Mareeba SHIRE COUNCIL

RAY ROAD DRAINAGE STUDY 2024

PREPARED FOR
MAREEBA SHIRE COUNCIL

Trinity Engineering and Consulting
design | consult | manage

DECEMBER 2024

DOCUMENT CONTROL SHEET

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	Title:	Ray Road Drainage Study 2024
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	Synopsis:	The 2024 Ray Road Drainage Study was undertaken to investigate the existing drainage and flooding issues within the Ray Road catchment area.

REVISION/CHECKING HISTORY					
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1. EXECUTIVE SUMMARY

The 2024 Ray Road Drainage Study was undertaken by Trinity Engineering and Consulting to investigate the Ray Road stormwater catchment area generally extending from McIver Road to the Mareeba Airport. This was in response to flooding and drainage issues arising in early 2024.

The intent of the 2024 study was to identify the extents of the contributing stormwater catchments, assess the capacity of existing drainage infrastructure, compare findings with the 2004 study, and identify opportunities to minimise the impacts of existing drainage and flooding issues.

1.1 KEY FINDINGS

The total Ray Road study area encompasses a footprint of approximately 820 hectares and generates flows in the order of 173m^3/s during the 1% Annual Exceedance Probability. That is, rainfall events that have a probability of being exceeded, on average, once every 100 years or a 1% probability of being exceeded in any given year.

The existing drainage infrastructure within the study area has a total capacity to convey flows up to approximately the 2-year ARI (Q2) rainfall event. That is, rainfall events that have a probability of being exceeded, on average, once every 2 years.

There are limited available road and drainage corridor options within the study area to convey the runoff through the catchment area to receiving creek systems. Of the seven (7) existing corridors with land tenure arrangements, almost 80% of the total catchment area is conveyed to the Chinaman Creek and Coolamon Close corridors.

The topography of the catchment area between George Fabris Road and Chinaman Creek identified a broad basin/flood plain with several existing Ray Road acreage lots located at the base of this basin. Preliminary 1-dimensional flood plain modelling provided a general indication of the flood plain and the potential risk of flooding to the acreage lots between George Fabris Road and Chinaman Creek.

Note: the preliminary 1D flood plain modelling software (HEC-RAS) was undertaken to inform Council and the community of the general flood extent and potential flooding risks to properties adjacent Ray Road. This model must not be relied upon to inform flood immunity, flood depths or peak flood extents.

1.2 POSSIBLE OPTIONS AND ACTIONS

It was identified that there is no single solution to resolve all the drainage issues and multiple solutions will be required to progressively improve the current drainage challenges within the Ray Road study area.

However, due to the existing catchment constraints, all these solutions, if affordable, would not necessarily prevent flooding, but, would limit the frequency that the existing flooding and drainage issues occur.

Potential drainage infrastructure upgrades have been presented for consideration, subject to the availability of sufficient resources. Improving the capacity of existing crossroad culverts and open drains, and detention of flows from new developments proposed within the study area are among the key options considered.

These upgrades seek to increase the level of service achieved by existing drainage infrastructure from at or below the 2-year ARI (Q2) rainfall event up to the 10-year ARI (Q10) rainfall event. While this would not prevent flooding issues from occurring, it would minimise the frequency that flooding issues would occur (from, on average, once every two years to once every 10 years).

The recommended actions from this drainage study are for Council to formalise the Ray Road Drainage Management Plan (DMP) with consideration for the findings and drainage options presented in this report.

The intent of the Ray Road DMP is to inform property owners located in the flood plain investigation area between George Fabris Road and Chinaman Creek, set development controls and requirements to assist with Council assessment of proposed expansion in the area, and guide Council's capital works commitments for drainage infrastructure resources.

2. INTRODUCTION

Trinity Engineering and Consulting (TEC) were engaged by Mareeba Shire Council (Council) to undertake a drainage investigation of the Ray Road catchment area in response to recent flooding (early 2024).

An earlier 2004 study by Maunsell Australia had identified existing drainage and flooding issues and drainage capacity limitations in the local area.

The significant rainfall received during Cyclone Jasper in December 2023 and heavy seasonal rain in 2024, into the already saturated catchment, resulted in overtopping of the road and flooding of homes.

This report has been prepared by TEC to present the findings of the investigation into the drainage and flooding issues in the study area.

2.1 Purpose

The purpose of the 2024 Ray Road Drainage Study was:

- To identify the extents of stormwater catchments contributing to the existing drainage and flooding issues within the study area;
- To assess the existing drainage infrastructure and overland flow paths within the study area;
- Compare the findings with the 2004 drainage study; and
- To identify opportunities to minimise existing drainage issues and improve accessibility / reduce the frequency of localised flooding.

2.2 Project Location

Ray Road is located approximately 2.5km south of the Mareeba CBD and extends almost 6.0km from McIver Road in the north, to the Mareeba Airport and Aviation Industrial Precinct, in the south. This route provides a crucial connection between the town centre and the airport, facilitating access to both commercial and industrial areas.

Figure 1: Ray Road, Mareeba

2.3 Project Drivers – Recent Events

The scope of the 2024 Ray Road Drainage Study was influenced by recent events and planned developments in the catchment area, including:

- December 2023 (Ex-Cyclone Jasper) rain depression;
- Very saturated catchment conditions;
- Subsequent property flooding in 2024 rain events;
- Stormwater flows impacting Ray Road;
- Agricultural properties impacted;
- 20 years since the 2004 drainage study;
- Increased enquiries from residents and land developments within the study area;
- Council's aim to have an updated drainage report to:
    - Consider opportunities for future works;
    - Inform Council's assessment of development applications; and
    - Inform the community.

2.4 Stormwater Terminology

This report refers to terminology used to describe rainfall events in accordance with the terminology adopted by the Queensland Urban Drainage Manual (QUDM).

This is based on the probability that intensity and duration of a particular rainfall event will be exceeded in any given year.

For example:

- A 5-year Average Recurrence Interval (ARI) rainfall event is the event that occurs on average once every 5 years and is assessed as having an 18% Annual Exceedance Probability (AEP) or 18% probability of being exceeded in any given year;
- A 10-year ARI rainfall event has a 10% AEP or 10% probability of being exceeded in any given year; and
- A 100-year ARI rainfall event has a 1% probability of being exceeded in any given year.

A common industry reference used by engineers and stormwater designers is to refer to the peak runoff from these events as being Q5, Q10, or Q100 where "Q" refers to flow in hydrology and hydraulic calculations.

Refer *Figure 2* below.

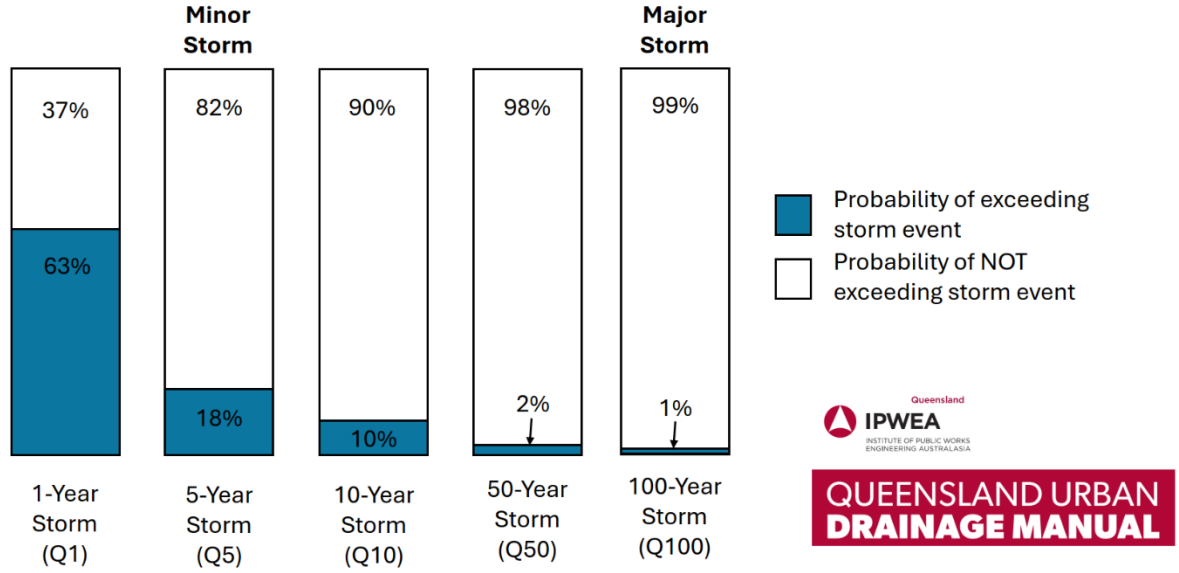


Figure 2: QUDM Storm Event Terminology

The FNQROC Development Manual refers to QUDM and the desired infrastructure level of service outcomes for the major and minor storm events. This establishes the level of service that the design of drainage infrastructure seeks to achieve.

For Mareeba Shire, the minor storm event generally corresponds to the 5-year rainfall event (Q5) and this is the event where pipes and drains are generally able to contain runoff within minimal nuisance to the community.

The major storm event refers to the 100-year rainfall event (Q100 event) where the aim is for flows (in urban areas) to be contained to major flow paths in road reserves or drainage easements.

