

**EAST LONDON AIRPORT PV FARM:**  
**PROPOSED STORMWATER CONCEPT DESIGN REPORT**



OUR REF NO. 1801691

**JULY 2020**

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# DOCUMENT CONTROL SHEET

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00	Internal Review	29 July 2020	PCD
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## **1 INTRODUCTION**

Element Consulting Engineers (Pty) Ltd (ECE) was appointed by Brand/Besamandla Engineering to compile a Storm Water Management Plan (SWMP). The SWMP is required for the construction of solar photovoltaic ground-mounted installations located at the East London Airport.

In general, a SWMP documents the final stormwater control and proposes infrastructure solutions of a specific engineering design for a specific facility. Due to the need for prior approval from the Department of Water and Sanitation (DWS) before the civil services design can be finalised a formal SWMP would not be possible at this time.

This report however addresses the general stormwater management principles and stormwater design philosophies which could be used to finalise the design after approval from DWS and will be referred to as a Proposed Stormwater Concept Design Report.

## **2 SITE TOPOGRAPHY AND GEOTECHNICAL INVESTIGATION**

The solar photovoltaic ground-mounted installation site is located along the North-Eastern boundary of the East London Airport, South Africa. Refer to the Locality Plan contained in Annexure A for the specific placement of the proposed site of works.

The existing topography slopes varies between gradients of 0.6% and 10%. The site is currently free draining as all stormwater run-off flows toward the adjacent wetland/river coarse way. A 1:100-year floodline has been identified and has an influence on the site as indicated on the drawing in Annexure B. The floodline was analysed by specialists in accordance with the National Water Act (ACT NO 36 OF 1998). The floodline investigation on the drawing (Annexure B) represents the approximate maximum levels that stormwater will reach during a flood with storm recurring interval of 1:100 years.

An environmental biodiversity report was compiled and is attached in Annexure H. In the biodiversity report, several alien plant species were identified on site. The alien plant species include dense Gum trees, Guava trees and Black Wattle trees. The invasive tree species reaches heights of approximately 10m. According to the biodiversity study the construction of a solar photovoltaic ground-mounted installation facility within the proposed study site will have little effect on the natural environment. A dedicated "No Work" area of 32m on each side of the low-lying area (64m total) was however identified.

A geotechnical investigation was also completed on the proposed site, as contained in Annexure C. From the report the topsoil horizon would contain transported materials. Within the three trial pits that were excavated, the soil varied between sandy silt with some ferricrete nodules and silty clay with slightly moist conditions and was observed to be firm in consistency. The Foundation Indicator results showed clayey horizons in the range between 9% to 51% with a PI varying between 6 and 25. Although no water seepage was recorded in any of the trial pits, it was recommended that high water tables should be taken into consideration in the design of any foundations. The geotechnical report concluded that the material on site would not be suitable for reuse and allowance should be made for the removal of unsuitable material and the importation of suitable construction materials. DCP tests indicated an estimated safe bearing pressure of more than 120kPa.

### **3 EXISTING STORMWATER CONDITIONS**

The current stormwater conditions on site is observed as an overland flow system accumulating into a low-lying wetland/river area. There is no additional formalised installed stormwater infrastructure. The low-lying area is affected by a 1:100 flood influence area as identified in Annexure B.

Based on The South African National Roads Agency Drainage Manual (The Drainage Manual) the site is identified as a Flat Area (From Table 3.7). The biodiversity report identifies the area as having 90% thick bush and 10% grassland.

A pre-development analysis of run-off flow was done based on procedures and calculations as set out in The Drainage Manual using the Rational Method and is attached in Annexure F. From this analysis it is calculated that the 1:100-year pre-development run-off would approximately be  $Q=0.120\text{m}^3/\text{s}$ .

### **4 PROBLEM IDENTIFICATION**

As stated previously in this report and indicated on the 1:100-year floodline layout plan (Annexure B). There is a flood risk due to the adjacent low-lying area to the site which also intrudes into a portion of the site.

As identified by the geotechnical report a high water table should also be taken into consideration when planning any infrastructure. The top layer of sandy silt will require special consideration in the form of erosion protection to areas with focused stormwater flow. A relatively low bearing capacity was identified with the possibility of soil heave due to a clay layer, this will require careful foundation and road layerworks design.

An additional influencing factor on the civil engineering design is that the solar panels have already been delivered to site on the previous site location and design. These solar panels limit the maximum allowable variation in ground gradients to 4%. The current proposed site of works however has ground slopes exceeding the maximum allowed 4 %.

The PV plant facility has specific requirements with regards to site clearance. In general, the entire plant area must be totally cleared from tall growing vegetation, such as trees, bushes, and undergrowth, to ensure effective system operations. The vegetation must be cut down to 150mm from natural ground level to accommodate the proposed tracker system. Where trees are removed in the proximity of the PV tracker support structure and anchoring system, the stump and roots should also be removed.

As indicated by the biodiversity report, the trees in the area may reach heights of approximately 10m. The height of the trees and subsequent resultant shadows from the trees may result in less effective electricity yield. It may thus be required to remove additional trees in certain areas.

## **5 ACCEPTABLE STORMWATER DESIGN PHILOSOPHIES/PRINCIPLES**

The purpose of the designed stormwater system will be to manage stormwater flows in a manner that causes minimum interference with naturally occurring overland flow routes. The proposed stormwater design philosophy will not incorporate any underground stormwater infrastructure. Roads will be constructed to tie into the natural ground level to accommodate the natural overland stormwater flow. Storm water from roads, buildings (structures) and open areas will be conveyed overland to the low-lying area.

Where high stormwater flow erosion is expected at concentrated flow areas, like road crossings, concrete or other suitable protective lining methods will be provided to protect the road surface. The properties of the in-situ soil identify the need for additional erosion protection and sediment control measures. Therefore, the intention is not to clear the majority of the PV plant areas of low growing vegetation, such as grass, but only clear areas where roads and above ground structures are to be located. Grass roots assist in topsoil preservation and soil stability. Grassed areas must be cut to 150mm from natural ground level and maintained at this level, to accommodate the PV tracker system. Slopes created through bulk earthworks will be stabilised and protected against erosion.



## 6 STORMWATER SOLUTIONS AND POSSIBLE APPROACHES

The maximum allowable gradient change for the solar panel mounting system (already delivered to site) is 4%. The site would therefore require additional bulk earthworks fill and/or cut within the low lying 1:100 flood line area (where steeper gradients are observed) intruding into the designated solar site to bring the site of works to the maximum 4% NGL allowable gradients.

There are currently two workable proposals for the construction of the civil infrastructure. Taking the influencing elements mentioned earlier in this report into account.

**Proposal 1** is for the site of works to incorporate bulk earthworks fill, with material from commercial sources, to address the steep gradients as per Annexure D. This option is the most expensive of the two options due to the importation of commercial fill material being very expensive. This option will however ensure easier access to the entire site.

**Proposal 2** is for the site of works to be cut into lower lying terraces as indicated in Annexure E. This is the most cost-effective option. This option will however require different levelled platforms and would restrict easy movement between the different sections of panels.

An alternate third option was discussed to lengthen the PV supporting structure poles of solar panels to accommodate the varying slopes of the natural ground level. It was however indicated by the Electrical Engineer that this would not be a workable proposal as maintenance difficulties would be encountered due to the varying heights and the construction costs would be unfeasible.

In line with the proposed stormwater design philosophy, all civil services will be constructed at natural ground level where possible. No attenuation will be done next to the demarcated low-lying wetland area. No clearing and grubbing will be done, only cutting of vegetation taller than 150mm. The Guidelines for Human Settlement Planning and Design Guidelines (Red Book) will be incorporated for design specifications.

A post-development analysis of the stormwater run-off flow was done based on procedures and calculations as set out in The Drainage Manual and is attached in Annexure G. From this analysis it is calculated that the 1:100 flood pre-development run-off will be approximately  $Q=0.149\text{m}^3/\text{s}$ .

## 7 OPERATION AND MAINTENANCE

Table 7 below provides a proposed summary of the maintenance activity and schedule of implementation. A lack of maintenance will cause major damage to the newly constructed infrastructure and the natural environment.

Table 7: Maintenance and Activity Schedule

<u>Activity</u>	<u>Schedule</u>
Stabilize any eroded areas	Annually in June, at the beginning of the rainy season
Replacement of dead or dying vegetation	Annually in June, at the beginning of the rainy season
Cutting and maintaining height of vegetation	Ongoing as required

## 8 CONCLUSION

From this report, the following can be concluded:

- No underground stormwater infrastructure will be constructed.
- The vegetation will have to be carefully managed.
- Low to weak soil bearing capacity and high soil erosion potential require engineering intervention.
- Due to topographical constraints, geotechnical conditions, and already pre delivered materials, the selected site of works would require special modification to accommodate the PV facility.
- Two possible solutions have been proposed, for consideration, in the form of bulk earthworks fill or cut interventions. Both proposals would influence the final stormwater management of the site.
- Either proposed engineering solution will have to be done in such a way to maintain the current stormwater drainage characteristics of the original site.



## 9 RECOMMENDATION

It is recommended that standard engineering design practices and methods be utilised to ensure acceptable stormwater infrastructure of the site of works. The Guidelines for Human Settlement Planning and Design Guidelines should be used for design specifications. Minimum and maximum slopes and gradients on stormwater infrastructure should be carefully considered and designed according to applicable minimum standards.

User surfaces (E.g. Roads, focused stormwater channels, walkways, storage areas etc.) would require hardened protection against erosion and to provide the minimum soil bearing capacities associated with the respected uses thereof.

Vegetation root systems will be left intact as far as possible to maintain soil stability. Vegetation must be cut to 150mm from natural ground level underneath PV panels and maintained at this level, to accommodate the PV tracker system.

Stormwater management will follow the principle of managing stormwater flows in a manner that causes minimum interference with naturally occurring overland flow routes and not use any underground stormwater infrastructure.

## **ANNEXURE A: LOCALITY PLAN**

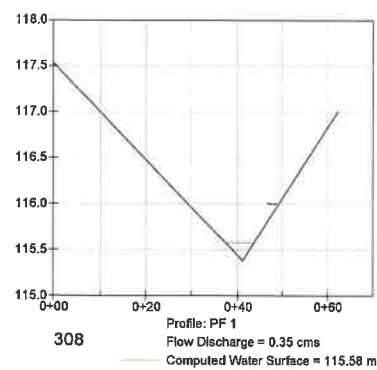
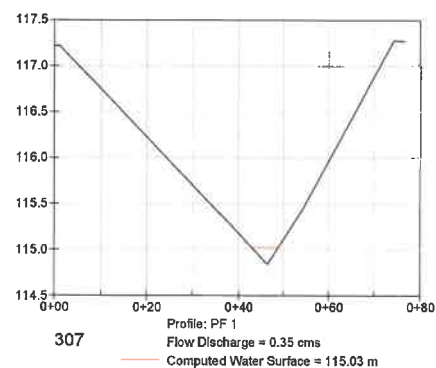
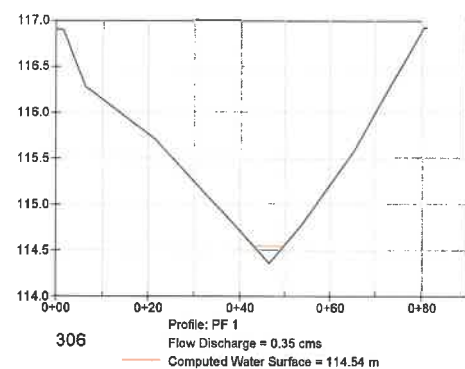
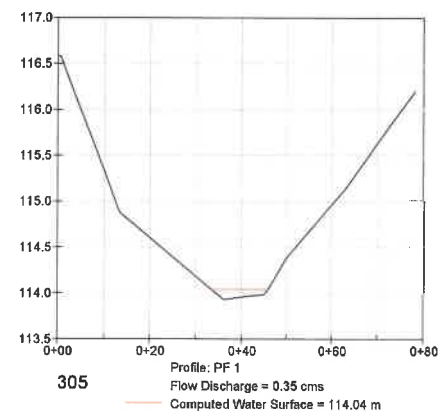
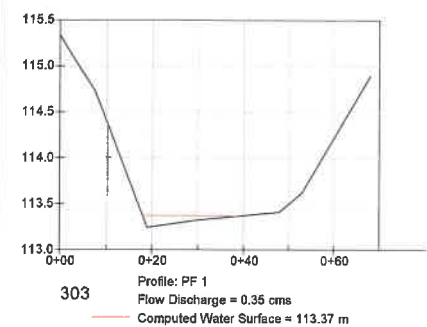




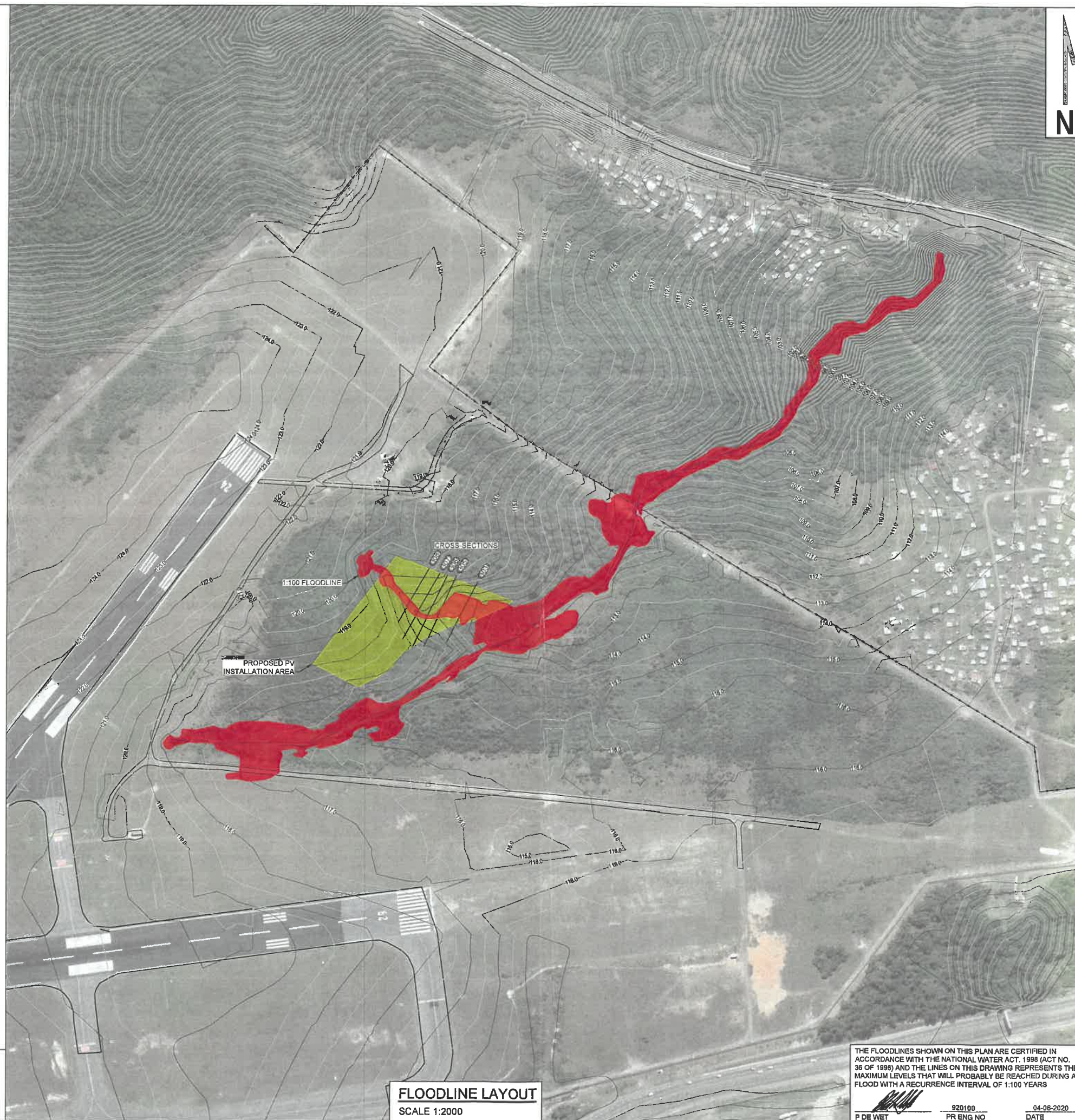


## **ANNEXURE B: FLOODLINE AREA**





**CROSS SECTIONS**  
SCALE 1:1000



THE FLOODLINES SHOWN ON THIS PLAN ARE CERTIFIED IN ACCORDANCE WITH THE NATIONAL WATER ACT, 1998 (ACT NO. 36 OF 1998) AND THE LINES ON THIS DRAWING REPRESENTS THE MAXIMUM LEVELS THAT WILL PROBABLY BE REACHED DURING A FLOOD WITH A RECURRENCE INTERVAL OF 1:100 YEARS

P DE WET 920100 04-08-2020  
PR ENG NO DATE

Case File Name: P16055-CA-01-CIV-FL-001_REV 1_FLOODLINE LAYOUT		DBEC-MRPRO-09-08
<div> </div>		
FOR COUNCIL APPROVAL		
PROPOSED PV SOLAR INSTALLATION AREA		
1:100 FLOODLINE EXTENT		
M CONTOUR (1m INTERVAL)		
G CONTOUR (0.5m INTERVAL)		
Client		
<div> </div>		
Consultant		
<div> </div>		P O BOX 35703 MENLO PARK 0102 TEL: (012) 368 1850 FAX: (012) 348 4738
Project ACSA EAST LONDON SOLAR PV		
Project Description PV SOLAR INSTALLATION		
Drawing Title FLOODLINE ANALYSIS LAYOUT		
Drawing Units METRES		
Date MAY 2020	Scale AS SHOWN	Designed By N DE BEER
Checked By D DERCKSEN	Drawn By R HURD	Approved By P DE WET
Drawing No. P16055-CA-01-CIV-FL-001		



## **ANNEXURE C: GEOTECHNICAL REPORT**





HEAD OFFICE: 1 Alfred Road, Vincent 5247, Tel: 043 726 7859, Fax: 043 726 7426

CENTRAL LABORATORY: 10 St Pauls Road, East London, 5201, Tel: 043 722 5420 / 722 8565, Fax: 043 743 9942, P O Box 346, East London, 5200

OTHER BRANCH OFFICES: Cape Town, Kokstad, Johannesburg, Mthatha, Queenstown, Lusaka - Zambia

Reference: 250620Rep - East London Airport Solar Plant

25 June 2020

Besamandla (Pty) Ltd  
P O Box 36636  
CHEMPET  
7442

ATTENTION: MR B DONALDSON

Dear Sir

## **P16055: PROPOSED NEW SOLAR PLANT EAST LONDON AIRPORT: GEOTECHNICAL REPORT**

Controlab was requested to do a geotechnical investigation at the East London Airport where a solar plant was planned. The East London Airport was situated on the western side of the city.



The study site was located within the city of East London within the Eastern Cape Province

The investigation consisted of three (3) trial pits excavated by hand to depths ranging between 700mm (TP3) and 1500mm (TP1). Dynamic Cone Penetrometer (DCP) tests were performed adjacent to the trial pit positions. The trial pits were profiled by a qualified Engineering Technician utilising "The Revised Guide to Soil Profiling for Civil Engineering Purposes in Southern Africa" produced by Jennings, Brink and Williams. The trial pit profiles are attached to this document. The proposed site for the solar plant was situated in the eastern part of the airport.

East London normally receives about 593mm of rain per year, with most rainfall occurring during summer. It receives the lowest rainfall (16mm) in July and the highest (79mm) in March. The average midday temperatures for East London range from 20°C in July to 26°C in February. The region is the coldest during July when the temperature drops to 9.3°C on average during the night. Consult the chart below (lower right) for an indication of the monthly variation of average minimum daily temperatures. East London falls within the coastal condensation belt.

Wienerts climatic N number for the area is less than 2, which should indicate that the rocks would decompose implying that chemical weathering would dominate over mechanical weathering.



