WHITSUNDAY REGIONAL COUNCIL PRIORITY INFRASTRUCTURE PLAN

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WHITSUNDAY REGIONAL COUNCIL

PRIORITY INFRASTRUCTURE PLAN

Water and Sewerage Network Model Updates

Existing System Strategy

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1 BACKGROUND

Whitsunday Regional Council (WRC) is currently preparing a Priority Infrastructure Plan (PIP) as part of the 2014 Planning Scheme update. The PIP is designed to detail the network infrastructure required to adequately service the existing and projected future demands generated by the various development types, in each of the areas serviced by WRC.

Hyder Consulting (Hyder) has been engaged to provide assistance with the development of a number of tools which will inform the assessment of required infrastructure.

2 PRIORITY INFRASTRUCTURE PLAN INPUTS

2.1 EXISTING TOOLS

Prior to commencement of the current project, WRC has developed and maintained a number of resources which play an important part in the assessment of the network's demand and capacity. Resources relevant to the PIP are described below:

2.1.1 GIS DATABASE

WRC has an extensive GIS asset database which contains detailed information on water and wastewater collection, treatment and distribution assets. This database has been built on the records previously maintained by the Bowen and Whitsunday Shire Councils and is maintained internally.

A screenshot of some typical GIS network information for water assets in Scottville is shown on Figure 1.

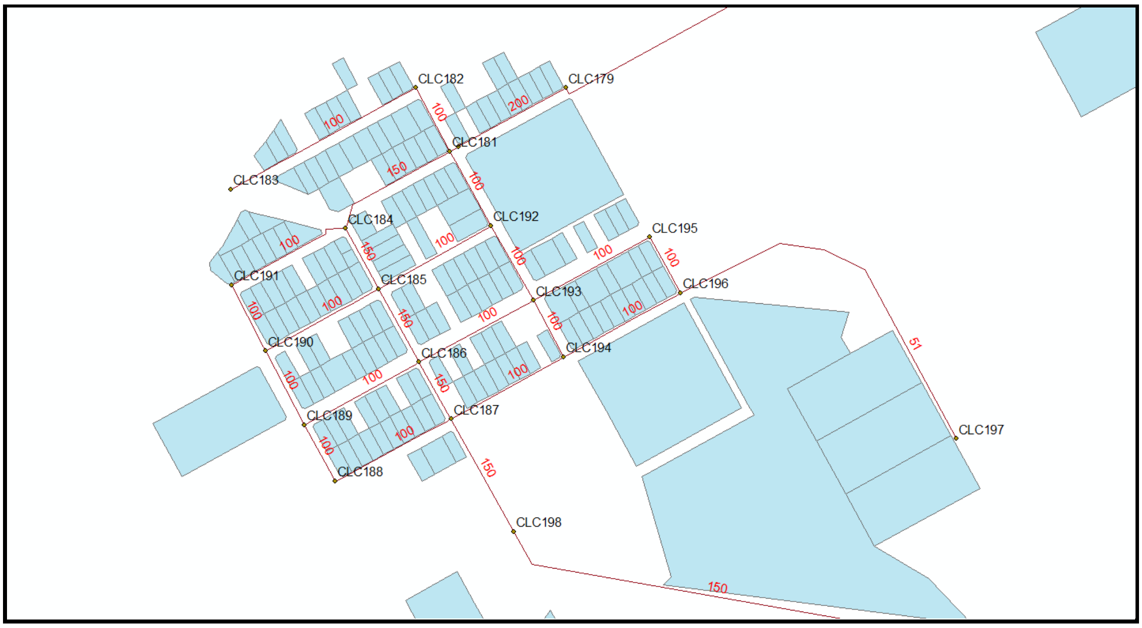

Figure 1 Scottville GIS Information Sample

2.1.2 RATES DATABASE

The WRC rates database contains records of all properties which are connected to the water distribution and wastewater collection networks.

2.1.3 WATER NETWORK HYDRAULIC MODELS

WRC has three existing water network hydraulic models, corresponding to the three discrete distribution systems:

- Bowen – covering infrastructure from the Proserpine river intake and including Heronvale, Whitsunday Shores, Bowen and Merinda
- Collinsville – covering Collinsville and Scottville
- Whitsunday – covering Proserpine, Cannonvale, Airlie Beach, Jubilee Pocket and Shute Harbour

These models were developed by GHD around 2011 and have been updated as required to account for new development. It is understood that WRC does not have a copy of the information used to develop the model loadings or calibration records, although it is possible the loadings were developed from meter reading records.

The models include some short term future growth scenarios, along with sets of suggested network augmentations. The scenarios do not correspond to the planning horizons considered in the Planning Scheme and have not been updated to account for the revised growth projections currently being developed for WRC.

A typical screenshot of the Collinsville water network model is shown on Figure 2.

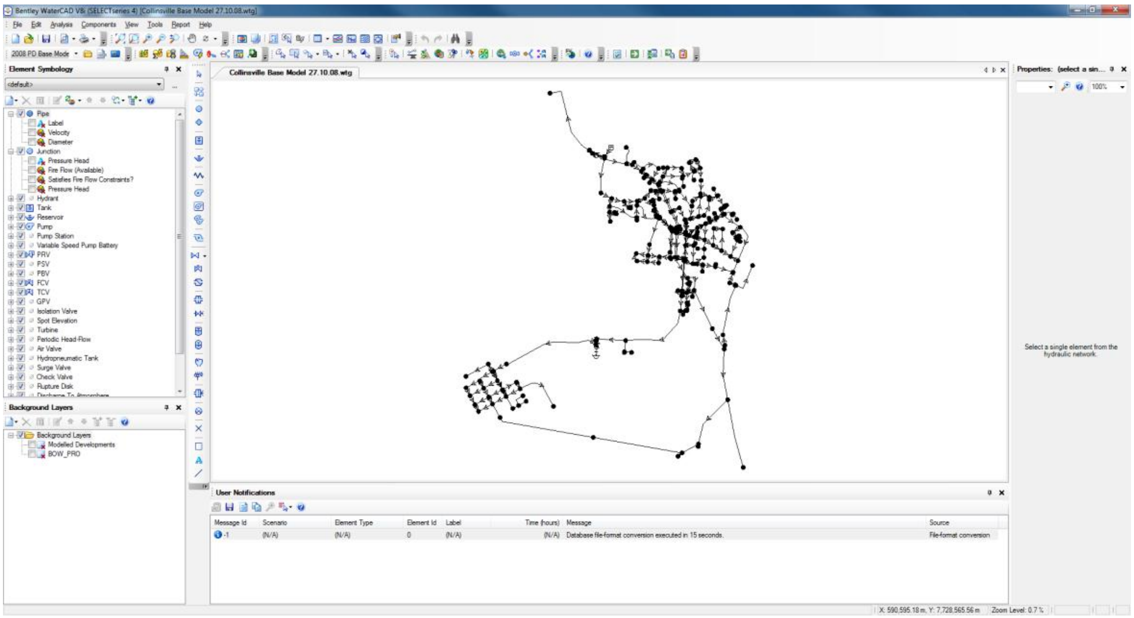

Figure 2 Collinsville Water Network Model Sample

2.1.4 SEWER NETWORK HYDRAULIC MODELS

WRC has five existing sewer network hydraulic models, corresponding to the five existing wastewater treatment plant catchments:

- Bowen – covering Bowen and Merinda
- Cannonvale – covering Cannonvale, Airlie Beach, Jubilee Pocket and Shute Harbour
- Collinsville – covering Collinsville and Scottville
- Proserpine – covering Proserpine
- Whitsunday Shores – covering Whitsunday Shores

These models were developed internally by WRC in 2012 and do not currently include projections for future development and network augmentation.

Network loading values for the sewer models were developed based on rates categories. A recent review of the flow rates generated by the model indicated that the rates categorisation data does not contain enough information to develop an accurate representation of network loadings. As a result, a more detailed demand estimate is required in order to develop models which accurately represent the operation of the WRC sewer networks.

A flow logging study was completed in early 2012 to determine typical and wet weather flow rates for sewer catchments in areas serviced by the Cannonvale and Proserpine sewer treatment plants. This information has been used in the calibration of the corresponding models.

2.1.5 CUSTOMER COMPLAINT AND FLOW TEST DATABASE

WRC has a database of recorded customer complaints and field flow rate tests which can be used in the review of the outputs of the water and sewer network hydraulic models.

This information has been used to compare low pressures indicated in the model to any observed groupings/ patterns of customer complaints of low pressures.

2.2 INFRASTRUCTURE DEMAND MODEL

As noted above, the existing information used for the development of loadings for the water and sewer network hydraulic models is incomplete and lacks transparency. In consideration of this, Hyder recommended the development of a new tool to store information on the estimated potable water demand and sewage generation for each lot serviced by WRC. The development of this tool is described below.

2.2.1 DEVELOPMENT OF IDM

The new WRC Infrastructure Demand Model is a database comprised of a GIS layer containing the following key data:

- A polygon outlining the extents of each parcel
- Appropriate references/ tags to identify each parcel within the WRC system
- Street address
- Lot area
- Numerical code and type description
- Equivalent Persons loading count for potable water connection

- Equivalent Persons loading count for sewer connection
- Nearest water network node
- Nearest sewer network manhole

Development of IDM Parcels

Each parcel in the IDM has been based on the WRC GIS Cadastre database. An IDM parcel was created for each lot in the WRC area, which has a physical connection to either the water distribution or sewer collection networks. It is noted that there are a number of lots which have a water connection, but do not have a reticulated sewerage connection. Information including street address and identification tags were taken from the Cadastre database.

Property Type Description

A review of information available to WRC indicated that the Emergency Services Levy classification, stored in the Civica system, provided the most detailed description of the use of each parcel. The majority of lots within the WRC service area were classified in one of 83 categories. Lots which did not have a classification in this system were assigned one manually based on available information on lot size, ownership and aerial photography records.

Equivalent Persons Loading Count

In order to provide a versatile data set for use in a number of different applications, an Equivalent Persons value for potable water demand and sewage generation was developed for each lot. Under the new WRC Desired Standards of Service (DSOS), one EP equates to:

- 500 litres per day of potable water demand
- 270 litres per day of sewage generation

This information is easily converted into flow rates for hydraulic modelling purposes.

The DSOS includes guidelines for the determination of EP, based on the Far North Queensland Regional Council Development Manual (FNQROC). These guidelines are summarised in Table 1.

Table 1 DSOS Equivalent Persons Guidelines

Description	Equivalent Persons/ Connection
Single Family Dwelling	
Lot > 1500m2	3.7
Lot 1101m2 to 1500m2	3.4
Lot 901m2 to 1100m2	3.1
Lot 401m2 to 900m2	2.8
Lot < 400m2	2.5
Multi Unit Accommodation	
Units > 3 bedrooms	0.4 + 0.6 / bedroom
Units = 3 bedrooms	2.2

Description	Equivalent Persons/ Connection
Units = 2 bedrooms	1.6
Units < 2 bedrooms	1
Caravan Parks	
Van Site / Camping Site	1.2
Shops / Offices	
Per 90m2 GFA	1

The above guidelines have been implemented to determine EP counts for each parcel where applicable. One issue encountered during this process was that there are no easily accessible records of the number of bedrooms for multi-unit residences. Development application records stored by WRC cover some of the multi-unit residences, however it is not feasible to individually extract plans for each residence and count the number of bedrooms. In consideration of this, an assumption of the number of bedrooms for each multi-residential unit was made based on the ACT Planning and Land Authority Apartment Guidelines (2006). Minimum apartment floor areas are nominated in Section 1.1.2 of this document as shown in Table 2.

Table 2 Input Assumptions for Apartments

Type	Minimum Floor Area (m^2)
Studio Apartments	40
1 Bedroom Apartments	50
2 Bedroom Apartments	70
3 + Bedroom Apartments	95

Based on the above guidelines and the recorded floor areas for multi-unit dwellings, it was assumed that dwellings with floor areas of:

- less than $70m^2$ corresponded to a 1 bedroom apartment;
- $70m^2$ to $95m^2$ corresponded to a 2 bedroom apartment; and
- greater than $95m^2$ corresponded to a 3 bedroom apartment.

These assumptions were combined with the EP guidelines in Table 1 to determine the EP counts for each multi-unit dwelling.

For parcels with a property type description which does not correspond with the guidelines in Table 1, an EP value was determined based on meter reading records for long term average consumption.

A sanity check was undertaken on all parcels with large EP values to ensure that the calculated numbers were realistic. A number of users, for example parks, have a high water consumption associated with irrigation, but very low sewer production. Sewer EP values were adjusted to suit the type of development in these cases.

Nearest Nodes

In order to determine which section of water and/ or sewer network infrastructure the demand for each parcel should be assigned to, the WRC GIS group performed a query to find the nearest node to the centroid of the parcel. This information has been recorded in the IDM and was used to assign loads to water model nodes and sewer model manholes.

2.2.2 UPDATES FOR FUTURE PLANNING HORIZONS

The initial phase of the PIP project has focussed on existing network loadings, as of 2014. The IDM includes fields for future projected EP values, which will be populated in the next phase of the project following the outcomes of the Planning Scheme.

2.2.3 POTENTIAL FOR FUTURE EXPANSION

As a newly developed tool, the IDM has substantial potential to be developed further and provide additional utility to WRC. While not within the scope of this project, information which could be included in a future revision of the IDM could include:

- Lot impervious areas and runoff coefficients
- Traffic counts
- Waste generation quantities

2.3 PRELIMINARY NETWORK CAPACITY ASSESSMENT

A preliminary network capacity assessment was undertaken following the completion of the first revision of the IDM. This exercise was undertaken at the request of WRC in order to determine any areas of severely constrained network capacity, which may impact the decision process for the selection of future growth areas.

A copy of the Preliminary Network Capacity Assessment is contained in Appendix A.

2.4 WATER NETWORK MODEL UPDATES

Following the completion of the IDM and Preliminary Network Capacity Assessment, a review of the existing network models was undertaken in order to determine if the models were an accurate representation of the field infrastructure.

2.4.1 NETWORK CONFIGURATION REVIEW

As WRC does not have access to the build files for the water network models, this process was undertaken initially by loading the GIS layers for water mains and nodes as a background into the existing WaterCAD models. Revisions to individual models are described below.

Bowen Model

A screenshot of the existing Bowen model is shown on Figure 3.

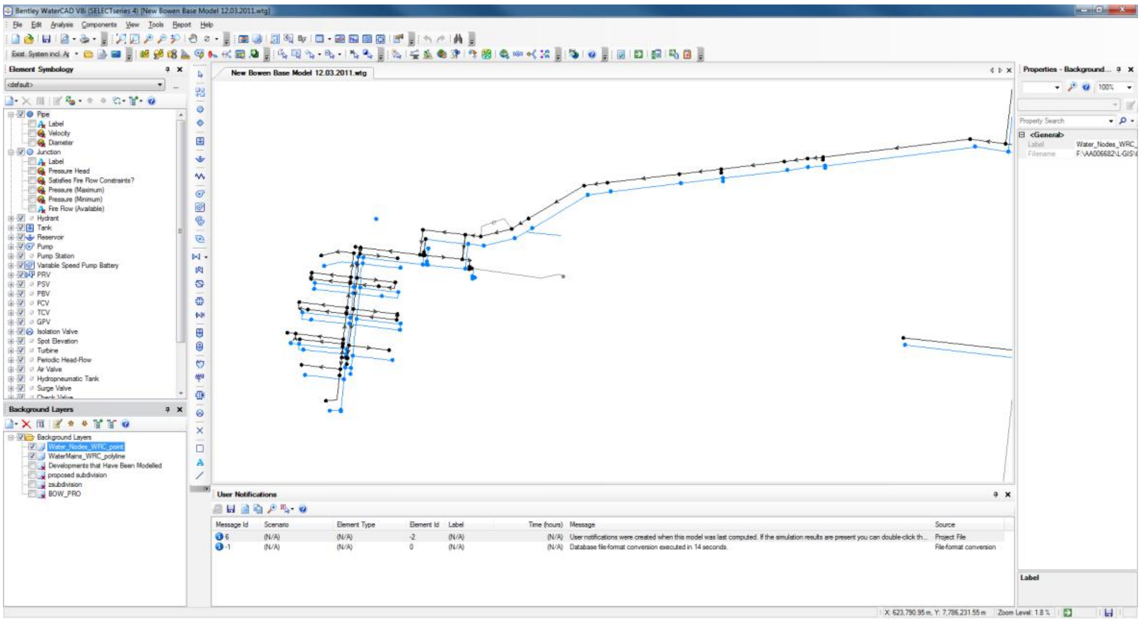

Figure 3 Bowen Water Network Model Sample

As shown on the figure, the existing Bowen model demonstrates a number of areas where the pipes are not aligned with the GIS information. The primary discrepancies between the existing models and the GIS data set are described for each model below.

The following network geometry issues were identified and rectified in the Bowen model:

- Misalignment of a significant portion of pipes and nodes in the model
- Incorrect node names (or placeholder node names)
- Recent development areas not included or incomplete:
  - Tropic Gardens Estate
  - Lemon Grove
  - Kapok Park
  - Mellaluca Cove
  - Whitsunday Breeze
  - Whitsunday Shores Stage 2

Whitsunday Model

The Whitsunday model did not exhibit the misalignment evident in the Bowen model, however the geometry required an update in order to ensure recent development areas were included.

The following issues were identified and rectified:

- Proserpine bore pumps feeding downstream of the Proserpine WTP were disabled in the model and the proposed infrastructure associated with the operation of the new Proserpine water treatment plant was enabled.
- Recent development areas not included or incomplete:
  - Southern Proserpine

- Cannon Valley
- Port of Airlie
- Southern Jubilee Pocket

Collinsville Model

The review of the Collinsville model indicated that the model geometry was largely consistent with GIS records. A small number of minor pipe additions were made.

2.4.2 LOADING REVISIONS

Loadings in the existing water network models were inconsistently applied between models, with a mixture of unit loads and directly applied node loads.

Existing loadings were replaced with unit loads derived from the IDM that was developed earlier.

2.5 SEWER NETWORK MODEL UPDATES

A review of the sewer network model updates was undertaken to ensure the layout matched the current WRC GIS database information, as well as to incorporate the loadings generated from the new IDM.

2.5.1 NETWORK CONFIGURATION REVIEW

For each model, the GIS information was overlaid onto the existing model layout in order to identify revisions and additions to the network. Network revisions are described below:

Bowen Model

The following issues in the Bowen model were identified and addressed:

- King Street sewer system added
- Recent development areas not included or incomplete:
  - Whitsunday Breeze

Cannonvale Model

The following issues in the Cannonvale model were identified and addressed:

- Reconfiguration around Cannonvale 5 SPS

Proserpine Model

The Proserpine model network configuration was found to be generally consistent with current GIS records.

Collinsville Model

The Collinsville model network configuration was found to be generally consistent with current GIS records.

Whitsunday Shores Model

The Whitsunday Shores model network configuration was found to be generally consistent with current GIS records.

2.5.2 LOADING REVISIONS

All existing loadings were replaced with unit loads derived from the IDM.

3 WATER NETWORK MODEL RESULTS

Hydraulic network modelling results for the 3 water supply networks serviced by WRC are presented below and in Appendices A to C. Results presented graphically have been colour coded as described in Table 3.

Table 3 Water Network Model Results Colour Coding

Colour	Description of Result
Red	Node minimum pressure is below 0.0m
Yellow	Node minimum pressure is between 0.0m and 22.0m
Green	Node pressure or fire flow capacity satisfies DSOS requirements
Magenta	Node maximum pressure exceeds 80.0m
Black	Node fire flow capacity does not meet DSOS requirements

3.1 BOWEN

Average day minimum pressure, peak day minimum pressure, average day maximum pressure and peak hour fire flow compliance for areas serviced by the Bowen water distribution network are shown on Figures 4 to 7 below.

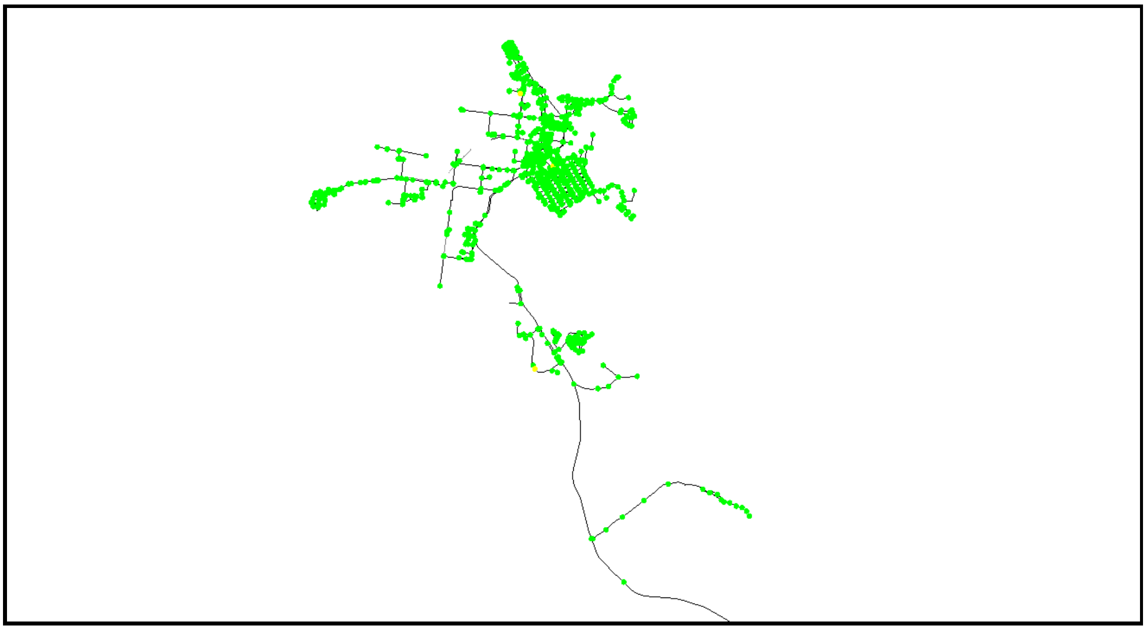

Figure 4 2014 Average Day Minimum Pressures – Bowen Overview

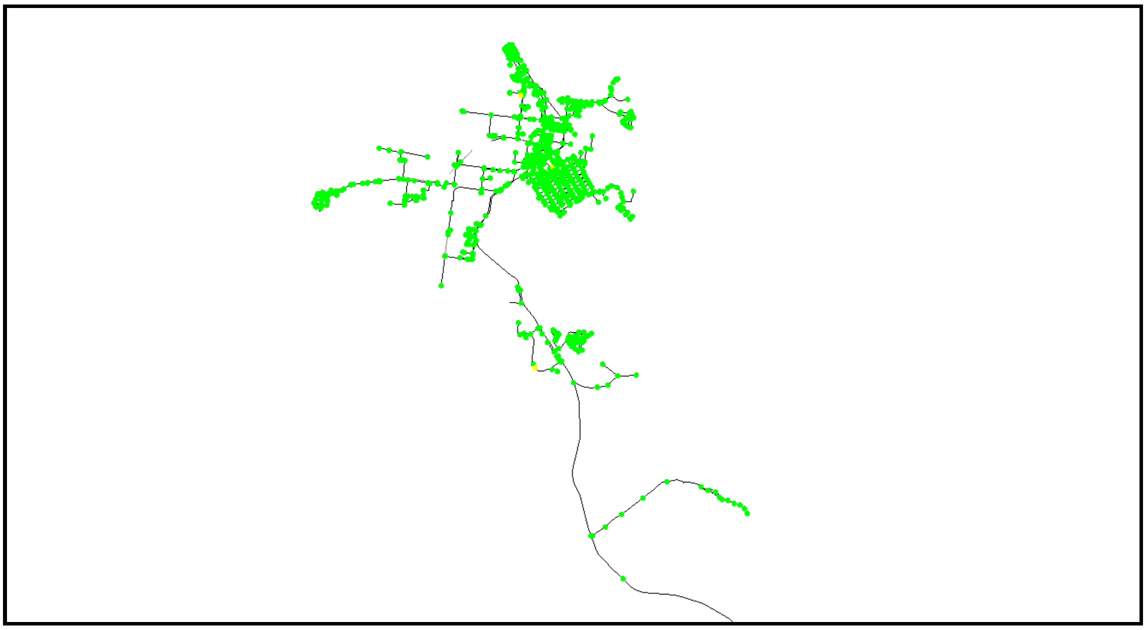

Figure 5 2014 Peak Day Minimum Pressures – Bowen Overview

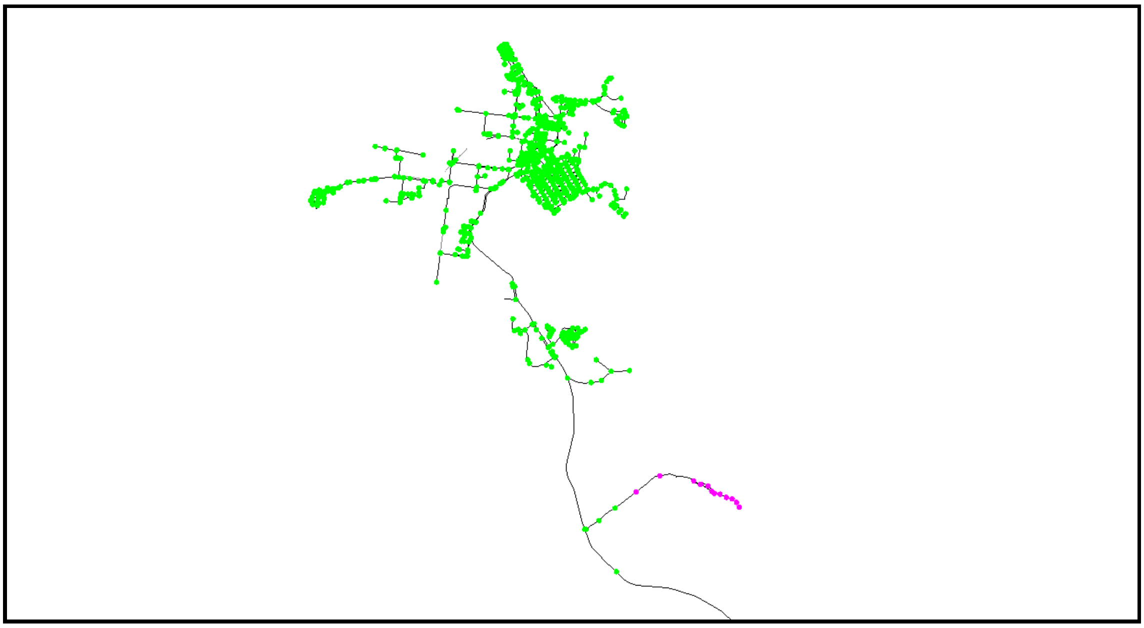

Figure 6 2014 Average Day Maximum Pressures – Bowen Overview

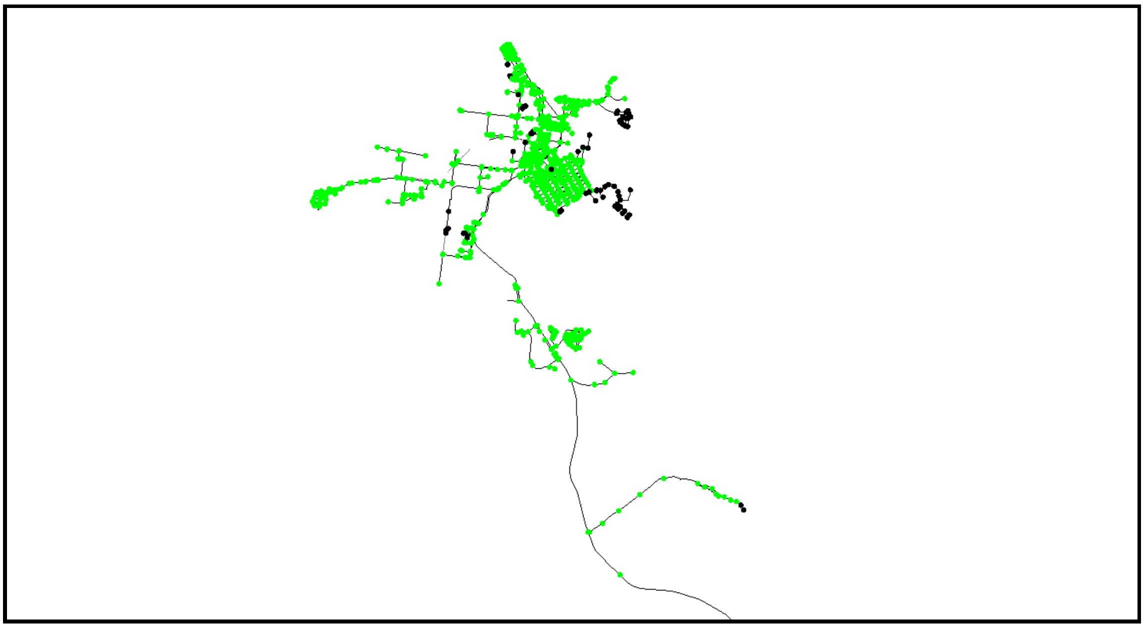

Figure 7 2014 Peak Day Fire Flow Compliance – Bowen Overview

Larger scale plots for each geographical area within the Bowen system are contained in Appendix B.

