Department of Planning and Environment

Our ref: SSD-7698 PA-11

Alycia O'Brien
Environmental Compliance Manager
PO Box 10
MOOREBANK NSW 1875

2 September 2022

Subject: **Surface Water Validation Report for Mayfield West Waste Facility Condition B35 of SSD-7698**

Dear Ms O'Brien

I refer to your submission dated 11 March 2022 requesting approval of the Surface Water Validation Report (version 3) dated 2 November 2020. I also acknowledge your response to the Department's review comments and requests for additional information.

I note the Surface Water Validation Report and supporting information have been:

- Prepared in consultation with the NSW Environment Protection Authority; and
- Contain the information required by the conditions of approval.

As nominee of the Planning Secretary, I approve the following documents prepared by EMM Consulting under Condition B35:

- Surface Water Validation Report (version 3) dated 2 November 2020
- Memorandum dated 12 August 2022 'EPL 20771 – Water management update'
- Memorandum dated 11 March 2022 'Mayfield West Recycling Facility: Surface Water Validation Report review outcomes'

You are reminded that if there is any inconsistency between the approved document and the conditions of approval, then the requirements of the conditions of approval prevail.

Please ensure you make the document and this approval letter publicly available on the project website.

Please ensure that the approved plan is placed on the project website at the earliest convenience.

If you wish to discuss the matter further, please contact Lindsey Blecher on (02) 9995 6611.

Yours sincerely

Lindsey Blecher

As nominee of the Planning Secretary

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Memorandum

12 August 2022

To: Alycia O'Brien
Environmental Compliance Manager
Benedict Recycling Pty Limited

From: Chris Kuczera

Subject: EPL 20771 - Water management update

Benedict Recycling Pty Ltd (Benedict) owns and operates a resource recovery facility at 1a McIntosh Drive, Mayfield West (hereinafter referred to as the facility or site). As the Environment Protection Authority (EPA) is aware, Environmental Protection Licence No. 20771 (EPL 20771) is held by Benedict. Following review of the Surface Water Validation Report (SWVR) (EMM 2022a) and subsequent information provided by Benedict, the EPA advised Benedict of an intention to establish a Pollution Reduction Study (PRS) on EPL 20771, focusing on water management.

A meeting was held on 21 July 2022 (the meeting) to discuss various aspects of the water management system, the PRS and to resolve a way forward. During this meeting Benedict described two potential water management system improvements that would be practical and reasonable to implement and made a commitment to prepare a Water Management Plan for the site. It was agreed by 12 August 2022 Benedict would provide the EPA with detailed information on these proposals. This memo provides this information.

- Section 1 describes the potential water management system improvements and updated water balance model results;
- Section 2 describes the proposed Water Management Plan framework and makes a commitment to include several measures that were recommended by the EPA; and
- Section 3 provides a summary of commitments and timing.

1 System improvements

This section describes the reasonable and practical potential water management system improvements that were described by Benedict during the meeting:

- Option 1 – new water application system to maximise water reuse to reduce basin overflow frequencies and volumes; and
- Option 2 – reconfigure the basin outlet to increase storage volume.

1.1 Option 1 – new water application system

1.1.1 System description

The site has historically used water captured in the Area 1 Tanks and the basin for dust suppression. This has been done by applying water to various roadway and hardstand areas within the site using a water cart. The application has been undertaken on an as needed basis to supress dust emissions that can occur due to vehicle movements. The water balance prepared for the SWVR (EMM 2022b) assumed that dust suppression was applied to 3 ha of the site, which is less than 40% of the 7.9 ha catchment area that contributes runoff to the water management system. The water balance also identified the basin overflow frequency is constrained by the dewatering rate (ie the rate at which water is extracted for dust suppression) rather than the basin volume, which has capacity to capture runoff from approximately 110 mm of rainfall, if empty at the start of the storm (EMM 2022b). Accordingly, there is an opportunity to reduce the basin overflow frequency and volume by increasing the water use rate.

Benedict have reviewed options to increase water use following rainfall to reduce the time taken to restore the basin capacity. It is proposed to:

- install a new fixed sprinkler system that will apply water to approximately 3.4 ha of the site; and
- repurpose the water cart to apply water only to the south-eastern portion of the site, where it is not practical to operate a fixed sprinkler system. This part of the site has a total area of 3.1 ha. However, the water cart will only apply water to the roads and hardstand areas and the application area is estimated to be 1.5 ha (out of the greater 3.1 ha area).

Figure 1.1 shows the abovementioned areas. It is noted that the water application is proposed in both SSD 7698 approval boundary (in which the waste management facility is operated) and the ancillary activities area, which is owned and operated by Benedict under a separate approval. Runoff from both areas drain to the basin via the perimeter drainage system.

Table 1.1 describes the proposed system and operation.

Table 1.1 System description

Aspect	Description
Water sources	The system will be configured so that water supply to the fixed sprinkler system and water cart can be sourced from the 250 KL Area 1 Tanks and the 2.8 ML basin. The Area 1 Tanks will be emptied before water is sourced from the basin.
Operation (during rainfall)	The system will not be operated during material rainfall to avoid increasing the potential for pollutants to leach from stockpiles.
Operation (after rainfall)	Following rainfall, the system will be run at full capacity (ie to maximise the application area) until the Area 1 Tanks are fully dewatered and the basin is dewatered to 50% capacity. Once this is achieved the water use rate will be adjusted based on weather forecast. If dry weather is forecast the use rate will be reduced to the minimum rate required for dust suppression purposes. If material wet weather is forecast, the system will continue to be run at full capacity to restore the basin capacity ahead of rainfall. The fixed sprinkler system will be operated such that water is applied at similar rates to evaporation losses. This will avoid oversaturation of stockpiles.

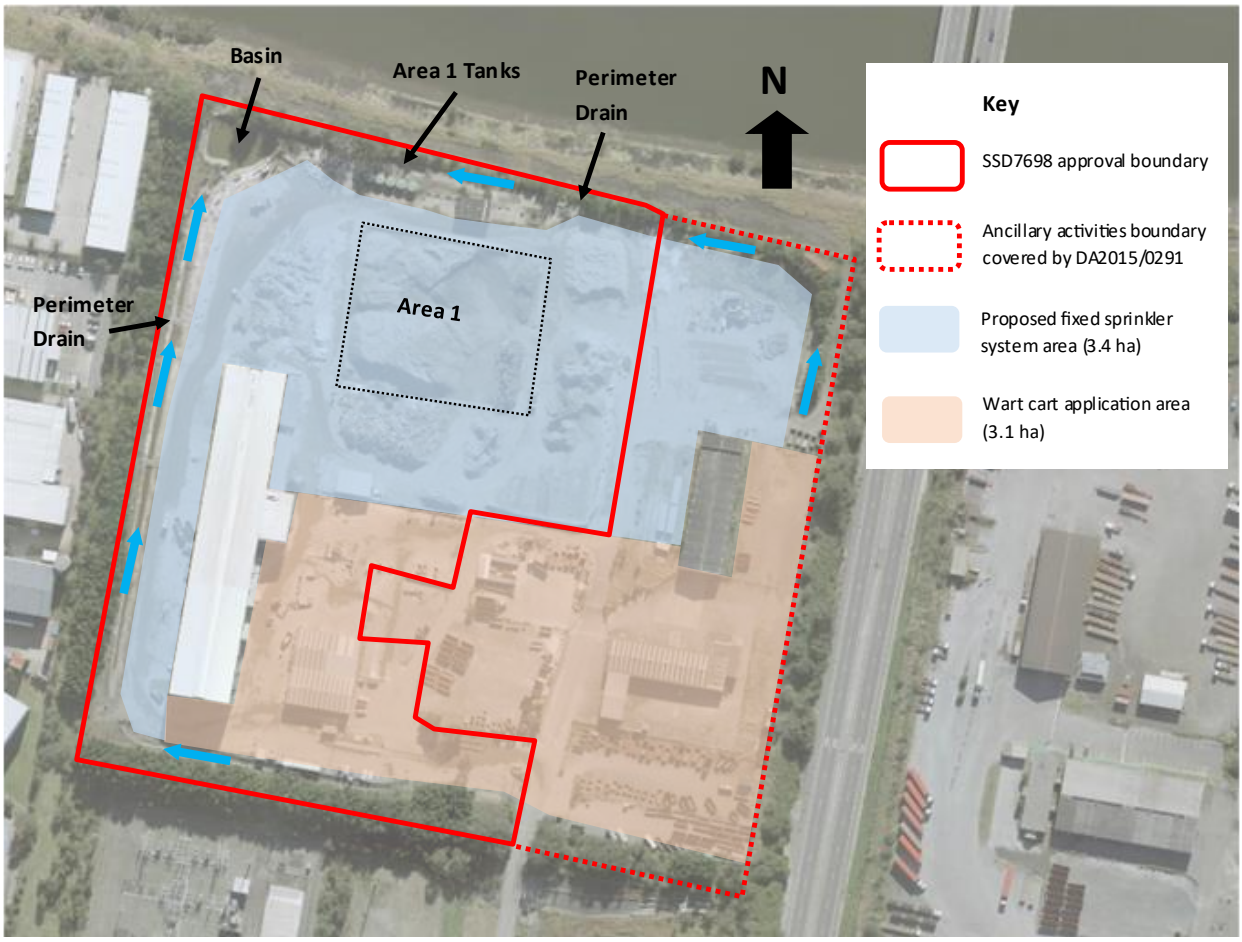

Figure 1.1 Proposed water use areas

1.1.2 System effectiveness

The proposed system relies on evaporation to dewater the basin. Therefore, the dewatering rate will vary based on the weather and seasonal variations in the evaporation rate. Applying the water balance methodology described in Section 1.3, if the system is run at full capacity the storages would take approximately eight non-rainfall days to fully dewater in summer months and sixteen non-rainfall days to fully dewater during winter months. The 50% capacity threshold described in Table 1.1 would be achieved in half of this time (ie four days in summer and eight days in winter).

1.1.3 Water quality risks

Table 1.2 describes several water quality risks associated with increasing water application. The proposed management approach to mitigate risks is also noted.

Table 1.2 Summary of water quality risks

Risk	Description of the risk and management approach
Overapplication	**Risks** • Stockpiles - overapplication of water to stockpiles can increase the moisture content and, in some cases, lead to the leaching of water and pollutants from stockpiles. • Access roads and hardstands – there are minimal risks associated with overapplication as excess water will simply runoff and return to the water management system. **Management approach** • The system will not be operated during material rainfall to avoid increasing the potential for pollutants to leach from stockpiles. • The fixed sprinkler system will be operated such that water is applied at similar rates to evaporation losses. This will avoid oversaturation of stockpiles. • An operating procedure will be developed in the proposed Water Management Plan (see Section 2).
Mixing of Area 1 Tank and basin water	**Risks** • The use of water captured in the Area 1 Tanks may result in pollutants captured in the Area 1 system entering the basin via wash-off processes. • As discussed with the EPA during the meeting, this risk is negligible as the quality of water captured in the Area 1 Tanks is similar to the basin water quality and the volume of water in the Area 1 Tanks (250 KL) is minor compared to the volume of water in the basin (2.8 ML or 2,800 KL). **Management approach** • The proposed Water Management Plan will include ongoing monitoring of the Area 1 Tanks and basin water quality to identify any changes to water quality trends that would warrant additional controls (see Section 2).
Pollutant wash-off from hardstands	**Risks** • Increasing the water application to hardstands will not introduce any new pollutants to the water cycle provided that stockpiles are not over saturated. • It is expected that some solids, nutrients and metals in the applied water will absorb to material in stockpiles and will not be remobilised by wash-off. Nitrogen will also likely be removed via nitrification. **Management approach** • The proposed Water Management Plan will include ongoing monitoring of the basin water quality to identify any changes to water quality trends that would warrant additional controls (see Section 2).

1.2 Option 2 - adjustments to the basin outlet level

Outflows from the basin occur via a pipe that has a manually operated shutoff value. Inflows to the pipe are controlled by a concrete weir that has a crest level of 7.72 m AHD, approximately 400 mm below the basin spillway. The current operating practice is to keep the outlet pipe valve shut until water ponds to near the spillway crest level. The valve is only opened when an overflow via the spillway is imminent and unavoidable.

It was initially thought that the 2.8 ML basin volume that was applied to the water balance related to the storage volume to the concrete weir crest and that the theoretical basin volume could be adjusted in the water balance to align with the operating practice.

As part of investigating this option, a detailed review of the storage volume of the basin was undertaken which concluded that assumed basin storage of 2.8 ML applies to a level that is between the concrete weir and spillway level and that volume applied to the water balance is representative of current operating practice. This review did identify an opportunity to reduce overflow volumes and durations by shutting the valve near the end of a wet weather event to allow for runoff that occurs near the end and shortly after the wet weather to be captured in the basin storage above the concrete weir. This revised operating practice will be documented in the Water Management Plan (see Section 2).

1.3 Water balance model update

1.3.1 Model updates

The water balance model that was prepared for the SWVR (EMM 2022b) was updated to assess the proposed water application system. The water balance calculates the application volume on a daily timestep as a function of rainfall, evaporation and the assumed application area. The following logic was applied:

If rainfall > 5mm/day then no application is applied

If rainfall < 5mm/day:

application rate = application area x (evaporation excess + 2mm)

evaporation excess = evaporation rate – daily rainfall

evaporation rate = a daily rate calculated from the average monthly Class A pan evaporation rate (see Figure 2.3 in EMM 2022b).

An assumed total application area of 4.3 ha was calculated by applying utilisation factors to the fixed sprinkler and water cart application areas establish in Section 1.1. A utilisation factor of 0.8 was applied to the fixed sprinkler system area of 3.4 ha to account for areas that will be not covered by the sprinkler system (which will apply water in circular patterns). A factor of 0.5 was applied to the water cart area of 3.1 ha as the water cart will only apply water to the roads and hardstand areas. Table 1.3 provides a break-down of the assumptions applied to calculate the 4.3 ha application area.

Table 1.3 Assumed application area

	Potential area	Utilisation factor	Assumed area
Fixed sprinkler system	3.4 ha	0.8	2.7 ha
Water cart area	3.1 ha	0.5	1.6 ha
Total	6.5 ha		4.3 ha

1.3.2 Results

The proposed water application system relies on evaporation to dewater the basin. Therefore, the dewatering rate will vary based on the weather and seasonal variations in the evaporation rate. The water balance methodology captures these contributing factors (see EMM 2022b for detailed descriptions). The following key water balance results are presented in Table 1.4 for the scenario presented in the SWVR (EMM 2022b) and the proposed scenario:

- Overflow frequency – refers to the average number of overflow events per year. This is calculated in the water balance by dividing the total number of overflows predicted by the number of years simulated (50 years).
- Design rainfall – refers to the average 5-day rainfall total predicted to initiate an overflow (ie the average rainfall that occurs over five days prior to basin overflowing). A higher value indicates a greater capacity to contain stormwater runoff.

Table 1.4 Water balance results

	Scenario reported in SWVR (EMM 2022b)	Increased water application scenario
Average overflow frequency	4.1 overflows per year	2.9 overflows per year
Design rainfall[1]	72 mm	92 mm

Notes: 1. The design rainfall is the average 5-day rainfall total calculated to initiate an overflow. As this is an average value, overflows can occur from less rainfall under certain circumstances such as the 5-day rainfall period occurring shortly after a wet period.

The proposed water application system will increase the rate at which the Area 1 Tanks and the basin are dewatered following rainfall. This will reduce overflow frequencies and volumes by increasing the likelihood that capacity will be restored before the next rainfall event occurs. The water balance model results (Table 1.4) indicate that relative to the scenario reported in the SWVR (EMM 2022b):

- **the average overflow frequency will reduce from 4.1 to 2.9 overflows per year, which equates to a 29% reduction in overflows;** and
- **the design rainfall will increase from 72 to 92 mm (over five days), a 27% increase**.

2 Water management plan framework

Benedict proposes to prepare a Water Management Plan for the site once the SWVR review process is finalised. The plan will follow a standard industry template and will describe the water management system, operating procedures and monitoring and reporting requirements. It will include the following specific measures:

- An operating procedure for the new water application system that describes when and how the system is to be operated.
- Six-monthly after wet weather monitoring of water quality in the Area 1 Tanks and the basin. The plan will include simple methods to analysis the data to:
  - verify (or otherwise) that the quality of water captured in the Area 1 tanks is similar to the basin;
  - assess water quality trends in the basin and identify any changes due to the operation of the new water application system; and
  - establish thresholds for further investigations.
- Specific measure to comply with EPL conditions (which may change once this SWVR review process is finalised).

3 Summary of commitments

Table 3.1 provides a summary of commitments made in this memo and implementation timeframes.

Table 3.1 Summary of commitments

Commitment	Timeframe
New water application system to increase water use after wet weather events • Install a new fixed sprinkler system to the 3.4 ha area shown in Figure 1.1. • Commence operating new water application system as described in Section 1.1.	8 weeks following EPA endorsement
Water Management Plan • Prepare a Water Management Plan as described in Section 2.	8 weeks following EPA endorsement

4 Closing

A meeting was held between the EPA and Benedict on 21 July 2022 to discuss various aspects of the water management system. During this meeting Benedict described two potential water management system improvements that would be reasonable and practical to implement and made a commitment to prepare a Water Management Plan for the site. It was agreed that Benedict would provide the EPA with detailed information on these proposals. This memo provides this information and makes a firm commitment to implement a new water application system and prepare a Water Management Plan.

If the EPA has any concerns with the information provided in this memo or the overall mitigation approach Benedict would appreciate an opportunity to discuss further.

Please note that if the design rainfall provided in Table 1.4 is referenced in a varied EPL 20771, the EPL should also include the definition provided in table note 1. This is important as the design rainfall is an average value which needs to be considered if using this value for compliance purposes.

Should you have any questions, please contact Alycia O'Brien (Benedict's Environmental Compliance Manager) on 0437 468 258 or at alycia@benedict.com.au.

Yours sincerely

Chris Kuczera
Associate Water Resources Engineer
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References

EMM 2022a Mayfield West Recycling Facility: Surface Water Validation Report review outcomes

EMM 2022b Mayfield West Recycling Facility: Water balance update

Memorandum

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11 March 2022

To: Alycia Campbell
Environmental Compliance Manager
Benedict Recycling Pty Limited
From: Chris Kuczera
Subject: Mayfield West Recycling Facility: Surface Water Validation Report review outcomes

1 Introduction

1.1 Background

Benedict Recycling Pty Ltd (Benedict) owns and operates a resource recovery facility at 1a McIntosh Drive, Mayfield West (hereinafter referred to as the facility or site). In 2018 the Minister for Planning approved the State significant development application (SSD 7698) enabling the facility to increase the processing capacity to 315,000 tonnes per year of general solid waste (non-putrescible). Schedule 2 of the consent includes several water management related conditions. Consent Condition 35 requires the preparation of a Surface Water Validation Report (SWVR).

A SWVR (Version 2 (V2)) was prepared by EMM Consulting Pty Ltd (EMM) in May 2020. The SWVR included a review of the facility's water management system and provided recommendations to improve both the effectiveness and operational aspects of the system. The NSW Environment Protection Authority (EPA) provided comments in a letter dated 16 October 2020. Benedict requested a meeting with the EPA to discuss their comments. A meeting was held on 28 October 2020. The agreed outcome from the meeting was that the SWVR would be updated to include commitments to:

- collect data to inform a water balance model (WBM) update;
- continue to monitor water quality during overflows;
- update the WBM using data collected; and
- undertake a further review of the water management system incorporating the outcomes of the WBM update and additional data collected.

The SWVR (V3) was updated to include these commitments and was submitted to the EPA on 20 November 2020. Benedict commenced implementing the SWVR commitments in late 2020. The associated monitoring and assessments are referred to as Additional Investigations in this report.

1.2 Report purpose and structure

This document addresses the commitments made in the SWVR (V3). It includes a summary of the Additional Investigations (Section 2) and review outcomes (Section 3). The following documents are provided as appendices:

- the SWVR (V3) – Appendix A
- Supplementary water quality monitoring report - Appendix B
- Water balance update report - Appendix C

2 Summary of Additional Investigations

SWVR (V3) included commitments to monitor water levels in the Site's stormwater basin (the basin) and to undertake water quality monitoring if overflows from the basin occur. Data was collected between 18 December 2020 to 31 January 2022 (the Monitoring Period) and was used to inform both the water balance update and the further review of the water management system. The following sections provide a summary of the supplementary water quality monitoring and water balance update reports.

2.1 Supplementary water quality monitoring report

This report describes water quality monitoring that was undertaken between 18 December 2020 and 31 January 2022 from the Site's basin. Water quality samples were collected during two separate rainfall events. The first event occurred in March 2021 and comprised more than 400 mm of rainfall over five days. Overflows from the basin occurred during this event and samples were collected on four consecutive days. The laboratory results for some metals (copper and zinc) were impacted by suspected container contamination and were deemed unreliable following reanalysis. The second sampling event occurred in August 2021 following approximately 70 mm of rainfall. The purpose of this sampling event was to validate the basin's water quality characteristics given that there were suspected contamination issues with the samples collected in March 2021. No overflows occurred during this event.

The water quality results (excluding results that were deemed unreliable due to sample contamination) from both the March and August 2021 events were similar to the results presented in the SWVR (V3), except for:

- pH was marginally higher that the SWVR range in two of the five samples; and
- chromium and lead exceeded the Default Guideline Value (DGV) in one of the five samples. The DGV for these metals was not exceeded in the SWVR samples.

The water quality results and conclusion from this report have been used to inform a review of the water quality risk assessment that is documented in SWVR (V3). This review is provided in Section 3.1.

Refer to Appendix B for further information on the supplementary water quality monitoring.

2.2 Water balance update

The objective of the WBM update was to assess the design capacity of the Site's water management system relative to the 5-day 90th percentile rainfall depth that is referenced in Consent Condition 25 (the design rainfall event). The following approach was applied to this assessment:

1. A continuous water level logger was installed in the Site's water management basin on 18 December 2020. The logger recorded the water level in the basin at 10-minute intervals and provided high resolution information on changes in the basin water level during and after runoff events. Runoff volumes and event-based runoff coefficients for the Site were calculated from this data.

2. The water level logger data and other relevant information collected between 18 December 2020 and 26 August 2021 was applied to develop, calibrate and validate a WBM. A predictive model was then developed using a 50-year rainfall timeseries.

3. The capacity of the Site's water management system was assessed by:

    a) calculating the basin capacity using the event-based runoff coefficients and other Site information; and

    b) calculating an overflow frequency using the predictive WBM.

These calculated values were used to assess the capacity of the Site's water management system relative to the design rainfall event (ie the 5-day 90th percentile rainfall depth). This analysis established that:

- The basin volume (2.8 ML) exceeds the minimum volume (1.3 ML) required to capture runoff from the design rainfall event.

- The predicted overflow frequency is within the range provided in Managing Urban Stormwater Volume 2E: Mines and Quarries (DECC 2008) for a basin that is sized for the 90th percentile 5-day event and is dewatered within five days of a rainfall event to restore basin capacity (as recommended in Landcom 2004 and DECC 2008).

The report concludes that the existing water management system meets or exceeds the design capacity and the requirements of Consent Condition 25.

Refer to Appendix C for further information on the WBM.

3 Review of SWVR outcomes and recommendations

This section provides a review of the receiving water risk assessment and water management system recommendations described in Chapter 4 of SWVR (V3). The review has been informed by the outcomes of the Additional Investigations (Section 2).

3.1 Receiving water risks

Section 4.1 of SWVR (V3) assessed receiving water risks due to site overflows. The assessment concluded that the risks are low because of:

- the infrequent nature and short duration of any basin overflows; and

- concentrations of toxicants being below acute trigger values.

The following sections apply the outcomes from the Additional Investigations to review the basis for the above conclusion.

3.1.1 Overflow regime

The WBM update concluded that overflows from the basin will occur four times per year (on average) and that overflows would only occur for short periods during and after rainfall. Hence, the Additional Investigations have confirmed that overflows will occur infrequently and for short durations.

3.1.2 Concentration of toxicants in the basin

The SWVR (V3) identified that concentrations of aluminium and copper exceeded DGVs on at least one occasion. The supplementary water quality monitoring results were similar, but also identified that chromium and lead exceeded DGVs on one occasion. The DGV for zinc was also revised from 0.015 to 0.008 mg/L to align with the recent recommendations in ANZG (2018). This resulted in the revised DGV being exceeded. In summary, concentrations of the following metals exceeded the DGV on at least one occasion across the SWVR and supplementary sampling campaigns: aluminium, chromium, copper, lead and zinc. It is noted that all samples were collected from the basin during wet weather conditions. However, the basin was generally not overflowing at the time of sampling.

Table 3.1 provides the maximum concentration of each metal recorded across both monitoring campaigns (nine samples in total). The maximum concentrations are compared to DGVs (based on chronic exposure) and acute trigger values. This analysis shows that the acute trigger values were not exceeded in any of the nine samples collected. Hence, the Additional Investigations have confirmed that the concentrations of metal toxicants in any overflows are likely to be below acute trigger values.

Table 3.1 Chronic and acute trigger values

Analyte	Units	Maximum concentration (SWVR and supplementary sampling)	DGV (chronic exposure)	Trigger value[1] (acute exposure)	Acute trigger value exceeded
Aluminium	mg/L	0.17	0.055	0.45[1]	No
Chromium	mg/L	0.005	0.004	0.006[2]	No
Copper	mg/L	0.006	0.0013	0.007[1]	No
Lead	mg/L	0.007	0.0044	0.013[3]	No
Zinc	mg/L	0.010	0.008	0.045[1]	No

Notes: 1. Sourced from SWCMP (Table 4.4). Refer to SWCMP Appendix E for further information on the assumptions applied to calculate acute trigger values.
2. Source ANZECC (2000) – Table 3.4.1
3. Calculated using a conservative Acute to Chronic ratio of 3:1

3.2 System functionality review

The SWVR reviewed the effectiveness of the existing water management system and provided recommendations to improve both the effectiveness and operational aspects of the system. These recommendations have been reviewed to incorporate the outcomes of the Additional Investigations (where relevant). Table 3.2 reproduces the recommendations from SWVR (V3) and adds additional comments from the current review.

Table 3.2 Water management system review

Aspect	SWVR review (from SWVR Table 4.2)		
	Summary of observed effectiveness (SWVR)	**SWVR recommendations**	**Current review outcomes**
1 – Area 1 water management system			
1.1 – System functionality	• The Area 1 water management system was observed to be operating effectively.	• Nil	• Nil
1.2 – Trade waste discharges	• EMM understands that a trade waste discharge agreement is yet to be finalised. • Based on the observation that the Area 1 tanks were generally only 50% utilised during the SWVR monitoring period, discharges to trade waste are not considered to be necessary.	• The trade waste discharge agreement is not pursued. • Trade waste discharges are removed from the water management plan.	• No change to SWVR recommendations as Area 1 Tanks are not known to overflow regularly to the basins.
1.3 – Area 1 tank dewatering	• Dewatering of the Area 1 tanks following rainfall was not consistently completed over the SWVR monitoring period. This may result in surplus water spilling into the Area 2 water management system.	• Water captured in the Area 1 tanks should be dewatered (via dust suppression use) following each rainfall event to ensure volume is available to capture runoff from the next rainfall event.	• No change to SWVR recommendations as the Area 1 system is functioning effectively, in that runoff is captured and used for dust suppression.
2 – Area 2 water management system			
2.1 – Basin water treatment system	The 'pump and treat' style treatment system was observed to have limited effectiveness as: • turbidity and suspended sediments exceeded relevant DGV or EPL discharge limits; and • the system is manually operated and therefore requires the site to be staffed when it is required and for the staff to observe that action is required. 'Pump and treat' style treatment systems are typically used to treat captured water following a rainfall event, with the treatment system generally needing to run for 1–2 days to achieve effective results. This style of system provides limited treatment during basin overflow conditions (should they occur), when water may overflow shortly after entering the basin. There is no benefit in treating captured water as it can be used for dust suppression following a rainfall event.	• The existing treatment system/approach is discontinued. • Benedict update the site water balance to more reliably estimate the frequency and magnitude of overflows from the basin. Alternative management measures may be required if overflows are assessed to occur more than 2–4 times per year (on average). This is a typical overflow frequency for a sedimentation basin that is sized to capture the 5-day 90th percentile rainfall event (DECC 2008). It is noted that: – the 5-day 90th percentile rainfall event is referenced in Consent Condition 25 as an acceptable design capacity for the basin; and – risks to receiving water from site discharges are assessed to be low due to the infrequent nature and short duration of any basin overflows and concentrations of toxicants being below acute trigger values.	• The water balance update has been completed (see Appendix C). • No change to SWVR recommendations as the Additional Investigations have concluded that: – the existing water management system meets or exceeds the design capacity and the requirements of Consent Condition 25. Specifically, overflows are predicted to occur four times per year (on average). This is within the range provided in DECC 2008. – there is no change to the receiving water risk assessment provided in the SWVR (V3) - see Section 3.1.

