Appendix 3

Sediment Dam Calculations prepared by R.W. Corkery & Co.

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1. SEDIMENT BASIN CALCULATIONS

1.1 BASIN TYPE

Based on the sediment type generated in the disturbed catchment, the basin should be designed as a Type D/F (Water Retention) Basin. These are also referred to as 'fill and spill' structures as they are designed to retain all in-flows to allow for settlement of sediment before the water is discharged after TSS of the water is reduced to criteria level (50mg/L).

1.2 CATCHMENT SIZE

Four catchments have been identified for Dowe's Quarry (see **Figure 4.8**). The effective catchments reporting to these are as follows.

- Northern Dam Catchment – 2.2ha.
- Central Dam Catchment – 1.8ha.
- Southern Dam Catchment – 0.7ha.
- Pit Catchment – 2.7ha.

Of these catchments, runoff from the Pit Catchment is assumed to be diverted back into the pit and would not be discharged. Capacity requirements for sediment basins for the remaining three catchments are required.

1.3 RAINFALL DATA

Volume 2E of the Blue Book identifies that the design rainfall event to be used to determine the sediment storage and water settlement zones as either:

- 5-day 90th percentile event for standard receiving environments; or
- 5-day 95th percentile for sensitive receiving environments.

A 'sensitive' receiving environment is defined by Volume 2E of the Blue Book as "*one that has a high conservation value, or supports human uses of water that are particularly sensitive to degraded water quality*". At this stage it is assumed that the receiving environment does not fit this definition. Therefore, the design rainfall event to be used to determine storage and settlement criteria is the **5-day 90th percentile event**.

For the Tenterfield locality, the Blue Book nominates the 5-day 90th percentile event as **47.4mm**.

1.4 EROSION DATA

1.4.1 Rainfall Erosivity (R-Factor)

The rainfall erosivity (R-factor) of a location influences the likely soil loss (erosion). Based on the maps generated by Figure 4.9 of Landcom (2004), the site has a moderate R-Factor of 1900.

1.4.2 Erodibility (K) Factor

A conservative K-factor of **0.05** is adopted in line with the recommendations of Volume 2E of the Blue Book.

1.4.3 Length / Gradient (LS) Factor

The local topography is generally 3:1 (H:V) (~30%), with the length of slopes within each catchment generally between 60m and 80m. There is currently no plan to bench these slopes to modify the LS Factor. The following slope lengths, gradients and LS Factors have been calculated for the three catchments.

- Northern Dam Catchment: gradient = 30%, length = 80m – LS Factor = 11.6.
- Central Dam Catchment: gradient = 16%, length = 75m – LS Factor = 5.26.
- Southern Dam Catchment: gradient = 30%, length = 60m – LS Factor = 9.23.

1.5 SOIL HYDROLOGIC GROUP AND RUNOFF COEFFICIENTS

For cleared catchments, i.e. those without significant vegetation or other cover likely to slow the flow of water and reduce runoff, the runoff coefficient is largely a factor of the permeability and saturation of the soil or surface. *Appendix F* of Landcom (2004) identifies four Soil Hydrologic Groups, derived by USDA (1993) through consideration of infiltration and permeability characteristics.

- Group A: very low runoff potential. Water moves into and through these soil materials relatively quickly, when thoroughly wetted. Usually, they consist of deep (>1.0m), well-drained sandy loams, sands or gravels. They shed runoff only in extreme storm events.
- Group B: low to moderate runoff potential. Water moves into and through these soil materials at a moderate rate when thoroughly wetted. Usually, they consist of moderately deep (>0.5m), well-drained soils with medium, loamy textures or clay loams with moderate structure. They shed runoff only infrequently.
- Group C: moderate to high runoff potential. Water moves into and through these soil materials at slow to moderate rates when thoroughly wetted. Usually, they consist of soils that have:
  - moderately fine (clay loam) to fine (clay) texture;
  - weak to moderate structure; and/or
  - a layer near the surface that impedes free downward movement of water.

