

NORTH BUNGENDORE PLANNING PROPOSAL ASSESSMENT STUDY 6: SEWERAGE

REPORT

PREPARED FOR QUEANBEYAN-PALERANG REGIONAL COUNCIL
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WATER & ENVIRONMENT

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ABBREVIATIONS

ADWF	Average Dry Weather Flow
A_{EFF}	Effective area capable of contributing rainfall dependent inflow and infiltration (IFF)
C	Leakage Severity Coefficient
EP	Equivalent Person
ET	Equivalent Tenement
F_C	Factor to reflect local environmental aspects and regulations on wet weather sewage containment
F_s	Catchment Size Factor
GW	Ground Water Ingress
I	Rainfall Intensity Coefficient
IIF	Peak Rainfall Dependent Inflow and Infiltration
PDWF	Peak Dry Weather Flow
PS	Sewer Pump Station
P_{wet}	Proportion of pipe network below the ground water table level
PWWF	Peak Wet Weather Flow
Q_d	Dry weather inflow to the wet-well
Q_p	Pumping Rate
S_{max}	Maximum number of pump starts per hour
VSD	Variable Speed Drive
V_w	Pump Control Volume
WSA	Water Services Association of Australia

1 INTRODUCTION

This report has been prepared in on behalf of Queanbeyan-Palerang Regional Council (QPRC) for the North Bungendore Planning Proposal Assessment (Lot 1 DP798111, part) Study 6: Sewerage.

QPRC received a planning proposal for the rezoning of partial Lot DP 7988111 (Figure 1-1) from RU1 Primary Production to R2 Low Density Residential, R5 Large Lot Residential and RE1 Public Recreation. The proposal states that the indicative lot yield is approximately 309 lots, with block sizes ranging between 800m² and 1200m².

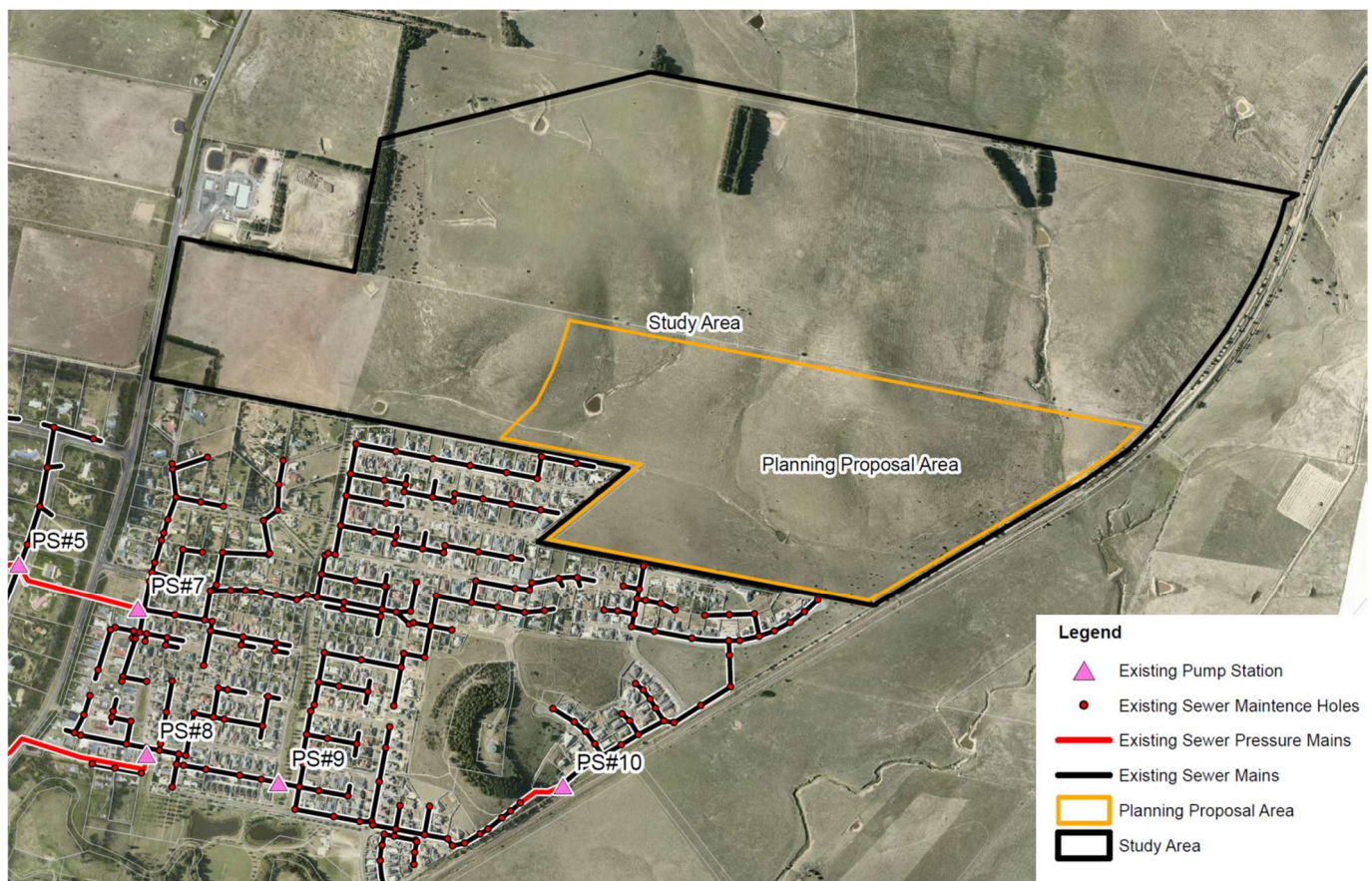


Figure 1-1: Study Area and Planning Proposal Area

On 27 April 2015 the NSW Department of Planning and Environment provided a gateway determination that the proposal may proceed, subject to a range of conditions, one of which is a network assessment and report outlining the methods proposed to connect to the existing sewerage reticulation.

It is possible that the area to the north of Lot DP 1 798111, Lot 1 DP8800871, may also be developed in the future subject to a planning proposal being supported by Council and the NSW Department of Planning and Environment. This parcel of land has been considered in this report for possible future growth identified as the study area.

1.1 SCOPE OF SERVICES

The scope of services for this project is summarised below:

- Undertake a review of the information provided by proponents within the submitted planning proposal as relevant to this study;
- Prepare a concept plan for the study area, identifying existing sewerage network short falls;
- Recommend strategies to service the study area in accordance with the Sewerage Code of Australia and Sewage Pumping Station Code;
- Prepare a report including maps, areas identifying that require further assessment (if identified), and recommendations; and
- Include the methods used for the gathering of data.

1.2 PURPOSE OF THE REPORT

The purpose of this report is to support a planning proposal to rezone the subject land from RU1 Primary Production to a range of land use zones including R2 Low Density Residential, R5 Large Lot Residential and RE1 Public Recreation.

The sewerage treatment plant capacity section of the planning proposal, provides a short section on the sewerage reticulation stating methods proposed to connect the identified parcels of land to the sewerage reticulation system. This report aims to expand on these desired outcomes.

1.3 CATCHMENT OVERVIEW

The topography within the study area varies from flat to undulating sloping areas. A knoll is located centrally within the study area. The study area is bound by Tarago Road to the West, the existing Elmslea Estate to the south, the Goulburn Bombala Railway to the east, agricultural land to the north and the waste transfer station to the north west. The study area consists of mostly cleared vegetation with small patches of planted vegetation located within the north and west of the study area, refer Figure 1-2.

The study area is located to the north east of the existing Bungendore sewer network and includes the planning proposal area within the south eastern corner. The total catchment area of the study area is 186.1 Ha and is proposed to contain 1,028 single residential dwellings. Due to the current topography, sewer flows will be conveyed away from the central knoll in a number of directions before reconnecting into and adjacent to the proposed planning proposal area sewer infrastructure.

The planning proposal area is located to the north east of the existing Bungendore sewerage reticulation network. The total catchment area provided by QPRC GIS layers was measured at 50.5 Ha and is proposed to contain 309 single residential dwellings.

This report focuses servicing initially the planning proposal area with a sewerage network able to convey flows through the existing network into the existing Bungendore STP, with consideration given to future growth from the study area.

Due to the existing topography and the planning proposal and study area boundaries, some crests and sags located within the boundaries may cause some concerns to a proposed internal gravity mains regarding minimum cover and or maximum cover. This report assumes the adopted flow directions can be achieved and are able to connect into the existing sewer network, refer Figure 1-2 and Figure 1-3.