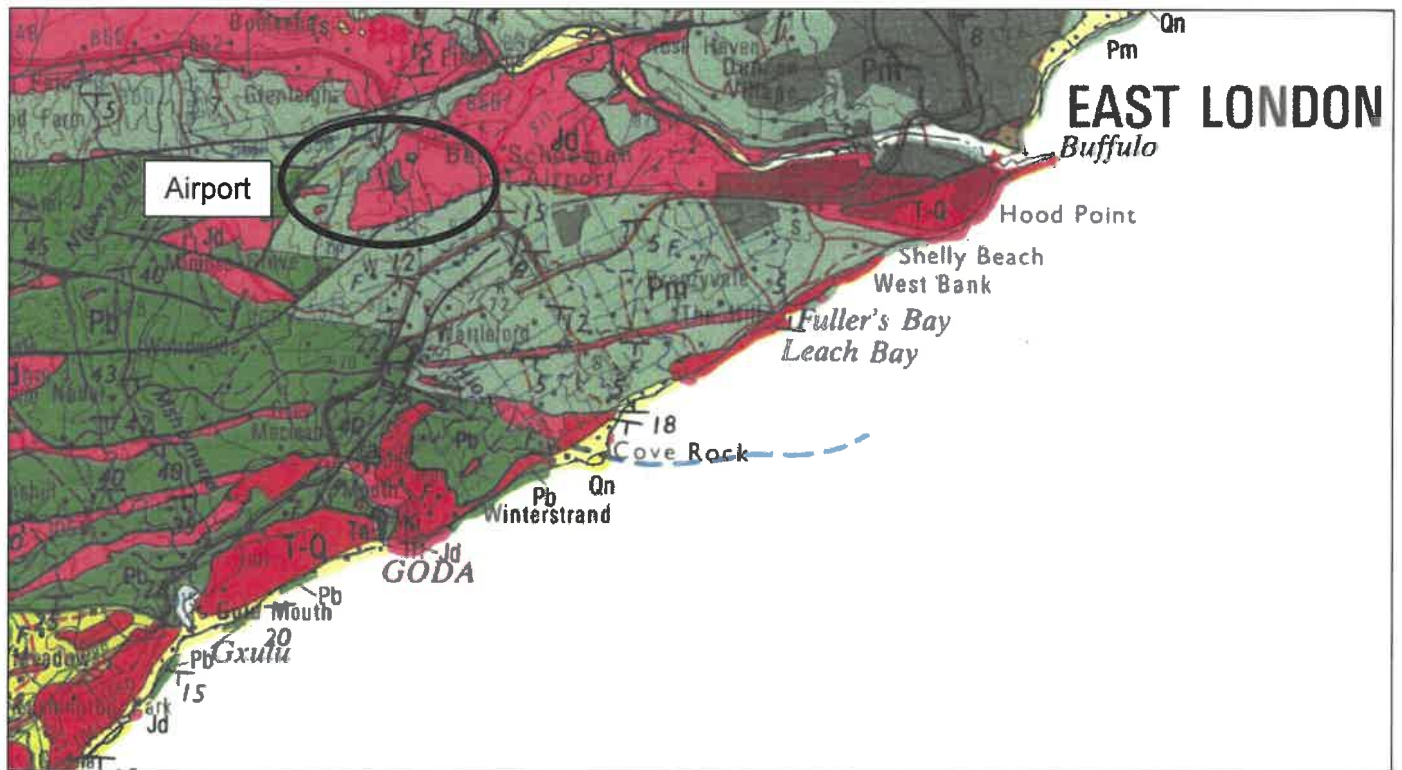
According to the geological map published in 1984 by the Chief Director of Surveys and Mapping, the site under investigation falls within alternating layers of sandstone and mudstone of the Adelaide Subgroup belonging to the greater Karoo Supergroup.

These formations consist of a great abundance of sandstone and red mudstone. The Subgroup attains a thickness of close to 200m and a minimum of about 150m in the north of its extent.

The light brown to grey sandstones are of a general fine to medium grain with scattered pebbles commonly found. The mudstones are very fine grained grey to greenish grey in colour and often contain calcareous nodules. All sediment is fractured and jointed. The Adelaide Subgroup attains a maximum thickness of 5000m in the south eastern regions of the Karoo Basin but thins out to about 800m towards the centre of the basin.

In the southern and central parts, the Adelaide Subgroup consists of alternating blueish grey, greenish grey or greyish red mudrock and grey, very fine to medium grained lithofelspathic sandstones. The sandstones become very coarse in the northern sections of the Basin.

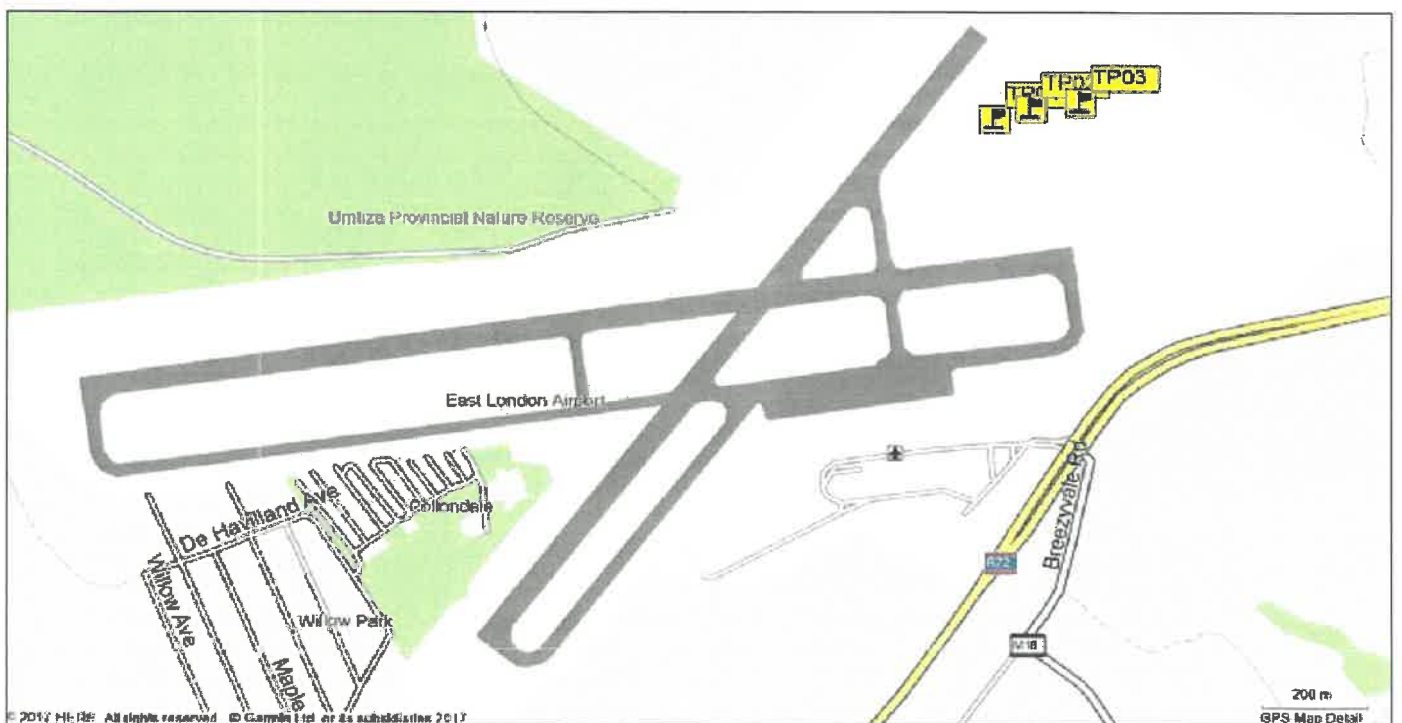
These formations consist of a great abundance of sandstone and red mudstone. The Subgroup attains a thickness of close to 200m and a minimum of about 150m in the north of its extent.



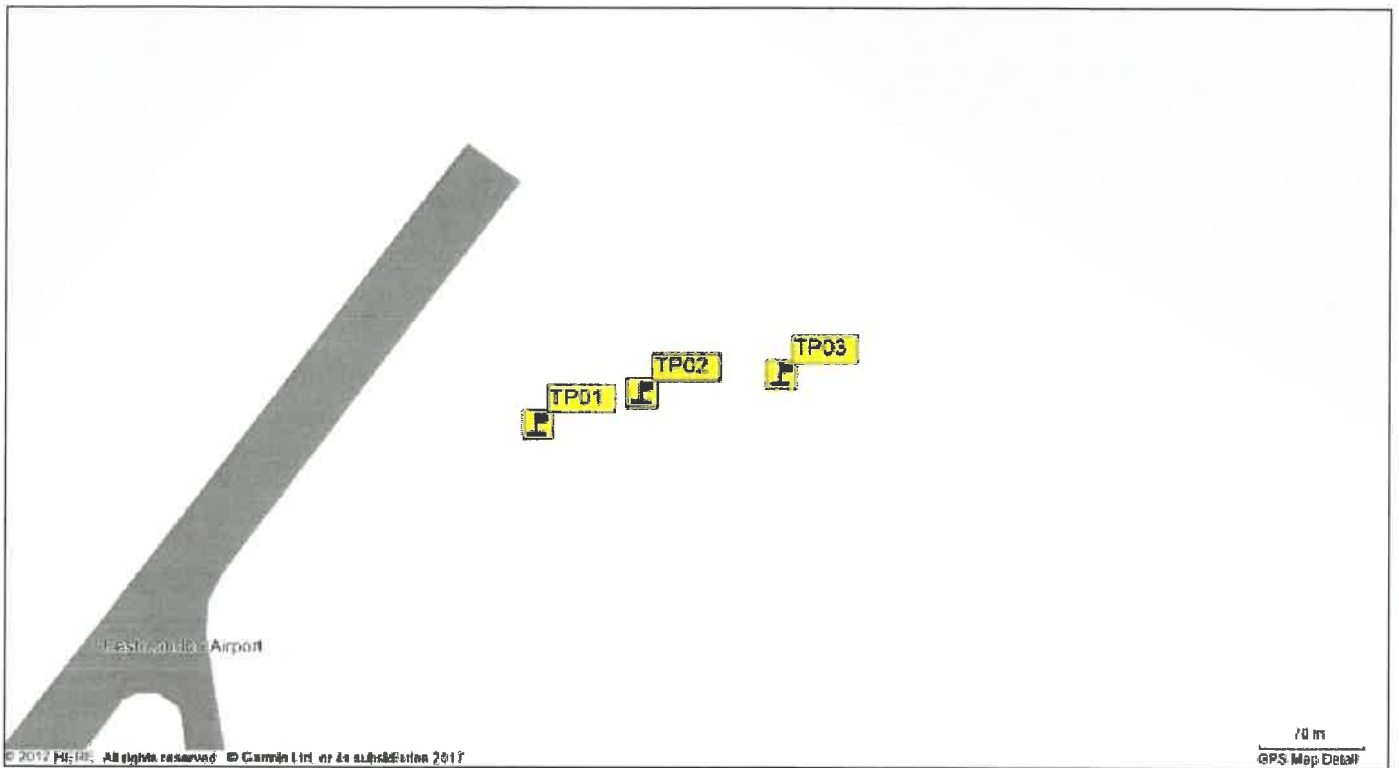
Position of the study site and relevant geological units of the Karoo Supergroup

The co-ordinates for the trial pits and DCP tests were as follows:

➤ Trial Pit 1	S 33°01'56.0"	E 27°49'51.0"
➤ Trial Pit 2	S 33°01'55.3"	E 27°49'53.7"
➤ Trial Pit 3	S 33°01'54.9"	E 27°49'57.3"







## BRIEF INTERPRETATION OF THE TEST RESULTS

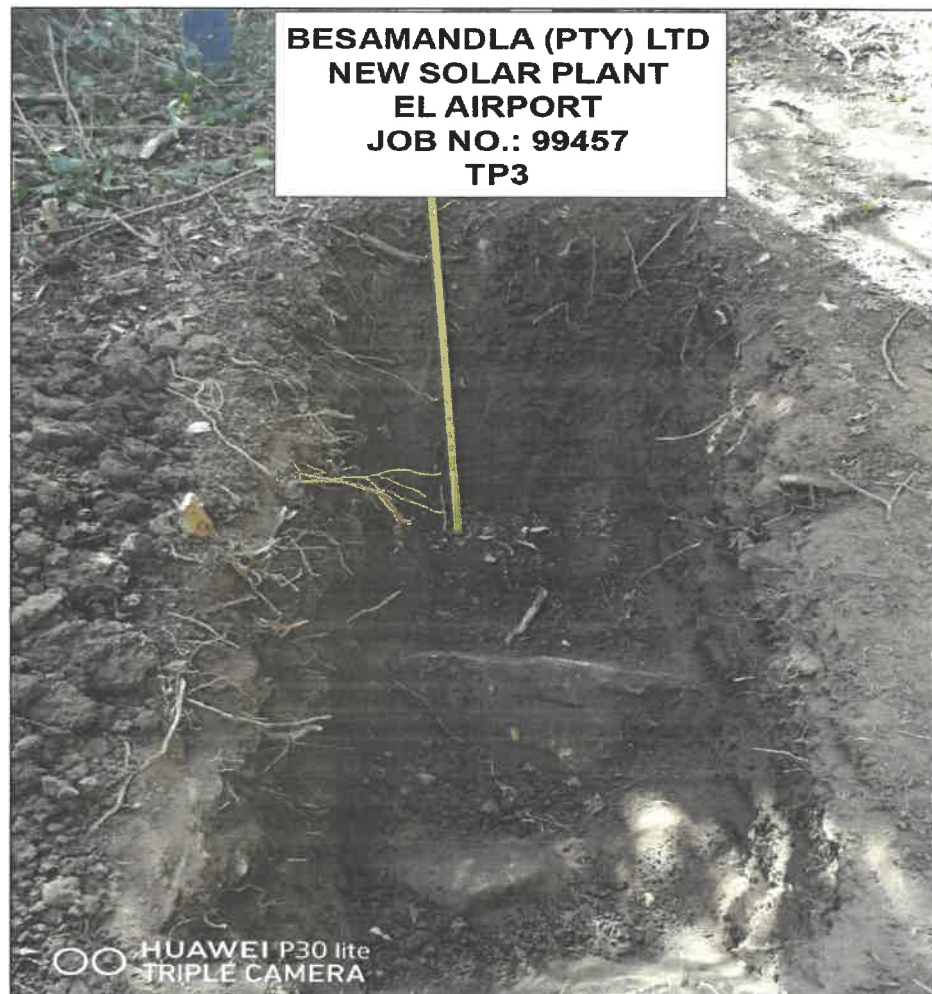
- **Typical Horizons**

The transported material profiled within the three trial pits varied between sandy silt with some ferricrete nodules and silty clay. The moisture conditions profiled was slightly moist, the consistency firm and the structures intact.

The residual material encountered consisted of weathered decomposed dolerite.

The excavation depths were as follows:

➤ Trial Pit 1	No ground water	No refusal @ 1500mm
➤ Trial Pit 2	No ground water	No refusal @ 1300mm
➤ Trial Pit 3	No ground water	Refusal @ 700mm on boulders



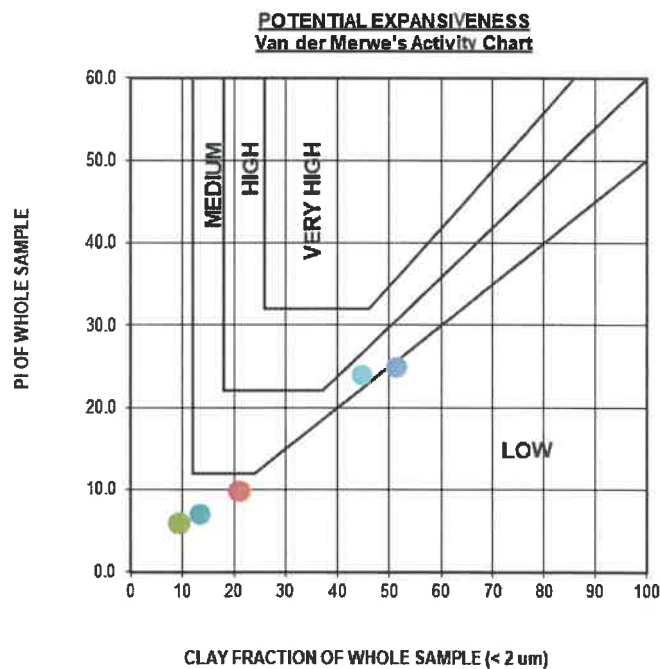
Excavation refusal on boulders in TP3

- Foundation Indicators**

The Foundation Indicator results showed that the clayey horizons were medium to highly expansive. The clay content determined ranged between 9% and 51% with the PI of the whole sample varied between 6 and 25.

These medium heave materials were encountered at depths in excess of 900mm and should be taken into consideration in the foundation design.

POSITION	DEPTH	DESCRIPTION	0.002 mm	LINEAR SHRINKAGE	PI WHOLE SAMPLE	POTENTIAL EXPANSIVENESS
TP 1	0 - 500	dk Br sdy st	9	3.0	6.0	LOW
TP 1	500 - 800	dk R Br Ferr + cly s	21	8.5	10.0	LOW
TP 1	1000 - 1500	dk Y weath dec Dol	45	13.0	24.0	MED
TP 2	540 - 930	dk Br sdy st + Ferr	13	7.0	7.0	LOW
TP 3	0 - 700	dk R Br sdy st	21	6.0	10.0	LOW
TP 3	930 - 1300	dk R Br sty cl	51	14.5	25.0	MED





- Road Indicators**

Three (3) Road Indicator samples were taken to determine the suitability of the material to be used during construction. The results indicated that the sandy silt would conform to a G9 material classification. The use of material on site would not be recommended. The horizons of material with high PI values were evident and it would be difficult to separate the transported material to select material suitable for use.

POSITION	DEPTH	DESCRIPTION	G. M.	LL (%)	PI (%)	LS (%)	MDD (kg/m <sup>3</sup> )	OMC (%)	C.B.R. @ 100%	C.B.R. @ 95 %	C.B.R. @ 90 %	SWELL (%)	TRH14 CLASS
TP 1	0 - 500	dk Br sdy st	0.7	25	7	3.0	1792	12.9	36	22	14	0.20	G7
TP 1	500 - 800	dk R Br Ferr + cly s	1.3	37	18	8.5	1720	19.5	41	18	8	0.40	G9
TP 1	1000 - 1500	dk Y weath dec Dol	0.3	58	27	13.0							
TP 2	540 - 930	dk Br sdy st + Ferr	1.4	35	13	7.0							
TP 2	930 - 1300	dk R Br sty cl	0.5	53	29	14.5							
TP 3	0 - 700	dk R Br sdy st	0.6	29	11	6.0	1834	13.9	34	15	7	0.30	G9

- DCP Results/Bearing Capacity**

DCP tests were performed at all of the tests. Based on the DCP penetration rate the estimated safe bearing pressure (ESBP) was in excess of 120kPa. The "Use and Interpretation of the Dynamic Cone Penetrometer (DCP) Test" by P Paige-Green and L Du Plessis was used to determine the estimated safe bearing pressure from the DCP penetration rate.

POSITION	CO-ORDINATE	DCP DEPTH
TP 1 @ Ground Level	S 33°01'56.0" E 27°49'51.0"	No Refusal
TP 1 Ground Level minus 1400mm	S 33°01'56.0" E 27°49'51.0"	Refusal @ 900mm
TP 2 Ground Level minus 1400mm	S 33°01'55.3" E 27°49'53.7"	No Refusal
TP 3 @ Ground Level	S 33°01'54.9" E 27°49'57.3"	Refusal @ 905mm
TP 3 Ground Level minus 700mm	S 33°01'54.9" E 27°49'57.3"	Refusal @ 695mm
TP 1 @ Ground Level	S 33°01'56.0" E 27°49'51.0"	No Refusal

Note that the DCP penetration rate will change with any changes to the moisture content or density of the material tested.

- Ground Water/Dampness**

Although no water seepage was recorded in any of the trial pits, the ferricrete nodules profiled in the second sandy silt horizon was an indication of fluctuating water tables and it would be recommended that high water tables should be taken into consideration in the design of the foundations.

- **Excavations**

Excavations were done by hand and all excavations for formal foundations can be classified as being soft. The residual material consisted of weathered decomposed dolerite that will vary in hardness.

Based on the profiles and DCP test results performed for the geotechnical investigation it can be said that the clayey material and decomposed dolerite had risks with regards to heave. The Road Indicator tests showed that the material on site would not be suitable for reuse and allowance should be made for the removal of unsuitable material and the importation of suitable material for the foundations. The DCP tests indicated an estimated safe bearing pressure in the order of an excess of 120kPa.

Please note that Controlab had no information with regards to the proposed founding solutions.

While every effort has been made during the fieldwork phase of this investigation to identify the various soil horizons, their problems and distribution, it is impossible to guarantee that isolated zones of poorer material have not been missed. The investigation was, however, thorough and conditions are not expected to vary from those described in this report. The engineers are nevertheless strongly urged to inspect service trenches and foundations once opened to assure themselves that conditions are not at a variance with those described in this report. Disparities in founding material type should be referred to an expert.

Note that this report does not give a foundation design but offers an interpretation of the laboratory test results.

