Santos

APPENDIX G: EROSION AND SEDIMENT CONTROL PLAN

April 2026

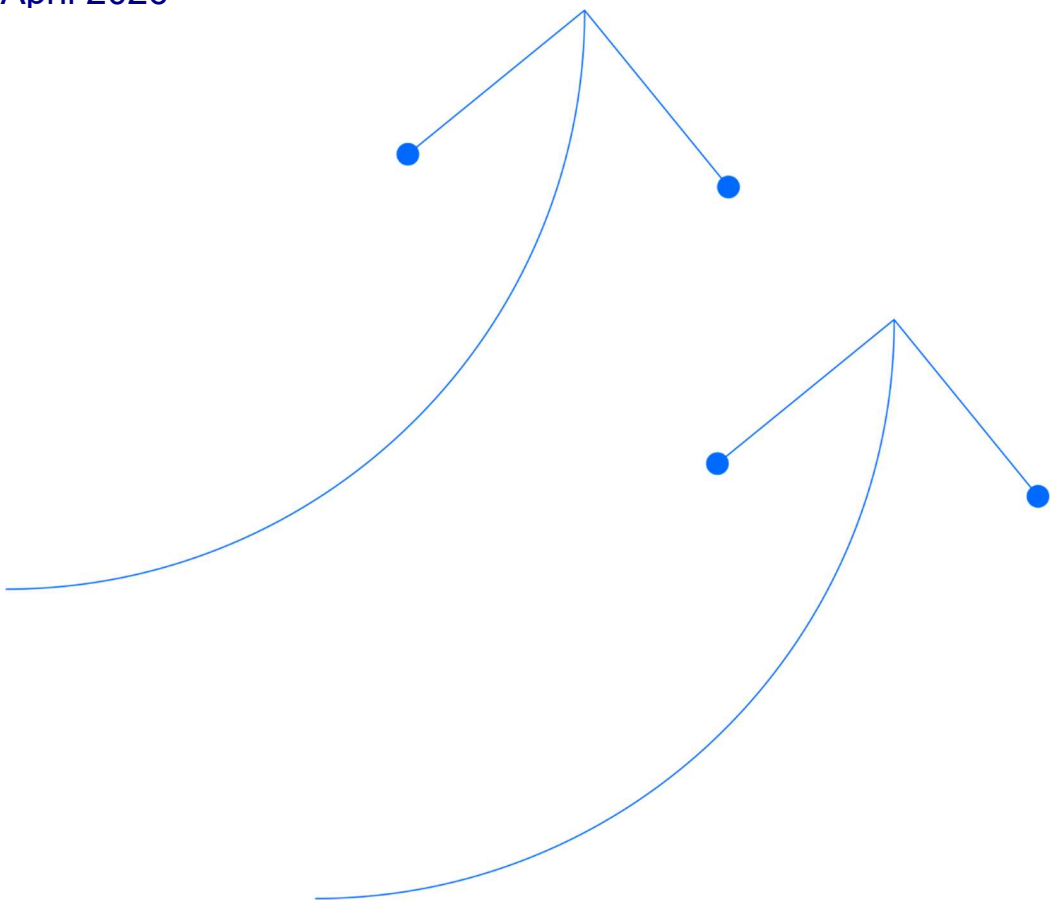

Table of Contents

1. Introduction

This Erosion and Sediment Control Plan (ESCP) provides the overarching framework for managing erosion and sediment risks associated with Santos QNT Pty Ltd's (the Interest Holder) activities under this Environmental Management Plan (EMP) within EP161, including the Jibera South and Newcastle South well pads and associated civil works (e.g. access tracks, laydown areas and borrow pits where applicable) established under STO1-4 and STO7-4.

This ESCP has been prepared to support implementation of controls consistent with:

- Northern Territory Code of Practice for Onshore Petroleum Activities (the Code).
- *Waste Management and Pollution Control Act 1998* (NT), which requires that pollution and environmental harm be prevented and managed.
- The requirements of the consolidated EMP, including the monitoring program, incident response and rehabilitation requirements as specific in Appendix K of the EMP.

The detailed, site-specific erosion and sediment control design and drawings for the Activity are provided in the Fyfe ESCP, appended to this document (Appendix A).

1.1. Scope

This ESCP applies to land disturbance activities under the consolidated EMP, including:

- Jibera South well pad construction and operations (where ground disturbance occurs).
- Newcastle South well pad construction and operations (where ground disturbance occurs).
- Ancillary civil works associated with the above (e.g. access tracks, drainage works, borrow pits and laydown areas).
- Ongoing rehabilitation, maintenance and monitoring activities for disturbance areas captured under this EMP.

1.2. Objectives

The key objectives of this ESCP are to:

- Implement reasonable and practicable measures to minimise erosion and sediment generation from disturbed areas.
- Prevent uncontrolled sediment movement from disturbed areas to surrounding land and drainage features.
- Manage clean and dirty water separation where practicable (i.e. divert clean stormwater away from disturbed/operational areas and manage sediment-laden runoff appropriately).
- Support progressive rehabilitation and stabilisation of disturbed areas so that erosion risks are reduced over time.

Ensure erosion and sediment controls are inspected, maintained and recorded in accordance with the EMP monitoring program and any applicable Code requirements.

1.3. Consolidation of previously approved ESCP

This consolidated EMP incorporates activities and ongoing obligations from previously approved Santos EMPs within EP161 (as detailed in the approved STO1-4, STO2-7 and STO7-4 EMP's). Santos acknowledges that erosion and sediment controls have been installed and/or monitored under those approvals, particularly for legacy disturbance areas such as existing well pads, campsites and access tracks.

For the purposes of this consolidated EMP:

- The Fyfe ESCP (Appendix A) is the current controlling ESCP for erosion and sediment control design and implementation for the Jibera South and Newcastle South well pads and associated civil works undertaken under this consolidated EMP.
- Where legacy disturbance areas authorised under previous EMPs remain in use under this consolidated EMP, or where ongoing rehabilitation/monitoring obligations remain, installed erosion and sediment controls will continue to be maintained and inspected in accordance with the current controlling ESCP.
- No further seismic acquisition or seismic line preparation is proposed under this consolidated EMP. As a result, seismic-line-specific erosion and sediment controls from earlier EMPs no longer apply.

Refer to Section 3.13 of the EMP for a full list of activities being undertaken under these consolidated EMPs.

Appendix A: STO8-1 Beetaloo Basin Appraisal Pilot EMP Erosion and Sediment Control Plan

EP161 – JIBERA SOUTH AND NEWCASTLE SOUTH EROSION AND SEDIMENT CONTROL PLAN

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Issued for Use

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VALUE THROUGH INTEGRATION

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Revision History

Revision	Revision Status	Date	Prepared	Reviewed	Approved
0	IFA	25/06/2026	MM/ELB	MM	ALH
1	IFU	15/10/2025	MM/ELB	MM	ALH
2	IFU	2/03/2026	MM/ELB	MM	ALH
3	IFU	17/03/2026	MM/ELB	MM	ALH

EP161 MCARTHUR APPRAISAL PROJECT
EROSION AND SEDIMENT CONTROL PLAN

INTRODUCTION AND PURPOSE

1. This plan has been developed for Santos to manage erosion and sedimentation during ground disturbance / civil works associated with the EP161 McArthur Appraisal Project. This overarching plan is accompanied by site-specific drawings of the project area.

2. This plan, which forms part of the Projects Environmental Management Plan (EMP), should be read in conjunction with the following documents:
   - Northern Territoy Government (NTG) Project Approvals
   - International Erosion Control Association (IECA) Best Practise Erosion & Sediment Control (2008)
   - NTG Code of Practice: Onshore Petroleum Activities in the Northern Territory (2025)
   - NTG Soil management, erosion and sediment control information technical notes
3. The figures of this report are listed as follows:
   - Figure 1: Santos EP161 Location and Boundaries
   - Figure 2: Santos Site, Access Tracks and Borrow Pits for Newcastle South
   - Figure 3: Santos Site, Access Tracks and Borrow Pits for Jibera South
   - Figure 4: Newcastle South Proposed Site Layout
   - Figure 5: Jibera South Proposed Site Layout
   - Figure 6: Newcastle South Concept Civil Earthworks and ESC
   - Figure 7: Jibera South Concept Civil Earthworks and ESC
   - Figure 8: IECA Standard Drawing Check Dams RCD-01
   - Figure 9: IECA Standard Drawing Flow Diversion Banks DB-01
   - Figure 10: IECA Standard Drawing Catch Drains CD-01
   - Figure 11: IECA Fact Sheet Energy Dissipator
   - Figure 12: U-Shaped Sediment Trap UST-1

PROJECT DESCRIPTION

4. The project includes construction, operation, decommissioning, dismantling and removal of up to 12 wells including land clearing.

5. The sites are located within the Exploration Permit (EP) 161 and located approximately 350km southeast of Katherine, Northern Territory (NT) in the Beetaloo Sub-Basin. Project Location outlined in Figure 1.

6. This Erosion and Sediment Control Plan (ESCP) will initially cover the earthworks, construction and installation of ancillary infrastructure relating to the Jibera South and Newcastle South sites. Project Areas shown in Figure 2 and Figure 3, with site specific layouts shown in Figure 4 and Figure 5.

CONSTRUCTION OVERVIEW AND STAGING

7. The civil works required to prepare for the Drilling Program including upgrading of access routes, the creation of well pads, water storage pads, dams and campsites as well as any civils required to maintain existing and approved infrastructure.

8. Civil works activities have been programmed to occur outside of the wet season (October to April inclusive).

9. Construction staging is anticipated to as per the project construction schedule included in the EMP.

Table 1: Indicative Project Schedule

Activity	Estimated Duration	Estimated Commencement
Mobilisation	1 week	April 2026
Jibera South Pad civil construction and stabilisation	1 month	April 2026
Newcastle South civil construction and stabilisation	1 month	May 2026
Jibera South Pad reinstatement	TBC	Rehabilitation will occur at the cessation of the activity.
Newcastle South reinstatement	TBC	

LOCAL SETTING

CLIMATE:

10. The project area is in the northeast of the NT which undergoes tropical wet-dry seasons. High humidity and rainfall are expected during the November to March months, April to October experience very dry and cooler conditions.
11. Table 2 shows climate averages data for Daly Waters (014618).

Table 2: Average Climate at Daly Waters

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean maximum temperature (°C)	36.6	35.5	34.6	33.7	31.4	28.7	28.9	31.9	35.0	37.7	38.4	38.2
Mean minimum temperature (°C)	24.0	23.4	22.4	19.3	15.8	12.9	11.8	13.5	17.2	21.1	23.5	24.0
Mean rainfall (mm)	166.0	188.1	110.0	21.0	6.1	2.8	2.7	0.3	2.3	21.3	53.9	115.6
Mean rain days	2.2	1.5	4.5	10	14.3	19	22.3	22.3	17.8	14.1	6.8	3.4

TOPOGRAPHY

12. The local topography is generally characterised by gently undulating slopes associated with the plain of the Sturt plateau, local slopes ranging from 1-2%.

WATERWAYS

13. The Newcastle South site is located in the headwaters of the Wiso drainage basin and would therefore not be expected to be impacted by riverine flooding. A catchment area of approximately 9.1 km2 drains through the project area (WRM, 2025).

14. The Jibera South site is located in the headwaters of the Wiso drainage basin and would therefore not be expected to be impacted by riverine flooding. A catchment area of approximately 17.3 km2 drains through project area (WRM, 2025).

SOILS

15. Soils within the project area are primarily kandosols and rudosols. Rudosols area typically shallow and underdeveloped, often found as rocky or gravelly soils in rugged landscapes. Kandosols are generally deep, massive and gravelly soils (previously referred to as red, yellow, or brown earths) and are common through the Sturt Plateau bioregion (Santos, 2021).

EROSION RISK ASSESSMENT

16. Revised Universal Soil Loss Equation (RUSLE) scores using the above parameters was undertaken.

A = R x K x LS x C x P

Where:

A = Annual soil loss due to erosion (t/ha/yr)

R = Rainfall erosivity factor (2,900 site specific based on IECA E3.2)

K = Soil erodibility factor (0.025 per Material Test 49250005-1 and IECA E4)

LS = Length 80m, Slope 2% = 0.41 (per IECA Table E3)

C = Cover and management factor (1 - no appreciable ground cover)

P = Erosion control practice factor (1.3 - default for construction)

Note: A rainfall erosivity factor of 2,900 has been adopted based on a 2-year, 6-hour rainfall event of 11.6 mm/hr and the following equation, $R = 164.74 (1.1177)^{S} S^{0.6444}$, from section E3.2 of IECA (2008). Refer to the Intensity, Frequency, Duration chart in Appendix A for site specific rainfall data. Table 3 outlines the RUSLE variables and outcome.

Table 3: Catchment RUSLE score

ESC MANAGEMENT STANDARDS								
LOCATION	**APPROX. AREA (ha)**	**R**	**K**	**L/S***	**C**	**P**	**A** (t/ha/yr)	**SEDIMENT CONTROL STANDARD**
JIBERA SOUTH SITE	15.0	2,900	0.025	0.41	1	1.3	39	TYPE 3
NEWCASTLE SOUTH SITE	14.9	2,900	0.025	0.41	1	1.3	39	TYPE 3

17. The site has an estimated soil loss of 39 t/ha/yr which is very low in accordance with IECA Table 4.4.3 shown in Table 4. The sediment control standard is Type 3 per IECA Table 4.5.1.

Table 4: Erosion risk rating based on IECA Table 4.4.3

EROSION RISK RATING	SOIL OSS (T/HA/YR)
Very Low	0 to 150
Low	150+ to 225

MONTHLY EROSION RISK ASSESSMENT

18. Erosion risk rating based on monthly rainfall depth per IECA Table 4.4.2, shown in Table 5.

Table 5: Monthly rainfall depth risk assessment

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Rainfall Depth (mm)	166.0	188.1	110.0	21.0	6.1	2.8	2.7	0.3	2.3	21.3	53.9	115.6
EROSION RISK RATING	HIGH	HIGH	HIGH	VERY LOW	VERY LOW	VERY LOW	VERY LOW	VERY LOW	VERY LOW	VERY LOW	MOD	HIGH

*MOD = MODERATE

GENERAL NOTES

Note: The management measures below combine established best practice ESC management measures with established best practice management measures provided by Santos as used on previous projects – refer to EcOz (2024).

