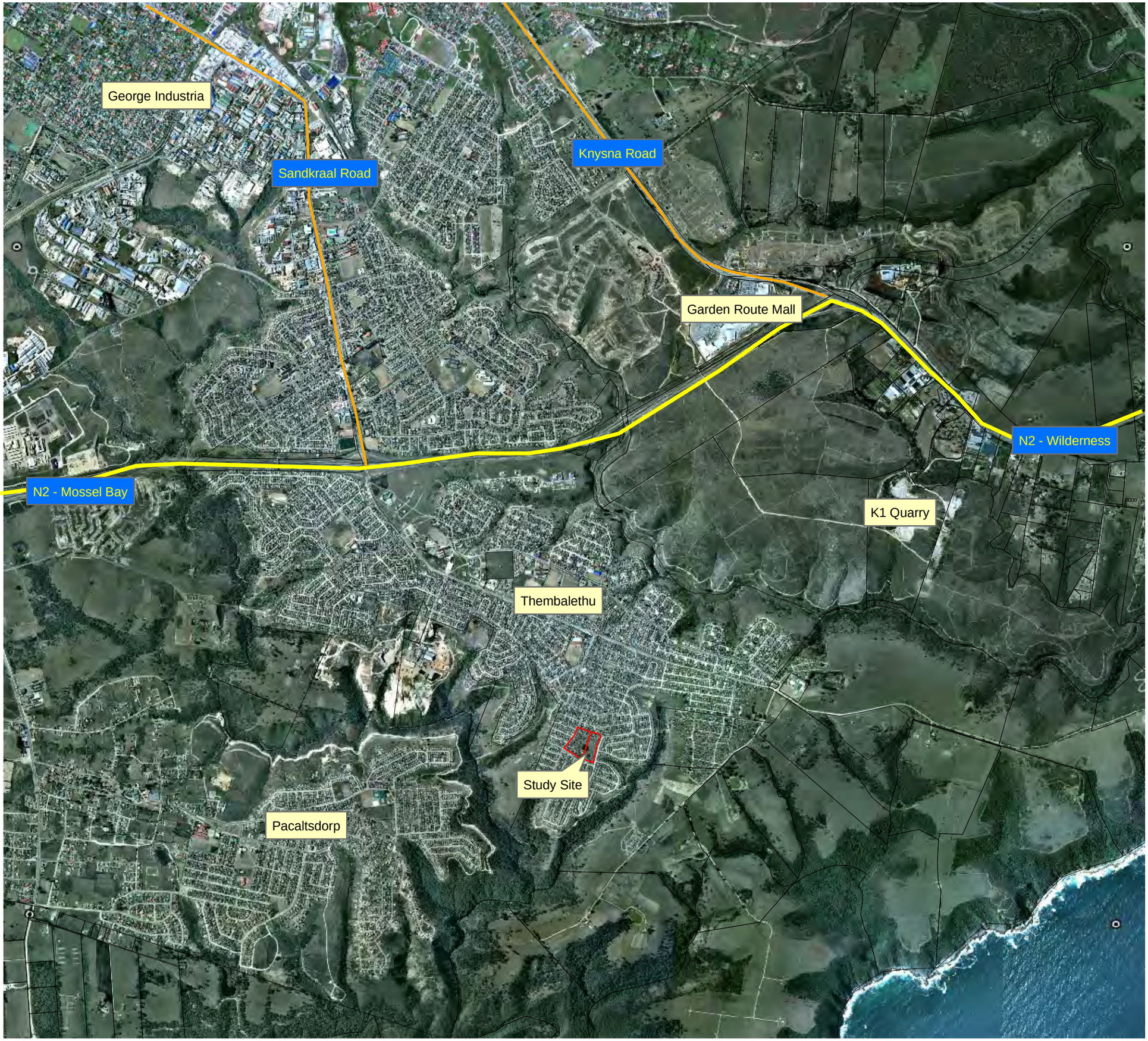


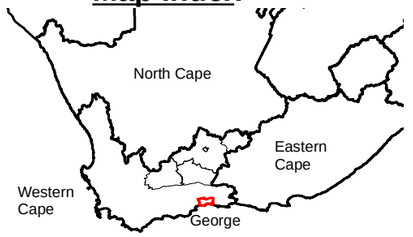
Notes

- Map Scale is 1 : 25 000 when printed on A3.
- Aerial Image courtesy of Google Earth Pro 2012
- Imagery date January 2010.

N

0 200 400 800 1,200 1,600 Meters

Map Index



Location Plan

Thembalethu Housing
Area 8A & B

Legend

Area 8A & B (erf 4056 & 4055)

Drawn	Checked	Date	Reference
Dale Holder	Sian Holder	12 November 2012	GEO191

Cape Environmental Assessment Practitioners (Pty) Ltd

SANBI
Biodiversity for Life

Thembalethu UISP

Legend

- Towns
- National roads
- Secondary roads
  - ARTERIAL ROUTE
  - MAIN ROAD
  - SECONDARY ROAD
- Minor roads
- GR CBA and ESA Lookup Tab
- GR Critical Biodiversity Areas a Support Areas
  - Protected Areas
  - Critical Biodiversity Areas
  - Ecological Support Areas
- GR Other Natural Areas
- GR Transformation
  - Alien Transformed
  - Dam
  - Degraded
  - Farm
  - Heavy Alien Degradation
  - Natural
  - Plantation
  - Urban
- GR Vegetation Types
  - Baviaanskloof Sandolienveld
  - Baviaanskloof Spekboom Thicket
  - Covie Coastal Proteoid Fynbos
  - De Vlugt Forest-Waboomveld
  - De Vlugt Sandolien-Renosterveld
  - Doornrivier Mesic Proteoid Fynbos
  - Doringrivier Arid Proteoid Fynbos
  - Doringrivier Waboomveld
  - Eensaamheid Renosterveld
  - Garden Route Estuary
  - Garden Route Wetlands
  - Groenvlei Coastal Forest
  - Groot Brak River and Floodplain
  - Haarlem Fynbos-Renosterveld
  - Hartenbos Primary Dune
  - Hartenbos Strandveld
  - Herold Renoster-Sandolienveld
  - Heroldsbay Asteraceous Fynbos

1: 25 138

1.3 0 0.64 1.3 Kilometers

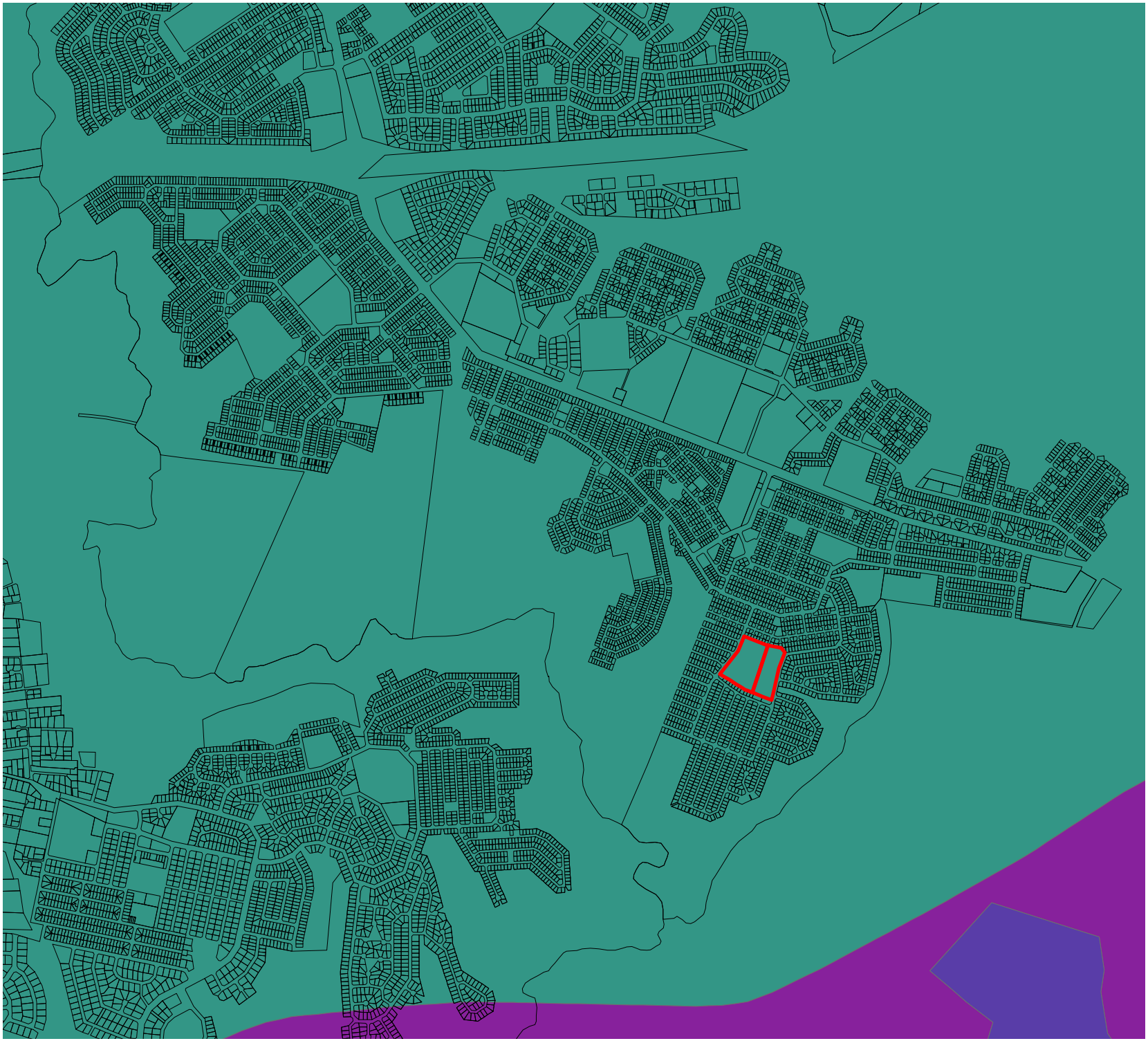
WGS_1984_Web_Mercator_Auxiliary_Sphere

This map is a user generated static output from an Internet mapping site and is for reference only. Data layers that appear on this map may or may not be accurate, current, or otherwise reliable.

THIS MAP IS NOT TO BE USED FOR NAVIGATION

Notes

BGIS Critical Biodiversity Area Map



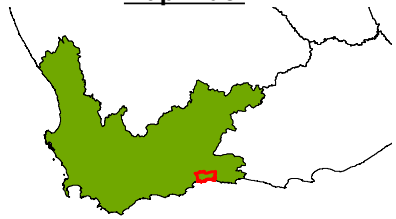
Notes

- Map Scale is 1 : 20 000 when printed on A4.
- Data source courtesy of SANBI BGIS 2012

N

0 125 250 500 750 1,000 Meters

Map Index



Location Plan

Thembalethu Housing
Area 8A & B
Critical Biodiversity Areas

Legend

Areas 8A & B (erf 4056 & 4055)

Vegetation Type, Ecosystem Status

- Garden Route Granite Fynbos, Endangered
- Groot Brak Dune Strandveld, Endangered
- Southern Afrotemperate Forest, Least threatened

Drawn	Checked	Date	Reference
Melissa Mackay	Sian Holder	12 November 2012	GEO191

Cape Environmental Assessment Practitioners (Pty) Ltd

Notes

- Map Scale is 1 : 10 000 when printed on A3.
- Aerial Image courtesy of Google Earth Pro 2012
- Imagery date January 2010.

N

0 55 110 220 330 440 Meters

Map Index

Location Plan

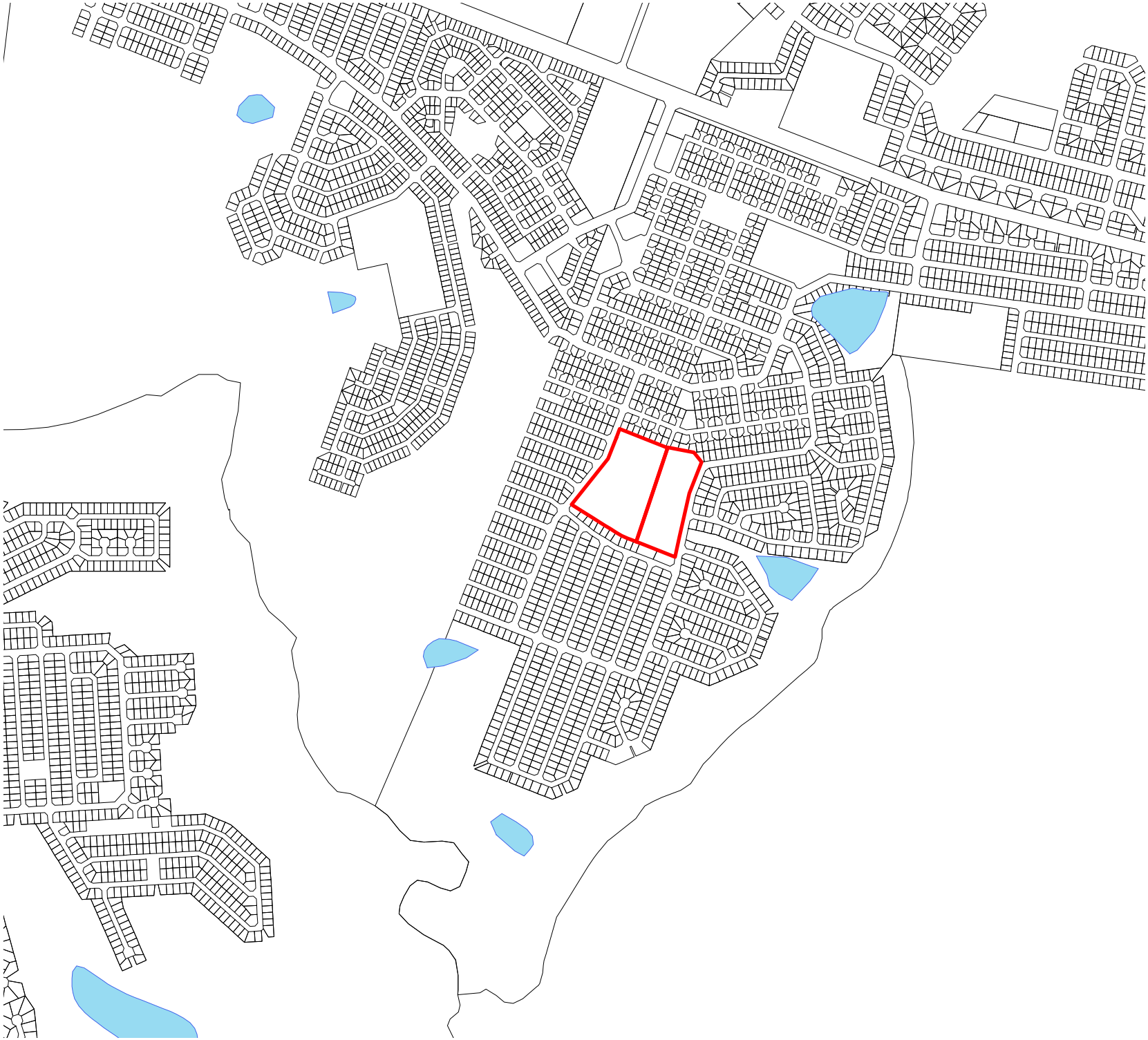
Thembalethu Housing
Area 8A & B
Critical Biodiversity Areas

Legend

- Areas 8A & B (erf 4056 & 4055)
- Critical Biodiversity Areas
- Ecological Support Areas

Drawn	Checked	Date	Reference
Dale Holder	Sian Holder	12 November 2012	GEO191

Cape Environmental Assessment Practitioners (Pty) Ltd



Notes

- Map Scale is 1 : 10 000 when printed on A3.
- Aerial Image courtesy of Google Earth Pro 2012
- Imagery date January 2010.

N

0 55 110 220 330 440 Meters

Map Index

Thembalethu Housing Areas 8A & B

National Freshwater Ecosystem Priority Areas Wetlands

Legend

NFEPA Wetlands

Areas 8A & B (erf 4056 & 4055)

Drawn	Checked	Date	Reference
Dale Holder	Sian Holder	12 November 2012	GEO 191

Cape Environmental Assessment Practitioners (Pty) Ltd

N2 Rd

RECENTLY UPGRADED N2 BULK SEWER

BULK SEWER TO BE UPGRADED (N2 EXTENSION)

SWARTKOP RIVER

350mm Ø BULK SEWER RIVER CROSSING No.4

OUTENIQUA WASTEWATER TREATMENT WORKS

AREA 1

EXISTING THEMBALETHU No.5 PUMP STATION TO BE DECOMMISSIONED

HIGH POINT

THEMBALETHU

NEW THEMBALETHU No.7 PUMP STATION PHASE 1

EXISTING 200mm Ø FIBRE CEMENT RISING MAIN

AREA 2

RIVER CROSSING No.3

AREA 5

OLD 'ALL BRICK' BRICKWORKS

AREA 7

AREA 8C

PLANNED NEW BULK SEWER PHASE 1

AREA 4B

OPTION 4

EXISTING 400mm Ø FC RISING MAIN, AUGMENTED WITH NEW 700mm Ø GRP RISING MAIN

AREA 6B

AREA 6A

RIVER CROSSING No.2

EXISTING THEMBALETHU No.3 PUMP STATION (TO BE UPGRADED OR DECOMMISSIONED)

NEW RISING MAIN PHASE 1

AREA 4A

AREA 8A

AREA 8B

PACALTSDORP No.1 PUMP STATION TO BE UPGRADED

AREA 3

RIVER CROSSING No.6

PROPOSED 350 - 400mm Ø BULK GRAVITY SEWER

EXISTING 600 / 700mm Ø GRP BULK GRAVITY SEWER

EXISTING THEMBALETHU No.4 PUMP STATION (TO BE DECOMMISSIONED)

NEW DAWN PARK

Dawn

OPTION 1

OPTION 3 REALIGNED

AREA 4C

OPTION 2

BULK SEWER UNDER CONSTRUCTION PHASE 1

Sea View

NEW THEMBALETHU No.6 PUMP STATION PHASE 1

EXISTING 250mm Ø PVC-u RISING MAIN TO BE AUGMENTED BY NEW 500mm Ø GRP RISING MAIN

RIVER CROSSING No.5

RIVER CROSSING No.1

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REV	DATE	REVISION DETAILS	APPROVED
B	05/2013	RIVER CROSSINGS ADDED	A van Molendorff
C	06/2013	STREAM CROSSINGS ADDED	A van Molendorff
D	07/2013	RIVER CROSSING No. 5 ADDED	A van Molendorff
E	07/2013	RIVER CROSSING No. 6 ADDED	A van Molendorff
F	08/2013	ENLARGED SCALE	A van Molendorff
G	11/2013	LAYOUT REVISED	A van Molendorff
H	11/2013	OPTION 3 REALIGNED	A van Molendorff
I	11/2013	LAYOUT REVISED	A van Molendorff

DRAWN	DESIGNED
MC Richards	A v Molendorff

CHECKED
A v Molendorff

APPROVED

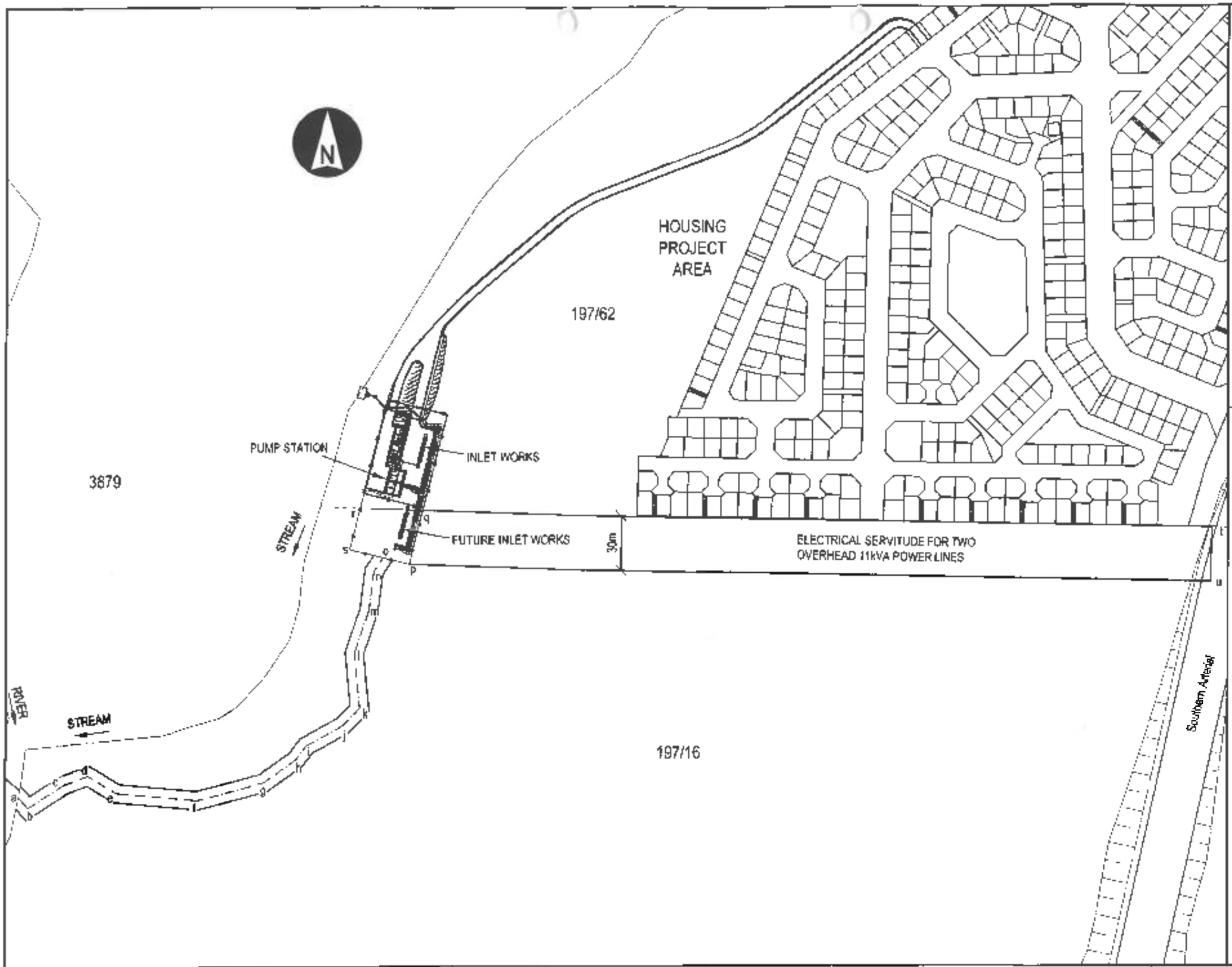
NAME	SIGNATURE	DATE
P.J. Jacobs		25/11/13

PROJECT
THEMBALETHU HOUSING PROJECT

TITLE
REVISED BULK SEWER MAIN PROPOSALS

FOR DISCUSSION PURPOSES

PROJECT No.	
108429	
SCALE	SIZE
1: 12 750	A3
DRAWING No.	REV.
108429 GE 400	I



AREA p, q, r & s REPRESENTS A PORTION OF LAND TO BE EXPROPRIATED FROM PORTION 16 OF FARM 197 FOR THE EXTENSION OF THE SEWER PUMP STATION IN THE FUTURE. EXTENT = 915m²

LINE a - o REPRESENTS THE CENTRE LINE OF A 10m PIPE LINE SERVITUDE AND MAINTENANCE ACCESS RIGHT - OF - WAY FOR GEORGE MUNICIPALITY'S USE.

AREA l, u, q & p REPRESENTS A 30m SERVITUDE FOR TWO OVERHEAD 11kVA POWER LINES.

PROPOSED SERVITUDE CO-ORDINATE LIST :

POINT	Y	X
a	47288.132	3766266.690
b	47282.952	3766272.733
c	47263.575	3766260.247
d	47250.174	3766256.392
e	47234.565	3766264.884
f	47190.552	3766259.042
g	47154.769	3766259.439
h	47136.837	3766246.696
i	47131.115	3766239.114
j	47111.175	3766228.060
k	47102.041	3766218.546
l	47104.952	3766188.389
m	47097.051	3766164.937
n	47094.333	3766143.727
o	47089.357	3766136.036
p	47074.903	3766139.635
q	47067.498	3766109.892
r	47101.957	3766108.601
s	47107.653	3766131.481
t	46638.788	3766120.153
u	46637.397	3766150.147

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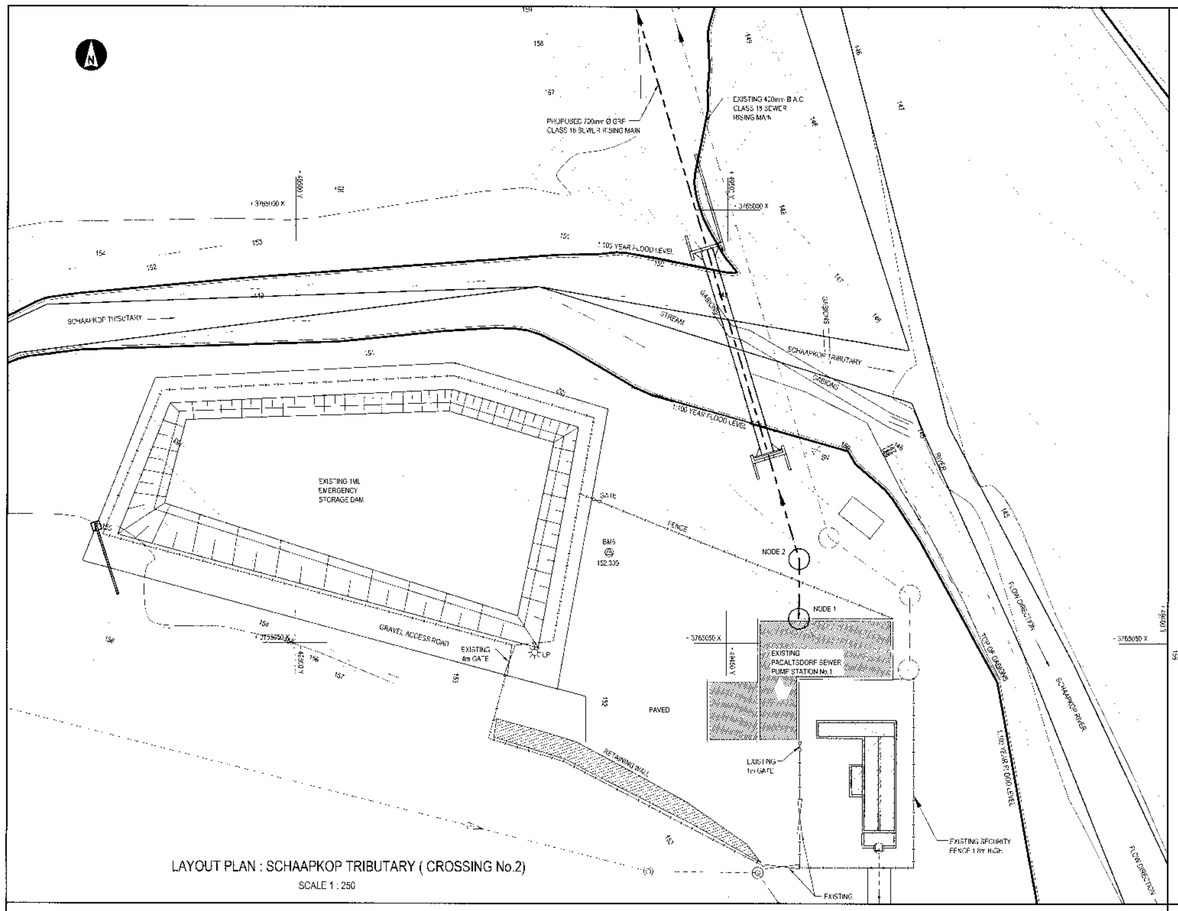
PROJECT DIRECTOR
Pr Eng
DATE : 9 May 2012

GEORGE MUNICIPALITY : SEWERAGE RETICULATION FOR PACALTSDORP : PHASE 2 (THEMBALETHU / ASAZANI)