Average Day Minimum Pressures

The model indicates that the existing Bowen system is generally compliant with the DSOS with regards to minimum pressures under current average and peak day demand conditions. A small number of nodes have minimum pressures lower than the DSOS specification of 22m, under average day flow conditions as detailed in Table 4 below.

Table 4 Whitsunday Model – Average Day Minimum Pressures Below 22m

Node	Minimum Pressure (m)	Comments
BNA357	18.6	Node elevation is 14m below base of Hospital Hill reservoir
BNB065	19.1	Node elevation is 12m below base of Hospital Hill reservoir
BNB069	19.1	Node elevation is 12m below base of Hospital Hill reservoir
BNB070	19.1	Node elevation is 12m below base of Hospital Hill reservoir
BNA235	20.4	Node elevation is 15m below base of Hospital Hill reservoir

All nodes listed in Table 4 have high elevations relative to the Hospital Hill reservoir. As such, the low pressures recorded do not represent an operational issue in the supply system. It is recommended that a review of customer pressures in these areas including field testing is undertaken and local pressure boosting be implemented if considered appropriate.

Peak Day Minimum Pressures

The model analysis did not indicate any additional nodes with minimum pressures below the DSOS requirements under peak day demand conditions.

Average Day Maximum Pressures

The model analysis indicated a number of nodes which have pressures in excess of the DSOS maximum value of 80m. These nodes are detailed in Table 5.

Table 5 Bowen Model – Average Day Maximum Pressures Above 80m

Node	Maximum Pressure (m)	Comments
BNA675	90	Heronvale node - high pressures due to operation of trunk feed line to Bowen
BNA689	88.2	Heronvale node - high pressures due to operation of trunk feed line to Bowen
BNA685	88.2	Heronvale node - high pressures due to operation of trunk feed line to Bowen
BNA688	87.7	Heronvale node - high pressures due to operation of trunk feed line to Bowen
BNA687	87.2	Heronvale node - high pressures due to operation of trunk feed line to Bowen
BNA686	87.2	Heronvale node - high pressures due to operation of trunk feed line to Bowen
BNA683	86.7	Heronvale node - high pressures due to operation of trunk feed line to Bowen
BNA682	86.2	Heronvale node - high pressures due to operation of trunk feed line to Bowen
BNA679	86.2	Heronvale node - high pressures due to operation of trunk feed line to Bowen
BNA684	83.7	Heronvale node - high pressures due to operation of trunk feed line to Bowen
BNA680	83.7	Heronvale node - high pressures due to operation of trunk feed line to Bowen
BNA681	83.2	Heronvale node - high pressures due to operation of trunk feed line to Bowen
BNA674	80.7	Heronvale node - high pressures due to operation of trunk feed line to Bowen

All customer nodes with maximum pressures in excess of the DSOS maximum are located in the Heronvale community. High pressures in this area are a result of the operation of the trunk supply main between the Bowen WTP and the Bowen distribution network. It is recommended that an assessment of the effect of high pressures on the Heronvale community is made and if necessary, a pressure reducing valve be installed on the main feeding Heronvale.

Fire Flow Compliance

The results of the Bowen model indicate a significant number of nodes which do not meet the DSOS requirement for fire flow available at the nominated minimum residual pressure of 12m. These nodes are detailed in Table 6.

Table 6 Bowen Model – Peak Hour Non-Compliant Fire Flow Nodes

Node	Available Fire Flow (L/s)	Comments
BNA357	0.0	Elevated node
BNB038	2.6	DN100 main feeding area is undersized for fire flow
BN235	3.0	DN100 main feeding Rose Bay is undersized for fire flow
BNA502	3.1	DN100 main feeding Rose Bay is undersized for fire flow
BNA503	5.4	DN100 main feeding Rose Bay is undersized for fire flow
BN250	5.4	DN100 main feeding Rose Bay is undersized for fire flow
BNA519	5.8	DN100 main feeding Rose Bay is undersized for fire flow
BNA506	5.9	DN100 main feeding Rose Bay is undersized for fire flow
BNA505	5.9	DN100 main feeding Rose Bay is undersized for fire flow
BNA504	6.0	DN100 main feeding Rose Bay is undersized for fire flow
BNA510	6.0	DN100 main feeding Rose Bay is undersized for fire flow
BNA520	6.1	DN100 main feeding Rose Bay is undersized for fire flow
BNA509	6.5	DN100 main feeding Rose Bay is undersized for fire flow
BNA511	6.5	DN100 main feeding Rose Bay is undersized for fire flow
BNA516	6.6	DN100 main feeding Rose Bay is undersized for fire flow
BNA508	6.6	DN100 main feeding Rose Bay is undersized for fire flow

Node	Available Fire Flow (L/s)	Comments
BNA507	6.6	DN100 main feeding Rose Bay is undersized for fire flow
BNA515	6.7	DN100 main feeding Rose Bay is undersized for fire flow
BNA518	6.7	DN100 main feeding Rose Bay is undersized for fire flow
BNA517	6.8	DN100 main feeding Rose Bay is undersized for fire flow
BNA514	6.8	DN100 main feeding Rose Bay is undersized for fire flow
BNA513	6.8	DN100 main feeding Rose Bay is undersized for fire flow
BNA777	6.9	DN100 main feeding Rose Bay is undersized for fire flow
BNB039	7.5	DN100 main feeding area is undersized for fire flow
BNA726	8.4	DN100 main feeding area is undersized for fire flow
BNA727	8.4	DN100 main feeding area is undersized for fire flow
BNA725	8.5	DN100 main feeding area is undersized for fire flow
BNA312	9.5	DN100 main feeding Dalrymple Point is undersized for fire flow
BNA313	9.7	DN100 main feeding Dalrymple Point is undersized for fire flow
BNA314	9.7	DN100 main feeding Dalrymple Point is undersized for fire flow
BNA604	9.8	DN100 main feeding area is undersized for fire flow
BNA102	10.4	DN100 main feeding area is undersized for fire flow
BNA311	10.6	DN100 main feeding Dalrymple Point is undersized for fire flow
BNA936	10.6	DN100 main feeding area is undersized for fire flow
BNA315	10.6	DN100 main feeding Dalrymple Point is undersized for fire flow
BNA317	10.7	DN100 main feeding Dalrymple Point is undersized for fire flow
BNA316	10.9	DN100 main feeding Dalrymple Point is undersized for fire flow
BNA935	11.0	DN100 main feeding area is undersized for fire flow
BNA310	11.2	DN100 main feeding Dalrymple Point is undersized for fire flow
BNA362	11.3	DN100 main feeding area is undersized for fire flow
BNA309	11.5	DN100 main feeding Dalrymple Point is undersized for fire flow
BNA521	11.5	DN100 main feeding area is undersized for fire flow
BNA308	11.8	DN100 main feeding Dalrymple Point is undersized for fire flow
BNA768	12.0	DN100 main feeding area is undersized for fire flow
BNA767	12.0	DN100 main feeding area is undersized for fire flow
BNA225	12.0	DN100 main feeding area is undersized for fire flow
BNB094	12.1	DN100 main feeding area is undersized for fire flow
BNB076	12.1	DN100 main feeding area is undersized for fire flow
BNA766	12.1	DN100 main feeding area is undersized for fire flow
BNA765	12.1	DN100 main feeding area is undersized for fire flow
BNA307	12.1	DN100 main feeding area is undersized for fire flow
BNA775	12.2	DN100 main feeding area is undersized for fire flow
BNB093	12.3	DN100 main feeding area is undersized for fire flow
BNA306	12.5	DN100 main feeding area is undersized for fire flow
B156	12.5	DN100 main feeding area is undersized for fire flow
BNB168	12.7	DN100 main feeding area is undersized for fire flow
BNA305	13.0	DN100 main feeding area is undersized for fire flow
BNB170	13.2	DN100 main feeding area is undersized for fire flow
BNA304	13.3	DN100 main feeding area is undersized for fire flow
BNA467	13.3	DN100 main feeding area is undersized for fire flow
BNA303	13.4	DN100 main feeding area is undersized for fire flow
BNA101	13.4	DN100 main feeding area is undersized for fire flow

Node	Available Fire Flow (L/s)	Comments
BNB077	13.4	DN100 main feeding area is undersized for fire flow
BNA15	13.4	DN100 main feeding area is undersized for fire flow
BNA524	13.5	DN100 main feeding area is undersized for fire flow
BNA688	13.5	DN100 main feeding area is undersized for fire flow
BNA151	13.7	DN100 main feeding area is undersized for fire flow
BNB075	13.8	DN100 main feeding area is undersized for fire flow
BNA466	13.9	DN100 main feeding area is undersized for fire flow
BNA525	14.1	DN100 main feeding area is undersized for fire flow
BNA712	14.1	DN100 main feeding area is undersized for fire flow
BNB091	14.3	DN100 main feeding area is undersized for fire flow
BNB092	14.4	DN100 main feeding area is undersized for fire flow
BNA105	14.6	DN100 main feeding area is undersized for fire flow
BNA14	14.6	DN100 main feeding area is undersized for fire flow
BNA782	14.8	DN100 main feeding area is undersized for fire flow
BNA285	14.8	DN100 main feeding area is undersized for fire flow

The model results indicate a number of areas in Bowen which do not meet the DSOS requirements for fire flow. These areas are typically fed by a single DN100 supply main, which would have a flow velocity of around 2m/s at a flow rate of 15L/s. While this velocity is within the DSOS design guideline, it results in significant head losses in long runs of pipe. This in turn results in low pressures under fire flow conditions, particularly where normal operating pressures are close to the DSOS minimums.

The main operational issues in the Bowen system under fire flow conditions can be summarised as:

- The DN100 supply main in Rose Bay Rd feeding Rose Bay is too small to satisfy fire flow requirements
- The DN100 section of supply main in Hay St/ Henry Darwen Memorial Dr restricts the fire flow capacity of the network in Peter Wyche Dr and Dalrymple Point
- The DN100 main feeding Kapok Park is too small to satisfy fire flow requirements
- The DN100 main in Morrill St is too small to satisfy fire flow requirements
- The DN100 main in Queens Rd is too small to satisfy fire flow requirements
- The DN100 main in Kirkpatrick Ct is too small to satisfy fire flow requirements
- The DN100 main in Lucinda Pl is too small to satisfy fire flow requirements
- The DN100 main in Eglington St and Troyon Ct is too small to satisfy fire flow requirements
- The DN100 main in West St is too small to satisfy fire flow requirements
- The DN100 main in Bolt St is too small to satisfy fire flow requirements
- The DN100 main in Sproule St is too small to satisfy fire flow requirements
- The DN100 main in Quay St is too small to satisfy fire flow requirements
- The DN100 main in Bootooloo Rd is too small to satisfy fire flow requirements

- The DN100 main in Banks Dr feeding the Whitsunday Breeze estate is too small to satisfy fire flow requirements
- The DN100 main in Heronvale Rd / Baxter Ave is too small to satisfy fire flow requirements

Suggested system upgrades to address these issues are detailed in Section 6.

3.2 WHITSUNDAY

Results

Average day minimum pressure, peak day minimum pressure, average day maximum pressure and peak hour fire flow compliance for areas serviced by the Whitsunday water distribution network are shown on Figure 8 to Figure 11 below.

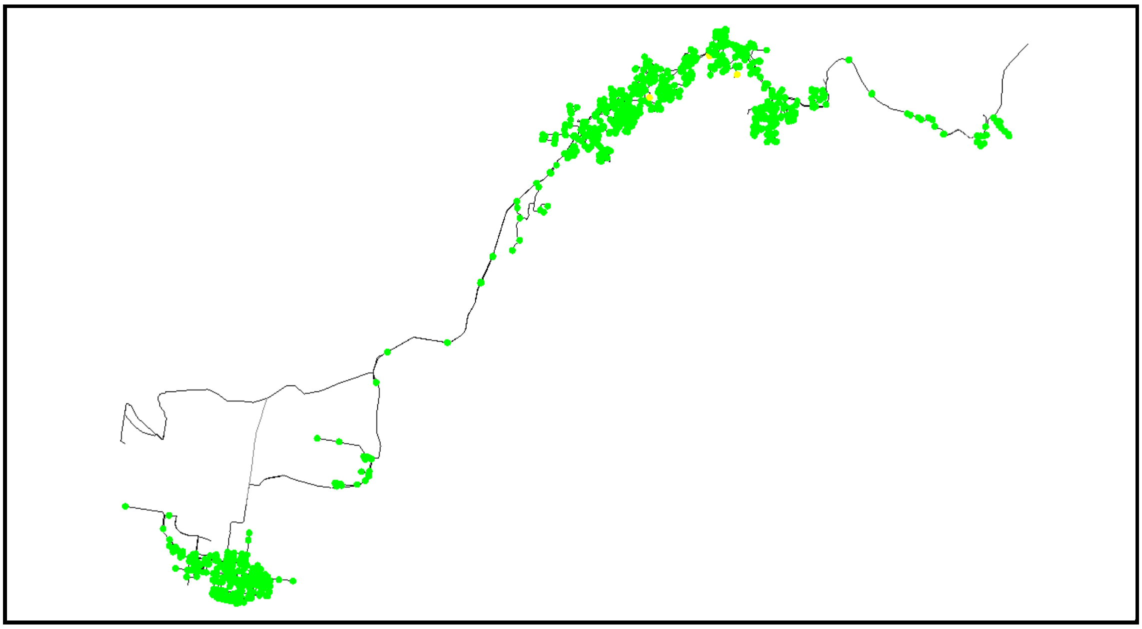

Figure 8 2014 Average Day Minimum Pressures – Whitsunday Overview

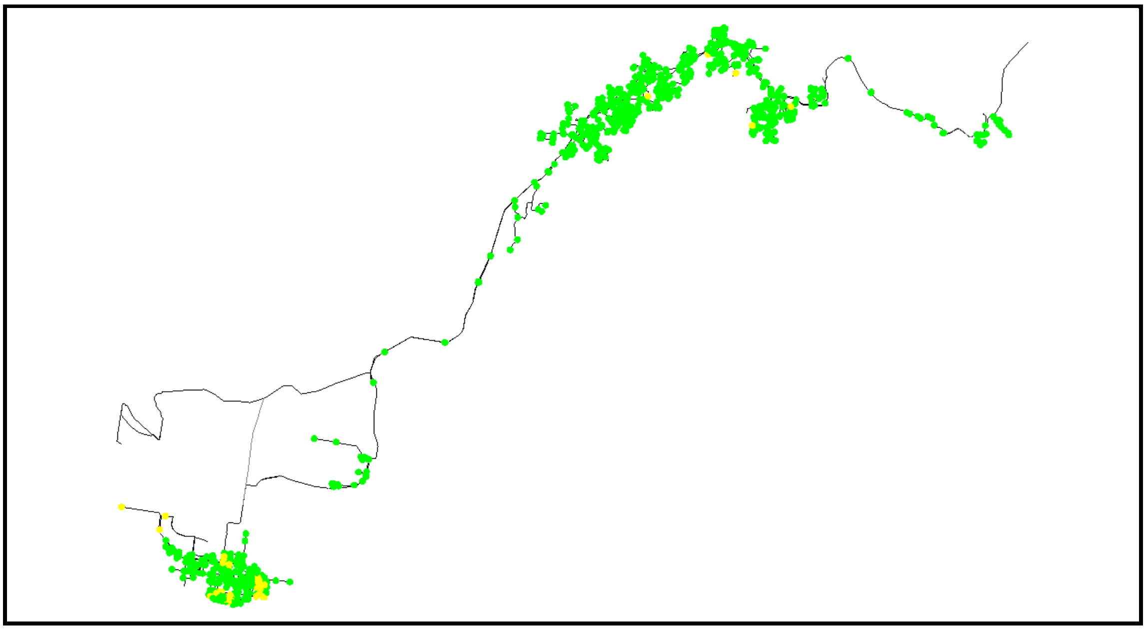

Figure 9 2014 Peak Day Minimum Pressures – Whitsunday Overview

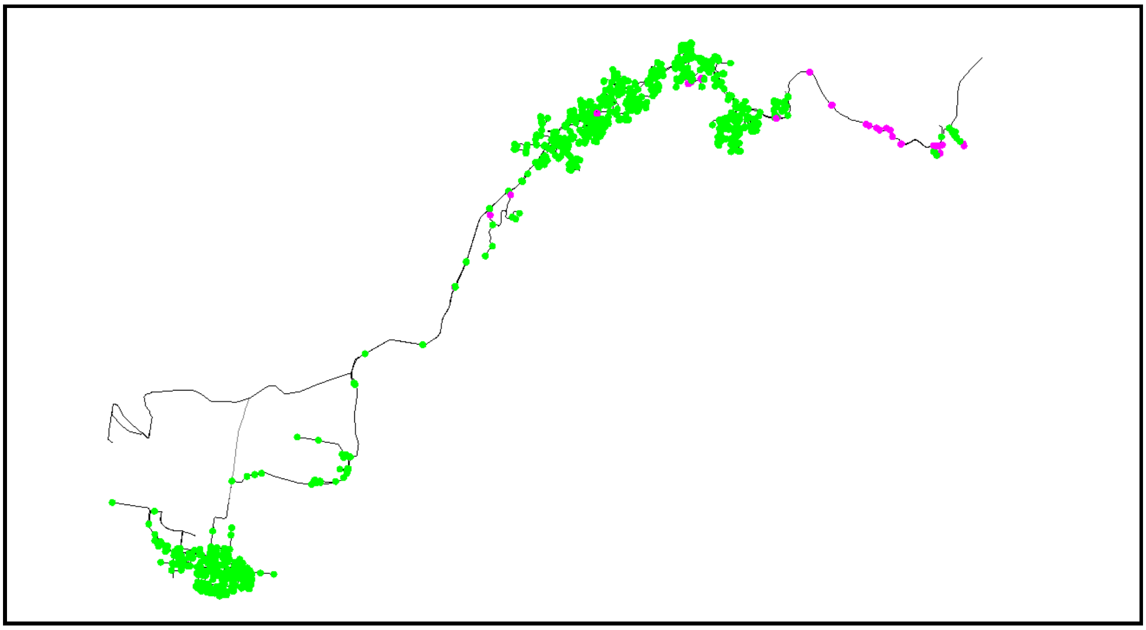

Figure 10 2014 Average Day Maximum Pressures – Whitsunday Overview

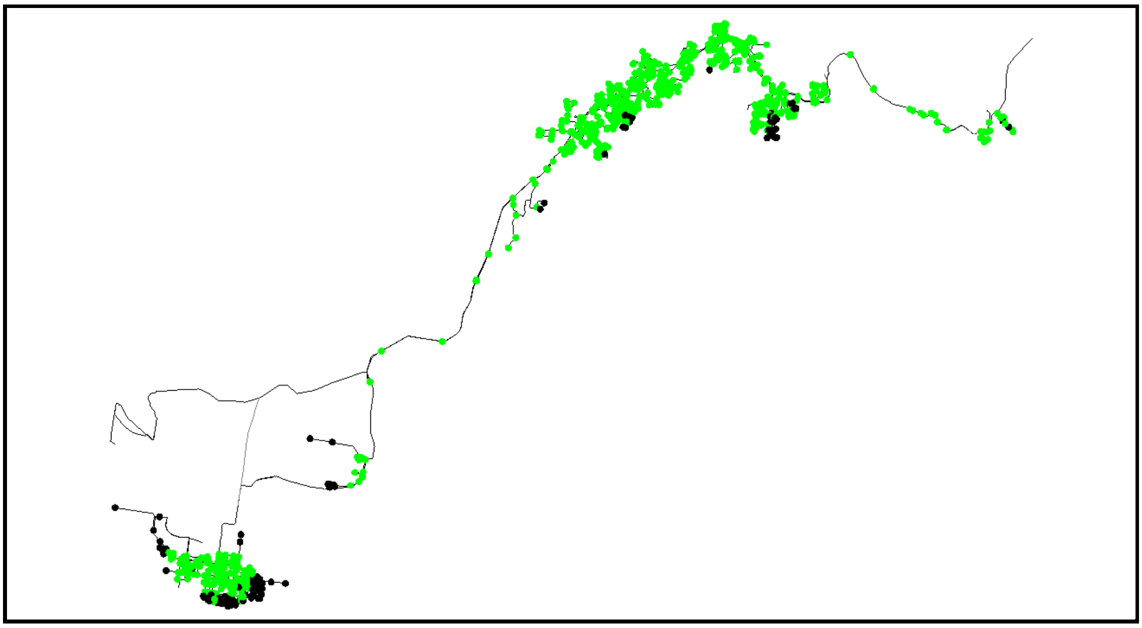

Figure 11 2014 Peak Day Fire Flow Compliance – Whitsunday Overview

Larger scale plots for each geographical area within the Whitsunday system are contained in Appendix C.

Average Day Minimum Pressures

The model indicates that the existing Whitsunday system is generally compliant with the DSOS with regards to minimum pressures under current average and peak day demand conditions. A small number of nodes have minimum pressures lower than the DSOS specification of 22m under average day flow conditions as detailed in Table 7 below.

Table 7 Whitsunday Model – Average Day Minimum Pressures Below 22m

Node	Minimum Pressure (m)	Comments
SH11	4.5	Node elevation is 6.8m below supply reservoir floor
AB36	12.5	Node elevation is 10.7m below supply reservoir floor
AB51	14.6	Node elevation is 15.2m below supply reservoir floor
AB52	14.6	Node elevation is 15.2m below supply reservoir floor
CA88	18.2	Node elevation is 16.2m below supply reservoir floor
AB37	21.4	Node elevation is 19.6m below supply reservoir floor

For each of the nodes identified above, the recorded minimum pressure is a function of the physical proximity of the node to its supply reservoir. As such, the low pressures do not indicate an operational issue with the system. If necessary, local pressure boosting should be considered for these properties, if not already installed.

Table 7 ignores nodes in the model that form part of the raw water infrastructure between bores and treatment plants, nodes close to reservoirs and those on the suction side of booster pump stations which do not directly service customers. It is noted that some nodes on the supply line from the Proserpine booster pumps to the Coastal WTP appear to service a number of customers in Shute Harbour Rd. Due to the configuration of this system, the operating pressure of the supply line is often substantially less than 22m. As there appears to be no residential customers fed from this line, and this is part of a long established system, it is assumed that the operational pressures supplied to these customers are acceptable and no changes in system configuration are required.

Peak Day Minimum Pressures

In addition to the low pressure nodes identified in Table 7, the minimum pressure delivered to a small number of nodes in the model falls below the DSOS requirement of 22m when the system is subjected to Peak Day loading. These additional nodes are listed in Table 8.

Table 8 Whitsunday Model – Peak Day Minimum Pressures Below 22m

Node	Minimum Pressure (m)	Comments
JP89	17.4	Local pressure variance with increasing demand.
PR253	19.8	Local pressure variance with increasing demand. Node close to service limits of Proserpine HLT.
PR151	20.9	Local pressure variance with increasing demand. Node close to service limits of Proserpine HLT.
CA217	21.1	Local pressure variance with increasing demand. Node close to service limits of Cannonvale Res
PR255	21.1	Local pressure variance with increasing demand. Node close to service limits of Proserpine HLT.
PR149	21.3	Local pressure variance with increasing demand. Node close to service limits of Proserpine HLT.
PR148	21.7	Local pressure variance with increasing demand. Node close to service limits of Proserpine HLT.
PR247	21.7	Local pressure variance with increasing demand. Node close to service limits of Proserpine HLT.
PR257	21.7	Local pressure variance with increasing demand. Node close to service limits of Proserpine HLT.
PR57B	21.7	Local pressure variance with increasing demand. Node close to service limits of Proserpine HLT.
PR219	21.8	Local pressure variance with increasing demand. Node close to service limits of Proserpine HLT.
PR222	21.8	Local pressure variance with increasing demand. Node close to service limits of Proserpine HLT.
PR256	21.8	Local pressure variance with increasing demand. Node close to service limits of Proserpine HLT.

The majority of the nodes listed in Table 8 are located at an elevation close to the limits of service of their respective supply reservoirs. As a consequence of the physical configuration, network pressures at these nodes are only slightly above the DSOS minimum during low demand periods and fall slightly below DSOS minimums during periods of high demand.

Average Day Maximum Pressures

The model indicates a number of nodes which have pressures in excess of the DSOS maximum value of 80m. These nodes are detailed in Table 9.

