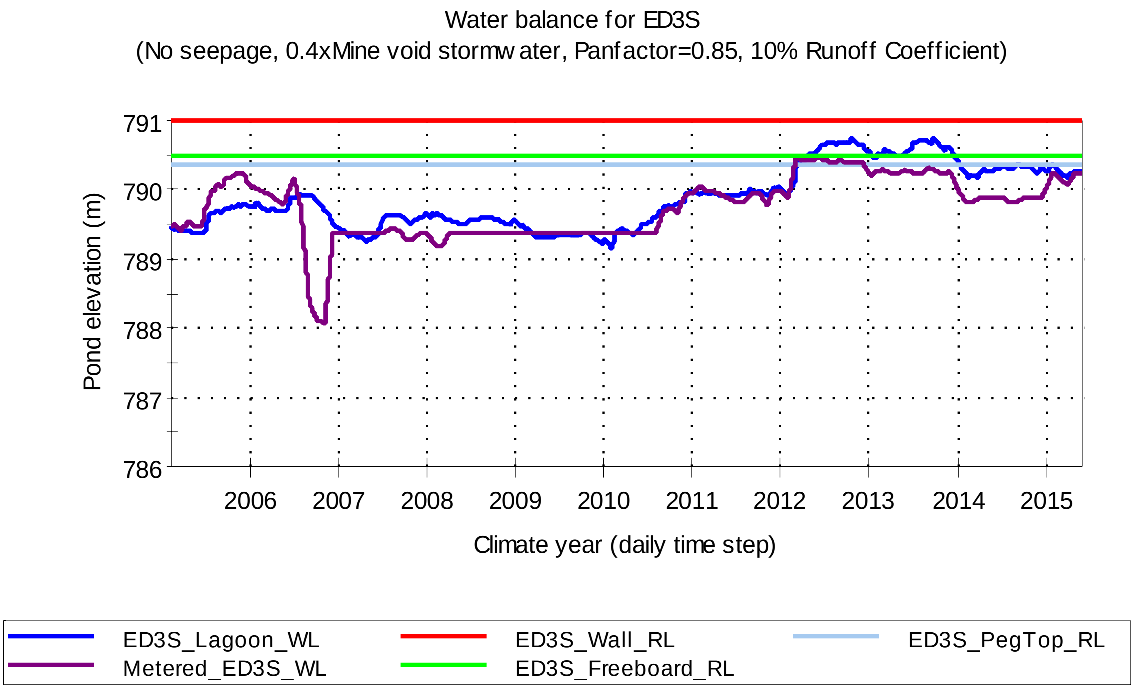


Figure 8.3 Water balance simulation result for ED3S with 40% of Veolia's mine void stormwater

8.2 ED3S LEACHATE STORAGE POND (ED3SL)

Veolia proposes to use a smaller portion of ED3S as a stormwater sump that will accept the mine void stormwater before transferring the stormwater to ED2. The exact location and type of infrastructure arrangement was not finalised by Veolia for inclusion in this report.

For water balance assessments, the ED3S stormwater pond was split into two lagoons for the purpose of simulating Veolia's proposed amendment:

- → The northern portion of the ED3S will function as a sump. The volumetric capacity of this sump is expected to be 10% of the total volume of ED3S (refer to Figure 8.4 for illustration).
- → The rest of the pond was assumed to be a single unit and referred to as ED3SL which will store the bioreactor leachate in future.

Veolia expects to transfer leachate from the mine void initially at higher rate (up to 4 L/s) and later at reduced rate. Historically the transfer rates from the mine void has been in between 0.25 L/s to 3.75 L/s (Figure 5.3). Veolia is interested in knowing time span available to them before ED3SL storage is filled up to the freeboard level.

Current operation practice for ED3N lagoons has been to pump the leachate until it reaches the allocated freeboard levels, which are 0.5 m below the lowest dam crest level for any lagoon embankment. Once a lagoon is filled up, the leachate is transferred to the next lagoon that has empty storage available to store the mine void leachate.

In case of emergency when all cells are full, Veolia's current procedure is to pump the leachate back to the mine void until situation improves.

With the proposed ED3SL dam, Veolia will have an additional storage capacity of up to 162 ML for leachate and local rainfall and runoff storage.

Water balance simulations for EDSL were undertaken to:

- test whether ED3SL will be able to contain local stormwater generated within its dam embankment above the freeboard level without spilling. The current ED3S freeboard level of 790.5 mAHD was assumed to be the freeboard for ED3SL in the simulations
- estimate a range of timeframe for the empty lagoon to fill up to the nominated freeboard level for the first time
- estimate feasible rates of leachate transfer once ED3SL pond fills up to the freeboard level of 709.5 mAHD for the first time. This simulation considers ED3N lagoons available for transfer of excess water above the freeboard level from ED3SL.

8.2.1 CLIMATE SEQUENCE

Water balance simulations were undertaken for ED3SL under historic wet and dry sequences including 3-year 90th percentile annual rainfall years to estimate quantify duration in months before it would fill up to the set freeboard level without spilling.

Climate sequence from 1944 to 2014 (Figure 8.5) was used in the assessment as it captures the highest and second highest annual rainfalls (refer to Section 3) as well as two consecutive periods of above average rainfalls and 5-year period of below average rainfall years. Annual rainfalls were greater than 1,000 mm in 1950 and 1974. The pan evaporation sequence from 1978 to 2014 was repeated from 1931 to match up with the length of rainfall record from Lake Bathurst (BOM70036).

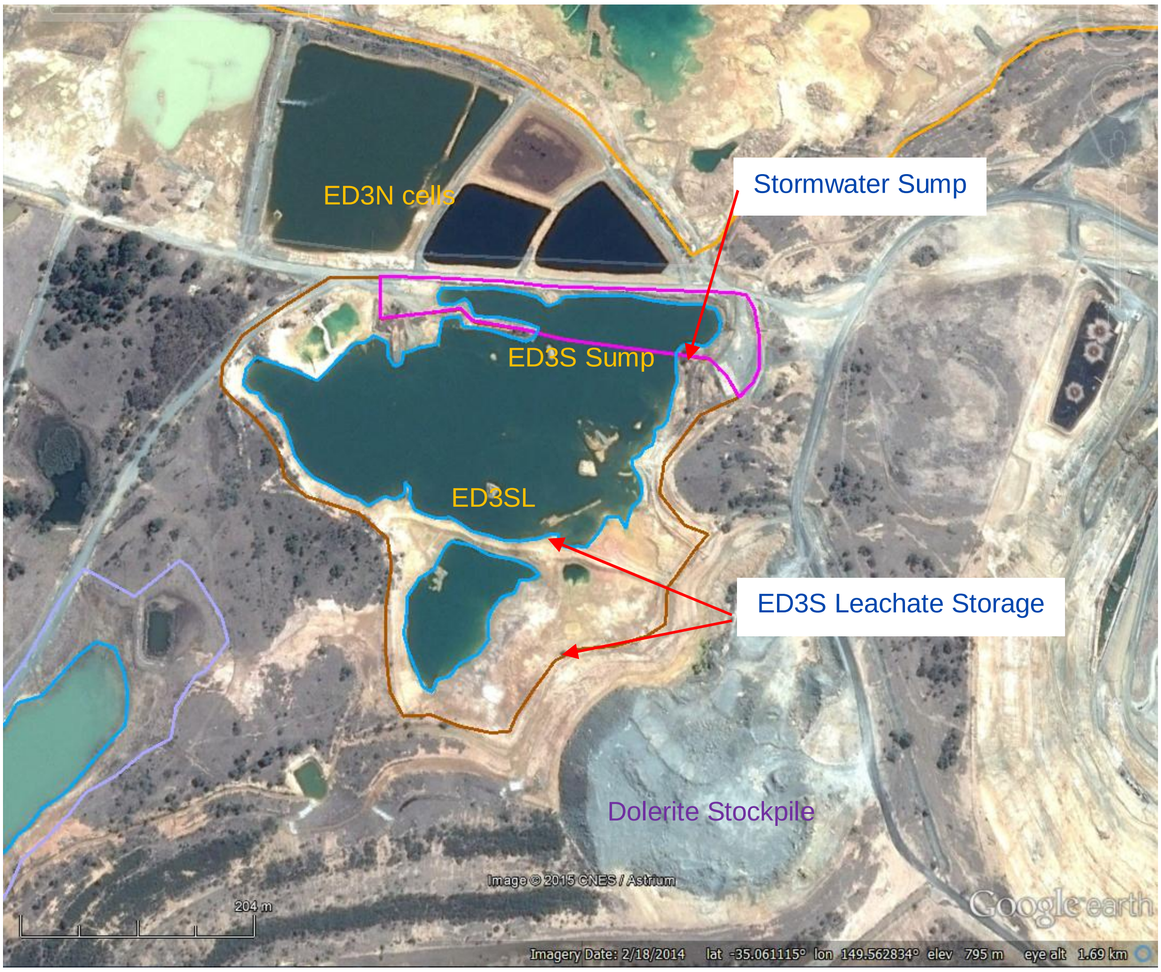
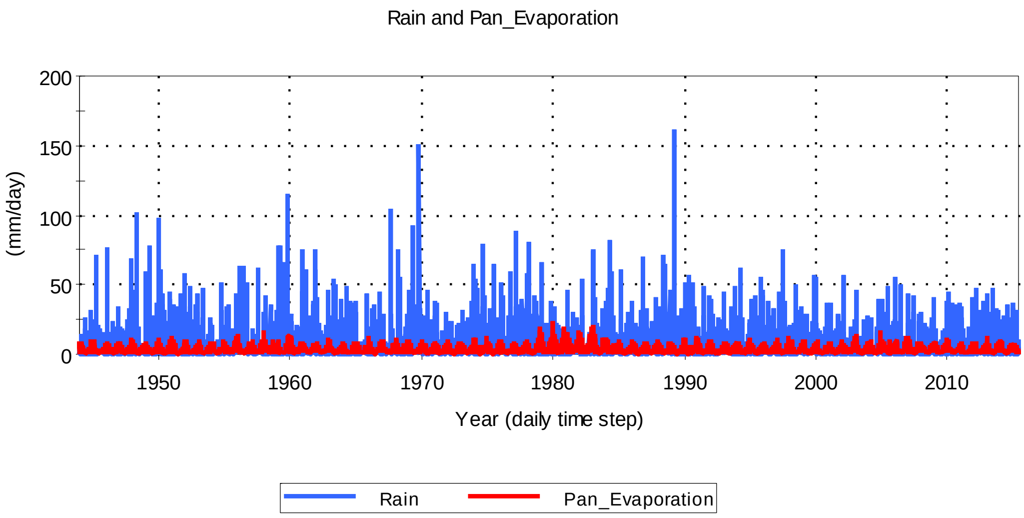


Figure 8.4 ED3S Leachate Storage Pond and ED3S Sump



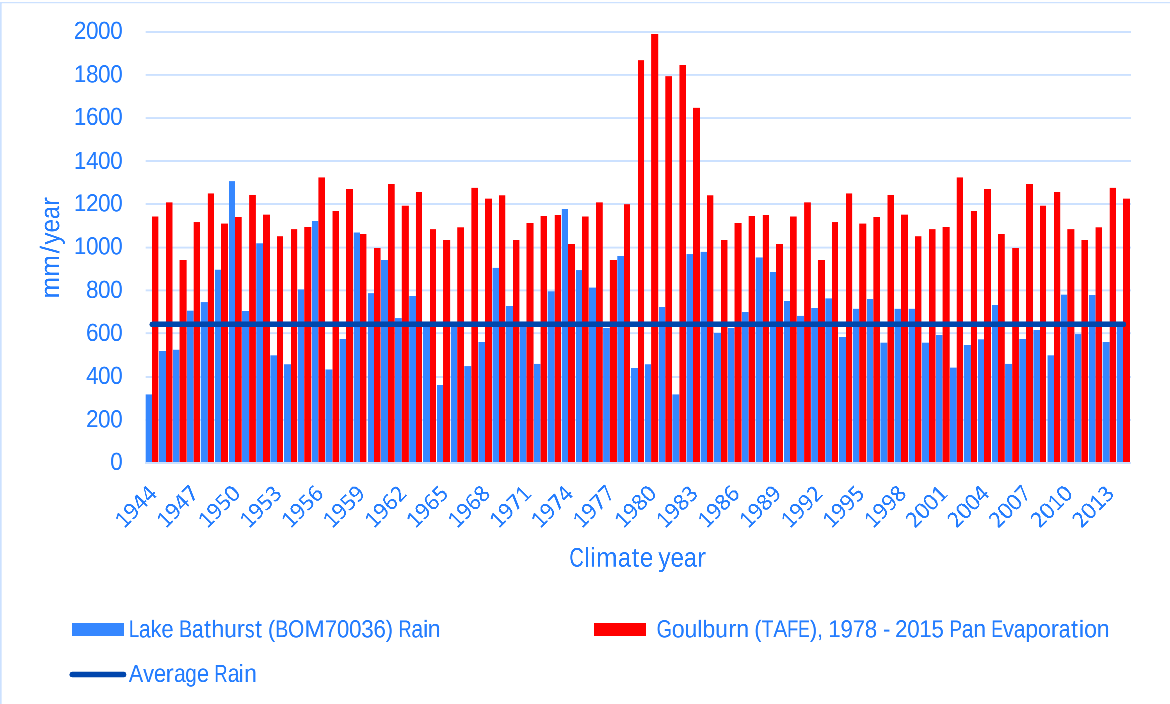


Figure 8.5 Daily (top chart) and annual (bottom chart) climate sequence from 1944 to 2014

8.2.2 BATHYMETRIC DATA

The water balance for ED3SL was based on the elevation-storage (Figure 8.6) and the elevation-area (Figure 8.7) relationships.

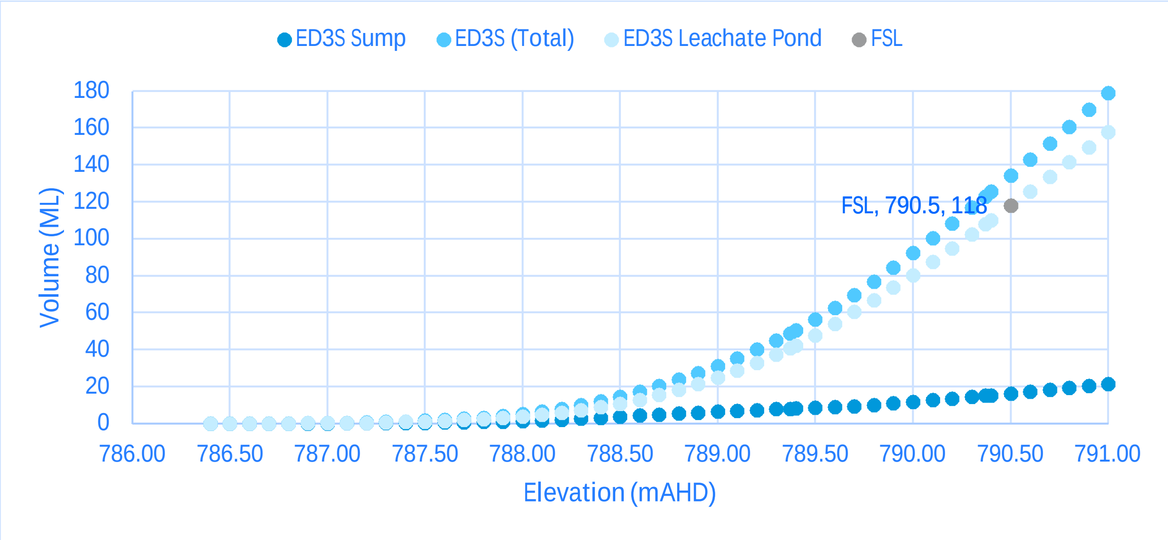


Figure 8.6 Elevation and volume relationships for ED3S, ED3S Sump and ED3S Leachate Pond

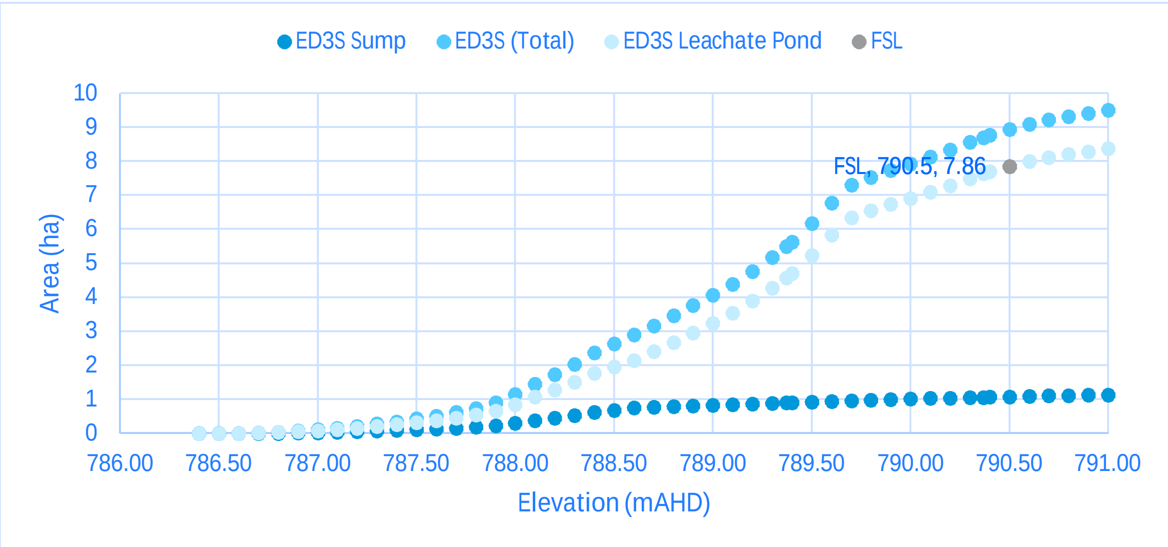


Figure 8.7 Elevation and area relationships for ED3S, ED3S Sump and ED3S Leachate Pond

8.2.3 MODEL PARAMETERS

The Pan factor of 0.85 and the runoff coefficient of 10% for the area between water surface and the pond embankment were kept the same as per the Heron Resources Limited water balance model (Parsons Brinckerhoff, 2012). No seepage from ED3SL was allowed for in the model as this dam will be suitably lined before storing any leachate from the mine void.

8.2.4 MODEL RUNS

The water balance model was first run with climate data only. The leachate pumped out of the bioreactor was not added to the ED3SL pond in the model. This simulation shows accumulation of rainfall-runoff volume in the pond.

In the follow up simulations, leachate from the bioreactor was added at a constant rate for the duration of the simulation. A number of simulations were undertaken, each time with increased leachate transfer rate, until the first incident of spill from ED3SL occurred (i.e. volume in EDSL exceeded the freeboard level volume). The constant mine void leachate transfer rate that led to a full ED3L without spillage was considered the absolute minimum rate of leachate transfer for the simulated climatic data that can be safely stored and evaporate from ED3SL.

8.2.5 WATER BALANCE RESULTS FOR ED3SL

8.2.5.1 WITHOUT ANY LEACHATE TRANSFER FROM THE MINE VOID

Assuming 10% runoff from the area between the pond water surface and its embankment, the rainfall runoff and associated evaporation may maintain a water level up to a level of 789.50 mAHD (refer to Figure 8.8). In terms of volume this equates to a maximum of 45 ML (refer to Figure 8.9). Given that the maximum allowable storage below the freeboard level is 118 ML, a net of 73 ML of storage is available to manage the leachate from the mine void. This equates to roughly 2.3 L/s continuously for a year. The sustainable daily rate will depend on the balance of direct rainfall and evaporation from the water surface area between 789.5 mAHD and 790.5 mAHD at the full supply level.

