



BARKLY REGIONAL COUNCIL TENNANT CREEK WASTE MANAGEMENT FACILITY

LEACHATE MANAGEMENT PLAN

NOVEMBER 2021

Document Control

Title: LEACHATE MANAGEMENT PLAN

Document Name: BRC-1912-02-LMPd

File Path: 01 JOBS/Barkly Regional Council/1912-02 Tennant Creek Landfill Management Plans/WP/LMP/BRC-1912-02-LMPd.docx

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Rev.	Status	Issue Date
A	Preliminary Draft	18/05/2020
B	For Review	19/05/2020
C	Reissue for Review	21/05/2021
D	Final	24/11/2021

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1 INTRODUCTION

1.1 BACKGROUND

Barkly Regional Council (BRC or Council) is located in the Northern Territory (NT) in central Australia, 1,000km south of Darwin and approximately 500km north of Alice Springs. The BRC area has a population of approximately 6,650 people and Tennant Creek is the principal town in the area with a population of approximately 3,000 people. The primary industries in Tennant Creek are mining and tourism.

BRC have engaged GreenTec Consulting Pty Ltd (GreenTec) to prepare a Leachate Management Plan (LMP) for Tennant Creek Landfill.

1.2 SCOPE

The LMP for Tennant Creek WMF will involve the assessment of current leachate management practices on site and the exploration of options for better management of leachate. Site drainage, weather conditions, environmental risks, infrastructure and Northern Territory (NT) Environmental Protection Agency (EPA) guidelines have been considered in preparation of this management plan.

1.3 LEACHATE MANAGEMENT PLAN STRUCTURE

A summary of the LMP structure is presented in **Table 1** below.

TABLE 1 - LEACHATE MANAGEMENT PLAN STRUCTURE

Section	Description
Section 1	Introduction, scope and structure.
Section 2	Provides a site description and defines the existing conditions for Tennant Creek Landfill including existing leachate management practices.
Section 3	Outlines the current leachate management practices at the site.
Section 4	Presents the recommended leachate management plan, strategies and actions for the Tennant Creek WMF.
Section 5	Presents the conclusions and recommendations.

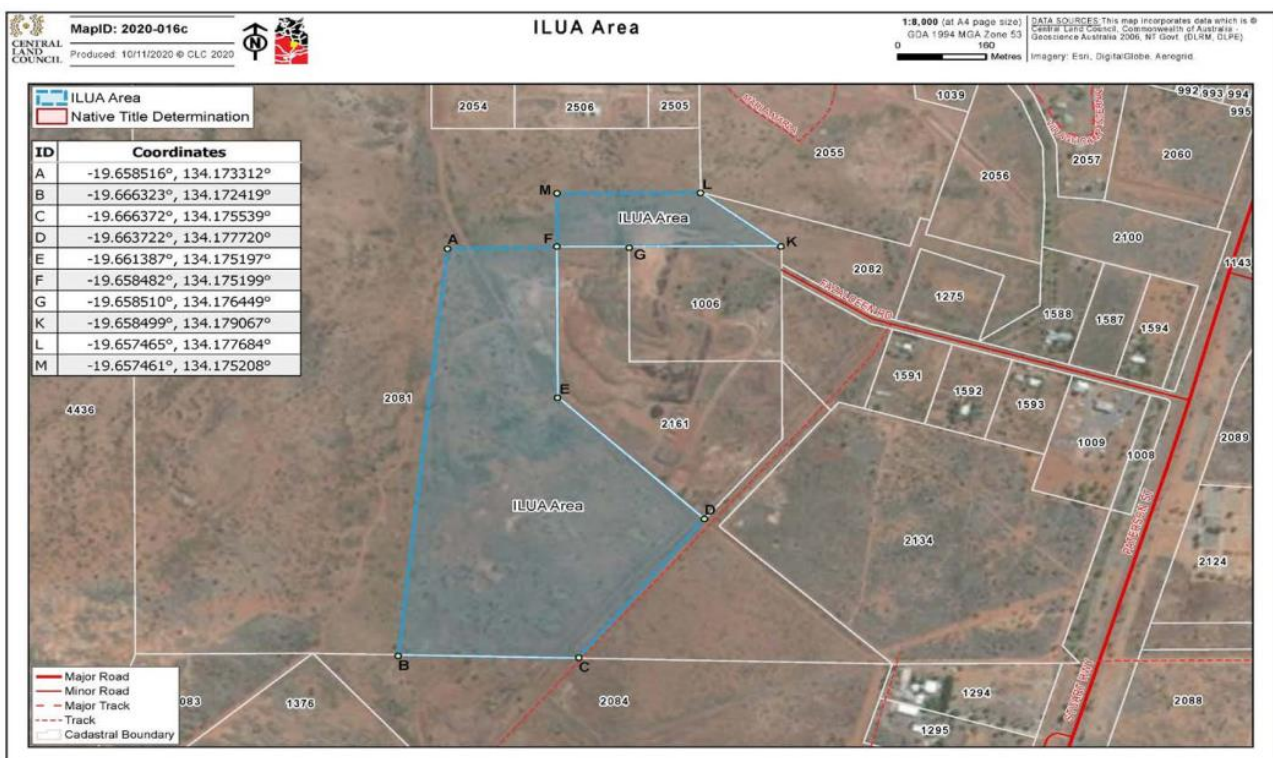
2 SITE DESCRIPTION AND EXISTING CONDITIONS

The Tennant Creek Waste Management Facility (WMF) provides a waste disposal site for the township and immediate community of Tennant Creek. As the only licenced landfill in the vicinity, it receives a combination of Municipal Solid Waste (MSW), Commercial and Industrial waste (C&I) and Construction and Demolition waste (C&D). The site consists of a landfill and a transfer station to allow for separation of material and reduce traffic at the tip face.

Waste from the Tennant Creek area is collected via collection trucks and deposited at the landfill with approximately 1,000 bins collected each week. Tennant Creek currently does not have a kerbside comingled recycling collection service or green waste collection service but does separate and recover green waste and steel at the landfill facility.

An Indigenous Land Use Agreement (ILUA) between Barkly Regional Council, Central Land Council and Patta Aboriginal Corporation RNTBC was formalised and signed on the 27th of May 2021. This ILUA allowed Council to expand particular site operations onto defined areas of Lot 2081, with the ILUA area shown in **Plate 1** below.

PLATE 1 - ILUA AREA



It is understood that Council will excavate soft shallow soils within Lot 2081 to use as cover soil in landfilling operations. These areas are also intended to be used for resource recovery operations and long-term storage. No landfilling is permitted to occur in the ILUA area, with historical waste placement in the ILUA area to be remediated. At this stage, Council intends to remediate the area north of Lots 2161 and 1006 ('Area 3') and to relocate the historical waste in the area west of Lot 2161 ('Area 4') to within the permissible landfilling footprint. Areas that require waste removal or remediation are shown on **Plate 2** below.

