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13th September 2017
(REVISED FOR NEW D.A.)

YellowDot Energy Pty Ltd
PO Box 1441
Coorparoo DC QLD 4151

Dear Sir,

Runoff Calculations for Proposed Solar Farm, Barcaldine

Method:
The overall aim of a stormwater management plan is to manage the extra run off typically caused by a developed site, and avoid overloading streams, drains etc. with increased flow rates. To achieve this result it requires that the rate of stormwater discharged from a developed site not exceed the pre-developed site discharge rate. It is intended that any increased stormwater runoff caused by an increase in impervious area be stored temporarily in a detention pond. Water is then to be released at a discharge rate that does not exceed the rate of discharge of the undeveloped site.

The time of concentration was calculated using the Australian Rainfall Runoff (Tc) formula, that is a function of area ($Tc = 0.75\ A^{0.38}$). Using this formula, a time of concentration was found to be 28 minutes, and 30 minutes was adopted from the IFD. It must be noted that the impervious area of the solar farm will have a slightly shorter time of concentration, but as the site is being analysed as whole, 30 minutes was used for both calculations. The rational method will be used to determine the runoff from the site before and after the development. The 1 in 100-year storm event from the Barcaldine Intensity Frequency Duration Table for a 30-minute event has an intensity of 125.6mm/hr (IFD Table attached). The total rain to fall in this 30 min event is therefore 62.8mm.

A. Calculation:

1) Existing Developed Catchment (Pre Developed Catchment)

Effective Lot Area

Total Lot Area: 30.0 ha (Currently all grassed – pre-developed site)

Total Lot Area not included as Buildings/Hardstand Areas (Land Only Area)

(Total Effective Area 300,000 m²) – (Roof Area/Hardstand Area 0 m²)

Runoff Coefficient	Buildings/Hardstand	C = 1.0
	Land	C = 0.5

Discharge $Q_{100(P)} = CIA/360$

A = Area (ha)
I = Rainfall Intensity (mm/hr)
C = Runoff Coefficient

$$Q_{100(P)} = \frac{((0.5 \times 30.0\ ha) + (1.0 \times 0\ ha)) \times 125.6}{360}$$

$Q_{100(P)} = 5.23$ cumec

2) Proposed Developed Catchment (Post Developed Catchment)

Proposed Hardstand Areas (Hardstand areas have been taken as the entire proposed development of lots 3 and 4, given that the lots are to be constructed on a compacted crusher dust pad.)

Proposed Lot 4	62,000 m^2
Proposed Lot 4	58,000 m^2
Total Roof Area	120,000 m^2

Proposed Landscaped (Grassed) Area

(Effective lot area: 300,000m^2) – (Total Hardstand Area: 120,000m^2)

Total lot area not included as Buildings or Impervious Hardstand (Land Only Area) 180,000 m^2

Runoff Coefficient	Buildings & Hardstand	C = 1.0
	Land	C = 0.5

$Q_{100(P)} = CIA/360$

A = Area (ha)
I = Rainfall Intensity (mm/hr)
C = Runoff Coefficient

$$Q_{100(P)} = \frac{((0.5 \times 18ha) + (1.0 \times 12ha)) \times 125.6}{360}$$

$Q_{100(P)} = 7.33$ cumec

Volume of water required to be delayed from entering system during the 6-minute storm event.