Table 9 Whitsunday Model – Average Day Maximum Pressures Above 80m

Node	Maximum Pressure (m)	Comments
AB57	124.9	Node fed from Raintree Place reservoir. Reservoir base to node elevation difference 122m.
AB58	121.1	Node fed from Raintree Place reservoir. Reservoir base to node elevation difference 118m.
AB59	117.4	Node fed from Raintree Place reservoir. Reservoir base to node elevation difference 114m.
BS141	110.5	Node on feed line from Mandalay Rd pump station to Shute Harbour high level reservoir.
BS145	110.2	Node on feed line from Mandalay Rd pump station to Shute Harbour high level reservoir.
BS242	109.6	Node on feed line from Mandalay Rd pump station to Shute Harbour high level reservoir.
BS242b	109.6	Node on feed line from Mandalay Rd pump station to Shute Harbour high level reservoir.
BS146	109.1	Node on feed line from Mandalay Rd pump station to Shute Harbour high level reservoir.
BS302	108.8	Node fed from Shute Harbour HL zone. Reservoir base to node elevation difference 95m.
SH1	108.4	Node fed from Shute Harbour HL zone. Reservoir base to node elevation difference 95m.
BS151	108.2	Node on feed line from Mandalay Rd pump station to Shute Harbour high level reservoir.
BS124	108.1	Node on feed line from Mandalay Rd pump station to Shute Harbour high level reservoir.
BS147	107.8	Node on feed line from Mandalay Rd pump station to Shute Harbour high level reservoir.
BS148	107.6	Node on feed line from Mandalay Rd pump station to Shute Harbour high level reservoir.
BS144	107.5	Node on feed line from Mandalay Rd pump station to Shute Harbour high level reservoir.
BS150	107	Node on feed line from Mandalay Rd pump station to Shute Harbour high level reservoir.
AB60	106.8	Node fed from Raintree Place reservoir. Reservoir base to node elevation difference 104m.
BS143	106.6	Node on feed line from Mandalay Rd pump station to Shute Harbour high level reservoir.
SH16	106.4	Node on feed line from Mandalay Rd pump station to Shute Harbour high level reservoir.
BS121	105.5	Node on feed line from Mandalay Rd pump station to Shute Harbour high level reservoir.
BS246	105.5	Node on feed line from Mandalay Rd pump station to Shute Harbour high level reservoir.
BS149	98.1	Node on feed line from Mandalay Rd pump station to Shute Harbour high level reservoir.
AB56	89.5	Node fed from Raintree Place reservoir. Reservoir base to node elevation difference 86m.

Node	Maximum Pressure (m)	Comments
BS125	89.2	Node on feed line from Mandalay Rd pump station to Shute Harbour high level reservoir.
SH5	89.1	Node fed by branch from feed line - Mandalay Rd PS to Shute Harbour high level reservoir
CA230	88.2	Node fed from Whitsunday Acres reservoir. Reservoir base to node elevation 85m.
SH17	88.1	Node on feed line from Mandalay Rd pump station to Shute Harbour high level reservoir.
BS122	87.1	Node on feed line from Mandalay Rd pump station to Shute Harbour high level reservoir.
AB55	84.9	Node fed from Raintree Place reservoir. Reservoir base to node elevation difference 82m.
BS236	84.2	Node on feed line from Mandalay Rd pump station to Shute Harbour high level reservoir.
BS127	82.9	Node on feed line from Mandalay Rd pump station to Shute Harbour high level reservoir.

Table 9 ignores nodes in the model that form part of the raw water infrastructure between bores and treatment plants and nodes on the discharge side of booster pump stations which do not directly service customers.

The majority of nodes with indicated pressures above the DSOS limit are located on the feed main connecting the Mandalay Rd pump station to the Shute Harbour high level reservoir. Under the current network configuration, the pressures in this main will typically need to exceed the DSOS value of 80m in order to maintain the level in the Shute Harbour reservoir. It may be possible to reconfigure the network by installing a new pump station in Shute Harbour to replace the Mandalay Rd pump station, reducing pressures in the intermediate section of main. This would, however, be an expensive exercise. As the existing arrangement has been in place for a significant amount of time, it is recommended that WRC monitor the performance of the Shute Harbour Rd main for issues related to high pressure including leaks and customer complaints (hot water system failure etc).

The existing network configuration may provide an opportunity to rezone a number of the high pressure zones with minor capital works or a simple re-configuration of existing zone valves. It is recommended that WRC undertake field investigation works to confirm high pressures and consider re-zoning areas associated with nodes AB55, AB56, AB57, AB58, AB59, AB60, BS302 and SH1.

Fire Flow Compliance

The model indicates a significant number of nodes which do not meet the DSOS requirement for fire flow available at the nominated minimum residual pressure of 12m. These nodes are detailed in Table 10.

Table 10 Whitsunday Model – Peak Hour Non-Compliant Fire Flow Nodes

Node	Available Fire Flow (L/s)	Comments
PR164	0.8	Pipe to node is DN32 - not suitable for fire flow
PR151	1.1	Pipe to node is DN80 - not suitable for fire flow. Possibly old service to Council Pound yard.

Node	Available Fire Flow (L/s)	Comments
PR149	1.9	DN80 / DN100 main feeding local area is undersized for fire flow.
PR178	2.2	Pipe to node is DN40 - not suitable for fire flow
PR148	2.5	DN80 main feeding local area is undersized for fire flow.
PR174	5.3	DN100 main feeding local area is undersized for fire flow.
CA217	6.4	DN100 main feeding local area is undersized for fire flow.
CA276	6.8	DN100 main feeding local area is undersized for fire flow.
PR173	6.9	DN100 mains feeding south-eastern section of Proserpine not capable of satisfying fire flow requirements.
PR146	6.9	DN100 main feeding local area is undersized for fire flow.
CA371	7.3	DN100 main feeding local area is undersized for fire flow.
PR28	7.4	DN100 main feeding local area is undersized for fire flow.
JP129	7.4	DN100 main feeding local area is undersized for fire flow.
PR172	7.4	DN100 mains feeding south-eastern section of Proserpine not capable of satisfying fire flow requirements.
CA218	7.6	DN100 main feeding local area is undersized for fire flow.
PR64	7.7	DN100 main feeding local area is undersized for fire flow.
JP130	7.9	DN100 main feeding local area is undersized for fire flow.
PR171	7.9	DN100 mains feeding south-eastern section of Proserpine not capable of satisfying fire flow requirements.
JP128	8.0	DN100 main feeding local area is undersized for fire flow.
PR107	8.0	DN100 mains feeding southern section of Proserpine not capable of satisfying fire flow requirements.
PR244	8.0	DN100 main feeding local area is undersized for fire flow.
JP89	8.2	DN100 main feeding local area is undersized for fire flow.
JP124	8.2	DN100 main feeding local area is undersized for fire flow.
PR27	8.4	DN100 main feeding local area is undersized for fire flow.
CA372	8.5	DN100 main feeding local area is undersized for fire flow.
JP122	8.8	DN100 main feeding local area is undersized for fire flow.
PR106	8.9	DN100 mains feeding southern section of Proserpine not capable of satisfying fire flow requirements.
PR235	8.9	DN100 mains feeding southern section of Proserpine not capable of satisfying fire flow requirements.
MJ1	8.9	DN100 main feeding local area is undersized for fire flow.
PR215	9.0	DN100 mains feeding southern section of Proserpine not capable of satisfying fire flow requirements.
SH13	9.0	DN100 main feeding local area is undersized for fire flow.
CA402	9.1	DN100 main feeding local area is undersized for fire flow.
PR236	9.1	DN100 mains feeding southern section of Proserpine not capable of satisfying fire flow requirements.
CA171	9.2	DN100 main feeding local area is undersized for fire flow.

Node	Available Fire Flow (L/s)	Comments
PR234	9.2	DN100 mains feeding southern section of Proserpine not capable of satisfying fire flow requirements.
PR237	9.3	DN100 mains feeding southern section of Proserpine not capable of satisfying fire flow requirements.
PR231	9.4	DN100 mains feeding southern section of Proserpine not capable of satisfying fire flow requirements.
PR253	9.4	DN100 mains feeding south-eastern section of Proserpine not capable of satisfying fire flow requirements.
JP126	9.4	DN100 main feeding local area is undersized for fire flow.
JP131	9.4	DN100 main feeding local area is undersized for fire flow.
JP127	9.4	DN100 main feeding local area is undersized for fire flow.
PR26	9.4	DN100 main feeding local area is undersized for fire flow.
JP125	9.5	DN100 main feeding local area is undersized for fire flow.
PR63	9.5	DN100 main feeding local area is undersized for fire flow.
MJ2	9.5	DN100 main feeding local area is undersized for fire flow.
PR238	9.6	DN100 mains feeding southern section of Proserpine not capable of satisfying fire flow requirements.
PR222	9.6	DN100 mains feeding southern section of Proserpine not capable of satisfying fire flow requirements.
PR233	9.6	DN100 mains feeding southern section of Proserpine not capable of satisfying fire flow requirements.
PR239	9.7	DN100 mains feeding southern section of Proserpine not capable of satisfying fire flow requirements.
JP123	9.8	DN100 main feeding local area is undersized for fire flow.
PR220	9.8	DN100 mains feeding southern section of Proserpine not capable of satisfying fire flow requirements.
PR232	9.9	DN100 mains feeding southern section of Proserpine not capable of satisfying fire flow requirements.
PR219	9.9	DN100 mains feeding southern section of Proserpine not capable of satisfying fire flow requirements.
CA366	10.0	DN100 main feeding local area is undersized for fire flow.
JP121	10.1	DN100 main feeding local area is undersized for fire flow.
PR145	10.1	DN100 mains feeding south-eastern section of Proserpine not capable of satisfying fire flow requirements.
PR139	10.2	DN100 mains feeding south-eastern section of Proserpine not capable of satisfying fire flow requirements.
PR133	10.2	DN100 mains feeding south-eastern section of Proserpine not capable of satisfying fire flow requirements.
PR240	10.3	DN100 mains feeding southern section of Proserpine not capable of satisfying fire flow requirements.
PR135	10.3	DN100 mains feeding south-eastern section of Proserpine not capable of satisfying fire flow requirements.

Node	Available Fire Flow (L/s)	Comments
PR25	10.4	DN100 main feeding local area is undersized for fire flow.
PR137	10.4	DN100 mains feeding south-eastern section of Proserpine not capable of satisfying fire flow requirements.
PR144	10.4	DN100 mains feeding south-eastern section of Proserpine not capable of satisfying fire flow requirements.
PR179	10.4	DN100 mains feeding south-eastern section of Proserpine not capable of satisfying fire flow requirements.
PR104	10.4	DN100 mains feeding southern section of Proserpine not capable of satisfying fire flow requirements.
PR218	10.5	DN100 mains feeding southern section of Proserpine not capable of satisfying fire flow requirements.
PR136	10.5	DN100 mains feeding south-eastern section of Proserpine not capable of satisfying fire flow requirements.
PR147	10.6	DN100 mains feeding south-eastern section of Proserpine not capable of satisfying fire flow requirements.
PR170	10.8	DN100 mains feeding south-eastern section of Proserpine not capable of satisfying fire flow requirements.
PR200	10.9	DN100 mains feeding south-eastern section of Proserpine not capable of satisfying fire flow requirements.
PR138	10.9	DN100 mains feeding south-eastern section of Proserpine not capable of satisfying fire flow requirements.
PR134	11.0	DN100 mains feeding south-eastern section of Proserpine not capable of satisfying fire flow requirements.
PR169	11.1	DN100 mains feeding south-eastern section of Proserpine not capable of satisfying fire flow requirements.
PR105	11.1	DN100 main feeding local area is undersized for fire flow.
JP19	11.1	DN100 main feeding local area is undersized for fire flow.
PR217	11.2	DN100 mains feeding south-eastern section of Proserpine not capable of satisfying fire flow requirements.
CA345	11.2	DN100 main feeding local area is undersized for fire flow.
CA344	11.3	DN100 main feeding local area is undersized for fire flow.
PR216	11.4	DN100 mains feeding southern section of Proserpine not capable of satisfying fire flow requirements.
CA275	11.6	DN100 main feeding local area is undersized for fire flow.
PR243	11.8	DN100 mains feeding southern section of Proserpine not capable of satisfying fire flow requirements.
PR24	11.9	DN100 main feeding local area is undersized for fire flow.
PR168	12.0	DN100 mains feeding south-eastern section of Proserpine not capable of satisfying fire flow requirements.
JP83	12.0	DN100 main feeding local area is undersized for fire flow.
PR132	12.2	DN100 mains feeding south-eastern section of Proserpine not capable of satisfying fire flow requirements.
MJ15	12.4	DN100 main feeding local area is undersized for fire flow.

Node	Available Fire Flow (L/s)	Comments
PR221	12.5	DN100 mains feeding southern section of Proserpine not capable of satisfying fire flow requirements.
MJ14	12.5	DN100 main feeding local area is undersized for fire flow.
MJ16	12.7	DN100 main feeding local area is undersized for fire flow.
JP82	12.8	DN100 main feeding local area is undersized for fire flow.
CA403	12.9	DN100 main feeding local area is undersized for fire flow.
JP72	13.1	DN100 main feeding local area is undersized for fire flow.
PR214	13.1	DN100 mains feeding southern section of Proserpine not capable of satisfying fire flow requirements.
PR143	13.1	DN100 mains feeding south-eastern section of Proserpine not capable of satisfying fire flow requirements.
PR167	13.2	DN100 main feeding local area is undersized for fire flow.
PR17	13.2	DN100 main feeding local area is undersized for fire flow.
SH8	13.3	DN100 main feeding local area is undersized for fire flow.
JP74	13.4	DN100 main feeding local area is undersized for fire flow.
MJ17	13.8	DN100 main feeding local area is undersized for fire flow.
CA172	13.9	DN100 main feeding local area is undersized for fire flow.
PR126	14.0	DN100 main feeding local area is undersized for fire flow.
MJ13	14.1	DN100 main feeding local area is undersized for fire flow.
JP81	14.1	DN100 main feeding local area is undersized for fire flow.
JP75	14.2	DN100 main feeding local area is undersized for fire flow.
JP71	14.3	DN100 main feeding local area is undersized for fire flow.
PR128	14.6	DN100 mains feeding southern section of Proserpine not capable of satisfying fire flow requirements.
CA362	14.6	DN100 main feeding local area is undersized for fire flow.
JP70	14.6	DN100 main feeding local area is undersized for fire flow.
JP76	14.7	DN100 main feeding local area is undersized for fire flow.
JP17	14.7	DN100 main feeding local area is undersized for fire flow.
PR130	14.7	DN100 mains feeding southern section of Proserpine not capable of satisfying fire flow requirements.
CA324	14.8	DN100 main feeding local area is undersized for fire flow.
PR103	14.9	DN100 mains feeding southern section of Proserpine not capable of satisfying fire flow requirements.

The modelled fire flow performance for the Whitsunday system indicates that substantial portions of the system have not been designed to meet the fire flow rates stipulated in the current DSOS. As noted in the Bowen system, fire flow supply for a number of nodes is restricted by high head losses in DN100 supply mains.

The main operational issues in the Whitsunday system under fire flow conditions can be summarised as:

- DN100 supply mains in Hansen Dr and the Bruce Hwy feeding the south-eastern section of Proserpine are too small to satisfy fire flow requirements
- DN100 supply mains in Honey Myrtle St and Dudley St feeding the southern section of Proserpine are too small to satisfy fire flow requirements
- DN80 and DN100 supply mains in Faust St, Proserpine are too small to satisfy fire flow requirements
- DN100 mains in Riverview Dr and Camm Rd, Mount Julian are too small to satisfy fire flow requirements
- The DN100 main in Stanley Dr, Cannon Valley is too small to satisfy fire flow requirements
- The DN100 main in Ridge View Rd, Cannonvale is too small to satisfy fire flow requirements
- The DN100 main in Jubilee Pocket Rd, Jubilee Pocket is too small to satisfy fire flow requirements
- The DN100 main in Kingfisher Terrace, Jubilee Pocket is too small to satisfy fire flow requirements

Suggested system upgrades to address these issues are detailed in Section 6.

3.3 COLLINSVILLE

Results

Average day minimum pressure, peak day minimum pressure, average day maximum pressure and peak hour fire flow compliance for areas serviced by the Collinsville water distribution network are shown on Figure 12 to Figure 15 below.

Figure 12 2014 Average Day Minimum Pressures – Collinsville Overview

Figure 13 2014 Peak Day Minimum Pressures – Collinsville Overview

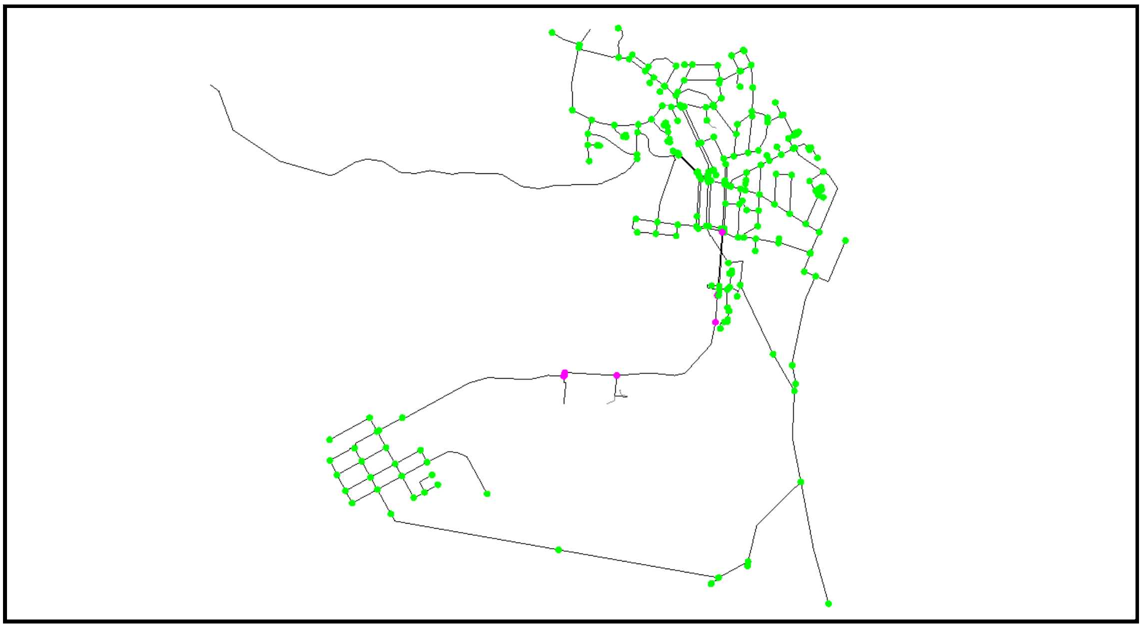

Figure 14 2014 Peak Day Maximum Pressures – Collinsville Overview

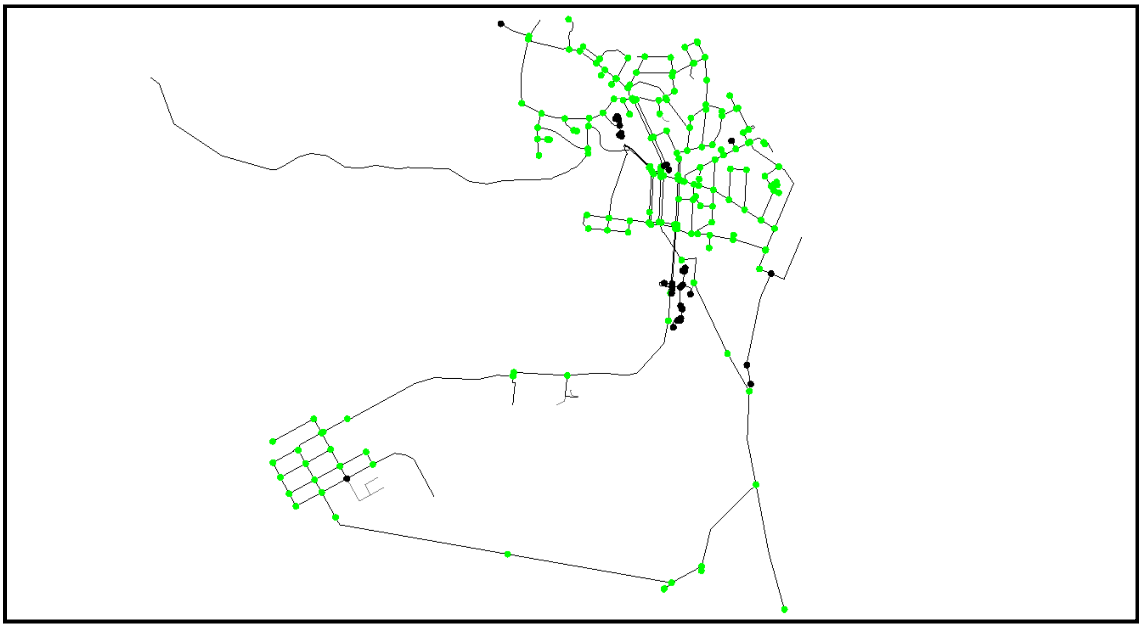

Figure 15 2014 Peak Hour Fire Flow Compliance – Collinsville Overview

Larger scale plots for each geographical area within the Whitsunday system are contained in Appendix D.

Average Day Minimum Pressures

The model indicates that the existing Collinsville water supply system is compliant with the DSOS with regards to minimum pressures under current average day demand conditions.

No nodes with connected customers were identified as being below the DSOS minimum pressure requirements under average day demand conditions.

Peak Day Minimum Pressures

While the Collinsville system is compliant with minimum pressure requirements under average day demand, the pressure delivered to a small number of nodes in the model falls below the DSOS requirement of 22m when the system is subjected to peak day loading. These nodes are listed in Table 11.

Table 11 Collinsville Model – Peak Day Minimum Pressures Below 22m

Node	Minimum Pressure (m)	Comments
CLC170	20.4	Node elevation 20m below base of supply reservoir
CLC147	20.8	Node elevation 22m below base of supply reservoir
CLC221	21.8	Node elevation 22m below base of supply reservoir
CLC169	21.8	Node elevation 22m below base of supply reservoir

All nodes listed in Table 11 are located at an elevation close to the limits of service of the supply reservoir. As a consequence of the physical configuration, network pressures at these nodes are only slightly above the DSOS minimum during low demand periods and fall slightly below DSOS minimums during periods of high demand. It is recommended that field testing of these nodes is undertaken to determine if customer pressures fall below the DSOS guidelines and local pressure boosting should be considered if appropriate.

Average Day Maximum Pressures

The model indicates a small number of nodes which have pressures in excess of the DSOS maximum value of 80m. These nodes are all located on the trunk supply line from Collinsville WTP to the Collinsville reservoir. As this configuration does not result in high customer pressures, no remedial actions are required.

Fire Flow Compliance

The model indicates a significant number of nodes which do not meet the DSOS requirement for fire flow available at nominated minimum residual pressure of 12m. These nodes are detailed in Table 12.

Table 12 Whitsunday Model – Peak Hour Non-Compliant Fire Flow Nodes

Node	Available Fire Flow (L/s)	Comments
CLC118	3.14	DN100 supply line is too small to satisfy fire flow requirements
CLC170	3.35	DN100 supply line is too small to satisfy fire flow requirements
CLC221	3.66	DN100 supply line is too small to satisfy fire flow requirements
CLC169	4.94	DN100 supply line is too small to satisfy fire flow requirements
CLC265	7.52	DN100 supply line is too small to satisfy fire flow requirements
CLC267	8.55	DN100 supply line is too small to satisfy fire flow requirements
CLC207	8.98	DN100 supply line is too small to satisfy fire flow requirements
CLC120	9.22	DN100 supply line is too small to satisfy fire flow requirements
CLC125	9.25	DN100 supply line is too small to satisfy fire flow requirements
CLC115	9.32	DN100 supply line is too small to satisfy fire flow requirements
CLC124	9.32	DN100 supply line is too small to satisfy fire flow requirements
CLC114	9.35	DN100 supply line is too small to satisfy fire flow requirements
CLC121	9.39	DN100 supply line is too small to satisfy fire flow requirements
CLC109	9.58	DN100 supply line is too small to satisfy fire flow requirements
CLC123	9.59	DN100 supply line is too small to satisfy fire flow requirements
CLC122	9.6	DN100 supply line is too small to satisfy fire flow requirements
CLC220	9.63	DN100 supply line is too small to satisfy fire flow requirements
CLC117	9.74	DN100 supply line is too small to satisfy fire flow requirements
CLC116	9.78	DN100 supply line is too small to satisfy fire flow requirements
CLC112	9.84	DN100 supply line is too small to satisfy fire flow requirements
CLC110	9.95	DN100 supply line is too small to satisfy fire flow requirements
CLC111	9.95	DN100 supply line is too small to satisfy fire flow requirements
CLC259	10.08	DN100 supply line is too small to satisfy fire flow requirements
CLC108	10.27	DN100 supply line is too small to satisfy fire flow requirements
CLC166	11.49	DN100 supply line is too small to satisfy fire flow requirements
CLC167	12.18	DN100 supply line is too small to satisfy fire flow requirements
CLC168	12.26	DN100 supply line is too small to satisfy fire flow requirements
CLC106	14.82	DN100 supply line is too small to satisfy fire flow requirements

The modelled fire flow performance for the Collinsville system indicates that parts of the system have not been designed to meet the fire flow rates stipulated in the current DSOS. As noted in the Bowen and Whitsunday systems, fire flow supply for a number of nodes is restricted by high head losses in DN100 supply mains.

The main operational issues in the Collinsville system under fire flow conditions can be summarised as:

- DN100 main in Collinsville Rd supplying Hillside Haven aged care is too small to satisfy fire flow requirements
- DN100 main in Logan St is too small to satisfy fire flow requirements
- DN100 main in Station St is too small to satisfy fire flow requirements
- DN100 main in Scottville Rd is too small to satisfy fire flow requirements

Suggested system upgrades to address these issues are detailed in Section 6.

4 EXISTING SEWER NETWORK MODEL RESULTS

Hydraulic network modelling results for the 5 sewage collection networks serviced by WRC are presented below. Results presented graphically have been colour coded as described in Table 13.

Table 13 Sewer Network Model Results Colour Coding

Colour	Description of Result
(red)	Node is overflowing
(green)	Node is not overflowing

4.1 BOWEN

Results

The performance of the existing Bowen sewer collection network under average dry weather and peak wet weather flow loading conditions is shown on Figure 16 and Figure 17 below.

