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Storm Water Management Plan for
Lot 33 Goroke-Harrow Road,
Charam.



August 2021

Our Ref: 21155

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Document Ref: 21155_r_SWMP_130821

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1. Introduction

This report has been prepared on behalf of Green Gold Energy Pty Ltd as part of the requirement to support a planning permit application for the proposed solar energy facility on land located 33 Goroke-Harrow Road, Charam.

The subject land is bounded by Goroke-Harrow Road to the West, Charam-Wombelano Road to the South, (Lot 35) 1687 Charam-Wombelano Road to the East and (Lot 5) 17 McLennans Road to the North with an approximate area of 76 ha in total. The subject land is in the Farming Zone (FZ1) and is predominantly used for the purpose of agricultural grazing.

A proposal has been made to use approximately 15.13 ha of the subject land as a solar energy facility as shown in Fig 1 and this report discusses the storm water management for the proposed solar farm.

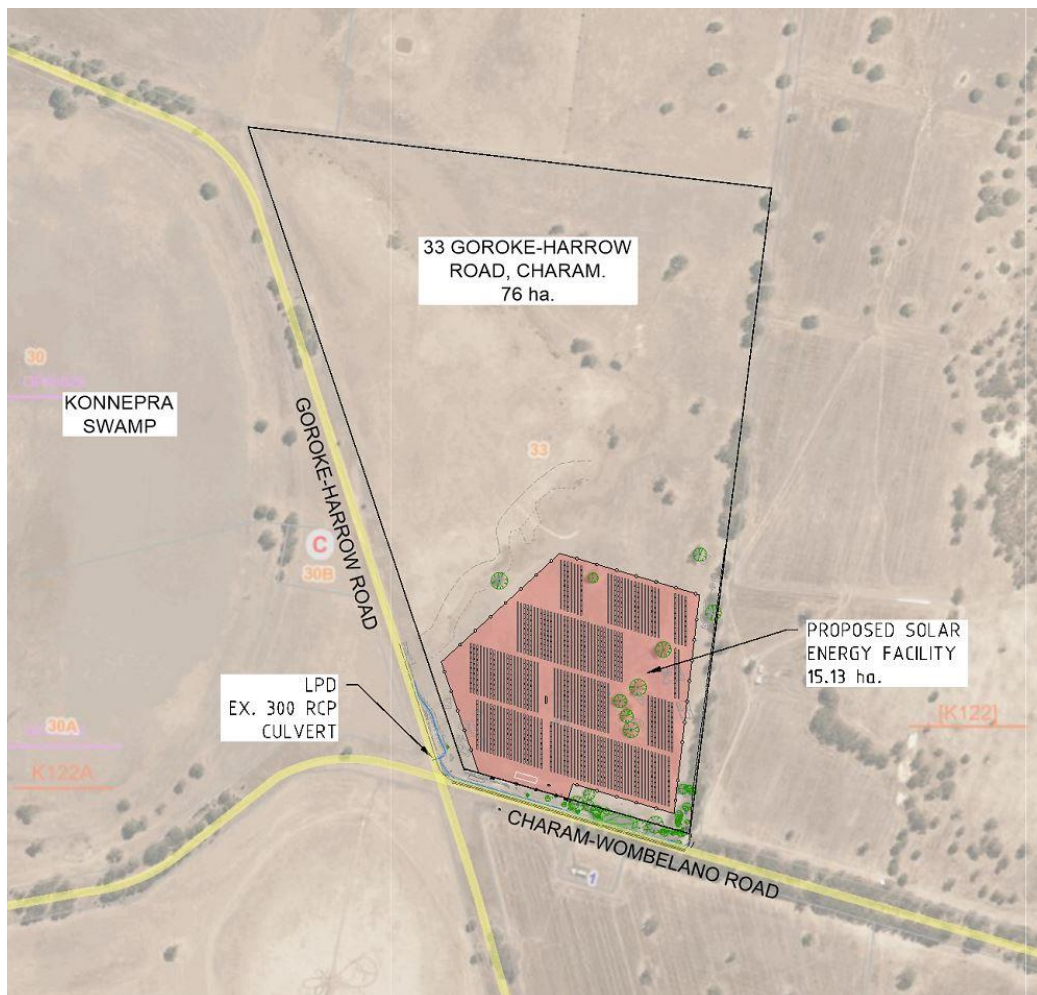


Fig 1 . Existing Conditions

2. Existing Site Drainage

Grampians Wimmera Mallee Water is the responsible Authority for drainage of the subject land.