TIMING

19. Construction is scheduled to take place between April to October which is within the *very low* erosion risk (per IECA Table 4.4.2) period as per the monthly risk assessment based on rainfall depth (Table 5).

SITE ACCESS

20. Access to the wellsite, borrow pits and all other project areas is via existing and new access tracks, all weather access will be established as required.

21. All areas external to the project area are no-go areas at all times.

GENERAL REQUIREMENTS

22. This ESCP is to be read in conjunction with the project EMP and any other relevant project documentation and/or written instructions issued in relation to works on site.

23. The provided drawings are indicative of appropriate control and practices to be implemented onsite.

24. Weather conditions are to be monitored during the proposed period of construction activities. Major construction activities are to be scheduled to avoid significant rain events as far as practicable.

25. Erosion and sediment controls to be implemented as per site layout plans and typical designs specified within this ESCP. Controls should always be adjusted to suit conditions and achieve the desired outcomes.

26. Erosion and sediment controls are to remain in place until permanent site stabilisation has been achieved.

27. Clean water from areas surrounding the project area to be diverted around work areas wherever possible.

SOIL MANAGEMENT AND STOCKPILE MANAGEMENT

28. Clearing to be within approved project area and to be to the minimum extent necessary.

29. Topsoil identified for removal is to be stripped (up to a depth of 100 mm) immediately prior to commencement of further earthwork activities: and preserved for reuse.

30. Avoid mixing topsoil with subsoil material.

31. No stockpiling of materials within protected areas of vegetation or dripline of trees.

32. Topsoil will be stripped and windrowed to form a clean water diversion bund, refer to site drawings

33. Stockpiled topsoil at a height no greater than 2m.

34. Any long-term stockpiles will be stabilised.

ACCESS TRACK DESIGN

35. Access tracks are to be designed to avoid impeding natural surface flow during rainfall.

36. Track gradients should direct rainfall back to the natural ground surface where possible.

37. Culverts or cross-drainage (cross banks/Whoa-Boys) structures must be installed where flow paths intersect tracks.

38. Type 3 sediment controls must be installed at pipe/culvert inlets, these must not obstruct flow.

BORROW PIT DESIGN

39. Gravel extraction is to occur only from the approved borrow pit as per the EMP.

40. Borrow pit access is to use existing tracks as far as practicable.

41. Perimeter bunds are to be formed from unsuitable overburden (min 0.5m height). These are to be managed to promote the re-establishment of vegetation (e.g. incorporate seed bank and organic matter).

42. Perimeter bunds are to be located to contain internal pit runoff during rainfall events.

43. Borrow pits will be designed to divert any clean water from entering the pit.

44. In cases where borrow pits have side slopes of 1:1 slope, must require perimeter/flow diversion bund, which are regularly maintained and monitored. Rehabilitation should be undertaken progressively once borrow pit is deemed to have provided the material required for the project.

45. Final voids created by gravel extraction are to be designed and located to receive internal pit drainage. Areas external to voids to be maintained at slopes <2% as far as practical.

46. Any direct rainfall will be contained within the borrow pit, water within required water quality specification (refer project approvals) may be released through dewatering erosion controls.

DRAINAGE CONTROL

CLEAN WATER DIVERSION

47. Clean water will be diverted around the site with flow diversion banks (Figure 9), location shown in Figure 6.

DIRTY WATER

48. Dirty water will be guided to Type 3 sediment controls (Figure 8, Figure 11 and Figure 12) using earth lined catch drains (Figure 10), locations as shown in Figure 6 and Figure 7.

EROSION CONTROL

49. Following clear and grade and civil works, sections of the site will be covered in non-erosive material, per IECA 4.4.7 shown in Table 6.

Table 6: Temporary Stabilisation Erosion Standard (per IECA 4.4.7)

	LIMIT ON FORWARD CLEARING	TEMPORARY STABILISATION STANDARD	PERMANENT STABILISATION STANDARD
ALL	All reasonable and practicable steps taken to apply best practice erosion control measures to completed earth works, or otherwise stabilise such works, prior to anticipated rainfall-including existing unstable, undisturbed, soil surfaces under the management or control of the building/construction works.		
VERY LOW	Clearing and stripping is limited to 8 weeks prior to scheduled commencement of civil works	Unfinished earthworks are suitably stabilised if disturbance is expected to be suspended for a period of 30 days	Disturbed surface area to be stabilised within 30 days of completion of activities.

50. Laydown areas are to stabilised i.e. compacted surface or gravel capped.

51. Dirty water to be diverted around laydown and camp areas as much as practical (i.e catch drain).

52. All compounds, laydowns access and detour tracks are to be rehabilitated to pre-construction conditions once works are complete.

53. Sediment controls are to remain in place until minimum 75% stabilised groundcover (or groundcover % consistent with adjacent undisturbed areas) is achieved for disturbed areas or determined by a CPESC.

SEDIMENT CONTROL

54. Sediment controls to be installed at locations identified on the site-specific plan.

DEWATERING

55. Dewatering activities must meet discharge criteria stipulated within the project EMP.

56. Dewatering must be conducted through a sediment control in such a manner that avoids concentrated surface runoff and/or erosion.

57. Any captured water onsite to be tested and, if suitable to be pumped to a velocity dissipation device offsite

58. Any unsuitable water to be dewatered is to be pumped to onsite storage for treatment or removal from site.

DUST SUPPRESION AND MANAGEMENT

59. Dust generated by project activities will be suppressed through the use of a water cart or supplemented by increased ground cover in the form of hardstands or erosion control matting.

60. Common practices when operating and managing dust controls include:

- Minimise the area of soil exposed to the wind by staging works across the site.
- Limit traffic to established roads and optimise the site layout to minimise travel distances (as per site design). This will also involve controlling vehicle speeds across the site.
- Maintain the surface of roads and initiate repairs in the first instance when degradation is observed.
- Minimise the dirt that is being tracked out on vehicle wheels onto paved surfaces (if observed).
- Limit the height of stockpiles, shelter stockpiles from wind, cover unstabilised surfaces and stockpiles with mulch binders or vegetation and consolidate loose surface material.

61. When maintaining dust controls:

- Progressively rehabilitate exposed areas as construction activities are completed.
- Reapply water/mist as required to effectively manage levels of dust generation, as soil moisture levels will become low during hot and windy conditions.

FLOOD RESPONSE

62. Where a significant rainfall event is anticipated including pre-wet season, management measures outlined within the project Environmental Management Plan must be adhered to.

63. Where significant rain event (as defined in EMP) is forecast and/or flooding or work areas is anticipated, the following steps are required:

- Removal of all plant and equipment from within drainage channels, including rock platforms.
- Securing of all erosion and sediment control measures.
- Erosion protection of any additional disturbed areas adjacent to or within drainage channels (i.e. abutments).

MONITORING AND MAINTENANCE

64. All erosion and sediment controls are to be inspected regularly (see Monitoring Frequencies) and noted on a HSE Checklist.

65. Monitoring Frequencies:

- Daily inspections during active ground-disturbing works when personnel are on site.
- Weekly inspections during manned periods in the wet season when no active disturbance is occurring.
- Pre- and post-wet season inspections during non-operational periods to identify required repairs and confirm stability.
- Post-rainfall inspections for significant rainfall (>20 mm in 24 hours) during manned periods where safe access is available.

66. Weather will be monitored during construction.

67. Ensure adequate supplies of erosion and sediment control products and required equipment is readily available on site

68. All temporary erosion and sediment control measures must be fully operational and are to be maintained in proper working order until permanent stabilisation is achieved.

69. Sediment control measures are to be maintained such that their capacity does not fall below 70%.

ESCP UPDATES AND VARIATIONS

70. As per Best Practice Guidelines (IECA 2008), a revised ESCP may be required where:

- controls require alteration due to change in work practices or new stage of works in commenced
- changes occur in slope gradients and drainage paths, with their exact form unpredictable before works start
- a change in the design occurs that materially affect the site works: or
- the desired outcome (e.g. protection of receiving environments) is clearly not being achieved.

71. This ESCP forms part of the overall soil and water management strategy (as per the EMP), with other aspects being appropriate implementation, monitoring and corrective action.

RESPONSIBILITIES

72. Details of responsibilities in relation to ESC:

- Plan preparation and certification – Matt McDermott (CPESC #8153) and Fyfe Pty Ltd.

73. Table 7 outlines key personnel and the roles and responsibilities regarding erosion and sediment controls.

Table 7 Key personnel roles and responsibilities

WHO	WHAT
All staff including contractors	• Complete a site induction prior to commencement of work • Implement and comply with this Erosion and Sediment Control Plan • Report any activity that has resulted in, or has the potential to result in, an environmental incident to their supervisors
Project Manager	• Ensure implementation of this Erosion and Sediment Control Plan • Provide necessary resources and technical support for implementation of Erosion and Sediment Control Plan • Ensure non-conformances/corrective actions have been investigated and closed out timely and appropriately
Project Engineer	• Implementation of requirements outlined in this Erosion and Sediment Control Plan • Ensure all staff including sub-contractors are inducted prior to commencement of works • Notify the Project Manager of incidents/non-conformances • Advise Site Supervisor immediately of any corrective actions that are required upon completion of site inspections • Report non-conformances to the Project Manager
Site Supervisors	• Implementation of requirements outlined in this Erosion and Sediment Control Plan • Ensure all staff including sub-contractors are inducted prior to commencement of works • Conduct and document weekly site inspections • Conduct regular visual inspections of erosion and sediment control measures on site during operational periods when there is heavy rainfall • Notify the Project Engineer and/or Project Manager of incidents/non-conformances

74. Table 8 outlines the responsibilities and timing associated with the identified ESC mitigation measures. These measures are to be read and actioned in conjunction with the Rehabilitation Management Plan.

Table 8 Responsibilities and timing

MITIGATION MEASURE	TIMING	RESPONSIBILTY
ESCPs shall be prepared by a suitably qualified person. These shall be updated regularly to reflect progressive work phases and potential risk changes	Prior to and during Works	HSE Manager
Erosion and sediment controls will be designed based upon historical rainfall data for the period (i.e. dry season or wet season) for which the controls are required to be operational, having regard to the IECA guidelines or equivalent best practice guidelines.	Prior to and during Works	HSE Manager
Erosion and sediment controls will be installed to minimise erosion and maximise sediment retention within the project area.	Prior to and during Works	Supervisor
Clean surface-water run-on will be diverted around the perimeter of construction areas where applicable. Dirty water will be diverted to appropriate sediment controls in accordance with the current ESCP	At all times	Supervisor
All erosion and sediment controls are to be implemented prior to the commencement of works for which they have been designed. Where possible, works will be staged to minimise exposure of soils to erosion	Prior to Works	Supervisor
Temporary erosion controls will be maintained in place until the corresponding catchment work areas are stabilised in accordance with the ESCP	At all times	Supervisor
If soil erosion is evident, exposed surfaces at the affected area will be stabilised with whatever means is considered practicable and satisfactory (e.g. matting, soils stabiliser) to mitigate and stabilise the area in accordance with the relevant ESCP.	At all times	Supervisor
ESCPs are to be maintained and up to date for the current site conditions	At all times	Supervisor
Sediment and erosion controls shall not be removed from their respective locations without prior consent of the HSE Manager	At all times	Supervisor

IECA STANDARD DRAWINGS AND SUPPORTING DOCUMENTS WILL BE KEPT ONSITE AND DISTRUBUTED TO SITE SUPERVISORS WHEN INSTALLING CONTROLS. THIS WILL ENSURE THE CORRECT CONTROLS ARE BEING INSTALLED AND ANY ALTERATIONS WILL BE DISCUSSED WITH THE SUPERVISORS

The following pages contain the below figures in order:

- Figure 1: Santos EP161 Location and Boundaries
- Figure 2: Santos Site, Access Tracks and Borrow Pits for Newcastle South
- Figure 3: Santos Site, Access Tracks and Borrow Pits for Jibera South
- Figure 4: Newcastle South Proposed Site Layout
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- Figure 12: U-Shaped Sediment Trap UST-1

