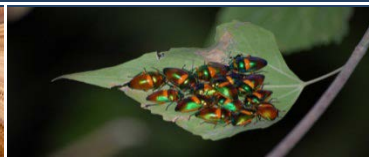




Appendix E Erosion & Sediment Control Plan



Sherwin Iron (NT) Pty Ltd
Sherwin Creek Iron Ore Project
Environmental Impact Statement



2013





Sherwin Creek Deposit C

Erosion and Sediment Control

EcOz Pty Ltd

November 2013

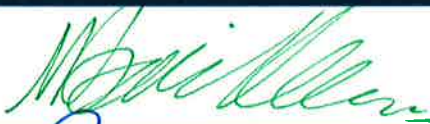
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1 INTRODUCTION

ADG Engineers have been engaged by EcOz Environmental Services Pty Ltd, on behalf of Sherwin Iron Limited, to prepare an Erosion and Sediment Control Plan (ESCP) to accompany an Environmental Impact Statement (EIS) being prepared for the proposed Sherwin Creek Iron Ore Mine. The proposed mine is located approximately 120km east of Mataranka in the Northern Territory (NT) and is within the Roper River catchment.

This plan was developed generally in accordance with the International Erosion Control Association, Best Practice Erosion and Sediment Control Guideline (IECA, 2008) and is considered to represent Best Practice Environmental Management (BPM).

1.1 Background

The Sherwin Creek Iron Ore Mine Project involves the establishment of a new open pit iron ore mine, ancillary infrastructure, waste dumps, loading site, workshops, offices, internal access roads, accommodation facilities, and haul roads. Direct shipping ore is to be transported to the Darwin Port Facility for export. The site is surrounded by small tributaries of Sherwin Creek, Roper River and ultimately the estuaries where the mouth of the river meets the Gulf of Carpentaria. The potential negative impact that fine sediment loads can have on riverine and estuarine ecosystem health can include, limiting light penetration, plant growth and aeration, shallowing of estuaries, increased particle bound toxicants/nutrients, and a reduction in overall biodiversity. The Northern Territory Environmental Protection Authority (NTEPA) has determined that the proposal requires formal assessment under the NT Environmental Assessment Act.

1.2 Objectives

The objectives of this ESCP are to ensure

- Adequate drainage and pollution control measures are implemented to manage runoff from disturbed areas of the site;
- Stormwater is managed to protect downstream water quality;
- Sedimentation from the site is reduced such that soil particles greater than 1mm are retained; and
- Erosion is prevented.

1.3 Scope

The scope of this ESCP includes the following components:

- Desktop study of relevant site data;
- Review of current ESC Best Practice Management literature;
- Modelling of the site to identify high risk areas and selection of suitable control techniques;
- Water quality monitoring and maintenance requirements;
- Comments on the management of uncontaminated stormwater within the lease; and
- Conceptual design details of the determined physical controls and processes.

This report serves as an overarching ESCP providing conceptual design details only. The level of detail is not suitable for construction purposes but this document will assist in the development of more practical on-site plans produced to manage each stage of the proposed disturbance.

1.4 Relevant Legislation and Guidelines

The following legislation and guidelines were used to prepare this ESCP:

- NTEPA Erosion and Sediment Control Plan Content (formally NRETAS, 2006);
- Best Practice Erosion and Sediment Control (IECA, 2008)
- Water Act (NT, Current Version);
- Waste Management and Pollution Control Act (NT, Current Version);
- Soil Conservation and Land Utilisation Act (NT, Current Version);

1.5 Performance Criteria

In accordance with the guidelines and legislation, the following performance criteria need to be addressed:

- Stable embankments and drainage channels;
- Soil particles greater than 1 mm do not leave the site;
- No obvious accumulation of sediment within downstream receiving waterways;
- No unnecessary disturbance of earth or vegetation;
- All batters or embankments to have slopes no steeper than 1:4;

2 Project Information

2.1 Site Details

The site is located on Mt McMinn Pastoral Lease, which is 120km east of Mataranka and 21km west of Roper Bar within the Northern Territory. It is accessed via the Roper Highway. The approximate mine lease and disturbance areas are displayed in Figure 1 below.

2.2 Project Details

The key areas are shown on the plans presented in Appendix A. For the purpose of this assessment, these areas have been broken down into disturbed catchment areas across the site. The proposed layout is shown below and the naming convention for each of these catchments is shown in figure 1 below.

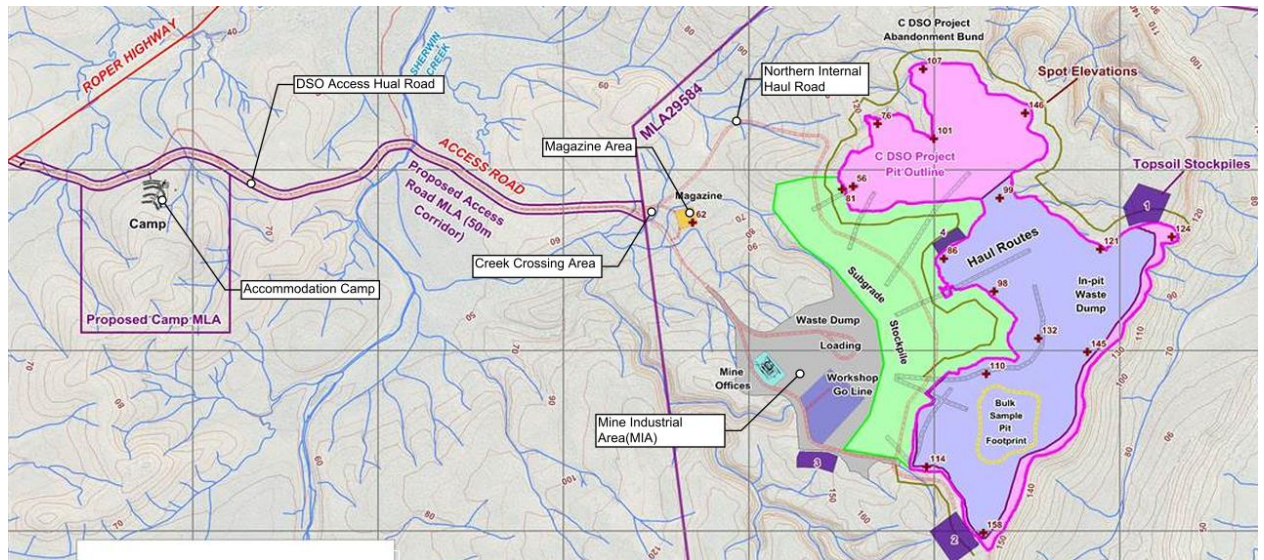


Figure 1 : Site Layout and Catchment Naming

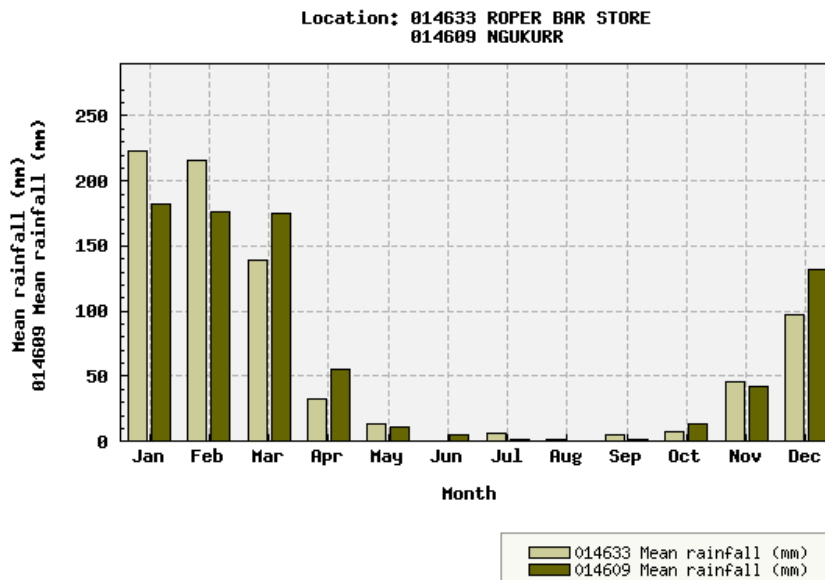
3 SITE CHARACTERISTICS

3.1 Topography

The proposed mine sits on a ridge line running roughly north to south at approximately 125mAHD. The proposed accommodation camp site at approximately 65mAHD and the lowest point on the proposed haul road is at approximately 45mAHD. Slopes across the site vary from flat areas at less than 1% to some of the existing natural channel banks at 50%.

3.2 Climate

Average monthly rainfall for Ngukarr (approximately 40km to the East of Site) and Roper Bar Station (approximately 20km east of the site) have been sourced from the Bureau of Meteorology (BoM) to display the climate data with greater clarity. These are displayed in figure 2 below. It can be seen that the rainfall is concentrated between November and March (i.e. the wet season), typical for the Northern Territory, with May to October averaging approximately 10mm per month. The wettest months are January and February with rainfall recorded as approximately 225mm and 200mm respectively at the Roper Bar Store.



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Figure 2: Rainfall

3.3 Soils

3.3.1 Desktop Assessment

The Australian Soil Resource Information System (ASRIS) data has been used to undertake a high level desktop assessment of the anticipated soil characteristics on the site.

3.3.2 Australian Soil Classification

ASRIS Level 4 mapping has been used to derive the Australian Soil Classifications (ASC) across the site. Rudosols are the dominant soil type across the site with some Kandosols. Figure 3 below

shows the mapped extent of Rudosols shown in green and the mapped extent of Kandosols shown in yellow.

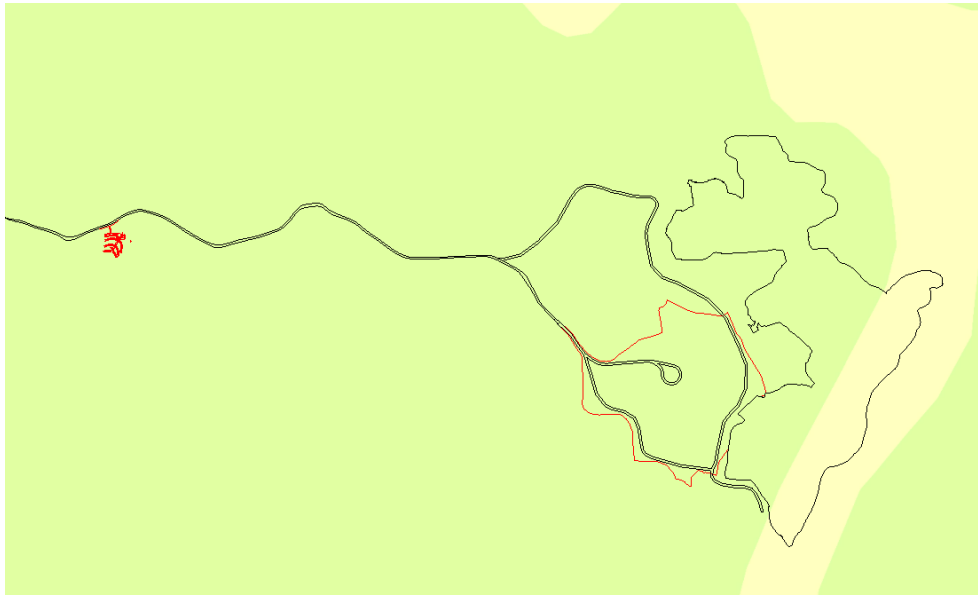


Figure 3: Soil Classification

3.3.3 Land Systems

The Land Systems data available to this area consists of the 1:250,000 study, 'Land Systems of the Roper River Catchment' (Aldrick & Wilson, 1992). The land units were mapped with the same extent as those shown for the ASC above. With the yellow area being Cliffdale land system (lbc) and the green area being Patterson land system (Alp). The general description of each of these land system is listed in Table 1 below.

Table 1: Soil Classification

lbc Cliffdale 	Gently undulating to undulating rises with abundant, often linear rocky outcrops and shallow sandy soils. Lithosols, minor siliceous and earthy sands. Mid-high open woodland of <i>Eucalyptus miniata</i> , <i>E. tetradonta</i> , <i>E. ferruginea</i> , with <i>E. dichromophloia</i> .
Alp Patterson 	Low hills, rises and undulating areas on reddish platy sandstones and siltstones, often micaceous, of the Kyalla Member. Lithosols, earthy sands and shallow red and brown earths

3.3.4 Dispersivity

The ASRIS level 4 mapping was also used to undertake a high level assessment of the potential for the soils to be dispersive. ASRIS has mapped the surface soils across the site as non-sodic. With a large area within the Patterson land system subsoils in the site as moderately sodic. From this it is likely that dispersion may be an issue in the deeper cuts.

3.4 Soils Field Investigation

An investigation, utilising test pits, was undertaken at various locations across the site by EcOz. The soil was characterised, logged and tested for Electric conductivity and Ph using field methods. The soils were generally sandy loam with shallow depths to rock around the proposed mine

industrial area, with higher proportions of clay and deeper rock profiles near the accommodation area to the west.

4 Erosion Risk Assessment

An erosion risk assessment of the proposed disturbed areas during construction has been undertaken using the Revised Universal Soil Loss (RUSLE) equation. This method can be used to give an indication of the erosion potential. Each factor of the RUSLE is discussed below. Refer to Appendix C for further details of the calculations.

4.1 Soil Erodibility (k)

The K factor is a measure of the ability of soils to resist the erosive energy of rain. These parameters have been derived based on the site soil textures observed in the field investigation on site and tables within IECA for each soil texture type. Figure 4 below shows a summary of the risk of each soil texture with the red circle representing $k \approx 0.055$ and the green circle representing soils at $k \approx 0.03$.

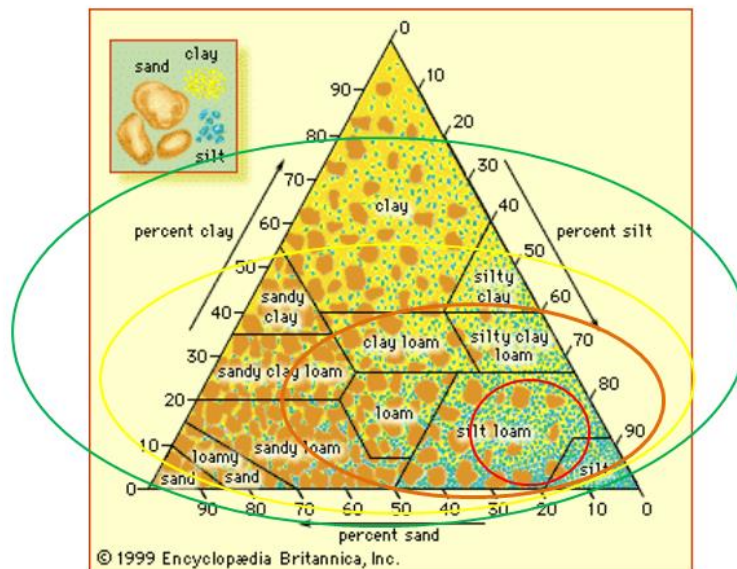


Figure 4: Soil Erodibility (k)

For this investigation, the factor has been estimated by undertaking an assessment of each of the test pits logs and deriving an average 'k' value. A summary of the adopted k values is shown in Table 2 below.

Table 2: Soil Erodibility (k)

Test Pit	Adopted 'k' Value
1	0.03
2	0.04
3	0.04
4	0.03
5	0.055
6	0.055
7	0.03
8	0.055
9	0.03
10	0.03
11	0.03
12	0.03

4.2 LS Factor

LS factor is a numerical representation of the length and slope combination. SAGA combined with the LIDAR data was used to determine the range of LS factors across the site. In the area values ranged from 0 in flat areas to 35 in some of the steep channel banks currently on site. The grid LS model was then overlaid with the derived catchment boundaries for the subject site and then statistics were derived for the LS values within each disturbed catchment area. The mean values within each catchment were taken. Further results of this investigation are shown in Appendix B. The LS factor taken for each catchment is shown in Table 3 below.

Table 3: LS Factor

Catchment Area Reference	Length Slope Factor (LS)
Accommodation Camp	0.6
DSO Access Haul Road Section 1	0.3
DSO Access Haul Road Section 2	0.6
DSO Access Haul Road Section 3	0.7
DSO Access Haul Road Section 4	0.6
DSO Access Haul Road Section 5	0.3
DSO Access Haul Road Section 6	0.2
DSO Access Haul Road Section 7	0.3
Creek Crossing Area	0.2
Magazine Area	0.2
North Internal Haul Road 1	0.2
North Internal Haul Road 2	0.5
North Internal Haul Road 3	1.2
North Internal Haul Road 4	2.4
North Internal Haul Road 5	1.7
South Internal Haul Road 1	1.3
MIA 1	0.8
MIA 2	0.9
MIA 3	0.9
MIA 4	3.8
MIA 5	2.2
EOY1 Pit	1.4
EOY2 Pit	1.4
EOY3 Pit	1.7
EOY4 Pit	2.7
EOY5 Pit	2.9
EOY6 Pit	3.7
EOY7 Pit	1.7

4.3 R Factor

NTEPA advises the IECA manual formula for the calculation of R (based on the 2 year 6 hour intensity) is unsuitable for the rainfall characteristics in the Northern Territory. The value that was recommended for the entire Northern Territory is R = 15724. This value has been adopted.

4.4 Site Management Factors

The below factors are associated with how the site is managed in regards to soil erosion.

4.4.1 Cover Factor (C)

The cover factor is influenced by how the disturbed areas across the site are covered i.e. protected from rainfall erosion, be it through matting, temporary or permanent vegetation, chemical binders etc. The cover factor adopted for this assessment was taken as the worst case scenario i.e. 1.

