Sediment Basin Design Options A and B

The Waterfall Way Upgrade: Erosion and Sediment Control

quality solutions sustainable future

Sediment Basin Design Options A and B

The Waterfall Way Upgrade: Erosion and Sediment Control

Prepared for: NSW Roads and Maritime Services

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Introduction

1.1 Background

GeoLINK has been engaged by the NSW Roads and Maritime Service (RMS) to provide erosion and sedimentation advice and support for works associated with the upgrade of the Waterfall Way (Main Road 76).

RMS proposes to realign the Waterfall Way between the Raleigh Interchange at the Pacific Highway and Connells Creek. The realignment would be approximately 3.1 km in length.

The section of the Waterfall Way under investigation commences west of the previously upgraded intersection with the Pacific Highway. Parts of this section of the Waterfall Way exhibit poor horizontal and vertical alignment, include a number of substandard corners and substandard pavement, and are subject to flood inundation.

Two concept designs for upgrading the Waterfall Way have been prepared:

- realignment to provide a design speed of 70 km/h – referred to as Option A; and
- realignment to provide a design speed of 80 km/h – referred to as Option B.

1.2 Objectives

Overall, the aim is to provide a project in harmony with the natural and social environment that meets current design standards and future growth predictions.

The objective of this report is to determine the size and location of sediment retention basins required for the construction period of the project, taking into consideration the existing topography and that of the proposed alignment options. The sizes and locations of sediment retention basins presented in this report are based on the road upgrade concept designs as at November 2012. It is likely that the road upgrade designs will be refined in the future, which may trigger the need to also refine the sizes and locations of the sediment retention basins.

Details and design of other erosion and sedimentation controls do not form part of this report, nor do specific details of sediment retention basins, such as outlet structure design, landscaping, vegetation specification and maintenance. These items will be covered in full in a subsequent report, once the design option has been selected and confirmed.

1.3 Site Characteristics

1.3.1 The Waterfall Way

The Waterfall Way between the Pacific Highway and Bellingen connects the Coffs Harbour area with some of its commuter towns. It is also a strategic link from the Mid-North Coast to the Northern Tablelands towns of Dorrigo, Armidale and beyond. Approximately 6,500 vehicles use this section of road as it is a primary commuter, freight and tourist route. The speed limit in the project area ranges from 60 km/h on the eastern end to 100 km/h at the west with the majority of the link being zoned as 80 km/h with relatively long straights and adjoining short arc compound curves either side of the Short Cut Road intersection and Cameron's Corner. The road reserve is narrow; typically 20 m wide and will require strip acquisition to achieve acceptable standards.

The study area on Waterfall Way consists of a 3.1 km length of road, lying to the south of the Bellinger River. The western portion of the site (approximately 1.1 km of road length) has an elevation of 5 to 12 m Australian

Height Datum (AHD) and lies within the Bellinger River Floodplain. The elevation of the eastern portion of the site ranges from 12 to 29 m AHD and is not on floodplain terrain.

Cameron's Corner and the straight to the west are subject to flooding from the Bellinger River. The project will provide a 1 in 5 year minimum flood immunity at Camerons Corner.

In parts, the existing pavement is in very poor condition and consists of two 3.2 m travel lanes with little or no shoulders. Parts of the eastern segment of the Waterfall Way are very rough and narrow with poorly aligned curves and badly worn pavement. The middle section of the proposed upgrading works is poorly aligned and narrow, and the intersection of Short Cut Road has visibility constraints. At the western end, Cameron's Corner incorporates poor alignment with a tight compound curve at the end of a long straight (east-bound lane) at the end of a 100 km/h section. This area is also subject to flooding and subsequent road closure on average once every two years.

1.3.2 Landform, Geology and Soils

The study area is located within an area of low hills, elevated landforms and low lying alluvial floodplains with long, narrow curved fluvial levees, interspersed with flat to gently inclined swampy floodplains at the western end of the study area. The slope of the land varies from approximately 0% in the vicinity of Cameron's Corner to in excess of 30% in the vicinity of the intersection with Short Cut Road.

A disused water supply dam (referred to as the Raleigh Dam) with a surface area of about 5000m^2, is located on the south-eastern side of the existing alignment and about 300 metres east of the intersection with Short Cut Road.

Soils within the study area consist of deep and moderately well-drained to poorly-drained alluvial clays, earthy sands, alluvial loams, yellow podzolic soils, and gleyed podzolic soils. Soils within the wetland areas (swampy floodplain) are very soft. Limitations of these soils include strong acidity, low wet bearing strength, high aluminium toxicity potential, high localised acid sulfate potential, localised salinity, high localised sodicity and extreme localised subsoil erodibility.

The land within the study area traverses several different soil landscapes, described by Milford (1999) as Pine Creek, Charlmont, Gleniffer and Raleigh (refer to **Illustration 1.1**).

The Pine Creek soil landscape occurs within the eastern portion of the site and is generally associated with elevated parts of the study area. This soil landscape is an erosional landscape. Soils are deep, moderately well-drained structure Brown Earths and Yellow Earths on crests and slopes, with moderately well-drained Brown Podzolic Soils and Yellow Podzolic soils on steeper slopes. These soils are strongly to very strongly acid, with moderately low fertility, high aluminium toxicity, high topsoil organic matter, low topsoils / shallow subsoil wet bearing strength and slow subsoil permeability. Additional limitations include high erosion hazard, high run-on and steep slopes.

The Charlmont soil landscape is a swamp landscape, dominated by broad, flat to gently inclined, occasionally elongated swampy floodplains and backplains along lower intertidal reaches of the Bellinger River. This soil landscape traverses the study area at Cameron's Corner. Slopes are less than 2% with elevations of less than 10 m AHD. Soils within this landscape are deep, poorly drained Yellow Podzolic Soils, structure plastic clays and Gleyed Podzolic Soils. These soils are strongly to extremely acid, sodic, saline soils with high aluminium toxicity potential, high organic matter, low to very low wet bearing strength and slow subsoil permeability. Additional limitations include flood hazard, waterlogging, permanently high watertable, high to severe foundation hazard and high to severe acid sulfate soil hazard (Milford1999).