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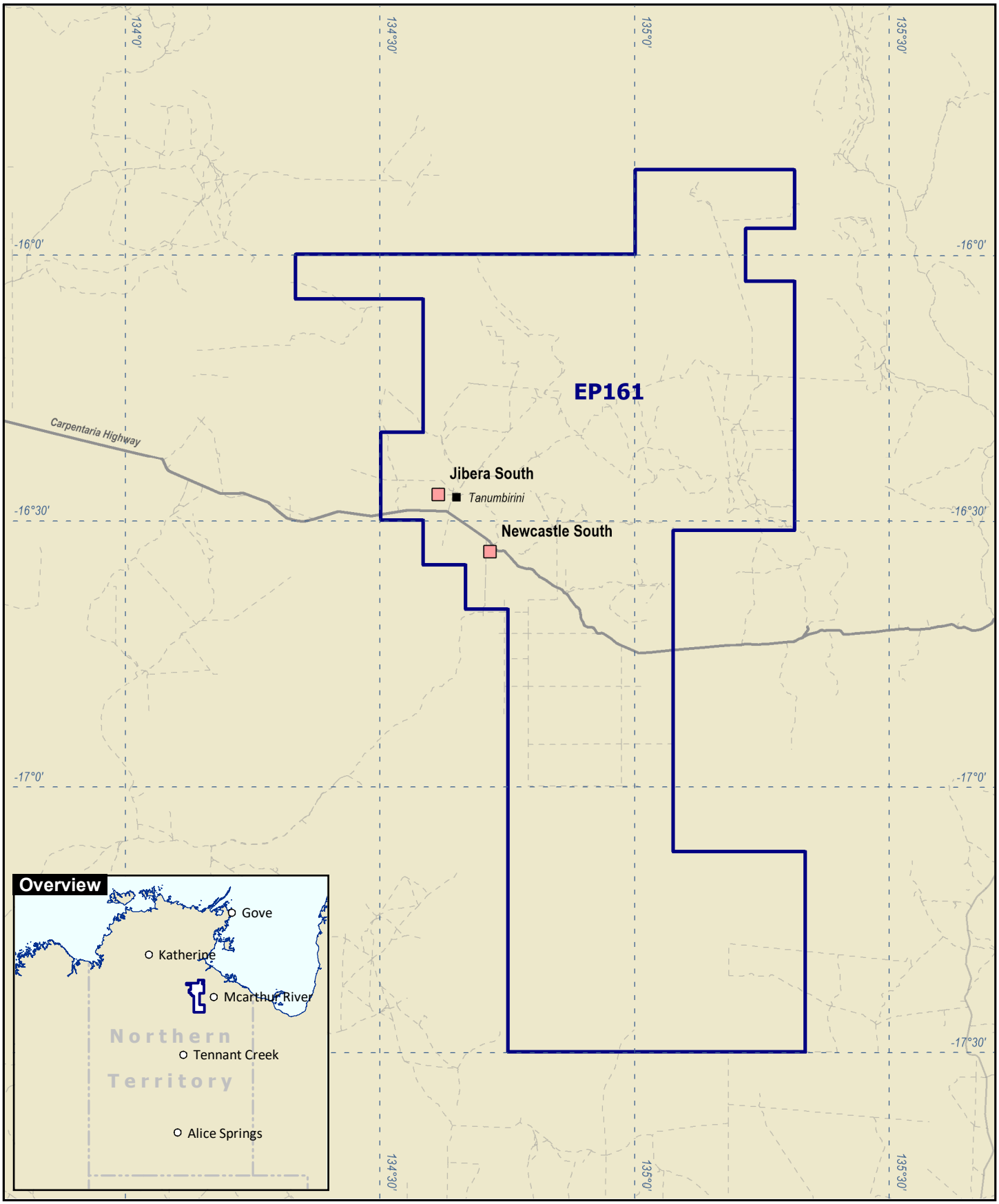

Legend

- Homestead
- Site location
- Carpentaria Highway
- Track
- Santos Tenement

Santos

Northern Territory

Project Location Overview

0 50

kilometres

DRAFT Date: 13/02/2025 File No. ENVIR 1055a.WOR

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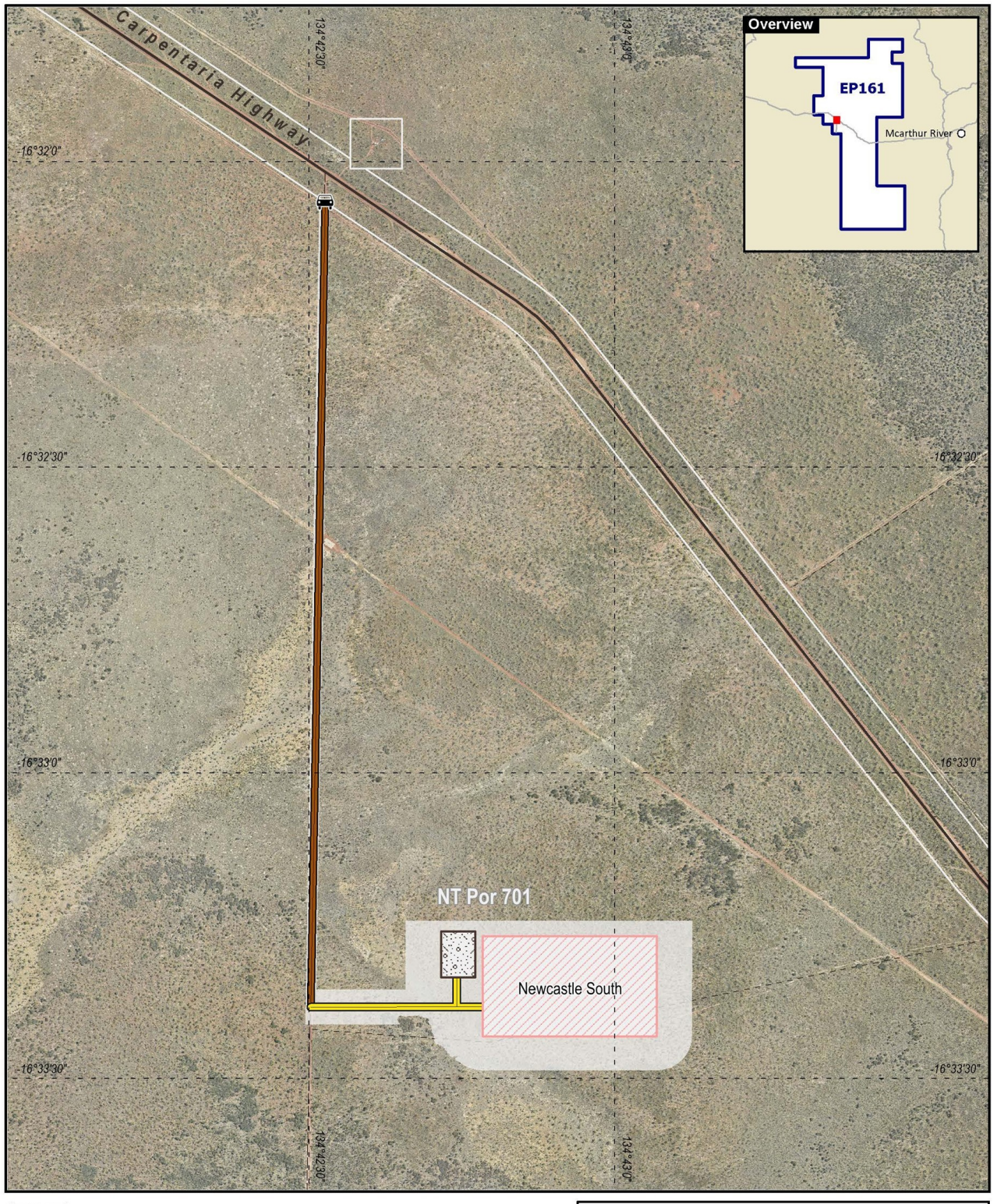

Legend

- Entry point
- Access Road - Existing - Upgrade and Gravel Cap
- Access Road - New - Gravel Cap
- Borrow Pit
- Well pad (including water bores)
- Cadastral Parcel
- Project Area

Santos

Northern Territory

Proposed Infrastructure

Newcastle South

0 500

meters

Rev 3 Date: 20/10/2025 File No. ENVIR 1088b.WOR

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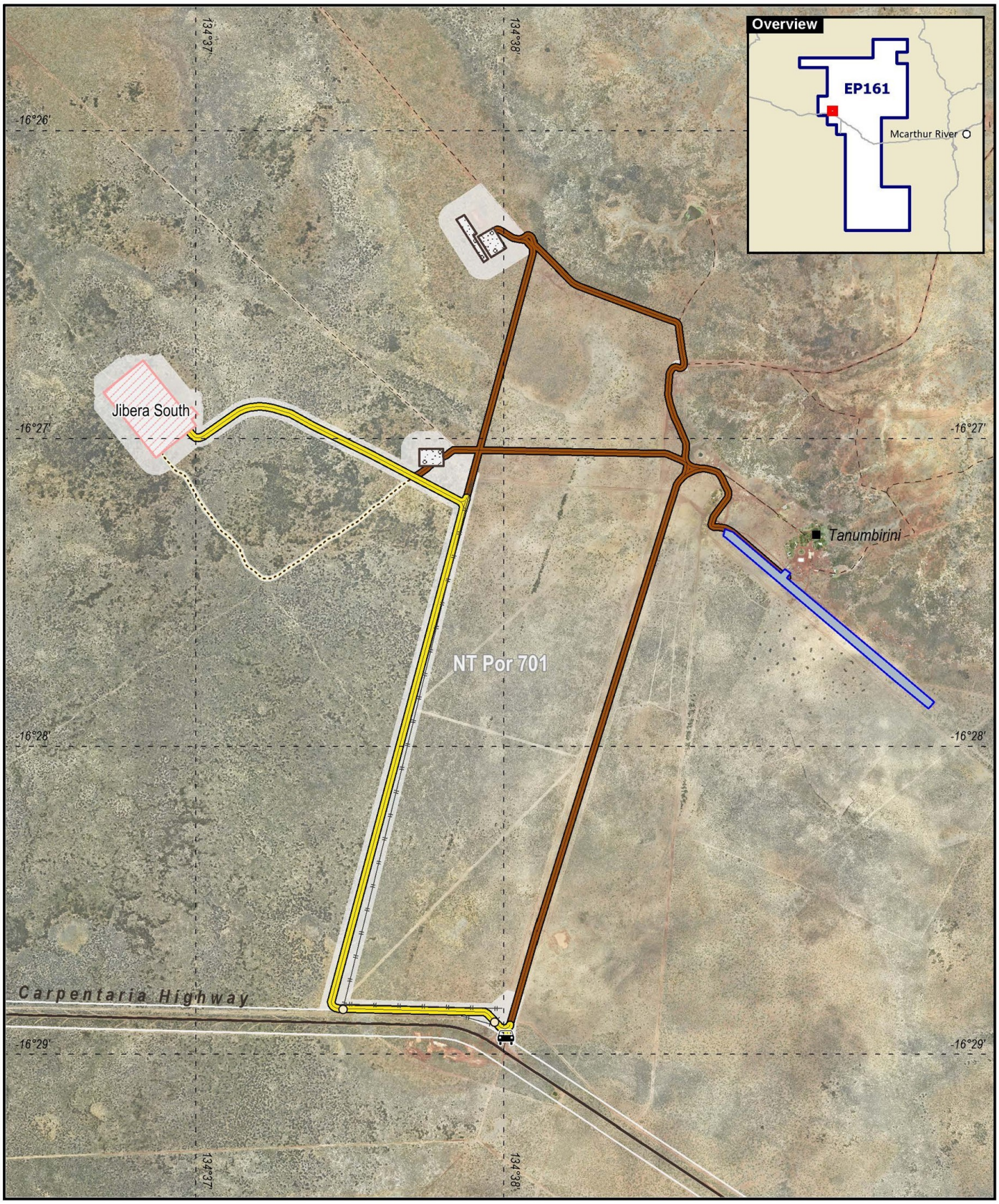

Legend

- Entry point
- Fence detail
- Homestead
- Access Road - Existing - Upgrade and Gravel Cap
- Access Road - New - Gravel Cap
- Access Road - Temporary
- Fencing - new
- Existing airstrip
- Borrow Pit
- Well pad (including water bores)
- Project area
- Cadastral Parcel

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Northern Territory

Proposed Infrastructure

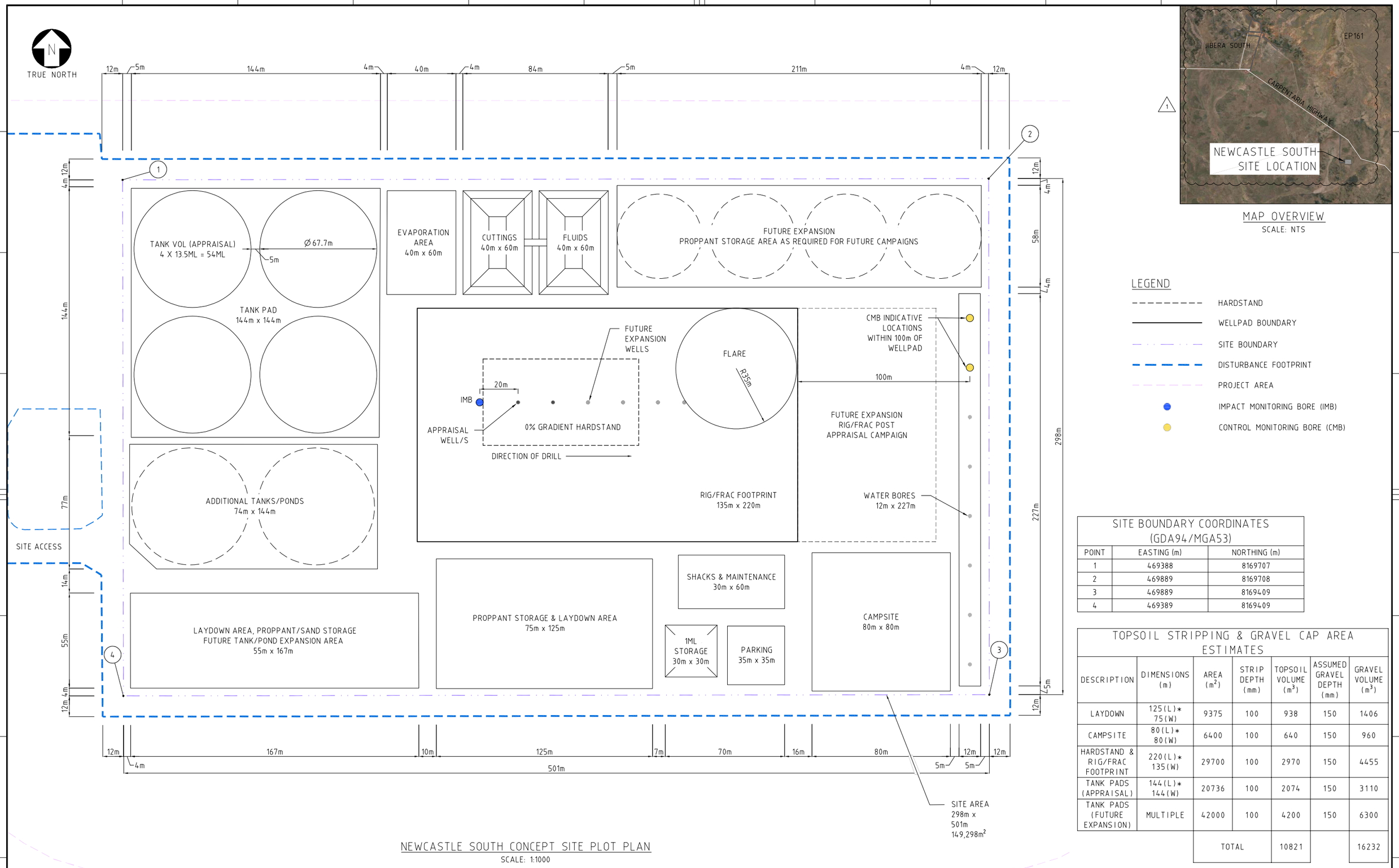
Jibera South

0 1

kilometers

Rev 3 Date: 20/10/2025 File No. ENVIR 1088b.WOR

GDA 2020



MAP OVERVIEW
SCALE: NTS

LEGEND

- HARDSTAND
- WELLPAD BOUNDARY
- SITE BOUNDARY
- DISTURBANCE FOOTPRINT
- PROJECT AREA
- IMPACT MONITORING BORE (IMB)
- CONTROL MONITORING BORE (CMB)

