



Lithgow City Council

Cullen Bullen Sewerage Scheme Concept Design Technical Report

December 2018

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Executive summary

This report has been developed for Lithgow City Council (LCC) to detail the initial network layout of the reticulated pipe network for the Cullen Bullen Sewer Scheme.

The layout has been developed based on LiDAR data of Cullen Bullen, with gravity pipelines utilising the existing topographical features to connect the vast majority of properties (approximately 140 lots) to the proposed STP site on the south west edge of town. LCCs preference to avoid low pressure pots has been largely adhered to, with the exception of 6 lots, 4 of which are currently undeveloped.

The information presented in this report has been compiled utilising the WSA-02 Sewerage Code of Australia, enabling a feasible network to be created that considers pipe grades (minimum for self-cleansing and maximum for capacity) as well as pipe size, likely depths, and potential manhole locations. The report also suggests a servicing boundary that can be modified at LCC direction.

The content of this report has been presented for LCC comment and review, with the intention that LCC will engage with the Cullen Bullen community and pass on their feedback for inclusion in the concept design as applicable

This report is subject to, and must be read in conjunction with, the limitations set out in section 1 and the assumptions and qualifications contained throughout the Report.

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Appendix A – Preliminary Pipe Profiles

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1. Introduction

1.1 Background

Lithgow City Council (LCC) is implementing a sewer scheme to provide reticulated sewer services to the township of Cullen Bullen, located 28 km North-West to the city of Lithgow with an approximate population of 130 residents. The scheme would consist of predominantly gravity sewer pipelines conveying sewage to a new sewage treatment plant (STP).

Currently the village of Cullen Bullen is serviced by on-site sewer systems (mainly septic tanks). These systems dispose of household effluent into absorption trenches or on-site irrigation, which introduces environmental and health issues to the community.

Previous investigations were undertaken by Sustainable Solution International Pty Ltd to investigate the extent of failing on-site wastewater managements system in the village and develop some interim and permanent solutions to the wastewater problem. The investigations concluded that a gravity sewer system at Cullen Bullen and a centralised STP had the lowest capital investment and further investigations should be conducted to assess the viability of sewerage Cullen Bullen.

GHD was engaged by LCC to conduct investigations and develop a concept design of a sewer network and STP located within Cullen Bullen. LCC provided GHD with an aerial image of the extent of Cullen Bullen that will be serviced. Figure 1 displays the service area boundary that has adopted for the works.

1.2 Purpose of this report

The purpose of this report is to present the initial network layout of the draft concept design development of the sewer network and the STP location for LCC review and comment. This report has been issued for LCC review and input into the concept design at an early stage, and will allow an opportunity for LCC to consult with the Cullen Bullen community prior to completion of the concept design. It comprises:

- Initial layout of the reticulation mains (open trench and trenchless crossings):
 - Figures indicating plan layout of the pipelines.
 - Graphs included on Appendix A to indicate likely long sections for each pipeline.
- Likely location of the STP to inform the inlet works location based on the likely reticulation layout

1.3 Scope and limitations

This report: has been prepared by GHD for Lithgow City Council and may only be used and relied on by Lithgow City Council for the purpose agreed between GHD and the Lithgow City Council as set out in section 1.2 of this report.

GHD otherwise disclaims responsibility to any person other than Lithgow City Council arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report (refer section(s) 1.4 of this report). GHD disclaims liability arising from any of the assumptions being incorrect.

GHD has prepared this report on the basis of information provided by Lithgow City Council and others who provided information to GHD (including Government authorities)], which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.

GHD has prepared the preliminary cost estimate comparison set out in section 2.4.4 of this report ("Line 3 Options Quantitative and Qualitative Comparison") using information reasonably available to the GHD employee(s) who prepared this report; and based on assumptions and judgments made by GHD using NSW Reference Rates Manual.

The Cost Estimate has been prepared for the purpose of comparison of Line 3 Options only and must not be used for any other purpose.

The Cost Estimate is a preliminary estimate only. Actual prices, costs and other variables may be different to those used to prepare the Cost Estimate and may change. Unless as otherwise specified in this report, no detailed quotation has been obtained for actions identified in this report. GHD does not represent, warrant or guarantee that the [works/project] can or will be undertaken at a cost which is the same or less than the Cost Estimate.

Where estimates of potential costs are provided with an indicated level of confidence, notwithstanding the conservatism of the level of confidence selected as the planning level, there remains a chance that the cost will be greater than the planning estimate, and any funding would not be adequate. The confidence level considered to be most appropriate for planning purposes will vary depending on the conservatism of the user and the nature of the project. The user should therefore select appropriate confidence levels to suit their particular risk profile.

1.4 Assumptions

Assumptions are presented across the report in addition to the following listed below:

- The sewer system and the sewage treatment process developed during the current stage is based on a gravity sewerage reticulation system, with secondary consideration given to pump station and low pressure sewer only when a gravity option cannot be identified.
- The design of a gravity system is based on WSA 02-2014 3.1 Gravity Sewerage Code of Australia.
- LCC have advised that the land acquisition for the STP site is not confirmed and the STP site is to be determined.
- LCC have provide GHD with an aerial image of Cullen Bullen which indicates the extent of Cullen Bullen will be serviced. The service area boundary has been displayed in Figure 1 of this report.

2. Methodology

A site inspection at Cullen Bullen was conducted by GHD and LCC on 26 November 2018 to assess the constraints and topography of the village, and to create a draft sewer layout. Utilising LiDAR and publicly available cadastre information, a desktop study was completed to refine the draft layout, the results of which are presented in Figure 1.

The design criteria used to determine the layout is detailed below:

- Use the topography of Cullen Bullen to utilise gravity pipelines as a priority. Utilise low pressure sewer only if gravity connections are deemed unfeasible.
- Avoid placing sewer pipelines on private properties unless necessary due to topographical and other constraints such as avoiding main road crossings, excessively steep terrain, vegetation constraints (to be considered further as the environmental investigations progress).
- Minimise the need for a pumping station if possible.
- Install sewer along the road corridors whilst limiting the number of crossings of the Castlereagh Highway as much as possible.
- Minimise the impact on the environment by not placing pipelines directly in drainage channels, avoid unnecessary tree clearing and allowing the STP to be placed further from residents to minimise odour concerns.

Cullen Bullen typically slopes from the north east to the south west, allowing the pipe alignments to generally follow the same direction, utilising the localised high points as starting points for the main line and branches.

The proposed location of the STP is in the south west end of the village, which is consistent with the natural slope of Cullen Bullen whilst also maximising potential treated effluent reuse options. The exact location and design criteria of the STP will be confirmed in further stages of the design.

2.1 Design basis

The design of a draft gravity system is based on WSA 02-2014 3.1 Gravity Sewerage Code of Australia. The alignments path was determined favouring LCC's preference of a gravity network over a pressure system. The initial network layout (draft concept) sewer network takes advantage of the natural topography of Cullen Bullen to utilise a gravity sewer network and currently avoids the need for a sewerage pumping station (SPS). Whilst avoiding the need for a SPS the alignment, where possible, the pipeline lies within the road reserves of Cullen Bullen. Where this is not possible, the alignment runs through private property, following fence lines or natural drainage lines to minimise disturbance to the residents.

For the design of the pipelines grades, the minimum pipe slope used are based on Table 5.1 of WSA 02-2014 3.1 and are displayed in Table 2-1.

Table 2-1 Grade Design Criteria

Design criteria	value	unit	Comments
Minimum Pipe Slope			
1.11%	1	ET	Based on Table 5.1 of WSA 02-2014 3.1
1.00%	2	ET	Based on Table 5.1 of WSA 02-2014 3.1
0.83%	3	ET	Based on Table 5.1 of WSA 02-2014 3.1
0.77%	4	ET	Based on Table 5.1 of WSA 02-2014 3.1

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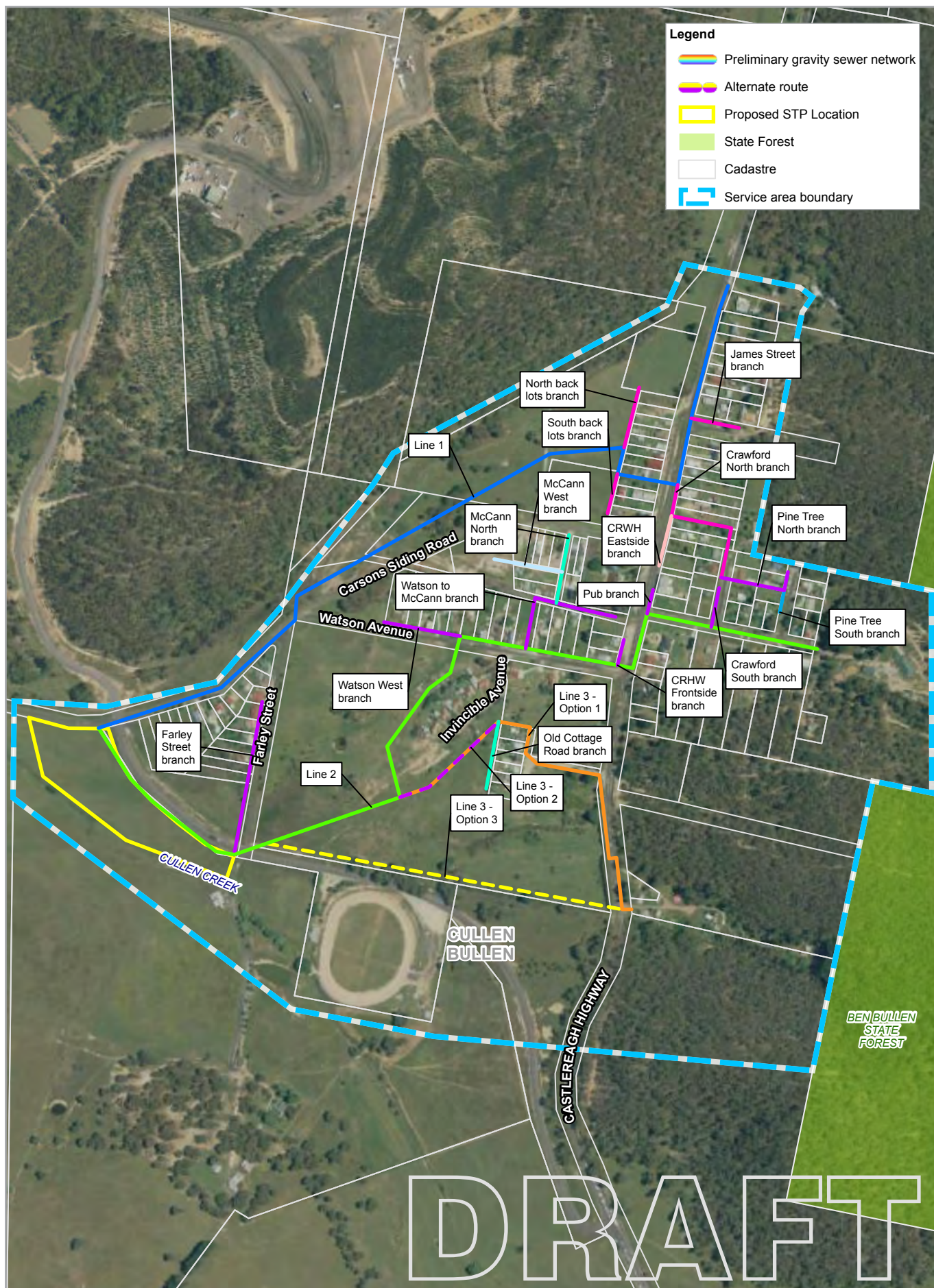
Design criteria	value	unit	Comments
0.67%	5	ET	Based on Table 5.1 of WSA 02-2014 3.1
0.63%	6	ET	Based on Table 5.1 of WSA 02-2014 3.1
0.59%	8	ET	Based on Table 5.1 of WSA 02-2014 3.1
0.56%	9	ET	Based on Table 5.1 of WSA 02-2014 3.1

The assessment was conducted by producing three main pipe runs, or lines, through Cullen Bullen to collect as many properties as possible. The remaining properties were connected into these main lines through the use of branch lines. The data presented discusses various options examined for each line and branch line, with the most feasible option presented in Figure 2. Where many options exist and the preferred option is not clear, options have been presented for LCC review and confirmation of the preferred option.