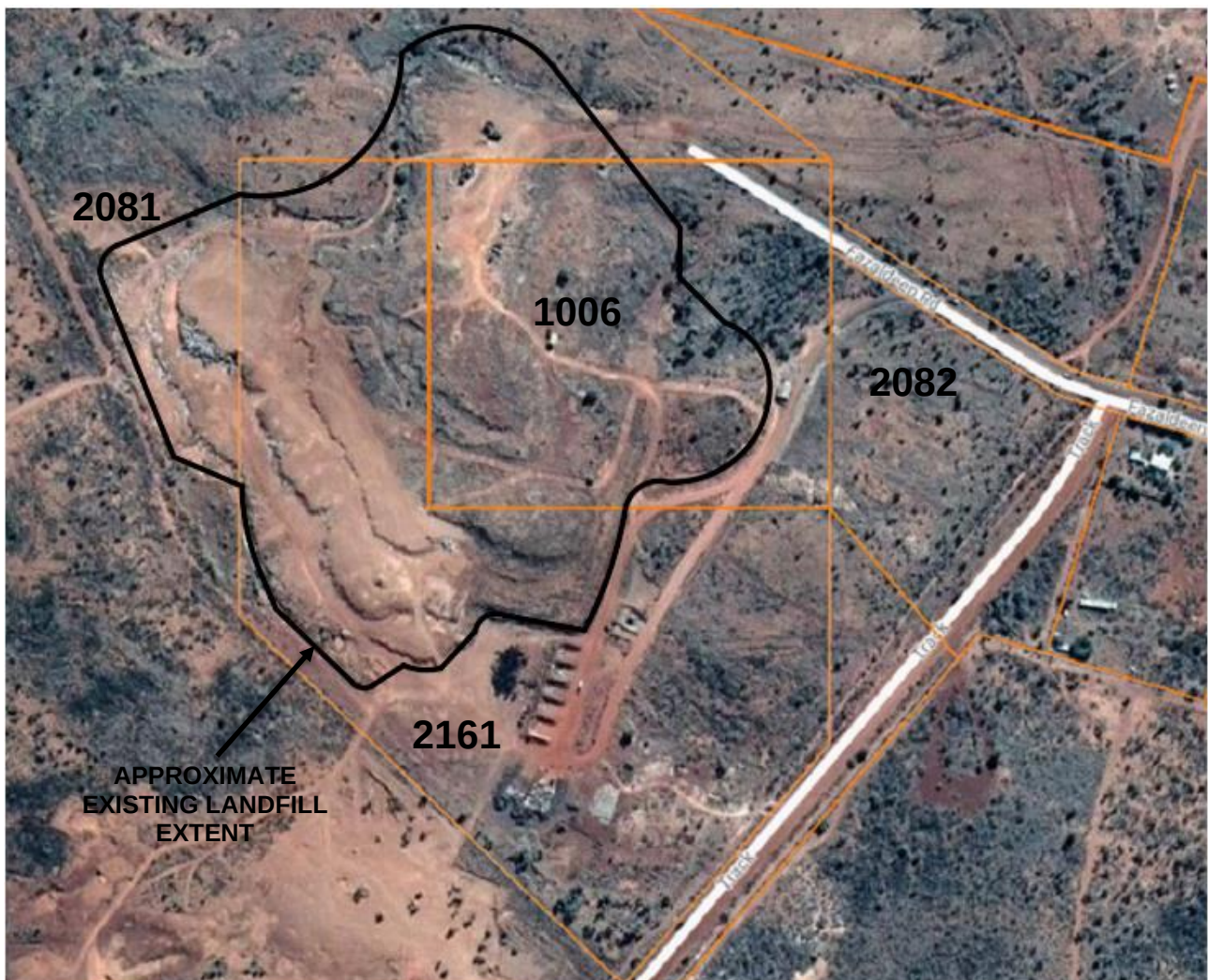
PLATE 2 - AREAS 3 AND 4 WITHIN THE ILUA AREA



2.1 SITE LOCATION

Tennant Creek WMF is located predominately within Lot 1006 and Lot 2161, at 79 Fazaldeen Road. The landfill extends into Lot 2081 and partially into Lot 2082 (entry road). Lot 1006 is held under a Crown Lease in Perpetuity to Tennant Creek Town Council. Lot 2161 is a new freehold lot. Part of Lot 2081 is currently being leased by Council as per the ILUA dated the 27th of May 2021 and Lot 2082 is Vacant Crown Land. An aerial image and layout of Tennant Creek WMF is provided in **Plate 3**.

PLATE 3 - TENNANT CREEK LOT EXTENTS



2.2 RAINFALL AND CLIMATE

Tennant Creek is located 376m above sea levels with climate considered to be arid in nature with evaporation exceeding rainfall. Temperatures in the summer range from average lows of ~24°C and average highs of 37°C with winter temperature averages ranging from 12°C to 28°C.

The average annual rainfall statistics for Tennant Creek (BoM - Station 015135) have been provided below in **Table 2**.

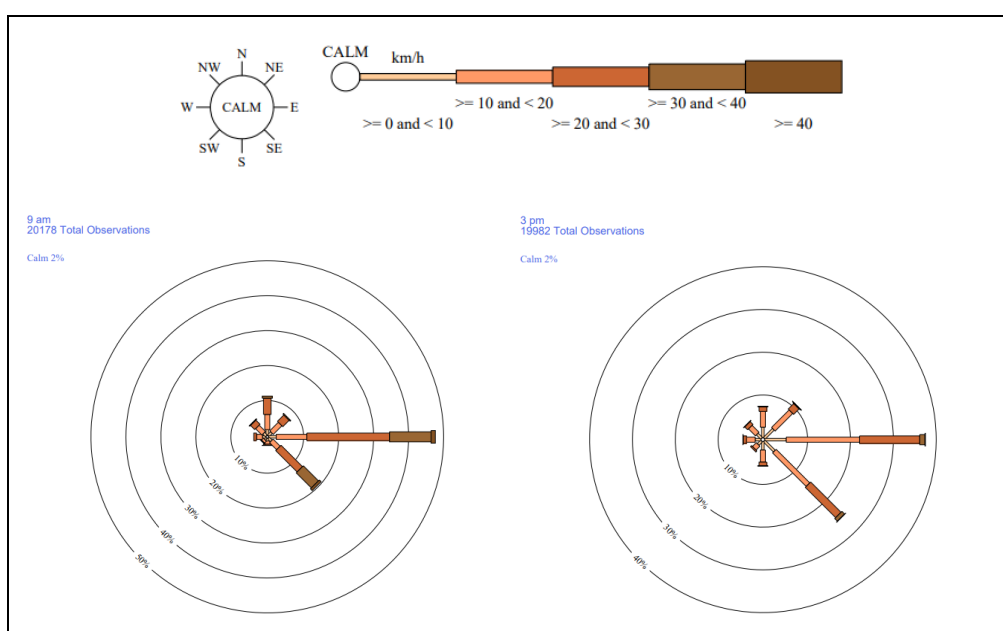
TABLE 2 - MEAN RAINFALL AND EVAPORATION

Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Rainfall (mm)	116	117	54	16	8	5	5	2	7	19	40	74	465
Evaporation (mm pan)	381	314	347	324	267	216	233	288	348	406	405	400	3,942
Difference (mm)	365	196	293	308	258	211	227	286	341	388	365	326	3,477
Ratio of Evaporation to Rainfall	3.3	2.7	6.4	20.5	32.5	40.8	45.6	125.3	47.0	21.8	10.1	5.4	8.5

The average pan evaporation statistics were calculated using the mean daily evaporation data for Tennant Creek (BoM – Station 015135) and multiplied by the corresponding number of days for that month (non-Leap year). The average annual pan evaporation is over 8 times the average rainfall, with evaporation in winter months between 40 to 125 times higher than the respective monthly rainfall and approximately 3 to 5 times higher in summer months.

The Wind Rose data for Tennant Creek Airport shown in **Plate 4** indicate predominantly easterly winds in both the morning and the afternoon.

PLATE 4 - WIND ROSE DATA FROM TENNANT CREEK AIRPORT



2.3 SITE TOPOGRAPHY

The landfill site is saddled against a natural rise in the topography with this rise seen at peak height of RL390m. The landfill site slopes from north to south east with the lowest point of the site at RL 365m. A topographic map is shown in **Plate 5**.