3. BACKGROUND

3.1 Previous Drainage Study (Maunsell 2004)

Mareeba Shire Council commissioned Maunsell Australia (now AECOM) in 2004 to investigate drainage issues in the Ray Road stormwater catchment.

The 2004 drainage study was conducted in two phases:

- Phase 1: Investigation of the existing drainage infrastructure along Ray Road and the associated contributing stormwater catchments; and
- Phase 2: Investigation of the potential upgrades to drainage infrastructure along Ray Road to improve the level of service and mitigate adverse impacts on properties and roads due to flooding.

A summary of each phase of the 2004 Drainage Study is provided below.

The 2004 stormwater catchment plans are provided in *Attachment 1.*

3.1.1 Phase 1 of 2004 Report

Phase 1 of the 2004 Ray Road Drainage Study investigated the existing drainage infrastructure along Ray Road and the associated contributing catchments for the 2-year and 10-year storm events.

3.1.2 Phase 2 of 2004 Report

Phase 2 of the 2004 Ray Road Drainage Study investigated the potential upgrades on drainage infrastructure along Ray Road to achieve the desired level of services and mitigate adverse impacts on properties and roads due to flooding.

The Jennings Road crossroad culvert upgrades and airport open drain upgrades were two recommendations from this study that have been undertaken since 2004.

3.1.3 Conclusion

The 2004 Drainage Study provided a good level of information on existing drainage infrastructure and associated drainage issues within the Ray Road catchments but provided limited advice on drainage corridors conveying flows away from Ray Road.

The report also provided design options to improve the drainage performance of within the Ray Road catchments and mitigate impacts on flooding on roads.

The 2004 report did not provide assess property flooding or provide advice on upgrades directly related to properties.

The 2024 Drainage Study seeks to reassess the existing drainage infrastructure based on the latest data and provide drainage infrastructure upgrade options for Council's consideration to address drainage and flooding issues within the Ray Road catchment area.

3.2 Updated Drainage Study (TEC 2024)

In response to the project drivers mentioned above, Council requested that the 2004 drainage study be updated to confirm what changes have occurred within the catchment over the last 20 years, and investigate what options are available to improve the drainage outcomes over the next 20-year design horizon.

The 2024 drainage study adopted the 2004 study area generally bound by McIver Road to the north, JRM Braes Road to the south (near the Mareeba Airport), Ray Road to the west, and the Kennedy Highway to the east.

This study considered the findings and recommendations from the 2004 drainage study by Maunsell, however, also focused on the capacity provided by the existing drainage infrastructure (open drain, crossroad culvert, driveway crossing etc) within the Ray Road corridor, including various intersections.

A site investigation was undertaken by TEC team members with Council Officers on 16 April 2024 and included areas west from Ray Road to gain a more thorough understanding of the stormwater catchment.

The site investigation provided a greater understanding of the characteristics, configuration, constraints and limitations of the existing drainage infrastructure within the Ray Road catchment.

It is understood that during peak rainfall events, the Ray Road study area is subject to drainage issues including but not limited to the following:

Stormwater runoff overtops the airport open drain (south from the runway) and is conveyed north along Ray Road;

Stormwater runoff overtops the George Fabris Road/Ray Road formation near the intersection carrying agricultural debris and silt from the upstream property;

Stormwater exceeds the capacity of the Ray Road open drains resulting in flooding of road and properties, located immediately north of George Fabris Road;

Stormwater runoff overtops the Cater Road/Ray Road intersection, resulting in flooding of road and properties;

Stormwater runoff ponds in the Ray Road open drains at various locations, cutting off access to properties; and

The limited capacity of existing crossroad culverts results in stormwater runoff overtopping intersections causing scouring damage to the roads and impacting trafficability; and

Driveway accesses restrict runoff conveyance through roadside open drains.

4. 2024 Study – Stormwater Catchments

4.1 Stormwater Catchments

An assessment of the Ray Road catchments was undertaken based on site investigations, the latest (2018) LiDAR elevation data, survey, photographs and video footage provided by Council, and future development layouts. The total catchment area contributing to drainage and flooding issues along Ray Road is approximately 820 hectares of agricultural, residential, and commercial land, excluding Catchment G which generally drains towards the Kennedy Highway.

For comparison, the Basalt Creek flood study by WMS in 2023 as part of the Bicentennial Lakes project identified a similar catchment area.

Generally, the identified stormwater catchments reflected those identified in the 2004 Drainage Study.

An exception is Catchment B3 on the western side of Ray Road that was not identified in the 2004 study, which was attributed to LiDAR elevation data not being available at the time the report was developed.

An extract of the stormwater catchments are shown in *Figure 3*, and can be found in *Attachment 2*.

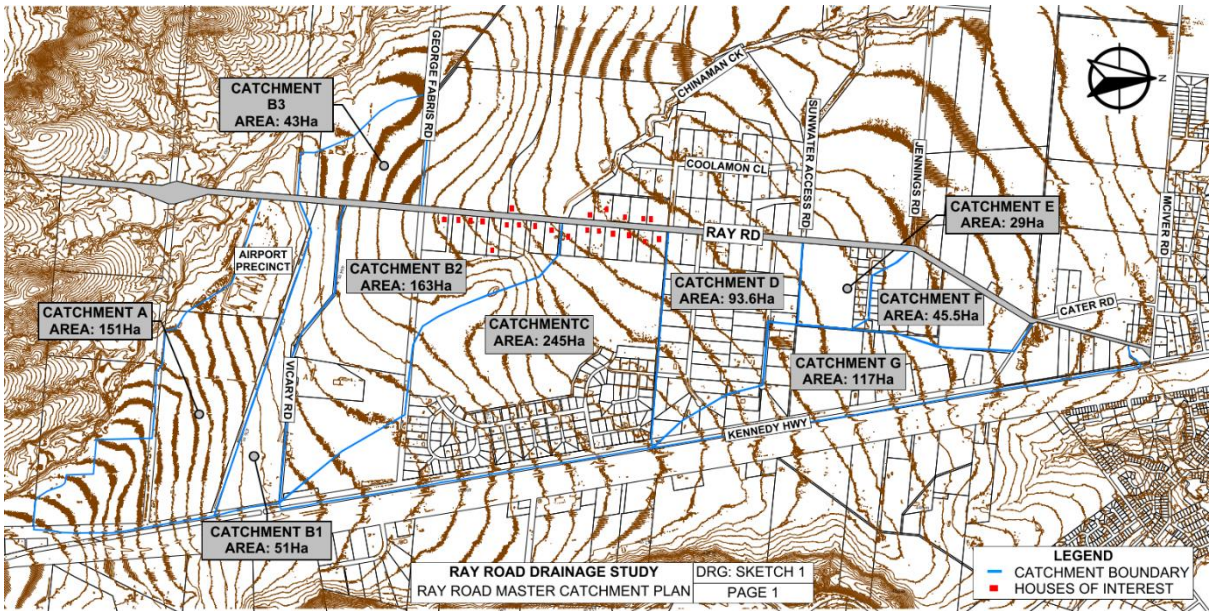


Figure 3: 2024 Ray Road Stormwater Catchments

4.2 Hydrology and Hydraulic Analysis

The Rational Method (specified by QUDM) was adopted to undertake hydrology analysis of the Ray Road drainage catchment to:

a) Calculate the peak design discharge (peak flow for a particular design rainfall intensity); and
b) Compare the calculated peak flows with the capacity of existing drainage infrastructure within the catchment.

The peak flows calculated were for the Q1, Q2, Q5, Q10, and Q100 design rainfall events and adopted a time of concentration of 60 minutes for each sub-catchment (A, B1, B2, B3, C, etc) to align with the expected flow velocities in the ultimate development scenario.

The ultimate development scenario is the most critical to the design of future drainage upgrades. It assumes all planned development proposed within the study area (at the time that this report is published) is approved.

The 60-minute time of concentration was considered appropriate for the calculation of peak runoff flowrates to assess the implications for Ray Road infrastructure.

Table 1 summarises the calculated peak flows for each design rainfall event in the ultimate development scenario.

Table 1: Ray Road Calculated Peak Flows (Ultimate Development Scenario)

Catchment	Peak Flow (m^3/s)				
	Q1	Q2	Q5	Q10	Q100
A	8.4	10.1	15.0	18.2	30.7
B1	2.9	3.5	5.2	6.4	10.8
B2	9.4	11.3	16.7	20.4	34.4
B3	2.4	2.8	4.2	5.1	8.6
C	14.1	16.9	25.2	30.7	51.7
D	5.4	6.5	9.6	11.7	19.7
E	1.7	2.0	3.0	3.6	6.1
F	3.1	3.7	5.4	6.6	11.2
G	2.0	2.7	3.8	4.4	7.7

Based on the peak flows shown in *Table 1* above, the total Q100 peak flow conveyed to and along Ray Road is in the order of $173m^3/s$ spread across Catchment A-F, or an average of $0.21m^3/s$ per hectare of catchment area.

5. Existing Infrastructure Capacity

The existing drainage infrastructure servicing the Ray Road stormwater catchments was investigated to confirm capacity limitations thereby assessing the level of service achieved at various points of interest.

Within the study area, there are limited existing road and drainage corridor options to convey runoff without establishing new land tenure arrangements (e.g. easements). Refer *Figure 4* below.