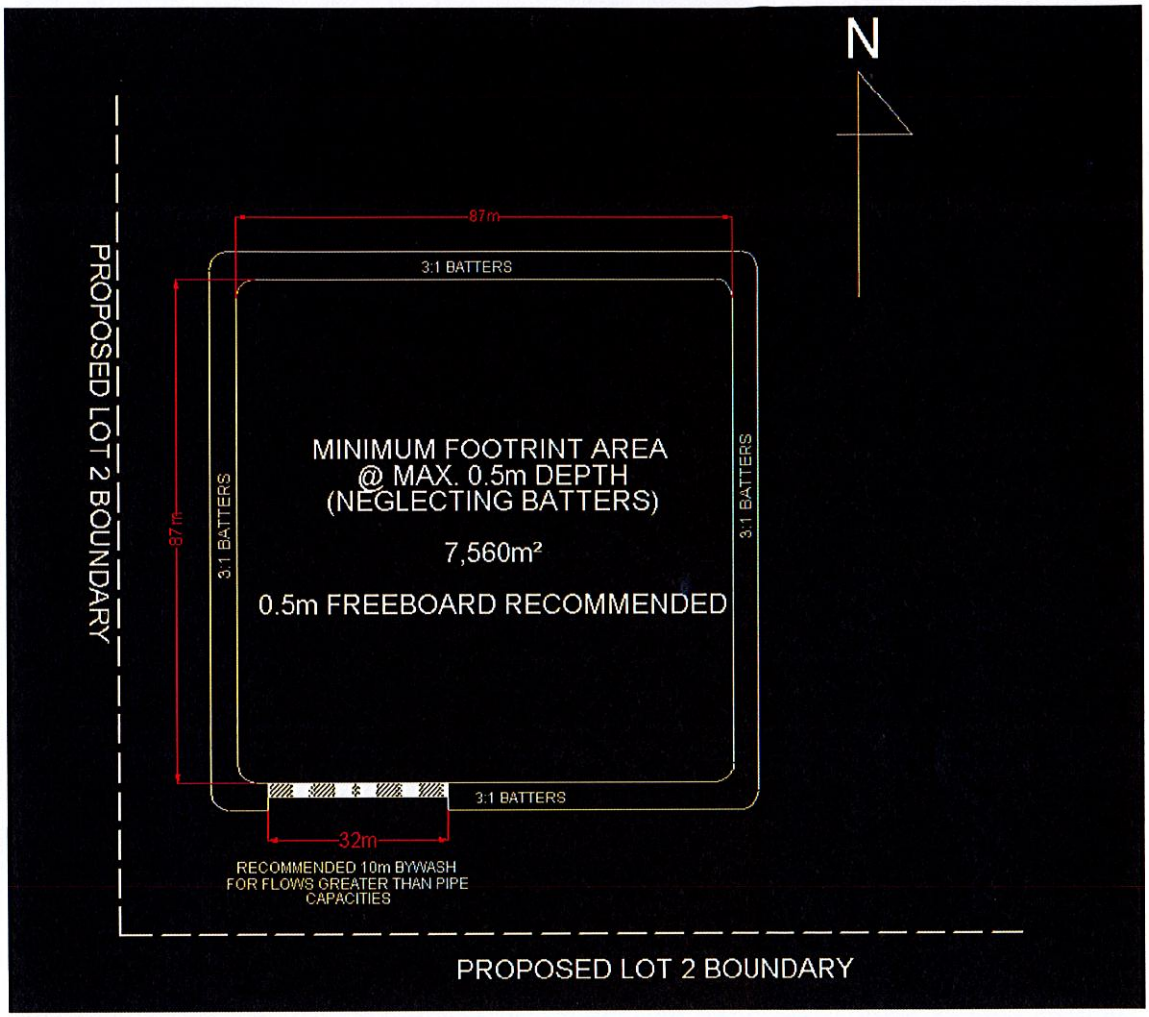
Vol. Water (cum) = (7.33 cumec – 5.23 cumec) x 30min
= 3,780 cum
= 3,780,000 litres

3) Proposed Detention Pond To Store Storm Water Runoff

The client has advised SMK Consultants that a detention pond is preferred as a temporary detention option as opposed to tanks. Given that the capacity of detention needed is 3,780,000 litres it is recommended that the south west section of 'proposed lot 2' be used as detention area. This area has been chosen since the block typically drains to the south west. Given the recommended location of the detention pond, it is advised that the hardstand pad of the solar farm be land levelled to drain east to west (due to the solar farm development being located on the southern boundary).

The detention basin can be a variety of sizes/dimensions providing it can capture the whole 3,780,000 litres.

SMK Consultants has recommended a pond water depth of 0.5m with 0.5m freeboard and 3:1 batters. Given these dimensions a minimum footprint area of 7,560m³ will be needed. A bywash will also be necessary given flows greater than the one used in the calculations. Dimensions of the proposed pond can be seen below.



Given a max depth of 0.5m it is recommended that 4 x 500mm pipes be used as drain pipes, to allow a maximum of 1.73m³/s to be released from the site. Any flows greater than this will use the 32m bywash, for the predeveloped flow of 5.23m³/s the bywash will run at 150mm of water depth across its face. It is important to note that pipe sizes are a function of head above natural surface. If a different size pond is used with a different top water level, pipes must be redesigned to make sure the maximum flowrate of the predeveloped site is not exceeded when draining the developed site.