Sections 2.2 to 2.20 provide further details on the selection of the draft concept design pipeline arrangement as displayed in Figure 2, whilst also highlighting options for LCC consideration.

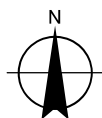
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Paper Size ISO A4
0 50 100 150 200
Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55



Lithgow Council
Cullen Bullen Sewage Scheme - Concept Design

Project No. 22-19903
Revision No. A
Date 12/12/2018

**Cullen Bullen Sewer
Draft Alignment with Section Labels**

FIGURE 2

2.2 Line 1 - Blue

Line 1 – Blue is the proposed sewer main line servicing the north side of Cullen Bullen at approximately 1.4 km in length. Line 1 – Blue runs from the north most properties of Cullen Bullen along the east side of the Castlereagh Highway (CRHW), crosses CRHW and the small side road. The pipeline then runs along the fence line of property 29 of CRHW (within private property), follows the creek bed line in property 10 of Carson Siding Road, south west until Watson Avenue and crosses Carsons Siding Road and then follows the east side of Carsons Siding Road until Portland Cullen Bullen Road and then to the approximate STP site.

Table 2-2 Line 1 – Blue Sections Table

Section	Position	Advantages	Disadvantages
CRHW to CRHW crossing	East side of CRHW – along road reserve	<ul style="list-style-type: none"> Properties of East side of CRHW slope to front Able to pick up James Street flow without additional cross of CRHW Low point at bend and can capture flow from properties North and South of bend 	<ul style="list-style-type: none"> Have to Cross CRHW Footpath along pipeline may need restoring if impacted
CRHW crossing and trenching along fence line of property 29	Under bore road (TBC in detailed design) – under road and private property	<ul style="list-style-type: none"> A lot of flow has been captured and number of crossings minimised Able to continue straight with minimal impact to property 29 of CRHW during trenching 	<ul style="list-style-type: none"> Boring under two streets not just one Crossing residents property
Alignment behind CRHW lots between the two bends	Behind properties close to fence line– Private property	<ul style="list-style-type: none"> Able to pick up North and South lots flow as localised low point Minimal disturbance to properties 	<ul style="list-style-type: none"> Crossing residents property
Creek bed run to Watson Street	Along creek bed - private property and road reserve	<ul style="list-style-type: none"> Creek bed allows for continual fall and remains out of the way. 	<ul style="list-style-type: none"> Crossing residents property Installation parallel to the creek will special require consideration for erosion control, and flooding

Section	Position	Advantages	Disadvantages
Crossing then following Carsons Siding Road	Crossing then following south east side of road - road reserve	<ul style="list-style-type: none"> • One crossing of Carsons Siding Road • Allows properties on Carsons siding road to be serviced • Continuing falling slope ideal for gravity network 	

2.3 Line 2 - Green

Line 2 – Green is the proposed sewer main line to service the central section of Cullen Bullen at approximately 1.4 km long. Line 2 - Green starts at the east most sealed section of Kings Street and runs west on the south side of the road until it reaches the CRHW. The pipeline then runs south along the east side of the CRHW until it aligns with the north side of Watson Avenue. The pipeline then crosses CRHW and continues to run along the north side of Watson Avenue, servicing all the properties until the alignment hits the front of property 22 Watson Avenue. The low point of Watson Avenue is located at the bend in the design, at which point the pipeline crosses the road and runs down the back of the Invincible Avenue properties. After the properties, the pipeline crosses to a second creek bed where it then bends and follows the natural topography of the lot until it hits the corner of the private road that Cullen Bullen Raceway is on and Farley Street. The alignment then crosses the private road and follows the slope down to the corner of Portland Cullen Bullen road where line it feeds into line one.

Table 2-3 Line 2 – Green Sections Table

Section	Position	Advantages	Disadvantages
King Street	South side of King Street – Road reserve	<ul style="list-style-type: none"> • Running along the south side of King Street allows all the properties to be serviced and the Crawford South and Pub branch to cross whilst picking up the properties on the opposite side of the road. 	<ul style="list-style-type: none"> • There are five driveways that will need to be reinstated • Some property connection will need to cross King Street unless a second section of pipe runs along the north side of Kings Street. Note: This will mean Pine Tree and Crawford streets will need to be crossed and additional pipeline installed.

Section	Position	Advantages	Disadvantages
CRHW and Watson crossing	West side of CRHW road reserve and road	<ul style="list-style-type: none"> Services properties on East side of CRHW. Crossing location sets up to service properties that on north side of Watson Avenue which slope to the front. 	<ul style="list-style-type: none"> Under bore required for crossing (for consideration in detailed design).
Watson Avenue to bend	North side of Watson Avenue - road reserve	<ul style="list-style-type: none"> Services properties along Watson and allows branches running through back of McCann to be collected. Properties on west side of Watson can be connected with an additional branch. 	<ul style="list-style-type: none"> Two properties on south side of Watson Avenue will need property connects to cross Watson Avenue or addition line to run on the South side of the road (option). Will need to reinstate driveways along Watson Avenue.
Watson Avenue crossing and along back properties	Along back side of Invincible Avenue properties – road, road reserve and private property	<ul style="list-style-type: none"> Minimal distance to properties Invincible Avenue properties slopes to the back which allows for servicing 	<ul style="list-style-type: none"> Permission to run pipeline through the plot of land.
Bend where Line 3 - Yellow option meets to Farley Street crossing	Through Mine owned plot of land in creek bed - private property, road reserve and road	<ul style="list-style-type: none"> Plot slopes naturally to Farley Street crossing. Allows for Old Cottage properties to be serviced and connect with an assisting slope. Crosses Private road which is fenced off so minimal disruption to traffic and minimal traffic control required. 	<ul style="list-style-type: none"> Permission to run pipeline through the plot of land. Installation near the creek/ drainage line will special require consideration for erosion control, and flooding.

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Section	Position	Advantages	Disadvantages
Along south side of Private road to Line 1 - Blue	South side of Private road - private property	<ul style="list-style-type: none"> Slope of the route assists gravity system and meets with Line 1- Blue to be taken to STP location (which is TBC). Minimal impact to surrounding properties. 	<ul style="list-style-type: none"> Private road may be used more often than anticipated and require traffic control.

2.4 Line 3 – Yellow options

There are three options currently being considered to determine how to service the properties of Windy Gully road. The options are described below.

2.4.1 Option 1

Option 1 aims to connect the properties of Windy Gully Road with the orange pipeline displayed in Figure 2. Option 1 pipeline starts at the southern section of Windy Gully Road and will service the properties around Windy Gully Road. The alignment runs north and crosses the CRHW just north of the northern section of Windy Gully Road. After crossing CRHW the pipeline runs north along CRHW until it hits Old Cottage Road where it heads west along the road. The alignment then continues north the around the back of the most north property of Old Cottage Road. The alignment then follows the creek bed until it reaches Line 2 - Green and then terminates.

Option 1 is a feasible option to service the Windy Gully Road properties as it avoids trenching through the properties adjacent to Windy Gully Road and allows the properties of Old Cottage Road to connect.

The advantages and disadvantages of Option 1 include:

Advantages

- Windy Gully Road properties will be able to be serviced.
- Old Cottage Road is serviced without additional pipework's.

Disadvantages

- Additional 415 m of pipeline to service approximately six (6) properties.
- Additional traffic control for trenching alongside CRHW.
- Additional RMS approvals for trenching alongside CRHW.

2.4.2 Option 2

Option 2 considers the option of not servicing Wind Gully Road via the sewer network and using other means to dispose of the sewage. Line 3 Option 2 simply then runs from the Old Cottage branch to Line 2 – Green without the sewage from Windy Gully feeding in.

Option 2 is a feasible option as LCC may choose to not service the Windy Gully Road properties to avoid extra costs to service only a few properties.

The advantages and disadvantages of Option 2 include:

Advantages

- Avoid additional 415 m (Option 1) or 524 m (Option 3) of pipeline to service the approximately six (6) properties.
- Avoid additional RMS approvals required to cross CRHW for that section.
- Only cross CRHW two times for entire network.
- Most economic option.

Disadvantages

- Windy Gully Road properties will be not be serviced, which may breach the goal of servicing the entire township.
- Old Cottage Road will require a connection pipeline section.

2.4.3 Option 3

Option 3 aims to connect the properties of Windy Gully Road with the Line 2 - Green. Option 3 pipeline starts at the southern section of Windy Gully Road and will service the properties around Windy Gully Road. The alignment runs west crossing CRHW and then runs down the fence line of the adjacent property and connects into Line 2 - Green close to the Farley Street crossing.

Since this option does not connect into Old Cottage Road to service those properties, the extra branch described in Option 2 - Green is also utilised.

Option 3 is a feasible option to service the Windy Gully Road properties as it avoids trenching alongside the CRHW which would require additional RMS approvals.

The advantages and disadvantages of Option 3 include:

Advantages

- Windy Gully Road properties will be able to be serviced.
- Provides a straight route to connect into Line 2- Green.
- Avoids additional RMS approvals required to trench alongside CRHW.

Disadvantages

- Additional 524 m of pipeline to service approximately six (6) properties.
- Requires trenching through private property to connect into Line 2- Green.

2.4.4 Line 3 Options Quantitative and Qualitative Comparison

GHD have prepared a high level cost comparison utilising the NSW Reference Rates Manual (Water.nsw.gov.au, 2014) to compare the options for Line 3 quantitatively. The options assessment was performed by summing the additional costs associated with servicing Windy Gully using Option 2 as a baseline (excluding 182 m section servicing Old Cottage Road). Each option was assess assuming a DN150 pipe, 1.5 m to 3 m depth rates for trenching and assuming construction difficulty of HIGH due to the highway and the requirements for traffic control. Table 2-4 displays a quantitative comparison of the options and summaries the estimated additional cost and the breakdown of each Line 3 option. Note it presents costs comparison information only and does not include construction preliminaries, overheads, on-costs, design costs, owner's costs etc.

Table 2-4 Line 3 Quantitative Options Comparison Table

Parameter	Rate	Option 1	Option 2	Option 3
Additional trenching length	\$248/m	415 m	-	541 m
Trenching in Rock – additional cost	\$18/m	120 m*	-	-
Trenching next to CRHW - Traffic control	\$119/m	225 m	-	32 m
Total additional Costs	-	\$131,805	\$ 0	\$ 137,855

*Assumes 120 m of alignment will require trenching through rock due to as alignment runs alongside a rock road cutting on CRHW.