4.4.2 Practice Factor (P)

The practice factor relates to compaction and construction practices across the site and how they impact the velocity and runoff and its tendency to flow directly downhill. The industry accepted default value is 1.3 and this value has been used for this assessment.

4.5 Results

The annual soil loss rate for each catchment area was calculated based on the assessment parameters described above. The erosion risk was then derived based on table 4.4.3 of IECA (2008). Appropriate techniques for different Ranges of Soil Loss Rate can also be determined. These are summarised in Table 4 below. Each technique type is explained further in section 4.3.

Table 4: Risk Assessment

Catchment Area Reference	Annual Soil Loss Rate t/ha/yr	Erosion Risk	Sediment Control Technique Type
Accommodation Camp	383.2	Moderate	Type 1
DSO Access Haul Road Section 1	198.5	Low	Type 1
DSO Access Haul Road Section 2	355.3	Moderate	Type 1
DSO Access Haul Road Section 3	416.9	Moderate	Type 1
DSO Access Haul Road Section 4	349.0	Moderate	Type 1
DSO Access Haul Road Section 5	273.0	Moderate	Type 1
DSO Access Haul Road Section 6	170.6	Low	Type 1
DSO Access Haul Road Section 7	206.8	Low	Type 1
Creek Crossing Area	159.3	Low	Type 1
Magazine Area	202.3	Low	Type 1
North Internal Haul Road 1	171.5	Low	Type 1
North Internal Haul Road 2	398.3	Moderate	Type 1
North Internal Haul Road 3	764.3	High	Type 1
North Internal Haul Road 4	1472.7	High	Type 1
North Internal Haul Road 5	1037.7	High	Type 1
South Internal Haul Road 1	800.7	High	Type 1
MIA 1	488.9	Moderate	Type 1
MIA 2	522.3	High	Type 1
MIA 3	580.3	High	Type 1
MIA 4	2321.0	Very High	Type 1
Subgrade Waste Stockpile	1341.8	High	Type 1
EOY1 Pit	1570.2	Very High	Type 1
EOY2 Pit	1540.7	Very High	Type 1
EOY3 Pit	1071.5	High	Type 1
EOY4 Pit	3061.2	Very High	Type 1
EOY5 Pit	3288.3	Very High	Type 1
EOY6 Pit	2267.1	Very High	Type 1
EOY7 Pit	1072.0	High	Type 1

As the table suggests, during construction, the site is at a high risk of erosion with only type 1 sediment control devices being recommended for every catchment investigated. This will be discussed further in section 6.

4.6 Implications, Limits and Targets

The following guidance is given for different targets and limits to be used in each identified risk rating area in accordance with Table 4.4.7 of the IECA guidelines. Each of these targets is expected to only be critical during the wet season.

Cover

Cover is the most influential factor when determining soil erosion using the RUSLE method. It follows that covering disturbed soil surfaces and stockpiles is a very important consideration in ESC management (See section 5 Erosion Control below). Table 5 below shows the targets to meet best management practice within each risk category areas.

Table 5: Cover

Risk Category	Target Cover	Time limit (days)
Very Low	60%	Within 30
Low	70%	Within 30
Moderate	70%	Within 20
High	75%	Within 10
Very High	80%	Within 5

Land Clearing

The IECA BPM guidelines recommend a limit for the advancement of land clearing (in weeks of work) prior to the stabilisation of existing disturbed areas (refer to table 5 above). Table 6 below shows these limits.

Table 6: Land Clearing Limits for Each Risk Category

Risk Category	Max Weeks of Work to Advance Land Clearing
Very Low	8
Low	8
Moderate	6
High	4
Very High	2

Sediment Control Technique Selection

Each of the catchments analysed was calculated to have a soil loss of greater than 150t/ha/yr. and as such each catchment will require a Type 1 sediment control device. Nonetheless, Table 7 below shows examples of each of the technique types should a lower soil loss be specified at a later stage.

Table 7: Sediment Control Selection

Type	Examples
1	Sediment basin (sized in accordance with design standard)
2	Filter tube dam, rock filter dam, sediment trench, sediment weir, compost/mulch berm
3	Sediment fence, sediment trap

5 Erosion Control

Prevention of erosion is the best strategy to reduce sedimentation.

5.1 Drainage Control

5.1.1 Design Standards

Each relevant drainage control structure has been sized for the 10 year ARI event with an allowance for 150mm of freeboard. The C10 value used was 0.7.

5.1.2 Slope

As mentioned previously all batters external to mining operations will be at a maximum of 1:4 grade to mitigate the erosion risks associated with steeper slopes.

Table 4.3.2 provides guidance on the minimum spacing of drains or benches on long continuous slopes. A summary of these values is shown in table 8 below.

Table 8– Minimum Horizontal Spacing of drainage control on long continuous slopes

Slope	Minimum Horizontal Spacing (m)
1%	90
2%	60
4%	40
6%	32
8%	28
10%	25
15%	22

5.1.3 Catch Drains

During the construction phase, all constructed effect areas with disturbed surfaces will have the possibility of collecting and discharging sediment laden runoff. These catchments will be addressed by providing Catch Drains to convey the runoff to the appropriate treatment device which in most cases is a sedimentation basin. Refer to Appendix A for location and Appendix E for the preliminary sizing of the drains.

5.1.4 Diversion

Existing discharge from unaffected areas do not need to be treated for uncontrolled sedimentation. All clean runoff from upstream of all works will be conveyed around the area of work with diversion drains. Due to the additional concentration of flow, level spreaders will need to be installed to control the release of the stormwater back to the sheet flow prior to discharge to receiving waterways. Dependant on the catchment area and subsequent flows the diversion drainage will either be a diversion bund or a diversion swale. Refer to Appendix A for location and Appendix E for the details of the drains/bunds.

5.1.5 Preservation of existing batters

Throughout the mine lease area, there are a number of existing batters with proposed works near or adjacent to steep sections of earth. During construction, the earthmoving works should be monitored closely at these areas as to not disturb the natural batter and cause rutting that would induce future scour of the natural surfaces. Constant supervision of all interface areas should be included in the daily report and monitoring programs.

5.2 Soil Management

Disturbed Soil and stockpiles need to be managed appropriately. Guidance from Table 4.4.13 of IECA has been modified and presented in Table 9 below.

Table 9 – Suitability of Erosion control options vs. slope

Slope	0-10%	10-25%	>25%
Erosion Control Blankets			
Erosion Control Matts and Mesh			
Gravelling			
Mulching		(anchored)	
Revegetation*			
Hydromulch/Bonded Fibre Matrix*			
Soil Binder			
Compost Blankets*			
Rock Armouring			

*Note: Revegetation options may struggle to establish and be effective in the dry season

5.2.1 Dispersivity

Any sodic soils encountered on site need to be managed by the application of Gypsum. Application rates can be determined at a later stage after testing of the expected soils has been undertaken.

5.2.2 Stockpiles

Most of the topsoil across the site has been characterised as silty loam, and these soils have a high susceptibility to erosion. Topsoil is generally very shallow, so the quantity and size of topsoil stockpiles are expected to be relatively small. Nonetheless topsoil stockpiles need to be managed to limit erosion. Stabilisation of the stockpile surface is required by re-vegetation or by covering with a geotextile during the wet season. Plastic (HDPE) liners should generally be avoided for use on topsoil stockpiles but may be suitable for a short term measure prior to an anticipated rain event. The perimeter of the pile should be protected with sediment fence or compacted earth bunding to prevent movement of the stockpile material.

6 Sediment Control

6.1 Rock Filter Dams and Sediment Weirs

Within the drainage channels, Rock Filter Dams can be utilized to reduce both the velocity and the sedimentation loading on the downstream controls. For minor catchments with minimal or very low sedimentation risk, Sedimentation Weirs can be used to collect sediment and discharge runoff to the receiving water course. Refer to Appendix A for details and locations of the rock dams and sediment weirs.

6.2 Sedimentation Basins

A Sediment Basin is a purpose build dam designed to collect and settle sediment-laden water. A Sediment Basin can control both the coarse grained and fine grain particles by providing a physical barrier for the sediment and providing a location for longer term settlement through retention of the storm flow. Based on the soil characteristics observed across the site, it is considered suitable to implement wet basins. However, due to the number of basins required, it is recommended that a slow flow discharge through a sediment sock or similar device is incorporated into wet basins. The basins will be able to be emptied (after sufficient treatment) without the need for pumping. Refer to Appendix A for locations and details of the basins. Flocculation may be required to settle out eroded clay particles. Gypsum is recommended as it has the least environmental risk.

7 Monitoring

7.1 Construction Phase Monitoring

During construction and operational phases of the mine, monitoring of the stormwater runoff is recommended. Where possible, baseline data should be taken. The recommended testing parameters are total suspended solids, turbidity (NTU), pH, dissolved oxygen and hydrocarbons. This data will ensure the sediment controls have been implemented and maintained to a satisfactory standard. Testing will be completed as nominated by the NTEPA Water Quality Sampling Manual by a NATA registered laboratory.

During the initial earthmoving works, the construction management plan should include monitoring of the topsoil stripping to ensure that the topsoil layers are kept separate from subsoil layers, particularly if the subsoil's are sodic. It is also recommended that any required top soil amelioration is done prior to stripping to avoid the need for manual mixing at a later stage.

7.2 Maintenance of Controls

During the construction and operational phase of the mine, all sediment and erosion control devices will require on-going maintenance to ensure they remain fully operational. Refer to Appendix D for sediment load expected with an estimated yearly maintenance program.

Operational plans are required to include the procedure and timing for visual inspection of all basins, channels, weirs and outlets. If any of the devices are seen to have a reduced level of service or is damaged in anyway, they are to be repaired immediately with the appropriate reporting documented filed and issued.

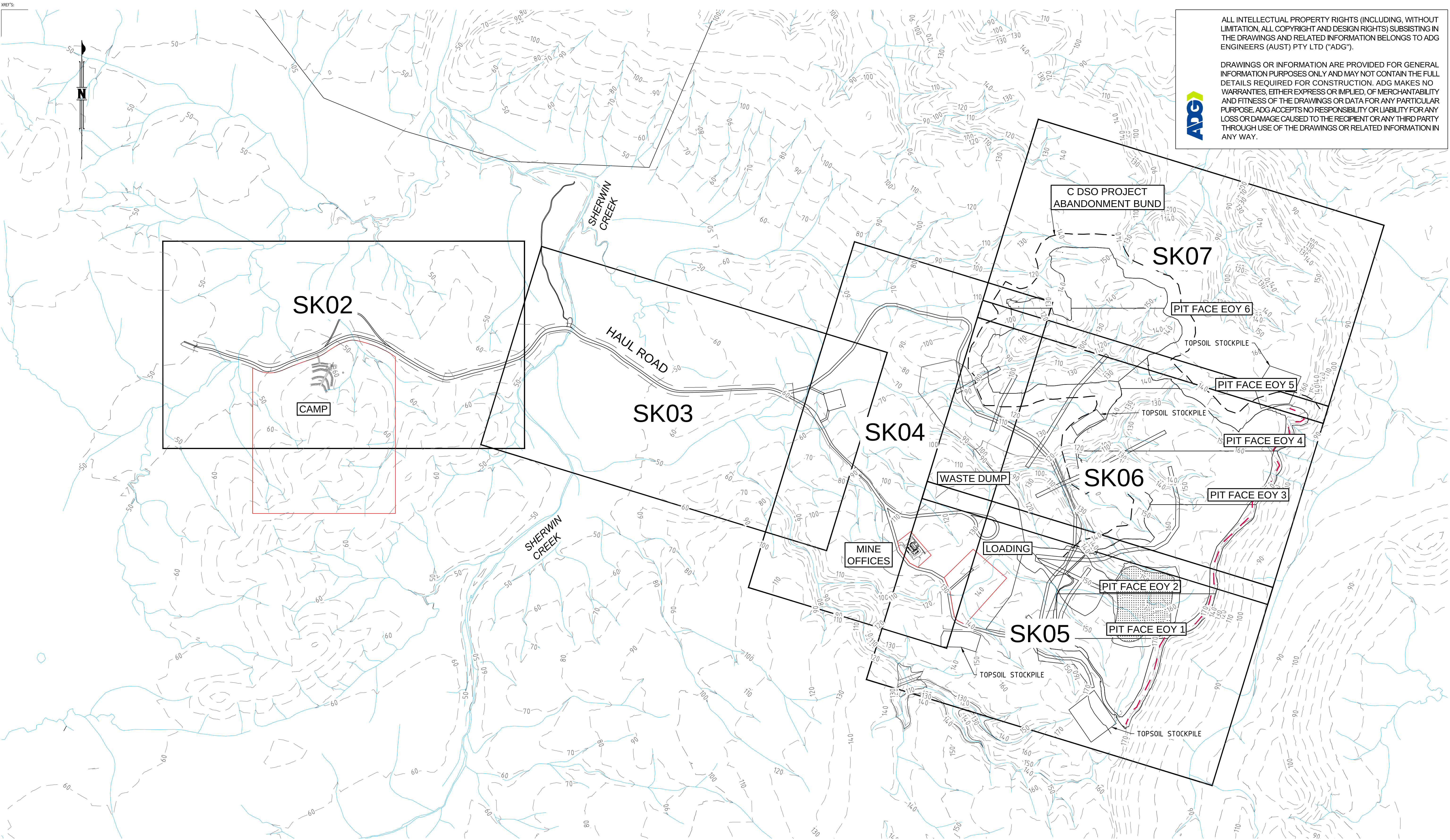
8 Conclusion

This review of the proposed works at Sherwin Creek Deposit C and its impact on the environment has provided comprehensive comments and recommendation for appropriate, sustainable and constructible Erosion and Sediment Control requirements. This report has recommended the following control measures to be implemented:

- Catchment Drains for upstream disturbed surfaces
- Sedimentation Basins for removing coarse and fine particles
- Diversion Drains and Bunds for undisturbed upstream catchments
- Level spreaders to maintain natural discharge flows
- Channelization controls for the nominated drains

The above recommendations will provide protection to the receiving environment and will prevent any adverse impact to the existing waterways.