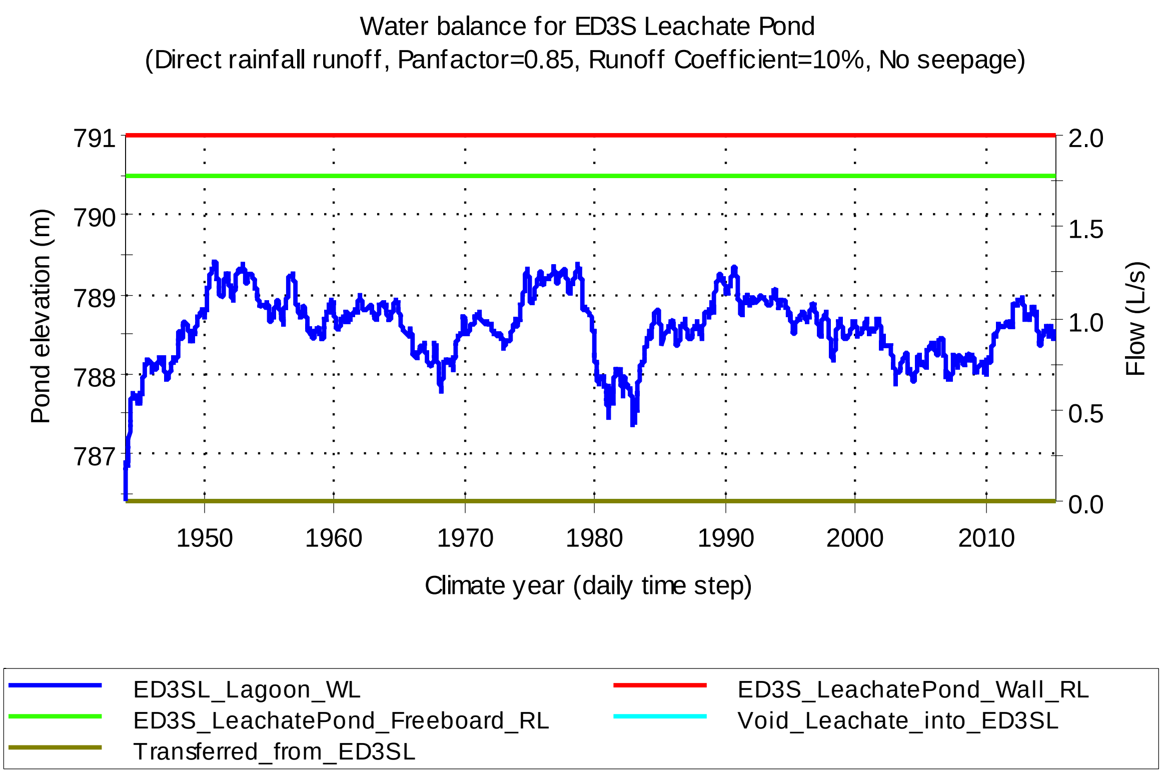


Figure 8.8 Simulated water level in ED3SL without mine void leachate

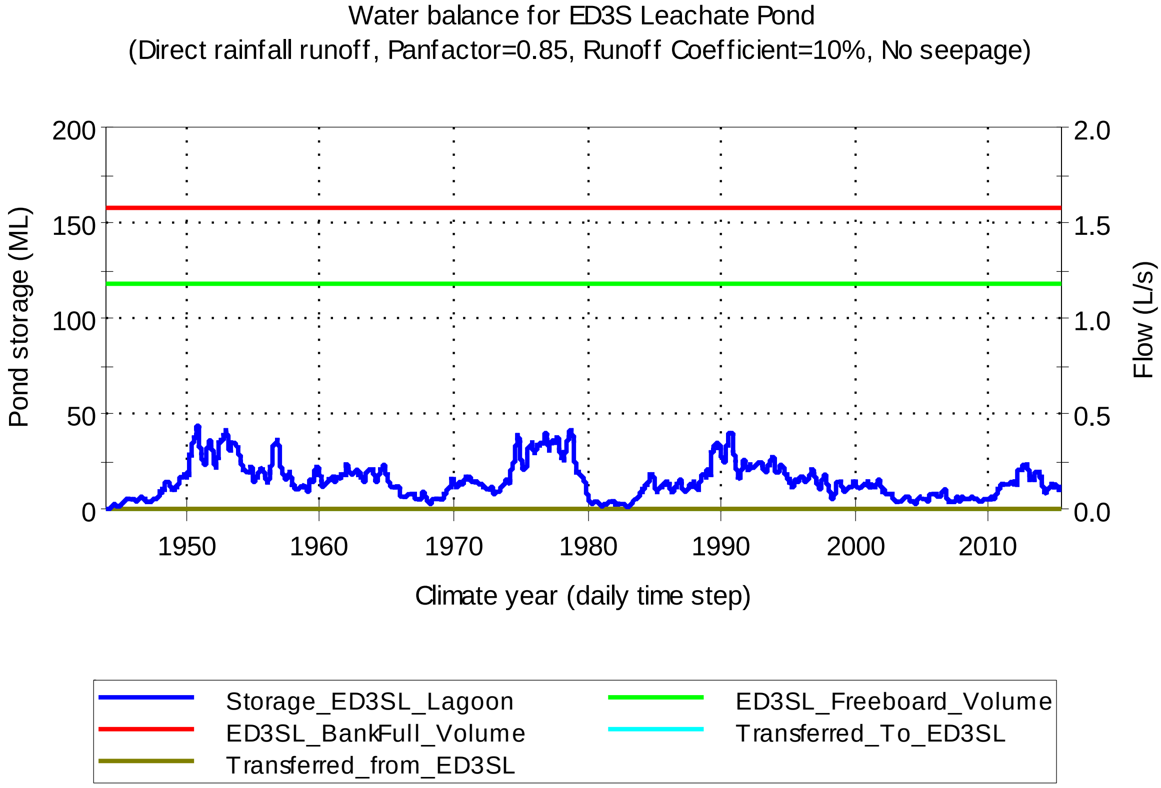


Figure 8.9 Simulated water storage in ED3SL without mine void leachate

8.2.5.2 LONG TERM LEACHATE TRANSFER FROM THE MINE VOID TO ED3SL

In this simulation the mine void leachate transfer to ED3SL was allowed at a constant rate for the simulated climate sequence from 1944 to 2014. This scenario was undertaken to identify the wettest, the driest and the average climate sequences for use in subsequent simulations.

When the leachate transfer from the mine void to ED3SL was allowed at a rate of 0.36 L/s in the model, the simulated storage in ED3SL was found to reach the freeboard level storage of 162 ML in 1978 (refer to Figure 8.10).

The climate sequence from 1970 to 1978 appear to have raised water level rapidly to freeboard level when adding the leachate at 0.36 L/s. This period was identified as the wettest climate sequence for subsequent runs.

The rapid decline in water level from 1979 to 1983 is due to the above average pan evaporation. Note that during this period the annual pan evaporation exceeded 1,500 mm/year and from 1983 onwards the recorded pan evaporation were less than 1,100 mm/year. This period was identified as the driest climate sequence for the subsequent runs. The recent climate sequence from 2003 to 2009 was identified as the second consecutive driest sequence

The water level responses to climate from 1990 to 2010 are similar to the responses from 1950 to 1970.

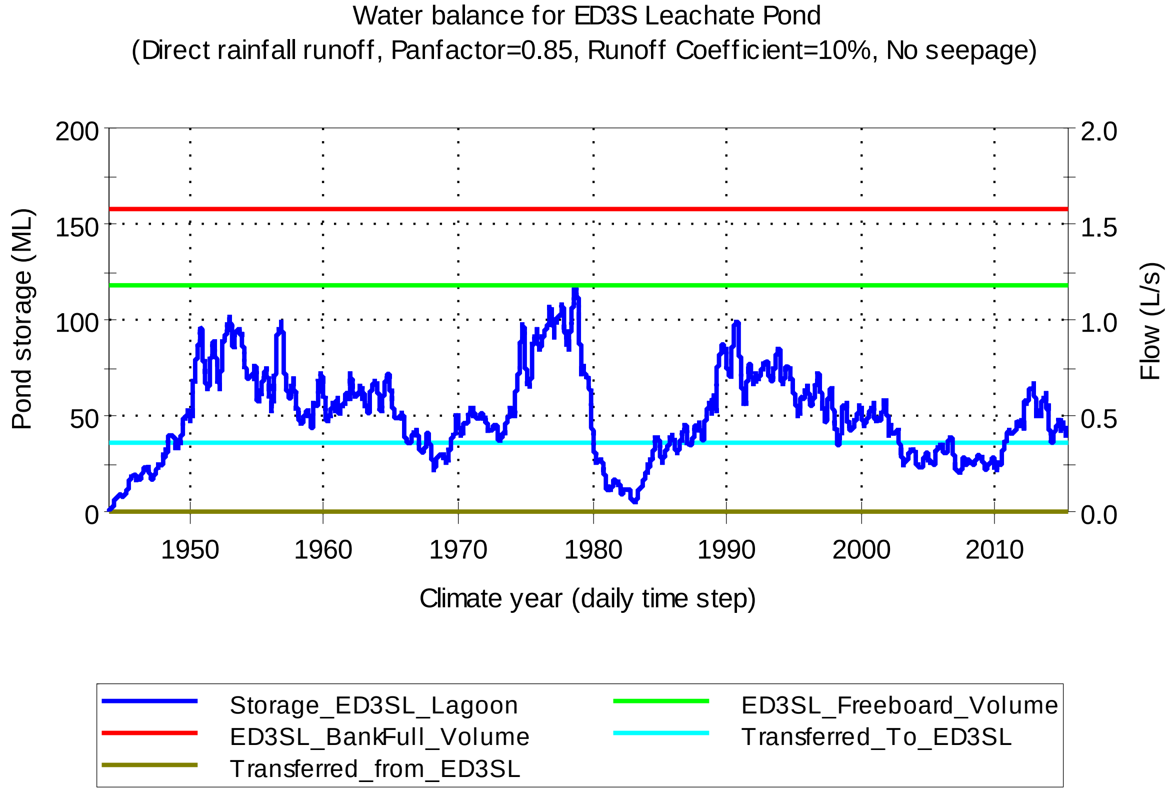


Figure 8.10 Simulated water storage in ED3SL with 0.36 L/s of mine void leachate

8.2.5.3 ESTIMATION OF MAXIMUM ALLOWABLE WATER STORAGE

This simulation was undertaken to test the adequacy of the freeboard level for the ED3SL lagoons. The freeboard level of 790.5 mAHD would be considered adequate if it can store entire year's stormwater within its dam embankment without spilling. In reality it is expected that Veolia would first transfer water to empty ED3N lagoons. Secondly if all of the leachate management lagoons are full then Veolia would transfer the leachate from one of the lagoons back to the mine void to avoid future spills.

The water balance simulation was undertaken by setting the initial water level in ED3SL at the freeboard level of 790.5 mAHD under the identified wettest climate sequence from 1970–1978. The simulation was started from the start of the wettest rainfall year (1 Jan 1974). No leachate transfer from the mine void was allowed in.

Figure 8.11 shows the time series of simulated water levels from 1 Jan 1974 to 31 May 1978. From this figure, it can be seen that the rainfall runoff generated within the footprint of ED3SL would be sufficient to fill up the ED3SL lagoons to its lowest embankment crest level of 791.0 mAHD without spilling. The figure also shows a sharp decline in water level in early months of 1975 which is primarily due to pan evaporation data that was adopted for the simulation.

The simulation also illustrates the likelihood of a sharp single day rise in volumes 138 ML on 27 August 2015 to 152 ML on 29 August 2015 due to a 3-day total rainfall of 171 mm.

For the subsequent simulations a freeboard of 0.5 m was considered adequate with an assumption that any water stored within the lagoons above the freeboard level will be transferred to the next available lagoons or the mine void if need be to reduce the chances of potential spills from the dams.

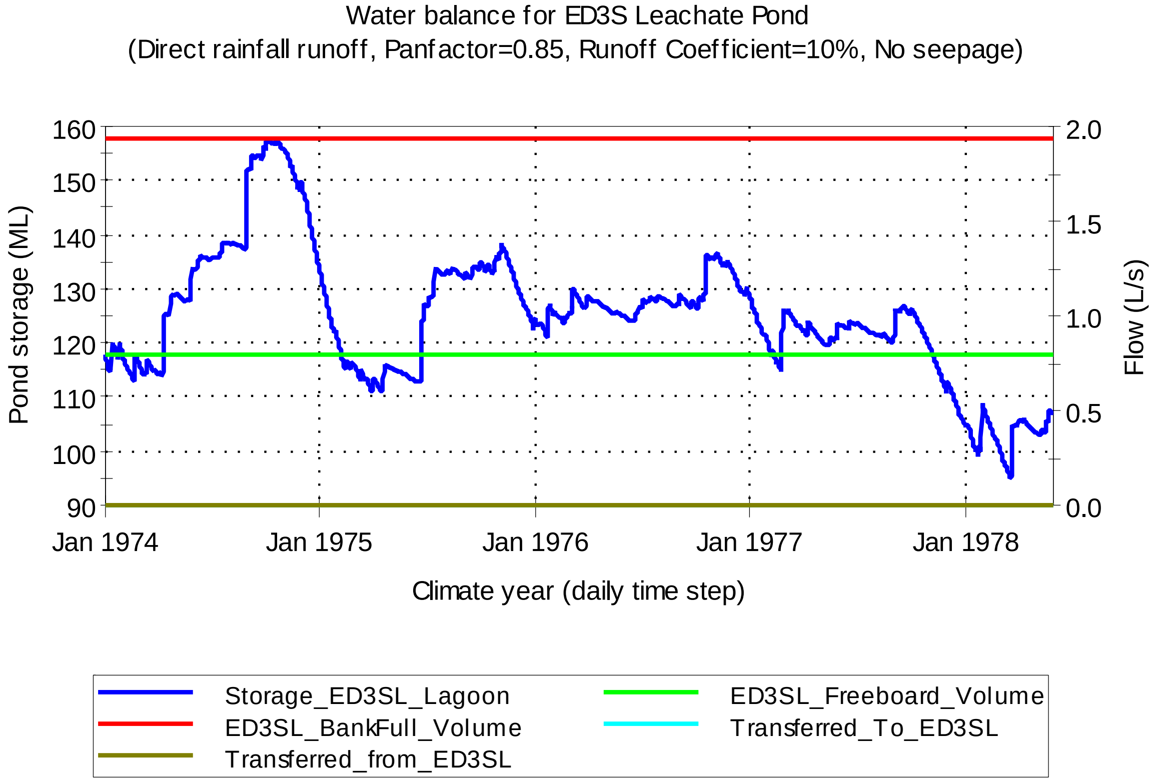


Figure 8.11 Simulated water storage in ED3SL without mine void leachate but starting at the freeboard level of 790.5 m AHD

8.2.5.4 TIME ESTIMATES FOR ED3SL TO FILL UP TO THE FREEBOARD LEVEL

Starting from an empty dam, the water balance model for ED3SL was run under the wettest (1974 to 1978), the driest (1979–1983) and the average climate sequence (1993 to 1997) to estimate time span to fill up the dam to the freeboard level when leachate from the mine void is discharged at certain rates. The rates considered in the simulations were: 1 L/s, 2 L/s, 3 L/s and 4 L/s.

The results for the wettest sequence are summarised in Table 8.1. If the leachate is transferred from the mine void at 4 L/s when the wettest rainfall like 1974 occurs, then the lagoons of ED3SL is likely to fill up in less than a year. If the leachate rate is limited to 1 L/s then it might take up to 4 years for ED3SL to fill up to the freeboard level. The leachate rates between 2 L/s to 3 L/s are likely to prolong filling time to 1.5 years. Daily sequenecs of simulated results for the wettest sequence are shown in Figure 8.12 through to Figure 8.15.

Table 8.1 Estimates of time to fill-up to freeboard level of ED3SL under the wettest climate

CLIMATE SEQUENCE	LEACHATE DISCHARGE (L/S)	DAYS TO REACH FREEBOARD LEVEL	DURATION (MONTHS)	DURATION (YEAR)
The wettest (1974 to 1979)	4	248	8.3	0.7
	3	471	15.7	1.3
	2	587	19.6	1.6
	1	1244	41.5	3.5

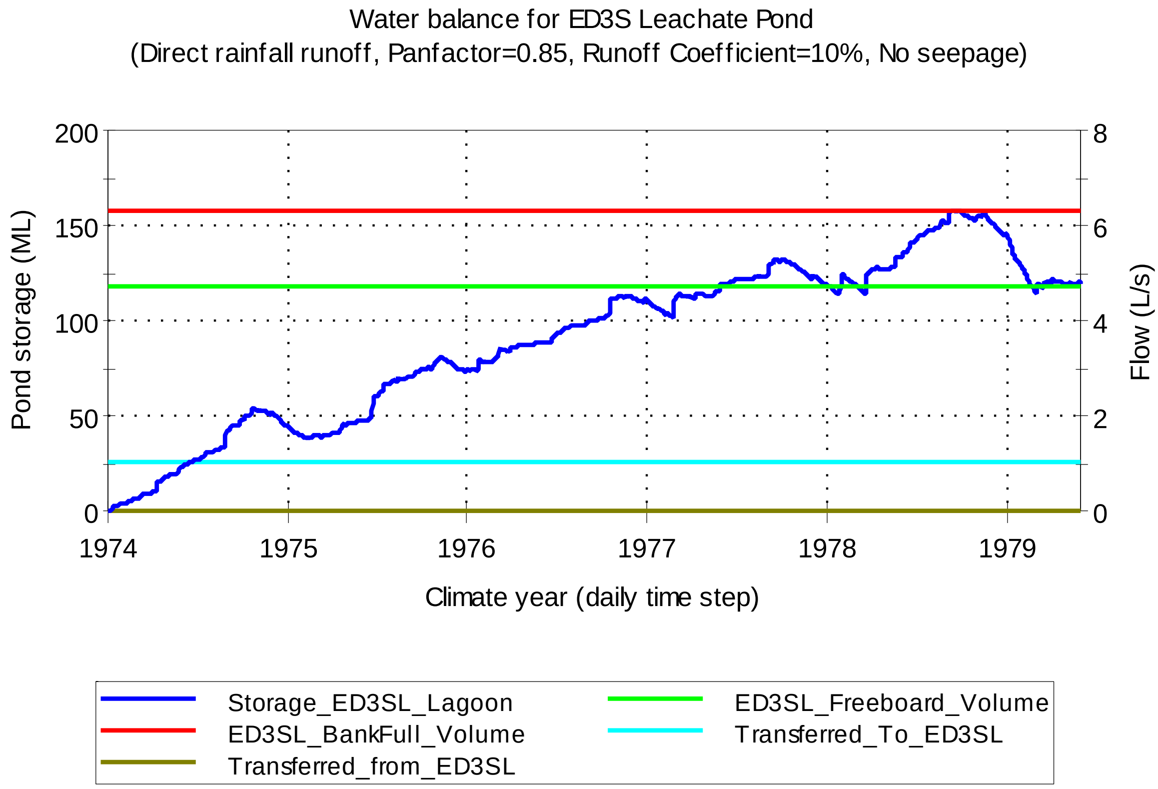


Figure 8.12 Simulated water storage in ED3SL with the mine void leachate discharge at 1 L/s under the wettest climate sequence

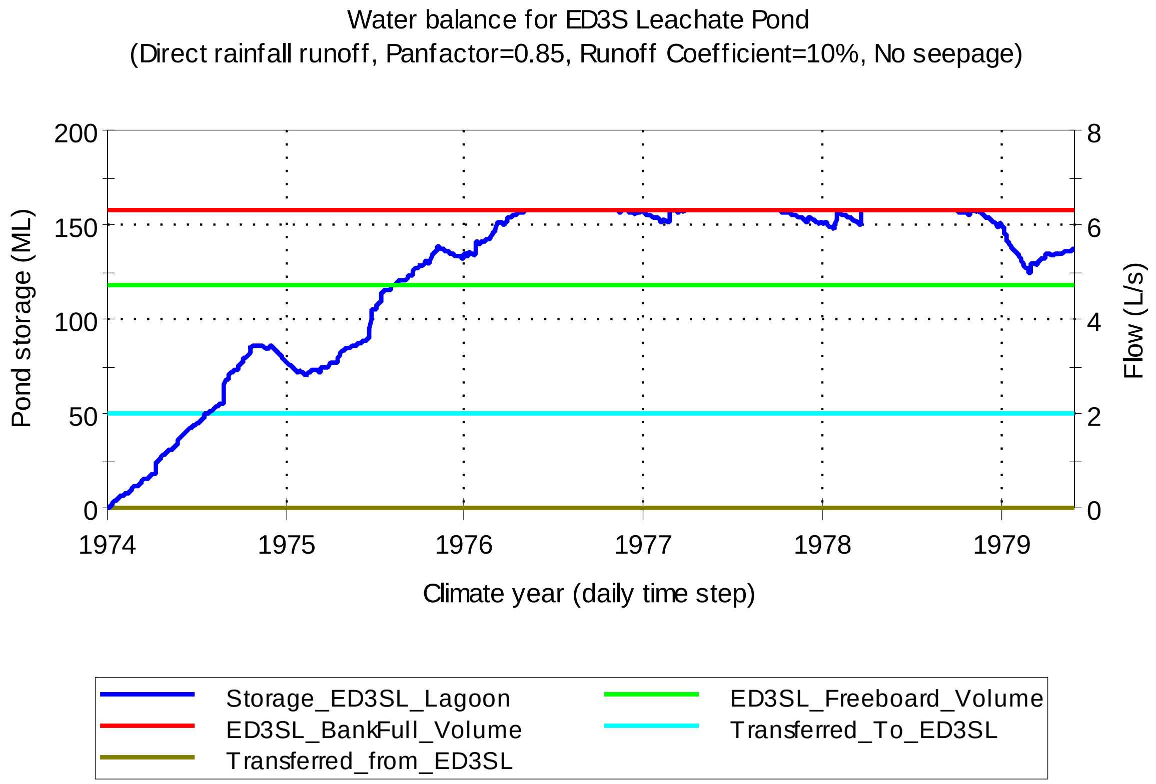


Figure 8.13 Simulated water storage in ED3SL with the mine void leachate discharge at 2 L/s under the wettest climate sequence

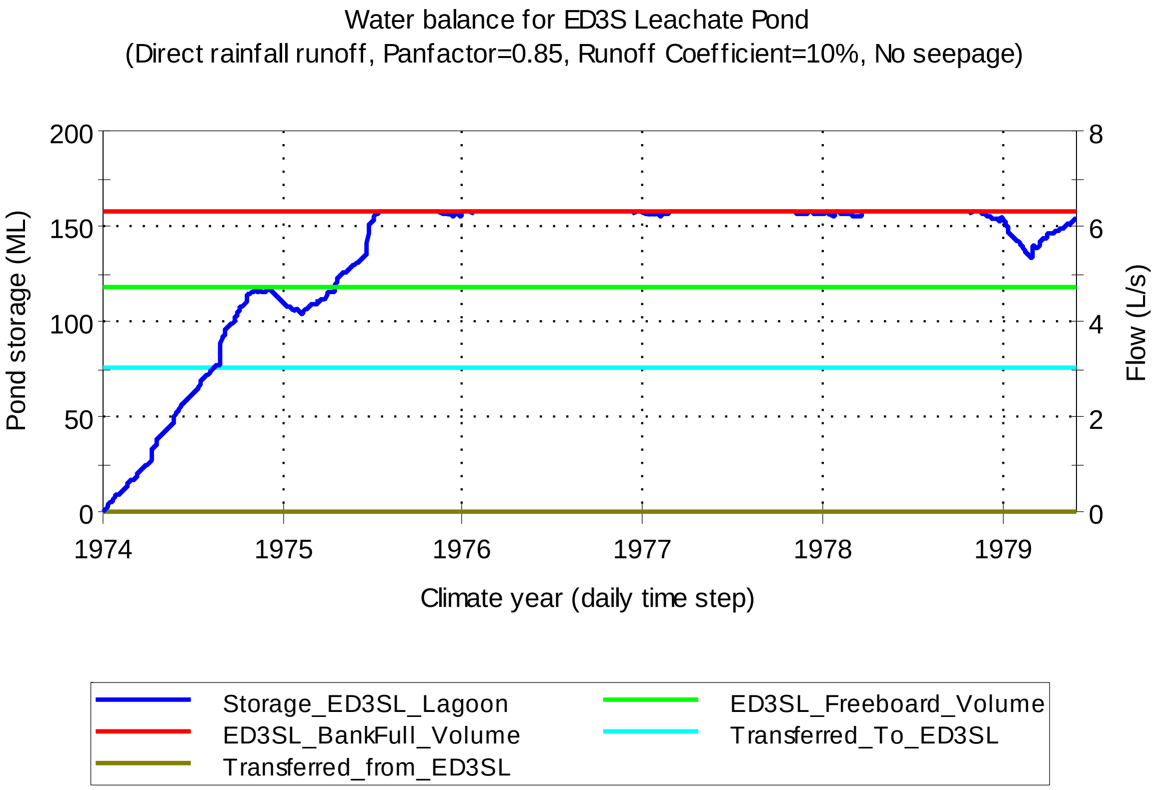


Figure 8.14 Simulated water storage in ED3SL with the mine void leachate discharge at 3 L/s under the wettest climate sequence