Table 3.2 Water management system review

Aspect	SWVR review (from SWVR Table 4.2)		
	Summary of observed effectiveness (SWVR)	**SWVR recommendations**	**Current review outcomes**
2.2 – Controlled discharges from the basin water treatment system	The facility water management plan makes provision for controlled discharges from the basin when water quality is suitable. The current management practice is to use water captured in both the basin and the Area 1 tanks for dust suppression following rainfall. This is the most practical management approach as it avoids the need for rapid water quality testing and potentially water treatment.	• Controlled discharges are removed from the water management plan and the basin is managed to minimise the frequency and magnitude of overflows by maximising the on-site use of water captured in the basin. • Monitoring of key analytes of concern is undertaken when basin overflows occur.	• No change to SWVR recommendations. • It is noted that this recommendation would change the discharge mechanism from controlled discharges to a managed overflow regime. This change in discharge approach should be reflected in the EPL (if endorsed by the EPA).
2.3 – Identification of alkaline stockpiles	**New item (not reported in SWVR)** The pH in the basin exceeded the EPL upper limit of 8.5 in two samples from 23 March and 25 August 2021. This indicates that some alkaline material was stockpiled in Area 1 at the time of sampling.	• Not reported in the SWVR	• If the pH in the basin is elevated in future sampling (that is required by EPL no. 20771) during overflow conditions, Benedict will undertake in-situ pH testing of puddles near Area 2 stockpiles to identify the source of alkaline runoff. Once identified, the alkaline material can be stored in Area 1.

4 Closing

This memo addresses the following commitments that were made in the SWVR (V3):

- collect data to inform a WBM update;
- continue to monitor water quality during overflows;
- update the site WBM using data collected; and
- undertake a further review of the water management system incorporating the outcomes of the water balance update and additional data collected.

The further review of the water management system concluded that:

- The existing water management system meets or exceeds the design capacity (based on the 5-day 90th percentile rainfall event) and the requirements of Consent Condition 25.
- There is no change to the SWVR conclusion that receiving water risks from Site discharge are low because:
  - basin overflows are infrequent and short duration; and
  - concentrations of toxicants are below acute trigger values.
- There is no change to the SWVR recommendations. However, one additional recommendation has been made.

It is noted that if the SWVR recommendations are implemented, the Site's discharge mechanism will change from a controlled discharge to a managed overflow regime. This change in discharge approach should be reflected in the EPL (if endorsed by the EPA).

Should you have any questions, please contact Alycia Campbell (Benedict's Environmental Compliance Manager) on 0437 468 258 or at alycia@benedict.com.au.

Yours sincerely

Chris Kuczera
Associate Water Resources Engineer
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Appendix A

Surface water validation report

Memorandum

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2 November 2020

To: Alycia Campbell
Environmental Compliance Officer
Benedict Recycling Pty Ltd
PO Box 10
Moorebank NSW 1875

From: Chris Kuczera
Subject: Mayfield West Recycling Facility: Surface Water Validation Report - response to EPA letter

Dear Alycia,

The NSW Environment Protection Authority (the EPA) reviewed a Surface Water Validation Report (SWVR) that was prepared for Benedict Recycling Pty Ltd's (Benedict's) Mayfield West Recycling Facility. The EPA provided comments in a letter dated 16 October 2020. Benedict requested a meeting with the EPA to discuss their comments. A meeting was held on 28 October 2020. The key agreed outcome from the meeting was that the SWVR would be updated to include commitments to:

- update the site water balance; and
- undertake a further review of the water management system once the water balance update is finalised.

The SWVR (Version 3) has been updated to include these commitments.

Yours sincerely

Chris Kuczera
Associate Water Resources Engineer
ckuczera@emmconsulting.com.au

Mayfield West Recycling Facility

Surface water validation report

Prepared for Benedict Recycling Pty Limited
November 2020

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Mayfield West Recycling Facility

Surface water validation report

Report Number

J14152 RP19

Client

Benedict Recycling Pty Limited

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2 November 2020

Executive Summary

Benedict Recycling Pty Ltd (Benedict) owns and operates a resource recovery facility at 1a McIntosh Drive, Mayfield West (the facility). In 2018 the Minister for Planning approved a consent modification (SSD 7698) enabling the facility to increase the processing capacity to 315,000 tonnes per year of general solid waste (non-putrescible). Schedule 2 of the consent includes several water management related conditions. This report addresses Consent Condition B35, which requires the preparation of a Surface Water Validation Report (SWVR).

The SWVR included: collection of water samples and field observations on four occasions between August 2019 to March 2020; laboratory analyses of the collected water samples; and collation and interpretation of the results to characterise the quality of surface water within the site. The results are compared to:

- default guideline values (DGVs) presented in the ANZECC/ARMCANZ (2000) guidelines, which are the same as the more recent ANZG (2018) guidelines for the analytes considered.
- concentration limits specified in the facility's Environment Protection Licence (EPL); and
- water characterisation results presented in the Surface Water Characterisation and Mitigation Plan (SWCMP) that was prepared by EMM in 2018 (EMM 2018).

All samples were collected during or shortly after separate wet weather events where rainfall totals ranged from 72 to 182 mm, generating surface runoff from some areas of the facility. During each event, samples were collected from the following locations:

- Holding tanks that receive (via pumping) runoff from a bunded area (referred to as Area 1) where general solid waste that is considered to have a higher risk of contaminating stormwater is stockpiled and processed. When full, the holding tanks overflow into the facility's greater water management system.
- The facility's sedimentation basin (the basin) that receives runoff from the waste management facility as well as an adjoining area that comprises derelict buildings and unused laydown areas. When full, the basin overflows to the Hunter River Estuary.

The basin's water quality was characterised as being slightly alkaline and having elevated turbidity, and nutrients, aluminium and copper concentrations relative to DGVs. The concentrations of all organic, inorganic and metal toxicants tested, other than aluminium and copper, were below detection limits and/or DGVs in all samples. The suspended solids concentration exceeded the EPL discharge limit of 50 mg/L in all four samples, although there were no discharges required from the site at the time of sampling. The water quality has improved relative to the SWCMP results. This is despite the operations being expanded post SSD approval.

The water quality of runoff from Area 1 was characterised poorer/higher risk than basin water quality due to:

- Higher turbidity and suspended sediment levels/concentrations.
- Higher concentrations of nutrients (nitrogen and phosphorus).
- A higher risk of metal toxicants exceeding DGVs.
- An increased risk of hydrocarbon related contamination (ie total recoverable hydrocarbons and total petroleum hydrocarbons).

Chapter 4 of this report reviews the existing water management system and provides recommendations to improve the operational effectiveness of the system.

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1 Introduction

1.1 Background and purpose

Benedict Recycling Pty Ltd (Benedict) owns and operates a resource recovery facility at 1a McIntosh Drive, Mayfield West (the facility). In 2018 the Minister for Planning approved a consent modification (SSD 7698) enabling the facility to increase the processing capacity to 315,000 tonnes per year of general solid waste (non-putrescible). Schedule 2 of the consent includes several water management related conditions. This report addresses Consent Condition B35, which requires the preparation of a Surface Water Validation Report (SWVR).

1.2 Surface Water Characterisation and Mitigation Plan

This report references a Surface Water Characterisation and Mitigation Plan (SWCMP) that was prepared by EMM in 2018 (EMM 2018). The SWCMP formed part of the State Significant Development (SSD) application and included:

- A description of water management system upgrades proposed as part of the SSD application.
- A surface water characterisation assessment that was informed by sampling completed between March and June 2018 (the SWCMP sampling). It is noted that this sampling was mostly completed prior to the completion of water management system upgrades.
- A framework for this SWVR.

1.3 ANZECC guidelines

As required by consent condition B35, this report references information from the ANZECC/ARMCANZ (2000) guidelines. At the time of writing, these guidelines are the same as the more recent ANZG (2018) guidelines for the analytes considered.

1.4 Consent Condition B35

Table 1.1 reproduces the requirements of Consent Condition B35 and explains how each requirement is addressed in the document.

Table 1.1 Summary of Consent Condition B35

Condition	Assessment overview
B35. Within six months of the commencement of operations and following the management measures being implemented as per SWCMP (Condition B33), the Applicant must provide a Surface Water Validation Report (SWVR) to the satisfaction of the Secretary. The SWVR must:	
a) be carried out by a suitably qualified and experienced expert whose appointment has been endorsed by the Secretary;	This SWVR has been prepared by Chris Kuczera, an Associate Water Resources Engineer at EMM. The Department of Primary Industry and Environment endorsed Chris in a letter dated 11 July 2019.

Table 1.1 Summary of Consent Condition B35

Condition	Assessment overview
b) be prepared in consultation with the EPA;	The framework for the SWVR was prepared in consultation with the Environmental Protection Agency (EPA) during the finalisation of the SWCMP. The EPA reviewed V2 of the SWVR and provided comments in a letter dated 16 October 2020. The EPA comments were discussed in a meeting held on 28 October 2020 and the SWVR was updated (to V3) to address agreed actions from this meeting.
c) collect a minimum of four surface water samples from the sediment basin and four from the two-stage pit system;	Four surface water samples have been collected during independent rainfall events from the sediment basin and holding tanks that receive water pumped from the two-stage pit.
d) characterise the surface water data (samples) and detail the potential impact of discharges on receiving surface waters with reference to ANZECC[/ARMCANZ] (2000) assessment criteria;	All surface water sampling results have been characterised relative to the relevant default values from the ANZECC/ARMCANZ (2000) guidelines. Refer to Section 3.2.
e) compare the results with the surface water characterisation in the SWCMP (Condition B33);	All surface water sampling results from the sedimentation basin have been compared to the relevant results presented in the SWCMP. Refer to Section 3.2.
f) ensure surface water is being managed in accordance the EPL;	All water quality sampling results have been characterised relative to the relevant default values from the ANZECC/ARMCANZ (2000) guidelines and concentration limits described in the Environment Protection Licence (EPL 20771).
g) provide an assessment of the effectiveness of implemented mitigation measures;	The effectiveness of the current water management system is reviewed in Section 4.2.
h) if necessary, provide additional mitigation measures to control and/or treat all pollutants to ensure the ANZECC[/ARMCANZ] (2000) assessment criteria can be met including further storage or the installation of a water treatment plant; and	Recommendations are made in Section 4.2.
i) update the SWCMP to reflect any changes to the surface water management system.	The SWCMP will be updated following finalisation of this SWVR.

1.5 Report structure

This report is structed as follows:

- Chapter 2 describes the existing water management system.
- Chapter 3 describes the SWVR monitoring methods and results.
- Chapter 4 reviews the existing water management system and makes recommendations.
- Chapter 5 describes a commitment to update the site water balance and undertake a further review of the water management system once the water balance update is finalised.

2 Water management system

This chapter describes the facility's existing water management system. Chapter 4 reviews the functionality of the existing system and recommends some changes, which are discussed separately in Section 4.2.

The facility's water management system receives surface water runoff from Lot 1 DP874109 (the lot), which has a total area of approximately 7.9 ha. The materials handling portion of the recycling facility is operated in the western portion of the lot, within a 3.7 ha area. The remaining 4.2 ha of the lot is used for ancillary activities approved under Newcastle City Council Development Application DA2015/0291 and includes buildings, storage of empty customer bins and laydown areas.

Water within the lot is managed separately in the following areas:

- Area 1 – is a 0.52 ha bunded area where general solid waste that is considered to have a higher risk of contaminating stormwater is stockpiled and processed. Runoff from Area 1 is managed as follows:
    - Surface water runoff drains to a sump (referred to as the two-stage pit). Water from the sump is pumped to a series of holding tanks (the Area 1 tanks). The Area 1 tanks comprise five connected 50-kL tanks, providing a total storage capacity of 250 kL (EMM 2018).
    - Water in the Area 1 tanks is used for dust suppression following each rainfall event. Surplus water either spills into the Area 2 water management system or is discharged to the sewer as trade waste (it is noted that this is subject to a trade waste agreement being finalised).
- Area 2 – refers to the remainder of the lot which includes site buildings, haul roads, stockpiles of material with low contamination risk and buildings, storage of empty customer bins and laydown areas that are not part of the recycling facility. Runoff from Area 2 is managed as follows:
    - Runoff is conveyed to a sedimentation basin (the basin) that is in the north-western corner of the lot. The basin has an estimated volume of 2.8 ML (EMM 2018).
    - A 'pump and treat' style water treatment system is manually operated during wet weather conditions. The treatment system extracts water from near the basin outlet and adds a coagulant at a controlled rate. Water is returned to the western perimeter drain, immediately upstream of the basin. The Ultrion coagulant was used during the SWVR period. Ultrion is a low molecular weight cationic coagulant that contains aluminium chloride hydroxide. 'Pump and treat' style systems are typically used to treat water captured in a basin and typically need to run for 1–2 days following the cessation of rainfall to achieve effective treatment.
    - Water collected in the basin is used for dust suppression following each rainfall event.
    - When full, the basin will discharge via overflow. The SWCMP describes a framework for controlled discharges (if water quality is suitable). Benedict have advised that no controlled discharges have been implemented since SSD approval. Any discharged water flows into the southern arm of the Hunter River Estuary via a drainage system.

Figure 2.1 shows the conceptual framework of the water management system and Figure 2.2 shows the water management system layout and locations of Area 1 and Area 2.

EMM site observations during monitoring undertaken to inform the SWVR are described in Section 3.1.2.

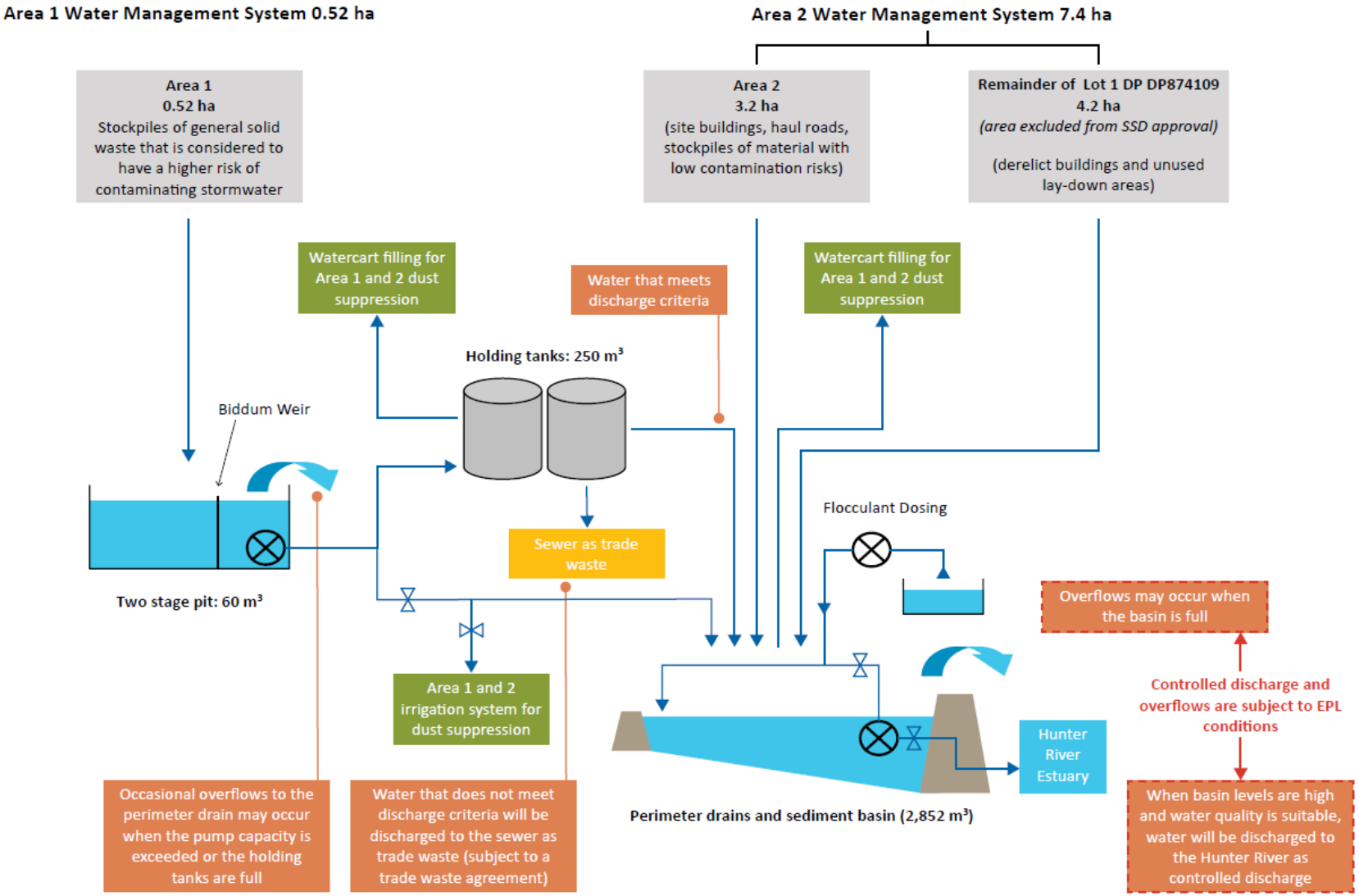
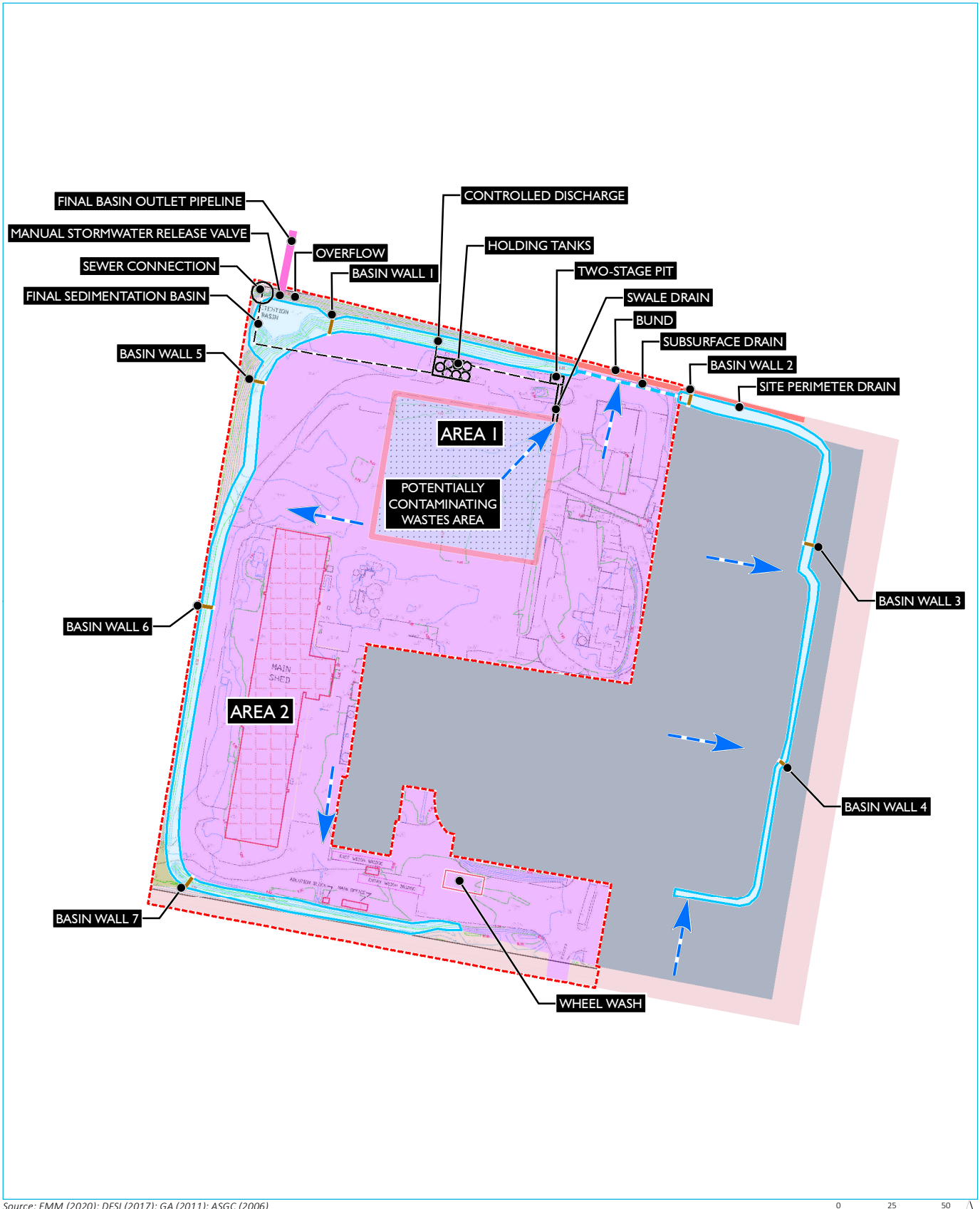


Figure 2.1 **Existing water management system framework**



Source: EMM (2020); DFSI (2017); GA (2011); ASGC (2006)

0 25 50 m

GDA 1994 MGA Zone 56

N

KEY

- Development area
- Recycling facility
- Drain and bund with single valved discharge point
- Bund
- Basin wall
- Overland flow path

Water management system layout

Mayfield West Recycling Facility
Surface water validation report
Figure 2.2

EMM creating opportunities

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3 Validation monitoring program

A surface water quality monitoring program was completed by EMM to inform this SWVR. The program comprised sampling and analysis of surface water within the facility from four independent rainfall events between August 2019 and March 2020 (the SWVR period).

Section 3.1 describes the sampling locations, methods and weather and site context for each sampling event. Results are presented in Section 3.2 and discussed in Section 3.3.

3.1 Completed monitoring

3.1.1 Locations

For each sampling event, water quality samples were collected from the following locations:

- The basin – samples were collected near the sedimentation basin outlet.
- Area 1 tanks – samples were collected from the top of the first tank that receives water pumped from the two-stage pit.

3.1.2 Rainfall and site context

A summary of the rainfall estimates, site observations and sampling locations for each sampling event are provided in Table 3.1. It is also noted that Benedict advised that no discharges occurred during the SWVR period.

Table 3.1 Sampling context and site observation

Sampling event	Rainfall context[1]	Site observations (at time of sampling)	Sampling locations
Event 1 31 August 2019 and 2 September 2019	**Wet weather**: **significant rainfall** • 110 mm of rainfall was recorded in the 36 hours prior to sampling on 31 August 2019. • 124 mm of rainfall was recorded in the 3 ½ days prior to sampling on 2 September 2019.	31 August 2019 • The water level in the basin was 200 mm below the outlet. • The water treatment plant had been operating for 2–3 hours prior to sampling. The water in the basin appeared to be turbid. 2 September 2019 • One and a half of the five 50-kL Area 1 tanks were full of water.	• Basin sampled on 31 August 2019 • Area 1 tank sampled on 2 September 2019
Event 2 17 September 2019	**Wet weather**: **significant rainfall** • 72 mm of rainfall was recorded in the 36 hours prior to sampling.	• The water level in the basin was 200 mm below the outlet. • The water treatment plant had been operating for 2–3 hours prior to sampling. The water in the basin appeared to be turbid. • One and a half of the five 50-kL Area 1 tanks were full of water.	Basin and Area 1 tank
Event 3 10 February 2020	**Wet weather**: **significant rainfall** • 113 mm of rainfall was recorded in the 36 hours prior to sampling. • 182 mm of rainfall was recorded in the week prior to sampling.	• The water level in the basin was 300 mm below the outlet. • The water treatment plant had been operating for 24 hours prior to sampling. The water in the basin appeared to be moderately turbid. • Two and a half of the five 50-kL Area 1 tanks were full of water.	Basin and Area 1 tank

Table 3.1 Sampling context and site observation

Sampling event	Rainfall context[1]	Site observations (at time of sampling)	Sampling locations
Event 4 27 March 2020	**Wet weather**: **significant rainfall** • 95 mm of rainfall was recorded in the 48 hours prior to sampling.	• The water level in the basin was 300 mm below the outlet. • The water treatment plant had been operating for 36 hours prior to sampling. The water in the basin appeared to be moderately turbid. • All five of the 50-kL Area 1 tanks were full of water. Benedict advised that the tanks had not been dewatered since Event 3.	Basin and Area 1 tank

1. The rainfall depths were recorded by Benedict's on-site weather station. The recorded depths are similar to totals recorded at local Bureau of Meteorology operated gauges.

3.1.3 Methods

Table 3.1 describes monitoring analytes and methods.

Table 3.2 Monitoring analytes and methods

Category	Analytes	Sampling and analysis methods
Physico-chemical parameters	pH, turbidity, electrical conductivity, total suspended solids and total dissolved solids Total alkalinity and hardness	Analysis was undertaken by a NATA-certified laboratory.
Nutrients	Ammonia, nitrite, nitrate, oxidised nitrogen (NOx), total kjeldahl nitrogen (TKN) and total nitrogen Reactive and total phosphorus	Analysis was undertaken by a NATA-certified laboratory.
Metals and metalloids	Aluminium (Al), arsenic (As), Boron (B), cadmium (Cd), chromium (Cr), cobalt (Co), copper (Cu), iron (Fe), lead (Pb), mercury (Hg), molybdenum (Mo), nickel (Ni), selenium (Se), silver (Ag), vanadium (V) and zinc (Zn)	Samples were filtered in the field using a 0.45 µm filter. Analysis was undertaken by a NATA-certified laboratory.
Organics	Benzene, toluene, ethylbenzene and xylene (BTEX) Polyaromatic hydrocarbons (PAHs) Phenols Total petroleum hydrocarbons (TPH) Total recoverable hydrocarbons (TRH)	Samples were filtered in the field using a 0.45 µm filter. Analysis was undertaken by a NATA-certified laboratory.
Inorganics	Fluoride and cyanide	Analysis was undertaken by a NATA-certified laboratory.
Surfactants	Anionic surfactants	Analysis was undertaken by a NATA-certified laboratory.

3.2 Monitoring results

Water quality results are presented in Table 3.3 (basin) and Table 3.4 (Area 1 tanks). The results are compared to default guideline values (DGVs) and EPL concentration limits, noting that the EPL concentration limits apply to discharges from the site (which did not occur). The approach to selecting DGVs is discussed further below.

The basin results (presented in Table 3.3) are compared to the results from the SWCMP sampling (EMM 2018). For each analyte, the range in water quality values between the SWVR and SWCMP monitoring programs are described as either trending lower, being similar or trending higher.

The Area 1 tank results (Table 3.4) are compared to the SWVR basin results to enable a comparison of water quality from Area 1 and Area 2. It is noted that the Area 1 tanks were not installed during the SWCMP sampling.

Laboratory certificates are provided in Appendix A.

i Selecting guideline values

The approach applied in the SWCMP (EMM 2018) to selecting DGVs was adopted. This approach is described below.

- **Stressors** – values for physical and chemical stressors in south-east Australia (estuaries) from the ANZECC/ARMCANZ (2000) guidelines were adopted.