PLATE 5 - TOPOGRAPHIC MAP



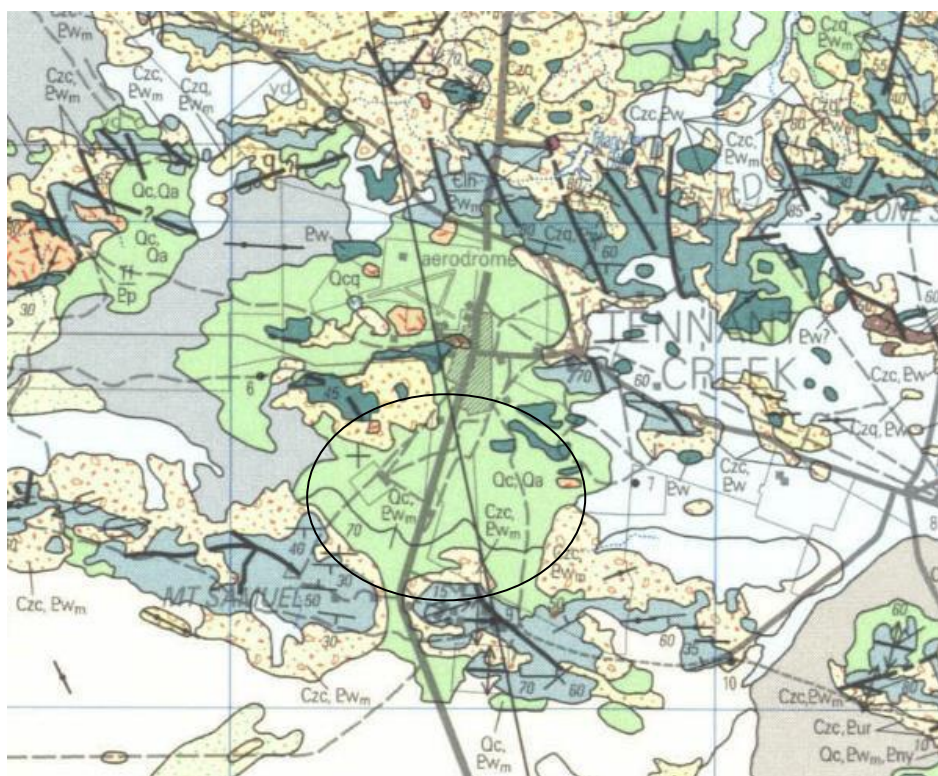
Source: <http://en-au.topographic-map.com/places/Tennant-Creek-9489749/>

2.4 GEOLOGY

A 1:100,000 geological map was sourced from Geoscience Australia as shown below in **Plate 6** which indicates geology of Carraman Formation of the Early Proterozoic Warramunga Group. Site soils consist of a gravelly clay material near the surface tending to be more clay extending beneath the surface with this evident in the sediment dam and new landfill trench excavations.

On site excavations conducted by Council show uniform brown clayey soils overlaying the Carraman Formation which appears to have the capacity to effectively isolate the landfill area from deeper aquifers. The existing natural soil formation (clayey soils) is estimated to have an approximated permeability of 10^{-6} to 10^{-8} m/sec. If confirmed, soils excavated to create future waste cells and leachate containment ponds, are suitable for construction of low permeability earthen waste cell liners and final capping.

PLATE 6 - SITE GEOLOGY



2.5 SITE HYDROLOGY

Groundwater hydrological conditions cannot be confirmed due to the absence of groundwater monitoring boreholes and associated data on site and in the local area. The following historical monitoring boreholes were checked in-field by Council staff in April 2021, with the aim to obtain groundwater level data (all bores were reported to be abandoned, decommissioned and/or unusable):

- RN013251;
- RN002099;
- RN016253; and
- RN001048.

Anecdotal evidence from a variety of sources and historical reporting in the Tennant Creek area indicates that the water table is at least 60 metres below ground level and that it is low yielding and of a quality unsuitable for domestic or agricultural use. Due to the groundwater conditions in the township area, the main water supply is sourced some distance south at the Kelly Well Borefields. It is also noted that the Tennant Creek WMF site is not located within the constraints imposed by a coastal estuarine or groundwater recharge area (*Hydrology of Australia, 1987*).

Groundwater in the wider regional area is deep and located beneath indurated Warramunga sediments, which are anticipated to be highly impervious, meaning groundwater contamination from landfilling is unlikely. Additionally, the aquifer which the town's main water supply is approximately 20km south, meaning landfilling activities are very unlikely to impact this specific aquifer. Furthermore, the installation of groundwater monitoring bores to depths between 60m – 100m on site is economically unfeasible based on discussions with Council.

It has been previously established in the 2006 EMP that the deep groundwater table, coupled with the low permeability soils encountered at the site, makes groundwater contamination “not likely to be a significant concern” (Tennant Creek Town Council).

2.6 SITE BOUNDARIES

GreenTec undertook a test pit investigation in March 2021 which determined the approximate depths and extents of landfilling which has occurred outside the boundary of Lot 2161 and into Lot 2081. Council have recently been granted approval to extend site operations onto Lot 2081, as per the ILUA dated the 27th of May 2021. Historical waste that is placed to the north of Lot 2161 is intended to be remediated, with waste to the west of Lot 2161 to be removed and relocated to within the permissible landfilling footprint. No remediation works have been undertaken on the waste located outside the boundaries at the time of this report. As per the ILUA, no landfilling operations shall occur in the ILUA area (Lot 2081). This area is intended for sourcing of cover soil for landfilling operations, as well as resource recovery and long-term storage.

2.7 LANDFILL ACCEPTANCE CRITERIA

The Tennant Creek WMF is currently operating under NT EPA Environmental Protection Licence EPL 281 for the following activities:

- a) *“Operating premises for the disposal of waste by burial that service, or are designed to service, the waste disposal requirements of more than 1,000 persons.”*
- b) *“Collecting, transporting, storing, re-cycling, treating or disposing of a listed waste (as per Table 1) on a commercial or fee for service basis, other than in or for the purpose of a sewerage treatment plant.”*
- c) *“Operating premises, other than a sewerage treatment plant, associated with collecting, transporting, storing, recycling, treating or disposing of a listed waste (as per Table 1) on a commercial or fee for services basis.”*

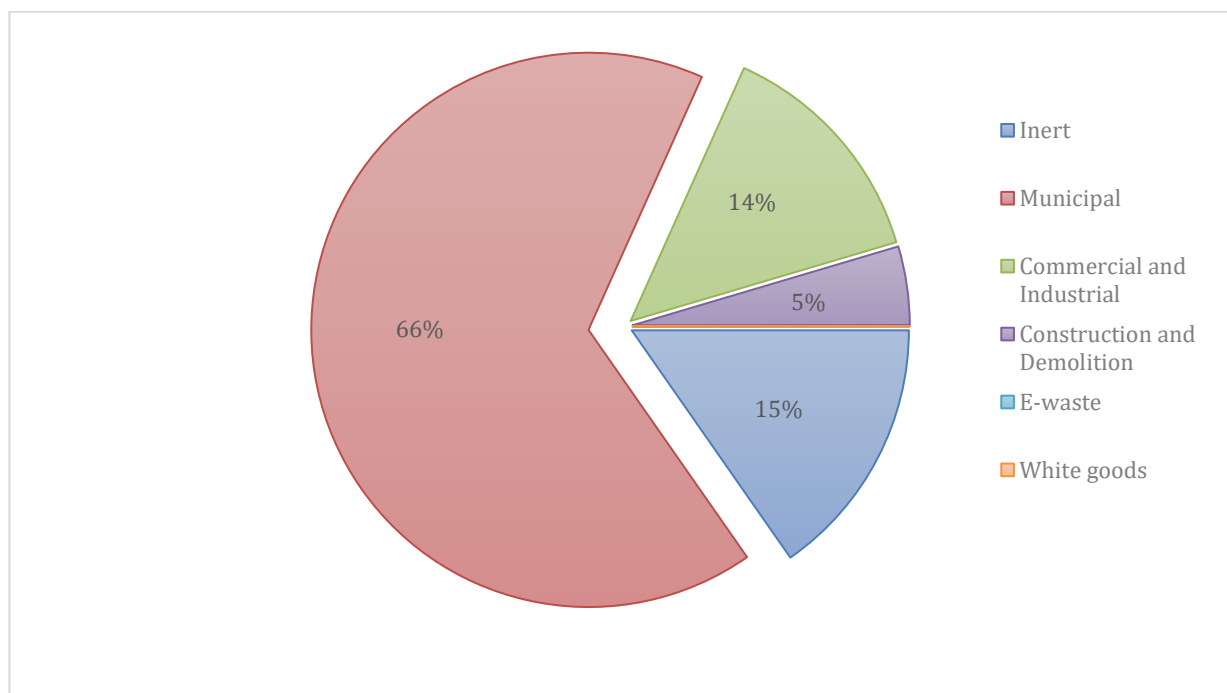
The landfill is defined as Municipal Solid Waste Landfill and accepts a range of waste materials from the local domestic and commercial sectors.

