- Remove redundant access culvert at chainage 220 metres;
- Widen the creek line between Edward Street and chainage 160m;
- Require surface levels of the future development adjacent to the Edward Street to be raised to 161 mAHD as discussed in Section 3; and
- Consider undertaking the road and rail crossing realignment as discussed in Section 4.5.

5 YOUL ROAD TO DRUMMOND STREET

5.1 DESCRIPTION

After passing under the Western railway line the bulk of stormwater heads southeast before rejoining the original alignment of Sheepwash Creek, west of Norfolk Street. This floodplain is used as farmland, as seen in Figure 13, which shows a northern view of the creek from the pine trees at Old Cemetery Road.

Figure 13. View of Sheepwash Creek upstream towards the rail line

Just to the north of Drummond Street the creek encounters the redundant 2150mm x 1200mm box culvert crossing for Old Cemetery Road (refer to Figure 14). Stormwater then passes through a wide and deeper section of the creek populated by willow trees (Figure 15), before hitting the 3 no. 1200mm diameter Drummond Street culverts (Figure 16).

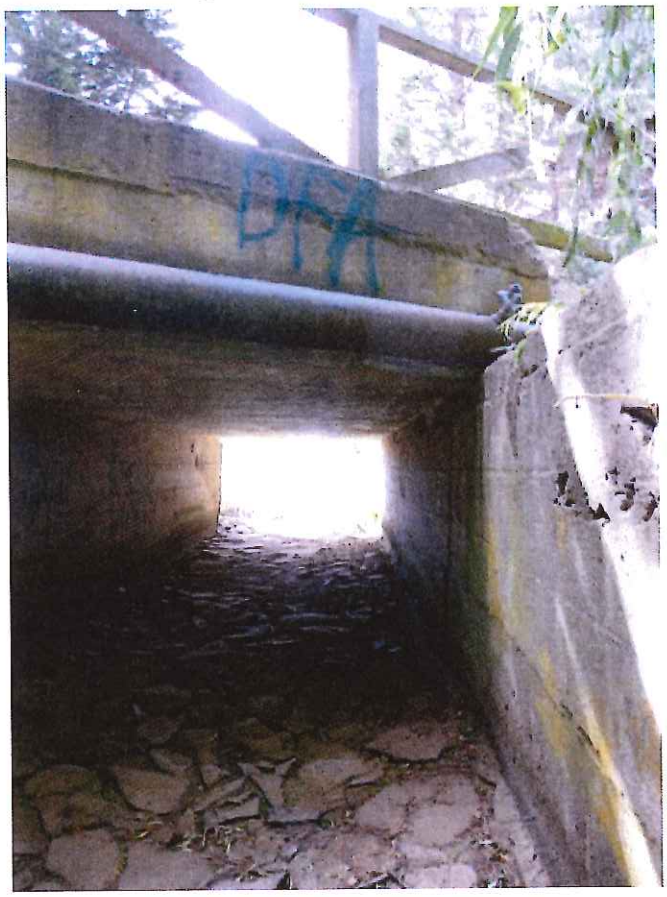

Figure 14. Old Cemetery Road culvert upstream

Figure 15. View of creek widening upstream to Old Cemetery Road

Figure 16. View of creek widening upstream to Old Cemetery Road

5.2 ASSESSMENT OF DRUMMOND STREET CULVERTS

The model predicts these culverts able to pass the 20 year flow which equates to approximately 2 m^3/s per culvert) with the headwater rising approximately to the top of the pipes (159.15 m AHD), assuming they are not restricted by debris.

Flooding of the roadway is predicted to occur during the 100 year event. Using the peak flow of 15.3 m^3/s Infoworks ICM predicts flooding would occur to 160.68 mAHD, the adjacent road low point. This enables a maximum of 13 m^3/s to be passed by the culverts and resulting in 2.3 m^3/s of flow over Drummond Street.

The backwater effects would also create extensive flooding of the area bounded by Drummond, Norfolk, Edward and Crowell Streets. The minimal longitudinal grade of the surveyed creek and the flat channel profile means that additional culvert capacity needs to be provided in order to further reduce the headwater levels caused by the culverts.

Survey also shows that the low point of Drummond Street does not align with the culvert or the creek alignment; it is some 40m further west in the vicinity of Cemetery Road. At 160.3 mAHD it is approximately 400mm lower than the crown above the culverts. As such flooding over the road may be greater and the true capacity of the culverts in the 100 year event.

Infoworks ICM confirms that the addition of two 1200mm diameter culverts prevents flooding of Drummond Street. These pipelines could be installed either by traditional trenching or pipe jacking (micro-tunnelling).

The predicted flood level of this arrangement resulting from headwater is 158.96 m AHD and 159.72 mAHD for the 20 year and 100 year events respectively. The height influences the extent to which the land upstream to Youl Street floods. Assuming the entire 100 year design flow is passed from Youl Road to Drummond Street unimpeded the water level effects will impact on Sheepwash Creek back to Youl Road and the rail bridge, and may restrict free discharge of incoming flows from these culverts. Drawing 1 (Appendix C) shows the indicative headwater level for this event.

An additional 400mm reduction in headwater from the 5 x 1200 diameter culverts 100 year flood scenario can be achieved by replacing the existing 3 no. 1200mm diameter culverts with 2 no. 3600mm x 1500mm box culverts. This triples the cross-sectional area provided under Drummond Street and potentially reduces flood levels to 158.69 mAHD (20 year event) and 159.31 mAHD (100 year event). Large box culverts are installed by trenching and therefore construction cause disruption to Drummond Street (B52), although one lane of traffic may be able to be maintained during construction. They are also significantly more costly that DN1200 pipes.

This arrangement could however effectively restrict flooding to the immediate locality of Sheepwash Creek. Refer to Drawing 4, Appendix C. Given the slight grade of the creek there will always be flooding upstream resulting from the roadway, however it can be reduced significantly by the addition of culvert capacity. The extent of works will depend on the extent to which this land needs to be drained.

Estimates provided by Humes and Gradco for the supply and installation of reinforced concrete culverts are summarised in Table 4. Refer to Appendix D for full estimates.

Table 4. Cost of supply of culverts

Materials	Supply Cost	Installation Cost	Total
2 no. DN1200 culverts (flush joint for open trenching)	$24,186	$64,679	$88,865
2 no. DN1200 culverts (butt joint for jacking pipe)	$39,459	$64,679 (assumed the same as trenching)	$104,138
2 no. 3600 x 900 box culverts	$131,056	$117,248	$248,304

5.3 RECOMMENDATIONS

Recommendations for creek and roadway are as follows:

- NMC should determine the minimum level of service required for Drummond Street. Based on this service level an assessment can be made on whether additional capacity needs to be

provided at the culverts, or whether a formal floodway over the roadway should be provided;

- NMC should also determine to what extent flooding of the land between Drummond Street and Youl Road is acceptable. As can be seen in the headwater levels mapped Appendix C a significant reduction can be achieved by expanding culvert capacity. This will influence to what extent the upstream land can be developed in future, or whether it is set aside as a floodplain;
- Remove the Old Cemetery Road culvert and restore the channel section;
- Eliminate any restrictions caused by pine and willow trees in this area. The trunks of these have grown in the major flow path and will increase turbulence and contribute to flooding. They also have long overhanging branches (refer to Figures 15 and 16) which may contribute to the collection of silt and debris and contribute to blockages of the culverts;
- Rework Drummond Street between the culvert crossing and the low point to the west. By providing the low point over the culvert will direct any overflows to the downstream creek rather than the properties in the vicinity of the Cemetery Road intersection; and
- Conduct modelling of the downstream sections of creek to determine if increasing floodwaters will impact negatively on existing properties.

APPENDIX A

EDWARD STREET DRAWINGS

REFERENCE: 2014016	SCALE.	1:1000 AT A3
	DRAWN.	DT
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	REVISION	01

Northern Midlands Council
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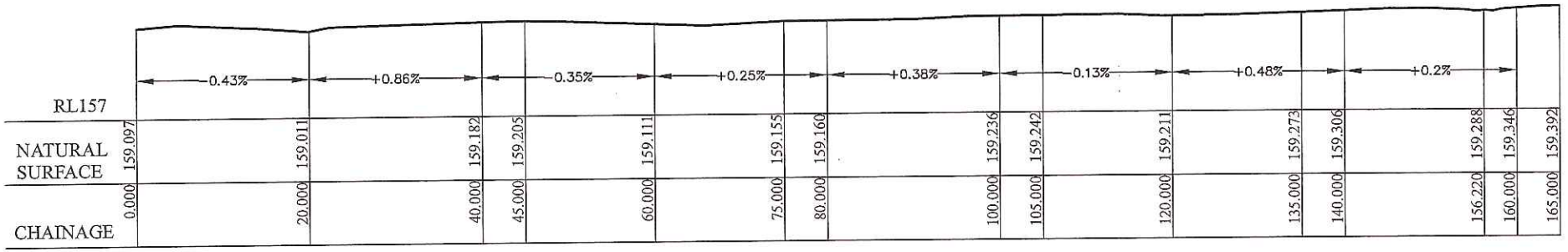
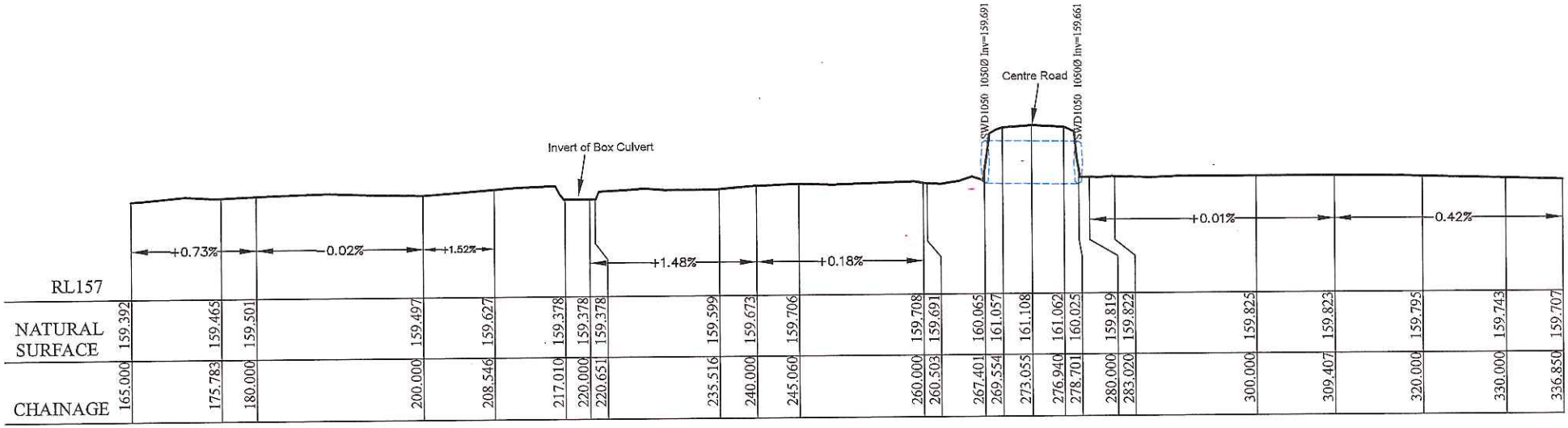


CULVERT INVERT - LONG SECTION - SCALE 500H 100V



CULVERT INVERT - LONG SECTION - SCALE 500H 100V

1 109

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2014016	DRAWN.	DT
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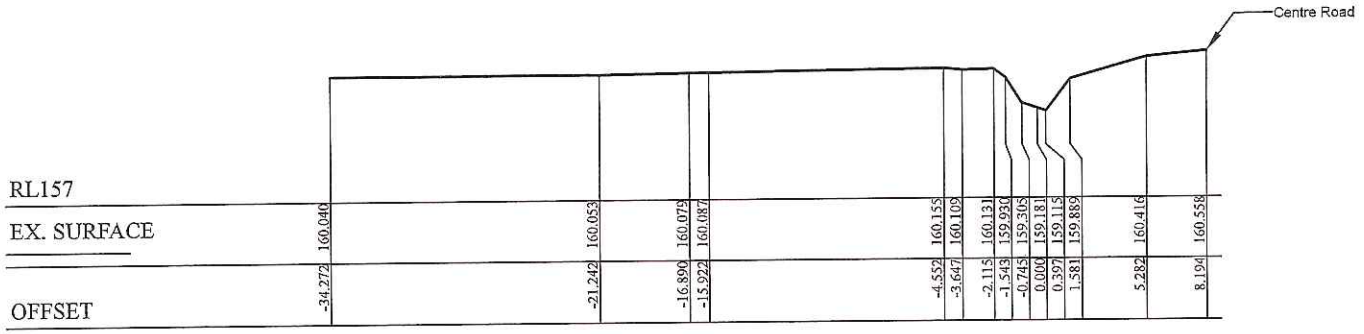

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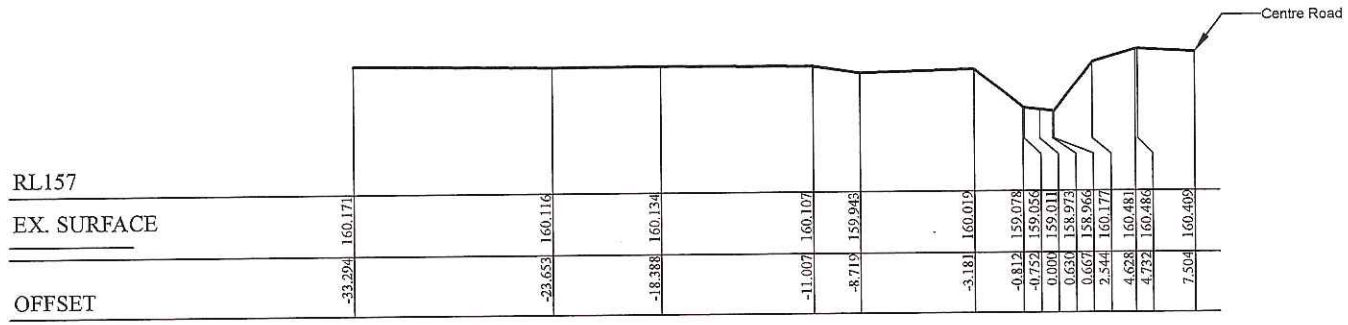

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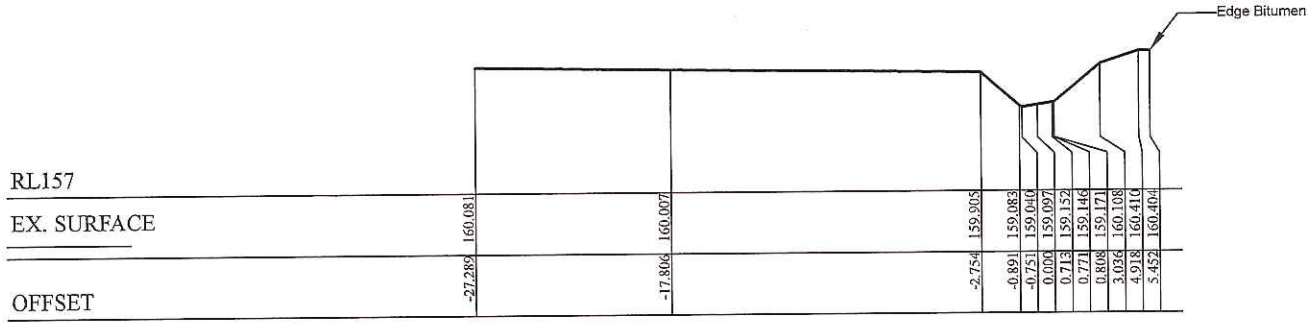

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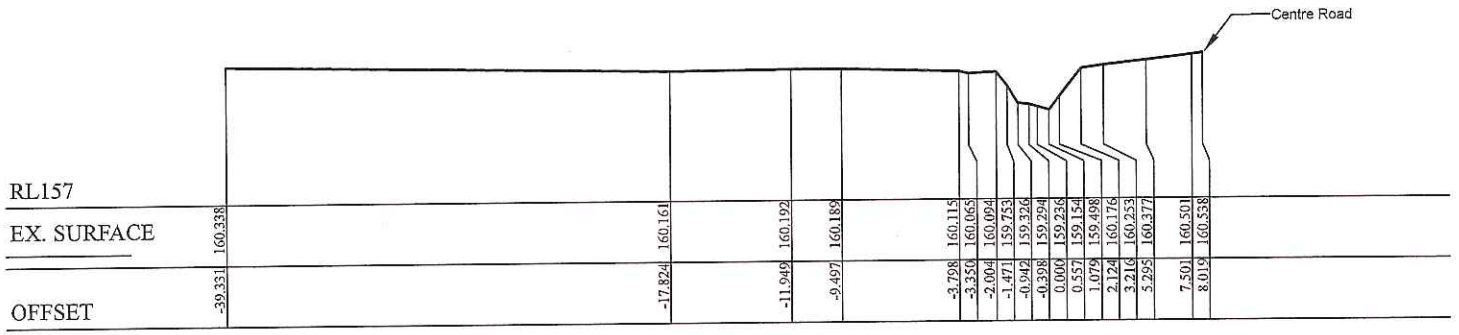

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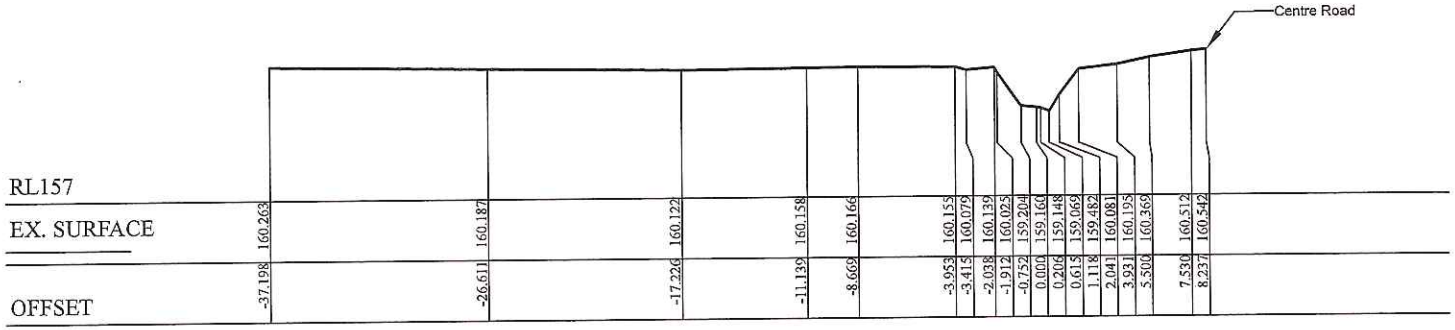

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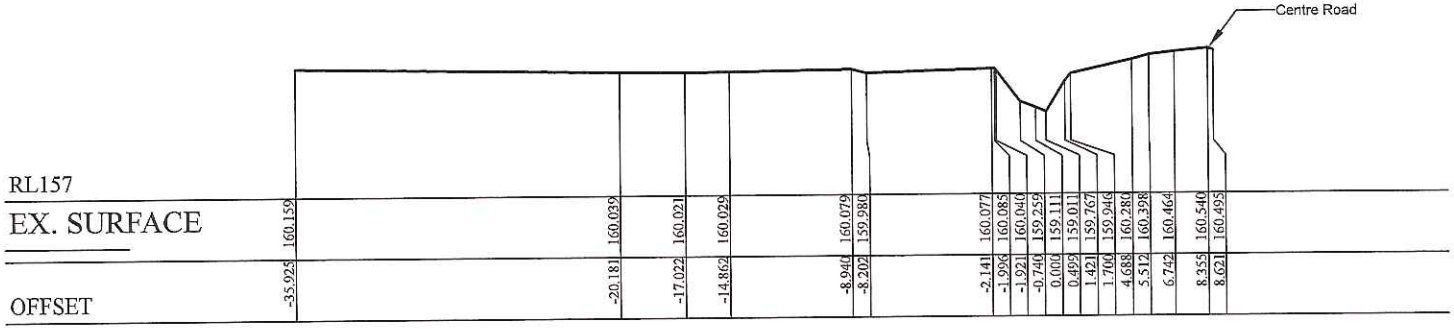

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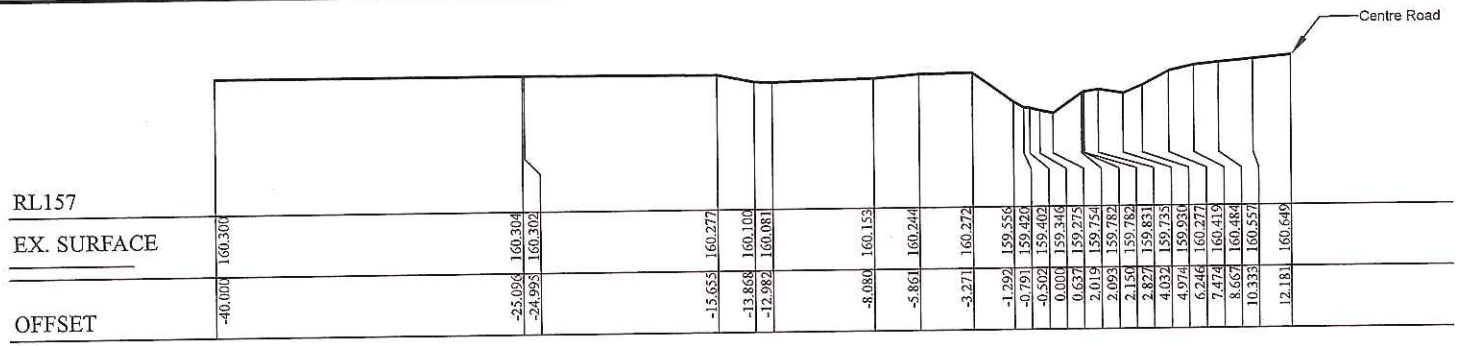

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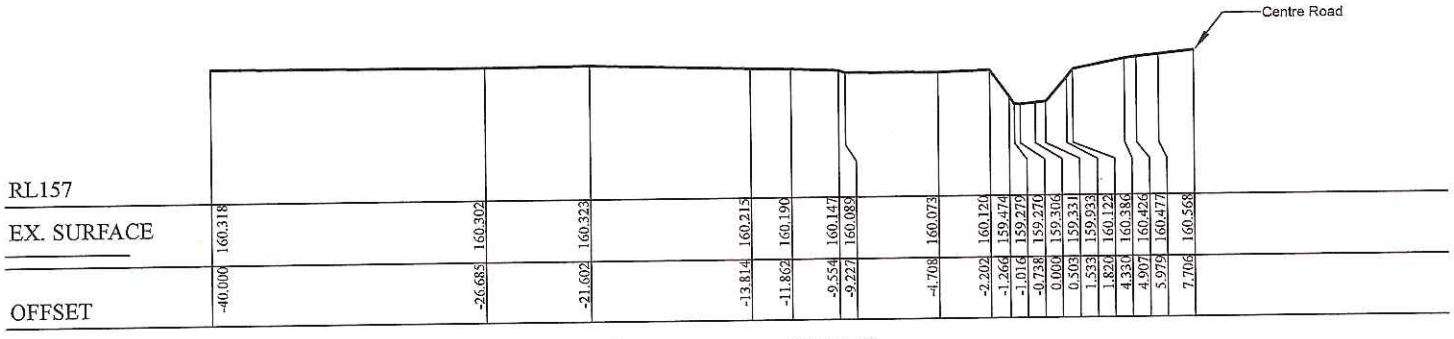

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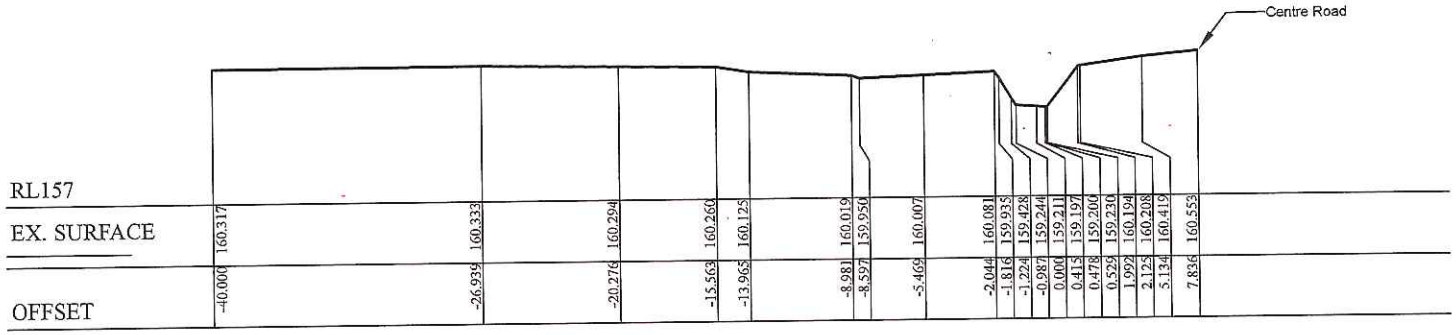

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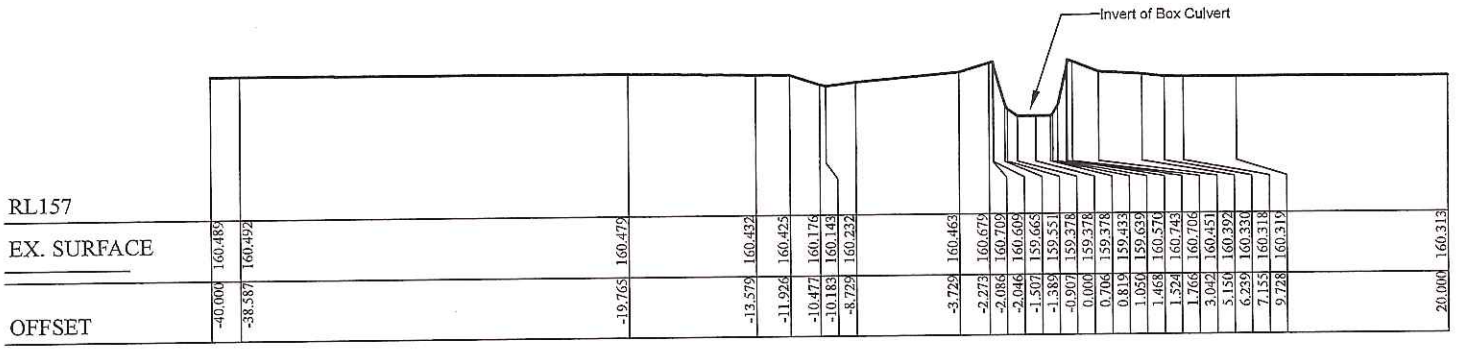

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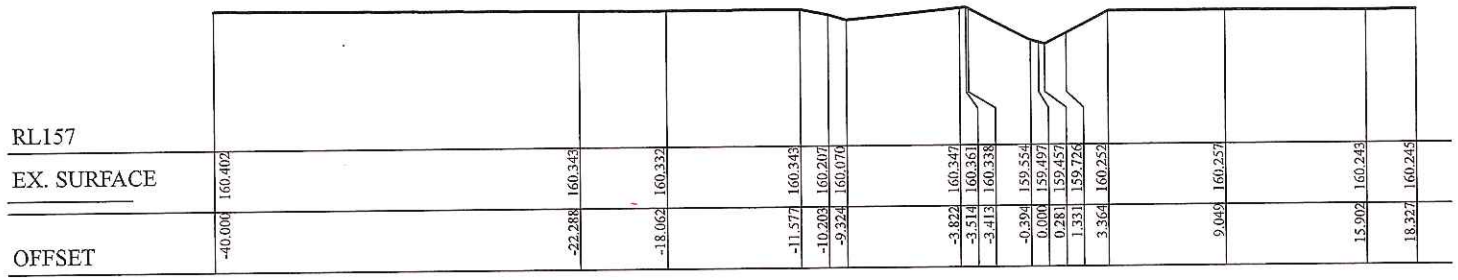