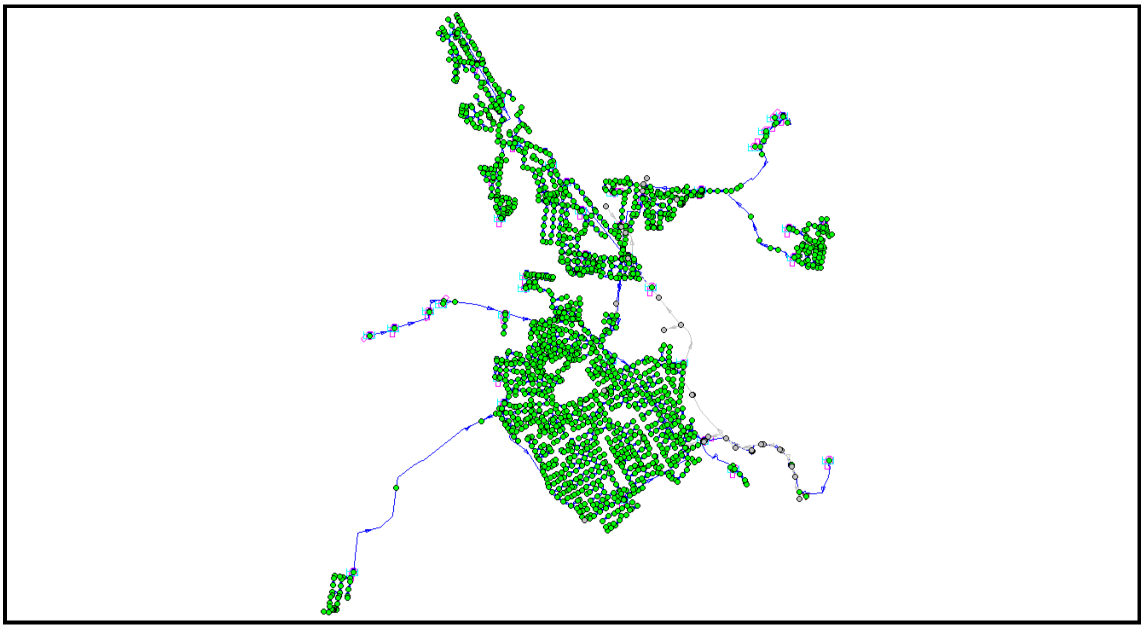

Figure 16 2014 Average Dry Weather Flow Overflow – Bowen

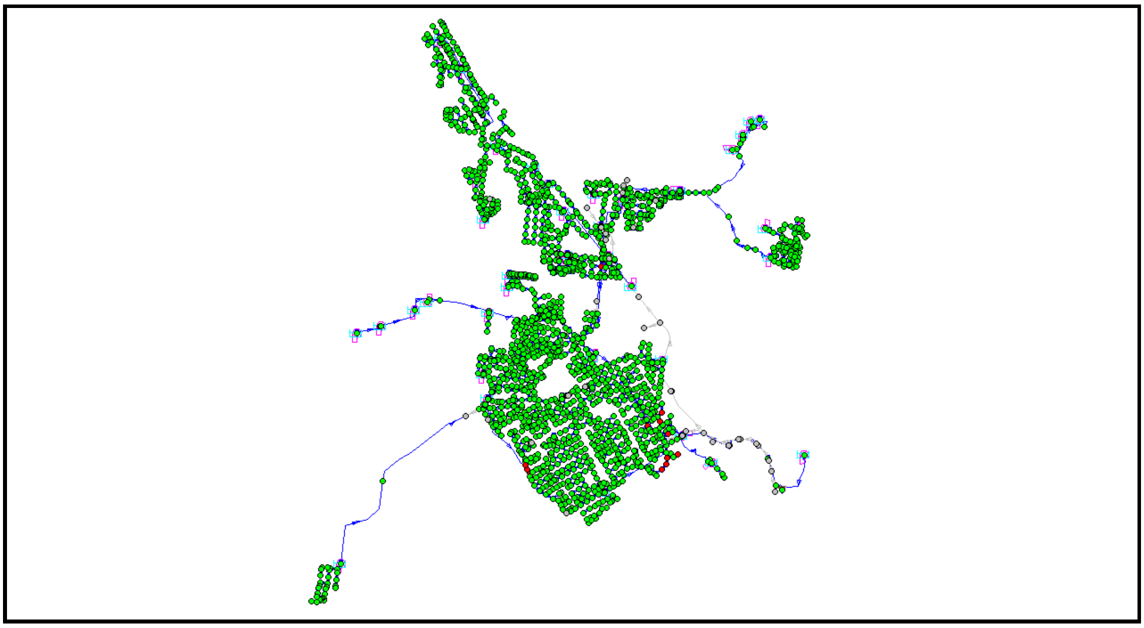

Figure 17 2014 Peak Wet Weather Flow Overflow – Bowen

ADWF

The existing network analysis indicated no overflows in the Bowen sewer network during normal operation under ADWF conditions.

PWWF

Under PWWF conditions, the analysis indicated that the network is likely to overflow at two primary locations. A summary of the problem areas and contributing factors is contained in Table 14.

Table 14 Bowen Model – PWWF Overflowing Nodes

Node	Pump Station Catchment	Comments
MH-77	Bowen 1	PWWF inflow exceeds capacity of Bowen 1, resulting in overflow
MH-B-873	Bowen 3	PWWF inflow exceeds capacity of Bowen 3, resulting in overflow
MH-B-385	Bowen 3	PWWF inflow exceeds capacity of Bowen 3, resulting in overflow
MH-B-353	Bowen 3	PWWF inflow exceeds capacity of Bowen 3, resulting in overflow
MH-B-664	Bowen 1	PWWF inflow exceeds capacity of Bowen 1, resulting in overflow
MH-B-316	Bowen 1	PWWF inflow exceeds capacity of Bowen 1, resulting in overflow
MH-B-618	Bowen 1	PWWF inflow exceeds capacity of Bowen 1, resulting in overflow
MH-B-576	Bowen 1	PWWF inflow exceeds capacity of Bowen 1, resulting in overflow
MH-B-280	Bowen 1	PWWF inflow exceeds capacity of Bowen 1, resulting in overflow
MH-B-336	Bowen 1	PWWF inflow exceeds capacity of Bowen 1, resulting in overflow
MH-B-586	Bowen 1	PWWF inflow exceeds capacity of Bowen 1, resulting in overflow
MH-B-876	Bowen 1	PWWF inflow exceeds capacity of Bowen 1, resulting in overflow
MH-B-339	Bowen 1	PWWF inflow exceeds capacity of Bowen 1, resulting in overflow

The capacity issues identified in the Bowen model can be summarised as:

- Bowen 1 SPS capacity is exceeded during wet weather flow, resulting in overflows in the upstream network
- Bowen 3 SPS is close to its capacity limits during wet weather flow, resulting in overflows in the upstream network when SPS 4 operates

It is noted that the flow capacity of Bowen 1 WWPS is limited by the capacity of the Bowen WWTP to receive inflow during wet weather events. As a consequence, the Bowen 1 pump station is typically operated at less than full speed during wet weather so as to not flood the STP.

4.2 CANNONVALE

Results

The performance of the existing Cannonvale sewer collection network under average dry weather flow and peak wet weather flow loading conditions is shown on Figure 18 and Figure 19 below.

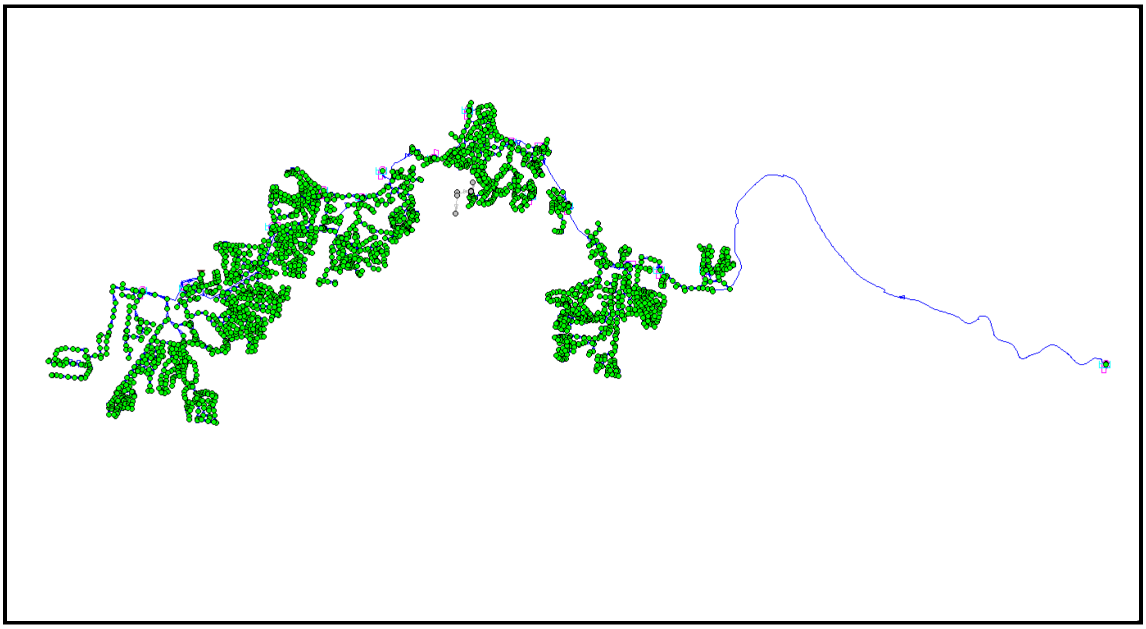

Figure 18 2014 Average Dry Weather Flow Overflow – Cannonvale

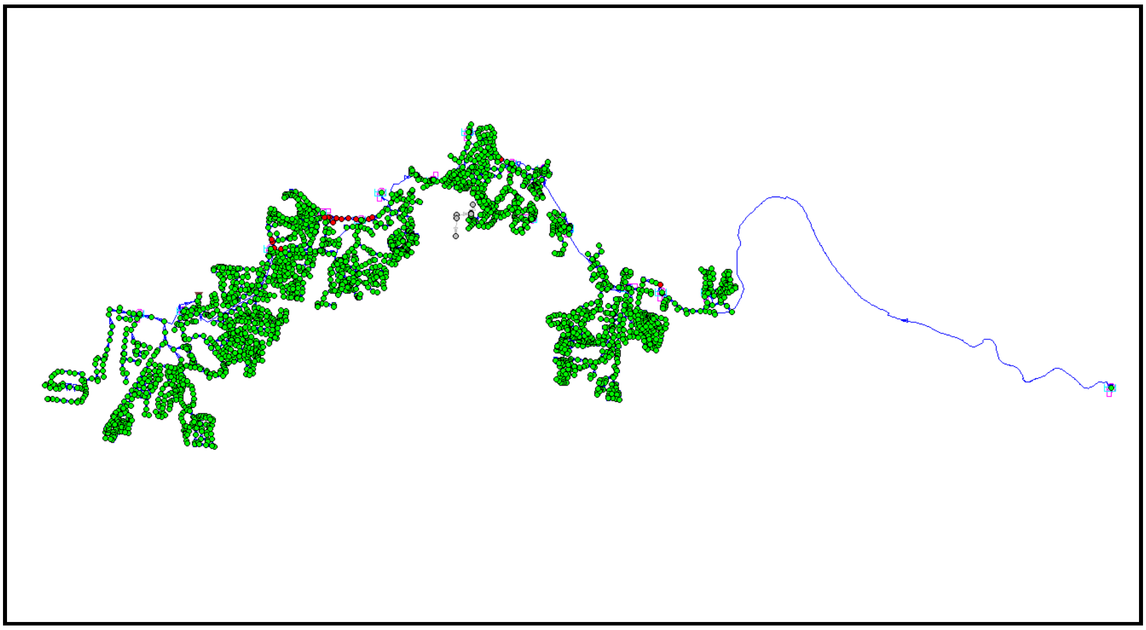

Figure 19 2014 Peak Wet Weather Flow Overflow – Cannonvale

ADWF

The existing network analysis indicated no overflows in the Cannonvale sewer network during normal operation under ADWF conditions.

PWWF

Under PWWF conditions, the analysis indicated that the network is likely to overflow at a number of locations. A summary of the problem areas and contributing factors is contained in Table 15.

Table 15 Cannonvale Model – PWWF Overflowing Nodes

Node	Pump Station Catchment	Comments
MH-P-1891	Jubilee Pocket 1	MH downstream of Jubilee Pocket 2. Pipe capacity exceeded by dual pump flow from JP2
MH-P-603	Cannonvale 3	MH is adjacent to Cannonvale 3. Pipe flow exceeds pumping capacity of Cannonvale 3 resulting in overflow
MH-P-53	Cannonvale 1	MH is adjacent to Cannonvale 1. Pipe flow exceeds pumping capacity of Cannonvale 1 resulting in overflow
MH-P-52	Cannonvale 1	MH is adjacent to Cannonvale 1. Pipe flow exceeds pumping capacity of Cannonvale 1 resulting in overflow
MH-P-604	Cannonvale 3	MH is adjacent to Cannonvale 3. Pipe flow exceeds pumping capacity of Cannonvale 3 resulting in overflow
MH-P-652	Cannonvale 3	MH is adjacent to Cannonvale 3. Pipe flow exceeds pumping capacity of Cannonvale 3 resulting in overflow
MH-P-653	Cannonvale 3	MH is adjacent to Cannonvale 3. Pipe flow exceeds pumping capacity of Cannonvale 3 resulting in overflow
MH-P-656	Cannonvale 3	MH is adjacent to Cannonvale 3. Pipe flow exceeds pumping capacity of Cannonvale 3 resulting in overflow

Node	Pump Station Catchment	Comments
MH-P-651	Cannonvale 3	MH is adjacent to Cannonvale 3. Pipe flow exceeds pumping capacity of Cannonvale 3 resulting in overflow
MH-P-655	Cannonvale 3	MH is adjacent to Cannonvale 3. Pipe flow exceeds pumping capacity of Cannonvale 3 resulting in overflow
MH-P-47	Cannonvale 1	MH is adjacent to Cannonvale 1. Pipe flow exceeds pumping capacity of Cannonvale 1 resulting in overflow
MH-P-649	Cannonvale 3	MH is adjacent to Cannonvale 3. Pipe flow exceeds pumping capacity of Cannonvale 3 resulting in overflow
MH-P-650	Cannonvale 3	MH is adjacent to Cannonvale 3. Pipe flow exceeds pumping capacity of Cannonvale 3 resulting in overflow
MH-P-654	Cannonvale 3	MH is adjacent to Cannonvale 3. Pipe flow exceeds pumping capacity of Cannonvale 3 resulting in overflow
MH-P-70	Cannonvale 1	MH is adjacent to Cannonvale 1. Pipe flow exceeds pumping capacity of Cannonvale 1 resulting in overflow
MH-P-865	Cannonvale 5	Downstream pipe flow capacity is exceeded

The capacity issues identified in the Cannonvale model can be summarised as follows:

- Dual pumping flow rate of the Jubilee 2 pump station exceeds the capacity of the receiving gravity pipeline
- Gravity pipe capacity downstream of MH-P-865 is exceeded by wet weather flow
- Cannonvale 1 flow capacity is exceeded during wet weather
- Cannonvale 3 flow capacity is exceeded during wet weather

The pipe flow capacity issues identified in the Jubilee Pocket 1 and Cannonvale 5 pump station catchments only affect short sections of gravity pipeline and can be addressed with minor augmentations or adjustments to system operation. The flow capacity issues at Cannonvale 1 and Cannonvale 3 are symptomatic of a much more significant issue. These pump stations form part of a cascading system running from Jubilee Pocket through Airlie Beach to the Cannonvale STP. This system in its current configuration is incapable of meeting wet weather flow requirements and requires substantial upgrades in order to do so. The issue has been addressed previously in a 2010 report prepared by GHD and again in a 2012 report prepared internally by WRC.

4.3 COLLINSVILLE

Results

The performance of the existing Collinsville sewer collection network under average dry weather flow and peak wet weather flow loading conditions is shown on Figure 20 and Figure 21 below.

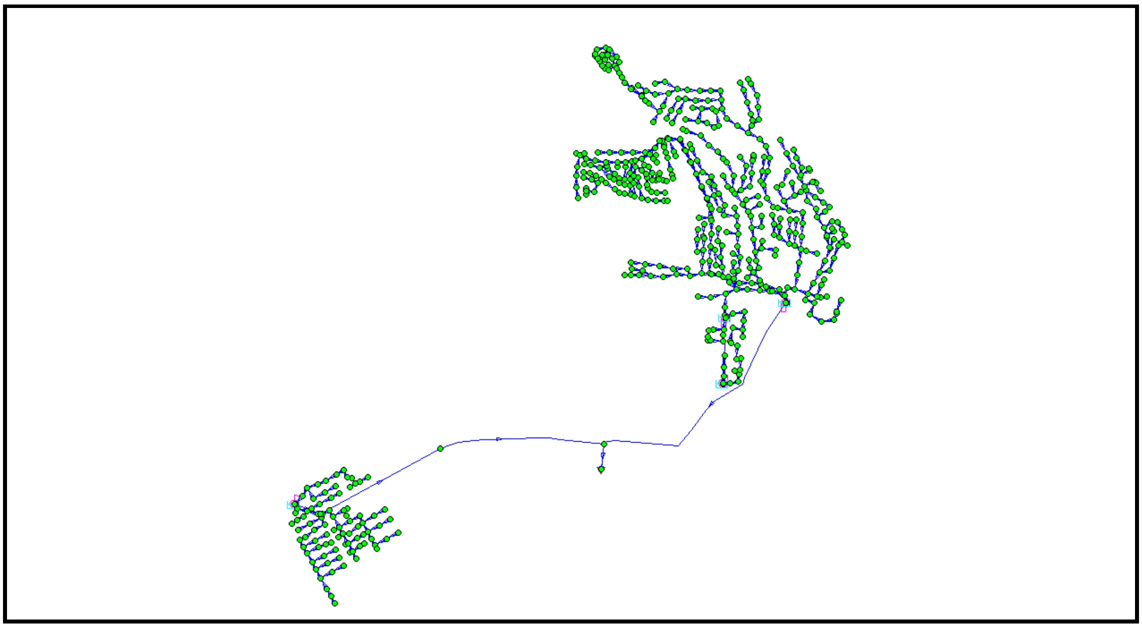

Figure 20 2014 Average Dry Weather Flow Overflow – Collinsville

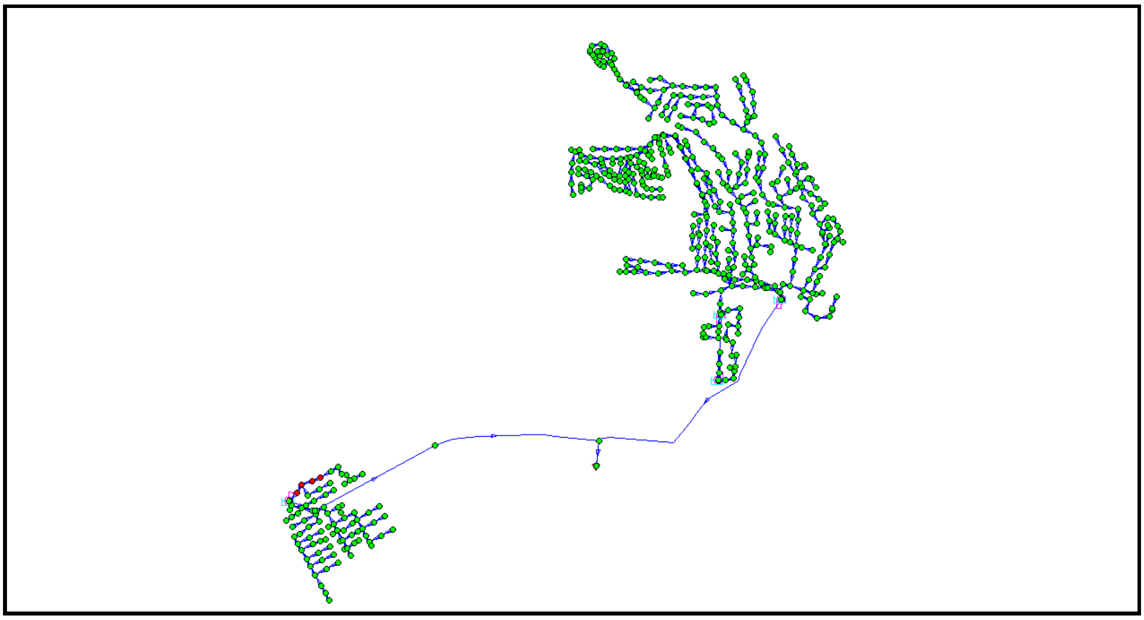

Figure 21 2014 Average Dry Weather Flow Overflow – Collinsville

ADWF

The existing network analysis indicated no overflows in the Collinsville sewer network during normal operation under ADWF conditions.

PWWF

Under PWWF conditions, the analysis indicated that the network is likely to overflow at a small number of locations. A summary of the problem areas and contributing factors is contained in Table 16.

Table 16 Collinsville Model – PWWF Overflowing Nodes

Node	Pump Station Catchment	Comments
MH-C-516	Scottville 2 C	MH is adjacent to Scottville 2C. Pipe flow exceeds pump station capacity resulting in overflow.
MH-C-199	Scottville 2 C	MH is adjacent to Scottville 2C. Pipe flow exceeds pump station capacity resulting in overflow.
MH-C-517	Scottville 2 C	MH is adjacent to Scottville 2C. Pipe flow exceeds pump station capacity resulting in overflow.
MH-C-521	Scottville 2 C	MH is adjacent to Scottville 2C. Pipe flow exceeds pump station capacity resulting in overflow.
MH-C-522	Scottville 2 C	MH is adjacent to Scottville 2C. Pipe flow exceeds pump station capacity resulting in overflow.

The issues identified in the Scottville system are related to the performance of the pumps and rising main in pump station 2 C. While these pumps have ample flow rate capacity when operating close to BEP, the Scottville 2C rising main has a nominal diameter of 100mm, which results in substantial head loss, inefficient pump operation and the potential for wet weather overflows.

4.4 PROSERPINE

Results

The performance of the existing Proserpine sewer collection network under average dry weather flow and peak wet weather flow loading conditions is shown on Figures 22 and Figure 23 below.

Figure 22 2014 Average Dry Weather Flow Overflow – Proserpine

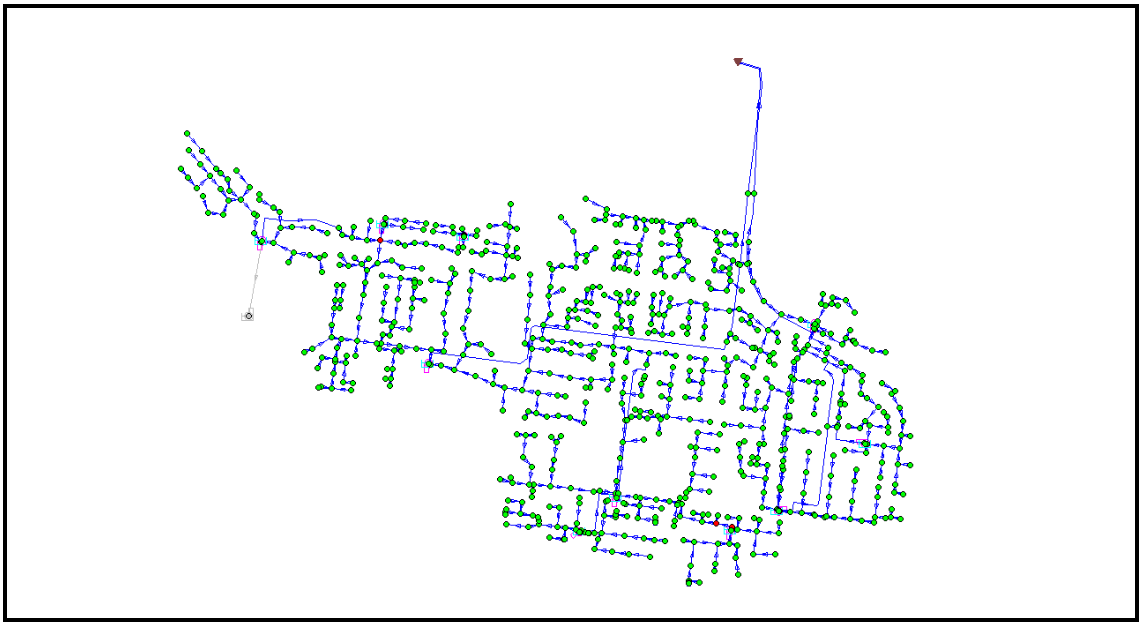

Figure 23 2014 Peak Wet Weather Flow Overflow – Proserpine

ADWF

The existing network analysis indicated no overflows in the Proserpine sewer network during normal operation under ADWF conditions.

PWWF

Under PWWF conditions, the analysis indicated that the network is likely to overflow at a small number of locations. A summary of the problem areas and contributing factors is contained in Table 17.

Table 17 Proserpine Model – PWWF Overflowing Nodes

Node	Pump Station Catchment	Comments
MH-P-2762	Proserpine 3	Manhole is downstream of Proserpine 5 discharge. Capacity of receiving pipe is exceeded resulting in overflow.
MH-P-2519	Proserpine 1	Manhole is downstream of Proserpine 11 discharge. Capacity of receiving pipe is exceeded resulting in overflow.
MH-P-2761	Proserpine 3	Manhole is downstream of Proserpine 5 discharge. Capacity of receiving pipe is exceeded resulting in overflow.

The issues noted above result from pipe capacity being exceeded when upstream pump stations cut in. These can be managed by throttling the flow rate from the upstream pump stations. It is understood that these measures are currently in place at a number of Proserpine sewer pump stations.

4.5 WHITSUNDAY SHORES

Results

The performance of the existing Whitsunday Shores sewer collection network under average dry weather flow and peak wet weather flow loading conditions is shown on Figure 24 and Figure 25 below.

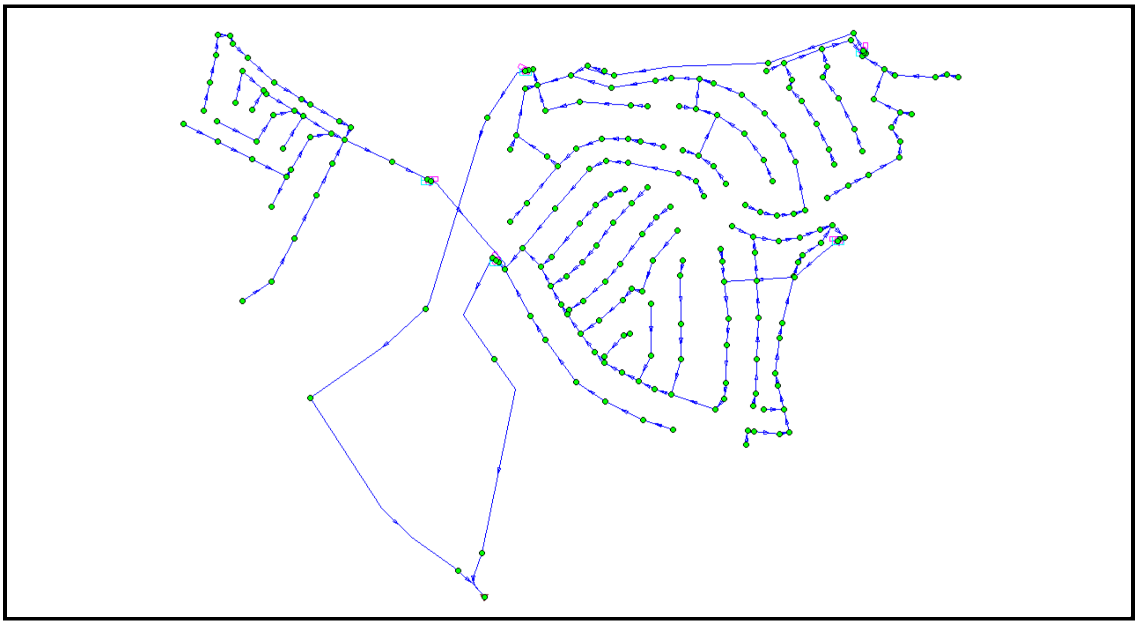

Figure 24 2014 Average Dry Weather Flow Overflow – Whitsunday Shores

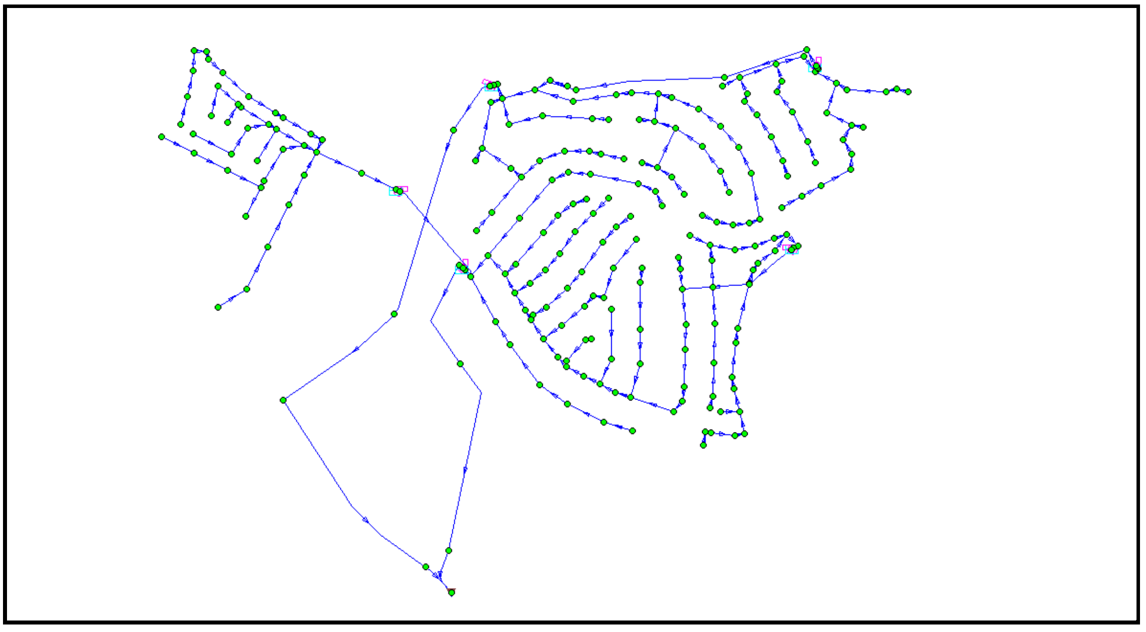

Figure 25 2014 Peak Wet Weather Flow Overflow – Whitsunday Shores

ADWF & PWWF

The existing network analysis indicated no overflows in the Whitsunday Shores sewer network during normal operation under ADWF or PWWF conditions. It was noted that the PS5 pump station was not capable of meeting the projected PWWF inflow, however the wet well at this pump station had not filled to overflowing after a period of 24 hours.