These include:

- **Ray Road North:**
  - Kennedy Highway Crossing (north-east)
  - Cater Road / McIver Road
- **Ray Road Central:**
  - Jennings Road
  - Sun Water Access Road
  - Coolamon Close
  - Chinaman Creek
- **Ray Road South:**
  - Drainage Outlet (opposite Airport precinct)

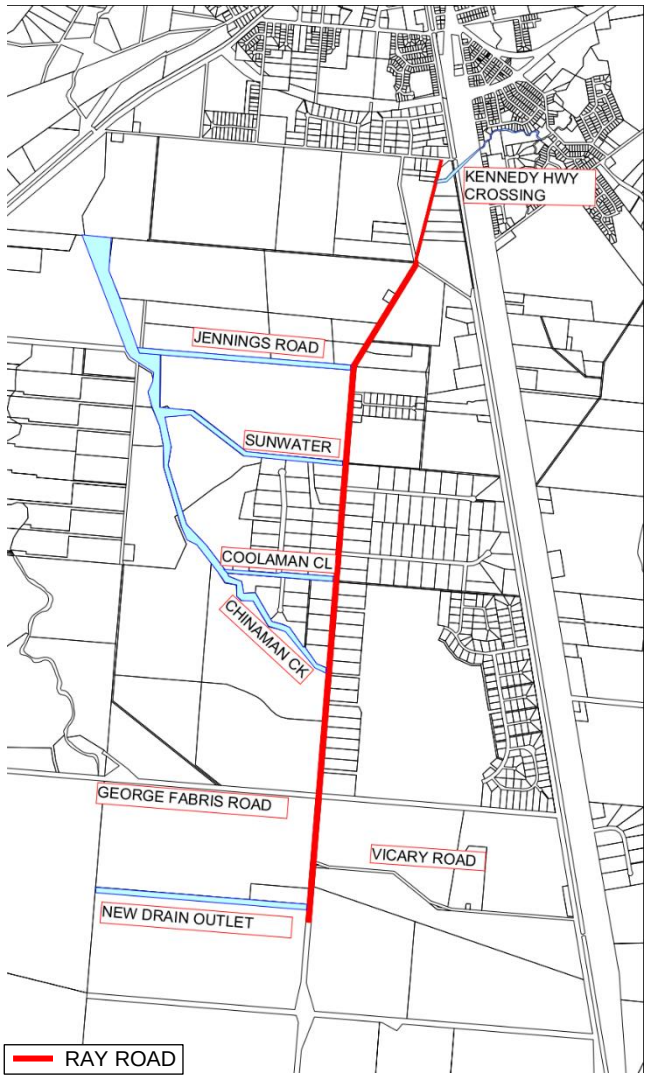


Figure 4: Key Ray Road Stormwater Corridors

The total capacity provided by these existing drainage corridors was assessed as approximately 90m^3/s which indicated that the existing Ray Road drainage outlets are significantly under capacity when compared to the volume of runoff from the catchment arriving during a Q100 rainfall event (refer 173m^3/s on *Page 11* above).

The assessed capacity of existing culvert and open drains within the study area, and peak catchment flows are provided in *Attachment 3*.

Reviewing other points of interest was also integral to understanding the peak flows arriving at the Ray Road crossroad culverts mentioned above. Open drains were the other key form of drainage infrastructure within the study area, and in most cases, restricted the runoff arriving to the larger capacity culverts crossing Ray Road. The size (depth and width) of many of these open drains are constrained by being in the road reserve and sharing this corridor with the roadway. The resulting capacity was generally limited to approximately 4m^3/s to 5m^3/s.

The constraints imposed on stormwater flow path such as the lower capacity open drains restricts the total runoff able to be controlled and conveyed through the catchment to one of the outlets identified above. Preliminary calculations indicate these restrictions may limit the drainage capacity able to be contained in the current drainage infrastructure at the catchment outlets to approximately 40m^3/s.

For reference, the total 2-year ARI (Q2) peak flow conveyed to Ray Road is in the order of 57m^3/s. This indicates the existing drainage infrastructure (culverts and open drains) within the study area may only currently provide an average level of service of slightly below the 2-year ARI (Q2) rainfall event.

Further review of the available drainage corridors identified that the catchment area contributing to discharge to Chinaman Creek and Coolamon Close represent almost 80% of the total study area.

Therefore, investigation of the Chinaman Creek and Coolamon Close outlets was a focus of the Updated Ray Road Drainage Study. By addressing drainage issues at these two points of interest, it was anticipated that a majority of drainage issues north from Coolamon Close would be improved due to better control of bypass flows.

5.1 Ray Road Topography – Southern Catchment

Assessments of the topography of Ray Road and adjacent stormwater catchments were undertaken using the LiDAR elevation data. The assessments identified that the stormwater catchments within the study area generally fall from the south-west towards the north-east.

It was also identified that the footprint of the study area between George Fabris Road and Chinaman Creek is located within a broad basin or "flood plain". This causes stormwater to channel/drain towards Ray Road between a ridge on George Fabris Road and a ridge located behind the properties on the eastern side of Ray Road.

This broad basin/flood plain intersects with Ray Road between George Fabris Road and Chinaman Creek.

A cross section (looking north) along the blue line in *Figure 5* is shown in *Figure 6* to show the broad basin and the approximate spread of the 1%AEP, (100-year ARI or Q100) rainfall event relative to Ray Road and the existing acreage lots on the east side of Ray Road.

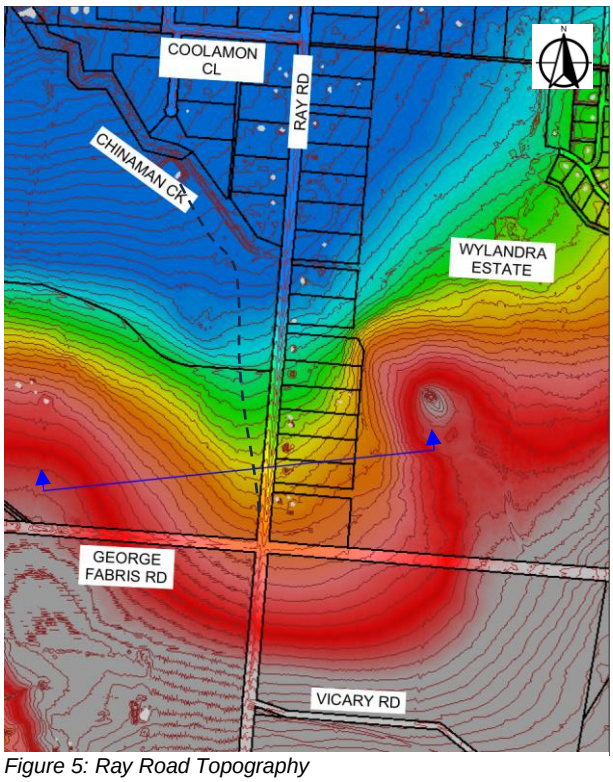


Figure 5: Ray Road Topography

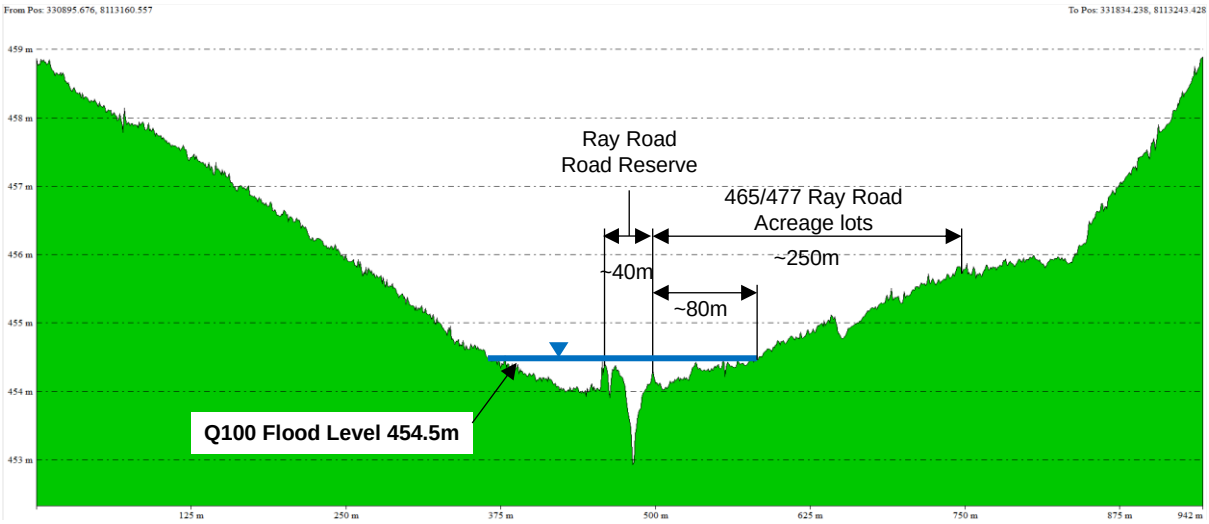


Figure 6: Cross Section of Ray Road Basin Looking North

As evidenced from the information presented in *Figure 5* and *Figure 6* above, Ray Road and the adjacent acreage lots are located across the base of the basin/flood plain. Preliminary analysis of the 1% annual exceedance probability (Q100) flood levels appears to indicate the road and adjacent lots are vulnerable to flooding impacts.