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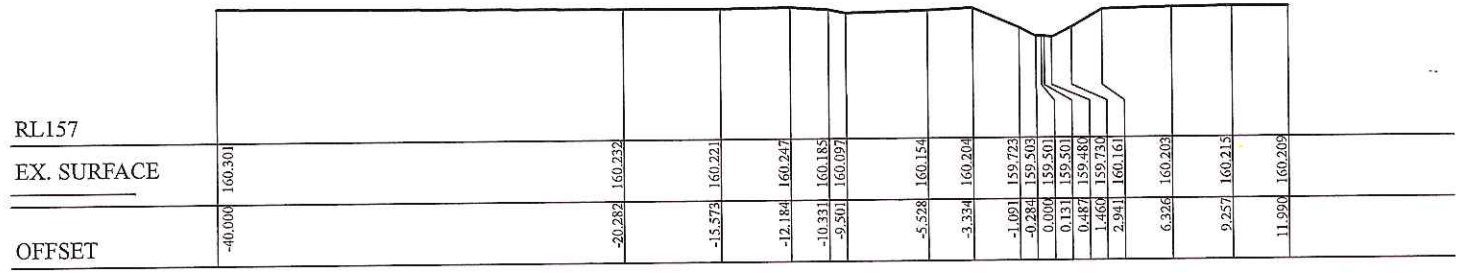

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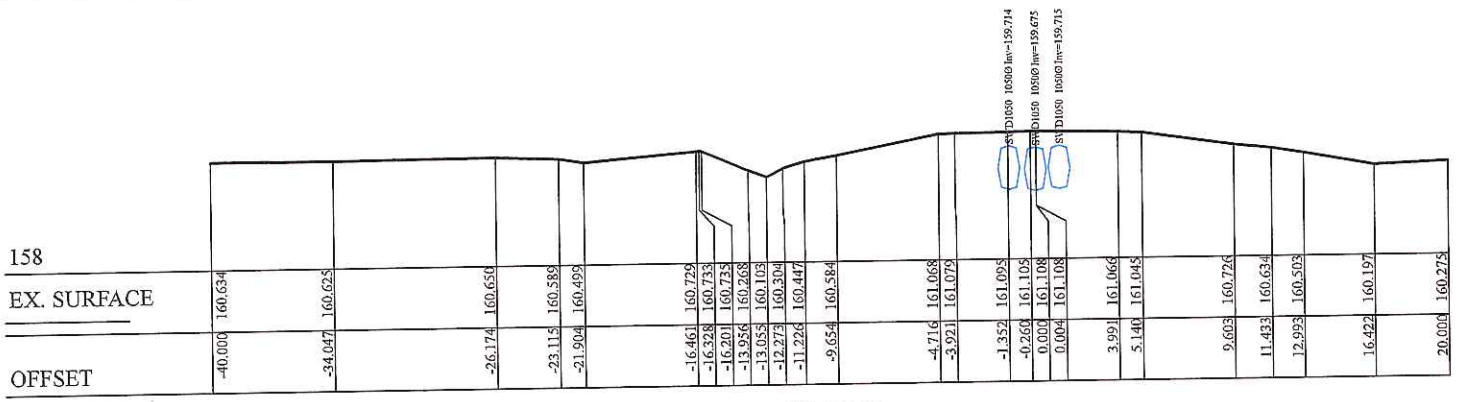

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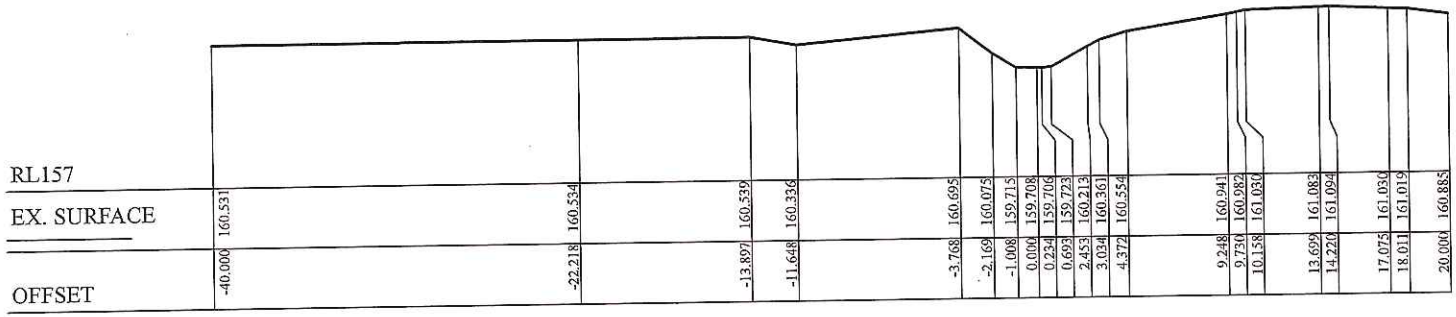

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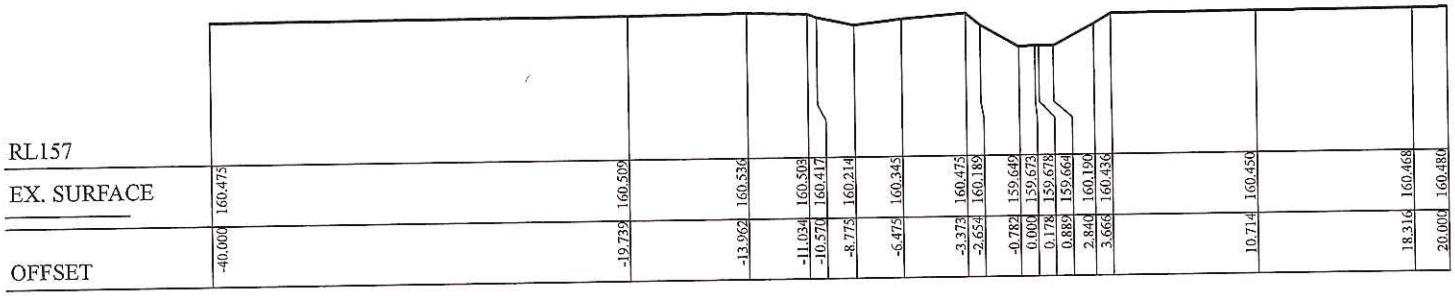

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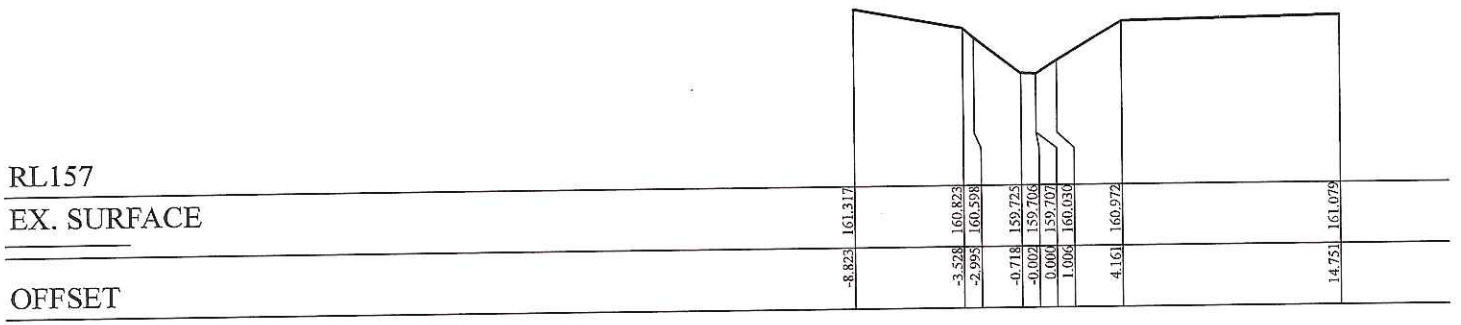

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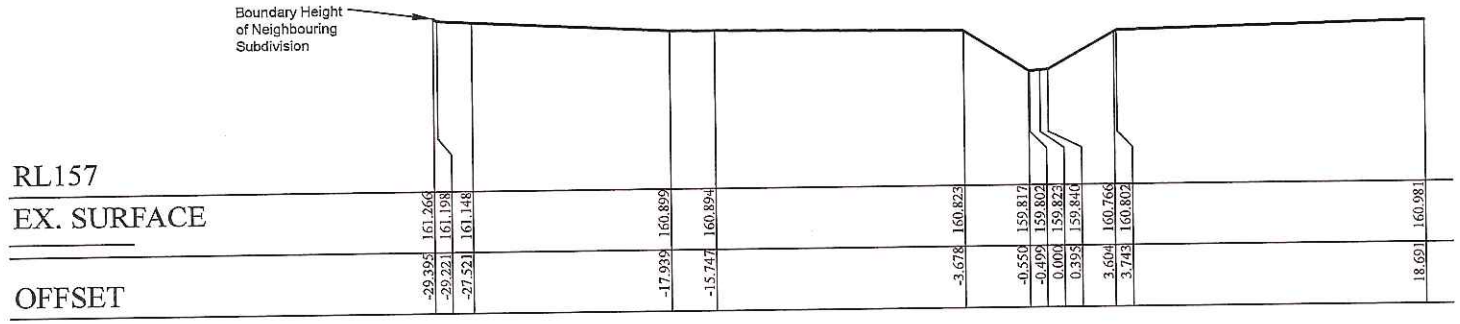

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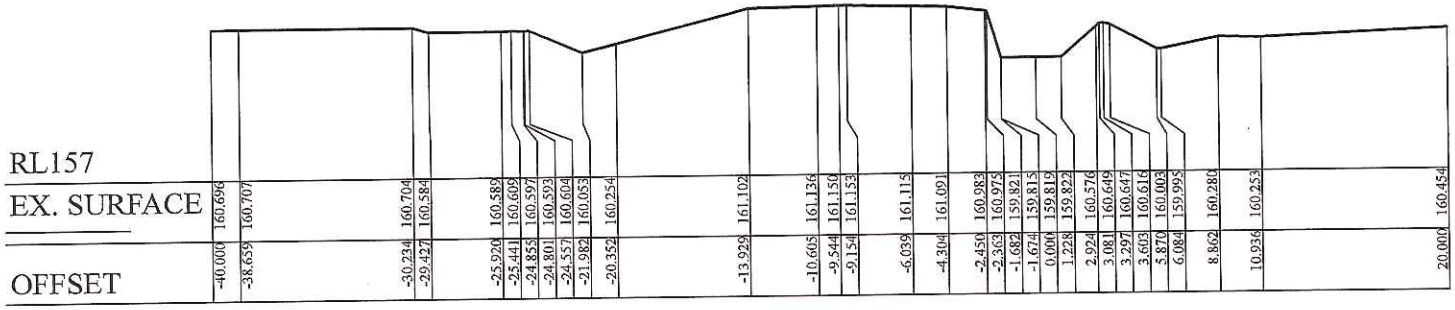

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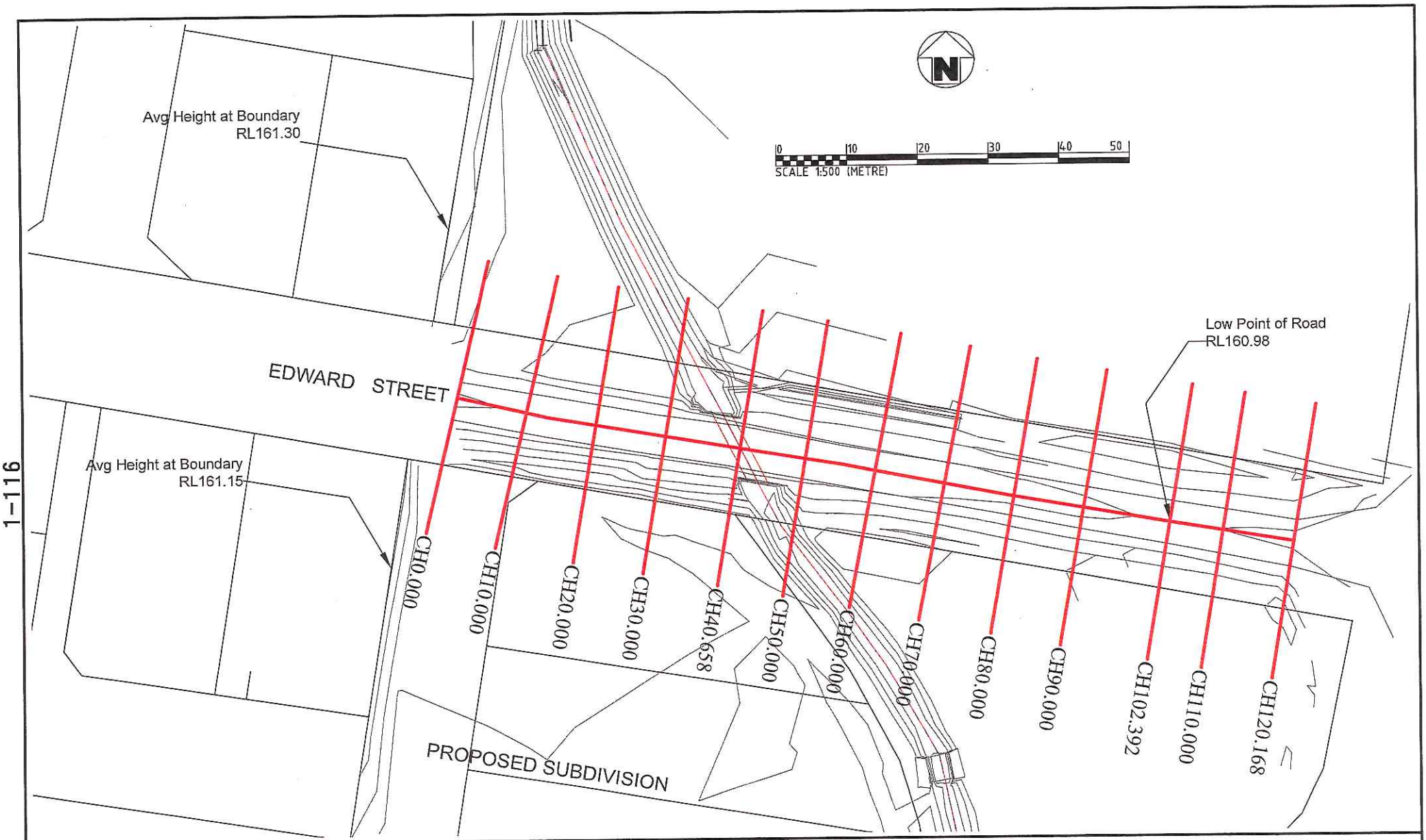

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	DATE.	31/07/2015
	REVISION	01

Northern Midlands Council

EDWARD STREET

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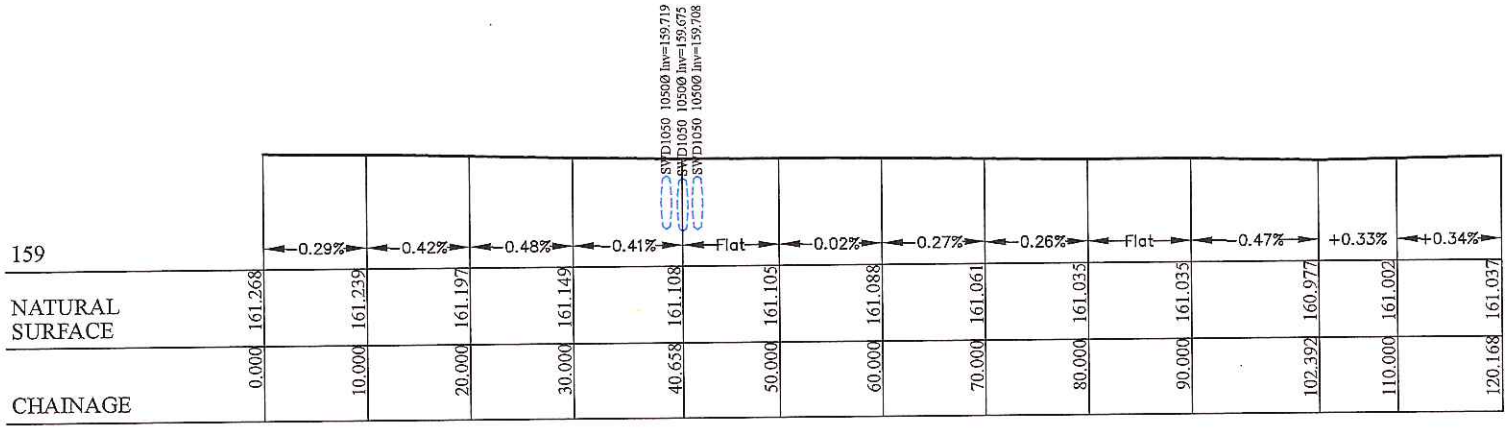
1-117



EDWARD STREET ℄ - LONG SECTION - SCALE 500H 100V

HYDRODYNAMICA

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	DRAWN.	DT	
	SURVEYED.	DT	
	DATE.	31/07/2015	
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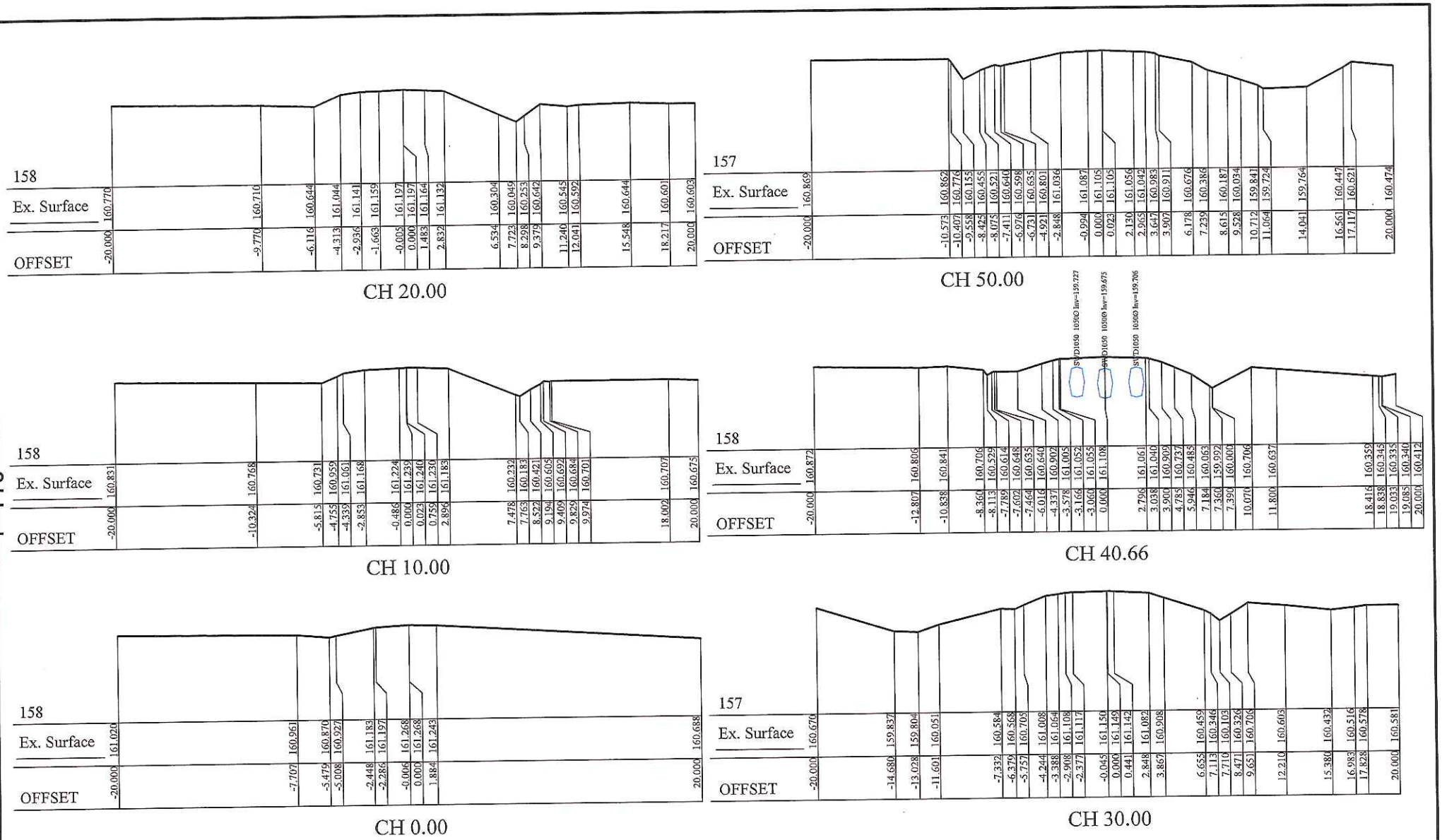

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HYDRODYNAMICA

REFERENCE:	SCALE.	NTS
2014016	DRAWN.	DT
	SURVEYED.	DT
	DATE.	31/07/2015
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Northern Midlands Council
Existing Culvert
EDWARD STREET
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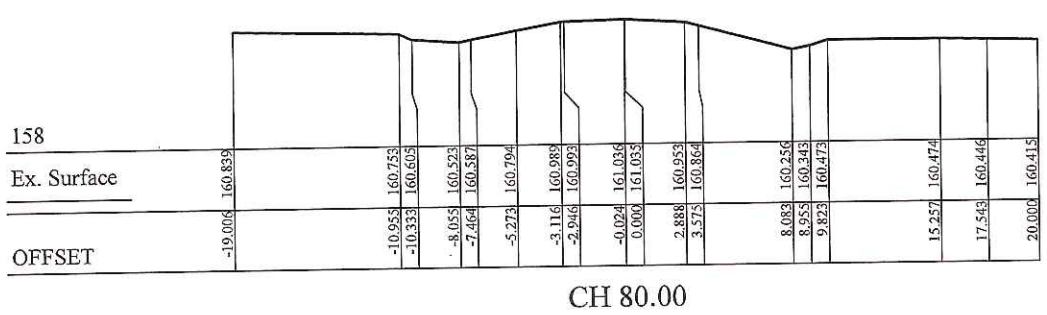

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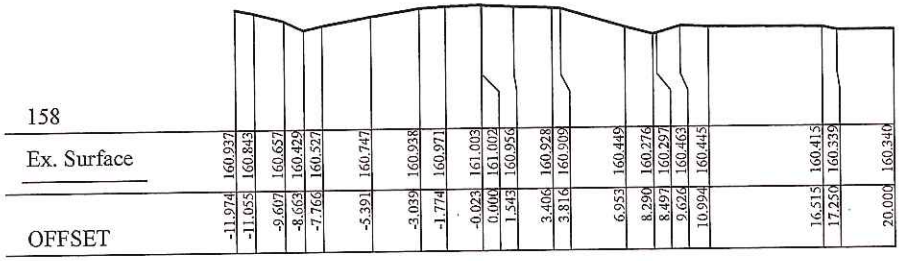

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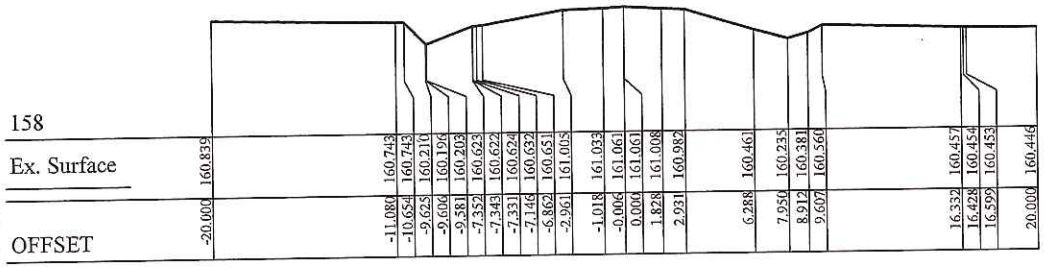

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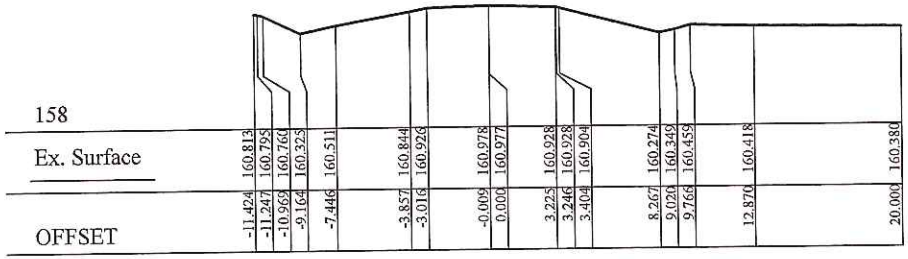

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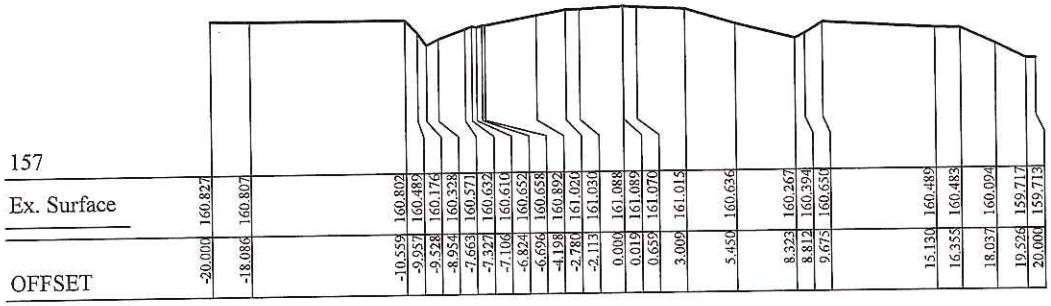

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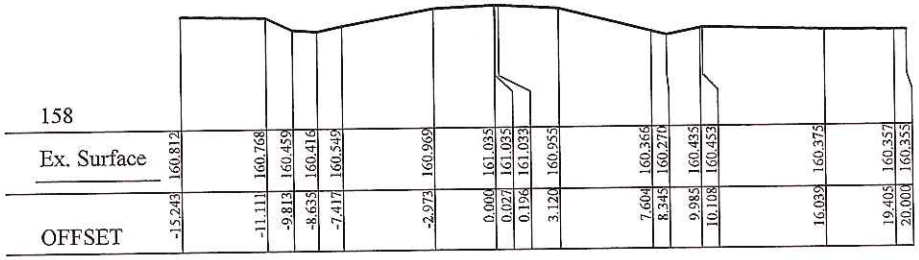

CH 90.00

1-119

HYDRODYNAMICA

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Existing Culvert
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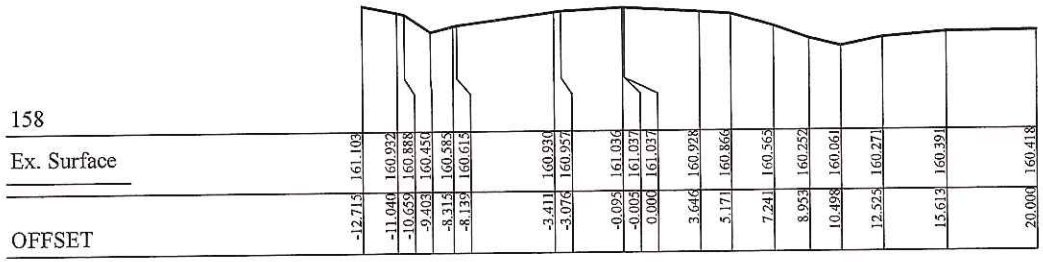