SITE BOUNDARY COORDINATES (GDA94/MGA53)

POINT	EASTING (m)	NORTHING (m)
1	469388	8169707
2	469889	8169708
3	469889	8169409
4	469389	8169409

TOPSOIL STRIPPING & GRAVEL CAP AREA ESTIMATES

DESCRIPTION	DIMENSIONS (m)	AREA (m^2)	STRIP DEPTH (mm)	TOPSOIL VOLUME (m^3)	ASSUMED GRAVEL DEPTH (mm)	GRAVEL VOLUME (m^3)
LAYDOWN	125(L)* 75(W)	9375	100	938	150	1406
CAMPSITE	80(L)* 80(W)	6400	100	640	150	960
HARDSTAND & RIG/FRAC FOOTPRINT	220(L)* 135(W)	29700	100	2970	150	4455
TANK PADS (APPRAISAL)	144(L)* 144(W)	20736	100	2074	150	3110
TANK PADS (FUTURE EXPANSION)	MULTIPLE	42000	100	4200	150	6300
	TOTAL			10821		16232

NEWCASTLE SOUTH CONCEPT SITE PLOT PLAN
SCALE: 1:1000

0 25 50 75 100
SCALE 1:1000 (A1) METRES

No	DATE	DRN	CHKD	ENG	SANTOS Q.A.	PROJ NO.	RE NAME	RE NO.	RE COMPANY	DESCRIPTION	DRG No.	SUBJECT
1	17/10/25	JWS	MXC	JAL						RE-ISSUED FOR APPROVAL (PMC-NA-000163)		
0	25/06/25	ELB	ALH	JAL						ISSUED FOR APPROVAL (PMC-NA-000163)	1052-040-LDD-0002	CIVIL AND EROSION & SEDIMENT CONTROL LAYOUT

REVISIONS | REFERENCE DRAWINGS

DRN: ELB | SANTOS Q.A.:
DATE: 25/06/25 | PROJ NO.:
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ENG: JAL | RE COMPANY: FYFE

A.B.N. 12 131 271 648

AREA NUMBER 1052 - EP161
NEWCASTLE SOUTH - McARTHUR APPRAISAL
SITE PLOT PLAN
LAYOUT

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DRAWING No. 1052-040-LDD-0001 | REV 1

CADFILE No. - 1052-040-LDD-0001

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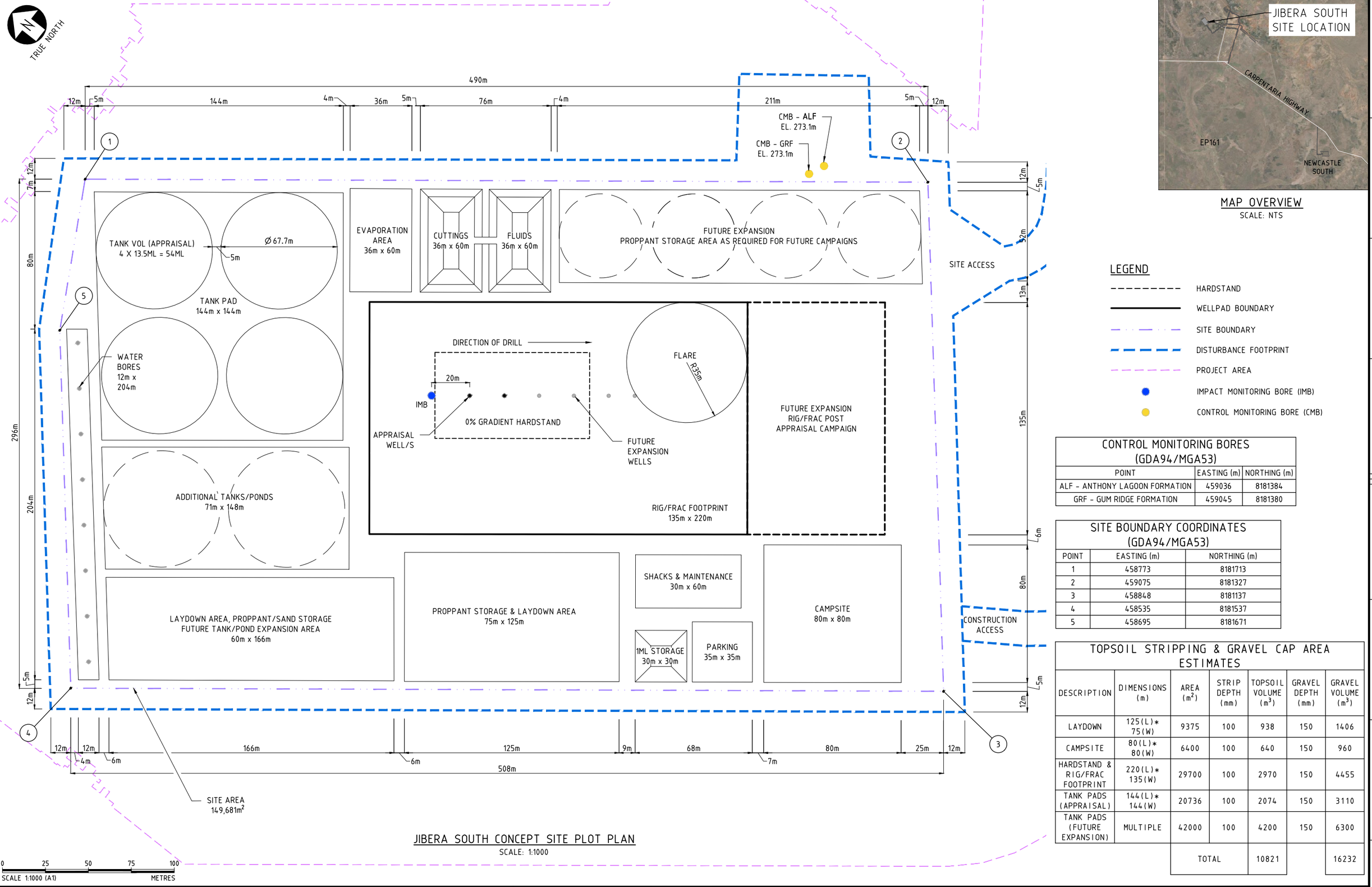

MAP OVERVIEW

SCALE: NTS

LEGEND

- HARDSTAND
- WELLPAD BOUNDARY
- SITE BOUNDARY
- DISTURBANCE FOOTPRINT
- PROJECT AREA
- IMPACT MONITORING BORE (IMB)
- CONTROL MONITORING BORE (CMB)

CONTROL MONITORING BORES (GDA94/MGA53)

POINT	EASTING (m)	NORTHING (m)
ALF - ANTHONY LAGOON FORMATION	459036	8181384
GRF - GUM RIDGE FORMATION	459045	8181380

SITE BOUNDARY COORDINATES (GDA94/MGA53)

POINT	EASTING (m)	NORTHING (m)
1	458773	8181713
2	459075	8181327
3	458848	8181137
4	458535	8181537
5	458695	8181671

TOPSOIL STRIPPING & GRAVEL CAP AREA ESTIMATES

DESCRIPTION	DIMENSIONS (m)	AREA (m^2)	STRIP DEPTH (mm)	TOPSOIL VOLUME (m^3)	GRAVEL DEPTH (mm)	GRAVEL VOLUME (m^3)
LAYDOWN	125(L)*75(W)	9375	100	938	150	1406
CAMPSITE	80(L)*80(W)	6400	100	640	150	960
HARDSTAND & RIG/FRAC FOOTPRINT	220(L)*135(W)	29700	100	2970	150	4455
TANK PADS (APPRAISAL)	144(L)*144(W)	20736	100	2074	150	3110
TANK PADS (FUTURE EXPANSION)	MULTIPLE	42000	100	4200	150	6300
	TOTAL			10821		16232

JIBERA SOUTH CONCEPT SITE PLOT PLAN

SCALE: 1:1000

No	DATE	DRN	CHKD	ENG	SANTOS Q.A.	PROJ NO.	RE NAME	RE NO.	RE COMPANY	DESCRIPTION
2	26/02/26	ELB	MME	JAL						RE-ISSUED FOR APPROVAL (PMC-NA-000163)
1	17/10/25	JWS	MXC	JAL						RE-ISSUED FOR APPROVAL (PMC-NA-000163)
0	25/06/25	ELB	ALH	JAL						ISSUED FOR APPROVAL (PMC-NA-000163)

REVISIONS

DRG No.	SUBJECT
1052-040-LDD-0004	CIVIL AND EROSION & SEDIMENT CONTROL LAYOUT

REFERENCE DRAWINGS

DRN: ELB	SANTOS Q.A.:
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CHKD: ALM	RE NO.:
ENG: JAL	RE COMPANY: FYFE

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AREA NUMBER 1052 - EP161
JIBERA SOUTH - McARTHUR APPRAISAL
SITE PLOT PLAN
LAYOUT

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CADFILE No. - 1052-040-LDD-0003

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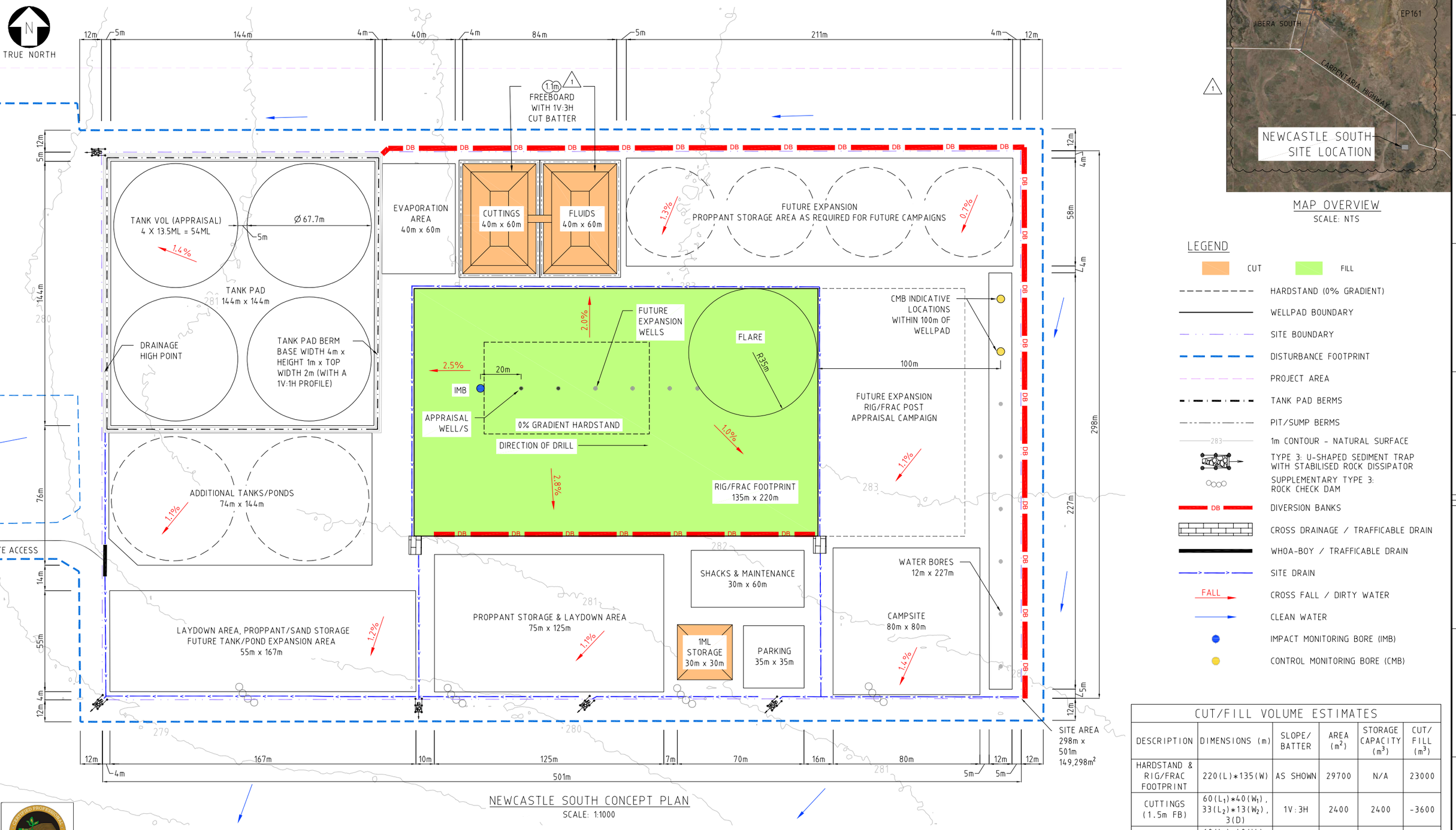