Appendix A Erosion and Sediment Control Drawings



PRELIMINARY
NOT FOR CONSTRUCTION

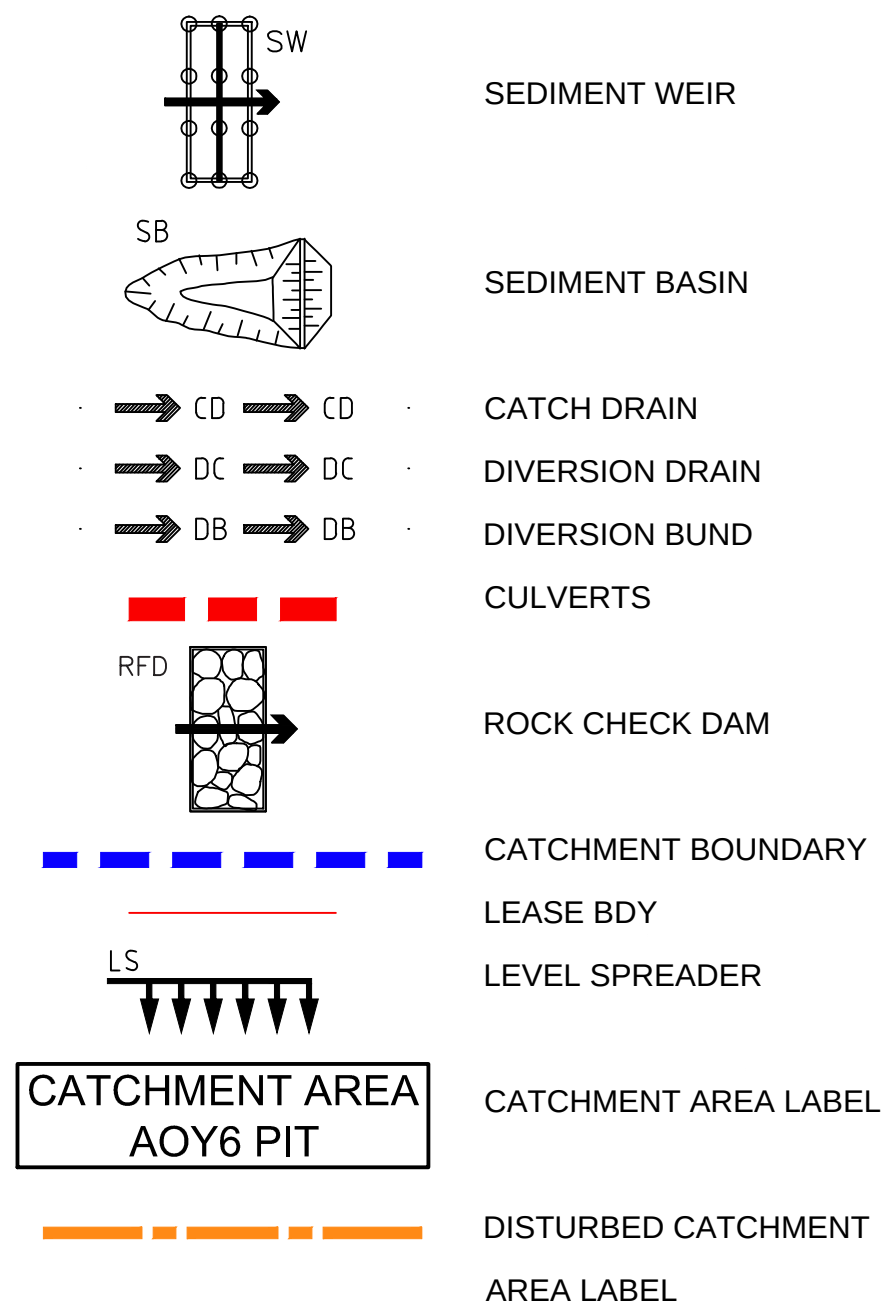
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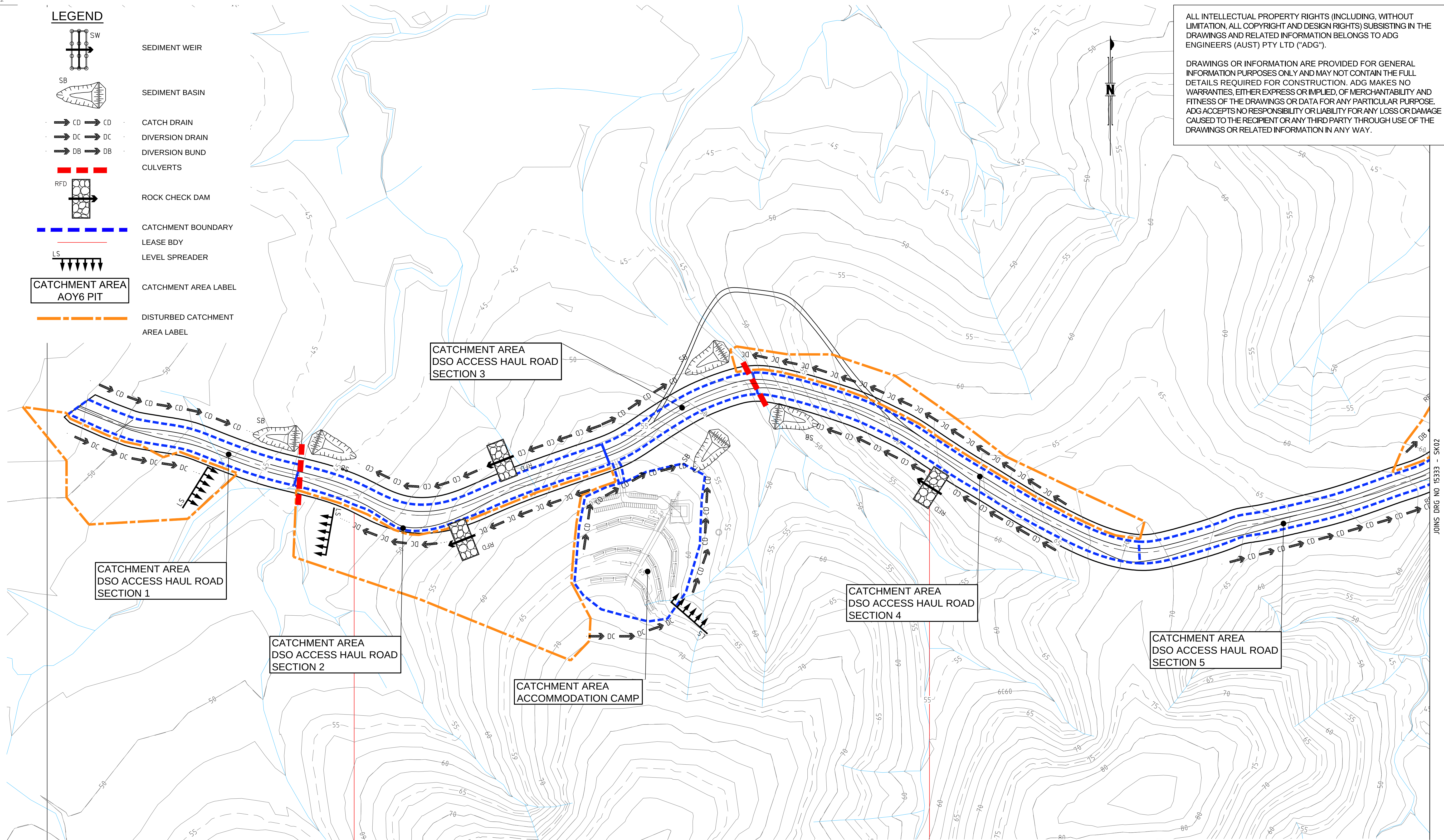
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01	13.09.13	Issued for ESCP	SW	MB

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ECOZ Pty LtdProject Name
SHERWIN CREEK DEPOSIT C
ROPER RIVER, NTDiscipline
CIVILDesigned By
MBProject No.
15333

Checked By

Drawn By
SWStatus
PRELIMINARY

Approved By

Scale at A1
1:2500

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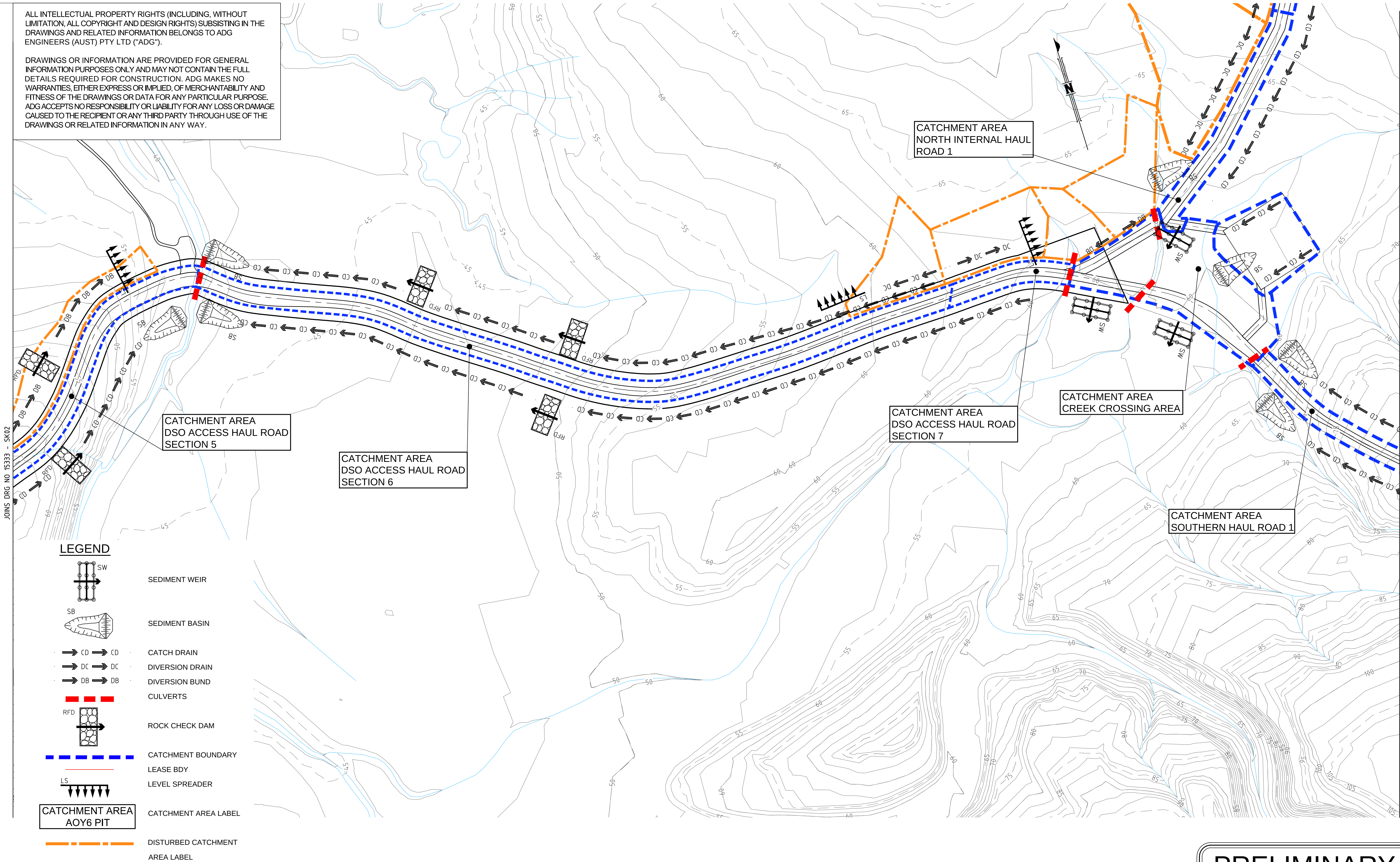
Title
EROSION AND SEDIMENT CONTROL
LAYOUT PLANDrawing No.
SK02Revision
03

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0 50 100 150m
SCALE 1:2500
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Client:
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Project Name
SHERWIN CREEK DEPOSIT C
ROPER RIVER, NT

Discipline
CIVIL

Designed By
MB

Project No.
15333

Checked By

Drawn By
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Status
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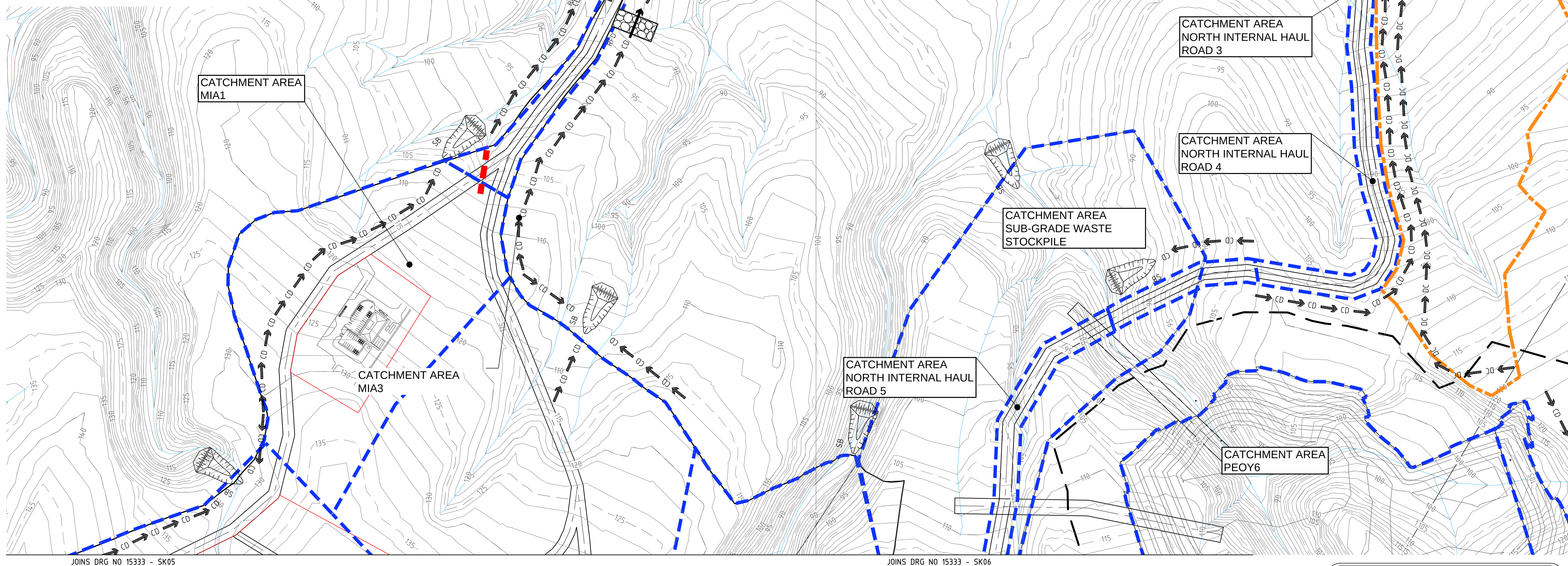
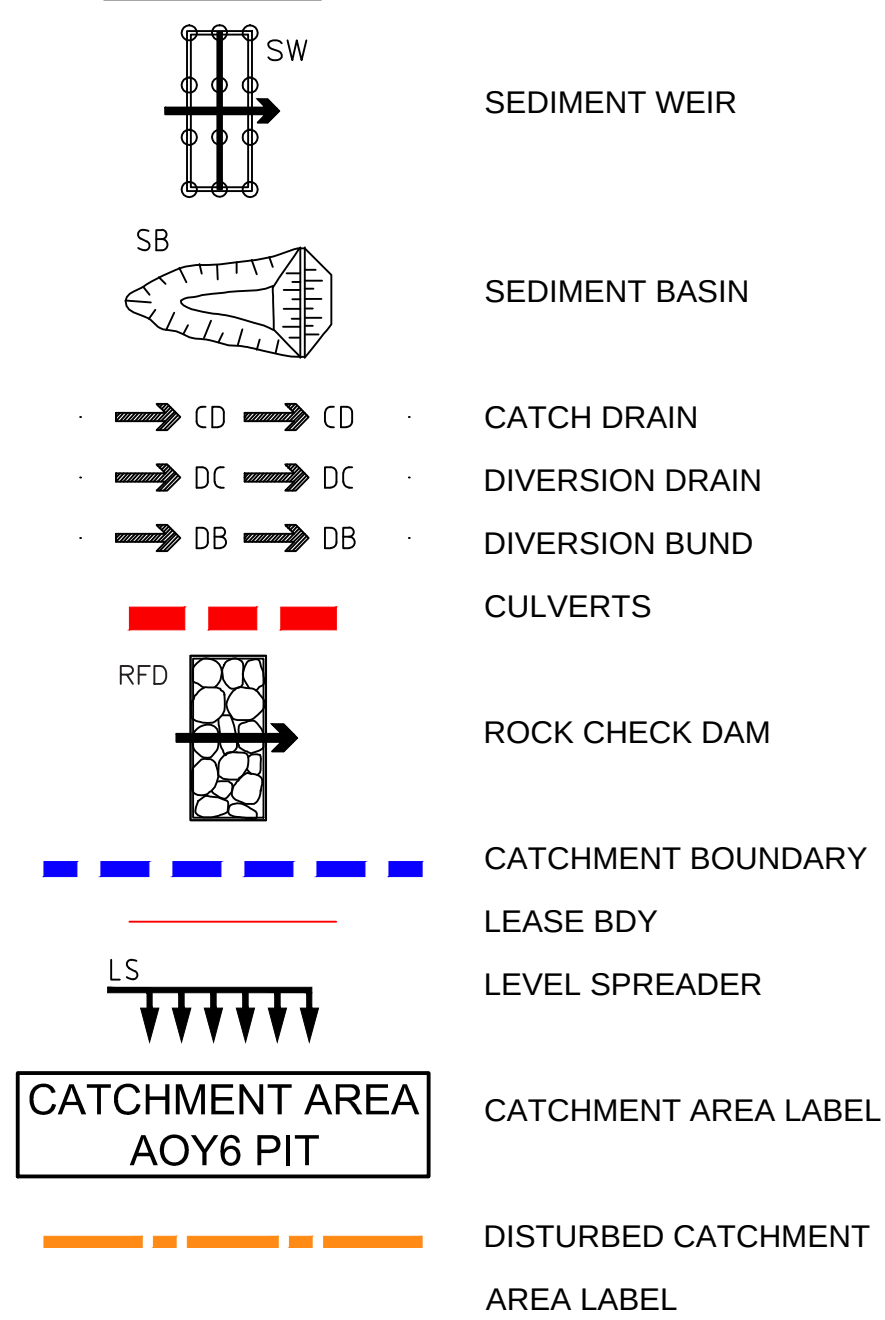
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Title
EROSION AND SEDIMENT CONTROL
LAYOUT PLAN

Drawing No.
SK03

Revision
03

LEGEND



JOINS DRG NO 15333 - SK05

JOINS DRG NO 15333 - SK06

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SCALE 1:2500
AT ORIGINAL SIZE (A1)



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CIVILDesigned By
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15333

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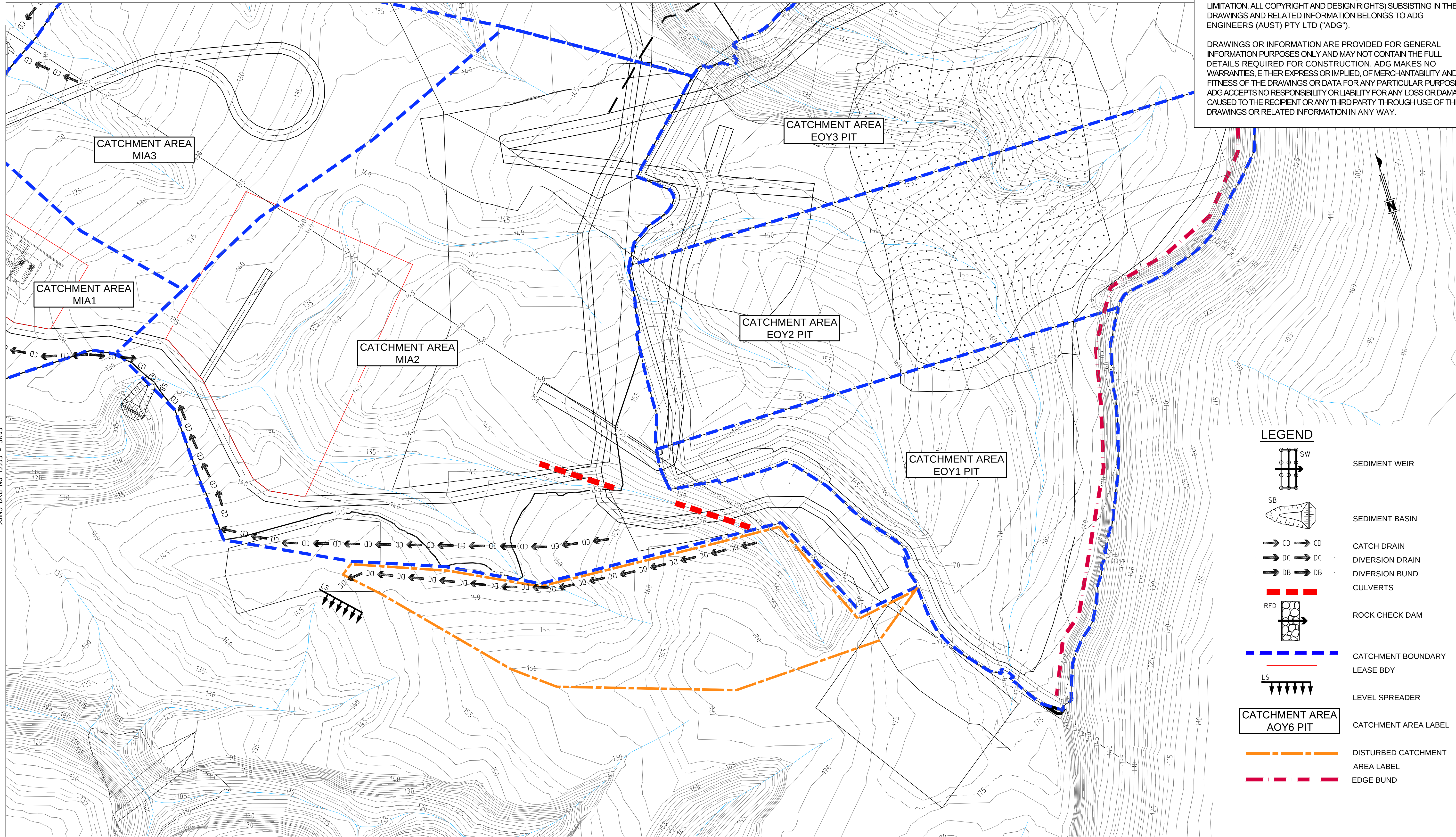
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EROSION AND SEDIMENT CONTROL
LAYOUT PLANDrawing No.
SK04Revision
03