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APPENDIX B

PROPOSED CHANNEL LONG AND CROSS-SECTIONS

REFERENCE: 2014016	SCALE.	1:1000 AT A3	Northern Midlands Council Design Options EDWARD STREET WEST PERTH
	DRAWN.	DT	
	SURVEYED.	DT	
	DATE.	11/08/2015	
	REVISION	00	

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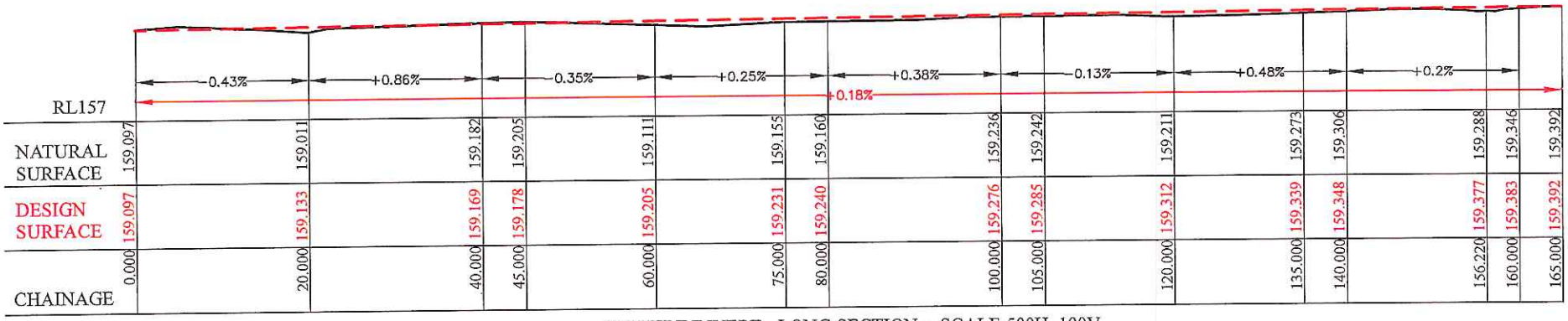
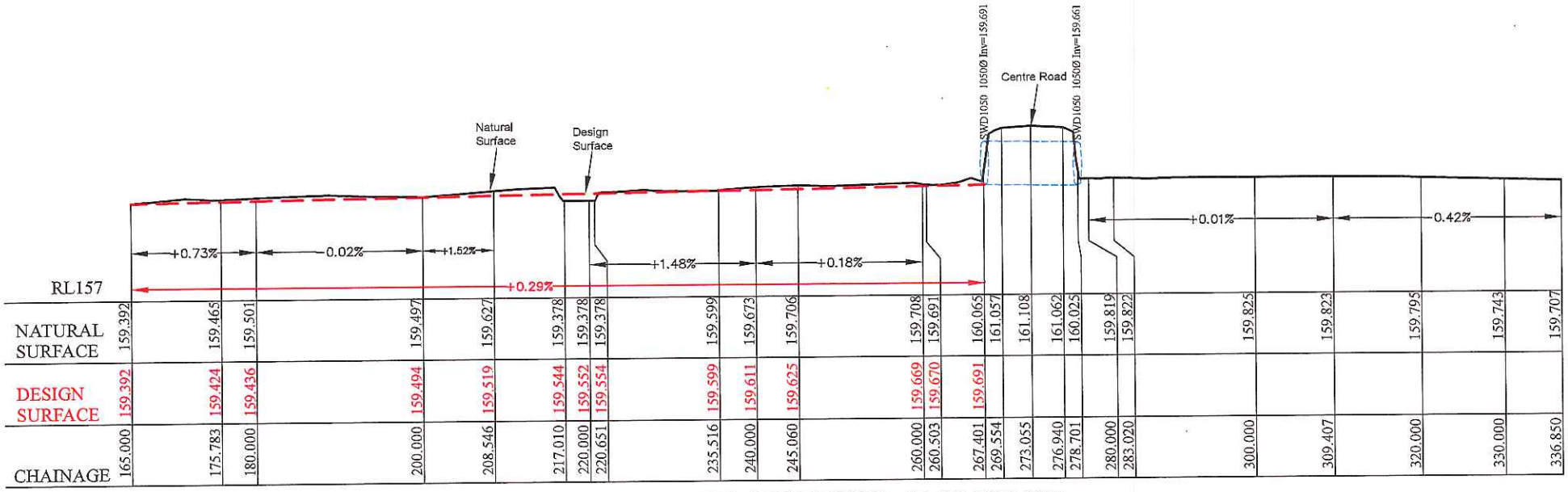
Mobile: 0429 003 584
Email: dtompkins81@gmail.com
Website: www.survalign.com.au



CULVERT INVERT - LONG SECTION - SCALE 500H 100V



CULVERT INVERT - LONG SECTION - SCALE 500H 100V

1-123

HYDRODYNAMICA

REFERENCE:		
2014016	SCALE.	AS SHOWN
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Northern Midlands Council
Design Options
EDWARD STREET
WEST PERTH

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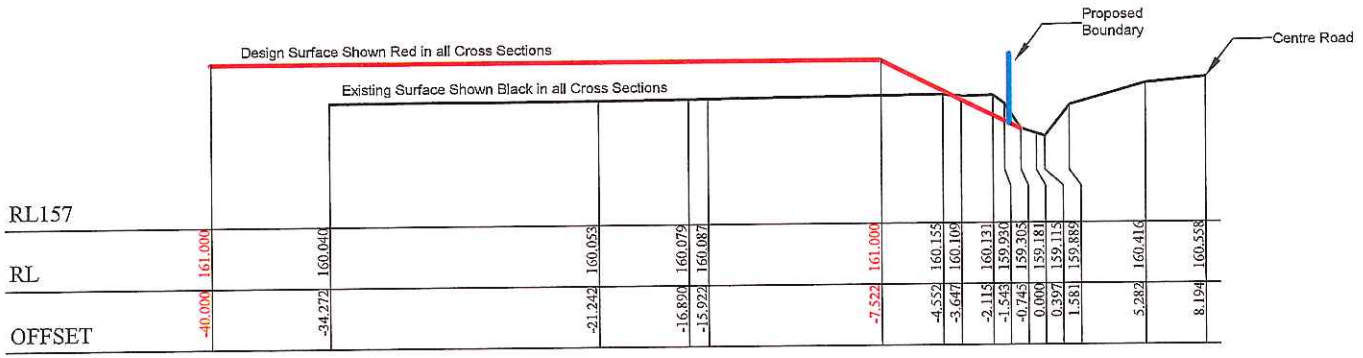
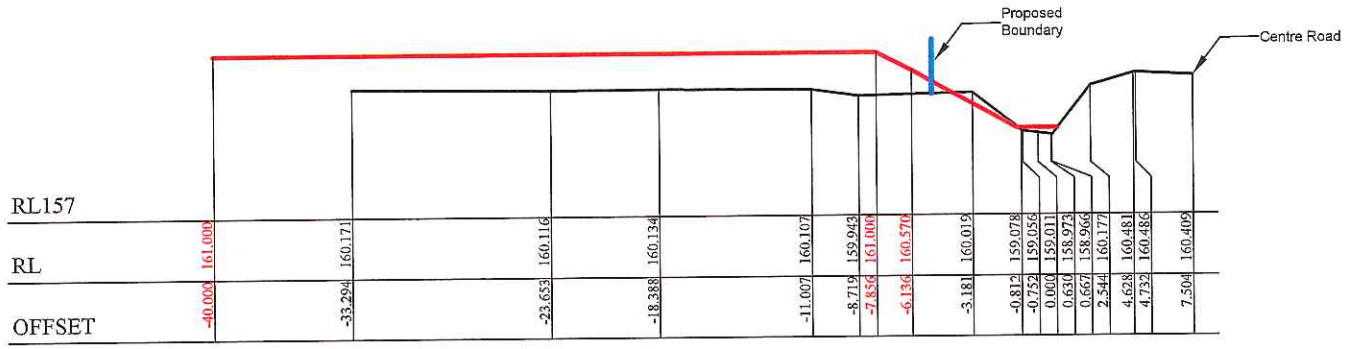
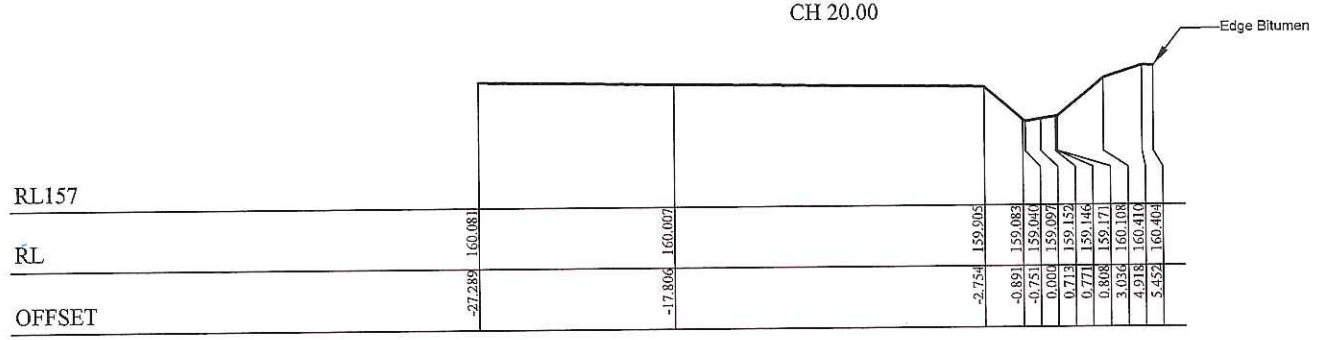
1-124



CH 40.00



CH 20.00



CH 0.00

HYDRODYNAMICA

REFERENCE:		
2014016	SCALE.	NTS
	DRAWN.	DT
	SURVEYED.	DT
	DATE.	11/08/2015
	REVISION	00

Northern Midlands Council
Design Options
EDWARD STREET
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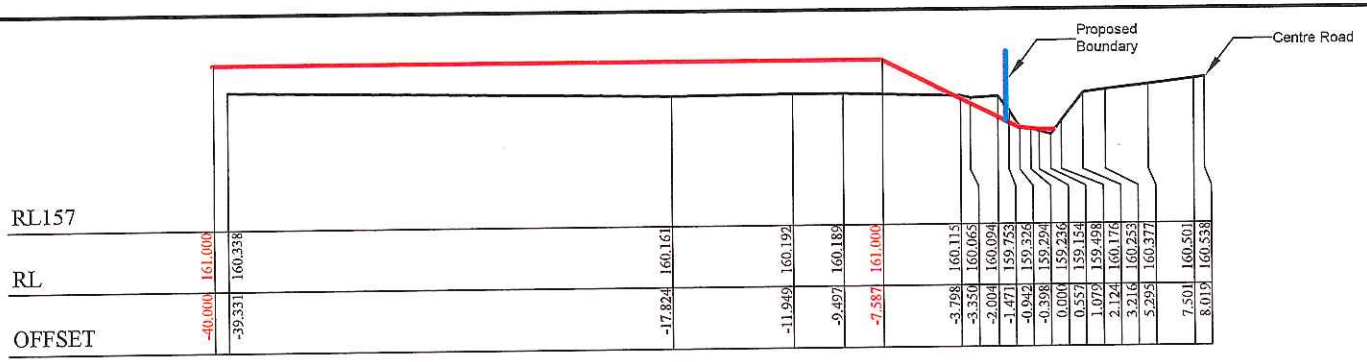

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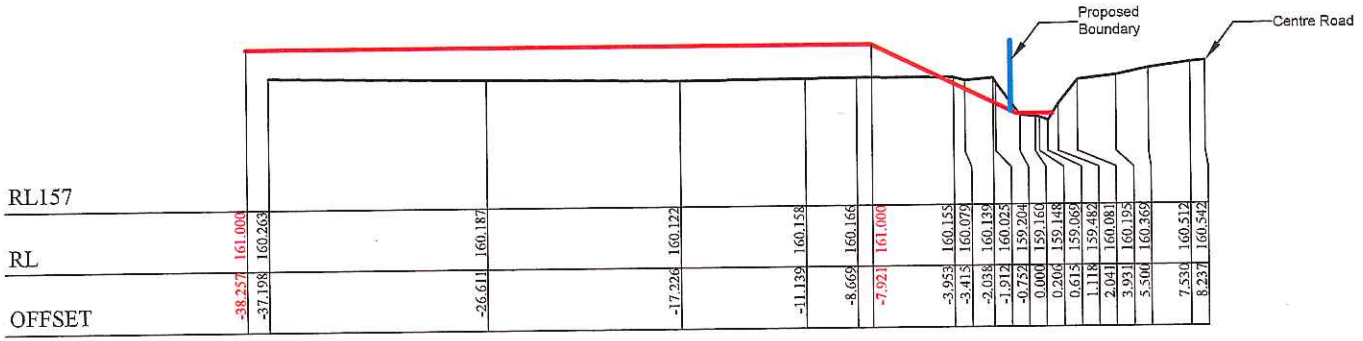

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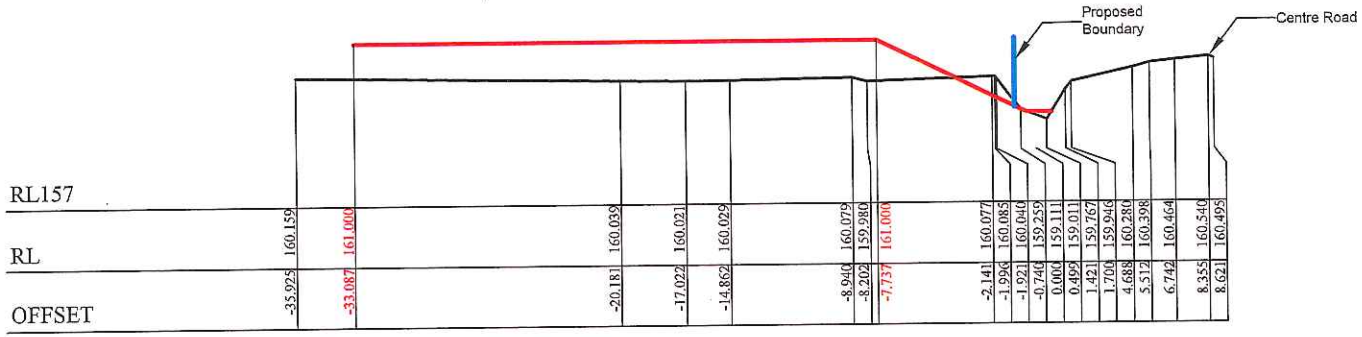

CH 60.00

HYDRODYNAMICA

REFERENCE:	SCALE.	NTS
2014016	DRAWN.	DT
	SURVEYED.	DT
	DATE.	11/08/2015
	REVISION	00

Northern Midlands Council
Design Options
EDWARD STREET
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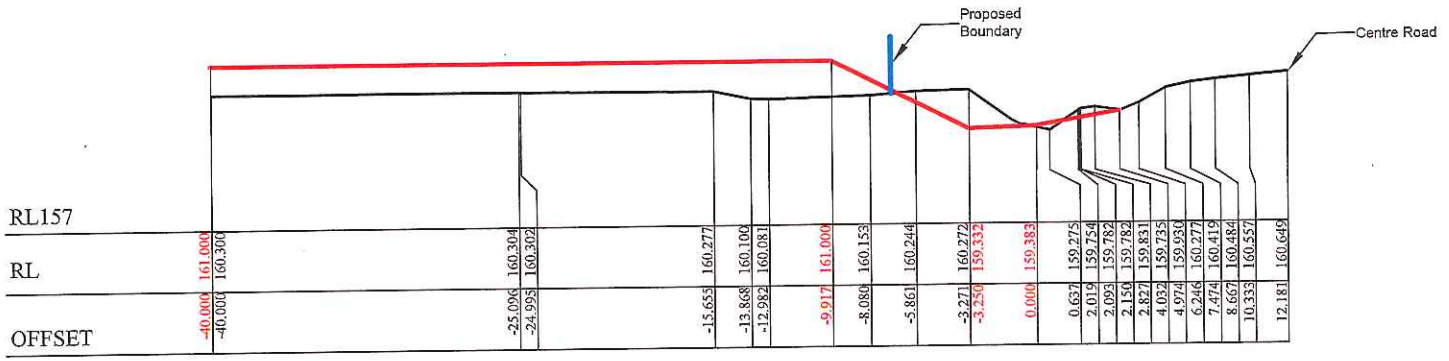
1 126



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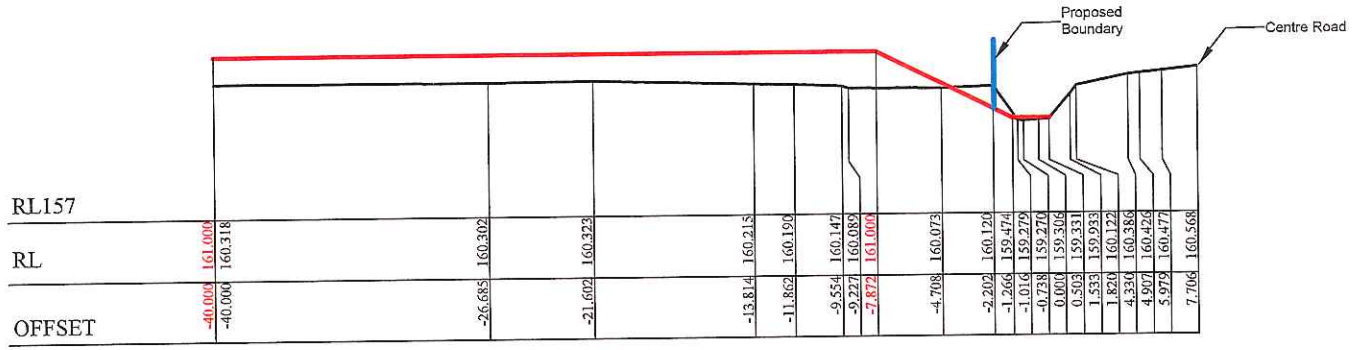
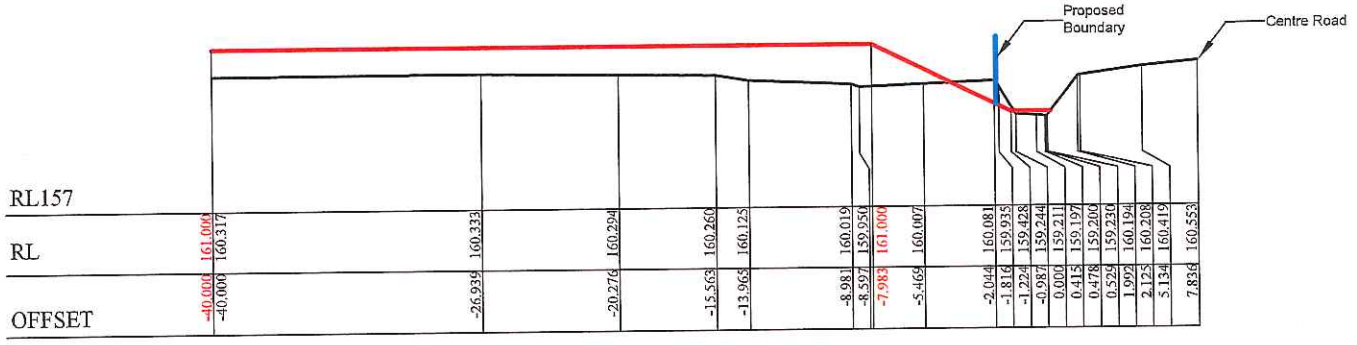


CH 140.00



CH 120.00

HYDRODYNAMICA

REFERENCE:	SCALE.	NTS
2014016	DRAWN.	DT
	SURVEYED.	DT
	DATE.	11/08/2015
	REVISION	00

Northern Midlands Council
Design Options
EDWARD STREET
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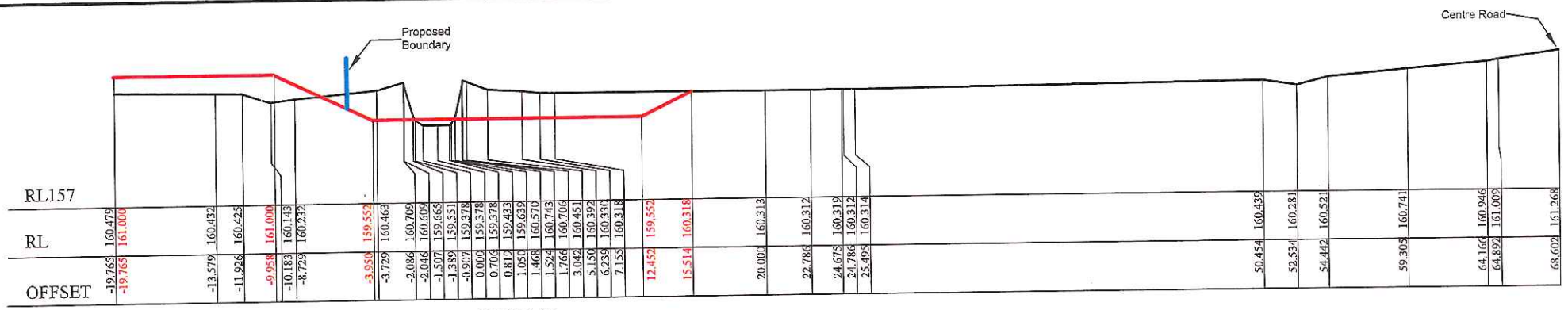

1-127

HYDRODYNAMICA

REFERENCE:	SCALE.	NTS
2014016	DRAWN.	DT
	SURVEYED.	DT
	DATE.	11/08/2015
	REVISION	00

Northern Midlands Council
Design Options
EDWARD STREET
WEST PERTH

SURVEY & ALIGNMENT SERVICES

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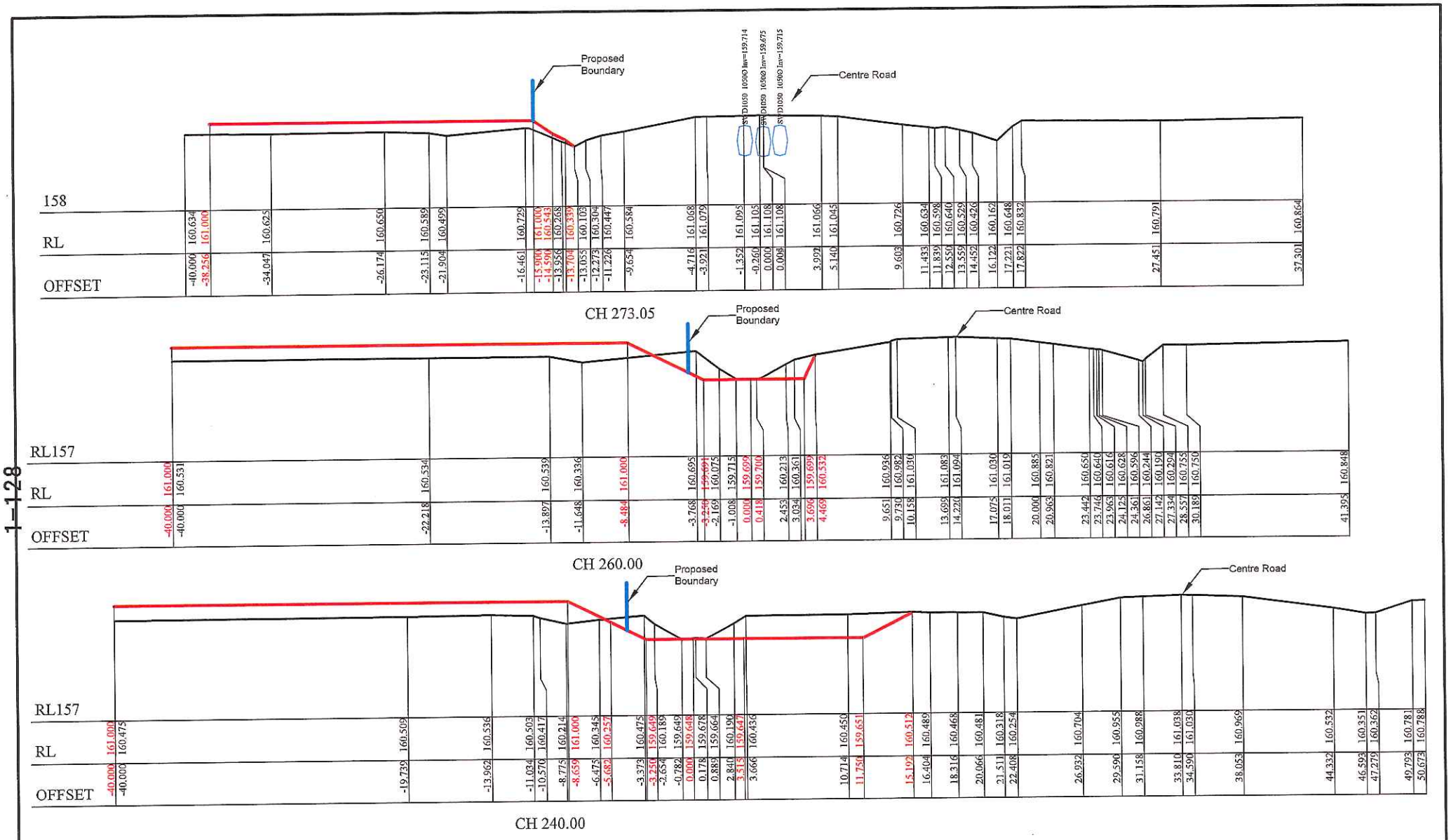