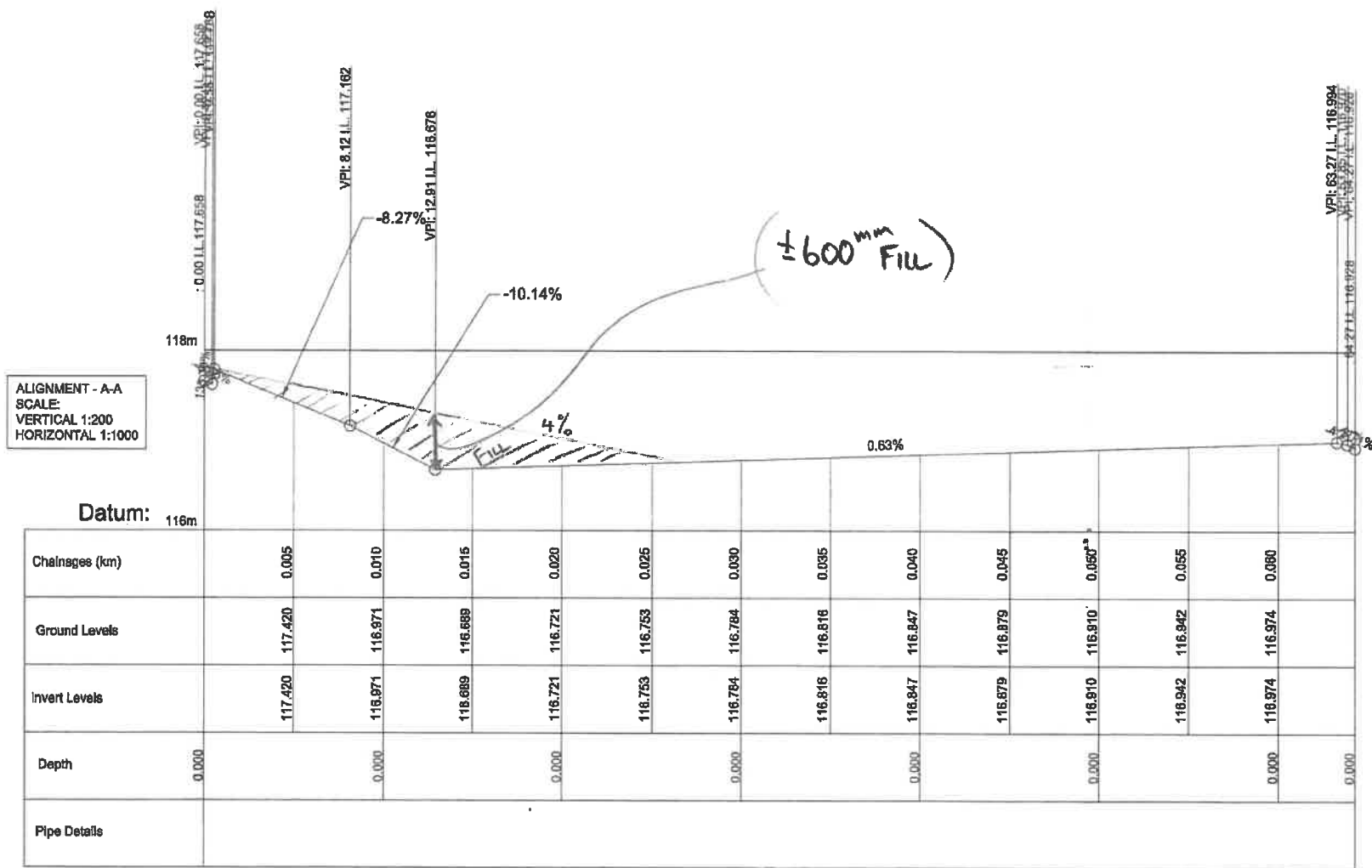
Regards,

A handwritten signature in black ink, appearing to read 'Deon Louw', with a long horizontal flourish extending to the right.

**DEON LOUW** Pr. Tech. Eng, MSc (Civil)  
**MANAGING DIRECTOR**

**ANNEXURE D: BULK EARTHWORKS PROPOSAL 1**  
**(BULK FILL)**





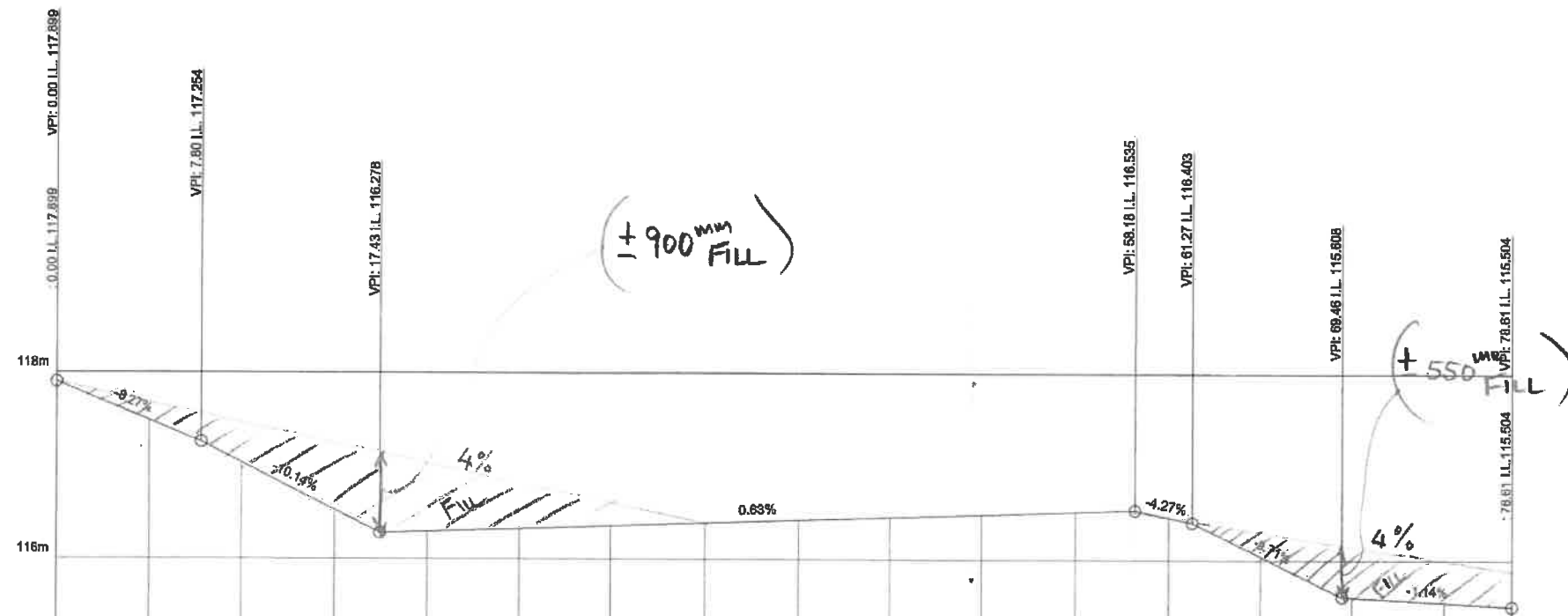
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SCALE:  
VERTICAL 1:200  
HORIZONTAL 1:1000

Datum: 1

Chainages (km)
Ground Levels
Invert Levels
Depth
Pipe Details

ALIGNMENT - B-B  
SCALE:  
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HORIZONTAL 1:1000

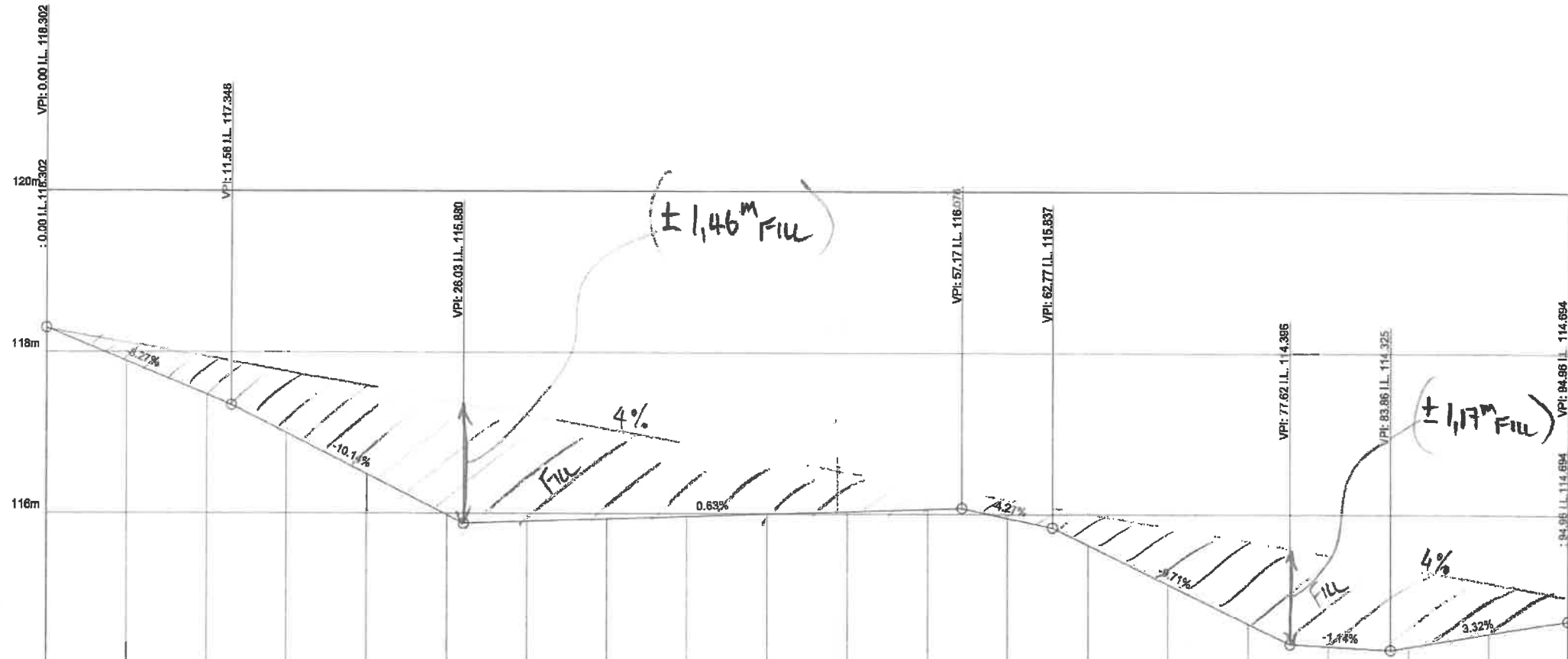
Datum: 114m																														
Chainages (km)		0.005		0.010		0.015		0.020		0.025		0.030		0.035		0.040		0.045		0.050		0.055		0.060		0.065		0.070		0.075
Ground Levels		117.488		117.031		116.524		116.294		116.326		116.357		116.389		116.421		116.452		116.484		116.515		116.458		116.042		115.602		115.545
Invert Levels		117.488		117.031		116.524		116.294		116.326		116.357		116.389		116.421		116.452		116.484		116.515		116.458		116.042		115.602		115.545
Depth	0.000		0.000		0.000		0.000		0.000		0.000		0.000		0.000		0.000		0.000		0.000		0.000		0.000		0.000		0.000	
Pipe Details																														

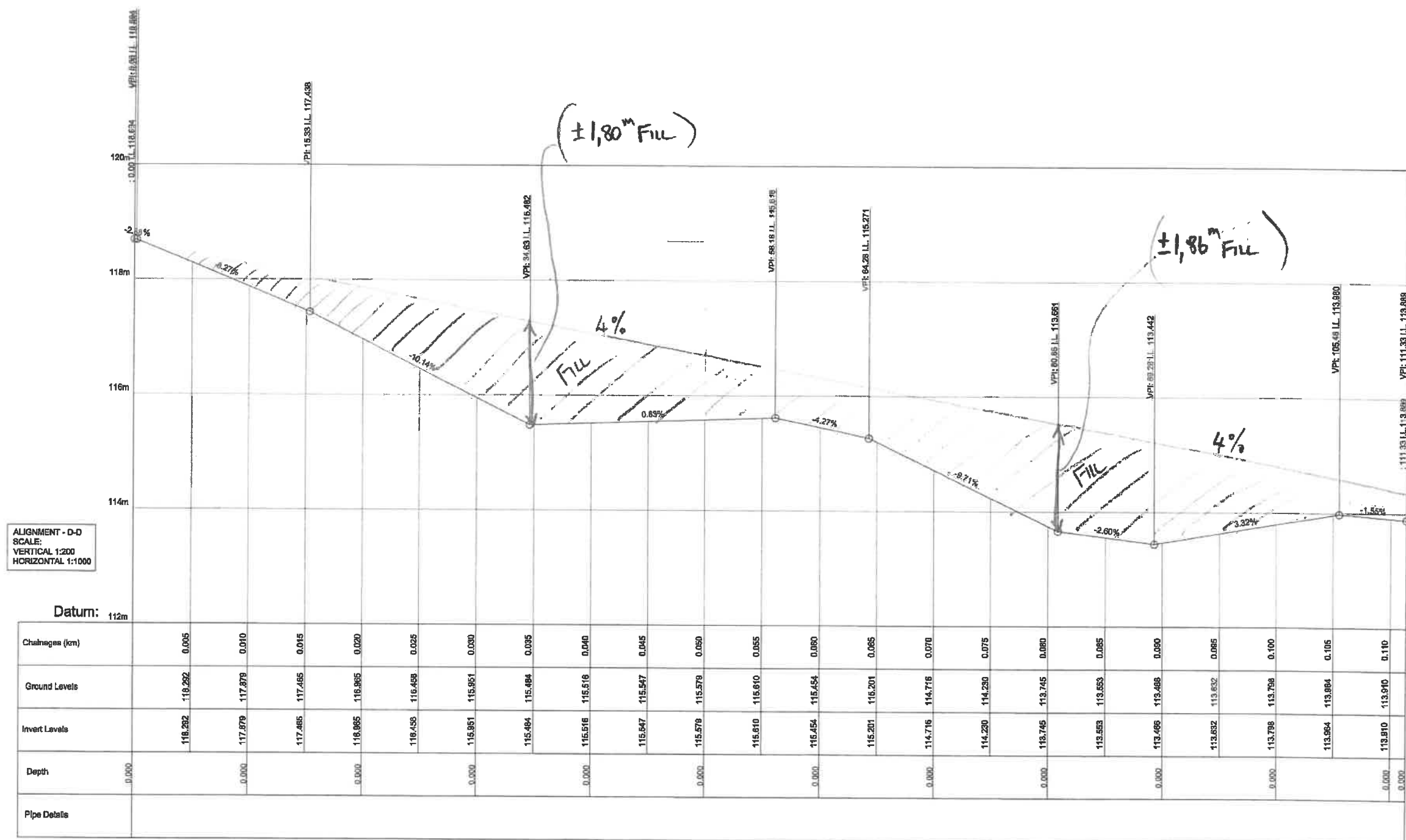




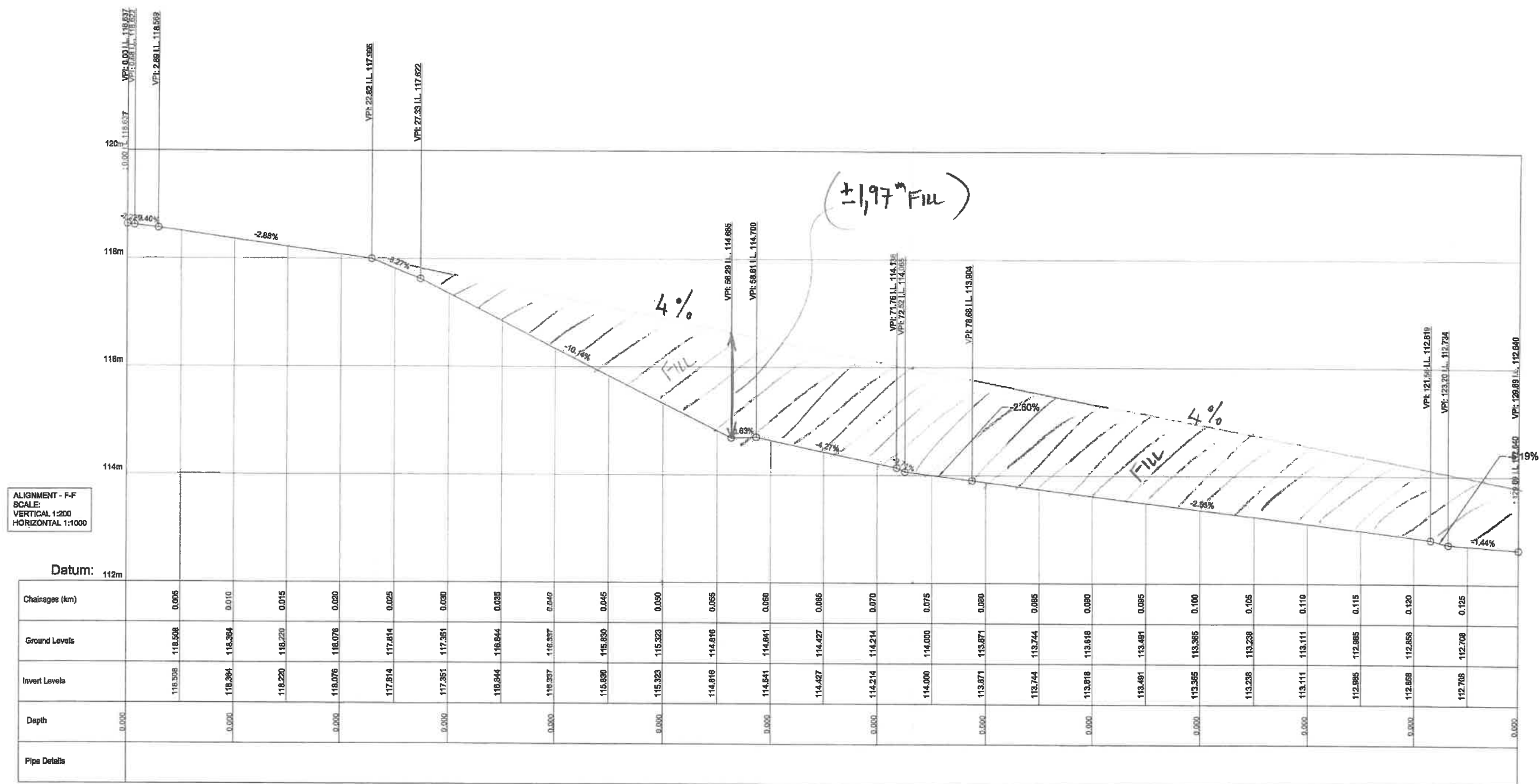
ALIGNMENT - C-C  
SCALE:  
VERTICAL 1:200  
HORIZONTAL 1:1000

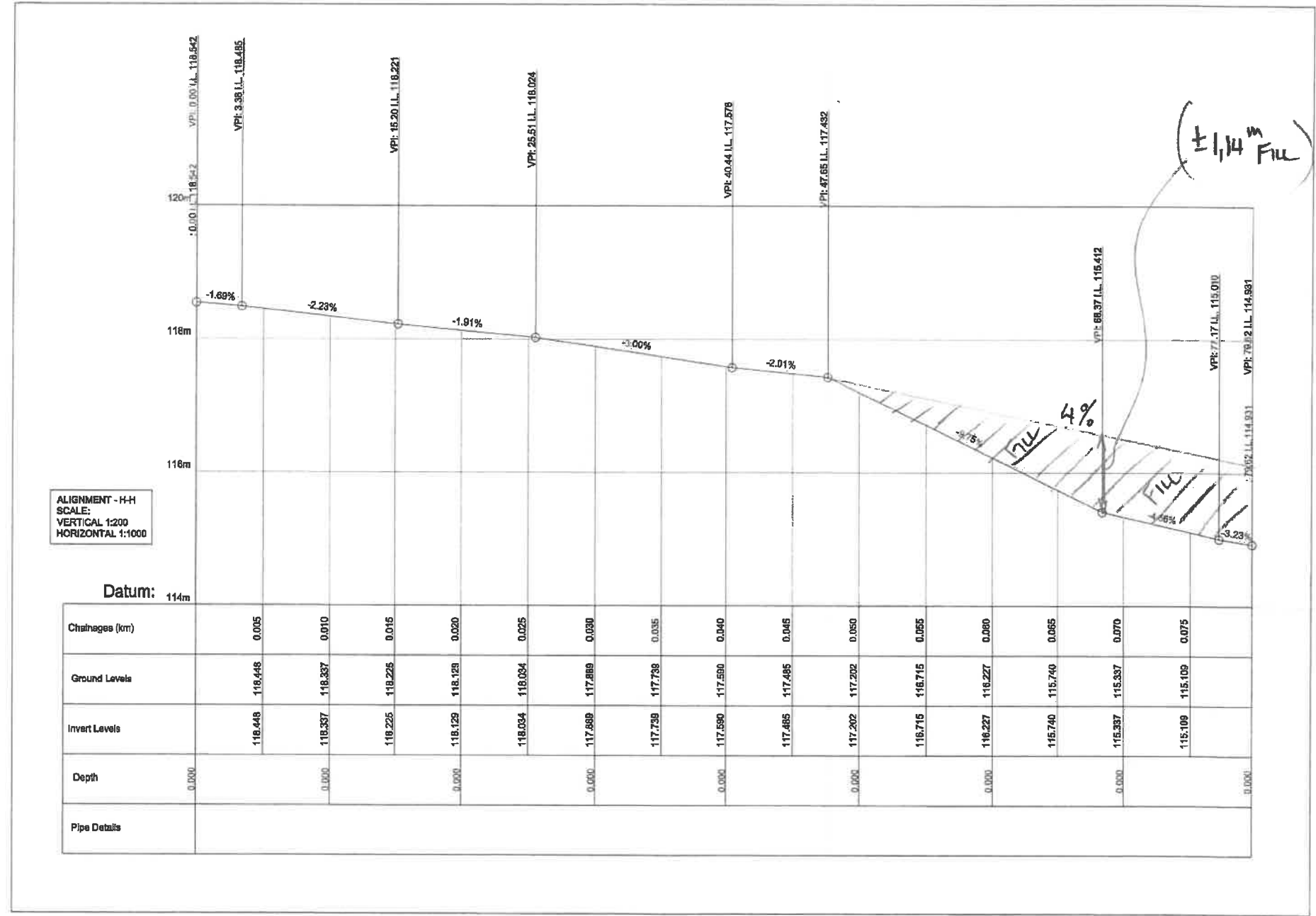
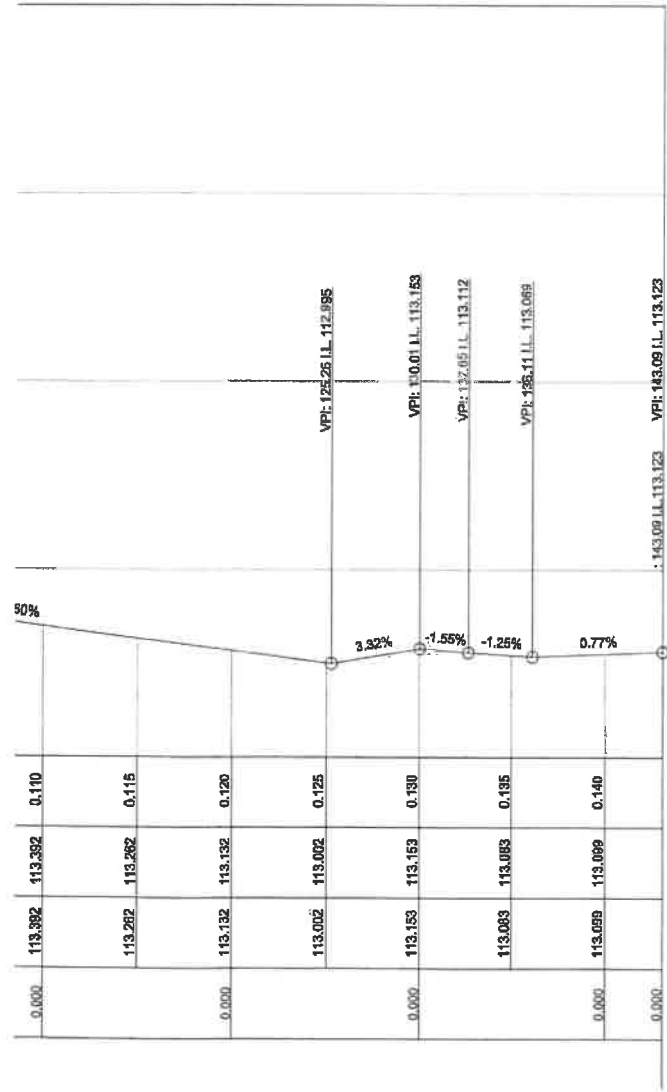
Datum: 114m				
Chainages (km)		0.005	0.010	0.015
Ground Levels		117.889	117.475	116.998
Invert Levels		117.888	117.475	116.998
Depth	0.000		0.000	0.000
Pipe Details				