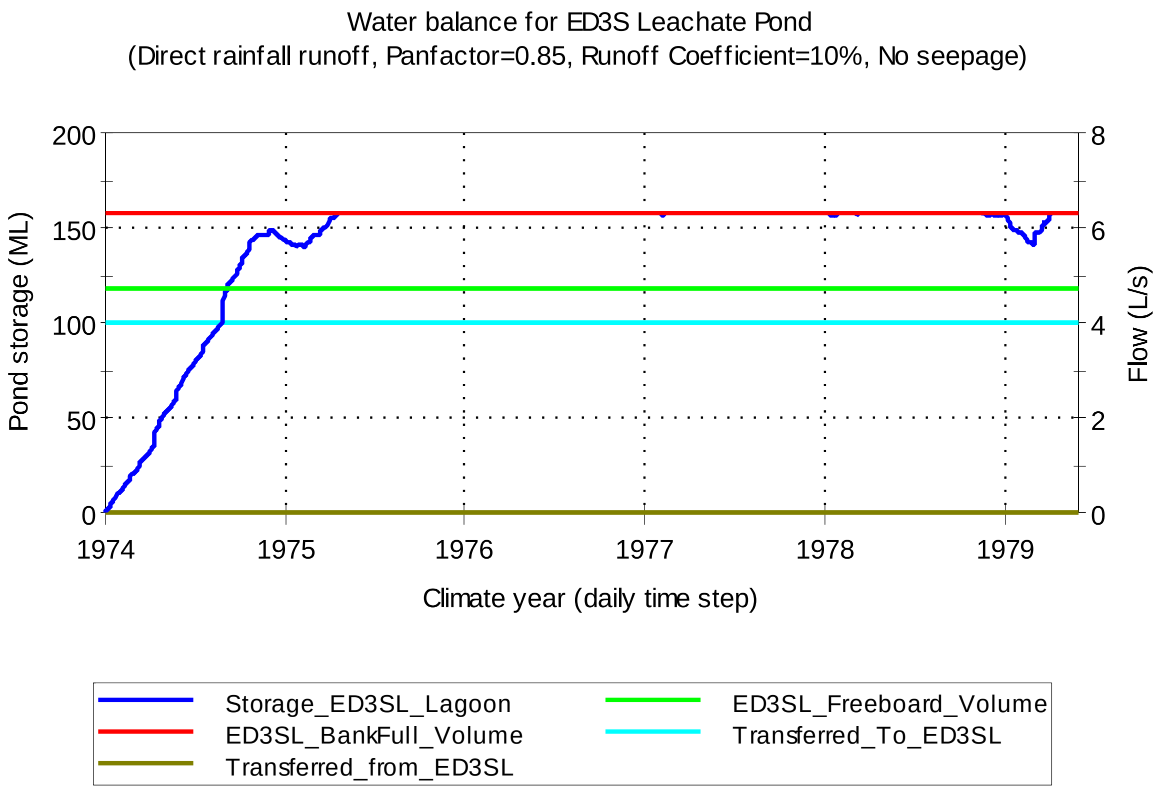


Figure 8.15 Simulated water storage in ED3SL with the mine void leachate discharge at 4 L/s under the wettest climate sequence

The results for the driest sequence are summarised in Table 8.2. If the leachate is transferred from the mine void at 4 L/s under the driest climate like 1979 through to 1985, then the lagoons of ED3SL is likely to fill up in less than 2 years. If the leachate rate is limited to 1 L/s then it might take much longer than 5 years for ED3SL to fill up to the freeboard level. The leachate rates between 2 L/s to 3 L/s are likely to prolong filling time to 5 years. Daily sequenecs of simulated results for the wettest sequence are shown in Figure 8.16 through to Figure 8.19.

Table 8.2 Estimates of time to fill-up to freeboard level of ED3SL under the driest climate

CLIMATE SEQUENCE	LEACHATE DISCHARGE (L/S)	DAYS TO REACH FREEBOARD LEVEL	DURATION (MONTHS)	DURATION (YEAR)
The driest (1979 to 1984)	4	615	20.5	1.7
	3	1257	41.9	3.5
	2	1953	65.1	5.4
	1	>1953	>65	>5.4

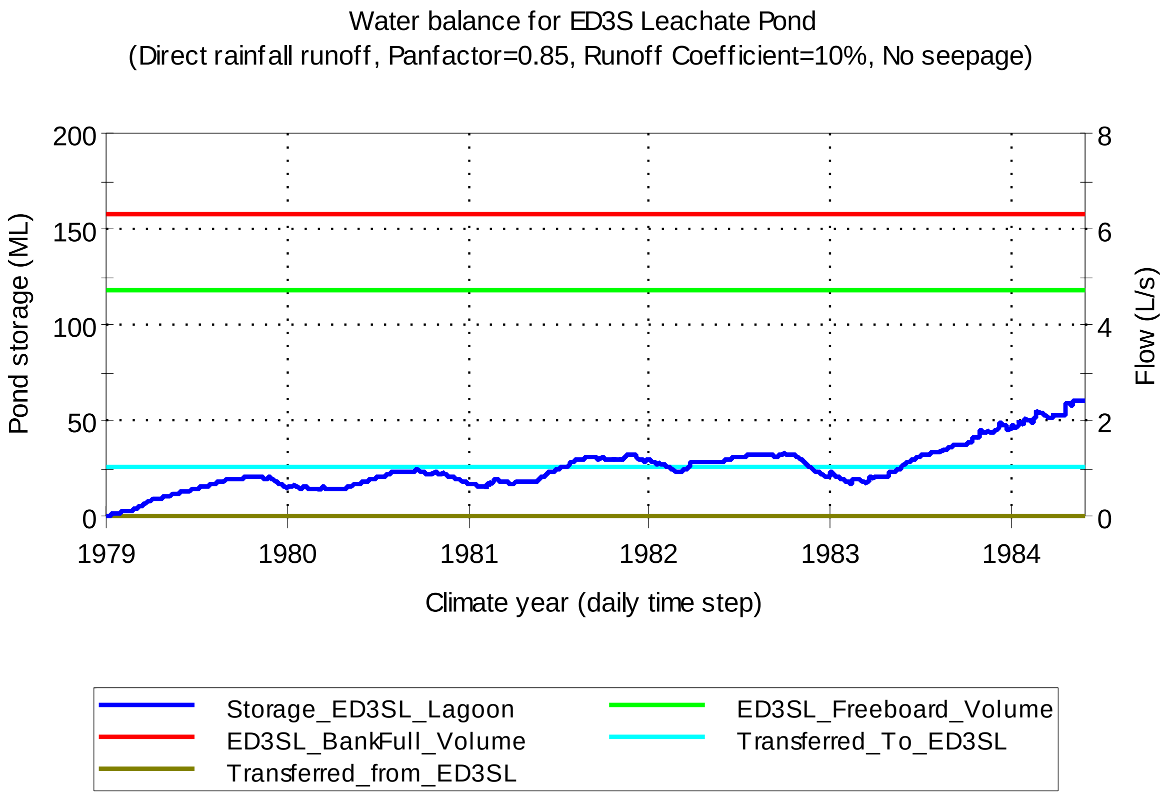


Figure 8.16 Simulated water storage in ED3SL with the mine void leachate discharge at 1 L/s under the driest climate sequence

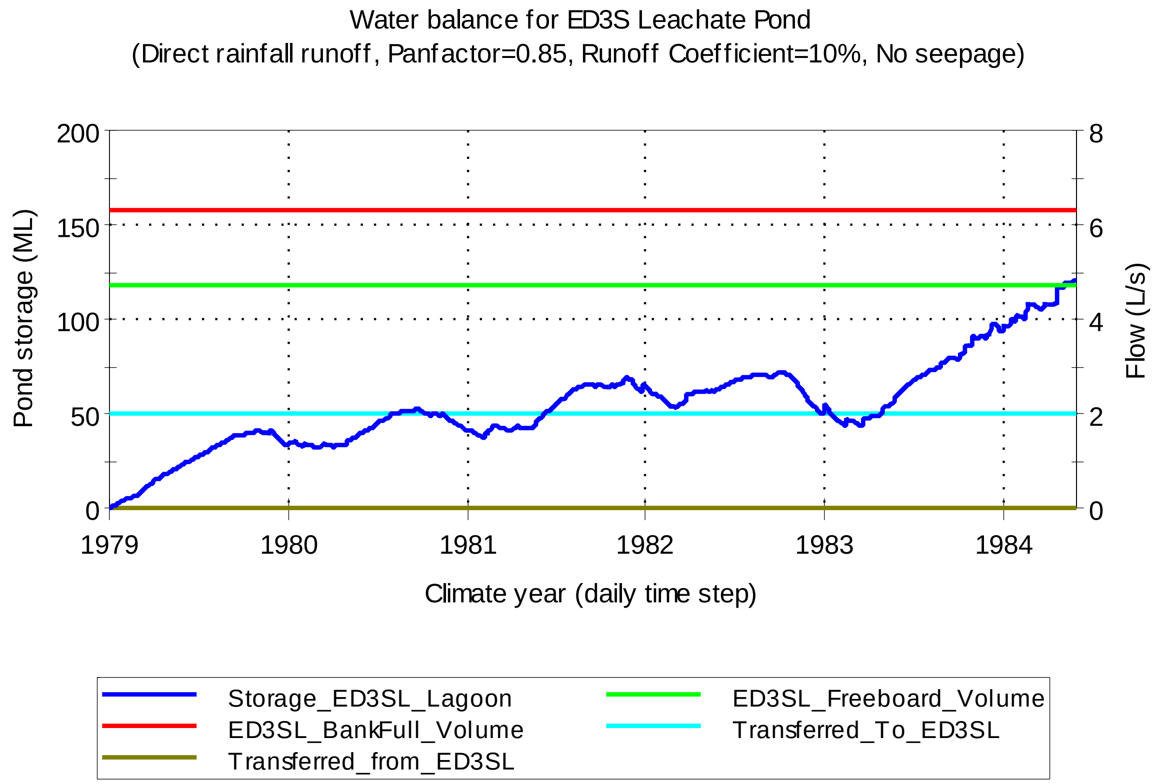


Figure 8.17 Simulated water storage in ED3SL with the mine void leachate discharge at 2 L/s under the driest climate sequence

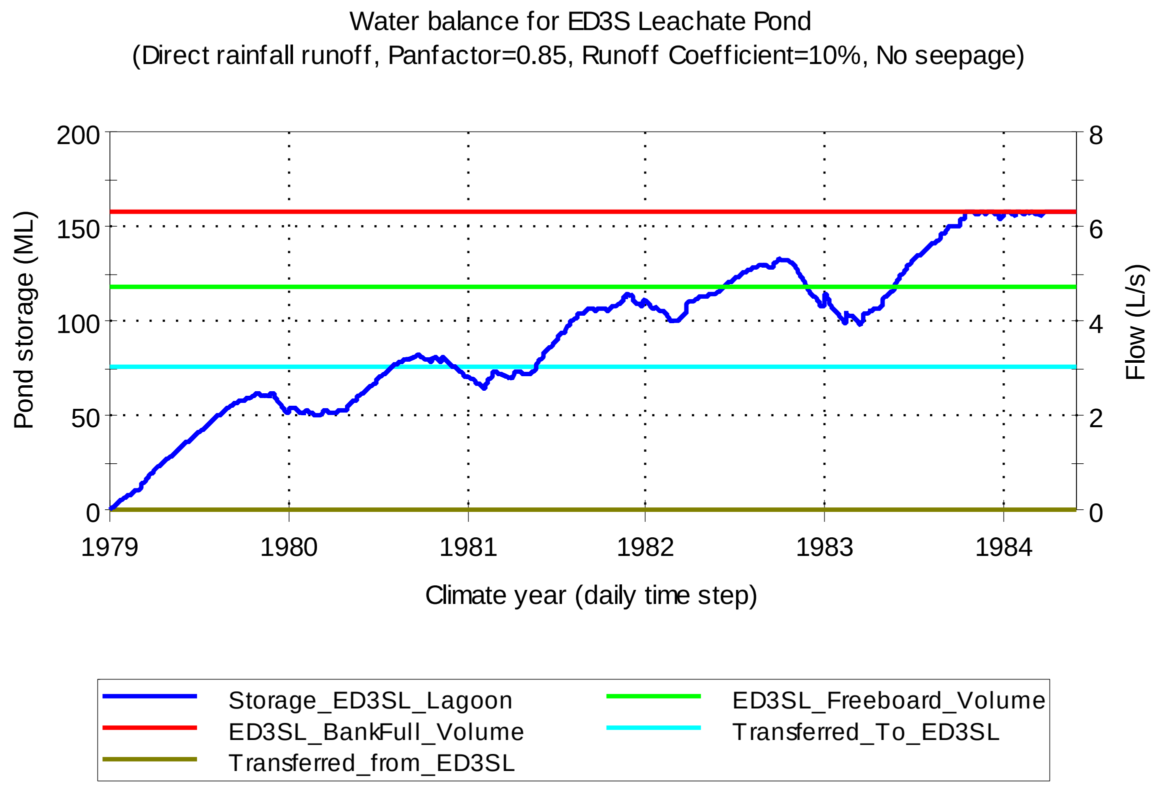


Figure 8.18 Simulated water storage in ED3SL with the mine void leachate discharge at 3 L/s under the driest climate sequence

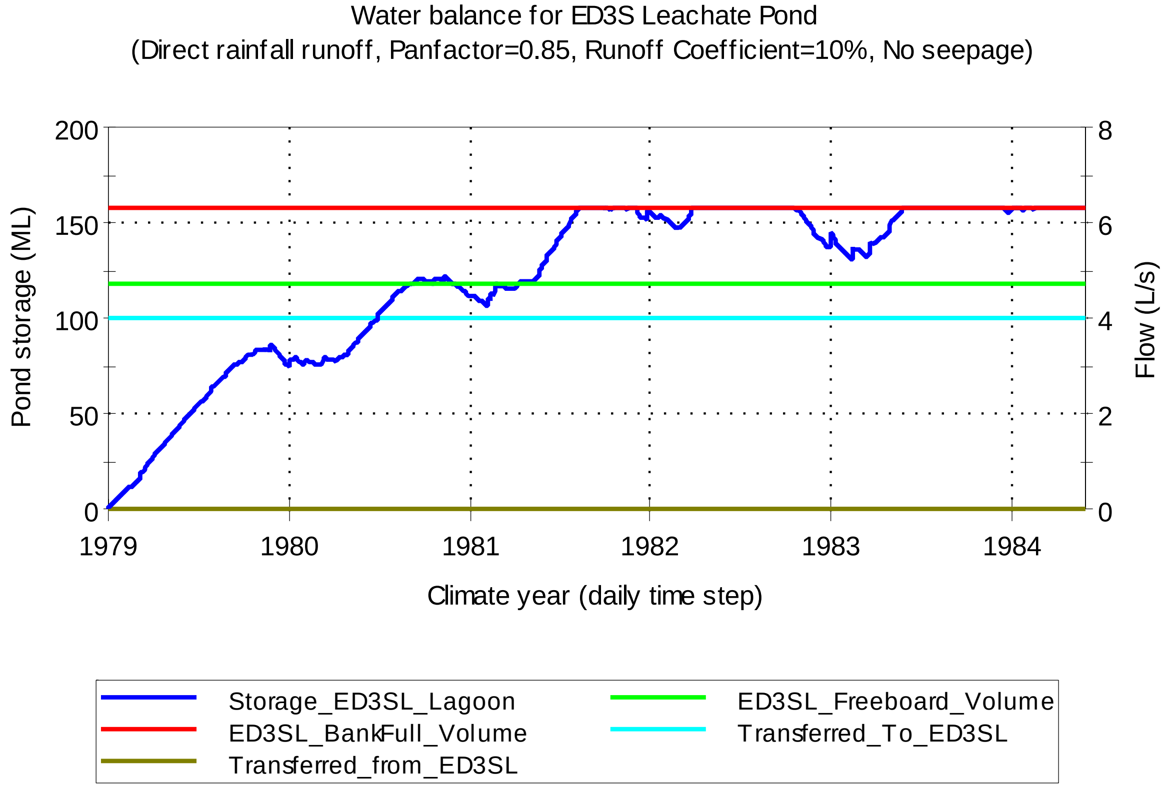


Figure 8.19 Simulated water storage in ED3SL with the mine void leachate discharge at 4 L/s under the driest climate sequence

The results for the driest sequence are summarised in Table 8.3. If the leachate is transferred from the mine void at 4 L/s under the driest climate like 1979 through to 1985, then the lagoons of ED3SL is likely to fill up in less than 2 years. If the leachate rate is limited to 1 L/s then it might take much longer than 5 years for ED3SL to fill up to the freeboard level. The leachate rates between 2 L/s to 3 L/s are likely to prolong filling time to 5 years. Daily sequenecs of simulated results for the wettest sequence are shown in Figure 8.20 through to Figure 8.23.

Table 8.3 Estimates of time to fill-up to freeboard level of ED3SL under the average climate

CLIMATE SEQUENCE	LEACHATE DISCHARGE (L/S)	DAYS TO REACH FREEBOARD LEVEL	DURATION (MONTHS)	DURATION (YEAR)
The average (1992 to 1999)	4	339	11.3	0.9
	3	511	17.0	1.4
	2	683	22.8	1.9
	1	2104	70.1	5.8

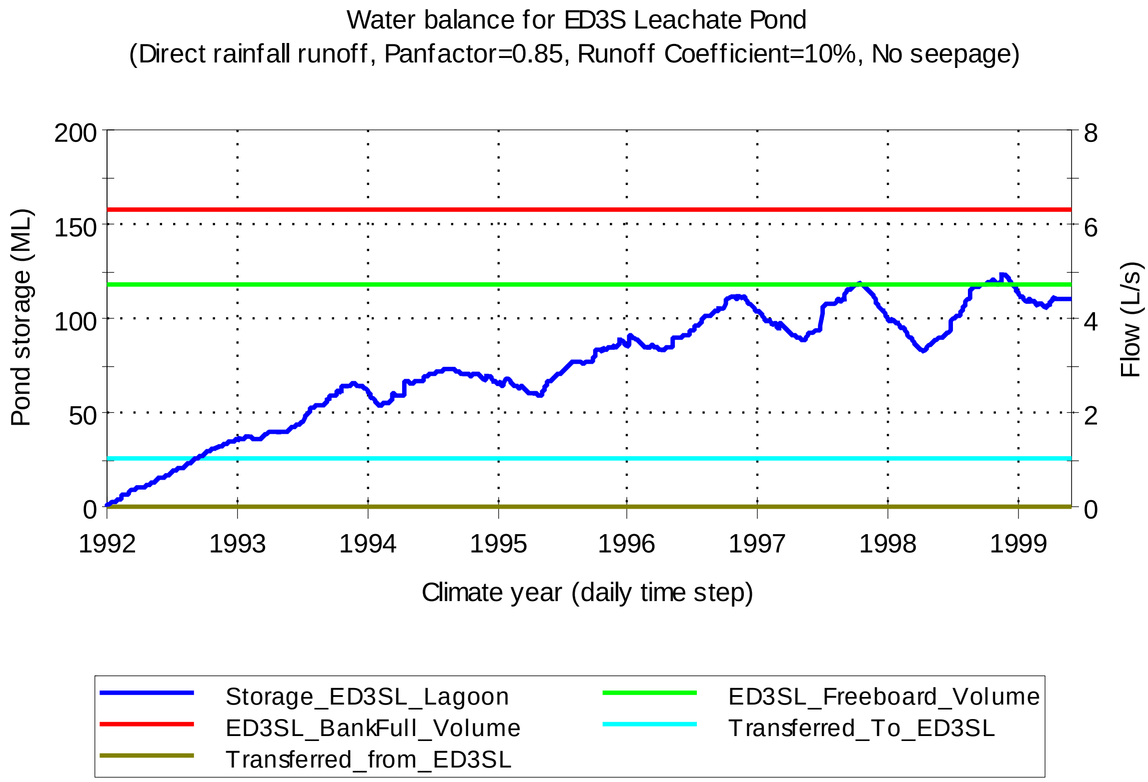


Figure 8.20 Simulated water storage in ED3SL with the mine void leachate discharge at 1 L/s under the average climate sequence