NEWCASTLE SOUTH CONCEPT PLAN
SCALE: 1:1000

MAP OVERVIEW
SCALE: NTS

LEGEND

- CUT
- FILL
- HARDSTAND (0% GRADIENT)
- WELLPAD BOUNDARY
- SITE BOUNDARY
- DISTURBANCE FOOTPRINT
- PROJECT AREA
- TANK PAD BERMS
- PIT/SUMP BERMS
- 283 — 1m CONTOUR - NATURAL SURFACE
- TYPE 3: U-SHAPED SEDIMENT TRAP WITH STABILISED ROCK DISSIPATOR
- SUPPLEMENTARY TYPE 3: ROCK CHECK DAM
- DB — DIVERSION BANKS
- CROSS DRAINAGE / TRAFFICABLE DRAIN
- WHOA-BOY / TRAFFICABLE DRAIN
- SITE DRAIN
- FALL — CROSS FALL / DIRTY WATER
- CLEAN WATER
- IMPACT MONITORING BORE (IMB)
- CONTROL MONITORING BORE (CMB)

CUT/FILL VOLUME ESTIMATES

DESCRIPTION	DIMENSIONS (m)	SLOPE/ BATTER	AREA (m^2)	STORAGE CAPACITY (m^3)	CUT/ FILL (m^3)
HARDSTAND & RIG/FRAC FOOTPRINT	220(L)*135(W)	AS SHOWN	29700	N/A	23000
CUTTINGS (1.5m FB)	$60(L_1)*40(W_1)$, $33(L_2)*13(W_2)$, 3(D)	1V:3H	2400	2400	-3600
FLUIDS (1.5m FB)	$60(L_1)*40(W_1)$, $33(L_2)*13(W_2)$, 3(D)	1V:3H	2400	2400	-3600
1ML STORAGE	$30(L_1)*30(W_1)$, $12(L_2)*12(W_2)$, 3(D)	1V:3H	900	1000	-1400
ESTIMATED REQUIRED FILL					14400

NOTES:

1. LEASE LEVEL TOLERANCE IN THE RIG PAD AREA IS TO BE MAINTAINED. THE AREA SHALL BE LEVELLED, AND GROUND COMPACTION SHALL BE FIRM ENOUGH TO SUPPORT THE RIG. A MINIMUM COMPACTED FILL DEPTH OF 150mm USING APPROVED SELECT FILL IS REQUIRED.
2. RIG HARDSTAND AREA (REFER TO STANDARD LEASE LAYOUT) SHALL HAVE A MINIMUM BEARING CAPACITY OF 192kPa. EXCAVATE TO A DEPTH OF 700mm BELOW THE FINISHED LEASE PAD LEVEL AND BACKFILL USING APPROVED MATERIAL WITH A HIGH SOAKED STABILITY RATING. BACKFILL SHALL BE COMPACTED IN 200mm LAYERS TO A MINIMUM OF 95% STANDARD MAXIMUM DRY DENSITY.
3. SLOPE ON SKIDDING LOCATIONS SHALL NOT EXCEED 1 DEGREE IN THE DIRECTION OF THE SKID PATH.
4. PROVIDE A 4m WIDE FLAT AREA AROUND ALL PITS.
5. CONSTRUCT A 300mm HIGH COMPACTED BUND AND INSTALL FENCING AROUND ALL SIDES OF THE PITS (TEMPORARY FENCE ON THE LEASE SIDE). FINAL FENCE TYPE TO BE CONFIRMED.
6. LEASES SHALL BE FENCED, WITH THE LEASE ENTRY EQUIPPED WITH A GATE OR GRID.
7. WELLSITE SHALL BE FREE-DRAINING WHERE PRACTICABLE.
8. ALL EROSION AND SEDIMENT CONTROLS TO BE INSTALLED PER IECA BEST PRACTICE GUIDELINES.

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CPESC #8153

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1	17/10/25	JWS	MXC	JAL						RE-ISSUED FOR APPROVAL (PMC-NA-000163)
0	25/06/25	ELB	ALH	JAL						ISSUED FOR APPROVAL (PMC-NA-000163)

REVISIONS

DRG No.	SUBJECT
1052-040-LDD-0001	SITE PLOT PLAN LAYOUT

REFERENCE DRAWINGS

DRN: ELB | SANTOS Q.A.:
DATE: 25/06/25 | PROJ NO.:
SCALE: 1:1000 | RE NAME:
CHKD: ALH | RE NO.:
ENG: JAL | RE COMPANY: FYFE

A.B.N. 12 131 271 648

AREA NUMBER 1052 - EP161
NEWCASTLE SOUTH - McARTHUR APPRAISAL
CIVIL AND EROSION & SEDIMENT CONTROL
LAYOUT

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DRAWING No. 1052-040-LDD-0002
REV 1

CADFILE No. - 1052-040-LDD-0002

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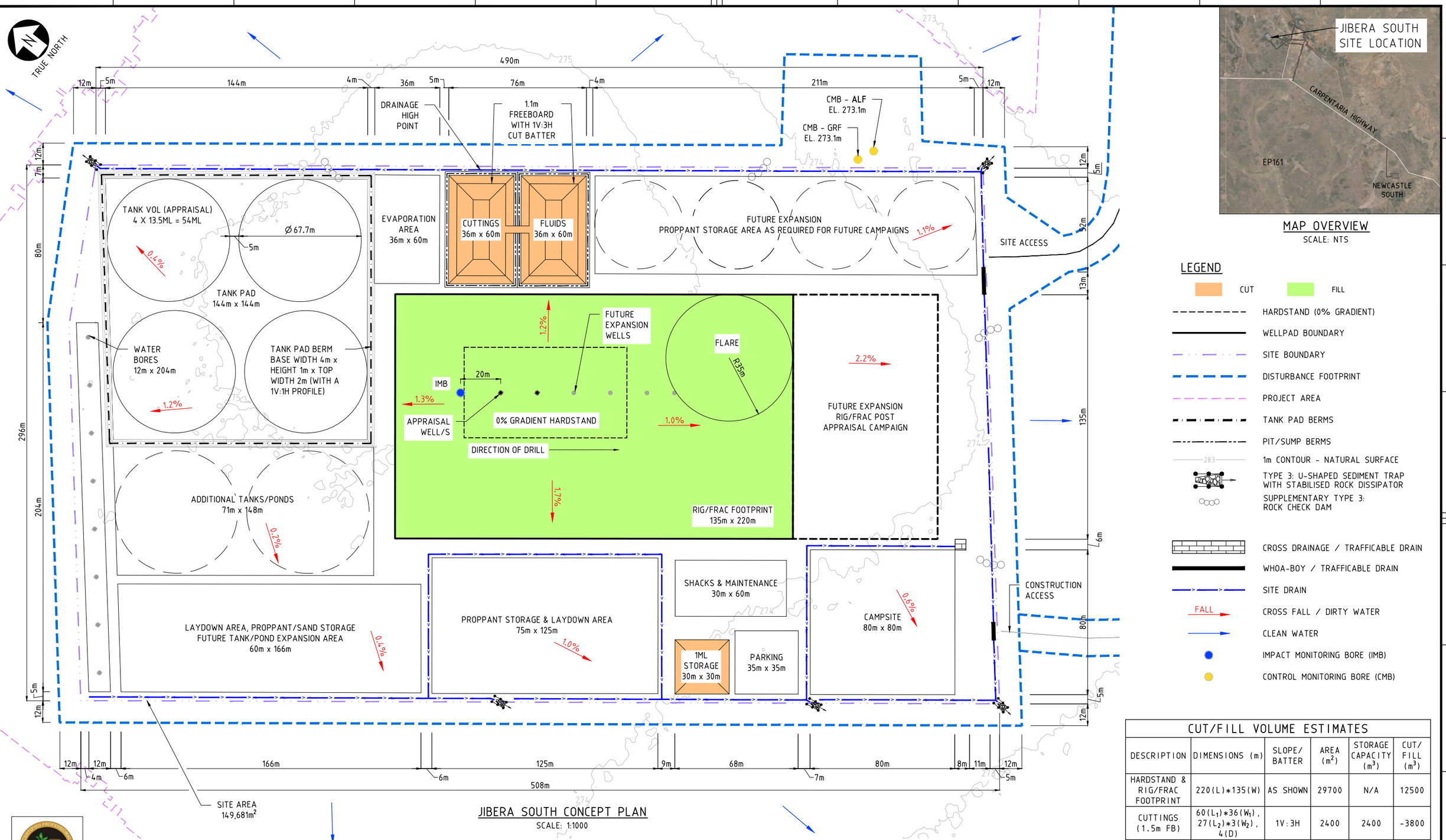

MAP OVERVIEW
SCALE: NTS

LEGEND

- CUT
- FILL
- HARDSTAND (0% GRADIENT)
- WELLPAD BOUNDARY
- SITE BOUNDARY
- DISTURBANCE FOOTPRINT
- PROJECT AREA
- TANK PAD BERMS
- PIT/SUMP BERMS
- 283 — 1m CONTOUR - NATURAL SURFACE
- TYPE 3: U-SHAPED SEDIMENT TRAP WITH STABILISED ROCK DISSIPATOR
- SUPPLEMENTARY TYPE 3: ROCK CHECK DAM
- CROSS DRAINAGE / TRAFFICABLE DRAIN
- WHOA-BOY / TRAFFICABLE DRAIN
- SITE DRAIN
- FALL — CROSS FALL / DIRTY WATER
- CLEAN WATER
- IMPACT MONITORING BORE (IMB)
- CONTROL MONITORING BORE (CMB)

JIBERA SOUTH CONCEPT PLAN
SCALE: 1:1000

CUT/FILL VOLUME ESTIMATES

DESCRIPTION	DIMENSIONS (m)	SLOPE/ BATTER	AREA (m^2)	STORAGE CAPACITY (m^3)	CUT/ FILL (m^3)
HARDSTAND & RIG/FRAC FOOTPRINT	220(L)*135(W)	AS SHOWN	29700	N/A	12500
CUTTINGS (1.5m FB)	60(L_1)*36(W_1), 27(L_2)*3(W_2), 4(D)	1V:3H	2400	2400	-3800
FLUIDS (1.5m FB)	60(L_1)*36(W_1), 27(L_2)*3(W_2), 4(D)	1V:3H	2400	2400	-3800
1ML STORAGE	30(L_1)*30(W_1), 12(L_2)*12(W_2), 3(D)	1V:3H	900	1000	-1400
ESTIMATED REQUIRED FILL					3500

NOTES:

1. LEASE LEVEL TOLERANCE IN THE RIG PAD AREA IS TO BE MAINTAINED. THE AREA SHALL BE LEVELLED, AND GROUND COMPACTION SHALL BE FIRM ENOUGH TO SUPPORT THE RIG. A MINIMUM COMPACTED FILL DEPTH OF 150mm USING APPROVED SELECT FILL IS REQUIRED.
2. RIG HARDSTAND AREA (REFER TO STANDARD LEASE LAYOUT) SHALL HAVE A MINIMUM BEARING CAPACITY OF 192kPa. EXCAVATE TO A DEPTH OF 700mm BELOW THE FINISHED LEASE PAD LEVEL AND BACKFILL USING APPROVED MATERIAL WITH A HIGH SOAKED STABILITY RATING. BACKFILL SHALL BE COMPACTED IN 200mm LAYERS TO A MINIMUM OF 95% STANDARD MAXIMUM DRY DENSITY.
3. SLOPE ON SKIDDING LOCATIONS SHALL NOT EXCEED 1 DEGREE IN THE DIRECTION OF THE SKID PATH.
4. PROVIDE A 4m WIDE FLAT AREA AROUND ALL PITS.
5. CONSTRUCT A 300mm HIGH COMPACTED BUND AND INSTALL FENCING AROUND ALL SIDES OF THE PITS (TEMPORARY FENCE ON THE LEASE SIDE). FINAL FENCE TYPE TO BE CONFIRMED.
6. LEASES SHALL BE FENCED, WITH THE LEASE ENTRY EQUIPPED WITH A GATE OR GRID.
7. WELLSITE SHALL BE FREE-DRAINING WHERE PRACTICABLE.
8. ALL EROSION AND SEDIMENT CONTROLS TO BE INSTALLED PER IECA BEST PRACTICE GUIDELINES.

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SCALE 1:1000 (A1) — 0 25 50 75 100 METRES

No	DATE	DRN	CHKD	ENG	SANTOS Q.A.	PROJ NO.	RE NAME	RE NO.	RE COMPANY	DESCRIPTION
										REVISIONS
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1	17/10/25	JWS	MXC	JAL						RE-ISSUED FOR APPROVAL (PMC-NA-000163)
0	25/06/25	ELB	ALM	JAL						ISSUED FOR APPROVAL (PMC-NA-000163)

DRG No.	SUBJECT
1052-040-LDD-0003	SITE PLOT PLAN LAYOUT
REFERENCE DRAWINGS	

DRN: ELB	SANTOS Q.A.:
DATE: 25/06/25	PROJ NO.:
SCALE: 1:1000	RE NAME:
CHKD: ALM	RE NO.:
ENG: JAL	RE COMPANY: FYFE

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AREA NUMBER 1052 - EP161
JIBERA SOUTH - McARTHUR APPRAISAL
CIVIL AND EROSION & SEDIMENT CONTROL LAYOUT

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MATERIALS

ROCK: 150 TO 300mm NOMINAL DIAMETER, HARD, EROSION RESISTANT ROCK. SMALLER ROCK MAY BE USED IF SUITABLE LARGE ROCK IS NOT AVAILABLE.

SANDBAGS: GEOTEXTILE BAGS (WOVEN SYNTHETIC, OR NON-WOVEN BIODEGRADABLE) FILLED WITH CLEAN COARSE SAND, CLEAN AGGREGATE, STRAW OR COMPOST.

INSTALLATION

1. REFER TO APPROVED PLANS FOR LOCATION AND INSTALLATION DETAILS. IF THERE ARE QUESTIONS OR PROBLEMS WITH THE LOCATION OR METHOD OF INSTALLATION, CONTACT THE ENGINEER OR RESPONSIBLE ON-SITE OFFICER FOR ASSISTANCE.