This vulnerability to flooding is discussed further below.

5.2 LiDAR Levels and Aerial Imagery

A review of the southern stormwater catchment was undertaken to confirm if the alignment of the basin identified in *Section 5.1* is consistent with the onsite operation and flood plain features.

In the 2009 aerial imagery, the apparent basin/flood plain is evident by the comparably greener and darker landscape between Ray Road and the existing dam leading to Chinaman Creek. This is the predicted low point of the flood plain and overland flow path. The features appear to confirm different vegetation and drainage patterns and characteristics that are indicators of low lying, flatter land consistent with the low point in a natural flood plain.

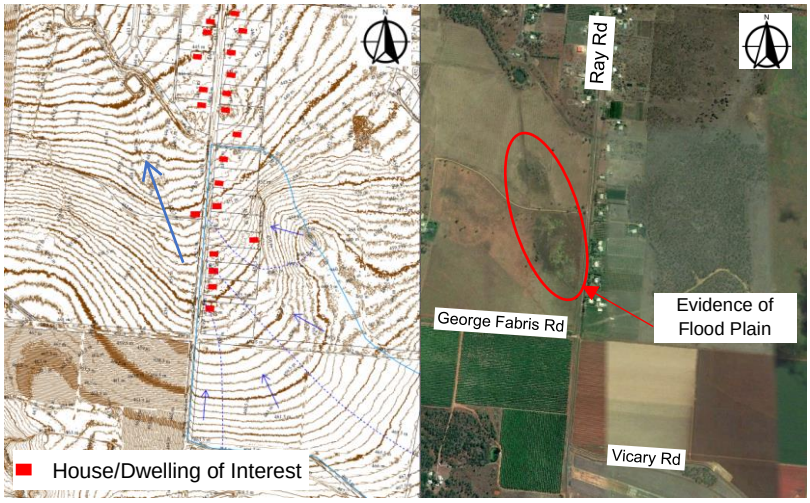


Figure 7: 2018 LiDAR Elevation Data & 2009 Aerial Imagery

The implications for drainage paths through this flood plain remain relevant to the current review as:

a) The majority of this basin area currently exists as agricultural land similar to in 2009; and
b) The 2018 LiDAR identified the basin like-characteristics of a flood plain.

Shown in *Figure 7* above, there are several houses/dwellings of interest generally located in the basin area between George Fabris Road and Chinaman Creek. Investigation of the surface level data and topography in this area identified four (4) stormwater sub-catchment portions north of Vicary Road that are funnelled into the basin, through several properties before intersecting with Ray Road.

Section 5.3 considers the extent of the natural flood plain during Q100 peak rainfall events relative to the flood risk for identified houses/dwellings of interest.

5.3 Southern Flow Path – Flood Plain Modelling

Preliminary modelling of the study area between George Fabris Road and Chinaman Creek was undertaken with a simplified, one-dimensional analysis using the HEC-RAS software program.

The purpose of this preliminary modelling was to understand the potential extent of flooding relative to Ray Road and to identify how the flow paths during peak flow events align with the available drainage corridors. The modelling also enabled a better appreciation of the potential flow extent and houses/dwellings of interest located within and adjacent the natural flood plain.

The output plots from the HEC-RAS model of the preliminary Q100 flood model is provided in *Attachment 4**.

> ***Important Note on modelling limitations:**
>
> **1D modelling using HEC-RAS software provides a relatively quick, simplified model using available input data to generate a predicted water spread extent. The current model adopts assumptions and catchment permeability, runoff rates and response times that have not been independently verified. The current outputs should not be considered a comprehensive model of the flood plain.**
>
> **The model was undertaken to inform the community of the general flood extent and potential flooding risks to properties adjacent Ray Road.**
>
> **The resolution of the model is not sufficient to confirm the flood implications for a particular house/dwelling and does not delineate flow depth across the flood extents.**
>
> **This model must not be relied upon to inform flood immunity, flood depths or peak flood extents.**
>
> **Mareeba Shire Council and Trinity Engineering and Consulting take no responsibility for decisions made by individual landowners based on this preliminary Q100 flood model.**

The preliminary model indicated that there is a potential for several acreage lots between Chinaman Creek and George Fabris Road to be impacted by flooding, particularly those properties with the house/dwelling located towards the front third of the property.

Property flooding near the George Fabris Road / Ray Road intersection is supported by photographs and video footage documented by Council and the community in previous rain events. *Figure 8* shows an example of water overtopping Ray Road near this intersection in March 2024.

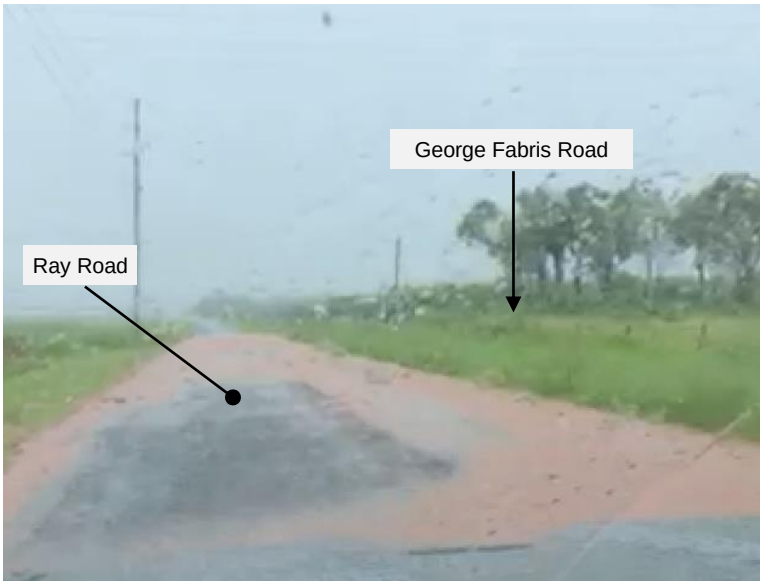


Figure 8: George Fabris Road / Ray Road Intersection (Source: M. Campman)

The alignment of Ray Road generally through the centre of the basin was also considered. It was identified that the formation of the road typically restricts runoff being conveyed from the east side of Ray Road to the west until it reaches the cross-road culverts at Chinaman Creek or overtops the road as shown in *Figure 8*.

Investigation of the surface levels adjacent existing dwellings fronting Ray Road between George Fabris Road and Chinaman Creek identified that the level of the Ray Road crown is typically at or above the current ground surface levels adjacent these dwellings.

The following drainage capacity limitations in the southern section of the catchment are noted:

a) The capacity of the open drains adjacent Ray Road are generally restricted to between 4m^3/s and 16m^3/s;
b) The Chinaman Creek crossroad culvert capacity is 8.1m^3/s; and
c) The runoff arriving to Chinaman Creek is in the order of 70m^3/s during Q100 rainfall events.

The capacity limitations confirm a reasonable probability that runoff arriving upstream of Ray Road (commencing from approximately (George Fabris Road) is not able to be conveyed within the drainage system and begins to “back up” creating localised ponding.

During rainfall events exceeding the available capacity of existing drainage infrastructure, this localised ponding is predicted to increase until the runoff can outlet either via the eastern roadside drain north to Chinaman Creek culverts, or to back up into adjacent properties before overtopping Ray Road.

These rainfall events may be as frequent as a 2-year average recurrence interval (Q2) rainfall event.

Figure 9 below shows examples of the existing ground surface levels (adjacent the building) relative to the level of Ray Road.

The review of ground surface levels for each property along the eastern side of Ray Road between George Fabris Road and Chinaman Creek is also provided in *Attachment 5*.

The validity of the preliminary flood model is considered reasonable for the purpose of identifying the general flood extent because it aligns with the topography and hydrology of the southern stormwater catchments. In particular, the runoff arriving to the flood plain is a combination of the following:

a) Almost half the study area (400 Ha) discharges to Chinaman Creek (Catchment B1, B2, B3, and most of Catchment A);
b) The topography of the study area upstream of George Fabris Road directs the runoff into a natural basin between George Fabris Road and Chinaman Creek; and
c) The capacity of existing drainage infrastructure, such as the Ray Road table drains, are undersized to contain the flows arriving during events generally exceeding a the 2-year ARI (Q2) rainfall event.

As already stated, the preliminary modelling undertaken within the study area provides a general indication of the flood plain and potential risk of flooding into the property adjacent several houses/dwellings located between George Fabris Road and Chinaman Creek. It is not to be relied upon to inform flood immunity, flood depths or peak flood extents.

Figure 9: Ground Surface Levels - Southern Lots

5.4 Catchment Constraints

The Ray Road drainage investigation identified multiple catchments within the study area that represent a challenge for drainage infrastructure upgrades within the constraints of Council's limited resources.