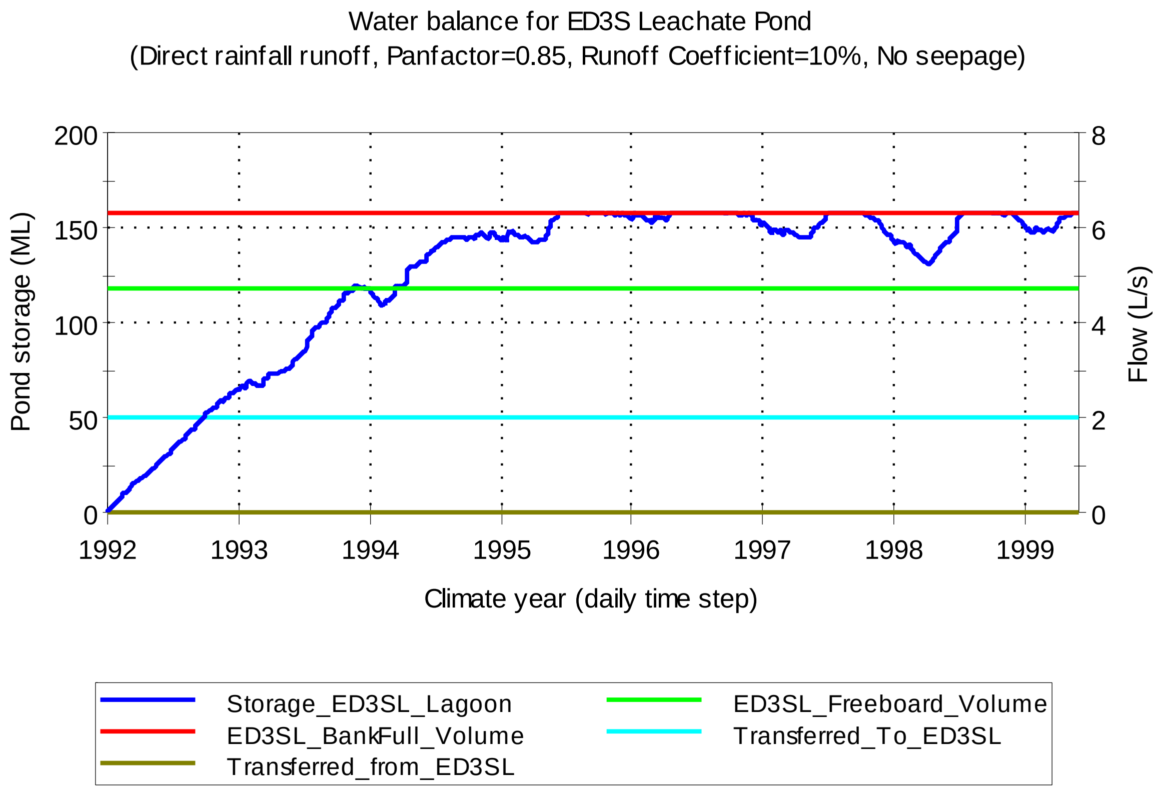


Figure 8.21 Simulated water storage in ED3SL with the mine void leachate discharge at 2 L/s under the average climate sequence

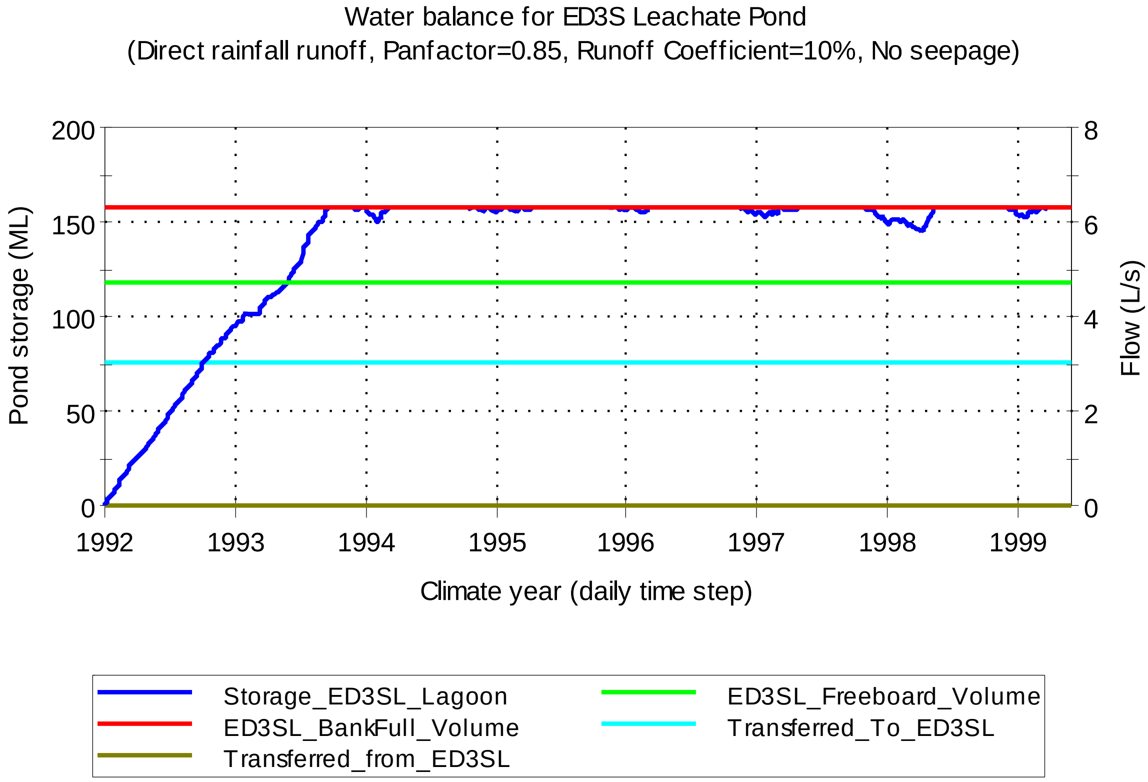


Figure 8.22 Simulated water storage in ED3SL with the mine void leachate discharge at 3 L/s under the average climate sequence

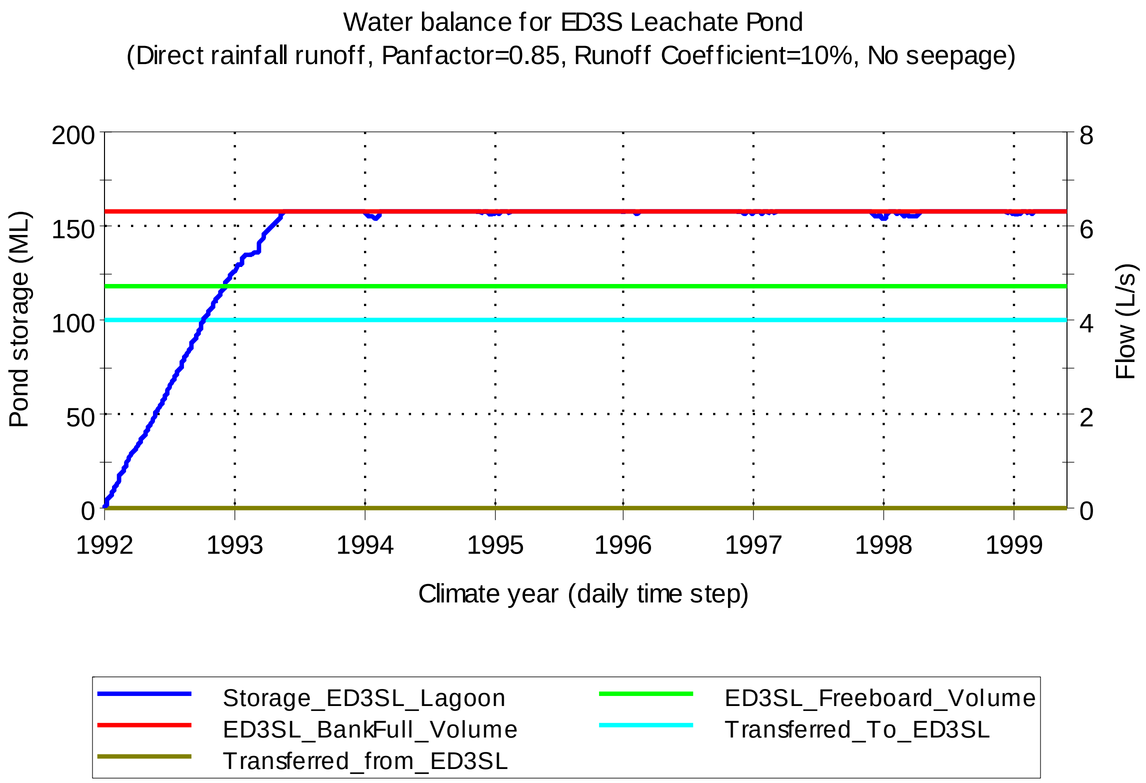


Figure 8.23 Simulated water storage in ED3SL with the mine void leachate discharge at 4 L/s under the average climate sequence

8.2.5.5 COMBINED USED OF ED3N AND ED3SL LAGOONS

Veolia's water management strategy is to use ED3SL until it reaches the freeboard level of storage from leachate discharge including direct rainfall and local runoff within the pond embankment. While the lagoons in ED3SL will be filling-up, the leachate stored in lagoons within ED3N will start drying due to natural evaporation. Once ED3SL storage reaches the freeboard level (or close enough to the freeboard level), the pumped leachate will start transferring from ED3SL if a single supply pipeline is implemented or the leachate discharge to ED3SL will be stopped completely and be transferred to ED3N utilising currently existing pipelines.

A water balance model was set up to assess what additional capacity to store leachate becomes available while ED3SL is filling up. In this simulation it was assumed that the leachate would be transferred via ED3SL to ED3N lagoons in the following order: ED3N1, ED3N2, ED3N3 and ED3N4. In this setup, the model starts transferring water from ED3SL as soon as the storage in ED3SL leaches within 95% of the freeboard level water volume in ED3SL.

ED3SL was assumed dry at start and the initial water levels for the lagoons of ED3N were set equal to the observed levels as per 27 August 2015 as follows:

- 791.42 mAHD for ED3N1 (Freebord level=791.30)
- 791.55 mAHD for ED3N2 (Freebord level=791.1)
- 791.44 mAHD for ED3N3 (Freebord level=791.00)
- 790.52 mAHD for ED3N4 (Freebord level=791.30).

Note that ED3N1 and ED3N2 had water stored above the freeboard level on 27 August 2015. The ED3N3 and ED3N4 lagoons had spare capacity to store leachate within the freeboard levels.

Historical leachate transfer data to ED3N varies between 0.5 L/s and 3.75 L/s. The most likely high rate of leachate transfer is expected to be about 3 L/s. In this simulation the case of 3 L/s summarised in Section 8.2.5.4 was further explored under the average and the wettest climate sequences.

If leachate is transferred from the mine void at a rate of 3 L/s to ED3SL, the lagoons of ED3SL will reach the freeboard level at the end of 511 days (Figure 8.24). It is expected that the pump will kick in and the water from ED3SL will start transferring to ED3N1 (Figure 8.25). The excess water above the freeboard level will be transferred from ED3N1 to ED3N2 (Figure 8.26), from ED3N2 to ED3N3 (Figure 8.27) and from ED3N3 to ED3N4 (Figure 8.28) where it will be fully contained. Note that the leachate discharge rate needs to be reduced from 3.0 L/s to 1.2 L/s once ED3SL becomes full at the end of 511 days for the simulated average climate condition (refer to Figure 8.24).

If the wettest climate sequence is to repeat as soon as ED3SL is commissioned, then the ability to discharge after ED3SL is full will be severely reduced from 1.2 L/s. Figure 8.29 illustrates that the leachate pumping rate to ED3SL needs to be reduced from 3 L/s to 0.15 L/s in order to contain the leachate and rainfall-runoff volumes in each of the lagoons of ED3SL and ED3N. Figure 8.30 illustrates that the water level in ED3N4 might be above the freeboard level but below the lowest dam crest level.

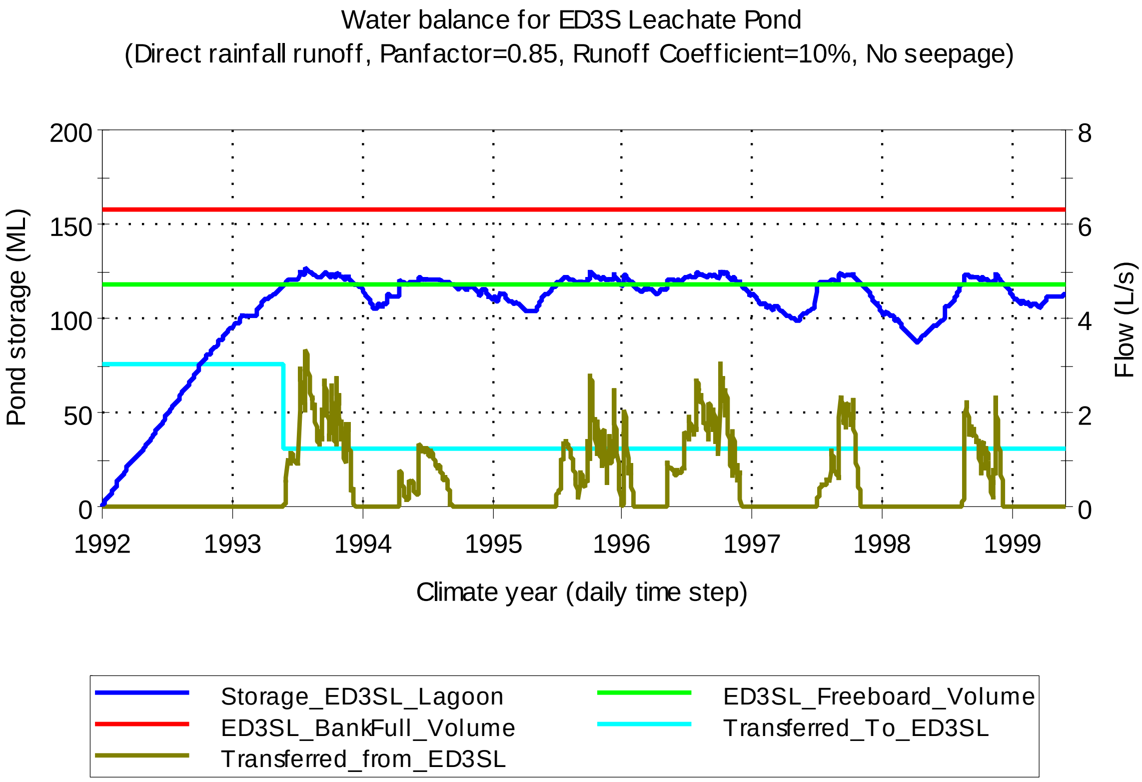


Figure 8.24 Simulated water storage in ED3SL with the mine void leachate being discharged at 3 L/s to ED3SL under the average climate sequence

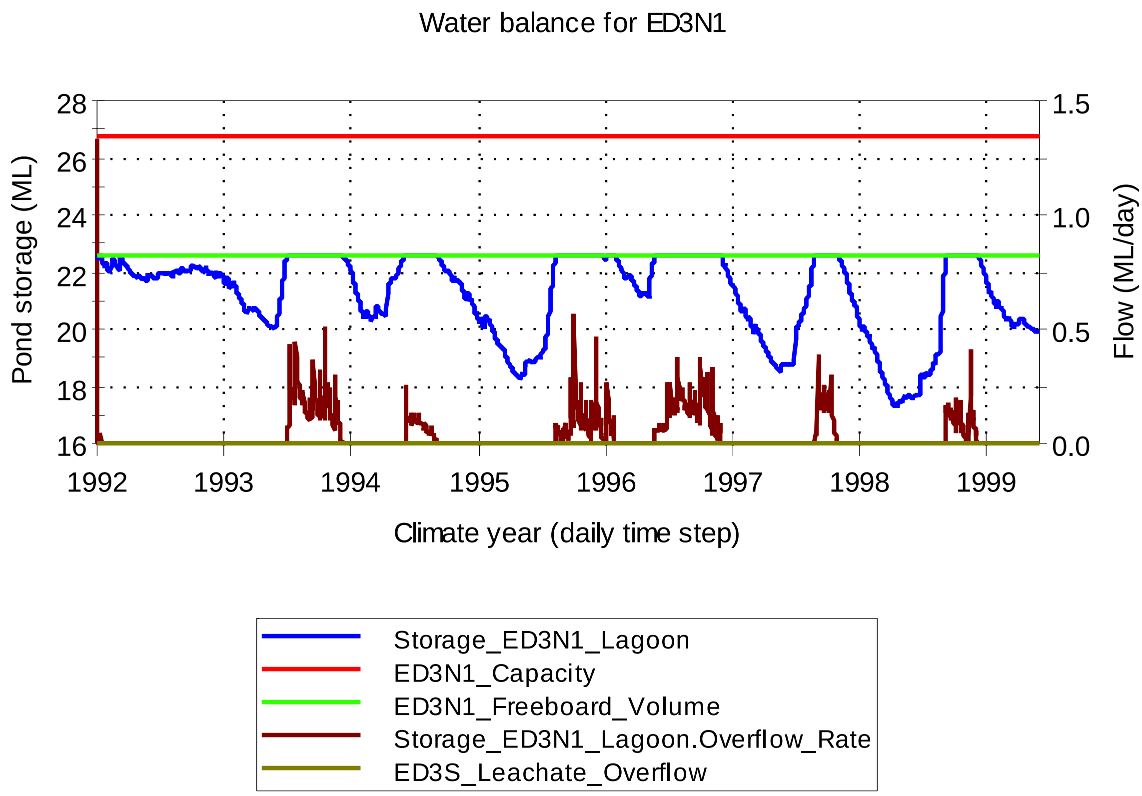


Figure 8.25 Simulated water storage in ED3N1 with the mine void leachate being discharged at 3 L/s to ED3SL under the average climate sequence

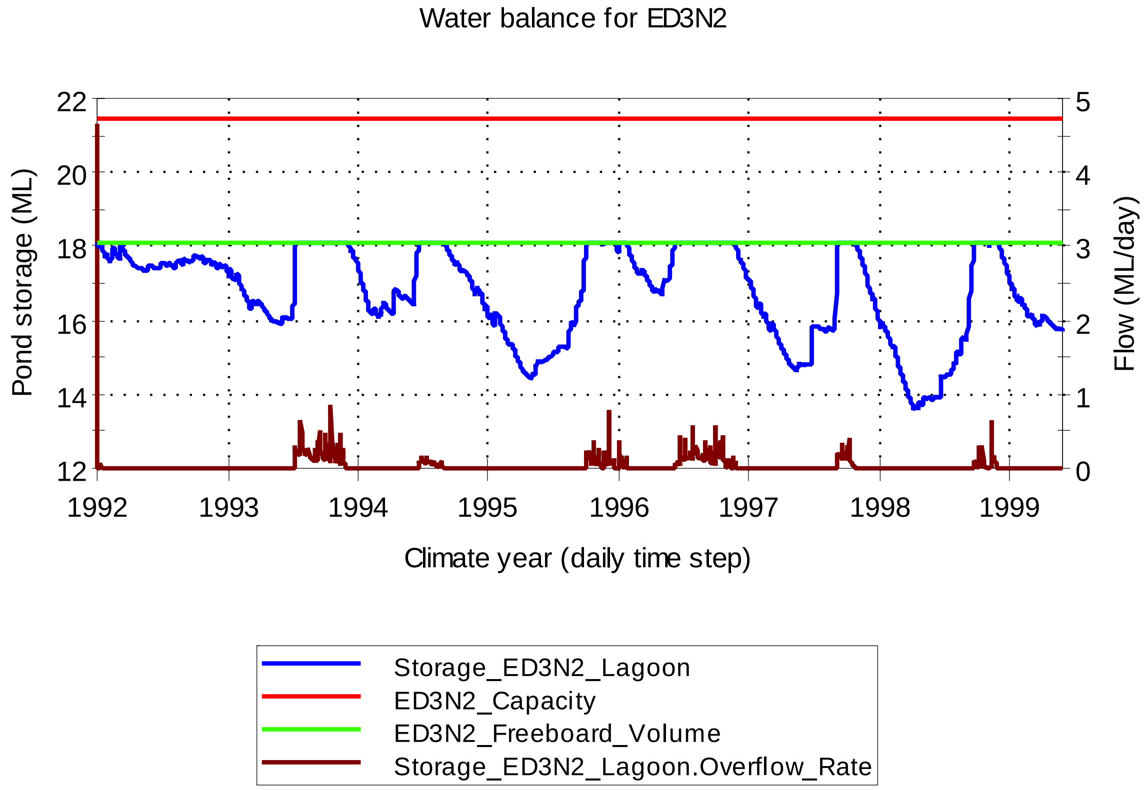


Figure 8.26 Simulated water storage in ED3N2 with the mine void leachate being discharged at 3 L/s to ED3SL under the average climate sequence