The Raleigh soil landscape is an alluvial landscape dominated by long, narrow curved fluvial levees and scrolls on the meander plain of the tidal Bellinger River. This soil landscape is located generally to the north of Waterfall Way within the western 1 km of the study area. Slopes are generally less than 2% with elevations of less than 10m AHD. Soils are deep, moderately well-drained to poorly drained Earthy Sands, alluvial loams, alluvial clays, Yellow Podzolic Soils and Gleyed Podzolic Soils. These soils are strongly acid soils with high aluminium toxicity potential, low to very low wet bearing strength, high erodibility and low subsoil fertility. Additional limitations include high water erosion hazard, flood hazard, seasonal waterlogging and foundation hazard (Milford1999).

The Gleniffer soil landscape is also an alluvial landscape, dominated by level to undulating alluvial terraces in the Bellinger and Orara Valleys. This soil landscape is found in two smaller portions of the study area, at Cameron's Corner, and adjacent to Connells Creek. Slopes are 0-10%, with elevations 10 to 30 m AHD. Soils are deep well-drained structured Red Earths in the Bellinger Valley. These soils are strongly acidic, with low wet bearing strength, low subsoil fertility, high aluminium toxicity potential, very high subsoil erodibility, high foundation hazard and water erosion hazard (Milford1999).

Acid sulfate risk maps produced by Department of Land and Water Conservation have shown the low lying wetland area within the study area as having a high risk occurrence of acid sulfate soils

1.3.3 Climate

The climate of the area is warm in summer and cool in winter. Average annual rainfall is between 1,500 mm to 1,700 mm. The highest average monthly rainfall (approximately 240 mm) occurs in March and the lowest average monthly rainfall (approximately 65 mm) occurs in September.

1.4 Description of Works

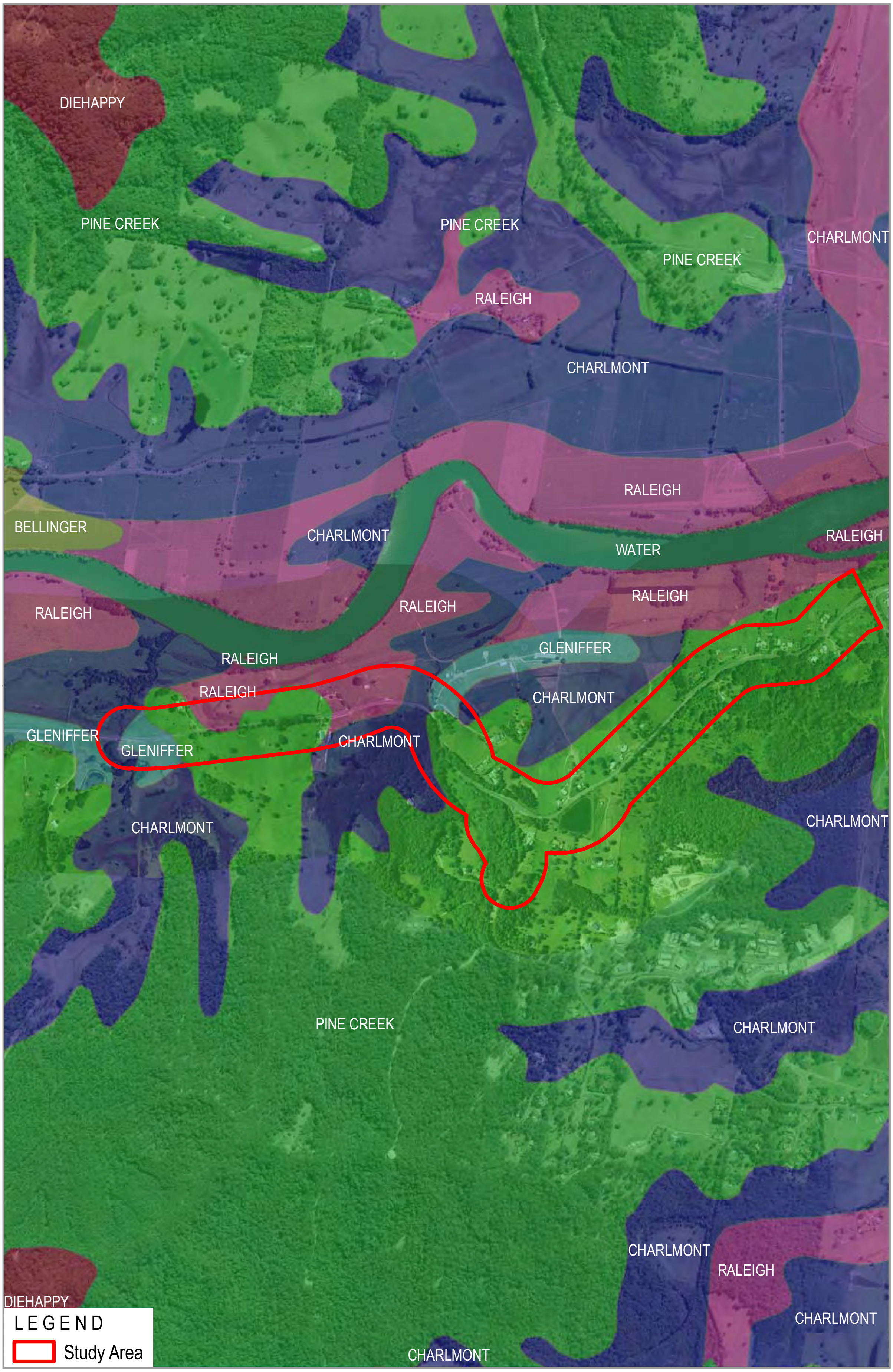
Works are anticipated to include:

- minor realignment of the substandard horizontal sections and regrading of vertical curves;
- reconstruction of the entire pavement;
- widening the road formation to current RMS standard, i.e. 3.5 m lanes, 2.0 m sealed shoulders and 0.5 m verges;
- improvements to the Short Cut Road intersection;
- installation of line marking, signage, safety barriers and other road furniture;
- upgrading of the surface drainage where necessary;
- utility and property adjustments; and
- private access adjustments.