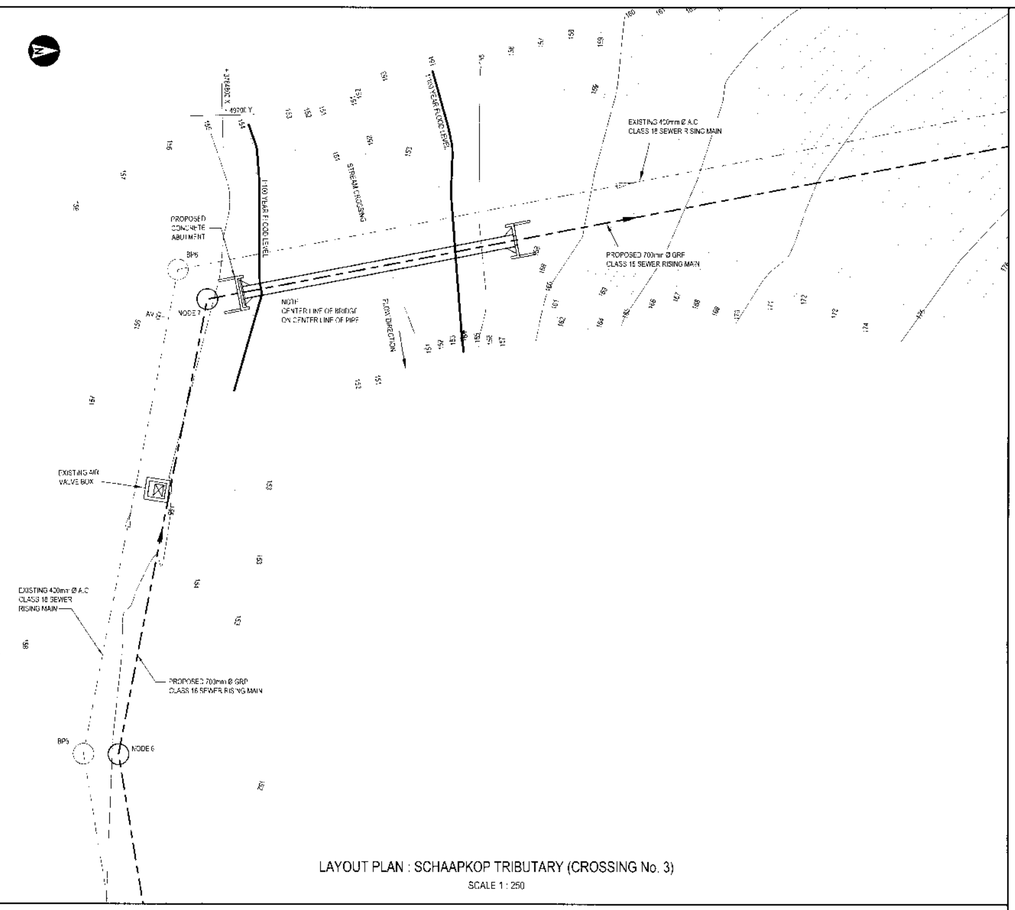
THEMBALETHU PUMP STATION : EXPROPRIATED AREA AND SERVITUDES

DRAWN	VC Dudgeon	SCALE 1 : 2000
DESIGNED :	R Meidenhamer	DRAWING No.
PROJ. MAN.	A van Molendorf	402947 GE 28



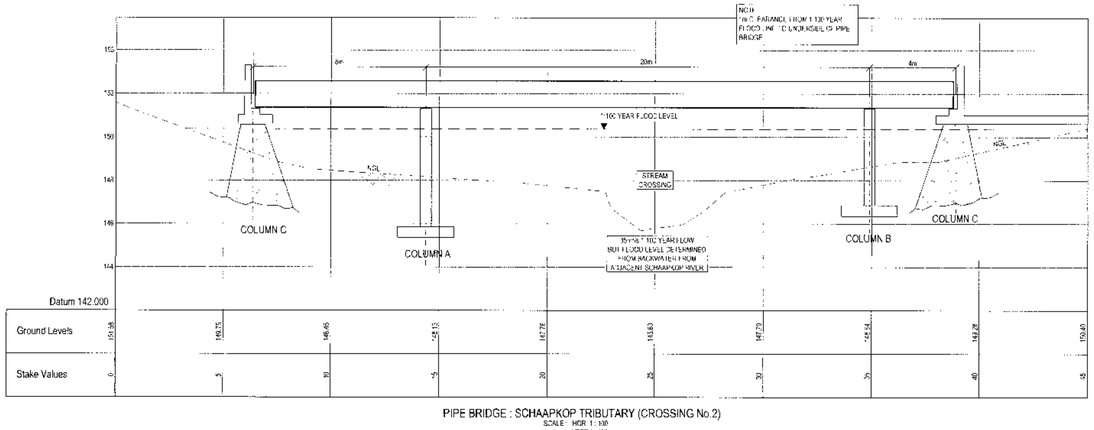
LAYOUT PLAN : SCHAAPKOP TRIBUTARY (CROSSING No.2)

SCALE 1 : 250



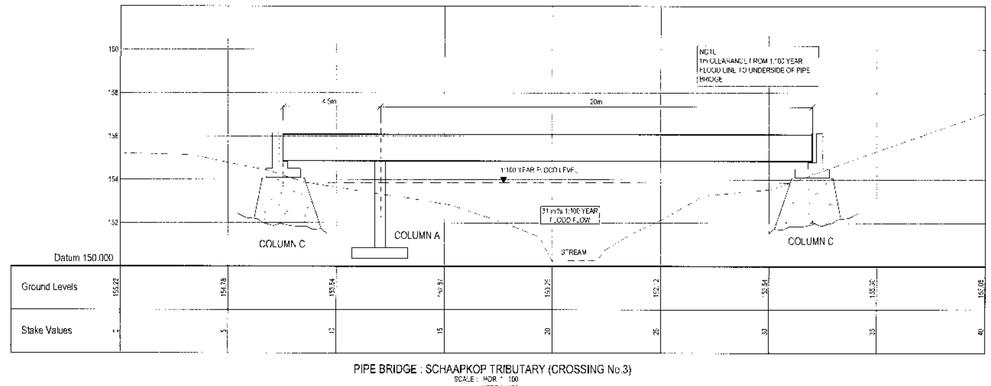
LAYOUT PLAN : SCHAAPKOP TRIBUTARY (CROSSING No. 3)

SCALE 1 : 250



PIPE BRIDGE : SCHAAPKOP TRIBUTARY (CROSSING No.2)

SCALE : HOR 1 : 100
VERT 1 : 100



PIPE BRIDGE : SCHAAPKOP TRIBUTARY (CROSSING No.3)

SCALE : HOR 1 : 100
VERT 1 : 100

APPROVED BY	SIGNATURE	DATE
DRAWN		04/12/2013
DESIGNED		4/12/2013
CHECKED		

THE MASTER HELD AT THE AURECON GEORGE OFFICE BEARS THE SIGNATURE OF APPROVAL

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GEORGE MUNICIPALITY

REV	DATE	REVISION DETAILS	APPROVED
D	08/2013	PIPE BRIDGE AMENDMENTS	A van Molsnorff
C	07/2013	CHANGED TO CONCRETE BRIDGE	A van Molsnorff
B	06/2013	FLOOD LINE ADDED	A van Molsnorff
A	05/2013	PIPE BRIDGE ADDED	A van Molsnorff

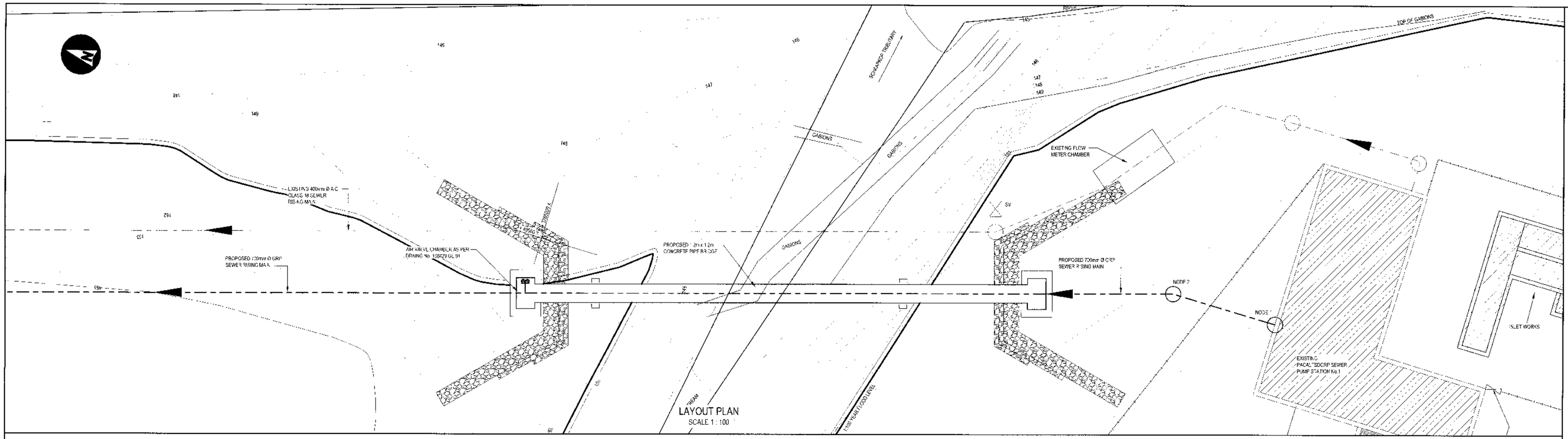
PROJECT

THEMBALETHU UISP BULK SEWER: PHASE 2

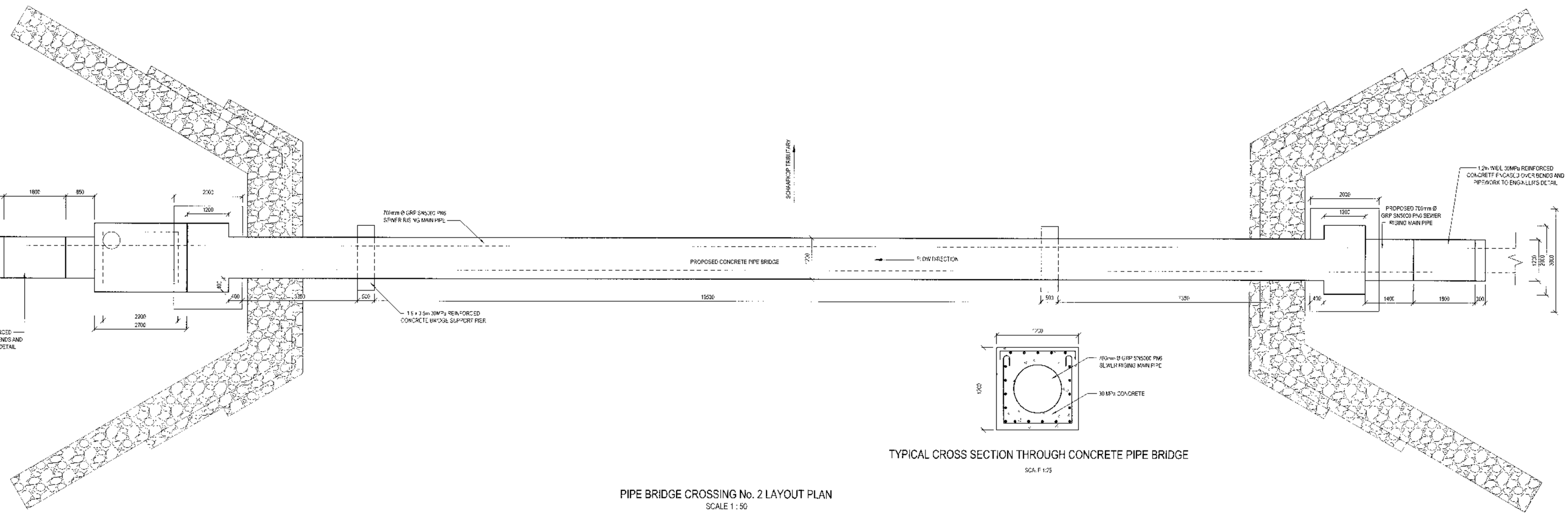
TITLE

PROPOSED PIPE BRIDGE LAYOUT PLAN AND LONGITUDINAL SECTIONS: CROSSING No. 2 AND No. 3

DRAWN	DESIGNED	FOR DISCUSSION PURPOSES ONLY
MC Richards	A Delle Donne	
CHECKED		PROJECT No.
A van Molsnorff		108429
APPROVED		SCALE / SIZE
NAME / SIGNATURE / DATE		AS SHOWN / A0
		DRAWING No. / REV
		108429 GE 404 / D

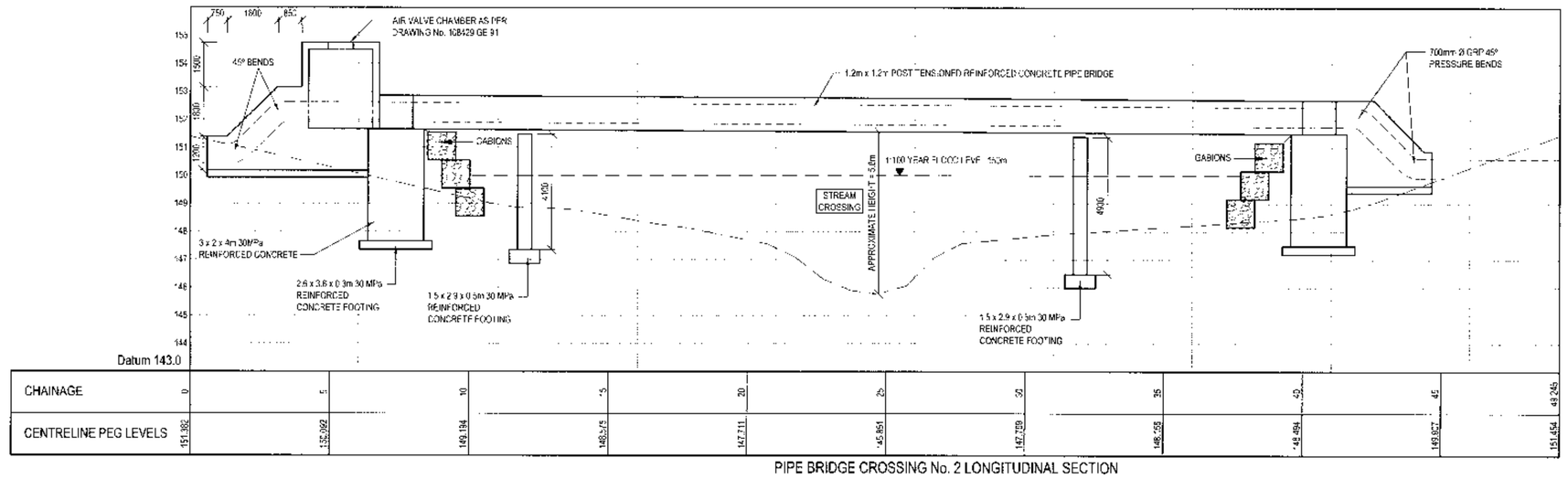


LAYOUT PLAN
SCALE 1 : 100



PIPE BRIDGE CROSSING No. 2 LAYOUT PLAN
SCALE 1 : 50

TYPICAL CROSS SECTION THROUGH CONCRETE PIPE BRIDGE
SCALE 1:25



PIPE BRIDGE CROSSING No. 2 LONGITUDINAL SECTION
SCALE : HOR 1 : 100
VERT 1 : 100

GENERAL NOTES:

APPROVED BY		
	SIGNATURE	DATE
DRAWN		
DESIGNED		30/10/2013
CHECKED		30/10/2013

THE MASTER HELD AT THE AURECON GEORGE OFFICE BEARS THE SIGNATURE OF APPROVAL

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THE CITY FOR ALL REASONS

REV	DATE	REVISION DETAILS	APPROVED
T0	25/10/2013	FOR TENDER PURPOSES ONLY	A van Molendorff
D	08/2013	PIPE BRIDGE AMENDMENTS	A van Molendorff
C	07/2013	CHANGED TO CONCRETE BRIDGE	A van Molendorff
B	06/2013	FLOOD LINE ADDED	A van Molendorff
A	05/2013	PIPE BRIDGE ADDED	A van Molendorff

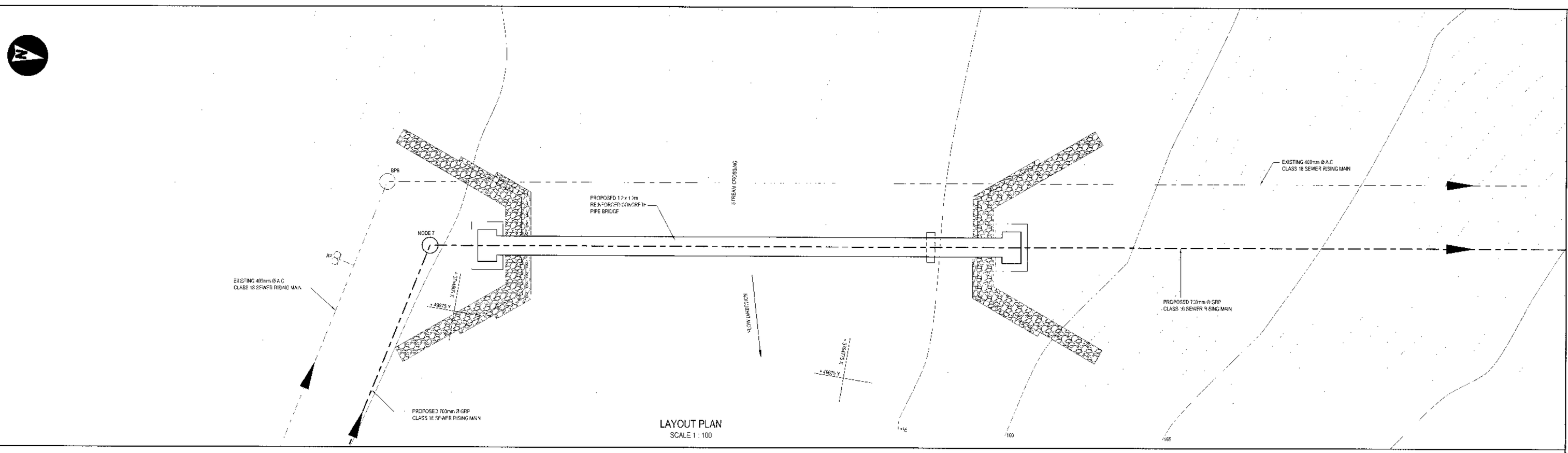
PROJECT

THEMBALETHU BULK SEWER: PHASE 3

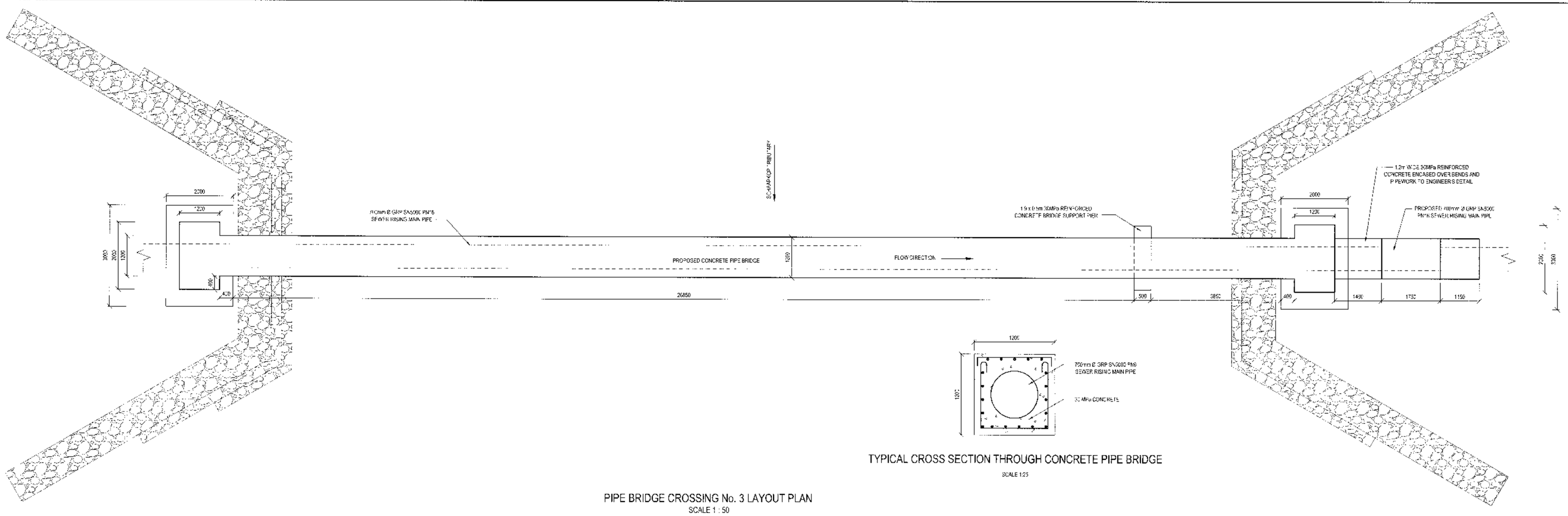
TITLE

RIVER CROSSING No. 2
PLAN, LONGITUDINAL SECTION AND DETAIL

DRAWN	DESIGNED	FOR TENDER PURPOSES ONLY
MC Richards	S Liwani	
CHECKED		PROJECT No.
A v Molendorff		108429
APPROVED		SCALE / SIZE
NAME / SIGNATURE / DATE		AS SHOWN / A0
		DRAWING No. / REV
		108429 GE 404 / T0

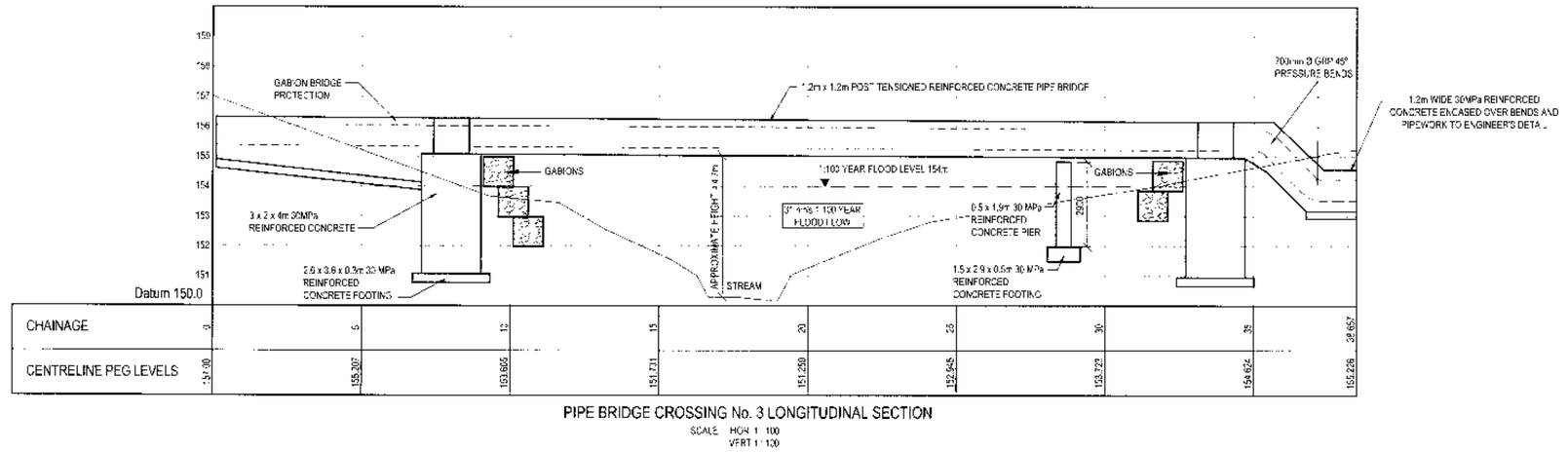


LAYOUT PLAN
SCALE 1 : 100



TYPICAL CROSS SECTION THROUGH CONCRETE PIPE BRIDGE
SCALE 1:25

PIPE BRIDGE CROSSING No. 3 LAYOUT PLAN
SCALE 1 : 50



PIPE BRIDGE CROSSING No. 3 LONGITUDINAL SECTION
SCALE: HOR 1 : 100
VERT 1 : 100

GENERAL NOTES:

APPROVED BY	SIGNATURE	DATE
DRAWN		
DS SIGNED		31/10/2013
CHECKED		31/10/2013

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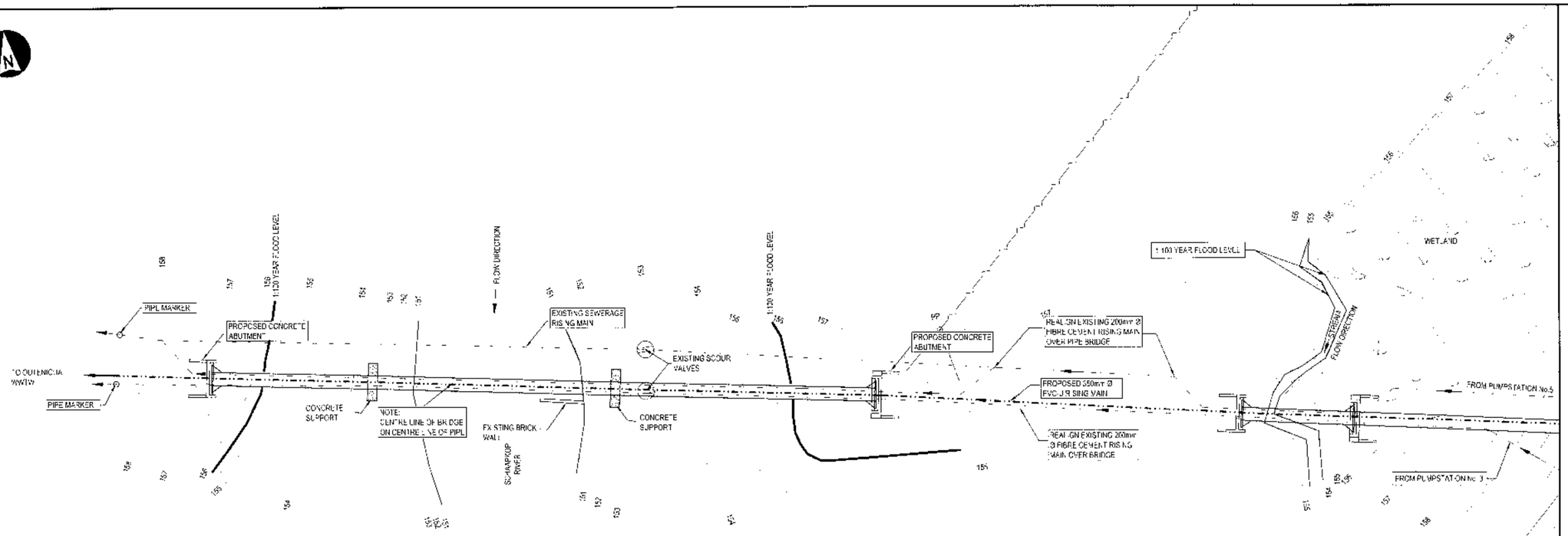
THE CITY OF ALL SEASONS

REV	DATE	REVISION DETAILS	APPROVED
T0	25/10/2013	FOR TENDER PURPOSES ONLY	A van Molendorff
D	08/2013	PIPE BRIDGE AMENDMENTS	A van Molendorff
C	07/2013	CHANGED TO CONCRETE BRIDGE	A van Molendorff
B	06/2013	FLOOD LINE ADDED	A van Molendorff
A	05/2013	PIPE BRIDGE ADDED	A van Molendorff