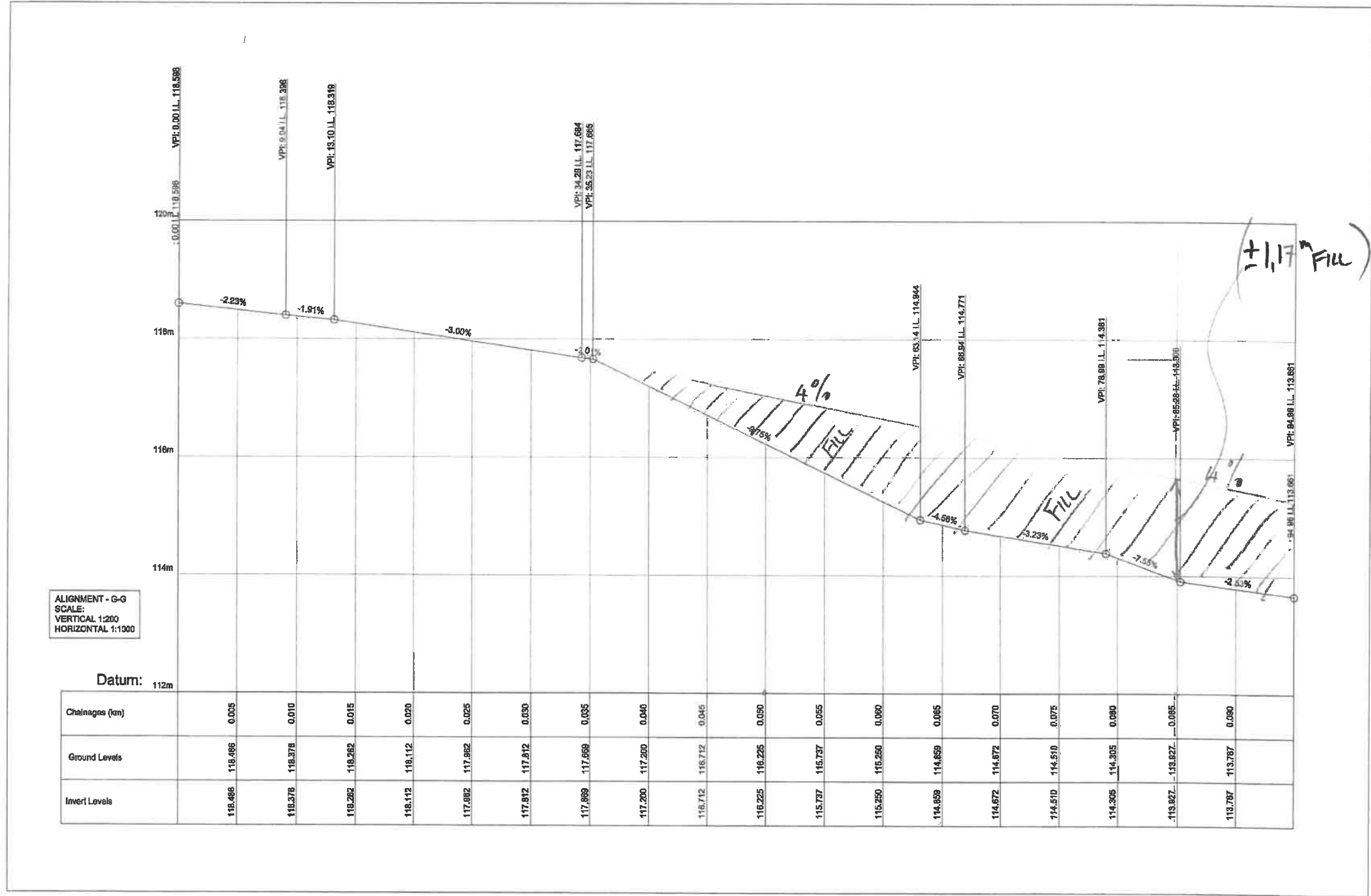
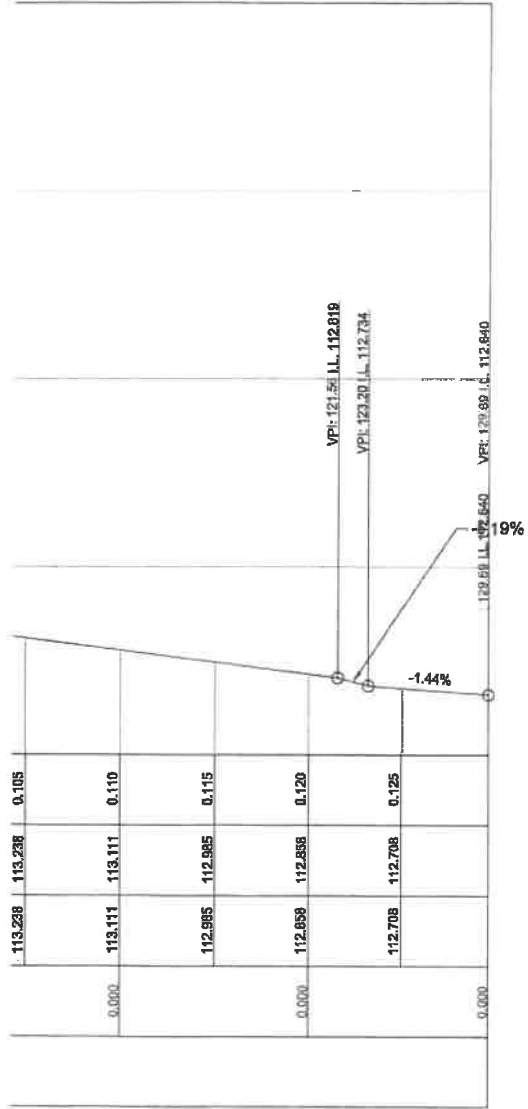














**ANNEXURE E: BULK EARTHWORKS PROPOSAL 2**  
**(BULK CUT)**



SITE ACCESS

EMBANKMENT  
VARIES FROM  
±0.5m - 2.0m

EMBANKMENT  
VARIES FROM  
±0.5 - 1.0m

MIDDLE

LOW



Mark C. O'Connell  
24 O'Connell Street  
Dublin 1, D01  
Tel: +353 (0)1 478 1100  
Fax: +353 (0)1 478 1101  
Email: info@element.ie

Client/Display

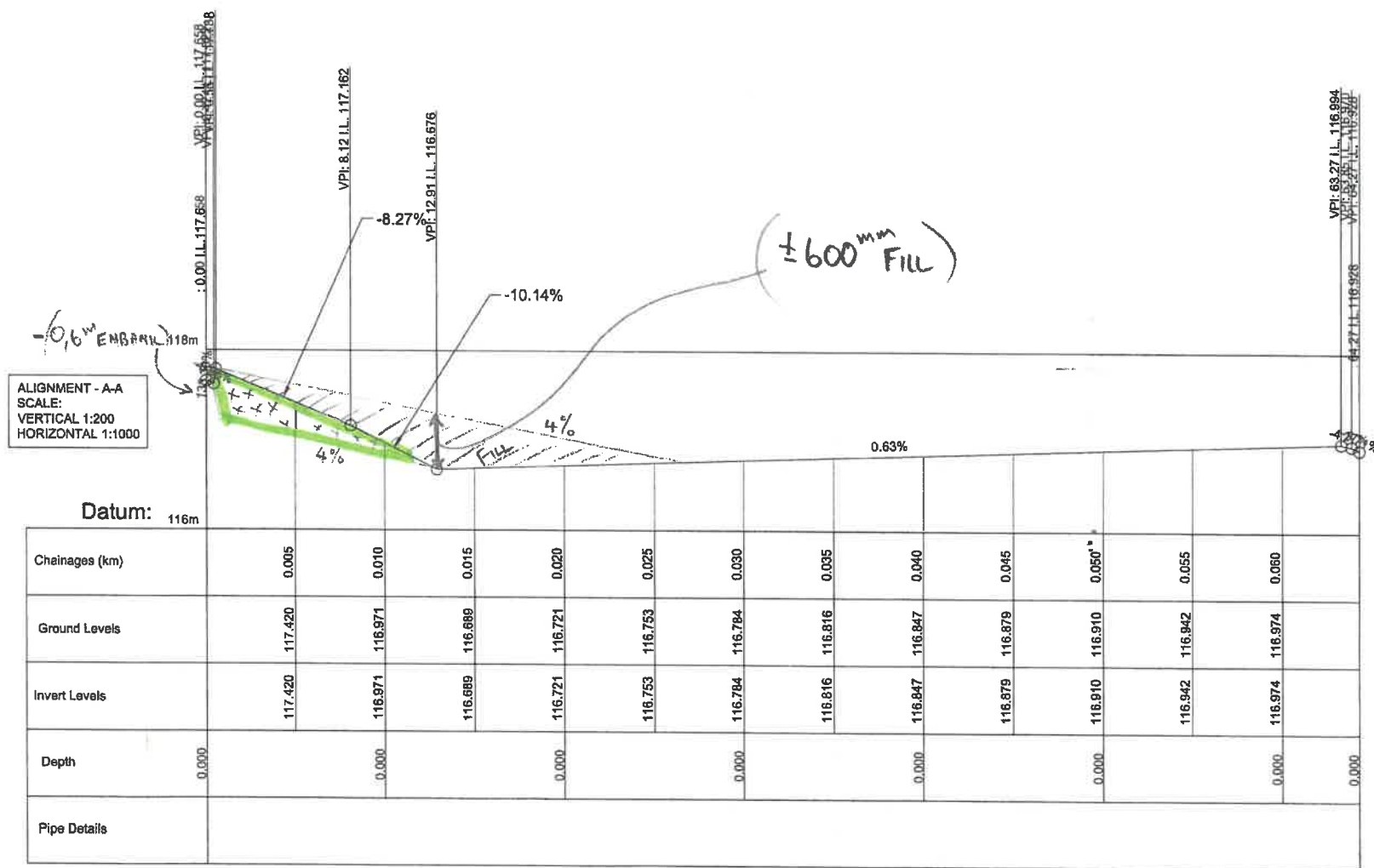
Project

Plan Description

Name	Signature	Date
Author		
Checker		
Designer		
Approver		
Pl. No.		

ORIGINAL SIZE A0

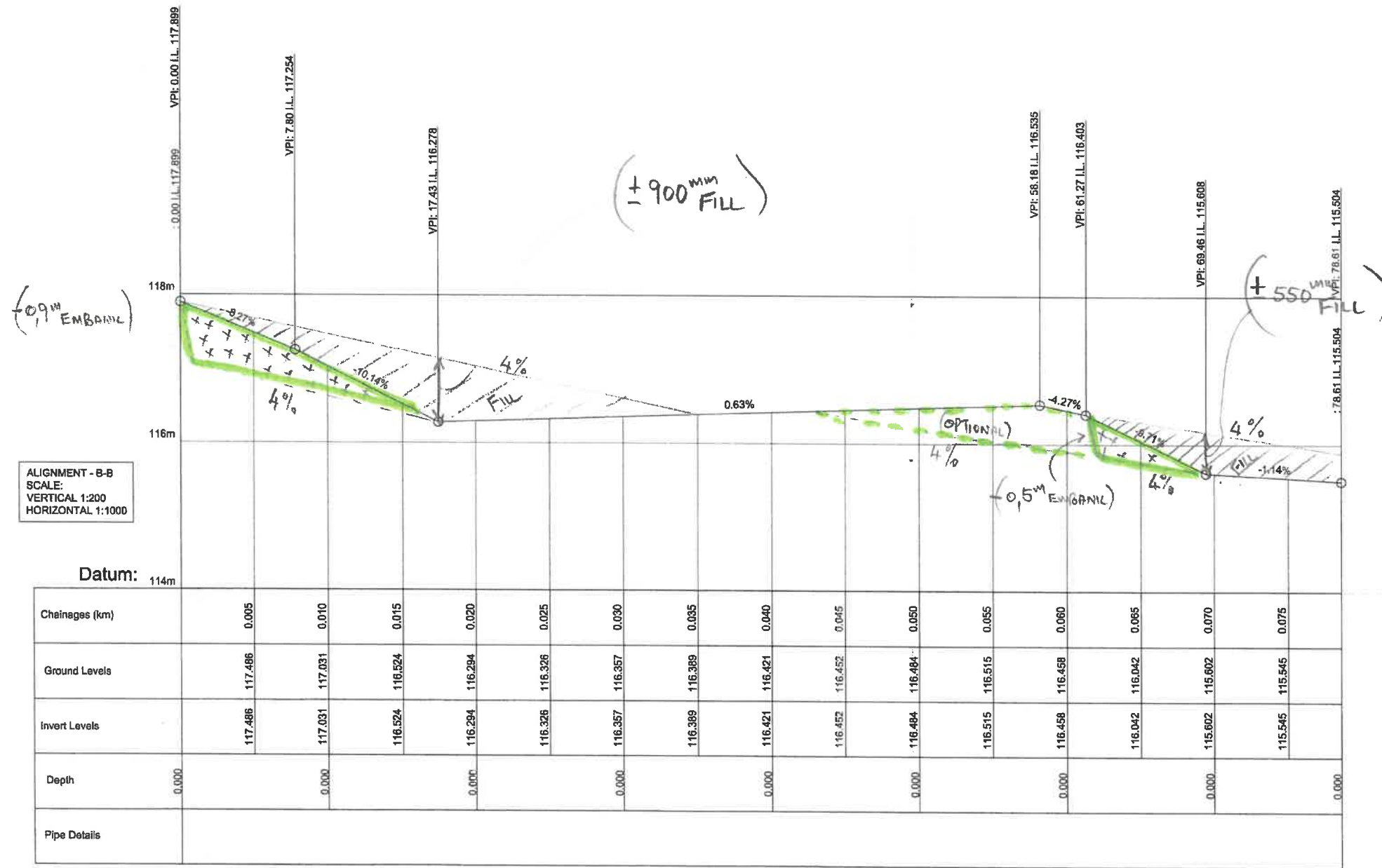
COPYRIGHT IS RESERVED IN ALL RIGHTS OF THE ENGINEER OR OTHERS  
IN TERMS OF THE COPYRIGHT ACT 1962 OF IRELAND