The main catchments constraints were:

a) Total catchment area is approximately 820 ha;
b) Peak flow during the 100-year (Q100) rainfall event approaching 173m^3/s;
c) Existing crossroad culvert capacities along Ray Road generally provide a level of service for the 1 to 2-year (Q1 to Q2) rainfall event (excluding Jennings Road and the Kennedy Highway culverts);
d) The flood plain corridor between George Fabris Road and Chinaman Creek does not have security of tenure west of Ray Road, so drainage capacity upgrades to infrastructure are currently restricted to the physical dimensions of the road reserve;
e) There are a limited number of available drainage corridors (with security of tenure). Those being Atherton Creek, Chinaman Creek, Coolamon Close, Sun Water Access Road, Jennings Road, and the Kennedy Highway;
f) The floor levels of houses located within and adjacent the flood plain corridor are fixed and appear to be generally built at or below the crown level of Ray Road; and
g) Driveway accesses to most properties along Ray Road are via a causeway or culvert crossover. The latter typically worsens drainage issues by restricting the flow of runoff in the upstream open drain during major storm events.

6. Initial Findings

Key findings of the updated drainage study include:

a) The topography of Ray Road is generally flat with large upslope stormwater catchments;
b) Many existing houses located between Goerge Fabris Road and Chinaman Creek are located within the broad flood plain corridor;
c) Some property flooding is likely to occur before runoff arrives at Ray Road;
d) Ray Road crossroad capacity is lower than current design levels of service;
e) There is no formal drainage reserve or secure tenure over the floodplain area identified form the modelling in the southern section of Ray Road;
f) Of the six (6) existing drainage corridors, two (2) of these drainage corridors receive flows from approximately half the study area (Chinaman Creek and Coolamon Close).

6.1 Drainage Infrastructure Upgrade Options

The updated drainage study identified that there is no single solution to resolve the drainage issues and multiple solutions would be required to progressively improve the current drainage challenges within the Ray Road catchment. However, all of these solutions, if affordable and able to be implemented, would not necessarily prevent flooding in its entirety.

Significant constraints to resolving flooding issues are imposed by the size of the stormwater catchment, the nature of the arriving overland flows to Ray Road, and the costly nature of the multiple solutions required.

The size and volume of runoff conveyed by the study area, in addition to the limited number of outlets with tenure security, create a challenge for mitigating all drainage and flooding issues up to and including the 1%AEP (100-year ARI or Q100) rainfall event.

Potential drainage infrastructure upgrades that may be considered by Council, if affordable, included the following options:

a) Increasing crossroad capacity commencing from the southern end of Ray Road to limit bypass flows north along Ray Road and cumulative flows arriving at the subsequent culvert crossings;
b) Increase the capacity of existing crossroad culverts coupled with associated capacity upgrades to the open drains downstream from the culverts;
c) Increase the capacity of the existing culvert crossing on the western side of Ray Road at the George Fabris Road intersection to enable runoff to be contained on the western side of Ray Road;
d) Construction of detention basins for new developments proposed within the study area.

Note: Further investigations and concept development is required to gain greater certainty on some of the corridors.

The above options for drainage infrastructure upgrades seek to increase the level of service from at or below the 2-year ARI (Q2) rainfall event up to a level of service generally able to convey the 10-year ARI rainfall event. This would minimise the frequency that flooding would impact on the road and adjacent properties, (but not prevent it). More simply, rainfall events contributing to flooding issues would have a probability of being exceeded, on average, once every 10 years instead of once every two years.

Some drainage issues exist on private land outside Council's road reserve. These property drainage issues upstream from the properties are not within Council's control and may need further investigation separate to road infrastructure considerations.

6.2 Formalise the Drainage Management Plan

In addition to the drainage infrastructure upgrade solutions outlined in *Section 6.1*, development of this drainage study is intended to assist Council with formalising the drainage management plan (DMP).

The intent of the DMP is to:

a) Inform property owners located in the flood plain investigation area between George Fabris Road and Chinaman Creek;
b) Set development controls and development requirements that Council can reference when assessing new development applications as growth in the area expands; and
c) Guide Council's capital works priorities to ensure drainage infrastructure upgrades are identified and scheduled with available resources and budgets.

7. SUMMARY AND CONCLUSIONS

Drainage and flooding issues were identified within the Ray Road study area in 2004 following the initial drainage study undertaken by Maunsell (now AECOM). The outcomes of the 2004 study recommended several infrastructure upgrades to improve the level of service to manage the identified drainage and flooding issues.

Since the 2004 report, a new drain on the southern side of the airport runway with a new culvert outlet to Atherton Creek, and upgrades to crossroad culverts at Jennings Road have been completed. This has improved the crossroad culvert capacity along Ray Road by 65m^3/s but requires upstream and downstream drainage improvements to optimise the utility of this substantial capacity increase.

Council requested this current update to the Ray Road drainage study in response to the heavy rainfall and saturated catchment conditions that followed ex-Tropical Cyclone Jasper in December 2023.

The 2024 investigation work using updated surface level data has enabled an independent review of the outcomes of the previous study.

The 2024 review has identified the current stormwater catchment boundaries and hydrology, calculated the capacity of existing drainage infrastructure, and potential options that Council could consider which may reduce the impacts of drainage and flooding issues noting that these may be cost prohibitive.

Ray Road study area encompasses a footprint of approximately 820 hectares and generates runoff approaching 173m^3/s during the 1%AEP (Q100) rainfall event.

Total infrastructure capacity within the study area (accounting for existing upstream restrictions) is in the order of 40m^3/s. Based on the numbers generated by hydrology calculations, this approximates the current capacity within the study area to be at or below the 2-year ARI (Q2) rainfall event.

Land tenure reviews within the study area identified there are only six available formalised drainage corridors to drain the catchment. Two of these outlets (Chinaman Creek and Coolamon Close) are the only corridors in the southern portion of the Ray Road corridor with security of tenure.

Modelling identified that peak flows arriving at Ray Road tip across the road formation through an identified flood plain corridor that does not align with current drainage corridors.

It was also identified that the flood plain located between George Fabris Road and Chinaman Creek has no crossroad drainage infrastructure aligned with the major flow path due to the absence of a formal corridor and secure land tenure.

The overland flows approaching through private land from south of Chinaman Creek and east from Ray Road are a significant contributor to drainage and flooding issues on the residential lots on the eastern side of Ray Road, rather than the road itself.

8. OPTIONS

The following options are provided for Council's consideration to address the drainage and flooding issues within the Ray Road stormwater catchment area.

As and when resources are available, the following potential locations for drainage infrastructure upgrades would address one or more of the upgrade options identified in *Section 6.1* above:

a) Progress with survey and detailed design of an upgraded culvert to increase the capacity of the Chinaman Creek crossroad culverts and downstream drainage channel (with contributions from the upstream developer who propose to increase flows to Chinaman Creek post development);
b) Progress with survey and detailed design of the George Fabris (west) crossroad drainage to increase the capacity and maximise the flow retained on the western side of Ray Road;
c) Undertake further investigations to formalise drainage and increase capacity of the northern drainage channel(s) at Cater/Ray/Zenel Road to seek to eliminate the need for a detention basin;
d) Undertake further investigations on the practicality of increasing the capacity of the crossroad culverts and downstream drains at Coolamon Close and Pleasant Close;
e) Undertake further investigations and develop concepts and costings for upgrades to increase the capacity of the crossroad culvert and downstream drain at the Sun Water Access Road; and
f) Work with the property owner south-east of the airport (banana farm) to divert runoff from the south-eastern most section of the catchment into Atherton Creek.

In addition, it is recommended that further investigation and modelling of the flood plain located between George Fabris Road and Chinaman Creek be undertaken to obtain a higher level of confidence of the flooding risk to houses located in this area.