Table 2-5 displays a qualitative comparison of the options.

Table 2-5 Line 3 Qualitative Options Comparison Table

Criteria	Option 1	Option 2	Option 3
Services the properties of Windy Gully	✓	✗	✓
Avoids additional traffic control	✗	✓	✓
Reduces Number of times Castlereagh Highway is crossed	✗	✓	✗
Collects to Old Cottage Road along route	✓	✗	✗
Avoids cutting through properties	✓	✓	✗

We will consider LCC comments, in conjunction with community input, to determine which option is progressed, or consider/ propose an alternative option that will be implemented into the final concept design.

2.5 James Street branch

James Street branch runs along the north side of the road and run west to connect into Line 1 - Blue. The advantages and disadvantages of this alignment includes:

Advantages

- Natural topography of the road slopes to west.
- Located on north side as to capture properties facing James Street.
- Able to service properties of north side of road with the two properties on the south of James Street to have property connections to the James Street branch or Line 1 - Blue, whichever is closest. Property connections to be determined in detailed design.

Disadvantages

- Required to reinstate driveways along north side.

2.6 Crawford North branch

Crawford North branch starts on the crest of Crawford Street and runs north along the west side of the road. The alignment then proceeds to run through the back of properties 30 and 32 of CRHW. This is advantageous as the alignment follows the slope of the lots. The pipeline is then bent to run along the southern fence line of property “34-40” of CRHW toward CRHW. When the branch means CRHW, the alignment then bends again to run north to connect into Line 1 - Blue. The advantages and disadvantages of this alignment includes:

Advantages

- Natural topography of the road slopes to north heading towards Line 1 – Blue.
- Able to service many properties and allow many connections of smaller branches.
- Cuts through property at back of lot away from house.
- Runs along property 34-40 of CRHW fence line with minimal impact to the surroundings.

Disadvantages

- Runs through three residential lots to follow the negative grade

Note

A localised crest along Crawford Street prevents all properties draining via a gravity into Line 2 – Green along the road reserve. Therefore, the flows are directed to Line 1- Blue through private property by following the localised low points and drainage lines to avoid the need for pressure sewer connections.

2.7 Castlereagh Highway (CRHW) East Side branch

The CRHW East Side branch services three lots (lots 28, 30 and 32 of CRHW) and connects to the Crawford North branch. The properties to be connected to the branch all slope towards CRHW. A localised crest is present on Castlereagh Highway approximately in front of the pub. The crest allows captured flows just north of the pub to flow back to Crawford North branch and then Line 1 - Blue.

2.8 North Back lots branch

North Back Lots branch runs from the back of lot 49 of CRHW to the back of lot 39 of CRHW where it connects into Line 1 - Blue. There is a localised crest in the North Back Lots branch which requires the pipe trench to be a maximum of 3.6 m deep for approximately 30 m. This is the preferred alignment to service the properties along this branch. Alternatively, an alignment could run along the front of the properties, however this would disrupt any existing infrastructure, such as footpaths, and add unnecessary cost to the restoration process.

2.9 South Back lots branch

South Back lots branch runs from the back of lot 25 of CRHW to lot 33 of CRHW where it connects into Line 1- Blue. The proposed alignment branch slopes towards Line 1- Blue with the properties that will be serviced sloping towards the south back sewer branch.

2.10 Pine Tree North branch

Pine Tree North branch runs along the front of properties 3 and 5 of Pine Tree Avenue (West side of road) then down the fence line of lot 2 of Crawford Street to connect into the Crawford North branch. This alignment was chosen as there is a localised sag in Pine Tree Avenue. To avoid deep trenching of up to 8.5 m when trying to connect into Line 2 – Green, the proposed alignment will run down the natural drainage line along the fence line of property 2 of Crawford Street, therefore causing with minimal disruption to the resident's property. The advantages and disadvantages of this alignment includes:

Advantages

- Utilises gravity system over pressure system.
- Avoids deep trenching.
- Able to service many properties and allow many connections of smaller branches.
- Pipeline sits in natural drainage line so minimise disturbance to the property.
- Cuts through property at back of lot away from the house.

Disadvantages

- Runs through residential lot while following the negative grade.
- Need to reinstate residential fences.

2.11 Pine Tree South branch

Pine Tree North branch runs along the West side of the road and slopes toward the sag where it then connects into Pine Tree North branch. Again, due to the sag of the road a deep trench would be required to connect into Line 2 – Green.

2.12 Crawford South branch

Crawford South branch runs from the top of the road crest south toward Line 2 - Green where it connects into Line 2 – Green. This alignment utilised the slope of the hill whilst servicing the properties on the southern end of Crawford Street.

2.13 Pub branch

Pub branch runs up CRHW on the eastern side of the highway. This alignment utilises the localised crest in front of the pub to capture the flows from the Pub and the future flows of the undeveloped sites adjacent.

2.14 Castlereagh Highway West Side branch

This branch runs on the western side of Castlereagh Highway to Watson Avenue where it connects into Line 2 - Green. This branch is primarily for servicing the residents of lots 9 and 11 of CRHW.

2.15 Watson to McCann branch

Watson to McCann branch runs along the back of properties 2, 4, 6, 13 of Watson Avenue and then along the fence line of Lot 8 to then connect into Line 2 - Green on Watson Avenue. This branch services a few of the residents close by including Cullen Bullen Primary School.

2.16 McCann North branch

McCann North branch runs south along McCann way and connects into the Watson to McCann branch. This branch is to service the surrounding properties and possibility a future amenities block at the children's playground.

2.17 McCann West branch

McCann North branch runs east along the side street of McCann Way and connects into the McCann North branch. This branch is to service residents at property 5, 9, 11 of McCann Way as well as Cullen Bullen rural fire service building.

2.18 Watson West branch

Watson West branch runs east toward Watson Avenue's localised sag where it connects into Line 2 - Green. This branch will service the properties on the western end of Watson Avenue.

2.19 Farley Street branch

Farley Street branch runs south along the west side of Farley Street and connects into Line 2 - Green. This branch services the properties on the west side of the street and used the natural slope of the hill to convey flow using gravity. An option was trialled to determine if Farley Street could connect into Line 1 – Blue, to reduce its length but it was found a maximum 4.4 m deep trench over 100 m was required to connect. The option displayed in Figure 1 which is to connect into Line 2 – Green was found to be the more logical approach to service these lots.

2.20 Old Cottage Road branch

The Old Cottage Road branch runs along the back of the Old Cottage Road as the properties all slope towards the rear. The branch then runs north towards Line 3 (Option 1, 2, or 3 depending on the preferred option) where it then connects. The branch's alignment slopes towards Line 3 which benefits the gravity system being utilised.

3. Summary of pipeline lengths

Table 3-1 summaries the approximate lengths of each section and compares the total length of the sewer network with the three (3) different options for Line 3. Whilst the values are listed to the meter, these lengths are not reliable indicators of the lengths of pipelines that will be determined in the concept design. They are provided for information and discussion purposes only. This is because there has been no inclusion of accurate manhole locations or number, fittings, or other considerations regarding REF input and geotechnical conditions.

Table 3-1 Approximate Proposed Section Lengths

Section	Unit (m)
Line 1 - Blue	1,312
Line 2 - Green	1,388
Line 3 – Orange - Option 1	597
Line 3 – Orange - Option 2	182
Line 3 – Yellow - Option 3	706
James Street	70
Crawford North	206
CRHW Eastside	82
North Back Lots	90
South Back Lots	58
Pine Tree North	117
Pine Tree South	31
Crawford South	58
Pub Branch	33
CRHW Front side	36
Watson to McCann	189
McCann North	100
McCann West	98
Watson West	109
Farley Street	225
Old Cottage Road	94
Total: Line 3 - Option 1	4,894
Total: Line 3 - Option 2	4,479
Total: Line 3 - Option 3	5,003

4. Additional and future connections

Table 4-1 below lists the lots that are not provided with a gravity pipeline connection either on the lot or at the boundary to allow wastewater connections with the service area displayed in Figure 1.

Table 4-1 Properties Not Provided with Gravity Pipeline at their Boundary

Lot and DP number	Reasoning
Lot 25, DP 2284	Lot is not currently developed. Gravity pipe “James Street branch” could be extended to service this property at LCC direction.
Lot 5, DP 13644	Lot is not currently developed.
Lot 6, DP 13644	Lot is not currently developed.
DP528538	Lot is not currently developed.
Lot 100, DP 1050450	Lot is difficult to connect under gravity with full consideration to the methodology and constraints listed in Section 3 above. Connection into “Line 2” before it crosses CRHW may be feasible; however, this would need to be confirmed during detail design when property surveys are completed. Otherwise, a low pressure pot is required to service this property.
Lot 101, DP 1106315	Lot is difficult to connect under gravity with full consideration to the methodology and constraints listed in Section 3 above. With “Line 1” placed on the other side of CRHW, a feasible yet likely expensive method to service this property is through an individual property connection crossing of CRHW. Alternatively, “North Back Lots branch” could be extended closer to Lot 101, or a longer property connection from Lot 101 through Lot 102 DP 1106315 could be achieved. LCC to advise, following community consultation. Information from the property survey (gathered in detail design) is required to further define the servicing options for this lot.

We recommend that LCC place the requirement to provide wastewater connection for any future development on these lots (and future lots/ subdivisions) onto the relevant developer. The most likely connection type for these lots will be via low pressure sewer connections to the nearest gravity main, with the exception of lots that are upstream of a proposed gravity line (for example battle axe subdivisions). We note that should any development be undertaken in the Cullen Bullen STP catchment, particularly regarding new trade waste produces, then the capacity of the pipelines and STP will need to be reviewed.

5. Conclusion

The initial network layout (draft concept design) has been issued to LCC for review. Following LCC consideration, the draft design may be used for the LCC's upcoming community consultation session. We will incorporate LCC and the Cullen Bullen community's comments in the next stage of the concept design development.