1-128

HYDRODYNAMICA

REFERENCE:	SCALE.	NTS
2014016	DRAWN.	DT
	SURVEYED.	DT
	DATE.	11/08/2015
	REVISION	00

Northern Midlands Council
Design Options
EDWARD STREET
WEST PERTH

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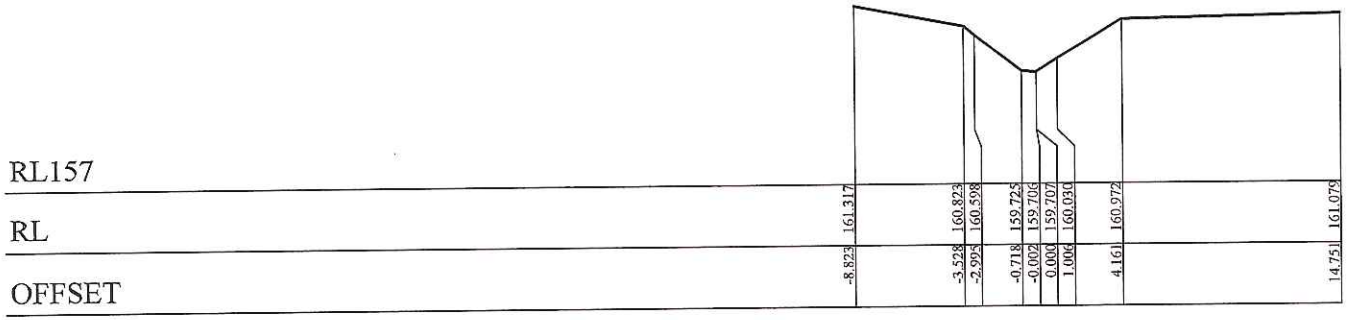
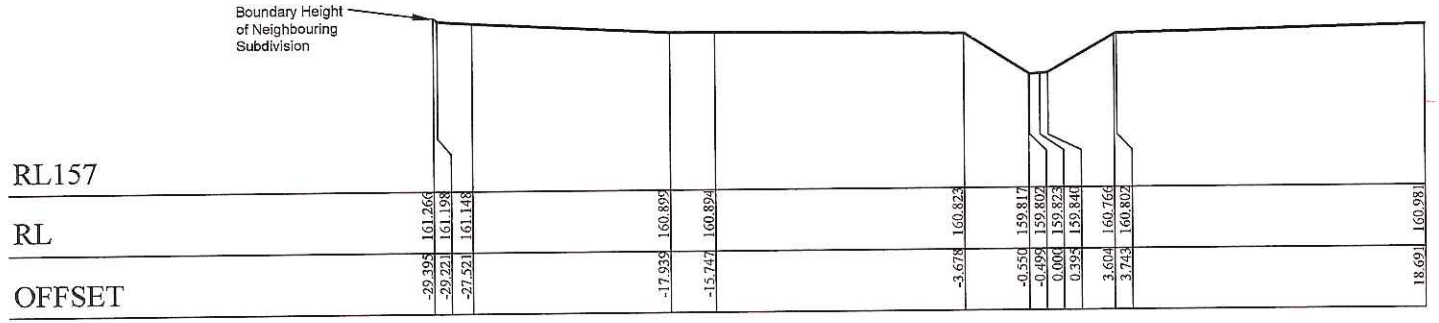
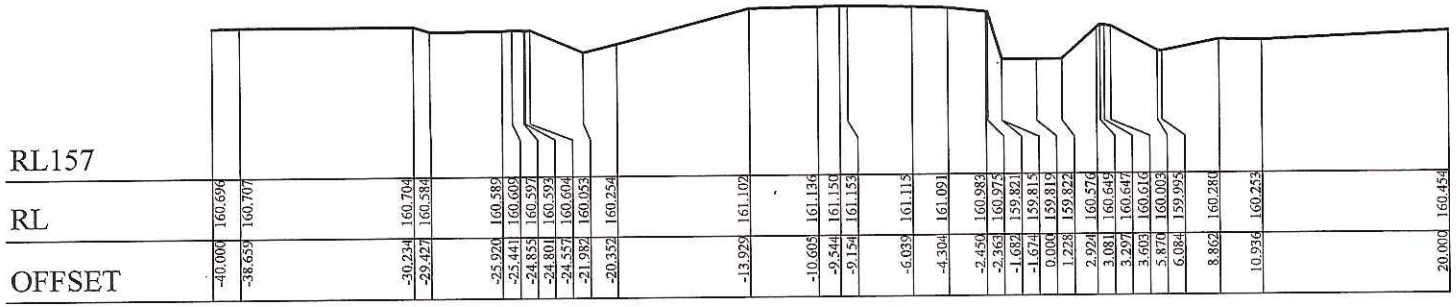


CH 336.85



CH 309.41



CH 280.00

HYDRODYNAMICA

REFERENCE:	SCALE.	NTS
2014016	DRAWN.	DT
	SURVEYED.	DT
	DATE.	11/08/2015
	REVISION	00

Northern Midlands Council
Design Options
EDWARD STREET
WEST PERTH

SURVEY & ALIGNMENT SERVICES

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- ENGINEERING SURVEYING
- LAND DEVELOPMENT

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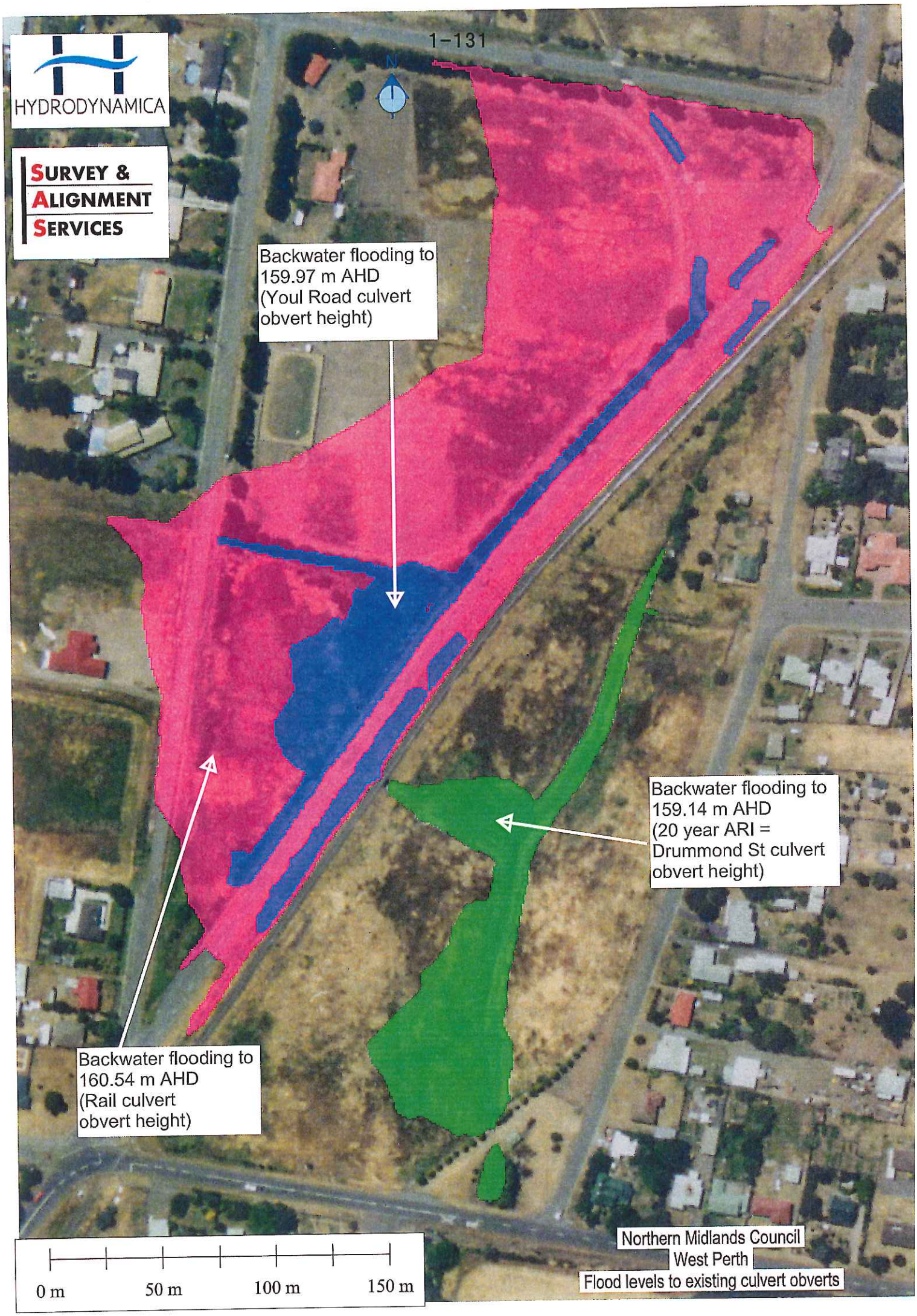
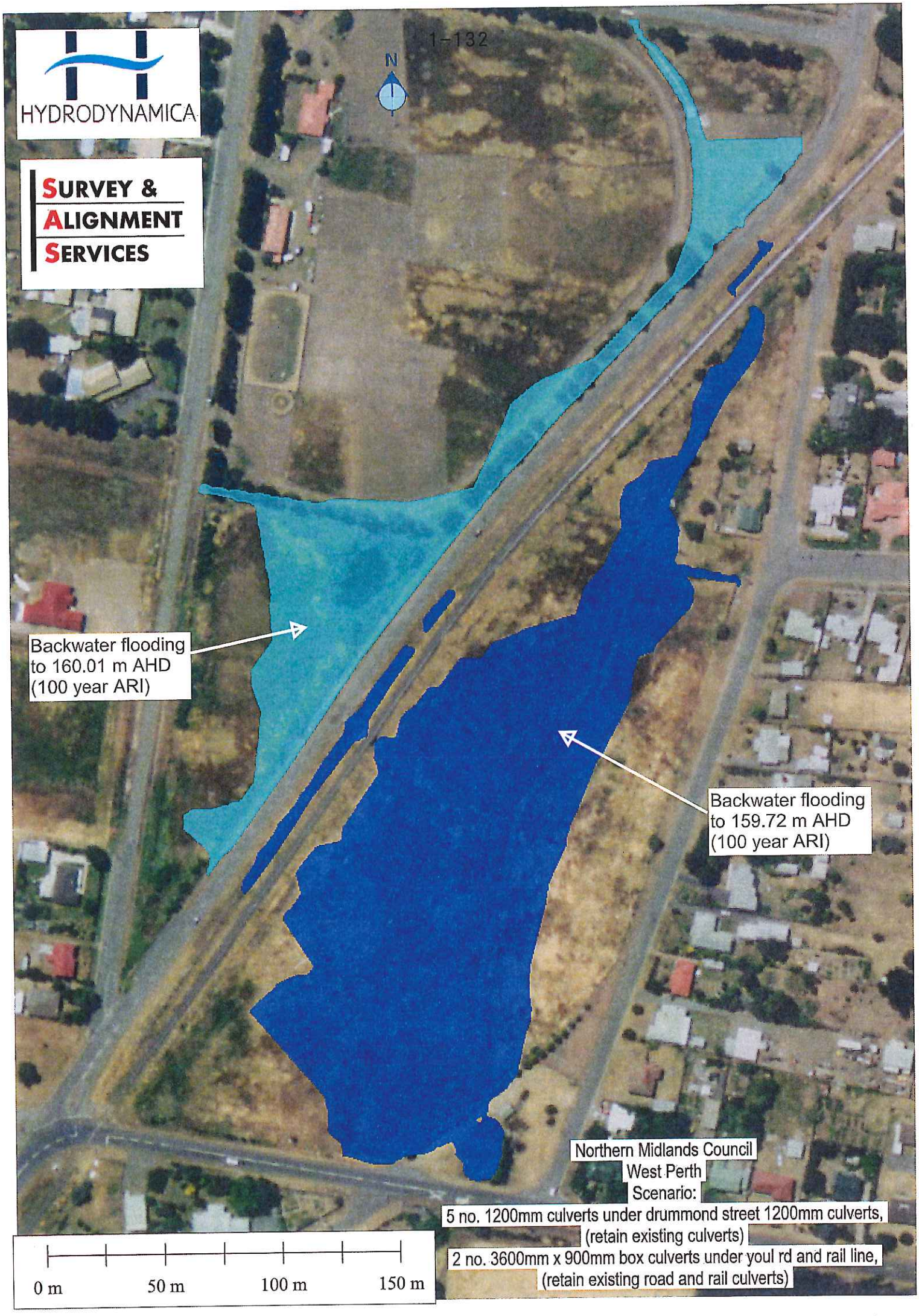
Website: www.survalign.com.au

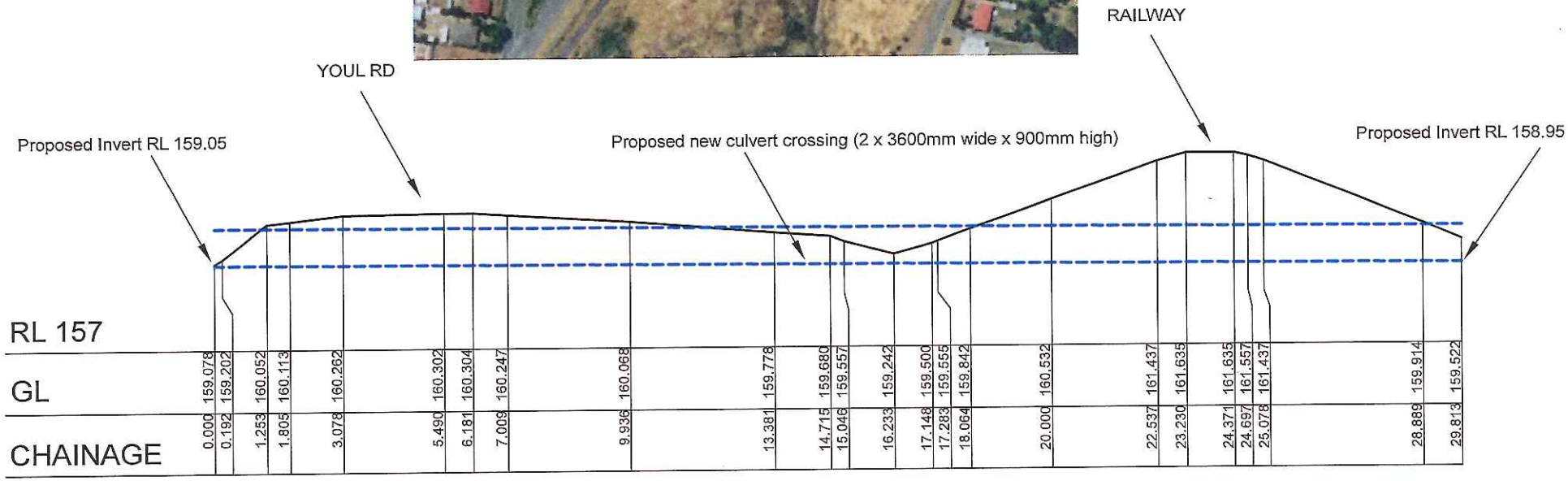
APPENDIX C

HEADWATER LEVELS


HYDRODYNAMICA
SURVEY & ALIGNMENT SERVICES
1-131
N
Backwater flooding to 159.97 m AHD (Youl Road culvert obvert height)
Backwater flooding to 159.14 m AHD (20 year ARI = Drummond St culvert obvert height)
Backwater flooding to 160.54 m AHD (Rail culvert obvert height)
0 m
50 m
100 m
150 m
Northern Midlands Council
West Perth
Flood levels to existing culvert obverts


HYDRODYNAMICA
SURVEY &
ALIGNMENT
SERVICES
1-132
N
Backwater flooding
to 160.01 m AHD
(100 year ARI)
Backwater flooding
to 159.72 m AHD
(100 year ARI)
Northern Midlands Council
West Perth
Scenario:
5 no. 1200mm culverts under drummond street 1200mm culverts,
(retain existing culverts)
2 no. 3600mm x 900mm box culverts under youl rd and rail line,
(retain existing road and rail culverts)
0 m
50 m
100 m
150 m

1–133



West Perth Proposed Culvert LS - SCALE 100H 100V

HYDRODYNAMICA

REFERENCE:	SCALE.	AS SHOWN
2014016	DRAWN.	DT
	SURVEYED.	DT
	DATE.	25/02/2015
	REVISION	00

Northern Midlands Council
Proposed Culvert
YOUL Road
WEST PERTH

SURVEY & ALIGNMENT SERVICES

- INDUSTRIAL ALIGNMENT
- ENGINEERING SURVEYING
- LAND DEVELOPMENT

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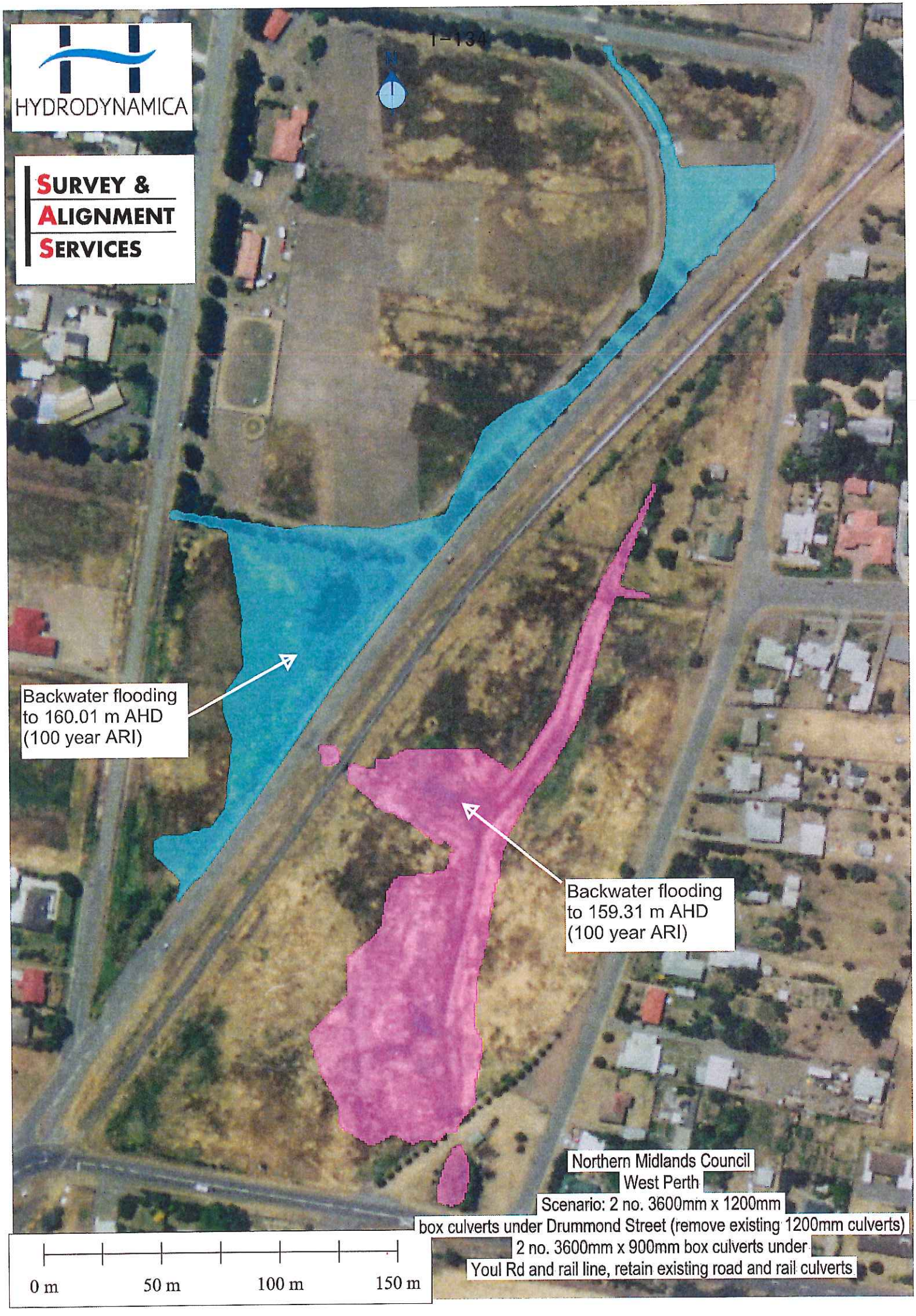

HYDRODYNAMICA
SURVEY & ALIGNMENT SERVICES
1-134
N
Backwater flooding to 160.01 m AHD (100 year ARI)
Backwater flooding to 159.31 m AHD (100 year ARI)
Northern Midlands Council
West Perth
Scenario: 2 no. 3600mm x 1200mm box culverts under Drummond Street (remove existing 1200mm culverts)
2 no. 3600mm x 900mm box culverts under Youl Rd and rail line, retain existing road and rail culverts
0 m
50 m
100 m
150 m

APPENDIX D

CONCEPT ESTIMATES

Gradco Cost Estimate

Project: NMC - Youl Road Drainage Upgrades
Tender No.: 15-191

Item	Description	Unit	Quantity	Rate	FINAL Totals	Time
1	**Preliminaries**					
1.1	**Establishment.**	Item	1	$7,750.40	$ 7,750.40	
1.2	**Traffic Management**	Item	1	$13,362.76	$ 13,362.76	
1.3	**Survey and set-out of works.**	Item	1	$13,362.76	$ 13,362.76	
1.4	**Production of 'As Constructed' drawings as per specification.**	Item	1	$2,672.55	$ 2,672.55	
1.5	**Project Management in Advance**	Item	1	$6,681.38	$ 6,681.38	
1.6	**Pothole and locate existing services**	Item	1	$1,336.28	$ 1,336.28	
1.7	**Establish Compound**	Item	1	$13,362.76	$ 13,362.76	
2	**Twin 3600 x 900 RCBC under Youl Rd**					
2.1	**Supply units & Lids 2 x 25m**	Item	1	$0.00	$ -	
2.2	**Installation under Rail (ch18-30)**	Item				
	Exc to remove rail, sleepers & ballast	Hrs				0.5
	Labour for same	Hrs				
	30t Exc to Excavate - max depth 3m	Hrs				0.5
	20t Exc to assist sidecast	Hrs				
	Labour for same	Hrs				
	Gravel for Base 12 x 8 x 100mm	t				
	20t Exc to place	Hrs				0.5
	Labour to Place	Hrs				
	80T Crane to install bases and crown units	Hrs				0.5
	Labour	Hrs				
	Consumables	Item				
	Exc to Backfill	Hrs				1
	Skidsteer	Hrs				
	Labour	Hrs				
	Gravel to Backfill	tonnes				
	Stab Dust to Backfill 15 x1 x1 x 2	m3				
	Exc to reinstate ballast, sleepers & rail	Hrs				0.5
	Labour for same	Hrs	1	$25,890.36	$ 25,890.36	
2.3	**Installation under Side Track (ch11-18)**	Item				
	20t Exc to Excavate - max depth 1.5m	Hrs				0.5
	Labour	Hrs				
	Gravel for Base 7 x 8 x 100mm	t				
	20t Exc to place	Hrs				0.5
	Labour to Place	Hrs				
	80T Crane to install bases and crown units	Hrs				0.5
	Labour	Hrs				
	Consumables	Item				
	Exc to Backfill	Hrs				1
	Skidsteer	Hrs				
	Labour	Hrs				
	Gravel to Backfill	tonnes				
	Stab Dust to Backfill 7 x1 x1 x 2	m3	1	$17,572.04	$ 17,572.04	

1-136

2.4	**Construct Sidetrack**	Item				3
	Allowance	Item				
	Traffic Management	Item	1	$34,743.19	$ 34,743.19	
2.5	**Installation under Youl Rd (ch00-11)**	Item				
	20t Exc to Excavate - max depth 1.5m	Hrs				1
	Labour	Hrs				
	Gravel for Base 11 x 8 x 100mm	t				
	20t Exc to place	Hrs				0.5
	Labour to Place	Hrs				
	80T Crane to Install bases and crown units	Hrs				0.5
	Labour	Hrs				
	Consumables	Item				1
	Exc to Backfill	Hrs				
	Skidsteer	Hrs				
	Labour	Hrs				
	Gravel to Backfill	tonnes				
	Stab Dust to Backfill 11 x1 x1 x 2	m3	1	$21,667.72	$ 21,667.72	
2.6	**Drainage & Armour Rock**	Item				
	Exc	Hrs				
	Labour	Hrs				
	Armour Rock	t				
	Geofabric	m2	1	$10,823.84	$ 10,823.84	
2.7	**Asphalt**	Item				
	Allowance 15 x 9	m2				
	Traffic Management	Item	1	$6,748.20	$ 6,748.20	1
3	**Twin 3600 x 1500 RCBC under Drummond St**					
3.1	**Supply units & Lids 2 x 21m**	Item				
	Ex Humes	Item				
	Transport	Item	1	$0.00	$ -	
3.2	**Installation (assuming traffic diverted via Youl Rd and Drummond St Closed)**	Item				1
	20t Exc to Excavate - max depth 2.5m	Hrs				
	Labour	Hrs				
	Gravel for Base 21 x 8 x 100mm	t				1
	20t Exc to place	Hrs				
	Labour to Place	Hrs				1
	80T Crane to Install bases and crown units	Hrs				
	Labour	Hrs				
	Consumables	Item				1
	Exc to Backfill	Hrs				
	Skidsteer	Hrs				
	Labour	Hrs				
	Gravel to Backfill	tonnes				
	Stab Dust to Backfill 21 x1 x1 x 2	m3	1	$41,491.38	$ 41,491.38	
3.3	**Demolition of Existing Bridge**	Item				
	30t Exc	Hrs				
	Breaker	Hrs				
	10yds	Hrs				
	Pit Run Backfill 21x 3 x 2.5	tonnes				
	Exc to backfill	Hrs				
	Labour	Hrs				
	Small Plant	Days	1	$22,983.96	$ 22,983.96	
3.4	**Drainage & Armour Rock**	Item				
	Exc	Hrs				
	Labour	Hrs				
	Armour Rock	t				
	Geofabric	m2	1	$7,750.40	$ 7,750.40	
3.5	**Asphalt**	Item				
	Allowance 50 x 9	m2				
	Traffic Management	Item	1	$19,376.01	$ 19,376.01	1
						Days
					$ 267,575.99	19

1-137

4	**Twin 1200 RCP Class 4 under Drummond St**					
4.1	**Supply units 2 x 21m** Ex Humes Transport	Item Item Item	1	$0.00	$ -	
4.2	**Installation (assuming traffic diverted via Youl Rd and Drummond St Closed)** 20t Exc to Excavate - max depth 2.5m Labour Gravel for Base 21 x 4 x 100mm 20t Exc to place Labour to Place 20t Exc to install pipes Labour Consumables Exc to Backfill Skidsteer Labour Gravel to Backfill Slab Dust to Backfill 21 x1 x1 x 2	Item Hrs Hrs t Hrs Hrs Hrs Hrs Item Hrs Hrs Hrs tonnes m3	1	$38,437.99	$ 38,437.99	1 0.5 2 1
4.3	**Precast Enwalls** Ex Humes Transport Exc to Install Labour	Item Item Item Hrs Hrs	1	$12,093.30	$ 12,093.30	1
					$ 50,531.29	

1-138

Humes
Holcim (Australia) Pty Ltd
ABN 87 099 732 297
19-21 Churchill Park Dve
Invermay TAS 7250
Australia
Phone (03) 6335 6314
Fax (03) 6335 6330
www.humes.com.au

16 March 2015

Cameron Oakley
Consulting Engineer

HUMES™ Precast Concrete
WEST PERTH CROSSING, TAS

Dear Cameron,

We thank you for the opportunity to submit this proposal for the supply of precast concrete parapets associated with West Perth Crossing Project. We have enclosed Humes' proposal and the budget estimates below are for feasibility purposes only.

Humes is the leading manufacturer of steel reinforced concrete pipes and associated precast products in Australia. Available in a wide range of diameters, lengths and with varying strengths, Humes concrete pipes have a proven track record and are custom designed for user applications including drainage, sewage, water supply and irrigation.

Humes' Box Culverts are an ideal solution for instant bridging for pedestrian, fauna and stock crossings under road and rail applications. Humes precast concrete box culverts are also suitable for difficult site conditions as installation requires minimal excavation and backfill.