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SCALE 1:2500
AT ORIGINAL SIZE (A1)



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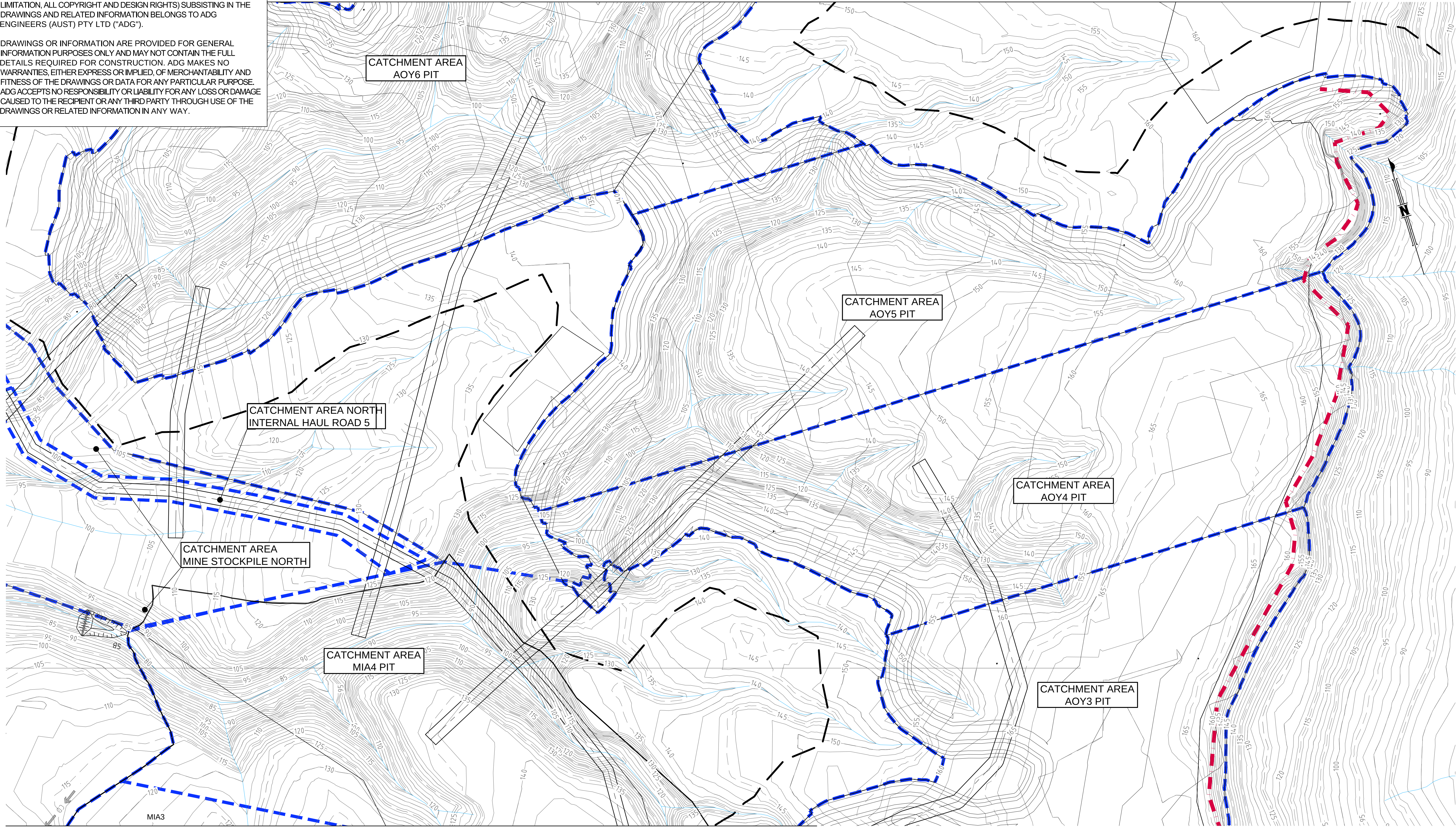
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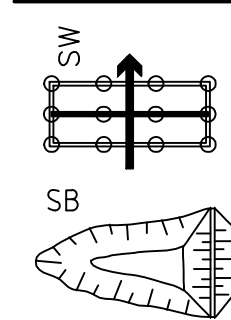
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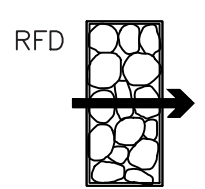
JOINS DRG NO 15333 - SK05

LEGEND



SEDIMENT WEIR
SEDIMENT BASIN

CD → CD
DC → DC
DB → DB
CATCH DRAIN
DIVERSION DRAIN
DIVERSION BUND
CULVERTS



ROCK CHECK DAM



CATCHMENT BOUNDARY
LEASE BDY



CATCHMENT AREA
AOY6 PIT

ROCK CHECK DAM

CATCHMENT BOUNDARY
LEASE BDY



DISTURBED CATCHMENT AREA LABEL



EDGE BUND



C DSO PROJECT ABANDONMENT BUND

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SCALE 1:2500
AT ORIGINAL SIZE (A1)



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Client:
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Project Name
SHERWIN CREEK DEPOSIT C
ROPER RIVER, NT

Discipline
CIVIL

Designed By
MB

Project No.
15333

Checked By

Drawn By
SW

Status
PRELIMINARY

Approved By

Scale at A1
1:2500

Title
EROSION AND SEDIMENT CONTROL
LAYOUT PLAN

Drawing No.
SK06

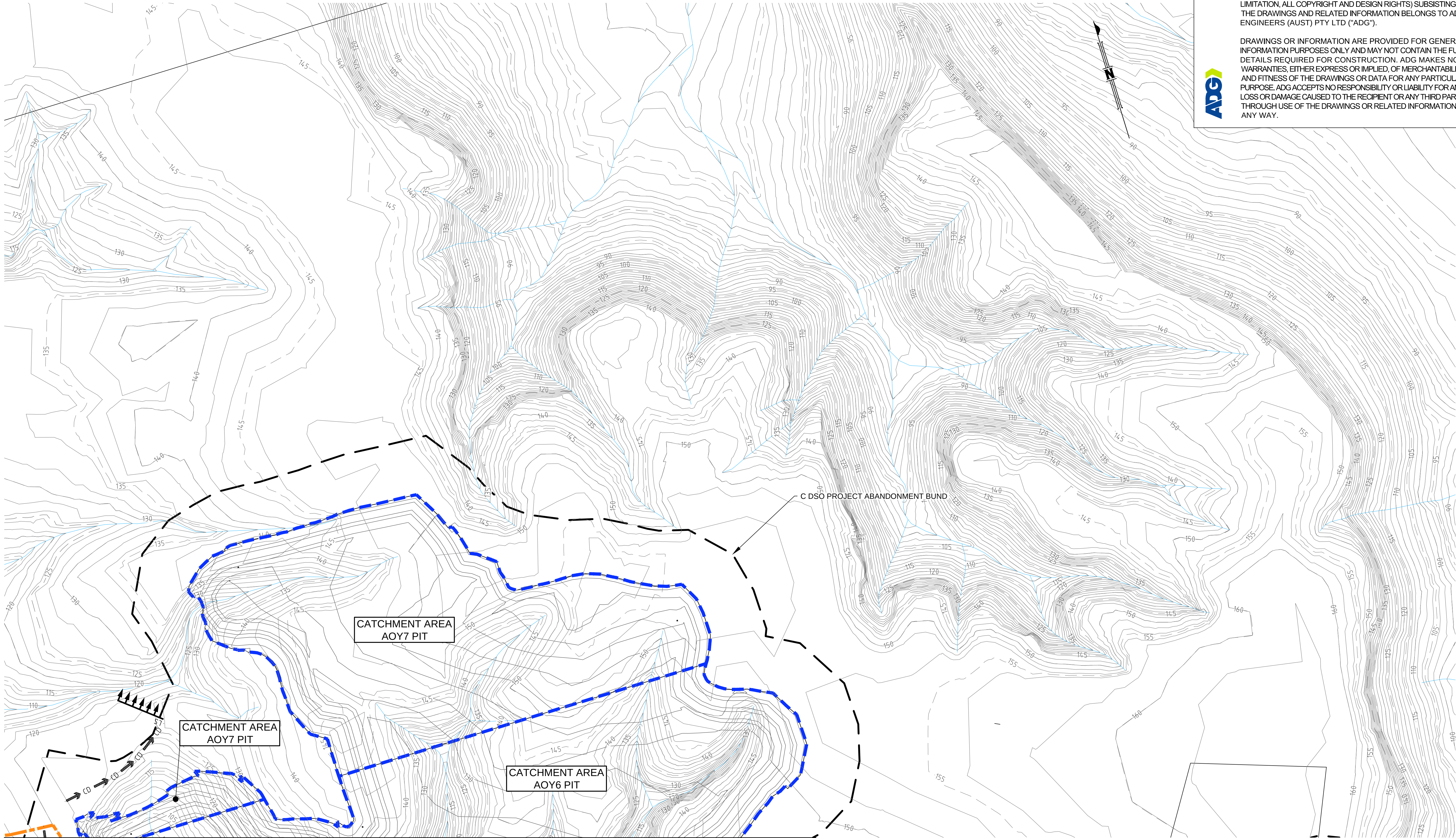
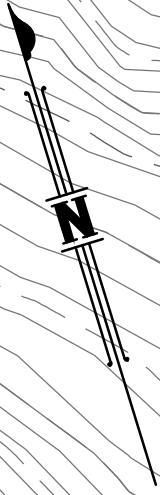
Revision
03

FULL SIZE ON ORIGINAL 0 10 20 30 40 50 60 70 80 90 100mm

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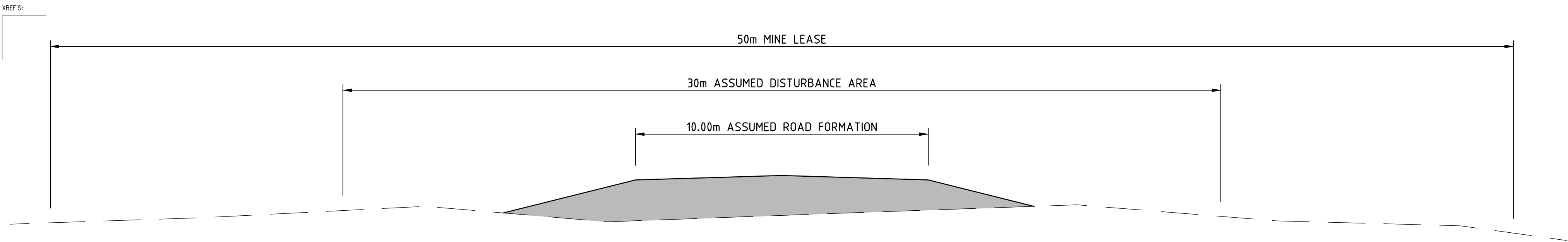
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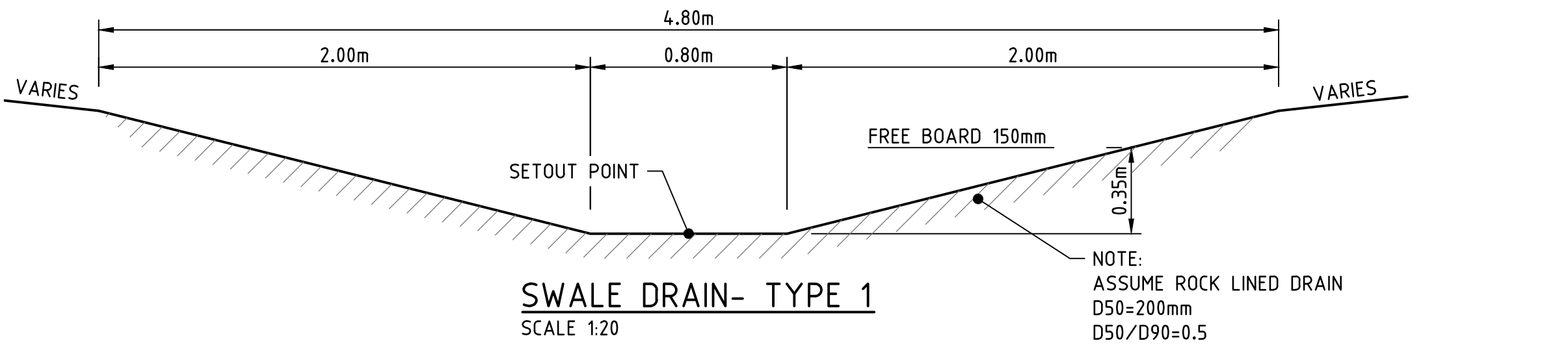
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Project Name: SHERWIN CREEK DEPOSIT C ROPER RIVER, NT	Designed By: MB	Checked By:	Approved By:
	Project No. 15333	Drawn By: SW	Scale at A1: 1:2500
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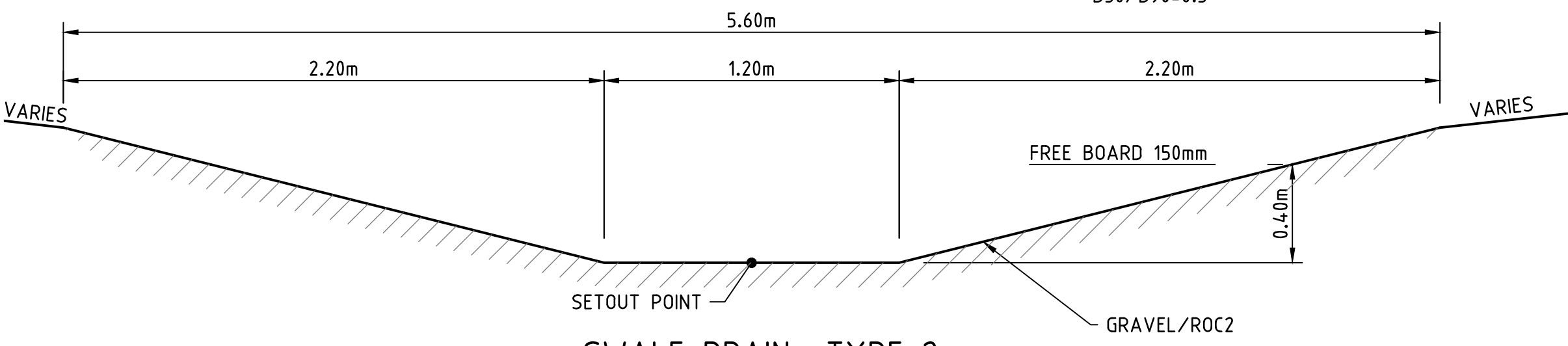
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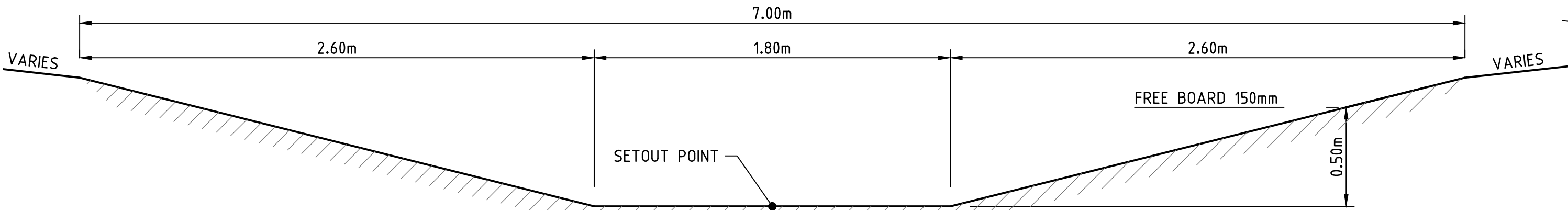
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SCALE 1:50