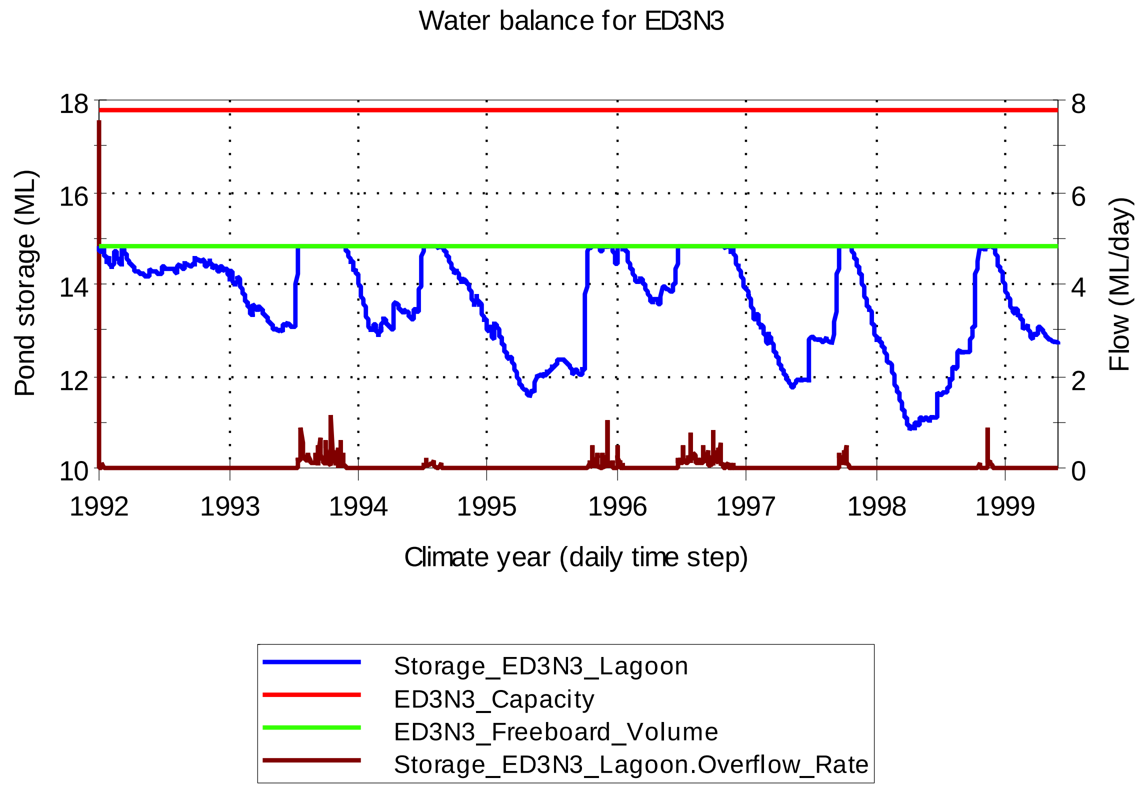


Figure 8.27 Simulated water storage in ED3N3 with the mine void leachate being discharged at 3 L/s to ED3SL under the average climate sequence

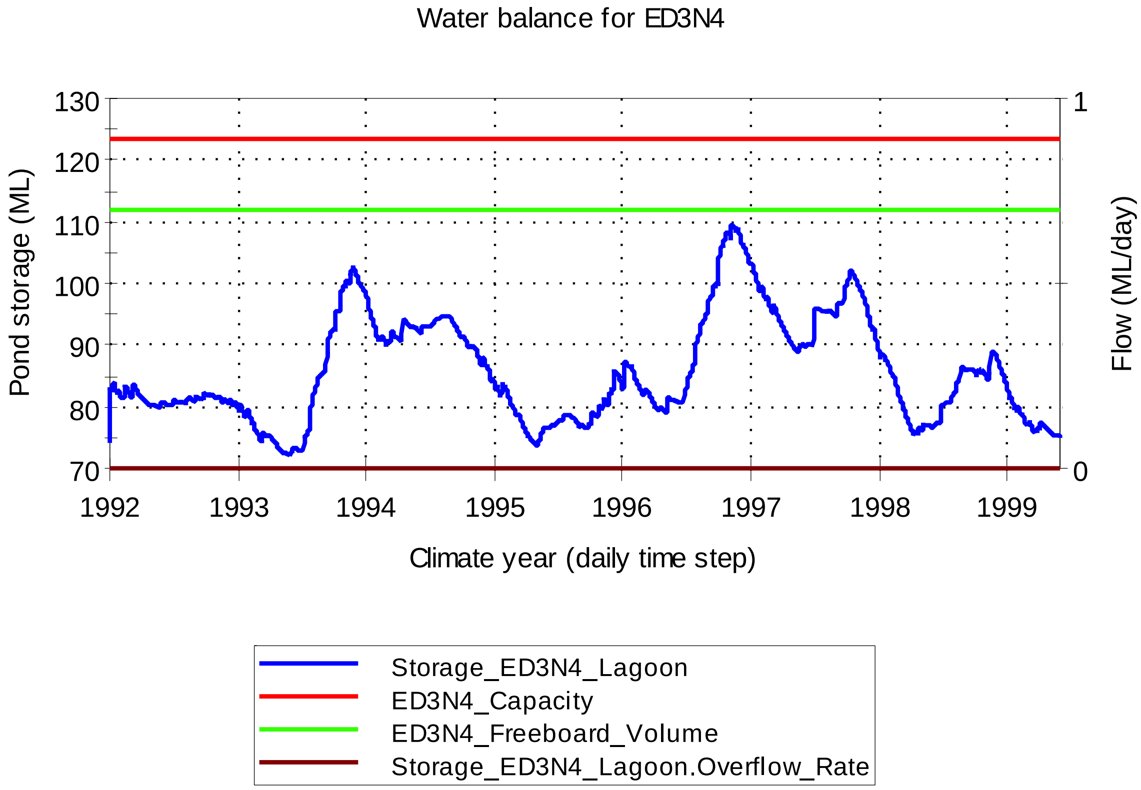


Figure 8.28 Simulated water storage in ED3N4 with the mine void leachate being discharged at 3 L/s to ED3SL under the average climate sequence

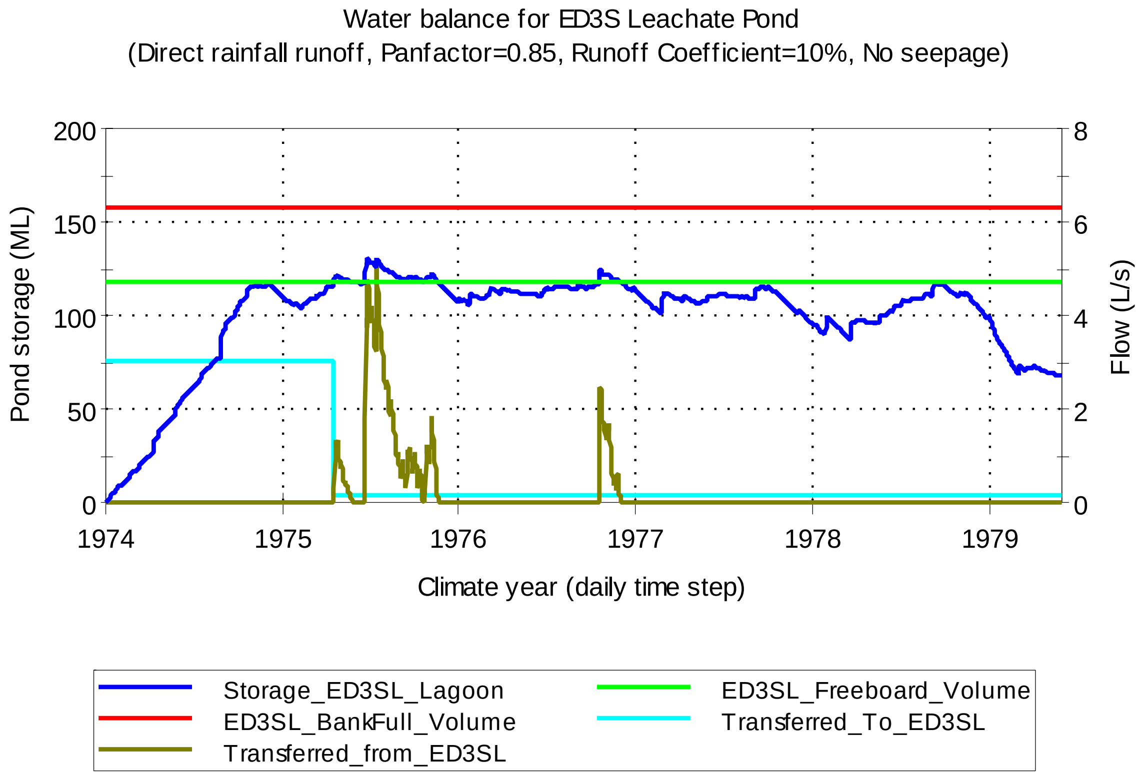


Figure 8.29 Simulated water storage in ED3SL with the mine void leachate being discharged at 3 L/s to ED3SL under the wettest climate sequence

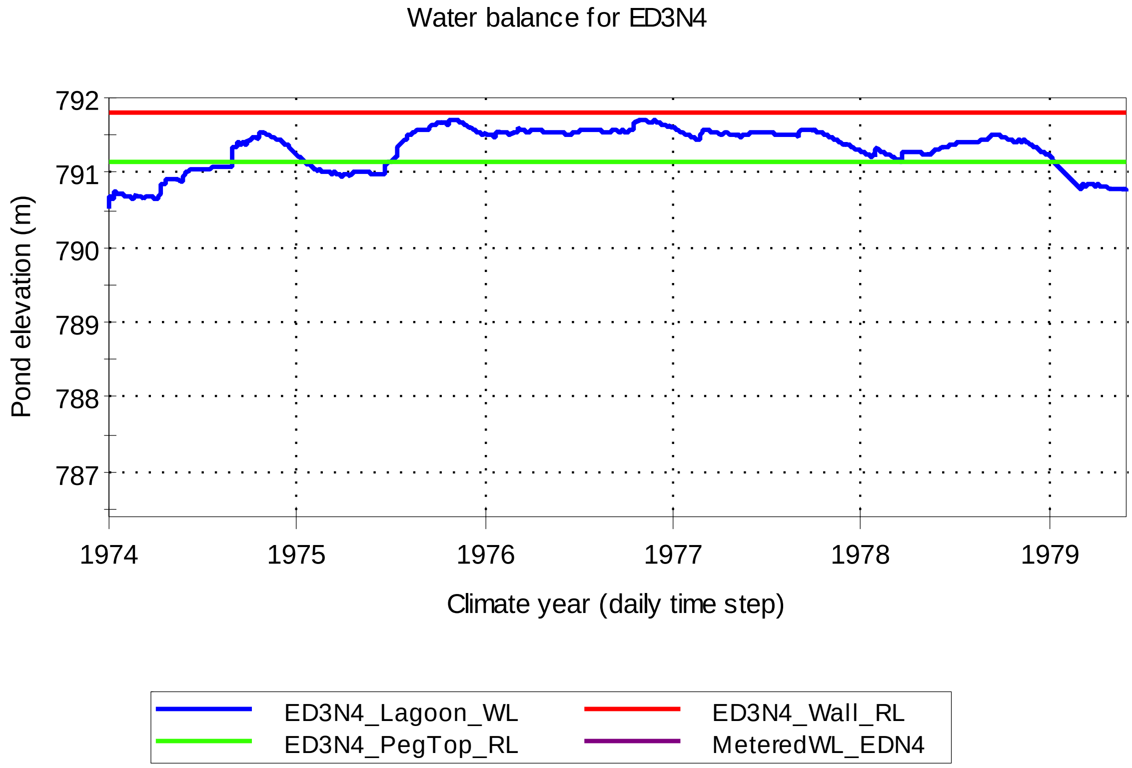


Figure 8.30 Simulated water storage in ED3N4 with the mine void leachate being discharged at 3 L/s to ED3SL under the wettest climate sequence

8.3 ED2

Water balance was undertaken to assess the impact of future delivery of stormwater from the mine void to ED2. Note that ED2 would only receive direct rainfall and runoff until Veolia's proposed amendment to the mine void stormwater management is implemented. In an emergency ED2 may receive overflows from ED1, but that is unlikely unless external sources of water to ED1 increases from current condition.

Water balance modelling for ED2 is based on the bathymetric characteristics presented in Figure 8.31. The maximum storable capacity for ED2 is reported to be 846 ML in AEMR reports from Veolia (Veolia, 2006).

A relationship between annual rainfall and total volume of stormwater pumped out of the mine void (refer to Figure 5.5) was developed to enable simulation in climate years other than the measurement period. The relationship between annual rainfalls and ratios of annual mine void volume to the annual the rainfall volume, also termed as volumetric runoff coefficient, is shown in Figure 8.32. The relationship is based on annual rainfall and runoff coefficients presented in

Table 8.4. The adopted relationship is likely to over-predict the mine void stormwater but is considered conservative in terms of predicting water balance for ED2. The runoff volume extracted from the mine void varied from 12% to 30% for annual rainfall about 650 mm.

The mine void stormwater runoff was calculated for a climate year based on a runoff coefficient obtained from the relationship presented in Figure 8.32.

The AEMR reports since 2005–2006 have been reporting the storage in ED2 to be less than 150 ML, which could mean that the current water elevation as of 1 July 2015 could be about 785 mAHD. The Google image of ED3S from 18 February 2014 indicates that the total water surface area of ED3S was 7.2 ha. This relates to a water elevation of 785 mAHD (refer to Figure 8.31). For future water balance assessment an initial level of 785 mAHD was adopted.

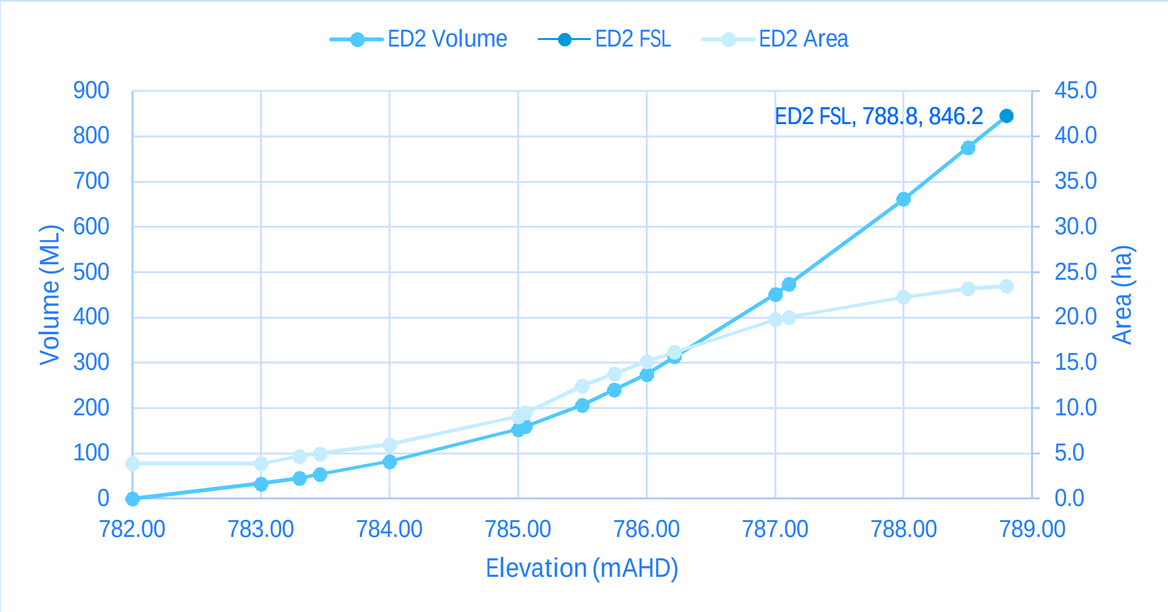


Figure 8.31 Relationships between elevation, surface area and volume for ED2

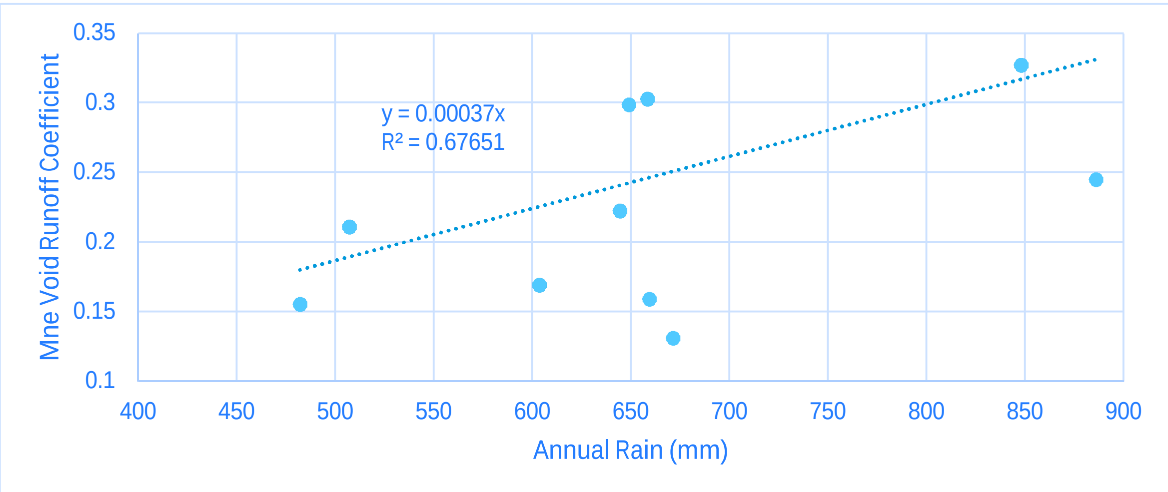


Figure 8.32 Annual rain and runoff coefficient relationship for the mine void stormwater

Table 8.4 Annual summary of rainfall and Veolia's Mine Void stormwater volume data

YEAR	ANNUAL RAIN (MM)	METERED VOID STORMWATER (ML/DAY)	RAINFALL VOLUME FROM 44.93 HA (ML)	RUNOFF COEFFICIENT
2004	571	39	257	15%
2005	659	90	296	30%
2006	507	48	228	21%
2007	649	87	292	30%
2008	604	46	271	17%
2009	482	34	217	16%
2010	886	98	398	25%
2011	660	47	296	16%
2012	848	125	381	33%
2013	645	64	290	22%
2014	672	40	302	13%
2015	468	22	210	10%

8.3.1 ED2 POND MODEL VALIDATION

The water balance model parameters adopted for the Heron Resources Limited mine site water balance model was tested for validation for ED2. The model for ED2 pond was run from a known water level of 786.59 mAHD on 2 October 1998 to simulate observed water levels as presented in Figure 5.2. Note that during the development of models for Heron Resources Limited the model parameters were adopted based on the MREMP report of 1999/2000 (Woodlawn Mine, 2000) that stated "*The volume of water stored in ED2 has decreased substantially since 1997. For the reporting period of 1999/2000 the volume of water in ED2 dropped by 33 ML from 314 ML to 281 ML*". The water level data as presented in Figure 5.2 was not available.

Adopting the same model parameters as the Heron Resources Limited Woodlawn Site model (pan factor= 0.85, no pond seepage and internal rainfall-runoff at 10% of the rainfall) the water balance model under predicted the decline rate of water levels in ED2 (Figure 8.33). Additional loss of water is required to match the observed water levels in the dam. It is recorded in Veolia's AEMR reports that ED2 loses water from seepage.

Seepage in the model for ED2 was introduced to recalibrate the water balance model. Figure 8.34 shows simulated water volumes and levels for ED2 with a seepage rate of 0.6 mm/day, which illustrates that the model simulates the rate of decline of water levels in the dam very well. According to the simulation result in Figure 8.34, ED2 was supposed to have 2.2 ML of water left in ED2 on 18 February 2014. However the water surface area from Google image for 18 February 2014 suggest the water stored in the dam would have been 55 ML at an elevation of 783.47 mAHD.

This can only be explained by increasing runoff coefficient for ED2. With 20% runoff from rainfall over the area between the water surface and the embankment perimeter, the model was able to simulate stored volume of 55 ML on 18 February 2014. Figure 8.35 shows simulated water volumes and levels for ED2 with an increased runoff coefficient of 20% and a seepage rate of 0.6 mm/day from the dam. The revised parameters presented in Figure 8.35 were adopted for assessments of likely changes to ED2 water balance when Veolia's proposed discharge of mine void stormwater to ED2 would occur.