5 WATER NETWORK AUGMENTATIONS

A number of network capacity issues have been identified in Section 4 of this report, along with those identified in the preliminary capacity assessment. The required augmentations to address each of the identified issues are described below.

5.1 BOWEN

While the Bowen network generally meets pressure requirements, a number of areas have been identified where the fire flow requirements are not met. Augmentations to address this involve generally increasing the size of mains leading to problem nodes. Where possible, cross connections to other parts of the network have been nominated in preference to replacement of mains with larger diameter infrastructure. Suggested augmentations are summarised in Table 18 below:

Table 18 Bowen Network – Recommended Pipe Augmentations

Issue	Proposed Works	Pipe Size	Pipe Length
Fire flow supply to Rose Bay	Replace existing DN100 supply main with new DN150	DN150	744
Fire flow supply to Peter Wyche Dr and Dalrymple Point	Install new DN150 feed main from Herbert St DN225 to Henry Darwen Memorial Dr	DN150	660
Fire flow supply to Kapok Park	Install DN100 loop main to Mt Nutt Rd	DN100	130
Fire flow to Morrill St	Install DN100 connection main from dead end in Morrill St to Queens Rd	DN100	180
Fire flow in Queen St	Install DN100 missing link to join dead ends in Queens Rd	DN100	615
Fire Flow in Kirkpatrick Ct	Install DN100 connection main from dead end in Kirkpatrick Ct to Tracey St	DN100	180
Fire flow in Lucinda Pl	Install DN100 connection main from dead end in Lucinda Pl to Bryant Ave	DN100	90
Fire flow in Eglington St and Troyon Ct	Install DN100 connection main between dead ends in Storey St and Eglington St	DN100	160
Fire flow in West St	Install DN100 connection main between West St and Richmond St	DN100	60
Fire flow in Bolt St	Install DN100 connection main between dead end in Bolt St and Flemington Rd	DN100	300
Fire flow in Sproule St	Install DN100 connection main to Gragory St	DN100	130
Fire flow in Quay St	Install DN100 missing link from dead end in Quay St to Thomas St	DN100	130

Issue	Proposed Works	Pipe Size	Pipe Length
Fire flow in Bootooloo Rd	Install DN100 missing link from dead end in Bootooloo Rd to Drays Rd	DN100	740
Banks Dr fire flow	Install DN100 connection main from Athena Dr to Bruce Hwy	DN100	10
Heronvale fire flow	Replace dead end DN100 main in Baxter Ave with DN150 main	DN150	600

In addition to the identified pipe network upgrades, reservoir upgrades are required in order to meet the DSOS requirements for operating and emergency storage based on the current network loading. Reservoir augmentations are detailed in Table X.

Table 19 Bowen Network – Reservoir Capacity Augmentations

Reservoir	Peak Day Flow (kL)	Firefighting Storage Required (kL)	Total Storage Required (kL)	Existing Storage Volume (kL)	Current % of required capacity	Nominal Capacity Upgrade (kL)
Bowen	18499	432	18931	16300	86%	2600

Due to the high capital costs involved, any reservoir upgrade should take into account projections of future loading in the Bowen network.

5.2 WHITSUNDAY

Supply nodes in the Whitsunday network generally meet the DSOS minimum pressure requirements; however there are a number of areas where the fire flow requirements are not met. Suggested augmentations to address the identified issues are summarised in Table 20 below:

Table 20 Whitsunday Network – Recommended Pipe Augmentations

Issue	Proposed Works	Pipe Size	Pipe Length
Fire flow supply to south-eastern section of Proserpine	Extend DN200 main in Ruge St to Bruce Highway, with connection to dead end in Jasmine Dr	DN200	700
Fire flow supply to southern section of Proserpine	Install DN100 connection main from Honey Myrtle St to Renwick Rd.	DN100	100
	Install DN100 main to connect dead ends in Dudley Rd, Atkinson St and Debney St	DN100	270
	Install DN100 connection between Calista Ct and Renwick Rd	DN100	50
	Install DN100 connection main between dead ends in Cascara St and Tamarind Cr	DN100	80

Issue	Proposed Works	Pipe Size	Pipe Length
	Install DN100 connection main between Fuller St and Fuller St East	DN100	100
Fire flow in Faust St	Replace dead end DN80/ DN100 main with DN150 main	DN150	2500
Fire flow in Camm Dr and Riverview Terrace, Mt Julian*	Replace dead end DN100 mains with DN150 mains	DN150	2800
Fire flow in Stanley Dr, Cannon Valley	Replace dead end DN100 main with DN150 main	DN150	980
Fire flow in Ridge View Rd, Cannonvale	Install DN100 connection main between Johnswood Cl, Raddle Ct and Country Rd	DN100	90
Fire flow in Jubilee Pocket Rd, Jubilee Pocket.	Cross connect DN100 and DN150 mains in Jubilee Pocket Rd	DN100	40
Fire flow in Kingfisher Tce, Jubilee Pocket	Install DN100 connection main from dead ends in Kingfisher Tce, Curlew St to Sandpiper Cr	DN100	210

* Fire flow supply requirements in Camm Dr, Riverview Terrace and Stanley Dr to be confirmed.

As noted for the Bowen network, reservoir upgrades are required in order to meet the DSOS requirements for operating and emergency storage based on the current network loading. Reservoir augmentations for the Whitsunday network are detailed in Table 21.

Table 21 Whitsunday Network – Reservoir Capacity Augmentations

Reservoir	Peak Day Flow (kL)	Firefighting Storage Required (kL)	Total Storage Required (kL)	Existing Storage Volume (kL)	Current % of required capacity	Nominal Capacity Upgrade (kL)
Island Dr High Level	166	108	274	140	51%	140
Moonlight Dr High Level	89	108	197	98	50%	100
Shute Harbour	272	108	380	350	92%	30
Coyne Rd High Level	140	108	248	140	56%	110
Cannonvale	13870	432	14302	12300	86%	2000
Mt Julian	513	108	621	350	56%	270
Proserpine	5604	432	6036	4970	82%	1100

Any reservoir upgrades considered should take into account projections of future loading in the Whitsunday network.

5.3 COLLINSVILLE

Supply nodes in the Collinsville network generally meet the DSOS minimum pressure requirements; however there are a small number of areas where the fire flow requirements are not met. Suggested augmentations to address the identified issues are summarised in Table 22 below:

Table 22 Collinsville Network – Recommended Pipe Augmentations

Issue	Proposed Works	Pipe Size	Pipe Length
Fire flow supply to Hillside Haven aged care facility	Replace dead end DN100 main with DN150 min	DN150	200
Fire flow in Logan St	Install DN100 connection main from Logan St to Miller St	DN100	150
Fire flow in Station St	Install DN100 cross connection across Collinsville Mt Douglas Rd	DN100	60
Fire flow in Scottville Rd, Red Hill Rd, Collin Rd	Install DN100 cross connection between DN100 main in Moongunya Dr and adjacent DN250	DN100	50

While the Collinsville low level reservoir technical does not meet the DSOS storage requirements (78% of required capacity), it is noted that this reservoir is fed by the much larger Collinsville high level reservoir. In the event that the Collinsville low level reservoir is drained, it may be refilled under gravity from the high level reservoir. As such, no upgrade of the low level reservoir is recommended.

6 SEWER NETWORK MODEL AUGMENTATIONS

Network capacity issues have been identified for the sewer collection systems in Bowen, Cannonvale, Collinsville and Proserpine. A strategy to address the issues identified in the existing system is outlined below.

6.1 BOWEN

Based on the modelled results, the Bowen 1 sewer pump station requires a pump capacity upgrade. It is noted that the preliminary analysis indicated a number of additional pump stations in Bowen which are nominally under capacity in wet weather. The modelling has indicated that these pump stations will not necessarily overflow under the current conditions, so do not necessarily require immediate upgrade.

Pump station modifications required for the Bowen collection system are detailed in Table 23 below.

Table 23 Bowen Collection Network – Recommended Pump Station Revisions

Pump Station	Current Modelled Flow Rate (L/s)	Required Flow Rate (L/s)	Recommended Augmentation
Bowen 1	176 (both pumps in parallel)	191 (both pumps in parallel)	Modification of pumps or rising main configuration to achieve slightly higher flow rate.
Bowen 4	40	30	Modification of pump to reduced peak flow rate. May comprise trimmed impellors or VSD to reduce speed.

As noted earlier, the flow rate from SPS1 affects the operation of the Bowen STP. It is likely that upgrade works at the STP will be required before any flow increase from SPS 1 is considered.

6.2 CANNONVALE

The wet weather overflow issues experienced in the Cannonvale STP catchment are primarily the result of the incomplete common rising main network running from Jubilee Pocket, through Airlie Beach to the Cannonvale STP. It is understood that WRC has programmed at least some of the works required to complete this network in the upcoming capital works program for 2014/15. It is recommended that the previous reports completed for this system are re-visited and updated with the loading information from the new IDM to ensure that the flow assumptions made are still valid. The internal WRC report was based on rates database information, which may have indicated higher peak flow rates than the current IDM.

6.3 PROSERPINE

No capital works are recommended for Proserpine based on the network modelling results however reconfiguration of some pump station controls may be required to reduce the incidence of flooding in sections of network which receive rising main discharges.

6.4 COLLINSVILLE

Based on the modelled results, the Scottville 1 SPS is incapable of meeting the required flow rate in wet weather. This issue is related to the diameter of the rising main, as the existing pumps are capable of flow significantly in excess of the modelled PWWF. It appears that the pumps are operating inefficiently to the far left of their curve.

Pump station modifications required for the Collinsville collection system are detailed in Table 24 below.

Table 24 Collinsville Collection Network – Recommended Pump Station Revisions

Pump Station	Current Modelled Flow Rate (L/s)	Required Flow Rate (L/s)	Recommended Augmentation
Scottville	4	11	Review operation of current pumps and suitability for application. Investigate higher head/ lower flow options for replacement.

6.5 WHITSUNDAY SHORES

No immediate upgrades for the existing system have been identified.