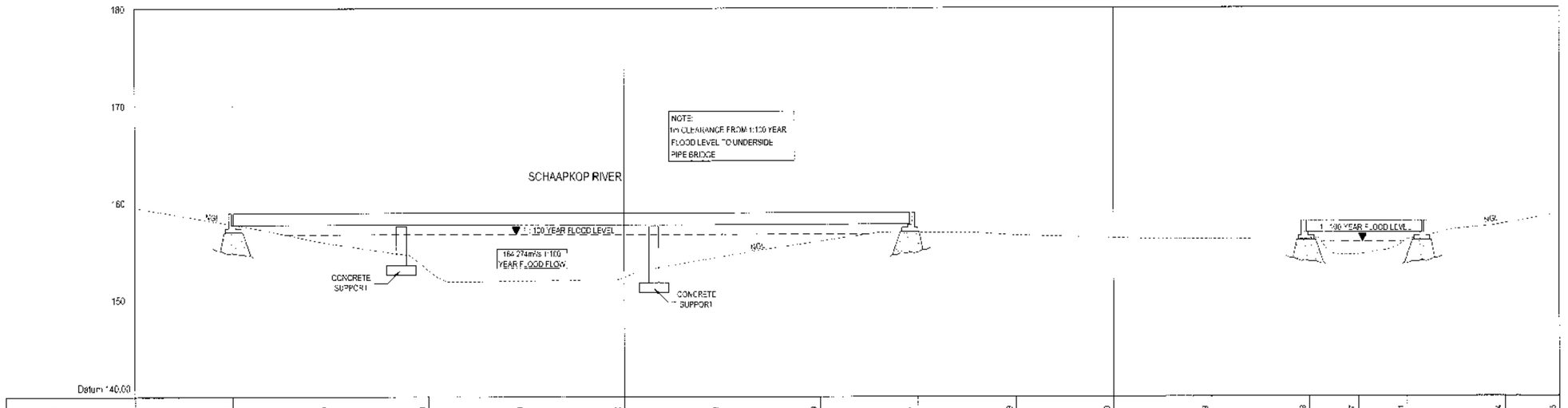
PROJECT
THEMBALETHU BULK SEWER: PHASE 3

TITLE
RIVER CROSSING No. 3
PLAN, LONGITUDINAL SECTION AND DETAIL

DRAWN	DESIGNED	
MC Richards	S Hoare	FOR TENDER PURPOSES ONLY
CHECKED		PROJECT No.
A v Molendorff		108429
APPROVED		SCALE / SIZE
NAME / SIGNATURE / DATE		AS SHOWN / A0
		DRAWING No. / REV
		108429 GE 413 / T0



LAYOUT PLAN (RIVER CROSSING NO. 4)
SCALE 1 : 250



NATURAL GROUND LEVEL (NGL)	158.50	156.74	154.79	151.99	152.94	151.32	153.42	154.99	155.97	155.59	152.30	153.19	155.18	153.37	155.11	156.74	157.75
STAKE VALUE	0	12	20	30	40	50	60	72	80	90	120	110	120	125	130	140	145.54

SCHAAPKOP RIVER AND TRIBUTARY PIPE BRIDGE (CROSSING NO. 4)
SCALE : VERT 1 : 250
HOR 1 : 250

APPROVED BY

	SIGNATURE	DATE
DRAWN		4/9/2013
DESIGNED		4/9/2013
CHECKED		

THE MASTER HELD AT THE AURECON GEORGE OFFICE BEARS THE SIGNATURE OF APPROVAL

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REV	DATE	REVISION DETAILS	APPROVED
C	29/8/2013	AMENDED TO CONCRETE BRIDGES	A v Molendorff
B	3/5/2013	AMENDMENT TO SMALL BRIDGE	A v Molendorff
A	9/5/2013	FOR DISCUSSION PURPOSES ONLY	A v Molendorff

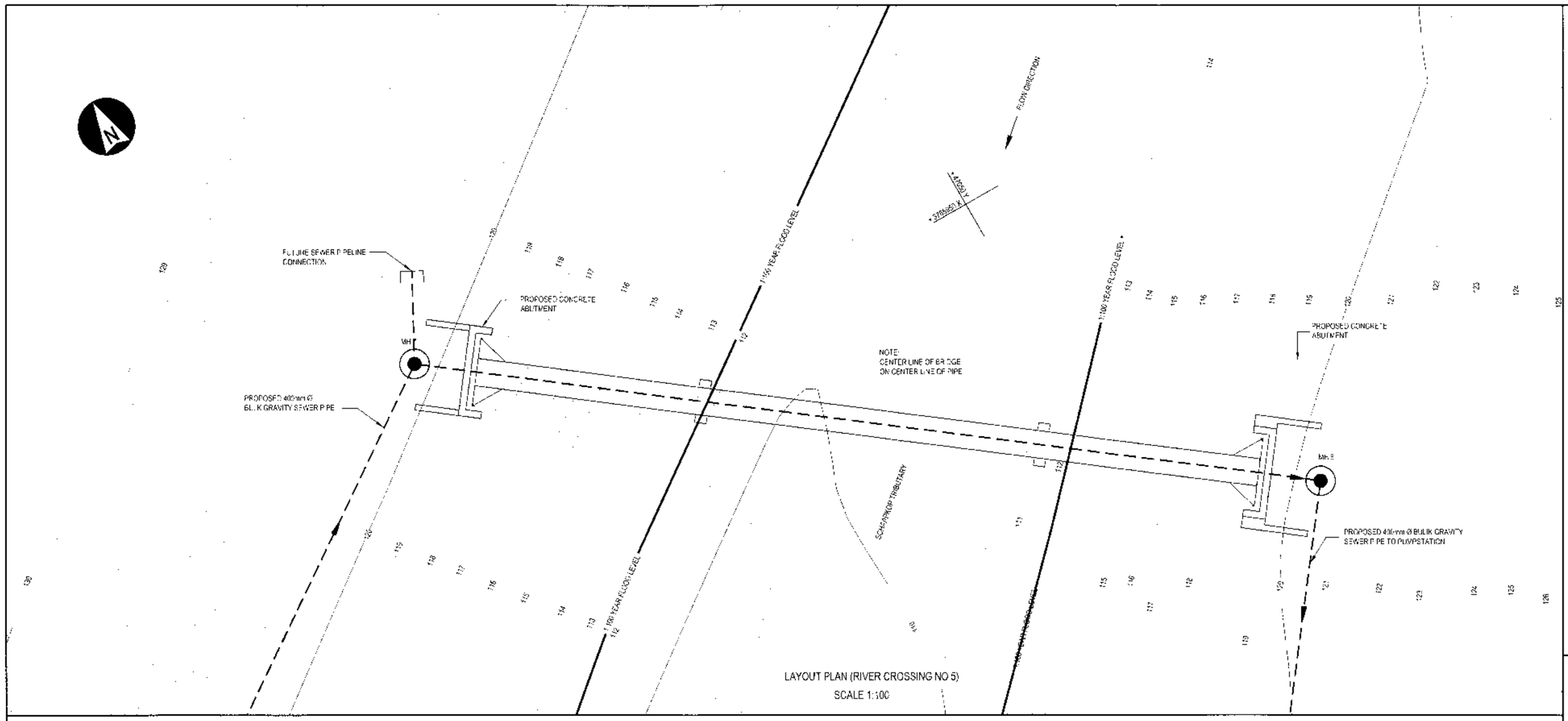
PROJECT

THEMBALETHU UISP BULK SEWER: PHASE 2

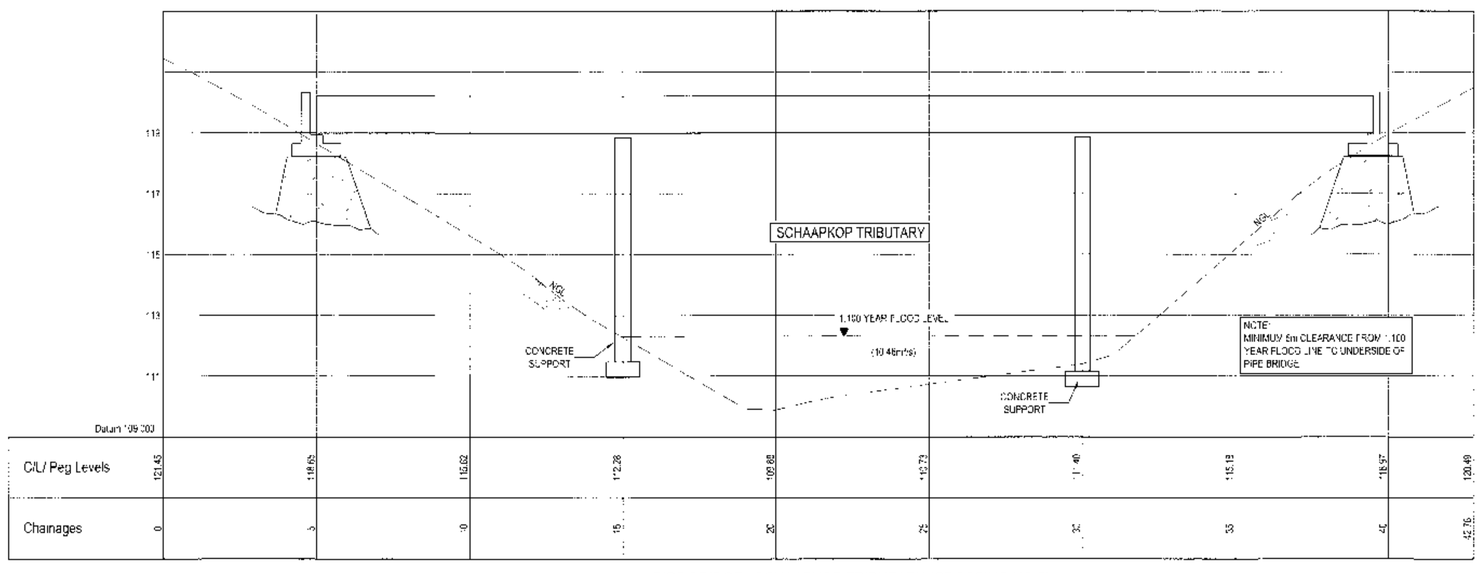
TITLE

PROPOSED PIPE BRIDGE: LAYOUT PLAN AND LONGITUDINAL SECTION (CROSSING NO.4)

DRAWN	DESIGNED	FOR DISCUSSION PURPOSES ONLY
MC Richards	S L Evans	
CHECKED		PROJECT No.
A van Molendorff		108429
APPROVED		SCALE 1 : 250 / SIZE A1
NAME SIGNATURE DATE		DRAWING No. 108429 REV 402 / REV C



LAYOUT PLAN (RIVER CROSSING NO 5)
SCALE 1:100



PIPE BRIDGE : SCHAAPKOP TRIBUTARY (CROSSING NO.5)
SCALE HOR 1:100
VERT 1:100

APPROVED BY		
	SIGNATURE	DATE
DRAWN		4/9/2013
DESIGNED		4/9/2013
CHECKED		

THE MASTER HELD AT THE AURECON GEORGE OFFICE BEARS THE SIGNATURE OF APPROVAL

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GEORGE MUNICIPALITY

REV	DATE	REVISION DETAILS	APPROVED
C	9/2013	CONCRETE PIPE BRIDGE ADDED	A van Molendorff
B	3/5/2013	AMENDMENT TO FLOOD LEVEL	A van Molendorff
A	9/5/2013	FOR DISCUSSION PURPOSES ONLY	A van Molendorff

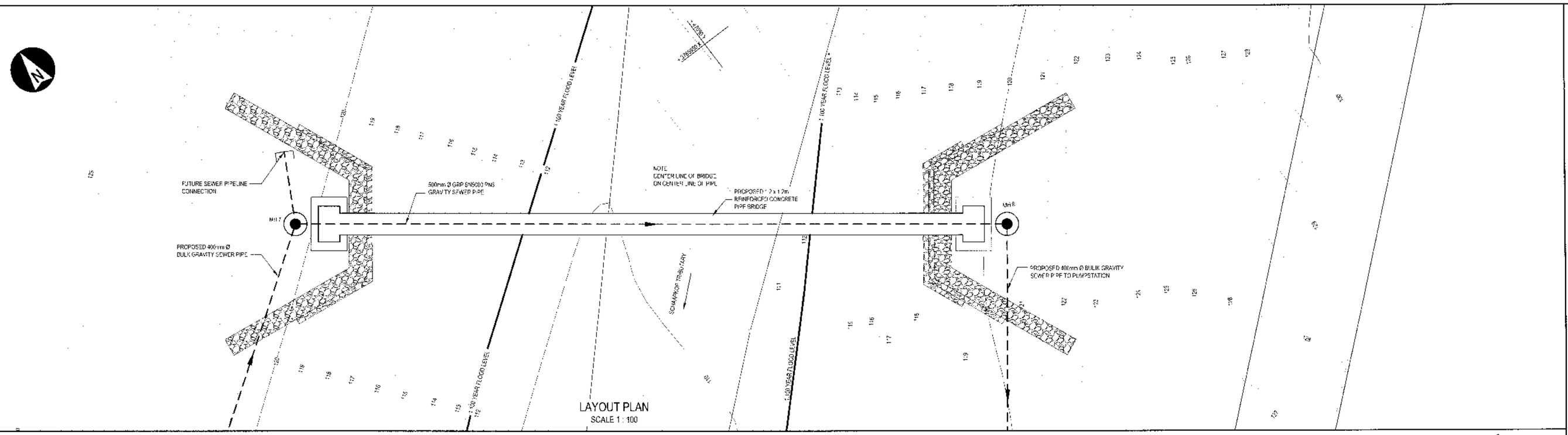
PROJECT

THEMBALETHU UISP BULK SEWER : PHASE 2

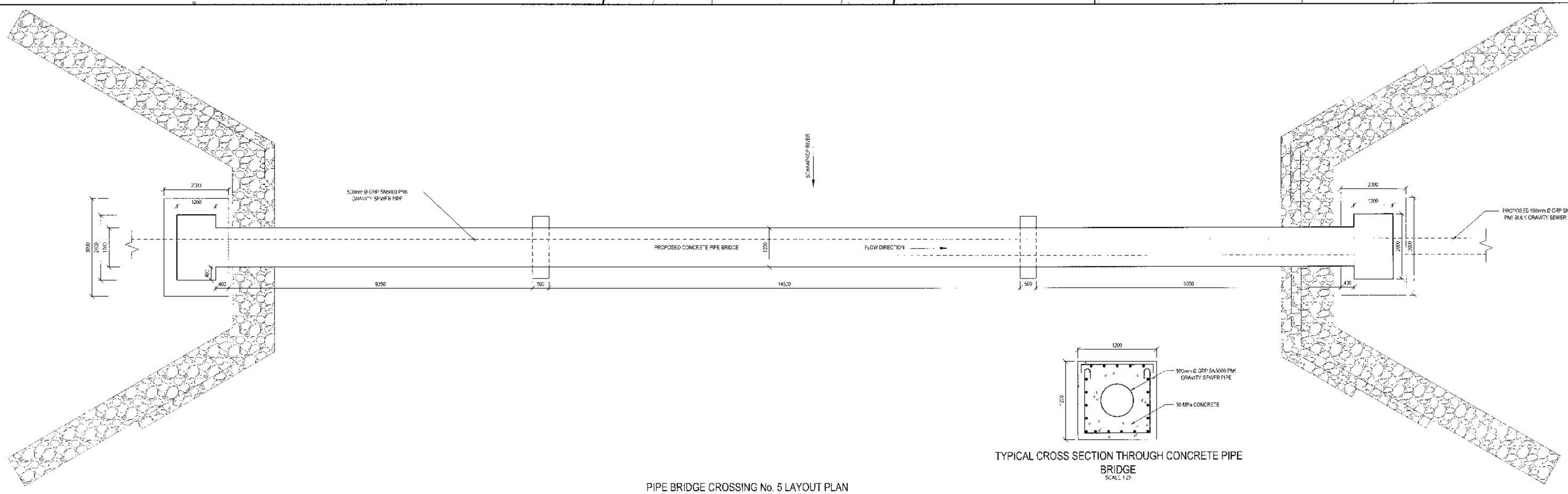
TITLE

PROPOSED PIPE BRIDGE LAYOUT PLAN AND LONGITUDINAL SECTION (CROSSING NO. 5)

DRAWN	DESIGNED	FOR DISCUSSION PURPOSES ONLY
MC Richards	S Liwani	
CHECKED		PROJECT No.
A van Molendorff		108429
APPROVED		SCALE / SIZE
NAME SIGNATURE DATE		AS SHOWN / A1
		DRAWING No. / REV
		108429 GE 405 / C

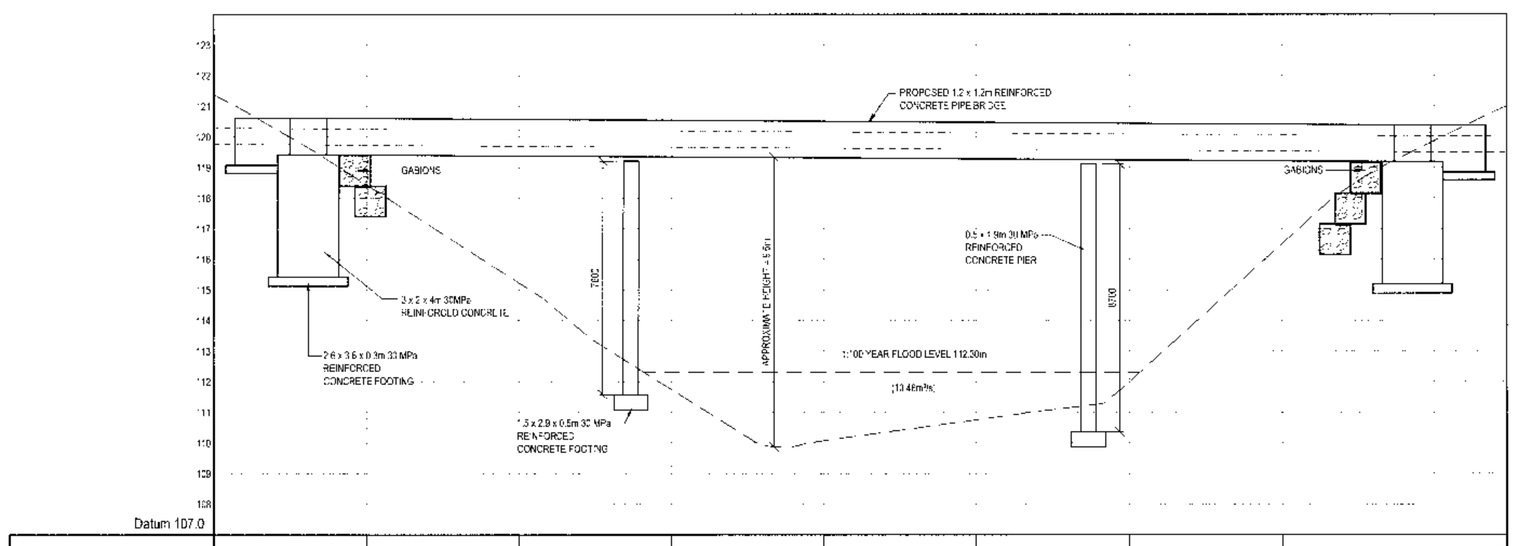


LAYOUT PLAN
SCALE 1 : 100



PIPE BRIDGE CROSSING No. 5 LAYOUT PLAN
SCALE 1 : 50

TYPICAL CROSS SECTION THROUGH CONCRETE PIPE BRIDGE
SCALE 1:25



PIPE BRIDGE CROSSING No. 5 LONGITUDINAL SECTION
SCALE : HOR 1 : 100
VERT 1 : 100

GENERAL NOTES:

APPROVED BY	SIGNATURE	DATE
DRAWN		
DESIGNED		25/9/2013
CHECKED		25/9/2013

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REV	DATE	REVISION DETAILS	APPROVED
T0	25/ 9/2013	FOR TENDER PURPOSES ONLY	A van Molendorff
C	9/2013	CONCRETE PIPE BRIDGE ADDED	A van Molendorff
B	4/9/2013	AMENDMENT TO FLOOD LEVEL	A van Molendorff
A	9/5/2013	FOR DISCUSSION PURPOSES ONLY	A van Molendorff

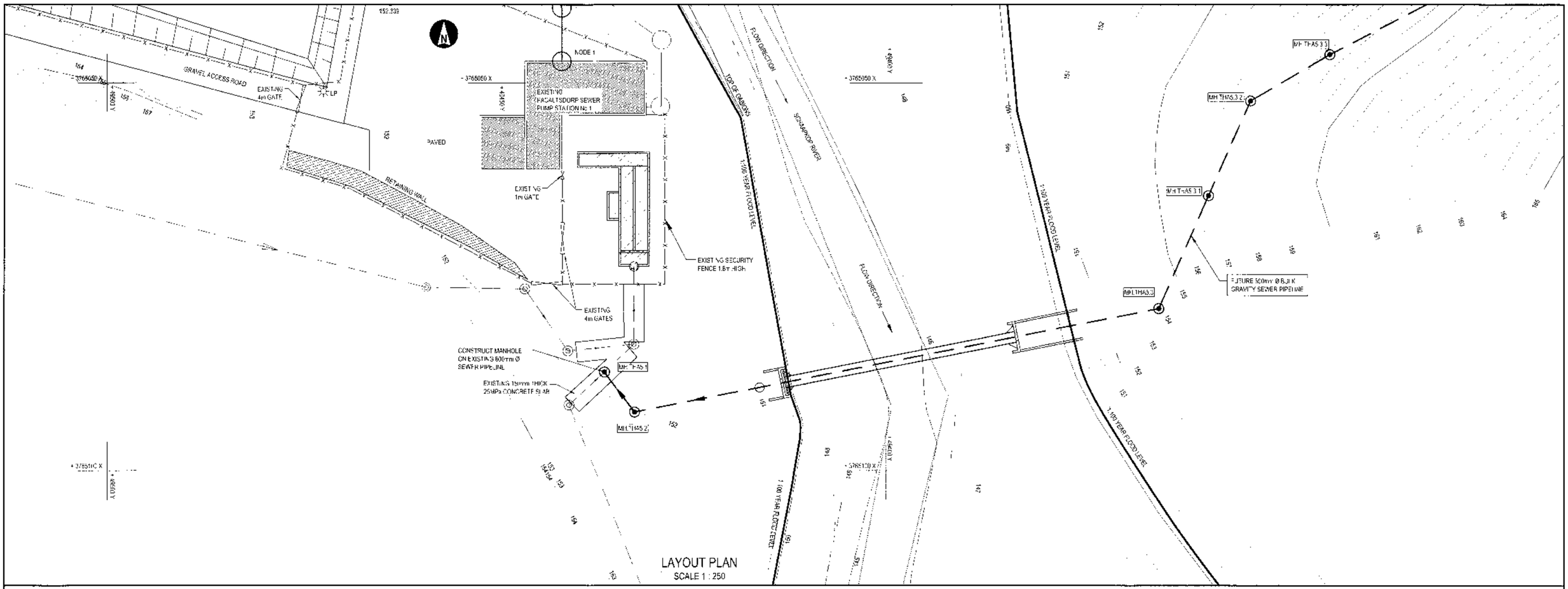
PROJECT

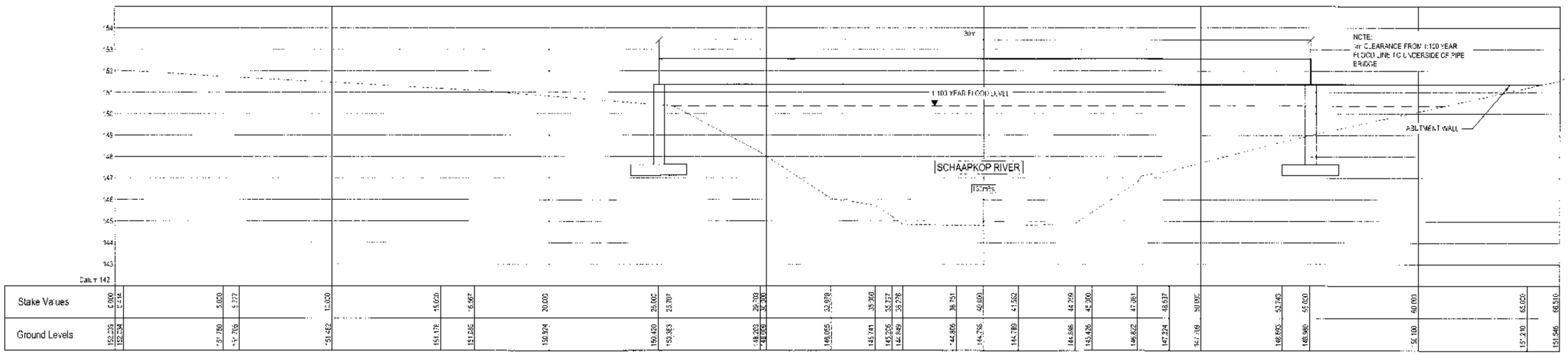
THEMBALETHU BULK SEWER: PHASE 3

TITLE

RIVER CROSSING No. 5
PLAN, LONGITUDINAL SECTION AND DETAIL

DRAWN	DESIGNED	FOR TENDER PURPOSES ONLY
MC Richards	S L van	
CHECKED		PROJECT No.
A v Molendorff		108429
APPROVED		SCALE / SIZE
NAME / SIGNATURE / DATE		AS SHOWN / A0
		DRAWING No. / REV
		108429 GE 405 / T0





PIPE BRIDGE : SCHAAPKOP RIVER (CROSSING No.6)
SCALE : HOR 1 : 400
VERT 1 : 100

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REV	DATE	REVISION DETAILS	APPROVED
A	05/2013	AMENDED TO CONCRETE PIPE BRIDGE	A van Molendorff
B	07/2013	FLOOD LINE ADDED	A van Molendorff
C	08/2013	FLOOD LINE DETAIL UPDATED	A van Molendorff

DRAWN	DESIGNED
NC Richards	A Zelie Dorne

CHECKED
A van Molendorff

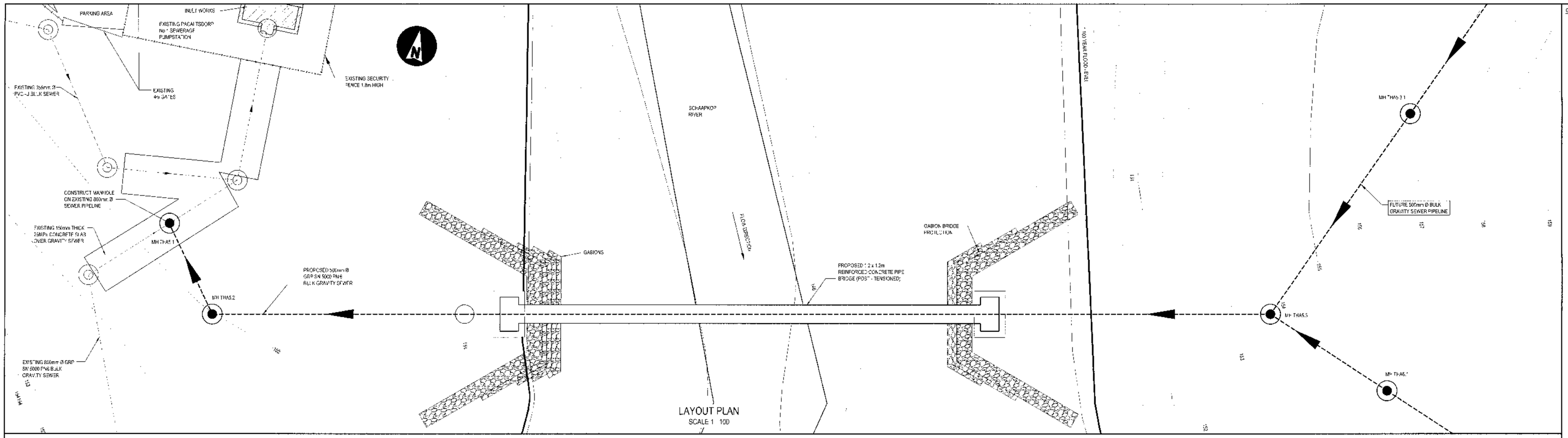
APPROVED
NAME | SIGNATURE | DATE

PROJECT
THEMBALETHU UISP BULK SEWER:
PHASE 2

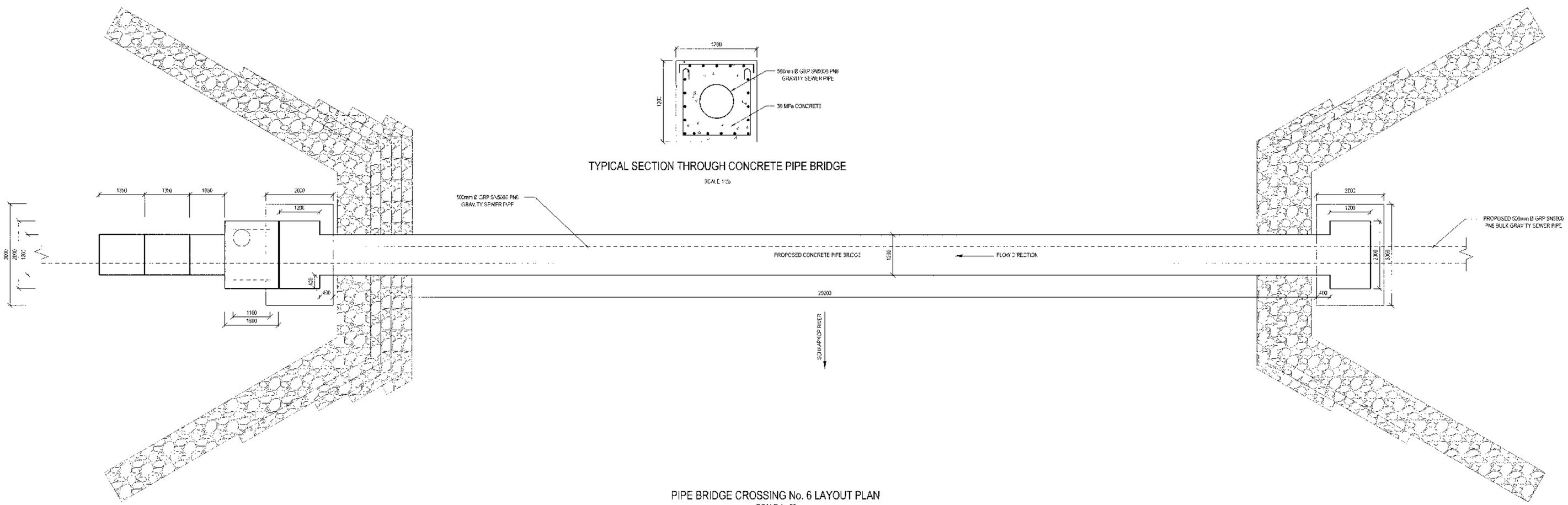
TITLE
SCHAAPKOP RIVER : FLOODLINE
CROSS-SECTION AT PACALTSDORP No.1
SEWER PUMPSTATION (CROSSING No. 6)