2.8 WASTE COMPOSITION

The site currently does not have a weighbridge, however, an airspace assessment conducted by GreenTec in 2021 established that the average landfilling rate is approximately 14,250m³ per year. This rate was estimated by comparing the current survey (2021) to a survey conducted in 2016 by Terramap and by subtracting out the assumed cover soil volume over the period.

Waste composition was estimated through visual observations of operations staff. Tonnages were obtained by assuming an average compaction rate of 0.8t/m³. The breakdown of waste to landfill is shown in **Plate 7**. Most of the deposited waste is municipal waste, meaning it is important to maintain daily and intermediate cover and progressively cap the site in a timely manner.

PLATE 7 - TENNANT CREEK LANDFILL WASTE COMPOSITION



Based on the breakdown provided above, in **Plate 7**, the municipal waste stream is the largest contributor to landfill, followed by inert material and then commercial and industrial. However, it is noted that waste type varies significantly from year to year. Based on visual observations at the active tip face, it is believed that a large proportion of the landfilled waste is recyclable or recoverable. Using the waste stream breakdown presented in **Plate 7** and the annual waste quantities, the breakdown of waste has been estimated in tonnes, as shown in **Table 3**.

TABLE 3 - WASTE STREAM BREAKDOWN PER ANNUM

WASTE TYPE	WEIGHT PER ANNUM (t)
Inert	1,745
Municipal	7,570
Commercial and Industrial	1,562
Construction and Demolition	522
E-waste	0.19
White goods	1
TOTAL	11,400

2.9 DAILY AND INTERMEDIATE COVERING OF WASTE

Waste is currently placed progressively over previously daily capped waste. The exposed active landfilling area is approximately 20m long and 5m wide with exposed waste kept to a minimum through daily pushing and covering of compacted waste. Cover soils for the landfill are sourced from the ILUA area within Lot 2081. The continual sourcing of cover soil from this area is important for Council as importing soils from other sources is extremely costly. Sourcing of cover soils from the ILUA area will allow Council to cover exposed waste in a cost efficient and timely manner, meaning

leachate generation across the landfill will be minimised. Since the landfill is unlined, covering and capping of the landfill are the most important environmental controls in terms of leachate management.

2.10 EXISTING LEACHATE MANAGEMENT

Tennant Creek has a very low annual rainfall, as well as low amounts of disposed putrescibles and greenwaste. It is understood that there are no primary leachate management practices used at Tennant Creek Landfill due to the site specific conditions and therefore no data available to characterise leachate composition.

Leachate at the site is lost by evaporation, absorption into dry waste and during biodegradation of any organic matter. The implementation of additional leachate management systems, other than current management measures, has historically been assessed as financially unviable.

Prior site geotechnical investigations as outlined in the 2006 EMP (Tennant Creek Town Council) have found that the soil underlying the waste mass is a clayey soil with an estimated permeability between 10^{-6} and 10^{-8} m/s, which was considered sufficient to protect deep groundwater aquifers. This combination of with significant attenuating depth to groundwater, evaporation far exceeding rainfall and implementation of cover soils and capping programs would likely see little to no impact to groundwater. Discussions with Council staff indicate that no impact on the regional groundwater system is evident in town bores.

However, it is noted that leachate and stormwater controls have been recommended in previous reports to reduce potential for contamination of stormwater discharged offsite. Using landfilling techniques such as bunding or trenching in the active tip face will retain leachate and reduce stormwater contamination. In regards to stormwater management, the formalisation of vegetation or rock lining of site water drains connected to the sediment dam will also result in cleaner water being discharged offsite in high rainfall events.

2.11 LANDFILL DEVELOPMENT

2.11.1 Overfilling

Landfilling has historically occurred outside of site boundaries into Lot 2081, which Council has recently acquired as part of the ILUA dated the 27th of May 2021. No further landfilling is permitted in the ILUA area and Council have indicated that historical waste placement in this area will be removed as follows:

- Excavate all waste to the west of Lot 2161 (known as 'Area 4') and place within the confines of the landfill boundary and all future landfilling to be conducted within the landfill site boundary; or
- Waste placed outside the boundary to the north of Lot 1006 and Lot 2161 (known as 'Area 3') is to be capped and rehabilitated and all future landfilling to be conducted within the landfill site boundary.

Site boundaries have been marked out on site to prevent further overfilling.

2.11.2 Staged Landfill Development

2.11.2.1 Overall Master Plan Concept/Assumptions

The following concepts/assumptions have been adopted throughout all stages of landfill development:

- The Master Plan presented is concept only and may change at the time of detailed design or during operations.

- All clean water is diverted around landfill and reports to the south. This is largely done by the landfills being saddled against a rise in the local topography.
- All site water to drain to a sediment dam located in the south of the site for treatment prior to release via a series of drains and batter chutes.
- Assumes that all future landfilling will remain within site boundaries.
- Assumes that landfilling can occur to the full extent of the site boundaries.
- The concept stages presented are to top of capping.
- Landfill batters to be no steeper than 5 (H): 1 (V)
- Landfill plateau grade to have at least 5% fall to shed water off the landform.
- Landforms will generally grade to the south to promote drainage to sediment dam and minimise additional drainage infrastructure.

The following concepts/assumptions are specific for each stage of landfill development.

2.11.2.2 Stage 1 - Concept/Assumptions

The following concepts/assumptions have been adopted for Stage 1 of the landfill development:

- Stage 1 landform will tie into existing landfill as shown on **Plate 6**;
- Any stored waste in this area (such as tyres) will need to be relocated; and
- The estimated volume for Stage 1 is 98,778m³ which is estimated to be 6.9 years of landfill life.

2.11.2.3 Stage 2 - Concept/Assumptions

The following concepts/assumptions have been adopted for Stage 2 of landfill development:

- Stage 2 landform will tie into existing landfill and connect to Stage 1 landform, as shown in **Plate 6**;
- The current area for general waste and green waste will be relocated to new resource recovery and stockpile area during this period to allow for ongoing landfill works;
- The estimated volume for Stage 2 is 102,112m³ which is estimated to be 7.1 years of landfill life; and
- Sediment dam and site water drainage channels to be upgraded to accommodate landfilling expansion.