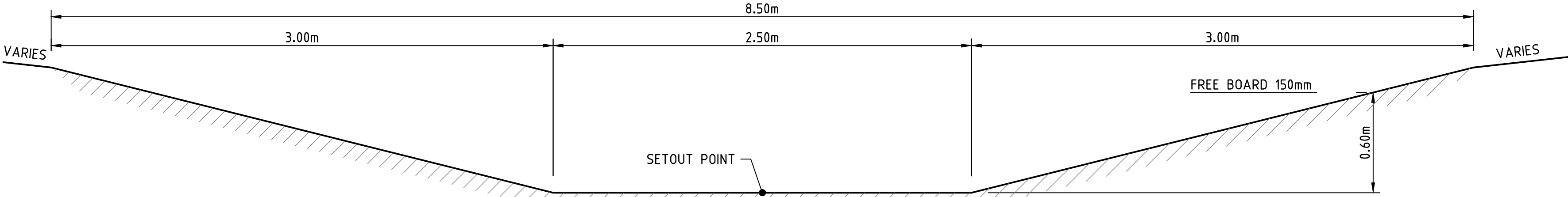
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SCALE 1:20



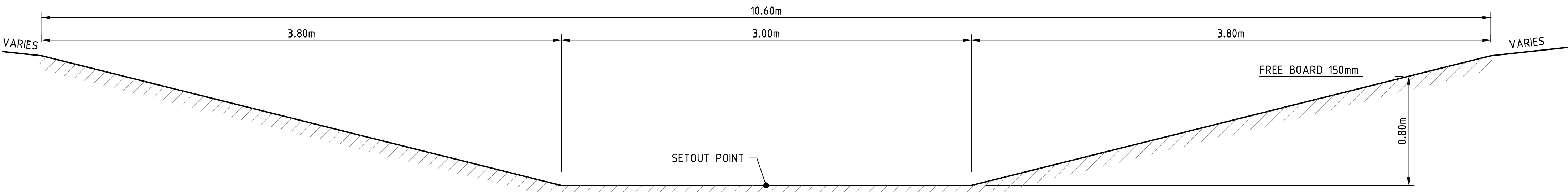
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SCALE 1:20



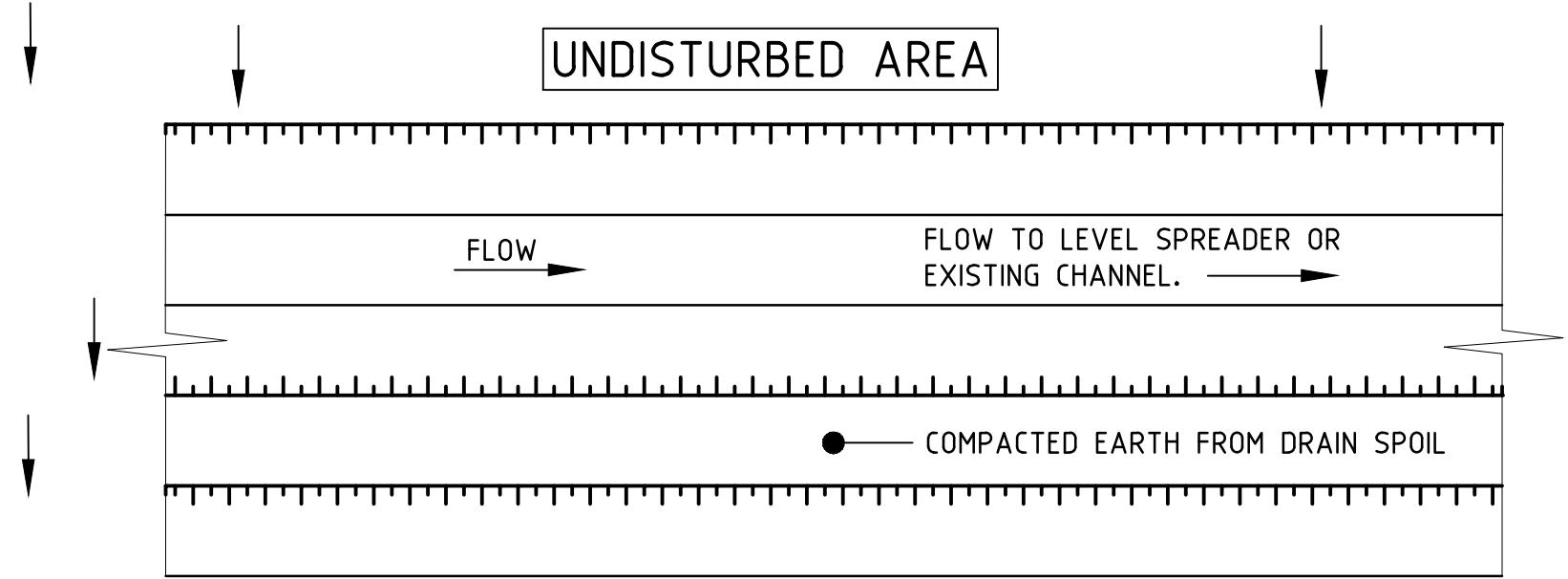
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SCALE 1:20



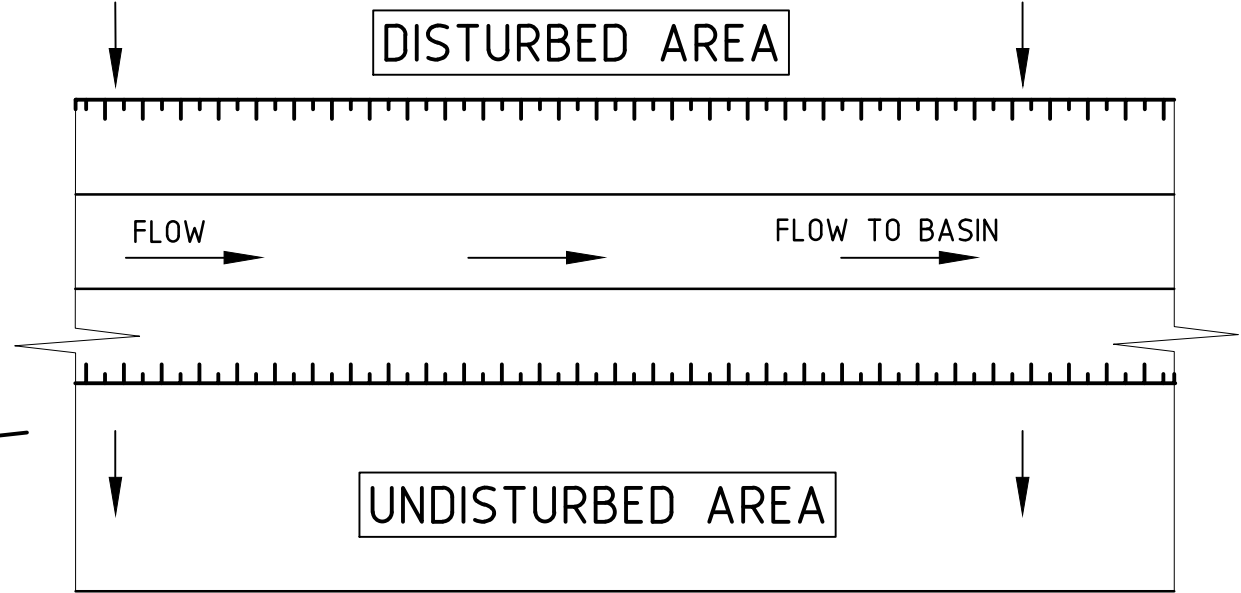
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SCALE 1:20



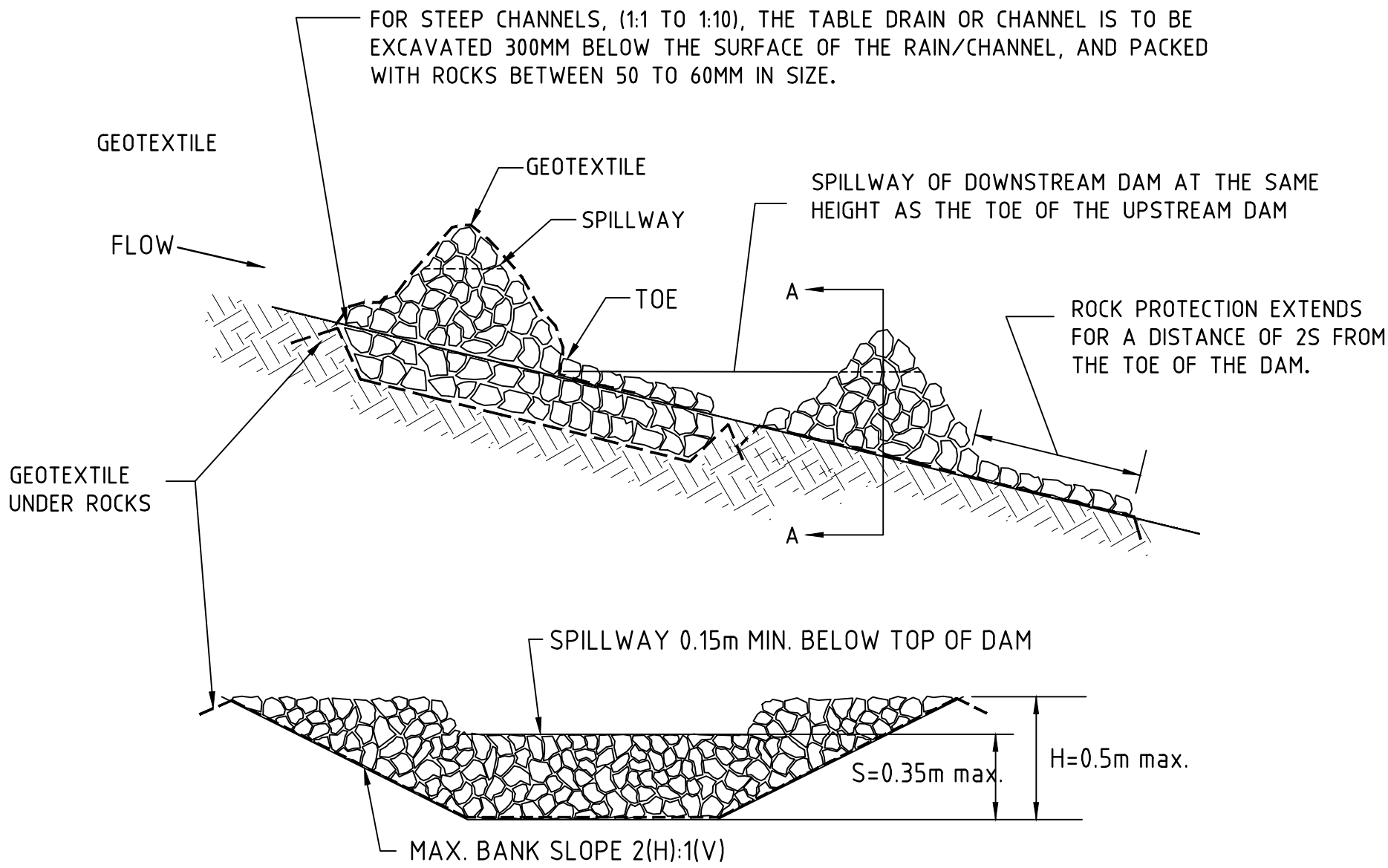
SWALE DRAIN- TYPE 5
SCALE 1:20



TYPICAL DIVERSION DRAIN
SCALE 1:20



TYPICAL CATCHMENT DRAIN
SCALE 1:20



SECTION A-A
ROCK CHECK DAMS

TABLE OF CHANNEL
SLOPE/ROCK CHECK
DAM SPACINGS

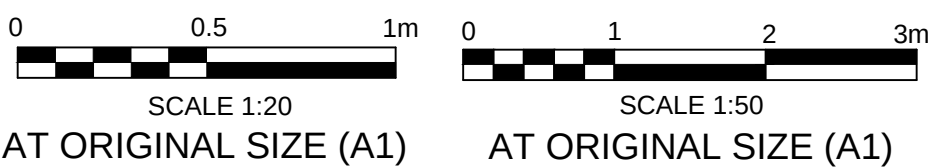
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3:1	11
5:1	17
7:1	25
10:1	35
20:1	70
30:1	105
40:1	140
50:1	175
75:1	260

CONSTRUCTION SEQUENCE

- IF CHANNEL/TABLEDRAIN IS BETWEEN 1:1 & 1:10 SLOPE EXCAVATE OUT TO A DEPTH OF 300mm WHERE THE ROCK CHECK DAMS ARE GOING TO BE PLACED.
- LAY DOWN GEOTEXTILE OVER AREA THE ROCK CHECK DAM IS TO BE CONSTRUCTED.
- PLACE ROCKS TO DIMENSIONS SHOWN ON DRAWING.

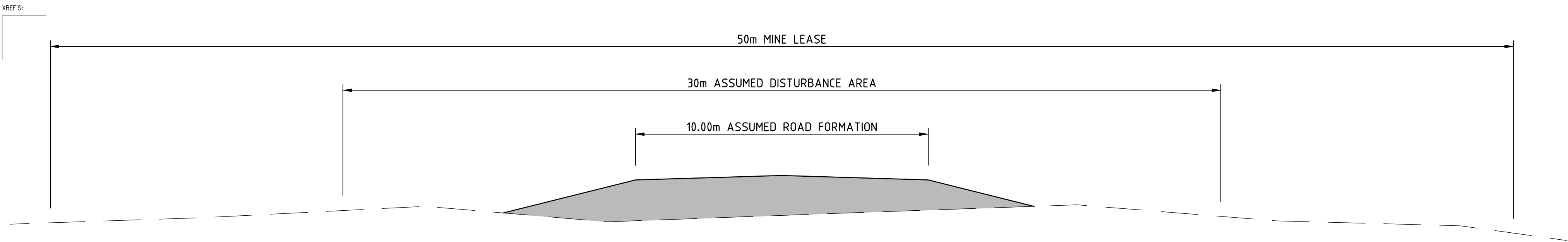
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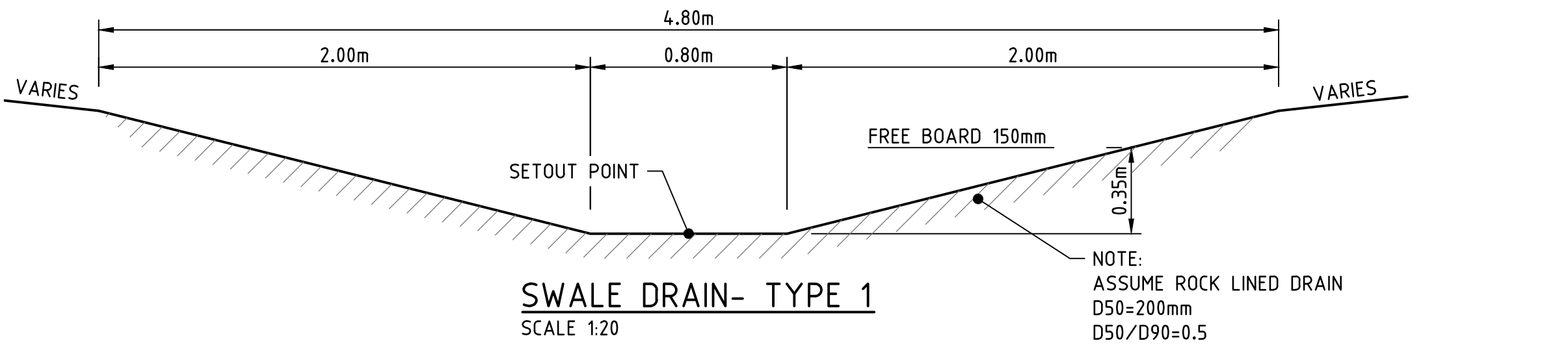