FOR DISCUSSION PURPOSES ONLY

PROJECT No.	
108429	
SCALE	SIZE
AS SHOWN	A1
DRAWING No.	REV
108429 GE 403	C

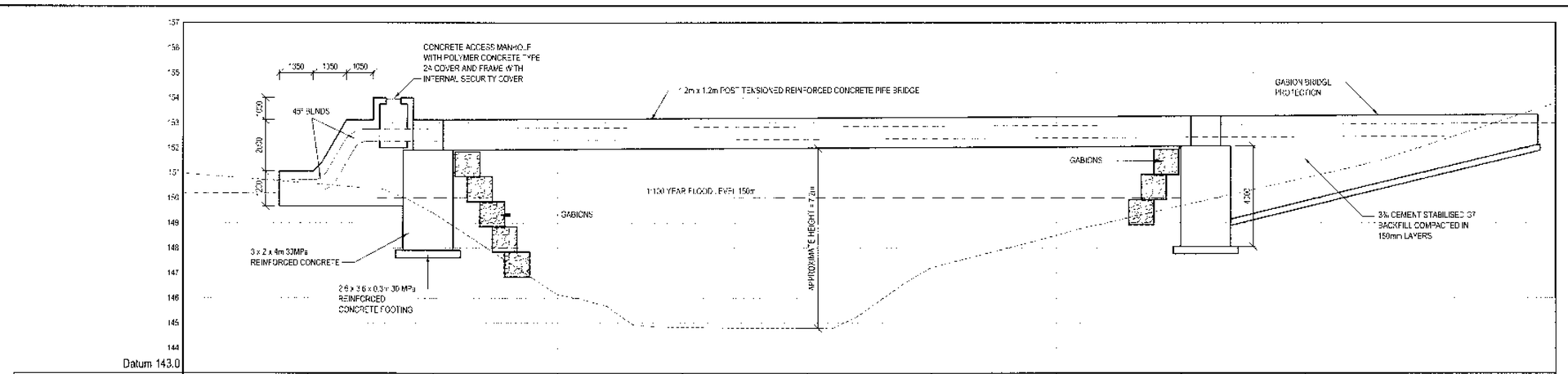


LAYOUT PLAN
SCALE 1 : 100



TYPICAL SECTION THROUGH CONCRETE PIPE BRIDGE
SCALE 1:25

PIPE BRIDGE CROSSING No. 6 LAYOUT PLAN
SCALE 1 : 50



CHAINAGE	0	5	10	15	20	25	30	35	40	45	50	55
CENTRELINE PEG LEVELS	150.28	150.53	149.40	148.14	146.83	144.78	147.22	148.50	149.89	150.80	152.15	153.75

PIPE BRIDGE CROSSING No. 6 LONGITUDINAL SECTION
SCALE: HOR 1 : 100
VERT 1 : 100

GENERAL NOTES:

APPROVED BY

	SIGNATURE	DATE
DRAWN		
DESIGNED		
CHECKED		

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REV	DATE	REVISION DETAILS	APPROVED
TO	25/10/2013	FOR TENDER PURPOSES ONLY	A v Molendorff
C	08/2013	FLOOD LINE DETAIL UPDATED	A v Molendorff
B	07/2013	FLOOD LINE ADDED	A v Molendorff
A	06/2013	AMENDED TO CONCRETE PIPE BRIDGE	A v Molendorff

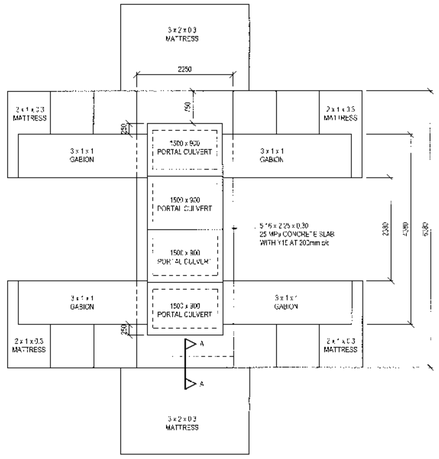
PROJECT

THEMBALETHU BULK SEWER: PHASE 3

TITLE

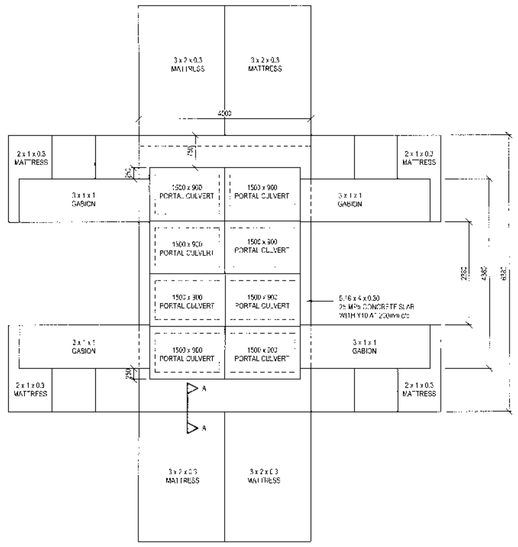
RIVER CROSSING No.6
PLAN, LONGITUDINAL SECTION AND DETAIL

DRAWN	DESIGNED	FOR TENDER PURPOSES ONLY
MC Richards	N Hinds	
CHECKED		PROJECT No.
A v Molendorff		108429
APPROVED		SCALE / SIZE
NAME / SIGNATURE / DATE		AS SHOWN / A0
		DRAWING No. / REV
		108429 GE 403 / T0



TYPE 1:PLAN OF FIRST LAYER OF GABIONS AND MATTRESSES

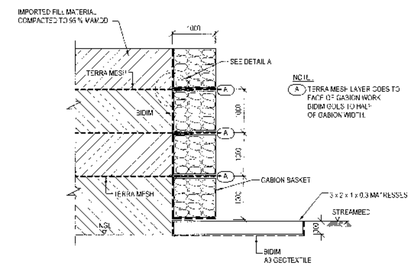
SCALE : 1:50



TYPE 2: PLAN OF FIRST LAYER OF GABIONS AND MATTRESSES

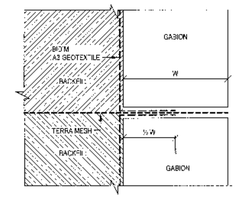
SCALE : 1:50

GABION LAYOUT PLAN



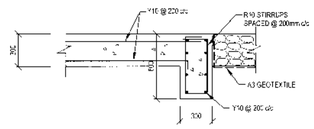
TYPICAL SECTION THROUGH GABION WALL

SCALE : 1:50



DETAIL A

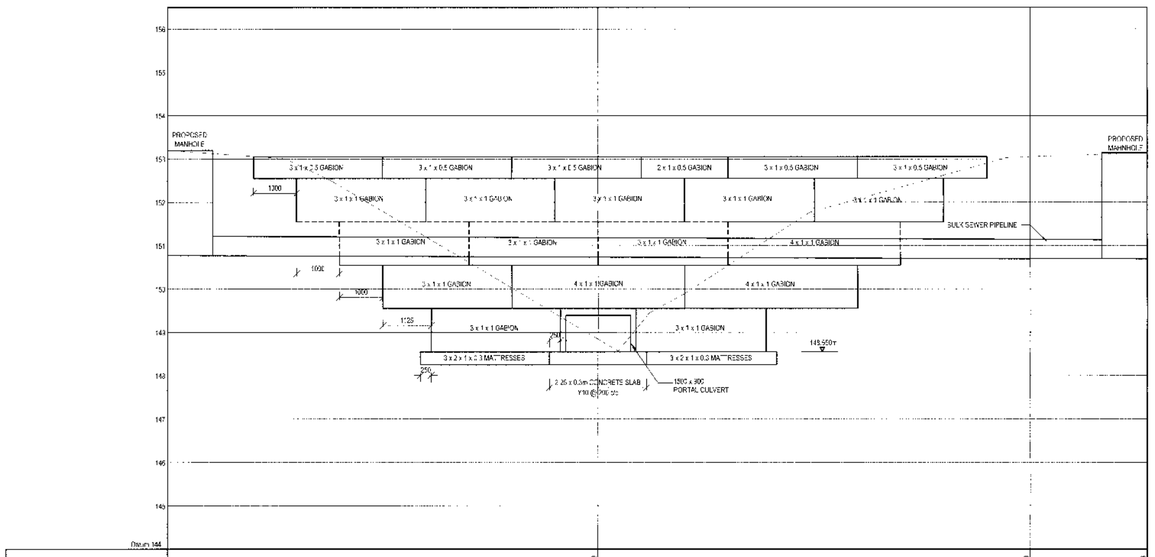
SCALE 1:20



SECTION A-A

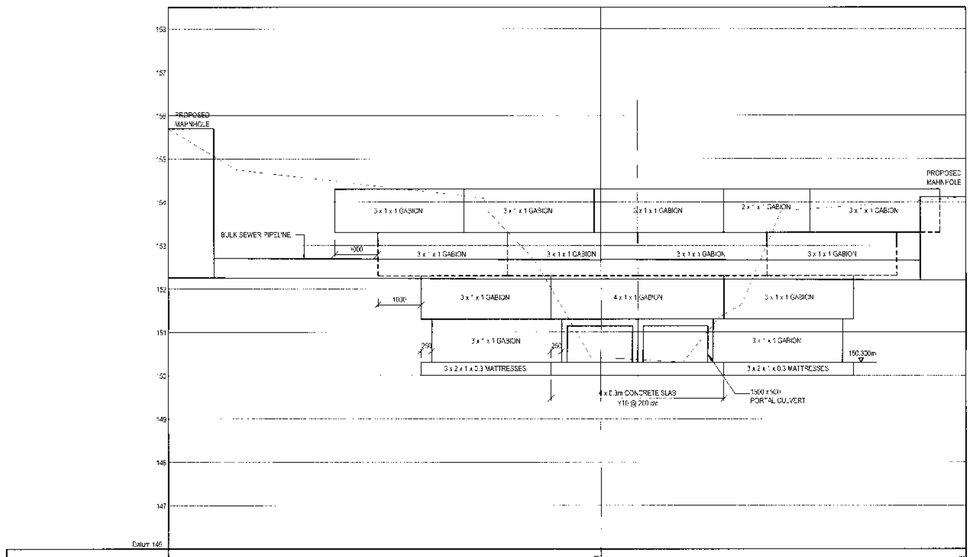
SCALE 1:20

GENERAL NOTES:



STREAM CROSSING TYPE 1 : POINT C (0.68m³/s), D (0.06m³/s), E (0.19m³/s), F (0.06m³/s) & G (1m³/s)

SCALE : VER : 1:50
HOR : 1:500



STREAM CROSSING TYPE 2 : POINT B (2.7m³/s) & I (2.14m³/s)

SCALE VER: 1:50
HOR: 1:500

APPROVED BY		
	SIGNATURE	DATE
DRAWN		6/09/2018
DESIGNED		10/09/2018
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A	9/2018	FOR DISCUSSION	A van Molendorff

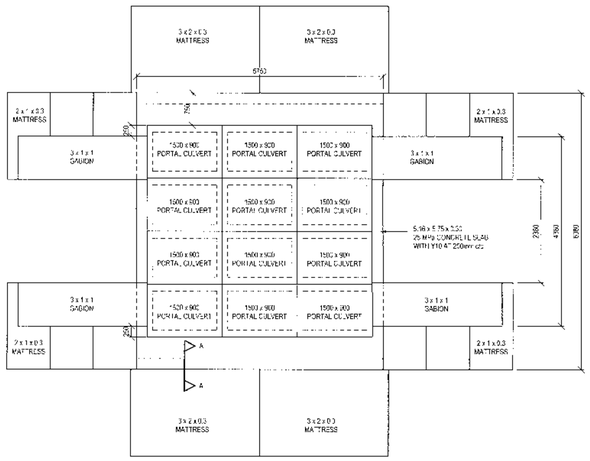
PROJECT

THEMBALETHU UISP BULK SEWER: PHASE 2

TITLE

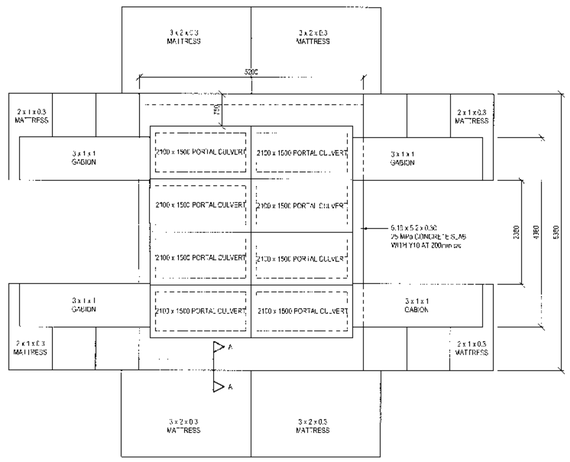
STREAM CROSSING TYPE 1 & 2

DRAWN	DESIGNED	FOR DISCUSSION PURPOSES ONLY
MC Richards	M van Wyk	
CHECKED		PROJECT No.
A van Molendorff		108429
APPROVED		SCALE / SIZE
NAME / SIGNATURE / DATE		AS SHOWN / A0
		DRAWING No. / REV
		108429 GE 410 / A



TYPE 3: PLAN OF FIRST LAYER OF GABIONS AND MATTRESSES

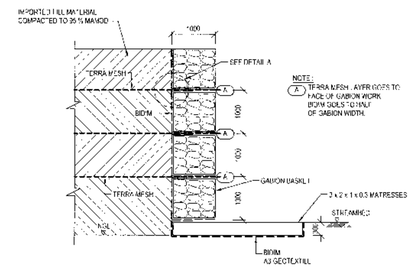
SCALE : 50



TYPE 4: PLAN OF FIRST LAYER OF GABIONS AND MATTRESSES

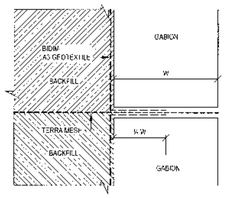
SCALE : 50

GABION LAYOUT PLAN



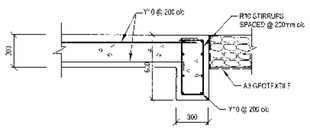
TYPICAL SECTION THROUGH GABION WALL

SCALE 1 : 50



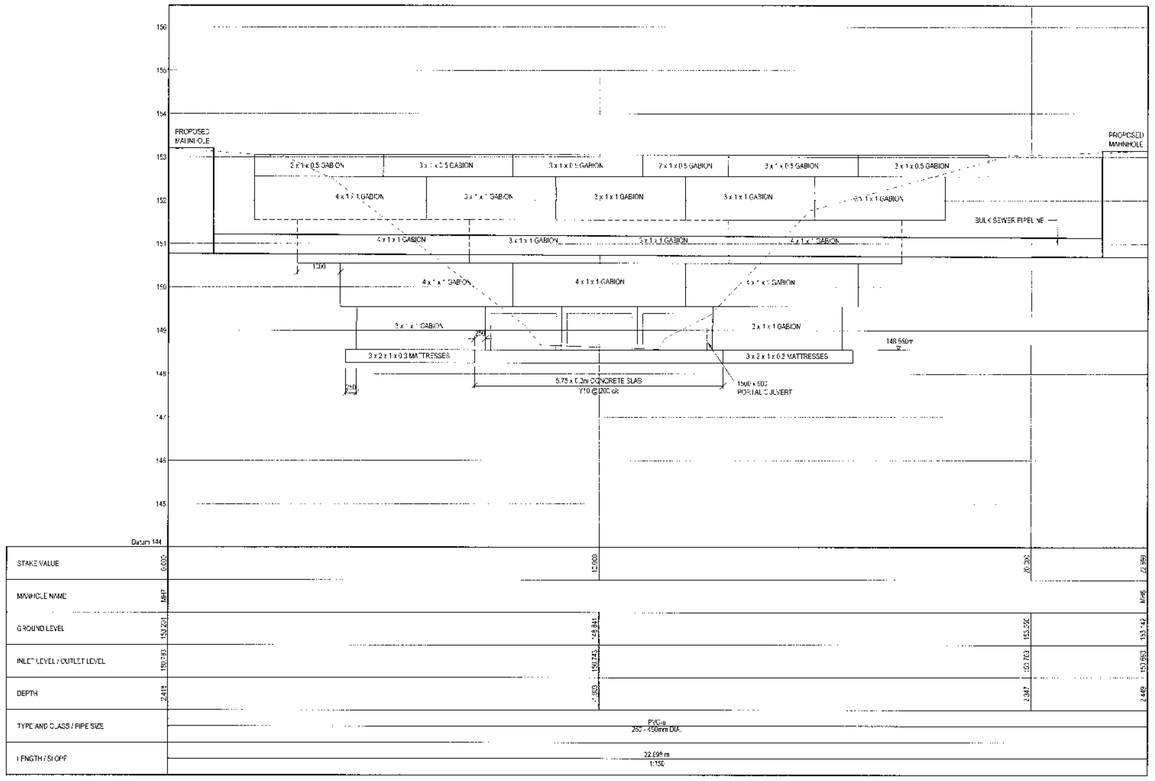
DETAIL A

SCALE 1 : 25



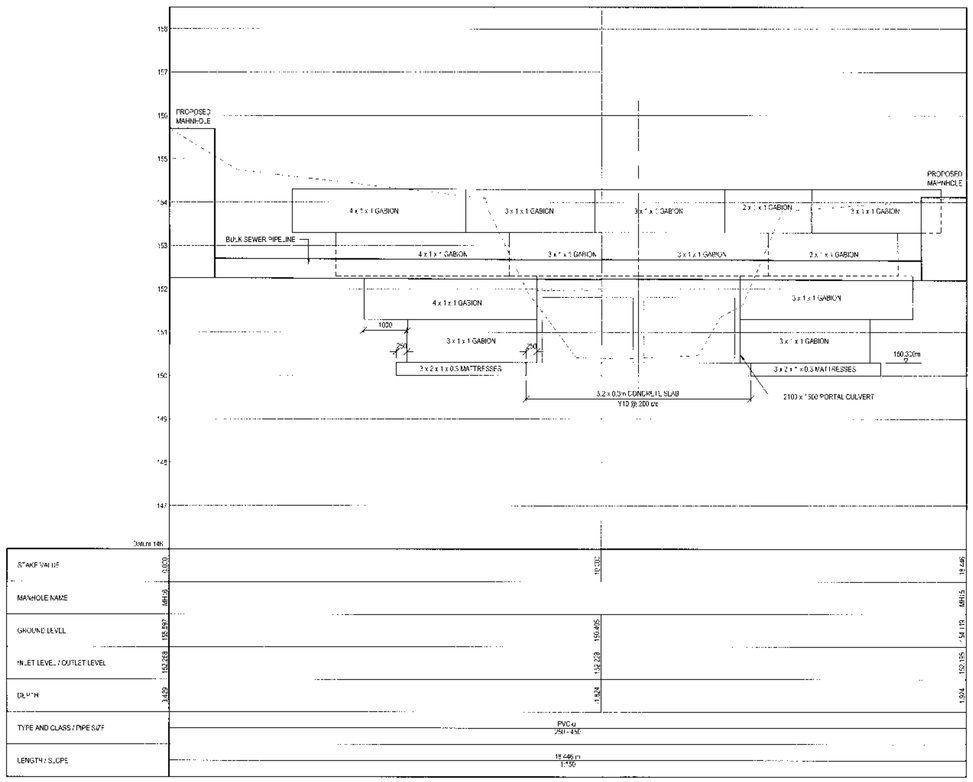
SECTION A-A

SCALE 1 : 10



STREAM CROSSING TYPE 3 : POINT H (3.5m³/s)

SCALE - VER : 1:50
HOR : 1:500



STREAM CROSSING TYPE 4 : POINT J (6m³/s) AND A (8.26m³/s)

SCALE - VER. 1:50
HOR : 1:500

GENERAL NOTES:

APPROVED BY	SIGNATURE	DATE
DRAWN		4/9/2013
DESIGNED		4/9/2013
CHECKED		

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REV	DATE	REVISION DETAILS	APPROVED
A	9/2013	FOR DISCUSSION	A van Mo endorff

PROJECT

THEMBALETHU UISP BULK SEWER: PHASE 2

TITLE

STREAM CROSSING TYPE 3 & 4

DRAWN	DESIGNED	FOR DISCUSSION PURPOSES ONLY
MC Richards	M van Wyk	
CHECKED		PROJECT No.
A van Mo endorff		108429
APPROVED		SCALE / SIZE
NAME / SIGNATURE / DATE		AS SHOWN / A0
		DRAWING No. / REV
		108429 GE 411 / A

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28 August 2013

Our Ref: 108429/13.22b AvM/mvw

Department: Civil Engineering Services
George Municipality
P O Box 19
GEORGE
6530

Attention: Ms Lindsay Mooiman/ Mr Nico Liebenberg

Madam/Sir,

GEORGE MUNICIPALITY: THEMBALETHU UISP PROJECT: REVISED BULK SEWER PROPOSALS: Revision 3: TECHNICAL REPORT FOR ENVIRONMENTAL AUTHORISATION PROCESS

1. Introduction:

Due to recent changes in the MIG allocation to the George Municipality, the municipality requested that Aurecon review the current proposals regarding the bulk sewer services required for the Thembalethu UISP project. The George Municipality requested Aurecon to look into possible alternative programmes to service the new housing areas in a practical way, these alternatives must be closely aligned to the available funding at the Municipality, as well as aligning with the UISP housing project to avoid any implementation delays.

We therefore take this opportunity to suggest an alternative programme for the bulk sewer infrastructure required in Pacaltsdorp and Thembalethu for the Thembalethu UISP Housing Project. All discussions will need to be read in conjunction with drawing No. 108429 GE 400 Revision F.

The proposal now proposed includes the following:

1) Proposed Bulk Gravity Sewers catering for sewerage flows around Area 3 ranging from approximately 10 ℓ/s to 92ℓ/s (1200m long 300mm diameter and 630m long 350mm diameter PVC-u (Un-plasticised Polyvinyl Chloride) sewer Class 34 (heavy duty) pipelines,

2) Proposed 60m concrete pipe-bridge, for 500mm diameter gravity sewer, over the Schaapkop River tributary,

3) Major upgrade of Pacaltsdorp No 1 Sewer Pump station; design flow increases from current 125 ℓ/s to interim design flow of 345 ℓ/s, with design consideration for a final design flow of 780 ℓ/s at the pump station with future developments), with a new 4m wide paved access road (approximately 500m long) also included,

4) Upgrade 1100 m long Pacaltsdorp No. 1 Pump station rising main with an additional 700mm diameter GRP (Glass Reinforced Polyester), sewer rising main adjacent to the existing 400mm diameter fibre cement rising main, with two (2) minor span concrete pipe bridges,

5) Proposed 30m post-tensioned concrete pipe-bridge, for 500mm diameter gravity sewer, over the Schaapkop River (New proposal) adjacent to Pacaltsdorp No. 1 sewer pump station,

6) Upgrade 710 m long Thembalethu No. 6 Pump station rising main with an additional 500mm diameter GRP (Glass Reinforced Resin), Class 16 sewer rising main adjacent to the existing 250mm diameter PVC-u rising main,

7) Major upgrade of Thembalethu No. 6 Sewer Pump station: current design flow increases from 60 ℓ/s to approximately 185 ℓ/s with design consideration for a final design flow of 380 ℓ/s at the pump station with future developments, with a new 320 ℓ/s inlet works, with mechanical screens, with a new 1.5 MVA emergency power generator. The existing 350kVA emergency generator will then be installed in the next most critical sewerage pump station as part of this contract.

8) New Bulk Gravity Sewers for UISP Areas 1, 5, 6A, 6B and 2; in two sections, catering for sewerage flows from 10 ℓ/s to 115 ℓ/s: First section approximately 2965m long (950m long 200mm diameter, 250m long 250mm diameter, 475m long 300mm diameter and 825m long 400mm diameter PVC-u (Un-plasticised Polyvinyl Chloride) sewer pipeline (Class 34 (heavy duty)) and 485m long 450mm diameter GRP (Glass Reinforced Resin), Class 6 sewer pipelines) Second section approximately 975m long (725m long 200mm diameter and 200m long 250mm diameter PVC-u (Un-plasticised Polyvinyl Chloride) sewer pipeline (Class 34 (heavy duty)),

9) De-commission Thembalethu sewer pump stations No. 4 (15 ℓ/s), No. 3 (45 ℓ/s) and No. 5 (15 ℓ/s).

The proposed programme will see the construction of items 1 to 4 in the 2013/2014 financial year, with items 5 to 9 being completed in the 2014/2015 and 2015/2016 financial years. The above options are now discussed in more detail below:

1. Proposed Bulk Gravity Sewers catering for sewerage flows around Area 3 and associated Pipe bridge

The proposed bulk sewer pipeline is indicated in blue as option 1 on the attached drawing, drawing No 108429 GE 400 Rev F. This pipeline is urgently required to allow the housing project to proceed in the next financial year. By installing the pipeline Area 3 of the Thembalethu UISP project can be serviced. Thembalethu sewerage pump station No. 6 currently only has 15 ℓ/s spare capacity, until it is upgraded in the 2014/2015 financial year. This means that only the new developments can be linked to the new bulk sewer until such time that both Pacaltsdorp No.1 and Thembalethu No. 6 Sewerage Pump stations' upgrades are completed.