Drawn by: AMM Checked by: TIM Reviewed by: SJW Date: February '12

Information shown is for illustrative purposes only

Source of base data: NSW Roads and Traffic Authority and Department of Land and Water Conservation



Soil Landscapes

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Illustration 1.1

2

Sediment Basin Design

2.1 Description of Options

Two options have been identified for upgrading the Waterfall Way. The realignment for both options commences approximately 400 m from the existing roundabout at the Pacific Highway. Option A has tighter horizontal curves than Option B. Earthworks for both options include similar provisions to maintain property accesses along the route.

The two options begin by following the existing alignment, with the first low point is at approximately chainage 870 and the first highpoint for both alignment options, matching the highpoint of the existing road, at chainage 992. The second low point also coincides with the existing topography, occurring at about chainage 1210. Both alignment options gradually deviate to the south with similar horizontal and vertical alignments until about chainage 1400. At this point, both options are wholly outside the existing carriageway area and the majority of the proposed cross sections for options A and B are above the level existing surface, resulting in a large quantity of fill being required to complete the project.

From here, the two options begin to differ more significantly. The table below lists the high and low points proposed for each option:

Table 2.1 Vertical Alignment High and Low Points

Option A		Option B	
Low Points	High Points	Low Points	High Points
CH 870	CH 992	CH 866	CH 992
CH 1207	CH 1400 - 1660	CH 1210	CH 1400-1740
CH 2440	CH 2870	CH 2400 - 2600	CH 2845
CH 3098	CH 3212	CH 3073	CH 3184
CH 3359	CH 3398	CH 3330	CH 3378
CH 3515 (end)		CH 3490 (end)	

2.2 Potential Impacts

The potential impacts of the works described above in terms of erosion and sedimentation are similar for both design options. These include:

- exposure of soils to erosion hazards through excavation works, vegetation removal, the extension of existing culverts within the drainage channels, construction of a large culvert at Cameron's Corner, as well as stockpiling and respreading of topsoil;
- working in close proximity to sensitive watercourses and wetlands causing pollution;
- the disturbance of soils near the existing drainage channel and within the Melaleuca wetland, potentially causing sedimentation downstream; and
- temporary works, including sidetracks, site compounds and stockpile sites.

2.3 Performance Criteria

All erosion and sediment controls are to be deisgned, installed and maintained in accordance with Managing Urban Stormwater: Soils and Construction Volume 1 (*The Blue Book*), (Landcom, 2004) and Volume 2D (DECC, 2008).

2.4 Sediment Retention Basins

2.4.1 General Design Principals

In NSW, the design of erosion and sediment control measures, including sediment retention basins, is specified by Managing Urban Stormwater: Soils and Construction Vol. 1 4th Ed. (*The Blue Book*) (Landcom, 2004). This document specifies several minimum and desirable design features which have been incorporated into the design wherever possible.

To provide hydraulic efficiency, *The Blue Book* states that the length to width ratio of basins should be 3:1 as a minimum, but desirably 5:1. In situations where this is not possible, baffles should be installed to increase the distance between the inlet and outlet and reduce the opportunity for short-circuiting.

A minimum depth of 1.5 m is specified, along with 750 mm of freeboard, internal batters of 2(h):1(v) and external batters of 3(h):1(v) (see **Illustration 2.1**). The invert of the primary outlet should be located at least 300 mm below the level of the spillway.

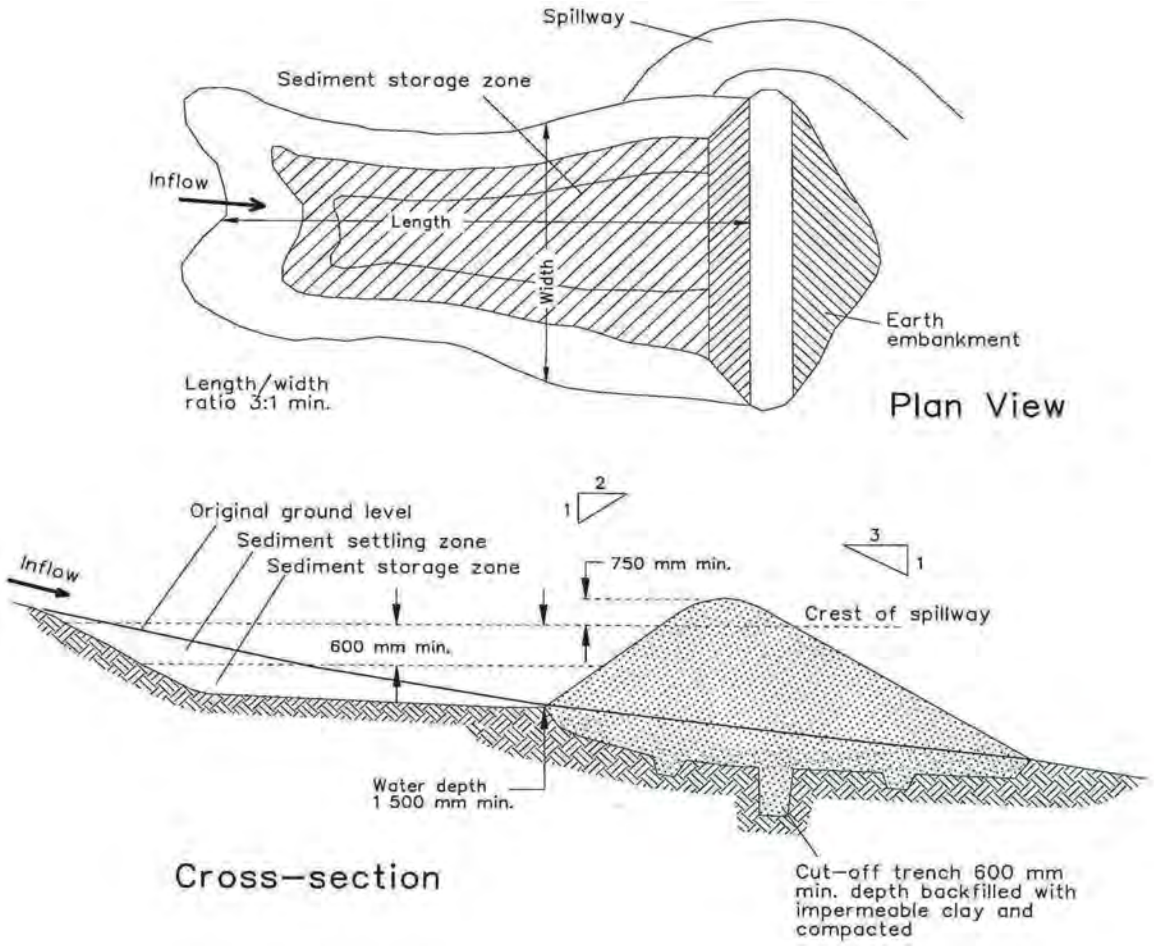
Access to the basins must be provided, especially to allow for maintenance including dredging of collected sediment from the basins. In most cases, a 3 m wide crest has been provided to allow a small excavator to track the perimeter of the basins. On flatter land, where space was in short supply, this width has been reduced.