DRAFT

6. References

- Water.nsw.gov.au (2014)
https://www.water.nsw.gov.au/_data/assets/pdf_file/0004/549598/nsw-reference-rates-manual-valuation-of-water-supply-sewerage-and-stormwater-assets.pdf [Accessed 12 Dec. 2018].
- WSA-02 – Sewerage Code of Australia Part 1 2014

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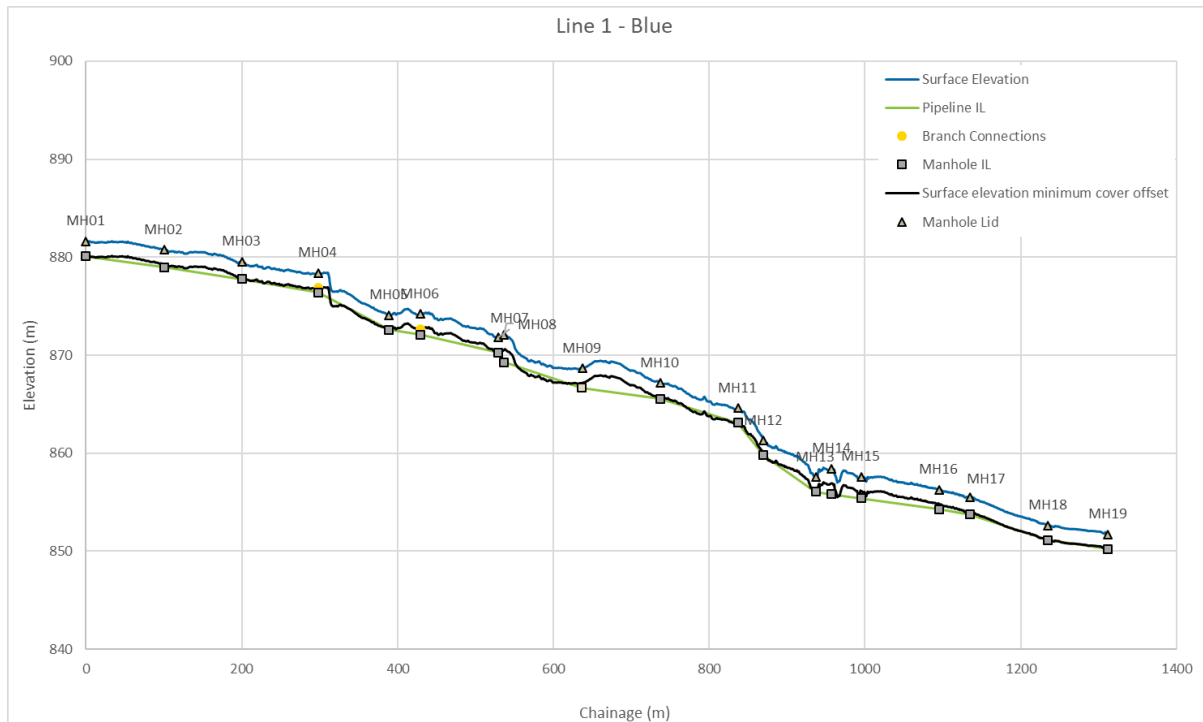
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Appendices

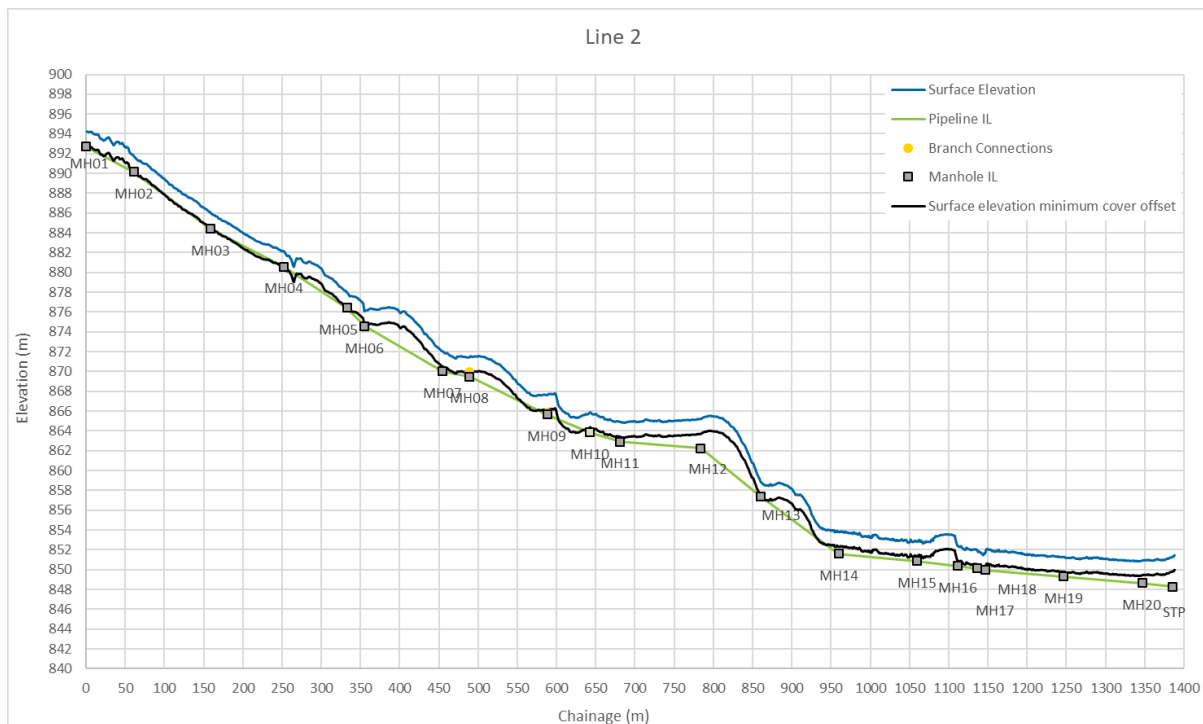
Appendix A – Preliminary Pipe Profiles

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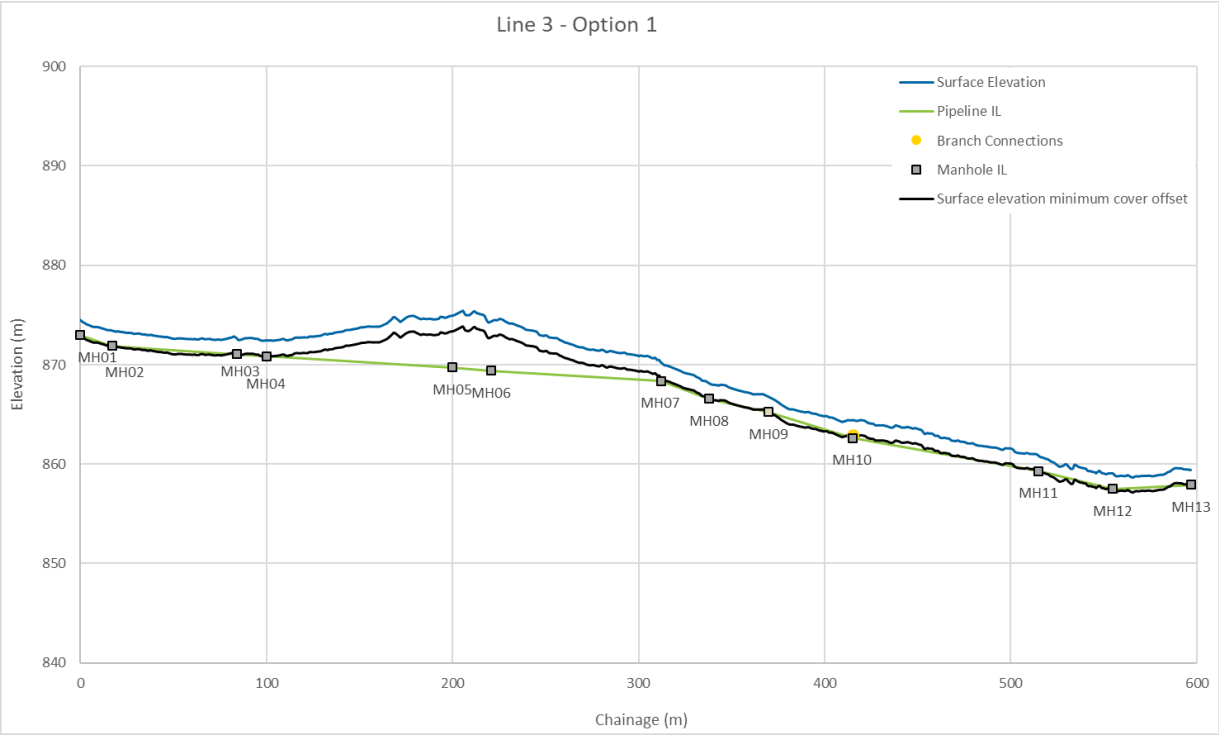
The long sectional profiles provided are indicative of chainages and elevations to demonstrate the feasibility of the layout presented in Figure 2. Further detailed long sections will be presented in the scaled technical drawings as the concept design progresses. MH locations and names are preliminary for the purposes of this appendix only and will be updated as the design progresses.