Schedule of Rates

Youl Road and Rail				
Option 1a – 3600x900. Rail 300mm ballast with 300mm sleeper depth + 1.2m fill. Road at 400mm fill.				
Item	**Description**	**Quantity**	**UOM**	**Rate (ex GST)**
1.	BC Crown 3609 Road x 2.464	10	EA	$ 4,983.63
2.	BC Crown 3609 Rail x 2.464	10	EA	$ 5,257.62
3.	BC Base 3600 Road x 2.464	10	EA	$ 3,893.84
4.	BC Base 3600 Rail x 2.464	10	EA	$ 4,092.57
	Total	***40***	***EA***	***$ 182,276.60***
Option 2a – 4200x900. Rail 300mm ballast with 300mm sleeper depth + 1.2m fill. Road at 400mm fill.				
Item	**Description**	**Quantity**	**UOM**	**Rate (ex GST)**
1.	BC Crown 4209 Road x 2.464	10	EA	$ 6,366.55
2.	BC Crown 4209 Rail x 2.464	10	EA	$ 6,839.24
3.	BC Base 4200 Road x 2.464	10	EA	$ 4,945.96
4.	BC Base 4200 Rail x 2.464	10	EA	$ 5,336.52
	Total	***40***	***EA***	***$ 234,882.70***
Option 3a – DN900 Class 4 Butt Joint Jacking Pipe				
Item	**Description**	**Quantity**	**UOM**	**Rate (ex GST)**
1.	DN900 Class 4 Butt Joint Jacking Pipe x 2.44	105	EA	$ 1,322.26
	Total	***105***	***EA***	***$ 138,837.30***

hdumes

Drummond Street				
Option 1b – DN1200 Flush Joint Class 4 Pipe				
Item	**Description**	**Quantity**	**UOM**	**Rate (ex GST)**
1.	DN1200 Flush Joint Class 4 Pipe x 2.44	18	EA	$ 1,343.65
	Total	***18***	***EA***	***$ 24,185.70***
Option 2b – DN1200 Class 4 Butt Joint Jacking Pipe				
Item	**Description**	**Quantity**	**UOM**	**Rate (ex GST)**
1.	DN1200 Class 4 Butt Joint Jacking Pipe x 2.44	18	EA	$2,192.16
	Total	***18***	***EA***	***$ 39,458.88***
Option 3b – 3600x1500. Road at 1.2m fill				
Item	**Description**	**Quantity**	**UOM**	**Rate (ex GST)**
1.	BC Crown 3600x1500 Road x 2.464	17	EA	$ 4,317.89
2.	BC Crown 3600 Rail x 2.464	17	EA	$ 3,391.29
	Total	***34***	***EA***	***$131,056.06***

Note: - ALL rates above are for min qty's stated; any variations may need to be quoted

Program for Supply:

- Project delivery schedule to be discussed between the Supplier (Humes) and the client prior to manufacture and agreed upon in writing. Any variation to the agreed design or delivery programme will be subject to additional costs and may affect lead times.
- Staged product deliveries are possible and will be dependent on the client's delivery schedule requirements as to which precast items are required first.
- Storage of units will be subject to negotiation and program of delivery dates. Our offer includes storage of one month's production of conforming product.
- Unless otherwise stated in this quotation, penalties for time delays will not apply.
- Additional deployment of moulds to accelerate the delivery programme will be subject to additional costs to be confirmed at time of order.

Special Notes:

PIPES

- Prices are FOG (Free on Ground) at site for sizes up to 1350 (excluding jacking pipes)
- Prices are FOT (Free on Truck) client to unload sizes over 1350
- All jacking pipes are to be unloaded by client
- Humes do not supply the Swiftlift lifting clutches. All unloading equipment is the responsibility of the client
- Minimum 20t for deliveries and minimum 20t for all crane truck deliveries otherwise additional cartage will be incurred
- Surplus 'stock' items returned will be charged a 25% restocking fee plus the cost of all cartage and handling
- Price is for complete order
- Quotation allows for 1 hour unloading, after which, waiting time may be charged at $150 per hour. Multiple drops may incur additional costs
- Delivery times may vary depending on when written order is received
- Pipes will be manufactured to Australian Standard AS4058-2007 'Precast Concrete Pipes' (Pressure and Non-Pressure Pipes)

LARGE BOX CULVERTS - B1 Exposure Classification

- Prices are FOT (Free on Truck) to site - Client to unload
- All costs associated with delays in planned deliveries (outside of Humes control) will be the responsibility of the contractor
- Surplus 'make to order' items that are returned are charged at full contract value plus an additional 25% restocking fee plus the cost of all cartage and handling
- Price is for complete order
- Multiple drops may incur additional costs. Quotation allows for 1 hour unloading, after which, waiting time may be charged at $150 per hour
- Delivery times may vary depending on when written order is received
- Suitable crane and lifting gear needs to be supplied by the client for unloading
- 'Precast Reinforced Concrete Box Culverts' are designed for AS5100-2004 SM1600 loading for Road, and 300LA (branch line) for Rail, through the fill depth noted in the schedule descriptions (above) with an exposure classification of B1 (25mm cover).
- Concrete mix will be a standard 50MPa mix
- Document precedence is quotation conditions, Humes Terms and Conditions of Sale (attached) followed by the Holcim Pty Ltd standard Terms and Conditions of Sale (available upon request)
- Base ground compaction recommended at 200kPa min in order to minimise settlement
- Humes box culverts are designed in accordance with AS1597.2 - 2013 using the slab shear design methodology. We recognise that Clause 3.6.1.2 of AS1597.2 - 2013 states that design using the shear for beams methodology in accordance with Clause 8.2.7 of AS3600-2009 is normally acceptable, however we do not view this as a mandatory requirement. Client to advise if design in accordance with Clause 8.2.7 of AS3600-2009 is required. Please note that additional costs may apply.

Other Notes:

- Rates are supplied for the complete order and exclude GST. Humes reserves the right to review this quotation should it not be accepted in its entirety. Please note that any variation to the supply scope may require re-pricing.
- Rates are valid for 30 days only.
- All precast barriers are delivered FOT (Free on Truck) to site, client to unload. Suitable crane and lifting gear needs to be supplied for unloading by the client.
- All costs associated with delays in planned deliveries (outside of Humes' control) will be the responsibility of the client.
- Multiple drops may incur additional costs. Delivery allows 1 hour for unloading, after which demurrage may be charged at $150/hr.
- Surplus made to order items that are returned are charged at full contract value plus an additional 25% restocking fee plus the cost of all cartage and handling.
- Rates include delivery for normal working hours only, Monday - Friday 7am to 3pm, excluding public holidays. Deliveries outside these times must be agreed in writing and may incur additional charges.
- No allowance has been made for splays, skews, starter bars, dowel pins/holes, unless noted otherwise.
- Concrete mix will be a standard 50MPa mix. Concrete mix to be confirmed once details and specifications are received.
- Rates do not include any special post-mould finishes such as painting, coating or surface preparation unless noted otherwise.
- No loose items such as nuts or bolts have been allowed for in these rates unless noted otherwise.
- Unless specifically noted in the quotation document, head contract conditions shall not apply to Humes. The products supplied will be manufactured to comply with the client's technical specifications.
- The client shall notify Humes in writing within 24 hours of any incident occurring where a claim against Humes may be made. Failure to do so may render the claim null and void.

- Humes will carry out all release cylinder compressive strength testing at its factories with all remaining cylinder testing completed at a NATA registered testing facility.
- Units will not include chamfered edges.
- Proof engineering has not been included.
- Humes have not reviewed any contract documentation in submitting this tender and as such does not constitute automatic acceptance of all terms and conditions. Any variation to the quoted units will require pricing review.
- Document precedence of sales conditions are the notes outlined in this letter, Humes Terms and Conditions of Sale (attached), followed by Holcim (Australia) Pty Ltd Terms of Sale (available upon request).

Thank you again and we look forward to hearing your feedback on the subject proposal.

Regards,

Michael Mihelakis

Engineered Solutions Manager - Tasmania

Humes

W+I 3

PROJECT SUMMARY

FOR NORTHERN MIDLANDS COUNCIL

TRANSLINK PRECINCT STORMWATER ASSESSMENT

Breadalbane

October 2015

NORTHERN MIDLANDS COUNCIL

HYDRODYNAMICA
44 PENQUITE ROAD LAUNCESTON TAS 7250
M 04312 08450 E cameron.oakley@h-dna.com.au
ABN16 944 299 350

HYDRODYNAMICA

44 Penquite Road

Launceston TAS 7250

Phone 04 3120 8450

Cameron.Oakley@h-dna.com.au

HYDRODYNAMICA

DATE	NATURE OF REVISION	REVISION NUMBER	ISSUE AUTHORISED BY
29/01/2015	FINAL	1	Cameron Oakley
29/09/2015	REVISED DRAFT FOR REVIEW	2	Cameron Oakley
02/10/2015	FINAL	3	Cameron Oakley

CONTENTS

EXECUTIVE SUMMARY

An assessment of the existing stormwater infrastructure and future requirements has been undertaken for Translink Precinct and catchment. The assessment found several risks to private property associated with deficiencies. The major risks are:

Property	Probability of Flood	Impact/Consequence Rating
No. 16 Johns Street	Less than every 5 years	High
No. 1 Hudson Fysh Drive	Less than every 5 years	High
Lots 21 & 26 Gatty St	Less than every 5 years	High
Evandale Rd & No. 2 Translink Avenue	Less than every 5 years	High

The potential for addition risks were determined near Boral Road and Hudson Fysh Drive due to the probability of future development of rural land within the catchment.

Resulting from extensive modelling, analysis, and consultation across Northern Midlands Council departments 8 projects have been conceptualised (refer to the overview plan in Appendix A). A summary of the projects and separate concept estimates are as follows:

Project	Description	Core Construction Management
1	Basin 1 infrastructure upgrades, swales and pipework	$295,414
2	Evandale Road culvert capacity improvements	$106,590
3	Piping of overland flows along Richard Street	$281,060
4	Decommission basin 2 and divert flows north	$904,816
5	New Boral Rd detention basin	$395,856
6	Expansion of detention basin 4 capacity	$573,248
7	Gatty Street overland flow path works	$115,400
8	New Gatty Street detention basin	$176,860
	Total	**$2,849,244**

These projects have been put forward by Northern Midlands Council for the Federal Governments National Stronger Regions Fund Grants (Round 2), with the goal of commencing detailed design in early 2016.

1 INTRODUCTION

The Translink Precinct is the commercial, industrial and logistics precinct located adjacent to Launceston Airport on the western side of Evandale Road. The inadequacies of its stormwater infrastructure were revealed during the severe weather between August and October 2013. This resulted in a number of businesses and undeveloped lots being inundated.

In 2014 and 2015 the Translink Subdivision stormwater network was assessed in order to identify and confirm deficiencies and the risks to public and private infrastructure, and to develop solutions necessary to mitigate those risks.

This process consisted of four stages:

Stage 1: Hydraulic model build and initial assessment (refer to Stormwater Modelling and Assessment Report Rev. 1b, Hydrodynamica 20/08/2014).

Stage 2: Modelling and assessment improvements through the acquisition of detailed survey of onsite detention basins, overland flow paths, missing asset levels, and through the acquisition of 0.5 metre LIDAR contours for the entire catchment.

Draft reports were produced for the four subcatchments and included revised recommendations. These reports were:

- Boral Road and Johns Street Catchment Works Recommendations Rev. 0 (Hydrodynamica, 9/01/2015);
- Southern Catchment Works Recommendations Rev. 0 (Hydrodynamica, 9/01/2015); and
- Northern Catchment Works Recommendations Rev. 0 (Hydrodynamica, 14/01/2015).

Guide costs were also compiled for capital works recommendations and included in a Draft Executive Summary (Hydrodynamica, 29/01/2015) which was presented to Northern Midlands Council (NMC) on the 3rd of February 2015.

Stage 3: A working group was formed in order to review the risks associated with modelled and observed stormwater flooding at Translink, and to prioritise investigations associated with the most vulnerable areas. Refer to:

- Risk Workshop Summary (28/04/2015); and

- Risk Assessment Matrix (28/04/2015).

Proposed solutions were further refined in order to account for Northern Midlands Councils (NMC) updated planning and future development requirements.

In addition Council queries and concerns were addressed, including a request to further examine additional options:

- Upper Catchment Diversion Assessment (Hydrodynamica, 28/04/2015)

On the 6/07/2015 the risk summary in addition to concept estimates for the recommended works was presented to NMC, who agreed in principal with and requested an application be made for funding from the federal National Stronger Regions Fund Round 2 Grants.

Stage 4: The concept designs were formalised and cost estimates revised for the Grant submission. The concept designs consisted of 8 projects; refer to Appendix A for a layout plan, and Appendices B and C for costings.

The Grant Application was submitted on the 31/07/2015.

2 DOCUMENT REGISTER

Table 1 shows the current documents associated with the Translink Subdivision Stormwater Assessment.

Title	Latest Revision	Date of Issue
Stormwater Modelling and Assessment Report	1b	20/08/2014
Lot 21 & 26 Gatty Street Stormwater Assessment (private report from Hydrodynamica to Phil Bowden)	2	21/11/2014
Draft Boral Road and Johns Street Catchment Works Recommendations	0	9/01/2015
Draft Southern Catchment Works Recommendations	0	9/01/2015
Draft Northern Catchment Works Recommendations	0	14/01/2015
Draft Executive Summary of Works Recommendations	1	29/01/2015
Risk Assessment Matrix	-	28/04/2015
Risk Workshop Summary	-	28/04/2015
Upper Catchment Diversion Assessment	-	28/04/2015
Concept Stormwater Designs for Grant Application	02	14/07/2015
Grant Application Concept Estimate Summary (Core)	4	21/07/2015
Grant Application Concept Estimate Schedule (Core)	4	21/07/2015
Grant Application Concept Estimate Schedule (IPD)	B	31/07/2015
Translink Precinct Stormwater Assessment – Project Summary	3	02/10/2015

Table 1. Document register

3 DESIGN STANDARDS & CONSTRAINTS

The minimum acceptable service to be provided by stormwater infrastructure was agreed to be the 1 in 20 year Average Recurrence Interval (ARI) peak storm event, for minor systems (pipelines, culverts etc). The 1 in 100 year ARI peak event was used for the assessment and design of major systems (detention basins, flood-ways and open drains).

There are three existing outlets from the Translink stormwater subcatchments:

- Northern subcatchment – the culvert to the north of Translink Avenue North/Evandale Road Roundabout;
- Johns Street & Boral Road subcatchments – the culvert under Evandale Rd at the north-western extent of the Launceston Airport; and
- Southern subcatchment – the culvert midway between the new and old airport entrances off Evandale Road.

It was determined that it was permissible to pass additional flows to the northern subcatchment outlet. Flows through the other outlets, however, could only be maintained if not decreased. This was due to the potential impact of major stormwater flows on the airport.

Both the Johns Street and Southern subcatchment outlets directly affect the Airport. Ultimately all of these flows must pass through a culvert under the runway apron and the runway proper which is in the vicinity of the Sharp Airlines terminal. As such additional flows could contribute to the increased incidence of flooding of the runway and therefore adversely impacting a major stakeholder.

4 CATCHMENT OVERVIEW

The Translink catchment totals approximately 237 ha in size and consists of four subcatchments as shown in Figure 1.

The overall catchment consists approximately of 66 ha of developed land, i.e. land that has already developed or subdivided awaiting development, and approximately 171 ha of rural land.

The key attributes and findings of the four subcatchments are as follows:

Northern Catchment

- Consists of 47 ha rural and 15 ha developed land;
- Includes the Statewide Independent Wholesalers site with extensive privately owned stormwater infrastructure, including a 2.2 ML detention basin;
- Publically owned 2 ML detention basin next to private basin; and
- Subcatchment outlet through DN450 culvert at north-west of Evandale Road/Translink Avenue North roundabout. This passes to an open channel towards Briarly Creek to the north-east, a tributary of the North Esk River.

There is no proposed extension of the subdivision apart from the parcel of land immediately to the north-west of the roundabout (no. 2 Translink Avenue North), and potentially land downstream which lies adjacent to Richard Street.

Johns Street Catchment

- Consists of 26 ha rural and 16 ha developed land;
- Thin catchment with 660 KL public detention basin; and
- Subcatchment outlet through DN900 and DN450 headwall to roadside drain on western side of Evandale Road.

There is no proposed extension of the Translink development in this catchment.

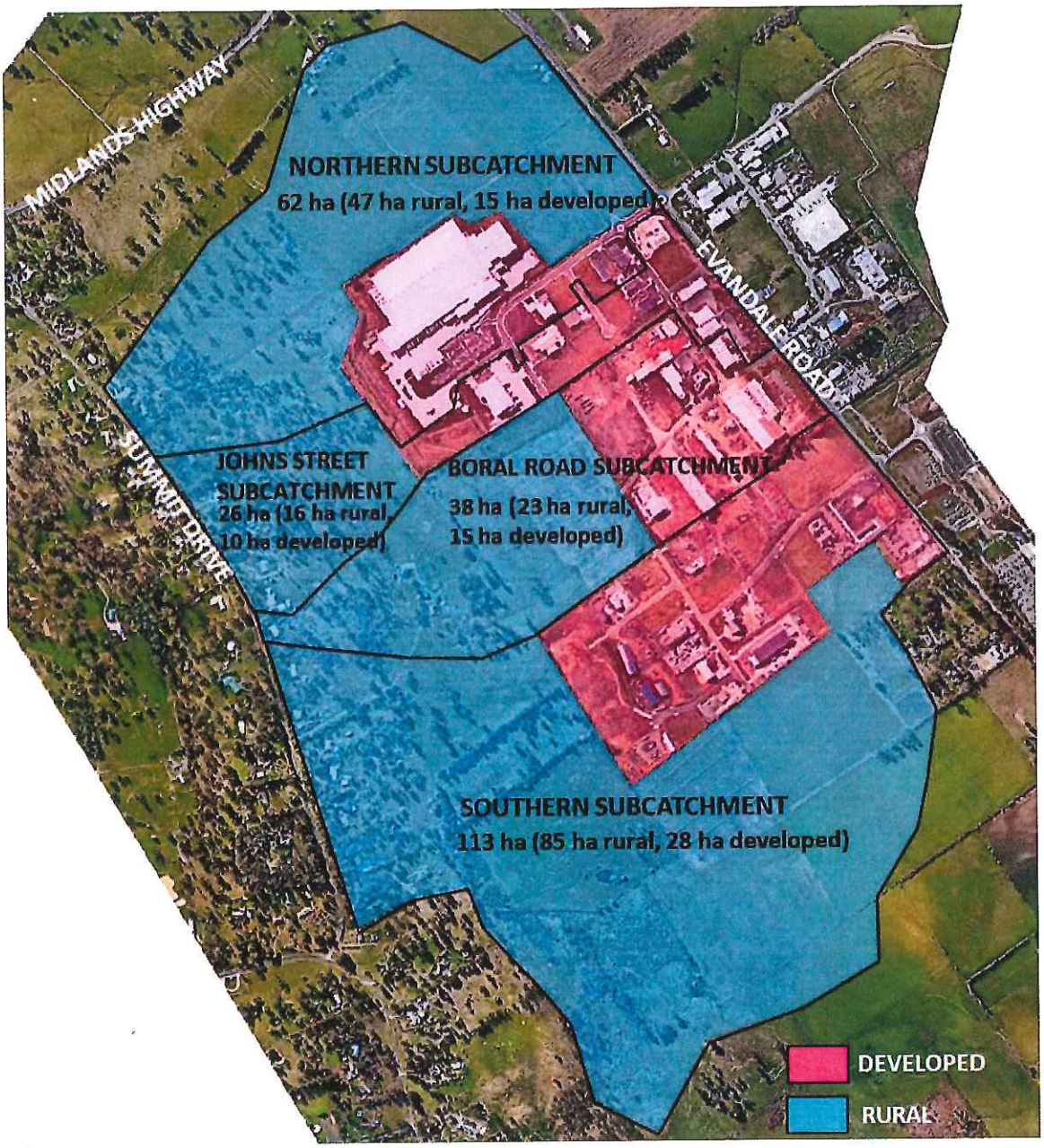


Figure 1. Translink stormwater subcatchments

Boral Road Catchment

- Consists of 23 ha rural and 15 ha developed land; and
- Subcatchment outlet via DN900 culvert under Evandale Road at the north-western extent of Launceston Airport;

It is proposed that future expansion of the subdivision at the western extent of Boral Road will occur and Translink Avenue North and South will be connected. This will result in the subdivision of 13 ha rectangular parcel of land between Munro Street and Translink Avenue North. Refer to Appendix C for the proposed subdivision layout.

Southern Catchment

- Very large catchment consisting of 85ha rural and 28 ha developed land;
- There are two detention basins; one (1.2 ML) is at the bottom of the catchment adjacent to Evandale Road. The other (1.7 ML) is accessed by an open channel of Translink Avenue South; and
- The subcatchment outlet is via a DN1200 pipeline under Evandale Road midway between the new and old entrances to Launceston Airport. This connects to a DN1500 stormwater main underneath the Airport car park before discharging adjacent to the Sharp Airlines terminal.

Following additional development of the Boral Road subcatchment it is possible that expansion will occur southwards into the rural subcatchment.

5 STORMWATER NETWORK CAPACITY

Hydraulic modelling using the InfoWorks CS and ICM software packages was undertaken to assess the deficiencies of existing infrastructure. An overview of the catchment hydrology and hydraulic modelling is given in Appendix D.

Detailed results and discussion of these analyses are included in the previous reports as per the Document Register.

Drawings showing the results of the Return Period Analysis of asset capacity are shown in Appendix E.

6 DEFICIENCIES & RISKS

A Risk Workshop was undertaken to assess the risks and consequences of the identified infrastructure deficiencies. The Risk Matrix and Summary Documents resulting from the workshop are listed in the Document Register.

The workshop confirmed that although the capacities of some stormwater assets are inadequate, the immediate risk of damage by flooding is currently restricted to a few key properties. In order of priority these risks are:

No. 16 Johns Street, Risk Register Item No. 6

Probability of Flood <=5 years

Impact of Flood= High

Description:

Johns Street Basin (Basin 2) is significantly undersized and is predicted to flood in less than the 1 in 5 year ARI rainfall event. Overtopping of this basin has been observed by Council employees. The basin spillway is at 90 degrees to Johns Street and flood waters spill from it, across Johns Street and down the driveway of no. 16 Johns Street, at which point water enters the building. The 5 year ARI peak spill rate is modelled to be 301 L/s with the 100 year rate increasing to over 1000 L/s.

No. 1 Hudson Fysh Drive

Risk register item 10

Probability of flood <=5 years

Impact = High

Description:

Basin 4, located behind no. 49 Translink Avenue South, is significantly undersized and is predicted to flood in less than the 1 in 5 year ARI rainfall event. Overtopping of this basin has been observed by Council employees. Overtopping of this basin and the inadequate overland flow path contribute to flooding of the storage units at the

rear no. 1 Hudson Fysh Drive. Peak flooding is modelled to be over 2.6 m^3/s in the 100 year event.

In addition to the risks to these developed lots there are risks for which development is desired. In order of priority the immediate risks identified to these lots are:

Lots 21 & 26 Gatty Street, Risk register items 7 & 9

Probability of flood <=5 years

Impact = High

Description:

The existing headwall and culvert at the top of Lots 21 and 26 Gatty Street is undersized and is predicted to flood in less than the 1 in 5 year ARI rainfall event. The headwall collects extensive flows from a privately constructed cut-off drain and when it overtops the flood waters flow overland towards Gatty Street. This is of concern as this area may affect future development of the property, and floodwaters may be passed downstream to 48 Translink Avenue and to the intersection of Gatty Street and Translink Avenue south. There is no direct flow through to basin 4 and there is potential in larger storm events for the flooding of no. 44 Translink Avenue South.

Evandale Road & No. 2 Translink Avenue

Risk register items 2, 3 & 4

Probability of flood <=5 years

Impact = High

Description:

Modelling suggests the Evandale Road culvert, at the south-east of no. 2, is inadequate to carry 5 year ARI flows, thus causing flooding across Evandale Road and in the corner Lot (no. 2). Compounding this issue is that basin 1 is predicted to overtop in the 20 year storm event, peaking at 850 L/s in the 100 year event. Overtopping will likely result in the immediate flooding of no. 2 Translink Avenue,

additional flows over Evandale Road just north of the roundabout, and potentially through the service station hardstand at no. 1 Translink Avenue.

7 FUTURE DEVELOPMENT RISKS

In addition to the risk caused by deficiencies of existing infrastructure it was required that the any solutions addressed the potential for subdivision expansion into the future. In this regarding although no immediate risks were determined for the Boral Road catchment it was necessary to investigate the impacts stormwater flows within the proposed development area and downstream on existing infrastructure.

The Southern subcatchment also has the potential for expansion into the future, as such proposed solutions also considered the effects of additional runoff by assuming a nominal extension of Translink Avenue South to the edge of the subcatchment.

8 DESIGN PROPOSALS

Concept solutions, which addressed these risks and considered additional flows from potential subdivision expansion scenarios, were investigated. The proposed mitigation options reduce incidence of flood of the future subdivision to greater than the 100 year ARI event. The following table outlines the deficiencies, the solutions investigated, and the preferred solution determined in consultation with NMC Working Group. Refer to Table 2 on the next page.

Item	Proposed Solution(s)	Preferred Approach(s)
Johns Street Subcatchment detention basin (Basin 2)	1. Expansion of the existing basin; 2. Provision of a new basin above Boral Road enabling rural flows to be diverted from basin 2 and to be used to detain future development flows; or 3. Upsize outlet and provide a new downstream pipeline through to the culvert at the intersection of Evandale Rd and Translink Avenue.	Option 3. This eliminates the need for additional land to be set aside for detention, although implications for greater flows downstream require assessment.
Southern Subcatchment upper basin (Basin 4)	1. Expand existing basin into land between basin and Avis on Evandale Road, enabling southern rural flows to be diverted to it; and/or 2. Provision for additional detention in the upper catchment in proximity of Lots 21 or 26 Gatty Street, to provide detention for the western rural flows.	Both options. Option 1 allows a large proportion of rural catchment to be controlled; option 2 prevents flooding of Gatty Street Lots and enables existing pipelines to function at capacity.
Gatty Street	1. Upsize the headwall and culvert and provide defined overland flow path from upper Gatty St through to basin 4; or 2. Utilise land at lot 21 or 26 Gatty Street to provide detention for adjacent rural catchment flows and alleviate demands on basin 4.	Both options. It is proposed that upper catchment flows be channelled to a new detention basin above Gatty Street with a spillway onto Gatty Street. In addition works will be undertaken to improve the flow path to Basin 4.
Northern Subcatchment public basin (Basin 1) & Evandale Rd Culvert	Increase capacity of basin outlet, upgrades to downstream pipeline including culvert, diversion northern rural catchment around no. 2 Translink Avenue	This will prevent basin 2 overtopping and protect the parcel of land between it and Evandale Road for development
Boral Road Catchment future development	Install a new detention basin above the existing extent of Boral Road. All future development stormwater will discharge to the basin.	This will allow increased flows to be managed, and prevent the Boral Road pipeline from being overloaded.

Table 2. Proposals and preferred approach

9 PROJECTS

Concept designs for eight projects are proposed. Refer to Appendix A which shows the overall concept plan.

NORTHERN SUBCATCHMENT

The proposed Northern Subcatchment works significantly reduce the identified risks associated with the flooding of Evandale Road and No. 2 Translink Avenue North, and risks caused by overtopping of the undersized detention basin.

Refer to Figure 2 for the three Northern subcatchment projects.