The legal point of discharge is the 300mm diameter RCP culvert under Goroke-harrow Road. Refer Fig 1.

Since the farm has been predominantly used for agricultural grazing, there are strategically located dams on the property which capture stormwater runoff and are used to provide water for animals. The site is relatively flat, with gentle undulations and there is a depression along the south-west corner of the site, which provides an outfall to the site into the Konnepra Swamp to the west of the site across Goroke-Harrow Road which is identified as the legal point of discharge.

2.1. Existing Onsite Stormwater Retention

The existing onsite stormwater retention for the subject land is assumed to be provided by inundation of the farmland. Several storage dams exist in the northern side of the land for stock water which are insignificant for storm water retention purposes.

2.2. Allowable Discharge

In accordance with the IDM the stormwater discharge rate should be limited to the predeveloped discharge rate. In this instance, the predevelopment discharge rate can be calculated as 93 l/s considering the capacity at the LPD (refer attachment 3).

By using standard value of 1.2 l/s/ha of pre-development discharge rate gives a total discharge of 91.7 l/s for the subject land area.

Hence, using the capacity of the LPD (culvert under the road) as the allowable discharge from the land (93 l/s) can be considered a fair assumption.

3. Proposed Drainage System

It is proposed that solar energy facility will utilise the existing drainage system (overland flow) to direct stormwater runoff into the existing legal point of discharge. The existing overland flow path which is an existing depression in the middle of the land to be reshaped and graded to improve the overland flow as part of the proposed drainage works.

Proposed hard stand areas (access path and storage facilities) will be above the top water levels to keep the areas dry at all times.

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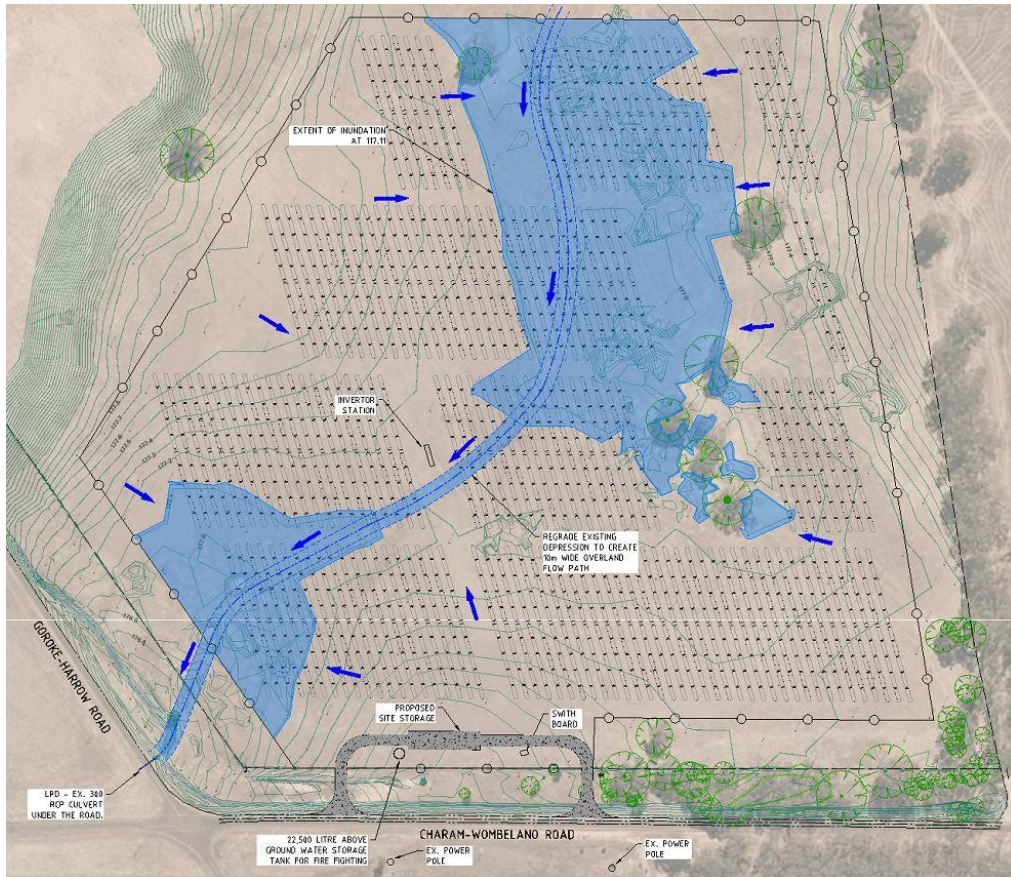