2.4.2 Location

The design and construction of sediment retention basins will allow for the detention of stormwater runoff providing adequate time for sedimentation of suspended matter to occur before the water is discharged into downstream environments. Flocculation may be required to facilitate the settling of fine or dispersible soil particles. Sediment retention basins need to have sufficient available volume to provide a settling zone volume and sediment storage volume determined in accordance with *The Blue Book*.

Illustrations 2.2 and **2.3** show the different catchment areas for each option. Note that in order to minimise volumes of runoff captured, 'clean' water run on from upstream undisturbed areas will need to be redirected via clean water diversion drains. The basins have been designed on the assumption that clean water diversions will be implemented.

Each catchment is expected to meet *The Blue Book's* recommendation for sediment basin construction, whereby the average annual soil loss from the total area of land disturbance is estimated to be greater than 150 cubic metres per year. Thus it is anticipated that the catchments will produce a sufficient volume of sediment-laden runoff to warrant a sediment retention basin. These basins are to be located such that they can capture as much runoff from the catchment as possible, taking into consideration existing topography and design levels for the inlet and outlet of the basins.



Construction Notes

1. Remove all vegetation and topsoil from under the dam wall and from within the storage area.
2. Construct a cut-off trench 500 mm deep and 1,200 mm wide along the centreline of the embankment extending to a point on the gully wall level with the riser crest.
3. Maintain the trench free of water and recompact the materials with equipment as specified in the SWMP to 95 per cent Standard Proctor Density.
4. Select fill following the SWMP that is free of roots, wood, rock, large stone or foreign material.
5. Prepare the site under the embankment by ripping to at least 100 mm to help bond compacted fill to the existing substrate.
6. Spread the fill in 100 mm to 150 mm layers and compact it at optimum moisture content following the SWMP.
7. Construct the emergency spillway.
8. Rehabilitate the structure following the SWMP.

EARTH BASIN - WET

(APPLIES TO 'TYPE D' AND 'TYPE F' SOILS ONLY)

SD 6-4

Sediment Basin

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Drawn by: MVE Checked by: DMT Reviewed by: DMT Date: November 2012
Source of base data: NSW Roads and Maritime Service

North

0 150

Option A - Catchments

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Illustration 2.2

Drawn by: MVE Checked by: DMT Reviewed by: DMT Date: November 2012
Source of base data: NSW Roads and Maritime Service

Option B - Catchments

Illustration 2.3

The location of property boundaries is another important consideration, given that the road reserve is narrow and bounded by private properties. Wherever possible, sediment basins have been located so as to minimise encroachment onto private land.

2.4.3 Sizing

Table 6.1 in Volume 2D of *Managing Urban Stormwater* (DECC, 2008) states that for a main road construction site with an expected operational life between six months and three years, operating upstream of a 'sensitive' receiving environment, designing for a five day 85th percentile rainfall depth would be appropriate. Thus, these sediment basins should be drained or pumped out within five days following rainfall of sufficient depth to produce runoff entering the basin. The indicative average annual sediment basin overflow frequency for the 85th percentile design storm event is between 4 and 6 spills per year.

Table 6.1 (DECC, 2008) specifies that the embankments and spillways of the sediment basins shall be designed to remain structurally sound in storm events up to and including the 1 in 50 year average recurrence interval (ARI) design event where the duration of disturbance is less than one year, and 1 in 100 year ARI where the duration of disturbance is between one and three years. It also states that temporary sediment and erosion controls such as diversion banks, catch drains, check dams and sediment fences, shall be designed to remain structurally sound and have a non-erosive hydraulic capacity to convey runoff generated from storms events up to and including the 1 in 10 year ARI and 1 in 20 year ARI for areas with expected duration of disturbance less than 1 year and between one and three years respectively.

The volume of the sediment retention basins must be sufficient to hold the stormwater runoff volume from a five-day 85th percentile rainfall event and thus allow sediment to settle out and be retained. More extreme storm events will result in overtopping of the basins via a spillway (to be designed at a later stage).