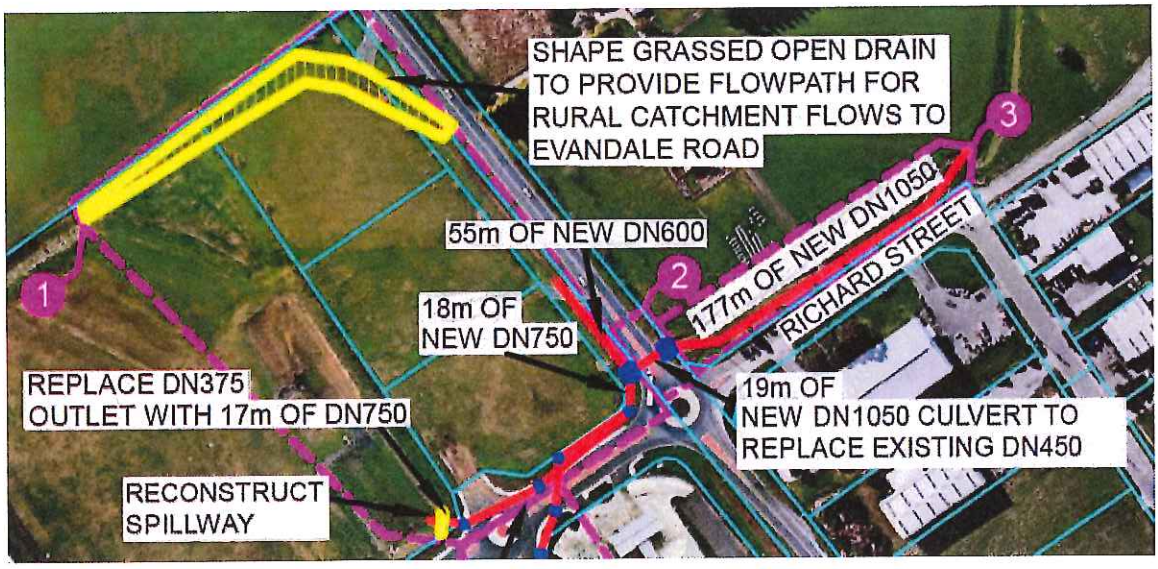


Figure 2. Northern subcatchment works (Projects 1, 2 & 3)

Project 1: Northern subcatchment works on the western side of Evandale Road

Project 1 includes works in the vicinity of the northern subcatchment detention basin (basin 1).

Concept estimates:

- Core Construction Management - $295,413

Objectives:

- Control overland flows from the rural catchment to the north and to the west of Statewide Independent Wholesalers;
- Prevent the Northern detention basin (basin 1) from overtopping during the peak 100 year ARI storm event; and
- Accommodate currently uncontrolled flows at the south-west corner of no.2 Translink Avenue north.

Proposed Works:

- **Providing a formal overland flow path for overland flows at the north-eastern boundary of Statewide to Evandale Road (shaded yellow in Figure 2).** A significant proportion of the northern rural subcatchment is intercepted by raised benching of the Statewide boundary. It currently passes to the north-east boundary where the land flattens and it disperses south-east towards the culvert. This helps to create a boggy area in the land adjacent the culvert to the east and the detention basins to the west. Construction of a formal drain to Evandale Road will alleviate this issue and allow the Lot(s) to be developed.
- **Repair/fill basin lip and reconstruct basin spillway.** Survey of the northern detention basin (basin 1) showed the average lip height (177.6 mAHD) gives a total capacity of 2.98ML. However the low point of the basin lip is 177.08 mAHD, giving a functional capacity of 2.04ML. By ensuring a uniform lip height will increase the effective capacity and utility of the detention basin. It is proposed that the emergency spillway height be formalised at 177.3 mAHD, and the basin lip repaired to a uniform level of 177.6 mAHD. The emergency spillway should be orientated to overflow onto in an easterly direction onto Translink Avenue North, therefore reducing the risk to adjacent properties.
- **Upsize northern basin (basin 1) outlet from DN375 to DN750.** Modelling suggests that basin 1 is undersized and begins overtopping in the 10 year ARI 3 hour duration rainfall event and the 20 year ARI 1 hour duration event. Increasing the outlet capacity prevents the basin from overtopping in the peak 100 year ARI event.
- **Upsize and extend pipework from basin 1 to the Evandale Road culvert crossing.** Increasing the basin outlet requires the downstream pipework to be suitably increased. The existing pipework discharges to an informal roadside drain near the intersection of Evandale Road. This flow path is caused by drop-off between the road level and adjacent land level from which in

meanders to the culvert and contributes to the bogginess of the Lot. Extending the pipework to the culvert will improve the utility of this Lot as most flows will be contained. Some fill of the Lot will be required to covert the pipe and to match in will levels.

Project 2: Northern subcatchment works under Evandale Road

Project 2 includes works under Evandale Road, refer to Figure 2.

Concept estimates:

- Core Construction Management - $106,590

Objectives:

- Prevent flooding of Evandale Road in the vicinity of the existing crossing during the 100 year ARI event; and
- Provide capacity to accommodate increased flows being passed from basin 1 (refer to Project 1) and Johns Street (refer to Project 4).

Proposed Works:

- **Upsize the Evandale Road culvert from DN450 to DN1050.** Modelling suggests that the DN450 culvert unable to fully service the 62 ha northern subcatchment. Flooding of Evandale Road in multiple-duration 5 year ARI rainfall events is predicted. With the upsizing of the basin 1 outlet as discussed in Project 1 the lack of capacity will be even more evident. As such it is proposed that the existing culvert either be upsized or an additional culvert be installed alongside it. This culvert will pick up piped flows as well as road flows from the adjacent section of Evandale Road. This culvert is sufficiently sized to cater for additional flows from the Project 4 pipeline diversion.

Project 3: Northern subcatchment works on the eastern side of Evandale Road

Project 3 includes works alongside Richard Street, refer to Figure 2.

Concept estimates:

- Core Construction Management - $281,060

Objectives:

- Contain the 100 year flow downstream of Evandale Road; and
- Provide capacity for future flows from potential development of the land adjacent to Richard Street.

Proposed works:

- **Installation of a new DN1050 pipeline from the Evandale Road culvert to the widening of the open channel.** There has been mention that the land adjacent the pipeline may be developed. This pipeline will formalise flows and protect adjacent land from flooding until the channel widening, which is sufficient to carry the increased flows. This pipeline is sufficiently sized to cater for additional flows from the Project 4 pipeline diversion.

JOHNS STREET SUBCATCHMENT

The proposed Johns subcatchment works eliminates highest risk item identified in the risk assessment which is the flooding of No. 16 Johns Street. Project 3 includes works in the vicinity of the Johns Street subcatchment detention basin (basin 2). Refer to Figure 3.

Project 4: Johns Street subcatchment works

Project 4 includes works between and including Johns Street detention basin and Translink Avenue South, refer to Figure 3.

Concept estimates:

- Core Construction Management - $904,815
-

Objectives:

- Abandon the existing Johns Street detention basin (basin 2); and
- Redirect flows from the upper Johns Street catchment to the Boral Road subcatchment; and
- Redirect flows from the lower Johns Street catchment to the Northern subcatchment.

Proposed works:

- **Diversion of upstream flows (incorporated in Project 6).** It is proposed that piped stormwater flows in the vicinity of the south-western extent of Translink Avenue North be diverted from the Johns Street subcatchment to the Boral Road subcatchment. This will significantly reduce the quantity of stormwater that must be dealt with in the vicinity of the Johns Street detention basin (basin 2).
- **Abandon Johns Street detention basin (basin 2).** Modelling suggests that the existing 660 KL detention basin is severely undersized and will likely spill during the 1 in 2 year ARI rainfall events. Due to its location and spillway orientation this is a major risk to adjacent properties. Abandoning the basin (with associated works) will eliminate this risk.
- **Pipe flows from the proposed abandoned basin and divert to the Northern subcatchment.** It is proposed that remaining flows from the vicinity of the basin be diverted to the northern catchment where they will utilise the proposed DN1050 upsized culvert and pipeline as per Projects 2 and 3.

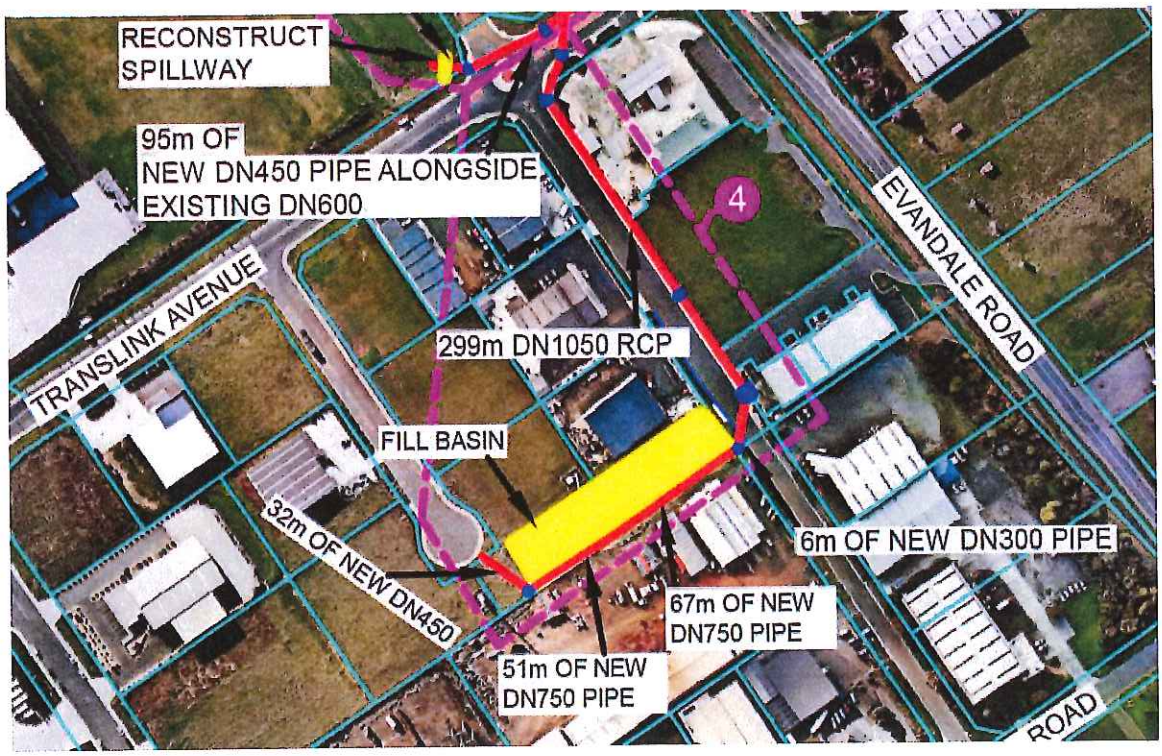


Figure 3. Johns Street subcatchment works (Project 4)

BORAL ROAD SUBCATCHMENT

The proposed Boral Road subcatchment works address the risks associated with expansion of the subdivision and the potential for increased stormwater flows.

Refer to Figure 4 for the Boral Road subcatchment project.

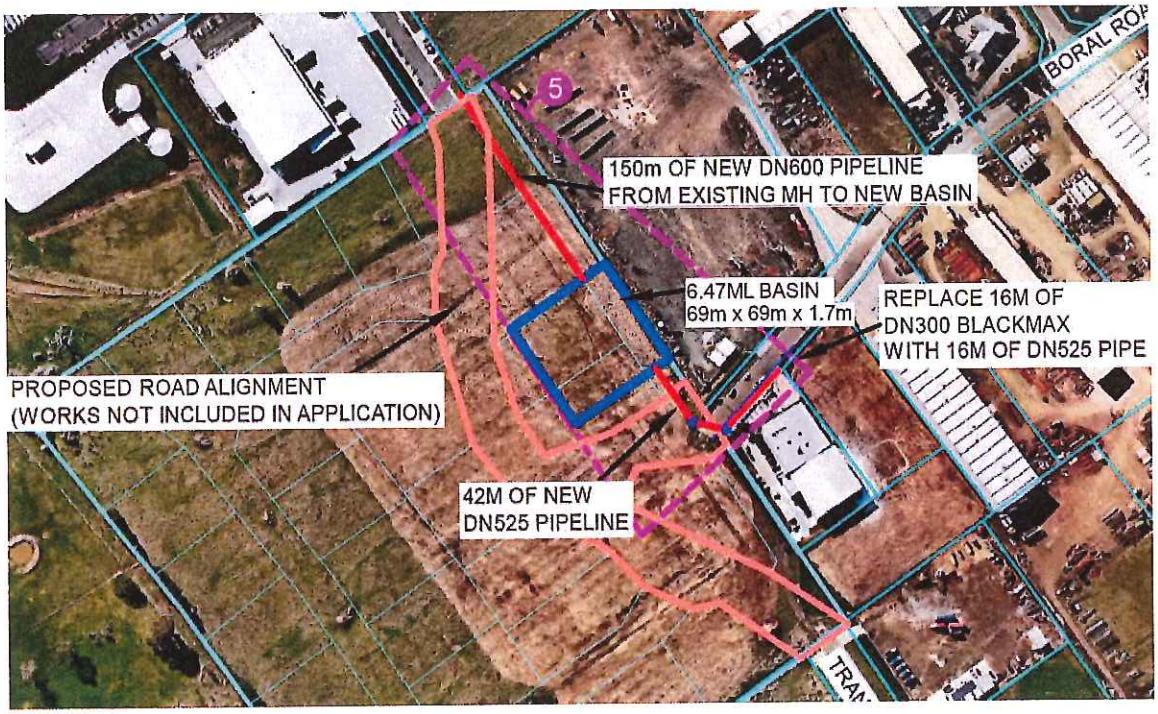


Figure 4. Johns Street subcatchment works (Project 5)

Project 5: Boral Road subcatchment works

Project 5 includes works at the top end of Boral Road in the proposed subdivision footprint, refer to Figure 4.

Concept estimates:

- Core Construction Management - $395,856

Objectives:

- Control flows from the rural catchment including allowances for the proposed subdivision;
- Incorporate upper Johns Street catchment flows to facilitate the abandonment of the Johns Street basin (basin 2); and

- Size the new basin so that it does not spill in up to the 100 year event; and
- Promote Boral Road as the overland flow path.

Proposed works:

- **Diversion John Street subcatchment flows.** As outline in the notes associated with Project 4, it is proposed the pipeline containing stormwater from the upper John Street subcatchment be diverted to Boral Road. This will be achieved by the construction of a new DN600 pipeline in the vicinity of the eastern boundary of the proposed subdivision expansion. This significantly reduces flows impacting on the lower section of the John Street subcatchment.
- **Construction of a 6.47 ML detention basin with a DN525 low level outlet.** According to modelling this proposed basin, with a 525mm diameter outlet is of sufficient capacity to accept the diverted John Street subcatchment flows, as well as potential flows coming from future development and rural land uses. It is proposed that the basins emergency spill be situated on its southern side onto Boral Road.
- **Construction of a DN525 pipeline from the basin to the existing Boral Road stormwater main.** This will connect the proposed basin to the existing Boral Road network. A small section of existing pipe requires upsizing as part of this work.

SOUTHERN SUBCATCHMENT

The proposed Southern subcatchment works address the risks associated with the flooding of Lots at the top of Gatty Street and flooding resulting from the inadequate capacity of basin 4, south of Hudson Fysh Drive.

Refer to Figure 5 for the Southern subcatchment projects.

Project 6: Southern subcatchment detention basin (basin 4) works

Project 6 includes works in the vicinity of detention basin 4, refer to Figure 5.

Concept estimates:

- Core Construction Management - $573,248

Objectives:

- Control flows from the rural catchment including allowances for future development; and
- Size the basin 4 so that it does not spill in up to the 100 year event.

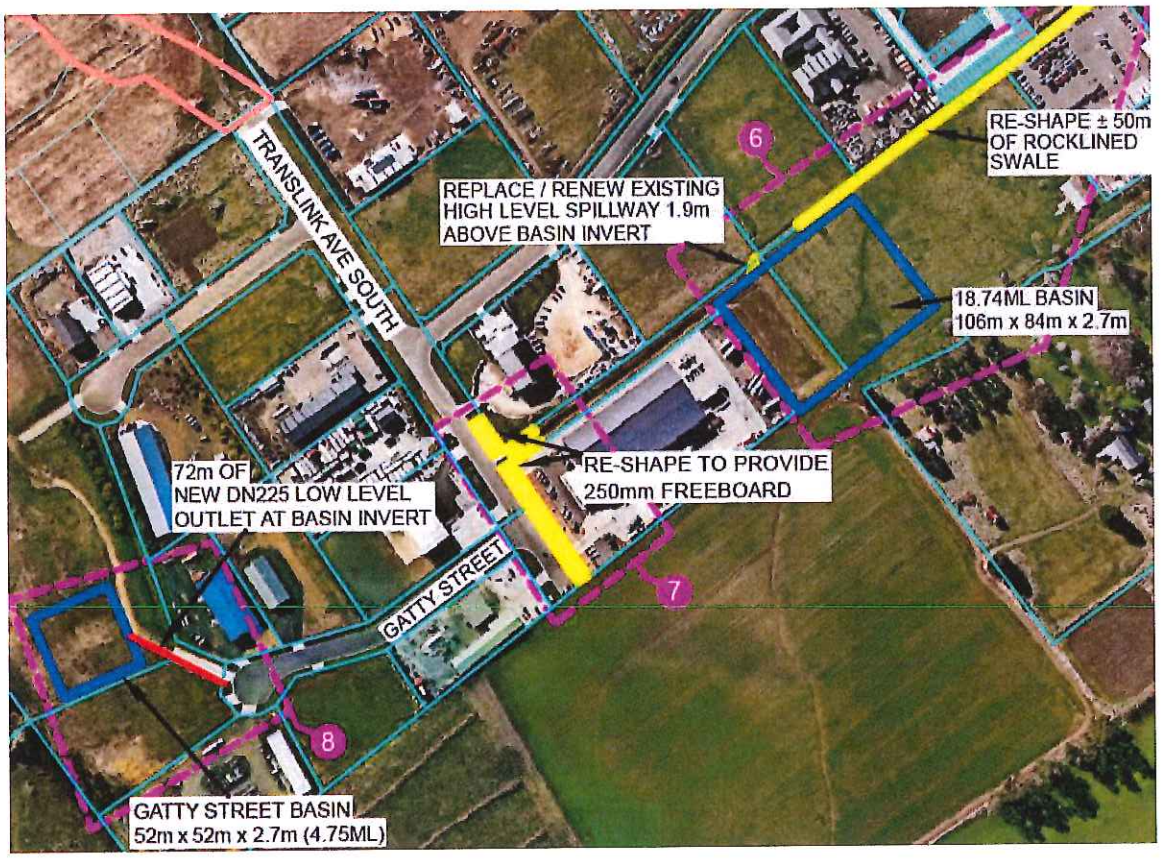


Figure 5. Southern subcatchment works (Projects 6, 7 & 8)

Proposed works:

- **Expansion of existing detention basin.** The storage capacity of basin 4 is approximately 1.7ML and is not sufficiently sized to accommodate flows from Gatty Street. This basin was not designed to intercept the extensive rural subcatchment to its south (approximately 50 ha). It is proposed that the basin be expanded to accept 100 year ARI flows from the entirety of upstream Southern subcatchment, including allowances for future development of the rural catchment. The existing DN600 outlet is to be retained in order to restrict peak outflows to existing flow rates. Works will include construction of a formal spillway which will discharge in excess of the 100 year event to the existing rock-lined swale through to Evandale Road.

- **The existing overland flow path from basin 4 is a rock-line channel.** Given the proposed basin will hold the 100 year ARI event the swale needs to be sized only to hold adjacent flows to the 100 ARI year level. The swale has recently been repaired and may be suitable to transmit overland flows which are not part of proposed basins catchment. However survey showed a constriction in the swale approximately 50m in length which may require widening to provide consistent capacity along the swale length.

Project 7: Southern subcatchment Gatty Street overland flow path.

Project 7 includes works in the vicinity of the southern extent of Translink Avenue South, refer to Figure 5. In large wet weather events Gatty Street acts as the overland flow path for flows in excess of what the existing DN300 culvert above Lots 21 and 26 can handle. Although Project 8 will discuss the proposal for a detention basin in these upper Lots, overflows will be directed to Gatty Street.

Translink Avenue South however runs perpendicular to this path and flows must turn left then right at 90 degree angles before entering the open channel directed towards basin 4. Overland flows, though unlikely to occur even in the peak 100 year ARI event, provide a specific risk to no.49 Translink Avenue South due to lack of freeboard between road and driveway level.

Concept estimates:

- Core Construction Management - $115,400

Objectives:

- Provide a definitive overland flow path between Gatty Street and basin 4.

Proposed works:

- **Reshape naturestrip and driveway adjacent to No. 49 Translink Avenue South.** Definition of the flow path is proposed by raising the height of the naturestrip and driveway access of no. 49 Translink Avenue South. In addition it is proposed that the crossover which delineates access to the open channel to the north of no. 49 be lowered, so overland flows are better facilitated towards basin 4. Concept design details and for this project are shown in Appendix F.

Project 8: Southern subcatchment Gatty Street detention basin

Project 8 includes works in Lots 21 and 26 at the western extent of Gatty Street, refer to Figure 5. Stormwater runoff from above Gatty and Munro Streets is diverted via a cut-off drain to a DN300 pipeline and headwall. This has regularly been observed to be unable to manage flows from the large rural catchment, which modelling suggests in inadequate during the 1 in 5 year ARI rainfall event.

Concept estimates:

- Core Construction Management - $176,860

Objectives:

- Control upper flows from above Gatty and Munro Streets in up to the peak 100 year ARI event; and
- Ensure the stormwater network between Gatty Street and basin 4 remains functional in the peak 20 year ARI event.

Proposed works:

- **Construction of a 4.7 ML detention basin with DN225 low level DN225 outlet.** The position of this proposed basin is suitable to intercept upper catchment flows with the aid of the existing cut-off drain. The basin will prevent the Gatty Street stormwater pipeline from surcharging during the peak 20 year event and is sized so as not to flood the roadway during the peak 100 year event. It is proposed that the emergency spillway will direct additional flows to Gatty Street. If this eventuates no. 49 Translink Avenue South is at risk however this would be during a storm greater than the 100 year event.

10 CONCEPT ESTIMATE SUMMARY

Table 3 summarises the concept estimates for each for the projects compiled by Core Construction Management and IPD Consulting. There is significant variation between the estimates which can be attributed to the stage of design and differing contingency sums applied.

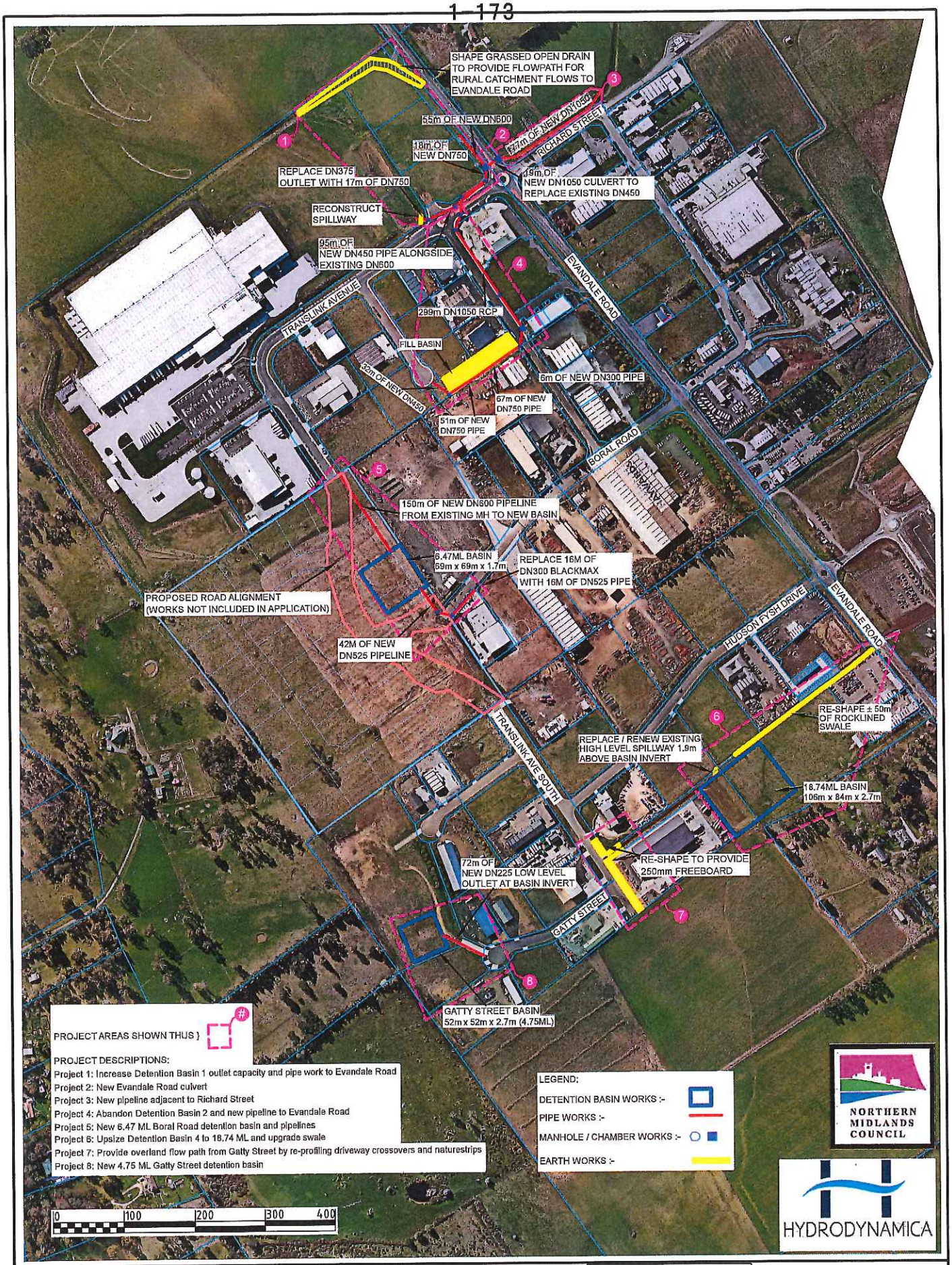
Appendices B and C gives the full costing schedules for each project and by each company.