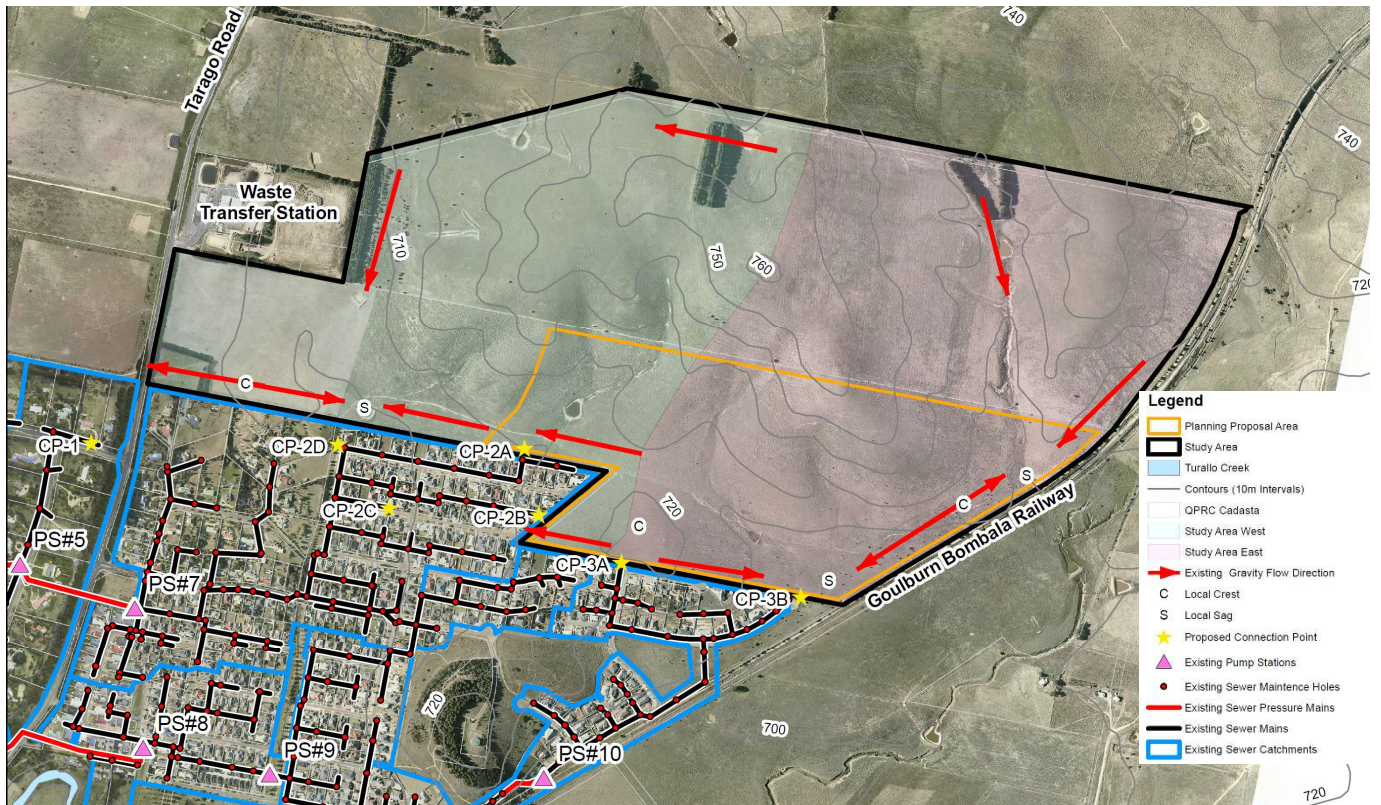


Figure 1-2: Bungendore Existing and Existing Contributing Sewer Catchments

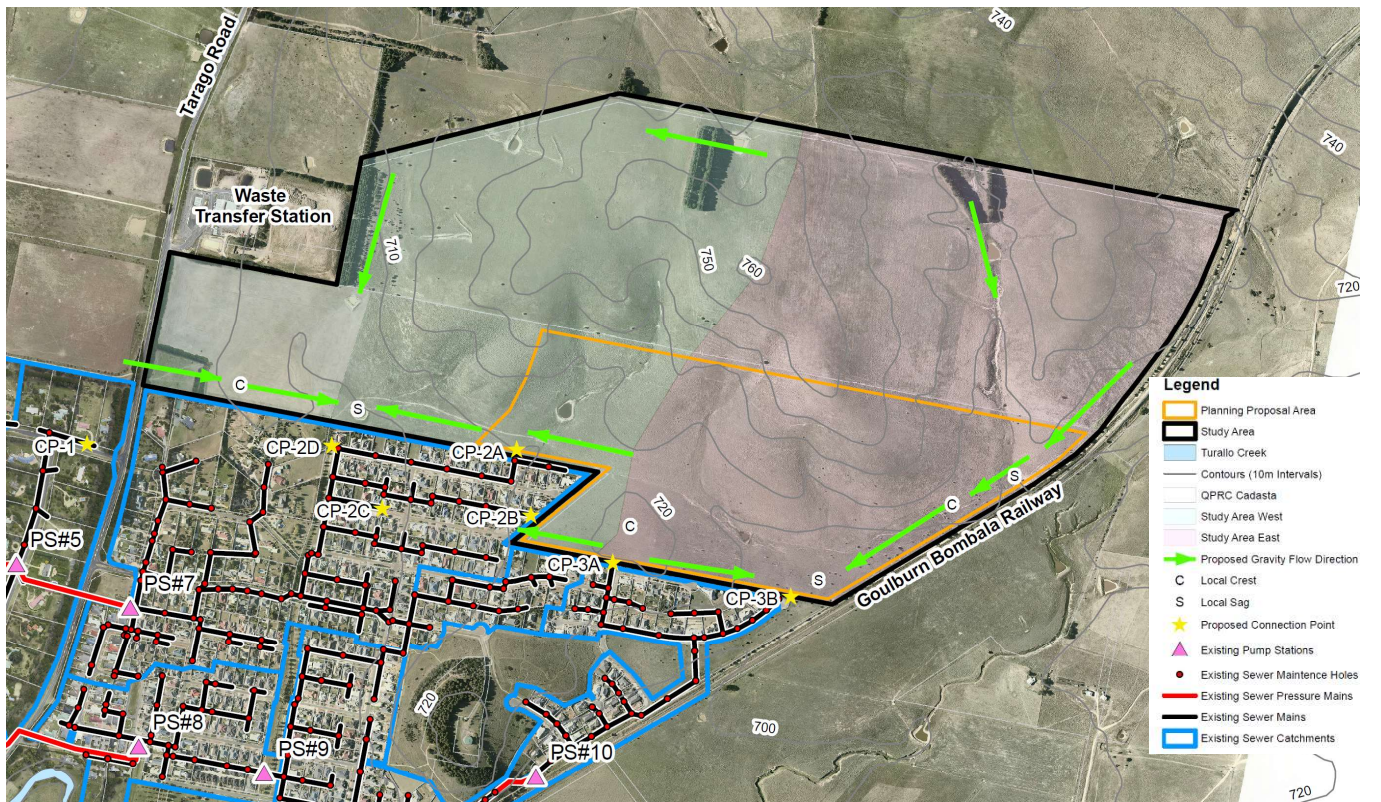


Figure 1-3: Bungendore Existing and Proposed Contributing Sewer Catchments

2 DESIRED STANDARDS OF SERVICE

QPRC is committed to maintaining and increasing its standards of services to its customers. The standards of service relevant to this project have been sourced from the Water Services Association of Australia's Sewerage Code of Australia and Sewage Pumping Station Code of Australia with assistance from QPRC for catchment specific parameters relevant to the Bungendore area. The adopted desired standards of service are summarised in Table 2-1.

Table 2-1 Desired Standards of Service

Design Criteria	Value	Notes	Source
Sewer Flow Estimation			
ADWF	210 L/EP/d		1
EP/ET	2.9		1
ET	1 res dwelling = 1 ET		1
GWI	$= 0.025 \times A \times P_{WET}$	Where A is the gross plan area	2
Pwet	10%		1
PDWF	$= d \times ADWF$		2
d		as noted on page 111 of WSA 02 -2002-2.3	2
PWWF	$= PDWF + GWI + IIF$		2
IIF	$= 0.028 \times A_{EFF} \times C \times I$		2
C	1		2
I	$= I_{1,2} \times F_s \times F_c$		2
Fs	$= (40/A)^{0.12}$		2
Fc	1.5		1
I _{1,2}	23.5		2 & 4
A _{EFF}	$= A \times (\text{density}/150)^{0.5}$	For Residential Developments. Where A is the gross plan area ¹	2
	$= A \times (1 - 0.75 \times \text{Portion}_{IMPERVIOUS})$	For Commercial and Industrial developments. Where A is the gross plan area ²	2
Gravity Sewer Design			
Flow Equation	Colebrook White		2
Friction Factor	1.5		
Minimum Velocity at PDWF + GWI	0.7 m/s		2
Pipe Capacity	ponding to 1m below surface level		1
Sewer Pump Station Design			
Max Pumping Rate (Qp)	= PWWF	Includes the PWWF of all upstream contributing pumped catchments	3
Pump Control Volume (Vw)	$= 900 \times Q_p / S_{max}$		3
Pump Starts / Hr (S)	$= 3600 \times Q_d (Q_p - Q_d) / V_w \times Q_p$	maximum of 8 / Hr	3
Detention Time (T)	$= 0.25 / S_{max} + 3.14 \times D^2 \times L / 4 \times Q_d$	maximum of 2hrs unless pre-treated	3

Design Criteria	Value	Notes	Source
Emergency Storage	8hrs×ADWF m ³	Excludes flows from upstream catchments	1
Pressure Main Design			
Flow Equation	Colebrook White		3
Friction Factor	= 0.15 - 0.6mm depending on velocity		3
Minimum Velocity	1.5 m/s		3
Maximum Velocity	2.0 m/s		3

Notes

- 1 QPRC Correspondence
- 2 WSA Sewerage Code of Australia 2.3
- 3 WSA Sewage Pumping Code of Australian 2.1
- 4 Australian Rainfall and Runoff

3 EXISTING AND PROJECTED DEMANDS

The QPRC regional cadasta has been provided by QPRC to assess the existing demands on the existing sewerage infrastructure within Bungendore. Six sewer pump station catchments exists north of Turallo Creek with an additional four located to the south. A total of six connection points have been identified to accept flows from the planning proposal and subsequent study area. The existing demands for the identified five sewer pump station catchments are shown in Table 3-1.

Table 3-1 Existing Demands

Connection Point (CP)	Sewer Pump Station Catchment	PS ID	Local			Total		
			Area (Ha)	ET	EP	Area (Ha)	ET	EP
1	5	PS#5	26	22	64	26	22	64
2A, 2B, 2C, 2D	7	PS#7	49	220	638	49	220	638
N/A	8 ²	PS#8	15	82	238	49	260	754
N/A	9 ¹	PS#9	21	123	357	35	178	516
3A & 3B	10	PS#10	14	55	160	14	55	160

Note

- 1 Accepts flows from PS#10 and pump station catchment 10
- 2 Accepts flows from PS#9 and pump station catchment 9
- 3 Refer to Figure 1-2 and Figure 1-3 for the proposed connection points

Due to the existing topography the study area and planning proposal area have been separated into two catchments (east and west), the catchment boundaries are based on the likely direction gravity sewer flows would be conveyed based on the existing topography. Table 3-2 summaries the likely demand required to be serviced by the existing sewer network.

Table 3-2 Proposed Development Demands

Development	East	West	Total
Planning Proposal Area - Area (Ha)	59	76	135
Study Area - Area (Ha)	59	76	135
Total - Area (Ha)	230	79	309
Planning Proposal Area - ET	316	403	719
Study Area - ET	546	482	1028
Total - ET	667	229	896
Planning Proposal Area - EP	916	1169	2085
Study Area - EP	1583	1398	2981
Total - EP	59	76	135

No additional future demand has been identified north of Turallo Creek that will utilise the existing sewer network. If future developable demand is identified, either greenfield and infill, any proposed augmentation works will need to account for any possible increase in demand.

4 EXISTING SEWERAGE SYSTEM

The Bungendore Township is serviced by an existing sewer network, the sewer network conveys sewage via a conventional gravity sewer network and a pressurised sewer network towards the Bungendore STP located to the south of Turallo Creek and West of the Bungendore Township. In total 10 pump stations convey sewage towards the Bungendore STP, refer Figure 4-1.

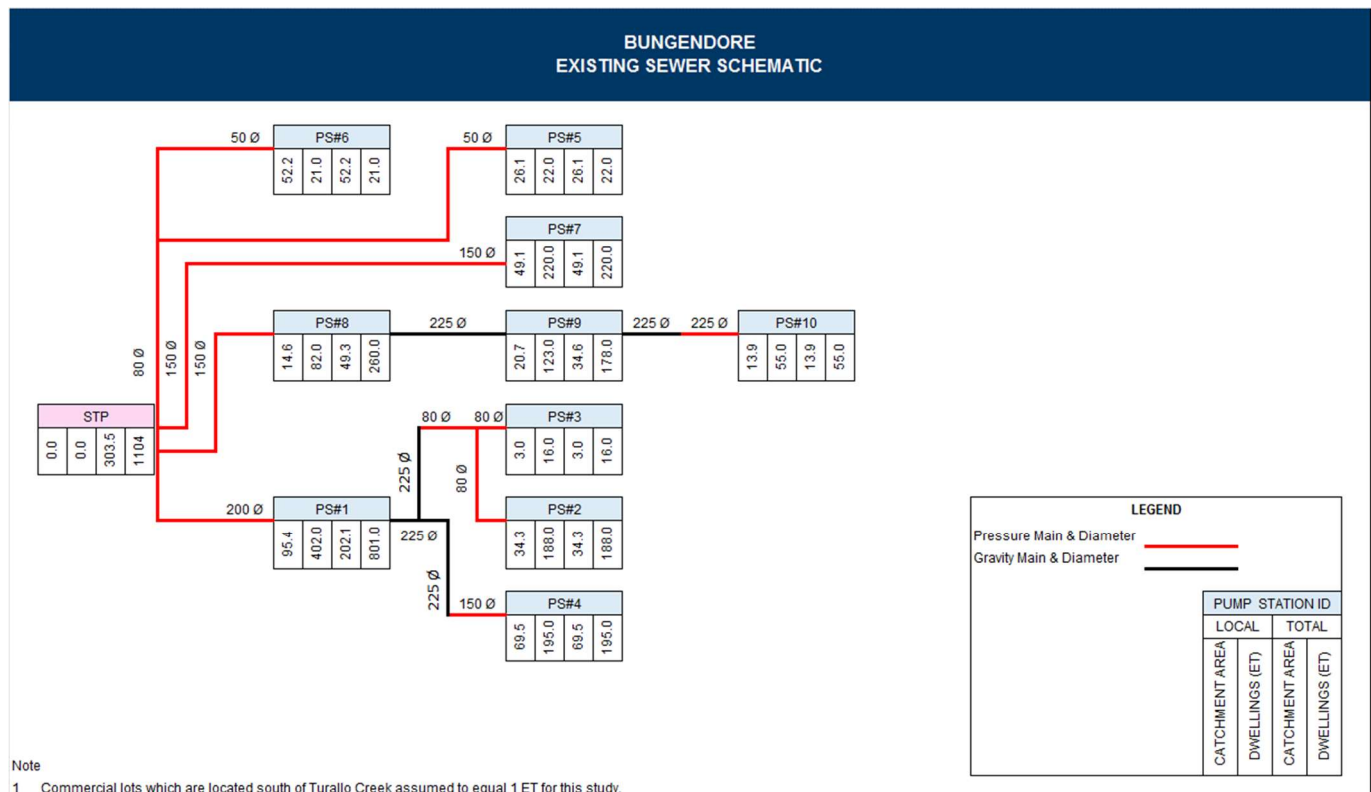


Figure 4-1: Existing Bungendore Sewer Schematic

4.1 MISSING DATA

In carrying out the modelling a number of data issues were identified from the 5 sewer pump station catchments assessed (PS#5, PS#7, PS#8, PS#9 and PS#10), which included:

- Gravity Mains – Missing diameters (0%);
- Gravity Mains – Invert levels missing, incorrect or datum issues (8.6%) (Invert Levels have been obtained from manhole supplied data);
- Gravity Mains – Downstream invert levels are higher than upstream invert levels (8.0%) (Invert Levels have been obtained from manhole supplied data)
- Gravity Mains – Provided pipe grades contain a 5% difference when compared to the grade between corresponding manholes (53.3%)
- Pressure Mains – Invert levels missing (100%);
- Pressure Mains – Missing diameters (50%);
- Pressure Mains – Where pressure main infrastructure is missing or questionable (0%);
- Sewer Nodes – Surface level missing, incorrect or datum issues (5.3%);
- Pump Stations – Refer below for missing data
- Overflow Structures – Invert levels missing (100%)

The following identifies the process in correcting missing or identified incorrect data for all pipes, nodes and pump stations.

Gravity Mains

- No changes have been made to the invert levels of the gravity network, the grade identified in the sewer data has been adopted over the manhole invert levels.

Pressure Mains

- Calibre sourced WAE and QPRC correspondence has identified the remaining unknown diameters.
- Invert levels were assumed to be the surface level from council provided 10m interval contour data.