Fig 3 . Proposed Solar Farm Drainage System

3.1 Runoff Coefficient

The IDM does not provide a specific runoff coefficient to be used for a solar farm. As such the following runoff coefficients were used to derive an overall weighted coefficient for the Solar farm.

Solar Panels

Even though the solar panels have an impermeable surface, considering the tilting ability of panels, stormwater runoff will have a minor effect from solar panels since they will have a minimal land coverage. (See figure 4).

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Fig 4 . Typical Solar Panel Arrangement

For the panel area a coefficient of 0.25 has been adopted. This has considered the soil permeability rates and the vegetation beneath the solar panels.

Other Areas

For hardstand area includes the access track, car park and the loading zone a coefficient of 0.9 has been used. The balance of the solar farm area will remain as grassed areas where a coefficient of 0.15 has been adopted. Refer table below for summary.

Area	Area (ha)	Adopted Coefficient
Panel Area (1m offset to panels)	9.21	0.25
Hardstand	0.16	0.9
Green Areas (Lot Balance)	5.76	0.15
Total	15.13	0.22

Adopting the above coefficients, a weighted runoff coefficient for the overall proposed solar farm has been calculated as 0.22.

3.2 Storage Requirements

Since the existing drainage system does not include storage facilities such as dams to cater storage requirements during major rainfall events, it is understood that the storage requirements have been fulfilled by inundating the farmland. 1% AEP pre-development discharge rate has been calculated as 7217 m³. (Please refer attachment 3 for pre-development storage calculations.)

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It is clear from the above table that the proposed Solar energy facility has no significant effect on the existing drainage discharge from the farmland.

The 1% AEP storage requirement of the proposed solar energy facility has been calculated as 2557 m³. The additional storage resulting from the proposed development will be achieved by inundating the subject land.

Please refer Attachment 3 for storage calculations and it is understood that the top water level of 117.11 will provide the required storage with an average inundation depth of 90mm.

4. Conclusion

Existing site conditions such as overland flow paths, LPD, Site discharge will not be affected by the proposed solar energy facility and also by evaluating the pre and post development drainage parameters it can be concluded that proposed solar energy facility has no significant impact on the existing farmland.

The additional storage requirement from proposed development which is 1112 m³ to be provided by inundating the solar energy facility to a top water level of 117.11

All proposed Solar infrastructure to be installed 300mm above inundation level of 117.11.

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Attachment 1 - Existing Conditions Plan

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Legend

- Major Contour (Interval 0.50m)
- Minor Contour (Interval 0.10m)
- Fence Line
- Gate
- Edge of Concrete
- Edge of Bitumen
- Centre Line of Bitumen
- Edge of Formation
- Top of Bank
- Toe of Bank
- Change of Grade Line
- Reinforced Concrete Pipe (RCP)
- Small Group of Trees
- Large Group of Trees (Drip Line)
- Large Group of Trees (Trunk Line)
- Temporary Bench Mark (TBM)
- Tree
- Dead Tree
- Guide Post
- Sign
- Gate Post
- Fence Post
- Telecommunications Pit
- Telecommunications Pillar
- Telecommunications Marker
- RCP Invert RL

Note:

Heights are to Australian Height Datum (AHD) based on Charam PM 20 RL:158.935
 Bearing Datum is to MGA2020 Zone 54 based on GNSS Observations.
 Coordinates are based on GNSS observations and have been localised to MGA 2020 Zone 54 at the site.
 Data is on Ground Distances (not scaled).