2. PRIOR TO PLACEMENT OF THE CHECK DAMS, ENSURE THE TYPE AND SIZE OF EACH CHECK DAMS WILL NOT CAUSE A SAFETY HAZARD OR CAUSE WATER TO SPILL OUT OF THE DRAIN.

3. LOCATE THE FIRST CHECK DAM AT THE DOWNSTREAM END OF THE SECTION OF CHANNEL BEING PROTECTED. LOCATE EACH SUCCESSIVE CHECK DAM SUCH THAT THE CREST OF THE IMMEDIATE DOWNSTREAM DAM IS LEVEL WITH THE TOE OF THE CHECK DAM BEING INSTALLED.

4. ENSURE THE CHANNEL SLOPE IS NO STEEPER THAN 10:1 (H:V). OTHERWISE CONSIDER THE USE OF A SUITABLE CHANNEL LINER INSTEAD OF THE CHECK DAMS.

5. CONSTRUCT THE CHECK DAM TO THE DIMENSIONS AND PROFILE SHOWN WITHIN THE APPROVED PLAN.

6. WHERE SPECIFIED, THE CHECK DAMS SHALL BE CONSTRUCTED ON A SHEET OF GEOTEXTILE FABRIC USED AS A DOWNSTREAM SPLASH PAD.

7. EACH CHECK DAM SHALL BE EXTENDED UP THE CHANNEL BANK (WHERE PRACTICABLE) TO AN ELEVATION AT LEAST 150mm ABOVE THE CREST LEVEL OF THE DAM.

MAINTENANCE

1. INSPECT EACH CHECK DAM AND THE DRAINAGE CHANNEL AT LEAST WEEKLY AND AFTER RUNOFF-PRODUCING RAINFALL.

2. CORRECT ALL DAMAGE IMMEDIATELY. IF SIGNIFICANT EROSION OCCURS BETWEEN ANY OF THE CHECK DAMS, THEN CHECK THE SPACING OF DAMS AND WHERE NECESSARY INSTALL INTERMEDIATE CHECK DAMS OR A SUITABLE CHANNEL LINER.

3. CHECK FOR DISPLACEMENT OF THE CHECK DAMS

4. CHECK FOR SOIL SCOUR AROUND THE ENDS OF EACH CHECK DAM. IF SUCH EROSION IS OCCURRING, CONSIDER EXTENDING THE WIDTH OF THE CHECK DAM TO AVOID SUCH PROBLEMS.

5. IF SEVERE SOIL EROSION OCCURS EITHER UNDER OR AROUND THE CHECK DAMS, THEN SEEK EXPERT ADVICE ON AN ALTERNATIVE TREATMENT MEASURE.

6. REMOVE ANY SEDIMENT ACCUMULATED BY THE CHECK DAMS, UNLESS IT IS INTENDED THAT THIS SEDIMENT WILL REMAIN WITHIN THE CHANNEL.

7. DISPOSE OF COLLECTED SEDIMENT IN A SUITABLE MANNER THAT WILL NOT CAUSE AN EROSION OR POLLUTION HAZARD.

REMOVAL

1. WHEN CONSTRUCTION WORK WITHIN THE DRAINAGE AREA ABOVE THE CHECK DAMS HAS BEEN COMPLETED, AND THE DISTURBED AREAS AND THE DRAINAGE CHANNEL ARE SUFFICIENTLY STABILISED TO RESTRAIN EROSION, ALL TEMPORARY CHECK DAMS MUST BE REMOVED.

2. REMOVE THE CHECK DAMS AND ASSOCIATED SEDIMENT AND DISPOSE OF IN A SUITABLE MANNER THAT WILL NOT CAUSE AN EROSION OR POLLUTION HAZARD.

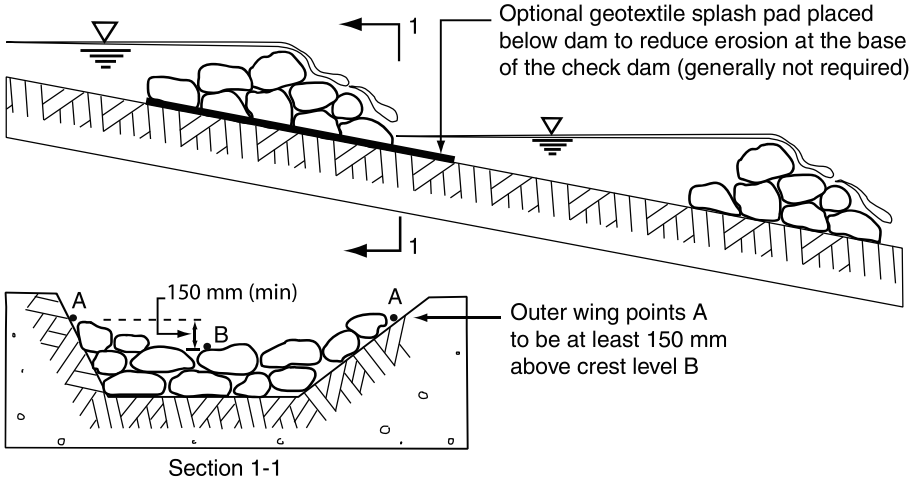

Figure 1 - Layout and profile of check dams (rock check dams shown)

Drawn:	Date:		
GMW	Dec-09	Check Dams	RCD-01

Catchments & Creeks Pty Ltd

INSTALLATION

1. REFER TO APPROVED PLANS FOR LOCATION, EXTENT, AND CONSTRUCTION DETAILS. IF THERE ARE QUESTIONS OR PROBLEMS WITH THE LOCATION, EXTENT, OR METHOD OF INSTALLATION, CONTACT THE ENGINEER OR RESPONSIBLE ON-SITE OFFICER FOR ASSISTANCE.

2. CLEAR THE LOCATION FOR THE BANK, CLEARING ONLY THE AREA THAT IS NEEDED TO PROVIDE ACCESS FOR PERSONNEL AND EQUIPMENT.

3. REMOVE ROOTS, STUMPS, AND OTHER DEBRIS AND DISPOSE OF THEM PROPERLY. DO NOT USE DEBRIS TO BUILD THE BANK.

4. FORM THE BANK FROM THE MATERIAL, AND TO THE DIMENSION SPECIFIED IN THE APPROVED PLANS.

5. IF EARTH IS USED, THEN ENSURE THE SIDES OF THE BANK ARE NO STEEPER THAN A 2:1 (H:V) SLOPE, AND THE COMPLETED BANK MUST BE AT LEAST 500mm HIGH.

6. IF FORMED FROM SANDBAGS, THEN ENSURE THE BAGS ARE TIGHTLY PACKED SUCH THAT WATER LEAKAGE THROUGH THE BAGS IS MINIMISED.

7. CHECK THE BANK ALIGNMENT TO ENSURE POSITIVE DRAINAGE IN THE DESIRED DIRECTION.

8. THE BANK SHOULD BE VEGETATED (TURFED, SEEDED AND MULCHED), OR OTHERWISE STABILISED IMMEDIATELY, UNLESS IT WILL OPERATE FOR LESS THAN 30 DAYS OR IF SIGNIFICANT RAINFALL IS NOT EXPECTED DURING THE LIFE OF THE BANK.

9. ENSURE THE EMBANKMENT DRAINS TO A STABLE OUTLET, AND DOES NOT DISCHARGE TO AN UNSTABLE FILL SLOPE.

MAINTENANCE

1. INSPECT FLOW DIVERSION BANKS AT LEAST WEEKLY AND AFTER RUNOFF-PRODUCING RAINFALL.

2. INSPECT THE BANK FOR ANY SLUMPS, WHEEL TRACK DAMAGE OR LOSS OF FREEBOARD. MAKE REPAIRS AS NECESSARY.

3. CHECK THAT FILL MATERIAL OR SEDIMENT HAS NOT PARTIALLY BLOCKED THE DRAINAGE PATH UP-SLOPE OF THE EMBANKMENT. WHERE NECESSARY, REMOVE ANY DEPOSITED MATERIAL TO ALLOW FREE DRAINAGE.

4. DISPOSE OF ANY COLLECTED SEDIMENT OR FILL IN A MANNER THAT WILL NOT CREATE AN EROSION OR POLLUTION HAZARD.

5. REPAIR ANY PLACES IN THE BANK THAT ARE WEAKENED OR IN RISK OF FAILURE.

REMOVAL

1. WHEN THE SOIL DISTURBANCE ABOVE THE BANK IS FINISHED AND THE AREA IS STABILISED, THE FLOW DIVERSION BANK SHOULD BE REMOVED, UNLESS IT IS TO REMAIN AS A PERMANENT DRAINAGE FEATURE.

2. DISPOSE OF ANY SEDIMENT OR EARTH IN A MANNER THAT WILL NOT CREATE AN EROSION OR POLLUTION HAZARD.

3. GRADE THE AREA AND SMOOTH IT OUT IN PREPARATION FOR STABILISATION.

4. STABILISE THE AREA BY GRASSING OR AS SPECIFIED IN THE APPROVED PLAN.

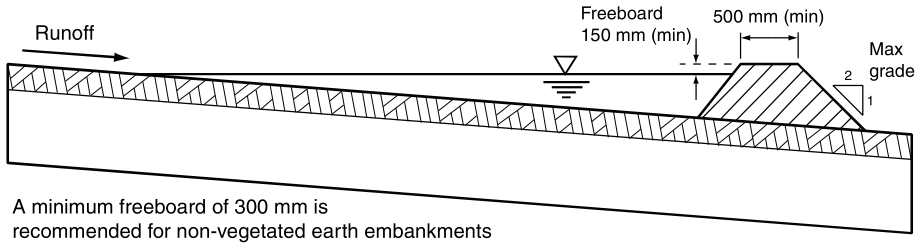

Figure 1 - Typical profile of flow diversion bank formed from earth

Table 1 - Recommended dimensions of flow diversion banks

Parameter	Earth banks	Vegetated banks	Compost berms	Sandbag berms
Height (min)	500 mm	500 mm	300 mm	N/A
Top width (min)	500 mm	500 mm	100 mm	N/A
Base width (min)	2500 mm	2500 mm	600 mm	N/A
Side slope (max)	2:1 (H:V)	2:1 (H:V)	1:1 (H:V)	N/A
Freeboard	300 mm	150 mm	100 mm	50 mm

Drawn:	Date:		
GMW	Dec-09	Flow Diversion Banks	DB-01

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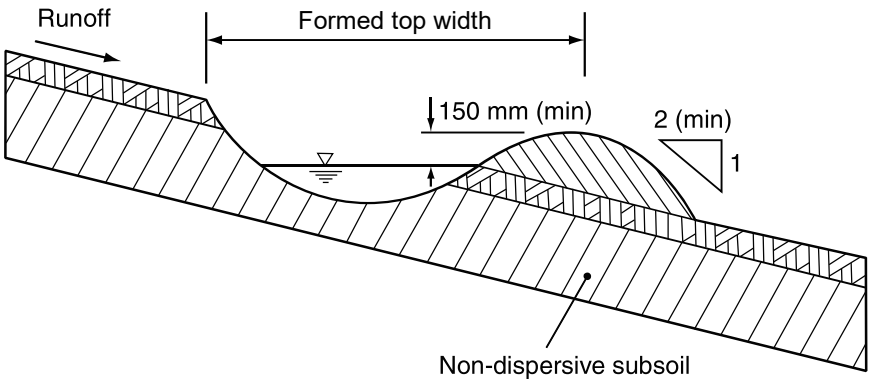
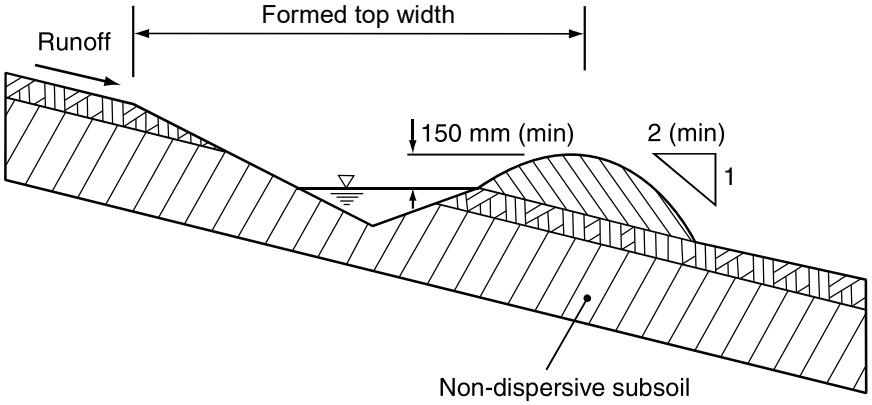
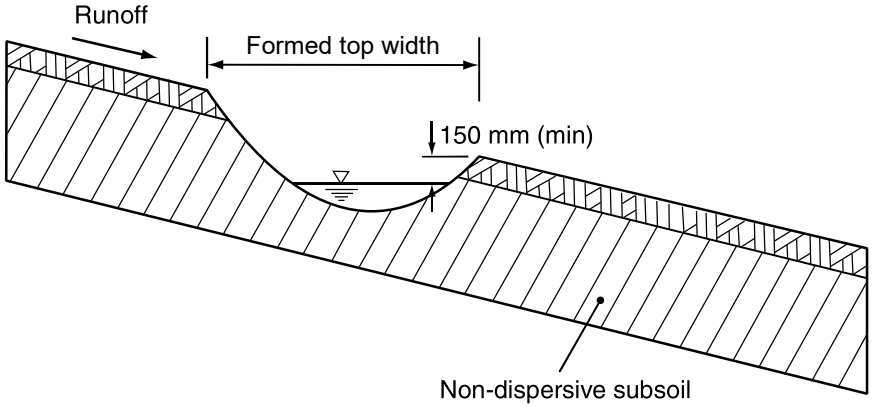


(a) Parabolic catch drain with down-slope bank



(b) Triangular V-drain with down-slope bank



(c) Parabolic catch drain without bank

Constructed dimensions of parabolic catch drains		
Drain type	Formed top width with or without bank	Formed depth with or without bank
Type-A	1.6 m	0.30 m
Type-B	2.4 m	0.45 m
Type-C	3.6 m	0.65 m

Constructed dimensions of triangular V-drains		
Drain type	Formed top width with or without bank	Formed depth with or without bank
Type-AV	2.0 m	0.30 m
Type-BV	2.7 m	0.45 m
Type-CV	3.9 m	0.65 m

NOT TO SCALE

Drawn:	Date:		
GMW	Dec-09	Catch Drains	CD-01

Catchments & Creeks Pty Ltd

Figure 11: IECA Fact Sheet Energy Dissipator

Energy Dissipaters

DRAINAGE CONTROL TECHNIQUE

Low Gradient		Velocity Control	✓	Short Term	✓
Steep Gradient		Channel Lining		Medium-Long Term	✓
Outlet Control	✓	Soil Treatment		Permanent	[1]

[1] The design of permanent energy dissipaters may require consideration of issues not discussed within this fact sheet. Obtaining expert hydraulic advice is always recommended.