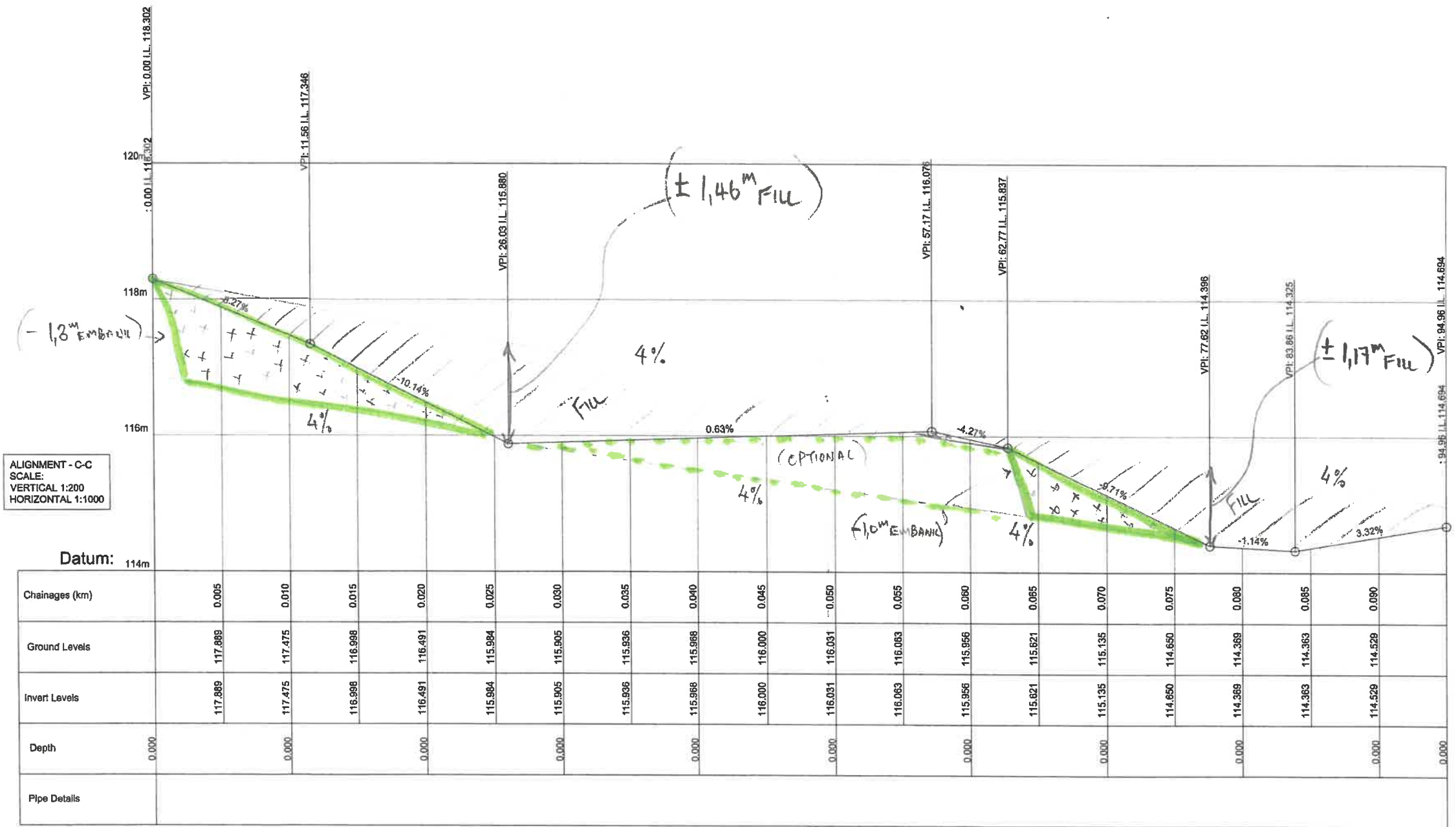


ALIGNMENT - B-B  
SCALE:  
VERTICAL 1:200  
HORIZONTAL 1:1000

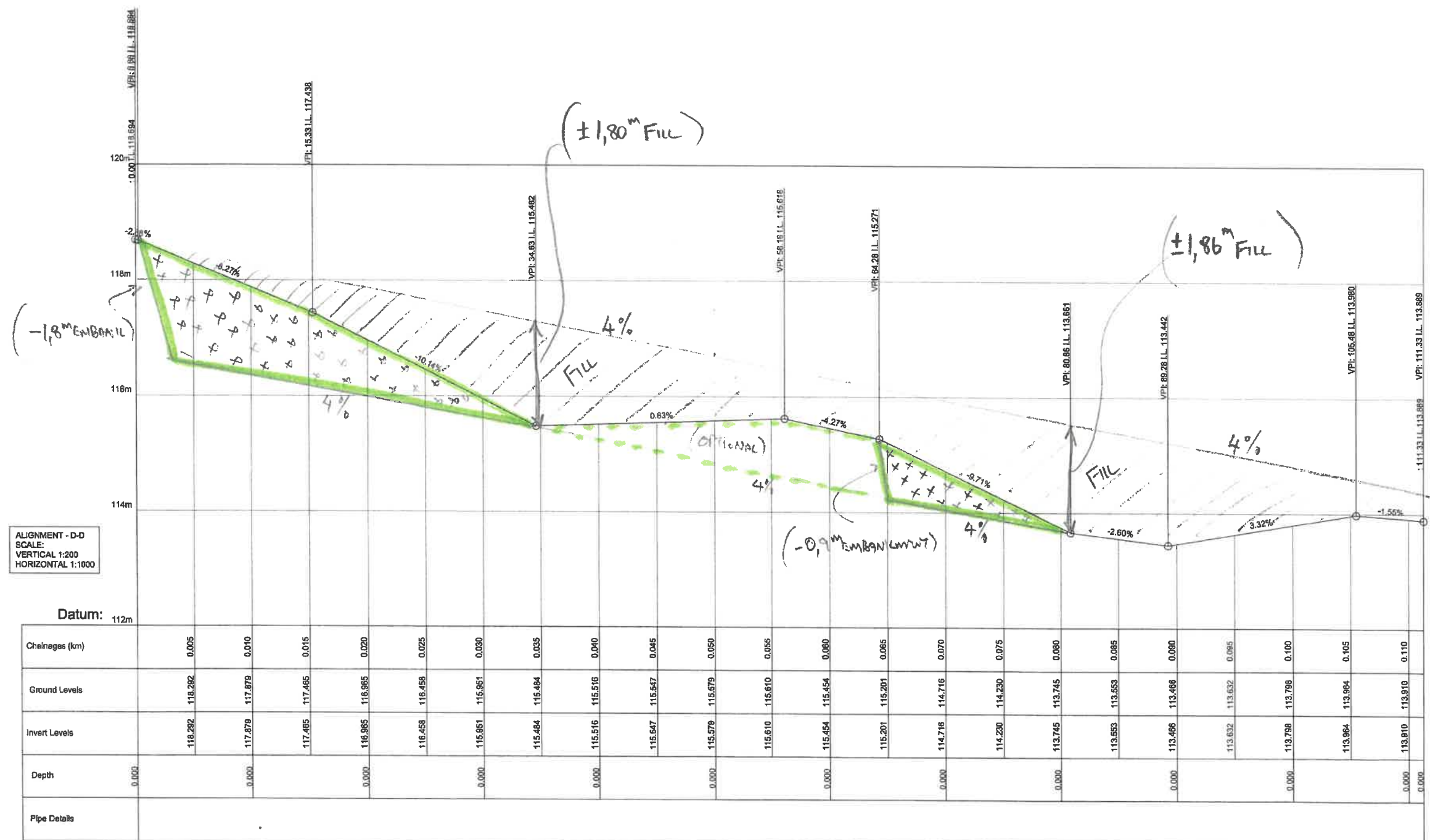
Datum: 1

Chainages (km)
Ground Levels
Invert Levels
Depth
Pipe Details



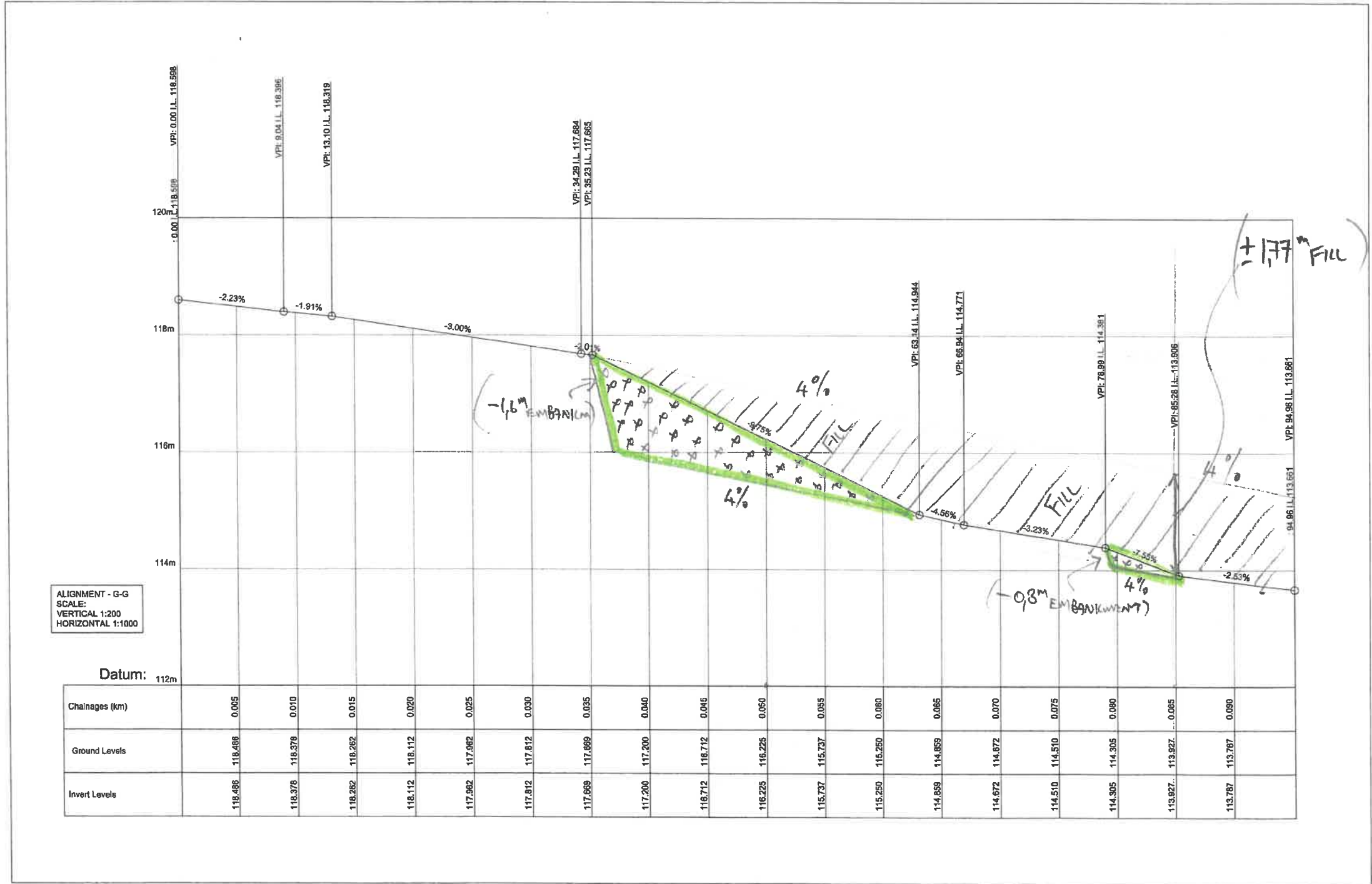
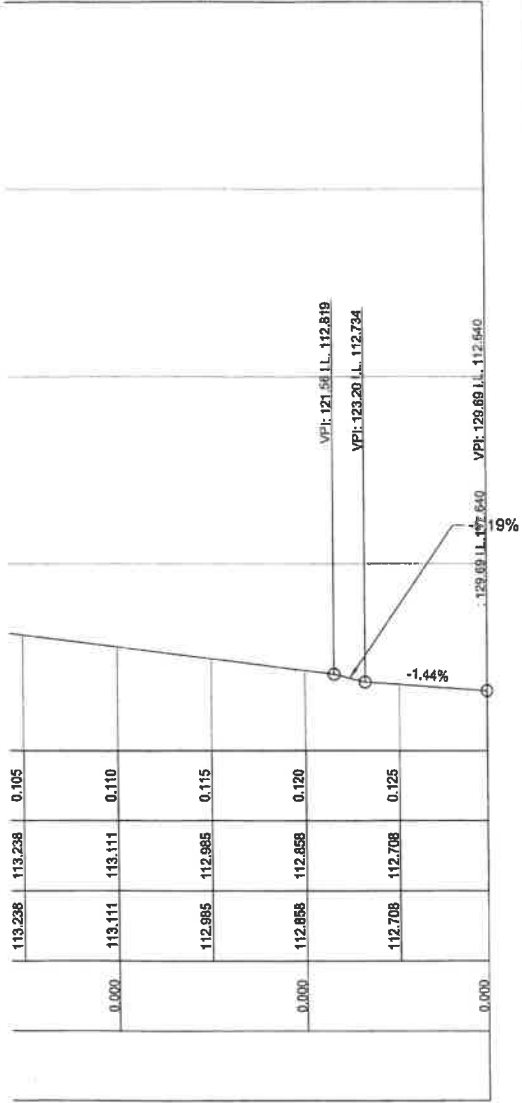




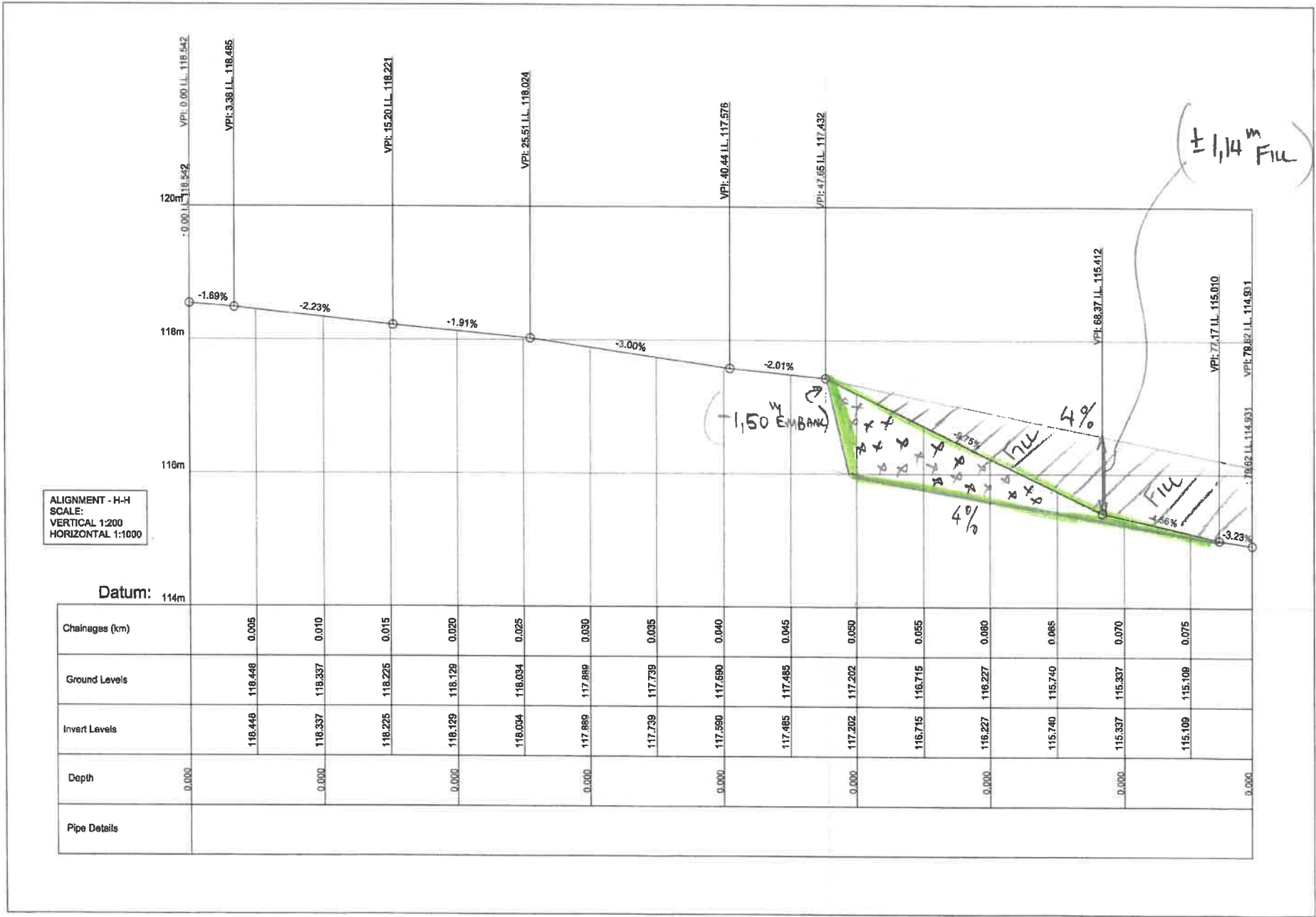
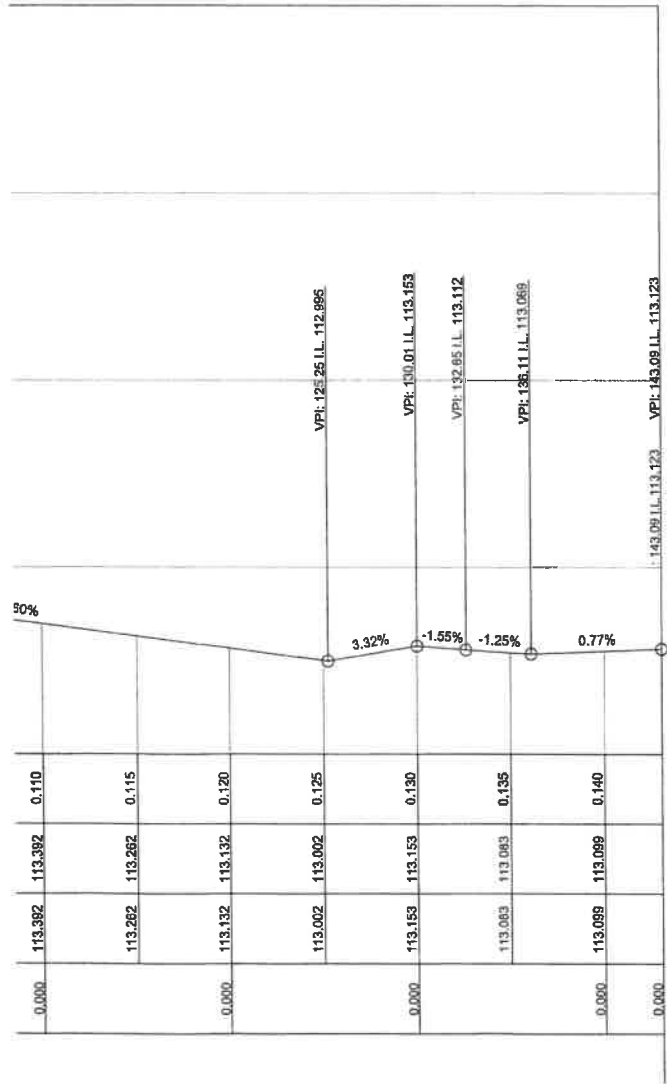












## **ANNEXURE F: PRE-DEVELOPMENT RUNOFF -RATIONAL METHOD**

# RATIONAL METHOD

## Project Number

1801691

## Description of Catchment

PV Farm-Bush Pre Development

## River Detail

## Calculated by

PC Dorfling

## Date

24-Jul-20

### Physical characteristics

Size of catchment (A)	0.011	km <sup>2</sup>
Longest watercourse (L)	0.2	km
Average slope(S <sub>av</sub> )	0.0500	m/m
Dolomitic Area (D%)	0.00%	
Mean Annual Rainfall (MAR)	874	mm

### Area distribution facto

Rural	100.00%	
Urban	0.00%	
Lakes	0.00%	
Rainfall Region	Inland	

### Surface slope, permeability, vegetation & land use

Rural			
Surface slope	%	Factor	C <sub>s</sub>
Vleis, pans (<3%)	0.00%	0.03	0.00
Flat areas (3-10%)	100.00%	0.08	0.08
Hilly (10-30%)	0.00%	0.16	0.00
Steep areas (>30%)	0.00%	0.26	0.00
Total	100.00%	-	0.08
Permeability	%	Factor	C <sub>p</sub>
Very permeable	0.00%	0.04	0.00
Permeable	50.00%	0.08	0.04
Semi-permeable	50.00%	0.16	0.08
Impermeable	0.00%	0.26	0.00
Total	100.00%	-	0.12
Vegetation	%	Factor	C <sub>v</sub>
Thick bush, plantation	90.00%	0.04	0.04
Light bush, farmlands	0.00%	0.11	0.00
Grasslands	10.00%	0.21	0.02
No vegetation	0.00%	0.28	0.00
Total	100.00%	-	0.06

Urban			
Lawns	%	Factor	C <sub>s</sub>
Sandy, flat (<2%)	0.00%	0.05	0.00
Sandy, steep (>7%)	0.00%	0.15	0.00
Heavy soil, flat (<2%)	0.00%	0.13	0.00
Heavy soil, steep (>7%)	0.00%	0.25	0.00
Residential Areas			
Houses	0.00%	0.30	0.00
Flats	0.00%	0.50	0.00
Industry			
Light Industry	0.00%	0.50	0.00
Heavy Industry	0.00%	0.60	0.00
Business			
City Centre	0.00%	0.70	0.00
Suburban	0.00%	0.50	0.00
Streets	0.00%	0.70	0.00
Maximum Flood	0.00%	1.00	0.00
Total (C <sub>2</sub> )	0.00%	-	0.00

### Time of Concentration (T<sub>c</sub>)

Tc (overland flow)	0.33	hours
Tc (watercourse)	0.06	hours
Tc total	0.39	hours
Tc (select value)	0.67	hours

40.2 min

r Value to use:

0.3

(Clean soil: 0.1; Paved area: 0.02; Sparse grass: 0.3;  
Mod. grass: 0.4; Thick grass: 0.8)

### Run-off coefficient

Return period (years), T	2	5	10	20	50	100	200
Run-off coefficient, C <sub>1</sub>	0.257	0.257	0.257	0.257	0.257	0.257	0.257
Adjustment for dolomite, C <sub>1D</sub>	0.257	0.257	0.257	0.257	0.257	0.257	0.257
Adjustment factor (F <sub>i</sub> )	0.500	0.550	0.600	0.670	0.830	1.000	1.000
Adjustment run-off (C <sub>1T</sub> )	0.129	0.141	0.154	0.172	0.213	0.257	0.257
Combined run-off (C <sub>T</sub> )	0.129	0.141	0.154	0.172	0.213	0.257	0.257

### Rainfall

Return period (years), T	2	5	10	20	50	100	200
Point Rainfall(mm), P <sub>T</sub>	80.0	119.0	148.0	181.0	228.0	269.0	315.0
Point Intensity(mm/h), P <sub>IT</sub>	45.5	67.6	84.1	102.9	129.6	152.9	179.0
Area Reduction Factor (ARF)	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Average Intensity(mm/h), I <sub>T</sub>	45.5	67.6	84.1	102.9	129.6	152.9	179.0
PEAK FLOW (m <sup>3</sup> /s)	0.018	0.029	0.040	0.054	0.084	0.120	0.141