9. RECOMMENDATIONS

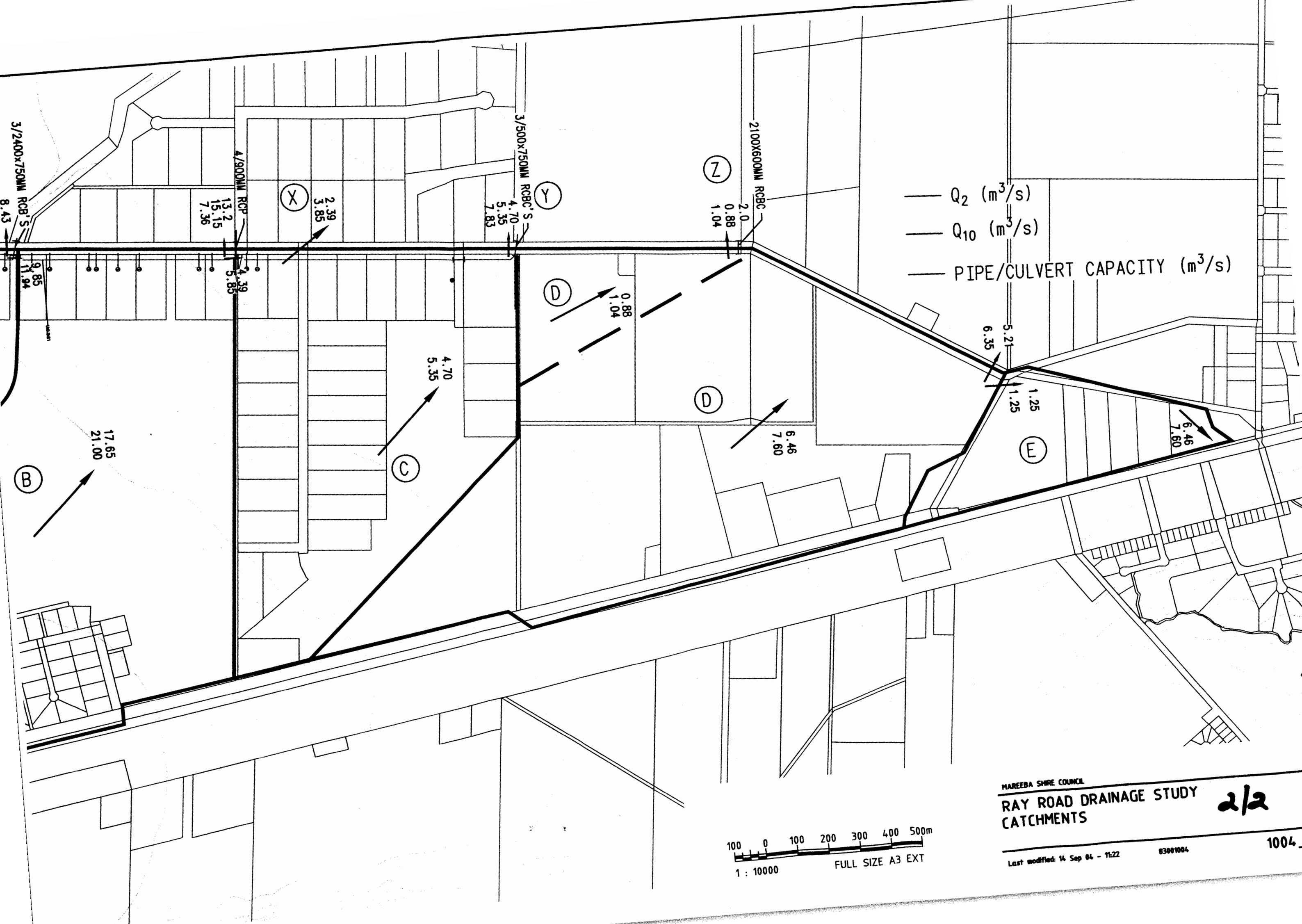
It is recommended that Council formalise the Ray Road Drainage Management Plan (DMP).

The intent of the Ray Road DMP is to:

a) Inform property owners located in the flood plain investigation area between George Fabris Road and Chinaman Creek;
b) Set development controls and development requirements that Council can reference when assessing new development applications as growth in the area expands; and
c) Guide Council's capital works priorities to ensure drainage infrastructure upgrades are identified and scheduled with available resources and budgets.

ATTACHMENT 1
2004 CATCHMENT PLANS


3/2400x750MM RCB'S
9.85
11.94
8.43
8.43
8.43
W
B
18.28
20.37
A
15.06
20.95
2100x600MM RCBC
2.4
2.4
2.4
V
17.46
23.35
A
5.36
14.42
19.34
2/2100x600MM RCBC'S
2.28
4.33
16.70
23.67
A
1/2


3/2400x750MM RCB'S
8.43
9.85
11.94
4/900MM RCP
13.2
15.15
7.36
4.39
5.85
X
2.39
3.85
3/500x750MM RCBC'S
Y
4.70
5.35
7.83
Z
2100X600MM RCBC
2.0
0.88
1.04
D
0.88
1.04
D
4.70
5.35
C
17.65
21.00
B
D
6.46
7.60
5.21
6.35
1.25
1.25
E
6.46
7.60
Q2 (m3/s)
Q10 (m3/s)
PIPE/CULVERT CAPACITY (m3/s)
100 0 100 200 300 400 500m
1 : 10000
FULL SIZE A3 EXT
MAREEBA SHIRE COUNCIL
RAY ROAD DRAINAGE STUDY
CATCHMENTS
2/2
Last modified: 14 Sep 04 - 11:22
83001004
1004