The proposed bulk gravity sewerage pipelines will be designed to accommodate the expected sewerage flows around Area 3 ranging from approximately 10 ℓ/s to 92ℓ/s: (1200m long 300mm diameter and 630m long 350mm diameter PVC-u (Un-plasticised Polyvinyl Chloride) sewer Class 34 (heavy duty) pipelines. Initially the pipeline will only be handling a flow of less than 15 ℓ/s until the Thembalethu No.6 sewerage pump station is upgraded. The bulk sewer drains to this pump station, which currently has a design capacity of 60 ℓ/s of which 75% is already committed to Area 4 of the UISP project.

slope. The bench will also allow the Municipality to maintain this asset, by providing a safe access track for maintenance work on the pipeline route. Manholes will be provided every 60m to allow proper maintenance to be carried out.

2. **Proposed 60m concrete pipe-bridge, for 500mm diameter gravity sewer, over the Schaapkop River tributary**

The proposed bulk sewer pipeline servicing Area 3, discussed in Item 1 above, requires a 60m concrete pipe bridge to accommodate the 500mm diameter bulk gravity sewer, as this pipeline needs to cross the Schaapkop River tributary. The position of this crossing is indicated as River crossing No. 5 on the attached drawing, drawing No. 108429 GE 400 Rev F. A 500mm diameter pipeline will be installed in the pipe bridge, which is over and above the initially required diameter of 350mm. This will allow the pipelines to be upgraded to the pipe bridge in the future to accommodate the increasing flows from the area as Thembalethu develops.

A concrete pipe bridge is considered prudent, as the recently completed steel pipe bridge over the Schaapkop River has already been vandalised, only months after being completed. The River valley is also very deep at the crossing point and 13m high piers will be required to support the pipe bridge. This does have the advantage that the pipe bridge is in no danger from flooding. The pipe bridge is proposed to have a 1m x 1m square section, with reinforcing being placed around the perimeter, while the pipeline will be placed in the middle of the concrete section.

3. **Proposed Upgrade of Pacaltsdorp Sewerage Pump station No.1 and Rising main**

3.1 Design flows

The design was based on the following design flows:

- Current inflow = 125 ℓ/s
- Interim flow scenario = 345 ℓ/s
- Future flow scenario = 780 ℓ/s

3.2 Optimisation

The existing rising main is a DN 400 pipeline. An additional rising main needs to be constructed to accommodate the future flows.

A pipeline optimisation was performed for the future rising main to calculate the effective diameter that would result in the lowest net present value (NPV). The optimisation was performed by developing a costing model to calculate the net present values (NPVs) for various pipeline diameters. The NPV takes into account capital, operating and maintenance costs for the ultimate design flow to determine the cost benefits for the various rising main pipe diameter options.

Table 4 below summarises the NPVs calculated for the various pipe diameters. It should be noted that the NPVs do not reflect the construction cost.

Table 4: **NPVs for Pacaltsdorp rising main**

Pipe diameter (mm)	NPV @ 4% discount	NPV @ 8% discount
600	45,944,237	38,668,924
700	41,992,560	35,982,063
800	40,641,160	34,912,456
900	40,429,949	34,822,313
1000	40,556,017	35,003,919

It is evident from **Table 4** that a rising main with an effective internal diameter of 900 mm would be the optimum solution. The effective diameter is, however, the combined diameter between the existing DN 400 rising main and the future rising main. **Table 5** shows the options that were considered for a future rising main diameter:

Table 5: Options for Pacaltsdorp future rising main

Existing pipe diameter (mm)	Future pipe diameter (mm)	Combined pipe diameter (mm)
400	700	757
400	800	847

3.3 Pump type selection

The design of the existing pump station makes provision for the installation of four (4) pumps, i.e. three duty and one standby. The initial pump selection was therefore based on three duty pumps.

Figure 5 shows the pipeline characteristic curves for DN 400, DN 700 and DN 800 pipelines, as well as the pump curves for an ABS XFP 250 pump, fitted with a 465 mm impeller, and a 200 kW motor operating at 1480 RPM.

Figure 6 shows the pipeline characteristic curves for DN 400 & DN 700, and DN 400 & DN 800, pipelines in parallel, as well as the pump curves for an ABS XFP 250 pump, fitted with a 465 mm impeller, and a 200 kW motor operating at 1480 RPM.

The following should be noted from **Figure 5** (additional comments are provided in italics where required):

- Flow in DN 400 (HW = 110) with one pump operating = 220 *l/s* (v = 1.75 m/s). *The minimum flow that must be achieved with the pump (i.e. based on its allowable operating range) should be 70 l/s. The pump will therefore operate satisfactorily in the DN 400 pipeline.*
- Flow in DN 700 (HW = 110) with one pump operating = 290 *l/s* (v = 0.76 m/s)
- Flow in DN 800 (HW = 110) with one pump operating = 300 *l/s* (v = 0.60 m/s) *The velocity in the DN 800 pipe is lower than the minimum recommended cleaning velocity of 0.7 m/s*
- Flow in DN 700 (HW = 110) with three pumps operating = 760 *l/s* (v = 1.97 m/s).
- Flow in DN 800 (HW = 110) with three pumps operating = 830 *l/s* (v = 1.65 m/s)

The following should be noted from **Figure 6** (additional comments are provided in italics where required):

- Flow in DN 400 & DN 700 (HW = 110) with one pump operating = 295 ℓ/s (v = 0.66 m/s). *The velocity in the combined DN 400 and DN 700 pipelines is marginally less than the minimum recommended cleaning velocity of 0.7 m/s.*
- Flow in DN 400 & DN 800 (HW = 110) with one pump operating = 300 ℓ/s (v = 0.53 m/s). *The velocity in the combined DN 400 and DN 800 pipelines will be much lower than the minimum recommended cleaning velocity of 0.7 m/s.*
- Flow in DN 400 & DN 700 (HW = 110) with three pumps operating = 810 ℓ/s (v = 1.80 m/s). *Three pumps in parallel in an aged DN 400 and DN 700 pipeline would deliver a flow that's higher than the future design flow of 780 ℓ/s*
- Flow in DN 400 & DN 800 (HW = 110) with three pumps operating = 845 ℓ/s (v = 1.50 m/s)
- Flow in DN 400 & DN 700 (HW = 140) with three pumps operating = 840 ℓ/s (v = 1.87 m/s)
- Flow in DN 400 & DN 800 (HW = 140) with three pumps operating = 860 ℓ/s (v = 1.53 m/s)

It is evident from **Figures 5 and 6** that the minimum required cleaning velocities would not be achieved in a DN 800 rising main with only one pump operational, especially when the existing DN 400 pipeline is operated in parallel with the DN 800 pipeline. The future rising main should therefore be a DN 700 pipeline

3.4 Rising Main Recommendation

It appears that a DN 700 rising main would be the optimal pipe diameter for the proposed 1100m rising main. This rising main will be constructed approximately 4m parallel to the existing 400mm diameter fibre-cement rising main. The routes would be the same, with the only exception being that the proposed 700mm diameter rising main will be crossing the two streams (see river crossing no. 2 and 3 on the attached drawing, drawing no. 108429 GE 400) in concrete pipe bridges. The two streams have relatively steep sides, which cannot be easily accommodated by this large diameter pipeline. Therefore a concrete pipe bridge is proposed for these relatively short spans. Due to the large diameter of the proposed rising main a square section of approximately 1.2m x 1.2m will be required for the pipe bridge. Concrete piers will be provided to support the bridge at both ends. The pipe bridge has been designed to be above the 1:100 year flood level. Air- and scour-valves will be provided to allow the pipeline to operate efficiently. The rising main will stop at the entrance to the Outeniqua Wastewater Treatment Works and the flow will be split between the existing inlet works and the proposed new inlet works. The upgrading of the Outeniqua Wastewater Treatment Works falls outside the scope of this report, but we can report that the works will be upgraded over the next three to four years to accommodate the Thembalethu UISP project (4939 erven), as well as the newly proposed Syferfontein Housing Project (7700 erven).

3.5 Pump station Upgrades required

Currently the pump station handles a flow of 125 ℓ/s. The bulk gravity sewer draining to the pump station and the inlet works was upgraded by the Municipality in 2009 to accommodate the ultimate future design flow of 780 ℓ/s. The inlet works was fitted with front-rake screens (one duty, one

standby). At the same time a 1 MVA emergency power supply generator was installed to allow the pump station to remain operational during prolonged power failures. No additional upgrading work is required at these components.

The flow passes through the inlet works and then split between two duty sumps, with a third sump provided. The third sump is currently been filled with a weak mix mortar. The existing flow is accommodated by two pump sets consisting of two pumps each, connected in series. These pumps cannot be re-used and will be sold for scrap. They have been in operation for 14 years and are of no use to the Municipality. The closed vane impellors of these pumps have also been a source of high maintenance due to frequent blockages caused by the pumps' limited solids handling capacity.

The proposal now is to construct a larger sump adjacent to the existing three sumps. The two (2) proposed approximately 2.5 ton pumps, which will have a height of approximately 2.4m, will be temporarily installed into this new sump. The pumps will be capable of pumping approximately 300 *l/s* each and will be linked temporarily to the existing rising main. Due to the existing 400mm diameter rising main's fairly limited capacity, the new pump's flow will initially be throttled back by the VSD drive to approximately 150 *l/s*. At the same time a new separate Motor Control Circuit (MCC) panel room will be constructed adjacent to the main pump dry well. This room will be air-conditioned to cool the variable speed drives (VSD) required for the pumps approximately 200kW motors, which will be housed in the MCC panel.

Once the MCC room is completed the new panel will be installed and connected to the new pumps located in the new sump. This will be a temporary installation, for as soon as the new pumps (one duty and one standby, are put in operation this will allow the existing pumps and the concrete floor between the two pumps connected in series to be demolished. This will then provide the space required for the permanent installation of the new pumps in the dry well, as well as allow the completion of the new upgraded pipework required for the higher design flows. A new 3-ton gantry will be installed to service the new pumps, while the existing two (2) 2-ton gantries will be retained to move the proposed new larger diameter valves around in the dry well for installation and in the future for servicing purposes.

At the same time the existing three sumps division walls will be removed and the sumps will be re-divided into two (2) enlarged sumps required for the higher flows. Once this is completed one of the new pumps will be removed from the sump initially constructed and installed in the newly modified dry well. Once the installation is completed the pump will be tested and put into service, thereby allowing the second pump to be installed and put in service in the dry well. The initial sump constructed will then be modified to accommodate the third pump required in the future. The MCC panel will have the electronics required for this third pump already installed, pending the approval of the Municipality.

The new pumps will also need to be connected to the new 700mm diameter rising main, which will work in conjunction with the existing 400mm diameter rising main to accommodate the future design flows expected at this pumps station. The cross connections required for this pipework will be completed once the new rising main is completed and tested. This will complete the upgrading

currently required at the Pacaltsdorp No. 1 sewerage pump station and allow the completion of the full Thembalethu 4939 erven UISP project.

4. **Proposed 30m post-tensioned concrete pipe-bridge, for 500mm diameter gravity sewer, over the Schaapkop River adjacent to Pacaltsdorp No. 1 sewer pump station**

The proposed bulk sewer pipeline servicing Areas 1, 5, 6A, 6B and Area 2 requires a 30m post tensioned concrete pipe bridge to accommodate the 500mm diameter bulk gravity sewer, as this pipeline needs to cross the Schaapkop River adjacent to the Pacaltsdorp No. 1 Sewerage Pump station. The position of this crossing is indicated as River crossing No. 6 on the attached drawing, drawing No. 108429 GE 400 Rev F. A 500mm diameter pipeline will be installed in the pipe bridge, which is over and above the initially required diameter of 450mm. This will allow the pipelines to be upgraded to the pipe bridge in the future to accommodate the increasing flows from the area as Thembalethu develops.

A post-tensioned concrete pipe bridge is considered prudent, as the recently completed steel pipe bridge over the Schaapkop River has already been vandalised, only months after being completed. The Schaapkop River flood plain is also shallow at the crossing point and the 30m span is required to provide a clear span over the flood-plain, thereby not providing any obstructions in the 1:100 flood levels that are below the bridge level. A concrete span this long can only be achieved by providing post-tensioning in the concrete structure and as discussed above this does have the advantage that the pipe bridge is in no danger from flooding. The pipe bridge is proposed to have a 1.1m x 1.1 m square section, with the reinforcing and the post-tensioning cables being placed around the perimeter, while the pipeline will be placed in the middle of the concrete section.

The bridge supports will be constructed on concrete piles that have been driven into the rock formations below the river bed. The piling position will be outside the 1:100 year flood-plain. The river banks around the piles will be protected with gabions. The adjacent pump station is protected by gabions on the river bank and the intention is merely to extend this protection to the pipe bridge support positions.

5. **Proposed Upgrade of Thembalethu Sewerage Pump station No. 6 and Rising main**

5.1 <u>Design flows</u>

The design was based on the following design flows:

- Current inflow = 60 *l/s*
- Interim flow scenario = 220 *l/s*
- Future flow scenario = 342 *l/s*

5.2 Optimisation

The existing rising main is a DN 250 pipeline. An additional rising main needs to be constructed to accommodate the future flows.

A pipeline optimisation was performed for the future rising main to calculate the effective diameter that would result in the lowest net present value (NPV). The optimisation was performed by developing a costing model to calculate the net present values (NPVs) for various pipeline diameters. The NPV takes into account capital, operating and maintenance costs for the ultimate design flow to determine the cost benefits for the various rising main pipe diameter options.

Table 1 below summarises the NPVs calculated for the various pipe diameters. It should be noted that the NPVs do not reflect the construction cost.

Table 1: NPVs for Thembalethu rising main

Pipe diameter (mm)	NPV @ 4% discount	NPV @ 8% discount
350	25,447,419	21,741,411
400	22,373,407	19,180,586
450	21,140,834	18,185,661
500	20,635,925	17,799,704
600	20,777,822	18,028,356
700	21,496,019	18,760,310
800	21,868,580	19,153,389

It is evident from **Table 1** that a rising main with an effective internal diameter of 500 mm would be the optimum solution. The effective diameter is, however, the combined diameter between the existing DN 250 rising main and the future rising main. **Table 2** shows the options that were considered for a future rising main diameter:

Table 2: Options for Thembalethu future rising main

Exisiting pipe diameter (mm)	Future pipe diameter (mm)	Combined pipe diameter (mm)
250	450	484
250	500	529

5.3 Pump type selection

The design of the existing pump station makes provision for the installation of four (4) pumps, i.e. three duty and one standby. The initial pump selection was therefore based on three duty pumps.

Figure 1 shows the pipeline characteristic curves for DN 250, DN 450 and DN 500 pipelines, as well as the pump curves for an ABS XFP 200 pump, fitted with a 427 mm impeller, and a 132 kW motor operating at 1480 RPM.

Figure 2 shows the pipeline characteristic curves for DN 250 & DN 450, and DN 250 & DN 500, pipelines in parallel, as well as the pump curves for an ABS XFP 200 pump, fitted with a 427 mm impeller, and a 132 kW motor operating at 1480 RPM.

The following should be noted from **Figure 1** (additional comments are provided in italics where required):

- Flow in DN 250 (HW = 110) with one pump operating = 80 ℓ/s (v = 1.63 m/s) *The minimum flow that must be achieved with the pump (i.e. based on its allowable operating range) should be 42 ℓ/s. The pump will therefore operate satisfactorily in the DN 250 pipeline.*
- Flow in DN 450 (HW = 110) with one pump operating = 130 ℓ/s (v = 0.82 m/s)
- Flow in DN 500 (HW = 110) with one pump operating = 135 ℓ/s (v = 0.69 m/s) *The velocity in the DN 500 pipe is marginally lower than the minimum recommended cleaning velocity of 0.7 m/s.*
- Flow in DN 450 (HW = 110) with three pumps operating = 300 ℓ/s (v = 1.89 m/s).
- Flow in DN 500 (HW = 110) with three pumps operating = 335 ℓ/s (v = 1.71 m/s)

The following should be noted from **Figure 2** (additional comments are provided in italics where required):

- Flow in DN 250 & DN 450 (HW = 110) with one pump operating = 133 ℓ/s (v = 0.72 m/s)
- Flow in DN 250 & DN 500 (HW = 110) with one pump operating = 137 ℓ/s (v = 0.62 m/s). *The velocity in the combined DN 250 and DN 500 pipelines will be less than the minimum recommended cleaning velocity of 0.7 m/s.*
- Flow in DN 250 & DN 450 (HW = 110) with three pumps operating = 327 ℓ/s (v = 1.77 m/s). *Three pumps in parallel in an aged DN 250 and DN 450 pipeline would deliver a flow that's slightly lower than the future design flow of 342 ℓ/s.*
- Flow in DN 250 & DN 500 (HW = 110) with three pumps operating = 350 ℓ/s (v = 1.59 m/s). *Three pumps in parallel in an aged DN 250 and DN 500 pipeline would deliver the future design flow of 342 ℓ/s.*
- Flow in DN 250 & DN 450 (HW = 140) with three pumps operating = 350 ℓ/s (v = 1.90 m/s)
- Flow in DN 250 & DN 500 (HW = 140) with three pumps operating = 370 ℓ/s (v = 1.68 m/s)

It is evident from **Figures 1 and 2** that the minimum required cleaning velocities would not be achieved in a DN 500 rising main with only one pump operational, especially when the existing DN 250 pipeline is operated in parallel with the DN 500 pipeline.

The option to install two pumps was also evaluated. **Figure 3** shows the pipeline characteristic curves for DN 250, DN 450 and DN 500 pipelines, as well as the pump curves for an ABS XFP 200 pump, fitted with a 450 mm impeller, and a 160 kW motor operating at 1480 RPM.

Figure 4 shows the pipeline characteristic curves for DN 250 & DN 450, and DN 250 & DN 500, pipelines in parallel, as well as the pump curves for an ABS XFP 200 pump, fitted with a 450 mm impeller, and a 160 kW motor operating at 1480 RPM.

The following should be noted from **Figure 3** (additional comments are provided in italics where required):

- Flow in DN 250 (HW = 110) with one pump operating = 105 *l/s* (v = 2.14 m/s). *The minimum flow that must be achieved with the pump (i.e. based on its allowable operating range) should be 42 l/s. The pump will therefore operate satisfactorily in the DN 250 pipeline.*
- Flow in DN 450 (HW = 110) with one pump operating = 180 *l/s* (v = 1.13 m/s)
- Flow in DN 500 (HW = 110) with one pump operating = 185 *l/s* (v = 0.94 m/s). *The velocity in the DN 500 pipe is higher than the minimum recommended cleaning velocity of 0.7 m/s.*
- Flow in DN 450 (HW = 110) with two pumps operating = 310 *l/s* (v = 1.95 m/s).
- Flow in DN 500 (HW = 110) with two pumps operating = 335 *l/s* (v = 1.71 m/s)

The following should be noted from **Figure 4** (additional comments are provided in italics where required):

- Flow in DN 250 & DN 450 (HW = 110) with one pump operating = 183 *l/s* (v = 0.99 m/s)
- Flow in DN 250 & DN 500 (HW = 110) with one pump operating = 167 *l/s* (v = 0.85 m/s). *The velocity in the combined DN 250 and DN 500 pipelines will be higher than the minimum recommended cleaning velocity of 0.7 m/s.*
- Flow in DN 250 & DN 450 (HW = 110) with two pumps operating = 330 *l/s* (v = 1.79 m/s) *Two pumps in parallel in an aged DN 250 and DN 450 pipeline would deliver a flow that's slightly lower than the future design flow of 342 l/s.*
- Flow in DN 250 & DN 500 (HW = 110) with two pumps operating = 345 *l/s* (v = 1.57 m/s). *Two pumps in parallel in an aged DN 250 and DN 500 pipeline would deliver the future design flow of 342 l/s.*
- Flow in DN 250 & DN 450 (HW = 140) with two pumps operating = 346 *l/s* (v = 1.88 m/s)
- Flow in DN 250 & DN 500 (HW = 140) with two pumps operating = 360 *l/s* (v = 1.64 m/s)

It is evident from **Figures 3 and 4** that the option with two pumps will be feasible when using a new DN 450 or DN 500 rising main. The DN 500 rising main would deliver approximately 4% more flow compared to the DN 450 rising main.

5.4 Recommendation

Based on the cost estimate provided in **Table 3**, it appears that the option with two pumps and a DN 500 rising main would be the most economical option. It would also be possible to install a DN 450 rising main together with two pumps at an approximate saving of R 200 000 (excluding VAT), but this would also result in a reduction in flow capacity of 4%. The rising main will be approximately 710m long.

This rising main will be constructed approximately 4m parallel to the existing 250mm diameter PVC-U rising main. A bench will be created in the slope above the existing 250mm rising main and the slope will be stabilised with gabions, where required. The route would be the same, with the proposed 500mm diameter rising main using the existing 30m steel pipe bridge to cross the Schaapkop River (see river crossing no. 1 on the attached drawing, drawing no. 108429 GE 400). The original pipe bridge design made provision for the future 500mm diameter rising main and the pipeline will be installed in the existing cradle provided for the rising main. The existing pipe bridge has been designed to be above the 1:100 year flood level. Air- and scour-valves will be provided on the new rising main to allow the pipeline to operate efficiently. The rising main will stop at the existing transfer manhole, where an existing connection point has been provided for this rising main. The sewerage then gravitates through the existing approximately 3.5km 700/800mm diameter Pacaltsdorp bulk sewerage main to the Pacaltsdorp Sewerage Pump station No.1. The proposed 500mm and existing 250mm diameter rising mains will be able to handle the flow generated by the UISP housing project draining to the Thembalethu No. 6 sewerage pump station.

5.5 Pump station Upgrades required

Currently the pump station handles a design flow of 60 ℓ/s, although a 25% spare capacity currently exists. A bulk gravity sewer draining Area 4 of the UISP housing project, the pump station and the inlet works was constructed by the Municipality in 2012 to accommodate Area 4. The pump station was designed to be upgradeable the ultimate future design flow of 380 ℓ/s. The existing 100 ℓ/s inlet works was fitted with front-rake screens (one duty, one standby). At the same time a 350 kVA emergency power supply generator was installed to allow the pump station to remain operational during prolonged power failures.

The pump station will now be upgraded to handle an interim design flow of 220 ℓ/s. This will require that the inlet works be upgraded and possibly an additional inlet works will need to be constructed to accommodate this increased flow. A new 700 mm diameter bulk sewer inlet pipeline will be constructed to accommodate the increased flow to the pump station.

The existing 350kVA emergency power generator will also then be replaced with a 1.5MVA unit, but this will be simply accomplished by swopping out the existing unit with the new unit. The existing 350kVA unit will then be installed at one of the Municipality's other sewerage pump stations, at this stage it is proposed that the unit be installed at the Eden sewerage pump station.

The existing flow passes through the inlet works and then discharges into one os the two existing sumps. Two additional sumps will now be constructed adjacent to the existing sumps. The existing flow is accommodated by two pump sets (one duty, one standby). These pumps will be re-used at one of the Municipality's existing sewerage pump stations, which require an upgrade This will be finalised later in conjunction with the Municipality. They have only been in operation for 1 year and are a valuable asset to the Municipality.

The proposed flow of 220 ℓ/s will make use of three of the four sumps, but the additional sump needs to be constructed to allow the construction of the dry well building to proceed. A new dry

well building will be constructed below the sumps for the installation of the three (3) new pumpsets (two duty, one standby). Each of the pumps will be able to handle a flow of approximately 183 ℓ/s, therefore to handle the design flow of 220 ℓ/s two pumpsets are required, under VSD control, to pump the proposed flow. The pumps will be linked to the new and existing rising mains to pump the required flow of 220 ℓ/s. At the same time a new Motor Control Circuit (MCC) panel will be installed adjacent to the existing pump's MCC panel. This room will be air-conditioned to cool the variable speed drives (VSD) required for the new pumps, which will be housed in the MCC panel. The MCC panel will have the electronics required for the future fourth pump already installed, pending the approval of the Municipality. The existing MCC panel will remain in operation until the new pump installation comes on-line. The existing pumps and MCC panel will then be moved to a new sewerage pump station, yet to be determined.

A new 2-ton gantry crane will be installed to service the new pumps and valves around in the dry well during installation and in the future for servicing purposes.

The new pumps will be connected to the new 500mm diameter rising main, which will work in conjunction with the existing 250mm diameter rising main to accommodate the future design flows expected at this pumps station. The cross connections required for this pipework will be completed once the new rising main is completed and tested. This will complete the upgrading currently required at the Thembalethu No. 6 sewerage pump station and allow the completion of the Thembalethu UISP project Areas draining to this pump station. This will also allow the connection of the existing sewer network to the new bulk sewer constructed under Item 1 of this project, which drains to the Thembalethu No. 5 sewerage pump station and allow the Municipality to de-commission the existing Thembalethu No. 4 (15 ℓ/s) and Thembalethu No. 3 (35 ℓ/s) sewerage pump stations, thereby reducing the maintenance burden on the municipality.

6. **Proposed Bulk Gravity Sewers catering for sewerage flows around Area 1, 5, 6A, 6B and 2; and associated stream crossings**

The proposed Bulk Gravity Sewers for UISP Areas 1, 5, 6A, 6B and 2;will be constructed in two sections (catering for sewerage flows from 10 ℓ/s to 115 ℓ/s). The proposed bulk sewer pipelines are indicated in blue and red around Areas 1, 5, 6A and 6B on the attached drawing, drawing No. 108429 GE 400 Rev F. The first section draining UISP Areas 1, 5 and a portion of Area 6A will be approximately 2965m long (950m long 200mm diameter, 250m long 250mm diameter, 475m long 300mm diameter and 825m long 400mm diameter PVC-u (Un-plasticised Polyvinyl Chloride) sewer pipeline (Class 34 (heavy duty)) and 485m long 450mm diameter GRP (Glass Reinforced Resin), Class 6 sewer pipelines). The second section draining the rest of Area 6A, 6B and Area 2 will be approximately 975m long (725m long 200mm diameter and 200m long 250mm diameter PVC-u (Un-plasticised Polyvinyl Chloride) sewer pipeline (Class 34 (heavy duty)).

The bulk sewer will be benched into the steep side slope over most of its length and the intention is to use gabions to stabilise the cut slope, which will limit the visual impact of the bench on the slope. The bench will also allow the Municipality to maintain this asset, by providing a safe access track for maintenance work on the pipeline route. Manholes will be provided every 80m to allow proper maintenance to be carried out.

Together with the second section of the bulk sewer, a number of bottlenecks in the Thembalethu connector sewer network have been identified by the Municipality's sewer section, around the housing areas, which will need to be addressed to ensure that the complete system is able to handle the additional flow added into the existing sewerage system. A number of critical areas have been identified, which means that approximately 4965m of existing connector sewers will need to be upgraded (2380m long 160mm diameter, 1325m long 200mm diameter and 1260m long 250mm diameter PVC-u (Un-plasticised Polyvinyl Chloride) sewer pipeline (Class 34: heavy duty), to remove any potential bottlenecks in the existing sewer reticulation network.

Stream crossings

The bulk sewers will all drain to the post tensioned concrete pipe-bridge described under item 4 above Indicated as River crossing No. 6 on the attached drawing, drawing No. 109429 GE 400 Rev F. The preliminarily proposed stream crossings, labelled A to J are also indicated on the attached drawing. As not all the routes have been surveyed yet, additional stream crossings could be identified at a later stage. If this occurs, The Department of Water Affairs (DWA) will be notified and the application will be amended to reflect these areas The proposed River and Stream crossings information are provided in the table below:

Table 4: River and Stream crossing details

Crossing No.	X	Y	River	Owner	1:100 Flood Flow (m^3/s)
A	3 764 159.089	48 977.187	Tributary to Schaapkop River	George Municipality	8.26
B	3 764 472.953	49 188.043	Tributary to Schaapkop River	George Municipality (Being expropriated from private land owner)	2.7
C	3 764 729.369	49 136.819	Tributary to Schaapkop River	George Municipality (Being expropriated from private land owner)	0.68
D	3 764 944.101	49 174.105	Tributary to Schaapkop River	George Municipality / Province	0.06
E	3 765 169.697	49 031.841	Tributary to Schaapkop River	George Municipality / Province	0.19
F	3 765 170.226	48 813.941	Tributary to Schaapkop River	George Municipality / Province	0.06
G	3 765 067.995	48 457.658	Tributary to Schaapkop River	George Municipality / Province	1.00
H	3 765 120.916	47 937.106	Tributary to Schaapkop River	George Municipality / Province	3.50
I	3 765 072.815	47 744.988	Tributary to Schaapkop River	George Municipality / Province	2.14
J	3 765 143.369	47 280.331	Tributary to Schaapkop River	George Municipality / Province	6.00
1	3 766 259.09	47 286.601	Schaapkop River	George Municipality / Province	160.00
2	3 765 014.246	49 445.006	Schaapkop River	George Municipality	35.00
3	3 764 770.032	49 719.900	Tributary to Schaapkop River	George Municipality	31.00
4	3 764 310.182	49 314 732	Tributary to Schaapkop River	George Municipality	124.00
5	3 766 065.883	47 103.521	Tributary to Schaapkop River	George Municipality / Province	10.46
6	3 765 132.358	49 356.519	Schaapkop River	George Municipality / Province	130.00

As per DWA's instructions each of these stream crossings has been provisionally designed for a 1:100 year flood event. Attached please find preliminary design proposals for each of these river and stream crossings. Although these are preliminary design proposals, these should be indicative of the final proposals been prepared for this work. The river crossings have been described separately as part of the programme for the works, but the proposed stream crossings will be discussed in more detail in the text below.