Project	Core Construction Management Construction Estimate
1	$295,414
2	$106,590
3	$281,060
4	$904,816
5	$395,856
6	$573,248
7	$115,400
8	$176,860
Total	**$2,489,244**

Table 3. Construction Estimates

APPENDIX A

CONCEPT DESIGN OVERVIEW SHEET



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	REVISION	02

NMC - TRANSLINK

CONCEPT STORMWATER DESIGNS FOR GRANT APPLICATION

SURVEY & ALIGNMENT SERVICES

- INDUSTRIAL ALIGNMENT
- ENGINEERING SURVEYING
- LAND DEVELOPMENT

Mobile: 0429 003 584
Email: dtompkins81@gmail.com
Website: www.survalign.com.au

APPENDIX B

CORE CONSTRUCTION MANAGEMENT

CONSTRUCTION ESTIMATES

NMC Translink - Grant Application Rev4

Job Name :	NMC TRANSLINK-GRANT1	**Job Description**	
Client's Name:	Northern Midlands Council	NMC Translink - Grant Application	

Trd No.	Trade Description	Trade %	Cost/m2	Trade Total
1	Project 1 - Increase basin 1 outlet capacity	10.37		295,414
2	Project 2 - New 1050 culvert crossing to Evandale Road	3.74		106,590
3	Project 3 - Airport Rd Pipeline - excludes RC Chamber	9.86		281,060
4	Project 4 - New pipeline	31.76		904,816
5	Project 5 - New Boral Rd Basin alternative 1	13.89		395,856
6	Project 6 - New basin 4 Alternative	20.12		573,248
7	Project 7 - Gatty Street Flowpath	4.05		115,400
8	Project 8 - New Gatty Street Basin	6.21		176,860
		100.00		**2,849,244**

Final Total :	$	**2,849,244**
G.S.T. 10.00% :		**284,924**
Final Total Incl. G.S.T. :	$	**3,134,168**

NMC Translink - Grant Application Rev4

Job Name : NMC TRANSLINK-GRANT1

Client's Name: Northern Midlands Council

Job Description

NMC Translink - Grant Application

Item No.	Item Description	Quantity	Unit	Rate	Mark Up %	Amount
Trade :	**1** ***Project 1 - Increase basin 1 outlet capacity***					
	Demolition					
1	Remove existing headwall	3.00	Hrs	170.00		510.00
2	Remove existing manhole	1.00	No	500.00		500.00
3						
	RC Chamber - West End					
4	New RC Chamber with bear trap - allow for humeceptor 1.7kl	1.00	No	15,000.00		15,000.00
5	Transport to site	1.00	Allow	1,000.00		1,000.00
6	Excavation	3.00	m3	200.00		600.00
7	Installation	1.00	Allow	3,000.00		3,000.00
8						
	Pipework					
9	DN750 - Laid on ground	35.00	m	350.00		12,250.00
10	Excavation for DN750 pipework	78.75	m3	65.00		5,118.75
11	DN375 Blackmax - Laid on ground	6.00	m	150.00		900.00
12	Excavation for DN375 pipework	5.76	m3	65.00		374.40
13	DN450 - Laid on ground	70.00	m	200.00		14,000.00
14	Excavation for DN450 Pipework	84.00	m3	95.00		7,980.00
15	DN600 - Laid on ground	60.00	m	210.00		12,600.00
16	Excavation for DN600 pipework	72.00	m3	65.00		4,680.00
17	Reinstate road pavement	20.00	m2	60.00		1,200.00
18						
	Headwall					
19	DN600 headwall	1.00	No	1,000.00		1,000.00
20	600mm Culvert	10.00	m	210.00		2,100.00
21						
	Manholes					
22	New stormwater manhole 1100diamx2000	3.00	No	4,000.00		12,000.00
23						
	Excavation					
24	Reconstruct spillway	20.00	m2	85.00		1,700.00
25	Fill required	600.00	m3	65.00		39,000.00

NMC Translink - Grant Application Rev4

Job Name : NMC TRANSLINK-GRANT1 **Job Description**

Client's Name: Northern Midlands Council NMC Translink - Grant Application

Item No.	Item Description	Quantity	Unit	Rate	Mark Up %	Amount
Trade :	**1** ***Project 1 - Increase basin 1 outlet capacity***					*(Continued)*
26	Open swale	2,200.00	m2	15.00		33,000.00
27	Seed swale	2,200.00	m2	5.00		11,000.00
28	Repair existing basin lip	540.00	m2	15.00		8,100.00
29						
	Make good on Completion					
30	Allowance to make good road, fencing on completion	40.00	Hrs	170.00		6,800.00
31						
	Contingency					
32	Design Contingency 10%	1.00	Item	20,000.00		20,000.00
33	Construction Contingency 10%	1.00	Item	20,000.00		20,000.00
34						
	Allowance for contractors preliminaries, profit and overhead recovery					
35	Allowance 15%	1.00	Item	35,000.00		35,000.00
36						
	Fees					
37	Design Fees	1.00	Item	26,000.00		26,000.00
	Project 1 - Increase basin 1 outlet capacity				**Total :**	**295,413.15**
Trade :	**2** ***Project 2 - New 1050 culvert crossing to Evandale Road***					
	Demolition					
1	Remove existing headwall	3.00	Hrs	170.00		510.00
2						
	RC Chamber - East end					
3	New RC Chamber with bear trap - allow for humeceptor 1.7kl	1.00	No	15,000.00		15,000.00
4	Transport to site	1.00	Allow	1,000.00		1,000.00
5	Excavation	3.00	m3	200.00		600.00
6	Installation	1.00	Allow	3,000.00		3,000.00
7						
	Pipework					
8	DN600 - Laid on ground	60.00	m	210.00		12,600.00
9	Excavation for DN600 pipework	72.00	m3	65.00		4,680.00

NMC Translink - Grant Application Rev4

Job Name : NMC TRANSLINK-GRANT1 — Job Description

Client's Name: Northern Midlands Council — NMC Translink - Grant Application

Item No.	Item Description	Quantity	Unit	Rate	Mark Up %	Amount
Trade : 2	*Project 2 - New 1050 culvert crossing to Evandale Road*					(Continued)
10						
	Headwall					
11	DN600 headwall		No			EXCL
12	600mm Culvert		m			EXCL
13	1050mm culvert	20.00	m	720.00		14,400.00
14	Excavation	100.00	m3	65.00		6,500.00
15	Reinstate road pavement	100.00	m2	60.00		6,000.00
16						
	Make good on Completion					
17	Allowance to make good road, fencing on completion	40.00	Hrs	170.00		6,800.00
18						
	Contingency					
19	Design Contingency 10%	1.00	Item	7,000.00		7,000.00
20	Construction Contingency 10%	1.00	Item	7,000.00		7,000.00
21						
	Allowance for contractors preliminaries, profit and overhead recovery					
22	Allowance 15%	1.00	Item	12,000.00		12,000.00
23						
	Fees					
24	Design Fees	1.00	Item	9,500.00		9,500.00
	Project 2 - New 1050 culvert crossing to Evandale Road				**Total :**	**106,590.00**
Trade : 3	*Project 3 - Airport Rd Pipeline - excludes RC Chamber*					
	Pipework					
1	DN1050 - Laid on ground	177.00	m	720.00		127,440.00
2	Excavation for DN1050 pipework	708.00	m3	65.00		46,020.00
3						
	Headwall					
4	DN1050 headwall	1.00	No	3,000.00		3,000.00
5	Excavation	20.00	m3	65.00		1,300.00
6						

NMC Translink - Grant Application Rev4

Job Name : NMC TRANSLINK-GRANT1
Client's Name: Northern Midlands Council
Job Description: NMC Translink - Grant Application

Item No.	Item Description	Quantity	Unit	Rate	Mark Up %	Amount
Trade : 3	*Project 3 - Airport Rd Pipeline - excludes RC Chamber*					(Continued)
	Make good on Completion					
7	Allowance to make good road, fencing on completion	40.00	Hrs	170.00		6,800.00
8						
	Contingency					
9	Design Contingency 10%	1.00	Item	18,500.00		18,500.00
10	Construction Contingency 10%	1.00	Item	18,500.00		18,500.00
11						
	Allowance for contractors preliminaries, profit and overhead recovery					
12	Allowance 15%	1.00	Item	34,000.00		34,000.00
13						
	Fees					
14	Design Fees	1.00	Item	25,500.00		25,500.00
	Project 3 - Airport Rd Pipeline - excludes RC Chamber				**Total :**	**281,060.00**
Trade : 4	*Project 4 - New pipeline*					
	RC Chamber					
1	New RC Chamber with bear trap - allow for humeceptor 1.7kl	2.00	No	15,000.00		30,000.00
2	Transport to site	2.00	Allow	1,000.00		2,000.00
3	Excavation	10.00	m3	200.00		2,000.00
4	Installation	2.00	Allow	3,000.00		6,000.00
5						
	Pipework					
6	DN300	6.00	m	100.00		600.00
7	Excavation for DN300 Pipework	3.60	m3	65.00		234.00
8	DN375 Blackmax - Laid on ground	25.00	m	150.00		3,750.00
9	Excavation for DN375 pipework	15.00	m3	65.00		975.00
10	DN750 - Laid on ground	118.00	m	400.00		47,200.00
11	Excavation for DN750 pipework	230.10	m3	65.00		14,956.50
12	DN1050 - Laid on ground	300.00	m	720.00		216,000.00
13	Excavation for DN1050 pipework	1,800.00	m3	65.00		117,000.00
14						

NMC Translink - Grant Application Rev4

Job Name : NMC TRANSLINK-GRANT1 **Job Description**

Client's Name: Northern Midlands Council NMC Translink - Grant Application

Item No.	Item Description	Quantity	Unit	Rate	Mark Up %	Amount
Trade :	4 ***Project 4 - New pipeline***					*(Continued)*
	Road Crossing					
15	Excavation	180.00	m3	45.00		8,100.00
16	Reinstate road pavement	150.00	m2	80.00		12,000.00
17						
	Manholes					
18	New stormwater manhole 1100diamx2000	8.00	No	4,000.00		32,000.00
19						
	Excavation					
20	Fill existing basin	3,300.00	m3	20.00		66,000.00
21						
	Make good on Completion					
22	Allowance to make good road, fencing on completion	200.00	Hrs	180.00		36,000.00
23						
	Contingency					
24	Design Contingency 10%	1.00	Item	60,000.00		60,000.00
25	Construction Contingency 10%	1.00	Item	60,000.00		60,000.00
26						
	Allowance for contractors preliminaries, profit and overhead recovery					
27	Allowance 15%	1.00	Item	108,000.00		108,000.00
28						
	Fees					
29	Design Fees	1.00	Item	82,000.00		82,000.00
30						
31						
	Project 4 - New pipeline				**Total :**	**904,815.50**
Trade :	5 ***Project 5 - New Boral Rd Basin alternative 1***					
	Pipework					
1	DN525 - Laid on ground	58.00	m	190.00		11,020.00
2	Excavation for DN375 pipework	75.40	m3	65.00		4,901.00
3	DN600 - Laid on ground	150.00	m	210.00		31,500.00

NMC Translink - Grant Application Rev4

Job Name : NMC TRANSLINK-GRANT1 **Job Description**

Client's Name: Northern Midlands Council NMC Translink - Grant Application

Item No.	Item Description	Quantity	Unit	Rate	Mark Up %	Amount
Trade :	5 ***Project 5 - New Boral Rd Basin alternative 1***					*(Continued)*
4	Excavation for DN600 pipework	234.00	m3	65.00		15,210.00
5	Reinstate road pavement	20.00	m2	60.00		1,200.00
6						
	Manholes					
7	New stormwater manhole 1100diamx2000	2.00	No	4,000.00		8,000.00
8						
	Excavation					
9	Construct spillway	20.00	m2	85.00		1,700.00
10	Basin excavation	12,282.50	m3	10.00		122,825.00
11	Seed basin	8,000.00	m2	5.00		40,000.00
12						
	Fencing					
13	1800 high chainmesh rail less galvanised fence to basin	340.00	m	65.00		22,100.00
14	Allowance for 6000mm double gates	2.00	No	1,200.00		2,400.00
15						
	Contingency					
16	Design Contingency 10%	1.00	Item	26,000.00		26,000.00
17	Construction Contingency 10%	1.00	Item	26,000.00		26,000.00
18						
	Allowance for contractors preliminaries, profit and overhead recovery					
19	Allowance 15%	1.00	Item	47,000.00		47,000.00
20						
	Fees					
21	Design Fees	1.00	Item	36,000.00		36,000.00
	Project 5 - New Boral Rd Basin alternative 1				**Total :**	**395,856.00**
Trade :	6 ***Project 6 - New basin 4 Alternative***					
	Pipework					
1	DN600 - Laid on ground	80.00	m	210.00		16,800.00
2	Excavation for DN600 pipework	96.00	m3	65.00		6,240.00
3						

NMC Translink - Grant Application Rev4

Job Name : NMC TRANSLINK-GRANT1 **Job Description**

Client's Name: Northern Midlands Council NMC Translink - Grant Application

Item No.	Item Description	Quantity	Unit	Rate	Mark Up %	Amount
Trade : 6	***Project 6 - New basin 4 Alternative***					*(Continued)*
	Excavation					
4	Construct spillway	20.00	m2	85.00		1,700.00
5	Basin excavation	24,040.80	m3	10.00		240,408.00
6	Seed basin	11,000.00	m2	5.00		55,000.00
7	Fill existing basin	2,000.00	m3	15.00		30,000.00
8						
	Fencing					
9	1800 high chainmesh rail less galvanised fence to basin	380.00	m	65.00		24,700.00
10	Allowance for 6000mm double gates	2.00	No	1,200.00		2,400.00
11						
	Contingency					
12	Design Contingency 10%	1.00	Item	38,000.00		38,000.00
13	Construction Contingency 10%	1.00	Item	38,000.00		38,000.00
14						
	Allowance for contractors preliminaries, profit and overhead recovery					
15	Allowance 15%	1.00	Item	68,000.00		68,000.00
16						
	Fees					
17	Design Fees	1.00	Item	52,000.00		52,000.00
	Project 6 - New basin 4 Alternative				**Total :**	**573,248.00**
Trade : 7	***Project 7 - Gatty Street Flowpath***					
	Excavation					
1	Create raised bund	360.00	m3	60.00		21,600.00
2	Top soil and seed	1,200.00	m2	15.00		18,000.00
3						
	Crossovers					
4	Allowance for new crossovers	3.00	No	10,000.00		30,000.00
5						
	Make good on Completion					
6	Allowance to make good road, fencing on completion	40.00	Hrs	170.00		6,800.00

NMC Translink - Grant Application Rev4

Job Name : NMC TRANSLINK-GRANT1 **Job Description**

Client's Name: Northern Midlands Council NMC Translink - Grant Application

Item No.	Item Description	Quantity	Unit	Rate	Mark Up %	Amount
Trade :	7 *Project 7 - Gatty Street Flowpath*					*(Continued)*
7						
	Contingency					
8	Design Contingency 10%	1.00	Item	7,500.00		7,500.00
9	Construction Contingency 10%	1.00	Item	7,500.00		7,500.00
10						
	Allowance for contractors preliminaries, profit and overhead recovery					
11	Allowance 15%	1.00	Item	14,000.00		14,000.00
12						
	Fees					
13	Design Fees	1.00	Item	10,000.00		10,000.00
	Project 7 - Gatty Street Flowpath				**Total :**	**115,400.00**
Trade :	8 *Project 8 - New Gatty Street Basin*					
	Pipework					
1	DN225 pipe	40.00	m	150.00		6,000.00
2	Excavation for DN225	12.80	m3	65.00		832.00
3						
	Excavation					
4	Construct spillway	60.00	m2	85.00		5,100.00
5	Gatty basin	7,300.80	m3	10.00		73,008.00
6	Seed basin	3,000.00	m2	5.00		15,000.00
7						
	Fencing					
8	1800 high chainmesh rail less galvanised fence to basin	208.00	m	65.00		13,520.00
9	Allowance for 6000mm double gates	2.00	No	1,200.00		2,400.00
10						
	Contingency					
11	Design Contingency 10%	1.00	Item	12,000.00		12,000.00
12	Construction Contingency 10%	1.00	Item	12,000.00		12,000.00
13						
	Allowance for contractors preliminaries, profit and overhead recovery					

NMC Translink - Grant Application Rev4

Job Name : NMC TRANSLINK-GRANT1 **Job Description**

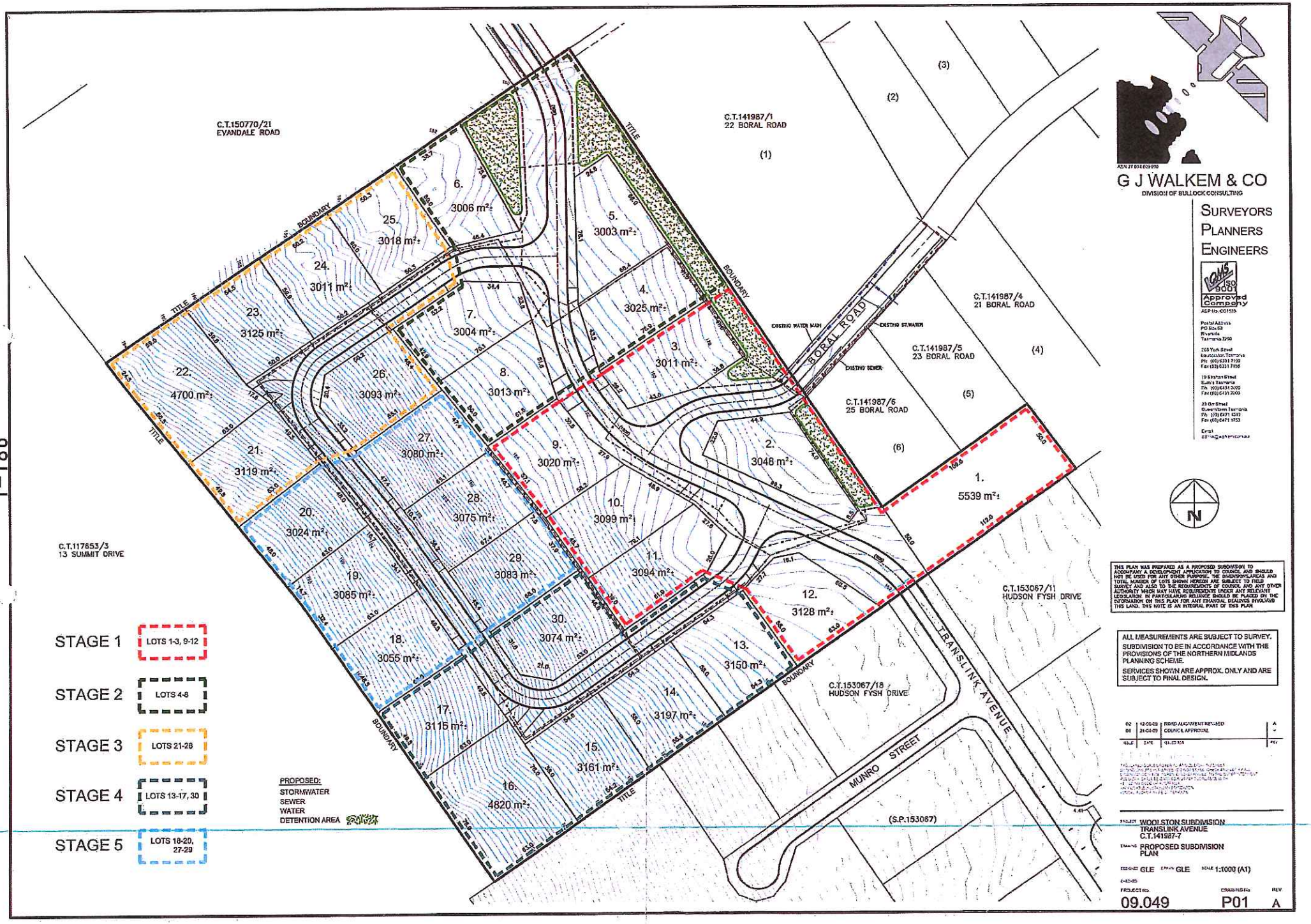
Client's Name: Northern Midlands Council NMC Translink - Grant Application

Item No.	Item Description	Quantity	Unit	Rate	Mark Up %	Amount
Trade :	**8** ***Project 8 - New Gatty Street Basin***					*(Continued)*
14	Allowance 15%	1.00	Item	21,000.00		21,000.00
15						
	Fees					
16	Design Fees	1.00	Item	16,000.00		16,000.00
	Project 8 - New Gatty Street Basin				**Total :**	**176,860.00**

APPENDIX C

BORAL ROAD CATCHMENT

PROPOSED SUBDIVISION LAYOUT



G J WALKEM & CO
DIVISION OF BULLOCK CONSULTING
SURVEYORS
PLANNERS
ENGINEERS
Postal Address
PO Box 63
Riverside
Tasmania 7250
268 York Street
Launceston Tasmania
Ph (03) 6331 7100
Fax (03) 6331 7156
19 Brisbane Street
Burnie Tasmania
Ph (03) 6431 3000
Fax (03) 6431 3000
23 Oil Street
Queenstown Tasmania
Ph (03) 6471 1531
Fax (03) 6471 1753

APPENDIX D

HYDROLOGY AND HYDRAULIC MODELLING OVERVIEW

INTRODUCTION

Hydraulic modelling was carried out with the Infoworks SD and Infoworks ICM software packages. They were used to construct a model representative of the hydraulics of physical assets (such as basins, pipes and manholes) and the hydrology of developed and undeveloped catchments which contribute stormwater flows to these assets.

The data from which the model was built came from several sources:

- Pipes, pits, manhole data, ad stormwater connections from NMCs GIS system, survey, and As Constructed Drawings;
- Detention basin and open drain data from survey;
- Industrial catchment land types, broken down into roofs, roads, and pervious areas, were estimated from aerial photography; and
- 0.5m LIDAR contours.

Although significant flows are known to come from the industrial roofs, car parks and roads, there are major flows emanating from the rural subcatchments which extend westwards to Devon Hills. Given the size of these subcatchments their assumed hydrology will significantly influence the behaviour of the model. Onsite it is evident that catchment topsoils overlay clays and rock. This material can be seen on subdivided land which has yet to be developed, such as above Gatty Street. This land has been benched to provide an even surface for development, but the re-profiled ground has a significant clay component. After rainfall the surface pools water due to low infiltration rates.

These observations align with observations that during significant rainfall events, or during periods of repeated rainfall, the rural catchments shed significant runoff with fast response times. As such an acute hydrological runoff response was assumed for these catchments in the model.

HYDROLOGY

There are three aspects to modelling of runoff in InfoWorks SD & ICM:

1. Initial Loss

    a. Depression storage (puddles and potholes)

    b. Interception by vegetation

    c. Infiltration into the soil

    d. Transmission loss through stream beds and banks

2. Volume – *Percentage Runoff*

    a. Continuing loss

    b. Connectivity of impermeable area

    3. Routing – *Distribution of Runoff with time*

For the purposes of this assessment it was deemed appropriate to adopt the **Fixed** and **Horton** runoff models for representing the percentage runoff from impermeable and permeable surfaces, respectively. **Fixed** is commonly used for such purposes and the **Horton** model can be better aligned to Australian guidelines.

Surfaces were divided into 3 types; roof, pavement and open ground. Fixed roof and road runoff was assumed to be 90%, which is the total proportion of rainfall that is converted to runoff.

The Horton Infiltration Model was used for open ground (pervious) surfaces. This model represents the potential infiltration as a function of time when the rainfall rate is unlimited; that is, when the rainfall is higher than the potential infiltration rate. The Horton Infiltration Model takes into account an initial infiltration rate (mm/hr), a final (limiting) infiltration rate (mm/hr) and a decay rate:

$$f = f_c + (f_0 - f_c)\, e^{-kt}$$

Where

- Initial infiltration rate = f_0 (mm/hr);
- Limiting rate = f_c (mm/hr); and
- Decay rate = 2.

Pervious surfaces in the catchments were assumed to consist predominately of clays that have very slow infiltration rates and have high runoff potential. Guidance

provided by Infoworks describes these as soil type D (high runoff potential) which are:

- Clay soils with a high swelling potential;
- Soils with a permanent high water table;
- Soils with a clay pan or clay layer at or near the surface; or
- Shallow soils over nearly impervious material

These soils all have slow rates of water transmission. For these soil types the suggested Infoworks factors for Horton equation were used:

- f_0 = 76 mm/hr
- f_c = 2.5 mm/hr and
- k = 2.

Table 1 shows that it takes 5 hours for the infiltration rate to decay to the limiting rate of 2.5 mm/hr:

Figure 1. Translink stormwater subcatchments

t (hrs)	Infiltration (mm/hr)
0	76.00
1	12.45
2	3.85
3	2.68
4	2.52
5	2.50

Simulations indicative of the rainfall were run in which indicative rainfall events were applied to the model to determine their effects. It was assumed that significant rainfall had occurred prior to the design rainfall events; as such the pervious catchments become even more prone to shedding runoff. The required of works are therefore sized conservatively.

The minimum acceptable service to be provided by stormwater infrastructure was agreed to be the 1 in 20 year average recurrence interval (ARI) peak storm event, for minor systems (pipelines, culverts etc), and the 1 in 100 year ARI peak event for major systems (detention basins and flood-ways).

It must be noted that the model is unverified and uncalibrated. That is, it has not been compared against historical rainfall events and measured flows from them, and the model settings have not been adjusted accordingly. This process can take a significant amount of time and resources, and would be dependent on measuring significant rainfall events at the subdivision. As such the current model is a 'best conservative guess' of the catchments likely behaviour.

The reports produced are based on the assessment of three areas; the northern section (in the vicinity of Translink Avenue north, the middle section (in the vicinity of Boral Road), and the southern section (in the vicinity of Hudson Fysh Drive).

Refer to these draft documents for additional detail:

- *Translink Subdivision Northern Catchment Improvements DRAFT R1*;
- *Translink Subdivision Boral Road Catchment Improvements DRAFT R1*; and
- *Translink Subdivision Southern Catchment Improvements DRAFT R2.*

These drafts have covered hydraulic modelling and outline drainage deficiencies with suggested works to reduce flood risks from known problem areas as well as those predicted in the long term 1 in 100 year events. The draft reports outline the progress to date prior to the development of an overall improvement priority program for Council`s consideration.

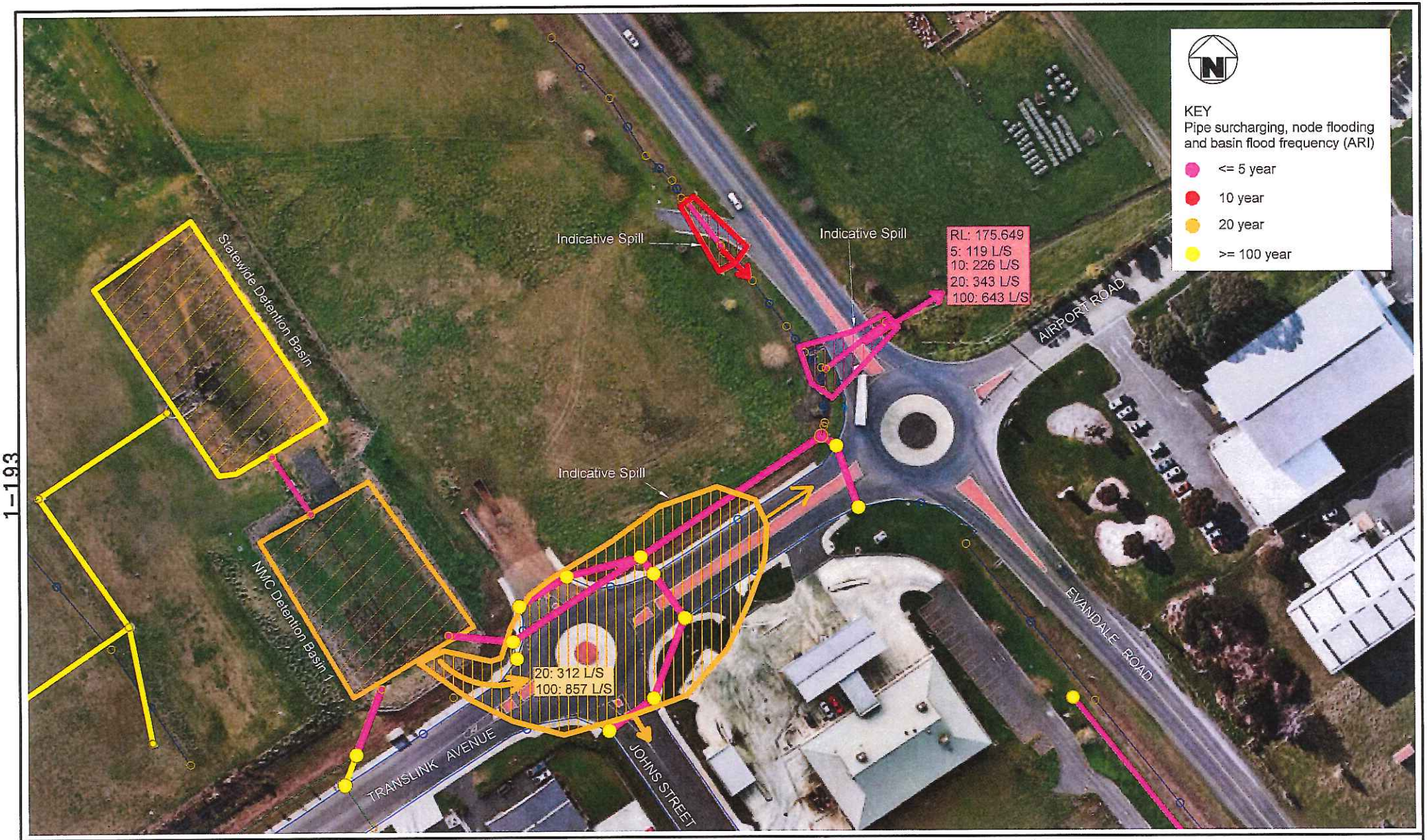
It needs to be recognised that current proposals must now be considered in a planning and development framework, including the potential and preferred Translink subdivision extension areas. This process will deliver inputs which will help to establish overall precedence for required works.