SMK was provided with limited survey over the site, particularly along the western boundary. It is recommended that extra survey be done, to identify areas where a diversion bank may be needed to direct stormwater to the onsite detention pond.

I believe the proposed pond and the pipe sizes shown achieve the requirements of reducing the average discharge from the site to that existing prior to development.

Yours faithfully,

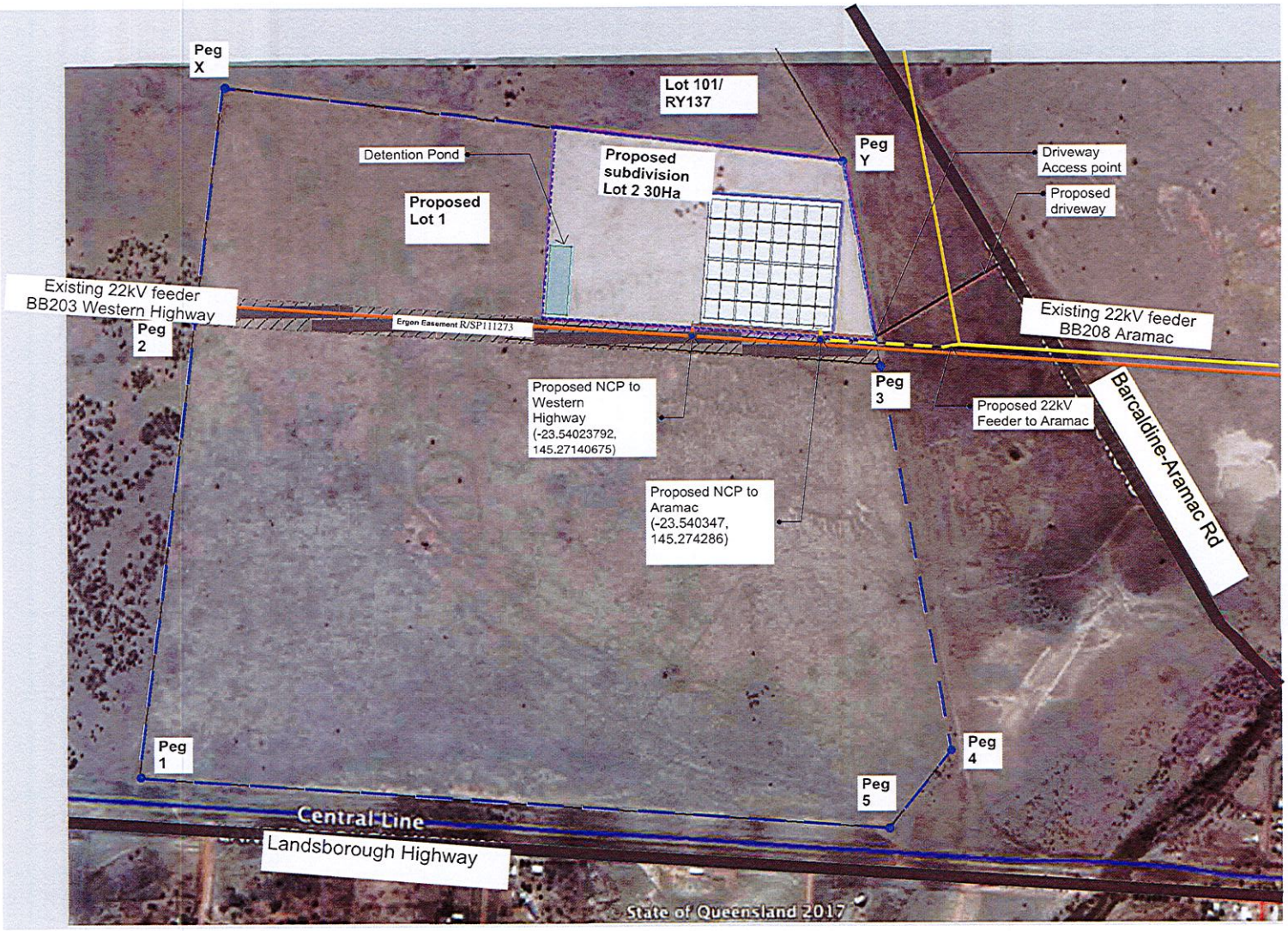
Mark Carrigan

Mark Carrigan
B.Eng (CIVIL). GradIEAust CID – Surface (IAL)
Civil Engineer/Irrigation Consultant
SMK Consultants