ATTACHMENT 2
2024 CATCHMENT PLANS

0 m
250 m
500 m
750 m
1250 m

CATCHMENT B3
AREA: 43Ha

CATCHMENT A
AREA: 151Ha

CATCHMENT B2
AREA: 163Ha

CATCHMENTC
AREA: 245Ha

CATCHMENT B1
AREA: 51Ha

CATCHMENT D
AREA: 93.6Ha

CATCHMENT E
AREA: 29Ha

CATCHMENT F
AREA: 45.5Ha

CATCHMENT G
AREA: 117Ha

AIRPORT PRECINCT

GEORGE FABRIS RD

VICARY RD

CHINAMAN CK

COOLAMON CL

SUNWATER ACCESS RD

JENNINGS RD

MCIVER RD

RAY RD

CATER RD

KENNEDY HWY

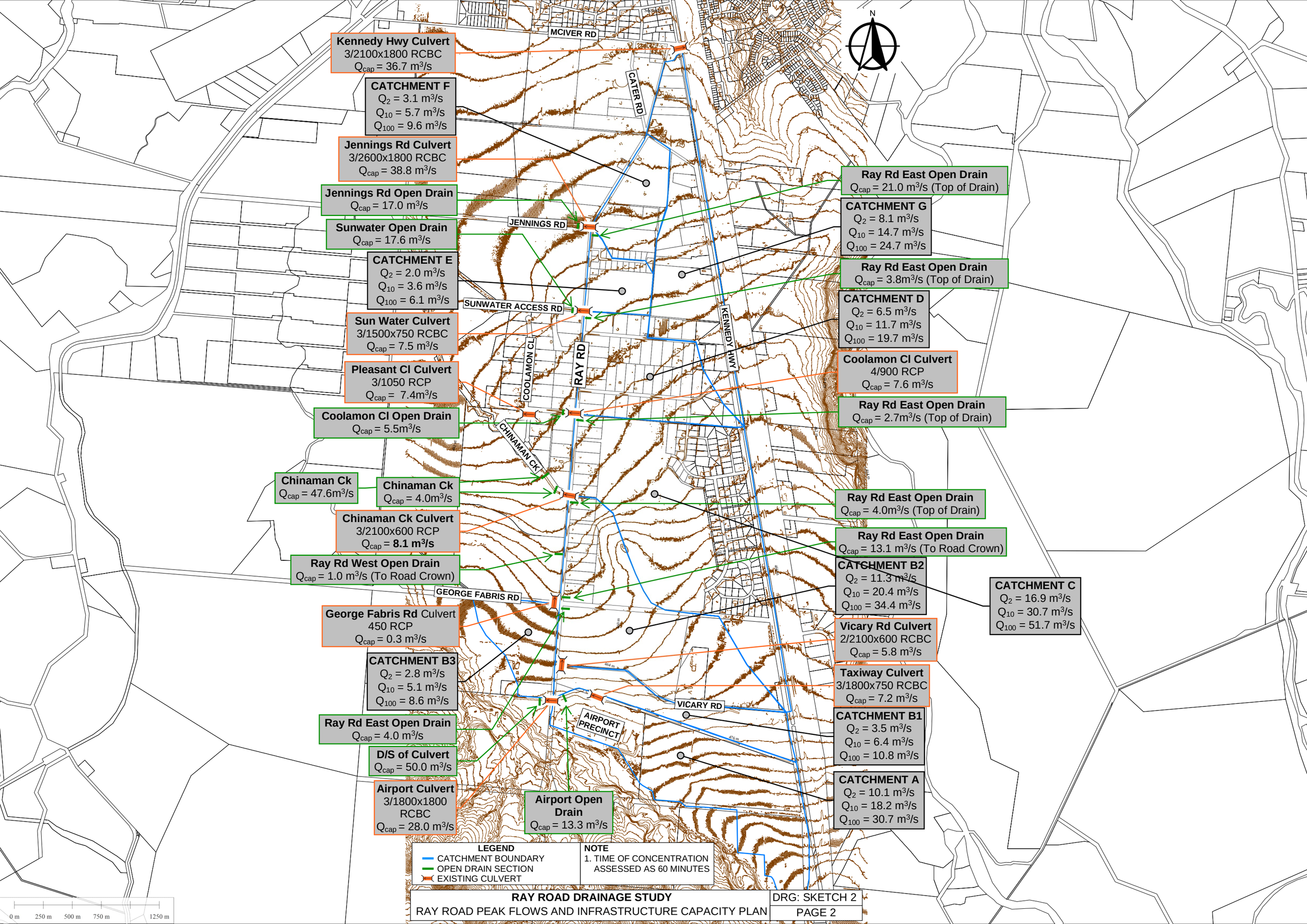
N

RAY ROAD DRAINAGE STUDY
RAY ROAD MASTER CATCHMENT PLAN

DRG: SKETCH 1
PAGE 1

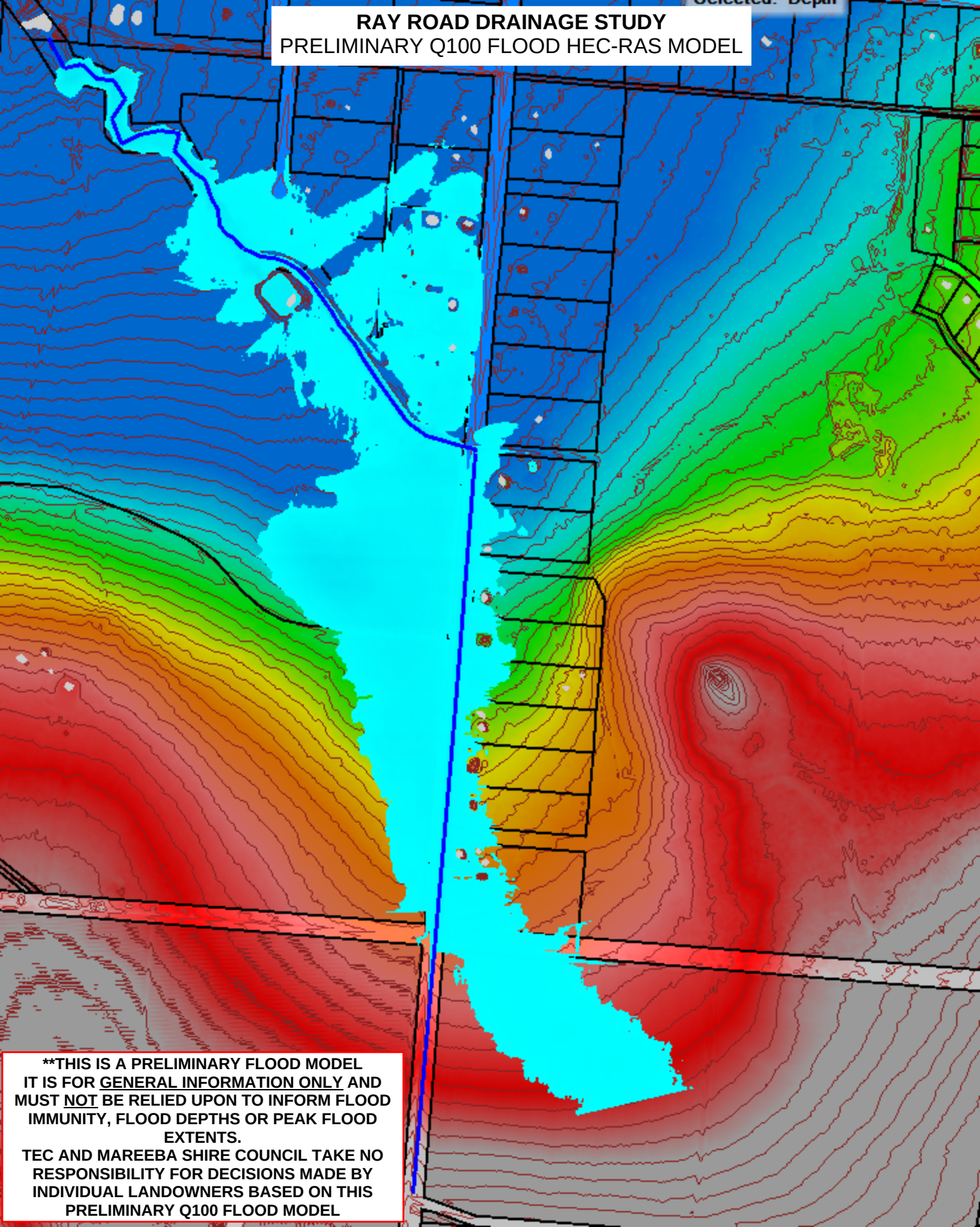
LEGEND
CATCHMENT BOUNDARY
HOUSES OF INTEREST

ATTACHMENT 3
CAPACITY AND PEAK FLOW PLAN


MCIVER RD
CATER RD
JENNINGS RD
SUNWATER ACCESS RD
RAY RD
COOLAMON CL
KENNEDY HWY
CHINAMAN CK
GEORGE FABRIS RD
VICARY RD
AIRPORT PRECINCT
N
Kennedy Hwy Culvert
3/2100x1800 RCBC
Qcap = 36.7 m3/s
CATCHMENT F
Q2 = 3.1 m3/s
Q10 = 5.7 m3/s
Q100 = 9.6 m3/s
Jennings Rd Culvert
3/2600x1800 RCBC
Qcap = 38.8 m3/s
Jennings Rd Open Drain
Qcap = 17.0 m3/s
Sunwater Open Drain
Qcap = 17.6 m3/s
CATCHMENT E
Q2 = 2.0 m3/s
Q10 = 3.6 m3/s
Q100 = 6.1 m3/s
Sun Water Culvert
3/1500x750 RCBC
Qcap = 7.5 m3/s
Pleasant Cl Culvert
3/1050 RCP
Qcap = 7.4m3/s
Coolamon Cl Open Drain
Qcap = 5.5m3/s
Chinaman Ck
Qcap = 47.6m3/s
Chinaman Ck
Qcap = 4.0m3/s
Chinaman Ck Culvert
3/2100x600 RCP
Qcap = 8.1 m3/s
Ray Rd West Open Drain
Qcap = 1.0 m3/s (To Road Crown)
George Fabris Rd Culvert
450 RCP
Qcap = 0.3 m3/s
CATCHMENT B3
Q2 = 2.8 m3/s
Q10 = 5.1 m3/s
Q100 = 8.6 m3/s
Ray Rd East Open Drain
Qcap = 4.0 m3/s
D/S of Culvert
Qcap = 50.0 m3/s
Airport Culvert
3/1800x1800
RCBC
Qcap = 28.0 m3/s
Airport Open
Drain
Qcap = 13.3 m3/s
Ray Rd East Open Drain
Qcap = 21.0 m3/s (Top of Drain)
CATCHMENT G
Q2 = 8.1 m3/s
Q10 = 14.7 m3/s
Q100 = 24.7 m3/s
Ray Rd East Open Drain
Qcap = 3.8m3/s (Top of Drain)
CATCHMENT D
Q2 = 6.5 m3/s
Q10 = 11.7 m3/s
Q100 = 19.7 m3/s
Coolamon Cl Culvert
4/900 RCP
Qcap = 7.6 m3/s
Ray Rd East Open Drain
Qcap = 2.7m3/s (Top of Drain)
Ray Rd East Open Drain
Qcap = 4.0m3/s (Top of Drain)
Ray Rd East Open Drain
Qcap = 13.1 m3/s (To Road Crown)
CATCHMENT B2
Q2 = 11.3 m3/s
Q10 = 20.4 m3/s
Q100 = 34.4 m3/s
CATCHMENT C
Q2 = 16.9 m3/s
Q10 = 30.7 m3/s
Q100 = 51.7 m3/s
Vicary Rd Culvert
2/2100x600 RCBC
Qcap = 5.8 m3/s
Taxiway Culvert
3/1800x750 RCBC
Qcap = 7.2 m3/s
CATCHMENT B1
Q2 = 3.5 m3/s
Q10 = 6.4 m3/s
Q100 = 10.8 m3/s
CATCHMENT A
Q2 = 10.1 m3/s
Q10 = 18.2 m3/s
Q100 = 30.7 m3/s
LEGEND
CATCHMENT BOUNDARY
OPEN DRAIN SECTION
EXISTING CULVERT
NOTE
1. TIME OF CONCENTRATION ASSESSED AS 60 MINUTES
RAY ROAD DRAINAGE STUDY
RAY ROAD PEAK FLOWS AND INFRASTRUCTURE CAPACITY PLAN
DRG: SKETCH 2
PAGE 2
0 m
250 m
500 m
750 m
1250 m