Symbol (not applicable)

Photo 1 – Rock mattress lined basin spillway and energy dissipater

Photo 2 – Rock lined basin spillway and energy dissipater

U-Shaped Sediment Traps

SEDIMENT CONTROL TECHNIQUE

Type 1 System		Sheet Flow		Sandy Soils	✓
Type 2 System		Concentrated Flow	✓	Clayey Soils	[1]
Type 3 System	✓	Supplementary Trap		Dispersive Soils	

[1] Generally only limited control of clay and silt-sized particles.

Symbol

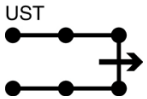


Photo 1 – U-shaped sediment trap within a wide drainage swale

Photo 2 – U-shaped sediment trap within a mild gradient table drain

Key Principles

1. Primarily used to collect the coarser sediment particles. Provides limited collection of clay-sized particles and thus there is usually no measurable change in the colour of water passing through the fence.
2. Functions by temporarily ponding sediment-laden water within the chamber to allow the coarser sediment particles to settle.
3. Critical design parameters are the design flow rate, which determines the size (width) of the spill-through weir, and the shape and fall of the drain, which determines the length and/or width of the sediment trap.
4. It is critical that the ends of each wing wall extends to a location that is higher (at least 100mm) than the crest elevation of the spill-through weir (see Figures 5 and 10).
5. When located within a table drain, the allowable width of the sediment trap may be governed by restrictions placed on the location of support posts within the road shoulder. Typically, it is not advisable to disturb the compacted shoulder of a road, thus the trenching of a sediment fence, or the placement of support posts close to the road may not be allowed. In such cases, a sandbag flow diversion bank can be used to direct flow into a narrow U-shaped sediment trap (refer to Figure 5).
6. Critical operational issues include:
   (i) ensuring the width of the sediment trap is sufficient to allow maintenance (clean-out) by a backhoe; and
   (ii) ensuring all flow is directed into the sediment trap, thus avoiding flow bypass.

Design Information

The maximum support post spacing is 1m (Figure 9).

Wherever practical, the fabric should be anchored into a 150 to 200mm deep trench (Figure 8).

Unless placed on a very steep slope, a spill-through weir (Figure 3) must be installed at the low point in the sediment trap. The spill-through weir crest must not be less than 300mm above the ground surface.

Design procedure:

1. Select the preferred type of U-shaped sediment trap from Table 1.

Table 1 – Selection of sediment trap layout

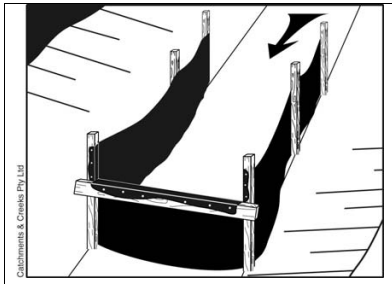


Figure 1 – Type AU 'narrow' sediment trap

Preferred usage:

- Steep table drains (drains adjacent a roadway) with a gradient of at least 6%.
- Locations where it is not practical to disturb the adjacent earth batters for the purpose of installing the sediment trap.
- Shallow drains where good elevation can only be gained by extending the wing walls up the drain's invert to elevate the ends of the fence above the spill-through weir crest.

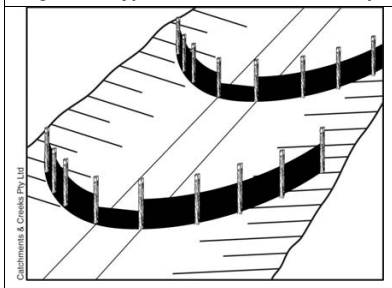


Figure 2 – Type BU 'wide' sediment trap

Preferred usage:

- Wide drainage swales where good elevation can be gained by extending the wing walls up the batter slopes to elevate the ends of the fence above the spill-through weir crest.

2. Determine the design discharge, Q (m^3/s).
3. Calculate the required width of the spill-through weir (refer to Table 2). The minimum width of the sediment trap is usually set by the width of the backhoe bucket that will be used to de-silt the trap.
4. Nominate the height of the spill-through weir. Usually set to 300mm on drains with a gradient less than 25% (refer to Table 3).
5. Determine the required ground elevation at the ends of each wing wall. Usually set at least 100mm above the height of the spill-through weir.
6. Knowing the required ground elevation at the ends of each wing wall, determine the overall dimensions (width and length) of the U-shaped sediment trap. For narrow sediment traps, Table 3 can be used to estimate the required length (L) of the sediment trap.

Design of spill-through weir

Where appropriate, spill-through weirs should be installed into the end of the sediment trap to prevent flows bypassing around the structure, and reduce the risk of hydraulic failure.

The required width (W) of the spill-through weir depends on the nominated design flow rate. The weir flow equation for a rectangular spill-through weir is provided below as Equation 1, as well as being tabulated in Table 2.

$$Q = 1.7\ W\ H^{3/2} \qquad \text{(Eqn 1)}$$

where: Q = Design flow rate (usually 0.5 times the 1 in 1 year ARI peak discharge) [m^3/s]
W = Weir width [m]
H = Hydraulic head = height of upstream water level above weir crest [m]

Table 2 – Flow rates passing over a spill-through weir (m^3/s)

Hydraulic head, H (m)	Spill-through weir width, W (m)									
	0.3	**0.5**	**1.0**	**1.5**	**2.0**	**2.5**	**3.0**	**3.5**	**4.0**	**4.5**
0.10	0.016	0.027	0.054	0.081	0.108	0.134	0.161	0.188	0.215	0.242
0.15	0.030	0.049	0.099	0.148	0.198	0.247	0.296	0.346	0.395	0.444
0.20	0.046	0.076	0.152	0.228	0.304	0.380	0.456	0.532	0.608	0.684
0.25	0.064	0.106	0.213	0.319	0.425	0.531	0.638	0.744	0.850	0.956
0.30	0.084	0.140	0.279	0.419	0.559	0.698	0.838	0.978	1.12	1.26
0.35	0.106	0.176	0.352	0.528	0.704	0.880	1.06	1.23	1.41	1.58
0.40	0.129	0.215	0.430	0.645	0.860	1.08	1.29	1.51	1.72	1.94

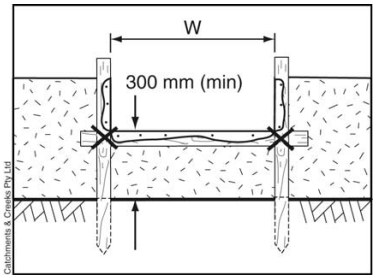


Figure 3 – Spill-through weir profile

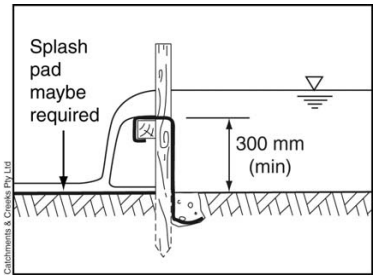


Figure 4 – Side profile of a spill-through weir

If the sediment trap is to be installed within a table drain (i.e. a side drain of a road adjacent to the shoulders), then it may not be appropriate to disturb the compacted road shoulder to bury the fabric, or even drive support posts. Reasons for such restrictions include:

- disturbance of the heavily compacted road shoulder can allow water to enter the road foundations causing early failure of the road;
- safety risks associated with support posts and other structures placed too close to a roadway.

In order to construct a suitable sediment trap within such a drain it is usually necessary for the sediment trap to be relatively narrow, and for the wing walls to extend up the drain invert a distance (L) such that the ground elevation is above the crest of the spill-through weir. The minimum required length of the sediment trap is provided in Table 3 for various drain gradients.

Table 3 – Required length of a Type AU sediment trap

Drain grade (%)	Required length, L (m) [1]	Height of spill-through weir, Z (m)
< 6%	Use a Sandbag Check Dam Sediment Trap	
6%	6m	0.3m
8%	5m	0.3m
10%	4m	0.3m
14%	3m	0.3m
20%	2m	0.3m
25%	3m	No spill-through weir required
> 35%	2m	

[1] Length assumes minimal bank slope. The required length may be reduced if the wing walls can be extended up the bank slope.

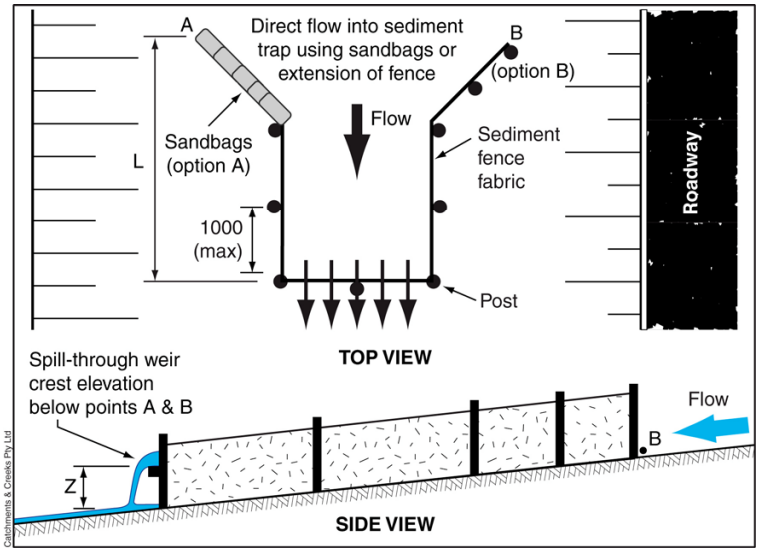


Figure 5 – Profile of a Type AU 'narrow' sediment trap

Type AU (narrow) sediment traps (Figure 6) use the fall in the drain's invert to elevate the ends of each wing wall above the height of the spill-through weir crest.

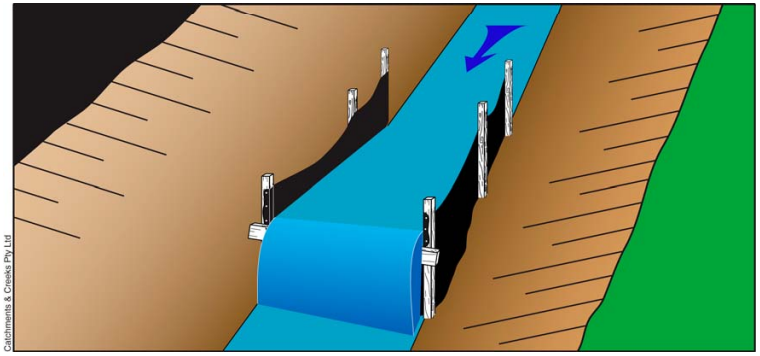


Figure 6 – Type AU sediment trap

Type BU (wide) sediment traps (Figure 7) use the gradient of the drain's banks to elevate the ends of each wing wall above the height of the spill-through weir crest.

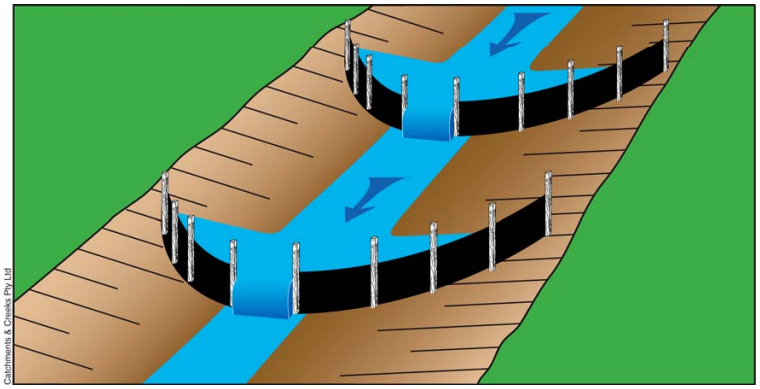


Figure 7 – Type BU sediment trap

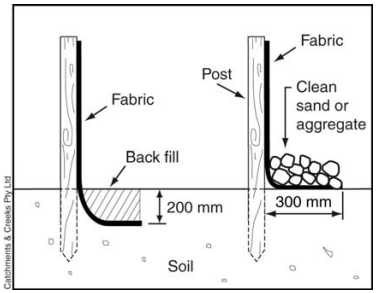


Figure 8 – Trenching fabric

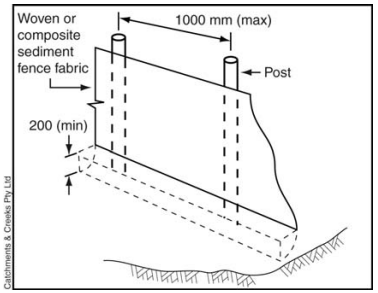


Figure 9 – Spacing of support posts

Care must be taken when placing any form of sediment trap within an area of concentrated flow such as a drainage swale. Issues for consideration include:

- potential increase in flood waters, possible causing water to bypass into adjacent properties, or cause the flooding of adjacent roadways;
- undesirable flow bypassing around the sediment trap;
- damage to the sediment trap caused by the deep and/or high velocity floodwaters;
- potential flood and/or erosion damage caused by flows in excess of the nominated design discharge.