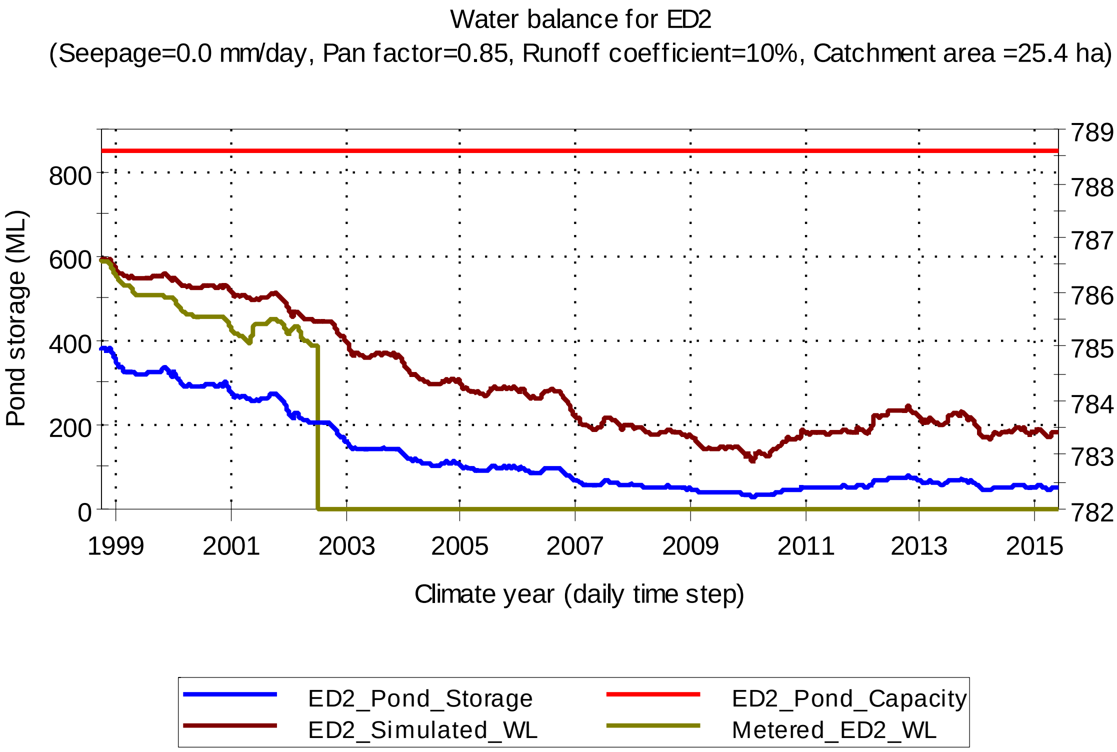


Figure 8.33 Validation of water balance model for ED2

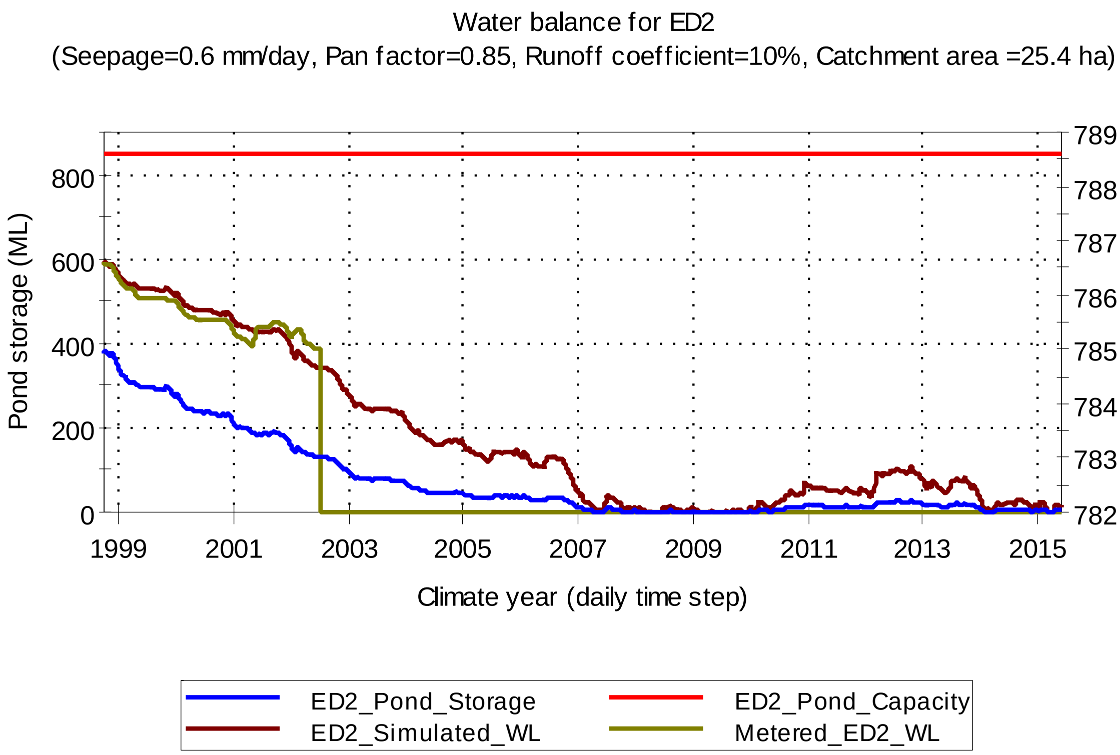


Figure 8.34 Simulated water volume and levels for ED2 with increased runoff coefficient of 20% and a seepage rate of 0.6 mm/day

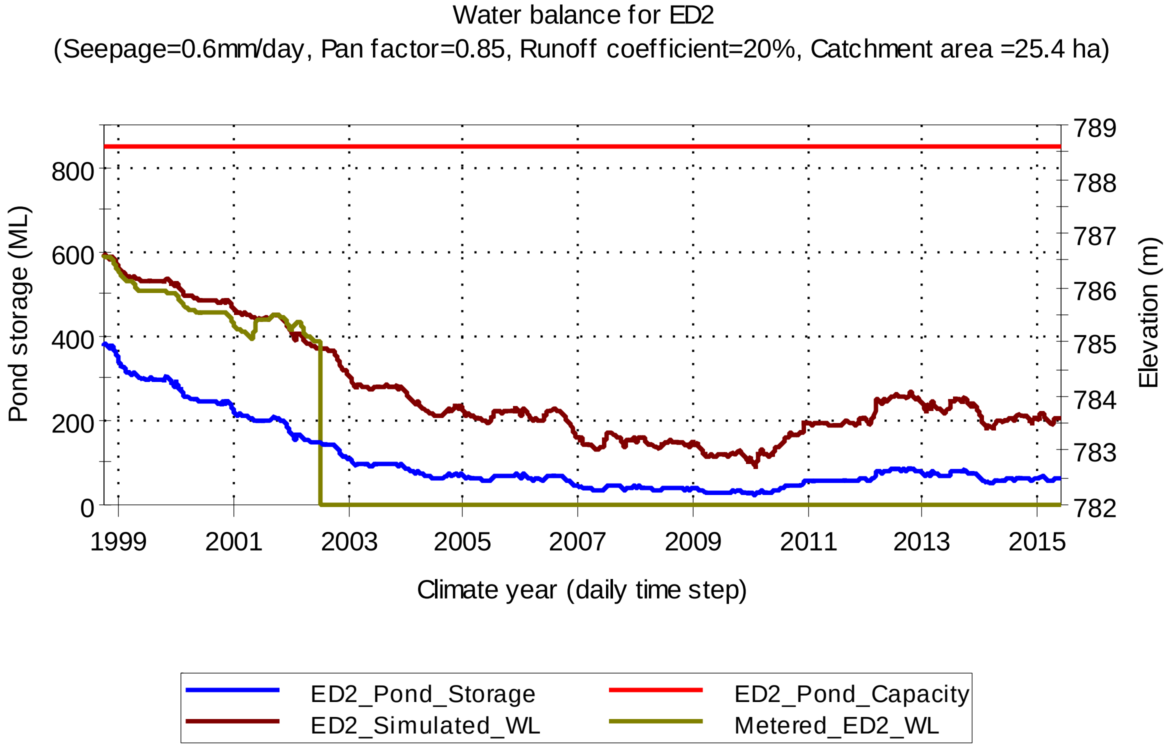


Figure 8.35 Simulated water volume and levels for ED2 with increased runoff coefficient of 20% and a seepage rate of 0.6 mm/day

8.3.2 ED2 WATER BALANCE ASSESSMENTS

Figure 8.36 shows simulated water volumes and levels for climate sequence from 1944 to 2014 without any mine void stormwater added to ED2. Under direct rainfall and runoff the ED2 pond volume is expected to vary between 0 and 140 ML. The dam capacity is 846 ML. ED2 has approximately 700 ML of volume to store mine void stormwater. The evaporative loss of mine void storm water would occur from additional surface area as the water level rises.

The total volume of water stored in ED3S was 110 ML as of 1 June 2015. This volume was added to the known volume of 55 ML in ED2. Starting with the total initial water storage of 165 ML, Veolia's estimated mine void storm water was transferred to ED2 during simulation. The simulated volumes and water levels for the climate sequence from 1944 to 2014 are shown in Figure 8.37. The figure shows that the dam would fill up, but without spilling, twice over the sequence when the wettest and the second wettest annual rainfalls like 1950 and 1974 would occur. If the climate sequence from 1986 to date repeats then the dam would not fill up as shown by the water volumes from 1980 to 2014.

Figure 8.38 shows simulated volumes and water levels for ED2 when only 40% of Veolia's estimated stormwater volumes from the mine void is transferred to ED2 via the proposed ED3S sump. Under reduced mine void stormwater, ED2 water storage is likely to be within half of its capacity to store.

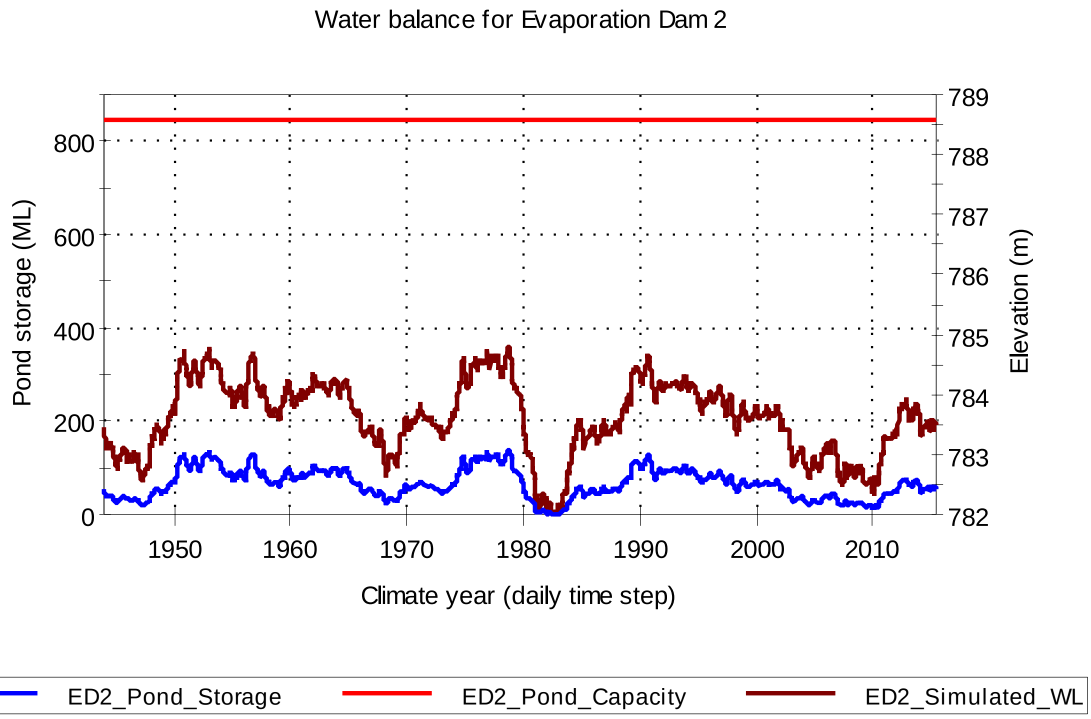


Figure 8.36 Simulated volume and water level in ED2 from rainfall and runoff within its footprint

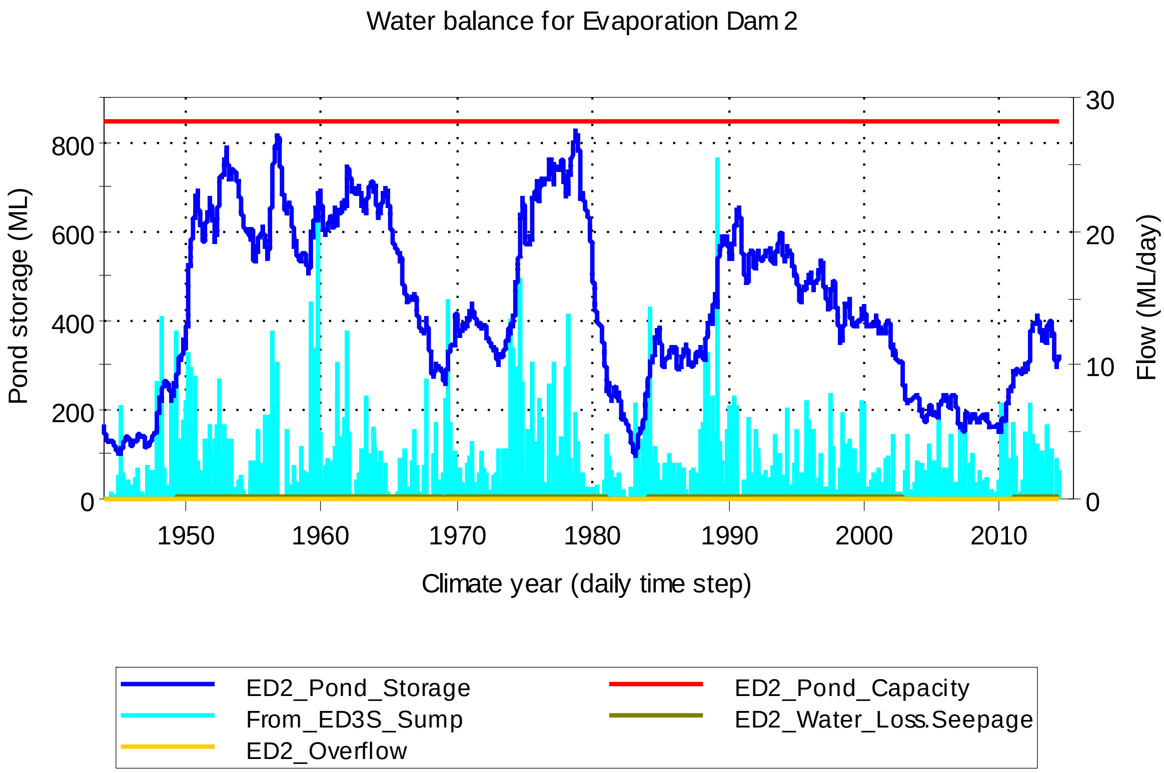


Figure 8.37 Simulated volume and water level in ED2 including Veolia's estimates of the stormwater transfer from the mine void and rainfall and runoff within its footprint

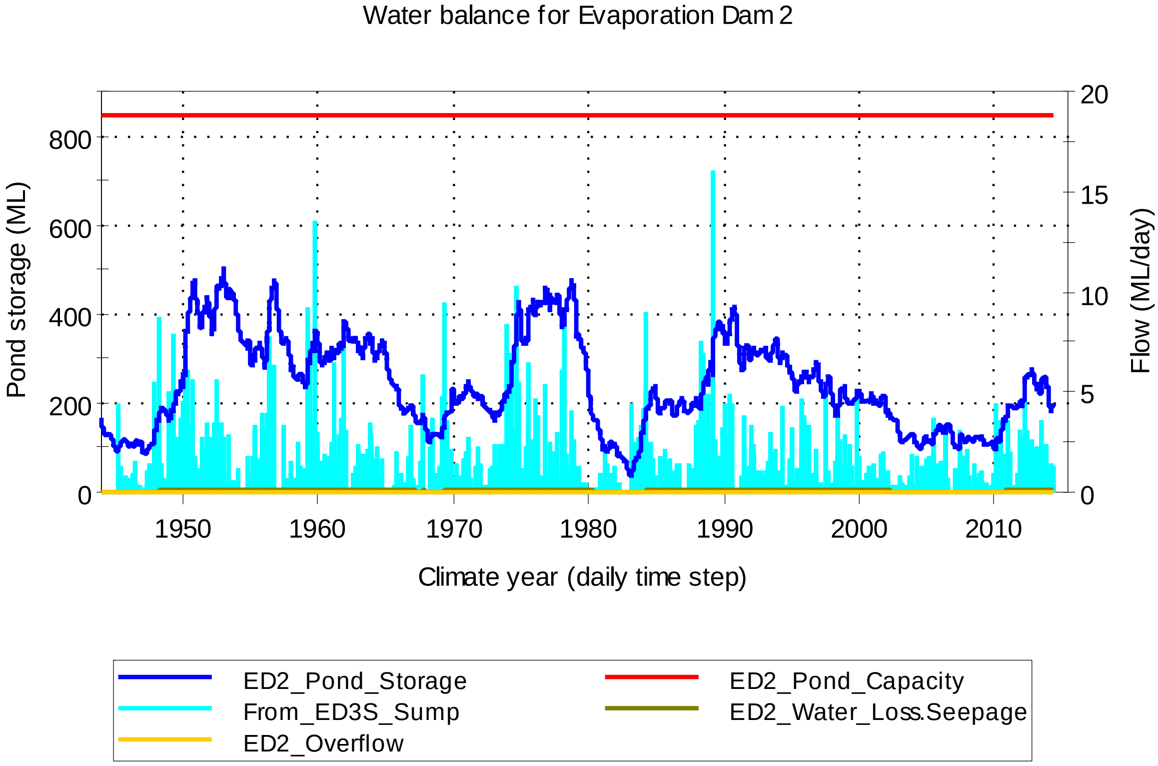


Figure 8.38 Simulated volume and water level in ED2 including 40% of Veolia's estimates of the stormwater transfer from the mine void and rainfall and runoff within its footprint

8.4 OTHER PONDS

Veolia's proposed amendments to the mine void water management is not expected to impact other ponds.

Simulations for ED1 were undertaken to recalibrate the water balance model and to test the PCD stormwater runoffs. The simulations for ED1 confirmed that the stormwater runoff data provided by Veolia is likely to be over estimation (refer to Appendix A).

Simulations for decant ponds TDN, TDW and TDS were also undertaken to demonstrate that these ponds maintain fairly consistent water levels modulated by direct rainfall and runoff from within tailings surface. It is highly unlikely that these ponds will fill up such that water transfers to ED1 will be required under no mining activity as of 2015.

9 CONCLUSIONS

Veolia has been using the northern half of the ED3 to store and evaporate leachate from the Woodlawn Bioreactor. The northern half of ED3 (ED3N) has four lagoons. The water level data supplied by Veolia indicate that the ED3N1, ED3N2 and ED3N3 are at its allowable maximum water level (as of 27 August 2015). The water level in ED3N4 is 0.8 m below its maximum allowable level (as of 27 August 2015).

The southern half of ED3 (ED3S) has two lagoons and only stormwater extracted from the mine void are stored and evaporated in ED3S. The northern lagoon is close to its allowable maximum water level (28 cm below the spillway level of 790.50 mAHD). The southern lagoon of ED3S is at much lower level.

Both of the evaporation dams, ED3N and ED3S, are nearing their capacities.

Veolia is proposing to use ED2 to store and evaporate stormwater from the mine void and ED3S lagoons for leachate from the bioreactor in addition to ED3N lagoons. The stored water from ED3S will be transferred to ED2. ED3S lagoons will be lined before its use as leachate storage facility. About 10% of the storage area from the northern lagoon of ED3S will be used as a sump to facilitate water transfer from the mine void to ED2. The remainder of ED3S has been termed as ED3SL and will store leachate from the mine void.

The proposed amendment of leachate and stormwater management for the mine void has potential to change water balance for ED2 and ED3S

Water balance simulations were undertaken for the evaporation dams: ED3SL and ED2 to assess likelihood of exceeding their allowable maximum water level. The external inflow to ED3SL in the water balance was constant rate of leachate extraction from the bioreactor. The external inflow to ED2 was estimated stormwater runoff from the mine void based on a regression relationship that was developed from the metered stormwater data provided by Veolia.

Water balance for ponds also considered direct rainfall over water surface, runoff from the area between the water surface and the dam wall, evaporation and seepage from the area inundated by the stored water within the dam.

The findings from the water balance assessments are as follows.

9.1 EXTRACTED BIOREACTOR LEACHATE MANAGEMENT USING ED3SL AND ED3N LAGOONS

- The current freeboard level of 790.5 mAHD for ED3S is also suitable for ED3SL. It is assumed that Veolia will actively empty any storage of water above this freeboard level to either ED3N lagoons or the mine void or future storage ponds that might be developed.
- Veolia intends to extract leachate from the bioreactor in the first year at much higher rate. The likely hood of ED3SL filling up within the first 2 years is high if the average daily leachate extraction rates are kept greater than 3 L/s and it depends on the expected climate sequences.
- Leachate discharge from the mine void is expected to vary between 0.5 L/s and 3.0 L/s. Time estimates for ED3SL pond to fill up to freeboard level depend on future climate sequences and rates of leachate transfer to ED3SL. Simulated estimates for the historic wettest, the driest and the average climate sequences are as follows:

Table 9.1 Summary of modelled outcomes for ED3SL as a result of leachate rates and climate conditions

CLIMATE SEQUENCE	LEACHATE DISCHARGE (L/S)	DAYS TO REACH FREEBOARD LEVEL	DURATION (MONTHS)	DURATION (YEAR)
The wettest (1974 to 1979)	4	248	8.3	0.7
	3	471	15.7	1.3
	2	587	19.6	1.6
	1	1244	41.5	3.5
The driest (1979 to 1984)	4	615	20.5	1.7
	3	1257	41.9	3.5
	2	1953	65.1	5.4
	1	>1953	>65	>5.4
The average (1992 to 1999)	4	339	11.3	0.9
	3	511	17.0	1.4
	2	683	22.8	1.9
	1	2104	70.1	5.8

- Once ED3SL fills up to the freeboard level, the daily average rate of leachate transfer from the bioreactor will need to be reduced to contain the leachate and direct rainfall and runoff volumes within the leachate management ponds, ED3N and ED3SL as the following:
  - The simulated results presented for the average climate sequence indicates that the system can keep receiving the leachate from the bioreactor at 1.2 L/s.
  - The simulated results presented for the wettest climate sequence indicates that the system can keep receiving the leachate from the bioreactor at 0.15 L/s.
- Future climatic sequence is difficult to predict therefore a risk based approach to leachate management is required. Depending on whether the wettest sequence returns, there will be a period during the bioreactor operation that leachate extraction may need to be completely stopped unless alternative storage pond is developed or the leachate treatment system is upgraded sufficiently to facilitate offsite discharge.
- From and empty state, ED3SL is unlikely to fill up to its freeboard level if leachate from the bioreactor is transferred at a constant rate of 0.36 L/s under the range of climatic conditions recorded by BOM from 1944 to 2014.

9.2 EXTRACTED MINE VOID STORMWATER MANAGEMENT USING ED2

- ED2 will be able to safely store stormwater from the mine void without exceeding its maximum allowable water level subject to model parameters adopted in the water balance model.
- No changes in water balance for ED1, TDS, TDN and TDW are expected by the proposed amendment to the mine void water management (refer to Appendix A).

10 BIBLIOGRAPHY

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Appendix A

WATER BALANCE SIMULATIONS FOR ED1 AND OTHER PONDS

WATER BALANCE SIMULATIONS FOR ED1 AND OTHER PONDS

A.1 ED1

The ED1 water storage will not be impacted by Veolia's proposed mine void stormwater and leachate management strategy.

ED1 will continue to receive stormwater from the PCD catchment, the dolerite stockpile area, and WRD. Also in unlikely event water from tailings dams may be transferred. Since no new tailings are being deposited in the north, west and south tailings dams since 1998, it is expected that such transfer would not occur. This section presents water balance model results for ED1 to demonstrate that the PCD stormwater runoff has been over estimated.

Starting with a known elevation of 786.78 on 2 Oct 1998, a water balance simulation was undertaken with the same model parameters as were adopted for the Heron Resources Limited mine site water balance. The pan factor of 0.85, 10% runoff coefficient for dam footprint, the dolerite area (8 ha) and the PCD catchment area (33 ha) were used.