After each rainfall event, the water in the basin can be used for dust control or irrigation of any revegetated parts of the site. Any excess water retained in the basin that cannot be used will be released downstream once the water quality complies with the prescribed criteria under the EPL.

As mentioned previously, there are four soil landscapes through which the proposed road upgrade works pass. These are Pine Creek, Charlmont, Gleniffer and Raleigh. Appendix C of *The Blue Book* lists various characteristics of the different soil landscapes across NSW. Soils within these landscapes are listed as having sediment types F and D (fine and dispersive, respectively). They are also expected to be within the B and C soil hydrological groups, meaning that they have a low to moderate or moderate to high run off potential. For the purpose of design, the calculations outlined in this report have taken the worst case in each instance (i.e. Type D soils and type C soil hydrological group).

As outlined in *The Blue Book*, the formula for calculating the required settling zone volume for Type D soils is as follows:

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

Where
C_v = volumetric runoff co-efficient
$R_{-\%ile,\ x\ day}$ = is the x-day total rainfall depth (mm) that is not exceeded in y percent of rainfall events
A = total catchment area (ha)

Table 6.3a in *The Blue Book* lists data for $R_{-\%ile,\ x\ day}$. The closest location to the site that is listed in that table is Coffs Harbour, for which the five day 85th percentile rainfall depth is 55.8 mm. Appendix F of *The Blue Book* indicates that for the 55.8 mm rainfall and the Soil Hydrologic Group C (moderate to high runoff potential) the volumetric runoff coefficient would be 0.63.

An additional sediment storage zone needs to be provided below the settling zone to store at least the estimated two month sediment yield from the catchment.

The revised universal soil loss equation (RUSLE) is designed to predict the long term, average, annual soil loss from sheet and rill flow at nominated sites under specific management conditions.

Using RUSLE to predict the soil loss allows the sediment storage zone of the sediment retention basin to be sized. As per *The Blue Book*, the RUSLE equation is represented by:

A = R x K x LS x P x C

Where
A = computed soil loss (tonnes/ha/year)
R = rainfall erosivity factor
K = soil erodibility factor
LS = slope length / gradient factor
P = erosion control practice factor
C = ground cover and management factor

The soil erodibility factor, or 'K' factor, used in the following calculations has been selected by taking a weighted average of the listed factors for each soil landscape, based on the soil landscape mapping (see Illustration 3.1). The sediment retention basin is required to store the predicted two-month accumulated soil loss, such that:

$V_{storage}$ = 0.17 x B x Total disturbed area

Where
B = computed soil loss (m^3/ha/year)

Markers can be used to indicate the design sediment storage capacity and trigger the need for cleaning.

Tables 2.2 and **2.3** below show the parameters used to calculate the settling and storage volumes required for the sediment retention basins within each catchment for Option A and Option B respectively.

Table 2.2 Option A Sediment Basin Design Parameters

OPTION A	Catchment							
	C1	C2	C3a	C3b	C4a	C4b	C5	C6
Total catchment area (ha)	0.67	1.00	3.45	0.38	0.99	2.27	0.87	0.6
Disturbed area (ha)	0.67	0.77	2.23	0.38	0.63	2.27	0.69	0.6
Sediment Type (C, F or D)	D	D	D	D	D	D	D	D
Soil Hydrological Group	C	C	C	C	C	C	C	C
Design rainfall depth (days), x	5	5	5	5	5	5	5	5
Design rainfall depth (%ile), y	85	85	85	85	85	85	85	85
x-day, y-%ile rainfall event	55.8	55.8	55.8	55.8	55.8	55.8	55.8	55.8
Rainfall erosivity (*R*-factor)	4780	4780	4780	4780	4780	4780	4780	4780
Soil erodibility (*K*-factor)	0.041	0.041	0.041	0.041	0.063	0.063	0.063	0.063
Slope length (m)	80	80	80	80	80	80	80	80
Slope gradient (%)	12	6	10	25	7	8	8	8
Length/gradient (LS)	3.70	1.47	2.81	9.51	1.76	2.05	2.05	2.05
Erosion control practice (P)	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
Ground cover (C)	1	1	1	1	1	1	1	1
Soil loss (t/ha/yr)	943	374	715	2424	688	803	803	803
Soil Loss Class	6	4	5	7	5	6	6	6
Soil loss (m^3/ha/yr)	726	288	550	1864	530	618	618	618
Volumetric runoff coefficient (C_v)	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63
Sediment storage volume (m^3)	83	38	209	120	57	238	72	63
Settling zone volume (m^3)	236	351	1213	134	348	798	306	211
Total volume required (m^3)	**319**	**390**	**1421**	**254**	**405**	**1036**	**378**	**274**

Table 2.3 Option B Sediment Basin Design Parameters

OPTION B	Catchment								
	C1	C2	C3a	C3b	C3c	C4a	C4b	C5	C6
Total catchment area (ha)	0.67	1	3.48	0.52	1.08	0.66	2.78	0.87	0.6
Disturbed area (ha)	0.67	0.77	1.78	0.52	1.02	0.66	2.78	0.69	0.6
Sediment Type (C, F or D)	D	D	D	D	D	D	D	D	D
Soil Hydrological Group	C	C	C	C	C	C	C	C	C
Design rainfall depth (days), x	5	5	5	5	5	5	5	5	5
Design rainfall depth (%ile), y	85	85	85	85	85	85	85	85	85
x-day, y-%ile rainfall event	55.8	55.8	55.8	55.8	55.8	55.8	55.8	55.8	55.8
Rainfall erosivity (*R*-factor)	4780	4780	4780	4780	4780	4780	4780	4780	4780
Soil erodibility (*K*-factor)	0.041	0.041	0.041	0.041	0.041	0.063	0.063	0.063	0.063
Slope length (m)	80	80	80	80	80	80	80	80	80
Slope gradient (%)	12	6	10	25	14	8	8	18	8
Length/gradient (LS)	3.70	1.47	2.81	9.51	4.61	2.05	2.05	2.05	2.05
Erosion control practice (P)	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
Ground cover (C)	1	1	1	1	1	1	1	1	1
Soil loss (t/ha/yr)	943	374	715	2424	1174	803	803	803	803
Soil Loss Class	6	4	5	7	6	6	6	6	6
Soil loss (m^3/ha/yr)	726	288	550	1864	903	618	618	618	618
Volumetric runoff coefficient (C_v)	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63
Sediment storage volume (m^3)	83	38	166	165	157	69	292	72	63
Settling zone volume (m^3)	236	351	1223	183	380	232	977	306	211
Total volume required (m^3)	**319**	**390**	**1389**	**348**	**537**	**301**	**1269**	**378**	**274**