- **Toxicants** – as a first preference, values for slightly-to-moderately disturbed ecosystems from the ANZECC/ARMCANZ (2000) guidelines were adopted (where available). Given the receiving water is the Hunter River Estuary, DGVs for marine water were preferentially used for analytes that have high reliability DGVs for marine water. The following approach was applied to establish DGVs for analytes that do not have high reliability trigger values for marine water:

    - 2nd preference – high reliability DGVs for freshwater (where available).

    - 3rd preference – low reliability DGVs for marine water that are reported in Volume 2 of ANZECC/ARMCANZ (2000).

    - 4th preference – low reliability DGVs for freshwater that are reported in Volume 2 of ANZECC/ARMCANZ (2000).

The table notes describe the assumptions applied to selecting each DGV. It is also noted that the DGVs for toxicants are based on chronic (ie long term) exposure to toxicants. This is discussed further in Section 3.3.

Table 3.3 Water quality summary – Basin

	Unit	EPL limit[4]	DGV[1,2]		SWVR sampling (basin)					SWCMP (basin)	SWVR to SWCMP comparison[6]
			Fresh	Marine	Event 1	Event 2	Event 3	Event 4	Range	Range	
Physico-chemical parameters											
pH	-	6.5 – 8.5	-	7.0 – 8.5	8.3	**8.6**	8.1	8.3	8.1 – **8.6**	6.9 – **8.6**	Similar
Electrical conductivity	µS/cm	-	-	-	434	444	349	294	294 – 444	289 – 305	Higher
Total dissolved solids	mg/L	-	-	-	302	336	231	230	230 – 336	Not sampled	-
Turbidity	NTU	-	-	10	**228**	**271**	**110**	**169**	**110 – 271**	Not sampled	-
Suspended solids	mg/L	50	-	-	**100**	**160**	**79**	**101**	**79 – 160**	**147 – 1,015**	Lower
Total hardness (as $CaCO_3$)	mg/L	-	-	-	183	172	113	106	113 – 183	45 – 189	Similar
Total alkalinity (as $CaCO_3$)	mg/L	-	-	-	33	42	49	48	33 – 49	37 – 104	Similar
Analytical results – nutrients (as N or P)											
Ammonia	mg/L	-	-	0.91 (toxicant) 0.015 (stressor)	<0.01	<0.01	**0.67**	0.03	<0.01 – **0.67**	<0.01 – **0.12**	Higher
Oxidised nitrogen	mg/L	-	-	0.015	**0.19**	**0.23**	**0.30**	**0.26**	**0.19 – 0.30**	**0.34 – 1.70**	Lower
Total kjeldahl nitrogen	mg/L	-	-	-	1.0	1.1	3.4	1.2	1.0 – 3.4	0.7 – 1.2	Higher
Total nitrogen	mg/L	-	-	0.30	**1.2**	**1.3**	**3.7**	**1.5**	**1.2 – 3.7**	**0.8 – 1.7**	Higher
Reactive phosphorus	mg/L	-	-	0.005	**0.03**	**<0.01**	**0.02**	**0.10**	**<0.01 – 0.10**	Not sampled	-
Total phosphorus	mg/L	-	-	0.030	**0.22**	**0.34**	**0.15**	**0.31**	**0.15 – 0.34**	**0.12 – 1.14**	Lower
Analytical results – inorganics											
Cyanide	mg/L	-	**0.007**	**0.004**	-	-	-	<0.004	<0.004	Not sampled	-
Fluoride	mg/L	-	**2.4**[5]	**-**	0.3	0.2	0.3	0.1	0.1 – 0.3	0.2 – 0.3	Similar
Surfactants											
Anionic Surfactants as MBAS	mg/L		**0.28**	**0.0001**[3]	<0.1	0.2	<0.1	<0.1	<0.1 – 0.2	<0.1 – 0.2	Similar

Table 3.3 Water quality summary – Basin

	Unit	EPL limit[4]	DGV[1,2]		SWVR sampling (basin)					SWCMP (basin)	SWVR to SWCMP comparison[6]
			Fresh	Marine	Event 1	Event 2	Event 3	Event 4	Range	Range	
Organics											
Oil and Grease	mg/L	10	-	-	-	<5	6	<5	<5 - 6	<5 – **78**	Lower
TRH	µg/L	-	-	-	All below detection					Below detection	Similar
TPH	µg/L	-	-	-	All below detection					Below detection	Similar
BTEX	µg/L	-	-	-	All below detection					Below detection	Similar
Phenols	µg/L	-	-	-	All below detection					Below detection	Similar
Naphthalene	µg/L	-	16	50	<5	<5	<5	<1	<5	Not sampled	-
Other PAHs	µg/L	-	-	-	-	-	-	below detection	below detection	Not sampled	-
Analytical results – metals (0.45µm field filtered)											
Aluminium (Al)	mg/L	-	0.055	0.0005[3]	0.03	**0.17**	**0.09**	0.04	0.03 – **0.17**	0.04 – **0.18**	Similar
Arsenic (As)	mg/L	-	0.024(As III) 0.013 (As V)	0.0023 (As III)[3] 0.0045(As V)[3]	0.002	0.002	0.003	0.002	0.002 – 0.003	<0.001 – 0.001	Higher, but below DGV
Boron (B)	mg/L	-	0.37	-	0.07	0.06	0.08	<0.05	<0.05 – 0.08	<0.05	Higher, but below DGV
Cadmium (Cd)	mg/L	-	0.0002	0.0007	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	Similar
Chromium – Total (Cr)	mg/L	-	0.003[3] Cr (III) 0.001 (Cr VI)	0.027 (Cr III) 0.004 (Cr VI)	0.002	-	0.003	0.002	0.002 – 0.003	<0.001 – **0.016**	Lower
Cobalt (Co)	mg/L	-	0.0028[3]	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	Similar
Copper (Cu)	mg/L	-	0.0014	0.0013	**0.006**	**0.006**	**0.005**	**0.002**	**0.002 – 0.006**	**0.002 – 0.030**	Lower
Iron (Fe)	mg/L	-	0.3[3]	-	<0.05	0.11	<0.05	<0.05	<0.05 – 0.11	<0.05	Similar
Lead (pb)	mg/L	-	0.0034	0.0044	<0.001	0.001	<0.001	<0.001	<0.001 – 0.001	<0.001 – **0.059**	Lower
Mercury (Hg)	mg/L	-	0.00006	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	Similar

Table 3.3 Water quality summary – Basin

			DGV[1,2]		SWVR sampling (basin)					SWCMP (basin)	SWVR to SWCMP comparison[6]
	Unit	EPL limit[4]	Fresh	Marine	Event 1	Event 2	Event 3	Event 4	Range	Range	
Molybdenum (Mo)	mg/L	-	0.034[3]	0.23[3]	0.003	0.003	0.002	0.003	0.002 – 0.003	0.002 – 0.005	Lower
Silver (Ag)	mg/L	-	0.00005	0.0014	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	Similar
Vanadium (V)	mg/L	-	0.006[3]	0.100	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01 – 0.03	Lower
Zinc (Zn)	mg/L	-	0.008	0.015	<0.005	0.010	0.009	<0.005	<0.005 – 0.010	<0.005 – **0.154**	Lower

Notes:
1. The DGV for physico-chemical parameters and nutrients refer to the values for physical and chemical stressors in south-east Australia (estuaries) that are reported in Tables 3.3.2 and 3.3.3 of ANZECC/ARMCANZ (2000). DGV for toxicants refer to the values for slightly–moderately disturbed freshwater and marine ecosystems that are reported in Table 3.4.1 of ANZECC/ARMCANZ (2000) unless otherwise stated.
2. Unless otherwise stated, the DGV for dissolved metals refer to the high reliability trigger values for slightly–moderately disturbed ecosystems that are reported in Table 3.4.1 of ANZECC/ARMCANZ (2000). It is noted that no hardness adjustments have been made.
3. The DGV refers to a low reliability trigger values that are provided in Volume 2 of ANZECC/ARMCANZ (2000).
4. Refers to an EPL concentration limit (EPL 20771).
5. The DGV was provided by the EPA (August 2018).
6. Comparison is SWVR to SWCMP ranges (ie 'Higher' refers to the SWVR range being materially greater than the SWCMP range).

Bold denotes a DGV or Range is exceeded.
Red denotes the adopted DGV. Given the receiving water is the Hunter River Estuary, preference has been given to the guideline values for estuarine and marine environments, where a suitable value is available.
Purple denotes a low reliability marine trigger value that has not been used as a high reliability freshwater trigger value is available.

Table 3.4 Water quality summary – Area 1 tanks

			DGV		SWVR sampling – Area 1 tanks					SWVR sampling (basin)	SWVR sampling Area 1 tanks to basin comparison[6]
	Unit	EPL limit	Fresh	Marine	Event 1	Event 2	Event 3	Event 4	Range	Range[6]	
Physico-chemical parameters											
pH	-	6.5 – 8.5	-	7.0 – 8.5	7.3	7.8	7.7	7.7	7.3 – 7.7	8.1 – **8.6**	Lower pH
Electrical conductivity	µS/cm	-	-	-	618	807	664	629	618 – 807	294 – 444	Higher
Total dissolved solids	mg/L	-	-	-	464	535	590	528	464 – 590	230 – 336	Higher
Turbidity	NTU	-	-	10	**152**	**159**	**580**	**231**	**152 – 580**	**110 – 271**	Higher
Suspended solids	mg/L	50	-	-	**100**	**78**	**266**	**136**	**78 – 266**	**79 – 160**	Similar
Total hardness (as $CaCO_3$)	mg/L	-	-	-	215	264	177	181	177 – 264	113 – 183	Higher
Total alkalinity (as $CaCO_3$)	mg/L	-	-	-	84	95	80	65	65 – 95	33 – 49	Higher
Analytical results – nutrients (as N or P)											
Ammonia	mg/L	-	-	0.91 (toxicant) 0.015 (stressor)	<0.01	<0.01	0.07	**0.24**	**<0.01 – 0.24**	<0.01 – **0.67**	Similar
Oxidised nitrogen	mg/L	-	-	0.015	<0.01	**0.03**	**1.09**	**1.20**	**<0.01 – 1.20**	**0.19 – 0.30**	Higher
Total kjeldahl nitrogen	mg/L	-	-	-	2.9	1.9	3.7	2.3	1.9 – 3.7	1.0 – 3.4	Higher
Total nitrogen	mg/L	-	-	0.30	**2.9**	**1.9**	**4.8**	**3.5**	**1.9 – 4.8**	**1.2 – 3.7**	Higher
Reactive phosphorus	mg/L	-	-	0.005	**0.07**	**0.04**	**0.26**	**0.51**	**0.04 – 0.51**	**<0.01 – 0.10**	Higher
Total phosphorus	mg/L	-	-	0.030	**0.67**	**0.36**	**0.61**	**0.68**	**0.36 – 0.68**	**0.15 – 0.34**	Higher
Analytical results – inorganics											
Cyanide	mg/L	-	0.007	0.004	-	-	-	<0.004	-	<0.004	Similar
Fluoride	mg/L	-	2.4[5]	-	0.4	0.3	1.0	0.5	0.3 – 1.0	0.1 – 0.3	Similar
Surfactants											
Anionic Surfactants as MBAS	mg/L	-	0.28	0.0001[3]	<0.1	0.2	<0.1	<0.1	<0.1 – 0.2	<0.1 – 0.2	Similar

Table 3.4 Water quality summary – Area 1 tanks

			DGV		SWVR sampling – Area 1 tanks					SWVR sampling (basin)	SWVR sampling Area 1 tanks to basin comparison[6]
	Unit	EPL limit	Fresh	Marine	Event 1	Event 2	Event 3	Event 4	Range	Range[6]	
Organics											
Oil and Grease	mg/L	**10**	-	-	-	<5	6	<5	<5 - 6	<5 - 6	Similar
TRH (sum of total)	µg/L	-	-	-	360	Events 2 to 4 were below detection				Below detection	Higher
TPH (sum of total)	µg/L	-	-	-	360	Events 2 to 4 were below detection				Below detection	Higher
BTEX	µg/L	-	-	-	All below detection					Below detection	Similar
Phenols	µg/L	-	-	-	All below detection					Below detection	Similar
Naphthalene	µg/L	-	16	50	<5	<5	<5	<1.0	<5	<5	Similar
Other PAHs	µg/L	-	-	-	-	-	-	below detection	below detection	below detection	Similar
Analytical results – metals (0.45 µm field filtered)											
Aluminium (Al)	mg/L	-	0.055	0.0005[3]	0.04	**0.06**	**0.27**	0.01	**0.01 – 0.27**	0.03 **– 0.17**	Similar
Arsenic (As)	mg/L	-	0.024(As III) 0.013 (As V)	0.0023 (As III)[3] 0.0045(As V)[3]	0.006	0.004	0.005	0.005	0.004 – 0.006	0.002 – 0.003	Higher, but below DGV
Boron (B)	mg/L	-	0.37	-	<0.05	0.07	0.07	0.06	<0.05 – 0.07	<0.05 – 0.08	Similar
Cadmium (Cd)	mg/L	-	0.0002	0.0007	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	Similar
Chromium – Total (Cr)	mg/L	-	0.003[3] (Cr III) 0.001 (Cr VI)	0.027 (Cr III) 0.004 (Cr VI)	0.004	-	0.003	0.002	0.002 – 0.004	0.002 – 0.003	Lower
Cobalt (Co)	mg/L	-	0.0028[3]	0.001	0.001	<0.001	<0.001	<0.001	<0.001 – 0.001	<0.001	Similar
Copper (Cu)	mg/L	-	0.0014	0.0013	**0.005**	**0.002**	**0.010**	**0.008**	**0.002 – 0.010**	**0.002 – 0.006**	Higher
Iron (Fe)	mg/L	-	0.3[3]	-	0.16	0.10	0.12	<0.05	<0.05 – 0.16	<0.05 – 0.11	Higher, but below DGV
Lead (pb)	mg/L	-	0.0034	0.0044	<0.001	<0.001	0.001	<0.001	<0.001 – 0.001	<0.001 – 0.001	Similar
Mercury (Hg)	mg/L	-	0.00006	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.001	<0.001	Similar

Table 3.4 Water quality summary – Area 1 tanks

			DGV		SWVR sampling – Area 1 tanks					SWVR sampling (basin)	SWVR sampling Area 1 tanks to basin comparison[6]
	Unit	EPL limit	Fresh	Marine	Event 1	Event 2	Event 3	Event 4	Range	Range[6]	
Molybdenum (Mo)	mg/L	-	0.034[3]	0.23[3]	0.006	0.007	0.004	0.008	0.004 – 0.008	0.002 – 0.003	Higher, but below DGV
Silver (Ag)	mg/L	-	0.00005	0.0014	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	Similar
Vanadium (V)	mg/L	-	0.006[3]	0.100	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	Similar
Zinc (Zn)	mg/L	-	0.008	0.015	0.018	0.012	0.008	0.006	0.006 – **0.018**	<0.005 – 0.010	Higher

Notes:
1. The DGV for physico-chemical parameters and nutrients refer to the values for physical and chemical stressors in south-east Australia (estuaries) that are reported in Tables 3.3.2 and 3.3.3 of ANZECC/ARMCANZ (2000). DGV for toxicants refer to the values for slightly–moderately disturbed freshwater and marine ecosystems that are reported in Table 3.4.1 of ANZECC/ARMCANZ (2000) unless otherwise stated.
2. Unless otherwise stated, the DGV for dissolved metals refer to the high reliability trigger values for slightly–moderately disturbed ecosystems that are reported in Table 3.4.1 of ANZECC/ARMCANZ (2000). It is noted that no hardness adjustments have been made.
3. The DGV refers to a low reliability trigger values that are provided in Volume 2 of ANZECC/ARMCANZ (2000).
4. Refers to an EPL concentration limit (EPL 20771).
5. The DGV was provided by the EPA (August 2018).
6. Comparison is SWVR Area 1 tanks to SWVR basin ranges (ie 'Higher' refers to the SWVR Area 1 tanks range being materially greater than the SWVR basin range).

Bold denotes a DGV or Range is exceeded.
Red denotes the adopted DGV. Given the receiving water is the Hunter River Estuary, preference has been given to the guideline values for estuarine and marine environments, where a suitable value is available.
Purple denotes a low reliability marine trigger value that has not been used as a high reliability freshwater trigger value is available.

3.3 Results discussion

This section discusses the basin and Area 1 tanks water quality results that are presented in Table 3.3 and Table 3.4.

3.3.1 Basin results

As discussed in Chapter 2, the basin receives surface water runoff from a 7.9 ha catchment that comprises of Area 1 and Area 2.

The basin water quality is characterised as being slightly alkaline and having elevated (relative to DGVs) turbidity levels and nutrients, aluminium (2 of 4 samples) and copper (all samples) concentrations (Table 3.3). It is noted that all organics (PAHs, TRH, TPH, BTEX and Phenols) and metal and inorganic toxicants tested, other than aluminium and copper, were below detection limits and/or DGVs in all samples. Benedict has advised that there were no discharges from the basin during the SWVR period.

i Comparison to EPL concentration limits

Comparison of the SWVR basin water quality to concentration limits from the EPL (Table 3.3) indicates that:

- Suspended solids concentrations exceed the EPL limit of 50 mg/L in all four samples.
- pH and oil and grease concentrations were generally within the EPL limits.

ii Comparison to SWCMP results

Comparison of the SWVR and SWCMP basin water quality results (Table 3.3) indicate that:

- Salinity levels have increased.
- Turbidity and suspended sediment levels/concentrations are lower but still exceed DGV and EPL limits.
- Organic nitrogen (ammonia and total kjeldahl nitrogen) have increased. However, oxidised nitrogen and phosphorus are lower.
- Metal toxicants are generally lower with less metals exceeding DGVs and exceedances were generally of lower magnitude.

In summary, the SWVR results indicate that the water quality has improved relative to the SWCMP results. This is despite the operations being expanded post SSD approval and indicates that the water management system is improving water quality at the site.

iii Water treatment chemicals

As noted in Chapter 2, Ultrion coagulant was used to treat water in the basin during the SWVR period. Ultrion is a modern low molecular weight cationic coagulant that contains aluminium chloride hydroxide. The use of this coagulant has potential to increase both water salinity and aluminium concentrations. With reference to Table 3.3:

- While aluminium concentrations exceeded the DGV in 2 out of 4 samples, the range in concentrations were similar to the SWCMP sampling range. Hence, there is no evidence that aluminium concentrations have increased as a result of coagulant use.
- The increase in salinity is likely to be due to the coagulant use. It is noted that the receiving water (the Hunter River Estuary) would not be sensitive to changes in salinity.

3.3.2 Area 1 tank results

As discussed in Chapter 2, Area 1 is a 0.52 ha bunded area where general solid waste that is considered to have a higher risk of contaminating stormwater is stockpiled and processed. Runoff from Area 1 drains to a sump (referred to as the two-stage pit). Water from the sump is pumped to the Area 1 tanks, which comprise five connected 50-kL tanks, providing a total storage capacity of 250 kL. The Area 1 tanks were observed by EMM to be less than 50% utilised during the SWVR monitoring events 1 to 3, which comprised up to 182 mm of rainfall in the week prior to sampling (see Table 3.1). This is likely to be due to significant rainfall absorption in stockpiles and rainfall storage in puddles between stockpiles within the bunded area.

Water quality samples were collected from the top of the first tank that receives water pumped from the two-stage pit. The water quality (Table 3.4) is characterised as having a near neutral pH and elevated (relative to DGVs) turbidity, nutrients, aluminium (2 of 4 samples), copper (all samples) and zinc (1 of 4 samples). TRHs and TPHs were also detected in one sample. TRHs and TPHs are hydrocarbon related chemicals.

Comparison to the SWVR basin results indicates that the water quality of runoff from Area 1 is poorer/higher risk than runoff from Area 2 due to:

- Higher turbidity and suspended sediment levels/concentrations.
- Higher concentrations of nutrients (nitrogen and phosphorus).
- A higher risk of metal toxicants with additional metals exceeding DGVs and generally higher magnitudes of exceedance.
- An increased risk of hydrocarbon related contamination (ie TRH and TPHs).

4 Water management system review

This chapter reviews receiving water risks and the functionality of the existing water management system.

4.1 Receiving water risks

As described in Chapter 2, discharges from the facility's water management system can occur from the basin via overflows (when full) or controlled discharge (if water quality is suitable). Any discharged water flows into the southern arm of the Hunter River Estuary via a drainage system. No basin overflows were observed by EMM during the SWVR site inspections (see Table 3.1). Benedict have also advised that no overflows or controlled discharges from the basin occurred over the SWVR period.

Overflows from the basin may occur occasionally for short periods under certain rainfall conditions. The water quality characterisation results presented in Table 3.3 were collected during or shortly after significant rainfall events and are considered to be representative of the water quality of any potential basin overflows. The water quality is characterised as being slightly alkaline and having elevated (relative to DGVs) turbidity and nutrient aluminium and copper concentrations. All organics (PAHs, TRH, TPH, BTEX and phenols) and metal and inorganic toxicants other than aluminium and copper tested were below detection limits and/or DGVs in all samples.

As basin overflows are expected to occur occasionally for short periods (ie less than 4 days), receiving water quality risks associated with overflows are considered to be acute (ie due to short-term exposure) rather than chronic (ie due to long-term exposure). Acute trigger values for aluminium and copper were established in the SWCMP using information provided in ANZECC/ARMCANZ (2000) guidelines, international guidelines and eco-toxicity literature.

The maximum concentrations of aluminium and copper that were recorded during the SWVR sampling exceeded the DGVs but were below the acute trigger values (Table 4.1).

Table 4.1 Chronic and acute trigger values

Analyte	Units	Maximum concentration	DGV (chronic exposure)	Trigger value[1] (acute exposure)	Acute trigger value exceeded
Aluminium	mg/L	0.17	0.055	0.45	No
Copper	mg/L	0.006	0.0013	0.007	No

Notes: 1. Sourced from SWCMP (Table 4.4). Refer to SWCMP Appendix E for further information on the assumptions applied to calculate acute trigger values.

In summary the risks to receiving water from site discharges are low because of:

- the infrequent nature and short duration of any basin overflows; and
- concentrations of toxicants being below acute trigger values.

4.2 System functionality review

The functionality and effectiveness of the existing water management system has been reviewed to address Consent Condition B35(g). The review considered:

- the water quality data presented in this report;
- site observations made by EMM during the collection of water quality samples (see Table 3.1);

- information provided by Benedict; and
- feedback from the EPA in the meeting dated 28 October 2020.

The following aspects of the water management system have not been reviewed:

- Drainage system effectiveness (ie drainage system capacity).
- Matters addressed in the groundwater monitoring program, which is presented separately as required by Consent Condition B40.
- Compliance with consent conditions. This will be addressed in the Surface Water Audit that is required by Consent Condition B38.

The effectiveness of key elements of the facility's water management system are reviewed in Table 4.2. Recommendations are made to improve both the effectiveness and operational aspects of the system.

Table 4.2 Water management system review

Aspect	Observed effectiveness	Recommendations
1 – Area 1 water management system		
1.1 – System functionality	• During Events 1 to 3 the Area 1 water management system was observed to be operating effectively as: – runoff from the bunded area was being captured in the Area 1 tanks; and – no overflows from the Area 1 tanks into the Area 2 water management system were observed (see Table 3.1). • The effectives during Event 4 is discussed below (see aspect 1.3).	• Nil
1.2 – Trade waste discharges	• EMM understands that a trade waste discharge agreement is yet to be finalised. • Based on the observation that the Area 1 tanks were only 50% utilised during events 1 to 3 (despite significant rainfall occurring), discharges to trade waste are not considered to be necessary.	• The trade waste discharge agreement is not pursued. • Trade waste discharges are removed from the water management plan.
1.3 – Area 1 tank dewatering	• Benedict advised that the Area 1 tanks were not dewatered between events 3 and 4 (see Table 3.1). This may have resulted in some surplus water spilling into the Area 2 water management system.	• Water captured in the Area 1 tanks should be dewatered (via dust suppression use) following each rainfall event to ensure volume is available to capture runoff from the next rainfall event.

Table 4.2 Water management system review

Aspect	Observed effectiveness	Recommendations
2 – Area 2 water management system		
2.1 – Basin water treatment system	The 'pump and treat' style treatment system was observed to have limited effectiveness as: • turbidity and suspended sediments exceeded relevant DGV or EPL discharge limits (although water was not being discharged) in all samples (see Table 3.3); and • the system is manually operated and therefore requires the site to be staffed when it is required and for the staff to observe that action is required. 'Pump and treat' style treatment systems are typically used to treat captured water following a rainfall event, with the treatment system generally needing to run for 1–2 days to achieve effective results. As evidenced by the monitoring results (see Table 3.3), this style of system provides limited treatment during basin overflow conditions (should they occur), when water may overflow shortly after entering the basin. There is no benefit in treating captured water as it can be used for dust suppression following a rainfall event.	• The existing treatment system/approach is discontinued. • Benedict update the site water balance to more reliably estimate the frequency and magnitude of overflows from the basin. Alternative management measures may be required if overflows are assessed to occur more than 2–4 time per year (on average). This is a typical overflow frequency for a sedimentation basin that is sized to capture the 5-day 90th percentile rainfall event (DECC 2008). It is noted that: – the 5-day 90th percentile rainfall event is referenced in consent condition B25 as an acceptable design capacity for the basin; and – risks to receiving water from site discharges are assessed to be low due to the infrequent nature and short duration of any basin overflows and concentrations of toxicants being below acute trigger values (see Section 4.1). The water balance update is discussed further in Chapter 5.
2.2 – Controlled discharges from the basin water treatment system	As described in Figure 2.1, the water management plan makes provision for controlled discharges from the basin when water quality is suitable. The current management practice is to use water captured in both the basin and the Area 1 tanks for dust suppression following rainfall. This is the most practical management approach as it avoids the need for rapid water quality testing and potentially water treatment.	• Controlled discharges are removed from the water management plan and the basin is managed to minimise the frequency and magnitude of overflows by maximising the on-site use of water captured in the basin. • Monitoring of key analytes of concern is undertaken when basin overflows occur.

Figure 4.1 shows an updated conceptual framework of the water management system with the above recommendations implemented.