Pump Stations

- Pump wet well storages, diameters, depths and pump duties were provided from the Council provided pump station data.
- Pump operating levels were assumed to be the obvert of the incoming gravity main to the base of the wet well.
- Cover levels for all pump stations was obtained from the council provided 10m interval contour data.

Overflow Structures

No overflow structures have been provided, emergency storage volumes provided by Council have been used in its place.

4.2 EXISTING CAPACITY

The QPRC provided cadastra and sewer GIS data was collated and analysed in an excel model, created by Calibre Consulting. The existing system generally meets the required design requirements. However, there are a number of restrictions in the system, primarily related to PS#8. Refer to F004 in Appendix A for the location of the existing restrictions in the assessed sewer catchments.

4.2.1 GRAVITY NETWORK

The existing gravity network was run utilising the total PWWF for each catchment. The existing gravity network generally complies with the desired standards of service under the existing PWWF conditions, with flow depths located deeper than 1m below the manhole surface level.

4.2.2 PRESSURISED NETWORK

Average Day pump hours provide the most reliable method for identifying where pump stations are currently overloaded. Assuming a duty/assist arrangement, average pump hours for a typical pump station should not exceed 5 to 6 hours/day.

Low pump hours at injector pump stations do not imply that the hydraulic capacity is adequate as duties at injector pump stations will vary significantly between dry and wet weather conditions.

No SCADA data was available at the time of the assessment, the assessment was undertaken on a Peak Wet Weather Flow basis utilising the supplied pump duties and requested draw down tests. The following pumps may require replacement, refer Table 4-1.

Table 4-1 Existing Pump Station Assessment

Pump Station	No. of Pumps	Pump Duty Point l/s (Single)	Pump Duty Point l/s (Combined) ¹	PWWF (L/s)	Calculated Pump Starts / Hour
PS#5	2	3.6	4.68	2.2	1
PS#7	2	19	24.7	18.5	3
PS#8	2	15.2 & 12.5 ³	22.8 ⁴	20.5	3
PS#9	2	19	24.7	14.9	2
PS#10	2	16.5 & 15.8 ³	21.5	5.8	1

Note

- 1 The combined pump values have been assumed at 1.3 × single pump rate in the absence of any other information.
- 2 Cells highlighted in red do not meet the desired standards of service.
- 3 Provided draw down testing carried out by QPRC.
- 4 Interpolated based on supplied pump types and provided single pump draw down test.

The corresponding pressure mains were assessed utilising the supplied pump duty. The following pressure mains may require augmentation or the pump duty head increased. The static head was based off supplied 10m interval contour data, this could lead to a discrepancy in the actual total head, refer Table 4-2.

Table 4-2 Existing Pressure Main Assessment

Pressure Main ID	Corresponding Pump Station ID	Length (m)	Nominal Diameter 1 (mm)	Nominal Diameter 2 (mm)	Equivalent Diameter (mm)	Maximum Velocity (m/s)	Total Head (m)	Pump Head Duty (m)
RM5/1 & RM5/2	PS#5	1402	50	80	50/80	1.13	23.0	25.0
RM7	PS#7	1700	150	N/A	150	1.05	24.2	25.0
RM8	PS#8	1445	150	N/A	150	1.16	25.3	19.5 ¹
N/A	PS#9	1	150	N/A	150	0.84	5.1	25.0
N/A	PS#10	107	225	N/A	225	0.15	5.0	13.9

Note

- 1 Provided draw down test indicates the pump head has reduced from the originally supplied 25.0m to 19.5m.
- 2 Cells highlighted in red do not meet the desired standards of service.

4.2.3 EMERGENCY STORAGE

An emergency storage analysis was undertaken to assess the available emergency storage for each pump station catchment. The assessment was based on QPRC provided emergency storage volumes for each pump station against the local contributing catchment, refer Table 4-3.

Table 4-3 Existing Emergency Storage Assessment

Pump Station #	Surcharge Node Type	Local ADWF (l/s)	Existing Emergency Storage (m3)	Required Emergency Storage (total) (m3)	Actual Time to Overflow (total) (hr)
PS#5	Unknown	0.12	32.70	3.42	76.47
PS#7	Unknown	1.67	51.00	48.20	8.47
PS#8	Unknown	0.61	20.00	17.70	9.04
PS#9	Unknown	0.92	41.00	26.46	12.40
PS#10	Unknown	0.42	20.00	12.17	13.15

Note

- 1 All assessed wet wells meet the desired standards of service of 8 hours ADWF.

4.2.4 PUMP STATION NO. 8 CAPACITY ISSUES

The supplied PS#8 draw down test indicates that the catchment flow and required head exceed the actually pump capacity. Correspondence with QPRC indicates that there have been no issues with PS#8. The discrepancy could be attributed to a possible overestimation of the theoretical PWWF when compared to the actual flows for the PS#8 catchment and draw down tests carried out. Additionally, infrastructure within the Catchment 8 is generally new and may not be experiencing the anticipated Inflow and Infiltration currently experienced within older catchments within Bungendore, refer Section 4.3.

It is likely that PS#8 is nearing its capacity under PWWF conditions, with any additional development loads potentially exceeding the pump station capacity.

4.3 RENEWALS

The existing sewer network located east of Tarago Road and north of Turallo Creek was built on or after 1995 (21 years old). All existing gravity sewer and pressure mains will therefore not be near their anticipated design life of 100 years and is therefore assumed that this infrastructure is of good working order. Augmentations such as pipe bursting are not proposed on any existing mains with any proposed main augmentations to be laid in an adjacent trench.

Pumps, valves and telemetry typical have a design life in the order of 15-30 years. Any proposed pump station augmentations will likely require the existing pump station to be augmented as components of the pump station will be nearing its design life.

5 PLANNING PROPOSAL AREA

The proposed planning proposal area demands for the East and West catchment were added to the existing network model. A schematic of the proposed connection points and proposed augmentations for the planning proposal area is shown in Figure 5-1. Refer to F005 in Appendix A for the location of the proposed connection details and proposed augmentations.

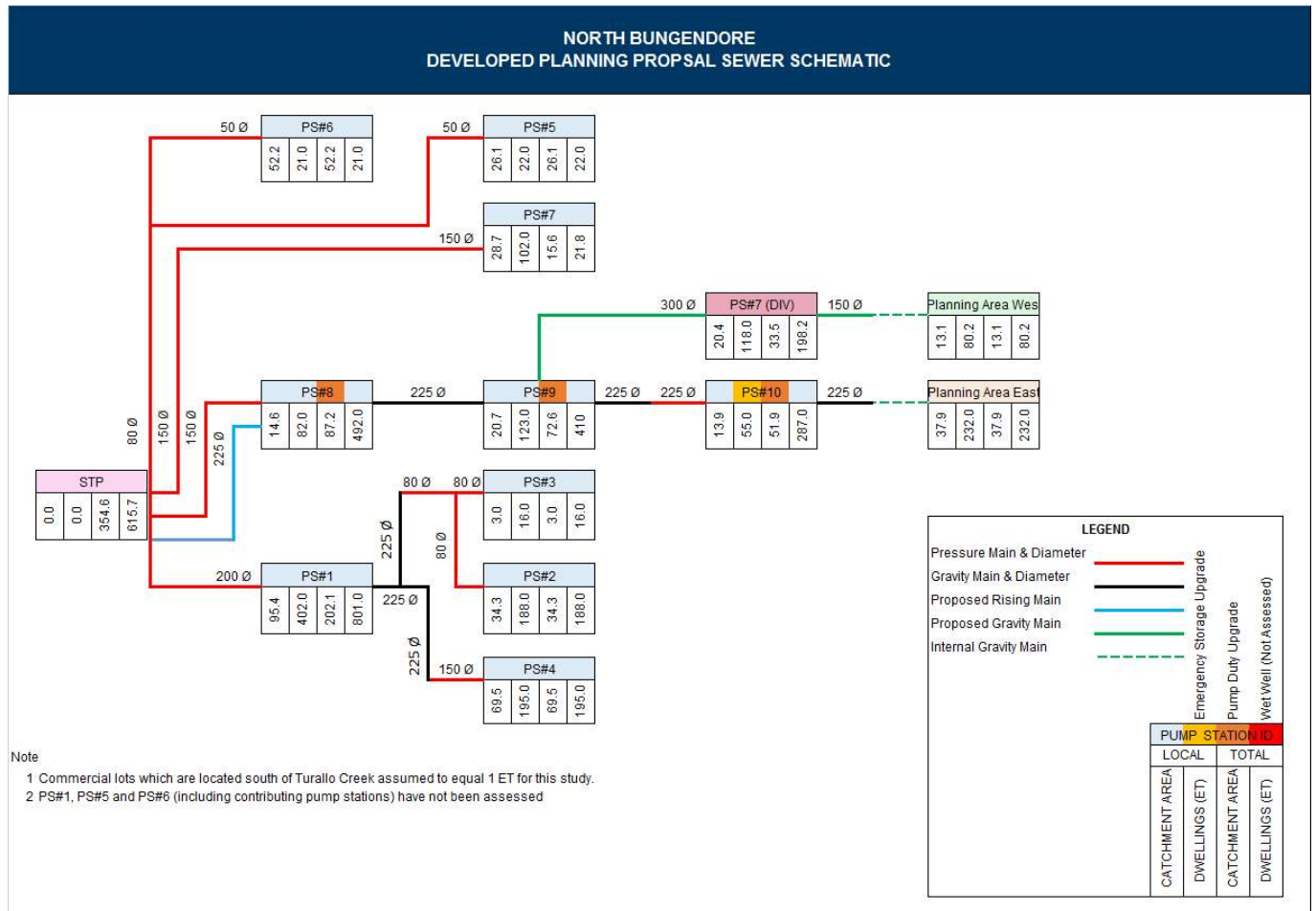


Figure 5-1: Planning Proposal Area Proposed Augmentation Sewer Schematic

All proposed augmentations assume the study area development will be fully developed within 5-10 years of the planning proposal area. With this assumption any proposed augmented gravity, pressure mains or emergency storage requirements will be sized for the study area demand and any proposed pump upgrades will be sized for the planning proposal area with future augmentations required in the study area.

5.1 PLANNING PROPOSAL AREA CAPACITY RESTRICTIONS

It is proposed to service the planning proposal area via the four adjacent connection points (CP-2A, CP-2C, CP-3A and CP-3B). The planning proposed east area is proposed to connect into the existing gravity network at CP-3A and CP-3B located within Catchment 10. The planning proposal west area is proposed to connect into the existing gravity network at CP-2A and CP-2C located within Catchment 7. A connection into CP-2B was considered, however QPRC will require to exercise its powers under the NSW Local Government ACT (1993) to construct a new section of gravity main through the back of Lot 616 DP1061647. This report assumes that CP-2C is the preferred connection point in preference to CP-2B.

Flows that discharge into Catchment 10 will be conveyed via the existing gravity network towards downstream pump stations PS#10, PS#9 and PS#8 before discharging into the Bungendore STP.

To reduce the need for multiple pump station upgrades and associated gravity mains, it is proposed to divert a portion of Catchment 7 towards PS#9 which is currently identified to collect the planning proposal area east flows. The total planning proposal area flows will then be conveyed towards PS#8 before discharging into the Bungendore STP.

The following sections detail the proposed augmentations required to service the planning proposal area.

5.1.1 GRAVITY NETWORK

The proposed connection point CP-2A and CP-2C are located upstream of an existing sewer line that is nearing its hydraulic capacity. An increase in development of approximately 17ET would likely see the gravity network exceed the desired standards of service and will increase the potential of surcharging within the downstream network, irrespective of any pump station augmentations.

To reduce the length and cost of any gravity main augmentations, it is proposed to divert a portion of Catchment 7 away from PS#7 towards PS#9. This will be achieved by constructing a 300mm diameter sewer main from Ashby Drive towards PS#9. The 300mm diameter gravity main is sized to account for the future demand of the study area. More detailed analysis will be required to confirm if this can be reduced to a 225mm main, subject to available grades, existing services and proposed demands.

With the exception of the diversion gravity main, all other gravity mains assessed comply with the desired standards of service with PWWF depths located deeper than 1m below the manhole surface level, assuming the proposed diversion takes place.

5.1.2 PRESSURISED NETWORK

The pump station and pressure main network downstream of the proposed connection points were assessed against the desired standards of service. The existing pump stations were analysed to determine augmentation requirements based on the best information available. Table 5-1 and Table 5-2 highlight the required augmentations to service the planning proposal area.

Table 5-1 Planning Proposal Area Pump Assessment

Pump Station	No. of Pumps	Pump Duty Point l/s (Single)	Pump Duty Point l/s (Combined) ¹	PWWF (L/s)	Calculated Pump Starts / Hour
PS#7 ²	2	19	24.7	10.1	1
PS#8 ³	2	15.2 & 12.5 ⁴	22.8 ⁵	39.6	6
PS#9 ³	2	19	24.7	34.6	5
PS#10	2	16.5 & 15.8 ⁴	21.5	23.2	3

Note

- 1 The combined pump values have been assumed at 1.3 × single pump rate in the absence of any other information.
- 2 Catchment 7 contains a proposed diversion, refer Section 5.1.1
- 3 Receives an additional existing catchment load (partial catchment 7), refer Section 5.1.1
- 4 Provided draw down testing carried out by QPRC.
- 5 Interpolated based on supplied pump types and provided single pump draw down test.
- 6 Cells highlighted in red require augmentation to service the planning proposal area.