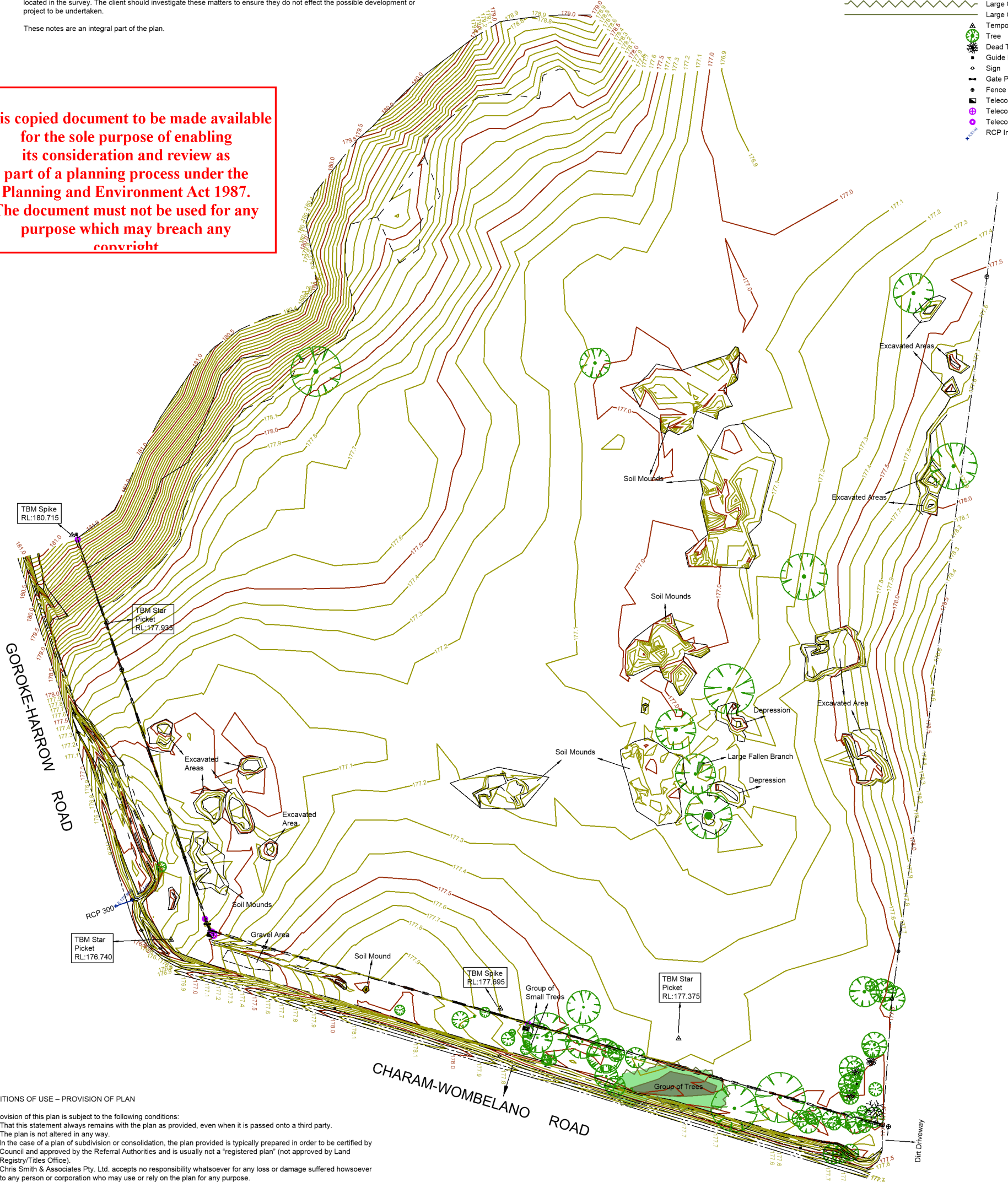
Every endeavour has been taken to locate visible structures and services however, there is no guarantee given that all existing structures and services are shown or located exactly. Positions and levels of these services should be proven on site before the commencement of any works.

For the purposes of plan clarity, some levels may not be displayed on this plan, however, they are visible in model space of this 'DWG'.

No responsibility is taken by Chris Smith & Associates, as to the location of underground services or footings of buildings located in the survey. The client should investigate these matters to ensure they do not effect the possible development or project to be undertaken.

These notes are an integral part of the plan.