The system we are proposing has been successfully implemented in the previous Pacaltsdorp bulk sewer project, completed in 2009. The system for handling stream crossings is described below

i) The temporary berm is constructed in the stream, which is used to divert the existing flow to a pipeline installed to divert the normal flow past the construction area. The flow is discharged below the construction area and passes through two sets of silt-traps. The silt-traps are required to minimise the loss of silt caused by the construction activities.
ii) Box culverts are installed on a concrete surface bed in the stream bed. The box culverts are sized to accommodate the 1:100 year flood requirements, as per DWA's requirements.

iii) Two gabion walls are constructed parallel to each other, with a 3m distance between the inner faces of the gabion wall. The gabion walls are constructed perpendicularly over the stream over the box-culverts. The two walls are tied together with wire gabion mesh at each 1m height interval. The area in between the gabion walls is then filled with G7 road material to form an access track, which is then used by the Municipality to gain access and maintain the sewer pipeline along its entire length.

iv) The bulk sewer is laid to the correct levels in between the two gabion walls in the road fill material. This removes the need for steel pipe bridges to span over the stream, which are prone to vandalism and theft. The pipeline is now protected between the gabions under the road in-fill material, protecting it from any potential damage from vandals. Access to the bulk sewer and associated manholes is now possible from one convenient access route aligned alongside and above the existing sewer pipeline, which avoids the need for numerous access tracks down the slope to reach the sewer pipeline alignment for maintenance purposes.

v) Reno-mattresses are provided ahead and below the gabion walls to prevent under-mining and erosion of the soil on either side of the structure. Gabion walls are also constructed 5 to 10m downstream of the structure in the stream bed to prevent the river cutting back to the gabion structure and under-mining it in the future.

vi) Once the structure is complete the river flow is diverted through the box-culvert. Once the flow has stabilised the silt behind the silt traps is removed and used to rehabilitate the construction area. Once the flow stabilises the silt traps are then removed.

SUMMARY OF MAIN PROPOSAL

The above-mentioned upgrades will give the most feasible long term solution to the Municipality, but the phasing and sequencing will be adjusted to conform to the Municipalities funding requirements, since the upgrading of the two pump stations (Pacalisdorp No. 1 and Thembalethu No. 6) and related rising mains would require the bulk of this expenditure. It does make the management of these proposals very critical for the next two financial years. This report attempts to go some way in explaining what will be required and why, before the next housing phases begin. A provisional cash-flow and programme is attached for discussion and planning purposes.

ALTERNATIVE PROPOSALS INVESTIGATED

Various other alternatives were investigated to fit the available capital flows and are discussed below, however these have been rejected as being wasteful expenditure and having no major environmental advantage. Contrarily these options have higher energy ouputs, with more pump stations being required to handle the flow.

1. Upgrading of Thembalethu Pump station No. 3:

As an intermediate upgrade proposal the existing Thembalethu pump station No. 3 can be upgraded. This would open up an additional 700 erven (Areas 3, 7 and 8) for development in the next housing phases, but this is not considered the best use of funds. The reasons behind this statement are discussed in more detail later on in this section.

The existing 200mm diameter fibre cement rising main conveys sewage from Pumpstation No. 3 to the Outeniqua Wastewater Treatment Works. The existing 200mm diameter rising main is indicated in yellow on the attached drawing, drawing No. 108429 GE 400 Rev F. The existing Thembalethu sewerage Pump station No. 3 currently has a pumping capacity of approximately 32 l/s, while we estimate (using the "red-book" design guidelines) the existing flow could be as high as 45 l/s, and therefore both the pump station and rising main are already at or over their design capacity. The pumpstation will have to be upgraded to handle a flow of approximately 65 l/s, to provide for the additional serviced erven created by the new UISP housing project phases in the area (Housing Areas 3, 7 and 8A). This pump station currently has only one functional pump, but was due to receive urgent attention. Upgrading of the pump station would consist of a new inlet works, the installation of two new pumps in a new sump, mechanical screens, a back-up generator installation and related electrical supplies, as well as a telemetry system. Initially the basic items will be upgraded, with more costly items like the standby generator being added later. The existing pump station building and sump will have to be extended and provision made for the upgraded access road, stormwater provision and a new security fence. Two alternatives can be considered regarding the rising main for Pump station No. 3, as described below:

1.1 Alternative 1:

One option would be for a 3,8km long 250mm diameter PVC-u rising main, pumping sewage from Pump station No. 3 to the transfer manhole at the Outeniqua Wastewater Treatment Works. The intention is to follow a route that will intersect the least existing services, such as water, stormwater and sewer pipelines, electrical and Telkom cables and existing roads and sidewalks, as well as avoiding certain high points along the route. This proposal is indicated in dark blue below the existing 200mm diameter rising main which is indicated in yellow on the attached drawing, drawing No. 108429 GE 400 Rev F. The existing rising main has a high point in the first third of its length and then flows under siphon action to the Outeniqua WWTW. The new rising main will operate alongside the existing 200mm diameter fibre cement rising main, but will avoid having a siphon action by ensuring the rising main high point is at the Outeniqua WWTW.

This option results in a lengthy rising main, which will have a relatively high pumping head. This requires powerful pumps which will consequently have a reasonably high operating cost, as well as relatively high initial capital expenses.

1.2 Alternative 2:

This option is linked to the upgrading of Thembalethu Pump station No. 5, as described in the next section, and would see a 315mm diameter PVC-u rising main from Pumpstation No. 3 to a point connecting to the proposed 350 – 400 mm diameter bulk gravity sewer proposed to drain the housing Areas 5, 6A and 6B. Please note that the bulk gravity sewer around Area 5, 6A and 6B would need a larger diameter to accommodate the increased flow generated by the rising main discharging the flow from Pump staton No. 3 into this bulk sewer. This option would result in a lower pumping head, with consequently smaller pumps, which will be more cost effective in terms of operating costs as well as initial capital expense. The shorter length of rising main will also be more economical to operate, as opposed to the 250mm diameter rising main described in the previous paragraph. This alternative will allow the Municipality to service a much larger amount of erven, as well as saving on operating costs.

2. Upgrading of Pumpstation No. 5:

The existing Thembalethu Pump station No. 5 will have to be upgraded and re-built at a position lower down the slope. This will allow the upgraded northern bulk sewer (draining Area 1) to gravitate to the new pump station. The current bulk sewer has insufficient fall in places and needs to be re-aligned and upgraded to drain Area 1 (288 erven) of the UISP housing project. Pump station No. 5 currently has a capacity of 15 ℓ/s, and will have to be upgraded to cater for sewer flows of up to 180 ℓ/s. This made up of the existing expected flow of 55 ℓ/s for Pump station No.5, the additional flow of 10 ℓ/s from Housing Area No.1, the flow of 40 ℓ/s from Areas No. 2, 5 and 6, the flow of 60 ℓ/s from Pump station No.3, as well as giving the option of Pump station No.4's flow of 15 ℓ/s to be diverted here as well. By diverting Pump station No.4's flow to the new Pump station No, 5, we allow the new Pump station No.7 which is currently under construction to accommodate 600 existing erven's flow, thereby reducing the stress on the bulk sewer draining to Pump station No. 2 and also improving the operating conditions at the pump station as well.

The upgrade will entail a new inlet works, a new pumpstation building, new pumps and mechanical screens, provision for a back-up generator and associated electrical reticulation upgrades, as well as some gabion work, an access road, a telemetry system and a new fence.

The upgrading of Pump station No. 5 will allow the proposed housing Areas 2, 5, 6A and 6B to be serviced (1 792 UISP erven) and allow the flow from the upgraded Pump station No. 3 to be accommodated at the newly upgraded pump station. The development of these housing areas is however subject to the expropriation of the land on which the development of Areas 6 and 8 is to take place. The process of the expropriation of the portion of land in question has commenced, as part of the housing project. A short section (approximately 555m) of 400 mm diameter sewer rising main will join the upgraded Pump station No. 5, with the existing transfer manhole at the Outeniqua WWTW.

The proposed rising mains servicing Pump stations 3 and 5, discussed in item 1 and 2 above, requires a 50m concrete pipe bridge to accommodate the 450mm diameter rising main, as this pipeline needs to cross the Schaapkop River. The position of this crossing is indicated as River crossing No. 4 on the attached drawing drawing No. 108429 GE 400 Rev F. A 450mm diameter pipeline will be installed in the pipe bridge, which is over and above the initially required diameter of 400mm. This will allow the pipelines to be upgraded to the pipe bridge in the future to accommodate the increasing flows from the area as Thembalethu develops.

A concrete pipe bridge is considered prudent, as the recently completed steel pipe bridge over the Schaapkop River has already been vandalised, only months after being completed. The River valley is wide at the crossing point and piers will be required to support the pipe bridge These piers would need to be designed to withstand the 1:100 year flood waters. The pipe bridge is proposed to have a 1m x 1m square section, with reinforcing being placed around the perimeter, while the pipeline will be placed in the middle of the concrete section

The complete upgrade of Pump station No. 5 will have to include the construction of a 2,5 km long 350 – 400mm diameter gravity sewer to Pumpstation No. 5, draining housing Areas 2, 5, 6A and 6B, as well as the short section of 315mm diameter rising main from Pumpstation No 3, which links to the new bulk sewer. This will include the upgrade of the sewer line described in paragraph 3.1 below. This alternative will however, as mentioned before, serve significantly more erven, provided the expropriation process receives priority.

2.1 Upgrading of northern Thembalethu bulk sewer pipeline:

The Emergency Rehabilitation of Thembalethu Sewer Pipeline along the N2 national road was completed in June 2009 Only a short section at the upstream end of the bulk sewer was upgraded at the time due to cost constraints. A complete upgrade of the bulk sewer line that extends from this pipeline is necessary to accommodate Area 1 of the housing project. Operational difficulties (blockages due to flat gradients) exist further downstream in the bulk sewers alignment to the existing Thembalethu Pump station No.5. Area 1 of the UISP housing project is located adjacent and over the existing pipeline alignment, which would require the realignment of the bulk sewer to accommodate the UISP housing development The existing 1560m pipeline will need to be rerouted to accommodate the development. The newly realigned sewer would be unable to connect to the existing Pump station No 5 due to the

required improved gradient required, resulting in the bulk sewer pipeline ending below the existing pump station incoming invert level.

We recommend that consideration be given to realigning the section from Manhole No.TA35 to the Pump station No.5 to remove any problems with the vertical alignment and to accommodate Area 1 of the UISP housing project.

This will also allow the gradual improvement of the sewer pipelines feeding into the bulk sewer main, as and when funding becomes available. To achieve this, the existing sewer main will be upgraded by installing 930m of 250mmØ and 850m of 200mmØ heavy duty PVC-U sewer pipes, with associated manholes. Manholes will be spaced at a maximum distance of 80m and at all changes in direction or gradient. All existing erf connections will be re-connected into the new sewer main. Minimal disruption of the existing sewerage flow is expected.

The above proposals provide a short-term solution, but due to further development proposed in Thembalethu (Possible sewerage link of Kraaibosch and Victoria Bay areas to Thembalethu) and around the Pacaltsdorp (Syferfontein 7 000 to 15 000 housing development), which could see the need to upgrade the Pacaltsdorp No. 1 pump station and the Thembalethu No. 6 sewerage pump stations in the near future, we feel that the upgrading of the Pacaltsdorp No.1 and Thembalethu No.6 sewerage pump stations must receive priority.

We trust that you find the foregoing acceptable. If you have any queries, please do not hesitate to contact us.

Yours faithfully

AJ VAN MOLENDORFF Pr Tech Eng
Project Manager
pp Aurecon

BG H JACOBS Pr Eng
Office Manager
pp Aurecon

Enclosed: 108429GE400 REV E: Revised Bulk Sewer Main Proposals

Annexure

Existing Gabion Stream Crossing photographs

Concrete Pipe Bridge Photos (for illustration purposes)

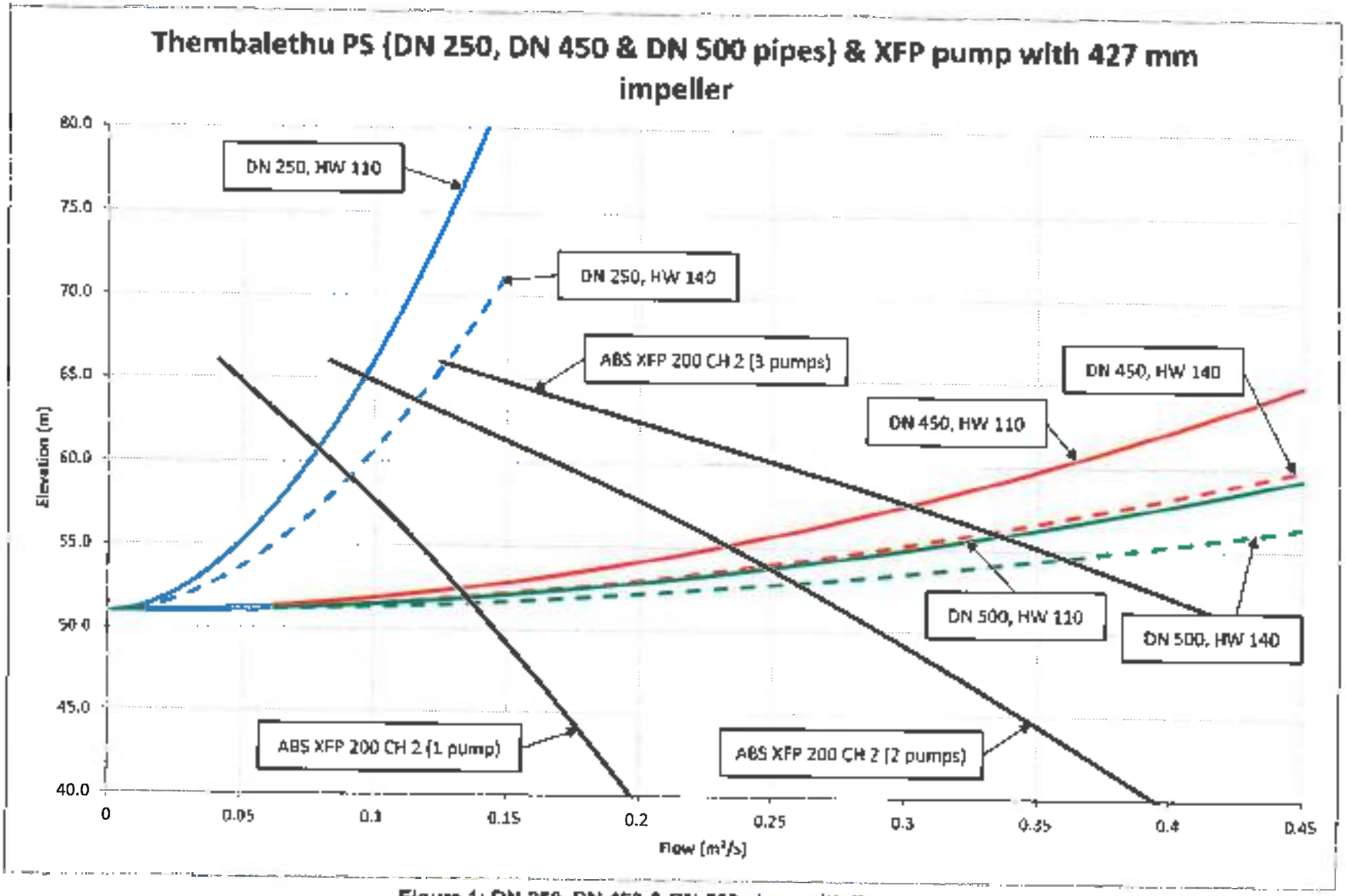


Figure 1: DN 250, DN 450 & DN 500 pipes with three pump option

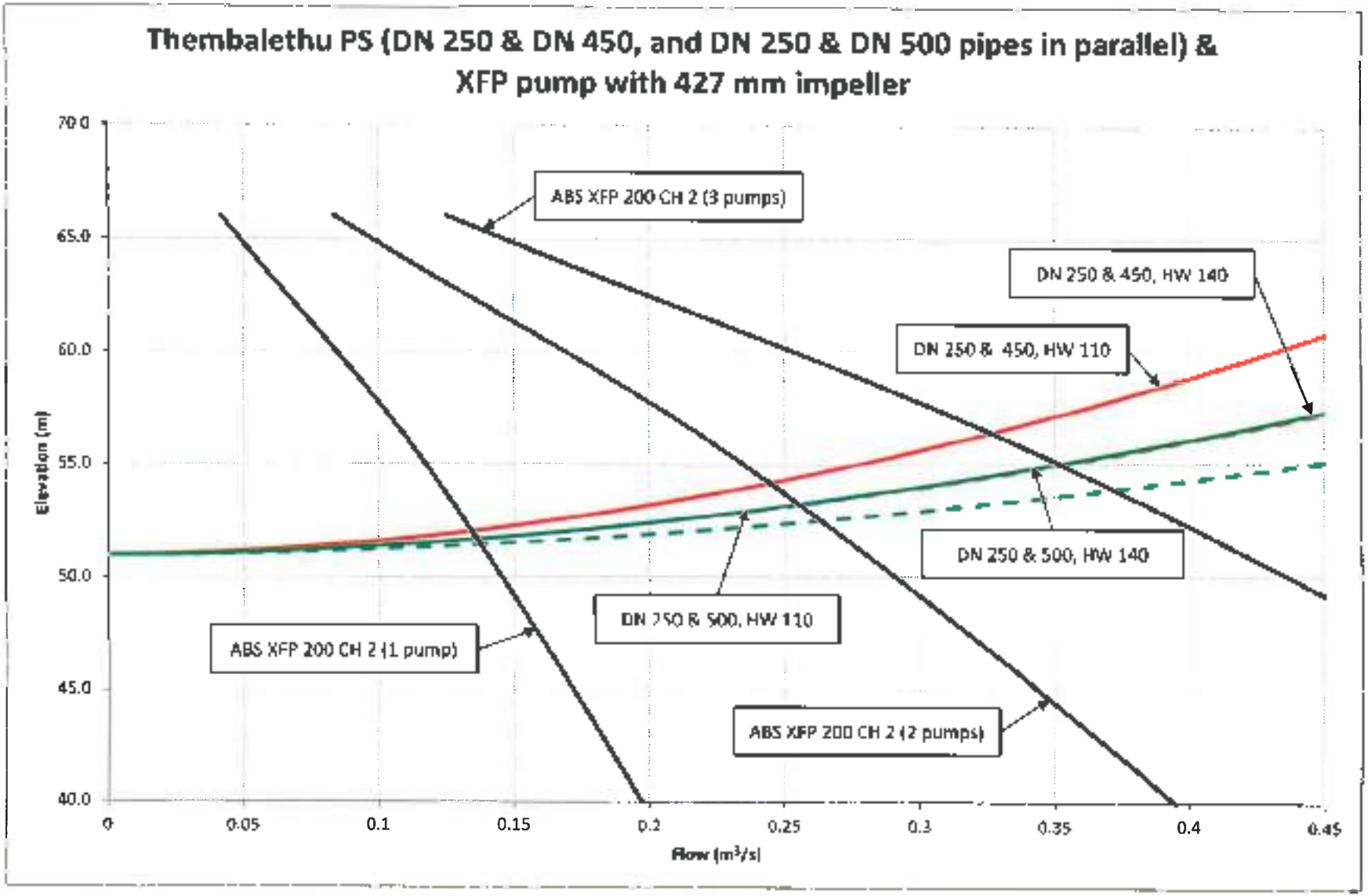


Figure 2: DN 250 & DN 450 and DN 250 & DN 600 pipes in parallel with three pump option

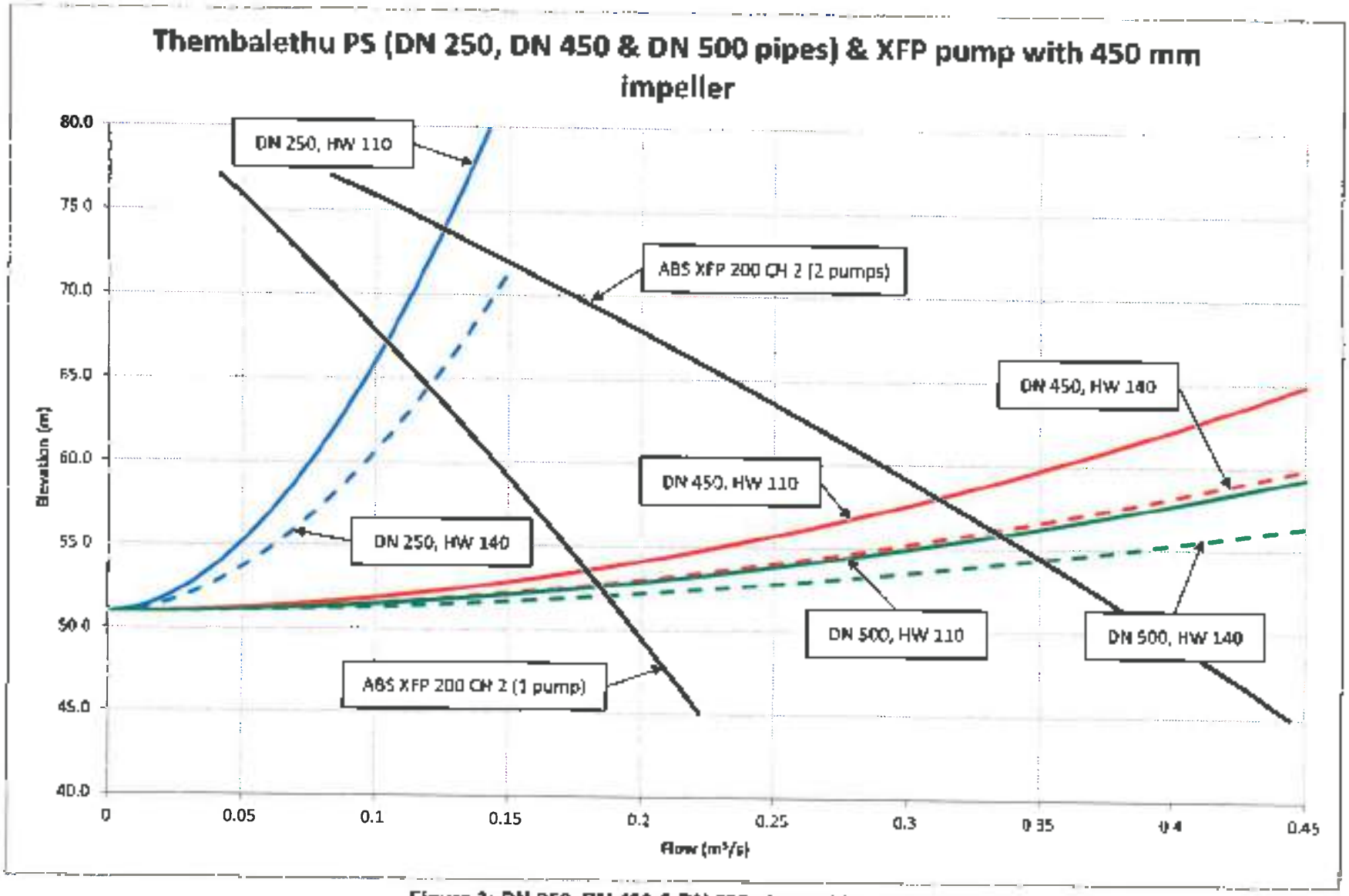


Figure 3: DN 250, DN 450 & DN 500 pipes with two pump option

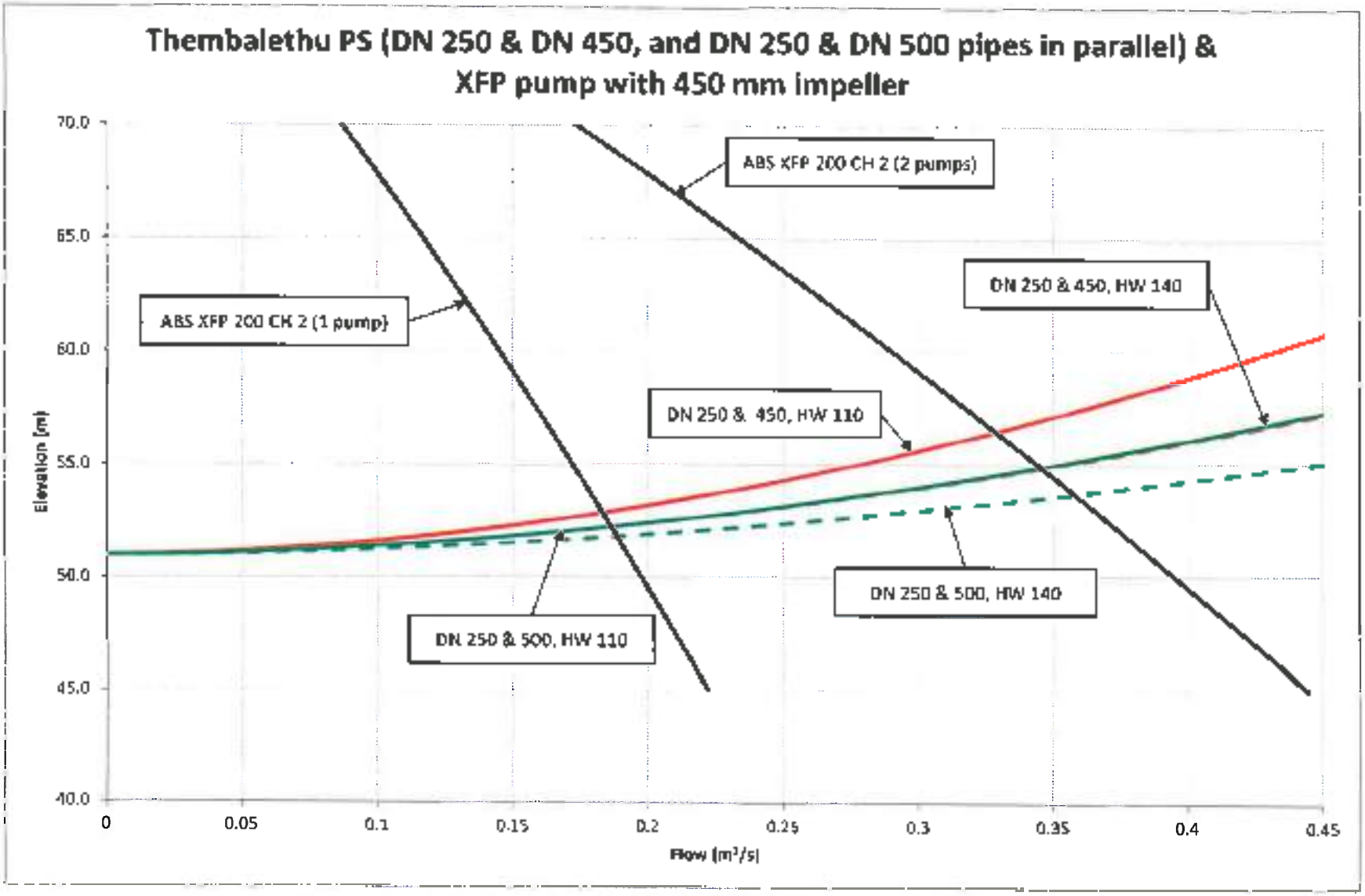


Figure 4: DN 250 & DN 450 and DN 250 & DN 500 pipes in parallel with two pump option