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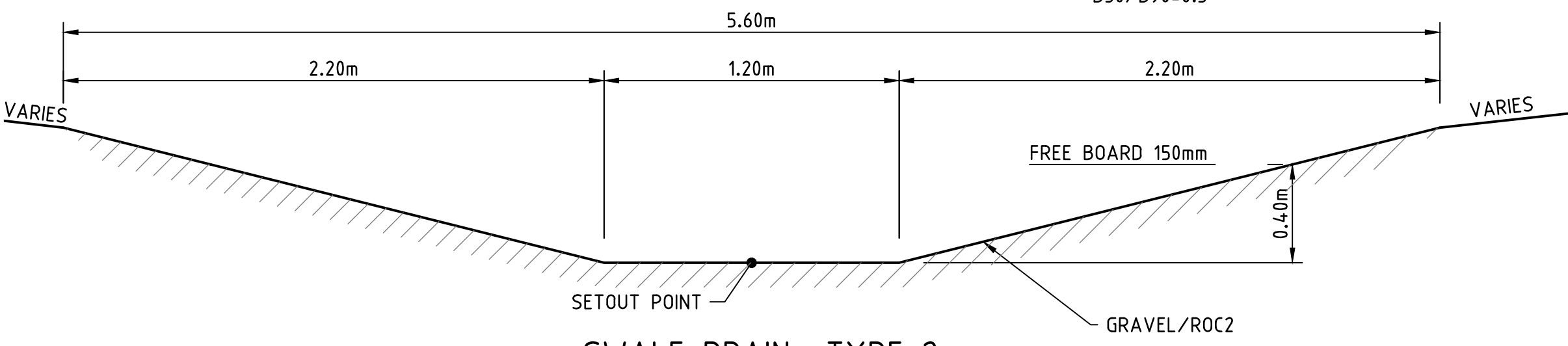
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Project Name SHERWIN CREEK DEPOSIT C ROPER RIVER, NT	Designed By MB	Checked By	Approved By
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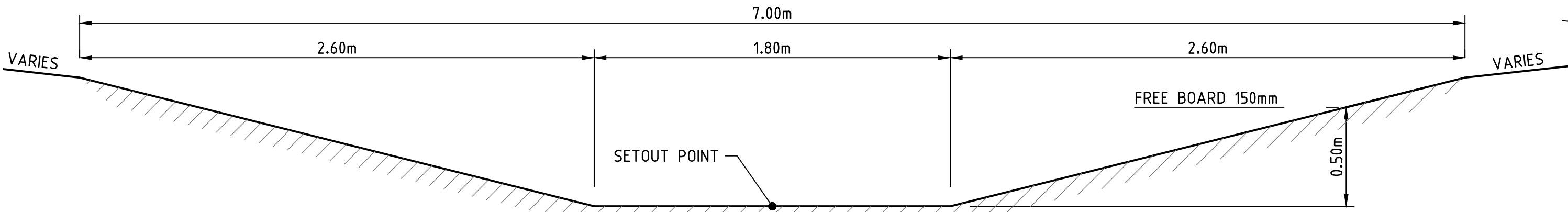
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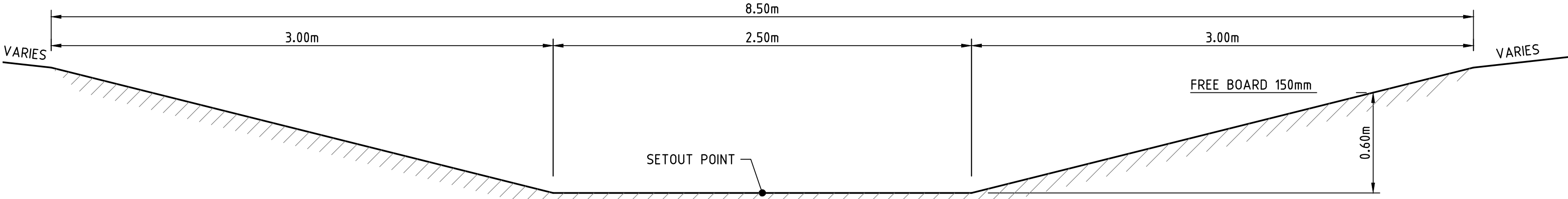
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SCALE 1:20



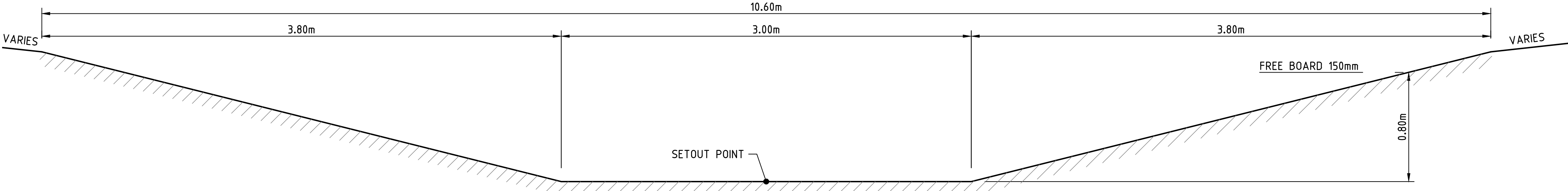
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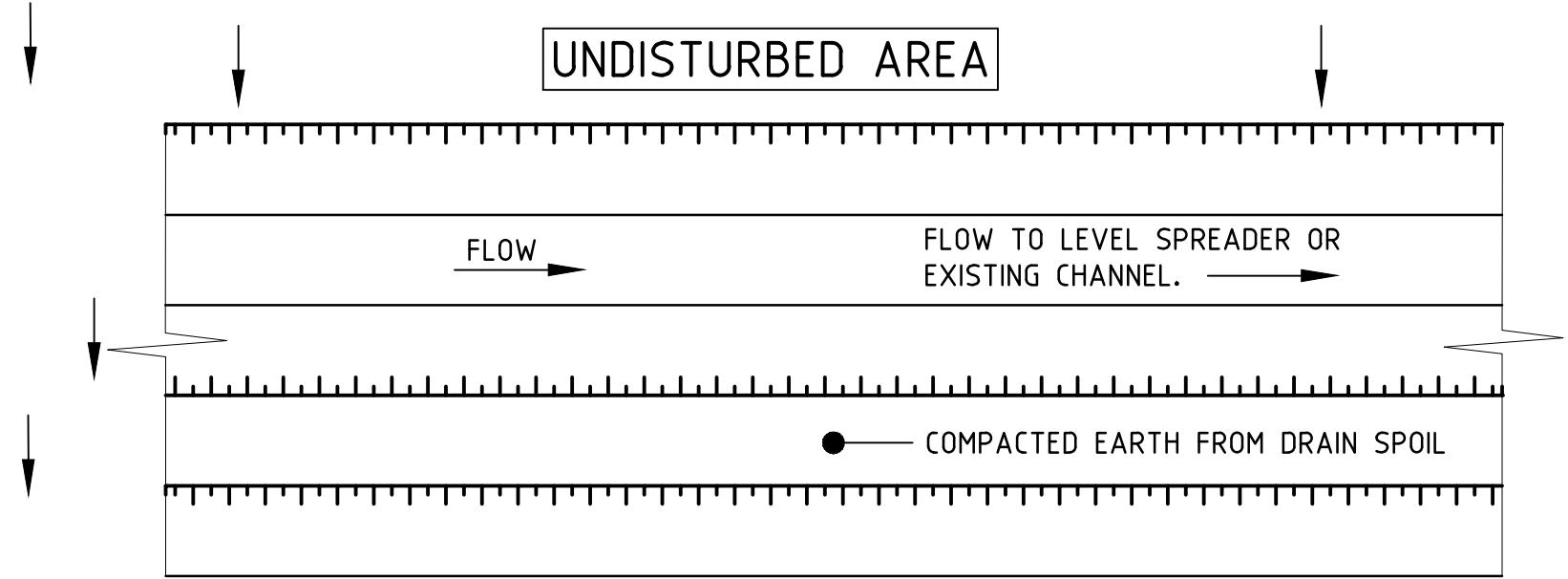
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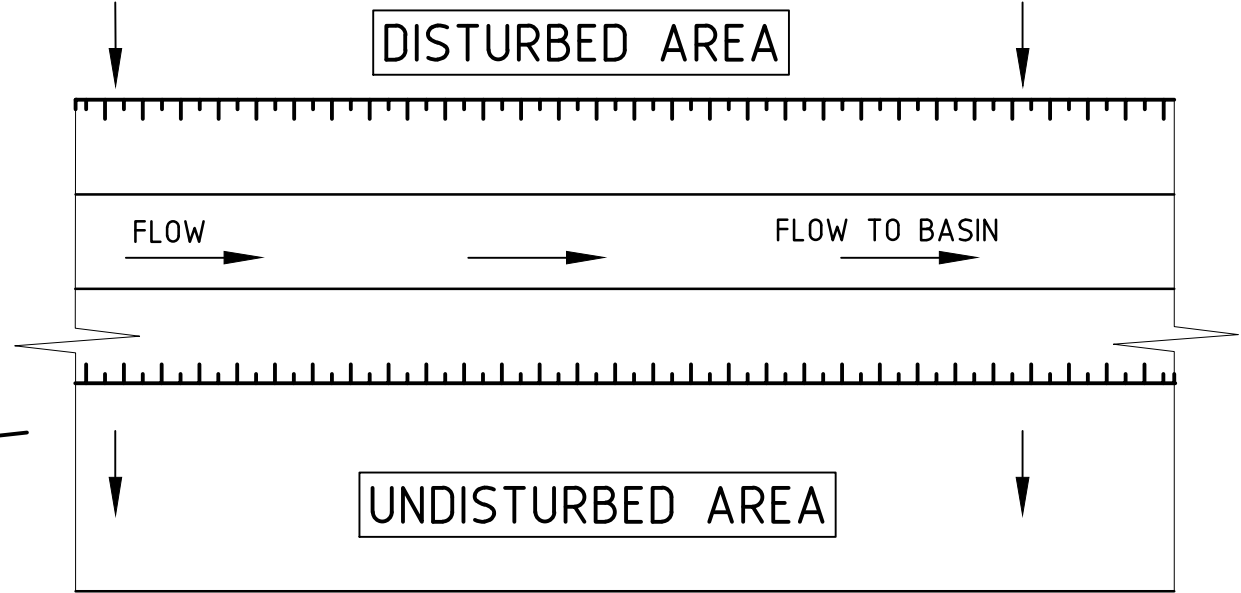
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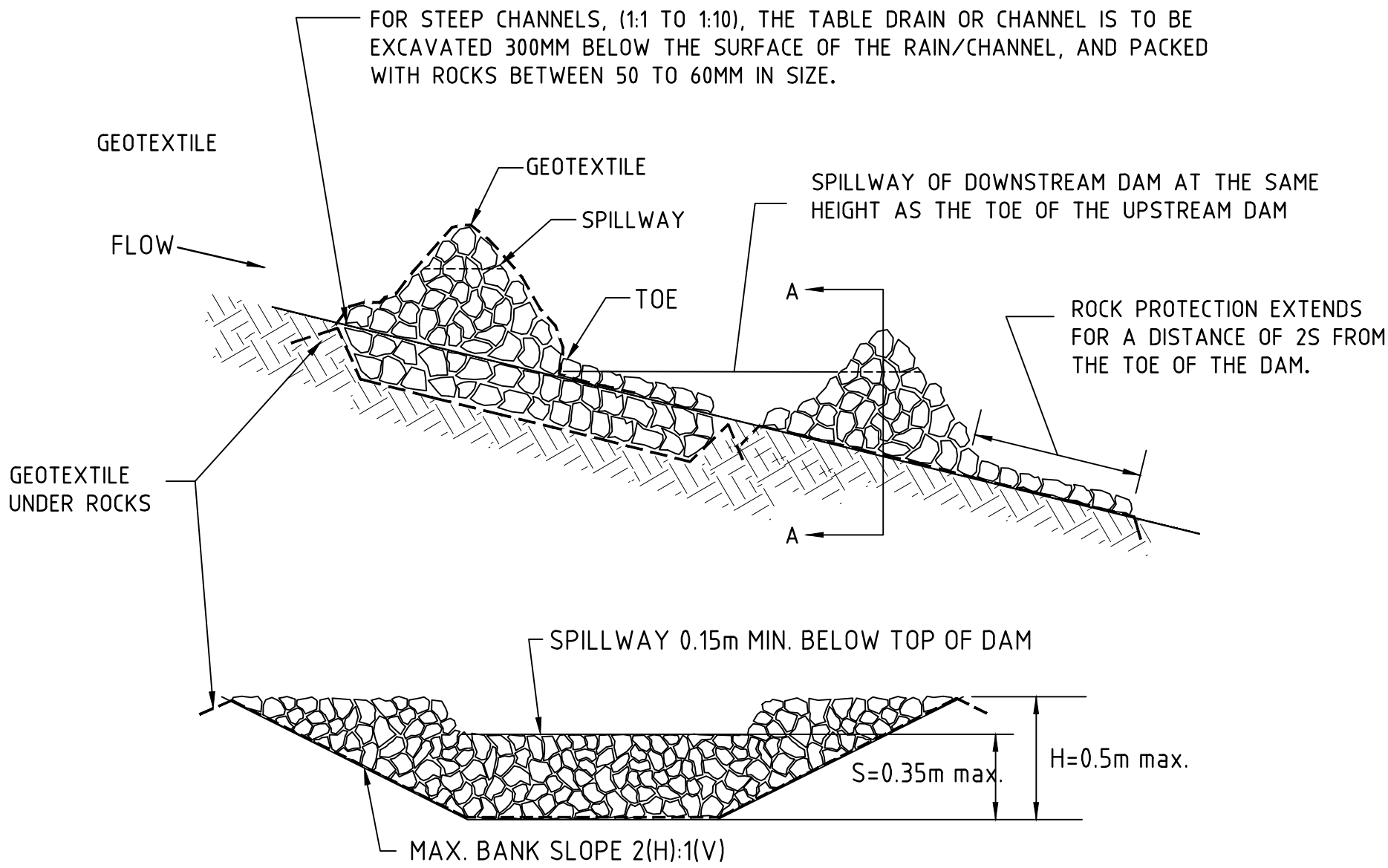
SWALE DRAIN- TYPE 5
SCALE 1:20



TYPICAL DIVERSION DRAIN
SCALE 1:20



TYPICAL CATCHMENT DRAIN
SCALE 1:20



SECTION A-A
ROCK CHECK DAMS

TABLE OF CHANNEL
SLOPE/ROCK CHECK
DAM SPACINGS

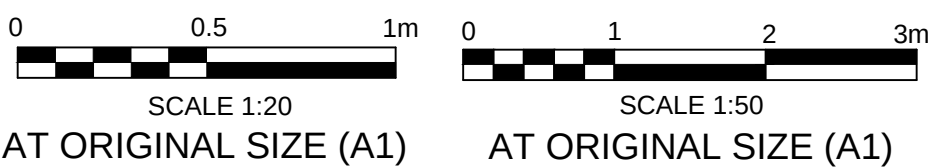
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5:1	17
7:1	25
10:1	35
20:1	70
30:1	105
40:1	140
50:1	175
75:1	260

CONSTRUCTION SEQUENCE

- IF CHANNEL/TABLEDRAIN IS BETWEEN 1:1 & 1:10 SLOPE EXCAVATE OUT TO A DEPTH OF 300mm WHERE THE ROCK CHECK DAMS ARE GOING TO BE PLACED.
- LAY DOWN GEOTEXTILE OVER AREA THE ROCK CHECK DAM IS TO BE CONSTRUCTED.
- PLACE ROCKS TO DIMENSIONS SHOWN ON DRAWING.