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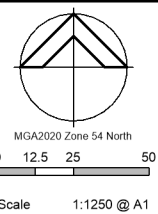


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REVISION	DATE	ZONE



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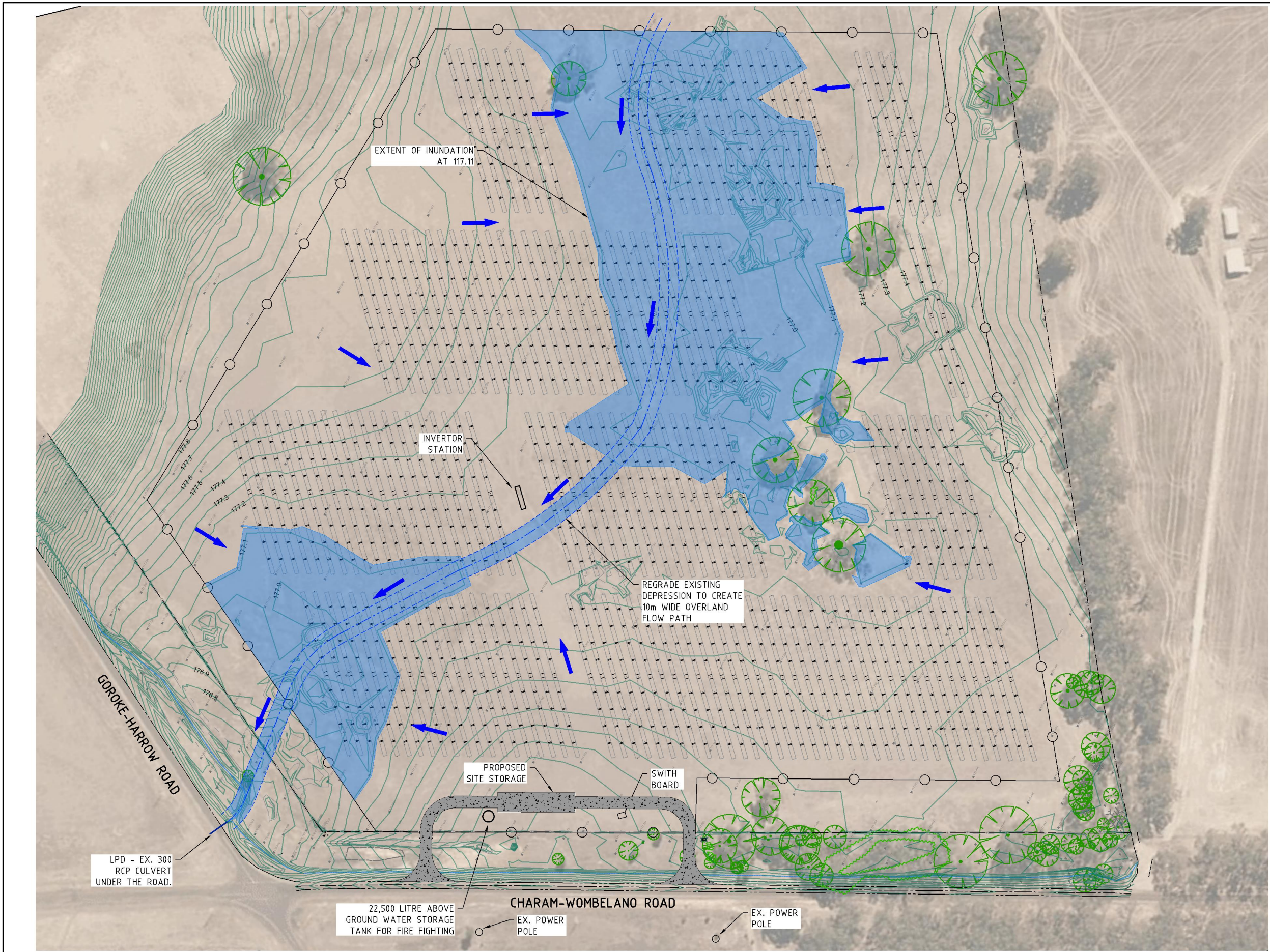
LEVEL 1 / 135 FRYERS STREET, SHEPPARTON, VIC. 3630
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Designed: Robert Spiby-Jones 2nd July 2021
 Drawn: David O'Halloran
 Checked: 6th July 2021
 Approved:

Green Gold Energy Pty. Ltd.
Feature & Conceptual Drainage Design
 Goroke-Harrow Road
 Charam, VIC, 3318
Plan of Existing Conditions as of 23rd June 2021
Drawing No. 21155/01 **Rev. 0**
 Sheet No. 1 of 1 2115501r0.dwg
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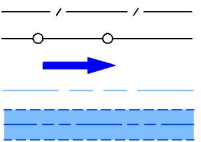


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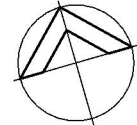
REVISION	DATE	ZONE

LEGEND

- EX. FENCE LINE
- PROP. COMPOUND FENCE
- MAJOR FLOW DIRECTION
- EX. DRAIN
- PROP. OPEN DRAIN (10m WIDE)



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 Designed: Sahar Dinesh August 2021
 Drawn: Sahar Dinesh August 2021
 Checked: Tom Kerrins August 2021
 Approved:

Green Gold Energy Solar Energy Facility
 (micro solar farm)
 33 Goroce-Harrow Rd, Charam
Drainage Works
Overall Layout Plan
 Drawing No. 21155 - D01 Rev. -
 Sheet No. 1 of 1 21155_D01.dwg
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Attachment 3 - Drainage Calculations

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SUMMARY OF RETENTION CALCULATIONS (PRE-DEVELOPMENT)

Client : **Green Gold Energy**
Project : **33 Goroke-Harrow Road, Charam.**
Ref. No. : **21155**

Temporal Rainfall Pattern data for A.R.I. >30 years.		
Catchment area.	75.60	ha
Volumetric runoff coefficient.	0.15	
Design A.R.I.	100	Years
Diameter of outfall discharge pipe.	300	mm
Hydraulic gradient of pipe.	1 in 107	
Pipe roughness coefficient 'k'.	0.15	mm
Discharge rate.	93.0	l/sec

Allowable Discharge 93 L/s
(Culvert Capacity)

Duration	30min		60min		120min		180min		360min		720min		1440min		*Adopted Cumulative Equivalent Intensity mm/hr	Cumulative		Excess m ³							
	Intensity	64.8 mm/hr	41.1 mm/hr	25.8 mm/hr	19.7 mm/hr	12.4 mm/hr	7.86 mm/hr	4.86 mm/hr	Runoff	Outflow															
Interval min.	%	Equivalent Intensity mm/hr.	Cumulative Equivalent Intensity mm/hr.	%	Equivalent Intensity mm/hr.	Cumulative Equivalent Intensity mm/hr.	%	Equivalent Intensity mm/hr.	Cumulative Equivalent Intensity mm/hr.	%	Equivalent Intensity mm/hr.	Cumulative Equivalent Intensity mm/hr.	%	Equivalent Intensity mm/hr.	Cumulative Equivalent Intensity mm/hr.	%	Equivalent Intensity mm/hr.	Cumulative Equivalent Intensity mm/hr.	CIA*(dt) /360 m ³	93 l/s					
0																			0						
60	Pattern			100	41.10	41.10	78.4	40.45	40.45	65.4	38.65	38.65	35.9	26.71	26.71	18.9	17.83	17.83	9.6	11.20	11.20	41.10	4660.74	334.80	4325.94
120							21.6	11.15	51.60	22.9	13.53	52.19	27.5	20.46	47.17	28.6	26.98	44.80	22.8	26.59	37.79	52.19	5917.81	669.60	5248.21
180										11.7	6.91	59.10	14.7	10.94	58.11	8.0	7.55	52.35	14.1	16.45	54.24	59.10	6701.94	1004.40	5697.54
240													10.8	8.04	66.14	8.9	8.39	60.74	6.9	8.05	62.29	66.14	7500.46	1339.20	6161.26
300	Rainfall											6.8	5.06	71.20	5.4	5.09	65.84	5.1	5.95	68.23	71.20	8074.17	1674.00	6400.17	
360												4.3	3.20	74.40	8.2	7.73	73.57	4.1	4.78	73.02	74.40	8436.96	2008.80	6428.16	
420															6.5	6.13	79.70	6.5	7.58	80.60	80.60	9139.84	2343.60	6796.24	
480															4.4	4.15	83.85	4.4	5.13	85.73	85.73	9721.83	2678.40	7043.43	
540	Temporal													4.1	3.87	87.72	1.9	2.22	87.95	87.95	9973.14	3013.20	6959.94		
600														2.7	2.55	90.26	3.4	3.97	91.91	91.91	10422.86	3348.00	7074.86		
660														2.5	2.36	92.62	2.8	3.27	95.18	95.18	10793.21	3682.80	7110.41		
720														1.8	1.70	94.32	2.1	2.45	97.63	97.63	11070.98	4017.60	7053.38		
780																		2.5	2.92	100.54	100.54	11401.65	4352.40	7049.25	
840																		3.8	4.43	104.98	104.98	11904.28	4687.20	7217.08	
900																		1.5	1.75	106.73	106.73	12102.68	5022.00	7080.68	
960																		1.7	1.98	108.71	108.71	12327.54	5356.80	6970.74	
1020																		1.0	1.17	109.87	109.87	12459.81	5691.60	6768.21	
1080																		0.8	0.93	110.81	110.81	12565.63	6026.40	6539.23	
1140																		1.4	1.63	112.44	112.44	12750.80	6361.20	6389.60	
1200																		1.1	1.28	113.72	113.72	12896.30	6696.00	6200.30	
1260																		0.9	1.05	114.77	114.77	13015.34	7030.80	5984.54	
1320																		0.7	0.82	115.59	115.59	13107.93	7365.60	5742.33	
1380																		0.4	0.47	116.06	116.06	13160.84	7700.40	5460.44	
1440																		0.5	0.58	116.64	116.64	13226.98	8035.20	5191.78	