  They regularly shed runoff from moderate rainfall events.

- Group D: very high runoff potential. Water moves into and through these soils very slowly when thoroughly wetted. Usually, they consist of soils:
  - that are fine-textured (clay), poorly structured, surface-sealed or have high shrink/swell properties, and/or
  - with a permanent high water table, and/or
  - with a layer near the surface that is nearly impervious.

  They shed runoff from most rainfall events.

Considering the three catchments for which sediment basins are required, the Northern and Southern Dam Catchments are considered most likely representative of Soil Hydrologic Group C given the stockpiling of clay materials within these catchments. Based on the predominantly hardstand surface of the Central Dam Catchment, this is considered most likely representative of Soil Hydrologic Group D.

With reference to *Table F2* of the Blue Book, the volumetric runoff coefficient (C_v) for the 5-day 90th percentile rainfall event for the three catchments will be as follows.

- Northern Dam Catchment – 0.58 (58% of rainfall accumulates as runoff).
- Central Dam Catchment – 0.69 (69% of rainfall accumulates as runoff).
- Southern Dam Catchment – 0.58 (58% of rainfall accumulates as runoff).

1.6 SETTLEMENT AND STORAGE VOLUME REQUIREMENTS

Considering the likely volume of runoff and sediment load under a 5-day 90th percentile rainfall event, **Table A** provides the minimum water settlement and sediment storage zone requirements for the two sediment basins.

Table A
Settlement and Storage Volume Requirements

Basin	Water Settlement Zone (m^3)	Sediment Storage Zone (m^3)	Total (m^3)
Northern Dam	605	412	1 017
Central Dam	589	153	742
Southern Dam	192	104	296

The work sheets used estimate these minimum capacities are provided as **Attachment 1**.

1.7 ADDITIONAL CONSTRAINTS / COMMENTS

The sediment dam calculation worksheets identify that the potential soil loss rate (t/ha/year) within each of the three catchments is relatively high as a result of the moderate rainfall erosivity (R-factor), elevated erosivity (K-factor) and elevated length to gradient ratio (LS-factor) of the landform within each catchment.

The Soil Loss Class is subsequently elevated (Class 5 and 6) which indicates that any soil and water management plan will either require restriction on when clearing may be undertaken (refer to *Table 4.3* of Landcom, 2004) or implementation of special erosion control measures. Alternatively, the LS factor may be modified, e.g. by restricting the length of slope disturbed, benching the recreated landform, or increasing the slope of the recreated landform, to reduce the soil loss and soil loss class.

The Environment Protection Authority is almost certainly likely to require the preparation of:

- An Erosion and Sediment Control Plan; and
- Stormwater Management Scheme.

These will present the design, management and maintenance specifications for the soil and water management at the quarry.