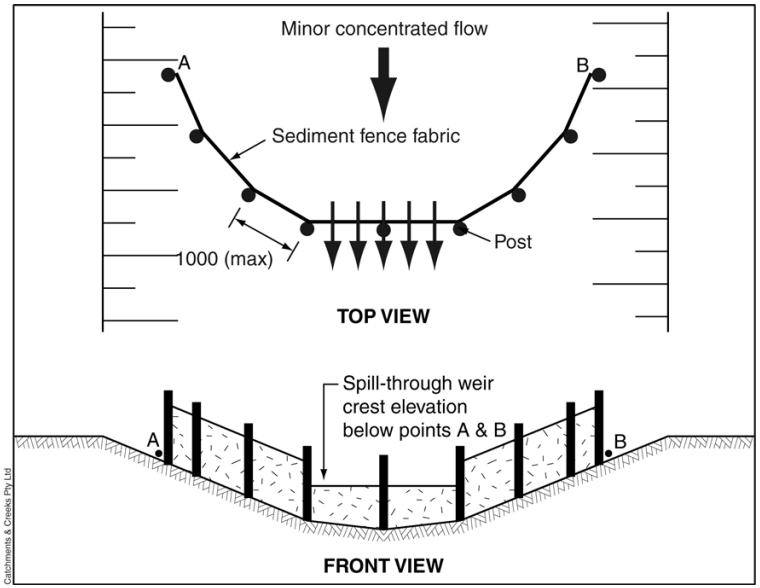


Figure 10 – Profile of a Type BU 'wide' sediment trap

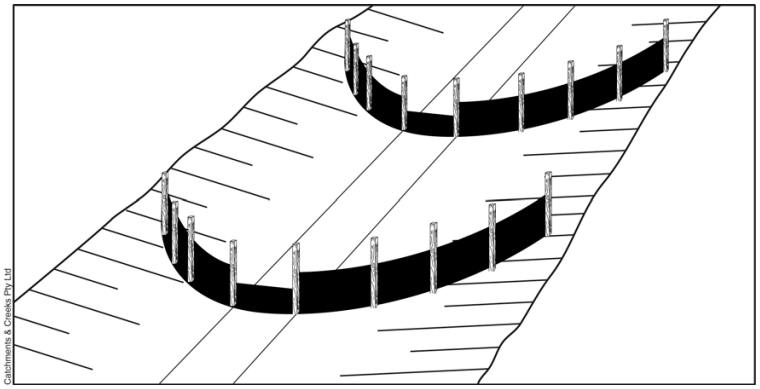


Figure 11 – Type BU sediment trap

Design examples

The nominated design discharge should not bypass around the ends of the sediment trap as shown in Figures 12 and 13.

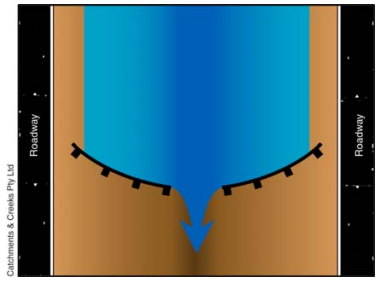


Figure 12 – When placed in a wide drainage swale, the sediment trap takes the shape of a gradual arc

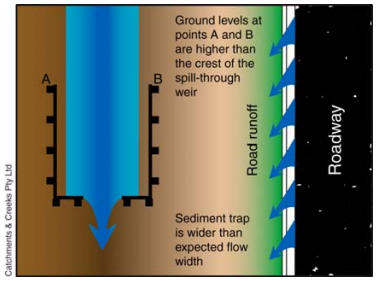


Figure 13 – When placed in a narrow table drain, the sediment trap normally needs to be installed as a narrow U-shape trap

Photo 3 – Up-slope ends of the fence are flared out to adequately capture the inflow

Photo 4 – U-shaped sediment trap incorporating a filter tube and geotextile outlet chute (note the sediment trap is formed from impervious plywood panels covered in fabric)

Photo 5 – U-shaped sediment trap within a steep table drain

Photo 6 – U-shaped sediment trap within a mild-sloping table drain

What <u>not</u> to do!

U-shaped sediment traps have often been inappropriately designed and/or installed. The following figures and photos discuss common design and installation problems.

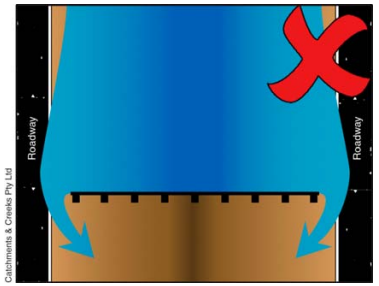


Figure 14 – A sediment fence must <u>not</u> be placed 'straight' across a drain

Photo 7 – Clearly, this sediment trap will not allow adequate ponding, and the shape of the structure prevents the spill-through weir from being functional

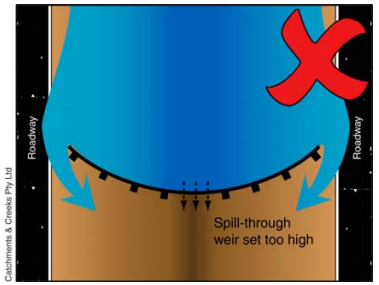


Figure 15 – The spill-through weir needs to be at least 300mm high, and the ends of the fence need to be extended to ground that is higher than the weir's crest

Photo 8 – If the ends of the fence are lower than the spill-through weir, then flows will bypass around the sediment trap causing erosion (as above)

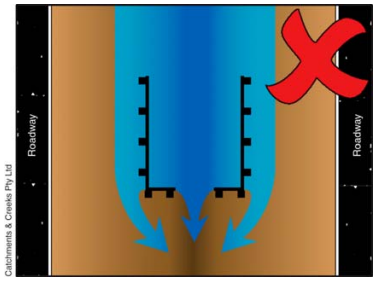


Figure 16 – The width of the U-shaped sediment trap should be wider than the expected width of flow

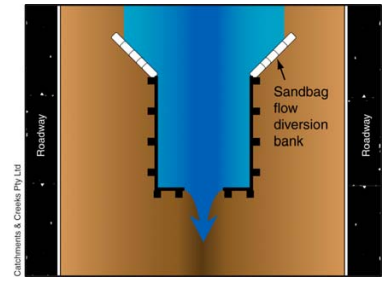


Figure 17 – One solution to the problem (left) is to use sandbags to direct all flow into a narrow sediment trap

Description

A sediment trap formed from typical sediment fence materials, but heavily curved in a U-shape.

The sediment trap is designed such that the essential 'ponding' is confined between the two wing walls of the sediment trap.

Purpose

Used as a coarse trap sediment within minor drainage swales and roadside table drains.

Limitations

Application is generally limited to steep drains with a gradient exceeding 5%.

The design flow rate is limited by the available width of the spill-through weir.

Potential service life of around 6 months.

Advantages

Reasonably easy to install.

Controls sediment runoff close to the source of the erosion.

A highly visible sediment control measure.

Generally more effective, durable and cheaper than straw bale sediment traps.

Disadvantages

The spill-through weir is often incorrectly installed.

Can be difficult to appropriately bury the bottom of the fabric within the shoulder of the road.

Common Problems

Often incorrectly installed in a 'straight' alignment instead of a U-shape.

Ends of the fence not turned up the slope to prevent flow bypassing.

The spill-through weir is set too low (<300mm), or not placed within the low point of the fence.

Excessive spacing of support posts.

Fabric not adequately attached to the support posts.

Special Requirements

The crest of the spill-through weir must be at least 300mm high, and must be below the ground level at the ends of the wing walls.

Location

Normally located as a series of sediment traps along the drain.

Site Inspection

Check for excessive sediment deposition.

Investigate the source of any excessive sediment.

Ensure the appropriate selection of fabric (i.e. woven or non-woven composite).

Ensure the fabric is adequately buried.

Check the spacing of support posts/stakes.

Check if flow will bypass the wing walls.

Materials

- Fabric: polypropylene, polyamide, nylon, polyester, or polyethylene woven or non-woven fabric, at least 700mm in width and a minimum unit weight of 140gsm. All fabrics to contain ultraviolet inhibitors and stabilisers to provide a minimum of 6 months of useable construction life (ultraviolet stability exceeding 70%).
- Fabric reinforcement: wire or steel mesh minimum 14-gauge with a maximum mesh spacing of 200mm.
- Support posts/stakes: 1500mm^2 (min) hardwood, 2500mm^2 (min) softwood, or 1.5kg/m (min) steel star pickets suitable for attaching fabric.

Installation

1. Refer to approved plans for location, extent, and required type of fabric (if specified). If there are questions or problems with the location, extent, fabric type, or method of installation contact the engineer or responsible on-site officer for assistance.
2. Install the fabric in a U-shape, extending the wing walls either up the side slopes and/or up the channel invert (as directed) to a point where the ground level is at least 100mm higher than the crest of the spill-through weir.
3. Ensure that the expected channel flow will enter the sediment trap, either by extending the wing walls up the bank slope, or constructing sandbag flow diversion banks.
4. Unless directed by the site supervisor, excavate a 200mm wide by 200mm deep trench along the alignment of the spill-through weir and wing walls.
5. Along the lower side of the trench, appropriately secure the stakes into the ground spaced no greater than 1m.
6. Construct the sediment trap from a continuous roll of fabric.
7. Securely attach the fabric to the support posts/stakes using 25mm staples or tie wire at maximum 150mm spacing with the fabric extended at least 200mm into the trench.
8. Install a spill-though weir at the lowest point in the fence. The weir must be at least 300mm above adjacent ground level, and below the lowest ground level at the ends of the wing walls.
9. Securely tie a horizontal cross member (weir) to the adjacent support posts. Cut the fabric down the side of the posts and fold the fabric over the cross member and appropriately secure the fabric.
10. If directed, install a suitable splash pad immediately down-slope of the spill-through weir to control soil erosion downstream of the sediment trap.
11. Backfill the trench and tamp the fill to firmly anchor the bottom of the fabric and mesh to prevent water from flowing under the fence.

Maintenance

1. Inspect the sediment trap at least weekly and after any significant rain. Make necessary repairs immediately.
2. Repair any torn sections with a continuous piece of fabric from post to post.
3. When making repairs, always restore the system to its original configuration unless an amended layout is required or specified.
4. If the fabric is sagging between stakes, install additional support posts/stakes.
5. Remove accumulated sediment if the sediment deposit exceeds a depth of 150mm.
6. Dispose of sediment in a suitable manner that will not cause an erosion or pollution hazard.
7. Replace the fabric if the service life of the existing fabric exceeds six months.

Removal

1. When disturbed areas up-slope of the sediment trap are sufficiently stabilised to restrain erosion, the sediment trap must be removed.
2. Remove materials and collected sediment and dispose of in a suitable manner that will not cause an erosion or pollution hazard.
3. Rehabilitate/revegetate the disturbed ground as necessary to minimise the erosion hazard.

Appendix A: Intensity, Frequency, Duration Chart

Australian Government
Bureau of Meteorology

LOCATION 16.450 S 134.625 E * NEAR.. McArthur Appraisal

LIST OF COEFFICIENTS TO EQUATIONS OF THE FORM

$$ln(I) = A + B \times (ln(T)) + C \times (ln(T))^2 + D \times (ln(T))^3 + E \times (ln(T))^4 + F \times (ln(T))^5 + G \times (ln(T))^6$$

T = TIME IN HOURS AND I = INTENSITY IN MILLIMETRES PER HOUR

RETURN PERIOD	A	B	C	D	E	F	G
1	3.529980	-0.62116E+0	-0.10246E+0	0.10652E-1	0.62831E-2	-0.77876E-3	-0.83184E-4
2	3.773011	-0.61816E+0	-0.99866E-1	0.10427E-1	0.61809E-2	-0.73163E-3	-0.86195E-4
5	3.990340	-0.60833E+0	-0.93563E-1	0.86154E-2	0.62051E-2	-0.45863E-3	-0.13086E-3
10	4.098230	-0.60317E+0	-0.90294E-1	0.76802E-2	0.62339E-2	-0.31589E-3	-0.15441E-3
20	4.230407	-0.59911E+0	-0.87573E-1	0.70522E-2	0.62326E-2	-0.21090E-3	-0.17103E-3
50	4.381379	-0.59419E+0	-0.84020E-1	0.63276E-2	0.61683E-2	-0.97874E-4	-0.18634E-3
100	4.484075	-0.59102E+0	-0.81878E-1	0.57986E-2	0.61647E-2	-0.10920E-4	-0.19995E-3

RAINFALL INTENSITY IN mm/h FOR VARIOUS DURATIONS AND RETURN PERIODS

DURATION	RETURN PERIOD (YEARS) 1	2	5	10	20	50	100
5 mins	96.7	124.	155.	173.	198.	231.	257.
6 mins	90.2	115.	145.	162.	185.	217.	241.
10 mins	75.9	97.0	121.	136.	155.	181.	201.
20 mins	59.4	75.8	94.1	105.	119.	139.	154.
30 mins	49.9	63.5	78.7	87.5	99.8	116.	128.
1 hour	34.1	43.5	54.1	60.2	68.7	79.9	88.6
2 hours	21.2	27.1	34.1	38.1	43.7	51.0	56.7
3 hours	15.6	20.0	25.2	28.4	32.6	38.2	42.6
6 hours	9.00	11.6	14.9	16.9	19.5	23.1	25.9
12 hours	5.28	6.86	8.98	10.3	12.0	14.4	16.2
24 hours	3.21	4.22	5.69	6.62	7.84	9.52	10.9
48 hours	1.94	2.59	3.62	4.31	5.20	6.44	7.44
72 hours	1.37	1.84	2.64	3.18	3.88	4.86	5.67

(Raw data: 45.41, 6.94, 1.87, 79.59, 13.80, 4.69,skew= 0.150)

HYDROMETEOROLOGICAL ADVISORY SERVICE
(C) AUSTRALIAN GOVERNMENT, BUREAU OF METEOROLOGY

* ENSURE THE COORDINATES ARE THOSE REQUIRED SINCE DATA IS BASED ON THESE AND NOT LOCATION NAME.