For 100 Year ARI

Maximum Retardation for no outflow condition =
Maximum Retardation for given outflow =
Outflow 300 mm dia. @ 1 in 107

13226.98 m³
7217.08 m³

* Used for plotting of Unit Area Envelope.

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SUMMARY OF RETENTION CALCULATIONS (Proposed Solar Energy Facility)

Client : **Green Gold Energy**
Project : **33 Goroke-Harrow Road, Charam.**
Ref. No. : **21155**

Allowable Discharge 18.6 L/s

Temporal Rainfall Pattern data for A.R.I. >30 years.		
Catchment area.	15.13	ha
Volumetric runoff coefficient.	0.22	
Design A.R.I.	100	Years
Diameter of outfall discharge pipe.		mm
Hydraulic gradient of pipe.	1 in	
Pipe roughness coefficient 'k'.		mm
Discharge rate.	18.6	l/sec

Duration	30min		60min		120min		180min		360min		720min		1440min		*Adopted Cumulative Equivalent Intensity mm/hr	Cumulative		Excess m ³							
	Intensity	64.8 mm/hr	41.1 mm/hr	25.8 mm/hr	19.7 mm/hr	12.4 mm/hr	7.86 mm/hr	4.86 mm/hr	Runoff m ³	Outflow l/s															
Interval min.	%	Equivalent Intensity mm/hr.	Cumulative Equivalent Intensity mm/hr.	%	Equivalent Intensity mm/hr.	Cumulative Equivalent Intensity mm/hr.	%	Equivalent Intensity mm/hr.	Cumulative Equivalent Intensity mm/hr.	%	Equivalent Intensity mm/hr.	Cumulative Equivalent Intensity mm/hr.	%	Equivalent Intensity mm/hr.	Cumulative Equivalent Intensity mm/hr.	%	Equivalent Intensity mm/hr.	Cumulative Equivalent Intensity mm/hr.	CIA*(dt) /360 m ³	18.6 l/s					
0																			0						
60	Pattern			100	41.10	41.10	78.4	40.45	40.45	65.4	38.65	38.65	35.9	26.71	26.71	18.9	17.83	17.83	9.6	11.20	11.20	41.10	1368.05	66.96	1301.09
120							21.6	11.15	51.60	22.9	13.53	52.19	27.5	20.46	47.17	28.6	26.98	44.80	22.8	26.59	37.79	52.19	1737.04	133.92	1603.12
180										11.7	6.91	59.10	14.7	10.94	58.11	8.0	7.55	52.35	14.1	16.45	54.24	59.10	1967.20	200.88	1766.32
240													10.8	8.04	66.14	8.9	8.39	60.74	6.9	8.05	62.29	66.14	2201.59	267.84	1933.75
300													6.8	5.06	71.20	5.4	5.09	65.84	5.1	5.95	68.23	71.20	2369.99	334.80	2035.19
360													4.3	3.20	74.40	8.2	7.73	73.57	4.1	4.78	73.02	74.40	2476.48	401.76	2074.72
420																6.5	6.13	79.70	6.5	7.58	80.60	80.60	2682.79	468.72	2214.07
480																4.4	4.15	83.85	4.4	5.13	85.73	85.73	2853.62	535.68	2317.94