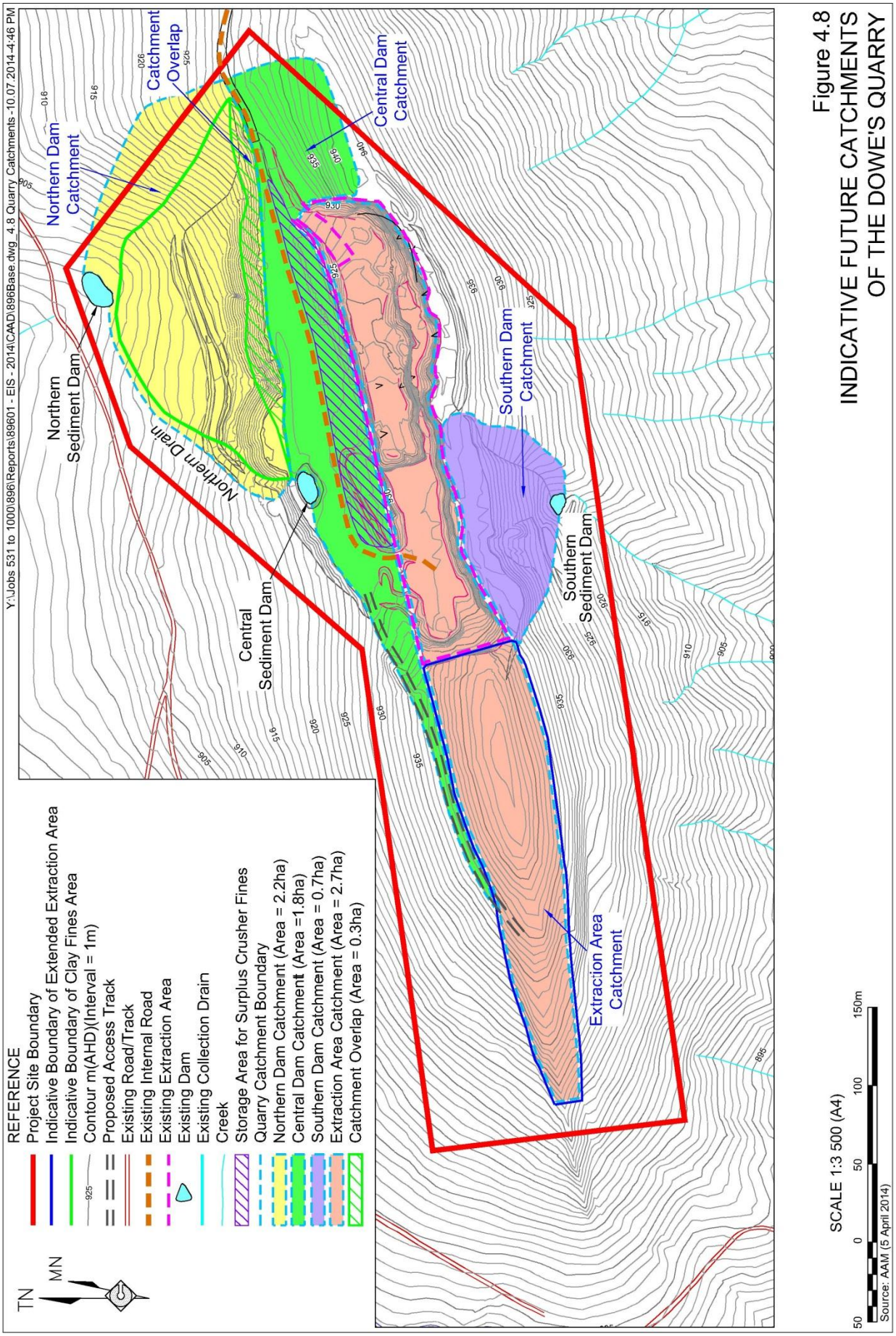

Figure 4.8
INDICATIVE FUTURE CATCHMENTS
OF THE DOWE'S QUARRY

Note: These "Detailed Calculation" spreadsheets relate only to high erosion hazard lands as identified in figure 4.6 or where the designer chooses to use the RUSLE to size sediment basins. The "Standard Calculation" spreadsheets should be used on low erosion hazard lands as identified by figure 4.6 and where the designer chooses not to run the RUSLE in calculations.

1. Site Data Sheet

Site Name: **Dowes Quarry**

Site Location: **Mount Lindsey Road, Tenterfield**

Precinct:

Description of Site: **Sediment Basins**

Site area	Sub-catchments						Remarks
	NSD	CSD	SSD				
Total catchment area (ha)	2.2	1.8	0.7				
Disturbed catchment area (ha)	2.2	1.8	0.7				

Soil analysis (enter sediment type if known, or laboratory particle size data)