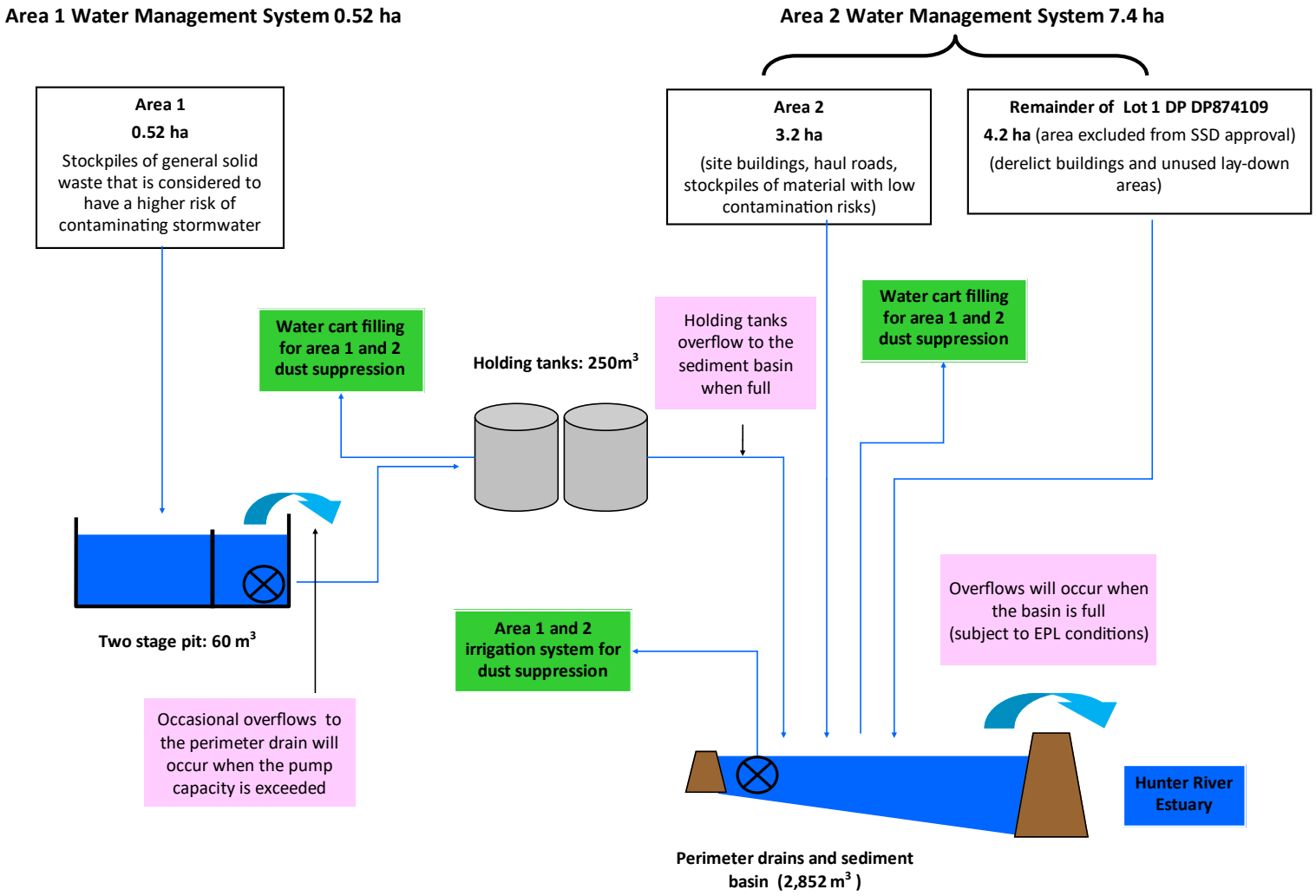

Figure 4.1 **Revised water management system framework**

5 Water balance update

Benedict proposes to update the site water balance and undertake a further review of the water management system once the water balance update is finalised. This chapter describes:

- data that will be collected to inform the water balance update and water management system review;
- the water balance model update methodology; and
- the terms of reference for the water management system review.

5.1 Data collection

The data that will be collected to inform the water balance update and water management system review is described in Table 5.1. Data from several material rainfall events of varying magnitudes will be required to enable the water balance model to be reliably updated. While the timeframe is weather dependent, it is expected that six months of data collection will be required.

Table 5.1 Proposed data collection

Data	Data collection method	Reason for data collection
Data to inform a water balance update		
Rainfall	• The site weather station will continue to be operated.	To quantify site specific rainfall conditions at the site.
Area 1 tanks	• Following each material rainfall event, the volume of water stored in the Area 1 tanks will be measured to the nearest ½ tank.	This data will allow the Area 1 runoff characteristics to be established and the adequacy of the Area 1 storage system to be assessed.
Area 1 tank overflow	• If there are overflows from the Area 1 tanks to the sediment basin, the date time and duration of each overflow will be recorded.	If an overflow occurs, this data will enable the rainfall thresholds for overflows to be established.
Sediment basin level and overflows	• A water level logger will be installed in the sediment basin. The logger will continuously measure the water level in the basin. • Runoff volumes and the occurrence, duration and volume of overflows can be identified/calculated from the basin level data.	This data will enable runoff volumes, basin dewatering rates and the occurrence, duration and volume of overflows to be quantified.
Water quality monitoring		
Overflows from the sediment basin	The following key water quality parameters will be monitored near the basin outlet during or shortly after an overflow event: • Total suspended solids • Turbidity • pH • Oil and grease • Nutrients – ammonia, oxidised nitrogen, total Kjeldahl nitrogen, total nitrogen, reactive phosphorus and total phosphorus • Metals – aluminium, chromium, copper, lead and zinc (field filtered using a 0.45µm filter)	To characterise the water quality of any overflows.

5.2 Water balance update

Once the data collection phase is complete, a site water balance model will be developed using industry standard methods. The model will be calibrated using the data described in Table 5.1 and will be applied to assess the system overflow characteristics for a full range of rainfall conditions.

5.3 Water management system review

The key outcomes from the water balance update and other data collected will be applied to review:

- the receiving water risk assessment documented in Section 4.1; and
- the recommendations in Table 4.2.

A report will be prepared that documents the water balance update and review outcomes.

6 References

ANZECC/ARMCANZ 2000, *Australian and New Zealand Guidelines for Fresh and Marine Water Quality*, Australian and New Zealand Environment Conservation Council and Agriculture and Resource Management Council of Australian and New Zealand.

ANZG 2018, *Australian and New Zealand Guidelines for Fresh & Marine Water Quality*. Australian and New Zealand governments.

DECC 2008, *Managing Urban Stormwater – Soils and Construction Vol 2B: Waste Landfills*. Department of Environment and Climate Change

EMM 2018, *Mayfield West Recycling Facility – Surface Water Characterisation and Mitigation Plan.* Prepared for Benedict Recycling Pty Ltd by EMM Consulting Pty Limited.

Appendix A

Laboratory certificates of analysis

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **ES2010659**	Page	: 1 of 7
Amendment	: **1**		
Client	: **EMM CONSULTING PTY LTD**	Laboratory	: Environmental Division Sydney
Contact	: MR CHRIS KUCZERA	Contact	: Customer Services ES
Address	: 6/146 Hunter Street Newcastle 2300	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
Telephone	: ----	Telephone	: +61-2-8784 8555
Project	: J14152 BENEDICT NEWCASTLE	Date Samples Received	: 27-Mar-2020 11:23
Order number	: ----	Date Analysis Commenced	: 27-Mar-2020
C-O-C number	: ----	Issue Date	: 06-Apr-2020 11:45
Sampler	: JASON O'BRIEN		
Site	: ----		
Quote number	: SY/327/16		
No. of samples received	: 2		
No. of samples analysed	: 2		

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results
- Surrogate Control Limits

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Ankit Joshi	Inorganic Chemist	Sydney Inorganics, Smithfield, NSW
Celine Conceicao	Senior Spectroscopist	Sydney Inorganics, Smithfield, NSW
Edwandy Fadjar	Organic Coordinator	Sydney Organics, Smithfield, NSW
Neil Martin	Team Leader - Chemistry	Chemistry, Newcastle West, NSW

General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- Benzo(a)pyrene Toxicity Equivalent Quotient (TEQ) per the NEPM (2013) is the sum total of the concentration of the eight carcinogenic PAHs multiplied by their Toxicity Equivalence Factor (TEF) relative to Benzo(a)pyrene. TEF values are provided in brackets as follows: Benz(a)anthracene (0.1), Chrysene (0.01), Benzo(b+j) & Benzo(k)fluoranthene (0.1), Benzo(a)pyrene (1.0), Indeno(1.2.3.cd)pyrene (0.1), Dibenz(a.h)anthracene (1.0), Benzo(g.h.i)perylene (0.01). Less than LOR results for 'TEQ Zero' are treated as zero.
- Amendment (06/04/2020): This report has been amended and re-released to allow the reporting of additional analytical data.
- MBAS is calculated as LAS, molecular weight 348
- TDS by method EA-015 may bias high for various samples due to the presence of fine particulate matter, which may pass through the prescribed GF/C paper.
- Sodium Adsorption Ratio (where reported): Where results for Na, Ca or Mg are <LOR, a concentration at half the reported LOR is incorporated into the SAR calculation. This represents a conservative approach for Na relative to the assumption that <LOR = zero concentration and a conservative approach for Ca & Mg relative to the assumption that <LOR is equivalent to the LOR concentration.

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Client sample ID	BASIN	TANK	----	----	----
			Client sampling date / time	27-Mar-2020 10:20	27-Mar-2020 10:00	----	----	----
Compound	CAS Number	LOR	Unit	ES2010659-001	ES2010659-002	--------	--------	--------
				Result	Result	----	----	----
EA005: pH								
pH Value	----	0.01	pH Unit	**8.27**	**7.72**	----	----	----
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	**294**	**629**	----	----	----
EA015: Total Dissolved Solids dried at 180 ± 5 °C								
Total Dissolved Solids @180°C	----	10	mg/L	**230**	**528**	----	----	----
EA025: Total Suspended Solids dried at 104 ± 2°C								
Suspended Solids (SS)	----	5	mg/L	**101**	**136**	----	----	----
EA045: Turbidity								
Turbidity	----	0.1	NTU	**169**	**231**	----	----	----
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	----	----	----
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	----	----	----
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	**48**	**65**	----	----	----
Total Alkalinity as CaCO3	----	1	mg/L	**48**	**65**	----	----	----
ED093F: SAR and Hardness Calculations								
Total Hardness as CaCO3	----	1	mg/L	**106**	**181**	----	----	----
EG020F: Dissolved Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	**0.04**	**0.01**	----	----	----
Arsenic	7440-38-2	0.001	mg/L	**0.002**	**0.005**	----	----	----
Barium	7440-39-3	0.001	mg/L	**0.015**	**0.038**	----	----	----
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	----	----	----
Chromium	7440-47-3	0.001	mg/L	**0.002**	**0.002**	----	----	----
Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	----	----	----
Copper	7440-50-8	0.001	mg/L	**0.002**	**0.008**	----	----	----
Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	----	----	----
Molybdenum	7439-98-7	0.001	mg/L	**0.003**	**0.008**	----	----	----
Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	----	----	----
Silver	7440-22-4	0.001	mg/L	<0.001	<0.001	----	----	----
Strontium	7440-24-6	0.001	mg/L	**0.175**	**0.235**	----	----	----
Vanadium	7440-62-2	0.01	mg/L	<0.01	<0.01	----	----	----
Zinc	7440-66-6	0.005	mg/L	<0.005	**0.006**	----	----	----
Boron	7440-42-8	0.05	mg/L	<0.05	**0.06**	----	----	----
Iron	7439-89-6	0.05	mg/L	<0.05	<0.05	----	----	----
EG035F: Dissolved Mercury by FIMS								

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	BASIN	TANK	----	----	----
				Client sampling date / time	27-Mar-2020 10:20	27-Mar-2020 10:00	----	----	----
Compound	CAS Number	LOR	Unit		ES2010659-001	ES2010659-002	--------	--------	--------
					Result	Result	----	----	----
EG035F: Dissolved Mercury by FIMS - Continued									
Mercury	7439-97-6	0.0001	mg/L		<0.0001	<0.0001	----	----	----
EK026SF: Total CN by Segmented Flow Analyser									
Total Cyanide	57-12-5	0.004	mg/L		<0.004	<0.004	----	----	----
EK040P: Fluoride by PC Titrator									
Fluoride	16984-48-8	0.1	mg/L		**0.1**	**0.5**	----	----	----
EK055G: Ammonia as N by Discrete Analyser									
Ammonia as N	7664-41-7	0.01	mg/L		**0.03**	**0.24**	----	----	----
EK057G: Nitrite as N by Discrete Analyser									
Nitrite as N	14797-65-0	0.01	mg/L		**0.06**	**0.60**	----	----	----
EK058G: Nitrate as N by Discrete Analyser									
Nitrate as N	14797-55-8	0.01	mg/L		**0.20**	**0.60**	----	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser									
Nitrite + Nitrate as N	----	0.01	mg/L		**0.26**	**1.20**	----	----	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser									
Total Kjeldahl Nitrogen as N	----	0.1	mg/L		**1.2**	**2.3**	----	----	----
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser									
^ Total Nitrogen as N	----	0.1	mg/L		**1.5**	**3.5**	----	----	----
EK067G: Total Phosphorus as P by Discrete Analyser									
Total Phosphorus as P	----	0.01	mg/L		**0.31**	**0.68**	----	----	----
EK071G: Reactive Phosphorus as P by discrete analyser									
Reactive Phosphorus as P	14265-44-2	0.01	mg/L		**0.10**	**0.51**	----	----	----
EP020: Oil and Grease (O&G)									
Oil & Grease	----	5	mg/L		<5	<5	----	----	----
EP050: Anionic Surfactants as MBAS									
Anionic Surfactants as MBAS	----	0.1	mg/L		<0.1	<0.1	----	----	----
EP075(SIM)A: Phenolic Compounds									
2-Methylphenol	95-48-7	1.0	µg/L		<1.0	<1.0	----	----	----
3- & 4-Methylphenol	1319-77-3	2.0	µg/L		<2.0	<2.0	----	----	----
4-Chloro-3-methylphenol	59-50-7	1.0	µg/L		<1.0	<1.0	----	----	----
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons									
Naphthalene	91-20-3	1.0	µg/L		<1.0	<1.0	----	----	----
Acenaphthylene	208-96-8	1.0	µg/L		<1.0	<1.0	----	----	----
Acenaphthene	83-32-9	1.0	µg/L		<1.0	<1.0	----	----	----

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	BASIN	TANK	----	----	----
				Client sampling date / time	27-Mar-2020 10:20	27-Mar-2020 10:00	----	----	----
Compound	CAS Number	LOR	Unit		ES2010659-001	ES2010659-002	--------	--------	--------
					Result	Result	----	----	----
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons - Continued									
Fluorene	86-73-7	1.0	µg/L		<1.0	<1.0	----	----	----
Phenanthrene	85-01-8	1.0	µg/L		<1.0	<1.0	----	----	----
Anthracene	120-12-7	1.0	µg/L		<1.0	<1.0	----	----	----
Fluoranthene	206-44-0	1.0	µg/L		<1.0	<1.0	----	----	----
Pyrene	129-00-0	1.0	µg/L		<1.0	<1.0	----	----	----
Benz(a)anthracene	56-55-3	1.0	µg/L		<1.0	<1.0	----	----	----
Chrysene	218-01-9	1.0	µg/L		<1.0	<1.0	----	----	----
Benzo(b+j)fluoranthene	205-99-2 205-82-3	1.0	µg/L		<1.0	<1.0	----	----	----
Benzo(k)fluoranthene	207-08-9	1.0	µg/L		<1.0	<1.0	----	----	----
Benzo(a)pyrene	50-32-8	0.5	µg/L		<0.5	<0.5	----	----	----
Indeno(1.2.3.cd)pyrene	193-39-5	1.0	µg/L		<1.0	<1.0	----	----	----
Dibenz(a.h)anthracene	53-70-3	1.0	µg/L		<1.0	<1.0	----	----	----
Benzo(g.h.i)perylene	191-24-2	1.0	µg/L		<1.0	<1.0	----	----	----
^ Sum of polycyclic aromatic hydrocarbons	----	0.5	µg/L		<0.5	<0.5	----	----	----
^ Benzo(a)pyrene TEQ (zero)	----	0.5	µg/L		<0.5	<0.5	----	----	----
EP080/071: Total Petroleum Hydrocarbons									
C6 - C9 Fraction	----	20	µg/L		<20	<20	----	----	----
C10 - C14 Fraction	----	50	µg/L		<50	<50	----	----	----
C15 - C28 Fraction	----	100	µg/L		<100	<100	----	----	----
C29 - C36 Fraction	----	50	µg/L		<50	<50	----	----	----
^ C10 - C36 Fraction (sum)	----	50	µg/L		<50	<50	----	----	----
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions									
C6 - C10 Fraction	C6_C10	20	µg/L		<20	<20	----	----	----
^ C6 - C10 Fraction minus BTEX (F1)	C6_C10-BTEX	20	µg/L		<20	<20	----	----	----
>C10 - C16 Fraction	----	100	µg/L		<100	<100	----	----	----
>C16 - C34 Fraction	----	100	µg/L		<100	<100	----	----	----
>C34 - C40 Fraction	----	100	µg/L		<100	<100	----	----	----
^ >C10 - C40 Fraction (sum)	----	100	µg/L		<100	<100	----	----	----
^ >C10 - C16 Fraction minus Naphthalene (F2)	----	100	µg/L		<100	<100	----	----	----
EP080: BTEXN									
Benzene	71-43-2	1	µg/L		<1	<1	----	----	----
Toluene	108-88-3	2	µg/L		<2	<2	----	----	----
Ethylbenzene	100-41-4	2	µg/L		<2	<2	----	----	----

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	BASIN	TANK	----	----	----
				Client sampling date / time	27-Mar-2020 10:20	27-Mar-2020 10:00	----	----	----
Compound	CAS Number	LOR	Unit		ES2010659-001	ES2010659-002	--------	--------	--------
					Result	Result	----	----	----
EP080: BTEXN - Continued									
meta- & para-Xylene	108-38-3 106-42-3	2	µg/L		<2	<2	----	----	----
ortho-Xylene	95-47-6	2	µg/L		<2	<2	----	----	----
^ Total Xylenes	----	2	µg/L		<2	<2	----	----	----
^ Sum of BTEX	----	1	µg/L		<1	<1	----	----	----
Naphthalene	91-20-3	5	µg/L		<5	<5	----	----	----
EP075(SIM)S: Phenolic Compound Surrogates									
Phenol-d6	13127-88-3	1.0	%		21.2	20.4	----	----	----
2-Chlorophenol-D4	93951-73-6	1.0	%		43.5	45.2	----	----	----
2.4.6-Tribromophenol	118-79-6	1.0	%		38.2	45.1	----	----	----
EP075(SIM)T: PAH Surrogates									
2-Fluorobiphenyl	321-60-8	1.0	%		59.1	63.3	----	----	----
Anthracene-d10	1719-06-8	1.0	%		61.7	65.4	----	----	----
4-Terphenyl-d14	1718-51-0	1.0	%		78.0	83.8	----	----	----
EP080S: TPH(V)/BTEX Surrogates									
1.2-Dichloroethane-D4	17060-07-0	2	%		111	107	----	----	----
Toluene-D8	2037-26-5	2	%		102	102	----	----	----
4-Bromofluorobenzene	460-00-4	2	%		96.8	94.0	----	----	----

Surrogate Control Limits

Sub-Matrix: **WATER**		Recovery Limits (%)	
Compound	*CAS Number*	*Low*	*High*
EP075(SIM)S: Phenolic Compound Surrogates			
Phenol-d6	13127-88-3	10	44
2-Chlorophenol-D4	93951-73-6	14	94
2.4.6-Tribromophenol	118-79-6	17	125
EP075(SIM)T: PAH Surrogates			
2-Fluorobiphenyl	321-60-8	20	104
Anthracene-d10	1719-06-8	27	113
4-Terphenyl-d14	1718-51-0	32	112
EP080S: TPH(V)/BTEX Surrogates			
1.2-Dichloroethane-D4	17060-07-0	71	137
Toluene-D8	2037-26-5	79	131
4-Bromofluorobenzene	460-00-4	70	128

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **ES2004247**	Page	: 1 of 7
Client	: **EMM CONSULTING PTY LTD**	Laboratory	: Environmental Division Sydney
Contact	: MR CHRIS KUCZERA	Contact	: Customer Services ES
Address	: 6/146 Hunter Street Newcastle 2300	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
Telephone	: ----	Telephone	: +61-2-8784 8555
Project	: J14152 BENEDICT NEWCASTLE	Date Samples Received	: 10-Feb-2020 12:00
Order number	: ----	Date Analysis Commenced	: 10-Feb-2020
C-O-C number	: ----	Issue Date	: 17-Feb-2020 16:33
Sampler	: Jason O'Brien		
Site	: ----		
Quote number	: EN/112/18 - Primary work only		
No. of samples received	: 2		
No. of samples analysed	: 2		

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results
- Surrogate Control Limits

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Ankit Joshi	Inorganic Chemist	Sydney Inorganics, Smithfield, NSW
Edwandy Fadjar	Organic Coordinator	Sydney Organics, Smithfield, NSW
Ivan Taylor	Analyst	Sydney Inorganics, Smithfield, NSW
Neil Martin	Team Leader - Chemistry	Chemistry, Newcastle West, NSW

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- Benzo(a)pyrene Toxicity Equivalent Quotient (TEQ) per the NEPM (2013) is the sum total of the concentration of the eight carcinogenic PAHs multiplied by their Toxicity Equivalence Factor (TEF) relative to Benzo(a)pyrene. TEF values are provided in brackets as follows: Benz(a)anthracene (0.1), Chrysene (0.01), Benzo(b+j) & Benzo(k)fluoranthene (0.1), Benzo(a)pyrene (1.0), Indeno(1.2.3.cd)pyrene (0.1), Dibenz(a.h)anthracene (1.0), Benzo(g.h.i)perylene (0.01). Less than LOR results for 'TEQ Zero' are treated as zero.
- MBAS is calculated as LAS, molecular weight 348
- TDS by method EA-015 may bias high for samples 1 and 2 due to the presence of fine particulate matter, which may pass through the prescribed GF/C paper.
- Sodium Adsorption Ratio (where reported): Where results for Na, Ca or Mg are <LOR, a concentration at half the reported LOR is incorporated into the SAR calculation. This represents a conservative approach for Na relative to the assumption that <LOR = zero concentration and a conservative approach for Ca & Mg relative to the assumption that <LOR is equivalent to the LOR concentration.

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Client sample ID	Basin	Tank	----	----	----
			Client sampling date / time	10-Feb-2020 10:45	10-Feb-2020 10:30	----	----	----
Compound	CAS Number	LOR	Unit	ES2004247-001	ES2004247-002	--------	--------	--------
				Result	Result	----	----	----
EA005: pH								
pH Value	----	0.01	pH Unit	**8.13**	**7.70**	----	----	----
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	**349**	**664**	----	----	----
EA015: Total Dissolved Solids dried at 180 ± 5 °C								
Total Dissolved Solids @180°C	----	10	mg/L	**231**	**590**	----	----	----
EA025: Total Suspended Solids dried at 104 ± 2°C								
Suspended Solids (SS)	----	5	mg/L	**79**	**266**	----	----	----
EA045: Turbidity								
Turbidity	----	0.1	NTU	**110**	**580**	----	----	----
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	----	----	----
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	----	----	----
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	**49**	**80**	----	----	----
Total Alkalinity as CaCO3	----	1	mg/L	**49**	**80**	----	----	----
ED093F: SAR and Hardness Calculations								
Total Hardness as CaCO3	----	1	mg/L	**113**	**177**	----	----	----
EG020F: Dissolved Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	**0.09**	**0.27**	----	----	----
Arsenic	7440-38-2	0.001	mg/L	**0.003**	**0.005**	----	----	----
Barium	7440-39-3	0.001	mg/L	**0.017**	**0.041**	----	----	----
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	----	----	----
Chromium	7440-47-3	0.001	mg/L	**0.003**	**0.003**	----	----	----
Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	----	----	----
Copper	7440-50-8	0.001	mg/L	**0.005**	**0.010**	----	----	----
Lead	7439-92-1	0.001	mg/L	<0.001	**0.001**	----	----	----
Molybdenum	7439-98-7	0.001	mg/L	**0.002**	**0.004**	----	----	----
Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	----	----	----
Silver	7440-22-4	0.001	mg/L	<0.001	<0.001	----	----	----
Strontium	7440-24-6	0.001	mg/L	**0.193**	**0.215**	----	----	----
Vanadium	7440-62-2	0.01	mg/L	<0.01	<0.01	----	----	----
Zinc	7440-66-6	0.005	mg/L	**0.009**	**0.008**	----	----	----
Boron	7440-42-8	0.05	mg/L	**0.08**	**0.07**	----	----	----
Iron	7439-89-6	0.05	mg/L	<0.05	**0.12**	----	----	----
EG035F: Dissolved Mercury by FIMS								

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Client sample ID	Basin	Tank	----	----	----
			Client sampling date / time	10-Feb-2020 10:45	10-Feb-2020 10:30	----	----	----
Compound	CAS Number	LOR	Unit	ES2004247-001	ES2004247-002	--------	--------	--------
				Result	Result	----	----	----
EG035F: Dissolved Mercury by FIMS - Continued								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	----	----	----
EK040P: Fluoride by PC Titrator								
Fluoride	16984-48-8	0.1	mg/L	**0.3**	**1.0**	----	----	----
EK055G: Ammonia as N by Discrete Analyser								
Ammonia as N	7664-41-7	0.01	mg/L	**0.67**	**0.07**	----	----	----
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N	14797-65-0	0.01	mg/L	**0.04**	**0.06**	----	----	----
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N	14797-55-8	0.01	mg/L	**0.26**	**1.03**	----	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	**0.30**	**1.09**	----	----	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	0.1	mg/L	**3.4**	**3.7**	----	----	----
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser								
^ Total Nitrogen as N	----	0.1	mg/L	**3.7**	**4.8**	----	----	----
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	0.01	mg/L	**0.15**	**0.61**	----	----	----
EK071G: Reactive Phosphorus as P by discrete analyser								
Reactive Phosphorus as P	14265-44-2	0.01	mg/L	**0.02**	**0.26**	----	----	----
EP020: Oil and Grease (O&G)								
Oil & Grease	----	5	mg/L	**6**	**6**	----	----	----
EP050: Anionic Surfactants as MBAS								
Anionic Surfactants as MBAS	----	0.1	mg/L	<0.1	<0.1	----	----	----
EP075(SIM)A: Phenolic Compounds								
Phenol	108-95-2	1.0	µg/L	<1.0	<1.0	----	----	----
2-Chlorophenol	95-57-8	1.0	µg/L	<1.0	<1.0	----	----	----
2-Methylphenol	95-48-7	1.0	µg/L	<1.0	<1.0	----	----	----
3- & 4-Methylphenol	1319-77-3	2.0	µg/L	<2.0	<2.0	----	----	----
2-Nitrophenol	88-75-5	1.0	µg/L	<1.0	<1.0	----	----	----
2.4-Dimethylphenol	105-67-9	1.0	µg/L	<1.0	<1.0	----	----	----
2.4-Dichlorophenol	120-83-2	1.0	µg/L	<1.0	<1.0	----	----	----
2.6-Dichlorophenol	87-65-0	1.0	µg/L	<1.0	<1.0	----	----	----
4-Chloro-3-methylphenol	59-50-7	1.0	µg/L	<1.0	<1.0	----	----	----

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	Basin	Tank	----	----	----
				Client sampling date / time	10-Feb-2020 10:45	10-Feb-2020 10:30	----	----	----
Compound	CAS Number	LOR	Unit		ES2004247-001	ES2004247-002	--------	--------	--------
					Result	Result	----	----	----
EP075(SIM)A: Phenolic Compounds - Continued									
2.4.6-Trichlorophenol	88-06-2	1.0	µg/L		<1.0	<1.0	----	----	----
2.4.5-Trichlorophenol	95-95-4	1.0	µg/L		<1.0	<1.0	----	----	----
Pentachlorophenol	87-86-5	2.0	µg/L		<2.0	<2.0	----	----	----
EP080/071: Total Petroleum Hydrocarbons									
C6 - C9 Fraction	----	20	µg/L		<20	<20	----	----	----
C10 - C14 Fraction	----	50	µg/L		<50	<50	----	----	----
C15 - C28 Fraction	----	100	µg/L		<100	<100	----	----	----
C29 - C36 Fraction	----	50	µg/L		<50	<50	----	----	----
^ **C10 - C36 Fraction (sum)**	----	50	µg/L		<50	<50	----	----	----
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions									
C6 - C10 Fraction	C6_C10	20	µg/L		<20	<20	----	----	----
^ **C6 - C10 Fraction minus BTEX (F1)**	C6_C10-BTEX	20	µg/L		<20	<20	----	----	----
>C10 - C16 Fraction	----	100	µg/L		<100	<100	----	----	----
>C16 - C34 Fraction	----	100	µg/L		<100	<100	----	----	----
>C34 - C40 Fraction	----	100	µg/L		<100	<100	----	----	----
^ **>C10 - C40 Fraction (sum)**	----	100	µg/L		<100	<100	----	----	----
^ **>C10 - C16 Fraction minus Naphthalene (F2)**	----	100	µg/L		<100	<100	----	----	----
EP080: BTEXN									
Benzene	71-43-2	1	µg/L		<1	<1	----	----	----
Toluene	108-88-3	2	µg/L		<2	<2	----	----	----
Ethylbenzene	100-41-4	2	µg/L		<2	<2	----	----	----
meta- & para-Xylene	108-38-3 106-42-3	2	µg/L		<2	<2	----	----	----
ortho-Xylene	95-47-6	2	µg/L		<2	<2	----	----	----
^ **Total Xylenes**	----	2	µg/L		<2	<2	----	----	----
^ **Sum of BTEX**	----	1	µg/L		<1	<1	----	----	----
Naphthalene	91-20-3	5	µg/L		<5	<5	----	----	----
EP075(SIM)S: Phenolic Compound Surrogates									
Phenol-d6	13127-88-3	1.0	%		**21.5**	**18.0**	----	----	----
2-Chlorophenol-D4	93951-73-6	1.0	%		**45.1**	**37.2**	----	----	----
2.4.6-Tribromophenol	118-79-6	1.0	%		**58.8**	**64.0**	----	----	----
EP075(SIM)T: PAH Surrogates									
2-Fluorobiphenyl	321-60-8	1.0	%		**65.8**	**64.7**	----	----	----