Table 5-2 Planning Proposal Area Pressure Main Assessment

Pressure Main ID	Connection Pump Station	Length (m)	Existing Equivalent Diameter (mm)	Augmented Diameter (mm)	Augmented Equivalent Diameter (mm)	Maximum Velocity (m/s)	Total Head (m) Before Augmentation / After Augmentation		Existing Pump Head Duty (m)
RM7	PS#7 ¹	1770	150	N/A	150	0.57	11.3	11.3	25.0
RM8	PS#8 ²	1445	150 ⁴	225 ⁴	225	1.00	72.0	14.3	19.5
N/A	PS#9 ²	1 ⁵	150	N/A	150	1.96	5.3	5.3	25.0
N/A	PS#10	107	225	N/A	225	0.58	5.3	5.3	13.0

Note

- 1 Catchment 7 contains a proposed diversion, refer Section 5.1.1
- 2 Receives an additional existing catchment load (partial catchment 7), refer Section 5.1.1
- 3 Cells highlighted in red require augmentation to service the planning proposal area.
- 4 The existing 150mm diameter pressure main is to be temporary decommission once the augmented 225mm is constructed. Once the study area development occurs the existing 150mm diameter pressure main can be recommissioned and operated in parallel to the 225mm diameter pressure main.
- 5 GIS data indicates this pump station is a lift pump station due to no corresponding pressure main, adopted length is assumed to be the internal pressurised pipe work of 1m.

The required pump duties to service the planning proposal area are shown in Table 5-3.

Table 5-3 Planning Proposal Area Proposed Pump Duties

Pump Station	No. of Pumps	Single Pump Duty (l/s)	Pump Head
PS#8 ¹	2	40	15
PS#9	2	35	10
PS#10	2	25	10

Note

- 1 PS#8 requires its corresponding pressure main to be augmented to account for the increase in flow from the planning proposal area
- 2 Pumping arrangement assumes a duty standby arrangement to pump the existing network and planning proposal area flows towards the Bungendore STP.

5.1.3 EMERGENCY STORAGE

The corresponding pump stations downstream of the proposed connection points were assessed regarding available emergency storage against the desired standards of service, refer Table 5-4.

Table 5-4 Planning Proposal Area Emergency Storage Assessment

Pump Station #	Surcharge Node Type	Local ADWF (l/s)	Existing Emergency Storage (m ³)	Required Emergency Storage (total) (m ³)	Actual Time to Overflow (total) (hr)	Assumed Depth of Emergency Storage (m) ¹	Additional Required Wet Well Diameter (m)
PS#7 ²	Unknown	0.79	51.00	22.77	17.92	N/A	N/A
PS#8	Unknown	1.63	20.00	17.70	9.04	N/A	N/A
PS#9 ^{3,5}	Unknown	2.63	41.00	38.36	8.55	N/A	N/A
PS#10 ⁴	Unknown	2.31	20.00	66.67	2.40	3.99	4.51 ⁷

Note

- 1 Assumed depth 1m less than the total wet well depth.
- 2 Catchment 7 contains a proposed diversion, refer Section 5.1.1
- 3 Receives an additional existing catchment load (partial catchment 7), refer Section 5.1.1
- 4 Includes upstream planning proposal area east flows.
- 5 Includes upstream planning proposal area west flows.
- 6 Cells highlighted in red require augmentation to service the planning proposal area.
- 7 Sized to meet the study area demand volume of 130.31 m³

5.1.4 INTERNAL INFRASTRUCTURE

The planning proposal area east and west developments can be serviced by an internal gravity network, subject to minimum and maximum cover of existing low points near the planning proposal area boundaries, refer to F004 in Appendix A for identified restrictions. The gravity network will consist of 150mm diameter mains to service the development, consideration for the study area will be required to assess the need for increasing selected mains to 225mm diameter, refer Section 6.

The section of land located to the south west of the planning proposal east area will natural convey sewage away from Catchment 10 towards Catchment 7 with no immediate downstream connection point. This report identifies the need for

150mm gravity main along Eyre Street to connect into the existing gravity network 320m away. To remove the need for this main, it may be possible that this portion of the catchment be redirected towards Catchment 10 or a gravity main be constructed within the back of Lot 616 DP1061647. This is subject to final road layouts, proposed earthworks and detailed survey.

Subject to a final road layout it may be possible to divert all the planning proposal area west flows towards the planning proposal east area into Catchment 10, with the exception of approximately 17 dwellings which can be serviced by PS#7 and associated gravity mains. If this is pursued it will negate the need for the 300mm diameter gravity main and identified Catchment 7 diversions required for the planning proposal area. The diversion will still be required for the study area.

5.2 PLANNING PROPOSAL AREA REQUIRED AUGMENTATIONS SUMMARY

To service the planning proposal area, the following augmentations will be required.

- Internal gravity mains consisting of 150mm – 225mm in diameter;
- 320 m of 150mm diameter gravity main (Connection Point CP-2C);
- 435 m of 300mm diameter gravity main (Catchment 7 Diversion);
- 1,440 m of 225mm diameter pressure main for PS#8;
- 3 pump duty upgrades for PS#10, PS#9 and PS#8; and
- 1 wet well upgrades for emergency storage located at PS#10.

Refer to F005 in Appendix A for the location of proposed connection details and proposed augmentation locations.

6 STUDY AREA

The proposed study area demands (including the planning proposal area demands) for the east and west catchments were added to the existing network model. A schematic of the proposed connection points and proposed augmentations for the study area is shown in Figure 6-1. Refer to F010 in Appendix A for the location of proposed connection details and proposed augmentations.

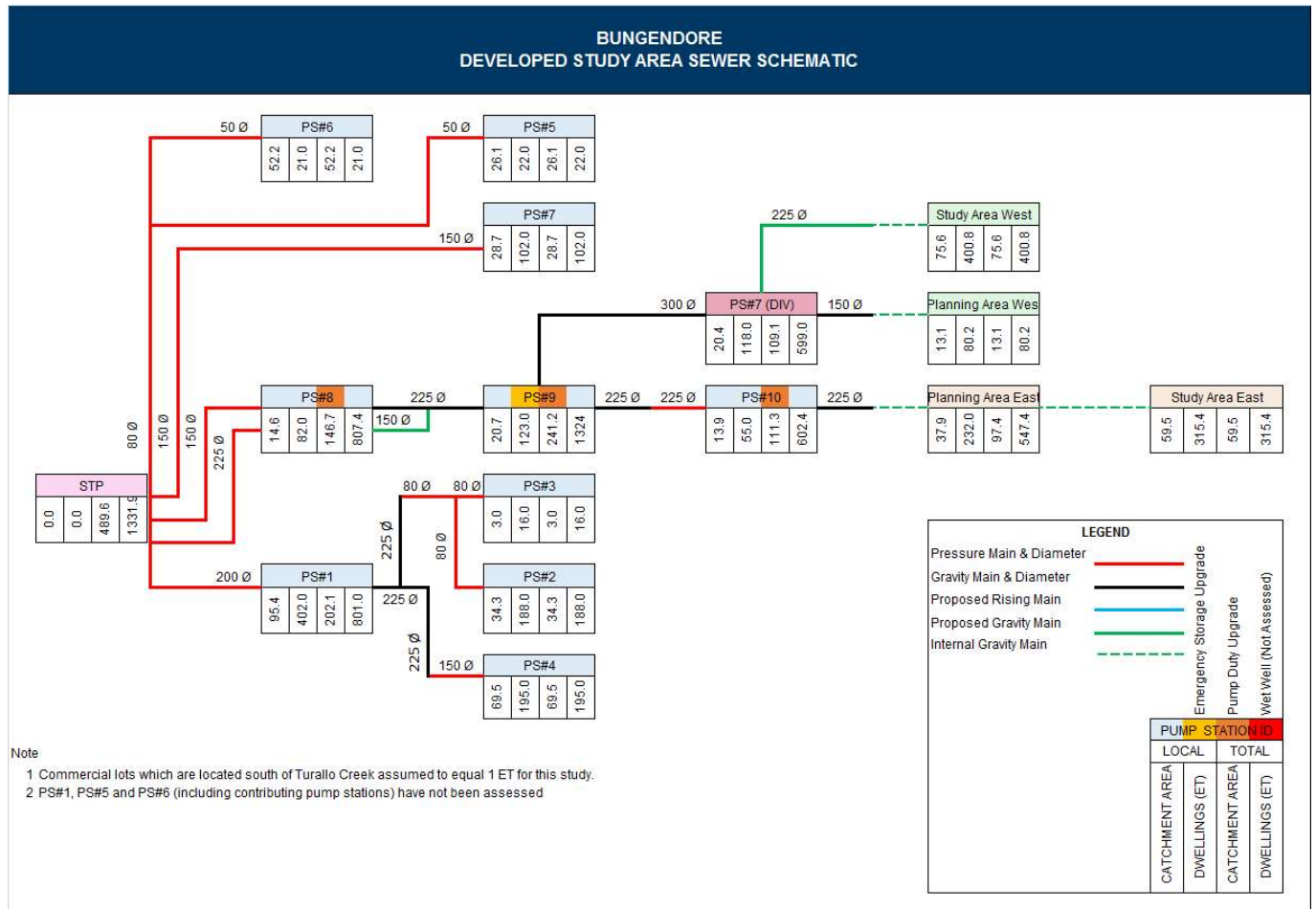


Figure 6-1: Study Area Proposed Augmentation Sewer Schematic

6.1 STUDY AREA CAPACITY RESTRICTIONS

It is proposed to service the study area east flows through the planning proposal area east gravity infrastructure via connection point CP-3B. Flows will be conveyed through the planning proposal area towards PS#10, PS#9 and PS#8 before discharging into the Bungendore STP.

The study area west flows are proposed to be conveyed separately from the planning proposal area west gravity network towards connection point CP-2E. Flows will be conveyed via a separate gravity main towards Ashby Drive before reconnecting into the proposed 300mm diameter gravity main identified in the planning proposal area augmentations, refer Section 5.1.1. Flows will then be conveyed towards PS#9 and PS#8 before discharging into the Bungendore STP.

The following sections detail the proposed augmentations required to service the study area.

6.1.1 GRAVITY NETWORK

The gravity network downstream of the study area towards the STP show that a number of gravity mains along the alignment fail the desired standards of service. The following gravity lines have been identified with the study area flows.

Table 6-1 Study Area Gravity Network Restrictions

Catchment	Line ID	Downstream Manhole ID	Upstream Manhole ID	Existing Diameter (mm)	Comment
8	FDA	FDA/1	FDA/2	225	These sections of sewer main will be under capacity and will likely surcharge at manhole FDF/3. Upgrading the sewer main between FDA/1 to FDF/2 (Birch Street and Day Circuit Intersection) will alleviate surcharging to Line ID FDA, FDC and FDF.
8	FDC	FDA/2	FDC/2	225	
8	FDF	FDC/2	PS#9	225	

All other gravity mains assessed including the augmented gravity mains required to service the planning proposal area flows, comply to the desired standards of service with PWWF flow depths located deeper than 1m below the manhole surface level.

6.1.2 PRESSURISED NETWORK

The pump station and pressure main network downstream of the proposed connection points were assessed against the desired standards of service. The existing pump stations were analysed to determine the augmentations required based on the best information available. Table 6-2 and Table 6-3 highlight the required augmentations to service the study area.

Table 6-2 Study Area Pump Assessment

Pump Station	No. of Pumps	Planning Proposal Area Proposed Pump Duty Point l/s (Single) ¹	Planning Proposal Area Proposed Pump Duty Point l/s (Combined) ²	PWWF (L/s)	Pump Starts / Hour
PS#7 ³	2	19	24.7	10.1	1
PS#8 ⁴	2	40.0	52.0	81.4	7
PS#9 ⁴	2	35.0	45.5	76.9	7
PS#10	2	25.0	32.5	42.1	6

Note

- 1 Pump duties assumed to be augmented to account for the planning proposal area demand
- 2 The combined pump values have been assumed at $1.3 \times$ single pump rate in the absence of any other information.
- 3 Catchment 7 contains a proposed diversion, refer Section 5.1.1.
- 4 Receives an additional existing catchment load (partial catchment 7), refer Section 5.1.1.
- 5 Cells highlighted in red require augmentation to service the study area.