Figure A.1 compares simulated water levels with the observed water levels from 1998 to 2002. The simulated water levels appear to follow measured water levels very well from 1999 to 2001. The observed water levels indicate gain in water, however simulated water levels indicate decline in water levels due to lack of stormwater or higher evaporative loss. Moreover the simulated volume on 18 February 2014 was 190 ML while the Google Image surface area for ED1 indicated that the volume would have been 226 ML. The PCD catchment runoff was increased from 10% to 14% that provided a match in stored volume on 18 Feb 2014 (refer to Figure A.2).

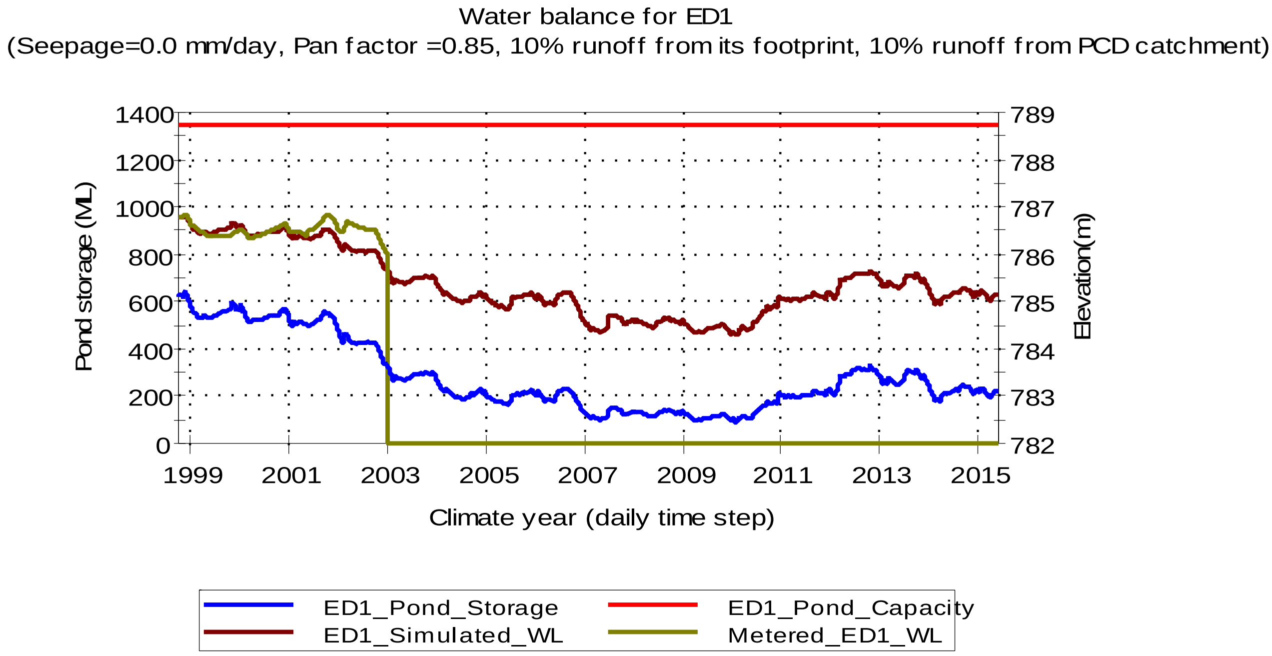

Figure A.1 Water balance model validation for ED1

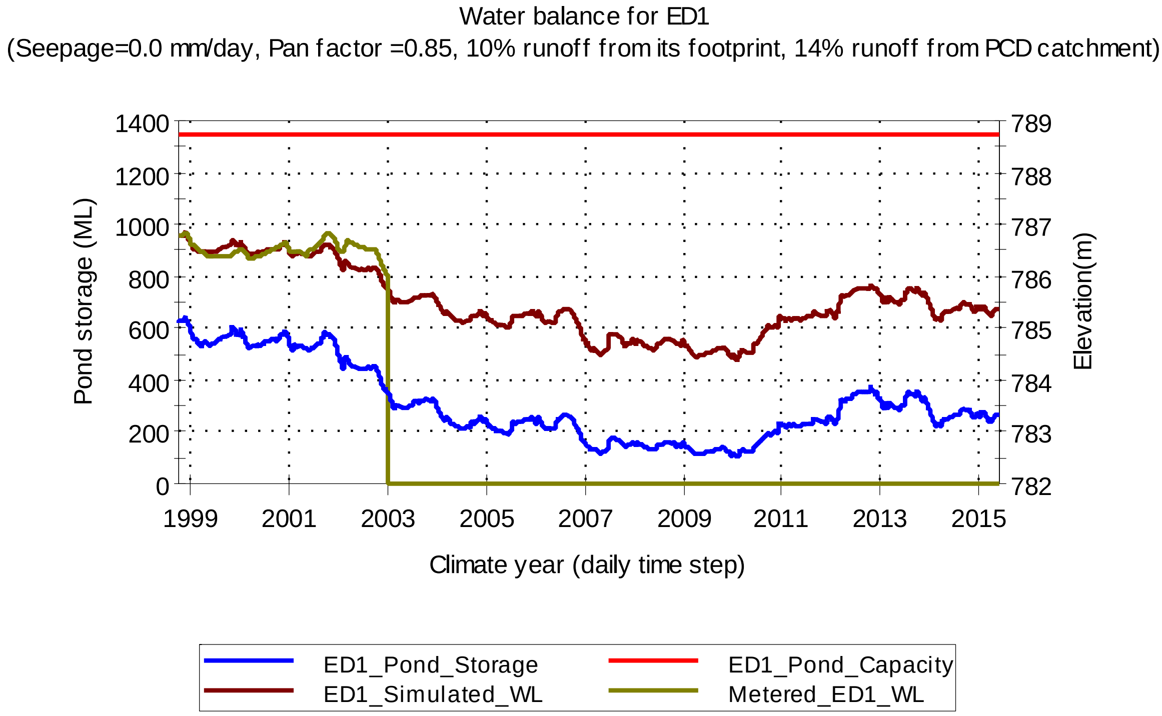

Figure A.2 Simulated water storage and levels for ED1 at 14% runoff from the PCD catchment

If seepage from ED1 pond floor is to be considered then the PCD catchment runoff would have to be higher than 14%. Since the calibrated seepage rate for ED2 in this study was found to be 0.6 mm/day, the same was adopted for ED1. With a seepage rate of 0.6 mm/day, the PCD average annual runoff of 37% is required to match the stored volume on 18 Feb 2014 (refer Figure A.3). Simulated water levels in Figure A.3 show that the match between the water levels for 2001 and 2002 is worse than that shown in Figure A.2. This suggests that the seepage rate for ED1 could be lower, consequently the PCD annual runoff would also be lower than 37%. However, to be conservative the parameters presented in Figure A.3 were adopted for the rest of simulations and analyses.

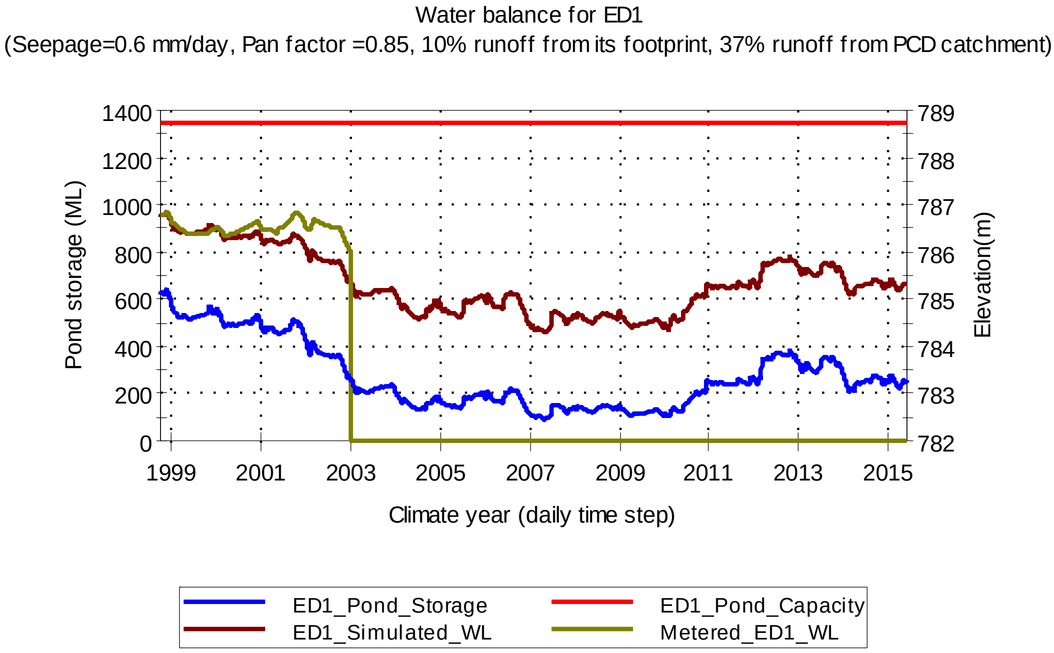

Figure A.3 Simulated water storage and levels for ED1 at 37% runoff from the PCD catchment and dam seepage rate of 0.6 mm/day

When the metered stormwater volumes provided by Veolia was used in the water balance, ED1 was found to fill up rapidly from 2010 and full in 2012 and 2013. On 18 February 2014, the simulated water storage in ED1 (Figure A.4) was 1,090 ML but Google's imagery for this date indicates that the volume in ED1 would have been 227 ML. This demonstrates that the stormwater volumes estimated by Veolia from the pumping hour records may be too high.

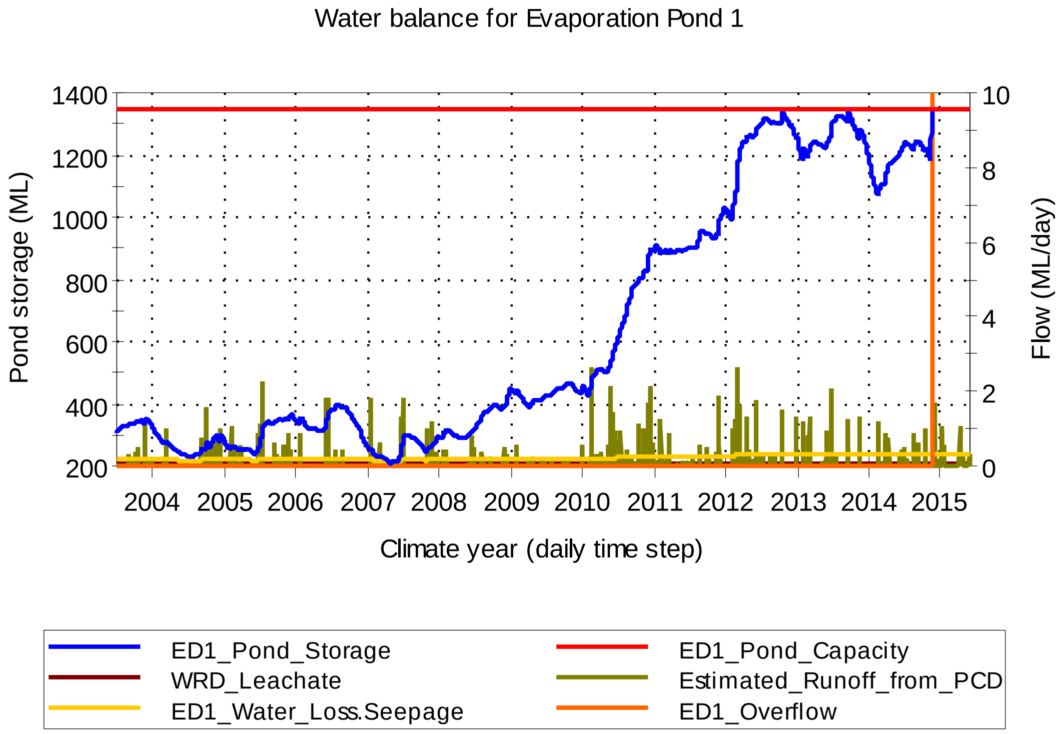

Figure A.4 Simulated water storage and levels for ED1 at 37% runoff from the PCD catchment and dam seepage rate of 0.6 mm/day and Veolia's stormwater data

A.2 TAILINGS PONDS

Water levels in TDS, TDN and TDW have been below the peg marks for a number of years. The AEMR for the site prepared by Veolia since 2011 have reported the water storage in TDS to be less than 700 ML and for TDN to vary between 100 to 300 ML.

Water volumes were simulated for TDS, TDN and TDW to demonstrate that the water levels in these ponds will not exceed the peg levels since mining has ceased in 1998.

Figure A.5 shows the water surface as of 18 February 2014 from Google image for the Woodlawn Site. The calculated surface areas in the tailings dam on this date were:

- 17.5 ha in TDS
- 9.3 ha in TDN
- 4.8 ha in TDW.

Figure A.6 shows the elevation and surface area relationships for the tailings ponds. Similarly, Figure A.7 shows the elevation and volume relationships for the tailings ponds. From these relationships the stored water levels and volumes for the tailings ponds were estimated as:

- 472 ML in TDS at a level of 784.4 mAHD
- 116 ML in TDN at a level of 792.8 mAHD
- 20.7 ML in TDW at a level of 822.0 mAHD.

Resulting water balances for these ponds were simulated for climate data from 1944 to date starting from the elevation on 18 February 2014. The pan factor of 0.85 and local runoff rate of 10% of the rainfall were adopted in the simulation which were the same in the Heron Resources Limited mine site water balance model. The simulated results for TDW, TDN and TDS are shown in Figure A.8, which demonstrates that the storage would remain well below the capacity of the dam if the same climate sequence repeats.

Figure A.5 Water surface area in tailings dam as of 18 Feb 2014

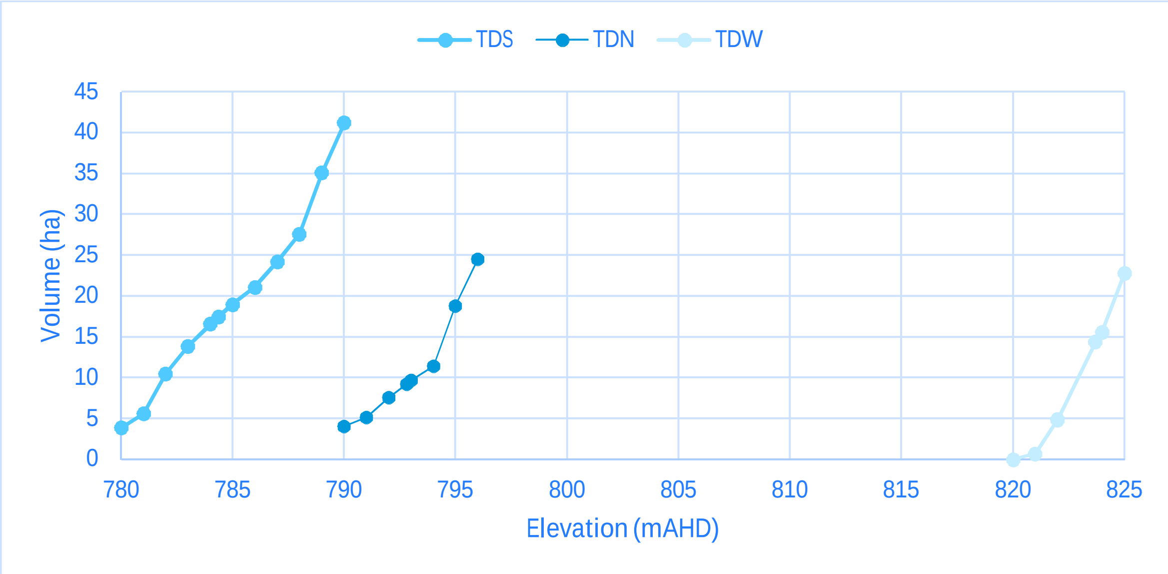

Figure A.6 Elevation surface area relationships for TDS, TDN and TDW

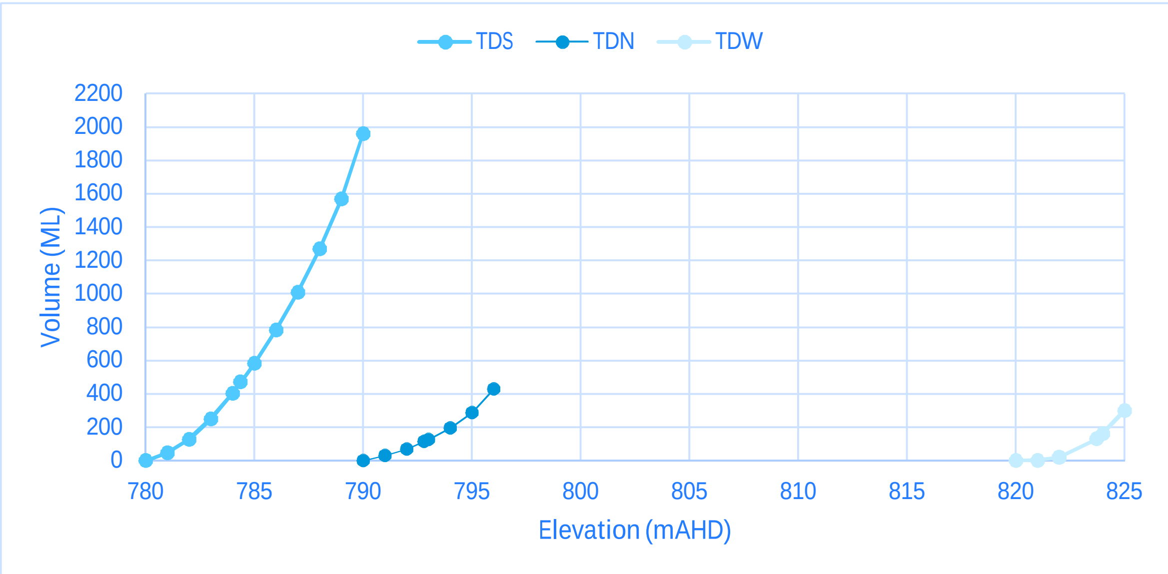

Figure A.7 Elevation volume relationships for TDS, TDN and TDW

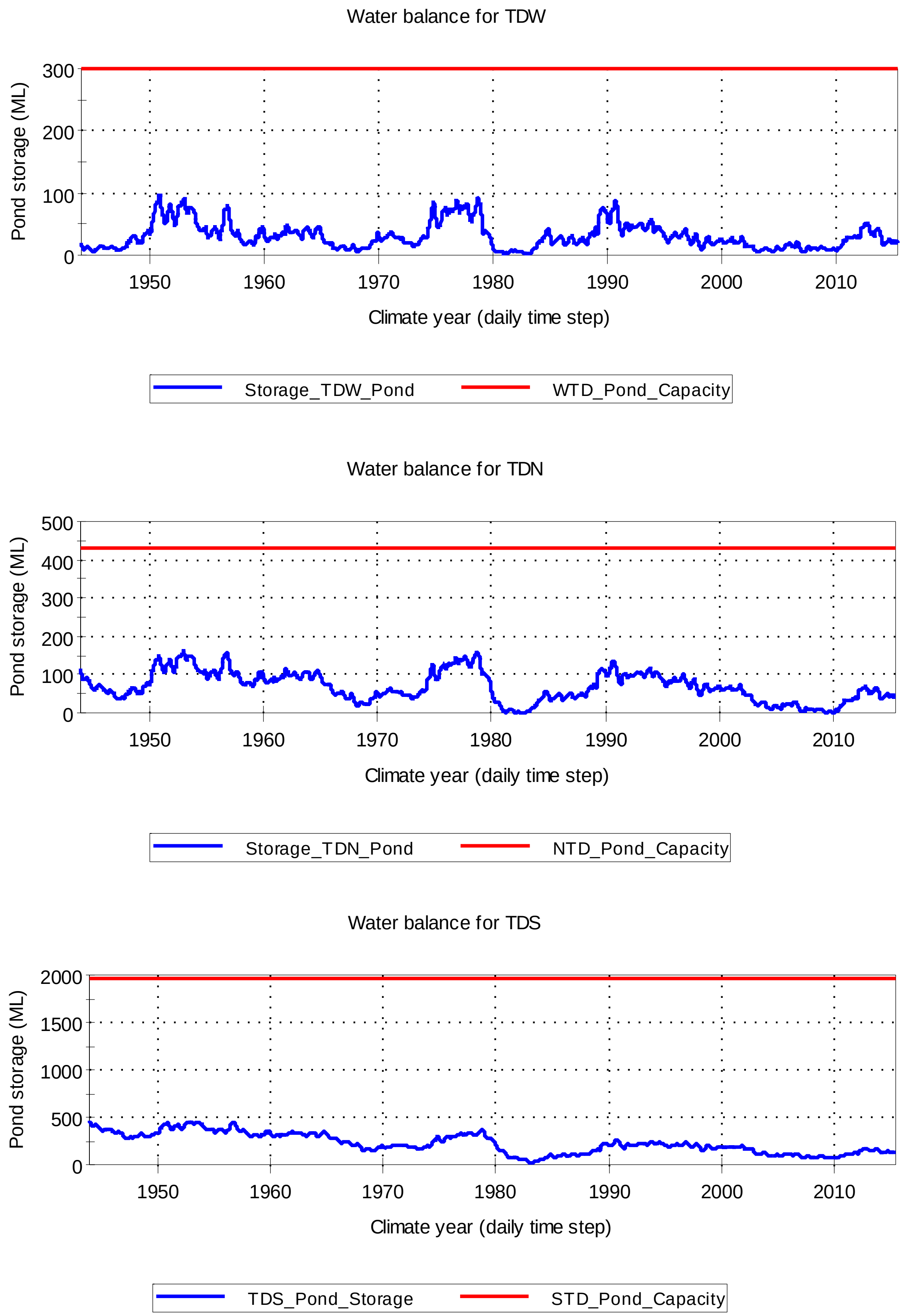

Figure A.8 Simulated volumes in TDW, TDN and TDS

Appendix C

Odour assessment

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30 October 2015

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WOODLAWN BIOREACTOR FACILITY ODOUR ASSESSMENT STUDY – ADDITION OF ED3S TO LEACHATE MANAGEMENT SYSTEM

Dear Stephen,

As requested, The Odour Unit Pty Ltd (TOU) has reviewed the odour emissions data from the recent 2015 Odour Audit in the context of Veolia's proposal to incorporate the Evaporation Dam 3 South (ED3S) into the existing Woodlawn Leachate Management System, which is based on the storage and evaporation of treated leachate in the Evaporation Dam 3 North (ED3N) system. We have prepared this letter as a formal report on the findings of our investigation.