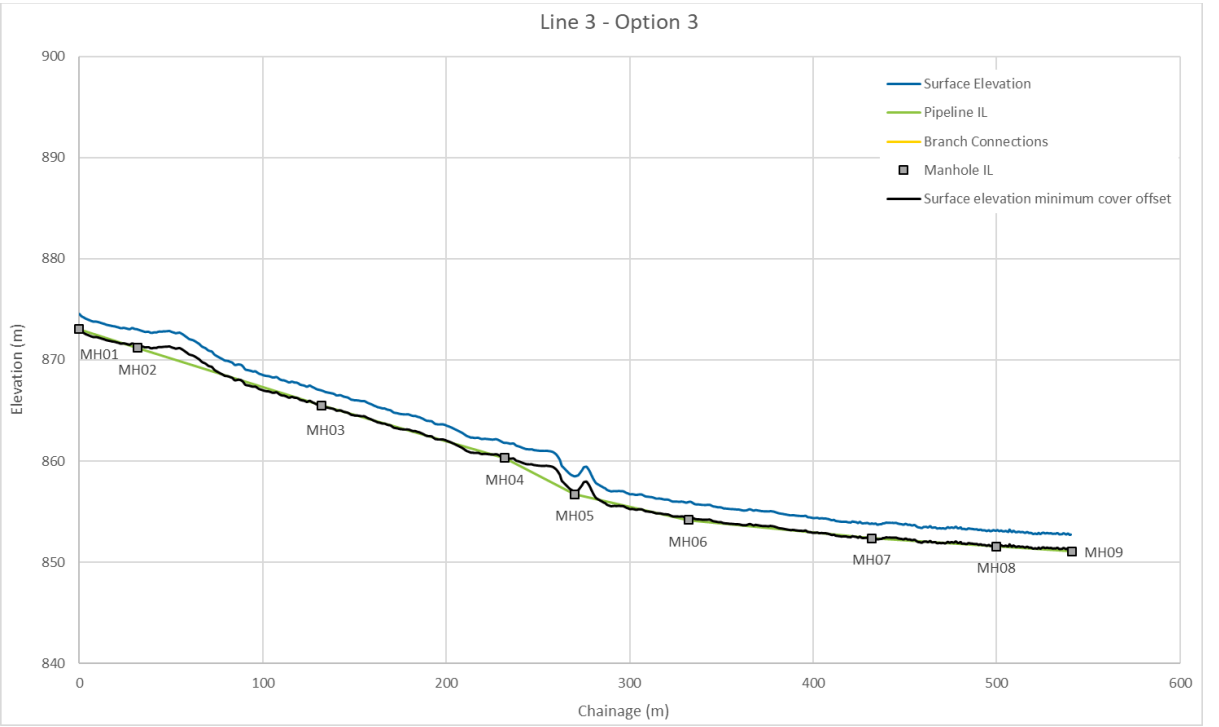
2.2 Line 2 - Green



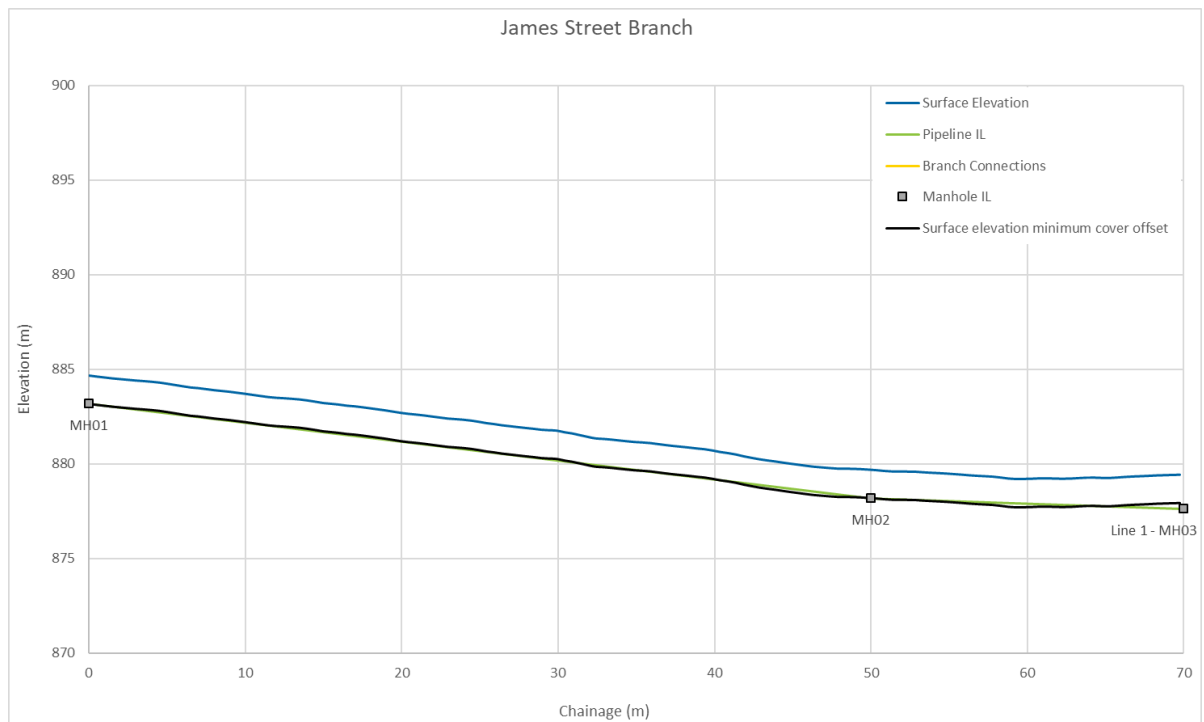
1.3.1 Orange



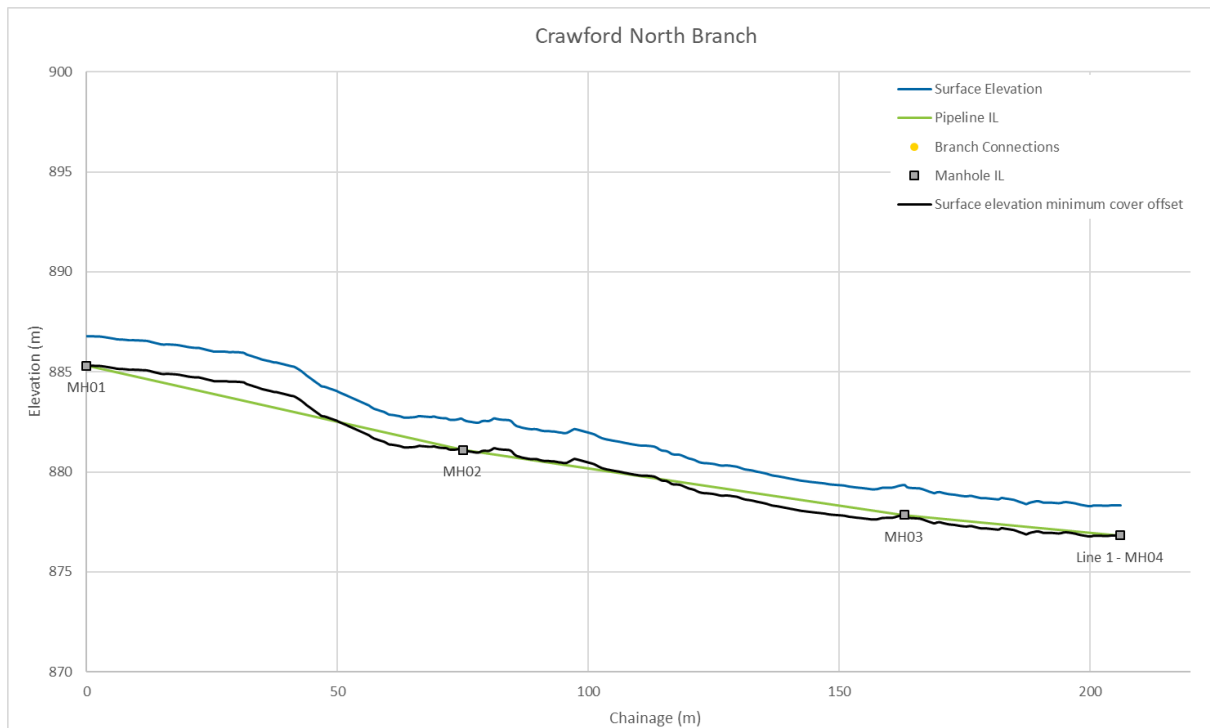
1.3.2 Yellow Dashed



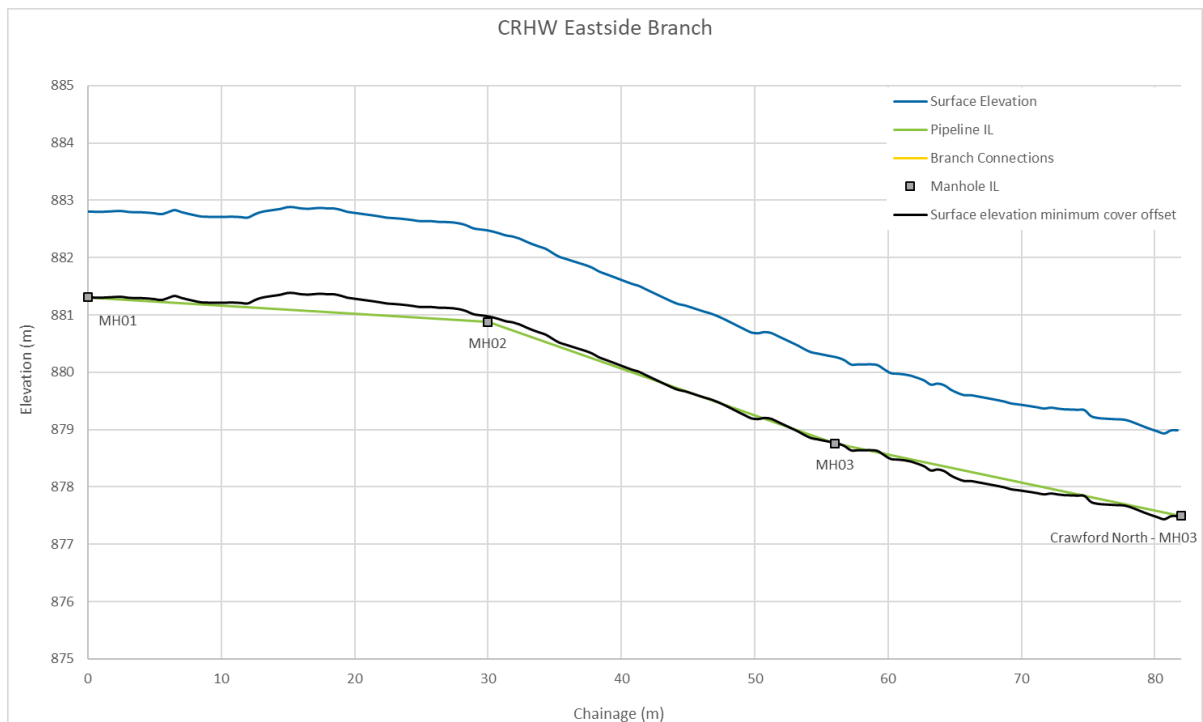
2.3 James Street Branch



2.4 Crawford North Branch

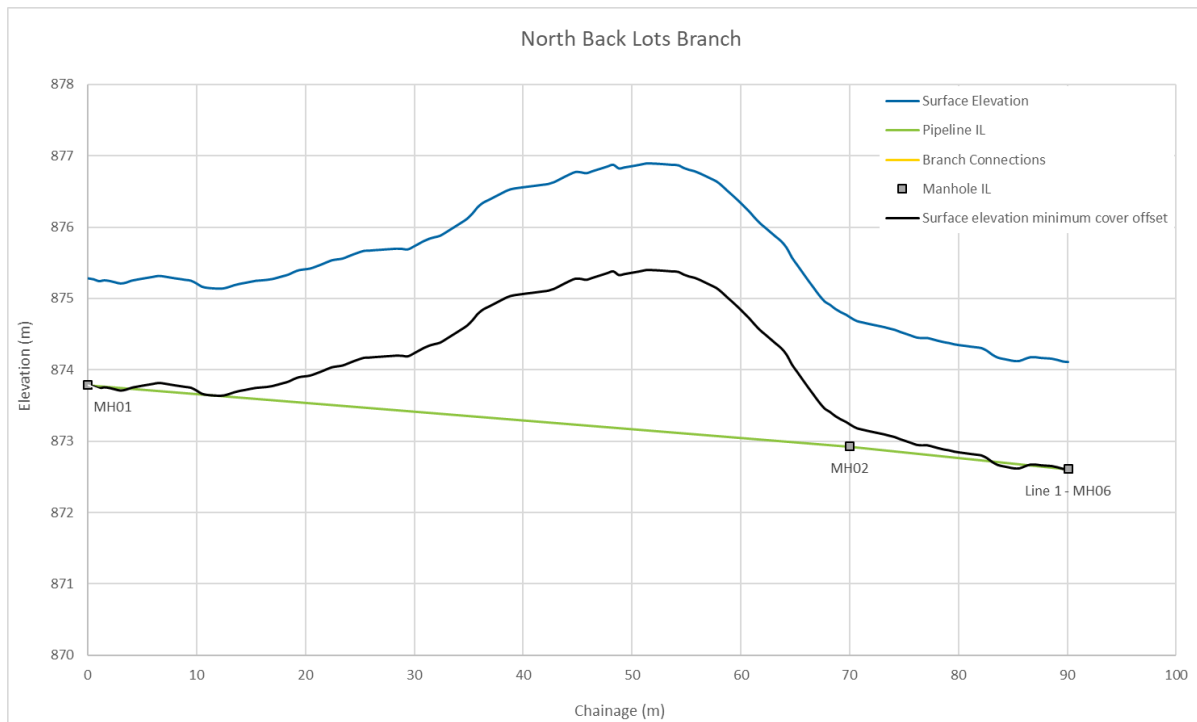


2.5 Castlereagh Highway (CRHW) East Side Branch

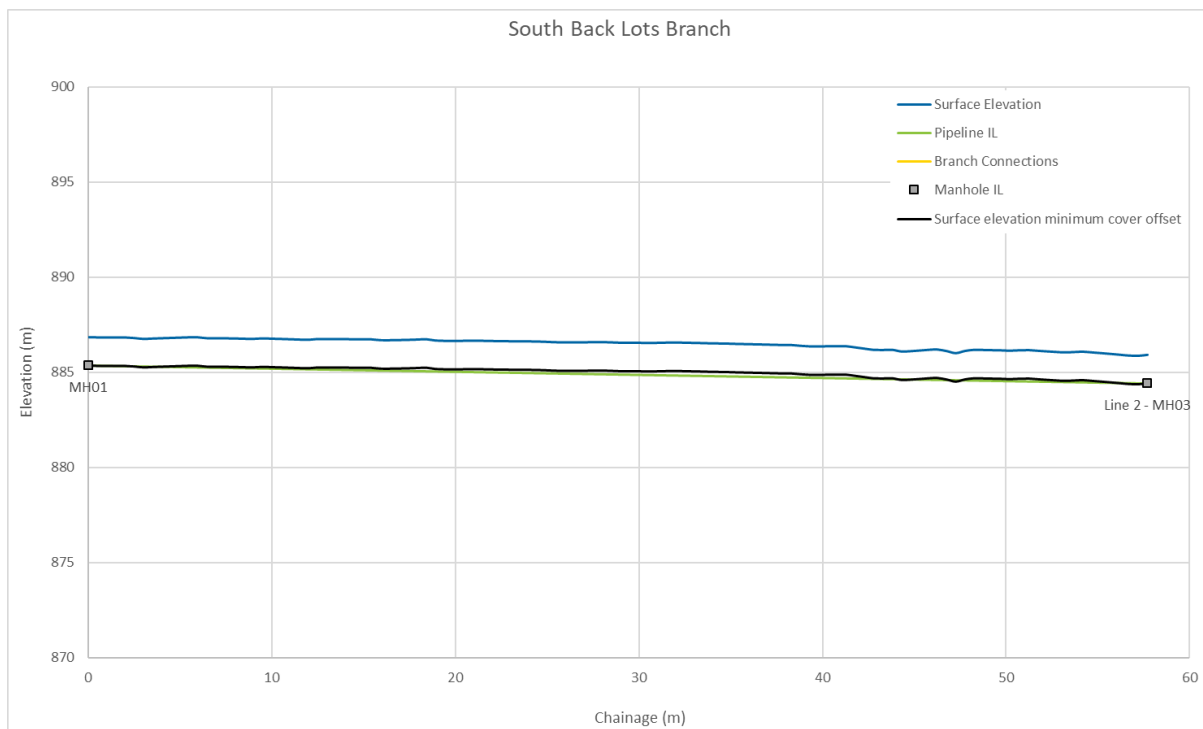


NOTE: Extended for empty lots.