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	Basin	Tank	----	----	----
				Client sampling date / time	10-Feb-2020 10:45	10-Feb-2020 10:30	----	----	----
Compound	CAS Number	LOR	Unit		ES2004247-001	ES2004247-002	--------	--------	--------
					Result	Result	----	----	----
EP075(SIM)T: PAH Surrogates - Continued									
Anthracene-d10	1719-06-8	1.0	%		**98.4**	**79.5**	**----**	**----**	**----**
4-Terphenyl-d14	1718-51-0	1.0	%		**78.6**	**64.9**	**----**	**----**	**----**
EP080S: TPH(V)/BTEX Surrogates									
1.2-Dichloroethane-D4	17060-07-0	2	%		**100**	**91.3**	**----**	**----**	**----**
Toluene-D8	2037-26-5	2	%		**113**	**123**	**----**	**----**	**----**
4-Bromofluorobenzene	460-00-4	2	%		**87.4**	**89.1**	**----**	**----**	**----**

Surrogate Control Limits

Sub-Matrix: **WATER**

Compound	CAS Number	Recovery Limits (%) Low	Recovery Limits (%) High
EP075(SIM)S: Phenolic Compound Surrogates			
Phenol-d6	13127-88-3	10	44
2-Chlorophenol-D4	93951-73-6	14	94
2.4.6-Tribromophenol	118-79-6	17	125
EP075(SIM)T: PAH Surrogates			
2-Fluorobiphenyl	321-60-8	20	104
Anthracene-d10	1719-06-8	27	113
4-Terphenyl-d14	1718-51-0	32	112
EP080S: TPH(V)/BTEX Surrogates			
1.2-Dichloroethane-D4	17060-07-0	71	137
Toluene-D8	2037-26-5	79	131
4-Bromofluorobenzene	460-00-4	70	128

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **ES1930176**	Page	: 1 of 6
Amendment	: **1**		
Client	: **EMM CONSULTING PTY LTD**	Laboratory	: Environmental Division Sydney
Contact	: MR CHRIS KUCZERA	Contact	: Customer Services ES
Address	: 6/146 Hunter Street Newcastle 2300	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
Telephone	: ----	Telephone	: +61-2-8784 8555
Project	: J14152 BENEDICT NEWCASTLE	Date Samples Received	: 18-Sep-2019 16:39
Order number	: ----	Date Analysis Commenced	: 18-Sep-2019
C-O-C number	: ----	Issue Date	: 25-Sep-2019 13:56
Sampler	: CHRIS KUCZERA		
Site	: ----		
Quote number	: SY/327/16		
No. of samples received	: 2		
No. of samples analysed	: 2		

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results
- Surrogate Control Limits

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Alex Rossi	Organic Chemist	Sydney Organics, Smithfield, NSW
Ankit Joshi	Inorganic Chemist	Sydney Inorganics, Smithfield, NSW
Celine Conceicao	Senior Spectroscopist	Sydney Inorganics, Smithfield, NSW
Neil Martin	Team Leader - Chemistry	Chemistry, Newcastle West, NSW

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- Benzo(a)pyrene Toxicity Equivalent Quotient (TEQ) per the NEPM (2013) is the sum total of the concentration of the eight carcinogenic PAHs multiplied by their Toxicity Equivalence Factor (TEF) relative to Benzo(a)pyrene. TEF values are provided in brackets as follows: Benz(a)anthracene (0.1), Chrysene (0.01), Benzo(b+j) & Benzo(k)fluoranthene (0.1), Benzo(a)pyrene (1.0), Indeno(1.2.3.cd)pyrene (0.1), Dibenz(a.h)anthracene (1.0), Benzo(g.h.i)perylene (0.01). Less than LOR results for 'TEQ Zero' are treated as zero.
- Amendment (25/09/2019): This report has been amended and re-released to allow the reporting of additional analytical data.
- Sodium Adsorption Ratio (where reported): Where results for Na, Ca or Mg are <LOR, a concentration at half the reported LOR is incorporated into the SAR calculation. This represents a conservative approach for Na relative to the assumption that <LOR = zero concentration and a conservative approach for Ca & Mg relative to the assumption that <LOR is equivalent to the LOR concentration.

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Client sample ID	BASIN	TANK	----	----	----
			Client sampling date / time	18-Sep-2019 00:00	18-Sep-2019 00:00	----	----	----
Compound	CAS Number	LOR	Unit	ES1930176-001	ES1930176-002	--------	--------	--------
				Result	Result	----	----	----
EA005: pH								
pH Value	----	0.01	pH Unit	**8.57**	**7.76**	----	----	----
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	**444**	**807**	----	----	----
EA015: Total Dissolved Solids dried at 180 ± 5 °C								
Total Dissolved Solids @180°C	----	10	mg/L	**336**	**535**	----	----	----
EA025: Total Suspended Solids dried at 104 ± 2°C								
Suspended Solids (SS)	----	5	mg/L	**160**	**78**	----	----	----
EA045: Turbidity								
Turbidity	----	0.1	NTU	**271**	**159**	----	----	----
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	----	----	----
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	----	----	----
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	**42**	**95**	----	----	----
Total Alkalinity as CaCO3	----	1	mg/L	**42**	**95**	----	----	----
ED093F: SAR and Hardness Calculations								
Total Hardness as CaCO3	----	1	mg/L	**172**	**264**	----	----	----
EG020F: Dissolved Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	**0.17**	**0.06**	----	----	----
Arsenic	7440-38-2	0.001	mg/L	**0.002**	**0.004**	----	----	----
Barium	7440-39-3	0.001	mg/L	**0.024**	**0.049**	----	----	----
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	----	----	----
Chromium	7440-47-3	0.001	mg/L	**0.003**	**0.002**	----	----	----
Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	----	----	----
Copper	7440-50-8	0.001	mg/L	**0.006**	**0.002**	----	----	----
Lead	7439-92-1	0.001	mg/L	**0.001**	<0.001	----	----	----
Molybdenum	7439-98-7	0.001	mg/L	**0.003**	**0.007**	----	----	----
Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	----	----	----
Silver	7440-22-4	0.001	mg/L	<0.001	<0.001	----	----	----
Strontium	7440-24-6	0.001	mg/L	**0.285**	**0.351**	----	----	----
Vanadium	7440-62-2	0.01	mg/L	<0.01	<0.01	----	----	----
Zinc	7440-66-6	0.005	mg/L	**0.010**	**0.012**	----	----	----
Boron	7440-42-8	0.05	mg/L	**0.06**	**0.07**	----	----	----
Iron	7439-89-6	0.05	mg/L	**0.11**	**0.10**	----	----	----
EG035F: Dissolved Mercury by FIMS								

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	BASIN	TANK	----	----	----
				Client sampling date / time	18-Sep-2019 00:00	18-Sep-2019 00:00	----	----	----
Compound	CAS Number	LOR	Unit		ES1930176-001	ES1930176-002	--------	--------	--------
					Result	Result	----	----	----
EG035F: Dissolved Mercury by FIMS - Continued									
Mercury	7439-97-6	0.0001	mg/L		<0.0001	<0.0001	----	----	----
EK010: Chlorine									
Chlorine - Total Residual	----	0.2	mg/L		**4.6**	<0.2	----	----	----
EK040P: Fluoride by PC Titrator									
Fluoride	16984-48-8	0.1	mg/L		**0.2**	**0.3**	----	----	----
EK055G: Ammonia as N by Discrete Analyser									
Ammonia as N	7664-41-7	0.01	mg/L		<0.01	<0.01	----	----	----
EK057G: Nitrite as N by Discrete Analyser									
Nitrite as N	14797-65-0	0.01	mg/L		<0.01	<0.01	----	----	----
EK058G: Nitrate as N by Discrete Analyser									
Nitrate as N	14797-55-8	0.01	mg/L		**0.23**	**0.03**	----	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser									
Nitrite + Nitrate as N	----	0.01	mg/L		**0.23**	**0.03**	----	----	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser									
Total Kjeldahl Nitrogen as N	----	0.1	mg/L		**1.1**	**1.9**	----	----	----
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser									
^ Total Nitrogen as N	----	0.1	mg/L		**1.3**	**1.9**	----	----	----
EK067G: Total Phosphorus as P by Discrete Analyser									
Total Phosphorus as P	----	0.01	mg/L		**0.34**	**0.36**	----	----	----
EK071G: Reactive Phosphorus as P by discrete analyser									
Reactive Phosphorus as P	14265-44-2	0.01	mg/L		<0.01	**0.04**	----	----	----
EP020: Oil and Grease (O&G)									
Oil & Grease	----	5	mg/L		<5	<5	----	----	----
EP050: Anionic Surfactants as MBAS									
Anionic Surfactants as MBAS	----	0.1	mg/L		**0.2**	**0.2**	----	----	----
EP075(SIM)A: Phenolic Compounds									
2-Methylphenol	95-48-7	1.0	µg/L		<1.0	<1.0	----	----	----
3- & 4-Methylphenol	1319-77-3	2.0	µg/L		<2.0	<2.0	----	----	----
2.4-Dimethylphenol	105-67-9	1.0	µg/L		<1.0	<1.0	----	----	----
4-Chloro-3-methylphenol	59-50-7	1.0	µg/L		<1.0	<1.0	----	----	----
EP080/071: Total Petroleum Hydrocarbons									
C6 - C9 Fraction	----	20	µg/L		<20	<20	----	----	----
C10 - C14 Fraction	----	50	µg/L		<50	<50	----	----	----

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	BASIN	TANK	----	----	----
				Client sampling date / time	18-Sep-2019 00:00	18-Sep-2019 00:00	----	----	----
Compound	CAS Number	LOR	Unit		ES1930176-001	ES1930176-002	--------	--------	--------
					Result	Result	----	----	----
EP080/071: Total Petroleum Hydrocarbons - Continued									
C15 - C28 Fraction	----	100	µg/L		<100	<100	----	----	----
C29 - C36 Fraction	----	50	µg/L		<50	<50	----	----	----
^ C10 - C36 Fraction (sum)	----	50	µg/L		<50	<50	----	----	----
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions									
C6 - C10 Fraction	C6_C10	20	µg/L		<20	<20	----	----	----
^ C6 - C10 Fraction minus BTEX (F1)	C6_C10-BTEX	20	µg/L		<20	<20	----	----	----
>C10 - C16 Fraction	----	100	µg/L		<100	<100	----	----	----
>C16 - C34 Fraction	----	100	µg/L		<100	<100	----	----	----
>C34 - C40 Fraction	----	100	µg/L		<100	<100	----	----	----
^ >C10 - C40 Fraction (sum)	----	100	µg/L		<100	<100	----	----	----
^ >C10 - C16 Fraction minus Naphthalene (F2)	----	100	µg/L		<100	<100	----	----	----
EP080: BTEXN									
Benzene	71-43-2	1	µg/L		<1	<1	----	----	----
Toluene	108-88-3	2	µg/L		<2	<2	----	----	----
Ethylbenzene	100-41-4	2	µg/L		<2	<2	----	----	----
meta- & para-Xylene	108-38-3 106-42-3	2	µg/L		<2	<2	----	----	----
ortho-Xylene	95-47-6	2	µg/L		<2	<2	----	----	----
^ Total Xylenes	----	2	µg/L		<2	<2	----	----	----
^ Sum of BTEX	----	1	µg/L		<1	<1	----	----	----
Naphthalene	91-20-3	5	µg/L		<5	<5	----	----	----
EP075(SIM)S: Phenolic Compound Surrogates									
Phenol-d6	13127-88-3	1.0	%		**22.2**	**22.9**	----	----	----
2-Chlorophenol-D4	93951-73-6	1.0	%		**49.9**	**37.7**	----	----	----
2.4.6-Tribromophenol	118-79-6	1.0	%		**41.2**	**38.0**	----	----	----
EP075(SIM)T: PAH Surrogates									
2-Fluorobiphenyl	321-60-8	1.0	%		**82.0**	**79.4**	----	----	----
Anthracene-d10	1719-06-8	1.0	%		**68.0**	**67.3**	----	----	----
4-Terphenyl-d14	1718-51-0	1.0	%		**69.5**	**66.4**	----	----	----
EP080S: TPH(V)/BTEX Surrogates									
1.2-Dichloroethane-D4	17060-07-0	2	%		**72.8**	**83.5**	----	----	----
Toluene-D8	2037-26-5	2	%		**105**	**124**	----	----	----
4-Bromofluorobenzene	460-00-4	2	%		**110**	**125**	----	----	----

Surrogate Control Limits

Sub-Matrix: **WATER**

Compound	CAS Number	Recovery Limits (%) Low	High
EP075(SIM)S: Phenolic Compound Surrogates			
Phenol-d6	13127-88-3	10	44
2-Chlorophenol-D4	93951-73-6	14	94
2.4.6-Tribromophenol	118-79-6	17	125
EP075(SIM)T: PAH Surrogates			
2-Fluorobiphenyl	321-60-8	20	104
Anthracene-d10	1719-06-8	27	113
4-Terphenyl-d14	1718-51-0	32	112
EP080S: TPH(V)/BTEX Surrogates			
1.2-Dichloroethane-D4	17060-07-0	71	137
Toluene-D8	2037-26-5	79	131
4-Bromofluorobenzene	460-00-4	70	128

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **ES1927907-AA**	Page	: 1 of 6
Amendment	: **1**		
Client	: **EMM CONSULTING PTY LTD**	Laboratory	: Environmental Division Sydney
Contact	: MR CHRIS KUCZERA	Contact	: Customer Services ES
Address	: 6/146 Hunter Street Newcastle 2300	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
Telephone	: ----	Telephone	: +61-2-8784 8555
Project	: J14152 BENEDICT NEWCASTLE	Date Samples Received	: 02-Sep-2019 10:59
Order number	: ----	Date Analysis Commenced	: 02-Sep-2019
C-O-C number	: ----	Issue Date	: 05-May-2020 14:20
Sampler	: ----		
Site	: ----		
Quote number	: SY/327/16		
No. of samples received	: 2		
No. of samples analysed	: 2		

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results
- Surrogate Control Limits

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Ankit Joshi	Inorganic Chemist	Sydney Inorganics, Smithfield, NSW
Celine Conceicao	Senior Spectroscopist	Sydney Inorganics, Smithfield, NSW
Edwandy Fadjar	Organic Coordinator	Sydney Organics, Smithfield, NSW
Ivan Taylor	Analyst	Sydney Inorganics, Smithfield, NSW
Neil Martin	Team Leader - Chemistry	Chemistry, Newcastle West, NSW

General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- MBAS is calculated as LAS, molecular weight 348
- TDS by method EA-015 may bias high for sample 5due to the presence of fine particulate matter, which may pass through the prescribed GF/C paper.
- Amendment (05/05/2020): This report has been amended and re-released to allow the reporting of specific samples as requested by Chris Kuczera.
- Sodium Adsorption Ratio (where reported): Where results for Na, Ca or Mg are <LOR, a concentration at half the reported LOR is incorporated into the SAR calculation. This represents a conservative approach for Na relative to the assumption that <LOR = zero concentration and a conservative approach for Ca & Mg relative to the assumption that <LOR is equivalent to the LOR concentration.

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Client sample ID	BASIN	TANK	----	----	----
			Client sampling date / time	31-Aug-2019 10:00	02-Sep-2019 10:00	----	----	----
Compound	CAS Number	LOR	Unit	ES1927907-001	ES1927907-002	--------	--------	--------
				Result	Result	----	----	----
EA005: pH								
pH Value	----	0.01	pH Unit	**8.32**	**7.28**	----	----	----
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	**434**	**618**	----	----	----
EA015: Total Dissolved Solids dried at 180 ± 5 °C								
Total Dissolved Solids @180°C	----	10	mg/L	**302**	**464**	----	----	----
EA025: Total Suspended Solids dried at 104 ± 2°C								
Suspended Solids (SS)	----	5	mg/L	**100**	**100**	----	----	----
EA045: Turbidity								
Turbidity	----	0.1	NTU	**228**	**152**	----	----	----
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	----	----	----
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	----	----	----
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	**33**	**84**	----	----	----
Total Alkalinity as CaCO3	----	1	mg/L	**33**	**84**	----	----	----
ED093F: SAR and Hardness Calculations								
Total Hardness as CaCO3	----	1	mg/L	**183**	**215**	----	----	----
EG020F: Dissolved Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	**0.03**	**0.04**	----	----	----
Arsenic	7440-38-2	0.001	mg/L	**0.002**	**0.006**	----	----	----
Barium	7440-39-3	0.001	mg/L	**0.015**	**0.047**	----	----	----
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	----	----	----
Chromium	7440-47-3	0.001	mg/L	**0.002**	**0.004**	----	----	----
Cobalt	7440-48-4	0.001	mg/L	<0.001	**0.001**	----	----	----
Copper	7440-50-8	0.001	mg/L	**0.006**	**0.005**	----	----	----
Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	----	----	----
Molybdenum	7439-98-7	0.001	mg/L	**0.003**	**0.006**	----	----	----
Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	----	----	----
Silver	7440-22-4	0.001	mg/L	<0.001	<0.001	----	----	----
Strontium	7440-24-6	0.001	mg/L	**0.292**	**0.217**	----	----	----
Vanadium	7440-62-2	0.01	mg/L	<0.01	<0.01	----	----	----
Zinc	7440-66-6	0.005	mg/L	<0.005	**0.018**	----	----	----
Boron	7440-42-8	0.05	mg/L	**0.07**	<0.05	----	----	----
Iron	7439-89-6	0.05	mg/L	<0.05	**0.16**	----	----	----
EG035F: Dissolved Mercury by FIMS								

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	BASIN	TANK	----	----	----
				Client sampling date / time	31-Aug-2019 10:00	02-Sep-2019 10:00	----	----	----
Compound	CAS Number	LOR	Unit		ES1927907-001	ES1927907-002	--------	--------	--------
					Result	Result	----	----	----
EG035F: Dissolved Mercury by FIMS - Continued									
Mercury	7439-97-6	0.0001	mg/L		<0.0001	<0.0001	----	----	----
EK010: Chlorine									
Chlorine - Total Residual	----	0.2	mg/L		<0.2	<0.2	----	----	----
EK040P: Fluoride by PC Titrator									
Fluoride	16984-48-8	0.1	mg/L		**0.3**	**0.4**	----	----	----
EK055G: Ammonia as N by Discrete Analyser									
Ammonia as N	7664-41-7	0.01	mg/L		<0.01	<0.01	----	----	----
EK057G: Nitrite as N by Discrete Analyser									
Nitrite as N	14797-65-0	0.01	mg/L		**0.02**	<0.01	----	----	----
EK058G: Nitrate as N by Discrete Analyser									
Nitrate as N	14797-55-8	0.01	mg/L		**0.17**	<0.01	----	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser									
Nitrite + Nitrate as N	----	0.01	mg/L		**0.19**	<0.01	----	----	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser									
Total Kjeldahl Nitrogen as N	----	0.1	mg/L		**1.0**	**2.9**	----	----	----
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser									
^ **Total Nitrogen as N**	----	0.1	mg/L		**1.2**	**2.9**	----	----	----
EK067G: Total Phosphorus as P by Discrete Analyser									
Total Phosphorus as P	----	0.01	mg/L		**0.22**	**0.67**	----	----	----
EK071G: Reactive Phosphorus as P by discrete analyser									
Reactive Phosphorus as P	14265-44-2	0.01	mg/L		**0.03**	**0.07**	----	----	----
EP050: Anionic Surfactants as MBAS									
Anionic Surfactants as MBAS	----	0.1	mg/L		<0.1	<0.1	----	----	----
EP080/071: Total Petroleum Hydrocarbons									
C6 - C9 Fraction	----	20	µg/L		<20	<20	----	----	----
C10 - C14 Fraction	----	50	µg/L		<50	**160**	----	----	----
C15 - C28 Fraction	----	100	µg/L		<100	**200**	----	----	----
C29 - C36 Fraction	----	50	µg/L		<50	<50	----	----	----
^ **C10 - C36 Fraction (sum)**	----	50	µg/L		<50	**360**	----	----	----
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions									
C6 - C10 Fraction	C6_C10	20	µg/L		<20	<20	----	----	----
^ **C6 - C10 Fraction minus BTEX (F1)**	C6_C10-BTEX	20	µg/L		<20	<20	----	----	----

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	BASIN	TANK	----	----	----
				Client sampling date / time	31-Aug-2019 10:00	02-Sep-2019 10:00	----	----	----
Compound	CAS Number	LOR	Unit		ES1927907-001	ES1927907-002	--------	--------	--------
					Result	Result	----	----	----
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions - Continued									
>C10 - C16 Fraction	----	100	µg/L		<100	**190**	----	----	----
>C16 - C34 Fraction	----	100	µg/L		<100	**170**	----	----	----
>C34 - C40 Fraction	----	100	µg/L		<100	<100	----	----	----
^ **>C10 - C40 Fraction (sum)**	----	100	µg/L		<100	**360**	----	----	----
^ **>C10 - C16 Fraction minus Naphthalene (F2)**	----	100	µg/L		<100	**190**	----	----	----
EP080: BTEXN									
Benzene	71-43-2	1	µg/L		<1	<1	----	----	----
Toluene	108-88-3	2	µg/L		<2	<2	----	----	----
Ethylbenzene	100-41-4	2	µg/L		<2	<2	----	----	----
meta- & para-Xylene	108-38-3 106-42-3	2	µg/L		<2	<2	----	----	----
ortho-Xylene	95-47-6	2	µg/L		<2	<2	----	----	----
^ **Total Xylenes**	----	2	µg/L		<2	<2	----	----	----
^ **Sum of BTEX**	----	1	µg/L		<1	<1	----	----	----
Naphthalene	91-20-3	5	µg/L		<5	<5	----	----	----
EP080S: TPH(V)/BTEX Surrogates									
1.2-Dichloroethane-D4	17060-07-0	2	%		**90.0**	**87.8**	----	----	----
Toluene-D8	2037-26-5	2	%		**98.0**	**101**	----	----	----
4-Bromofluorobenzene	460-00-4	2	%		**91.5**	**89.3**	----	----	----

Surrogate Control Limits

Sub-Matrix: **WATER**		Recovery Limits (%)	
Compound	*CAS Number*	*Low*	*High*
EP080S: TPH(V)/BTEX Surrogates			
1.2-Dichloroethane-D4	17060-07-0	71	137
Toluene-D8	2037-26-5	79	131
4-Bromofluorobenzene	460-00-4	70	128

Appendix B

Supplementary water quality monitoring report

Mayfield West Recycling Facility

Supplementary water quality monitoring results

Prepared for Benedict Recycling Pty Limited
March 2022

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Mayfield West Recycling Facility

Supplementary water quality monitoring results

Report Number

J14152 RP24

Client

Benedict Recycling Pty Limited

Date

11 March 2022

Version

v3 Final

Prepared by

Jason O'Brien
Water Resources Engineer
11 March2022

Approved by

Chris Kuczera
Associate Water Resources Engineer
11 March 2022

Table of Contents

Annexures

Tables

1 Introduction

Benedict Recycling Pty Ltd (Benedict) owns and operates a resource recovery facility at 1a McIntosh Drive, Mayfield West (hereinafter referred to as the facility or site). A Surface Water Validation Report (SWVR) was prepared in 2020 in consultation with the NSW Environment Protection authority (EPA). SWVR (V3) was submitted to the EPA on 20 November 2020 and included a commitment to update the site water balance and undertake a further review of the water management system once the water balance is updated. The SWVR included commitments to monitor water levels in the Site's stormwater basin (the basin) and to undertake water quality monitoring if overflows from the basin occur. Data was collected between 18 December 2020 to 31 January 2022 (the Monitoring Period) and was used to inform both the water balance update and the further review of the water management system.

This report describes the water quality monitoring that was undertaken during the Monitoring Period. Where relevant, the water quality monitoring results are compared to results in the SWVR. This report is a technical appendix to the Mayfield West Recycling Facility: Surface Water Validation Report Review Outcomes (EMM 2022), which addresses the commitments made in the SWVR for a further review of the water management system.

Chapter 2 describes the monitoring methods and results. Certificates of Analysis (CoA) are provided in Attachment A.

The water balance update is documented in a separate technical appendix.

2 Water quality monitoring

2.1 Basin overflows

Water levels in the Site's basin were recorded during the Monitoring Period using a continuous water level logger (see Water Balance Update report for further details). Overflows from the basin occurred in March 2021 following substantial rainfall. No other overflows occurred during the Monitoring Period (18 December 2020 to 31 January 2022). However, it is noted that the water level in the basin exceeded the outlet level in September and November 2021. On both occasions overflows were avoided by holding water above the outlet structure (which can be manually opened and closed).

2.2 Sampling events

Water quality samples were collected from the basin during two separate rainfall events. The first event occurred in March 2021 and resulted in basin overflows. Samples were collected on four consecutive days (20 to 23 March 2021). The laboratory analysis results from all samples indicated that some metals were impacted by suspected container contamination (discussed in Section 2.5.3). A second sampling event occurred in August 2021. The purpose of the second sampling event was to validate the Site's water quality characteristics given that there were suspected contamination issues with the samples collected in March 2021. No overflows occurred during this event.

A summary of the rainfall estimates and site observations for each sampling event are provided in Table 3.1.

Table 2.1 Sampling context and site observations

Sampling event	Rainfall context[1]	Site observations
Event 1 20 to 23 March 2021	**Wet weather**: **significant rainfall, water management system design rainfall[2] exceeded.** • 430 mm of rainfall was recorded over a 5-day period.	• Benedict advised that overflows occurred from the basin on the 20, 21 and 22 March 2021.
Event 2 25 August 2021	**Wet weather**: **significant rainfall, water management system design rainfall[2] exceeded.** • 78 mm of rainfall was recorded in the 48 hours prior to sampling.	• The water level in the basin was 500 mm below the outlet at the time of sampling, no overflows occurred during this event. • The water in the basin appeared to be turbid.

1. Rainfall depths were recorded by Benedict's on-site weather station. The recorded depths are similar to totals recorded at local Bureau of Meteorology operated gauges.
2. Design rainfall refers to the 5-day 90th percentile rainfall depth (51.8 mm)

2.3 Monitoring method

The analytes and methods applied to each sampling event are described in Table 2.2. It is noted that the analytes are consistent with the proposed analytes in the SWVR (V3) and the Site's Environment Protection Licence (EPL no. 20771).

Table 2.2 Monitoring analytes and methods

Category	Analytes	Sampling and analysis methods
Physico-chemical parameters	pH, turbidity, total suspended solids	Analysis was undertaken by a NATA-certified laboratory.
Nutrients	Ammonia, oxidised nitrogen (NOx), total kjeldahl nitrogen (TKN) and total nitrogen Reactive and total phosphorus	Analysis was undertaken by a NATA-certified laboratory.
Metals and metalloids	Aluminium (Al), chromium (Cr), copper (Cu), lead (Pb) and zinc (Zn)	Samples were filtered in the field using a 0.45 µm filter. Analysis was undertaken by a NATA-certified laboratory.
Organics	Oil and grease	Analysis was undertaken by a NATA-certified laboratory.