Tables 2.5 and **2.6** show the physical specifications for each sediment retention basin, in terms of dimensions, depth, batter slopes etc, for Option A and Option B respectively.

Table 2.4 Option A Sediment Basin Specifications

OPTION A	Catchment			
	C1	C2	C3a	C3b
Basin floor dimensions (m)	2 x 21	3 x 22	5 x 50	2 x 15
Top water level dimensions (m)	10 x 29	11 x 30	15 x 60	10 x 23
Length to width ratio	2.9:1	2.7:1	2.1:1	2.3:1
Required volume (m^3)	319	390	1421	254
Provided volume (m^3)	332	396	1438	260
Depth (to top water level) (m)	2	2	2.5	2
Basin floor level (m AHD)	14.2	16.0	15.0	16.3
Spillway level (m AHD)	16.2	18.0	17.5	18.3
Width of bund (m)	3	3	3	3
Freeboard (above spillway) (m)	0.75	0.75	0.75	0.75
External batters	1:2.5	1:2.5	1:2	1:2.5
Internal batters	1:2	1:2	1:2	1:2

OPTION A	Catchment			
	C4a	C4b	C5	C6
Basin floor dimensions (m)	5 x 20	9.5 x 33.5	2 x 25	2 x 30
Top water level dimensions (m)	13 x 28	17.5 x 41.5	10 x 33	8.4 x 36.4
Length to width ratio	2.2:1	2.4:1	3.3:1	4.3:1
Required volume (m^3)	405	1036	378	274
Provided volume (m^3)	464	1044	380	293
Depth (to top water level) (m)	2	2	2	1.6
Basin floor level (m AHD)	2	0	2.7	1.4
Spillway level (m AHD)	4	2	4.7	3.0
Width of bund (m)	3	3	3	3
Freeboard (above spillway) (m)	0.75	0.75	2.00	0.75
External batters	1:3	1:3	1:3	1:2
Internal batters	1:2	1:2	1:2	1:2

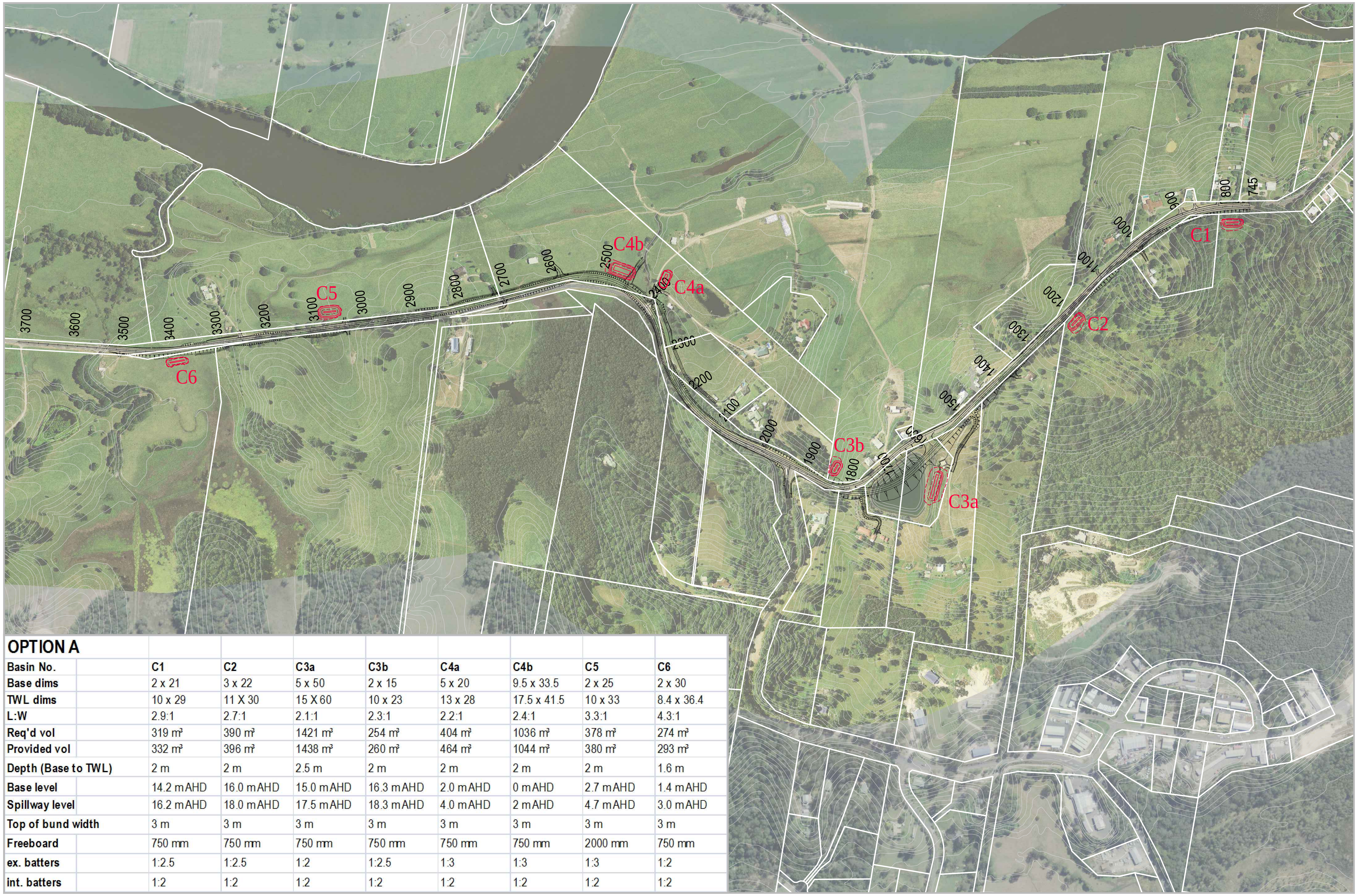
Table 2.5 Option B Sediment Basin Specifications