2.11.2.4 Stage 3 (Final Landform) - Concept/Assumptions

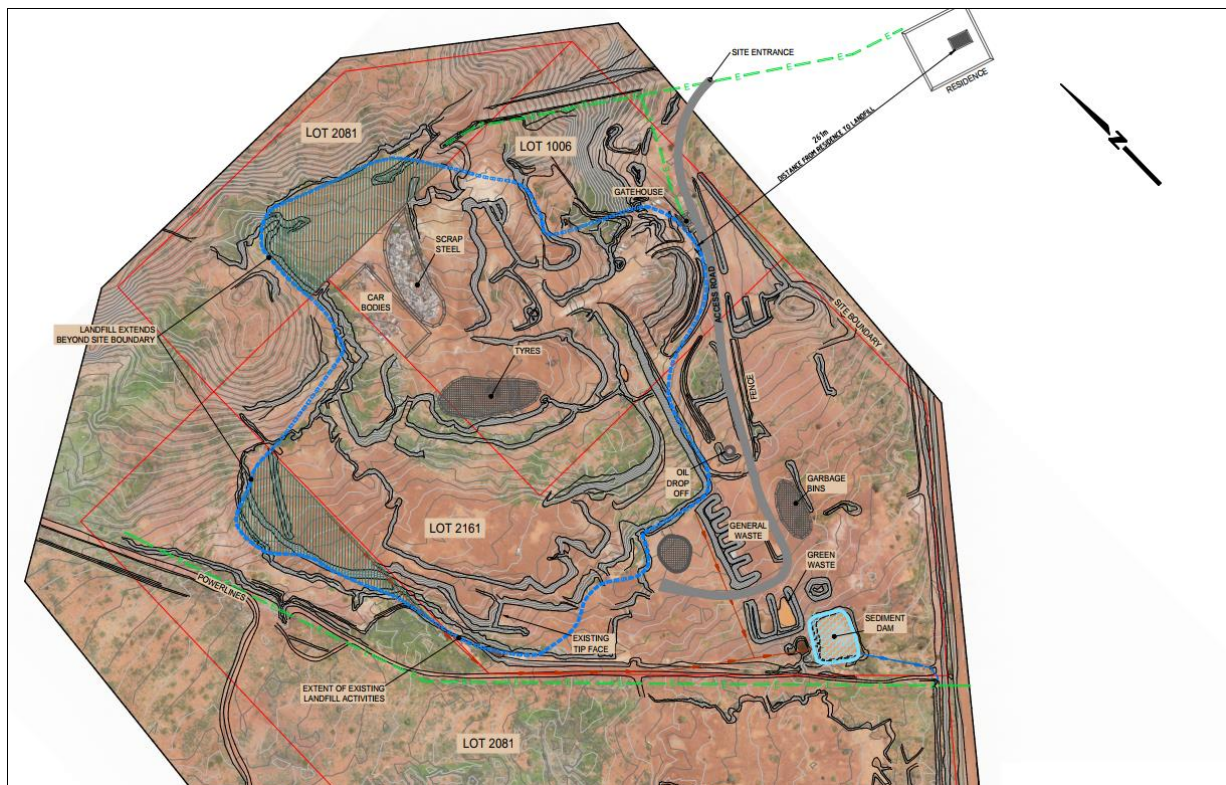
The following concepts/assumptions have been adopted for Stage 3 (final Landform) of landfill development:

- Stage 3 landform will see landfill occurring over all previous stages to form final landform profile;
- The estimated volume for Stage 3 is 177,515m³ which is estimated to be 12.4 years of landfill life;
- Site water drainage changes to suit ongoing landfilling operations; and
- Areas where final landform profile has been completed are to be capped and rehabilitated as per the Landfill Closure Management Plan.

Based on the Tennant Creek Waste Management Strategy and Master Plan prepared by GreenTec (2021), four (4) stages landfill development were proposed with these shown in **Plate 8** below.