Table 6-3 Study Area Pressure Main Assessment

Pressure Main ID	Connection Pump Station	Length (m)	Existing Equivalent Diameter (mm)	Augmented Diameter (mm)	Augmented Equivalent Diameter (mm)	Maximum Velocity (m/s)	Total Head (m) Before Augmentation / After Augmentation		Existing Pump Head Duty (m)
RM7	PS#7 ²	1700	150	N/A	150	0.57	11.3	11.3	25.0
RM8	PS#8 ³	1445	225	150	251 ¹	1.64	40.5	25.5	19.5
N/A	PS#9 ³	1 ⁴	150	N/A	150	4.35	6.6	6.6	25.0
N/A	PS#10	107	225	N/A	225	1.06	5.9	5.9	13.0

Note

- 1 Consists of a recommissioned 150mm and existing 225mm pressure main required to service the planning proposal area demand.
- 2 Catchment 7 contains a proposed diversion, refer Section 5.1.1.
- 3 Receives an additional existing catchment load (partial catchment 7), refer Section 5.1.1.
- 4 GIS data indicates this pump station is a lift pump station due to no corresponding pressure main, adopted length is assumed to be the internal pressurised pipe work of 1m.
- 5 Cells highlighted in red require augmentation to service the study area, proposed augmentation requires the pump station duty increased.

The required pump duties to service the study area are shown in Table 6-4.

Table 6-4 Study Area Proposed Pump Duties

Pump Station	No. of Pumps	Single Pump Duty (l/s)	Pump Head
PS#8	2	85.0	30
PS#9	2	80.0	10
PS#10	2	45.0	10

Note

- 1 Pumping arrangement assumes a duty standby arrangement to pump the existing network and study area flows towards the Bungendore STP.

6.1.3 EMERGENCY STORAGE

The corresponding pump stations downstream of the proposed connection points were assessed regarding available emergency storage against the desired standards of service, refer Table 6-5.

Table 6-5 Study Area Emergency Storage Assessment

Pump Station #	Surcharge Node Type	Local ADWF (l/s)	Existing Emergency Storage (m3)	Required Emergency Storage (total) (m3)	Actual Time to Overflow (total) (hr)	Assumed Depth of Emergency Storage (m) ¹	Additional Required Wet Well Diameter (m)
PS#7	Unknown	0.79	51.00	22.77	17.92	N/A	N/A
PS#8	Unknown	0.61	20.00	17.70	9.04	N/A	N/A
PS#9 ^{2,4}	Unknown	4.53	41.00	130.48	2.51	5.00	4.84
PS#10 ³	Unknown	4.52	130.31	130.31	8.00	N/A	N/A

Note

- 1 Assumed depth 1m less than the total wet well depth.
- 2 Receives an additional existing catchment load (partial catchment 7), refer Section 5.1.1
- 3 Includes upstream study area and planning proposal area east flows.
- 4 Includes upstream study area and planning proposal area west flows.
- 5 Cells highlighted in red require augmentation to service the study area.

6.1.4 INTERNAL INFRASTRUCTURE

The study area can be serviced by an internal gravity network, subject to minimum and maximum cover of existing low points near the planning proposal and study area boundaries, refer to F004 in Appendix A for identified restrictions. The gravity network will consist of 150mm and 225mm diameter mains to service the study area. Proposed diameters are subject to the final road layout.

The section of land located to the south west of the study area will naturally convey sewerage away from the proposed augmentations identified in this report. This report assumes that flows can be conveyed east towards the proposed augmentations of the study area either via a deep gravity main or pump station and pressure main. It is recommended the block layout and grading of the study area and planning proposal area, allow for the sewer main to convey flows east via a gravity main, refer F004 in Appendix A.

6.2 STUDY AREA REQUIRED AUGMENTATIONS SUMMARY

To service the study area, the following augmentations will be required.

- Internal gravity mains consisting of 150mm – 225mm in diameter;
- 160m of 150mm diameter gravity main (Catchment 8);
- 420 m of 225mm diameter gravity main (Catchment 7 diversion to PS#9)
- 3 pump duty upgrades for PS#10, PS#9 and PS#8; and
- 1 wet well upgrades for emergency storage located at PS#9.

Refer to F010 in Appendix A for the location of proposed connection details and proposed augmentation locations.

7 SEWERAGE TREATMENT PLANT

Recent upgrades to the Bungendore STP have increased the capacity to 5000 EP and is currently operating at 3000 EP. These recent upgrades were to accommodate the existing town boundaries which currently exclude the planning proposal area and study area. Any sewer flows generated from the planning proposal or study area will require the Bungendore STP to be augmented. It is unclear when the proposed development will occur and if there will be actual spare capacity when the developments come online. The following STP augmentations will need to be accounted for, refer Table 7-1.

Table 7-1 Required Treatment Plant Upgrades

Development Area	EP
Planning Proposal Area	896
Study Area	2,981

8 RECOMMENDATIONS

The identified strategy and augmentations outlined below are identified for the planning proposal and study area developments, based on assumed densities and proposed earthworks. This will need to be reviewed with the developer once the proposed demand, road layout and grading has been identified.

All proposed augmentations assume the study area development will be fully developed within 5-10 years of the planning proposal area. With this assumption any proposed augmented gravity, pressure mains or emergency storage requirements will be sized for the study area demand and any proposed pump upgrades will be sized for the planning proposal area with future augmentations required in the study area. Any proposed augmentations to an existing asset are compared with QPRC's asset renewals and anticipated design life.

8.1 PLANNING PROPOSAL AREA AUGMENTATIONS

To service the planning proposal area, the following augmentations will be required:

- Internal gravity mains consisting of 150mm – 225mm in diameter;
- 320 m of 150mm diameter gravity main (Connection Point CP-2C);
- 435 m of 300mm diameter gravity main (Catchment 7 Diversion);
- 1,440 m of 225mm diameter pressure main for PS#8;
- 3 pump duty upgrades for PS#10, PS#9 and PS#8; and
- 1 wet well upgrades for emergency storage located at PS#10.

8.1.1 CATCHMENT NO. 7 DIVERSION

This strategy requires a portion of catchment 7 to be diverted south towards PS#9. This diversion will neglect the need for any pump station and rising main augmentations at PS#7, while required gravity main augmentations will be located outside the road reserve of Ashby Drive and be located adjacent to the existing drainage reserve.

The proposed 300mm diameter gravity diversion main may be postponed to the study area provided the planning proposal area proposed flows, entering the Catchment 7, does not exceed 17 dwellings. Detailed survey and potholing will be required to confirm if the proposed 300mm diameter gravity main can be regraded to reduce the diameter to 225 and if the main can discharge downstream of PS#9 into the PS#8 catchment, reducing the need for additional upgrades to PS#9.

8.1.2 CONNECTION POINT CP-2C

The 150mm gravity main has been identified to connect a portion of the planning proposal area into CP-2C. To remove the need for this additional length of gravity main alternative connection points have been identified including:

- Connection into CP-2B via constructing a new section of gravity main through the back of Lot 616 DP1061647
- Connection into CP-3A (Catchment 10) subject to detailed survey and road layouts.

8.2 STUDY AREA AUGMENTATIONS

To service the study area, the following augmentations will be required in addition to the planning proposal area identified augmentations.

- Internal gravity mains consisting of 150mm – 225mm in diameter;
- 160m of 150mm diameter gravity main (Catchment 8);
- 420 m of 225mm diameter gravity main (Catchment 7 diversion to PS#9)
- 3 pump duty upgrades for PS#10, PS#9 and PS#8; and
- 1 wet well upgrades for emergency storage located at PS#9.

Upgrades to the Bungendore sewerage treatment plant will also be required for the planning proposal and study areas as the parcel of lands have not been accounted for in the recent STP upgrades.

9 CONCLUSIONS

The existing sewer network downstream of the proposed connection points generally complies with the desired standards of service, with the majority of the existing network currently nearing its capacity, notably Catchment 7 and Catchment 8. Any additional demand within these catchments will therefore trigger augmentations within the catchments.

A total of 5 sewer pump stations and 8 connections points were analysed to determine the preferred strategy to service the planning proposal and study areas. The site is capable of supporting development in accordance with QPRC desired standards of services, if the proposed augmentations identified in this report are carried out in conjunction with the proposed development staging and timing.

9.1 ASSUMPTIONS AND FURTHER ANALYSIS

The above recommendations are based on the information available from QPRC at the time of writing this report. The following additional information will be required during the detailed design of the offsite works to confirm if additional benefits to the strategy can be identified:

- A total of 1028 dwellings are proposed within the study area and are proposed to split between Catchment 10 and Catchment 7 based on the existing topography. If the road layout significantly alters the catchment area and or the road layout does not appease minimum or maximum cover, the proposed augmentation strategy may need to be revised to suit the revised demands and alternative sewer catchments.
- No assessment on the pump station operating volume was carried out due to limited information. Pump station levels including operating levels will be required to confirm if additional wet well volume will be required in addition to any required emergency storage.
- This strategy assumes the proposed diversion main from Catchment 7 towards PS#9 discharges upstream into PS#9. Subject to detailed survey and potholing, the diversion main could potentially discharge downstream of PS#9 into catchment 8, this revised alignment will provide savings in operating and capital costs associated with PS#9.

APPENDICES

APPENDIX A DRAWINGS



- Legend**
- Existing Pump Station
 - Existing Sewer Maintenance Holes
 - Existing Sewer Pressure Mains
 - Existing Sewer Mains
 - Planning Proposal Area
 - Study Area

Notes:

Details		
Issue	Amendment	Date
0	Draft	23-Dec-2016
1	QPRC comments	08-Sep-2017

Project

NORTH BUNGENDORE PLANNING PROPOSAL ASSESSMENT - STUDY 6 SEWERAGE

Drawing Title

PLANNING PROPOSAL AREA AND STUDY AREA

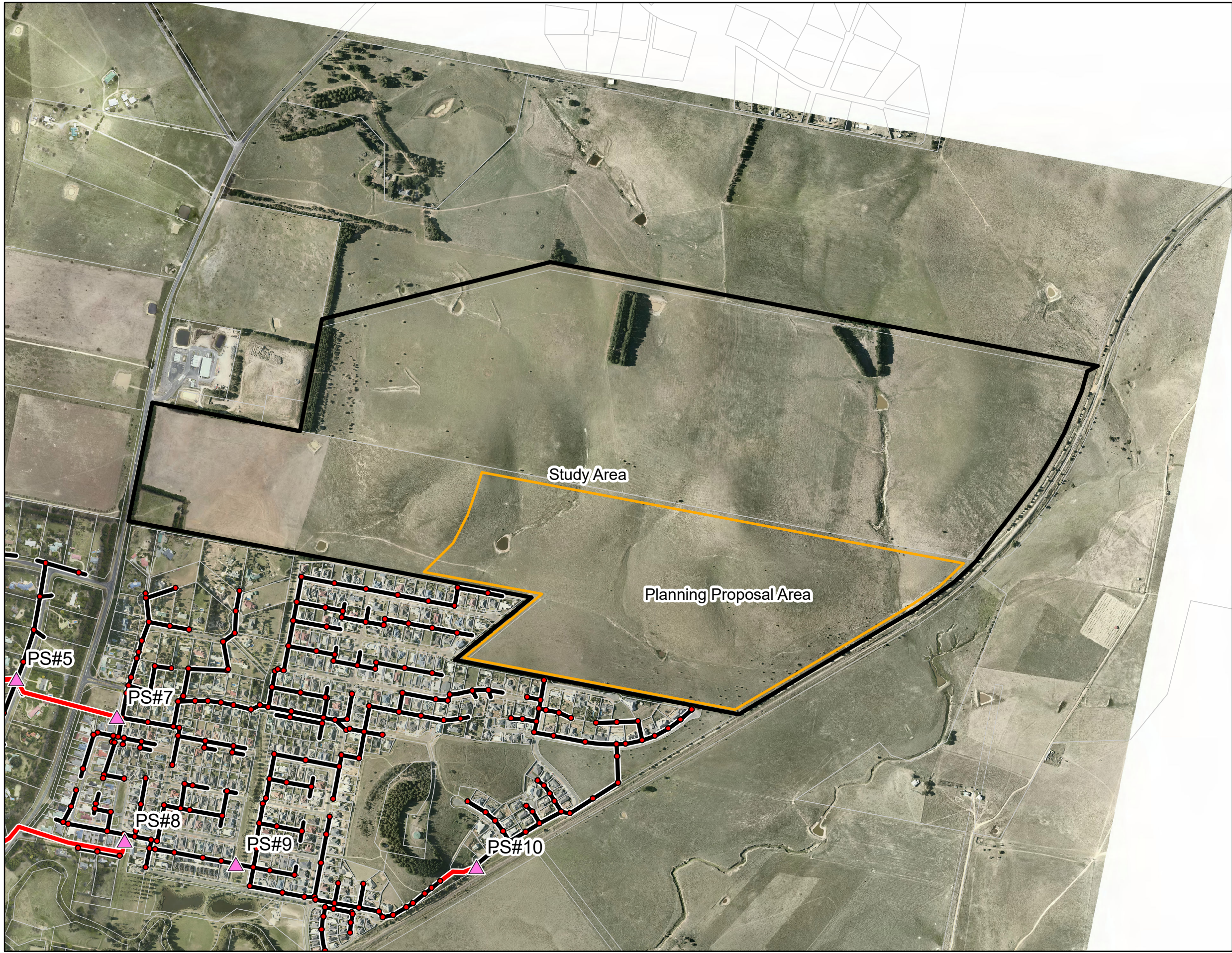
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Job No. 16-002361