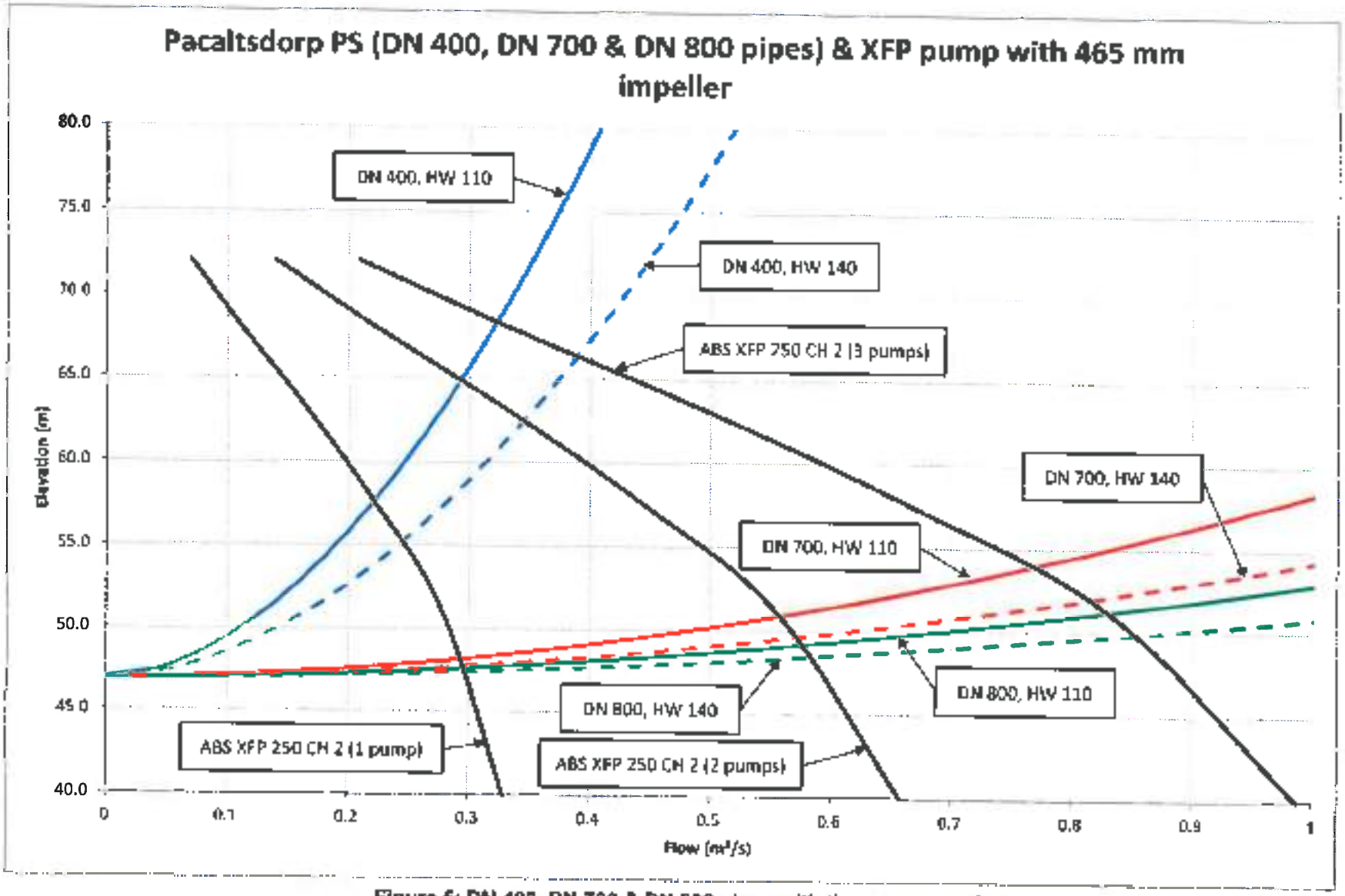


Figure 6: DN 400, DN 700 & DN 800 pipes with three pump option

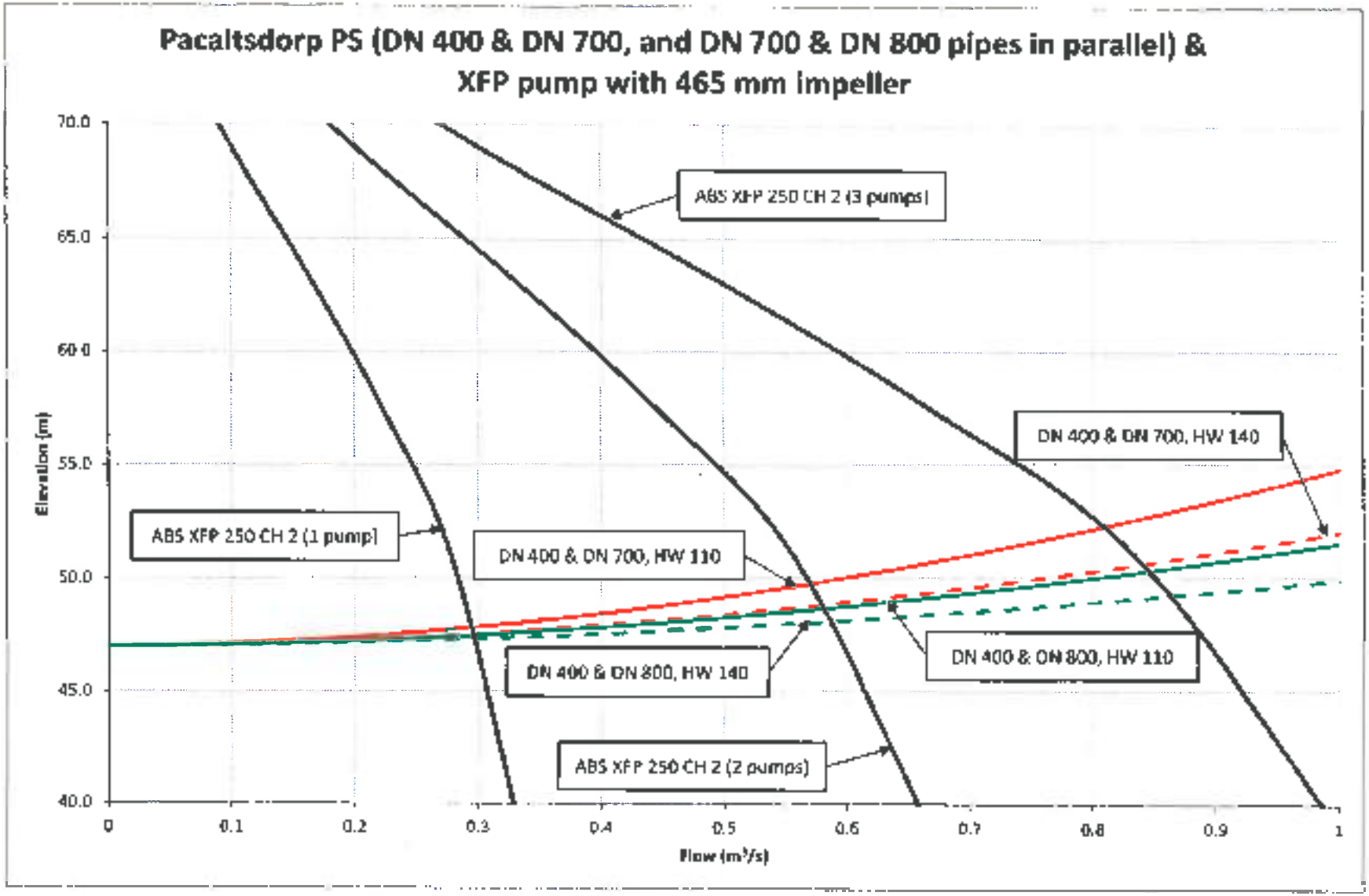


Figure 6: DN 400 & DN 700 and DN 400 & DN 800 pipes in parallel with three pump option

aurecon

GEORGE MUNICIPALITY

REV	DATE	DESCRIPTION OF CHANGE
A	04/2013	FOR DISCUSSION PURPOSES
B	05/2013	RIVER CROSSINGS ADDED
C	05/2013	STREAM CROSSINGS ADDED
D	07/2013	RIVER CROSSING No. 6 ADDED
E	07/2013	RIVER CROSSING No. 6 ADDED
F	09/2013	ENLARGED SCALE

APPROVED	DRAWN	DESIGNED
[illegible]	VC Dunsjans	A v Molendorff
[illegible]	CHECKED	
[illegible]	A v Molendorff	
[illegible]	APPROVED	
[illegible]	[illegible]	

PROJECT: THEMBALETHU HOUSING PROJECT

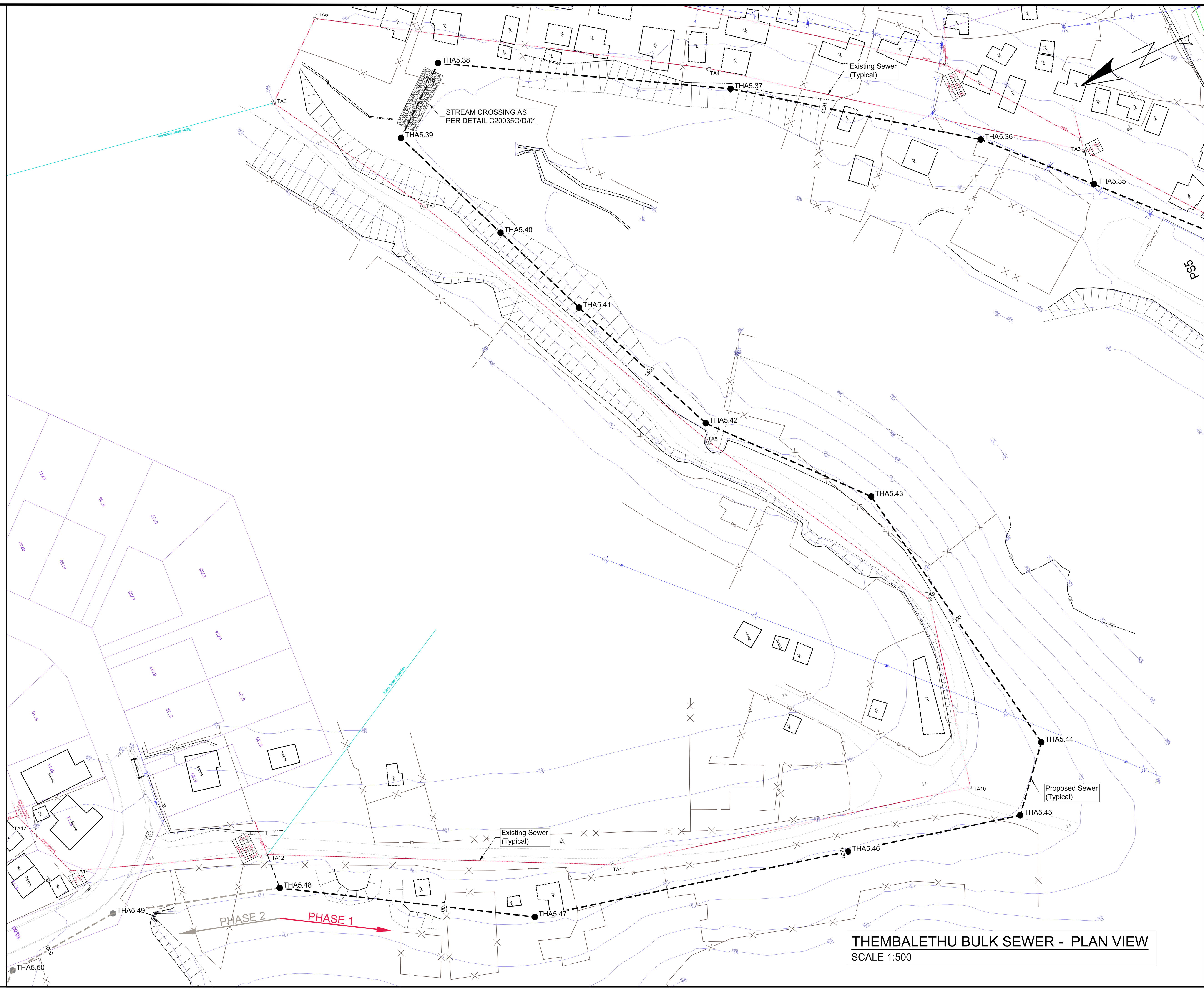
TITLE: REVISED BULK SEWER MAIN PROPOSALS

FOR DISCUSSION PURPOSES

PROJECT No. 108429

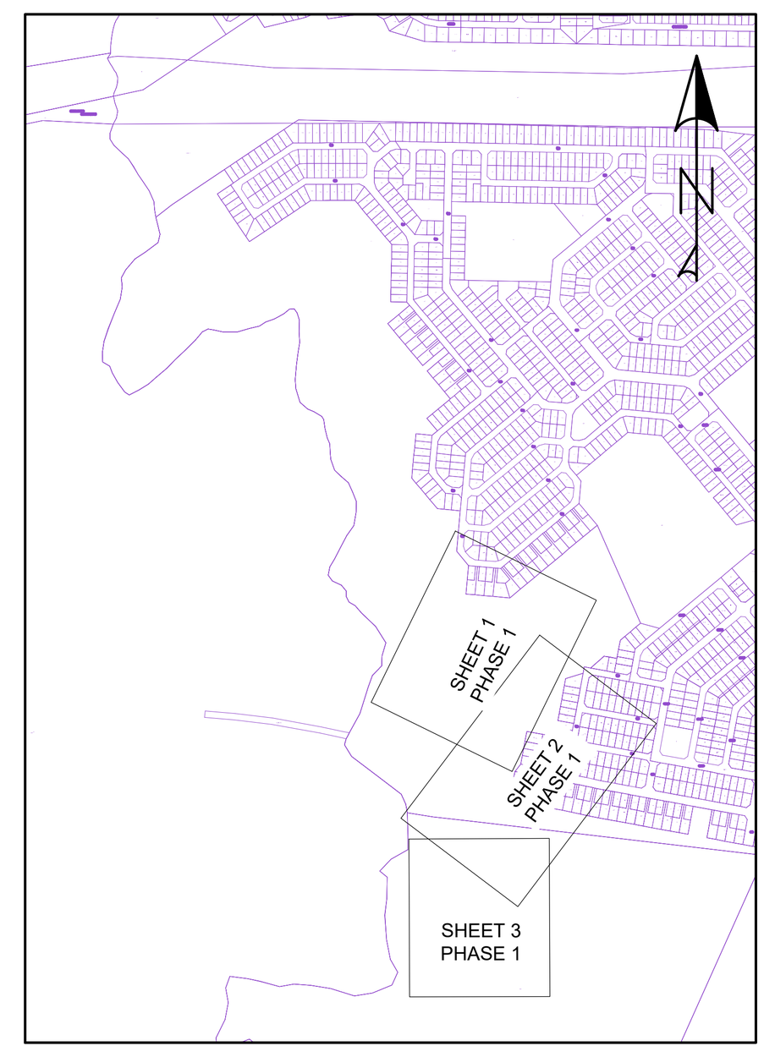
SCALE	SIZE
1 : 9 750	A3

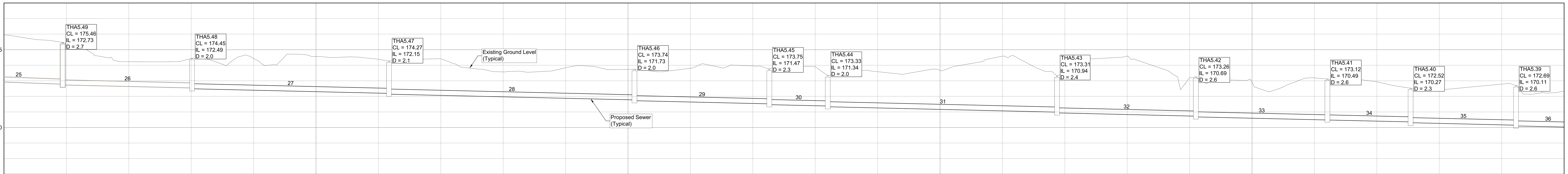
DRAWING No. 108429 GE 400 — REV F



THEMBALETHU BULK SEWER - PLAN VIEW
SCALE 1:500

SEE SHEET 2





SCALES:
Horizontal 1:250
Vertical 1:50

DATUM 167.000

DISTANCE (m) FREQUENTIAL	GROUND LEVELS ON CL
1000	175.95
1020	175.41
1040	174.22
1060	174.43
1080	174.44
1100	174.56
1120	174.39
1140	174.41
1160	173.57
1180	173.84
1200	173.74
1220	173.80
1240	173.96
1260	173.90
1280	173.59
1300	173.68
1320	174.58
1340	173.58
1360	174.58
1380	173.19
1400	172.90
1420	173.19
1440	172.94
1460	172.41
1480	172.79
1500	172.32

SLOPE / LENGTH	PIPE
0.73% / 1:136.1, 28.36m	UPVC CL34 315mm dia
0.47% / 1:212.8, 41.46m	UPVC CL34 315mm dia
0.47% / 1:212.8, 63.10m	UPVC CL34 315mm dia
0.47% / 1:212.8, 78.67m	UPVC CL34 315mm dia
0.47% / 1:212.8, 43.23m	UPVC CL34 315mm dia
0.47% / 1:212.8, 18.73m	UPVC CL34 315mm dia
0.47% / 1:212.8, 73.47m	UPVC CL34 315mm dia
0.47% / 1:212.8, 44.49m	UPVC CL34 315mm dia
0.47% / 1:212.8, 42.17m	UPVC CL34 315mm dia
0.47% / 1:212.8, 26.67m	UPVC CL34 315mm dia
0.47% / 1:212.8, 33.78m	UPVC CL34 315mm dia
0.47% / 1:212.8, 20.46m	UPVC CL34 315mm dia

STRUCTURES	PIPE INVERT LEVEL IL (IN)	IL (OUT)
		172.997
X: 3764023.37 Y:-49142.64	172.789	172.739
X: 3764062.91 Y:-49155.11	172.544	172.494
X: 3764116.04 Y:-49189.15	172.197	172.148
X: 3764192.25 Y:-49208.70	171.778	171.728
X: 3764234.13 Y:-49219.39	171.525	171.475
X: 3764246.76 Y:-49205.56	171.387	171.339
X: 3764235.86 Y:-49132.90	170.993	170.944
X: 3764207.30 Y:-49098.79	170.735	170.687
X: 3764191.88 Y:-49059.54	170.489	170.489
X: 3764182.69 Y:-49034.50	170.364	170.314
X: 3764171.06 Y:-49002.79	170.155	170.105
	170.009	

The reference made to Engineer will also refer to Employer's Agent for GCC 2015 Contracts

SCALEBAR
0 15 30 METER
SCALE 1:500

All dimensions must be verified on site before the works commence. Refer any discrepancies to the Engineer.

REV	DESCRIPTION	DATE	REV BY	CHKD
A	TENDER (DRAFT)			

REVISIONS

DESIGNED	RL
DRAWN	RL
CHECKED	MLR

CONSULTING ENGINEERS
LYNERS
PO Box 757
GEORGE
6530
Tel: 044 887 0223 / Fax: 044 887 0741
email: george@lyners.co.za

APPROVED
ENGINEER:
DATE:

APPROVED
CLIENT:
DATE:

CLIENT
GEORGE MUNICIPALITY
GEORGE THE CITY FOR ALL REASONS
PO Box 757
George
6530
Tel: 044 887 0223
Fax: 044 887 0741

PROJECT
UPGRADING OF THEMBALETHU BULK SEWER
GRAVITY MAIN - PHASE 1 (THA5.48 - THA5.22)

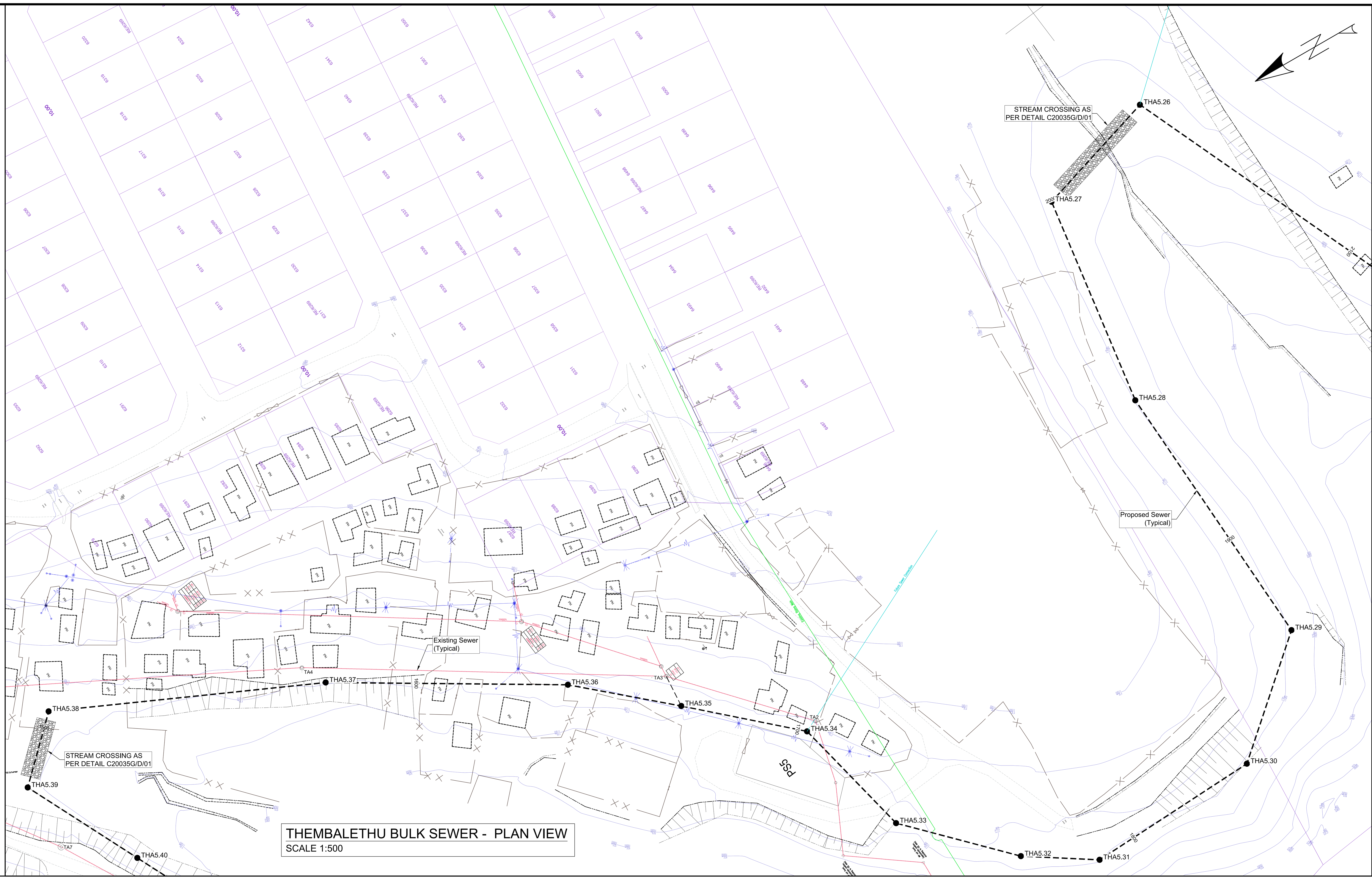
TITLE
LAYOUT AND PROFILE

SCALE on A0: 1:500	SHEET: 3 OF 5
CONTRACT No.	PROJECT No.: C20035G
DRAWING No.: C20035G-L-01	REV: A
COORDINATE SYSTEM: WGS84/23	

iso full bleed a0 (841.00 x 1189.00 mm)

S:\PROJECTS\SIVIEL\GEORGE\20035CG - THEMBALETHU BULK SEWER MAINS\DRAWINGS\WORKING\PHASE 1\THEMBA_WORKING 33.DWG

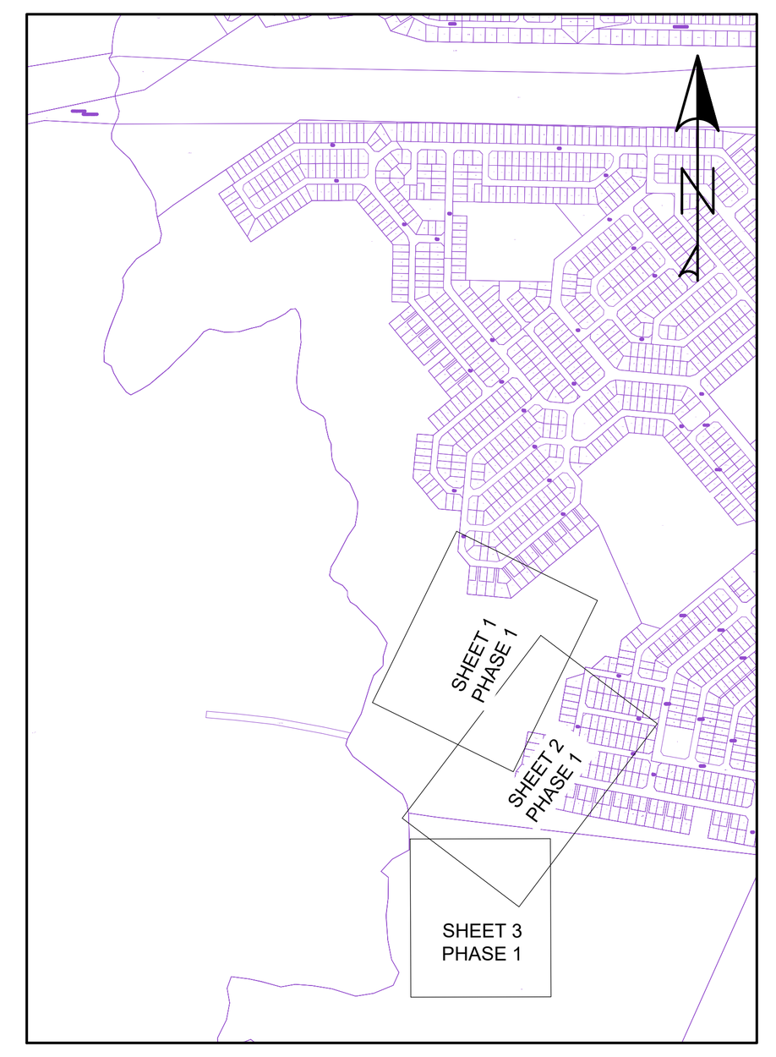
SEE SHEET 2

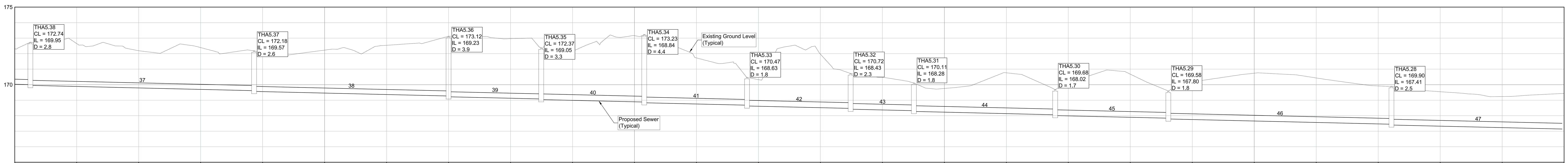


THEMBALETHU BULK SEWER - PLAN VIEW

SCALE 1:500

SEE SHEET 3





SCALES:
Horizontal 1:250
Vertical 1:50

DATUM 165.000

DISTANCE (m) FREQUENTIAL	GROUND LEVELS ON CL
1500	172.32
1520	172.65
1540	172.19
1560	172.39
1580	172.05
1600	172.23
1620	172.54
1640	173.12
1660	172.97
1680	172.15
1700	173.16
1720	171.72
1740	170.33
1760	171.97
1780	170.46
1800	169.76
1820	170.77
1840	170.02
1860	170.68
1880	170.24
1900	170.74
1920	170.43
1940	169.92
1960	169.55
1980	169.24
2000	169.44

SLOPE / LENGTH	PIPE
0.47% / 1:212.8 20.46m	UPVC CL34 315mm dia
0.47% / 1:212.8 72.19m	UPVC CL34 315mm dia
0.47% / 1:212.8 62.77m	UPVC CL34 315mm dia
0.47% / 1:212.8 29.89m	UPVC CL34 315mm dia
0.47% / 1:212.8 33.25m	UPVC CL34 355mm dia
0.47% / 1:212.8 33.15m	UPVC CL34 355mm dia
0.47% / 1:212.8 33.44m	UPVC CL34 355mm dia
0.47% / 1:212.8 20.42m	UPVC CL34 355mm dia
0.47% / 1:212.8 45.59m	UPVC CL34 355mm dia
0.47% / 1:212.8 36.50m	UPVC CL34 355mm dia
0.47% / 1:212.8 72.01m	UPVC CL34 355mm dia
0.47% / 1:212.8 55.87m	UPVC CL34 355mm dia

STRUCTURES	PIPE INVERT LEVEL IL (IN) / IL (OUT)
	170.105
X: 3764187.29 Y:-48990.33	170.009 / 169.960
X: 3764249.06 Y:-49027.69	169.621 / 169.571
X: 3764298.75 Y:-49066.04	169.276 / 169.226
X: 3764318.86 Y:-49088.16	169.085 / 169.045
X: 3764340.88 Y:-49113.07	168.889 / 168.839
X: 3764344.92 Y:-49145.98	168.683 / 168.633
X: 3764365.54 Y:-49172.31	168.476 / 168.426
X: 3764381.23 Y:-49185.38	168.330 / 168.281
X: 3764426.71 Y:-49188.54	168.067 / 168.017
X: 3764456.82 Y:-49167.91	167.845 / 167.796
X: 3764460.50 Y:-49095.99	167.457 / 167.408
	167.145

The reference made to Engineer will also refer to Employer's Agent for GCC 2015 Contracts

SCALEBAR

0 15 30 METER

SCALE 1:500

All dimensions must be verified on site before the works commence. Refer any discrepancies to the Engineer.