APPENDIX A

PRELIMINARY CAPACITY ASSESSMENT

APPENDIX B

BOWEN WATER NETWORK MODEL RESULTS

Figure 26 2014 Average Day Minimum Pressures – Bowen

Figure 27 2014 Peak Day Minimum Pressures – Bowen

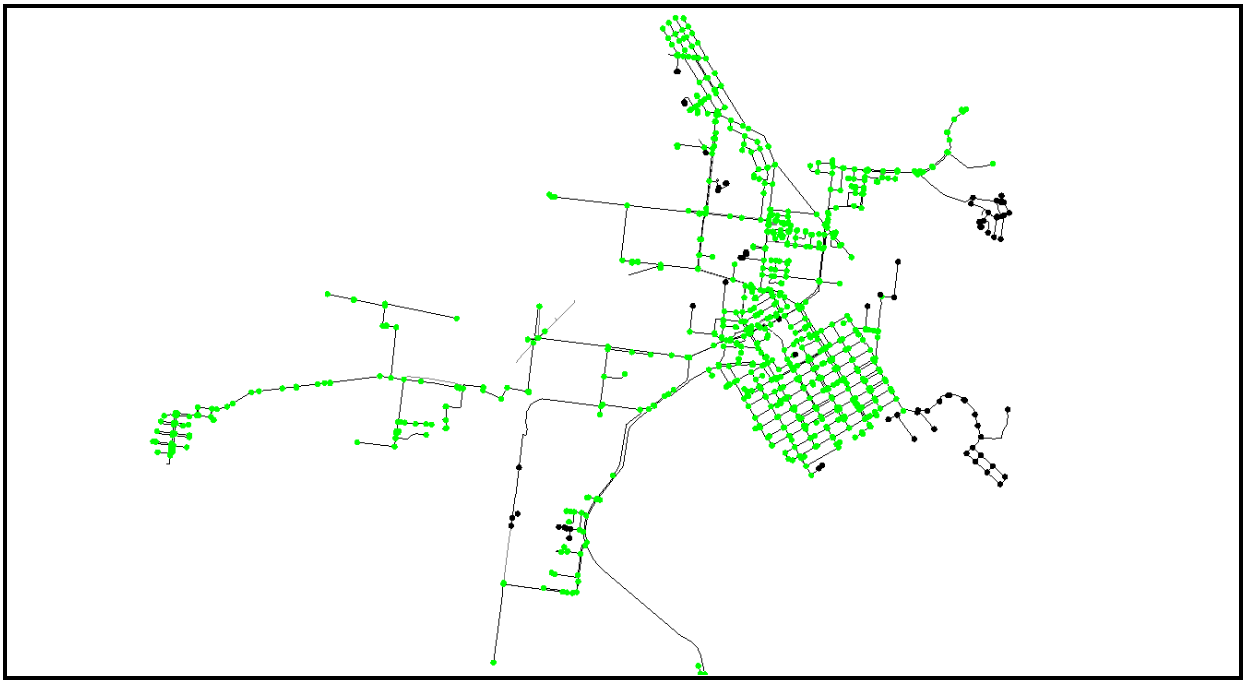

Figure 28 2014 Peak Hour Fire Flow Compliance – Bowen

Figure 29 2014 Average Day Maximum Pressures – Bowen

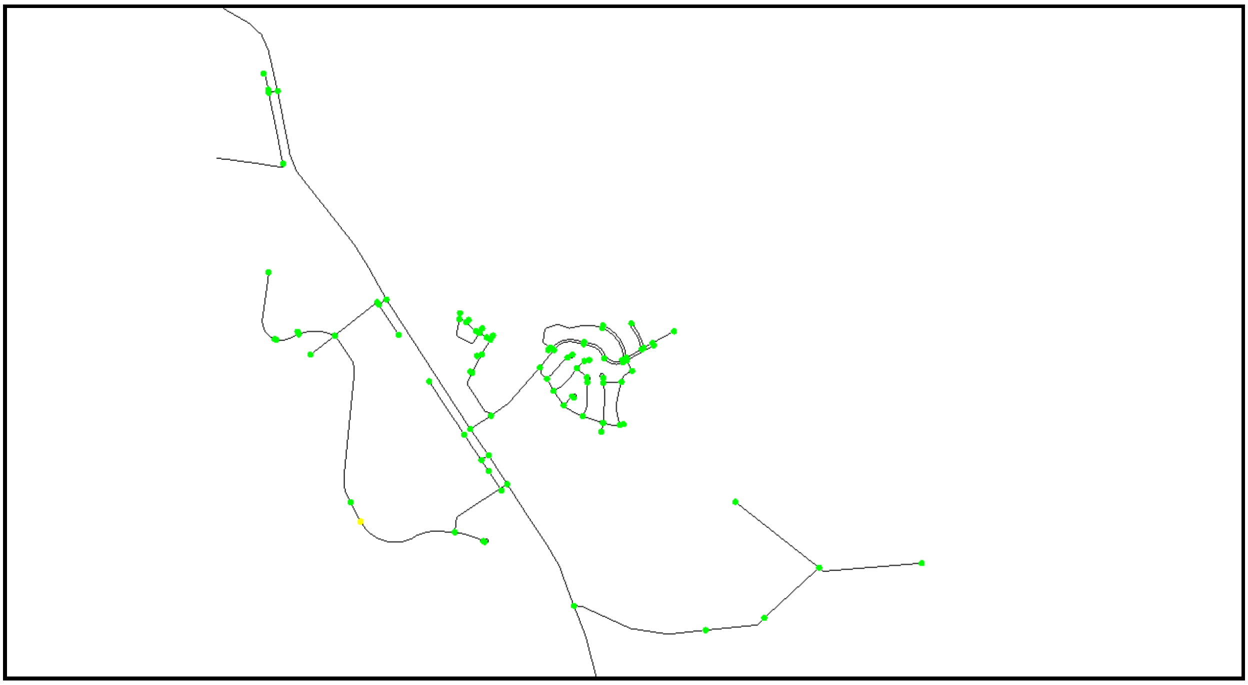

Figure 30 2014 Average Day Minimum Pressures – Whitsunday Shores

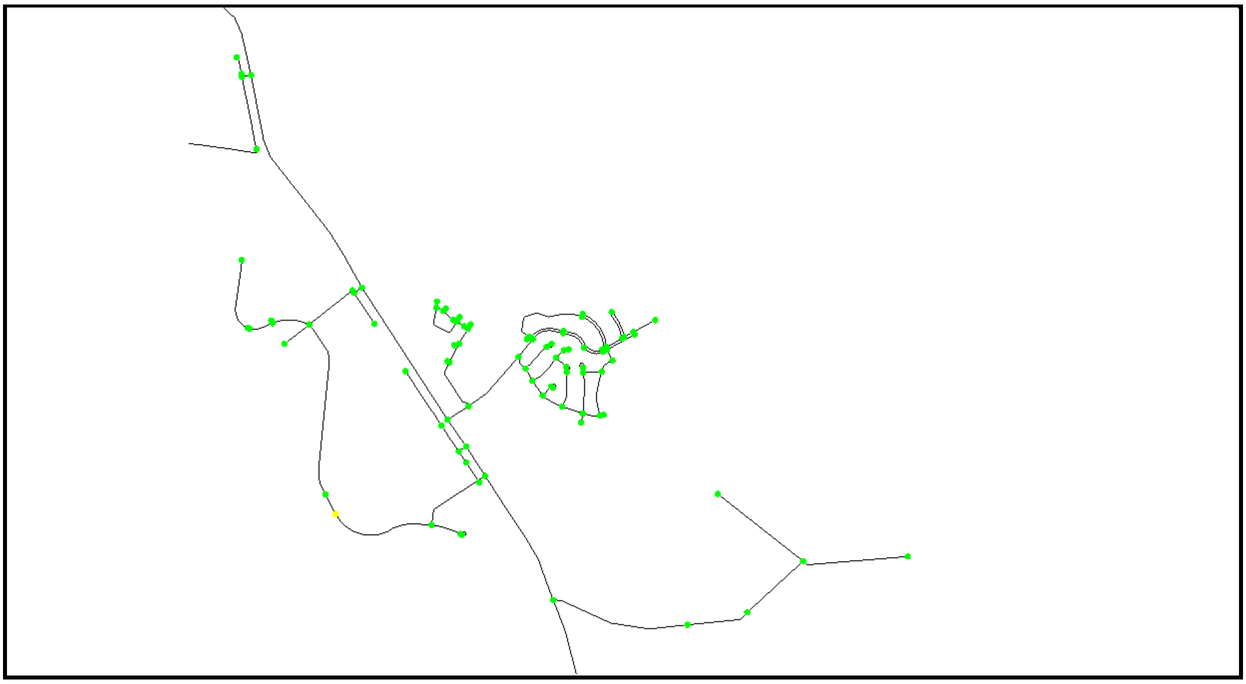

Figure 31 2014 Peak Day Minimum Pressures – Whitsunday Shores

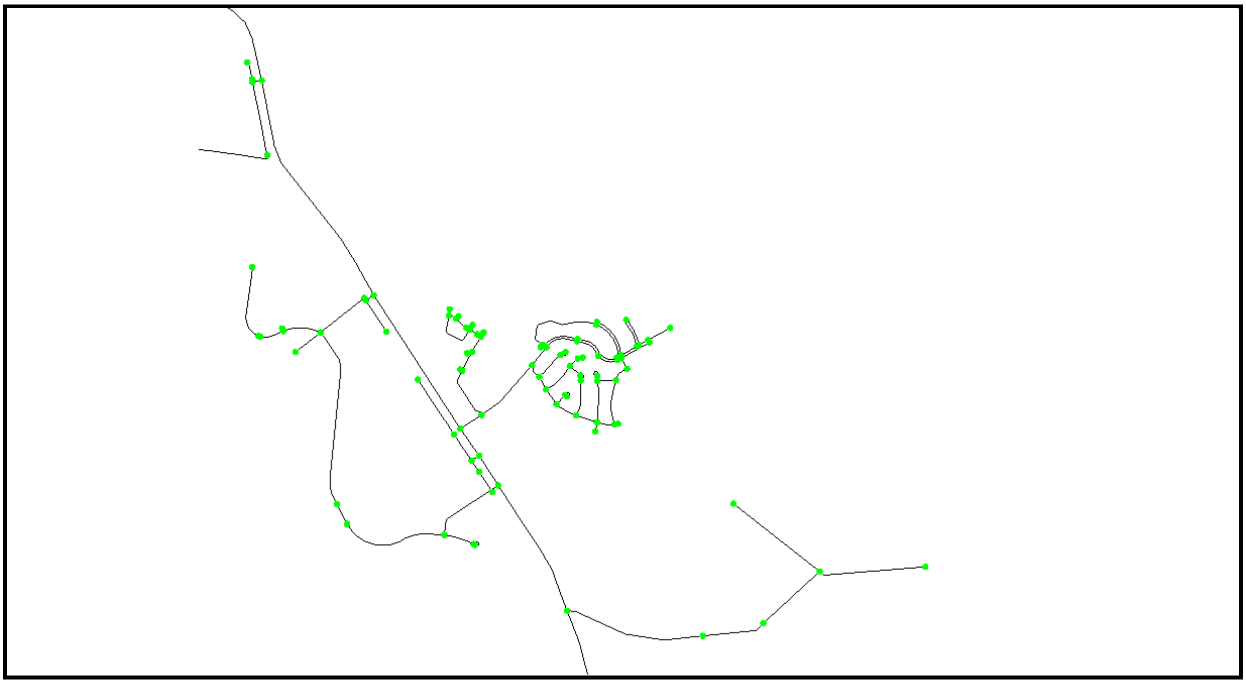

Figure 32 2014 Peak Hour Fire Flow Compliance – Whitsunday Shores

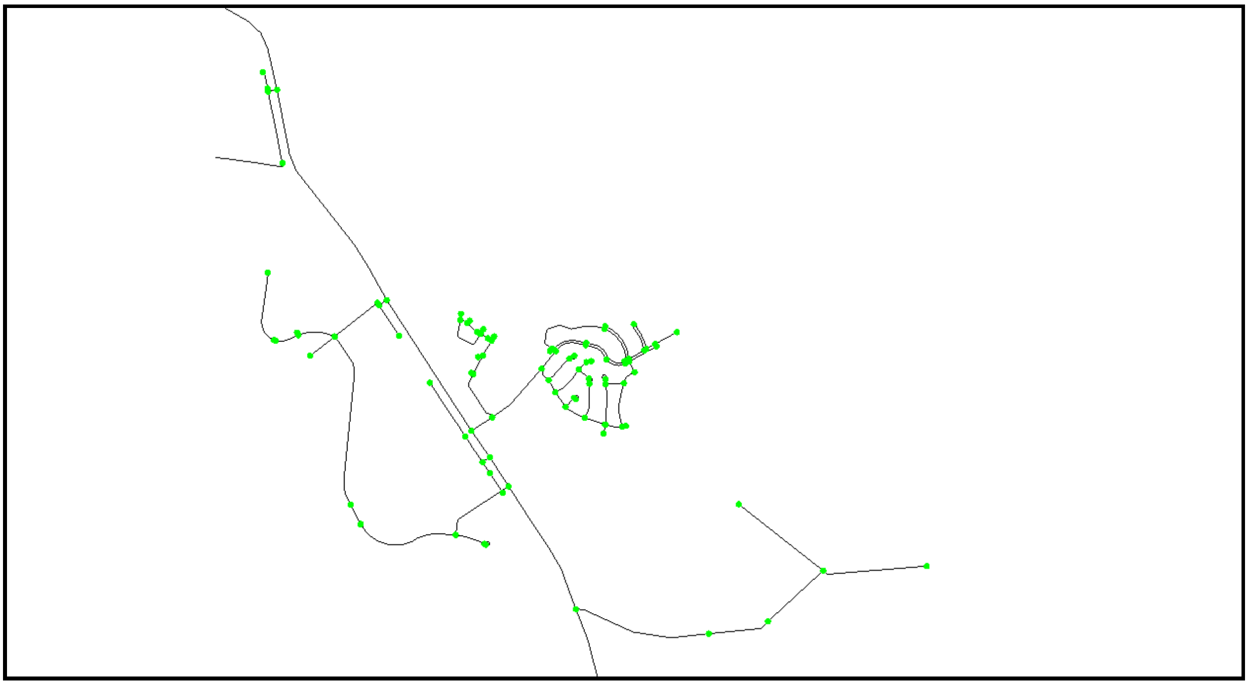

Figure 33 2014 Average Day Maximum Pressures – Whitsunday Shores

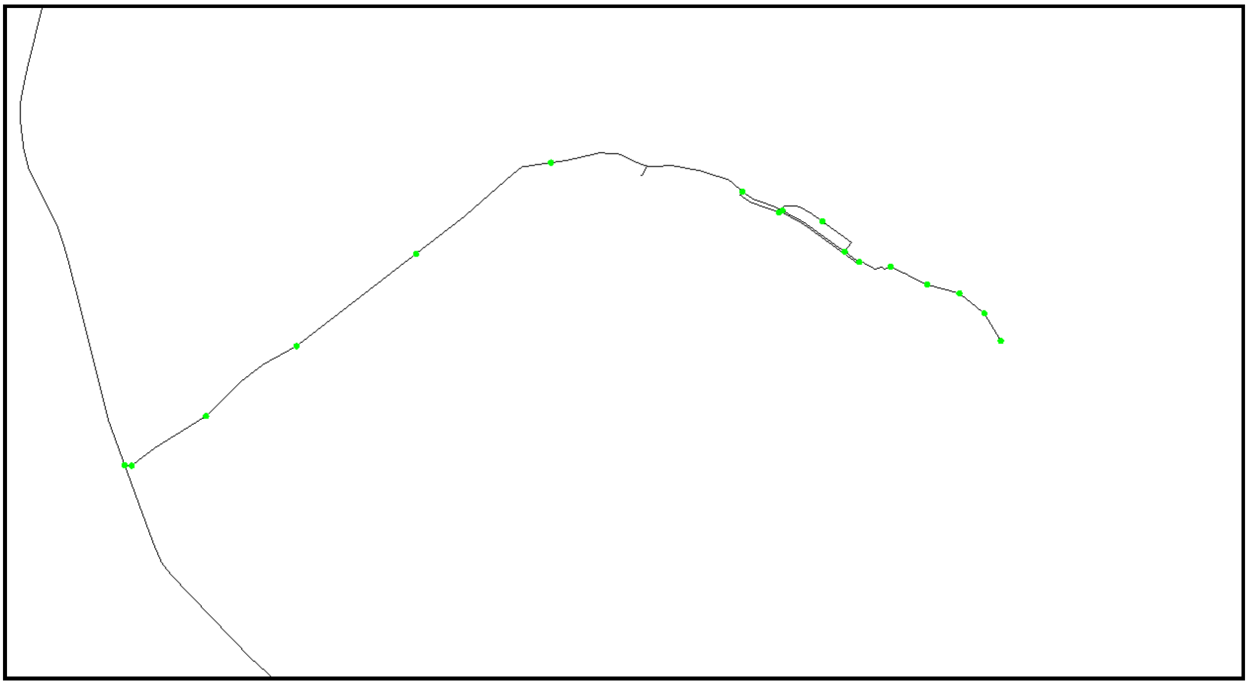

Figure 34 2014 Average Day Minimum Pressures – Heronvale

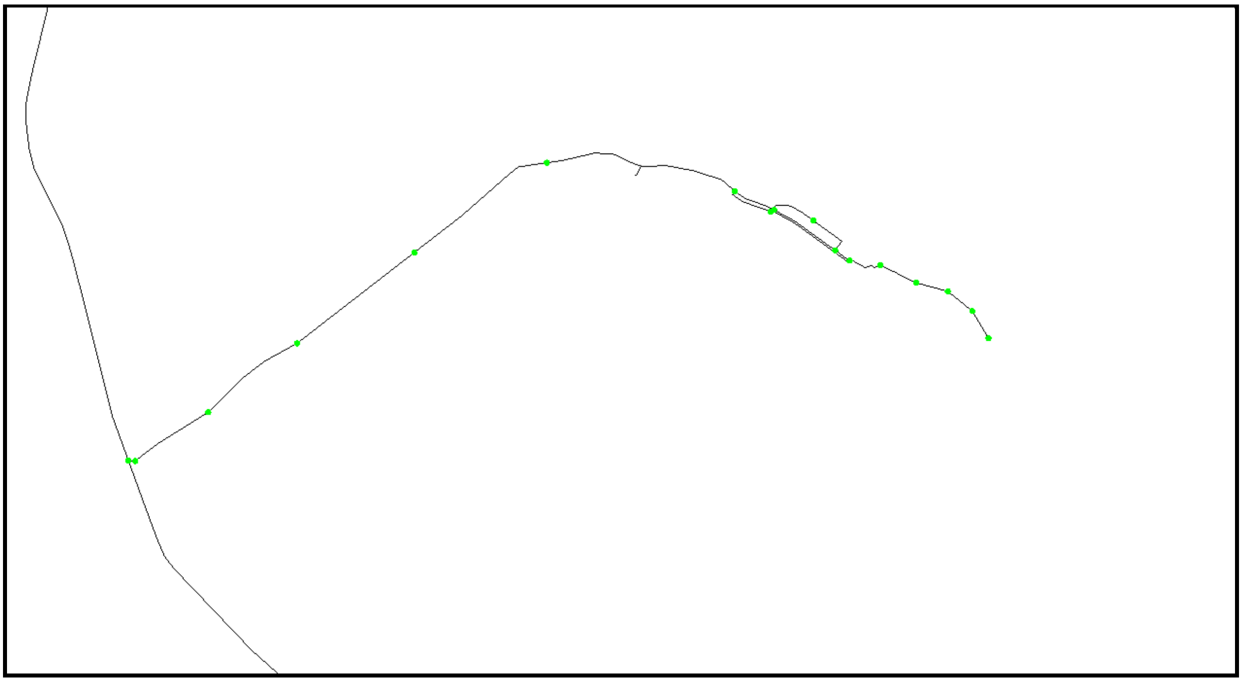

Figure 35 2014 Peak Day Minimum Pressures – Heronvale

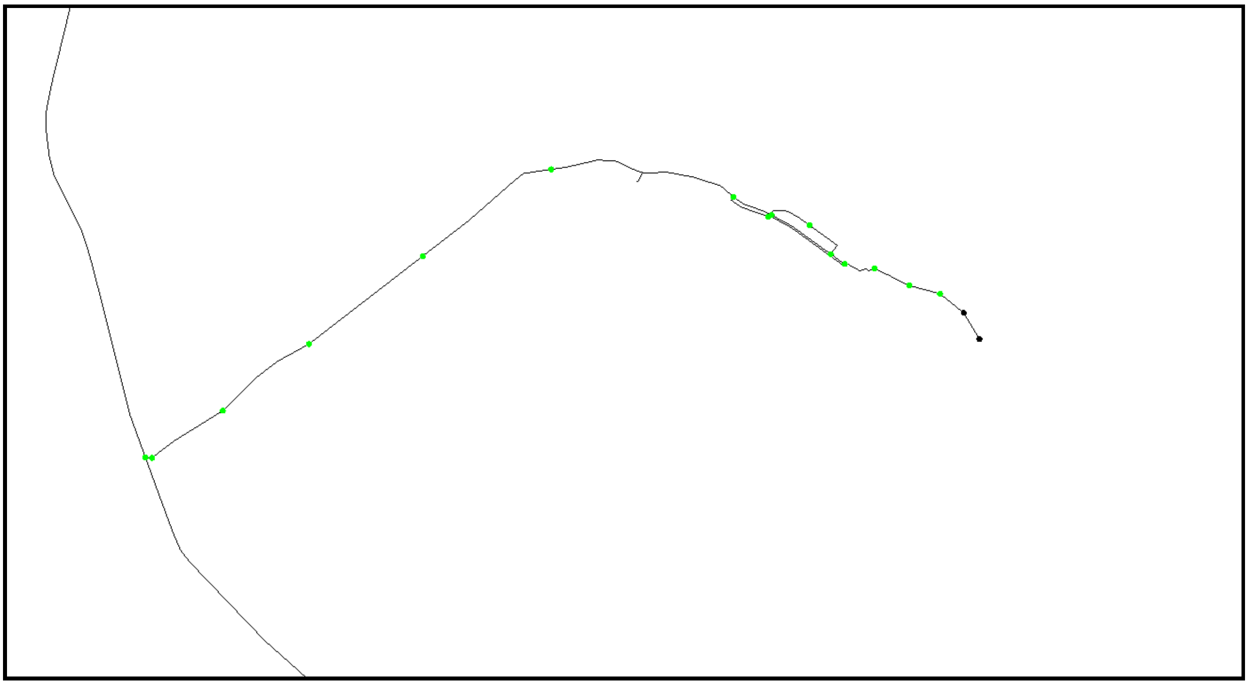

Figure 36 2014 Peak Hour Fire Flow Compliance – Heronvale

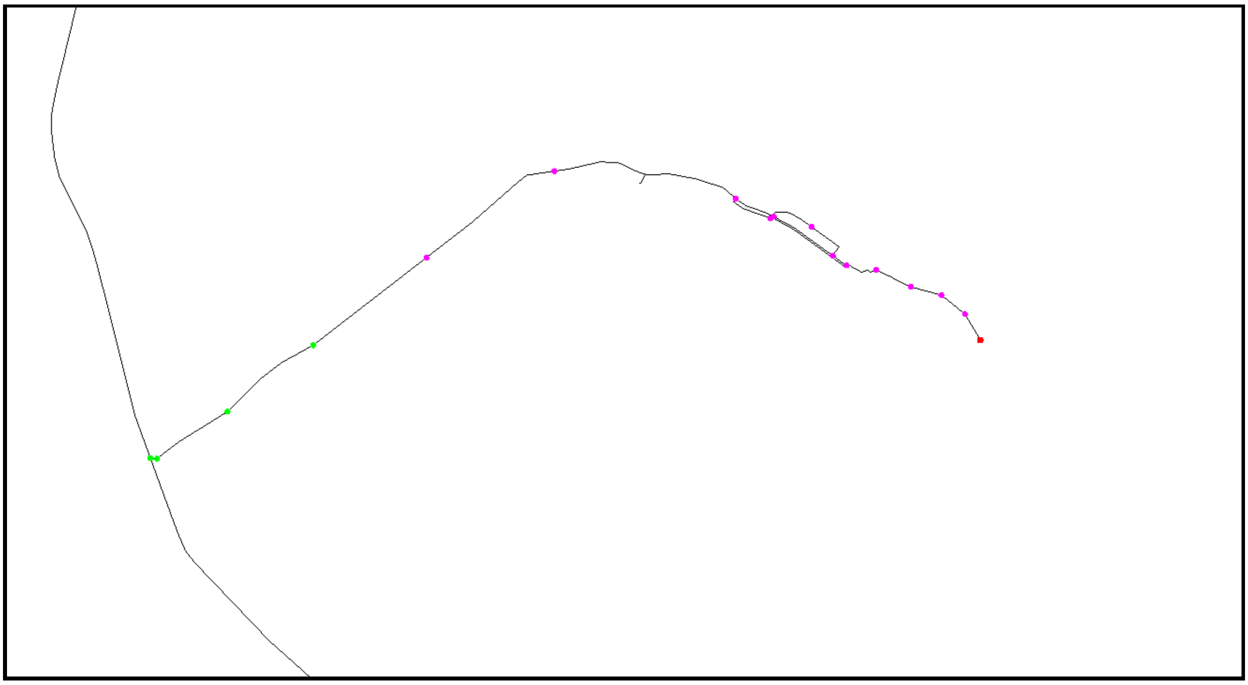

Figure 37 2014 Average Day Maximum Pressures – Heronvale

APPENDIX C

WHITSUNDAY WATER NETWORK MODEL RESULTS

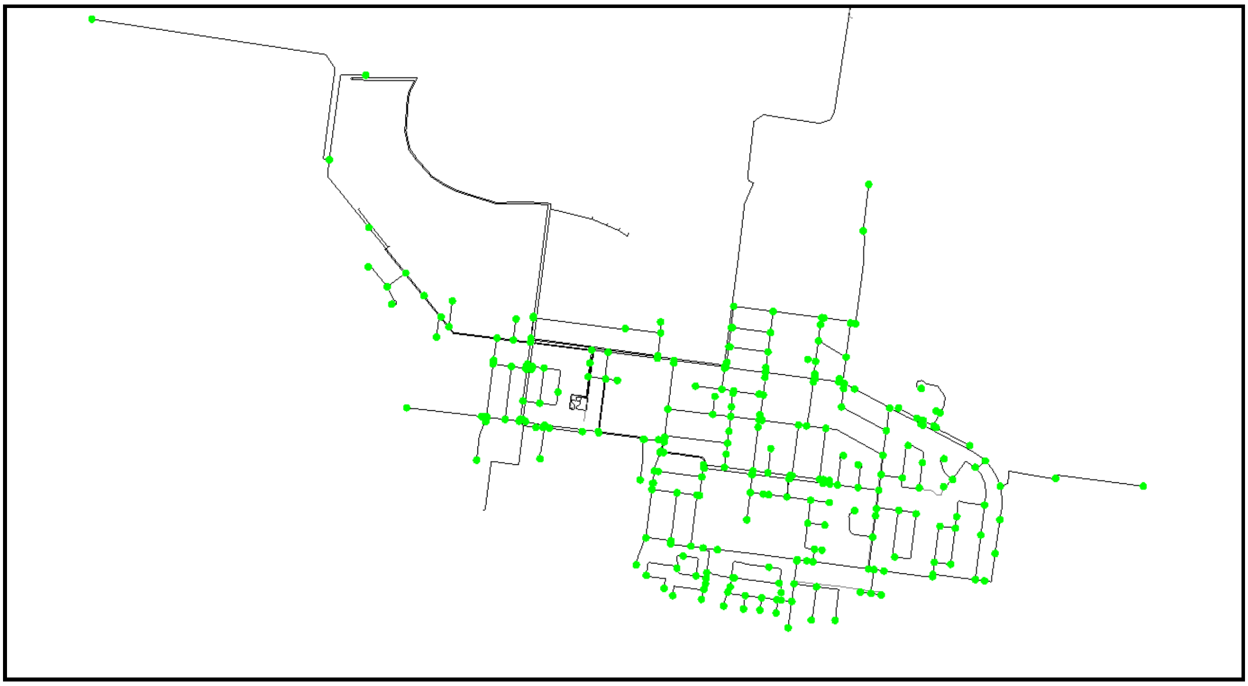

Figure 38 2014 Average Day Minimum Pressures – Proserpine

Figure 39 2014 Peak Day Minimum Pressures – Proserpine