Figure F001



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Legend

- Planning Proposal Area
- Study Area
- Turallo Creek
- Contours (10m Intervals)
- QPRC Cadasta
- Study Area West
- Study Area East
- Existing Gravity Flow Direction
- C Local Crest
- S Local Sag
- Proposed Connection Point
- Existing Pump Stations
- Existing Sewer Maintenance Holes
- Existing Sewer Pressure Mains
- Existing Sewer Mains
- Existing Sewer Catchments

Notes:

Details

Issue	Amendment	Date
0	Draft	23-Dec-2016
1	QPRC comments	07-SEP-2017

Project

**NORTH BUNGENDORE PLANNING
PROPOSAL ASSESSMENT - STUDY 6
SEWERAGE**

Drawing Title

**STUDY AREA
SEWER CATCHMENTS EXISTING**

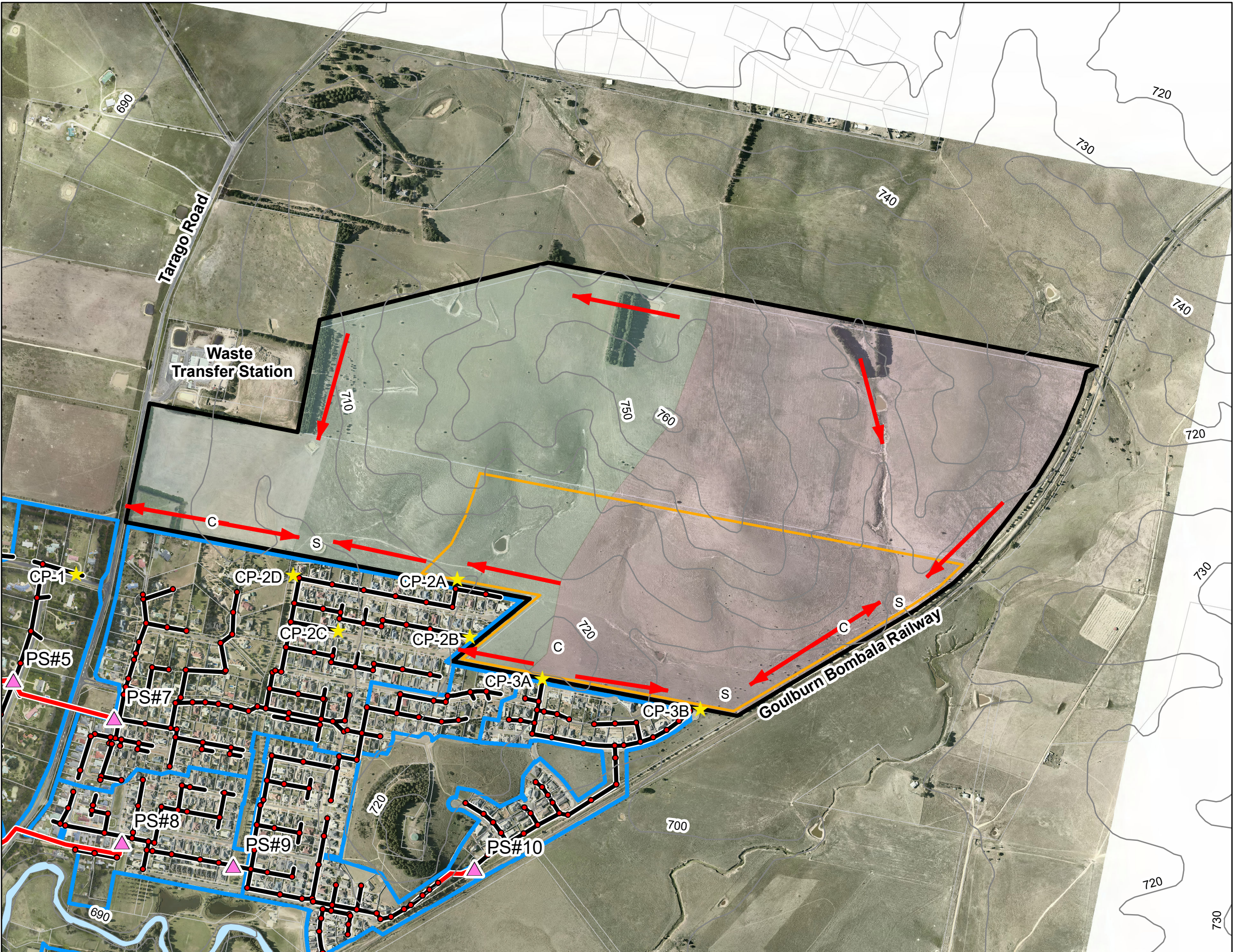
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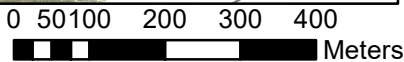
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Job No. 16-002361

Figure F002



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Legend

- Planning Proposal Area
- Study Area
- Turallo Creek
- Contours (10m Intervals)
- QPRC Cadasta
- Study Area West
- Study Area East
- Proposed Gravity Flow Direction
- C Local Crest
- S Local Sag
- Proposed Connection Point
- Existing Pump Stations
- Existing Sewer Maintenance Holes
- Existing Sewer Pressure Mains
- Existing Sewer Mains
- Existing Sewer Catchments

Notes:

Details

Issue	Amendment	Date
0	Draft	23-Dec-2016
1	QPRC comments	07-Sep-2017

Project

**NORTH BUNGENDORE PLANNING
PROPOSAL ASSESSMENT - STUDY 6
SEWERAGE**

Drawing Title

**STUDY AREA
SEWER CATCHMENTS PROPOSED**

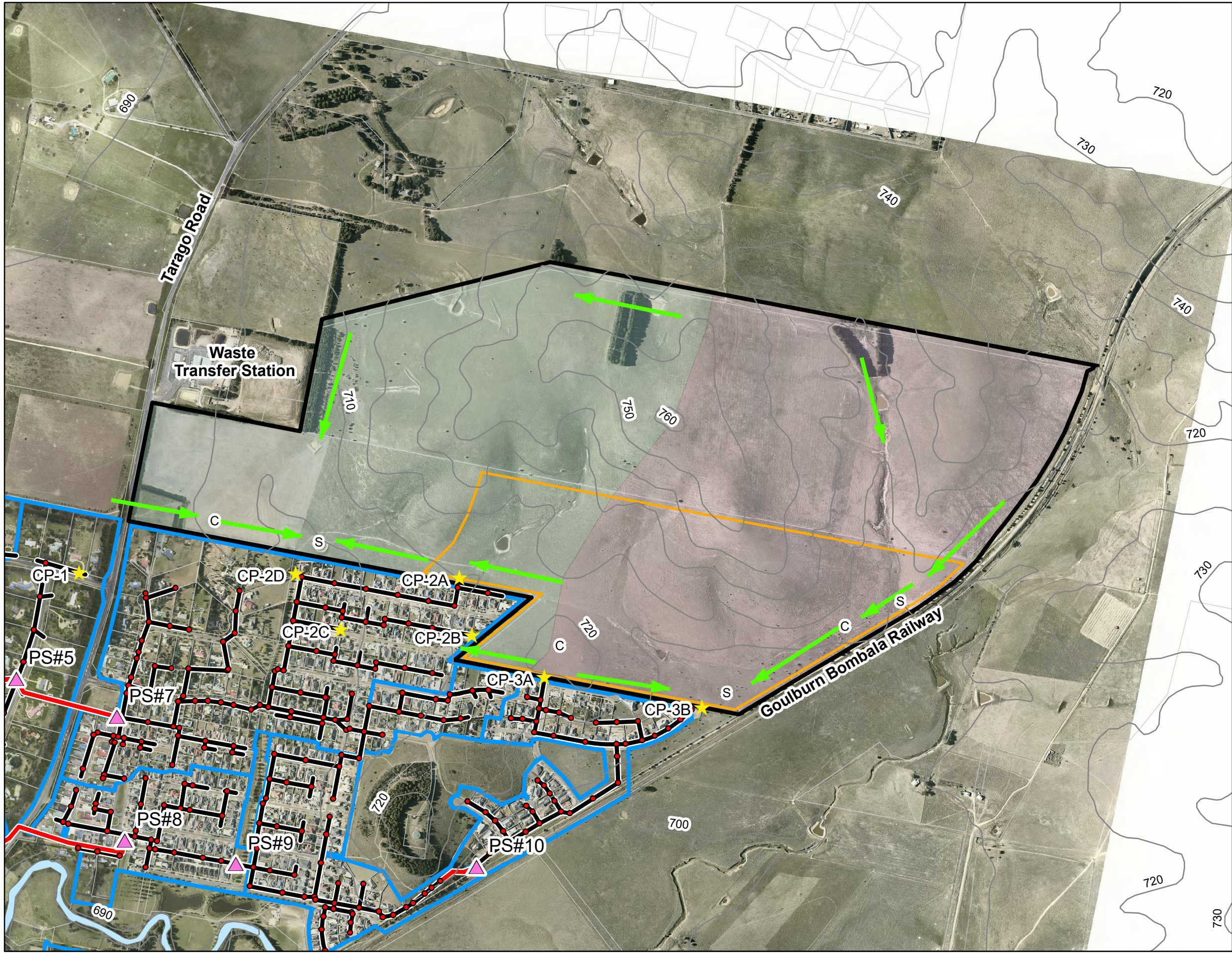
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Job No. 16-002361

Figure F003





Legend

- Planning Proposal Area
- Study Area
- Turallo Creek
- QPRC Cadasta
- Study Area West
- Study Area East
- Contours (10m Intervals)
- Existing Pump Stations
- Existing Sewer Maintenance Holes
- Existing Sewer Mains
- Existing Sewer Pressure Mains
- Existing Sewer Catchments
- C Local Crest
- S Local Sag
- Local Grading Constraints
- Proposed Connection Point
- Existing Pump Station Issues
- Existing Pressure Main Capacity Issue

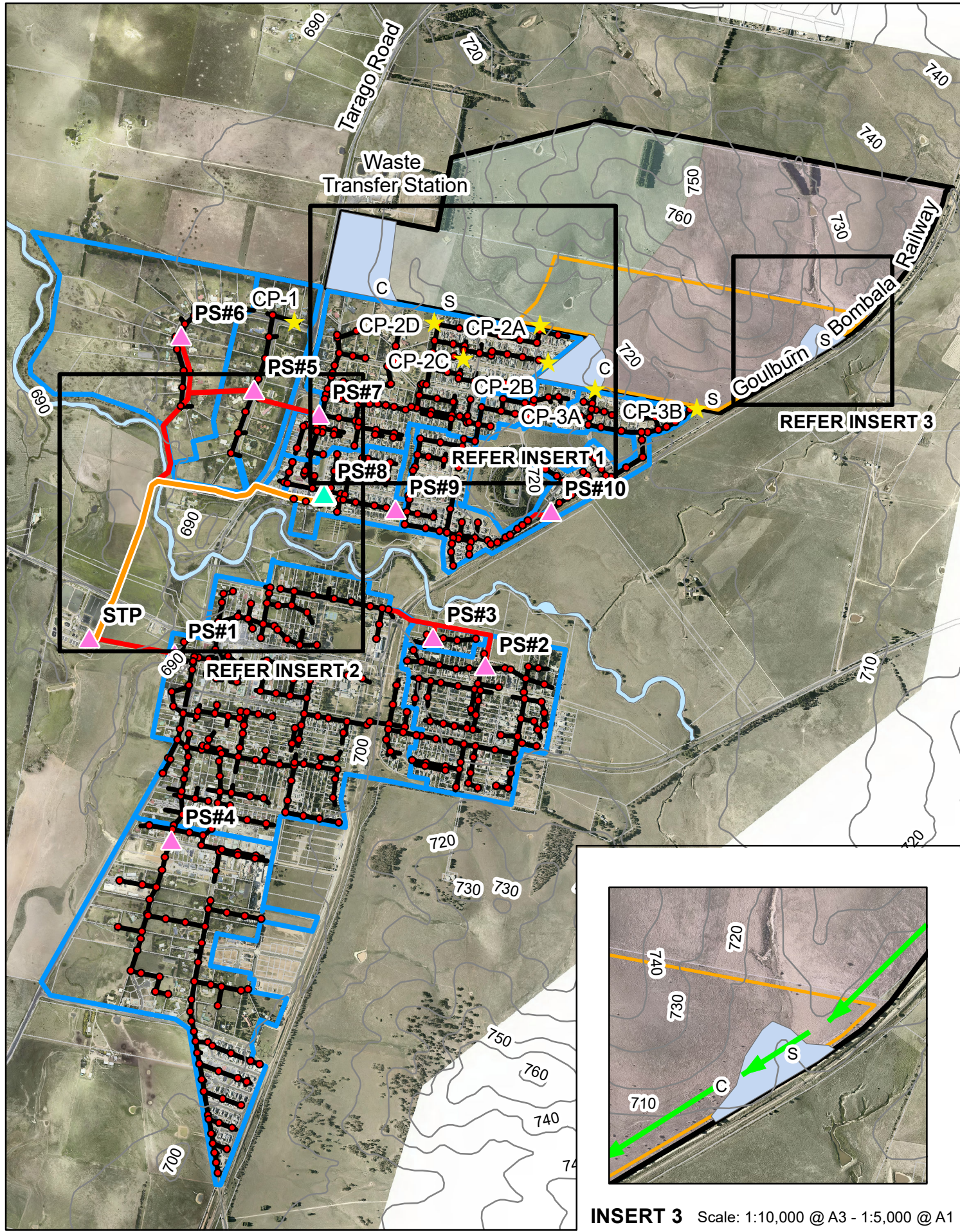
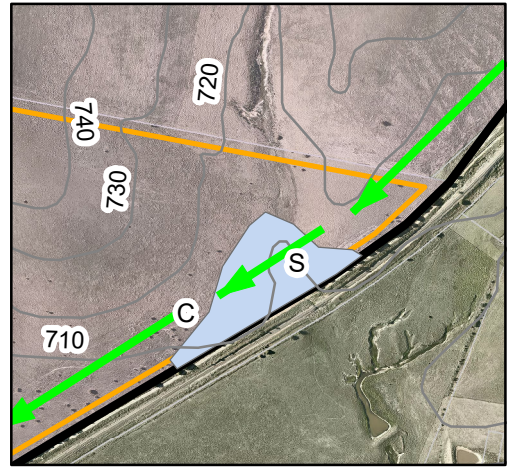
Notes:
Assessment carried out on supplied QPRC data.
Only sewer catchments that can be connected to the study area were assessed, including catchments PS#5, PS#7, PS#8, PS#9 and PS#10.