OPTION B	Catchment			
	C1	C2	C3a	C3b
Basin floor dimensions (m)	2 x 21	3 x 22	5 x 50	2 x 24
Top water level dimensions (m)	10 x 29	11 x 30	15 x 60	10 x 32
Length to width ratio	2.9:1	2.7:1	2.1:1	3.2:1
Required volume (m^3)	319	390	1389	348
Provided volume (m^3)	332	396	1439	368
Depth (to top water level) (m)	2	2	2.5	2
Basin floor level (m AHD)	14.2	16.0	15.0	14.25
Spillway level (m AHD)	16.2	18.0	17.5	16.25
Width of bund (m)	3	3	3	3
Freeboard (above spillway) (m)	0.75	0.75	0.75	0.75
External batters	1:2.5	1:2.5	1:2	1:3
Internal batters	1:2	1:2	1:2	1:2

OPTION B	Catchment				
	C3c	C4a	C4b	C5	C6
Basin floor dimensions (m)	2 x 25	3 x 16	7 x 49	2 x 25	2 x 30
Top water level dimensions (m)	12 x 35	11 x 24	15.4 x 57.4	10 x 33	8.4 x 36.4
Length to width ratio	2.9:1	2.2:1	3.7:1	3.3:1	4.3:1
Required volume (m^3)	537	301	1269	378	274
Provided volume (m^3)	587	312	1288	380	293
Depth (to top water level) (m)	2.5	2	2.1	2	1.6
Basin floor level (m AHD)	12	2	0.3	2.7	1.4
Spillway level (m AHD)	14.5	4	2.4	4.7	3.0
Width of bund (m)	3	3	3	3	3
Freeboard (above spillway) (m)	0.75	0.75	0.75	2.00	0.75
External batters	1:2	1:3	1:3	1:3	1:2
Internal batters	1:2	1:2	1:2	1:2	1:2

Illustration 2.4 depicts the sediment retention basins as per the design specifications above, for Option A. Similarly, **Illustration 2.5** depicts the sediment retention basins for Option B.

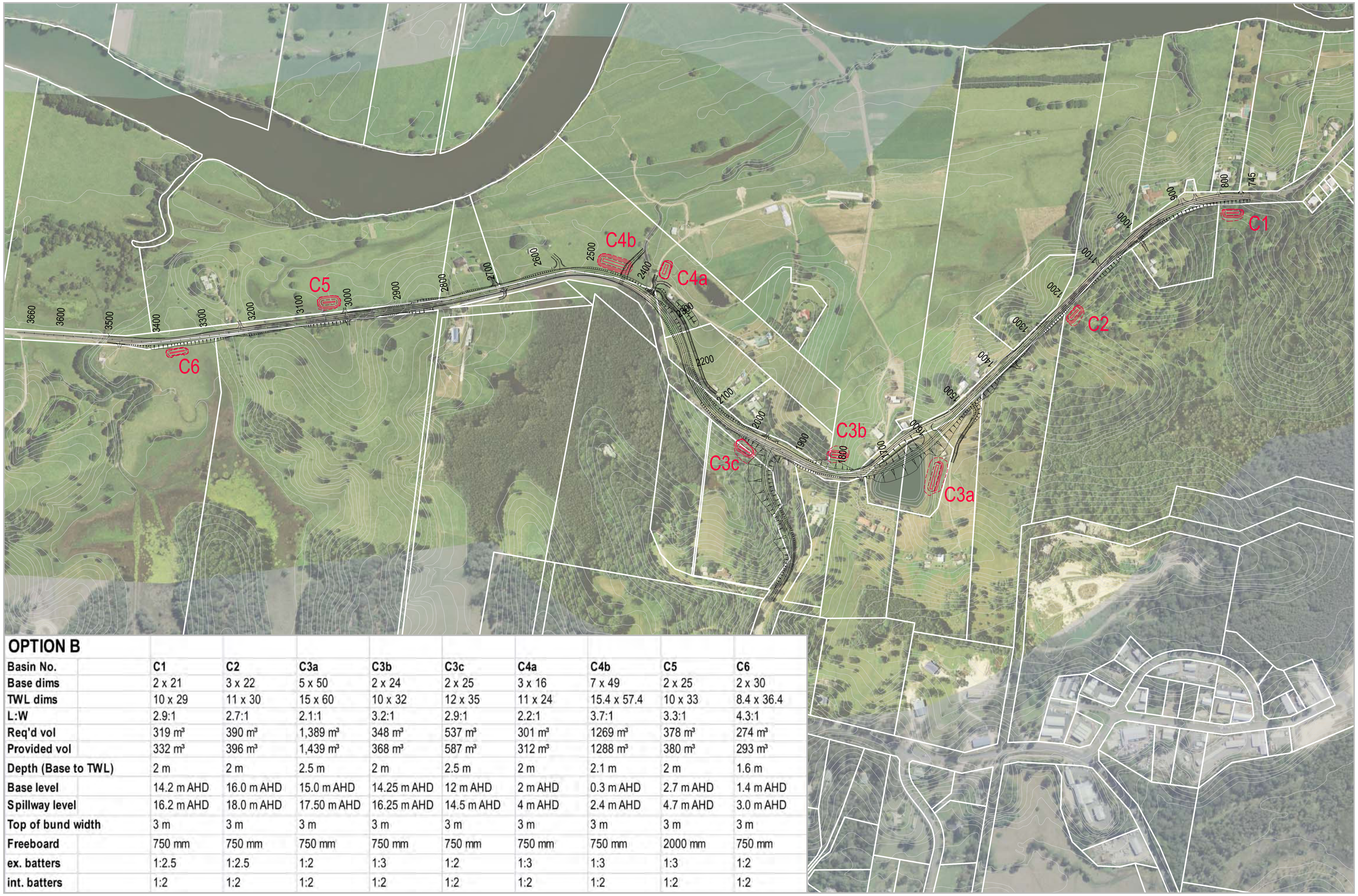
Drawn by: MVE Checked by: DMT Reviewed by: DMT Date: November 2012
Source of base data: NSW Roads and Maritime Service