2.4 Results

Water quality results are presented in Table 2.3. The results are compared to:

- the default guideline values (DGVs) established in the SWVR; and
- EPL concentration limits (noting that the EPL concentration limits only apply to discharges from the site).

The results are compared to the basin results from the SWVR sampling program (EMM 2020). For each analyte, the range in water quality values documented in this report and the SWVR monitoring program are described as either trending lower, being similar or trending higher. Laboratory certificates for the monitoring results are presented in Annexure A.

Table 2.3 Water quality summary – Basin

	Unit	EPL limit[4]	DGV[1,2]		SWVR supplementary monitoring 2021						SWVR range	Comparison to SWVR range[5]
					Event 1				Event 2			
			Fresh	Marine	20-march	21-march	22-march	23-march	25-august	Event Range	Basin Results (from SWVR Table 3.3)	
Physico-chemical parameters												
pH	-	6.5 – 8.5	-	7.0 – 8.5	7.5	7.4	8.0	**10.0**	**9.3**	7.4 – **10.0**	8.1 – **8.6**	Similar to Higher
Turbidity	NTU	-	-	10	**18**	**60**	**47**	**97**	**20**	**18 – 97**	**110 – 271**	Lower
Total suspended solids	mg/L	50	-	-	6	32	44	**58**	18	6 – **58**	**79 – 160**	Lower
Analytical results – nutrients (as N or P)												
Ammonia	mg/L	-	-	0.91 (toxicant) 0.015 (stressor)	**0.14**	**0.07**	**0.12**	**0.19**	**0.17**	**0.07 – 0.19**	<0.01 – **0.67**	Similar
Oxidised nitrogen	mg/L	-	-	0.015	**0.14**	**0.14**	**0.15**	**0.14**	**0.31**	**0.14 – 0.31**	**0.19 – 0.30**	Similar
Total kjeldahl nitrogen	mg/L	-	-	-	0.9	1.1	2.2	2.2	1.9	0.9 – 2.2	1.0 – 3.4	Similar
Total nitrogen	mg/L	-	-	0.30	**1.0**	**1.2**	**2.4**	**2.3**	**2.2**	**1.0 – 2.4**	**1.2 – 3.7**	Similar
Reactive phosphorus	mg/L	-	-	0.005	**0.02**	**0.02**	**0.01**	<0.01	<0.01	<0.01 **– 0.02**	<0.01 **– 0.10**	Similar
Total phosphorus	mg/L	-	-	0.030	**0.05**	**0.07**	**0.07**	**0.12**	**0.04**	**0.04 – 0.12**	**0.15 – 0.34**	Lower
Organics												
Oil and Grease	mg/L	10	-	-	<5	<5	<5	<5	<5	<5	<5 - 6	Similar
Analytical results – metals (0.45 µm field filtered)												
Aluminium (Al)	mg/L	-	0.055	0.0005[3]	0.02	0.02	**0.14**	0.03	0.02	0.02 – **0.14**	0.03 **– 0.17**	Similar

Table 2.3 Water quality summary – Basin

	Unit	EPL limit[4]	DGV[1,2]		SWVR supplementary monitoring 2021						SWVR range	Comparison to SWVR range[5]
					Event 1				Event 2			
			Fresh	Marine	20-march	21-march	22-march	23-march	25-august	Event Range	Basin Results (from SWVR Table 3.3)	
Chromium – total (Cr)	mg/L	-	0.003[3] Cr (III) 0.001 (Cr VI)	0.027 (Cr III) 0.004 (Cr VI)	0.001	0.002	0.002	0.002	**0.005**	0.001 – **0.005**	0.002 – 0.003	Similar to Higher
Copper (Cu)	mg/L	-	0.0014	0.0013	0.023	0.033	0.008	0.034	**0.005**	**0.005**	**0.002 – 0.006**	Similar
Lead (Pb)	mg/L	-	0.0034	0.0044	<0.001	0.001	**0.007**	<0.001	<0.001	<0.001 – **0.007**	<0.001 – 0.001	Similar to Higher
Zinc (Zn)	mg/L	-	0.008	0.008	0.014	0.031	0.042	0.013	<0.005	<0.005	<0.005 – 0.**010**	Similar

Notes:
1. The DGV for physico-chemical parameters and nutrients refer to the values for physical and chemical stressors in south-east Australia (estuaries) that are reported in Tables 3.3.2 and 3.3.3 of ANZECC/ARMCANZ (2000). DGV for toxicants refer to the values for slightly–moderately disturbed freshwater and marine ecosystems that are reported in ANZG 2018.
2. Unless otherwise stated, the DGV for dissolved metals refer to the high reliability trigger values for slightly–moderately disturbed ecosystems. It is noted that no hardness adjustments have been made.
3. The DGV refers to a low reliability trigger values that are provided in Volume 2 of ANZECC/ARMCANZ (2000).
4. Refers to an EPL concentration limit (EPL 20771).
5. Comparison is SWVR supplementary monitoring to SWVR ranges (ie 'Higher' refers to the water balance update range being materially greater than the SWVR range).

Bold denotes a DGV or Range is exceeded.

Green denotes the adopted DGV. Given the receiving water is the Hunter River Estuary, preference has been given to the guideline values for estuarine and marine environments, where a suitable value is available.

Purple denotes a low reliability marine trigger value that has not been used as a high reliability freshwater trigger value is available.

Orange denotes results impacted by sample contamination issues (discussed in Section 2.5.3). These results are included for transparency but have not been applied to the SWVR supplementary range or considered in report conclusions.

2.5 Results discussion

The basin water quality over the Monitoring Period is characterised as having a neutral to alkaline pH, elevated (relative to DGVs) turbidity levels and nutrient, aluminium (1 sample), chromium (1 sample), copper (1 sample) and lead (1 sample) concentrations (refer to Table 2.3).

2.5.1 Comparison to EPL concentration limits

Comparison to the EPL concentration limits indicates:

- Total suspended solids concentrations exceed the EPL limit of 50 mg/L in one of the five samples. The elevated concentration was 58 mg/L (compared to an EPL limit of 50 mg/L) and occurred on 23 March 2021 near the end of significant rainfall event comprising more than 400 mm of rain.

- pH exceeded the EPL upper limit of 8.5 in two samples from 23 March and 25 August 2021. This indicates that runoff from some stockpiles containing alkaline material occurred. This has been noted in the Mayfield West Recycling Facility: Surface Water Validation Report Review Outcomes (EMM 2022), which includes a new recommendation to identify the source of alkaline runoff if an elevated pH is identified in future basin sampling. Once identified, the relevant material type can be stored in Area 1, which does not drain to the basin.

- Oil and grease concentrations were below detection levels and EPL limits.

It is noted that despite the basin being reasonably full, overflows from the basin were not occurring at the time of sampling on 23 March or 25 August 2021.

2.5.2 Comparison to SWVR results

Comparison to the SWVR results indicate:

- pH is similar in three of the samples and higher in two of the samples (as noted above);

- total suspended solids concentrations are generally lower;

- turbidity levels are generally lower;

- nutrient concentrations are similar except for total phosphorus which is lower; and

- metal concentrations are similar. However, one DGV exceedances was recorded for both chromium and lead from the five samples.

It is also noted that the DGV for zinc was also revised from 0.015 to 0.008 mg/L to align with the recent recommendations in ANZG (2018). This resulted in the revised DGV being exceeded on two occasions in the SWVR sampling.

2.5.3 Elevated metal concentration in March 2021 samples

The copper and zinc concentrations reported for the March 2021 event samples were significantly higher than the range in concentrations that were reported in the SWVR and earlier water quality investigations. The containers used for these samples were provided by ALS laboratories to EMM, who distributed them to Benedict and other facilities for use in wet weather sampling programs. EMM is aware that other facilities that used containers from the box provided to EMM by ALS also recorded unexpectedly high copper and zinc concentrations. Accordingly, on

request, further analysis was undertaken by ALS laboratory to confirm (or otherwise) the potential for the results to have been affected by sample contamination.

The additional analysis was completed for the samples taken on 21 March 2021 using water from a different sampling container. The analysis identified the original copper and zinc results were subject to sample container contamination with revised concentrations of 0.004 mg/L (down from 0.033 mg/L) and 0.009 mg/L (down from 0.031 mg/L) respectively. Advice provided by the lab is provided in Annexure A.

These revised concentrations were consistent with historical trends. Unfortunately, the other samples were discarded by the lab before further reanalysis could be undertaken. However, on the balance of evidence the copper and zinc results from all of the Event 1 samples are deemed unreliable due to sample contamination.

A follow up monitoring round (Event 2) was completed during the next material rainfall (greater than 50 mm) event. Copper and zinc concentrations from this event were observed to be within the typical ranges and below acute trigger values presented in the SWVR.

Table 2.4 provides a summary of the original and revised results from the 21 March 2021 sample and the Event 2 results. The DGV and acute trigger values are also provided for context.

Table 2.4 Summary of copper and zinc results

Analyte	Units	DGV[1]	Acute trigger value[2]	21 March 2021 Samples		Event 2 (25 August 2021)	Below acute trigger value (revised and Event 2)
				Original result	Revised result		
Copper	mg/L	0.0013	0.007	**0.033**	**0.004**	**0.005**	Yes
Zinc	mg/L	0.015	0.045	**0.031**	0.009	<0.005	Yes

Notes: 1. Refers to the adopted DGV established in Table 2.3.
2. Sourced from Table 4.4 of Surface Water Characterisation and Mitigation Plan (SWCMP) (EMM 2018).
Bold denotes a DGV is exceeded.
Red denotes the acute trigger value is exceeded.

3 Conclusion

This report describes water quality monitoring that was undertaken between 18 December 2020 and 31 January 2022 from the Site's basin. Water quality samples were collected during two separate rainfall events. The first event occurred in March 2021 and comprised more than 400 mm of rainfall over five days. Overflows from the basin occurred during this event and samples were collected on four consecutive days. The laboratory results for some metals (copper and zinc) were impacted by suspected container contamination and were deemed unreliable following the reanalysis of a select sample. The second sampling event occurred in August 2021 following approximately 70 mm of rainfall. The purpose of this sampling event was to validate the basin's water quality characteristics given that there were suspected contamination issues with the samples collected in March 2021. No overflows occurred during this event.

The water quality results (excluding results that were deemed unreliable due to sample contamination) from both the March and August 2021 events were similar to the results presented in the SWVR (V3), except for:

- pH was marginally higher that the SWVR range in two of the five samples; and
- chromium and lead exceeded the DGV in one of the five samples. The DGV for these metals was not exceeded in the SWVR samples.

The water quality results and conclusion from this report have been used to inform a review of the water quality risk assessment that is documented in SWVR (V3). This review is provided in the Mayfield West Recycling Facility: Surface Water Validation Report Review Outcomes (EMM 2022).

References

ANZECC/ARMCANZ 2000, *Australian and New Zealand Guidelines for Fresh and Marine Water Quality*, Australian and New Zealand Environment Conservation Council and Agriculture and Resource Management Council of Australian and New Zealand.

ANZG 2018, *Australian and New Zealand Guidelines for Fresh and Marine Water Quality*, Australian and New Zealand Governments and Australian state and territory governments, https://www.waterquality.gov.au/anz-guidelines.

EMM 2020, *Mayfield West Recycling Facility – Surface water validation report (V3)*, prepared for Benedict Recycling Pty Ltd by EMM Consulting Pty Limited.

Annexure A

Certificates of Analysis

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **ES2110209**	Page	: 1 of 3
Client	: **Benedict Recycling Pty Ltd**	Laboratory	: Environmental Division Sydney
Contact	: JASON O'BRIEN	Contact	: Customer Services ES
Address	: Mayfield	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
Telephone	: ----	Telephone	: +61-2-8784 8555
Project	: J14152 MAYFIELD WEST FACILITY	Date Samples Received	: 22-Mar-2021 15:42
Order number	: ----	Date Analysis Commenced	: 22-Mar-2021
C-O-C number	: ----	Issue Date	: 29-Mar-2021 11:26
Sampler	: ----		
Site	: ----		
Quote number	: EN/333		
No. of samples received	: 1		
No. of samples analysed	: 1		

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted, unless the sampling was conducted by ALS. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Ankit Joshi	Inorganic Chemist	Sydney Inorganics, Smithfield, NSW
Celine Conceicao	Senior Spectroscopist	Sydney Inorganics, Smithfield, NSW

General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Sample ID	BASIN	----	----	----	----
				Sampling date / time	20-Mar-2021 10:00	----	----	----	----
Compound	CAS Number	LOR	Unit		ES2110209-001	--------	--------	--------	--------
					Result	----	----	----	----
EA005P: pH by PC Titrator									
pH Value	----	0.01	pH Unit		**7.46**	----	----	----	----
EA025: Total Suspended Solids dried at 104 ± 2°C									
Suspended Solids (SS)	----	5	mg/L		**6**	----	----	----	----
EA045: Turbidity									
Turbidity	----	0.1	NTU		**18.0**	----	----	----	----
EG020F: Dissolved Metals by ICP-MS									
Aluminium	7429-90-5	0.01	mg/L		**0.02**	----	----	----	----
Chromium	7440-47-3	0.001	mg/L		**0.001**	----	----	----	----
Copper	7440-50-8	0.001	mg/L		**0.023**	----	----	----	----
Lead	7439-92-1	0.001	mg/L		<0.001	----	----	----	----
Zinc	7440-66-6	0.005	mg/L		**0.014**	----	----	----	----
EK055G: Ammonia as N by Discrete Analyser									
Ammonia as N	7664-41-7	0.01	mg/L		**0.14**	----	----	----	----
EK057G: Nitrite as N by Discrete Analyser									
Nitrite as N	14797-65-0	0.01	mg/L		**0.02**	----	----	----	----
EK058G: Nitrate as N by Discrete Analyser									
Nitrate as N	14797-55-8	0.01	mg/L		**0.12**	----	----	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser									
Nitrite + Nitrate as N	----	0.01	mg/L		**0.14**	----	----	----	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser									
Total Kjeldahl Nitrogen as N	----	0.1	mg/L		**0.9**	----	----	----	----
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser									
^ **Total Nitrogen as N**	----	0.1	mg/L		**1.0**	----	----	----	----
EK067G: Total Phosphorus as P by Discrete Analyser									
Total Phosphorus as P	----	0.01	mg/L		**0.05**	----	----	----	----
EK071G: Reactive Phosphorus as P by discrete analyser									
Reactive Phosphorus as P	14265-44-2	0.01	mg/L		**0.02**	----	----	----	----
EP020: Oil and Grease (O&G)									
Oil & Grease	----	5	mg/L		<5	----	----	----	----

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **ES2110210**	Page	: 1 of 3
Client	: **Benedict Recycling Pty Ltd**	Laboratory	: Environmental Division Sydney
Contact	: JASON O'BRIEN	Contact	: Customer Services ES
Address	: Mayfield	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
Telephone	: ----	Telephone	: +61-2-8784 8555
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Site	: ----		
Quote number	: EN/333		
No. of samples received	: 1		
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Signatories

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Ankit Joshi	Inorganic Chemist	Sydney Inorganics, Smithfield, NSW
Celine Conceicao	Senior Spectroscopist	Sydney Inorganics, Smithfield, NSW
Neil Martin	Team Leader - Chemistry	Chemistry, Newcastle West, NSW

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^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Sample ID	BASIN	----	----	----	----
				Sampling date / time	22-Mar-2021 14:00	----	----	----	----
Compound	CAS Number	LOR	Unit		ES2110210-001	--------	--------	--------	--------
					Result	----	----	----	----
EA005: pH									
pH Value	----	0.01	pH Unit		**8.02**	----	----	----	----
EA025: Total Suspended Solids dried at 104 ± 2°C									
Suspended Solids (SS)	----	5	mg/L		**44**	----	----	----	----
EA045: Turbidity									
Turbidity	----	0.1	NTU		**47.1**	----	----	----	----
EG020F: Dissolved Metals by ICP-MS									
Aluminium	7429-90-5	0.01	mg/L		**0.14**	----	----	----	----
Chromium	7440-47-3	0.001	mg/L		**0.002**	----	----	----	----
Copper	7440-50-8	0.001	mg/L		**0.008**	----	----	----	----
Lead	7439-92-1	0.001	mg/L		**0.007**	----	----	----	----
Zinc	7440-66-6	0.005	mg/L		**0.042**	----	----	----	----
EK055G: Ammonia as N by Discrete Analyser									
Ammonia as N	7664-41-7	0.01	mg/L		**0.12**	----	----	----	----
EK057G: Nitrite as N by Discrete Analyser									
Nitrite as N	14797-65-0	0.01	mg/L		<0.01	----	----	----	----
EK058G: Nitrate as N by Discrete Analyser									
Nitrate as N	14797-55-8	0.01	mg/L		**0.15**	----	----	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser									
Nitrite + Nitrate as N	----	0.01	mg/L		**0.15**	----	----	----	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser									
Total Kjeldahl Nitrogen as N	----	0.1	mg/L		**2.2**	----	----	----	----
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser									
^ **Total Nitrogen as N**	----	0.1	mg/L		**2.4**	----	----	----	----
EK067G: Total Phosphorus as P by Discrete Analyser									
Total Phosphorus as P	----	0.01	mg/L		**0.07**	----	----	----	----
EK071G: Reactive Phosphorus as P by discrete analyser									
Reactive Phosphorus as P	14265-44-2	0.01	mg/L		**0.01**	----	----	----	----
EP020: Oil and Grease (O&G)									
Oil & Grease	----	5	mg/L		<5	----	----	----	----

Inter-Laboratory Testing

Analysis conducted by ALS Newcastle - Water, NATA accreditation no. 825, site no. 1656 (Chemistry) 9854 (Biology).

(WATER) EA005: pH

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **ES2110211**	Page	: 1 of 3
Client	: **Benedict Recycling Pty Ltd**	Laboratory	: Environmental Division Sydney
Contact	: JASON O'BRIEN	Contact	: Customer Services ES
Address	: Mayfield	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
Telephone	: ----	Telephone	: +61-2-8784 8555
Project	: J14152 MAYFIELD WEST FACILITY	Date Samples Received	: 22-Mar-2021 15:42
Order number	: ----	Date Analysis Commenced	: 23-Mar-2021
C-O-C number	: ----	Issue Date	: 29-Mar-2021 14:15
Sampler	: ----		
Site	: ----		
Quote number	: EN/333		
No. of samples received	: 1		
No. of samples analysed	: 1		

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted, unless the sampling was conducted by ALS. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

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Signatories	*Position*	*Accreditation Category*
Ankit Joshi	Inorganic Chemist	Sydney Inorganics, Smithfield, NSW
Celine Conceicao	Senior Spectroscopist	Sydney Inorganics, Smithfield, NSW

General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

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ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Sample ID	BASIN	----	----	----	----
				Sampling date / time	21-Mar-2021 10:00	----	----	----	----
Compound	CAS Number	LOR	Unit		ES2110211-001	--------	--------	--------	--------
					Result	----	----	----	----
EA005P: pH by PC Titrator									
pH Value	----	0.01	pH Unit		**7.43**	----	----	----	----
EA025: Total Suspended Solids dried at 104 ± 2°C									
Suspended Solids (SS)	----	5	mg/L		**32**	----	----	----	----
EA045: Turbidity									
Turbidity	----	0.1	NTU		**60.4**	----	----	----	----
EG020F: Dissolved Metals by ICP-MS									
Aluminium	7429-90-5	0.01	mg/L		**0.02**	----	----	----	----
Chromium	7440-47-3	0.001	mg/L		**0.002**	----	----	----	----
Copper	7440-50-8	0.001	mg/L		**0.033**	----	----	----	----
Lead	7439-92-1	0.001	mg/L		**0.001**	----	----	----	----
Zinc	7440-66-6	0.005	mg/L		**0.031**	----	----	----	----
EK055G: Ammonia as N by Discrete Analyser									
Ammonia as N	7664-41-7	0.01	mg/L		**0.07**	----	----	----	----
EK057G: Nitrite as N by Discrete Analyser									
Nitrite as N	14797-65-0	0.01	mg/L		**0.02**	----	----	----	----
EK058G: Nitrate as N by Discrete Analyser									
Nitrate as N	14797-55-8	0.01	mg/L		**0.12**	----	----	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser									
Nitrite + Nitrate as N	----	0.01	mg/L		**0.14**	----	----	----	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser									
Total Kjeldahl Nitrogen as N	----	0.1	mg/L		**1.1**	----	----	----	----
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser									
^ Total Nitrogen as N	----	0.1	mg/L		**1.2**	----	----	----	----
EK067G: Total Phosphorus as P by Discrete Analyser									
Total Phosphorus as P	----	0.01	mg/L		**0.07**	----	----	----	----
EK071G: Reactive Phosphorus as P by discrete analyser									
Reactive Phosphorus as P	14265-44-2	0.01	mg/L		**0.02**	----	----	----	----
EP020: Oil and Grease (O&G)									
Oil & Grease	----	5	mg/L		<5	----	----	----	----

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **ES2110386**	Page	: 1 of 3
Client	: **Benedict Recycling Pty Ltd**	Laboratory	: Environmental Division Sydney
Contact	: JASON O'BRIEN	Contact	: Customer Services ES
Address	: Mayfield	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
Telephone	: ----	Telephone	: +61-2-8784 8555
Project	: J14152 MAYFIELD WEST FACILITY	Date Samples Received	: 23-Mar-2021 14:36
Order number	: ----	Date Analysis Commenced	: 23-Mar-2021
C-O-C number	: ----	Issue Date	: 30-Mar-2021 13:22
Sampler	: HEATH NOWLAN		
Site	: ----		
Quote number	: EN/333		
No. of samples received	: 1		
No. of samples analysed	: 1		

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

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Signatories	*Position*	*Accreditation Category*
Ankit Joshi	Inorganic Chemist	Sydney Inorganics, Smithfield, NSW
Celine Conceicao	Senior Spectroscopist	Sydney Inorganics, Smithfield, NSW
Neil Martin	Team Leader - Chemistry	Chemistry, Newcastle West, NSW

General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

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LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Sample ID	BASIN	----	----	----	----
				Sampling date / time	23-Mar-2021 14:00	----	----	----	----
Compound	CAS Number	LOR	Unit		ES2110386-001	--------	--------	--------	--------
					Result	----	----	----	----
EA005: pH									
pH Value	----	0.01	pH Unit		**9.97**	----	----	----	----
EA025: Total Suspended Solids dried at 104 ± 2°C									
Suspended Solids (SS)	----	5	mg/L		**58**	----	----	----	----
EA045: Turbidity									
Turbidity	----	0.1	NTU		**96.6**	----	----	----	----
EG020F: Dissolved Metals by ICP-MS									
Aluminium	7429-90-5	0.01	mg/L		**0.03**	----	----	----	----
Chromium	7440-47-3	0.001	mg/L		**0.002**	----	----	----	----
Copper	7440-50-8	0.001	mg/L		**0.034**	----	----	----	----
Lead	7439-92-1	0.001	mg/L		<0.001	----	----	----	----
Zinc	7440-66-6	0.005	mg/L		**0.013**	----	----	----	----
EK055G: Ammonia as N by Discrete Analyser									
Ammonia as N	7664-41-7	0.01	mg/L		**0.19**	----	----	----	----
EK057G: Nitrite as N by Discrete Analyser									
Nitrite as N	14797-65-0	0.01	mg/L		**0.02**	----	----	----	----
EK058G: Nitrate as N by Discrete Analyser									
Nitrate as N	14797-55-8	0.01	mg/L		**0.12**	----	----	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser									
Nitrite + Nitrate as N	----	0.01	mg/L		**0.14**	----	----	----	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser									
Total Kjeldahl Nitrogen as N	----	0.1	mg/L		**2.2**	----	----	----	----
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser									
^ **Total Nitrogen as N**	----	0.1	mg/L		**2.3**	----	----	----	----
EK067G: Total Phosphorus as P by Discrete Analyser									
Total Phosphorus as P	----	0.01	mg/L		**0.12**	----	----	----	----
EK071G: Reactive Phosphorus as P by discrete analyser									
Reactive Phosphorus as P	14265-44-2	0.01	mg/L		<0.01	----	----	----	----
EP020: Oil and Grease (O&G)									
Oil & Grease	----	5	mg/L		<5	----	----	----	----

Inter-Laboratory Testing

Analysis conducted by ALS Newcastle - Water, NATA accreditation no. 825, site no. 1656 (Chemistry) 9854 (Biology).

(WATER) EA005: pH

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **ES2130905**	Page	: 1 of 3
Client	: **Benedict Recycling Pty Ltd**	Laboratory	: Environmental Division Sydney
Contact	: Heath Nowlan	Contact	: Customer Services ES
Address	: Mayfield	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
Telephone	: ----	Telephone	: +61-2-8784 8555
Project	: J14152 MAYFIELD WEST FACILITY	Date Samples Received	: 25-Aug-2021 13:05
Order number	: ----	Date Analysis Commenced	: 25-Aug-2021
C-O-C number	: ----	Issue Date	: 31-Aug-2021 13:46
Sampler	: Pat Carolan		
Site	: ----		
Quote number	: EN/333		
No. of samples received	: 2		
No. of samples analysed	: 2		

Accreditation No. 825
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Ankit Joshi	Inorganic Chemist	Sydney Inorganics, Smithfield, NSW
Ivan Taylor	Analyst	Sydney Inorganics, Smithfield, NSW
Neil Martin	Team Leader - Chemistry	Chemistry, Newcastle West, NSW

General Comments

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Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Sample ID	Basin	QA1	----	----	----
			Sampling date / time	25-Aug-2021 12:15	25-Aug-2021 00:00	----	----	----
Compound	CAS Number	LOR	Unit	ES2130905-001	ES2130905-002	--------	--------	--------
				Result	Result	----	----	----
EA005: pH								
pH Value	----	0.01	pH Unit	**9.29**	----	----	----	----
EA025: Total Suspended Solids dried at 104 ± 2°C								
Suspended Solids (SS)	----	5	mg/L	**18**	----	----	----	----
EA045: Turbidity								
Turbidity	----	0.1	NTU	**20.0**	----	----	----	----
EG020F: Dissolved Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	**0.02**	**0.02**	----	----	----
Chromium	7440-47-3	0.001	mg/L	**0.005**	**0.005**	----	----	----
Copper	7440-50-8	0.001	mg/L	**0.005**	**0.005**	----	----	----
Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	----	----	----
Zinc	7440-66-6	0.005	mg/L	<0.005	<0.005	----	----	----
EK055G: Ammonia as N by Discrete Analyser								
Ammonia as N	7664-41-7	0.01	mg/L	**0.17**	----	----	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	**0.31**	----	----	----	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	0.1	mg/L	**1.9**	----	----	----	----
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser								
^ Total Nitrogen as N	----	0.1	mg/L	**2.2**	----	----	----	----
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	0.01	mg/L	**0.04**	----	----	----	----
EK071G: Reactive Phosphorus as P by discrete analyser								
Reactive Phosphorus as P	14265-44-2	0.01	mg/L	<0.01	----	----	----	----
EP020: Oil and Grease (O&G)								
Oil & Grease	----	5	mg/L	<5	----	----	----	----

Inter-Laboratory Testing

Analysis conducted by ALS Newcastle - Water, NATA accreditation no. 825, site no. 1656 (Chemistry) 9854 (Biology).

(WATER) EA005: pH

Email from ALS

My apologies, please see below:

Analyte	Units	Rep. LOR	**RED ORIGINAL**	**RED RPT**	**RED RPT DUP**	**GREEN 0.1um RPT**	**GREEN 0.1um RPT DUP**	**GREEN 0.45um RPT**	**GREEN 0.45um RPT DUP**
Copper	mg/L	0.001	0.033	0.037	0.036	0.004	0.003	0.004	0.003
Zinc	mg/L	0.005	0.031	0.011	0.011	0.005	0.009	0.009	0.007

So it would appear that the issue is with the red bottle. Most likely something about the field process for the red bottle is causing the results discrepancy.