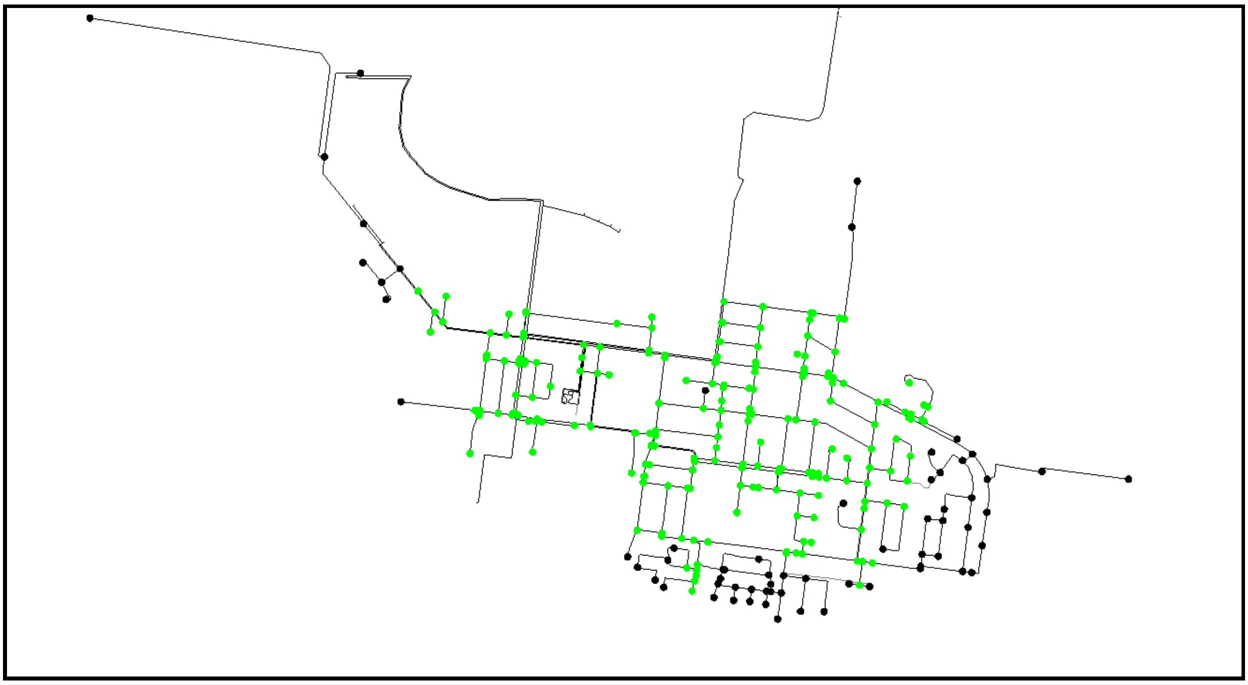

Figure 40 2014 Peak Hour Fire Flow Compliance – Proserpine

Figure 41 2014 Peak Day Maximum Pressures – Proserpine

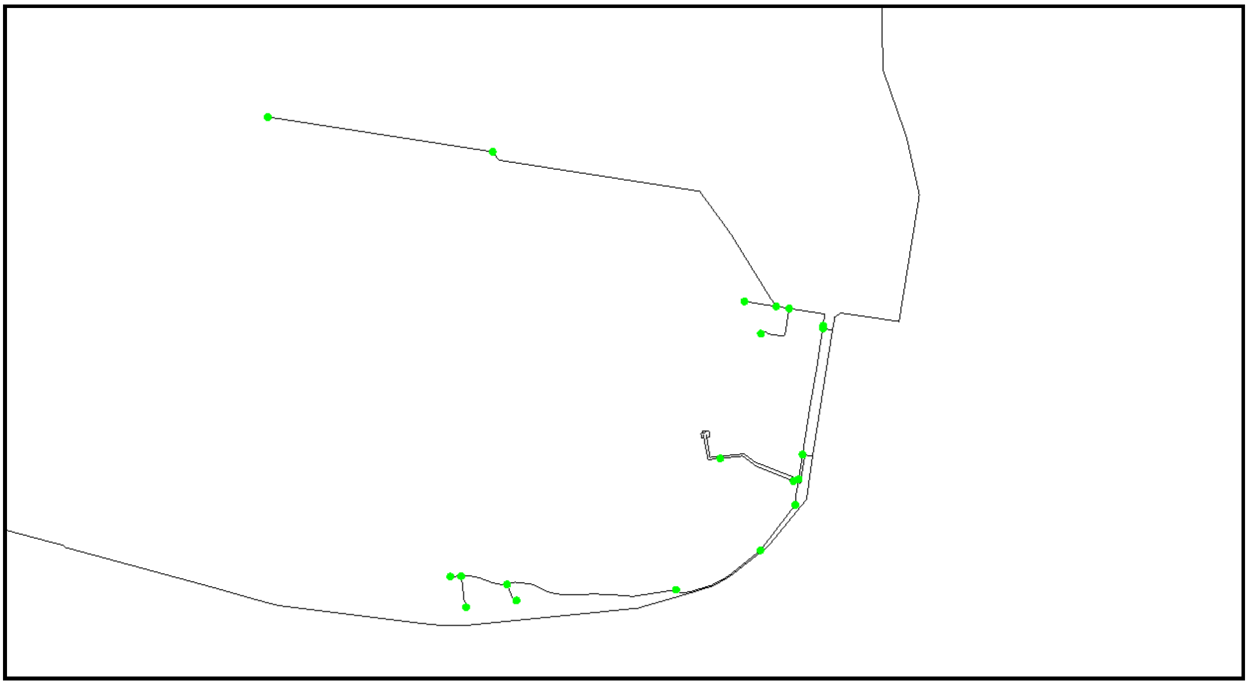

Figure 42 2014 Average Day Minimum Pressures – Mount Julian

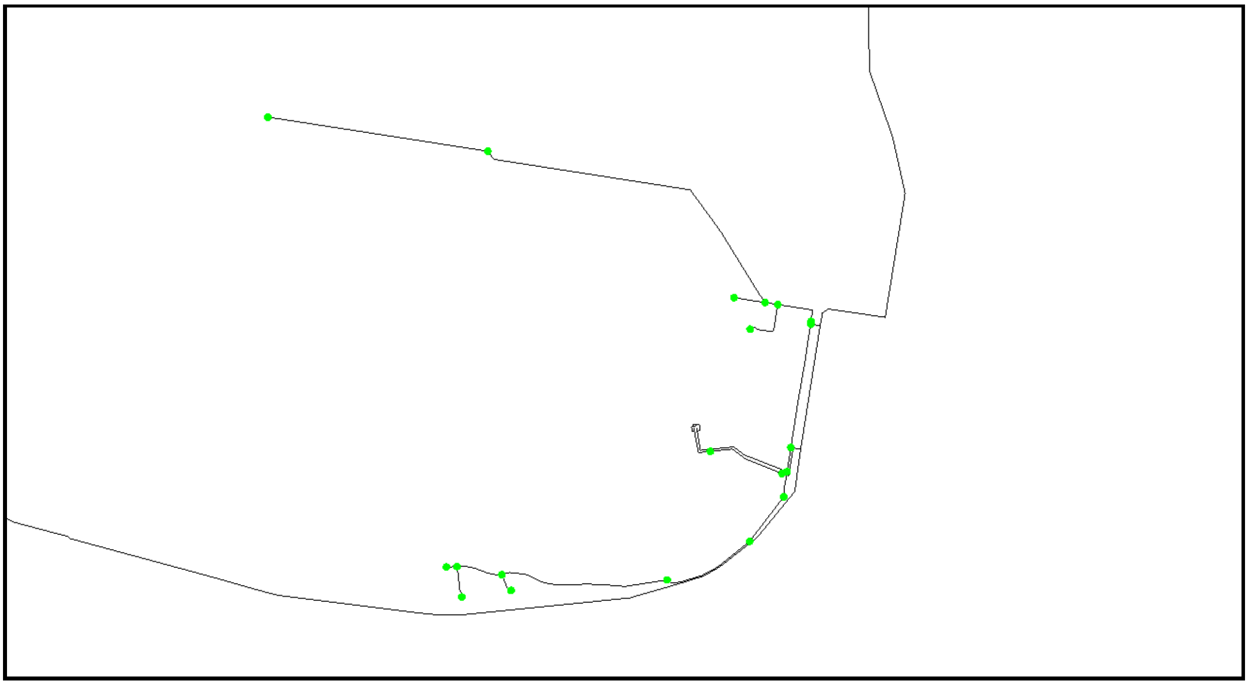

Figure 43 2014 Peak Day Minimum Pressures – Mount Julian

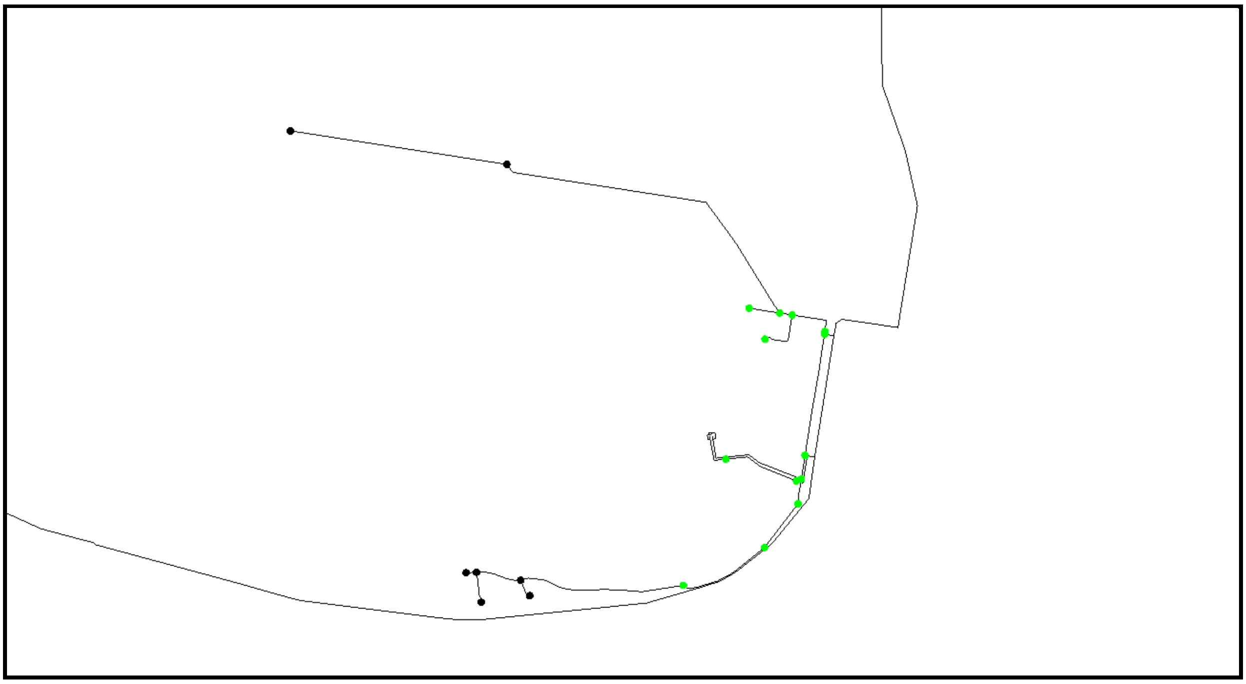

Figure 44 2014 Peak Hour Fire Flow Compliance – Mount Julian

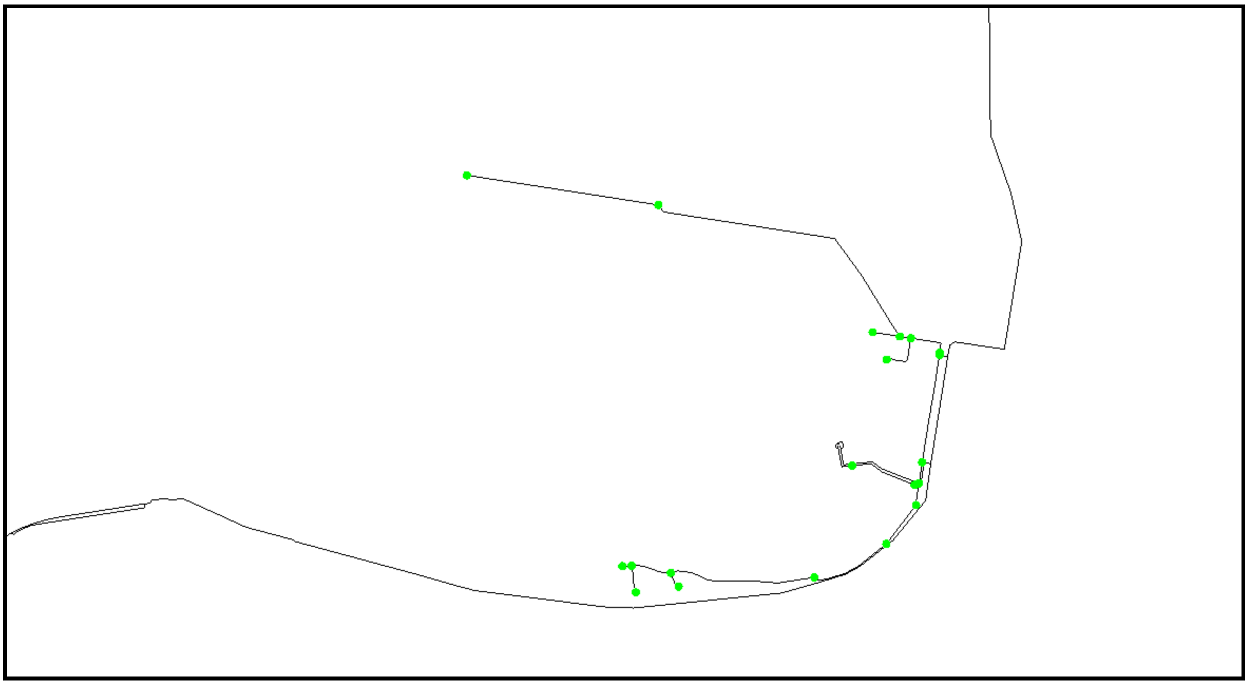

Figure 45 2014 Average Day Maximum Pressures – Mount Julian

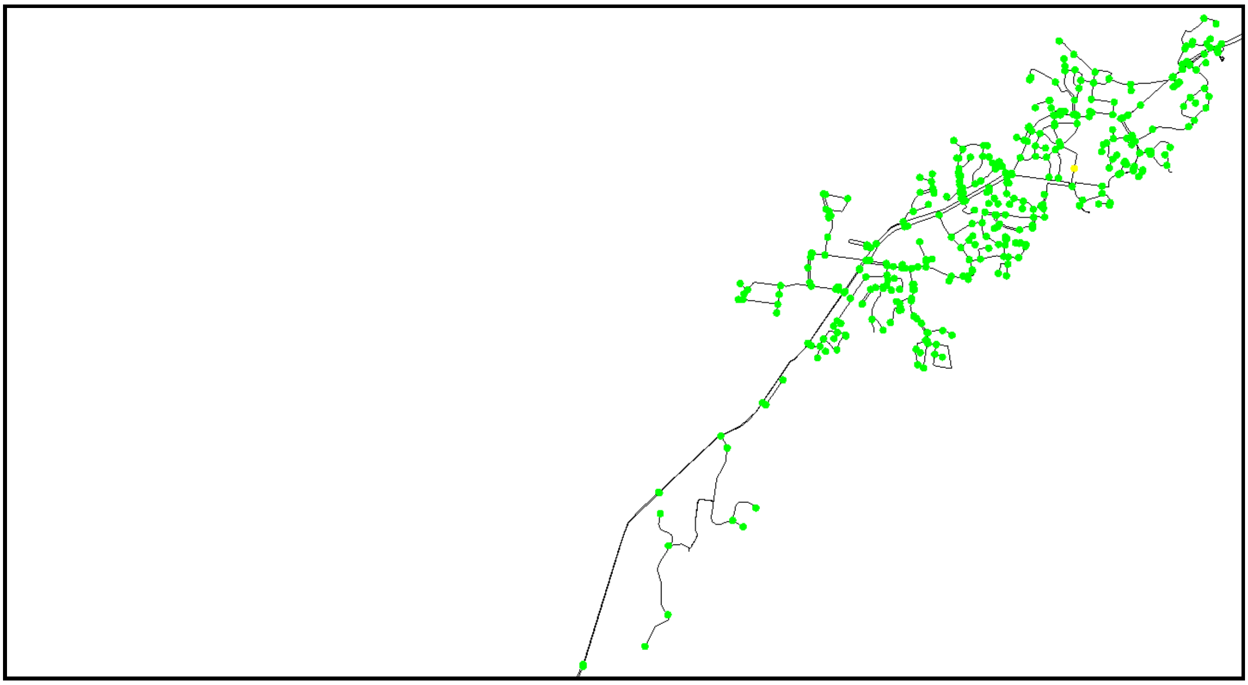

Figure 46 2014 Average Day Minimum Pressures – Cannonvale

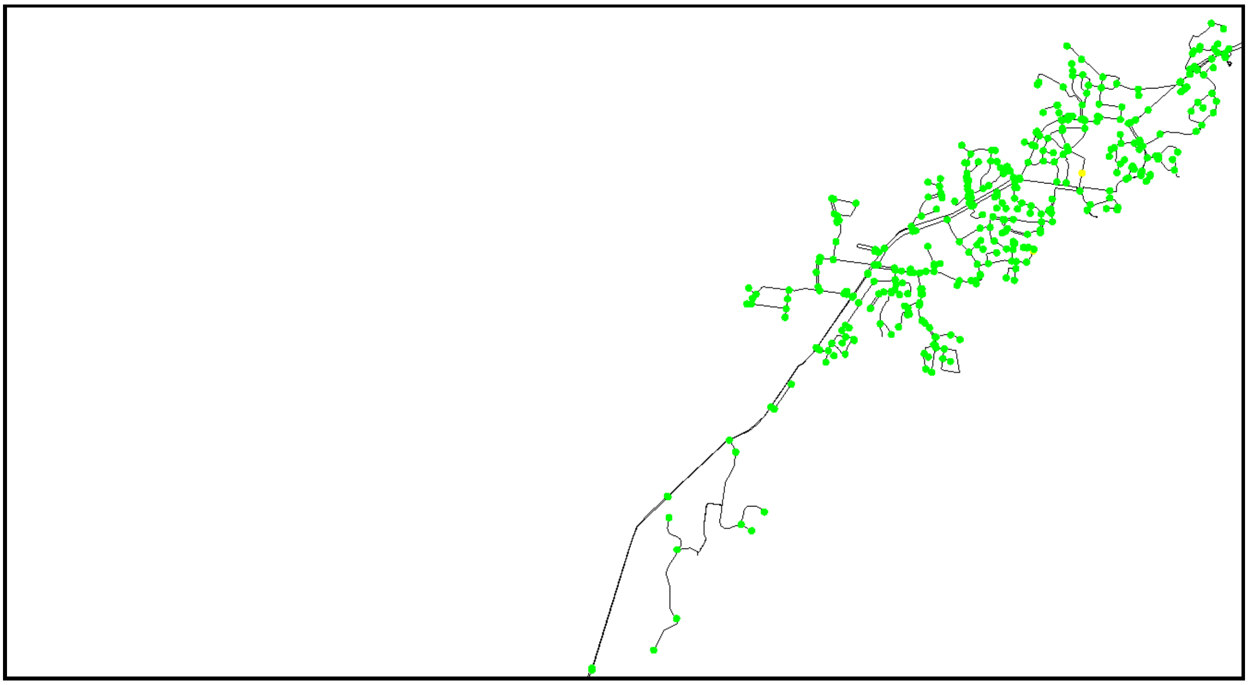

Figure 47 2014 Peak Day Minimum Pressures – Cannonvale

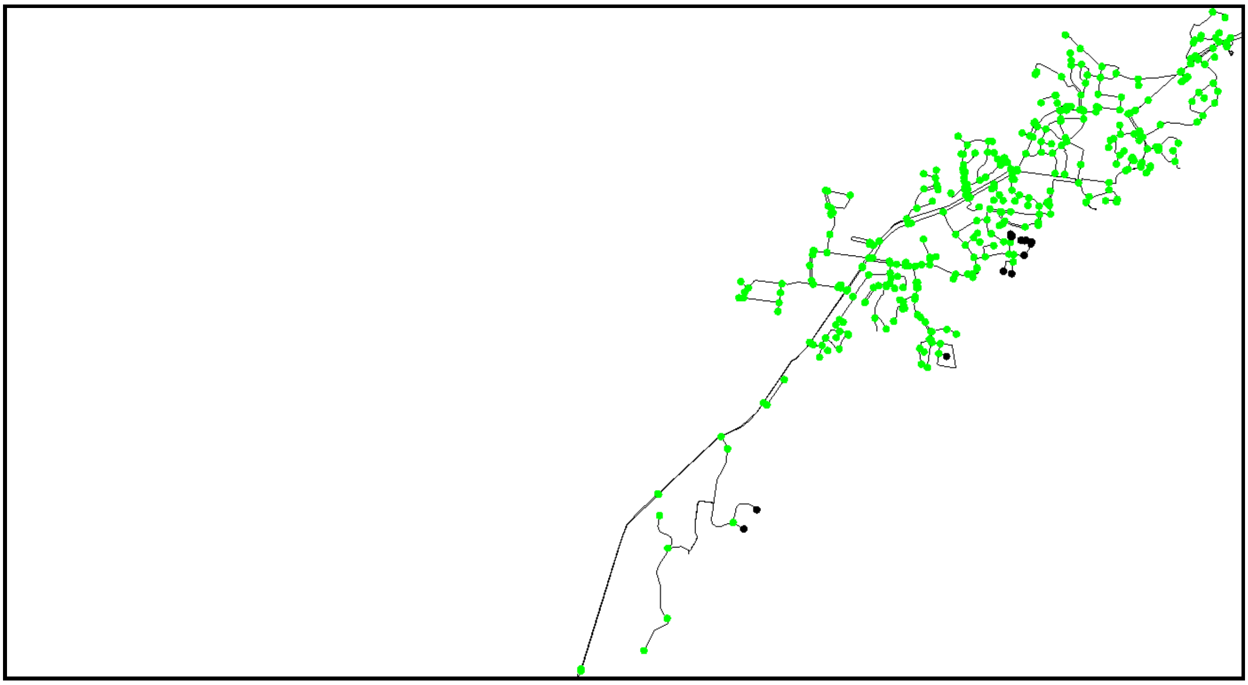

Figure 48 2014 Peak Hour Fire Flow Compliance – Cannonvale

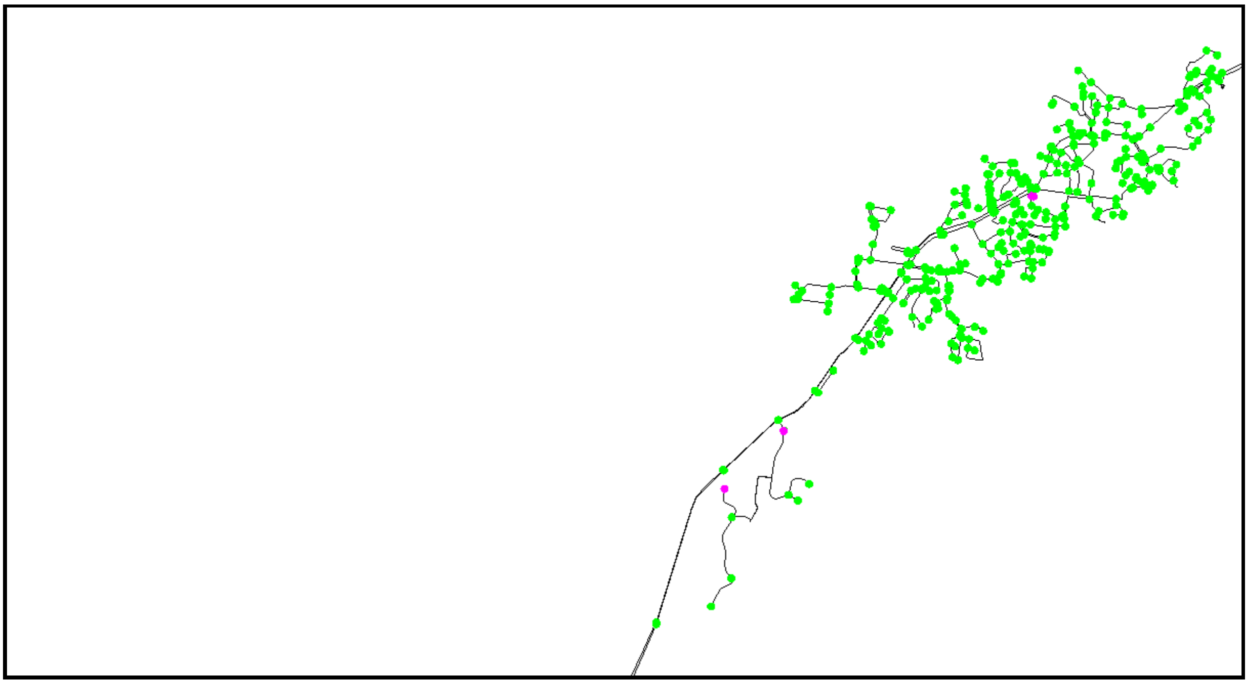

Figure 49 2014 Average Day Maximum Pressures – Cannonvale

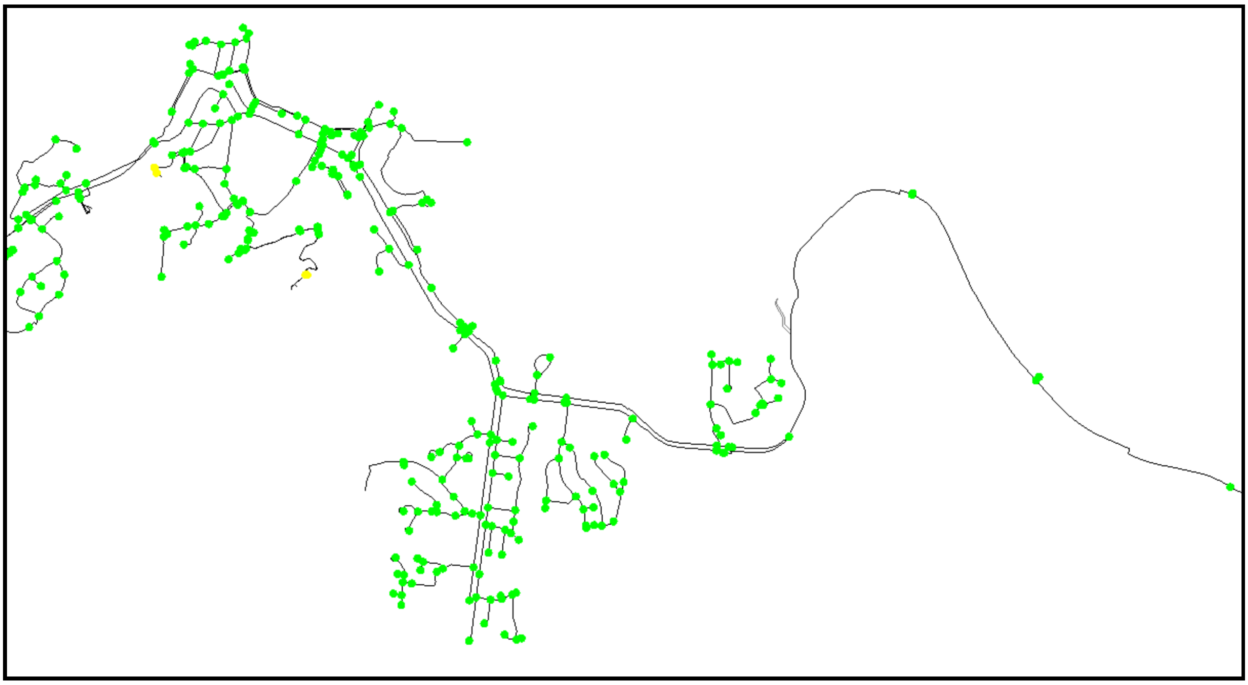

Figure 50 2014 Average Day Minimum Pressures – Airlie Beach and Jubilee Pocket

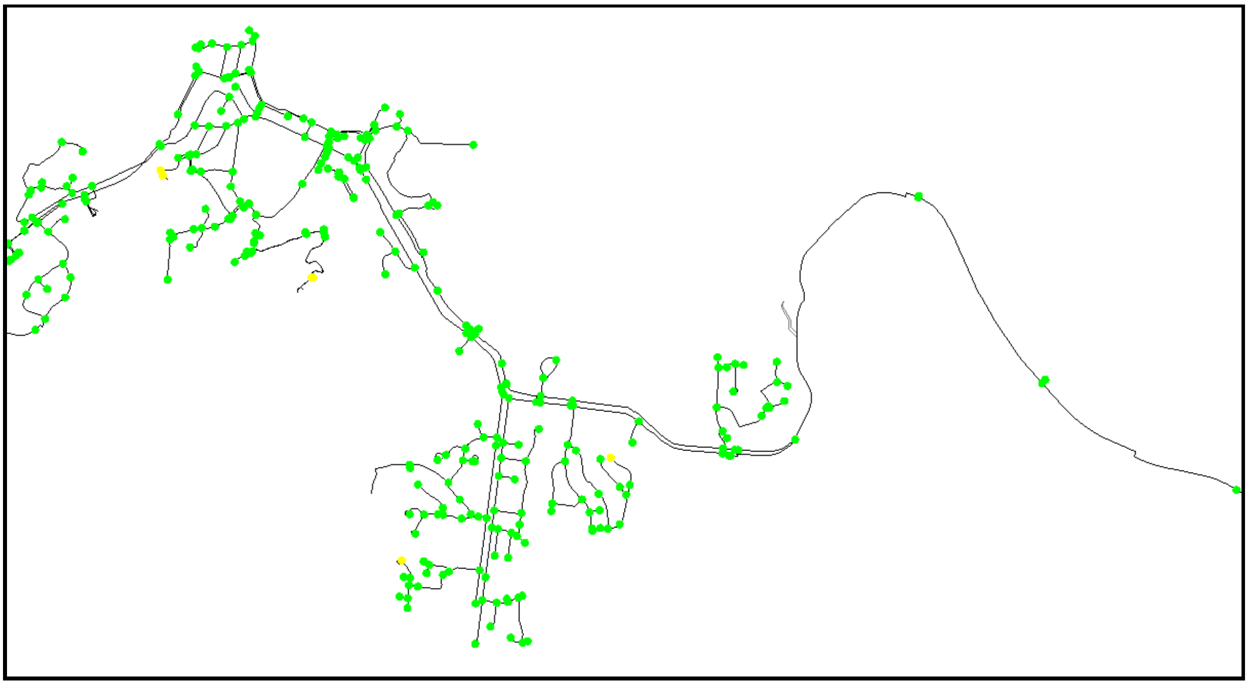

Figure 51 2014 Peak Day Minimum Pressures – Airlie Beach and Jubilee Pocket

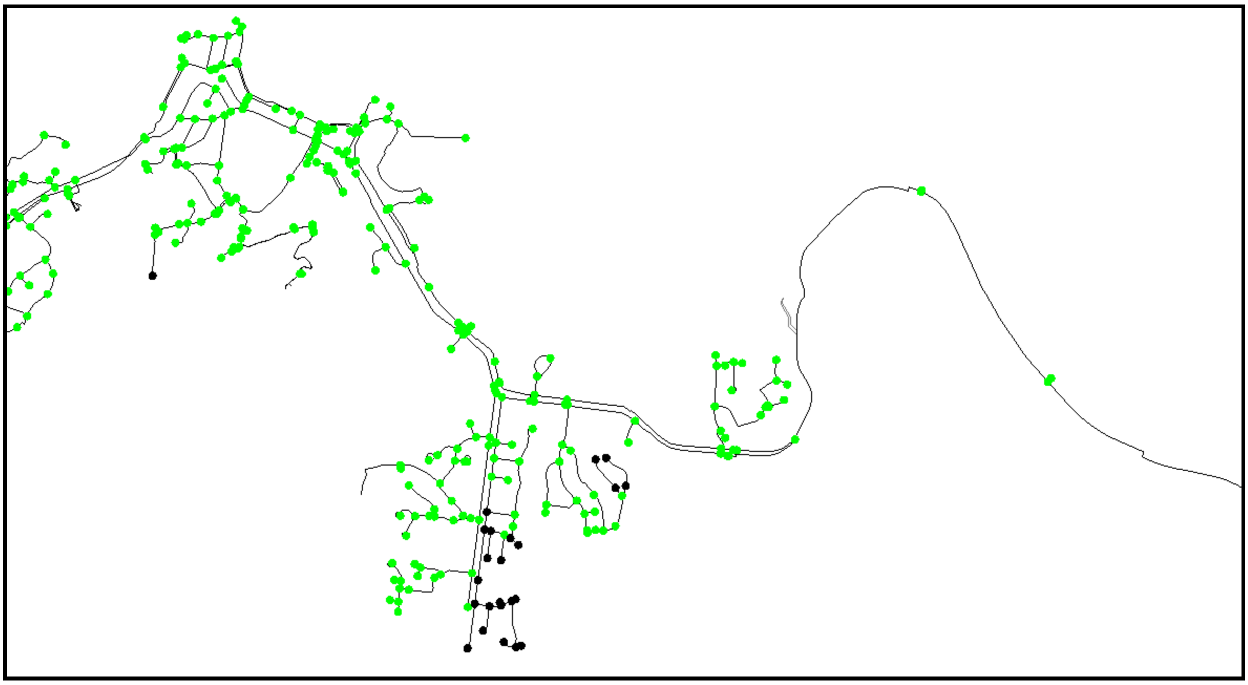

Figure 52 2014 Peak Hour Fire Flow Compliance – Airlie Beach and Jubilee Pocket