Our understanding of the proposed change is that Veolia proposes to pump the stormwater currently in ED3S to Evaporation Dam 2 (ED2), thereby freeing up storage volume and natural evaporation capacity for treated leachate in ED3S.

We also understand that the NSW Environment Protection Authority (NSW EPA) has requested an odour assessment of the proposed change to operation based on the odour emissions data from the October 2015 Odour Audit. Specifically, NSW EPA has confirmed with Veolia that the following odour assessment methodology would be suitable (emailed dated 28 September 2015 from Veolia to TOU):

- *Utilising data from existing treated leachate dams and extrapolate this to the new dam in order to quantify odour emission rates from ED3S;*
- *Comparing the data against the current odour emissions inventory developed for the site (as part of the annual odour audits); and*
- *Quantifying the impact as a percentile increase in comparison to the overall site emissions as well as the leachate pond system.*

The 2015 Odour Audit included ambient odour assessments immediately downwind of the Bioreactor and the ED3N system containing treated leachate, as well as far-field assessments as distant as the Tarago Township. I personally carried out these field assessments. While the quantitative findings of the Odour Audit, with respect to the ED3N system, will be discussed later in this report, it was clearly evident that at no stage were the pond odours detectable beyond the site boundary. This is supported by the low odour emission rate results from the Odour Audit.

TOU's understanding is that due to time constraints, Veolia is proposing to construct the leachate storage dam in two parts. Firstly, the ED3S-Southern partition (ED3S-S) liner will be constructed, which is separated via a breakwall from the main ED3S system. Survey data from Veolia, undertaken by LandTeam Australia Pty Ltd (LandTeam), indicate that the new ED3S-S partition pond will have a surface area between 2.30 ha at low water level, and 2.83 ha when full (see **Attachment 1 - LandTeam Drawing No. 16800-437**).

The second part will involve pumping water from the ED3S to ED2 and then constructing the liner for the main ED3S system. Survey data for this dam indicates that it will have a maximum surface area of 8.94 ha (see **Attachment 2 - Woodlawn Bioreactor ED3S Information** for projected volumes and surface areas). The combined surface area of both dams (i.e. ED3S & ED3S-S) have been added for the purposes of this assessment, as will be shown later in **Table 1**).

Previous audits in 2012 and 2013 found elevated odour emissions from pond ED3N-1 (2012) and ED3N-2 (2013) due to insufficient treatment in the Leachate Aeration Dam system. Improvements to this system saw a large decrease in odour emissions from all four ED3N ponds in 2014, following re-treatment of these liquids, to extremely low levels. These results, together with the 2015 audit results, are shown in **Attachment 3 - Odour Emissions Inventory Comparison Inventory & Odour Emissions Inventory 2015 Audit Excel Sheets**. It should be noted that the Specific Odour Emission Rate (SOER) values represent the measured rates of odour emission per square metre of exposed pond area (ou.m^3/m^2/s), while the Odour Emission Rate results represent the total odour emission rate determined for each source (ou.m^3/s).

The 2015 audit results show a slightly higher rate of odour emission from all four ED3N ponds, when compared with 2014, but still very low rates of odour emission for treated wastewater pond systems. At the time of writing this report, Veolia was in the process of investigating this matter. The findings from that investigation will be reported in the 2015 Odour Audit Formal Report. The results have been used to project emissions from pond ED3S, as shown in the **Table 1.** Note that the mean SOER result for the four ponds has been used in the projection.

Table 1 - Projected Odour Emission Rates for ED3S			
ED3N System 2015			
Source ID	**Dam Surface Area (m^2)**	**SOER ($ou.m^3/m^2/s$)**	**OER ($ou.m^3/s$)**
ED3N-1	6,000	0.132	794
ED3N-2	5,500	0.145	797
ED3N-3	5,500	0.091	500
ED3N-4	25,000	0.269	6,720
ED3N Total	**42,000**	**0.159 (mean)**	**8,810**
Projected ED3S System			
ED3S	89,435	0.159	14,200
ED3S-S	28,330		4,510
ED3S Total	**118,000**		**18,700**

It can be seen that the projected odour emission increase from the conversion of ED3S-S to leachate storage and evaporation duties would increase the pond systems odour emission rate by 4,510 $ou.m^3/s$ (51%). If the combined ED3S system projected surface areas, the overall odour emission rate would increase by 18,700 $ou.m^3/s$, equivalent to a twofold increase in odour emissions from the evaporation dam system. TOU considers this increase to be insignificant in the context of the distance of this odour source from potential receptors. The relatively neutral odour character in the pond emissions (described as earthy/mildly ammoniacal) further supports our view that this source is benign and will not cause problems off-site. TOU would expect this state of affairs to continue provided that the Leachate Aeration Dam system continues to be managed and operated effectively.

The question of the relative magnitude of the proposed ED3S system emissions compared to overall site odour emissions is difficult to address quantitatively, given the disparate Bioreactor odour sources and the inherent difficulties in quantifying odour emissions using the odour sampling and testing techniques available to the audit team. The 2015 Odour Audit was able to determine that the odour emission rate from the active tipping face inside the Bioreactor was 45,100 $ou.m^3/s$ – well below the estimate in the original Environmental Assessment projection (292,000 $ou.m^3/s$). This reduction is largely due to a decrease in the active tipping area – minimising the active tipping face is one of the key performance indicators at the Woodlawn site as addressed in previous audits. It is TOU's judgement at this stage that fugitive odour emissions are likely to be comparable to the active tipping face emissions to the overall Bioreactor emissions.

On this basis, and assuming a Bioreactor emission rate of at least 100,000 m^3/s, it can be seen that the proposed utilisation of the ED3S system will add a maximum of 17% to overall site odour emissions, at full dam capacity.

On the basis of this assessment, it can be safely concluded that the conversion of ED3S system to leachate management duties will not result in any increase in odour impacts from the Woodlawn site.

Yours sincerely,

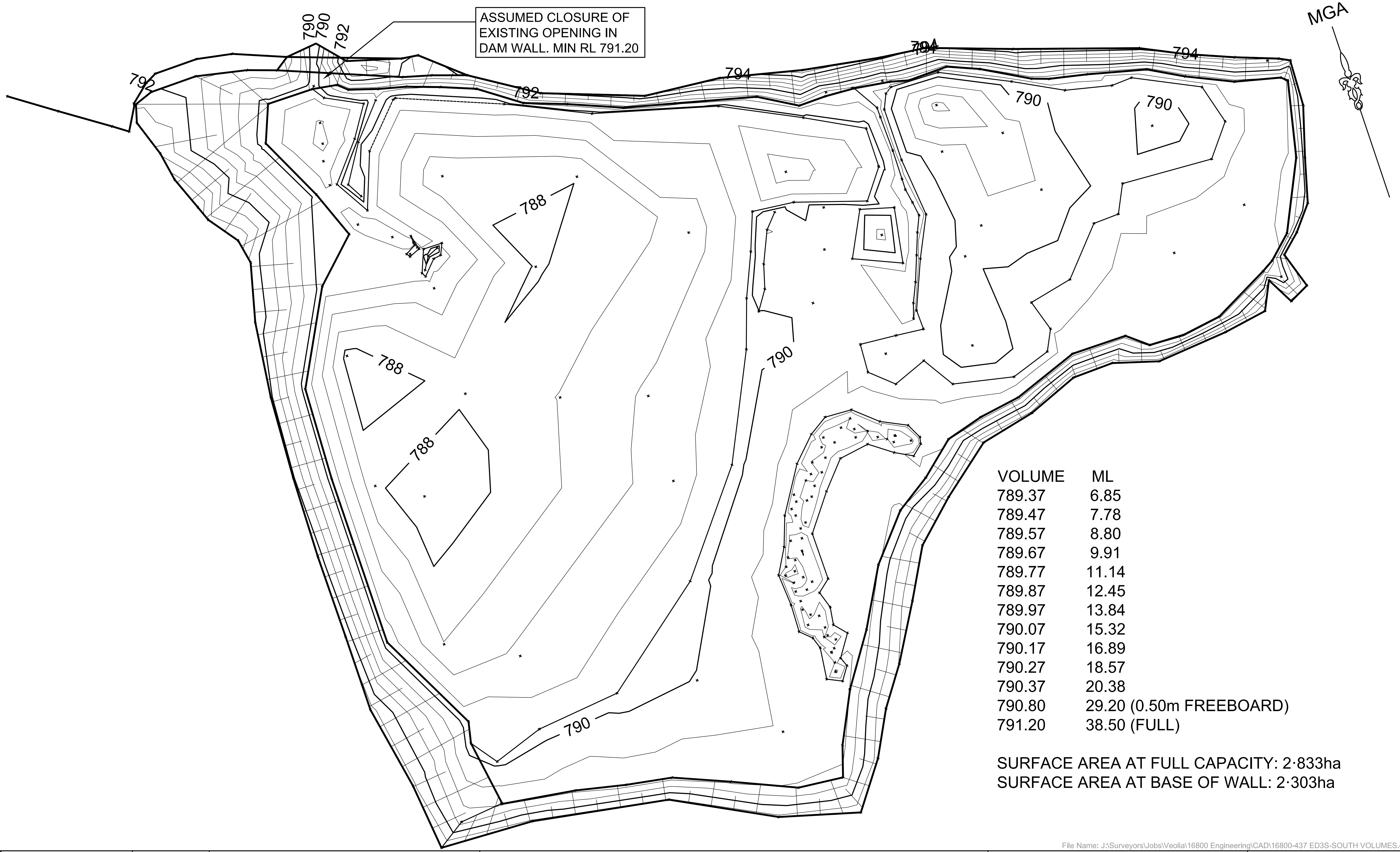
Terry Schulz
Principal & Managing Director

Attachments:

Attachment 1 – LandTeam Drawing No. 16800-437
Attachment 2 – Woodlawn Bioreactor ED3S Information
Attachment 3 - Odour Emissions Inventory Comparison Inventory & Odour Emissions Inventory 2015 Audit Excel Sheets

Attachment 1 –

LandTeam Drawing No. 16800-437



VOLUME	ML
789.37	6.85
789.47	7.78
789.57	8.80
789.67	9.91
789.77	11.14
789.87	12.45
789.97	13.84
790.07	15.32
790.17	16.89
790.27	18.57
790.37	20.38
790.80	29.20 (0.50m FREEBOARD)
791.20	38.50 (FULL)

SURFACE AREA AT FULL CAPACITY: 2·833ha
SURFACE AREA AT BASE OF WALL: 2·303ha

File Name: J:\Surveyors\Jobs\Veolia\16800 Engineering\CAD\16800-437 ED3S-SOUTH VOLUMES.dwg

ISSUE	AMENDMENT	DATE
A	INITIAL ISSUE	24/08/2015

SCALE 1:800

0 10 20 30 40 50

Metres

Liability limited by a scheme approved under Professional Standards Legislation.

A3 SHEET

VEOLIA ENVIRONMENTAL SERVICES

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VEOLIA ENVIRONMENTAL SERVICES

PLAN SHOWING STORAGE INFORMATION
EVAPORATION DAM 3 - SOUTH
(SOUTHERN PARTITION)
WOODLAWN BIOREACTOR

DATUM	AHD	CONTOUR INTERVAL	0.5m

DATE: 24/08/2015
SURVEYED: VAR
DRAWN: MK
CHECKED: JK
ISSUE A
DRAWING No. 16800-437

THE ODOUR UNIT

Attachment 2 –

Woodlawn Bioreactor ED3S Information

WOODLAWN BIOREACTOR ED3S INFORMATION

DAM: ED3SOUTH

Minimun RL: 786.40

Minimum Wall Level: 791.00

Maximum Water Level: 790.50 (0.5m freeboard)

Water Level	Volume (m³)	Area (m²)
786.40	0.0	0.0
786.50	0.3	13.3
786.60	4.9	89.4
786.70	20.4	233.1
786.80	54.0	454.0
786.90	114.2	762.4
787.00	209.0	1147.3
787.10	346.1	1608.6
787.20	533.3	2147.6
787.30	778.4	2769.6
787.40	1090.1	3477.4
787.50	1476.8	4271.6
787.60	1947.9	5175.5
787.70	2515.2	6182.5
787.80	3187.7	7302.1
787.90	4000.4	9044.2
788.00	5020.0	11544.8
788.10	6329.9	14605.3
788.20	7928.4	17372.5
788.30	9812.0	20341.8
788.40	12000.8	23840.0
788.50	14493.3	26446.4
788.60	17266.1	29052.6
788.70	20304.1	31711.6
788.80	23618.9	34639.8
788.90	27232.4	37649.8
789.00	31149.5	40706.2
789.10	35381.0	43989.0
789.20	39958.1	47625.5
789.30	44921.4	51714.8
789.40	50315.7	56314.8
789.50	56191.0	61757.4
789.60	62669.6	67889.9
789.70	69609.4	73133.4
789.80	76868.5	75406.4
789.90	84392.4	77377.4
790.00	92145.4	79343.5
790.10	100124.3	81359.7
790.20	108332.8	83408.3
790.30	116767.1	85617.2
790.40	125427.2	87739.4
790.50	134275.9	89434.7

	Filling rates			
	Low	Average	High	
	1L/s	1.5L/s	2L/s	Annual filling rate
	Volume (m³)			
Yr 1	31.6	47.3	63.1	
Yr 2	63.1	94.7	126.2	
Yr 3	94.7	142.0	189.3	
Yr 4	126.2	189.3	252.5	
Yr 5	157.8	236.7	315.6	
Yr 6	189.3	284.0	378.7	
Yr 7	220.9	331.4	441.8	
Yr 8	252.5	378.7	504.9	
Yr 9	284.0	426.0	568.0	
Yr 10	315.6	473.4	631.2	
Yr 11	347.1	520.7	694.3	
Yr 12	378.7	568.0	757.4	
Yr 13	410.2	615.4	820.5	
Yr 14	441.8	662.7	883.6	
Yr 15	473.4	710.0	946.7	
Yr 16	504.9	757.4	1009.8	
Yr 17	536.5	804.7	1073.0	
Yr 18	568.0	852.1	1136.1	
Yr 19	599.6	899.4	1199.2	
Yr 20	631.2	946.7	1262.3	
Yr 21	662.7	994.1	1325.4	
Yr 22	694.3	1041.4		
Yr 23	725.8	1088.7		
Yr 24	757.4	1136.1		
Yr 25	788.9	1183.4		
Yr 26	820.5	1230.7		
Yr 27	852.1	1278.1		
Yr 28	883.6	1325.4		
Yr 29	915.2			
Yr 30	946.7			
Yr 31	978.3			
Yr 32	1009.8			
Yr 33	1041.4			
Yr 34	1073.0			
Yr 35	1104.5			
Yr 36	1136.1			
Yr 37	1167.6			
Yr 38	1199.2			
Yr 39	1230.7			
Yr 40	1262.3			
Yr 41	1293.9			
Yr 42	1325.4			
	1357.0			

Attachment 3 –

Odour Emissions Inventory Comparison Inventory & Odour Emissions Inventory 2015 Audit Excel Sheets

THE ODOUR UNIT

VEOLIA

Location	2015			2014			2013				2012			Environmental Assessment		
	Current Area (m^2)	TOU SOER ($ou.m^3/m^2/s$)	TOU OER - Current Area ($ou.m^3/s$)	2014 Area (m^2)	TOU SOER ($ou.m^3/m^2/s$)	TOU OER - 2014 Area ($ou.m^3/s$)	2013 Area (m^2)	TOU SOER ($ou.m^3/m^2/s$)	TOU OER 2012 Area ($ou.m^3/s$)	TOU OER - Current Area ($ou.m^3/s$)	2012 Area (m^2)	TOU SOER ($ou.m^3/m^2/s$)	TOU OER ($ou.m^3/s$)	SOER ($ou.m^3/m^2/s$)	OER ($ou.m^3/s$)	OER - 2015 Current Area ($ou.m^3/s$)
ED3N-1	6,000	0.132	794	6,000	0.017	104	6,000	0.30	2,100	1,800	7,000	394	2,760,000	8.8	61,600	52,800
ED3N-2 & 3	11,000	0.118	1,300	11,000	0.049	543	11,000	11.6	150,000	127,000	13,000	0.29	3,800	7.4	96,200	81,400
ED3N-2	5,500	0.145	797	5,500	0.066	365	5,500	20.1	131,000	111,000	6,500	0.21	1,350	n/a		
ED3N-3	5,500	0.091	500	5,500	0.032	178	5,500	0.2	1,010	852	6,500	0.37	2,430			
ED3N-4	25,000	0.269	6,720	25,000	0.023	575	25,000	0.0603	965	1,510	16,000	0.41	6,600	0.7	11,200	17,500
Active Tipping Face	6,000	7.509	45,100	6,000	4.28	25,700	6,000	3.04	121,000	18,200	40,000	8.36	334,000	7.3	292,000	43,800
Leachate Aeration Dam	5,000	0.276	1,380	5,000	0.026	129	5,000	0.323	646	1,620	2,000	0.46	920	3.6	7,200	18,000
Construction and Demolition Tip Face	900	0.326	294	500	n/a^	n/a	500	0.293	264	147	900	n/a	n/a	n/a	n/a	n/a
Storage Pond 7	n/a	n/a	n/a	n/a	n/m^^	n/a	n/a	n/m	n/m	n/m	1,200	85	102,000	n/m	n/m	n/m

^ non-existent in this audit

^^ non-existent

n/a = not applicable

n/m = not measured

THE ODOUR UNIT

VEOLIA ENVIRONMENTAL SERVICES

Odour Emissions Inventory 2015 Audit

Client: Veolia (Australia & New Zealand)
Sampling Site: Woodlawn Bioreactor Facility
Project Number: N1806L.03 - Woodlawn Audit #4

Sample Location	TOU Sample Number	Odour Concentration (ou)	Specific Odour Emission Rate ($ou.m^3/m^2/s$)	Odour character	H_2S concentraton measurement in bag (ppm)
Evaporation Dam 3 North (ED3N) System					
Sample #1 - ED3N-4	SC15494	362	0.269	ammonical, dirt, soil	0.000
Sample #2 - ED3N-2	SC15495	197	0.145	ammonical, dirt, soil	0.000
Sample #3 - ED3N-1	SC15496	181	0.132	muddy, dirt	0.000
Sample #4 - ED3N-3	SC15497	118	0.091	muddy, dirt	0.000
Leachate Aeration Dam					
Sample #5 - Leachate Aeration Dam	SC15498	362	0.276	ammonical, dirt, soil	0.000
Active Tipping Area					
Sample #12 - Active Tipping Face Area: Soil Covered Final Layer (Point #1A)	SC15505	256	0.19	dirt, garbage	0.011
Sample #13 - Active Tipping Face Area: ConCover Secondary Layer (Point #1B)	SC15506	6,320	4.45	ammonical, garbage	0.026
Sample #14 - Active Tipping Face Area: Soil Covered (Point #2A)	SC15507	724	0.50	vanilla, gassy	0.000
Sample #15 - Active Tipping Face Area: ConCover (Point #2B)	SC15508	4,470	2.83	dirt, garbage	0.045
Sample #16 - Active Tipping Face Area: No cover (Point #3A)	SC15509	23,200	14.05	lime, sour, ammonical, garbage	0.60
Sample #17 - Active Tipping Face Area: No cover (Point #3B)	SC15510	27,600	17.11	ammonical, garbage	0.11
Sample #18 - Active Tipping Face Area: Freshly Waste (< 1 day old, Point #1)	SC15511	17,900	11.79	garbage	0.140
Sample #19 - Active Tipping Face Area: Freshly Waste (< 1 day old, Point #2)	SC15512	15,000	9.15	garbage	0.020
Waste Covered Area					
Sample #6 - Waste Covered Area: Normal Capping (Zone A between LE85 & SM13)	SC15499	181	0.127	sweet, fermented	0.000
Sample #7 - Waste Covered Area: Normal Capping (Zone A and parallel to LE99)	SC15500	558	0.388	sweet, fermented, pineapple, rotten egg, landfill gas	0.01
Sample #10 - Waste Covered Area: Biocovered Material Area (LE41)	SC15503	256	0.176	garbage, dirt, ammonical	0.004
Sample #11 - Waste Covered Area: Biocovered Material Area (LE57)^	SC15504	2,520,000	1,692.871	landfill gas, rotten egg	840
Sample #20 - Waste Covered Area: Normal Capping (Zone D - LE65)	SC15513	101,000	58.43	garbage, landfill gas, rotten, pineapple	n/m
Sample #21 - Waste Covered Area: Biocovered Material Area (Zone D - LE65)	SC15514	3,120,000	1,765.44	landfill gas, rotten egg, pineapple, garbage	180
Construction and Demolition Area					
Sample #8 - Construction and Demolition Area: Active Tipping Face (Point #1)	SC15501	431	0.299	sweet, fermented, pineapple, rotten egg, landfill gas	0.025
Sample #9 - Construction and Demolition Area: Active Tipping Face (Point #2)	SC15502	512	0.353	garbage, pineapple	n/m

n/m = not measured

^ estimated at 3,000 ou per 1 ppm of H_2S (i.e. mean of 2,000 - 4,000 ou per 1 ppm of H_2S)