PLATE 8 - PROPOSED FUTURE LANDFILL DEVELOPMENT

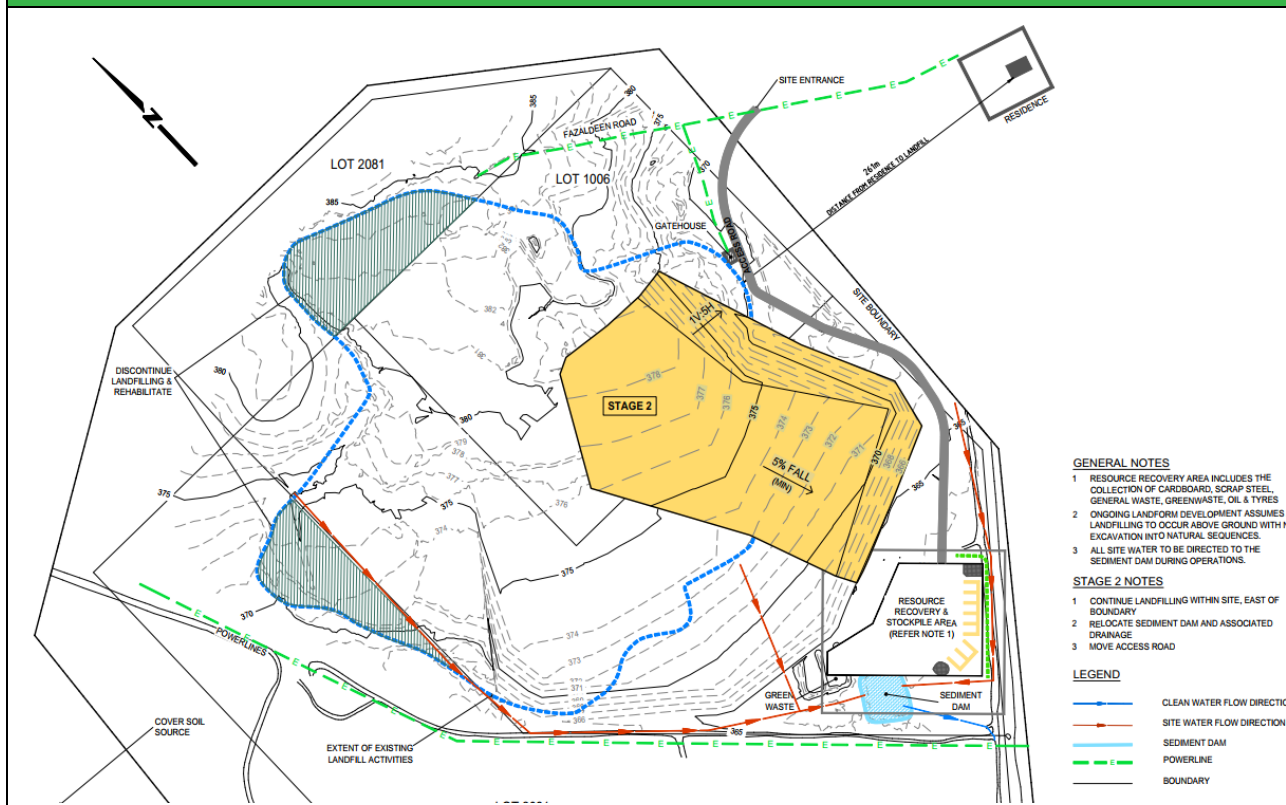
EXISTING CONDITIONS



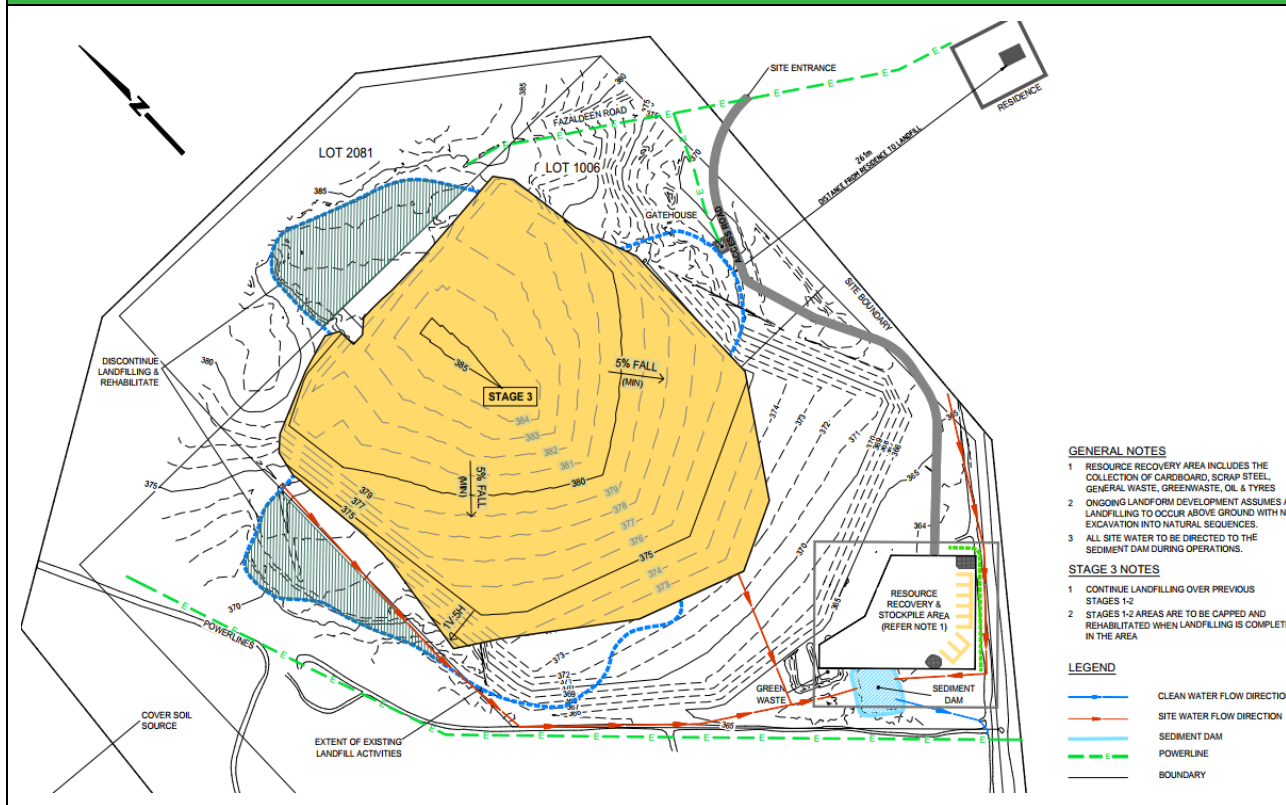
STAGE 1 LANDFILL DEVELOPMENT



STAGE 2 LANDFILL DEVELOPMENT



STAGE 3 (FINAL LANDFORM) LANDFILL DEVELOPMENT



3 LEACHATE MANAGEMENT CRITERIA

3.1 LEACHATE MANAGEMENT LICENCE CRITERIA

The site operates under the Environmental Protection License (EPL) number 281, dated the 1st of July 2019. Within this EPL the following conditions apply to the management of leachate on-site:

Condition 31: “The licensee must ensure that all leachate is managed in accordance with the NT EPA Guidelines for the Siting, Design and Management of Solid Waste Disposal Sites in the Northern Territory.”

Condition 32: “The licensee must ensure that leachate and water do not pond on the surface of the landfill.”

Condition 56: “The licensee must:

- 56.1:** Prepare a Leachate Management Plan in accordance with the NT EPA Guidelines for the Siting Design and Management of Solid Waste Disposal Sites in the Northern Territory;
- 56.2:** Characterise the composition of leachate at the licensed premises and provide a plan of implementation to effectively control and monitor the potential for leachate migration to stormwater discharged off-site and to groundwater;
- 56.3:** Include an assessment of the landfill footprint proposed in Attachment 1 to the 2016 Iolar Tennant Creek Landfill Concept Master Plan (Master Plan) and provide recommendations to implement a staged transition of leachate management from the licensed premises to the entire area specified in Attachment 1 to the Master Plan;
- 56.4:** Ensure the Plan is reviewed by a qualified person and they prepare a written report of their review, prior to submission of the Plan to the NT EPA; and
- 56.5:** Submit the Leachate Management Plan to the NT EPA, with a copy of the qualified person review, within 12 months from the commencement date of this license.”

It is to be noted that the existing Tennant Creek WMF landfill is unlined, meaning that Condition 56.1 which states the LMP must be in accordance with the NT EPA guidelines cannot ever be fully achieved. This means additional focus will be placed on effective covering of the waste to limit leachate ingress into the waste mass, as well as progressively capping the site in a timely manner.

3.2 LEACHATE DEFINITION

Leachate comprises of water that has contacted the waste mass either via infiltration through the landfill cover or via stormwater runoff after direct contact with waste. Subject to the nature of the waste contacted, leachate would generally be characterised by elevated metals, nutrients and organics. The reduction of contact of water and the waste mass is vital to reducing leachate generation. Water that falls on daily/intermediate covered surfaces is considered sediment laden and can report to the sediment dam before testing for suitability and discharge offsite or for evaporation. Water that falls on non-waste, non-exposed soils or capped and rehabilitated surface is considered clean and can be directly discharged offsite.

4 LEACHATE MANAGEMENT PLAN

4.1 ENVIRONMENTAL OBJECTIVES

The key environmental objectives with respect to leachate management for the landfill is to undertake all site activities in such a way to minimise as far as practical, the release of contaminants discharged off-site and to mitigate the potential negative impacts on receiving environments. It is to be noted that the Tennant Creek Waste Management Facility landfill is unlined so there is no leachate collection system in place. This shifts the environmental objective to focus on effectively covering and progressively capping the waste mass in a timely manner, to limit leachate ingress into the landfill.

Environment Protection Objectives (Part 4 of the WMPC Act), and Water Quality Standards (section 73 of the Water Act) are listed below:

- An Environment Protection Objective is a statutory instrument to establish principles on which:
 - a) Environmental quality is to be maintained, enhanced, managed or protected;
 - b) Pollution, or environmental harm resulting from pollution, is to be assessed, prevented, reduced, controlled, rectified or cleaned up; and
 - c) Effective waste management is to be implemented or evaluated.

To meet these objectives the following key management strategies should be undertaken.

4.2 KEY LEACHATE MANAGEMENT STRATEGIES AND JUSTIFICATION

The key management strategies to be adopted in relation to leachate will be as follows:

- Maintain direct off-site discharge of clean water, via a system established to direct stormwater runoff away from disturbed or active landfill surfaces;
- Reduce leachate generation by applying relevant capping standard to each area with aim of applying final capping to all completed landfill areas as soon as practical;
- Prepare LCMP to guide progressive capping of the landfill;
- Implement a water quality monitoring program to ensure that environmental objectives are being achieved, this would be largely in regards to surface water runoff as groundwater is deeply attenuated by a low permeability soil; and
- Continue regular monitoring and maintenance of stormwater infrastructure to ensure effective operation.

4.2.1 Clean Water Diversion

The site is saddled into a rise in the natural topography with clean water generally directed around the topography rise but may require assistance from the use of clean water diversion drains. It is important to maintain clean water diversion drains and extend as required (as the landfill develops) to direct clean water from upstream catchments around landfill activities. This will reduce water management within the site.

4.2.2 Daily Cover, Intermediate Cover and Final Capping

Daily cover, intermediate cover and final capping lower the amount of leachate generated on-site and is therefore favourable to ensure these operations meet the NT EPA guidelines.

Specifying the source, type, frequency and the amount of soil cover to be stored on-site is a requirement under Condition 54 in EPL 281. Covering the waste mass provides the following benefits:

- Reduces fire risk;
- Minimises water infiltration into the waste;
- Reduces access by pests and fauna;
- Minimises windborne litter and controls odour; and
- Helps to limit fly breeding.

Daily and intermediate cover will continue to be placed to thicknesses of 150mm for daily cover and 300mm for intermediate cover. Soil cover should be sloped and graded to prevent ponding of water.

Final capping will be constructed over areas where landfilling has reached the final profile height. GreenTec Consulting has prepared a Landfill Closure Management Plan (LCMP) to address final capping requirements.

Cover soils for the landfill are sourced from the ILUA area within Lot 2081. The continual sourcing of cover soil from this area is important for Council as importing soils from other sources is extremely costly. Sourcing of cover soils from the ILUA area will allow Council to cover exposed waste in a cost efficient and timely manner, meaning leachate generation across the landfill will be minimised. Since the landfill is unlined, covering and capping of the landfill are the most important environmental controls in terms of leachate management.

4.3 PROPOSED LEACHATE MANAGEMENT ACTIONS

The following ongoing measures are recommended to treat or minimise leachate generation and potential contamination.