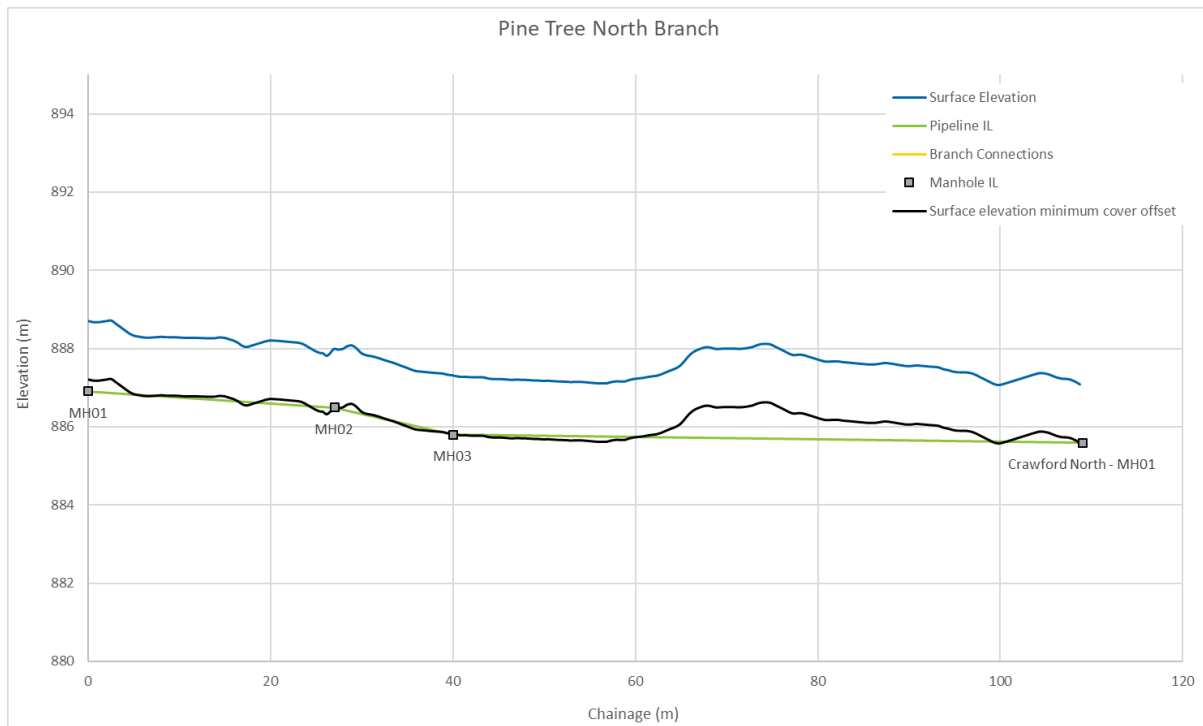
2.6 North Back Lots Branch



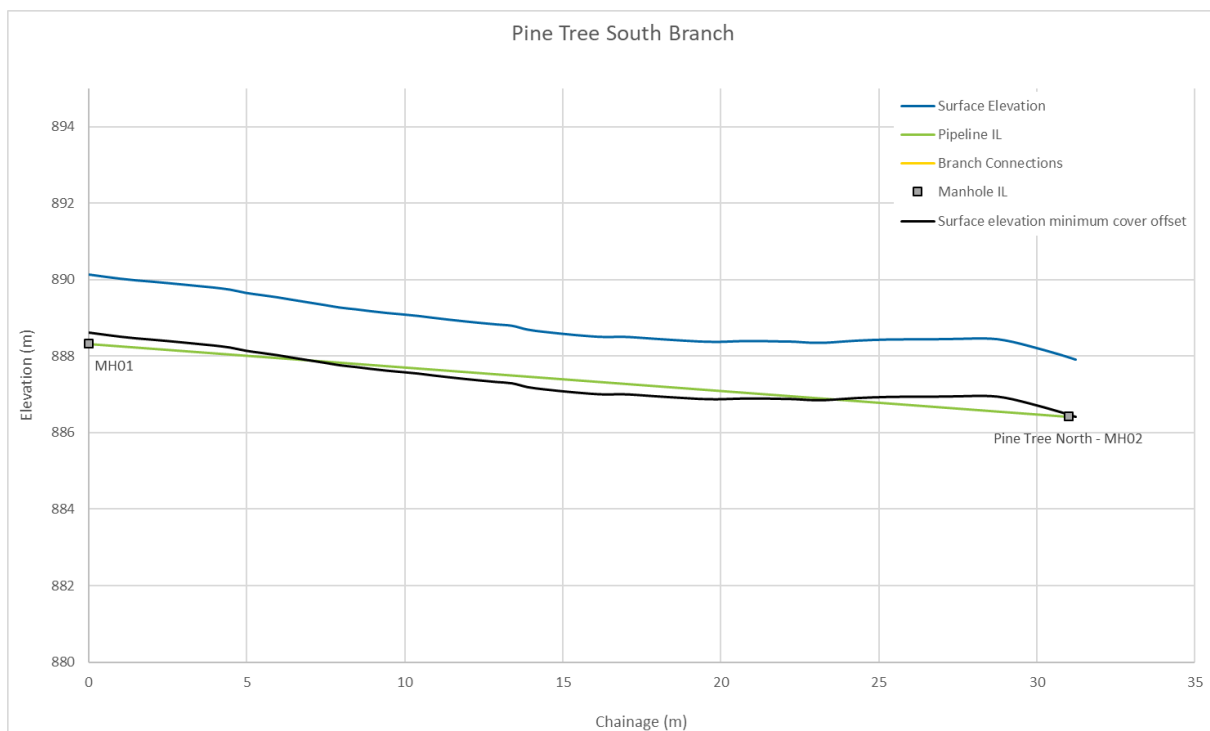
2.7 South Back Lots Branch



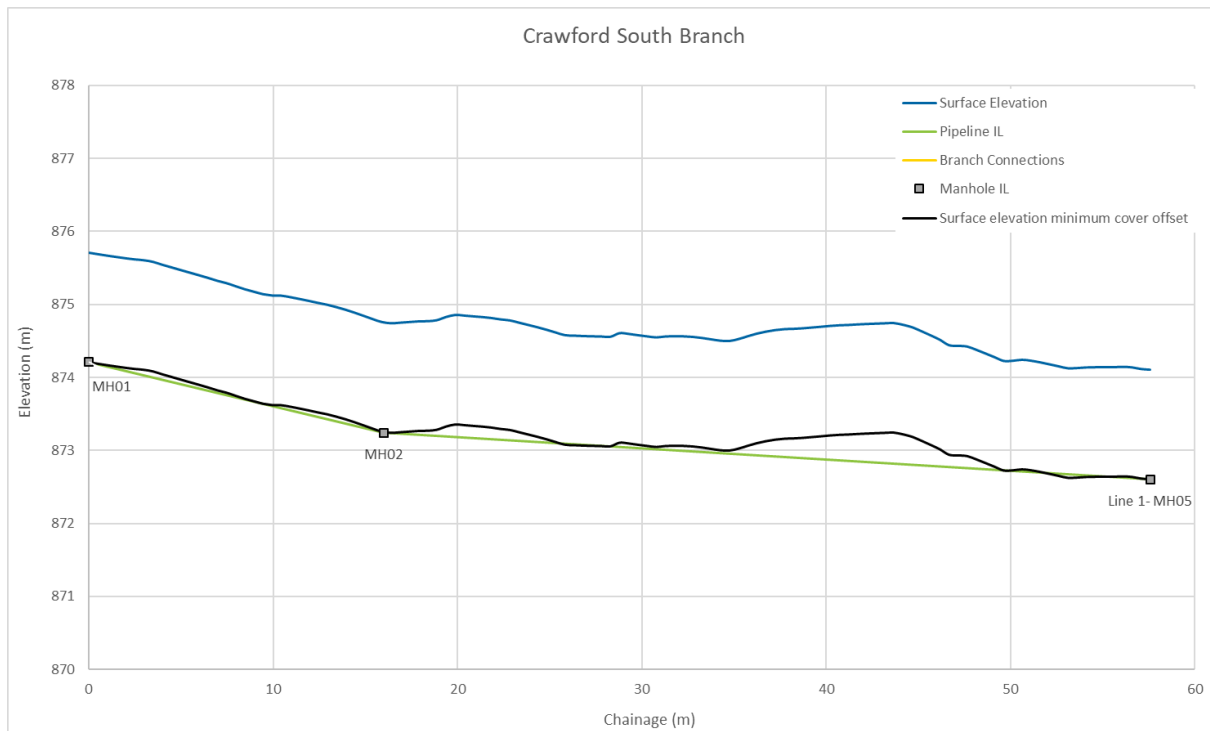
2.8 Pine Trees North Branch



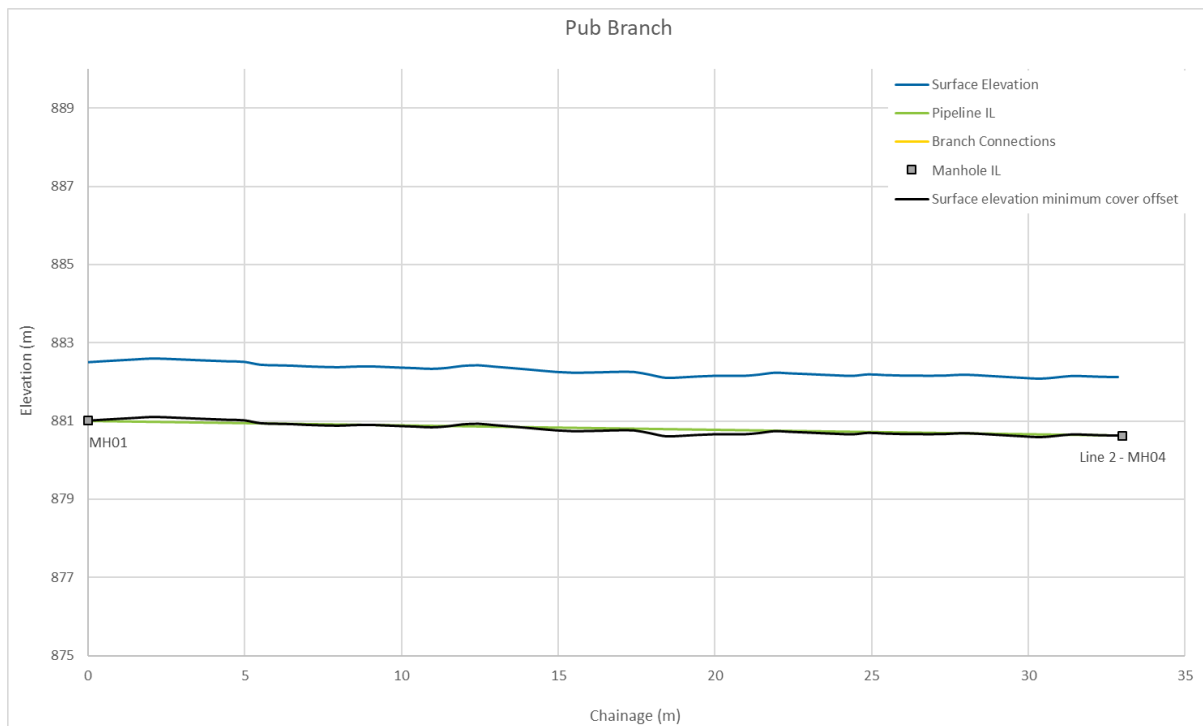