DESIGN RAINFALL DEPTHS AT SELECTED STATIONS IN SOUTH AFRICA

SAWB NUMBER	Station Name	Latitude		longitude		MAP (mm)	Altitude (m)	Years	Duration (days)	Return Period (years)																											
		(°)(')		(°)(')						2				5				10				20				50				100				200			
										L	D	U	L	D	U	L	D	U	L	D	U	L	D	U	L	D	U	L	D	U	L	D	U	L	D	U	
0058334 W	LINE DRIFT	33	4	27	12	402	177	42		1	51	51	94	94	75	75	75	93	94	94	113	114	115	142	144	147	166	170	174	193	199	205	243	257	274		
										2	65	66	66	66	97	98	98	121	122	124	145	149	152	181	187	194	210	220	232	243	257	277	298	280	298	320	
										3	70	70	71	104	105	105	129	131	133	156	160	164	194	202	210	225	237	251	259	277	298	280	298	320			
										4	74	75	75	111	112	112	138	140	142	167	171	175	208	216	225	243	255	269	280	298	320						
										5	76	76	77	113	114	114	140	142	144	168	173	178	209	219	229	243	258	274	281	302	327	281	302	327			
										6	79	80	81	118	119	119	146	148	150	175	180	186	218	228	239	253	268	286	290	314	342	290	314	342			
										7	82	83	83	121	122	122	149	152	154	179	184	189	222	232	242	257	273	290	295	318	345						
0059043 W	RELEASED AREAS 33 NAF	33	12	27	32	645	20	31		1	77	77	78	114	115	115	142	143	144	172	174	176	216	220	224	254	260	266	295	304	313	295	304	313			
										2	110	111	112	164	165	166	204	207	209	246	251	257	306	317	329	356	373	392	411	436	464	445	459	491	529		
										3	124	125	126	184	186	187	229	233	236	276	283	290	344	358	373	399	421	446	459	491	529						
										4	131	132	133	195	197	197	243	246	249	293	300	307	366	380	395	427	449	472	493	525	562	493	525	562			
										5	134	135	136	199	201	202	247	251	255	298	306	315	370	387	405	430	456	485	496	533	578	496	533	578			
										6	137	138	140	203	205	206	251	256	260	302	311	320	376	393	413	437	463	494	501	541	590	501	541	590			
										7	139	140	142	205	207	208	253	258	261	304	313	322	377	394	412	437	463	493	501	541	586						
0059158 W	RICHMOND 69	33	8	27	36	660	125	49		1	76	77	77	113	113	114	141	142	142	171	172	174	214	218	222	251	257	263	292	300	310	292	300	310			
										2	108	109	110	161	162	163	200	203	205	241	247	252	300	311	323	349	366	385	403	427	455	403	427	455			
										3	117	118	119	175	176	177	217	221	224	261	269	275	326	339	353	378	399	422	435	466	501	435	466	501			
										4	122	123	124	182	184	185	227	230	233	274	281	287	342	355	370	399	419	441	461	490	525	461	490	525			
										5	127	128	129	189	190	192	235	238	242	282	290	298	351	367	384	408	432	460	470	505	548	470	505	548			
										6	132	133	135	196	197	199	242	247	250	291	300	309	363	379	398	421	447	476	483	522	568	483	522	568			
										7	137	138	140	202	204	205	250	254	258	300	308	317	371	388	406	431	457	486	493	533	578	493	533	578			
0059243 W	SILVERDALES	33	3	27	39	783	180	65		1	83	83	84	123	123	124	153	154	155	186	188	189	233	237	241	274	280	286	317	327	337	317	327	337			
										2	117	118	119	175	176	177	217	220	223	262	268	274	326	338	351	379	398	418	438	464	494	438	464	494			
										3	126	127	128	187	189	190	233	236	240	280	288	295	349	363	378	405	427	452	466	499	537	466	499	537			
										4	132	133	134	197	198	199	245	249	252	296	303	310	370	384	399	431	453	477	497	530	567	497	530	567			
										5	137	138	139	204	205	207	253	257	261	304	313	322	379	396	414	440	466	496	507	545	591	507	545	591			
										6	141	142	144	209	210	212	258	263	267	310	320	329	387	404	424	449	476	508	515	556	606	515	556	606			
										7	145	146	147	213	215	216	263	268	272	316	325	334	392	410	428	454	482	512	520	562	609	520	562	609			
0059482 W	FORT GREY (BOS)	33	1	27	46	837	140	39		1	86	86	87	127	127	128	158	159	160	192	194	196	241	245	249	283	289	296	328	338	348	328	338	348			
										2	117	118	119	175	176	177	217	220	223	262	268	274	326	338	350	378	397	417	437	464	494	437	464	494			
										3	127	128	129	189	191	192	235	239	242	283	291	298	353	367	383	410	432	457	471	504	543	471	504	543			
										4	133	134	135	199	201	201	248	251	255	300	306	313	374	388	404	436	458	482	503	536	574	503	536	574			
										5	137	138	139	204	205	207	253	257	261	304	313	322	379	396	414	440	466	496	507	545	591	507	545	591			
										6	143	145	146	212	214	215	263	267	271	315	325	334	393	411	431	456	484	516	524	565	616	524	565	616			
										7	149	150	152	219	221	223	271	276	280	326	335	344	403	422	441	468	496	528	536	579	627	536	579	627			
0059572 A	OOS-LONDON W/K	33	2	27	50	874	117	52		1	80	80	81	118	119	119	148	148	149	179	181	182	224	228	232	263	269	275	305	315	324	305	315	324			
										2	111	112	113	166	167	167	206	209	211	248	254	259	309	320	332	359	377	396	415	439	468	415	439	468			
										3	119	120	121	178	179	180	221	225	228	266	273	280	332	345	359	385	406	430	443	474	510	443	474	510			
										4	126	127	128	188	189	190	234	237	240	283	289	296	353	366	381	412	432	455	475	506	542	475	506	542			
										5	132	134	135	197	198	200	244	248	252	294	302	311	366	382	400	425	451	479	490	527	571	490	527	571			
										6	137	138	140	203	205	206	251	256	260	302	311	320	376	393	413	437	463	494	501	542	590	501	542	590			
										7	140	141	143	206	208	209	255	259	263	306	315	324	380	397	415	440	467	497	504	545	591	504	545	591			
0059572 W	ALAMEIN	33	2	27	50	874	117	33		1	88	88	89	130	131	131	162	163	164	197	199	200	247	251	255	289	296	303	336	346	357	336	346	357			
										2	119	120	121	178	179	180	221	224	227	267	272	279	331	344	357	385	404	425	445	472	503	445	472	503			
										3	129	130	131	192	194	195	239	243	246	287	295	303	358	373	388	416	439	464	478	512	551	478	512	551			
										4	140	141	142	208	210	211	259	263	266	313	321	328	391	406	422	456	479	504	526	560	600	526	560	600			
										5	149	150	151	221	223	224	274	279	283	330	339	349	411	429	449	477	506	538	550	591	641	550	591	641			
										6	155	156	158	229	231	233	284	289	294	341	352	362	425	444	466	494	523	558	567	612	666	567	612	666			
										7	159	161	162	235	237	238	290	295	300	349	358	369	432	452	472	501	531	565	574	620	672	574	620	672			



## **ANNEXURE G: POST DEVELOPMENT RUNOFF -RATIONAL METHOD**

# RATIONAL METHOD

## Project Number

1801691

## Description of Catchment

PV Farm-Bush Post Development

## River Detail

## Calculated by

PC Dorfling

## Date

24-Jul-20

### Physical characteristics

Size of catchment (A)	0.011	km <sup>2</sup>
Longest watercourse (L)	0.2	km
Average slope(S <sub>av</sub> )	0.0400	m/m
Dolomitic Area (D%)	0.00%	
Mean Annual Rainfall (MAR)	874	mm

### Area distribution facto

Rural	100.00%	
Urban	0.00%	
Lakes	0.00%	
Rainfall Region	Inland	

### Surface slope, permeability, vegetation & land use

Rural			
Surface slope	%	Factor	C <sub>s</sub>
Vleis, pans (<3%)	0.00%	0.03	0.00
Flat areas (3-10%)	100.00%	0.08	0.08
Hilly (10-30%)	0.00%	0.16	0.00
Steep areas (>30%)	0.00%	0.26	0.00
Total	100.00%	-	0.08
Permeability	%	Factor	C <sub>p</sub>
Very permeable	0.00%	0.04	0.00
Permeable	50.00%	0.08	0.04
Semi-permeable	50.00%	0.16	0.08
Impermeable	0.00%	0.26	0.00
Total	100.00%	-	0.12
Vegetation	%	Factor	C <sub>v</sub>
Thick bush, plantation	0.00%	0.04	0.00
Light bush, farmlands	90.00%	0.11	0.10
Grasslands	10.00%	0.21	0.02
No vegetation	0.00%	0.28	0.00
Total	100.00%	-	0.12

Urban			
Lawns	%	Factor	C <sub>s</sub>
Sandy, flat (<2%)	0.00%	0.05	0.00
Sandy, steep (>7%)	0.00%	0.15	0.00
Heavy soil, flat (<2%)	0.00%	0.13	0.00
Heavy soil, steep (>7%)	0.00%	0.25	0.00
Residential Areas			
Houses	0.00%	0.30	0.00
Flats	0.00%	0.50	0.00
Industry			
Light Industry	0.00%	0.50	0.00
Heavy Industry	0.00%	0.60	0.00
Business			
City Centre	0.00%	0.70	0.00
Suburban	0.00%	0.50	0.00
Streets	0.00%	0.70	0.00
Maximum Flood	0.00%	1.00	0.00
Total (C <sub>2</sub> )	0.00%	-	0.00

### Time of Concentration (T<sub>c</sub>)

T <sub>c</sub> (overland flow)	0.34	hours
T <sub>c</sub> (watercourse)	0.07	hours
T <sub>c</sub> total	0.41	hours
T <sub>c</sub> (select value)	0.67	hours

40.2 min

r Value to use:

0.3

(Clean soil: 0.1; Paved area: 0.02; Sparse grass: 0.3;  
Mod. grass: 0.4; Thick grass: 0.8)

### Run-off coefficient

Return period (years), T	2	5	10	20	50	100	200
Run-off coefficient, C <sub>1</sub>	0.320	0.320	0.320	0.320	0.320	0.320	0.320
Adjustment for dolomite, C <sub>1D</sub>	0.320	0.320	0.320	0.320	0.320	0.320	0.320
Adjustment factor (F <sub>t</sub> )	0.500	0.550	0.600	0.670	0.830	1.000	1.000
Adjustment run-off (C <sub>1T</sub> )	0.160	0.176	0.192	0.214	0.266	0.320	0.320
Combined run-off (C <sub>T</sub> )	0.160	0.176	0.192	0.214	0.266	0.320	0.320

### Rainfall

Return period (years), T	2	5	10	20	50	100	200
Point Rainfall(mm), P <sub>T</sub>	80.0	119.0	148.0	181.0	228.0	269.0	315.0
Point Intensity(mm/h), P <sub>IT</sub>	45.5	67.6	84.1	102.9	129.6	152.9	179.0
Area Reduction Factor (ARF)	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Average Intensity(mm/h), I <sub>T</sub>	45.5	67.6	84.1	102.9	129.6	152.9	179.0
PEAK FLOW (m <sup>3</sup> /s)	0.022	0.036	0.049	0.067	0.105	0.149	0.175

DESIGN RAINFALL DEPTHS AT SELECTED STATIONS IN SOUTH AFRICA

SAWB NUMBER	Station Name	Latitude		longitude		MAP Altitude (mm)	Altitude (m)	Years (days)	Return Period (years)																							
		(')		(°)					2			5			10			20			50			100			200					
		33	4	27	12				402	L	D	U	L	D	U	L	D	U	L	D	U	L	D	U	L	D	U	L	D	U		
0058334 W	LINE DRIFT					177	42	1	51	51	75	75	75	93	94	94	113	114	115	142	144	147	166	170	174	193	199	205				
								2	65	66	97	98	98	121	122	124	145	149	152	181	187	194	210	220	232	243	257	274				
							3	3	70	70	104	105	105	129	131	133	156	160	164	194	202	210	225	237	251	259	277	298				
							4	4	74	75	111	112	112	138	140	142	167	171	175	208	216	225	243	255	269	280	298	320				
							5	5	76	76	113	114	114	140	142	144	168	173	178	209	219	229	243	258	274	281	302	327				
							6	6	79	80	118	119	119	146	148	150	175	180	186	218	228	239	253	268	286	290	314	342				
							7	7	82	83	121	122	122	149	152	154	179	184	189	222	232	242	257	273	290	295	318	345				
0059043 W	RELEASED AREAS 33 NAF	33	12	27	32	645	31	1	77	77	114	115	115	142	143	144	172	174	176	216	220	224	254	260	266	295	304	313				
						20		2	110	111	112	164	165	166	204	207	209	246	251	257	306	317	329	356	373	392	411	436	464			
								3	124	125	126	184	186	187	229	233	236	276	283	290	344	358	373	399	421	446	459	491	529			
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								6	137	138	140	203	205	206	251	256	260	302	311	320	376	393	413	437	463	494	501	541	590			
								7	139	140	142	205	207	208	253	258	261	304	313	322	377	394	412	437	463	493	501	541	586			
0059158 W	RICHMOND 69	33	8	27	36	660	49	1	76	77	113	113	114	141	142	142	171	172	174	214	218	222	251	257	263	292	300	310				
						125		2	108	109	110	161	162	163	200	203	205	241	247	252	300	311	323	349	366	385	403	427	455			
								3	117	118	119	175	176	177	217	221	224	261	269	275	326	339	353	378	399	422	435	466	501			
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								6	132	133	135	196	197	199	242	247	250	291	300	309	363	379	398	421	447	476	483	522	568			
								7	137	138	140	202	204	205	250	254	258	300	308	317	371	388	406	431	457	486	493	533	578			
0059243 W	SILVERDALES	33	3	27	39	783	65	1	83	83	84	123	123	124	153	154	155	186	188	189	233	237	241	274	280	286	317	327	337			
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								7	145	146	147	213	215	216	263	268	272	316	325	334	392	410	428	454	482	512	520	562	609			
0059482 W	FORT GREY (BOS)	33	1	27	46	837	39	1	86	86	87	127	127	128	158	159	160	192	194	196	241	245	249	283	289	296	328	338	348			
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								7	149	150	152	219	221	223	271	276	280	326	335	344	403	422	441	468	496	528	536	579	627			
0059572 A	OOS-LONDON W/K	33	2	27	50	874	52	1	80	80	81	118	119	119	148	148	149	179	181	182	224	228	232	263	269	275	305	315	324			
						117		2	111	112	113	166	167	167	206	209	211	248	254	259	309	320	332	359	377	396	415	439	468			
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								7	159	161	162	235	237	238	290	295	300	349	358	369	432	452	472	501	531	565	574	620	672			

## **ANNEXURE H: BIODIVERSITY REPORT**



## Biodiversity Assessment

### PROPOSED NEW 750 KWP SOLAR PHOTOVOLTAIC INSTALLATION AT EAST LONDON AIRPORT

Project Reference number: P16055

Prepared for:



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21 April 2017

## REVISIONS TRACKING TABLE

<i><b>EOH Report Revision</b></i>		
<i><b>Document Title</b></i>	Biodiversity Assessment: Proposed new 750 kwp Solar Photovoltaic Installation at East London Airport	
<i><b>Client Name &amp; Address</b></i>	Delta Built Environment Consultants 320 The Hillside Road, Rynlal Building, Lynnwood, 0180	
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<i><b>Auditor</b></i>	R de Kock	EOH East London
<i><b>Reviewer</b></i>	A Carter	EOH East London

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# 1 INTRODUCTION

## 1.1 Project description

Airports Company South Africa (ACSA) has appointed Delta Built Environment Consultants (Delta BEC) to undertake the required site clearance of approximately 1.1ha of vegetation for a proposed 750 kWp solar photovoltaic (PV) installation. The solar PV cells will have an extent of 52m x 216m. A site location (called the study site) has been identified (Figure 1.1). Site clearance requires that a biodiversity scan is undertaken prior to development.



**Figure 1.1. Location of the study site within the East London Airport**

## 1.2 Objective

The objective of this report was to:

- Conduct a Biodiversity Assessment which must include:
  - Identify all plant Species of Special Concern (SSC) that will require permits.
  - Conduct a desktop survey
  - Conduct field surveys
  - Determine the environmental impacts of the proposed development and specific mitigations and management measures to be incorporated into the Environmental Management Programme (EMPr).

## 1.3 Approach

The study site and surrounding areas were described using a two-phased approach. Firstly, a desktop assessment of the site was conducted in terms of current vegetation classifications and biodiversity programmes and plans. This included the consideration of:

- The South African Vegetation Map (Mucina and Rutherford, 2012)



- Eastern Cape Biodiversity Conservation Programme (ECBCP)
- Department of Agriculture, Fisheries and Forestry (DAFF) (Indigenous forestry maps)
- National Freshwater Ecosystem Priority Areas (NFEPA) Water bodies and wetlands
- National Environmental Management Biodiversity Act (NEMBA) Biodiversity Regulations

Further to the above, a site walkthrough was conducted on the 19<sup>th</sup> April 2017 to determine the environmental status of the study site, as well as identify & mark all indigenous & protected plant species situated within the site.

## 2 ASSESSMENT METHODOLOGY

The aim of this report is to identify areas of ecological importance. In order to do so, the ecological sensitivity of the study site is identified as well as all plant SSC that may occur in habitats present. To a large extent, the condition and sensitivity of the vegetation will also determine the presence of plant SSC and areas with high faunal biodiversity.

### 2.1 Plant species of special concern

Data on the known distribution and conservation status for each potential SSC has to be obtained in order to develop a list of '*Species of Concern*'. In general these will be species that are already known to be threatened or at risk, or those that have restricted distributions with a portion (at least 50%) of their known range falling within the study area. Species that are afforded special protection, notably those that are protected by CITES are also regarded as Species of Concern (see <http://www.cites.org/>). Efforts to provide assessments of conservation status ('*red list*' status) of individual species may provide additional valuable information on Species of Concern (see <http://www.iucnredlist.org/>).

A list of '*Species of Possible Concern*' is derived from the species list by examining the relevant literature and databases and eliminating those that have a widespread distribution and which are not covered by CITES regulations or red listed. From this initial list, the status of '*Confirmed Species of Concern*' may be conferred if the species is substantially restricted to the study area based on:

- recent literature (last 10 years) that provides comprehensive information on the distribution range
- examination of herbarium specimens available

Note that all uncertain identifications of species from the study area are regarded as '*Species of Possible Concern*' until they can be collected or recollected and studied further. Similarly, all species that are believed to be currently un-described – i.e. new to science – are regarded to be of Possible Concern unless a researcher working on the group in question can confirm that although currently unpublished, the plant is in fact widespread.

Definitions (taken for the IUCN Red Data List) include:

- **Critically Endangered (CR)** - A taxon is Critically Endangered when the best available evidence indicates that it meets any of the criteria A to E for Critically Endangered (see Section V), and it is therefore considered to be facing an extremely high risk of extinction in the wild.
- **Endangered (EN)** - A taxon is Endangered when the best available evidence indicates that it meets any of the criteria A to E for Endangered (see Section V), and it is therefore considered to be facing a very high risk of extinction in the wild.
- **Vulnerable (VU)** - A taxon is Vulnerable when the best available evidence indicates that it meets any of the criteria A to E for Vulnerable, and it is therefore considered to be facing a high risk of extinction in the wild.
- A taxon is **Near Threatened** when it has been evaluated against the criteria but does not qualify for Critically Endangered, Endangered or Vulnerable now, but is close to qualifying for or is likely to qualify for a threatened category in the near future.
- **Sensitive species** - Species not falling in the categories above but listed in Appendix 1 or 2 of the Convention of International Trade in Endangered Species (CITES).
- **Endemic species** - Species endemic to South Africa, and more specifically the Eastern Cape.

## 2.2 Sampling protocol

A sampling protocol was developed that would enable the evaluation of the existing interpretations of the vegetation of the study area, to improve on them if necessary, and to add detailed information on the plant communities present. The protocol took into account the level of detail required for the study, the accessibility of different parts of the area, and limitations such as the seasonality of the vegetation.

A generalised site assessment approach was adopted, whereby initial assumptions were made about the diversity of vegetation, based on initial reconnaissance visits, previous studies or from aerial photographs and satellite imagery. The study area was then stratified into basic vegetation communities based on what was observed during the site visit.

## 2.3 Vegetation mapping

Vegetation was mapped from aerial photographs, satellite images and literature descriptions (e.g. STEP, SANBI and ECBCP) and related to data gathered on the ground.

## 2.4 Sensitivity assessment

This section of the report explains the approach to determining the ecological sensitivity of the study site on a broad scale. The approach identifies zones of high, medium and low sensitivity according to a system developed by EOH and used in numerous proposed development studies. It must be noted that the sensitivity zonings in this study are based solely on ecological (primarily vegetation) characteristics and social and economic factors have not been taken into consideration. The sensitivity analysis described here is based on 10 criteria which are considered to be of importance in determining ecosystem and landscape sensitivity. The method predominantly involves identifying sensitive vegetation or habitat types, topography and land transformation (Table 2.1).

Although very simple, this method of analysis provides a good, yet conservative and precautionary assessment of the ecological sensitivity.

**Table 2.1. Criteria used for the analysis of the sensitivity of the area.**

CRITERIA		LOW SENSITIVITY	MODERATE SENSITIVITY	HIGH SENSITIVITY
1	<b>Topography</b>	Level, or even	Undulating; fairly steep slopes	Complex and uneven with steep slopes
2	<b>Vegetation</b> - Extent or habitat type in the region	Extensive	Restricted to a particular region/zone	Restricted to a specific locality / site
3	<b>Conservation status</b> of fauna/ flora or habitats	Well conserved independent of conservation value	Not well conserved, moderate conservation value	Not conserved - has a high conservation value
4	<b>SSC</b> - Presence and number	None, although occasional regional endemics	No endangered or vulnerable species, some indeterminate or rare endemics	One or more endangered and vulnerable species, or more than 2 endemics or rare species
5	<b>Habitat fragmentation</b> leading to loss of viable populations	Extensive areas of preferred habitat present elsewhere in region not susceptible to fragmentation	Reasonably extensive areas of preferred habitat elsewhere and habitat susceptible to fragmentation	Limited areas of this habitat, susceptible to fragmentation
6	<b>Biodiversity contribution</b>	Low diversity, or species richness	Moderate diversity, and moderately high species richness	High species diversity, complex plant and animal communities
7	<b>Visibility</b> of the site	Site is hidden or barely	Site is visible from some or a	Site is visible from many

CRITERIA		LOW SENSITIVITY	MODERATE SENSITIVITY	HIGH SENSITIVITY
	or landscape from other vantage points	visible from any vantage points with the exception in some cases from the sea.	few vantage points but is not obtrusive or very conspicuous.	or all angles or vantage points.
8	<b>Erosion potential</b> or instability of the region	Very stable and an area not subjected to erosion.	Some possibility of erosion or change due to episodic events.	Large possibility of erosion, change to the site or destruction due to climatic or other factors.
9	<b>Rehabilitation potential</b> of the area or region	Site is easily rehabilitated.	There is some degree of difficulty in rehabilitation of the site.	Site is difficult to rehabilitate due to the terrain, type of habitat or species required to reintroduce.
10	<b>Disturbance</b> due to human habitation or other influences (Alien invasives)	Site is very disturbed or degraded.	There is some degree of disturbance of the site.	The site is hardly or very slightly impacted upon by human disturbance.
11	<b>Water bodies</b> affected by the proposed development	No water bodies	No water bodies	Includes all water bodies (e.g. wetlands, perennial rivers, non-perennial rivers, drainage systems etc.)