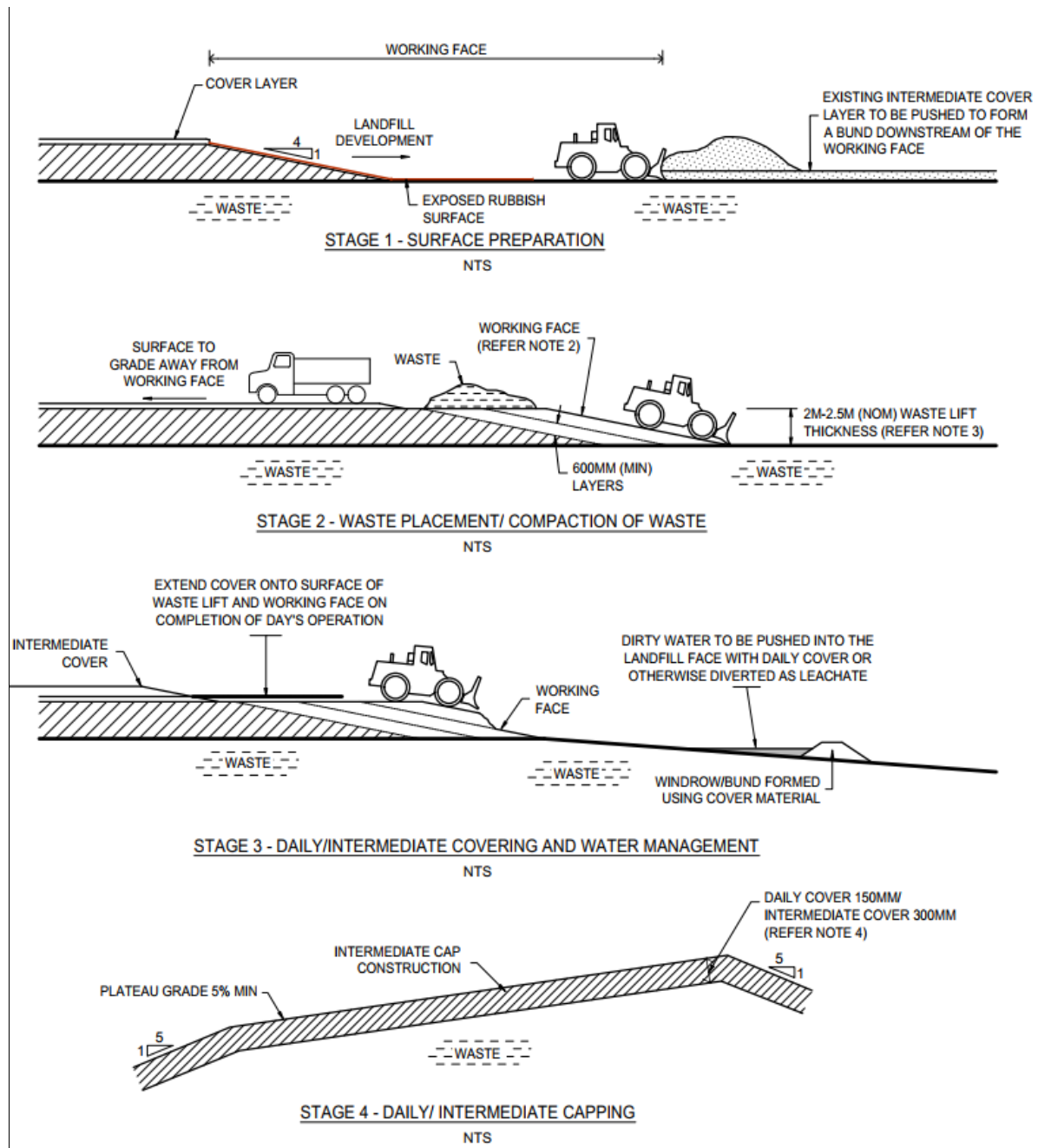
Surface water infiltration can be prevented or minimised by:

- Maintaining an unloading/turning area that slopes away from the operational area;
- Mounding the top of each filled area to create a uniform gradient (minimum 5 %) away from the top of the centre of the cell;
- Daily pushing, compacting of the unloaded waste;
- Daily covering of the filled area with on-site borrow material or imported material of low permeability clayey soils;
- Utilisation of diversion drains upstream of the waste mass to prevent surface water run-on from the surrounding environment;
- Bunding downstream of tip face to contain any leachate from rain events during daily landfill activities;
- Progressive final capping of the site;
- Performing regular maintenance and inspections on filling techniques, shaping of the waste mass, placement of cover and capping and drainage infrastructure; and
- Where possible, all surfaces shall be treated, to reduce sediment laden water runoff by the establishment of vegetation, mulch, hardstand, with drains and channels to be stabilised and protected with rock armouring, geotextiles or other appropriate stabilisation techniques as outlined in IECA (2008) Best Practice Erosion and Sediment Control Guidelines.

It is recommended that the following techniques are used to implement the actions discussed above to treat leachate that is generated onsite:

- Undertake general tip face operations as shown on **Plate 9**;
- Daily/Intermediate capping to have a grade of 5% as shown below on **Plate 9** Stage 4;
- Seeding and/or planting of native vegetation to assist removal of possible contaminants, reduce water infiltration and sediment runoff; and
- Constructing stormwater infrastructure to direct any stormwater run-off, which has had contact with the exposed surface, towards the sediment dam as shown on **Plate 10**.

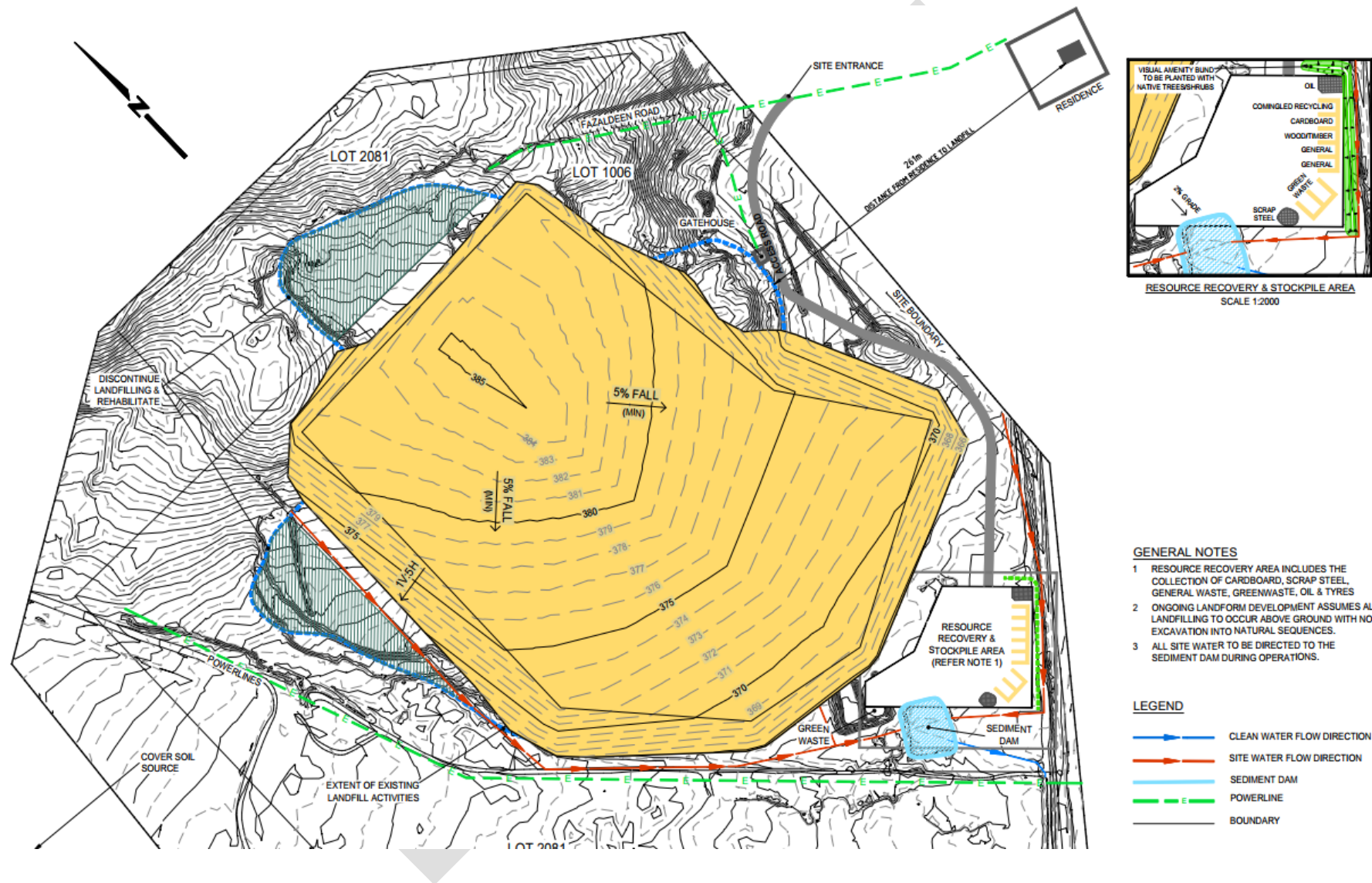
PLATE 9 - TIP FACE OPERATIONS TO REDUCE LEACHATE