Attachment 1: Barcaldine – IFD Table

Duration	1 Year	2 Years	5 Years	10 Years	20 Years	50 Years	100 Years
1 min	120.0	138.0	192.0	228.0	264.0	312.0	354.0
2 min	99.0	114.0	162.0	198.0	231.0	279.0	318.0
3 min	94.0	108.0	152.0	184.0	216.0	260.0	294.0
4 min	88.5	102.0	145.5	174.0	204.0	244.5	276.0
5 min	85.2	98.4	138.0	166.8	193.2	230.4	260.4
6 min	82.0	94.0	133.0	159.0	185.0	220.0	247.0
10 min	70.2	80.4	113.4	135.6	157.2	186.0	207.6
15 min	59.6	68.4	96.4	115.2	133.6	157.6	176.0
30 min	41.6	47.8	67.4	80.8	94.2	111.8	125.6
1 hour	26.7	30.7	43.6	52.6	61.6	73.9	83.6
2 hour	16.3	18.8	26.8	32.5	38.3	46.3	52.8
3 hour	12.1	13.9	19.9	24.2	28.6	34.7	39.6
6 hour	7.2	8.3	12.0	14.6	17.3	21.0	24.0
12 hour	4.3	5.0	7.3	8.9	10.5	12.8	14.6
24 hour	2.6	3.0	4.4	5.5	6.5	7.9	9.0
48 hour	1.6	1.8	2.7	3.3	4.0	4.9	5.6
72 hour	1.1	1.3	2.0	2.5	3.0	3.6	4.1

Attachment 2: Barcaldine – Solar Farm Concept Plan
REVISED 13-9-17 FOR NEW D.A.