### 3 DESKTOP ASSESSMENT

#### 3.1 Literature review and desktop information of the biological environment

Published literature on the ecology of the area was referenced in order to describe the study site in the context of the region and the Eastern Cape Province. The following documents/plans were considered:

- SANBI Vegetation (using Mucina & Rutherford, 2012);
- Subtropical Thicket Ecosystem project (STEP);
- Eastern Cape Biodiversity Conservation Plan (ECBCP; 2006);
- NFEPA water bodies;
- National and Provincial Protected areas legislation;
- National Environmental Management: Biodiversity Act (No 10 of 2004)(NEMBA);
- NEMBA – Threatened Ecosystems Listing (GN. R. 1002 of 2011);
- NEMBA Alien and Invasive Plants Listing (GN. R. 599 of 2014);
- NEMBA Protected Species Listing (GN. R. 256 of 2015); and
- Provincial Nature Conservation Ordinance (No 19 of 1974)(PNCO)

#### 3.2 SANBI Vegetation (Mucina and Rutherford, 2012)

Two vegetation types, both classified as Thicket Biome vegetation types, were classified within the study site (Figure 3.1):

- Albany Coastal Belt
- Buffels Thicket

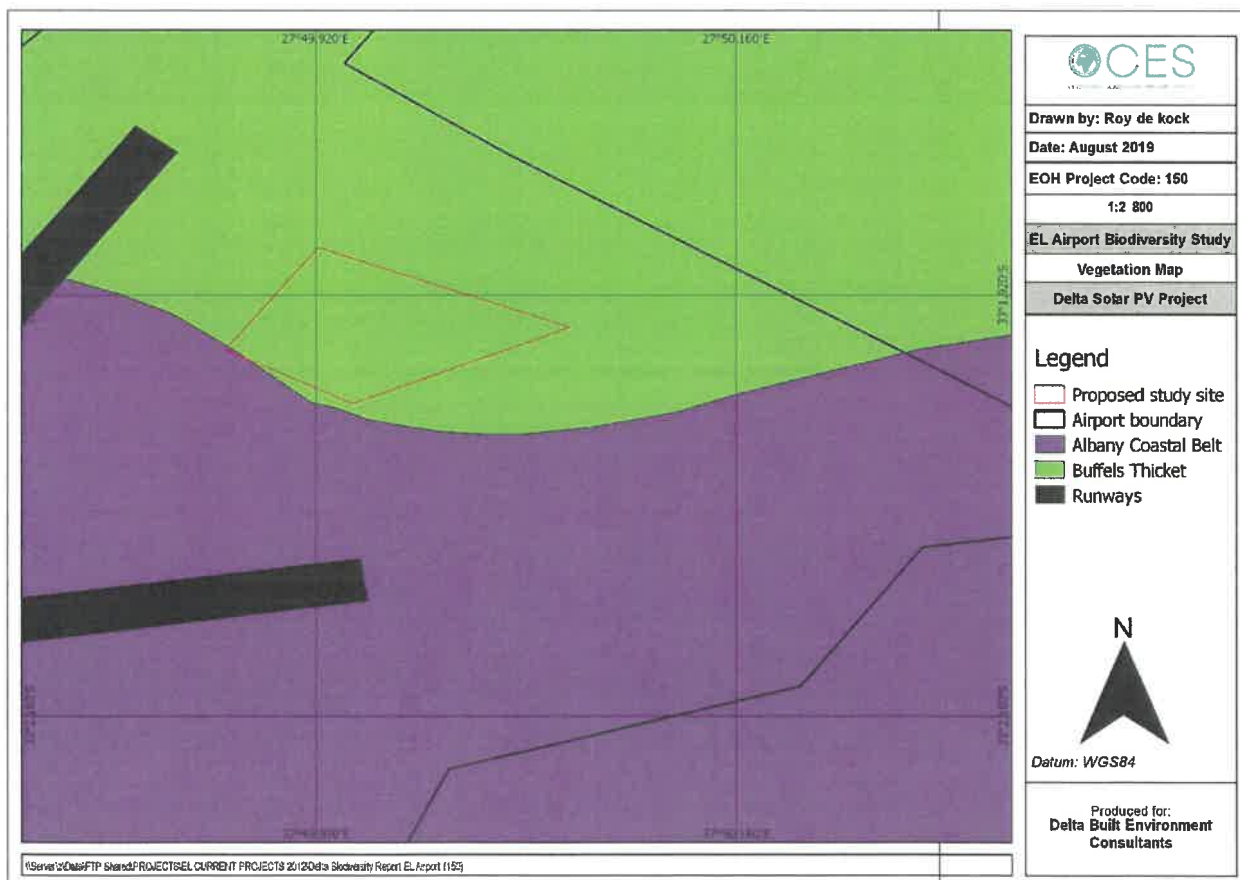


Figure 3.1. Vegetation types found within the ACSA Vegetation study site.



### 3.2.1 Albany Coastal Belt

Albany Coastal Belt vegetation occurs on gently sloping to moderately undulating landscapes and dissected hilltop slopes close to the coast. This vegetation type is dominated by short grasslands punctuated by scattered bush clumps or solitary *Acacia natalitia* (Coastal thorn) trees. Erosion is considered as low to moderate. SANBI considers Albany Coastal Belt is “**LEAST THREATENED**” with only 1% protected in local-authority and provincial nature reserves as well as the Greater Addo Elephant National Park.

### 3.2.2 Buffels thicket

Buffels Thicket is found in river valleys cantered around East London stretching 40-50km inland. It occurs on steep river valley slopes in highly dissected hills and moderately undulating plains where short, dense and tangled thicket stands reach up to 10m in height. This dense thicket grades into more open, shorter thornveld at the edges of the valley slopes. SANBI classified Buffels Thicket as “**VULNERABLE**”. Only 1% of this vegetation unit is protected with up to 21% transformed by cultivation, urban development, and plantations. Erosion is considered as low to moderate.

### 3.2.3 Subtropical Thicket (STEP)

The STEP Conservation Priority Map classifies areas into a number of categories, based on plant and animal biodiversity of the planning domain, with emphasis on Thicket biomes (Pierce, 2003). The Conservation Priority map for the study area is presented in Figure 3.2. The entire site is classified as “**VULNERABLE**”.

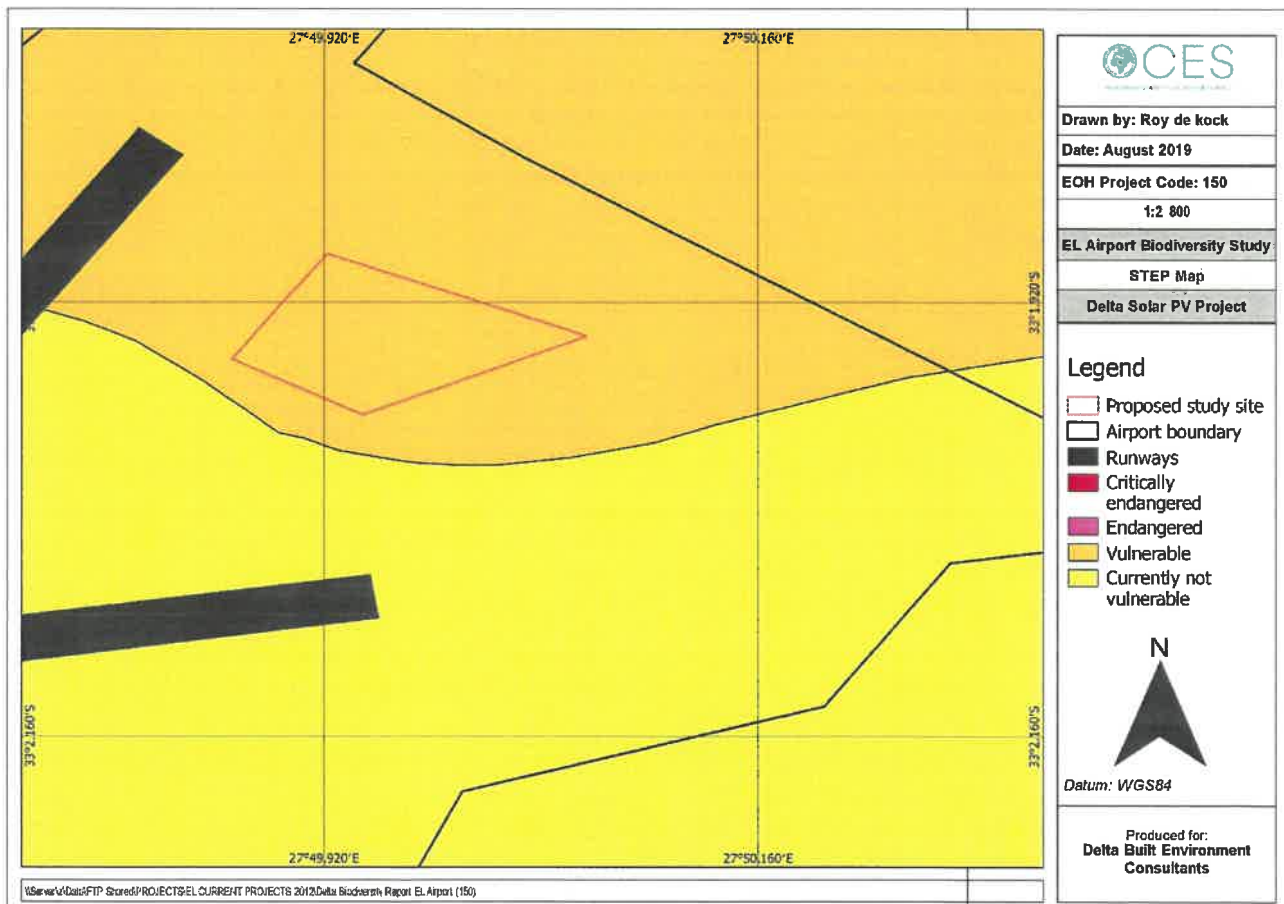


Figure 3.2. STEP map showing the conservation priority identified within the ACSA Vegetation study site.

The land-use management guidelines (taken from STEP) for areas classified as “*vulnerable*” requires that these areas can withstand limited loss of area through disturbance or development.

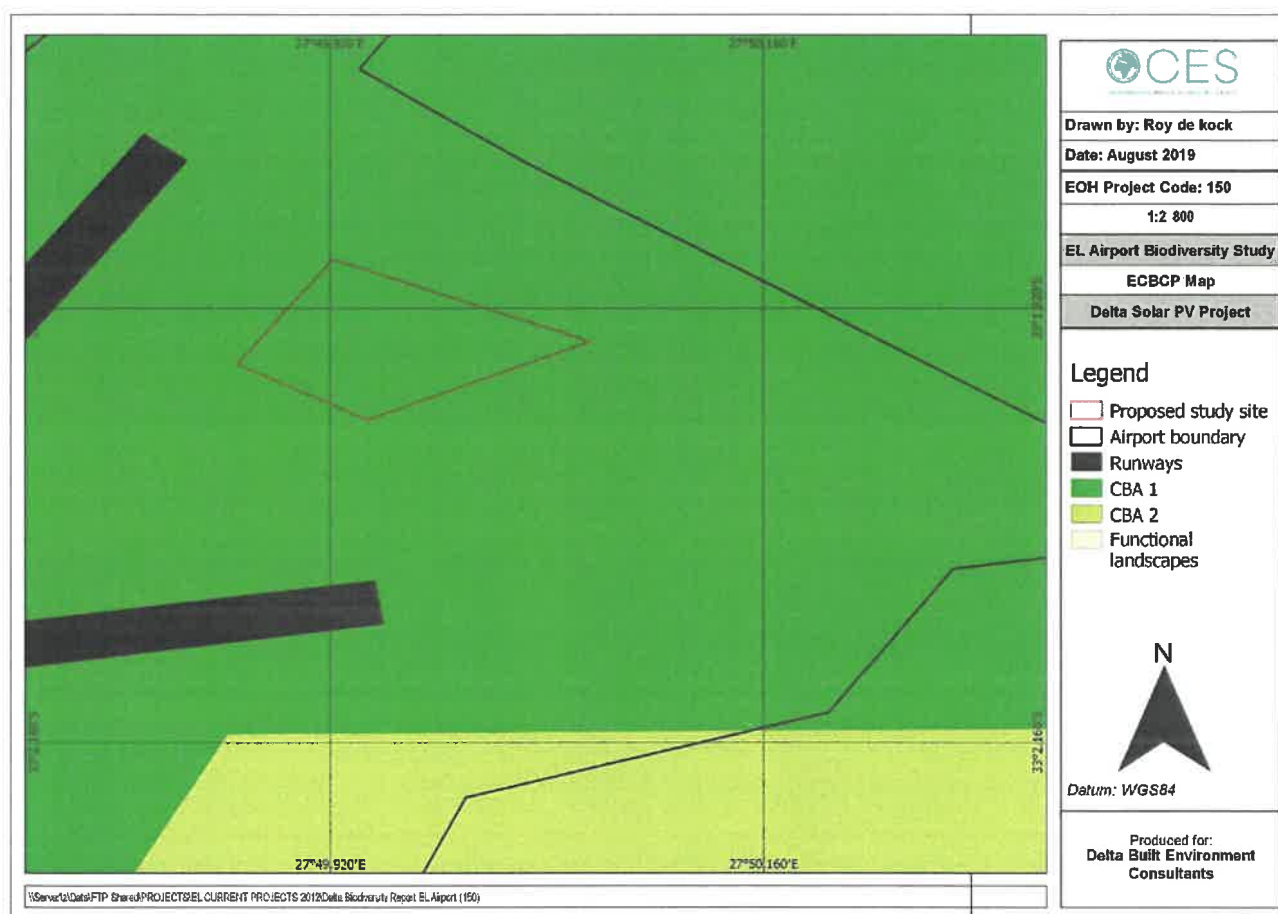
### 3.2.4 Eastern Cape Biodiversity Conservation Plan (ECBCP)

The ECBCP is a first attempt at detailed, low-level conservation mapping for land-use planning purposes. Specifically, the aims of ECBCP were to map critical biodiversity areas through a systematic conservation planning process. The current biodiversity plan includes the mapping of priority aquatic features, land-use pressures, and critical biodiversity areas and develops guidelines for land and resource-use planning and decision-making.

The main outputs of the ECBCP are "critical biodiversity areas" or CBA's (also called Biodiversity Land Management Classes or BLMC's), which are allocated the following management categories:

- **CBA 1** = Maintain in a natural state (also called BLMC 1)
- **CBA 2** = Maintain in a near-natural state (also called BLMC 2)
- **Functional Landscapes** (also called BLMC 3)

The ECBCP map (Figure 3.3) for the area shows that the surrounding landform is categorised as a CBA 1 area, which requires that the land is maintained in a natural state with no loss of biodiversity.

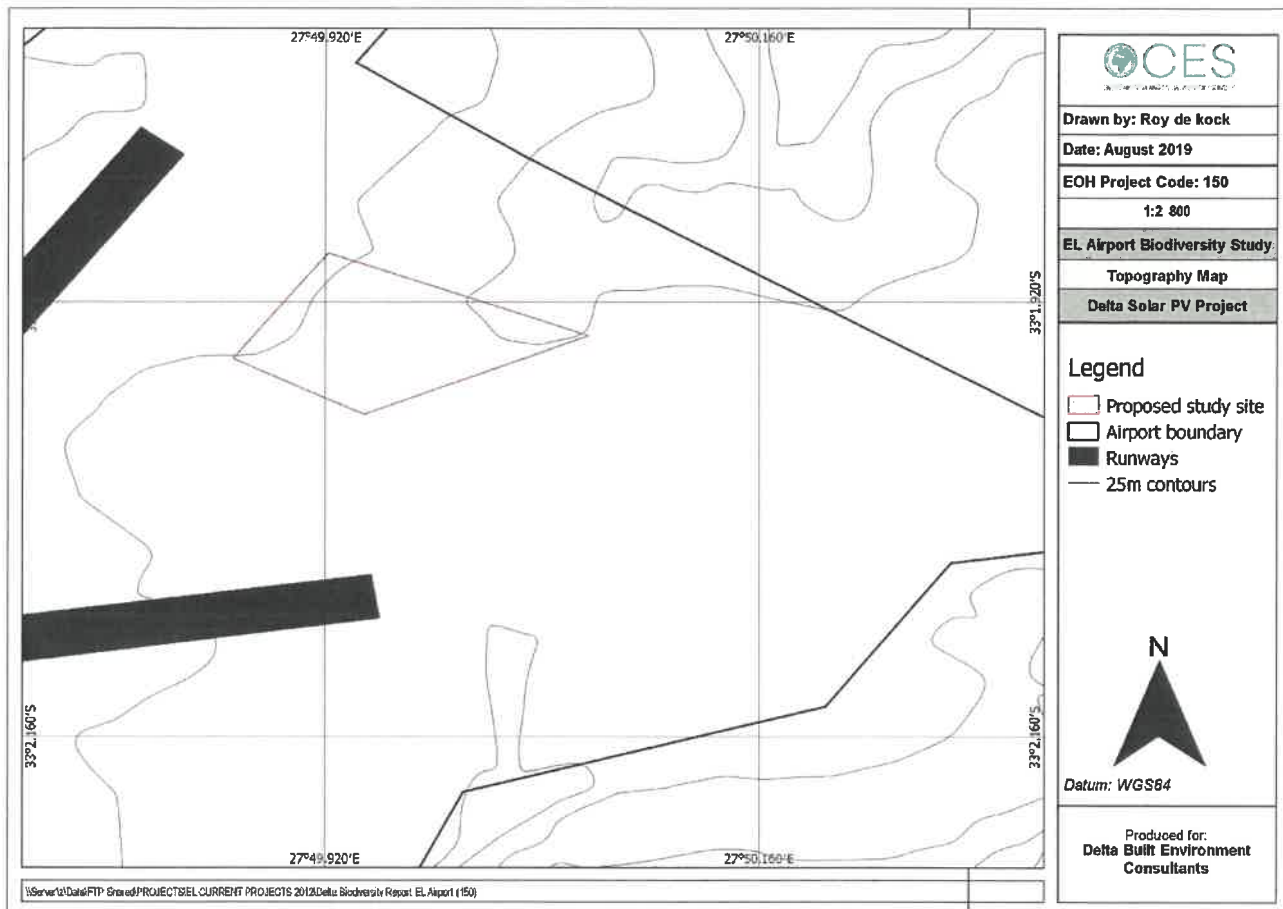


**Figure 3.3. ECBCP map showing the different biodiversity land management classes identified within and surrounding the study site.**

## 3.3 Literature review and desktop information of the physical environment

### 3.3.1 Topography

Elevation is considered as even throughout the study site. Elevation does decrease further north and south of the study site. This usually indicates a surface water drainage points with surface water draining offsite to the NNE and south. These areas are more that 100m away from the site.



**Figure 3.4. Elevation map showing the topography within and surrounding the study site.**

### 3.4 Surface water (National Water Act (No 36 of 1998; NWA))

No wetland was identified within 500m of the study site. A surface water drainage system occur in the eastern section of the site. A 100m buffer has been placed around the drainage system (Figure 3.5).

A Water Use License (WUL) may be required if any development is to take place within the indicated buffer area.

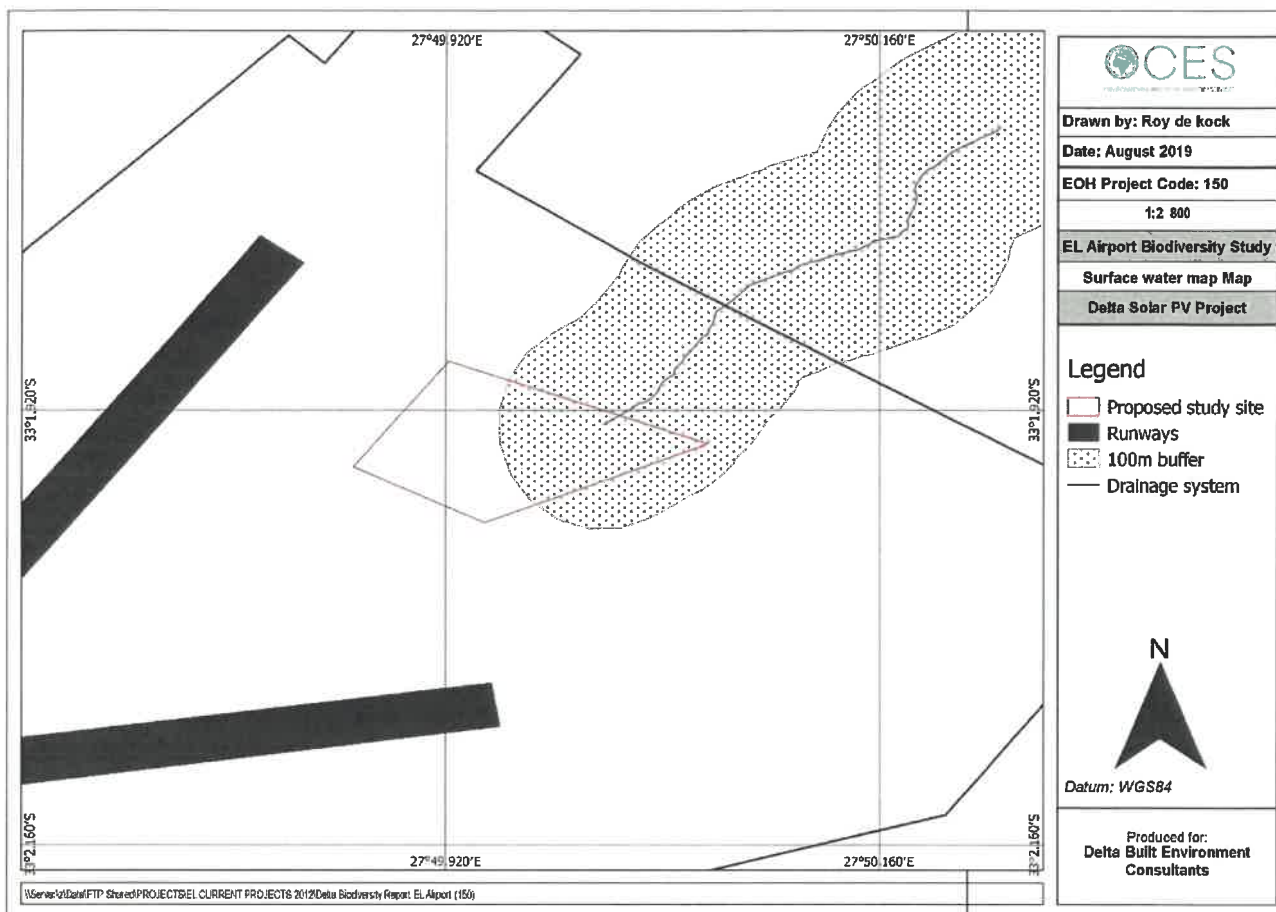


Figure 3.5. Aquatic map showing all surface water structures within the study site

### 3.5 Other legislated biodiversity indicators

None of the following legislated biodiversity indicators occur onsite or are within a close distance to the study site:

Legislated biodiversity Indicator	Comment
National Environmental Protected Areas Act (No 57 of 2003)(NEMPAA)	The nearest formally protected area is located 1km to the west. No National Park is located within 10km of the site
National Environmental Management Biodiversity Act (No 10 of 2004)(NEMBA) including: <ul style="list-style-type: none"> <li>NEMBA Threatened Ecosystems (GN. R. 1002 of 2011)</li> <li>NEMBA Threatened or Protected species (ToPs) (GN. R. 256 of 2015)</li> <li>NEMBA Alien and Invasive Species list (AIS) (GN. R. 599 of 2014)</li> </ul>	No ToPs plant species were identified onsite Various alien and invasive plants were identified. Dense alien vegetation was observed onsite and discussed in Chapter 6
Provincial Nature Conservation Ordinance (No 19 of 1974)(PNCO)	No protected plant species were identified onsite
National Forest Act (No 84 of 1998)(NFA)	No forest areas were identified within the study site. The nearest forest patch is located 12m to the north (Refer to Sensitivity Map in Chapter 5)



## 4 SITE ASSESSMENT

A site walkthrough was conducted on the 19<sup>th</sup> April 2017 to determine the status of the site, as well as identify and mark all indigenous and protected plant species situated within the site. The entire site was assessed and all observations recorded.