540																4.1	3.87	87.72	1.9	2.22	87.95	87.95	2927.39	602.64	2324.75
600																2.7	2.55	90.26	3.4	3.97	91.91	91.91	3059.39	669.60	2389.79
660	Rainfall														2.5	2.36	92.62	2.8	3.27	95.18	95.18	3168.10	736.56	2431.54	
720															1.8	1.70	94.32	2.1	2.45	97.63	97.63	3249.63	803.52	2446.11	
780																		2.5	2.92	100.54	100.54	3346.70	870.48	2476.22	
840																		3.8	4.43	104.98	104.98	3494.23	937.44	2556.79	
900																		1.5	1.75	106.73	106.73	3552.47	1004.40	2548.07	
960																		1.7	1.98	108.71	108.71	3618.47	1071.36	2547.11	
1020																		1.0	1.17	109.87	109.87	3657.30	1138.32	2518.98	
1080																		0.8	0.93	110.81	110.81	3688.36	1205.28	2483.08	
1140																		1.4	1.63	112.44	112.44	3742.71	1272.24	2470.47	
1200																		1.1	1.28	113.72	113.72	3785.42	1339.20	2446.22	
1260	Temporal																0.9	1.05	114.77	114.77	3820.36	1406.16	2414.20		
1320																	0.7	0.82	115.59	115.59	3847.54	1473.12	2374.42		
1380																	0.4	0.47	116.06	116.06	3863.07	1540.08	2322.99		
1440																	0.5	0.58	116.64	116.64	3882.48	1607.04	2275.44		

* Used for plotting of Unit Area Envelope.

For 100 Year ARI
Maximum Retardation for no outflow condition =
Maximum Retardation for given outflow =
Outflow mm dia. @ 1 in

3882.48 m³
2556.79 m³

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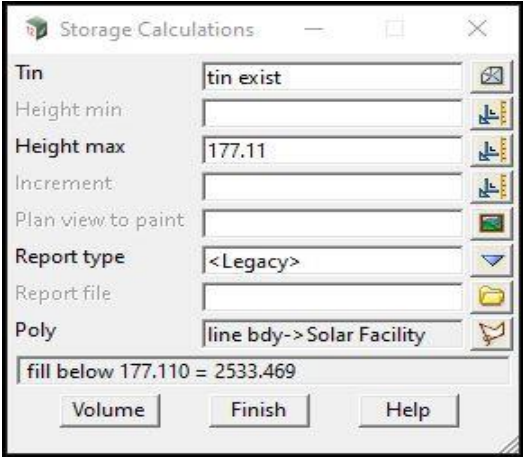
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ADVERTISED PLAN

Drainage Calculations

Client : Green Gold Energy
 Project : Proposed Solar Energy Facility - 33 Goroke-Harrow Road, Charam.

<u>Capacity - Existing Pipe culvert (300mm dia. RCP)</u>			
Pipe Inverts			
Upstream	=	176.1	
Downstream	=	176.0	
Pipe Lenth	=	10.71 m	
Existing Pipe Grade	=	1 IN	107
Pipe Capacity	=	93	l/s



ADVERTISED
PLAN

	Area (ha)	Discharge (l/s)
Total Farm Land Area	75.6	93
Proposed Solar Energy Facility	15.13	18.6

	Area (ha)	Pre-development		Post - development	
		Runoff Coefficient	Storage Requirement	Runoff Coefficient	Storage Requirement
Total Farm Land	75.6	0.15	7217		
Proposed Solar Energy Facility	15.13	0.15	1445	0.22	2557

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