OPTION A

Basin No.	C1	C2	C3a	C3b	C4a	C4b	C5	C6
Base dims	2 x 21	3 x 22	5 x 50	2 x 15	5 x 20	9.5 x 33.5	2 x 25	2 x 30
TWL dims	10 x 29	11 X 30	15 X 60	10 x 23	13 x 28	17.5 x 41.5	10 x 33	8.4 x 36.4
L:W	2.9:1	2.7:1	2.1:1	2.3:1	2.2:1	2.4:1	3.3:1	4.3:1
Req'd vol	319 m³	390 m³	1421 m³	254 m³	404 m³	1036 m³	378 m³	274 m³
Provided vol	332 m³	396 m³	1438 m³	260 m³	464 m³	1044 m³	380 m³	293 m³
Depth (Base to TWL)	2 m	2 m	2.5 m	2 m	2 m	2 m	2 m	1.6 m
Base level	14.2 mAHD	16.0 mAHD	15.0 mAHD	16.3 mAHD	2.0 mAHD	0 mAHD	2.7 mAHD	1.4 mAHD
Spillway level	16.2 mAHD	18.0 mAHD	17.5 mAHD	18.3 mAHD	4.0 mAHD	2 mAHD	4.7 mAHD	3.0 mAHD
Top of bund width	3 m	3 m	3 m	3 m	3 m	3 m	3 m	3 m
Freeboard	750 mm	750 mm	750 mm	750 mm	750 mm	750 mm	2000 mm	750 mm
ex. batters	1:2.5	1:2.5	1:2	1:2.5	1:3	1:3	1:3	1:2
int. batters	1:2	1:2	1:2	1:2	1:2	1:2	1:2	1:2

Option A - Sediment Basin Locations



OPTION B									
Basin No.	C1	C2	C3a	C3b	C3c	C4a	C4b	C5	C6
Base dims	2 x 21	3 x 22	5 x 50	2 x 24	2 x 25	3 x 16	7 x 49	2 x 25	2 x 30
TWL dims	10 x 29	11 x 30	15 x 60	10 x 32	12 x 35	11 x 24	15.4 x 57.4	10 x 33	8.4 x 36.4
L:W	2.9:1	2.7:1	2.1:1	3.2:1	2.9:1	2.2:1	3.7:1	3.3:1	4.3:1
Req'd vol	319 m³	390 m³	1,389 m³	348 m³	537 m³	301 m³	1269 m³	378 m³	274 m³
Provided vol	332 m³	396 m³	1,439 m³	368 m³	587 m³	312 m³	1288 m³	380 m³	293 m³
Depth (Base to TWL)	2 m	2 m	2.5 m	2 m	2.5 m	2 m	2.1 m	2 m	1.6 m
Base level	14.2 m AHD	16.0 m AHD	15.0 m AHD	14.25 m AHD	12 m AHD	2 m AHD	0.3 m AHD	2.7 m AHD	1.4 m AHD
Spillway level	16.2 m AHD	18.0 m AHD	17.50 m AHD	16.25 m AHD	14.5 m AHD	4 m AHD	2.4 m AHD	4.7 m AHD	3.0 m AHD
Top of bund width	3 m	3 m	3 m	3 m	3 m	3 m	3 m	3 m	3 m
Freeboard	750 mm	750 mm	750 mm	750 mm	750 mm	750 mm	750 mm	2000 mm	750 mm
ex. batters	1:2.5	1:2.5	1:2	1:3	1:2	1:3	1:3	1:3	1:2
int. batters	1:2	1:2	1:2	1:2	1:2	1:2	1:2	1:2	1:2

North

0 150

Option B - Sediment Basin Locations

3

Conclusions

The design, sizing and location of sediment retention basins outlined in this report have been carefully considered in order to meet industry standards and the relevant guidelines for erosion and sediment control. The sizes and locations of sediment retention basins presented in this report are based on the road upgrade concept designs as at November 2012. It is likely that the road upgrade designs will be refined in the future, which may trigger the need to refine the sizes and locations of the sediment retention basins.

The design will require the construction and maintenance of 'clean' and 'dirty' water diversion drains to ensure success of the system. The number of basins required has been minimised by the recommended provision of temporary culverts to transport runoff from one side of the alignment to the other, thereby eliminating the need for basins to be installed on both sides of the road at low points.

A high priority during the design of the sediment retention basins has been to minimise the need to encroach on private property. However, given the existing levels of the topography and the proposed road levels, the restrictions of the narrow road reserve and the volumetric size requirements of the basins, this has not been possible in all cases.

In situations where achieving a length to width ratio of 3:1 for each basin is not possible, baffles should be installed to increase the distance between the inlet and outlet and reduce the opportunity for short-circuiting.

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