The input of Council is sought at this time for guidance on values and principles that need to be considered as inputs to the priority ranking assessment.

Please not that the guide costs contained in this document **do not** account for any land acquisition or payments to private landowners.

APPENDIX E

ASSET CAPACITY DRAWINGS



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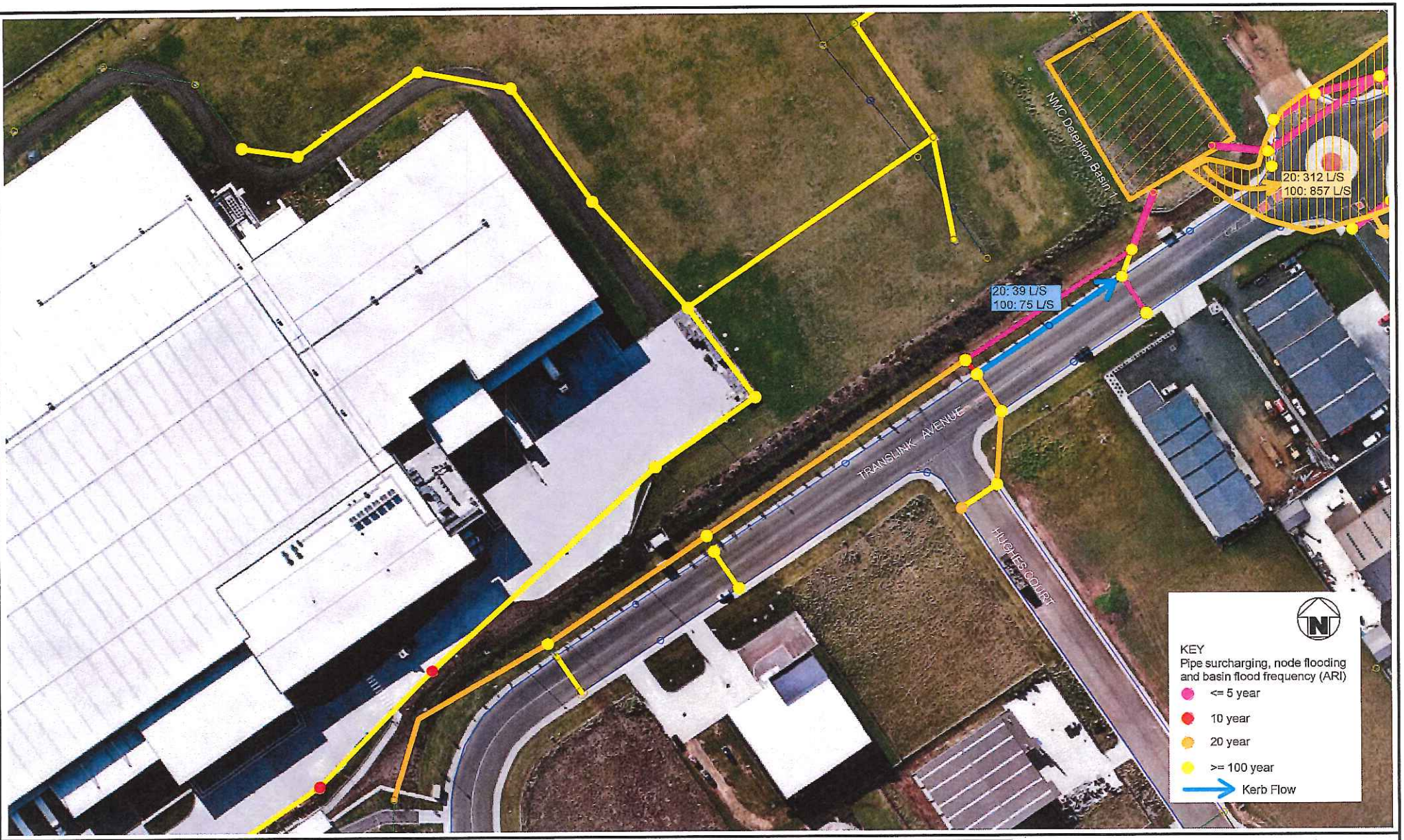

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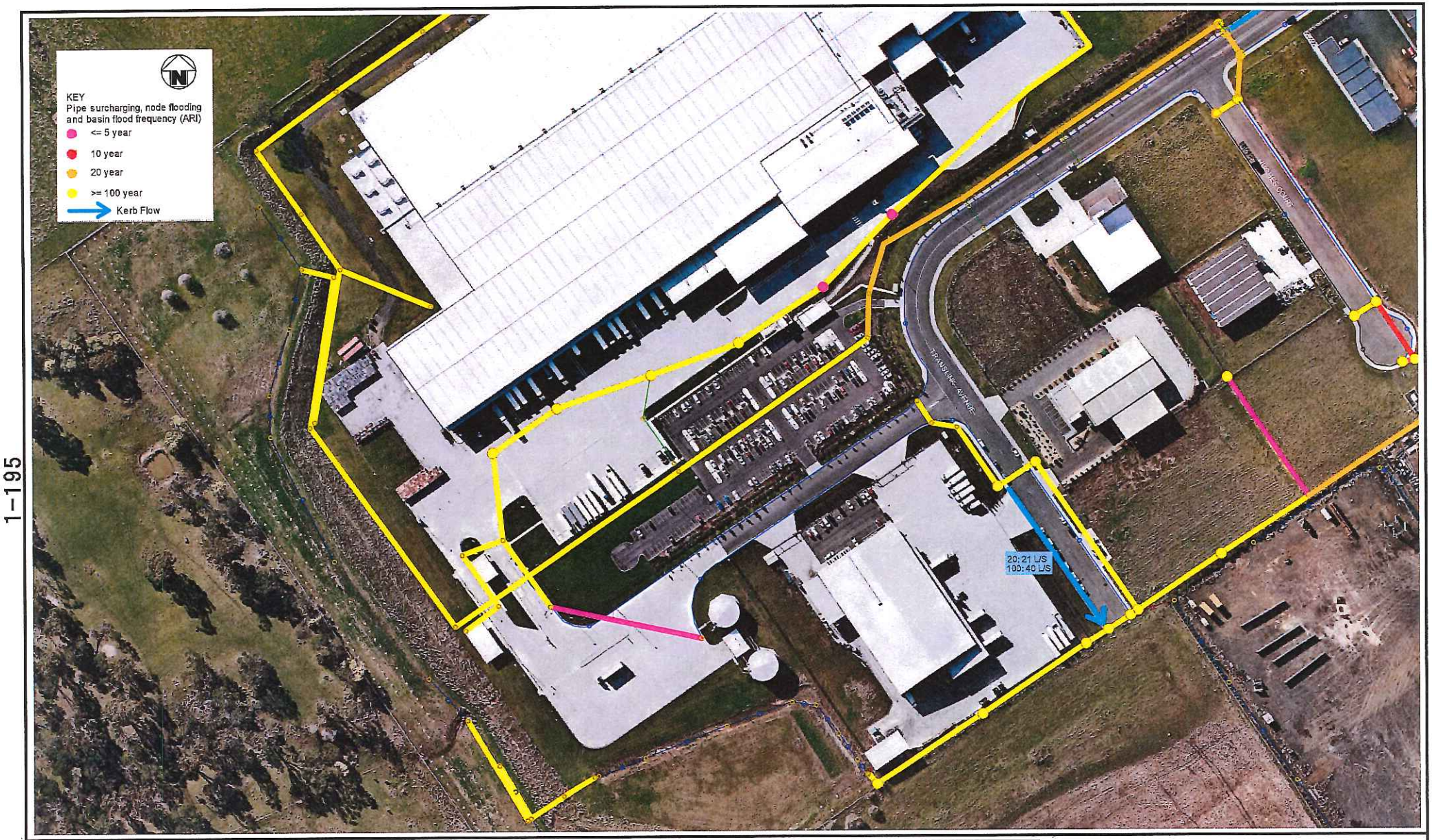

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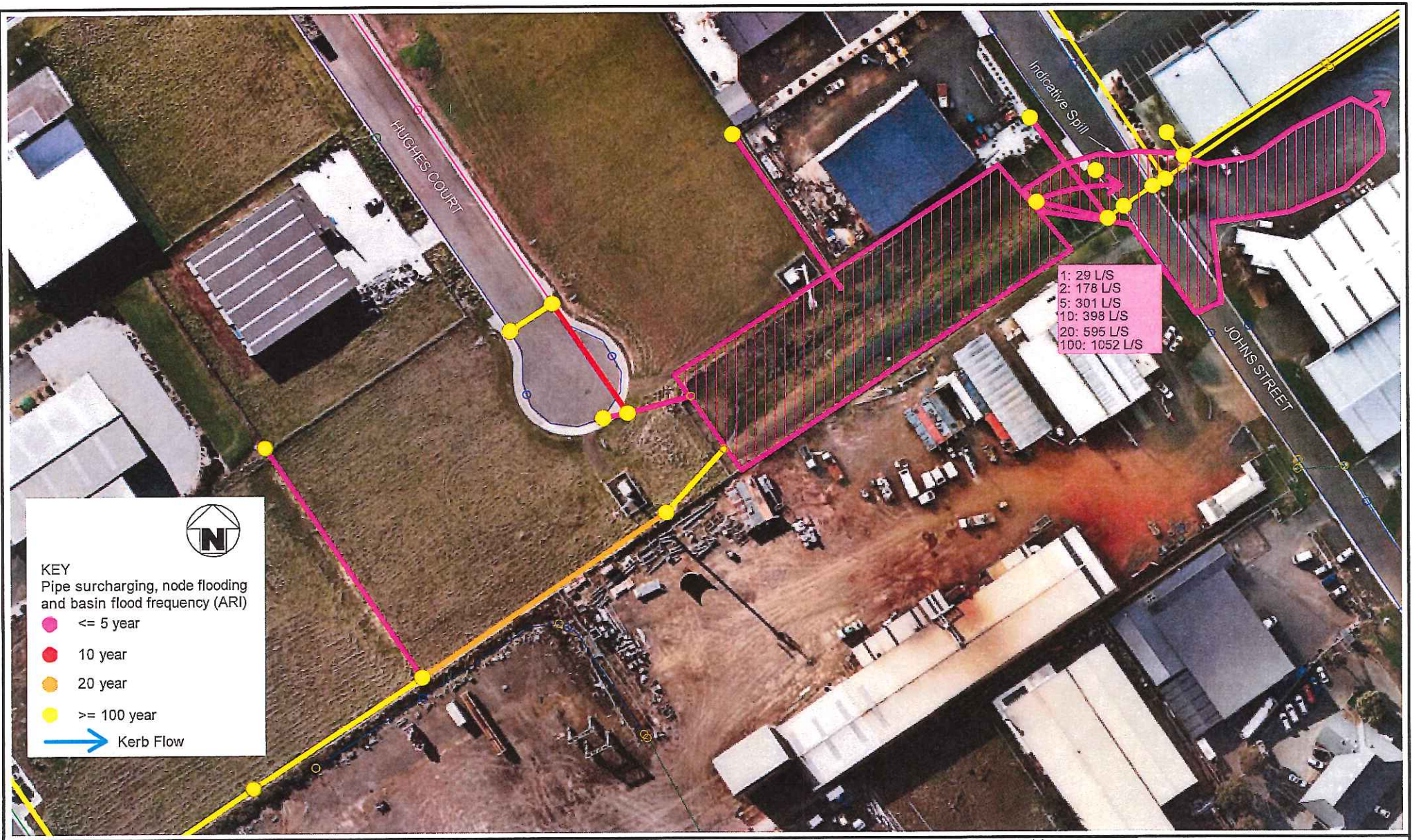

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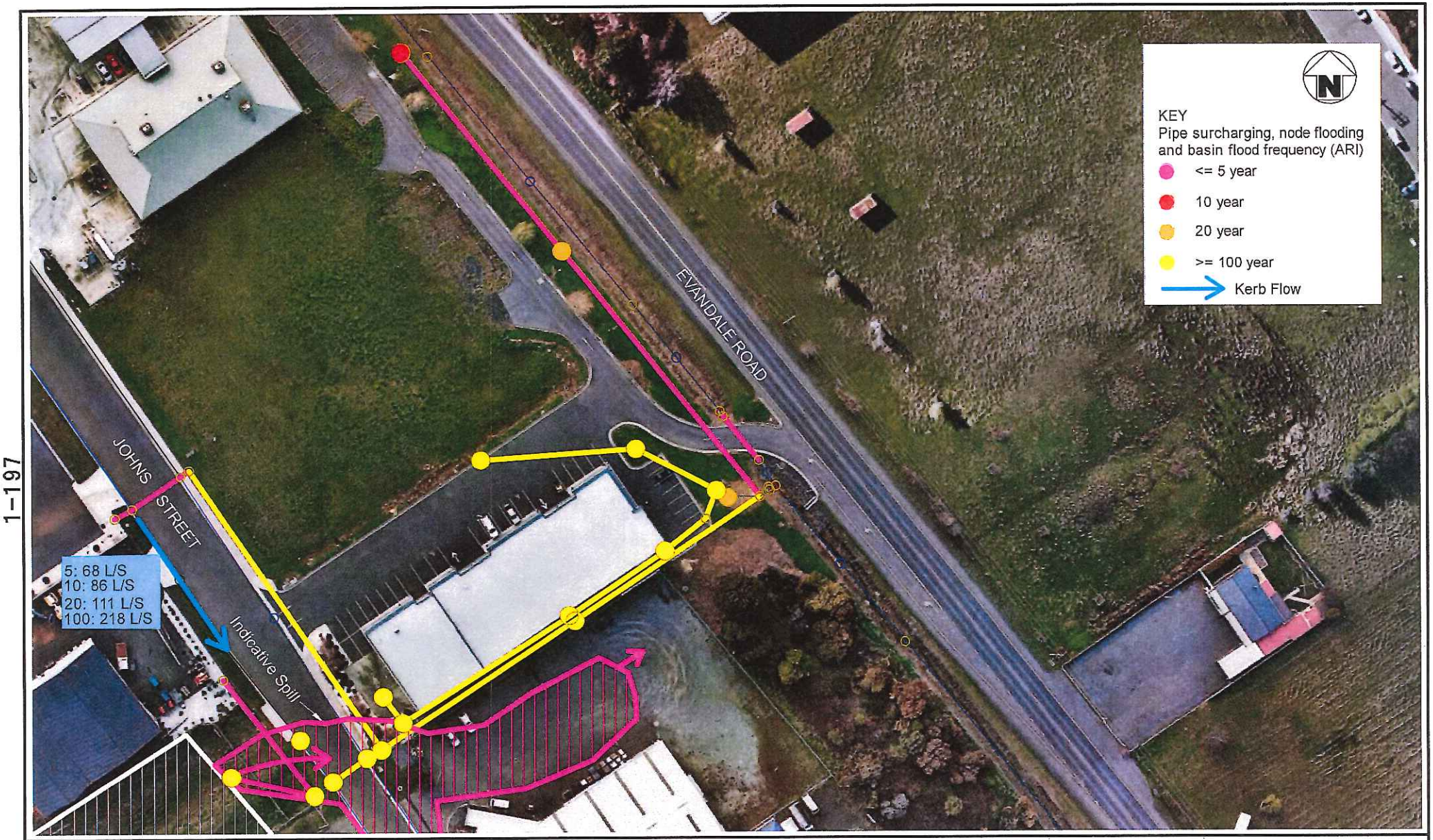

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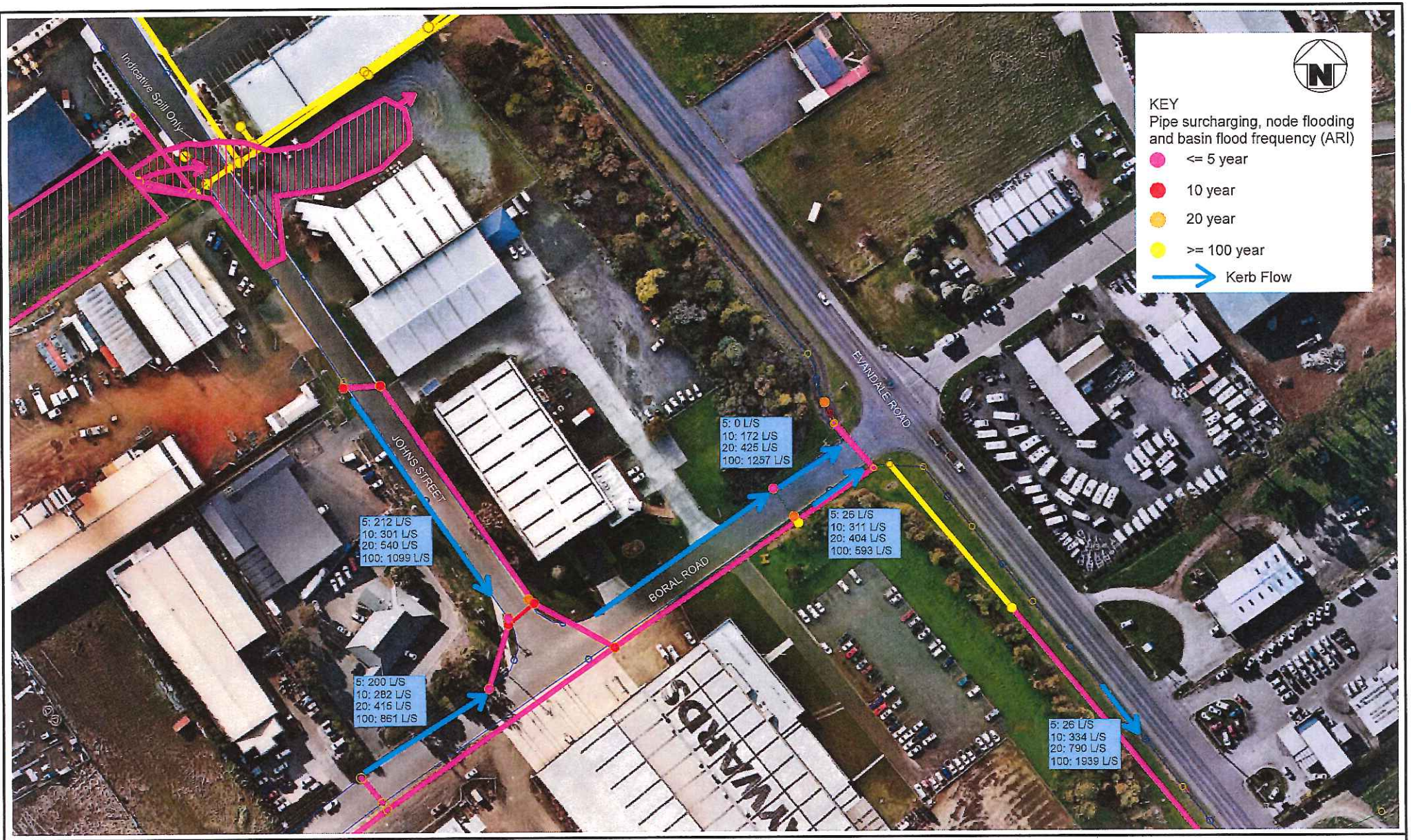

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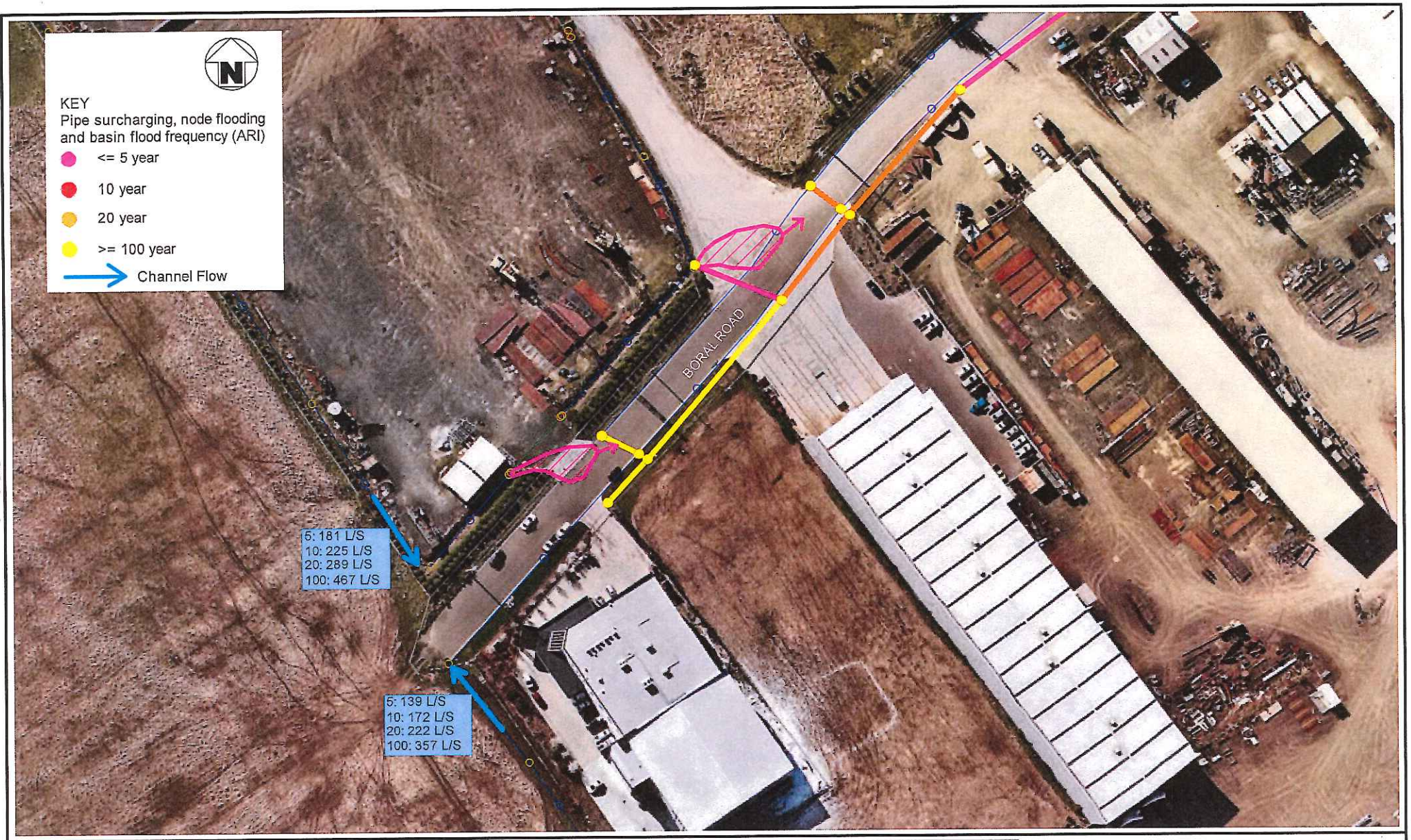

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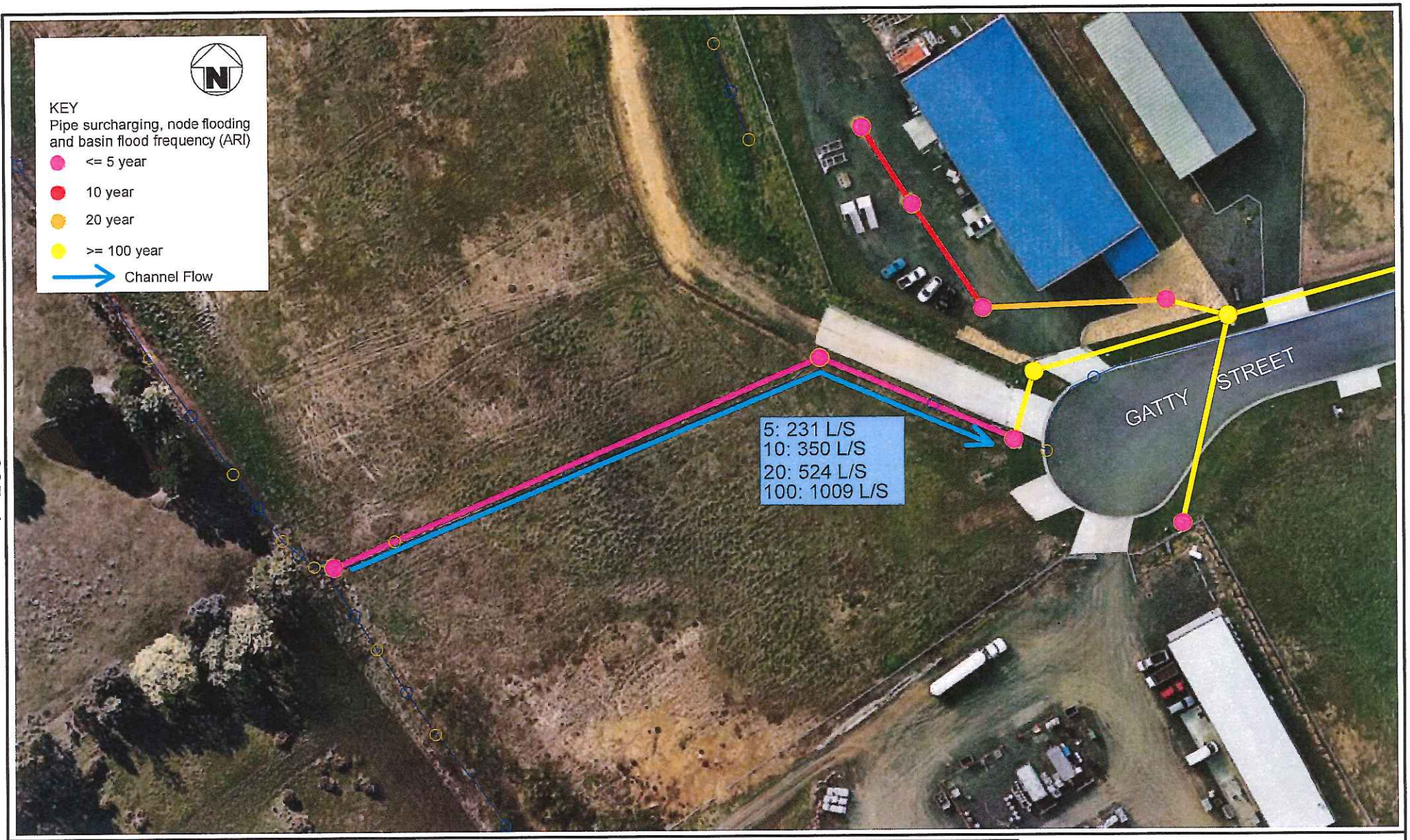

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