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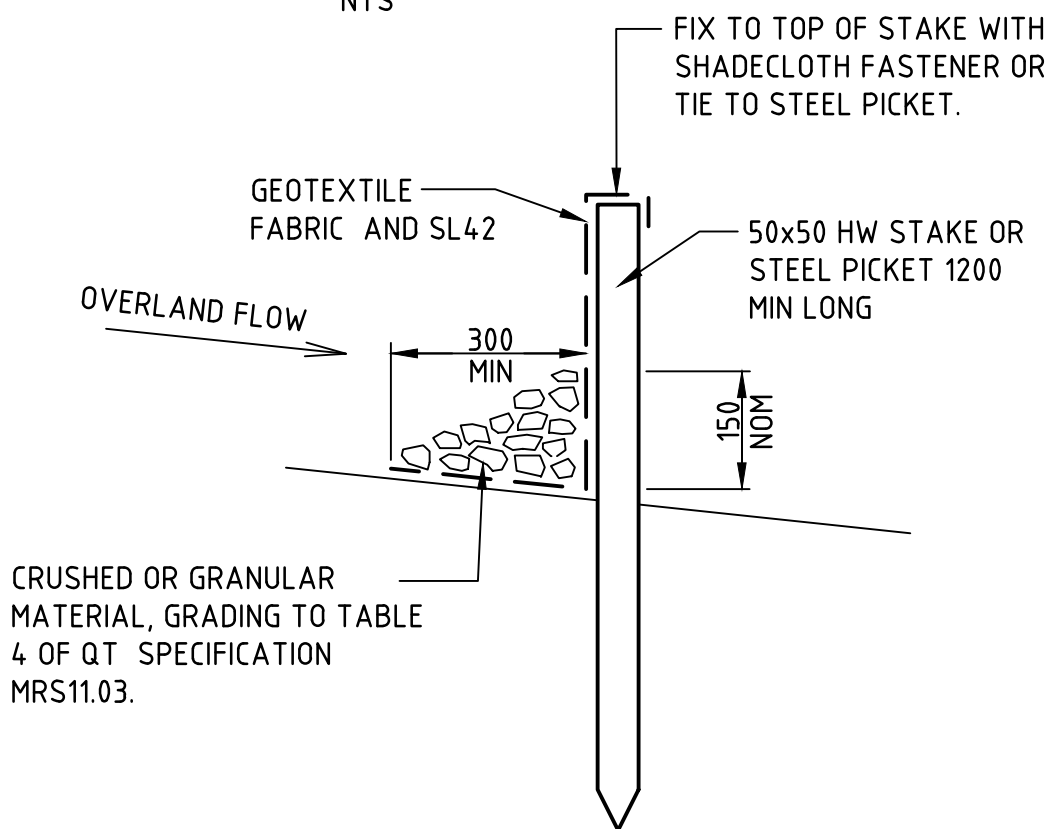
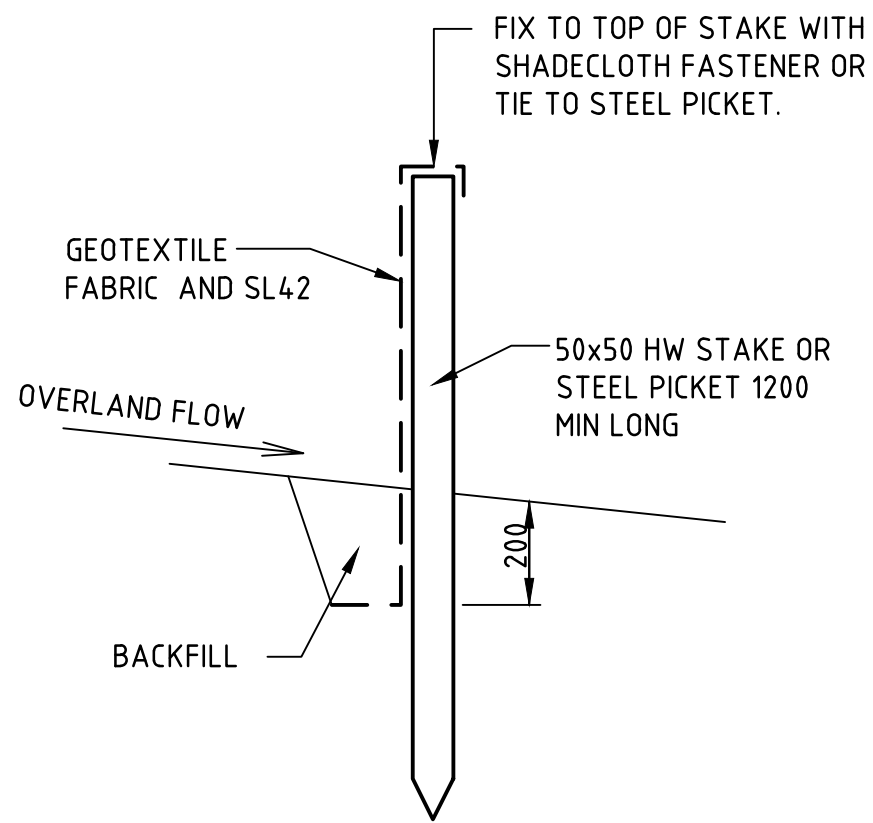
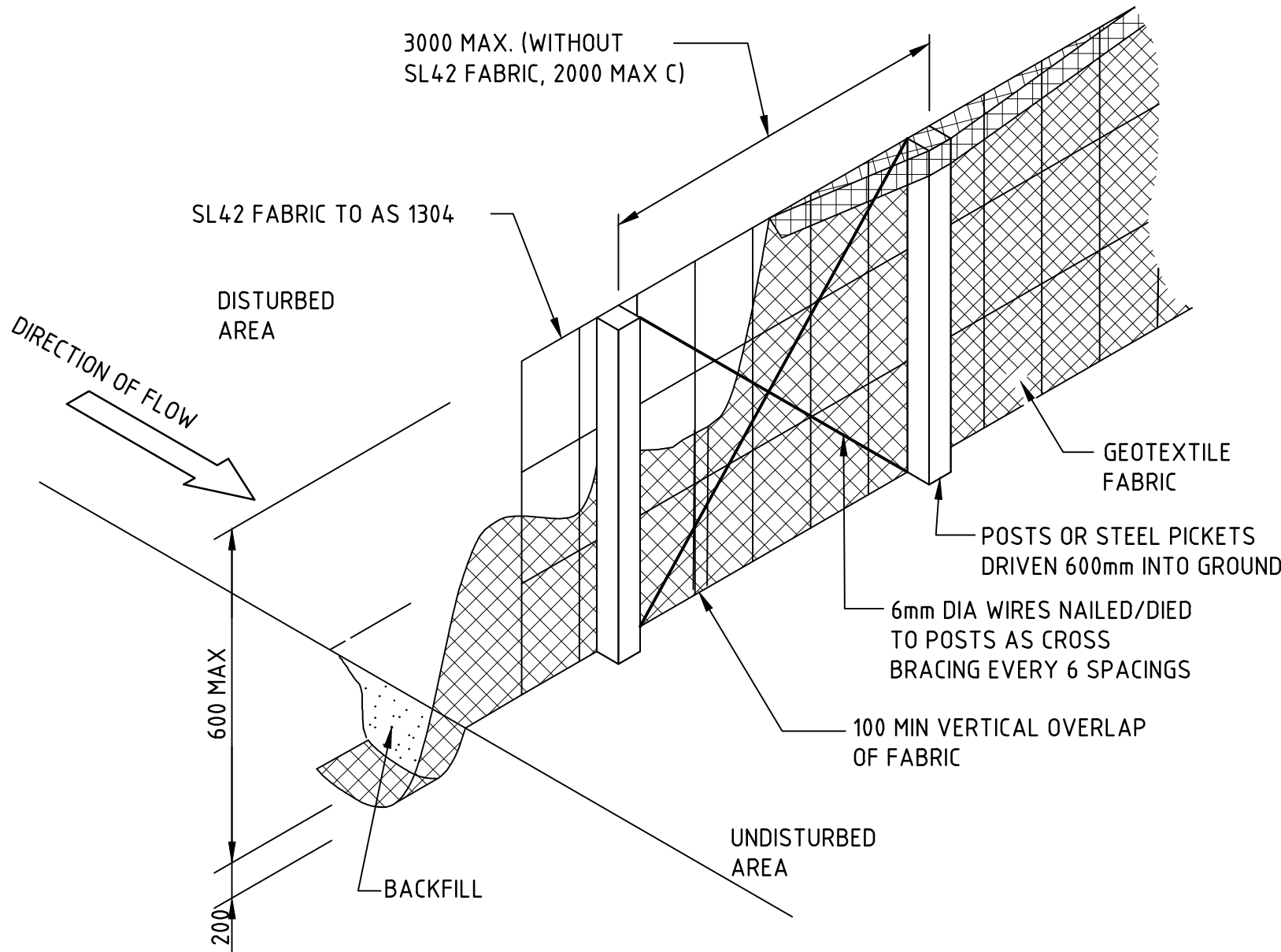
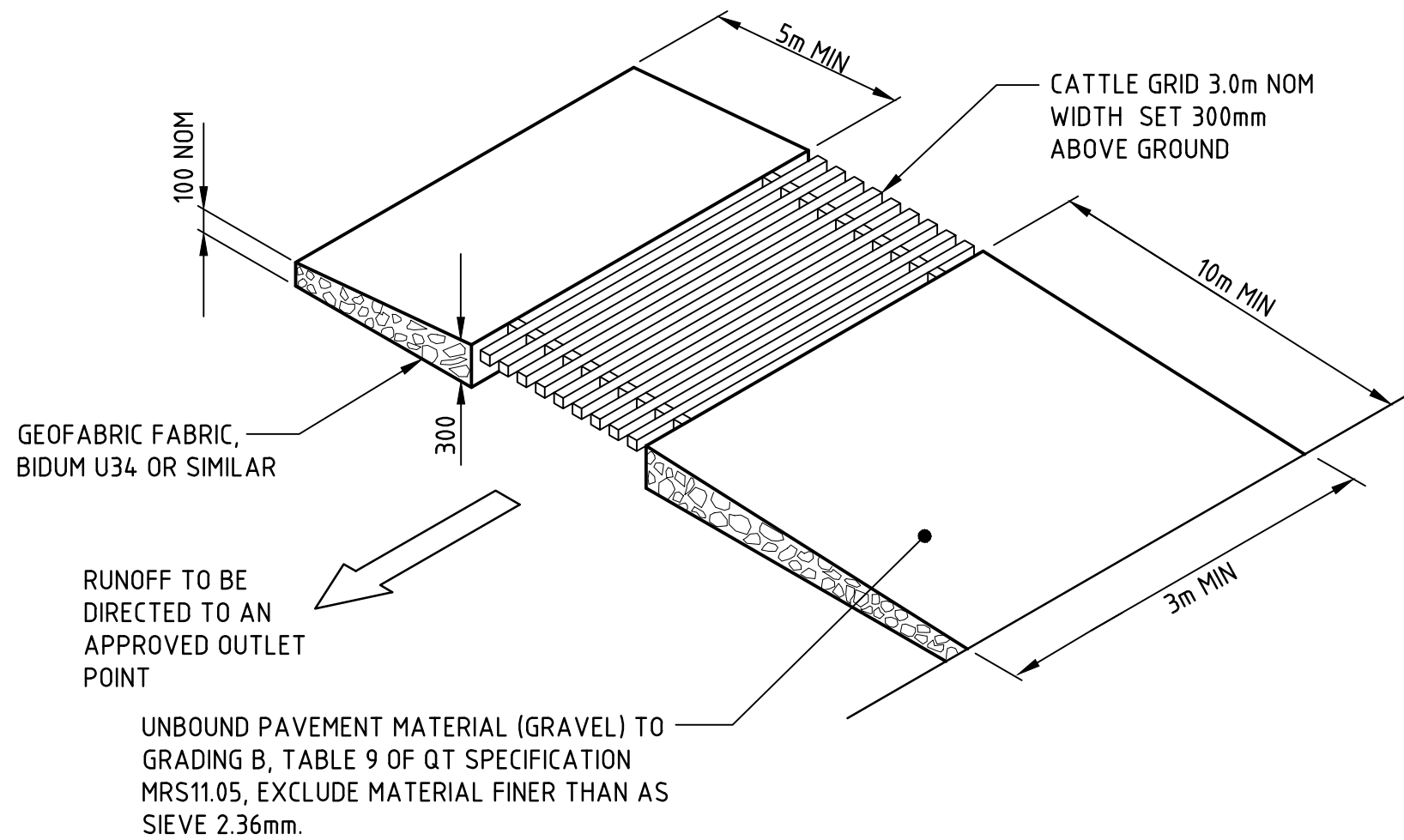
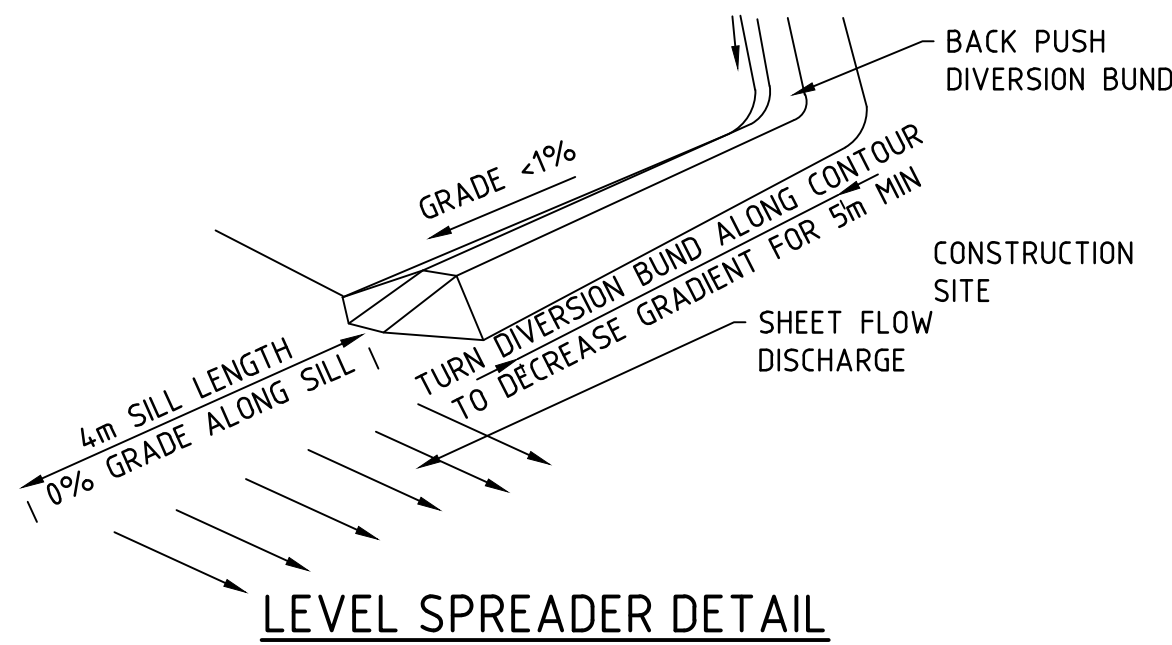


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Project Name SHERWIN CREEK DEPOSIT C ROPER RIVER, NT	Designed By MB	Checked By	Approved By
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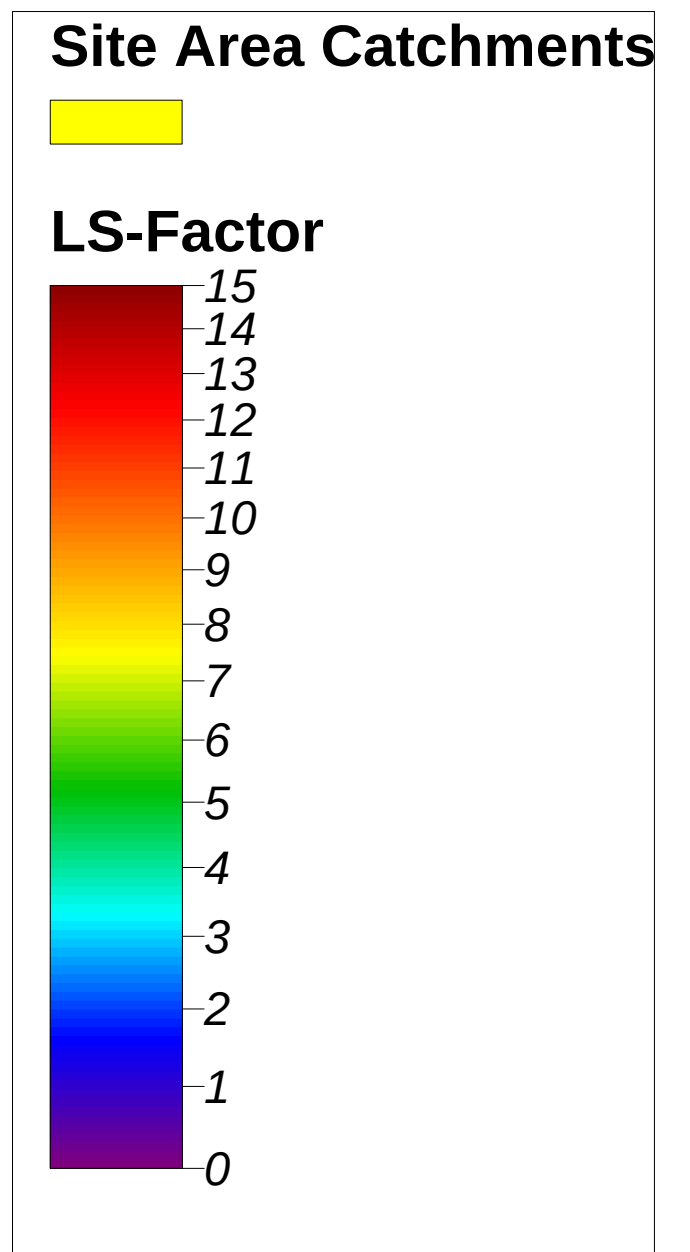
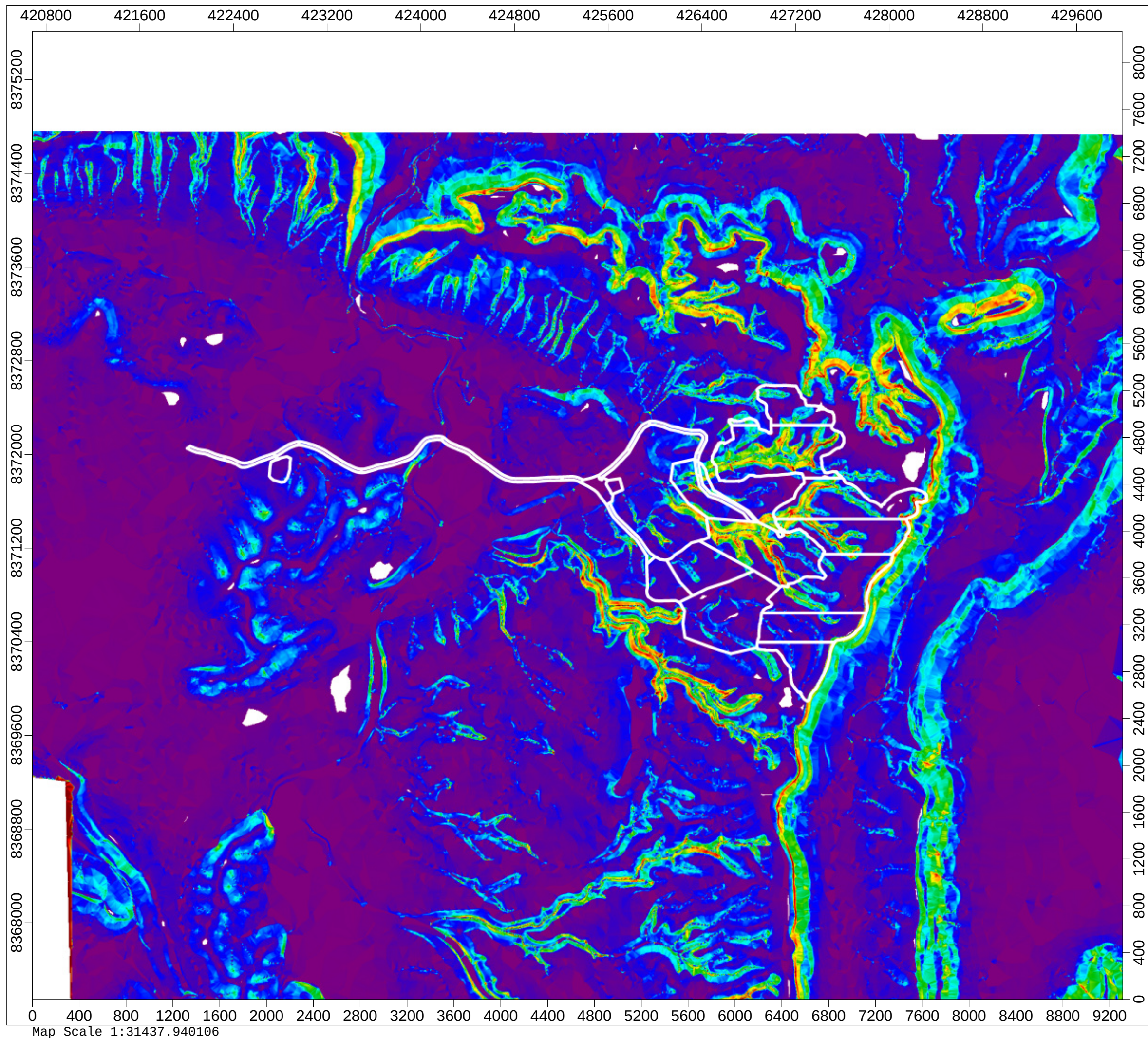