2.9 Pine Trees South Branch



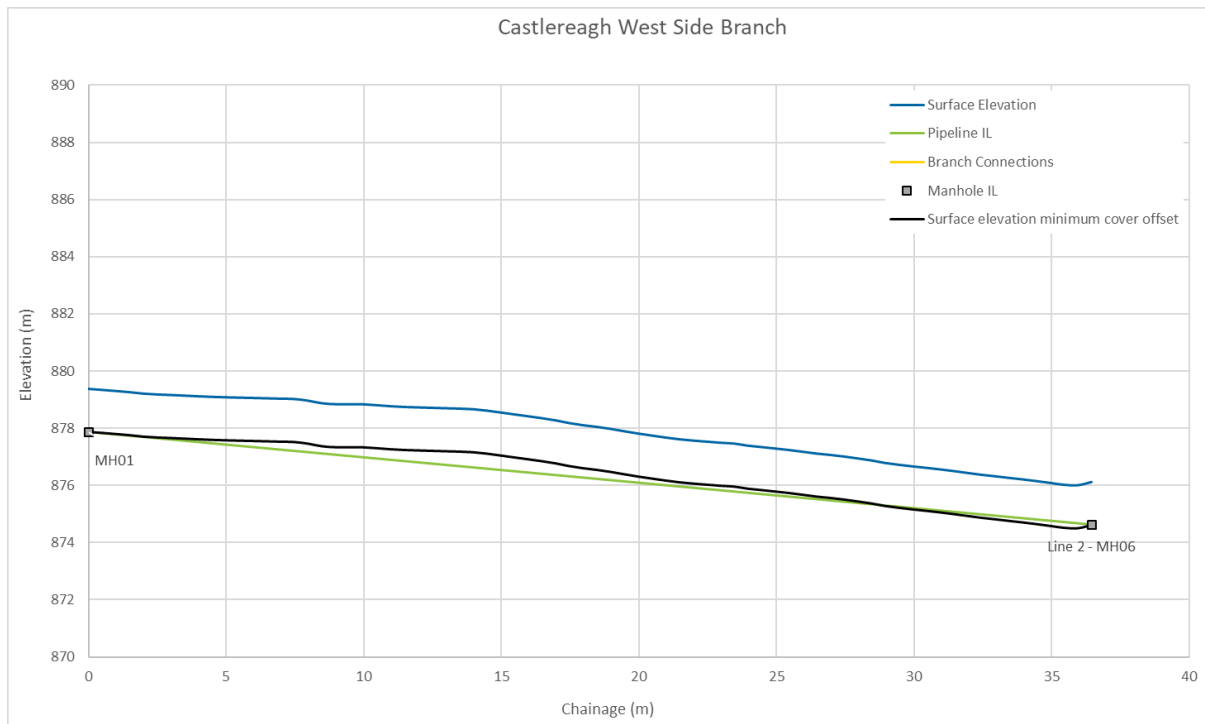
2.10 Crawford South Branch



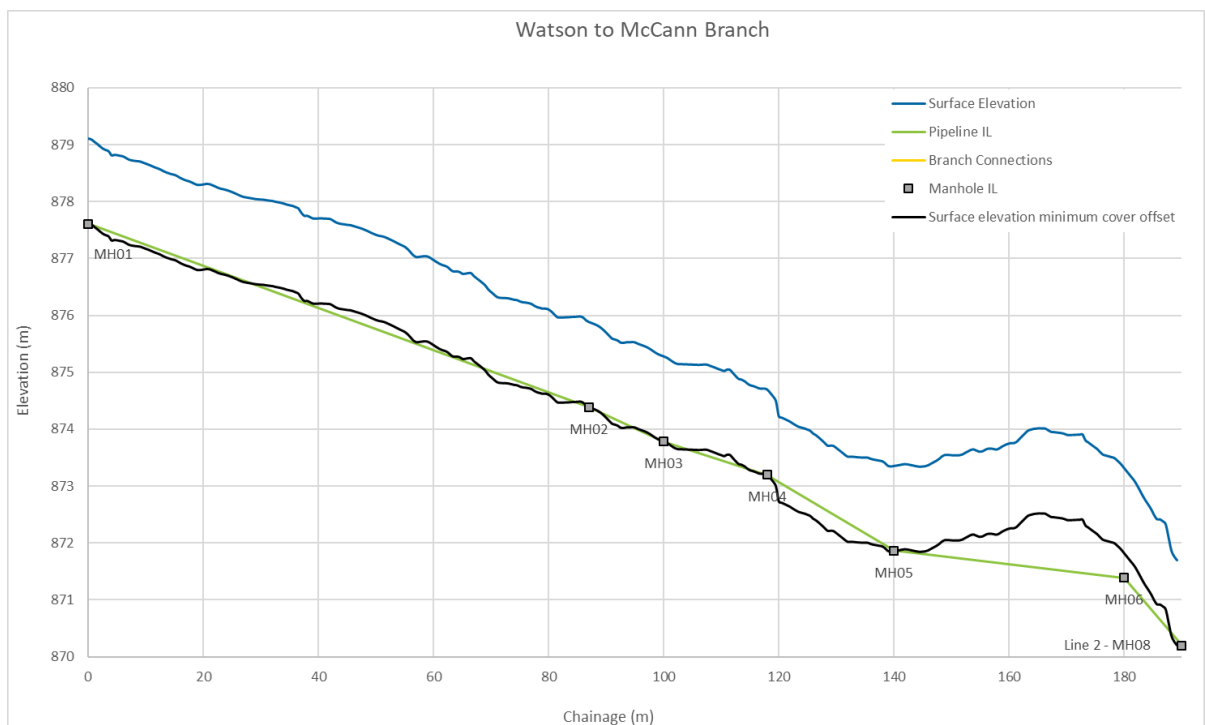
2.11 Pub Branch



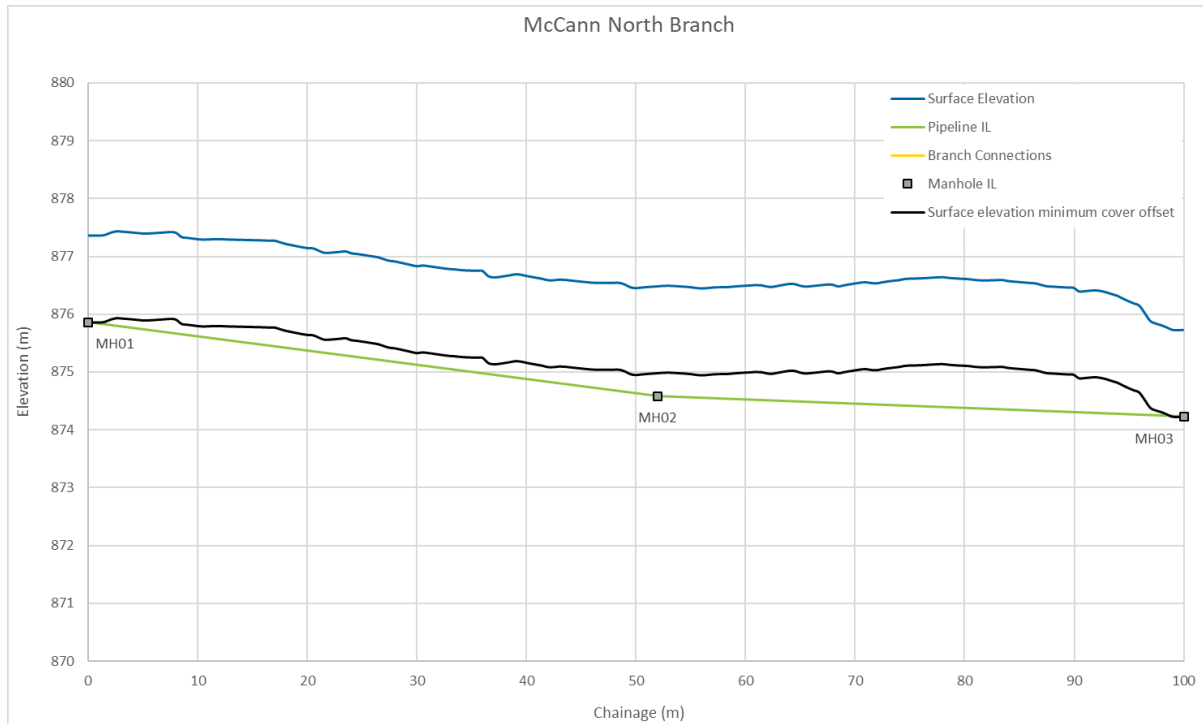
2.12 Castlereagh Highway West Side Branch