YD Projects

Project / Part Number:
YD-0916-DUN

Description
Dunblane Solar Farm

Version:
July 7, 2017

Drawn By:
AVV

Approval date:
July 5, 2017

Approved by:
RLM

Client:
Lot 72/SP136851
Dunblane Solar Farm

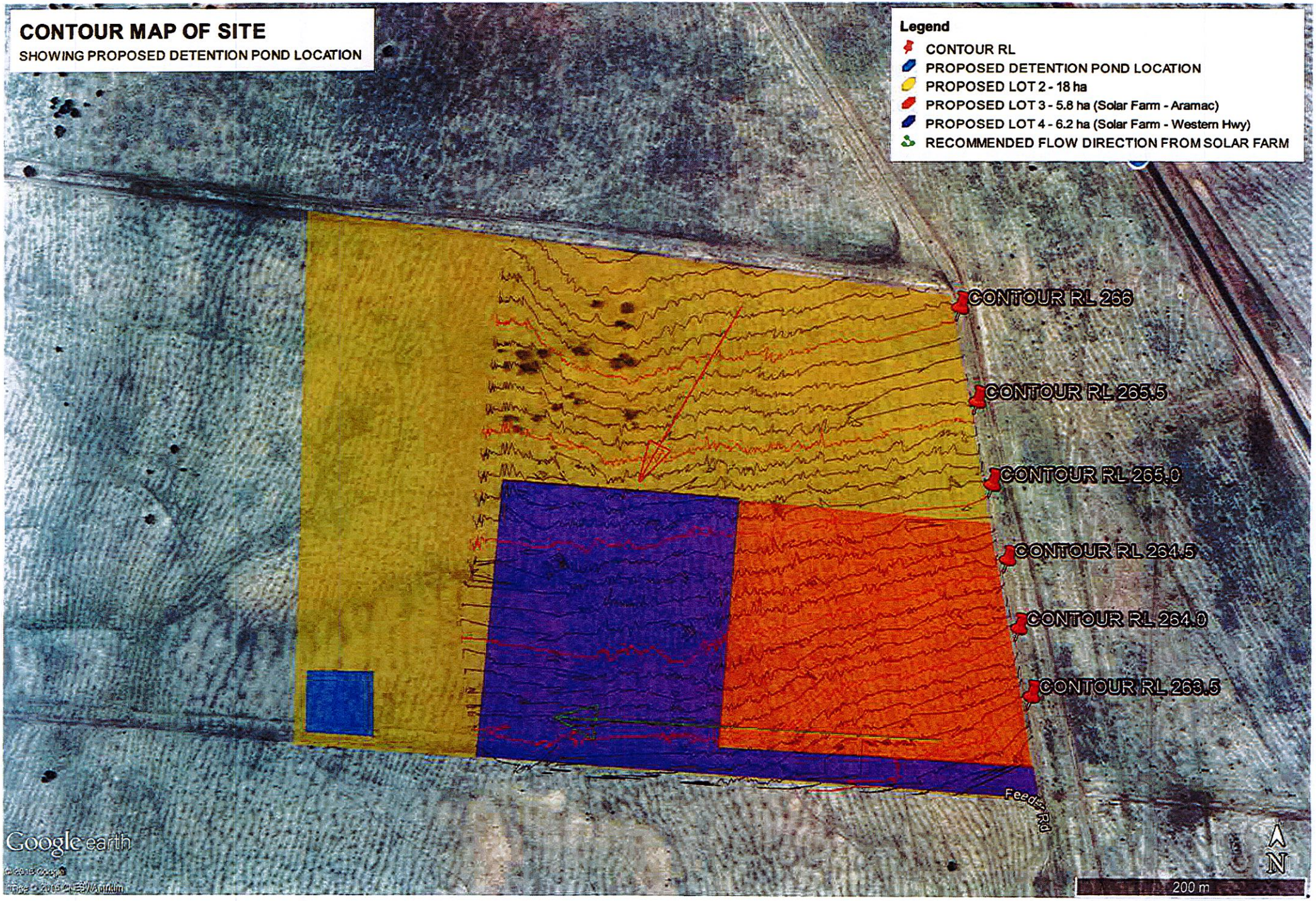
Designed By:
YD Projects

Status:
FOR APPROVAL / QUOTATION

Notes:
SCALE 1:10000 A3

Lot overview

Attachment 3: Barcaldine – Contour Map With Proposed Detention Pond Location


CONTOUR MAP OF SITE
SHOWING PROPOSED DETENTION POND LOCATION
Legend
CONTOUR RL
PROPOSED DETENTION POND LOCATION
PROPOSED LOT 2 - 18 ha
PROPOSED LOT 3 - 5.8 ha (Solar Farm - Aramac)
PROPOSED LOT 4 - 6.2 ha (Solar Farm - Western Hwy)
RECOMMENDED FLOW DIRECTION FROM SOLAR FARM
CONTOUR RL 266
CONTOUR RL 265.5
CONTOUR RL 265.0
CONTOUR RL 264.5
CONTOUR RL 264.0
CONTOUR RL 263.5
Feeder Rd
Google earth
200 m
N

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ADDENDUM - PART 1

5TH October 2021

Dunblane Solar Farm – Stormwater System Modifications

The following presents an outline of works required to modify the stormwater system on Dunblane Solar Farm as agree to by Barcaldine Regional Council.

Issue 1 –Erosion at eastern end of stormwater drain

The Council Engineer's report identifies that stormwater is released from the eastern end of the stormwater drain which could result in erosion. The following photographs from Council show the location of the problem.

Figure 1: Eastern end of stormwater drain open to east

Work required involves filling the eastern end section of the drain with rock. The rock to be used should be the same grade/size of rock placed in the drain at present. The additional rock is to fill the drain to natural surface level. The length of fill is to be a minimum of 5m along the channel starting from the fence corner and filling west.

The following aerial image shows the location of the section of channel to be rock filled.

Figure 2: Aerial image showing location to fill stormwater drain with rock.

Issue 2 – Condition 13 – Erosion at Western end of stormwater channel
The western end of the stormwater channel has eroded a gully into the detention pond. Work required involves reconstruction of the channel from the bed of the detention pond at a slope of 1 in 10. The channel is to be shaped with a 4m wide bed and 3H:1V batter. Spoil from the excavation is to be used to backfill the erosion and make good the new channel.