**Figure 4.1. Showing an aerial image of the study site (Google Earth 2019).**

### 4.1 Vegetation communities

Three different vegetation communities were identified within the study site namely:

1. Wet grassland (10%)
2. Dense alien vegetation (90%)

Each vegetation community are discussed below:



#### 4.1.1.1 Wet grassland



Grassland is not considered as a primary and pristine vegetation type. It is secondary in nature as a result of natural thicket clearing and grassland encroachment. Mucina and Rutherford (2012) identifies the area as thicket vegetation.

Various sedges (*Juncus* sp.) occur in this area indicating periods of soil wetness. The area is NOT considered a wetland even though a small drainage system occur in this area.

This vegetation community covers approximately 0.1ha (<5%)

Minimal alien vegetation occurs.

The dominant grasses are:

- *Digitaria* sp. (finger grass)
- *Themeda triandra* (red grass)
- *Pennisetum clandestinum* (kikuyu)

Other weedy and herbaceous vegetation was also observed but none were identified as protected.

Some alien vegetation occurs.

#### 4.1.2 Dense alien vegetation



This area consists almost entirely of alien and invasive tree species and includes:

- Gum trees (*Eucalyptus* sp.)
- Guava trees (*Psidium guajava*)
- Black wattle trees (*Acacia mearnsii*)
- Lantana (*Lantana camera*)

Some thicket like trees are also found and includes:

- *Gymnosporia* sp.
- *Acacia natalitia* (coastal thorn)

Vegetation is very dense

Vegetation was cleared and roots removed in the last 2 years. There are no large trees found onsite

Some areas contain concrete surfaces.

This vegetation community covers approximately 2.5ha (95%)

Below is a map showing the locality and size of each vegetation community identified within the study site.

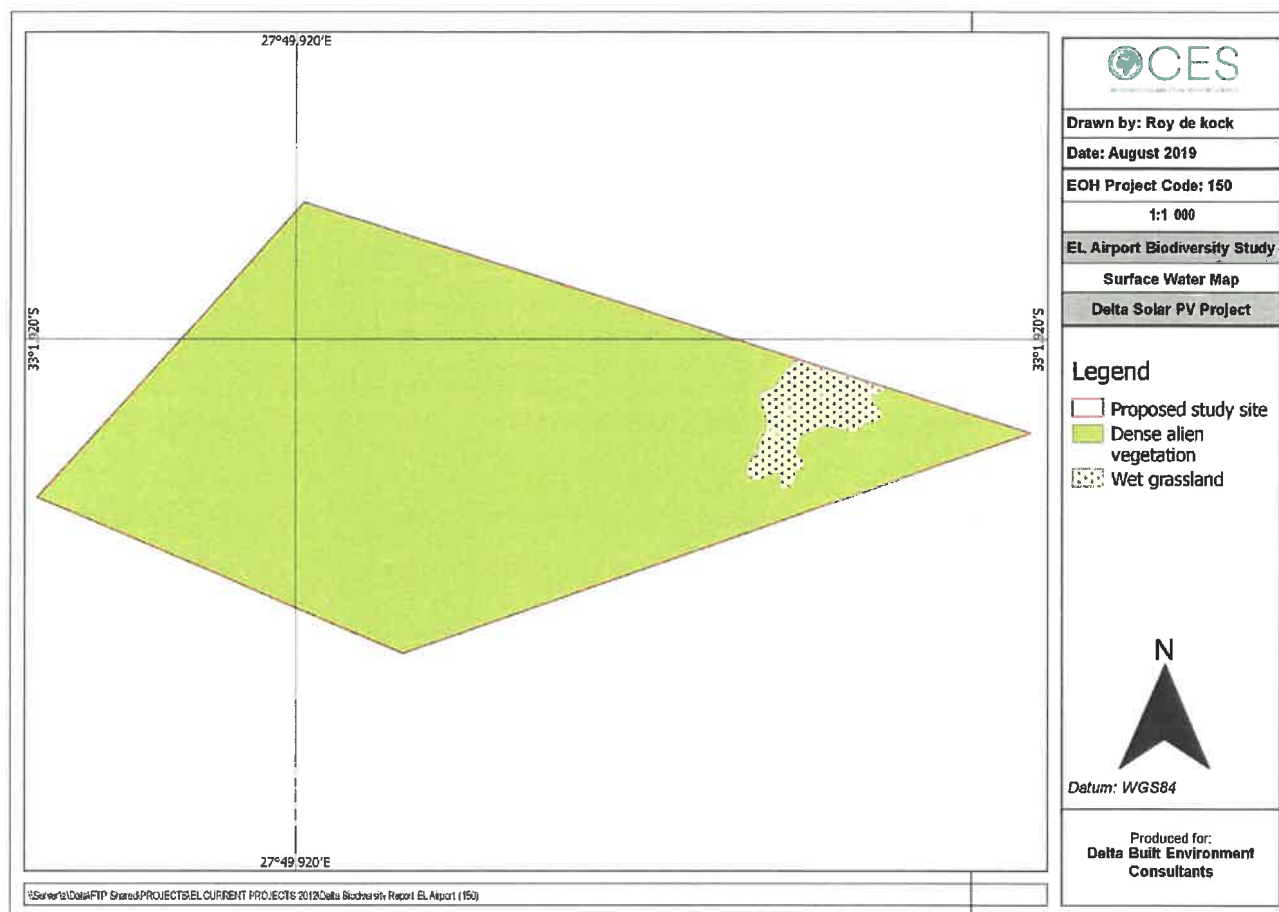


Figure 4.2. Vegetation communities found within the study site.



## 5 SENSITIVITY ASSESSMENT

The following table allocates ecological sensitivity for each environmental criterion identified:

**Table 5.1. Sensitivity allocation for each environmental criteria identified.**

CRITERIA		LOW SENSITIVITY	MODERATE SENSITIVITY	HIGH SENSITIVITY
1	<b>Topography</b>	Level, or even	Undulating; fairly steep slopes	Complex and uneven with steep slopes
2	<b>Vegetation</b> - Extent or habitat type in the region	Extensive	Restricted to a particular region/zone	Restricted to a specific locality / site
3	<b>Conservation status</b> of fauna/ flora or habitats	Well conserved independent of conservation value	Not well conserved, moderate conservation value	Not conserved - has a high conservation value
4	<b>SSC</b> - Presence and number	None, although occasional regional endemics	No endangered or vulnerable species, some indeterminate or rare endemics	One or more endangered and vulnerable species, or more than 2 endemics or rare species
5	<b>Habitat fragmentation</b> leading to loss of viable populations	Extensive areas of preferred habitat present elsewhere in region not susceptible to fragmentation	Reasonably extensive areas of preferred habitat elsewhere and habitat susceptible to fragmentation	Limited areas of this habitat, susceptible to fragmentation
6	<b>Biodiversity</b> contribution	Low diversity, or species richness	Moderate diversity, and moderately high species richness	High species diversity, complex plant and animal communities
7	<b>Visibility</b> of the site or landscape from other vantage points	Site is hidden or barely visible from any vantage points with the exception in some cases from the sea.	Site is visible from some or a few vantage points but is not obtrusive or very conspicuous.	Site is visible from many or all angles or vantage points.
8	<b>Erosion potential</b> or instability of the region	Very stable and an area not subjected to erosion.	Some possibility of erosion or change due to episodic events.	Large possibility of erosion, change to the site or destruction due to climatic or other factors.
9	<b>Rehabilitation</b> potential of the area or region	Site is easily rehabilitated.	There is some degree of difficulty in rehabilitation of the site.	Site is difficult to rehabilitate due to the terrain, type of habitat or species required to reintroduce.
10	<b>Disturbance</b> due to human habitation or other influences (Alien invasives)	Site is very disturbed or degraded.	There is some degree of disturbance of the site.	The site is hardly or very slightly impacted upon by human disturbance.
11	<b>Water bodies</b> affected by the proposed development	No water bodies	No water bodies	Includes all water bodies (e.g. wetlands, perennial rivers, non-perennial rivers, drainage systems etc.)

A sensitivity map was developed indicating the overall sensitivity of the study site (Figure 5.1).

Overall low sensitivity was allocated to the study area due to the following factors:

- Dense Gum trees occurs in northern areas (low sensitivity, alien infestation)

- Guava tree infestation in northern sections (low sensitivity, alien infestation)
- Black wattle tree infestation in northern section (low sensitivity, alien infestation)
- Grassland impacted and secondary in nature (Low sensitivity, impacted)

Overall moderate sensitivity was allocated to the study area due to the following factors:

- Non-perennial drainage stream occur in close vicinity to the site (high sensitivity including a 100m buffer)

Overall high sensitivity was allocated to the study area due to the following factors:

- Natural forest occurs in close vicinity to the site (High sensitivity, DAFF Forest)

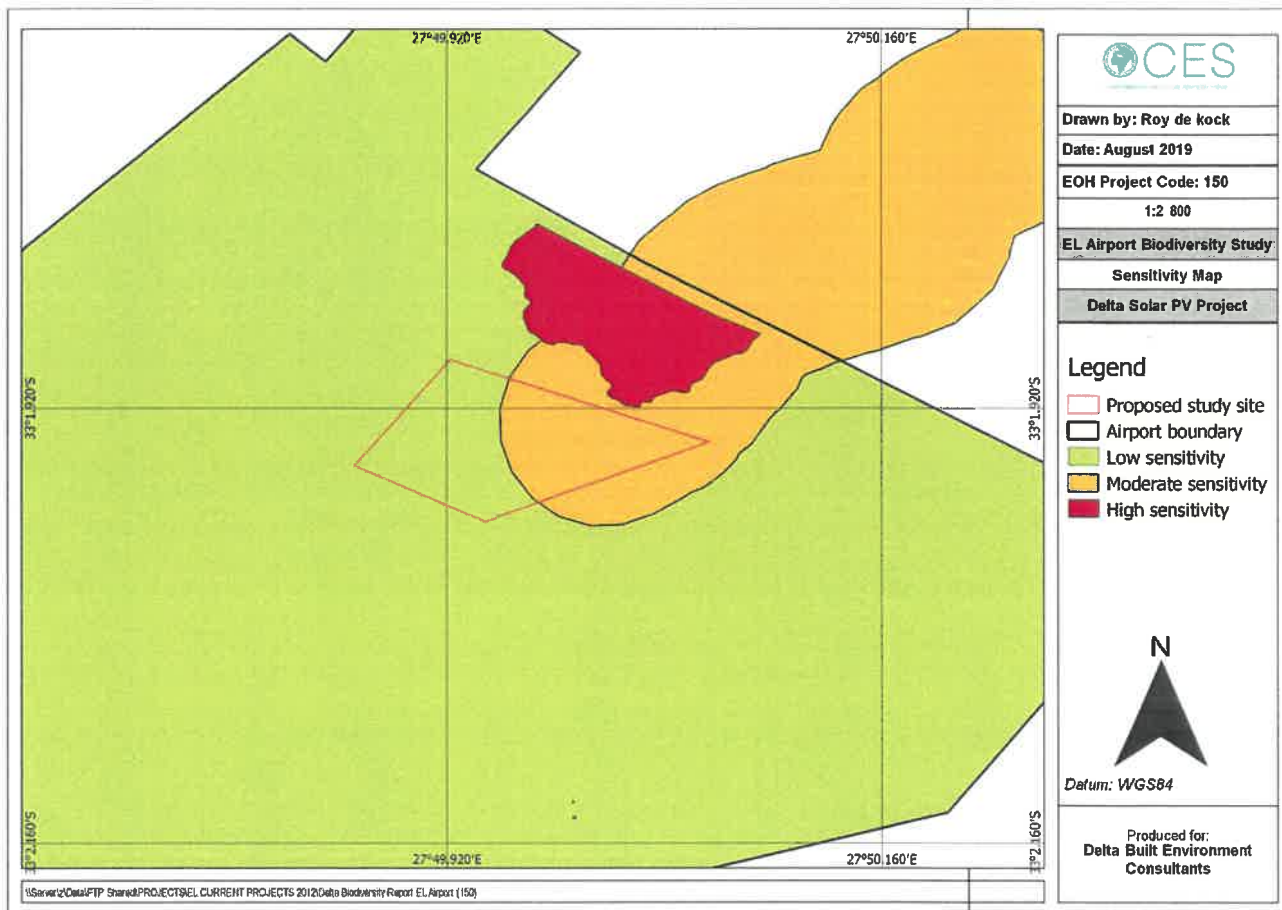


Figure 5.1. Sensitivity map of the study area.

No plant species of conservation concern were identified onsite.



## 6 ALIEN AND INVASIVE PLANTS

All alien and invasive (AIS) species, in terms of the Alien and Invasive Species list in terms of Sections 66(1), 67(1), 70(1) (a), 71(3) and 71A of the National Environmental Management: Biodiversity Act (Act 10 of 2004) are to be systematically eradicated, and any of these species colonising disturbed ground after the completion of construction are to be eradicated and destroyed prior to attaining the seed formation phase. A list of potential alien vegetation found onsite was identified during the site assessment and is included in Table 6.1 below.

**Table 6.1. List of alien invasive vegetation expected to be found onsite.**

Name of potential alien invasive species within the project side	Common name	NEMBA categories
<i>Acacia mearnsii</i>	Black wattle	2
<i>Cirsium vulgare</i>	Scottish thistle	1b
<i>Datura stramonium</i>	Thorn apple	1b
<i>Eucalyptus sp.</i>	Gum trees	Not listed in urban areas
<i>Ipomoea purpurea</i>	Morning glories	1b
<i>Lantana camara</i>	Lantana	1b
<i>Pinus pinaster</i>	Pine	1b
<i>Psidium guajava</i>	Guava	3
<i>Solanum mauritianum</i>	Bugweed	1b

The following table lists the management requirements for each AIS Category (NEMBA AIS List; 2014):

AIS Classification	Category 1a	Category 1b	Category 2	Category 3
Action	Must take immediate steps to combat or eradicate.	Must control listed AIS according to a developed Management Plan	Species which require a permit to carry out a restricted activity within an area specified in the Notice or permit.	Species which are subject to exemptions and prohibitions as specified in the Notice
Description	Must allow an authorised official from the Department to enter land to monitor and/or assist	Must allow an authorised official from the Department to enter land to monitor and/or assist	A landowner or permit holder must ensure that the specimens of the species do not spread outside of the area specified. Becomes a Category 1b species.	Species that occurs in riparian areas, must be considered to be a Category 1b species.

An Alien Vegetation Management Plan must be developed for all Category 1b alien and invasive vegetation.

## 7 CONCLUSION

### 7.1 Current status

Even though literature indicates thicket and thornveld as the main vegetation types (Mucina & Rutherford 2012), the site visit shows that the proposed Solar PV site at the East London Airport is heavily degraded with alien and invasive plants dominating the majority of the study site while secondary grassland occurs in a small patch in the eastern section (Figure 4.2).

No plants of conservation concern were identified within the study site.

There are a number of alien species present onsite. Alien species present on site and their category according to the NEMBA Alien and Invasive Species Regulations (published 1 August 2014) are presented in Table 6.1. The CARA alien invasive list is only referenced were an alien invasive species that does not appear on the NEMBA list appears on the CARA list. In this case there were no such species.

A non-perennial drainage stream was identified running in the eastern section of the study site (Figure 5.1). A 100m buffer was placed around the drainage system. The study site is partially located inside the regulated 100m buffer of this drainage system (indicated in Figure 5.1) and therefore may require a Water Use License (WUL) from the Department of Water Affairs (DWS) prior to commencement of activities onsite. An opinion will be required from DWS.

### 7.2 Alternatives

No site alternatives were assessed.

### 7.3 Recommendations to be included in the Final EMPr

The following impacts on the natural environment as a result of the construction and operation of a new Solar PV Plant were identified within the study site. Mitigations are proposed to reduce the risk of the impact. These impacts and mitigations must be included into an EMPr prior to commencement of construction activities onsite.

RISK	MITIGATION MEASURES
Removal of vegetation cover will increase the risk of soil erosion	<ul style="list-style-type: none"> <li>After construction the entire impacted area must be rehabilitated by replanting with an endemic grass species mix and allowed to regrow.</li> <li>Grasses must be mowed and managed throughout operation.</li> </ul>
Spreading of alien and invasive plants	<ul style="list-style-type: none"> <li>All alien and invasive plants occurring within the study area must be removed and disposed of at a registered landfill site prior to commencement of activities.</li> <li>An alien and invasive plant management plan must be developed and implemented throughout construction and operational phases.</li> </ul>
Dust is likely to be a potential nuisance due to the construction activities	<p>Fugitive/nuisance dust must be reduced by implementing the following:</p> <ul style="list-style-type: none"> <li>Damping down of un-surfaced and un-vegetated areas.</li> <li>Retention of vegetation where possible.</li> <li>Any complaints or claims emanating from the lack of dust control must be attended to immediately by the Contractor.</li> </ul>
Design and sighting of the PV arrays could result in an alteration of the landscape	<p>While mitigation options are limited, those that are proposed include:</p> <ul style="list-style-type: none"> <li>Colour of above ground infrastructure (excluding PV panels) to be sympathetic to the landscape character (preferably greys).</li> </ul>

RISK	MITIGATION MEASURES
character and sense of place.	<ul style="list-style-type: none"> <li>Underground cabling to be utilised where possible.</li> <li>The design and location of ancillary works are to incorporate measures which will reduce their visual impact.</li> </ul>
There is a potential risk associated with inappropriate planning for storm water management e.g. designs of the arrays could affect drainage and surface water run-off leading to onsite erosion.	<ul style="list-style-type: none"> <li>A Storm Water Management Plan must be developed and implemented. The plan should include management mitigation measures for water pollution, waste water management and the management of surface erosion, e.g. by considering appropriate contouring, etc.</li> </ul>
Unnecessary disturbance of vegetation due to illegal construction outside the construction footprint can cause loss of biodiversity.	<ul style="list-style-type: none"> <li>The construction area must be clearly demarcated during construction.</li> <li>The environmental officer must approve the final site layout and monitor during construction.</li> </ul>
The drainage system occurring on site may be impacted by construction activities.	<p>If any activity occur within the drainage system or within the 100m buffer:</p> <ul style="list-style-type: none"> <li>Comment must be obtained from DWS on whether a WUL is required. This consultation must take place prior to commencement of any activities onsite.</li> <li>Alternatively, the development must be moved to outside the indicated 100m buffer area.</li> </ul>

#### 7.4 Environmental Statement and Opinion of the Specialist

The ecological and biodiversity impacts of all aspects for the proposed new Solar PV Plant located at the East London Airport were assessed and considered to be ecologically acceptable, provided that the mitigation measures provided in this report are implemented (as per Section 7.3).

The local area is well developed with various urban clusters surrounding the airport. The East London Airport itself is extensively developed.

The study site was recently (within the last 2 years as confirmed with ACSA) cleared of all woody vegetation as part of the Airport Maintenance Plan. Regrowth appears to be limited to grasses and alien and invasive vegetation regrowth (mainly saplings). Therefore the site is considered as highly degraded with little natural ecological functions occurring onsite. This results in very low vegetation biodiversity within the study site.

Developing the Solar PV facility within the proposed study site will therefore have little effect on the natural environment provided that all mitigations as proposed in Section 7.3 are implemented.

## 8 REFERENCES

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