Details		
Issue	Amendment	Date
0	Draft	23-Dec-2016
1	QPRC comments	07-Sep-2017

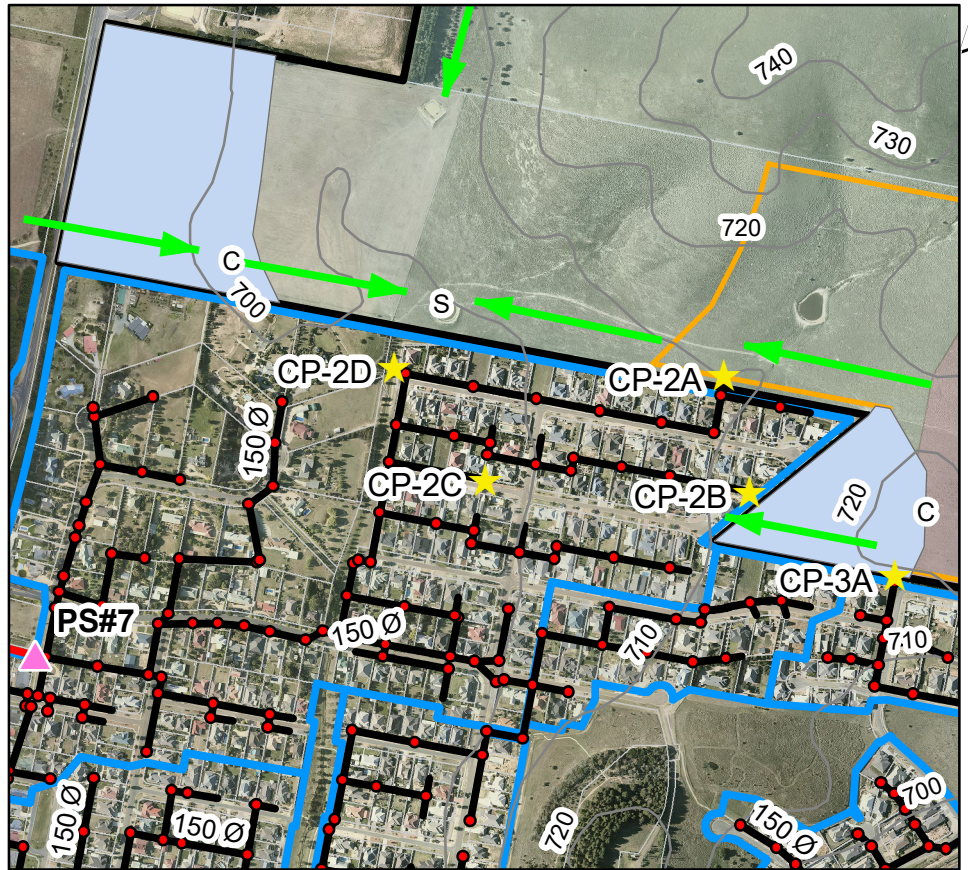
Project
NORTH BUNGENDORE PLANNING PROPOSAL ASSESSMENT - STUDY 6 SEWERAGE

Drawing Title
STUDY AREA EXISTING CONSTRAINTS / RESTRICTIONS

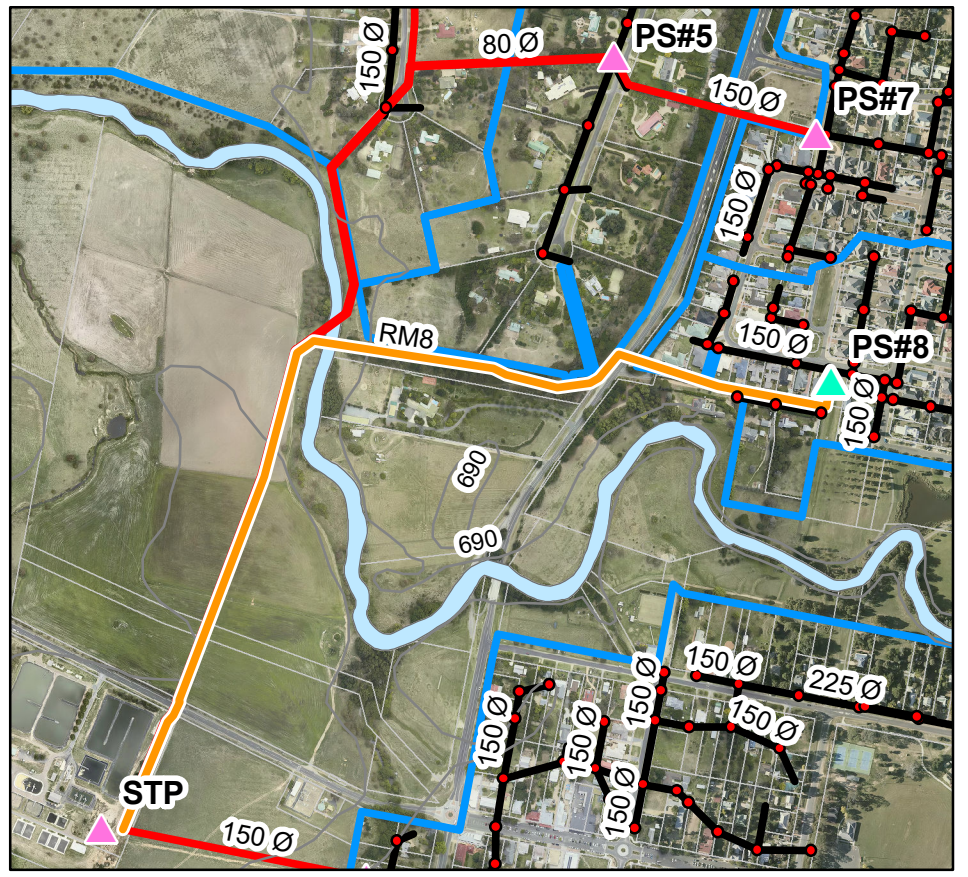
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Job No. 16-002361
Figure F004



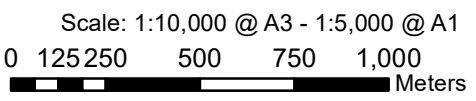
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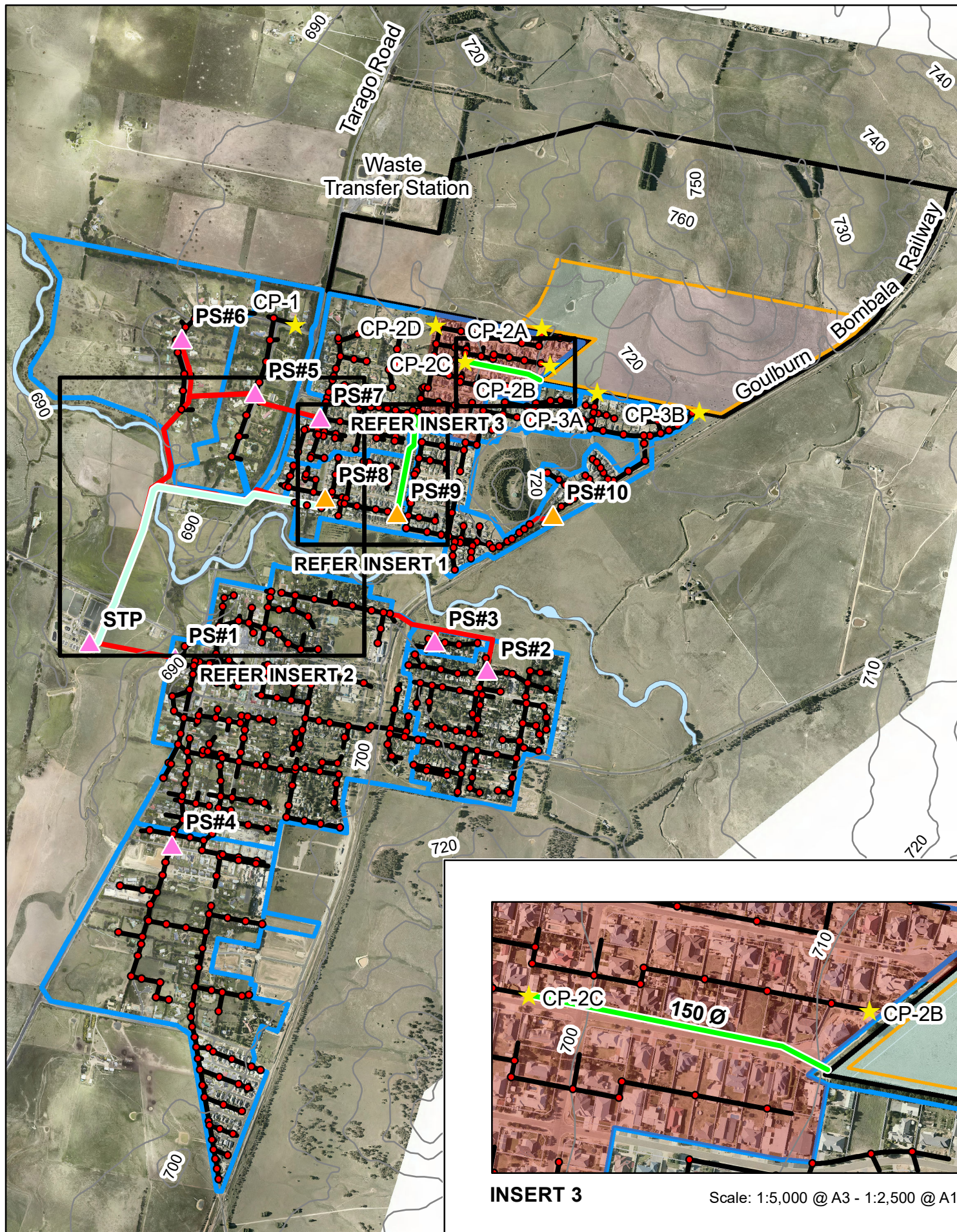