REV	DESCRIPTION	DATE	REV BY	CHKD
A	TENDER (DRAFT)			

REVISIONS

DESIGNED	RL
DRAWN	RL
CHECKED	MLR

CONSULTING ENGINEERS
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email: george@lyners.co.za

APPROVED
ENGINEER: ____________
DATE: ____________

APPROVED
CLIENT: ____________
DATE: ____________

CLIENT
GEORGE MUNICIPALITY
PO Box 757
George
6530
Tel: 044 887 0223
Fax: 044 887 0741
GEORGE
THE CITY FOR ALL REASONS

PROJECT
UPGRADING OF THEMBALETHU BULK SEWER
GRAVITY MAIN - PHASE 1 (THA5.48 - THA5.22)

TITLE
LAYOUT AND PROFILE

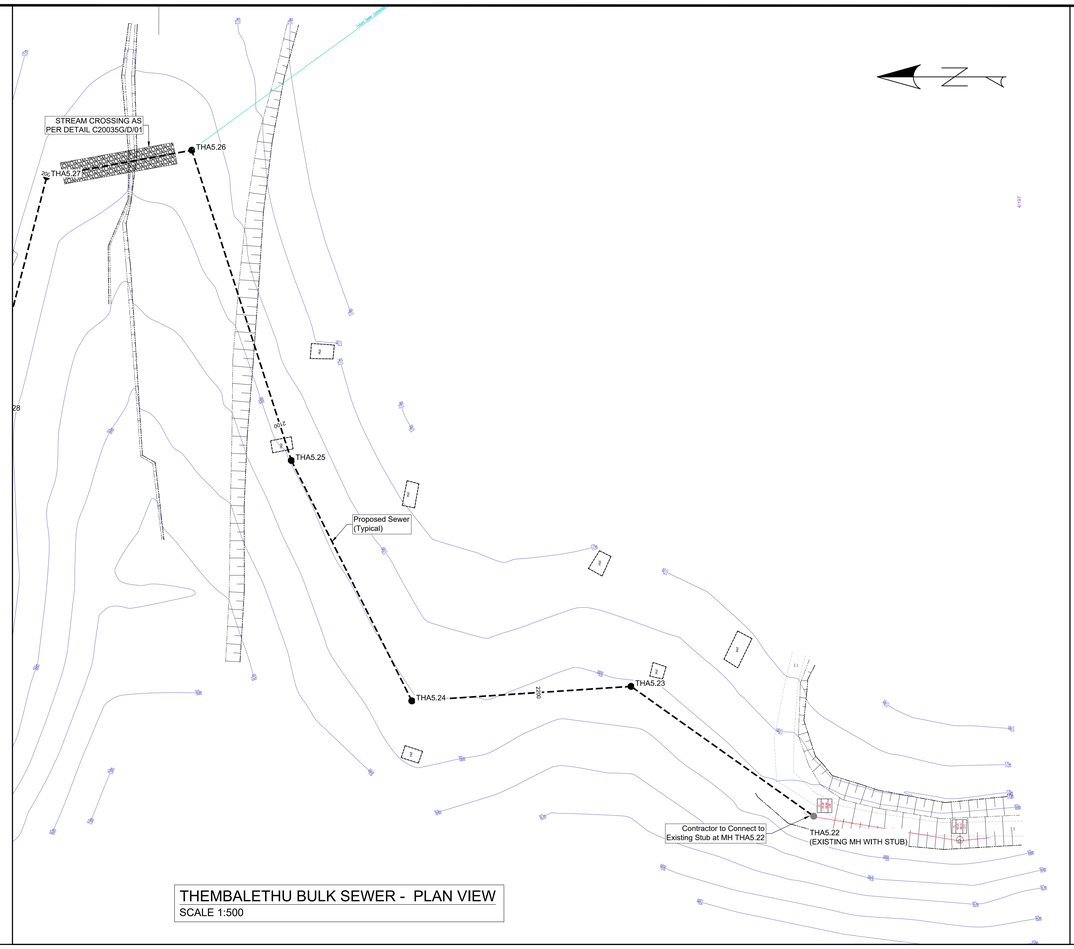
SCALE on A0: 1:500	SHEET: 4 OF 5
CONTRACT No.	PROJECT No.: C20035G
DRAWING No.: C20035G-L-02	REV: A
COORDINATE SYSTEM: WGS84/23	

Auditing: Roan Louwrens 2021-07-27 Checked: Date:

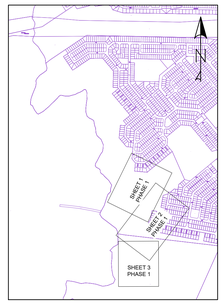
iso full bleed a0 (841.00 x 1189.00 mm)

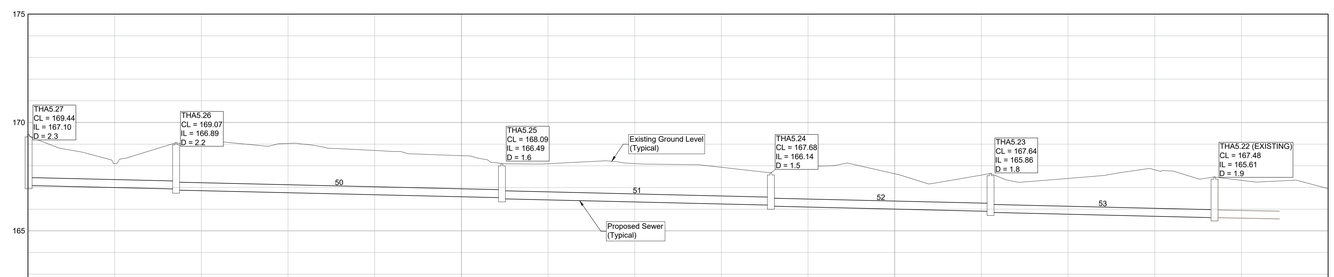
S:\PROJECTS\SIVEL\GEORGE\20035CG - THEMBALETHU BULK SEWER MAINS\DRAWINGS\WORKING\PHASE 1\THEMBA_WORKING 33.DWG

SEE SHEET 2



THEMBALETHU BULK SEWER - PLAN VIEW
SCALE 1:500





SCALES:
Horizontal 1:250
Vertical 1:50

DATUM 160.000

DISTANCE (m) FREQUENTIAL	2000	2020	2040	2060	2080	2100	2120	2140	2160	2180	2200	2220	2240	2260	2280	2300
GROUND LEVELS ON CL	169.44	168.10	169.07	169.03	168.71	168.47	168.10	168.10	167.93	167.97	167.63	167.57	167.42	167.42		
SLOPE / LENGTH	0.47% / 1:212.8 55.17m		0.47% / 1:212.8 34.03m		0.47% / 1:212.8 75.18m		0.47% / 1:212.8 62.07m			0.47% / 1:212.8 50.68m			0.47% / 1:212.8 51.71m			
PIPE	UPVC CL34 355mm dia		UPVC CL34 355mm dia		UPVC CL34 355mm dia		UPVC CL34 355mm dia			UPVC CL34 355mm dia			UPVC CL34 355mm dia			
STRUCTURES	X: 3764474.26 Y:-49054.84		X: 3764507.71 Y:-49035.62		X: 3764598.92 Y:-49107.13					X: 3764688.92 Y:-49168.82			X: 3764699.48 Y:-49158.99		X: 3764651.74 Y:-49198.79	
PIPE INVERT LEVEL IL (IN)	167.145		166.937		166.533					166.193			165.906		165.813	
IL (OUT)	167.000		166.887		166.485					166.144			165.856		165.613	

The reference made to Engineer will also refer to Employer's Agent for GCC 2015 Contracts

SCALEBAR
0 15 30 METER
SCALE 1:500

All dimensions must be verified on site before the works commence. Refer any discrepancies to the Engineer.

REV	DESCRIPTION	DATE	REV BY	CHKD
A	TENDER (DRAFT)			

REVISIONS

DESIGNED	RL	
DRAWN	RL	
CHECKED	MLR	

CONSULTING ENGINEERS
LYNERS
PO Box 757
GEORGE
6530
Tel: 044 887 0223 / Fax: 044 887 0741
email: george@lyners.co.za

APPROVED
ENGINEER: _____
DATE: _____

APPROVED
CLIENT: _____
DATE: _____

CLIENT
GEORGE MUNICIPALITY
PO Box 757
George
6530
Tel: 044 887 0223
Fax: 044 887 0741

PROJECT
UPGRADING OF THEMBALETHU BULK SEWER
GRAVITY MAIN - PHASE 1 (THA5.48 - THA5.22)

TITLE
LAYOUT AND PROFILE

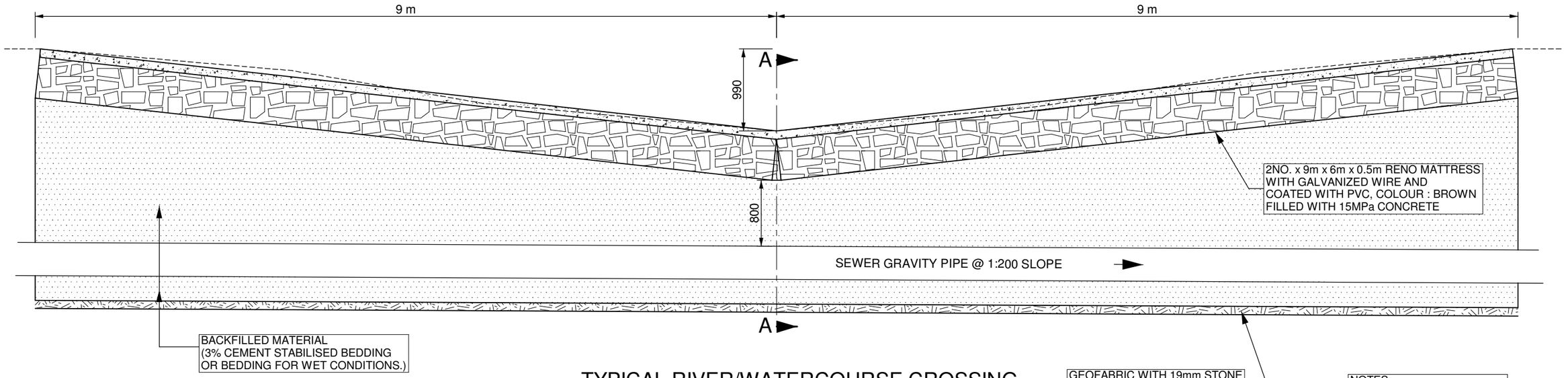
SCALE	on A0	SHEET
1:500		5 OF 5
CONTRACT No.		PROJECT No. C20035G

DRAWING No. C20035G-L-03 REV A
COORDINATE SYSTEM: WGS84/23

Date: 2021-07-27 Checked: Auditing: Riaan Louwrens

iso full bleed a0 (841.00 x 1189.00 mm)

S:\PROJECTS\SIVEL\GEORGE\20035CG - THEMBALETHU BULK SEWER MAINS\DRAWINGS\WORKING\PHASE 1\THEMBA_WORKING 33.DWG

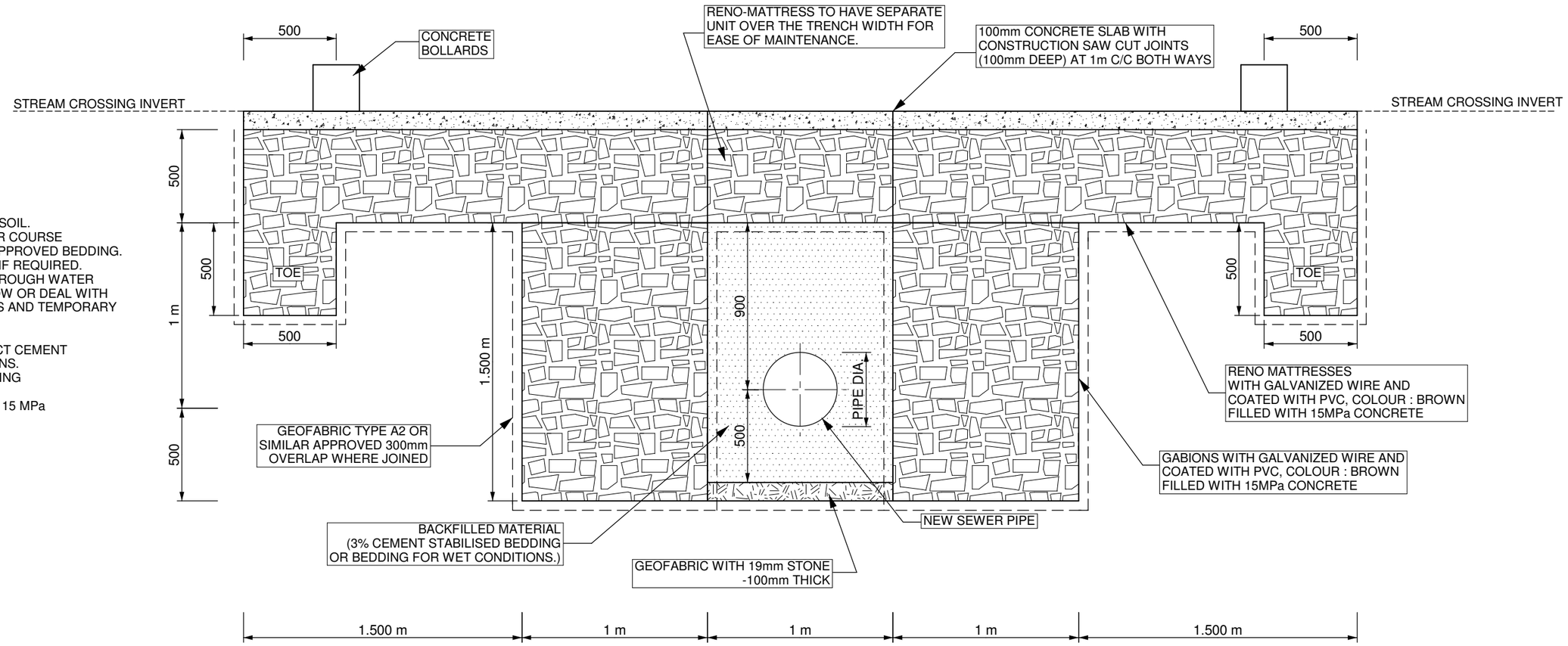


TYPICAL RIVER/WATERCOURSE CROSSING

SCALE 1:50

NOTES:

1. CLEAR SITE AND STOCKPILE TOPSOIL.
2. EXCAVATE TRENCH UP TO WATER COURSE CROSSING. INSTALL PIPE WITH APPROVED BEDDING. BEDDING FOR WET CONDITIONS IF REQUIRED.
3. EXCAVATE TRENCH FURTHER THROUGH WATER COURSE WHEN THERE IS NO FLOW OR DEAL WITH WATER BY MEANS OF SAND BAGS AND TEMPORARY DRAINAGE PIPES.
4. EXCAVATE FOR GABIONS.
5. INSTALL GEOTEXTILE, CONSTRUCT CEMENT STABILIZED BEDDING AND GABIONS.
6. BACKFILL AND REINSTATE WORKING AREA AND PLACE TOPSOIL.
7. FILL IN RENO MATTRESSES WITH 15 MPa MASS CONCRETE.



SECTION A-A

SCALE 1:25

REV	DESCRIPTION	DATE	REV BY	CHKD
A	ISSUED FOR APPROVAL	01/09/2020	WO	MleR

REVISIONS

DESIGNED	MleR	2020
DRAWN	WO	2020
CHECKED	MleR	2020

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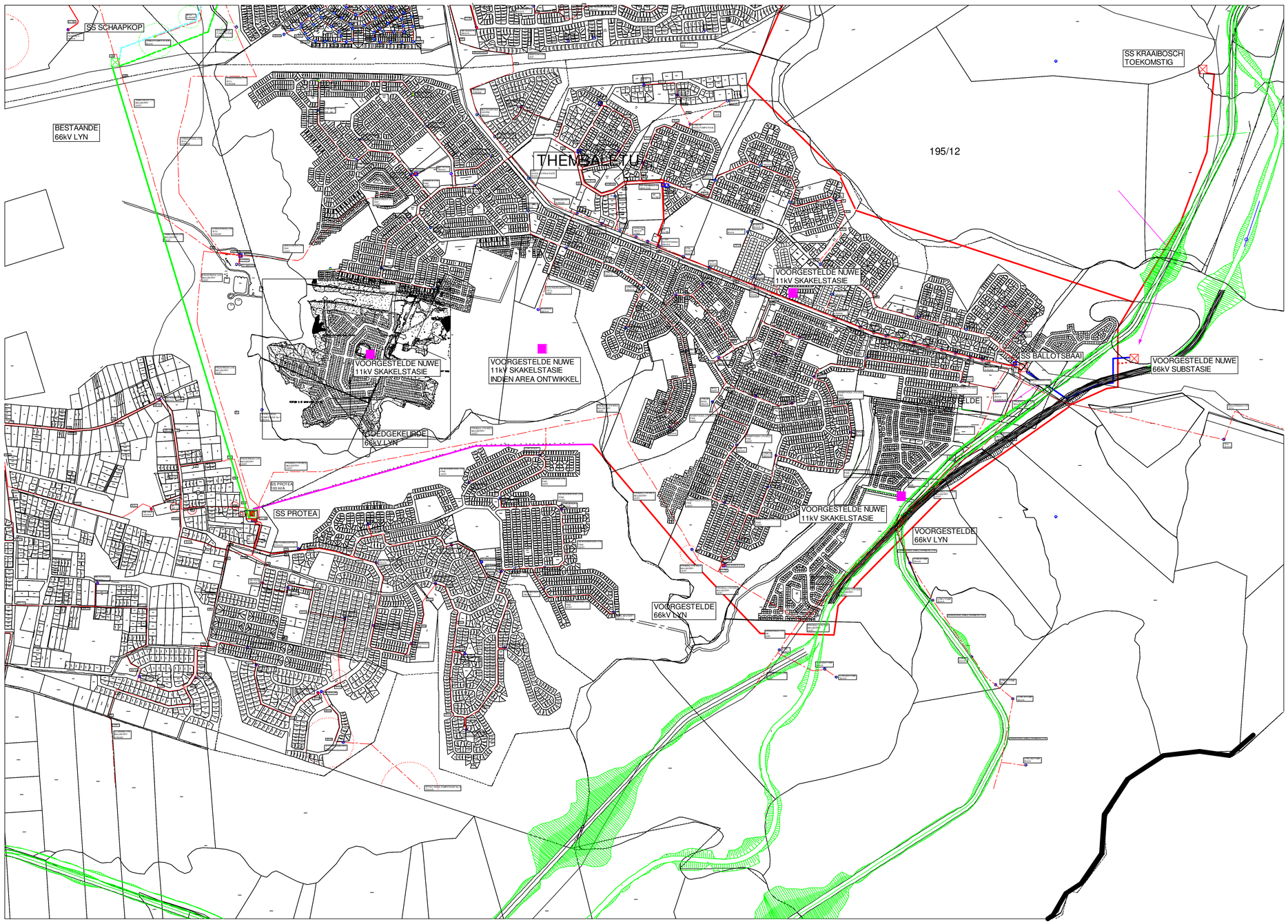
CLIENT

PROJECT: THEMBALETHU BULK SEWER MAINS

TITLE: DETAIL OF STREAM CROSSING

SCALE: AS SHOWN	SHEET: -
CONTRACT No.: C20035G	PROJECT No.: C20035G
DRAWING No.: C20035G/D/01	REV: A
DATE OF FIRST ISSUE:	

Z:\Projects\Sivel\George\20035CG - Thembalethu Bulk Sewer Mains*rawings\CAD C20035G-D-01 STREAM CROSSING DETAIL.DRG.pdf



DRAWING SCHEDULE

N

LEGEND

BESTAANDE SUBSTASIE	
TOEKOMSTIGE 66/11 KV SUBSTASIE	
TOEKOMSTIGE 11 KV SKAKELSTASIE	
BESTAANDE 66kV LYN	
TOEKOMSTIGE 66kV LYN	
GOEDGEKEURDE TOEKOMSTIGE 66kV LYN	
TOEKOMSTIGE 11kV LYN	

SCALE 1 : 7500

0 200 400m

NR. No.	DATUM DATE	WYSIGINGS AMENDMENTS

KLIANT / CLIENT

GEORGE MUNISIPALITEIT

BDE
RAADGEWENDE ELEKTRIESE INGENIEURS
CONSULTING ELECTRICAL ENGINEERS
KAAPSTAD P.O.BOX 53006 KENILWORTH 7745 TEL. (021) 696 4065
GEORGE P.O.BOX 1862 GEORGE 6530 TEL. (044) 801 9700
E-MAIL bde@bdeinsult.co.za

PROJEK / PROJECT

THEMBALETHU

TEKENING BESKRYWING / DRAWING DESCRIPTION

BEPLANNING : TOEKOMSTIGE 66kV LYN & SUBSTASIE

TEKENING Nr. / DRAWING No.	REV.
GRG 09 04 00005	

CAD NAAM CAD NAME	GRG 09 04 00005 20121113	GOEDGEKEUR APPROVED	
SKAAL SCALE	1 : 7500	NAGEGAAN CHECKED	
LêER No. FILE No.	GRG 09 04 00005	CAD NAGEGAAN CAD CHECKED	
AANVANGSDATUM COMMENCE DATE	20121112	GETEKEN DRAWN	REL

Siân Holder

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EDUCATION

Rhodes University
Masters: Environmental Education – with distinction ((Bursary awarded by National Ports Authority)
2009

Nelson Mandela University
BTech: Nature Conservation (Bursary awarded by Table Mountain Fund, WWF, South Africa)
2004

Pretoria Technikon
National Diploma: Nature Conservation (Bursary awarded by Foundation for Research Development)
1999

WORK EXPERIENCE

Environmental Consultant & Control Officer (ECO) | Cape EAPrac, George
2008 – Present

Environmental Consultant | Hilland Associates, George
Mar – Jun 2008

Acting Manager: Experiential Education & Wilderness Guide for Imbewu, Pride & Umzi Wethu Projects. | Wilderness Foundation, South Africa
Jan 2007 – Mar 2008

Student assistant & Editorial assistant for the South African Journal of Environmental Education (SAJEE) on behalf of the Environmental Education Association of Southern Africa (EEASA) | Rhodes University
Jan 2005 – Dec 2006

Wilderness Guide | Wilderness Foundation, South Africa
2005 – 2006

Co-ordinator of Garden Route Khula Nam Project | Wilderness Foundation & MTO Forestry
Aug 2002 – Dec 2004

Co-ordinator of Tsitsikamma Imbewu Project and Trail & Canoe Guide & Social Ecologist | South African National Parks: Tsitsikamma & Wilderness Sections of Garden Route National Park

2002 – 2004

CORE COMPETENCIES

Practicing as an Environmental Assessment Practitioner (EAP) since 2008, I have gained experience with a variety of projects working in the Eastern Cape, Western Cape and Northern Cape Provinces. My work requires of me to be acquainted with relevant local conservation / environmental management policies and legislation, including the National Environmental Management Act, the 2014 Environmental Regulations, National Environmental Management Waste Act, National Environmental Management Air Quality Act, National Environmental Management Biodiversity Act, Integrated Coastal Management Act, National Protected Areas Act, Outeniqua Sensitive Coastal Areas Regulations, National Forestry Act, National Water Act, National Heritage Resources Act and numerous conservation related regulations and guidelines that form the basis of environmental management.

PROFFESIONAL PORTFOLIO

ENVIRONMENTAL IMPACT ASSESSMENT, BASIC ASSESSMENT & EMP'S

- **Infrastructure:** Overhead transmission lines with associated substations (Municipal, Eskom or associated with renewable energy projects), construction and expansion of roads, flood damage road rehabilitation, stormwater reticulation, retention & dissipation facilities, sewage infrastructure, potable water supply networks etc.
- **Human Settlements:** Facilitate various scale residential developments with associated infrastructure, for Knysna Municipality, Oudtshoorn Municipality, George Municipality and Mossel Bay Municipality.
- **Renewable Energy:** Facilitating various applications for Wind Farms, Solar Farms, Biogas Waste-to-Energy applications.
- **Agricultural:** Applications for the construction and expansion of dams and water works (pipelines, canals, weirs etc.) associated with farming activities.
- **Integrated environmental management:** Environmental management and maintenance plans, environmental monitoring & control functions, environmental auditing.

ENVIRONMENTAL CONTROL AND MANAGEMENT (ECO)

- Management of construction activities for both civil and top-structures developments to ensure compliance with environmental approvals, environmental management plans and in terms of 'Principles of Duty of Care to the Environment'.
- Overseeing the implementation of Alien Invasive Control Plans and Rehabilitation Plans and providing advice on follow-up control and rehabilitation programmes.

ALIEN INVASIVE CONTROL PLANS (ACP)

- **Invasive Plants Control:** Compilation of Control Plans to advise and guide the initial and follow-up methodology for alien plant clearing and control, as well as rehabilitation of indigenous vegetation.

REHABILITATION PLANS & PROGRAMMES

- Compilation of Rehabilitation Plans for the restoration / rehabilitation disturbed environments to natural or near-natural conditions.

WASTE MANAGEMENT LICENCES

- Facilitating applications for general waste & recyclable waste handling/treatment and disposal.
- Applications for anaerobic biogas waste-to-energy projects with organic material at dairies, feedlots, abattoirs and fruit juice factories.

SECTION 24G RECTIFICATION APPLICATIONS

- Facilitating rectification assessment processes for listed activities that commenced unlawfully ito NEMA, NEMWA and NEMAQA (ranging from roads, storm water infrastructure, vegetation clearing, construction activities, air emission generation activities, waste management activities, wetland/riparian disturbances, dams).

ENVIRONMENTAL AWARNESS & TRAINING

- Induction of contractor teams and labourers associated with alien clearing projects, rehabilitation projects, construction projects, as well as school groups for site inspection and environmental awareness outings.