Email from EMM

We received results for several workorders (ES2110209, ES2110210, ES2110211 and ES2110386) this week with dissolved copper concentrations that are unusually high compared to typical concentrations observed on site. Three out of the four workorders are subject to the higher copper concentrations.

The red metals bottles used in these sampling rounds were obtained from ALS at the same time as another batch which were investigated for copper contamination. The ALS investigation concluding there may be a copper contamination in the bottles (see attached email correspondence).

Could you please re-run the dissolved copper analysis for workorder ES2110211 using the original metals bottle and the unpreserved green container to confirm the results. Could you also please do the same for zinc which was higher than expected.

Let me know if there are any issues.

Regards,

Appendix C

Water balance update report

Mayfield West Recycling Facility

Water balance update

Prepared for Benedict Recycling Pty Limited
March 2022

EMM Newcastle
Level 3, 175 Scott Street
Newcastle NSW 2300

T 02 4907 4800
E info@emmconsulting.com.au

www.emmconsulting.com.au

Mayfield West Recycling Facility

Water balance update

Report Number

J14152 RP23

Client

Benedict Recycling Pty Limited

Date

11 March 2022

Version

v3 Final

Prepared by

Jason O'Brien
Water Resources Engineer
11 March 2022

Approved by

Chris Kuczera
Associate Water Resources Engineer
11 March 2022

Table of Contents

Tables

Figures

1 Introduction

Benedict Recycling Pty Ltd (Benedict) owns and operates a resource recovery facility at 1a McIntosh Drive, Mayfield West (hereinafter referred to as the facility or site). A Surface Water Validation Report (SWVR) was prepared in 2020 in consultation with the NSW Environment Protection authority (EPA). SWVR (V3) was submitted to the EPA on 20 November 2020 and included a commitment to update the site water balance and undertake a further review of the water management system once the water balance is updated. The SWVR included commitments to monitor water levels in the Site's stormwater basin (the basin) and to undertake water quality monitoring if overflows from the basin occur. Data was collected between 18 December 2020 to 31 January 2022 (the Monitoring Period) and was used to inform both the water balance update and the further review of the water management system.

This report describes the water balance model (WBM) update. The objective of the WBM update is to assess the design capacity of the Site's water management system relative to the 5-day 90th percentile rainfall depth that is referenced in Consent Condition 25 (the design rainfall event). This assessment is relevant to reviewing the recommendations in the SWVR (V3).

The following approach was applied to update the Site WBM:

1. A continuous water level logger was installed in the Site's water management basin on 18 December 2020. The logger records the water level in the basin at 10-minute intervals and provides high resolution information on changes in the basin water level during and after runoff events. Runoff volumes and event-based runoff coefficients for the Site were calculated from this data.

2. The water level logger data and other relevant information collected over the 18 December 2020 to 26 August 2021 period was applied to develop, calibrate and validate a WBM. A predictive model was then developed using a 50-year rainfall timeseries.

3. The capacity of the Site's water management system was assessed by:

    a) calculating the basin capacity using the event-based runoff coefficients and other Site information; and

    b) calculating an overflow frequency using the predictive WBM.

These calculated values were used to assess the capacity of the Site's water management system relative to the design rainfall event (ie the 5-day 90th percentile rainfall depth).

This report is a technical appendix to the Mayfield West Recycling Facility: Surface Water Validation Report Review Outcomes (EMM 2022), which addresses the commitments made in the SWVR. Chapter 2 describes the data used to inform the assessment, Chapter 3 describes the model, development, calibration and validation and Chapter 4 assesses the design capacity of the Site's water management system.

The additional water quality monitoring is documented in a separate technical appendix.

2 Available data

This chapter describes the following data:

- weather (ie rainfall and evaporation data) that was used to inform the WBM calibration and validation, as well as the predictive model; and
- basin water level data that was used to calibrate and validate the WBM model and calculate event-based runoff coefficients for the Site.

2.1 Weather data

2.1.1 Rainfall

Rainfall data from the Site's weather station and regional gauges was used in this assessment. The Site data (when available) was used to calibrate and validate the model. The regional data was used to supplement the Site data and for the predictive model, which applies a 50-year simulation period.

The following sections describe the regional and Site rainfall data.

i Regional rainfall data

There are several Bureau of Meteorology (BoM) operated rainfall gauges that provide representative records for the facility. Key information and statistical data for three local gauges are provided in Table 2.1.

Table 2.1 Local rainfall statistics

Statistic	Units	Newcastle University (61390)	Williamtown RAAF (61078)	Newcastle Nobbys AWS (61055)
Rainfall record		1998 – Apr 2021	1942 – present	1862 – present
Distance from the Site		2.0 km south-west	14.5 km north-east	7.8 km east
Elevation	(m AHD)	21	8	33
Average rainfall	(mm/year)	1,130	1,122	1,118
Lowest rainfall	(mm/year)	659	541	597
5th percentile rainfall	(mm/year)	851	743	744
10th percentile rainfall	(mm/year)	938	788	792
Median rainfall	(mm/year)	1,068	1,088	1,048
90th percentile rainfall	(mm/year)	1,371	1,467	1,537
95th percentile rainfall	(mm/year)	1,409	1,552	1,617
Highest rainfall	(mm/year)	1,517	1,794	1,919

Source: BoM website (climate data online).

Comparison of the rainfall statistics in Table 2.1 indicate rainfall records for the three gauges correlate well with average and median annual rainfall being similar for all three gauges. Wet and dry weather extremes are shown to

vary more for the Williamtown RAAF and Newcastle Nobbys AWS gauges due to the longer rainfall record capturing a larger range of weather conditions.

Daily rainfall data for the three rainfall gauges presented in Table 2.1 was obtained as SILO (Scientific Information for Land Owners) Patched Point Data from the Queensland Climate Change Centre of Excellence. SILO Patched Point Data is based on historical data from the BoM rainfall stations, with missing data 'patched' in by interpolating data from nearby station records. The SILO data provided rainfall depths for periods in the BoM records where data is missing, resulting in a continuous rainfall record at each gauge.

The SILO data was used to calculate annual rainfall totals at each of the gauges over the coinciding available record (1998 to 2020) and is presented in Figure 2.1. Annual rainfall totals, including during wet and dry years, are shown to be similar for the three gauges over the 1998 to 2020 period. However, some variation is experienced due to local variation in rainfall.

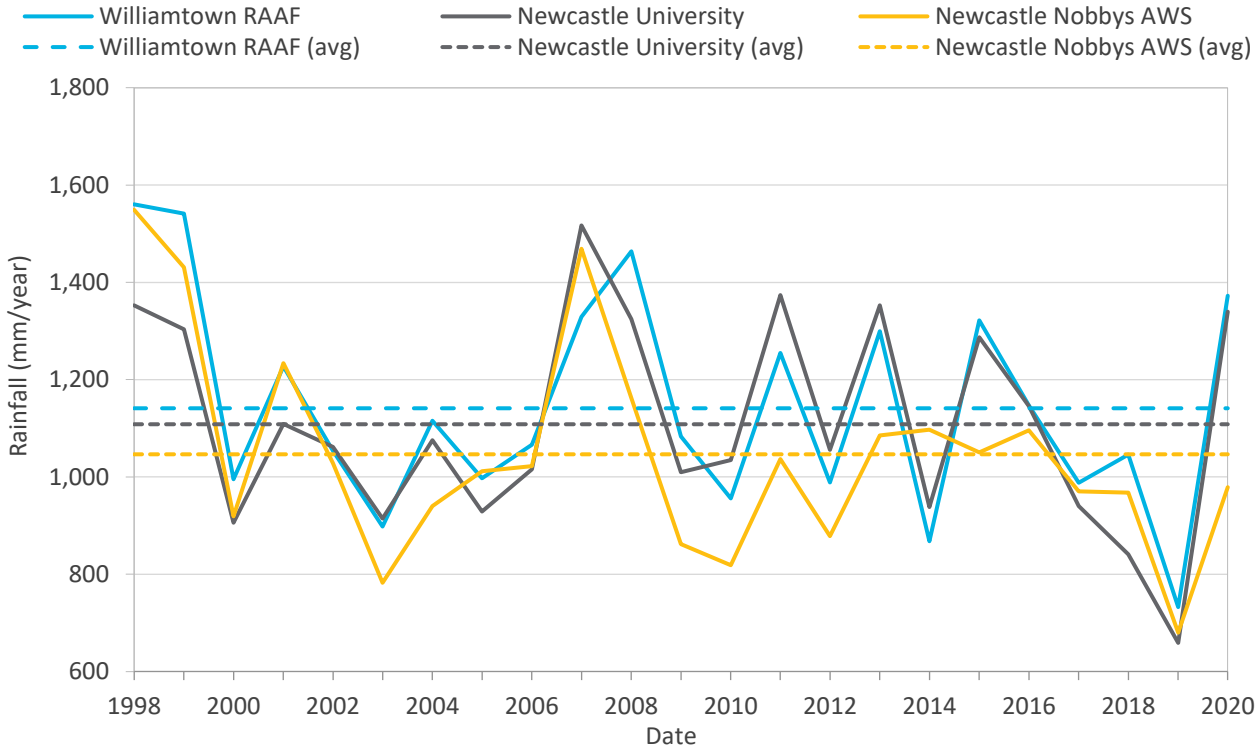

Figure 2.1 Comparison of local rainfall gauge data (1998–2020)

Rainfall data (from 1970 to 2020) from the Williamtown RAAF gauge has been applied to the predictive WBM due to the length of available record (50 plus years) and similarity to the observed Site rainfall data (discussed below). While the Newcastle Nobbys AWS gauge is closer to the facility and has a substantial historical rainfall record, the gauge's location is expected to experience a greater influence from coastal rainfall than the facility and Williamtown RAAF gauge, which are both located a few kilometres inland. The Newcastle University gauge commenced operation in 1998 and does not have an available post April 2021 record.

ii Site rainfall data

Data from the Site's rainfall gauge was available for the entire data collection period except for the initial five days (18 to 22 December 2022). This data was used to inform calibration and validation of the WBM. The Site weather gauge records rainfall at 15-minute intervals. Daily rainfall totals were calculated from the 15-minute interval data and are compared against the Williamtown RAAF rainfall gauge (Figure 2.2).

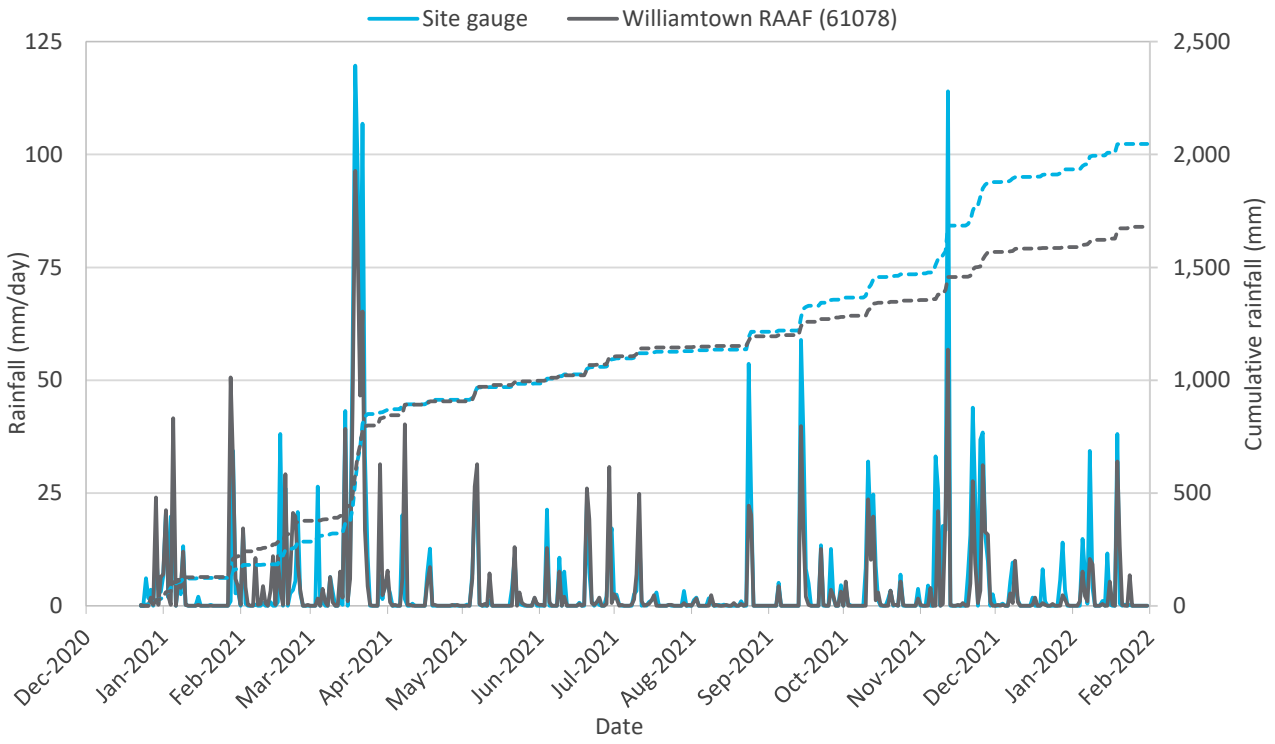

Figure 2.2 Available Site rainfall data – December 2020 to January 2022

The rainfall data presented in Figure 2.2 indicates:

- The magnitude and timing of rainfall events is similar between the two gauges. As expected, there is some variation in the daily rainfall totals due to spatial variation in rainfall.
- The long-term rainfall depth (cumulative rainfall) is similar at both gauges for the December 2020 to November 2021 period. The cumulative rainfall at the Site exceeds the Williamtown RAAF gauge from November 2021 onwards. This may be due to localised variation in rainfall associated with summer storms.

In summary, the Site rainfall data is considered to be reliable and data from the Williamtown RAAF gauge is considered to be representative of the long-term rainfall regime at the Site.

2.1.2 Evaporation

Daily evaporation rates were obtained as SILO patched point data at the Williamtown RAAF gauge over the 1970 to 2021 period. Evaporation data was sourced as Class A pan evaporation. Mean monthly evaporation values at Williamtown RAAF are shown in Figure 2.3. Average monthly evaporation is shown to exceed average monthly rainfall for most of the year (July to March). Rainfall is shown to exceed evaporation from April to June. Daily SILO Class A pan evaporation data from the Williamtown RAAF gauge has been applied to the WBM.

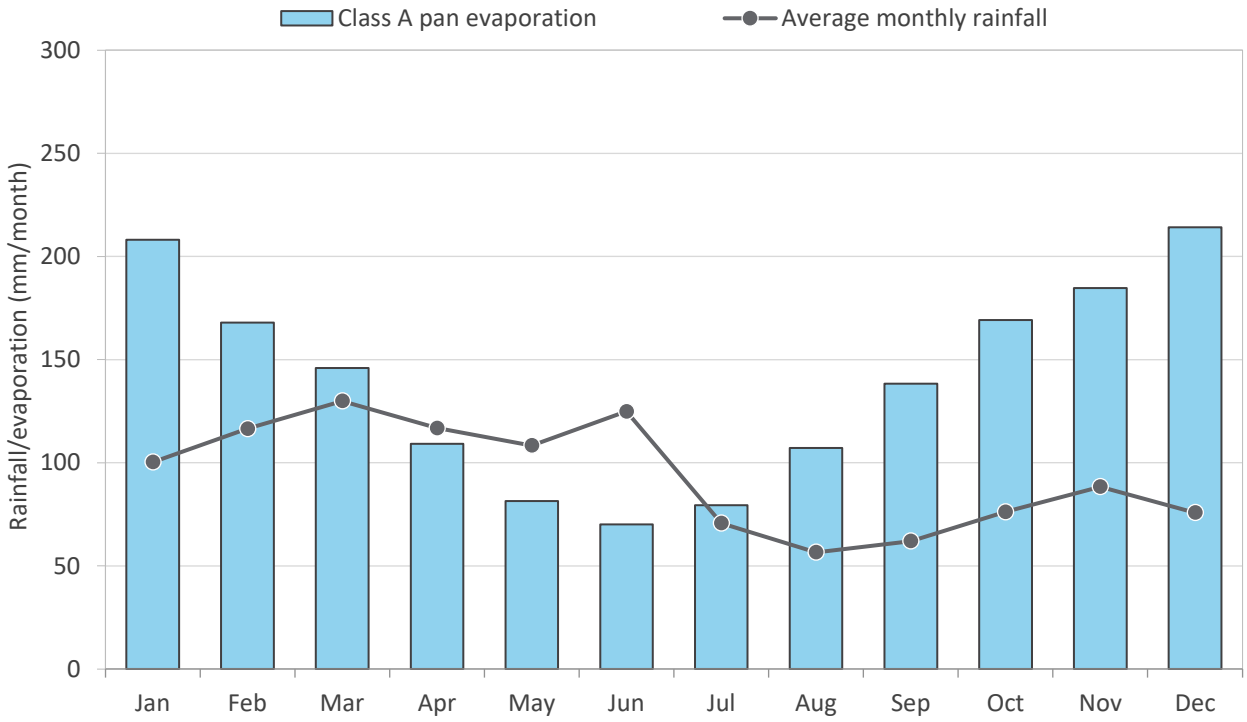

Figure 2.3 Average monthly evaporation rates – Williamtown RAAF (1970–2020)

2.2 Basin water level monitoring

2.2.1 Observed water level

EMM installed a Solinst Levelogger 5 water level logger in the basin on 18 December 2020. The water level logger was fixed to the basin outlet structure and the logger was installed near the bottom of the basin. A Solinst Barologger 5 was installed adjacent to the basin to allow for atmospheric compensation of the water level logger data. The recorded basin water level (relative to the floor of the basin) over the monitoring period is shown in Figure 2.4. The WBM model calibration and Validation Period, key rainfall events and the date of completion of basin repair works (discussed in Section 2.2.2) are noted. It is also noted that a period of data is missing between 4 January and 4 February 2021 due to a technical issue with the logger software.

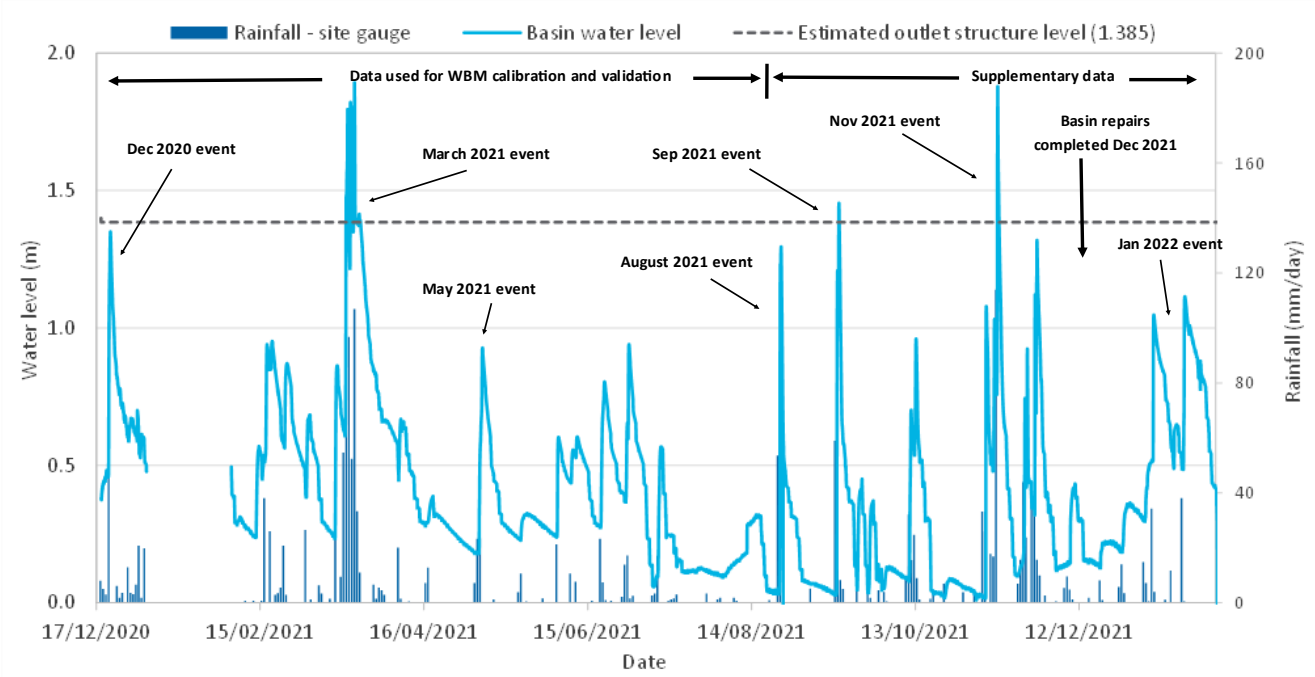

Figure 2.4 Observed basin water level

The recorded water level data indicates that the basin water level exceeded the outlet structure during the March 2021, September 2021 and November 2021 events. Benedict advised that discharges only occurred during the March 2021 event. Discharges were avoided during the September and November 2021 events by holding water above the outlet structure (which can be manually opened and closed).

The 2020/2021 data also identified that the basin was leaking, particularly at higher water levels. The basin leakage analysis is described below.

2.2.2 Basin leakage

i Observed leakage rates

The 2020/2021 basin water level monitoring data identified that the basin was leaking. To enable the data to be used for model calibration purposes, the magnitude of the leak was determined by calculating the change in water level each day for days without any influence of runoff or water extraction (censored data). The censored change in water level was adjusted for evaporation losses with the remaining loss assumed to be associated with leakage. The resulting estimated daily leakage rates are presented in Figure 2.5. This analysis shows that material leaks occurred when the basin water level was above 0.6 m and the leak rate increased with water level.

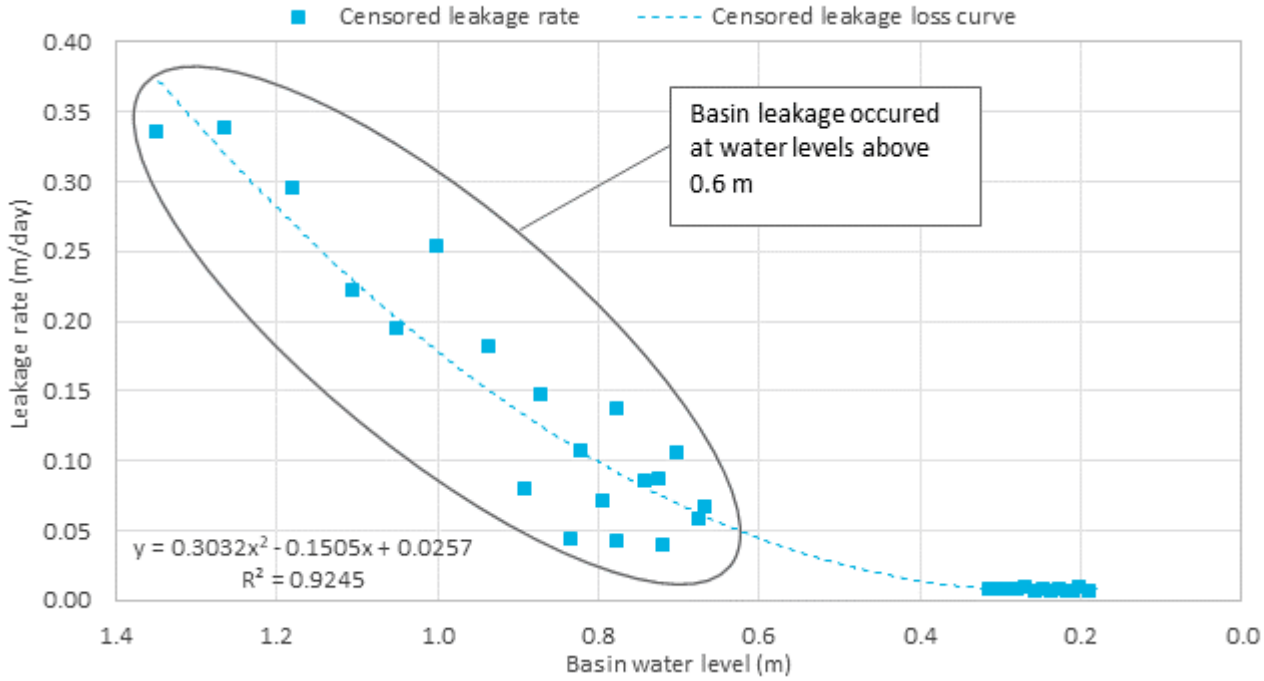

Figure 2.5 2020/2021 Basin leakage rate

ii Basin repairs

Benedict has repaired the basin, using concrete lining to seal cracks that may have facilitated any leaks. The repair works were completed in December 2021. The Site received approximately 40 mm of rainfall in a 24-hour period from 18 to 19 January 2022 causing the basin water level to rise to about 1.1 m. A review of the resulting water level drawdown identified that the repair works have been successful in reducing the leak rate five-fold, however, the monitoring data identified that some leakage still occurs (at substantially lower rates) when the basin water level is above 0.8 m. The basin catchment system will always require regular maintenance and Benedict are conducting further investigations with a purpose of enhancing the repair works already undertaken.

2.2.3 Event based runoff coefficients

A runoff coefficient is a term used to describe the portion of rainfall that converts to runoff in a catchment. Runoff coefficients will vary significantly for the various land surfaces within the Site. Impervious surfaces such as the shed and building roofs and the perimeter road would have high coefficients, while the stockpiles would have very low coefficients as most rainfall is absorbed in the stockpiled material. Rainfall intensity, antecedent conditions and seasonality can also influence coefficients.

Event-based runoff coefficients for the Site were calculated for eight rainfall events that resulted in material inflows into the basin. For each event the runoff coefficient was calculated based on the estimated rainfall and runoff volumes. The rainfall volumes were calculated using data from the Site's weather station and the known catchment area to the basin. Runoff volumes were calculated as the change in storage volume from the start of the event to the peak basin water level plus the estimated leakage losses over the rising limb of the water level hydrograph. The runoff coefficients were calculated as a function of the calculated rainfall and runoff volumes.

Table 2.2 provides the calculated coefficients and other key information.

It is noted that a runoff coefficient for the significant March 2021 rainfall event (that comprised more than 400 mm of rainfall) was not calculated as the volume of basin overflows that occurred during this event could not be reliably calculated from the water level data.

Table 2.2 Event based runoff coefficients

Rainfall event	Rainfall depth (mm)	Rainfall volume (ML)	Estimated runoff volume (ML)	Event runoff coefficient
Dec 2020	70	5.5	1.6	0.29
Mar 2021(15th)	43	3.4	1.0	0.30
May 2021	47	3.7	1.2	0.33
Aug 2021	78	6.2	2.1	0.33
Sept 2021	97	7,643	2,471	0.32
Nov 2021	91	7,199	2,341	0.33
Jan 2022 (8th)	34	2,717	810	0.30
Jan 2022 (19th)	38	3,018	972	0.32
Average	**63**	**5,011**	**1,580**	**0.32**

The calculated event-based coefficients ranged from 0.29 to 0.33 and averaged 0.32. This coefficient is in line with expectations for the Site. The average event-based coefficient was applied to calculate the design capacity of the Site's water management system (see Chapter 4). It should be noted that this coefficient should only be applied to rainfall events that range from say 30 to 100 mm. The average annual runoff coefficient would be much lower as proportionally less runoff occurs during smaller rainfall events.

3 Model development

3.1 Overview

A WBM was developed in GoldSim version 12.1 (GoldSim Technology 2017). The model was developed to be representative of the Site's water management system that is described in the SWVR. The rainfall runoff component of the model was calibrated and validated using available data (described in Chapter 2). A predictive model was then developed to assess the design capacity of the Site's water management system relative to the 5-day 90th percentile rainfall depth.

This chapter describes the model and its calibration and validation. The predictive model results are provided in Chapter 4.

3.2 Model description

3.2.1 Goldsim model

The water balance model applies a continuous simulation methodology to simulates the response of the water management system under a range of weather conditions (ie rainfall and evaporation). The model has been created by representing each process of the water management system with pre-determined responses that reflect how the water management system is operated.