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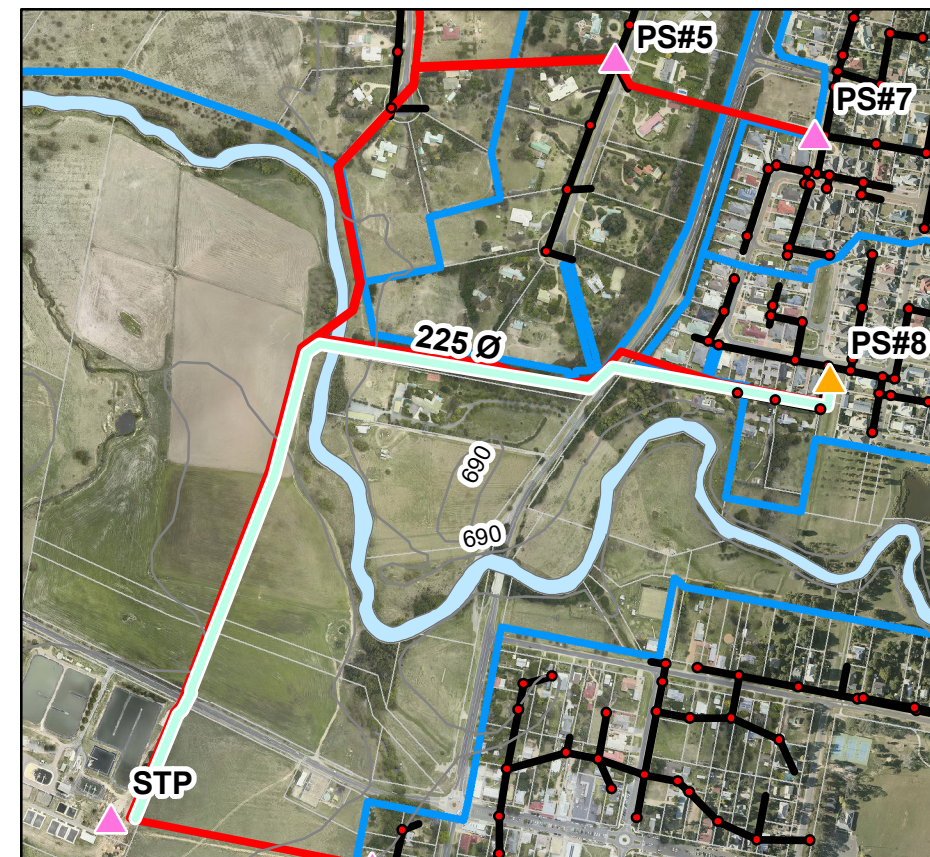
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Legend

- Planning Proposal Area
- Study Area
- Turallo Creek
- QPRC Cadasta
- Planning Proposal Area West
- Planning Proposal Area East
- Contours (10m Intervals)
- ▲ Existing Pump Stations
- Existing Sewer Maintenance Holes
- Existing Sewer Mains
- Existing Sewer Pressure Mains
- Existing Sewer Catchments
- ★ Proposed Connection Point
- ▲ Proposed Pump Station Augmentation
- Proposed Sewer Main Augmentation
- Proposed Sewer Pressure Main Augmentation
- Proposed Catchment 7 Diversion

Notes:
Assessment carried out on supplied QPRC data.
Only sewer catchments that can be connected to the study area were assessed, including catchments PS#5, PS#7, PS#8, PS#9 and PS#10.

Details

Issue	Amendment	Date
0	Draft	23-Dec-2016
1	QPRC comments	07-Sep-2017

Project

NORTH BUNGENDORE PLANNING PROPOSAL ASSESSMENT - STUDY 6 SEWERAGE

Drawing Title

PLANNING PROPOSAL AREA PROPOSED AUGMENTATIONS

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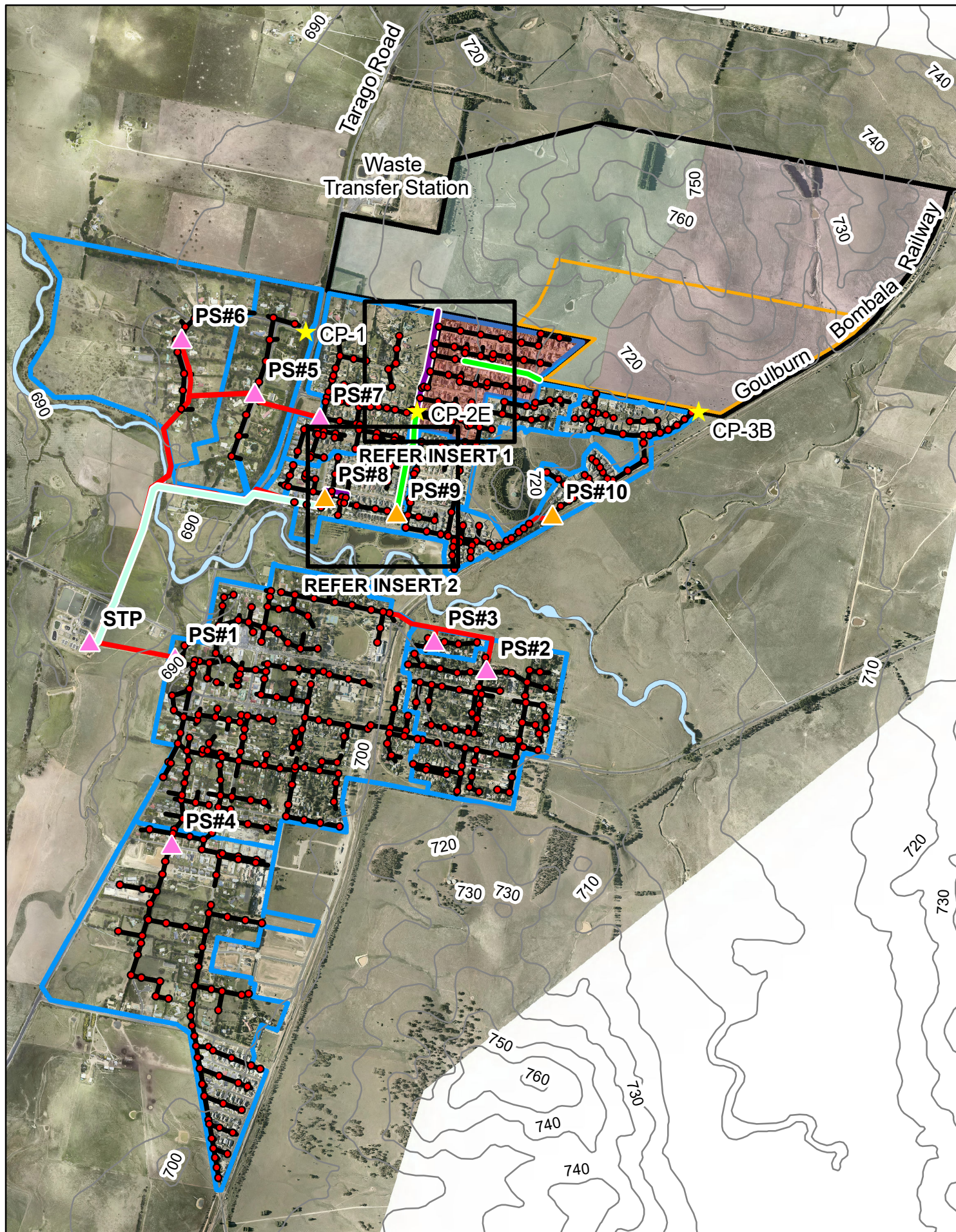
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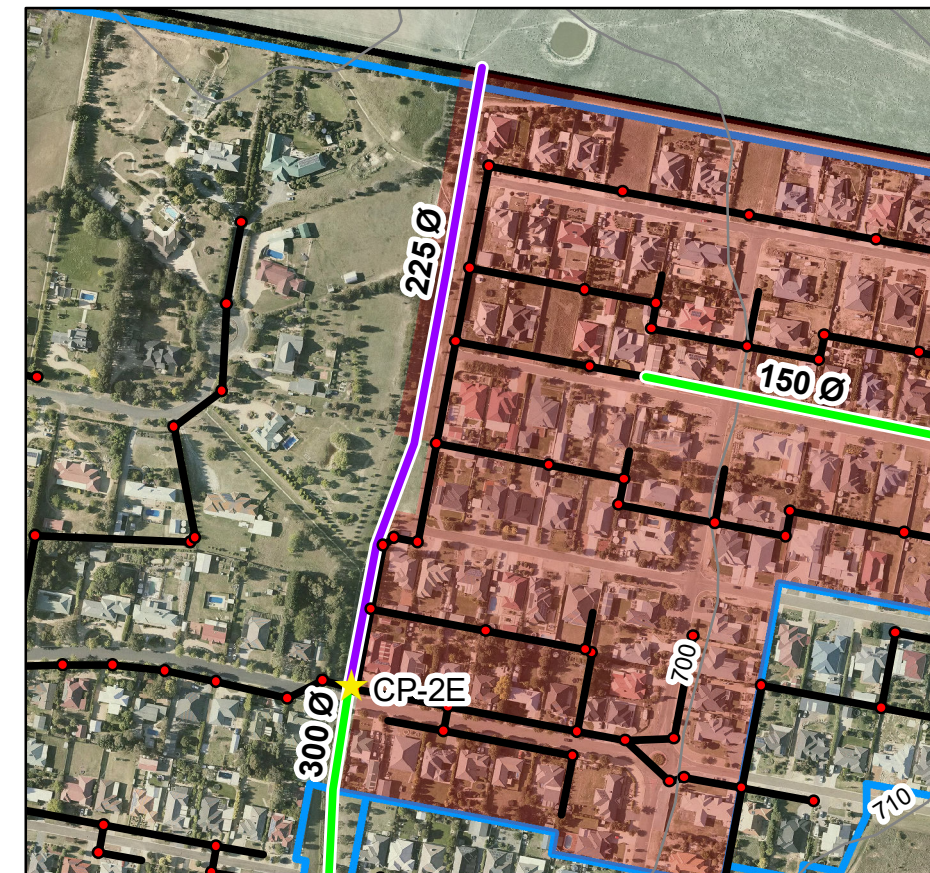
Figure F005

Issue

1

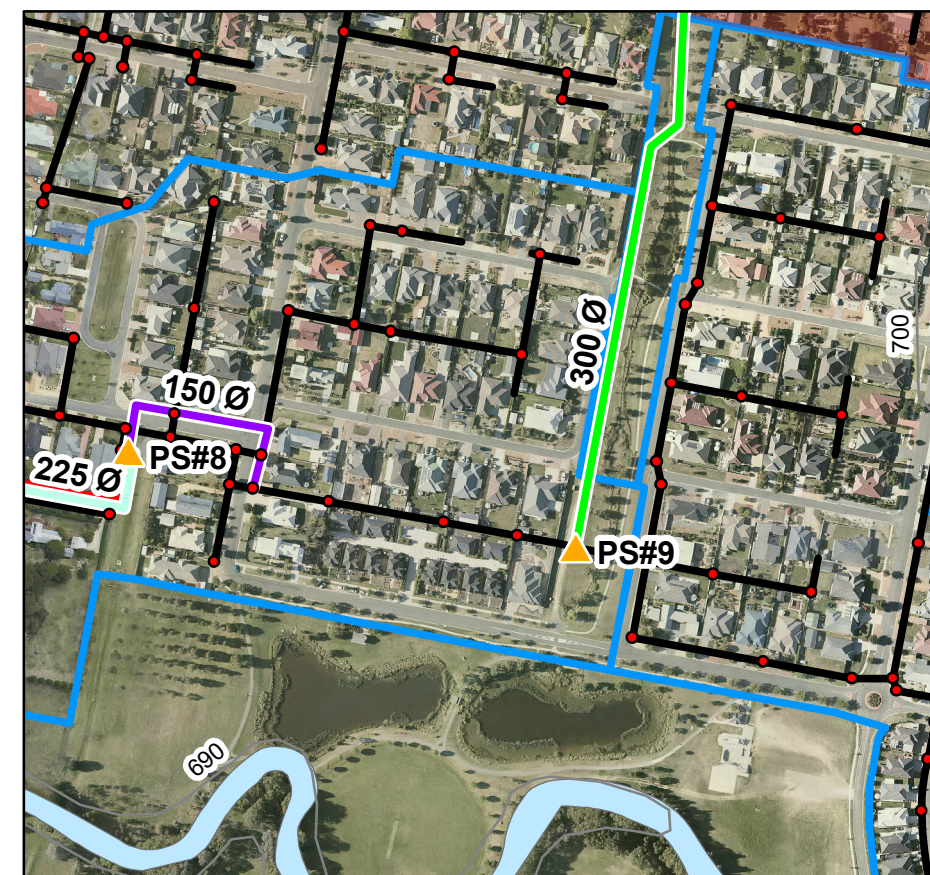


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Legend

- Planning Proposal Area
- Study Area
- Turallo Creek
- QPRC Cadasta
- Study Area West
- Study Area East
- Contours (10m Intervals)
- ▲ Existing Pump Stations
- Existing Sewer Maintenance Holes
- Existing Sewer Mains
- Existing Sewer Pressure Mains
- Existing Sewer Catchments
- Planning Proposal Sewer Main
- Planning Proposal Sewer Pressure Main
- Proposed Catchment 7 Diversion
- ★ Proposed Connection Point
- ▲ Proposed Pump Station Augmentation
- Proposed Sewer Gravity Main Augmentation

Notes:
Assessment carried out on supplied QPRC data. Only sewer catchments that can be connected to the study area were assessed, including catchments PS#5, PS#7, PS#8, PS#9 and PS#10.

Details

Issue	Amendment	Date
0	Draft	23-Dec-2016
1	QPRC comments	07-Sep-2017

Project

NORTH BUNGENDORE PLANNING PROPOSAL ASSESSMENT - STUDY 6 SEWERAGE

Drawing Title

STUDY AREA PROPOSED AUGMENTATIONS

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Job No. 16-002361

Figure F010

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1

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