Figure 3: Photo of erosion gully from stormwater channel into detention pond

The new section of channel is to be over-excavated by 200mm below the bed of the detention pond and the stormwater channel. The 200mm excavation in the stormwater drain should extend for a distance of 10m into the existing channel, past the section of the new sloped channel. Once completed, the channel and batters are to be rock lined with a rock size of between 40mm and 150mm. The rock is to extend 10m upstream of the sloped section of channel. The rock is to be spread to form an even surface and rolled to form a uniform surface across the stormwater drain.

Refer attached typical section plan for cross section details.

Issue 4 – Condition 13 – Batters of Existing Detention Pond
The stormwater management plan recommended 3-horizontal to 1-vertical batters. Based on the Council inspection, batters are currently at 1-horizontal to 1-vertical.

The batters are to be re-excavated to form a 3H:1V slope to reduce erosion and encourage vegetation growth to stabilise the banks. Spoil from the excavation is to be placed around the northern and eastern sides of the detention pond to prevent overland flow from entering the pond.

Refer attached typical section for details.

Issue 5 – Condition 13 – Bywash for detention pond
Council has identified the detention pond to not have a formal bywash. It has been agreed that a ground level bywash can be built along the western side of the detention pond for a width of approximately 50m.

Work required involves:

- Removal of all spoil from the western side of the detention pond and stockpile this on the northern side of the pond;
- Level the existing surface on the western side of the pond to create a flat bywash area of 50m in width above the revised 3:1 batter of the storage.
- Smooth the area and make good to remove all potential rills and marks created by construction equipment.

Prepared by:

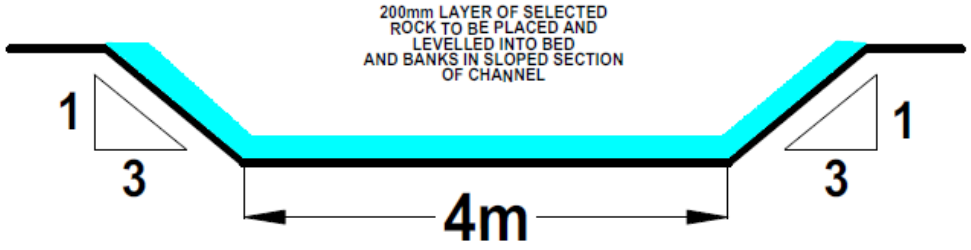
Peter Taylor BSc. MEIANZ CIAg LAA
Environment and Resource Consultant
Licensed Asbestos Assessor 000 180
Director, SMK Consultants


Dunblane Solar Farm
Stormwater Works Plan
Legend
Detention Pond
Graded drain entry into Pond
Detention pond batters to be cut to 3H:1V around all four sides of detention pond
Drain to be sloped to 1 in 10 slope and then rock lined as per typical section
All spoil to be removed from west side of storage and area to be levelled to natural surface
Google Earth
© 2021 Google
Image © 2021 CNES / Airbus
N
50 m

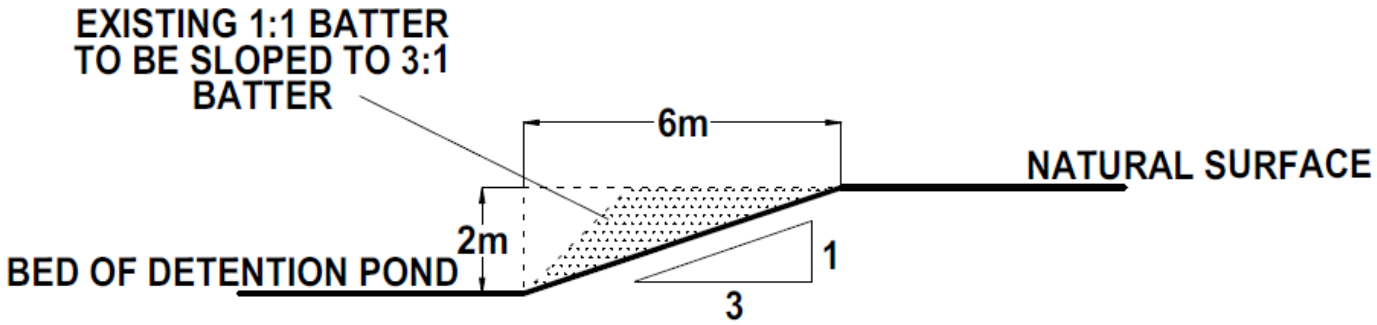
TYPICAL SECTION SHOWING ROCK PROTECTION OF CHANNEL INTO DETENTION POND

CONSTRUCTION NOTES:

- ROCK SIZE TO RANGE BETWEEN 40mm TO 150mm
- ROCK TO BE ROLLED INTO BED BY TRACTOR/EXCAVATOR
- ROCK NOT TO BE HIGHER THAN 100mm ABOVE BED
- ROCK TO EXTEND TO TOP OF BATTER
- ROCK BEDDING TO EXTEND 10m EAST AND 10m INTO DETENTION POND



TYPICAL SECTION OF EXCAVATION REQUIRED TO EXCAVATE POND BATTER



SCALES : HORIZ NOT TO SCALE (A3) VERT NOT TO SCALE	S.M.K. CONSULTANTS surveying - irrigation - environmental PO BOX 774 MOREE 2400 PHONE (02) 67 521021	CLIENT : DUNBLANE SOLAR FARM	DESCRIPTION : SKETCH PLAN SHOWING REBATTERING OF DETENTION POND AND ROCK MATTRESSING OF SLOPED CHANNEL INTO POND	PLAN REVISION :	DATE			FILE No. 21-249	SHEET No. 1	No OF SHEETS 1
SURVEYED		PROJECT : STORMWATER SYSTEM MODIFICATIONS		A INITIAL ISSUE	8-10	D		PLAN No. 1		
DESIGNED				B		E		DATE 5-10-21		
CHECKED P. TAYLOR				C		F		DRAWING FILE : TYPICAL SECTIONS		
						G		CALC. FILE :		

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ADDENDUM - PART 2

23rd November 2021

Dunblane Solar Farm – Stormwater System Modifications

The following presents an update of works completed in accordance with the Stormwater System Modification Action Plan.

Issue 1 –Erosion at eastern end of stormwater drain
The Council Engineer's report identifies that stormwater is released from the eastern end of the stormwater drain which could result in erosion. The following photographs from Council show the location of the problem.

Work agreed involved filling the eastern end section of the drain with rock. The rock to be used should be the same grade/size of rock placed in the drain at present. The additional rock is to fill the drain to natural surface level. The length of fill is to be a minimum of 5m along the channel starting from the fence corner and filling west.

The following image provides a photograph of the competed work.

Figure 1: Eastern end of stormwater drain with additional rock material

Issue 2 – Condition 13 – Erosion at Western end of stormwater channel
The western end of the stormwater channel had eroded a gully into the detention pond. Work required involved reconstruction of the channel from the bed of the detention pond at a slope of 1 in 10. The channel is to be shaped with a 4m wide bed and 3H:1V batter. Spoil from the excavation is to be used to backfill the erosion and make good the new channel.

Figure 2: Photo showing rock lined channel inlet between stormwater drain and detention pond

Issue 4 – Condition 13 – Batters of Existing Detention Pond
The stormwater management plan recommended 3-horizontal to 1-vertical batters. The batters were re-excavated to form a 3H:1V slope to reduce erosion and encourage vegetation growth to stabilise the banks. Spoil from the excavation was mostly removed from the area of the detention pond.

Figure 3: Stormwater inlet into detention pond with pond batters reshaped to 3H:1V.

Issue 5 – Condition 13 – Bywash for detention pond
Council had identified the detention pond did not have a formal bywash as per the original plans which included a pipe outlet. It has been agreed that a ground level bywash can be built along the western side of the detention pond for a width of approximately 50m.

Figure 4: Landscape view of detention pond looking northeast showing ground level bywash on western side (left side of photo)

Work Completed on Detention Pond:

- Removal of all spoil from the western side of the detention pond and stockpile this on the northern side of the pond - Completed
- Level the existing surface on the western side of the pond to create a flat bywash area of 50m in width above the revised 3:1 batter of the storage - Completed
- Smooth the area and make good to remove all potential rills and marks created by construction equipment - Completed

Council Representative Inspection

Lukas Rudman of GBA Consulting Engineers undertook a site inspection on behalf of Council on or about the 23rd of November. Photos were provided to show the completed works.

Lukas Rudman advised Council, Dunblane Solar Farm and SMK Consultants that he is satisfied that the works were complete satisfactorily.

Prepared by:

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Licensed Asbestos Assessor 000 180
Director, SMK Consultants