Sediment Type (C, F or D) if known:	F	D	D				From Appendix C
% sand (fraction 0.02 to 2.00 mm)							Soil texture should be assessed through
% silt (fraction 0.002 to 0.02 mm)							mechanical dispersion only. Dispersing
% clay (fraction finer than 0.002 mm)							agents (e.g. Calgon) should not be used
Dispersion percentage							E.g. enter 10 for dispersion of 10%
% of whole soil dispersible							See Section 6.3.3(e). Auto-calculated
Soil Texture Group	F	D	D				Automatic calculation from above

Rainfall data

Design rainfall depth (days)	5	5	5				See Sections 6.3.4 (d) and (e)
Design rainfall depth (percentile)	90	90	90				See Sections 6.3.4 (f) and (g)
x-day, y-percentile rainfall event	47.4	47.4	47.4				See Section 6.3.4 (h)
Rainfall R-factor (if known)	1900	1900	1900				See Appendix B
IFD: 2-year, 6-hour storm (if known)	8.98	8.98	8.98				See IFD chart for the site

RUSLE Factors

Rainfall erosivity (*R*-factor)	1900	1900	1900				Auto-filled from above
Soil erodibility (*K*-factor)	0.05	0.05	0.05				
Slope length (m)	80	75	60				
Slope gradient (%)	30	16	30				RUSLE LS factor calculated for a high
Length/gradient (*LS*-factor)	11.60	5.26	9.23				rill/interrill ratio.
Erosion control practice (*P*-factor)	1.3	1.3	1.3	1.3	1.3	1.3	
Ground cover (*C*-factor)	1	1	1	1	1	1	

Calculations

Soil loss (t/ha/yr)	1432	650	1140				
Soil Loss Class	6	5	6				See Section 4.4.2(b)
Soil loss (m^3/ha/yr)	1102	500	877				
Sediment basin storage volume, m^3	412	153	104				See Sections 6.3.4(i) and 6.3.5 (e)

4. Volume of Sediment Basins, *Type D* and *Type F* Soils

Basin volume = settling zone volume + sediment storage zone volume

Settling Zone Volume

The settling zone volume for *Type F* and *Type D* soils is calculated to provide capacity to contain all runoff expected from up to the y-percentile rainfall event. The volume of the basin's settling zone (V) can be determined as a function of the basin's surface area and depth to allow for particles to settle and can be determined by the following equation:

$V = 10 \times C_v \times A \times R_{x\text{-day, y-\%ile}}$ (m^3)

where:

10 = a unit conversion factor

C_v = the volumetric runoff coefficient defined as that portion of rainfall that runs off as stormwater over the x-day period

$R_{x\text{-day, y-\%ile}}$ = is the x-day total rainfall depth (mm) that is not exceeded in y percent of rainfall events. (See Sections 6.3.4(d), (e), (f), (g) and (h)).

A = total catchment area (ha)

Sediment Storage Zone Volume

In the detailed calculation on Soil Loss Classes 1 to 4 lands, the sediment storage zone can be taken as 50 percent of the settling zone capacity. Alternately designers can design the zone to store the 2-month soil loss as calculated by the RUSLE (Section 6.3.4(i)(ii)). However, on Soil Loss Classes 5, 6 and 7 lands, the zone must contain the 2-month soil loss as calculated by the RUSLE (Section 6.3.4(i)(iii).

Place an "X" in the box below to show the sediment storage zone design parameters used here:

	50% of settling zone capacity,
X	2 months soil loss calculated by RUSLE

Total Basin Volume

Site	C_v	$R_{x\text{-day, y-\%ile}}$	Total catchment area (ha)	Settling zone volume (m^3)	Sediment storage volume (m^3)	Total basin volume (m^3)
NSD	0.58	47.4	2.2	604.824	412	1016.824
CSD	0.69	47.4	1.8	588.708	153	741.708
SSD	0.58	47.4	0.7	192.444	104	296.444
	0.58					
	0.58					

Note that designers should achieve a minimum 3:1 length:width ratio in Type D or F basins

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