Rainfall and evaporation are the key environmental variables applied to the model. The response of the system to these variables is evaluated by investigating specific outputs across the system over the simulation timeframe.

3.2.2 Time step and simulation time

The calibration and validation models simulated the water management system from 18 December 2020 to 26 August 2021 using observed Site data and hourly time steps.

The predictive model simulated the water management system using 50 years of historical weather data with hourly time steps.

3.2.3 Water management system

The water balance model has been used to simulate the performance of the water management system described in the SWVR. The water management system framework is shown in Figure 3.1. Each of the key water management system features is discussed further in Section 3.3.

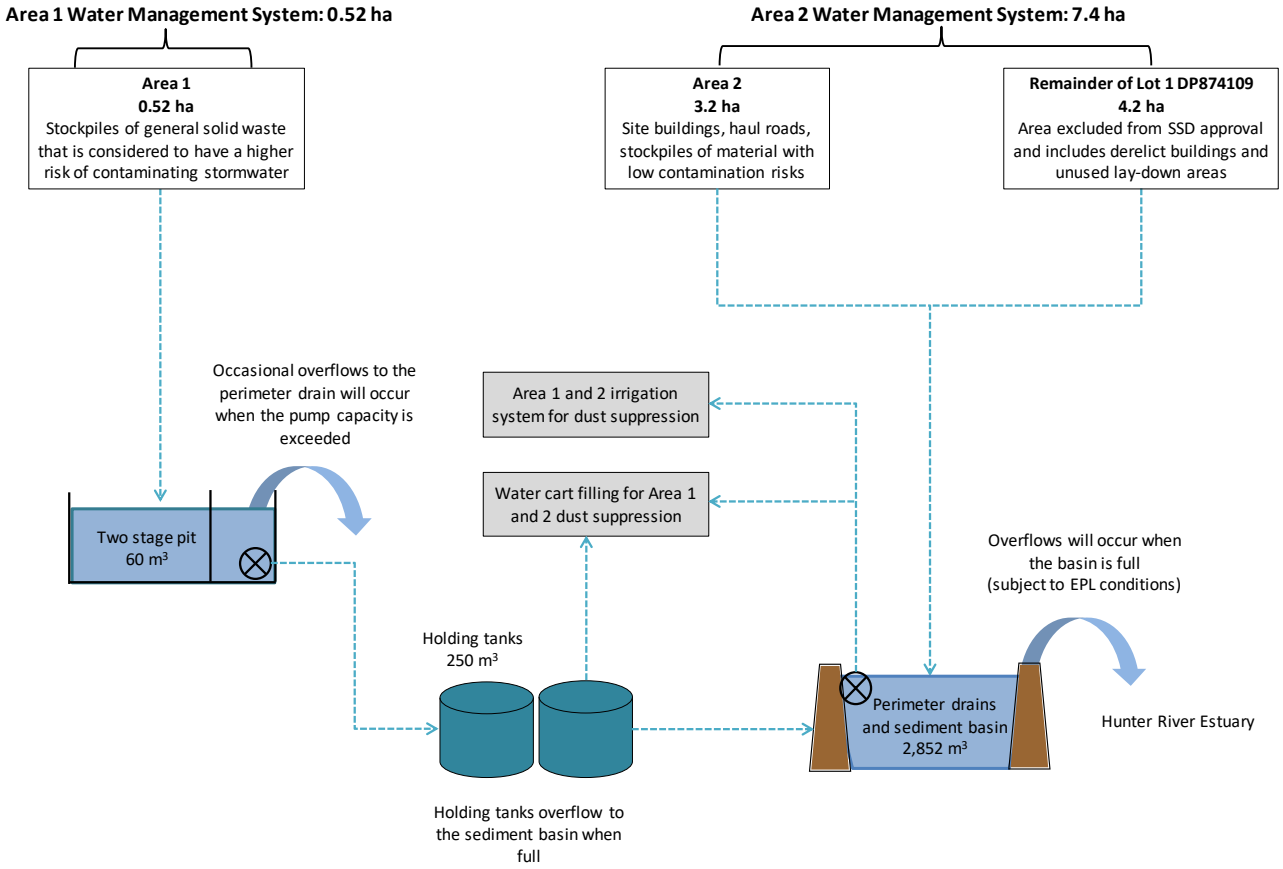

Figure 3.1 **Water management system framework**

3.3 Model assumptions

3.3.1 Rainfall runoff model (AWBM)

Surface runoff was estimated using the Australian Water Balance Model (AWBM). The AWBM is a 'bucket model'. It describes runoff processes using the concept of surface stores (buckets), which trap rainfall and must fill before runoff can occur. Spatial variability is incorporated by using three stores, each with a different capacity (C1, C2 and C3) and partial areas (A1, A2 and A3, where A1+A2+A3=1). Hence, some portions of the Site will generate runoff after only a small depth of rain has fallen (eg building roofs), while other parts of the Site only generate runoff after significant ponds have formed and overflowed (eg stockpile areas).

Since the AWBM is a continuous simulation model, antecedent moisture conditions within the catchment are tracked over time within the stores such that catchment wetness from preceding rainfall affects runoff generated by subsequent rainfall. For example, the first day of rain after a dry summer may generate a lower percentage of runoff than subsequent days of rainfall.

A schematic of how the AWBM represents rainfall runoff is shown in Figure 3.2. Calibration of the AWBM and parameter values applied to each land use category at the Site (hardstand, yard and stockpile) are discussed further in Section 3.4.

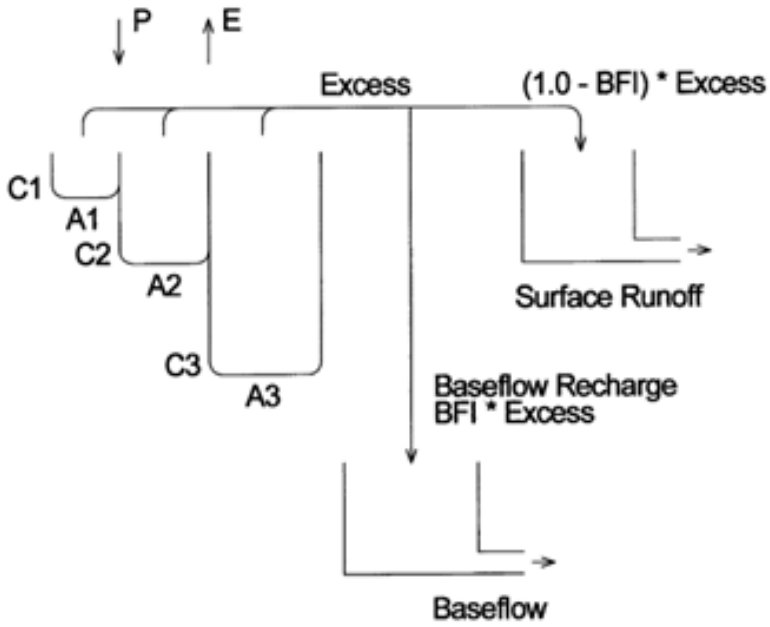

Figure 3.2 Schematic of the AWBM rainfall runoff representation (Boughton 2004)

3.3.2 Water management system

i Water management areas

The water management area characteristics applied to the WBM are described in Table 3.1.

Table 3.1 Water management area characteristics

			Land use category		
Catchment	**Area (ha)**	**Land-use**	**Stockpile**	**Yard**	**Hardstand**
Area 1	0.52	Stockpiles of general solid waste that is considered to have a higher risk of contaminating stormwater.	100%	0%	0%
Area 2	3.2	Site buildings, haul roads, stockpiles of material with low contamination risks.	30%	50%	20%
Remainder of the lot	4.2	Area excluded from SSD approval and includes unused buildings and lay-down areas.	0%	50%	50%

ii Storages

The water management system storages included in the water balance model are described in Table 3.2.

Table 3.2 Water management system storages

Storage ID	Description	Modelled storage volume (kL)	Overflows to
Two stage pit	Sump pit that receives runoff from Area 1 prior to being pumped to the holding tanks.	60	Basin
Holding tanks	Storage tanks used to hold runoff from Area 1. Water in tanks is used for dust suppression.	250	Basin
Basin	Sediment basin that captures runoff from Area 2 and overflows from Area 1.	2,852	Hunter River estuary

iii Water demand

Water is sourced from the holding tanks and basin for onsite dust suppression. Dust suppression is assumed to be required for all of Area 1 and the stockpile and yard portions of Area 2. Dust suppression application rates were calculated using to the following equation:

Dust Suppression (t) = [(Evaporation (t) – Rainfall (t)] x Area

Where:

Evaporation (t) = evaporation rate

Rainfall (t) = rainfall rate

Area = 3 ha

Dust suppression water is sourced from the holding tanks and basin via water carts, and from the basin via an irrigation system. For modelling purposes, dust suppression demand sourced via watercart, or the irrigation system are not differentiated.

Dust suppression demand is assumed to be preferentially sourced from the holding tanks. Dust suppression demand is sourced from the basin if the holding tanks are empty.

iv Transfers

Water transfer between storages, demands and sources are controlled using transfer rules based on storage levels, demand requirements and availability. The transfer rules and rates adopted in the WBM are described in Table 3.3.

Table 3.3 Assumed transfer rates

Transfer from	Transfer to	Description
Two-stage pit	Holding tanks	Assumed to occur at the Area 1 runoff rate until the holding tanks are full.
Holding tanks	Dust suppression	Assumed to occur at the dust suppression demand rate and is limited by the available water stored in the holding tanks.
Basin	Dust suppression	Assumed to occur at the dust suppression rate less the volume supplied from the holding tanks.

3.3.3 Basin leakage

The water balance update monitoring program identified the basin was leaking (refer to Section 2.2). Basin leakage was included in the calibration and validation models as the leak was not repaired until December 2021, after the calibration and Validation Period. Leakage losses were applied to the model using the second order polynomial water level to leakage loss rate relationship shown in Figure 2.5. Zero leakage was assumed to occur when the basin water level is less than 0.15 m.

No basin leakage was assumed in the predictive model that was developed to calculate a site overflow frequency. This approach is conservative in terms of calculating overflow frequency as any leak would reduce the frequency and magnitude of basin overflows.

3.4 Model calibration and validation

3.4.1 Overview

Model calibration and validation improves the reliability of the WBM. The model was calibrated using available data from 18 December 2020 to 1 January 2021 (the Calibration Period) and validated using available data from the 4 February 2021 to 26 August 2021 (the Validation Period). This section describes the WBM calibration and validation process and results.

3.4.2 Data and assumptions

The data and assumptions used to calibrate and validate the WBM are described in Table 3.4.

Table 3.4 Calibration and validation data

Rainfall	**Calibration Period** (18 December 2020 to 1 January 2021) • Daily rainfall obtained as SILO data at Williamtown RAAF and Newcastle University was used for the Calibration Period from 18 December 2020 to 23 December 2021 – this is discussed further in Section 3.4.3. • Site rainfall data was used for the Calibration Period from 23 December 2020 to 1 January 2021. **Validation Period** (4 February 2021 to 26 August 2021) • Site rainfall data was used for the entire Validation Period.

Table 3.4 Calibration and validation data

Evaporation	• Daily pan evaporation rates obtained as SILO data (refer to Section 2.1.2) at Williamtown RAAF gauge was used for both the calibration and Validation Periods.
Storage water level	• Basin water levels from 18 December 2020 to 26 August 2021 (refer to Section 2.2).
Site observations	• Number of daily water cart loads sourced from holding tanks and basin from 23 December to 18 February 2021.[1]

3.4.3 Rainfall and runoff

i Rainfall applied to Calibration Period

Site rainfall data was used to inform the Calibration Period from 23 December onwards. As Site rainfall data was not available prior to 23 December, weighted daily rainfall totals from the BoM operated Williamtown RAAF and Newcastle University rainfall gauges (refer to Section 2.1.1) were applied to the WBM from 17–23 December 2020. Gauge weightings were based on distance to Site with the Williamtown RAAF and Newcastle University gauges having a 12% and 88% weighting respectively. The weighted rainfall totals applied to the WBM are presented in Table 3.5.

Table 3.5 Calibration weighted rainfall totals

	Rainfall depth (mm)		
Date[1]	**Williamtown RAAF**	**Newcastle University**	**Applied to calibration**
17 December 2020	13.6	6.0	6.9
18 December 2020	8.0	10.0	9.8
19 December 2020	5.0	7.2	6.9
20 December 2020	3.0	2.6	2.6
21 December 2020	48.6	73.2	70.2
22 December 2020	0.2	0.0	0.0

Notes: 1. Rainfall totals shifted one day earlier.

The BoM website (climate data online) reports rainfall totals for the preceding 24 hours to 9 am while the WBM calculates rainfall from 12 am for the following 24 hours. To rectify this difference and match the BoM reported rainfall totals to the water level rise that occurred in the basin on 21 December 2020, the BoM reported rainfall totals were shifted one day early in Table 3.5.

As the WBM uses a 1-hour timestep (refer to Section 3.2.2), the daily rainfall totals shown in Table 3.5 were assumed to be evenly distributed throughout the day. Hourly rainfall totals from the Site weather gauge were applied from the 22 December 2020 onwards.

ii AWBM runoff model parameters

As described in Section 3.3.1, the AWBM is used to estimate catchment runoff. The AWBM is defined by nine parameters: three soil storage capacities, three partial areas, and three recession parameters. The AWBM parameters were calibrated to reflect the different hydrological responses of each of the three land use types

included in the WBM. The AWBM parameters for each land use were manually adjusted until a reasonable calibration was achieved (refer to Section 3.4.4). The adopted AWBM parameters are provided in Table 3.6.

Table 3.6 Adopted AWBM parameter values

	Recession parameters			Partial areas			Soil storage capacities		
Land use	**BFI**	**K_{base}**	**K_{surf}**	**A1**	**A2**	**A3**	**C1**	**C2**	**C3**
Hardstand	0	0	0.3	0.3	0.3	0.4	0	40	115
Yard	0	0	0.4	0.1	0.3	0.6	15	85	160
Stockpile	0.5	0.95	0.4	0.1	0.3	0.6	50	145	220

3.4.4 Calibration outcomes

The WBM was calibrated using the recorded basin water levels from 18 December 2020 to 1 January 2021. The Calibration Period included several days of minor (less than 10 mm) rainfall totals followed by a 70 mm rainfall day (see Table 3.5).

A model warm-up period was applied to allow antecedent moisture conditions to be established within the AWBM runoff model. The warm-up period commenced 1 January 2020 and ran until the Calibration Period commenced 18 December 2020. The modelled basin water level was set to the observed water level (0.38 m) at the start of the Calibration Period to allow for an equal comparison.

The simulated basin water level is compared to the recorded basin water level over the Calibration Period in Figure 3.3. The calibration results show:

- the simulated peak water level of 1.36 m is similar to the observed peak water level of 1.35 m, indicating the calibration adequately matches peak water level and storage volumes; and
- the simulated water level rises and falls at a similar rate to the observed water level indicating the modelled runoff response (for the rising limb) and leakage rate (for the falling limb) are reliably represented in the WBM.

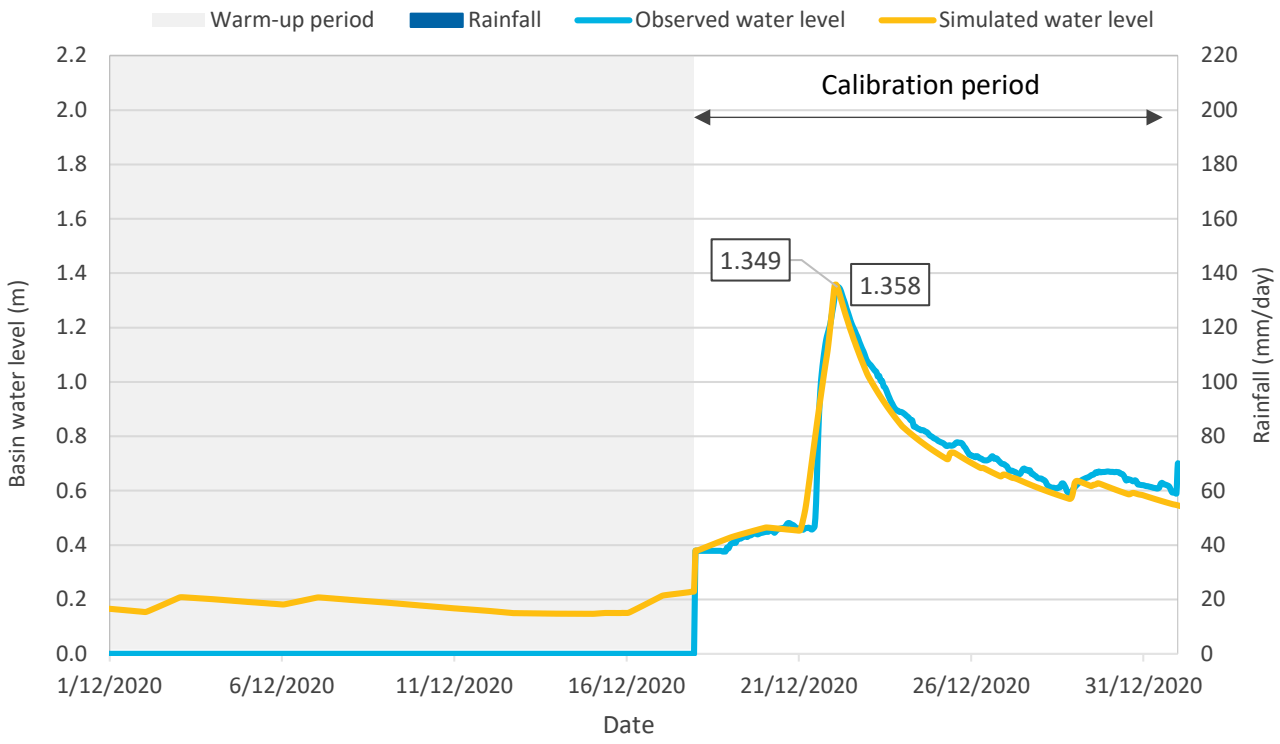

Figure 3.3 Water balance calibration results

3.4.5 Validation

The calibrated WBM was used to simulate basin water levels from 4 February 2021 to 26 August 2021 (the Validation Period). The simulated basin water levels are compared to observed water levels in Figure 3.4. The cumulative volume of stored water in the basin over the Validation Period is shown in Figure 3.5. The validation results show:

- The WBM generally produces peak water levels of a similar magnitude to recorded levels. The calibrated WBM occasionally under or overestimates observed peak water levels depending on the rainfall event.
- The rise and fall of water levels in the basin are similar between simulated and recorded data.
- The cumulative volume of stored water for the simulated basin is similar than the recorded data indicating the WBM is producing a good match to overall Site runoff volumes.

In general, the WBM appears to provide a good representation of Site water balance processes.

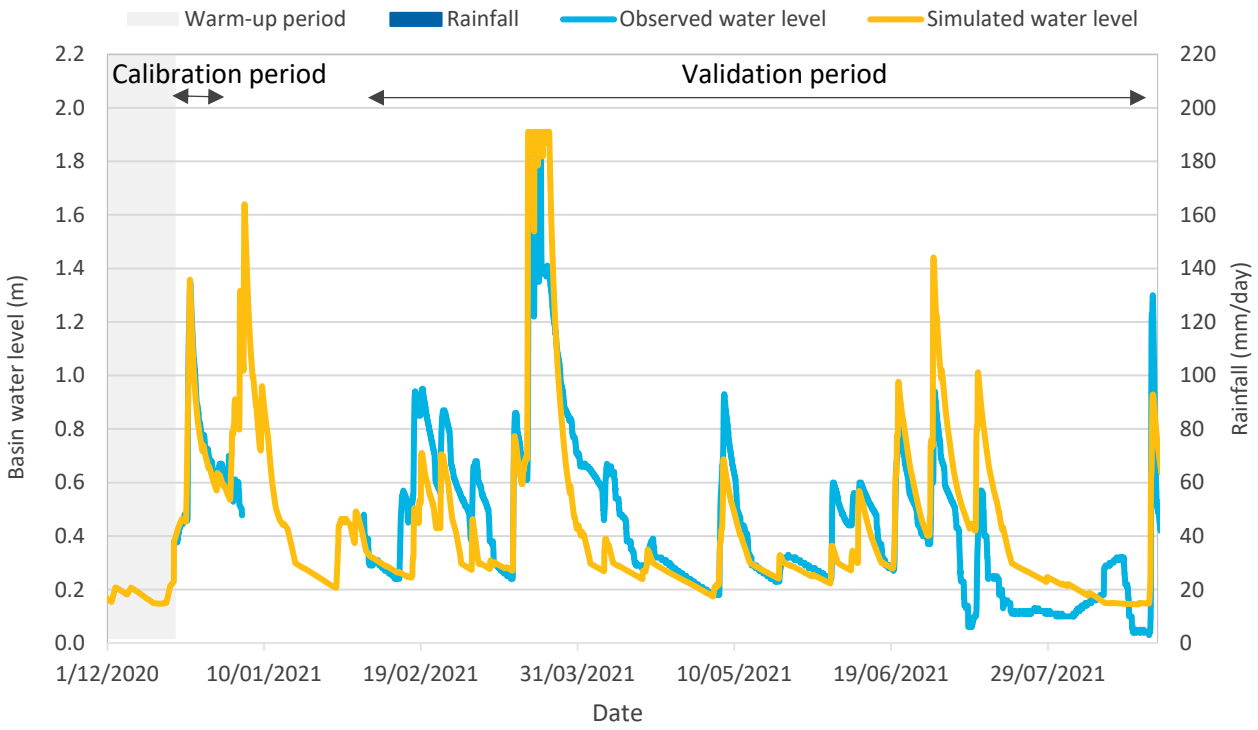

Figure 3.4 **Water balance validation results – water level**

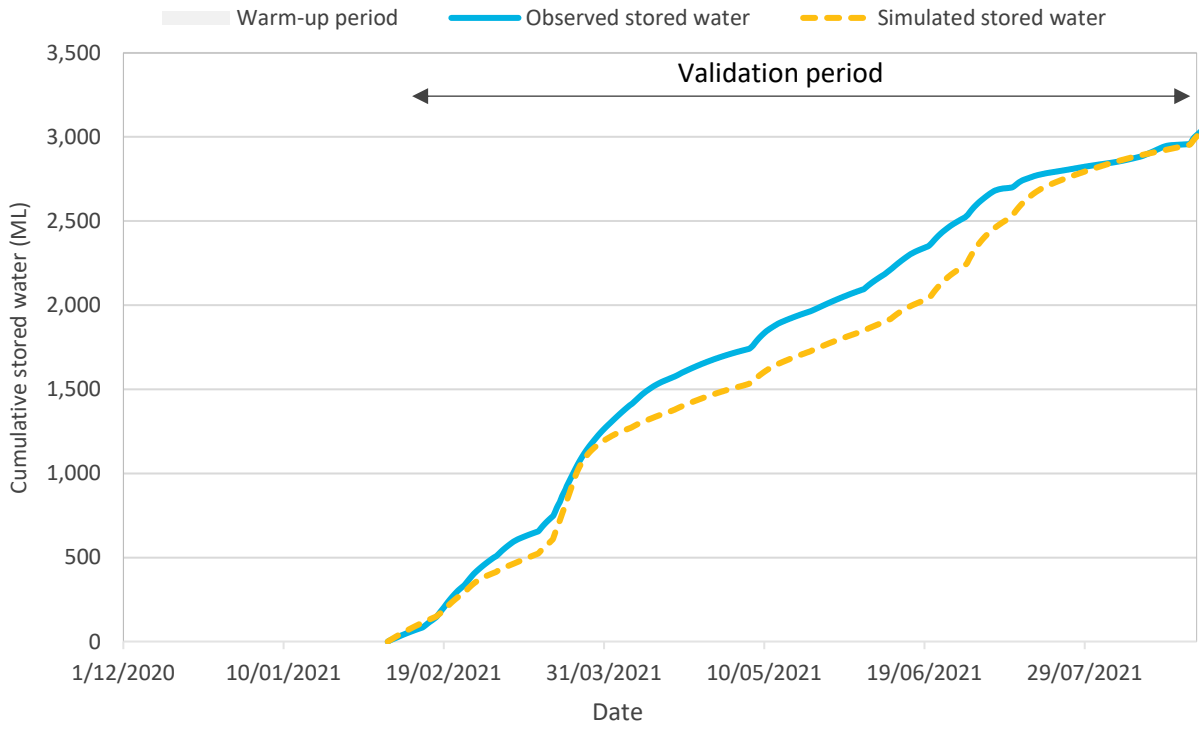

Figure 3.5 **Water balance validation results – cumulative stored water**

4 System design capacity

4.1 Overview

The purpose of this water balance update is to assess the capacity of the Site's water management system relative to the design rainfall event (ie the 5-day 90th percentile rainfall depth). This assessment has been done by:

- calculating the basin capacity using the Site runoff coefficient established in Section 2.2.3; and
- calculating an overflow frequency using the predictive WBM.

These calculated values were compared to relevant information from Managing Urban Stormwater: Soils and Construction (Landcom 2004) and Managing Urban Stormwater Volume 2E: Mines and Quarries (DECC 2008) to establish consistency with the system's design capacity, and Consent Condition 25.

4.2 Basin capacity

The capacity of a stormwater basin can be described using a design rainfall event from which runoff can be captured in the basin. Runoff volume is a function of the rainfall depth, contributing catchment area and a representative runoff coefficient. A representative runoff coefficient was established for the Site in Section 2.2.3 using water level data from eight rainfall events that had rainfall totals ranging from 34 to 97 mm.

The design rainfall event for the facility is the 5-day 90th percentile rainfall event. Table 4.1 shows the rainfall depth, contributing catchment area, site runoff coefficient and a calculated runoff volume for this event. These calculations indicate that the basin volume (2.8 ML) is more than double the design runoff volume (1.3 ML). It can therefore be concluded that the basin volume exceeds the minimum design capacity volume.

Table 4.1 Basin capacity calculation

	value	Notes
Design rainfall	51.8 mm	5-day 90th percentile rainfall depth for Newcastle (Landcom 2004)
Contributing catchment area	7.92 ha	see Figure 3.1 and SWVR for further information
Site runoff coefficient (Cv)	0.32 or 32% of rainfall	Calculated from on eight representative rainfall events (see Section 2.2.3)
Design runoff volume	1.3 ML	Calculated as a function of rainfall depth, area and Cv
Basin volume	2.8 ML	Refers to the volume below the basin outlet

4.3 Overflow frequency

Overflow frequency can be used to establish the capacity of a stormwater system. The frequency of overflows is a function of the storage available to capture runoff and the rate at which captured water is used within the Site to restore basin capacity.

Managing Urban Stormwater Volume 2E: Mines and Quarries (DECC 2008) describes the overflow frequency of basin sized for the 90th percentile 5-day event to be two to four times per year (on average). This range is based on a basin that is dewatered within 5-days after rainfall to restore capacity to capture the next rainfall event.

The predictive WBM was applied to assess the overflow frequency from the basin (see Section 3.3 for model assumptions). The WBM results indicate that an average of four overflow events per year will occur. It is noted that

this is conservative as the predictive WBM does not allow for any leaks from the basin or storage above the basin outlet structure, which can be manually opened and closed.

As the conservatively predicted overflow frequency is within the range provided in DECC 2008, it can be concluded that the existing water management system meets or exceeds the design capacity.

4.4 Conclusion

The analysis provided in this section has established that:

- The basin volume (2.8 ML) exceeds the minimum volume required to capture runoff from the design rainfall event (1.3 ML).

- The predicted overflow frequency is within the range provided in DECC 2008 for a basin that is sized for the 90th percentile 5-day event and dewatered within five days of a rainfall event to restore basin capacity (as recommended in Landcom 2004 and DECC 2008).

It can therefore be concluded that the existing water management system meets or exceeds the design capacity and the requirements of Consent Condition 25.

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