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Client: ECOZ Pty Ltd	Discipline: CIVIL	Status: PRELIMINARY	Title: EROSION AND SEDIMENT CONTROL TYPICAL SECTIONS AND DETAILS SHEET 2 OF 2
Project Name: SHERWIN CREEK DEPOSIT C ROPER RIVER, NT	Designed By: MB	Checked By:	Approved By:
	Project No. 15333	Drawn By: SW	Scale at A1: AS SHOWN
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			Revision 03

Appendix B Length Slope Calculation

LAYER	Area (ha)	Average	Number of	Min Value	Max Value	Range	Variance	Std Dev.	Q25	Q50	Q75
_ACCOM	3.05	1218	0.06	4.30	4.25	0.62	0.18	0.42	0.41	0.49	0.62
_HR1	0.96	385	0.00	0.69	0.68	0.32	0.02	0.12	0.27	0.31	0.39
_HR2	1.40	559	0.00	1.42	1.42	0.58	0.06	0.25	0.32	0.62	0.72
_HR3	0.72	290	0.00	7.62	7.62	0.68	0.47	0.69	0.43	0.50	0.79
_HR4	1.77	712	0.00	8.36	8.36	0.57	0.37	0.61	0.25	0.40	0.75
_HR5	2.33	931	0.00	1.66	1.66	0.33	0.06	0.25	0.18	0.29	0.45
_HR6	3.36	1349	0.00	1.24	1.24	0.21	0.04	0.19	0.07	0.18	0.29
_HR7	0.53	214	0.00	2.27	2.27	0.25	0.09	0.30	0.11	0.20	0.29
_CROSSINGS	3.01	1208	0.00	3.61	3.61	0.19	0.08	0.28	0.00	0.11	0.30
_MAG	1.29	513	0.00	0.92	0.92	0.25	0.03	0.16	0.15	0.22	0.34
_NHR1	1.07	433	0.00	1.93	1.93	0.21	0.05	0.21	0.14	0.16	0.20
_NHR2	0.88	348	0.00	4.66	4.66	0.49	0.17	0.41	0.21	0.48	0.64
_NHR3	1.95	781	0.00	12.10	12.10	1.25	1.06	1.03	0.71	1.08	1.50
_NHR4	0.60	242	0.72	13.37	12.64	2.40	1.92	1.39	1.02	2.48	3.22
_NHR5	1.97	786	0.00	17.66	17.66	1.69	3.16	1.78	0.70	1.11	1.84
_SHR1	2.03	811	0.00	6.79	6.79	1.31	1.01	1.00	0.71	1.08	1.52
_MIA1	9.52	3815	0.00	6.44	6.44	0.80	0.43	0.66	0.52	0.70	0.86
_MIA2	38.11	15130	0.00	10.14	10.14	0.85	0.71	0.84	0.31	0.63	1.08
_MIA3	18.22	7282	0.00	9.33	9.33	0.95	0.90	0.95	0.47	0.66	0.97
_MIA4	36.70	14675	0.00	37.43	37.43	3.78	12.90	3.59	0.72	2.47	6.44
_MINSTOCKPII	17.13	6855	0.00	22.18	22.18	2.19	4.78	2.19	0.71	1.47	2.88
_PEOY1	15.67	6302	0.00	10.92	10.92	1.40	3.22	1.80	0.46	0.95	1.50
_PEOY2	20.76	8284	0.00	17.10	17.10	1.37	2.83	1.68	0.48	0.91	1.48
_PEOY3	34.57	13804	0.00	23.10	23.10	1.75	5.95	2.44	0.25	0.77	2.22
_PEOY4	26.11	10473	0.00	22.65	22.65	2.72	10.89	3.30	0.33	1.16	4.22
_PEOY5	30.39	11992	0.00	30.52	30.52	2.92	11.13	3.34	0.39	1.52	4.56
_PEOY6	41.74	16655	0.00	36.54	36.54	3.70	9.57	3.09	1.09	3.05	5.70
_PEOY7	1.08	419	0.00	7.13	7.13	3.11	1.86	1.37	1.98	3.25	4.22
_PEOY7	15.01	5879	0.00	15.54	15.54	1.54	2.84	1.68	0.29	0.70	2.65



Appendix C RUSLE Calculations

Rainfall Erosivity (R)	15724
Cover Factor (C)	1
Practice Factor (P)	1.3

	RUSLE					
Catchment Area Reference	Nearest Test Pit	Soil Erosion Resistivity (K)	Length Slope Factor (LS)	Annual Soil Loss Rate t/ha/yr	Erosion Risk	Sediment Control Technique Type
Accomodation Camp	1	0.03	0.6	383.2	Moderate	Type 1
DSO Access Haul Road Section 1	1	0.03	0.3	198.5	Low	Type 1
DSO Access Haul Road Section 2	1	0.03	0.6	355.3	Moderate	Type 1
DSO Access Haul Road Section 3	1	0.03	0.7	416.9	Moderate	Type 1
DSO Access Haul Road Section 4	1	0.03	0.6	349.0	Moderate	Type 1
DSO Access Haul Road Section 5	2	0.04	0.3	273.0	Moderate	Type 1
DSO Access Haul Road Section 6	3	0.04	0.2	170.6	Low	Type 1
DSO Access Haul Road Section 7	3	0.04	0.3	206.8	Low	Type 1
Creek Crossing Area	3	0.04	0.2	159.3	Low	Type 1
Magazine Area	3	0.04	0.2	202.3	Low	Type 1
North Internal Haul Road 1	3	0.04	0.2	171.5	Low	Type 1
North Internal Haul Road 2	3	0.04	0.5	398.3	Moderate	Type 1
North Internal Haul Road 3	10	0.03	1.2	764.3	High	Type 1
North Internal Haul Road 4	10	0.03	2.4	1472.7	High	Type 1
North Internal Haul Road 5	4	0.03	1.7	1037.7	High	Type 1
South Internal Haul Road 1	4	0.03	1.3	800.7	High	Type 1
MIA 1	4	0.03	0.8	488.9	Moderate	Type 1
MIA 2	4	0.03	0.9	522.3	High	Type 1
MIA 3	4	0.03	0.9	580.3	High	Type 1
MIA 4	4	0.03	3.8	2321.0	Very High	Type 1
Subgrade Waste Stockpile	4	0.03	2.2	1341.8	High	Type 1
EOY1 Pit	5	0.055	1.4	1570.2	Very High	Type 1
EOY2 Pit	5	0.055	1.4	1540.7	Very High	Type 1
EOY3 Pit	7	0.03	1.7	1071.5	High	Type 1
EOY4 Pit	7	0.055	2.7	3061.2	Very High	Type 1
EOY5 Pit	8	0.055	2.9	3288.3	Very High	Type 1
EOY6 Pit	9	0.03	3.7	2267.1	Very High	Type 1
EOY7 Pit	10	0.03	1.7	1072.0	High	Type 1

Appendix D Basin Calculations

SEDIMENT BASIN DESIGN

SEDIMENT BASIN DESIGN

SEDIMENT BASIN DESIGN

Appendix E Swale Calculations

DRAIN CALCULATIONS

*Assumed d50 of 200mm and d50/d90 = 0.5

Catchment Area Reference	Design Flow Rate														Drain Sizing														
	Catchment Area (ha)	Length (km)	RL @ Top of Catchment	RL @ Catchment Outlet	Slope	Hathaway n	Mannings	Kirpich	Bransby-Williams	Kerby-Hathaway	Friends	Time of Concentration	Design Event	Design Flow Rate - Q (m3/s)	Type	W	dfull	A	B	S	Freeboard	Wfull	Area(m2)	Wetted Perimeter (m)	Hydraulic Radius (m)	Channel Lining	n	Swale Capacity (m3/s)	Swale Velocity (m/s)
Accomodation Camp	3.04	0.24	66.4	57.4	3.8%	0.15	0.035	4.6	23.8	16.5	17.8	18 mins	10 years	0.739	T3	1.8	0.5	4.0	4.0	0.5%	0.5	5.8	1.9	5.9	0.3	Rock Lined	0.080	0.8	0.4
DSO Access Haul Road Section 1	0.96	0.32	52.4	44.0	2.6%	0.15	0.035	6.8	39.0	20.8	21.2	22 mins	10 years	0.214	T2	1.2	0.4	4.0	4.0	0.5%	0.5	4.4	1.1	4.5	0.2	Rock Lined	0.100	0.3	0.3
DSO Access Haul Road Section 2	1.40	0.44	57.5	44.3	3.0%	0.15	0.035	8.1	49.7	23.2	22.8	23 mins	10 years	0.306	T1	0.8	0.4	4.0	4.0	3.0%	0.5	3.6	0.8	3.7	0.2	Rock Lined	0.100	0.5	0.6
DSO Access Haul Road Section 3	0.72	0.25	58.7	46.8	4.0%	0.15	0.035	4.7	28.6	16.7	17.9	18 mins	10 years	0.176	T1	0.8	0.4	4.0	4.0	4.0%	0.5	3.6	0.8	3.7	0.2	Rock Lined	0.100	0.5	0.7
DSO Access Haul Road Section 4	1.77	0.59	70.1	47.2	3.9%	0.15	0.035	9.2	61.5	25.0	23.8	24 mins	10 years	0.379	T1	0.8	0.4	4.0	4.0	4.0%	0.5	3.6	0.8	3.7	0.2	Rock Lined	0.100	0.5	0.7
DSO Access Haul Road Section 5	2.33	0.77	70.1	42.0	3.7%	0.15	0.035	11.6	79.3	28.7	26.4	27 mins	10 years	0.470	T1	0.8	0.4	4.0	4.0	4.0%	0.5	3.6	0.8	3.7	0.2	Rock Lined	0.100	0.5	0.7
DSO Access Haul Road Section 6	3.36	1.09	62.0	42.3	1.8%	0.15	0.035	19.9	124.6	39.9	34.1	36 mins	10 years	0.595	T2	1.2	0.4	4.0	4.0	2.0%	0.5	4.4	1.1	4.5	0.2	Rock Lined	0.100	0.6	0.6
DSO Access Haul Road Section 7	0.53	0.17	62.4	60.0	1.4%	0.15	0.035	5.1	24.1	17.6	19.2	20 mins	10 years	0.125	T1	0.8	0.4	4.0	4.0	2.0%	0.5	3.6	0.8	3.7	0.2	Rock Lined	0.100	0.4	0.5
Magazine Area	1.29	0.21	63.4	60.3	1.4%	0.15	0.035	6.2	28.3	19.7	20.8	21 mins	10 years	0.293	T1	0.8	0.4	4.0	4.0	2.0%	0.5	3.6	0.8	3.7	0.2	Rock Lined	0.100	0.4	0.5
North Internal Haul Road 1	1.07	0.36	67.2	60.2	2.0%	0.15	0.035	8.1	45.1	23.2	23.1	24 mins	10 years	0.229	T1	0.8	0.4	4.0	4.0	2.0%	0.5	3.6	0.8	3.7	0.2	Rock Lined	0.100	0.4	0.5
North Internal Haul Road 2	0.88	0.25	67.5	63.9	1.4%	0.15	0.035	7.1	34.8	21.3	22.0	23 mins	10 years	0.191	T1	0.8	0.4	4.0	4.0	2.0%	0.5	3.6	0.8	3.7	0.2	Rock Lined	0.100	0.4	0.5
North Internal Haul Road 3	1.95	0.66	108.1	65.1	4.0%	0.15	0.035	10.0	68.4	26.3	24.7	25 mins	10 years	0.409	T1	0.8	0.4	4.0	4.0	4.0%	0.5	3.6	0.8	3.7	0.2	Rock Lined	0.100	0.5	0.7
North Internal Haul Road 4	0.60	0.20	107.0	75.1	4.0%	0.15	0.035	3.9	22.9	14.9	16.5	17 mins	10 years	0.150	T1	0.8	0.4	4.0	4.0	4.0%	0.5	3.6	0.8	3.7	0.2	Rock Lined	0.100	0.5	0.7
North Internal Haul Road 5	1.97	0.59	131.4	91.6	4.0%	0.15	0.035	9.2	61.2	25.0	23.8	24 mins	10 years	0.422	T1	0.8	0.4	4.0	4.0	4.0%	0.5	3.6	0.8	3.7	0.2	Rock Lined	0.100	0.5	0.7
South Internal Haul Road 1	2.03	0.62	105.8	61.9	4.0%	0.15	0.035	9.6	64.3	25.6	24.2	25 mins	10 years	0.426	T1	0.8	0.4	4.0	4.0	4.0%	0.5	3.6	0.8	3.7	0.2	Rock Lined	0.100	0.5	0.7
MIA 1	9.52	0.50	136.0	104.9	4.0%	0.15	0.035	8.0	43.9	23.0	22.5	23 mins	10 years	2.074	T3	1.8	0.5	4.0	4.0	4.0%	0.5	5.8	1.9	5.9	0.3	Rock Lined	0.080	2.2	1.2
MIA 2	38.11	0.78	154.4	131.1	3.0%	0.15	0.035	12.6	63.2	30.3	27.6	28 mins	10 years	7.633	T5	3.0	0.8	4.0	4.0	3.0%	0.5	13.4	5.0	9.6	0.5	Rock Lined	0.060	9.2	1.9
MIA 3	18.22	0.56	139.9	108.0	4.0%	0.15	0.035	8.8	46.6	24.4	23.4	24 mins	10 years	3.896	T4	2.5	0.6	4.0	4.0	4.0%	0.5	11.3	2.9	7.4	0.4	Rock Lined	0.080	4.0	1.3
MIA 4	36.70	0.92	147.4	80.0	4.0%	0.15	0.035	12.9	71.0	30.7	27.6	28 mins	10 years	7.349	T5	3.0	0.8	4.0	4.0	4.0%	0.5	13.4	5.0	9.6	0.5	Rock Lined	0.060	10.6	2.1

DIVERSION DRAIN CALCULATIONS

*Assumed d50 of 200mm and d50/d90 = 0.5

Catchment Area Reference	Design Flow Rate					Drain Sizing														
	Catchment Area (ha)	Length (km)	Time of Concentration	Design Event	Design Flow Rate - Q (m3/s)	Type	W	dfull	A	B	S	Freeboard	Wfull	Area(m2)	Wetted Perimeter (m)	Hydraulic Radius (m)	Channel Lining	n	Swale Capacity (m3/s)	Swale Velocity (m/s)
MIA 2	9.38	0.75	15 mins	10 years	2.463	T5	3.0	0.8	4.0	4.0	0.5%	0.5	9.4	5.0	9.6	0.5	Rock Lined	0.060	3.8	0.8
North Internal Haul Road 3	10.99	0.88	15 mins	10 years	2.886	T5	3.0	0.8	4.0	4.0	0.5%	0.5	9.4	5.0	9.6	0.5	Rock Lined	0.060	3.8	0.8
North Internal Haul Road 2	1.22	0.10	15 mins	10 years	0.320	T1	0.8	0.4	4.0	4.0	4.0%	0.5	3.6	0.8	3.7	0.2	Rock Lined	0.100	0.5	0.7
North Internal Haul Road 2	0.31	0.02	15 mins	10 years	0.081	B														
North Internal Haul Road 1	2.70	0.22	15 mins	10 years	0.709	T2	1.2	0.4	4.0	4.0	4.0%	0.5	4.4	1.1	4.5	0.2	Rock Lined	0.100	0.9	0.8
South Internal Haul Road 1	1.28	0.10	14 mins	10 years	0.347	T1	0.8	0.4	4.0	4.0	4.0%	0.5	3.6	0.8	3.7	0.2	Rock Lined	0.100	0.5	0.7
South Internal Haul Road 1	0.72	0.06	11 mins	10 years	0.213	T1	0.8	0.4	4.0	4.0	2.0%	0.5	3.6	0.8	3.7	0.2	Rock Lined	0.100	0.4	0.5
DSO Access Haul Road Section 7	1.38	0.11	16 mins	10 years	0.354	T2	1.2	0.4	4.0	4.0	2.0%	0.5	4.4	1.1	4.5	0.2	Rock Lined	0.100	0.6	0.6
DSO Access Haul Road Section 6	1.09	0.09	13 mins	10 years	0.304	T2	1.2	0.4	4.0	4.0	2.0%	0.5	4.4	1.1	4.5	0.2	Rock Lined	0.100	0.6	0.6
DSO Access Haul Road Section 5	1.38	0.11	14 mins	10 years	0.373	T1	0.8	0.4	4.0	4.0	2.0%	0.5	3.6	0.8	3.7	0.2	Rock Lined	0.100	0.4	0.5
DSO Access Haul Road Section 4	2.18	0.17	19 mins	10 years	0.517	T1	0.8	0.4	4.0	4.0	2.0%	0.5	3.6	0.8	3.7	0.2	Rock Lined	0.100	0.4	0.5
DSO Access Haul Road Section 1	2.37	0.19	17 mins	10 years	0.590	T2	1.2	0.4	4.0	4.0	4.0%	0.5	4.4	1.1	4.5	0.2	Rock Lined	0.100	0.9	0.8
DSO Access Haul Road Section 2	5.57	0.45	22 mins	10 years	1.245	T3	1.8	0.5	4.0	4.0	4.0%	0.5	5.8	1.9	5.9	0.3	Rock Lined	0.080	2.2	1.2

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