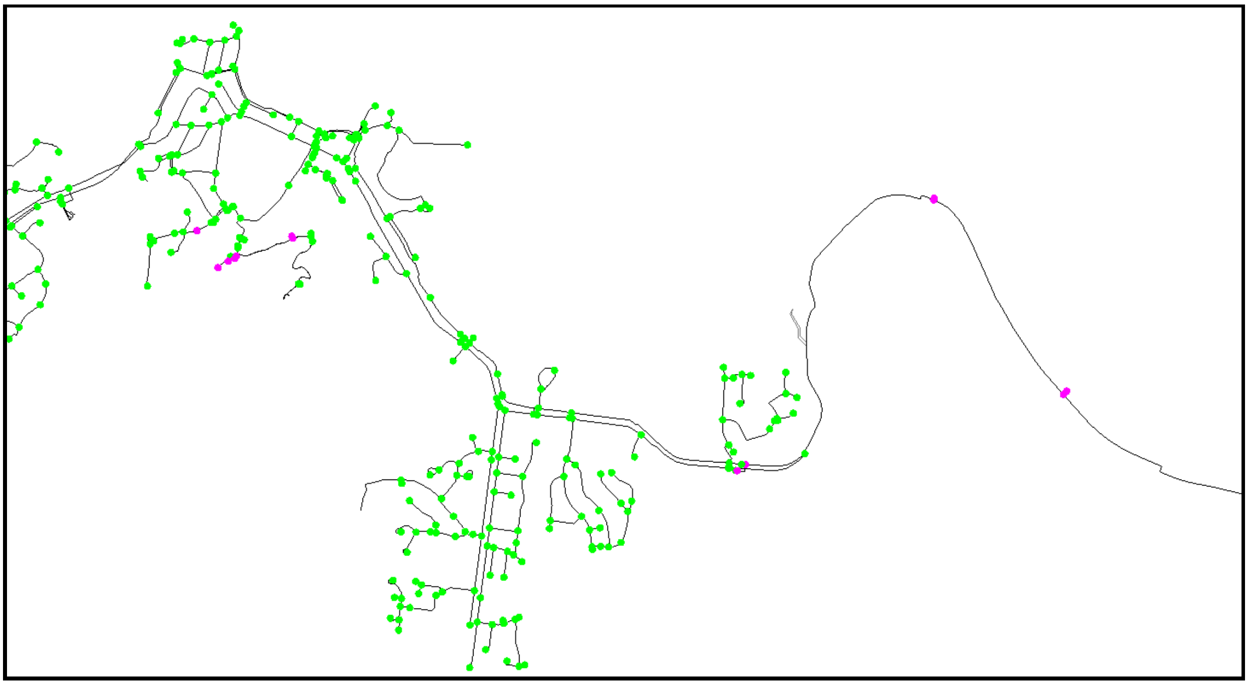

Figure 53 2014 Average Day Maximum Pressures – Airlie Beach and Jubilee Pocket

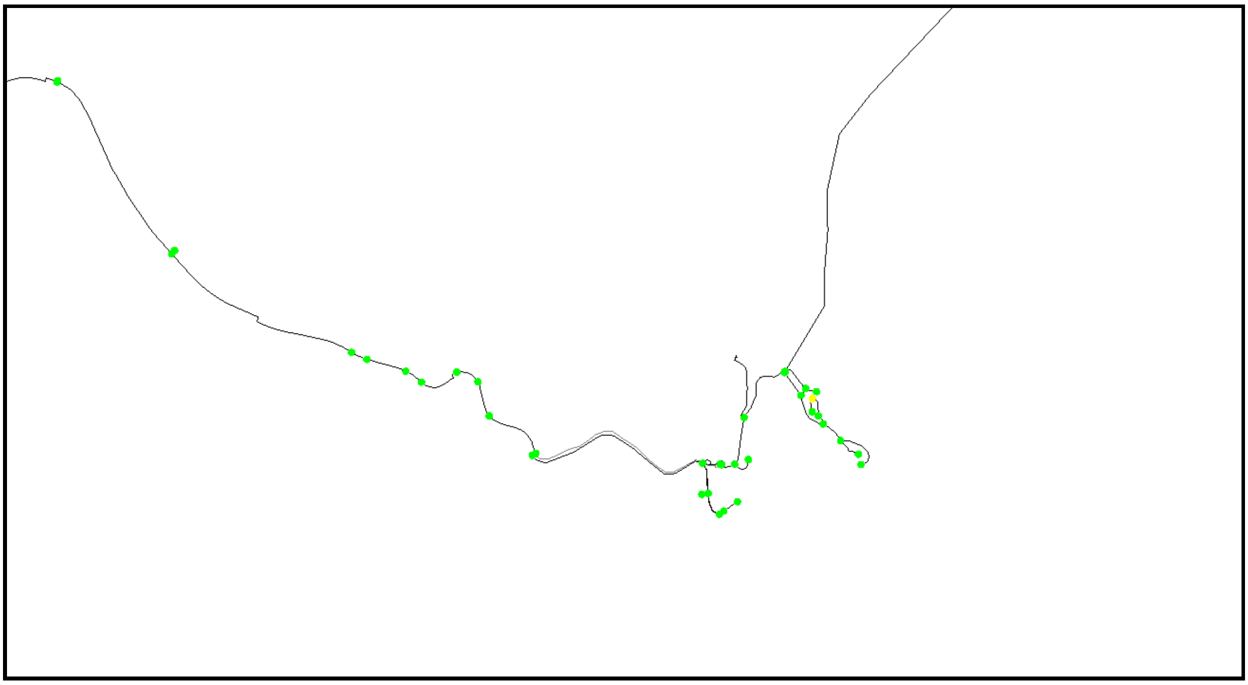

Figure 54 2014 Average Day Minimum Pressures – Shute Harbour

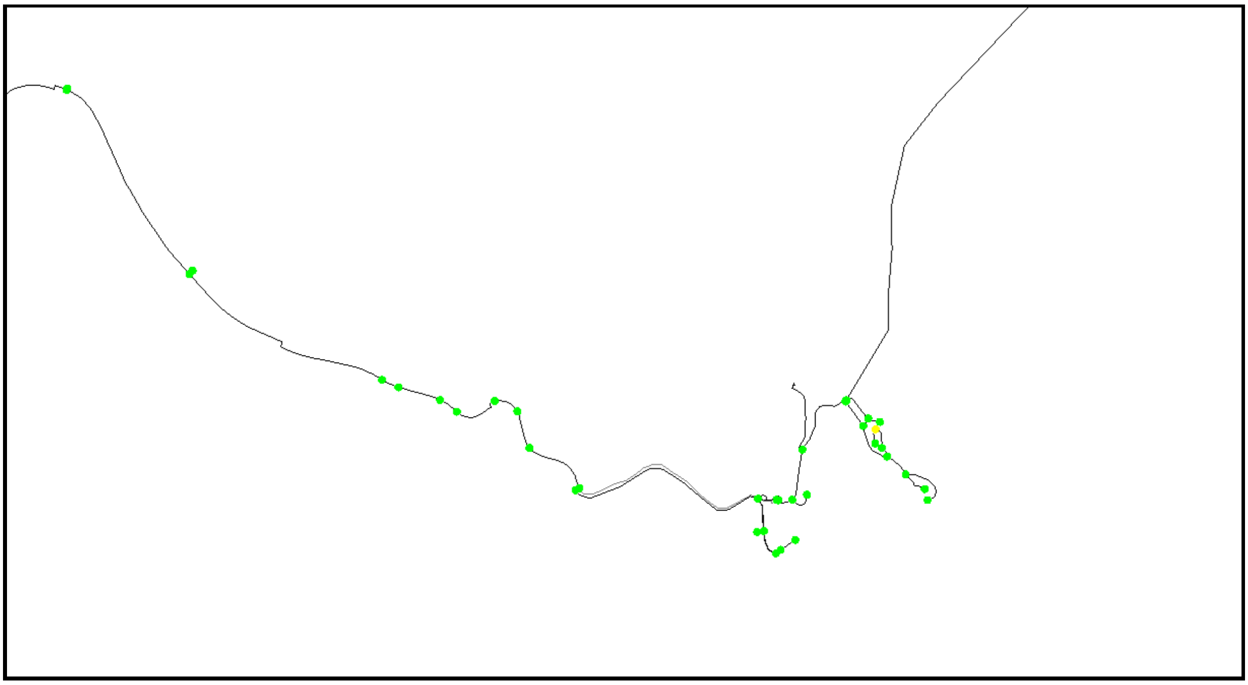

Figure 55 2014 Peak Day Minimum Pressures – Shute Harbour

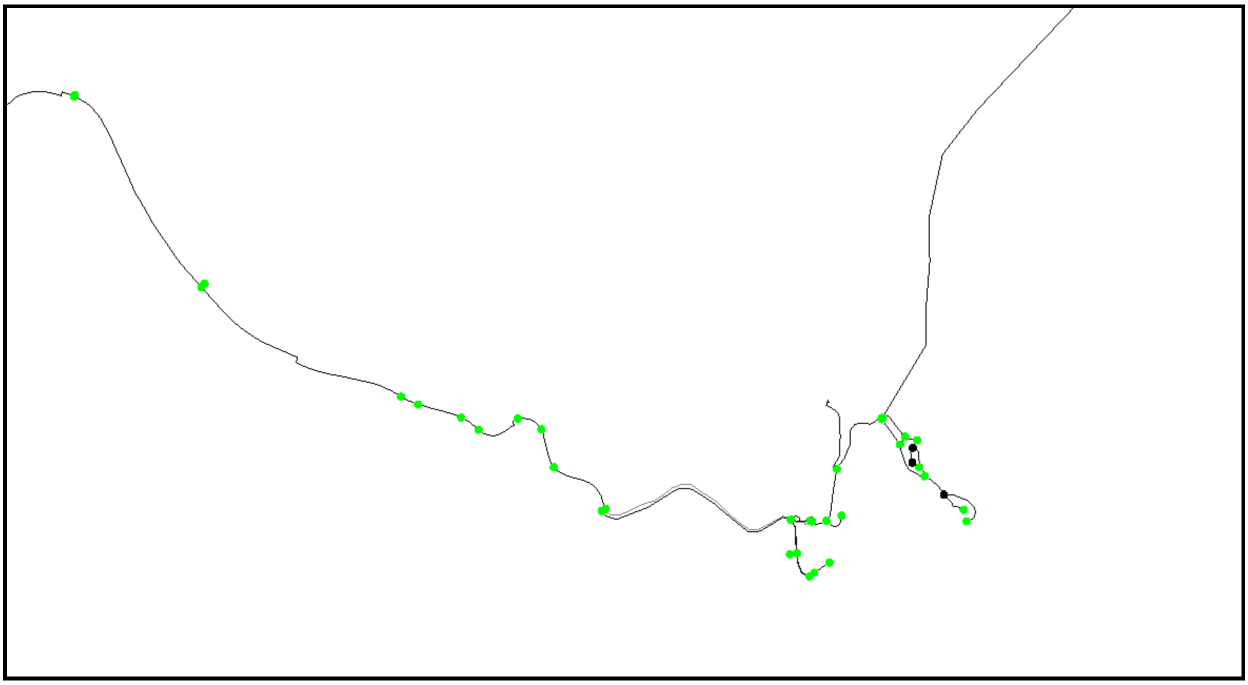

Figure 56 2014 Peak Hour Fire Flow Compliance – Shute Harbour

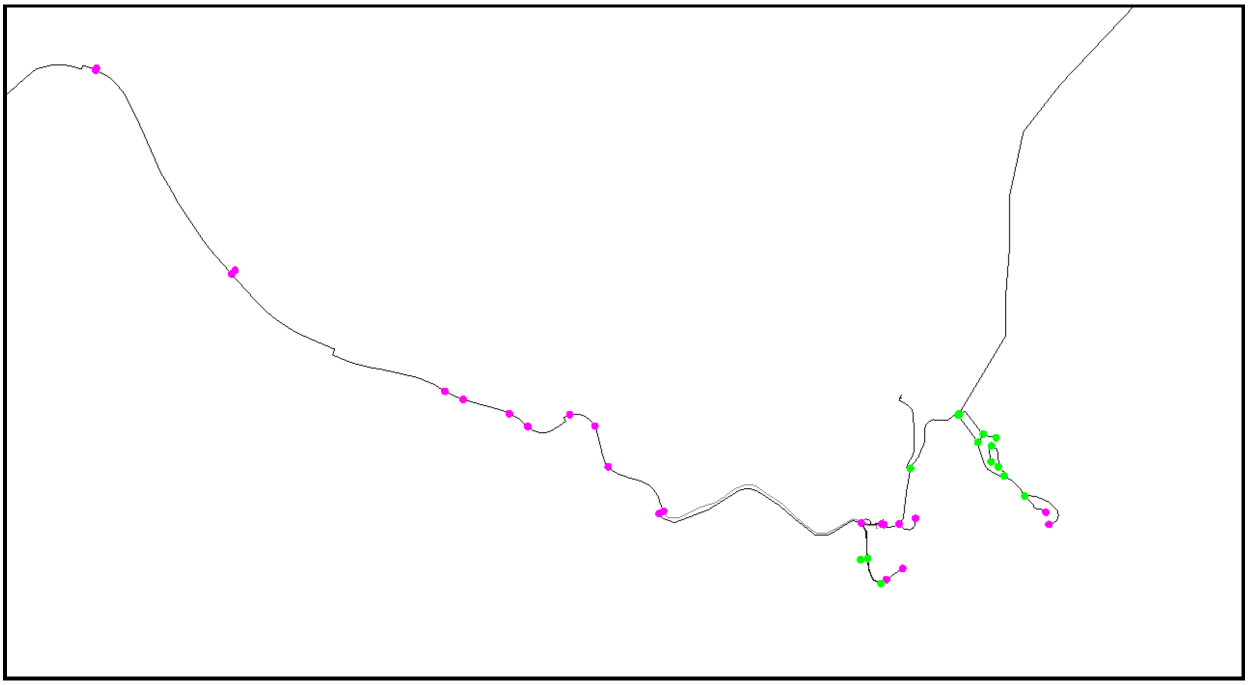

Figure 57 2014 Average Day Maximum Pressures – Shute Harbour

APPENDIX D

COLLINSVILLE WATER NETWORK MODEL RESULTS

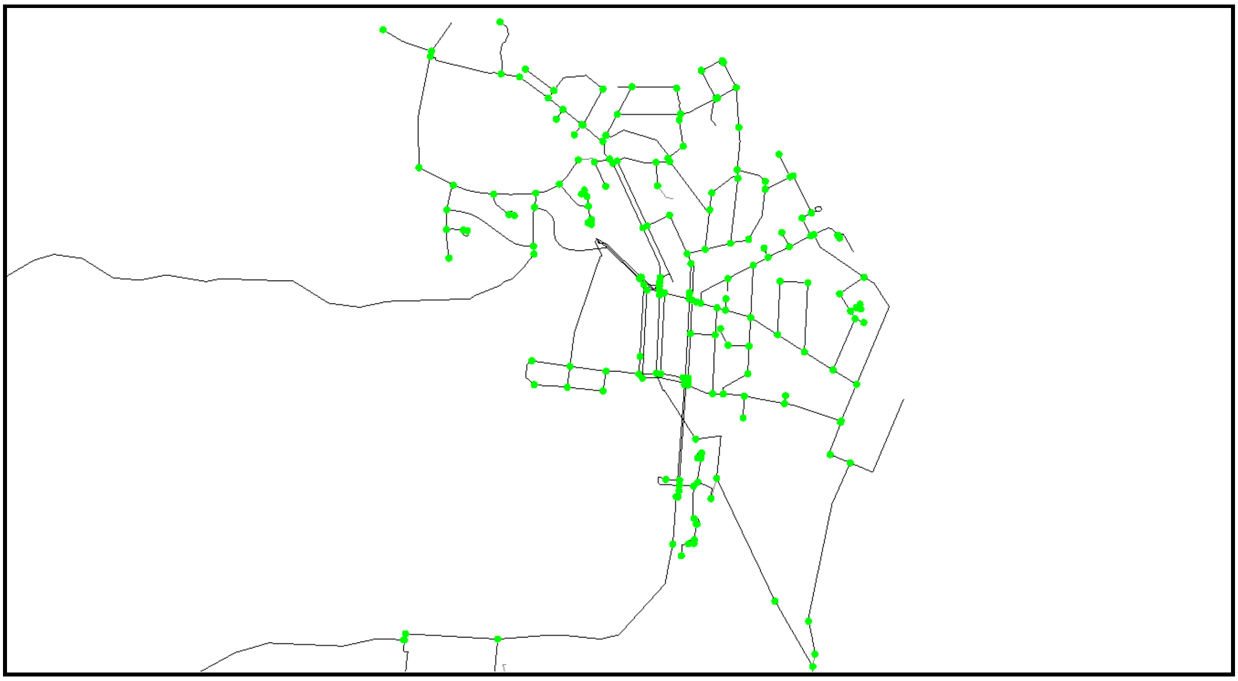

Figure 58 2014 Average Day Minimum Pressures – Collinsville

Figure 59 2014 Peak Day Minimum Pressures – Collinsville

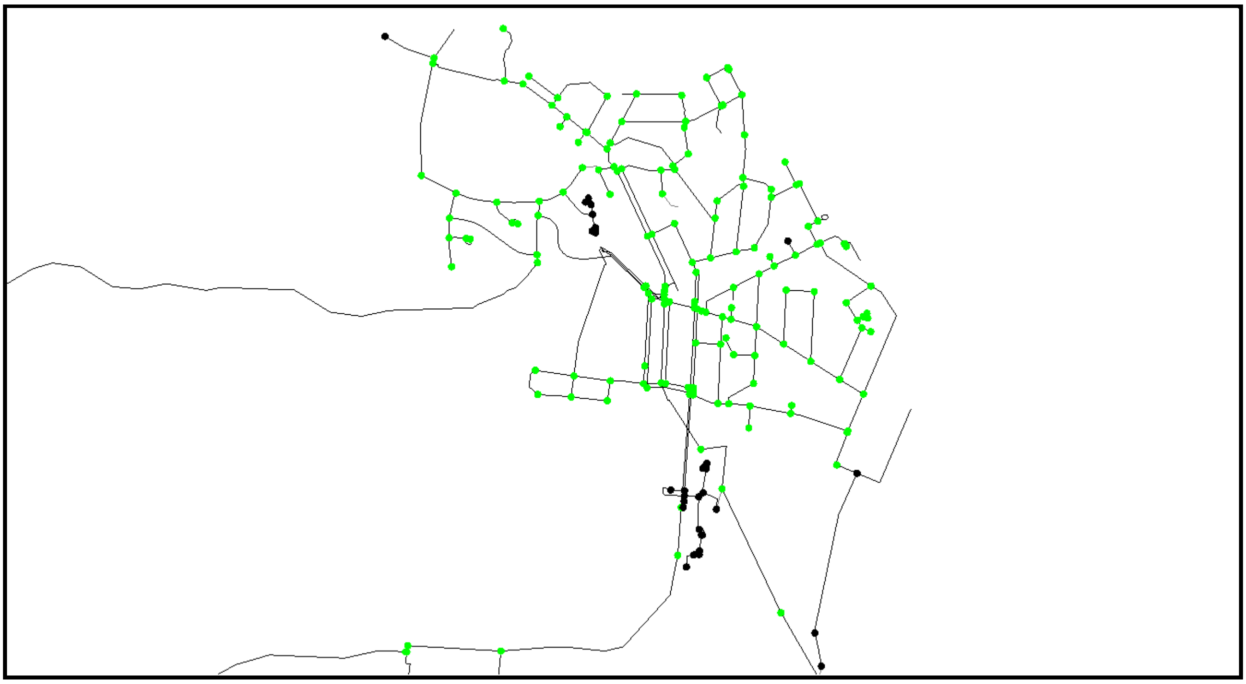

Figure 60 2014 Peak Hour Fire Flow Compliance – Collinsville

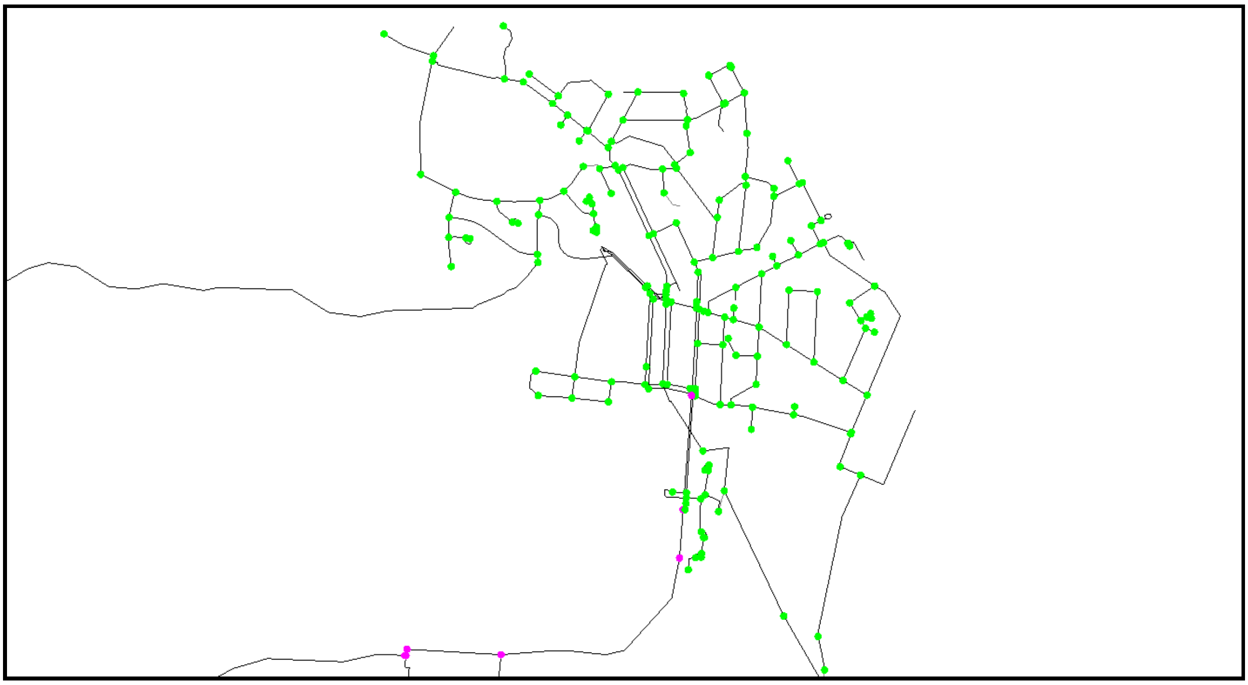

Figure 61 2014 Average Day Maximum Pressures – Collinsville

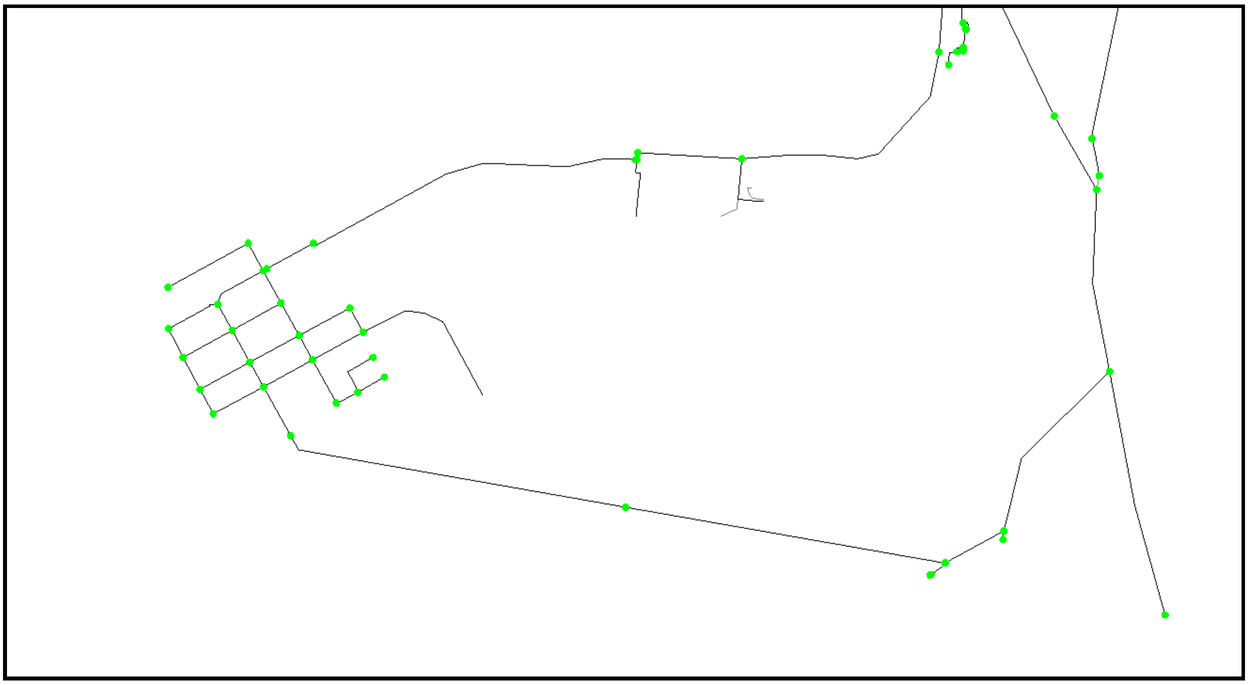

Figure 62 2014 Average Day Minimum Pressures – Scottville

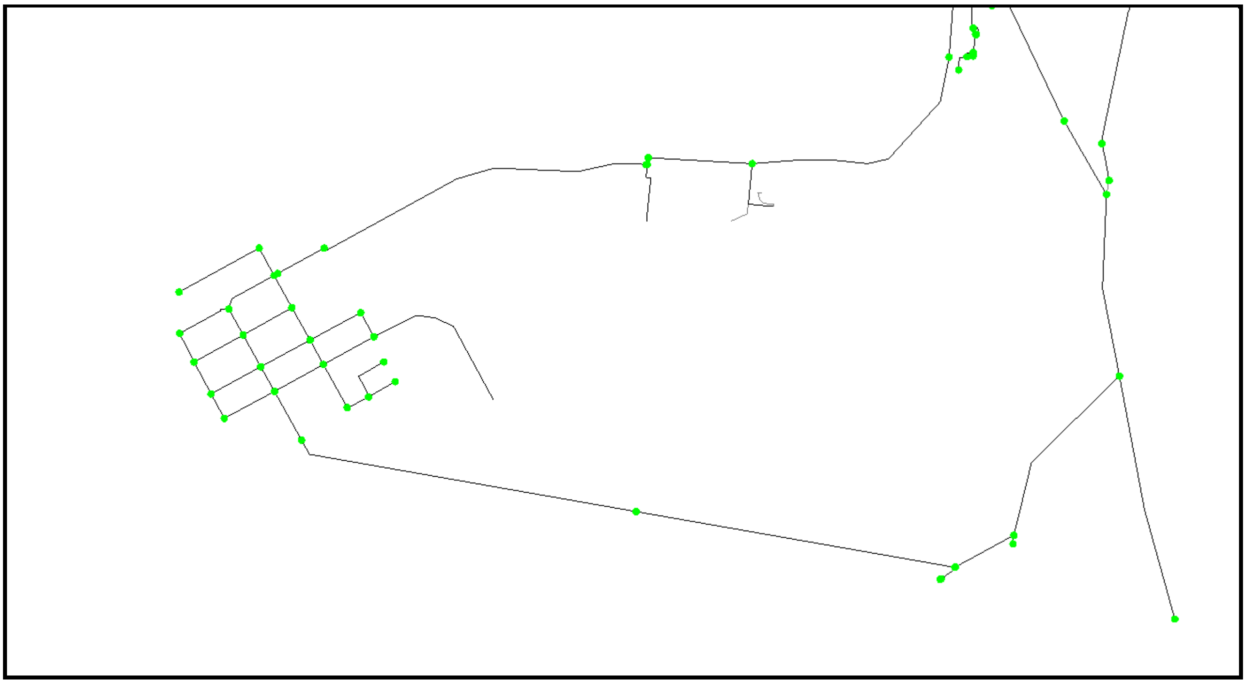

Figure 63 2014 Peak Day Minimum Pressures – Scottville

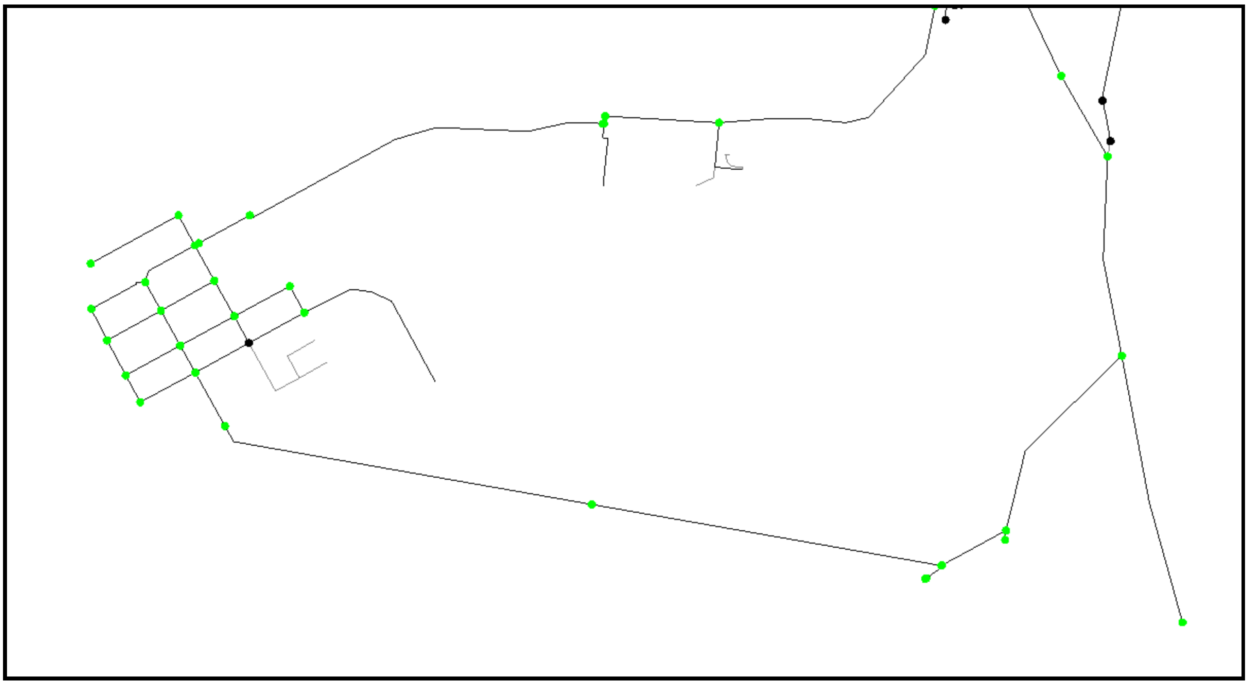

Figure 64 2014 Peak Hour Fire Flow Compliance – Scottville

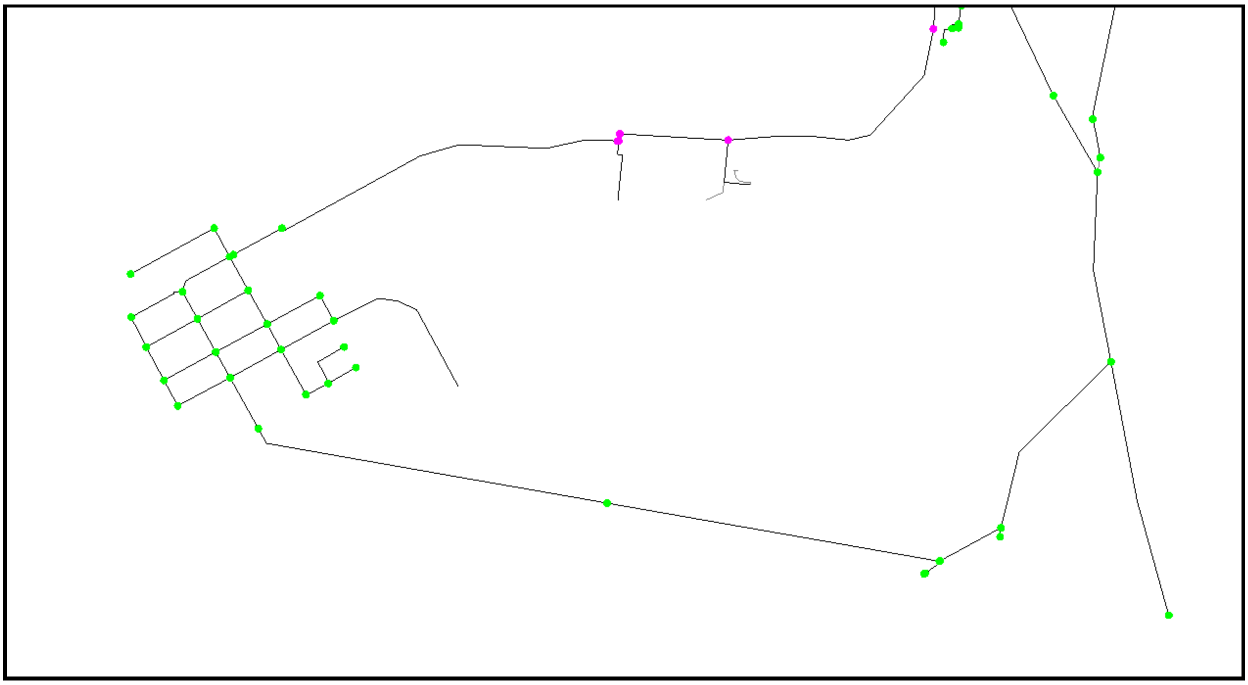

Figure 65 2014 Average Day Maximum Pressures – Scottville