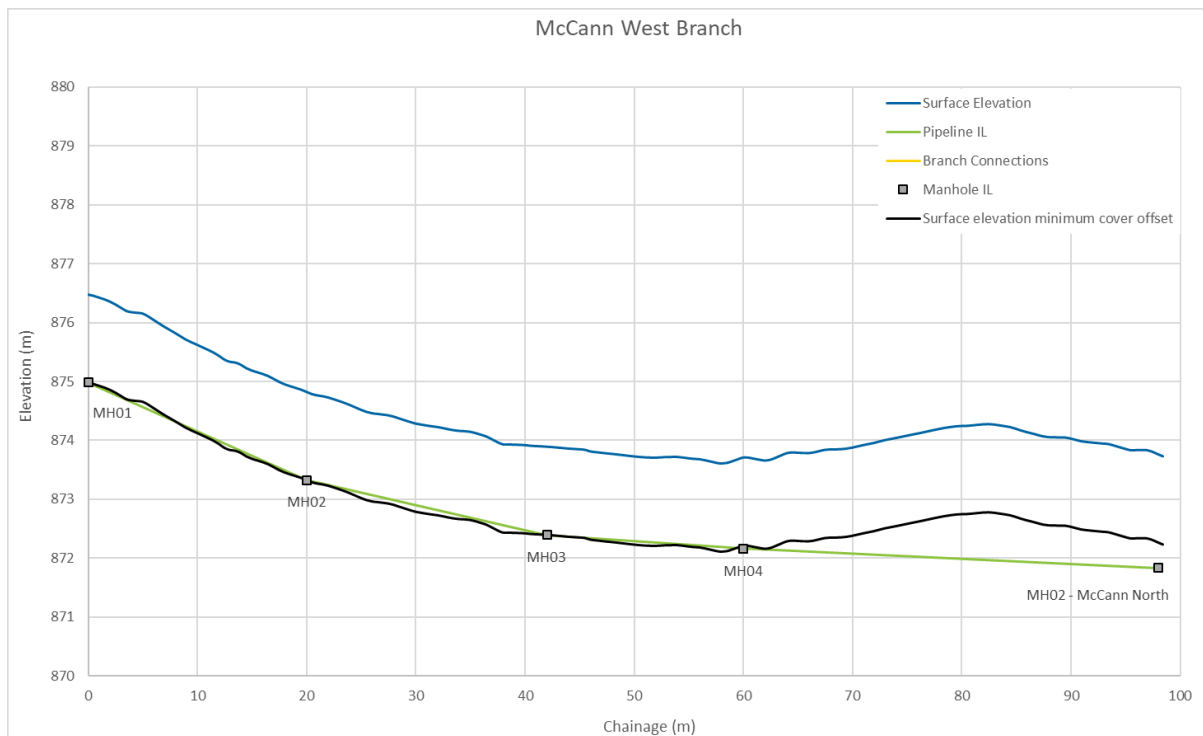
2.13 Watson to McCann Branch



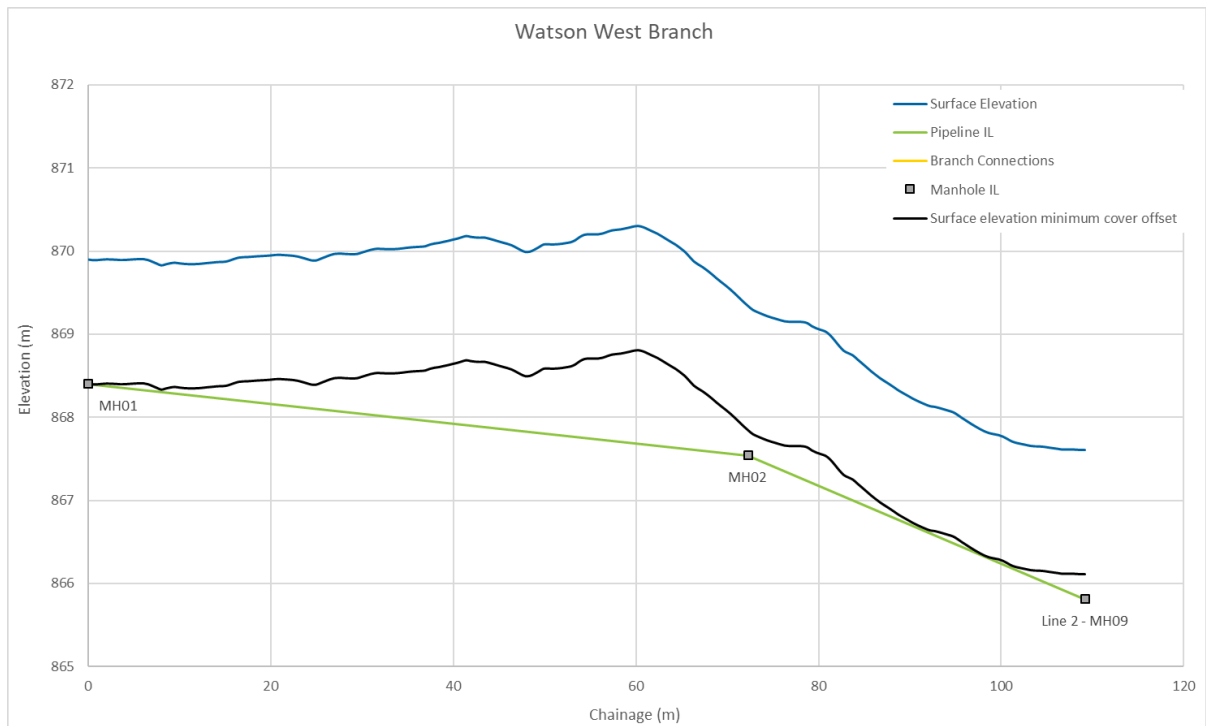
2.14 McCann North Branch



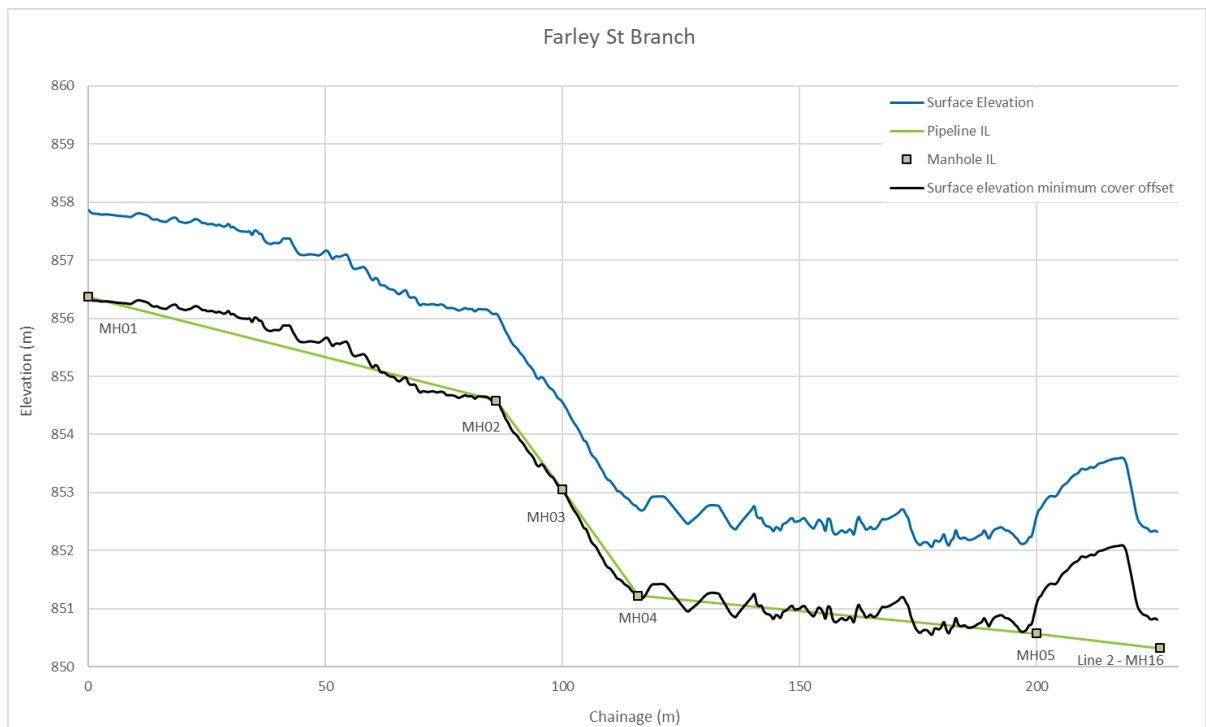
2.15 McCann West Branch



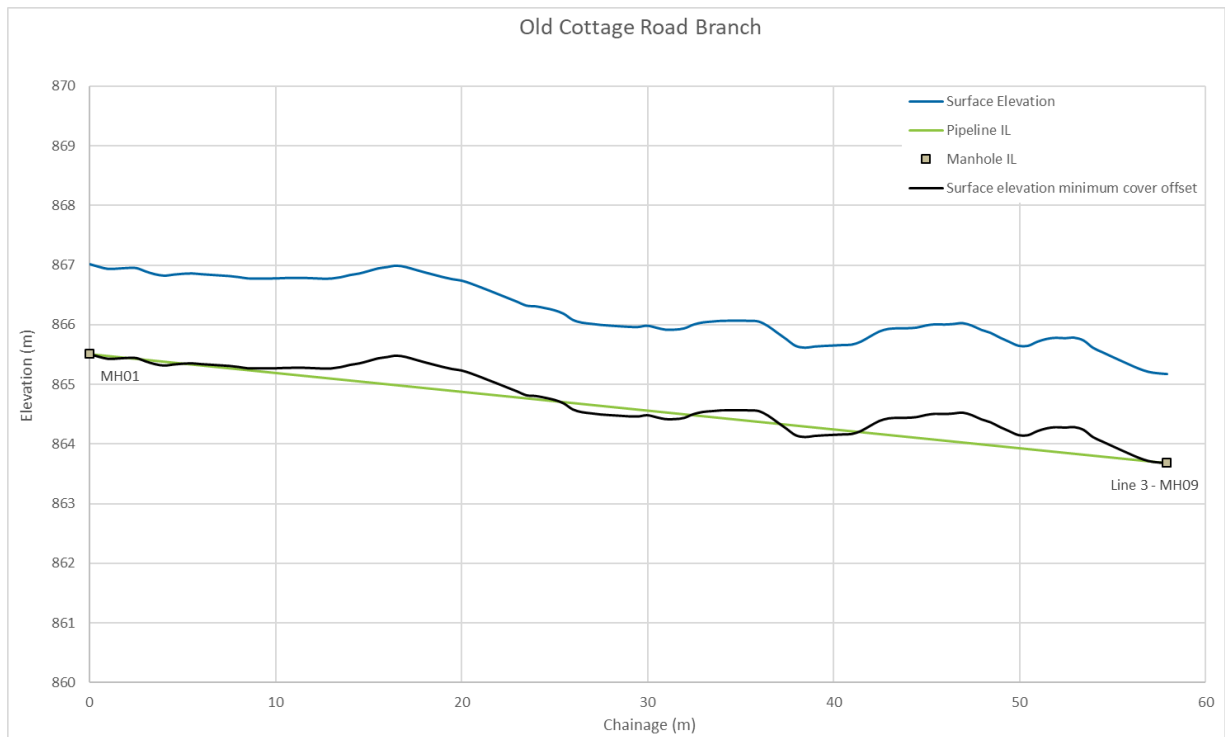
2.16 Watson West Branch



2.17 Farley Street Branch



2.18 Old Cottage Road Branch



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63745/https://projects.ghd.com/oc/Newcastle2/cullenbullensewerage/Delivery/Documents/2219903_REP_0_Initial_Network_Layout.docx

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Revision	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
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