NOTES:

1. SUBSEQUENT LIFTS WILL FOLLOW LIFT 1 SEQUENCING SCHEDULE MOVING OUTWARD FROM EXISTING LANDFORM UNTIL FINAL LANDFORM PROFILE IS REACHED.
2. LIFTS WILL BE 2.5M - 3M IN HEIGHT.
3. THE WORKING FACE WILL BE 1(V):4(H) SLOPE WHERE FILLING INTERCEPTS THE FINAL LANDFORM PROFILE.
4. INTERMEDIATE COVER SHALL BE APPLIED TO AREAS WHERE LANDFILLING WILL NOT OCCUR FOR >90 DAYS.

PLATE 10 - PROPOSED FINAL LANDFORM WITH DRAINAGE



A summary of capping requirements during landfilling operations to minimise leachate generation is outlined in **Table 4** below.

TABLE 4 - LANDFILL COVER AND CAPPING OPERATIONS

OPERATIONAL STATUS	REQUIRED CAPPING/ COVER TYPE	DESCRIPTION
Landfilling Completed	Final Capping	Final capping areas should make up the largest part of an established landfill to reduce additional water management controls and treatment. An LCMP has been undertaken by GreenTec.
Ongoing Landfilling Long Term	Intermediate Cover	Areas with intermediate cover should be confined to active landfill cell or cells which additional filling will take place. Once filling is complete to final profile then apply final capping to reduce leachate generation quantities. Intermediate cover should be a minimum of 300mm in depth, fine grained cohesive soil with a low permeability.
Ongoing Landfilling Short Term	Daily Cover	This area should be limited in size to reduce additional leachate generation. If area is not to be landfilled for 3 months, then apply intermediate cover. Daily cover should consist of a virgin excavated natural soil or imported clean fill and be applied at a minimum thickness of 150mm or other NT EPA approved means.

4.4 INSPECTION, MONITORING AND MAINTENANCE OF WATER INFRASTRUCTURE

4.4.1 General

The Tennant Creek Waste Management Facility will continue to be developed over an extended period with regular inspection, monitoring and maintenance to be undertaken on all water infrastructure to ensure the effectiveness. The following section outlines the minimum requirements.

4.4.2 Infrastructure

The following infrastructure shall be regularly inspected, monitored and maintained:

- Sediment laden drains;
- Clean water drains; and
- Sediment and erosion controls.

4.4.3 Frequency

The above-listed infrastructure will be inspected:

- Monthly (at minimum);
- Immediately following a significant rainfall event (typically rainfall events in greater than 100mm in a 24hour period); and
- Following any completion of stage of landfill works, as required.

Sediment and erosion control measures will be maintained for the duration of the landfill and earthwork activities until the areas have been completed, rehabilitated and stabilised.

4.4.4 Monitoring

Leachate data onsite cannot be obtained as there is no centralised collection point for leachate with no landfill basal liner in place. Since leachate onsite has not been characterised and establishment of a groundwater monitoring network was determined as unfeasible by Council due to a variety of site specific constraints (refer to the EMP and LCMP prepared by GreenTec, 2021), sampling and testing of leachate is therefore not required. Instead, the focus should be on progressive capping and implementation of techniques to reduce leachate generation.

4.5 SUMMARY OF LICENSE CONDITIONS

A summary of the conditions outlined in EPL 281 for leachate management are outlined **Table 5** below.

TABLE 5 - SUMMARY OF LICENSE CONDITIONS

LEACHATE MANAGEMENT CONDITION		RESPONSE
Condition 31	The licensee must ensure that all leachate is managed in accordance with the NT EPA Guidelines for the Siting, Design and Management of Solid Waste Disposal Sites in the Northern Territory.	This leachate management plan provides leachate management strategies and actions to apply NT EPA Guidelines approach where relevant to landfill operations at Tennant Creek WMF.
Condition 32	The licensee must ensure that leachate and water do not pond on the surface of the landfill.	The proposed final landform has a minimum of 5% grade on all plateau surfaces with landfill batters of 5(H):1(V). Sufficient drainage infrastructure is proposed to divert clean water around operations and collect and direct sediment laden water to sediment pond.
Condition 56.1	Prepare a Leachate Management Plan in accordance with the NT EPA Guidelines for the Siting Design and Management of Solid Waste Disposal Sites in the Northern Territory.	This leachate management plan provides leachate management strategies and actions to apply NT EPA Guidelines as best as practicably able to landfill operations at Tennant Creek WMF given the site constraints.
Condition 56.2	Characterise the composition of leachate at the licensed premises and provide a plan of implementation to effectively control and monitor the potential for leachate migration to stormwater discharged off-site and to groundwater.	The composition of leachate is unknown with no monitoring in place. The waste composition and quantities have been characterised. Based on the high evaporation and low rainfall combined with deep groundwater depth and low permeability soils, leachate generation is thought to be low to negligible with minimal risk to groundwater.
Condition 56.3	Include an assessment of the landfill footprint proposed in Attachment 1 to the 2016 Iolar Tennant Creek Landfill Concept Master Plan (Master Plan) and provide recommendations to implement a staged transition of leachate management from the licensed premises to the entire area specified in Attachment 1 to the Master Plan.	The proposed landfill development has been described, with the footprint defined for future landfill operations. To date, no leachate has been collected as there is no centralised collection point for leachate and no landfill basal liner in place. In addition, based on climatic conditions presented in Section 2.2 little leachate generation is expected combined with a large attenuation distance to groundwater in low permeability soils resulting in low risk to groundwater table.
Condition 56.4	Ensure the Plan is reviewed by a qualified person and they prepare a written report of their review, prior to submission of the Plan to the NT EPA.	GreenTec Consulting are specialist waste management and landfill engineering consulting company experienced in all areas of landfill management and engineering.

5 CONCLUSION AND RECOMMENDATIONS

A Leachate Management Plan has been prepared to address Tennant Creek Waste Management Facility Licence conditions where possible or provide suitable alternatives to meet site specific conditions.

The Tennant Creek WMF is situated in an area of high evaporation, where the annual evaporation is more than eight times the annual rainfall. This means that evaporation of leachate is an extremely viable leachate management technique. It is understood that leachate impacting groundwater is unlikely to occur due to the high attenuation distance to groundwater and low permeability of the underlying soils, combined with a climate where evaporation far exceeds rainfall to provide limited quantities of leachate.

Based on these site specific conditions the key leachate management strategies are summarised as follows:

- Divert clean water around landfill and around working face;
- Reduce working face size and bund the working face area;
- Cover waste as soon as practical;
- Apply appropriate level of cover for operation stages;
- Implement progressive capping program to maximum extent as possible;
- Regularly inspect and monitor filling operations, including compaction and grade of cover material; and
- Ensure leachate impacted stormwater runoff is collected and stored, not discharged to the environment.

The management measures proposed in this leachate management plan should provide sufficient control and management of leachate at Tennant Creek WMF based on site specific conditions. This report should be reviewed every three years at a minimum to ensure it is compliant with current conditions and proposed future developments. This review shall include:

- Results of internal audits and evaluation of compliance with legal and environmental requirements applicable to the management of leachate;
- Complaints or relevant external party correspondence;
- Environmental performance;
- Tracking of objectives and targets;
- Status of corrective and preventative actions;
- Follow up actions from previous management reviews;
- Changing circumstances, including developments in legal and other requirements pertaining to environmental aspects; and
- Recommendations.

6 REFERENCES

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