ATTACHMENT 4
PRELIMINARY Q100 HEC-RAS MODEL

RAY ROAD DRAINAGE STUDY
PRELIMINARY Q100 FLOOD HEC-RAS MODEL

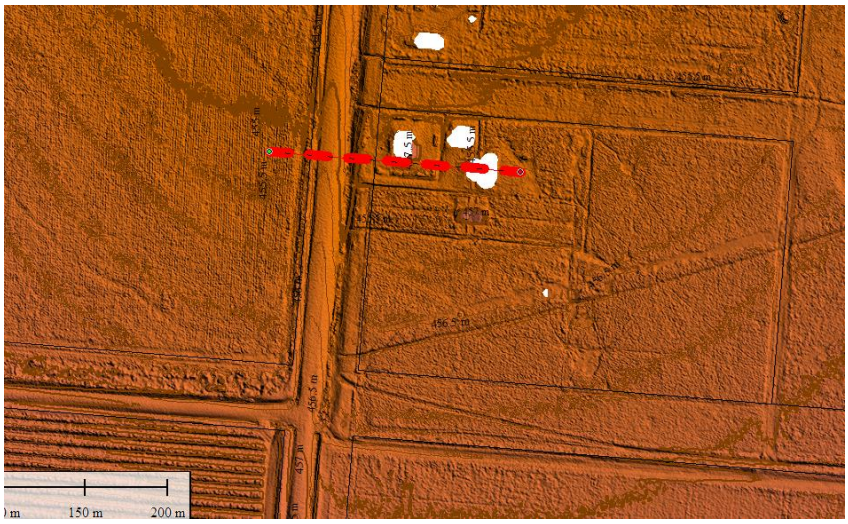


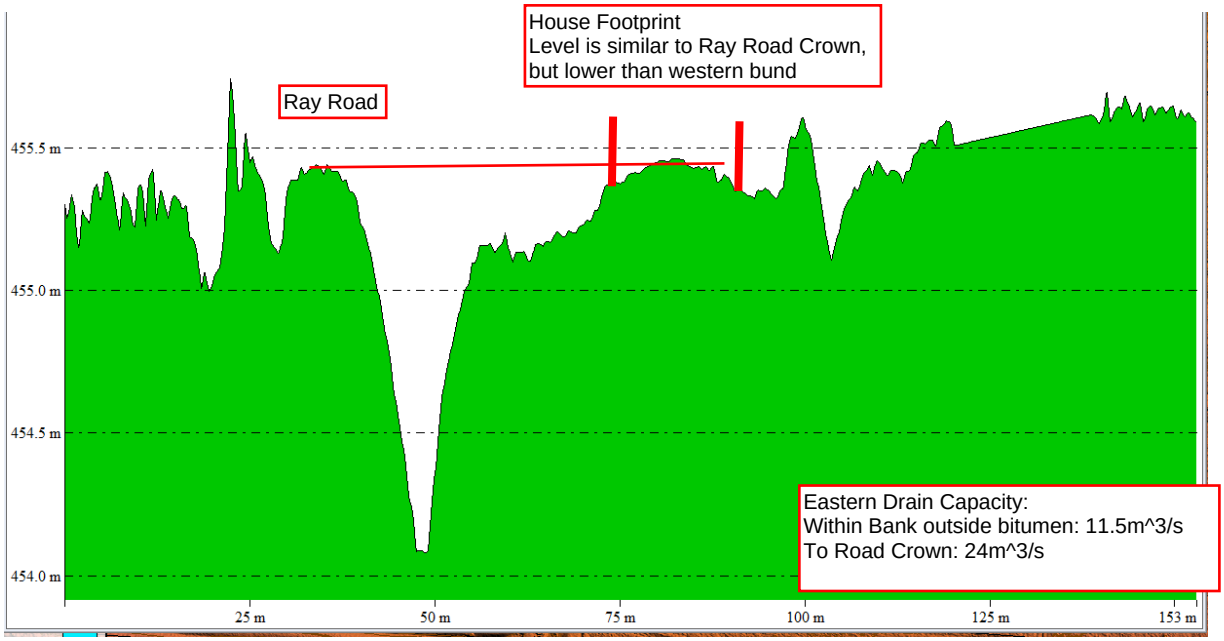
****THIS IS A PRELIMINARY FLOOD MODEL**
IT IS FOR GENERAL INFORMATION ONLY AND MUST NOT BE RELIED UPON TO INFORM FLOOD IMMUNITY, FLOOD DEPTHS OR PEAK FLOOD EXTENTS.
TEC AND MAREEBA SHIRE COUNCIL TAKE NO RESPONSIBILITY FOR DECISIONS MADE BY INDIVIDUAL LANDOWNERS BASED ON THIS PRELIMINARY Q100 FLOOD MODEL

ATTACHMENT 5
SOUTHERN PROPERTY GROUND SURFACE ASSESSMENTS

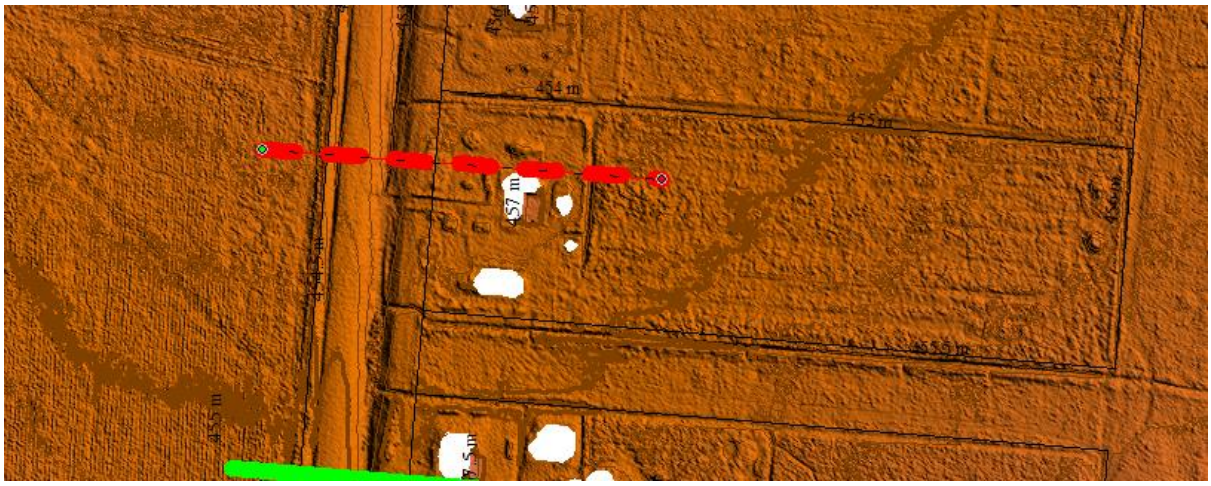
1756 Cross Sections Through Lots between George Fabris and Chinaman Creek

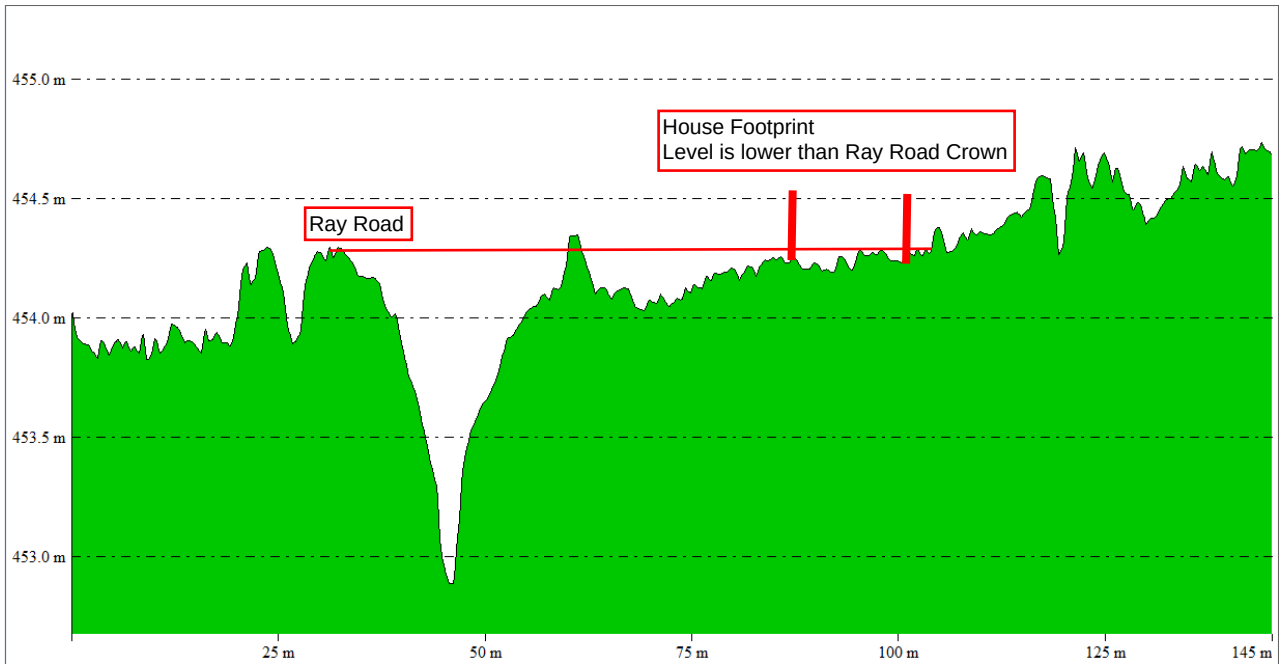
Lot 109 RP867033





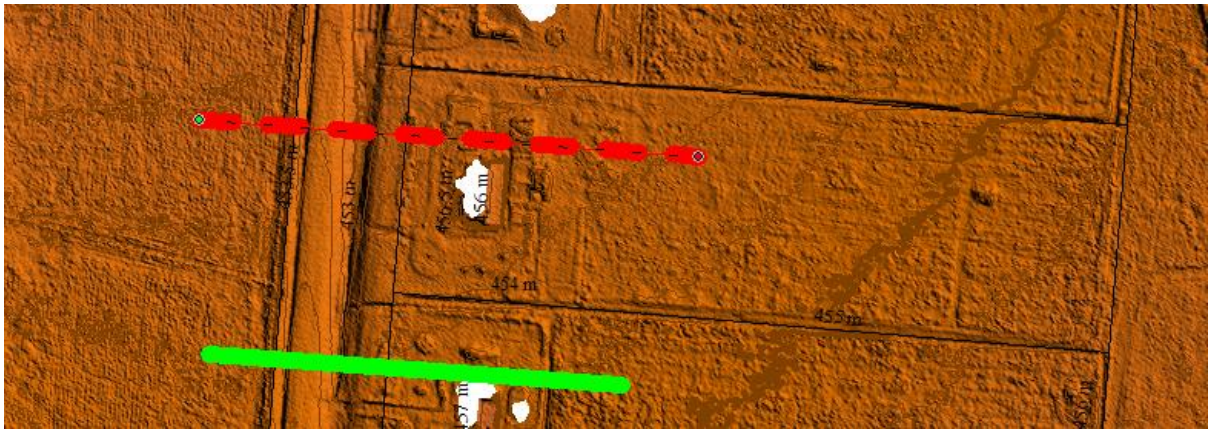
Lot 110 RP851422

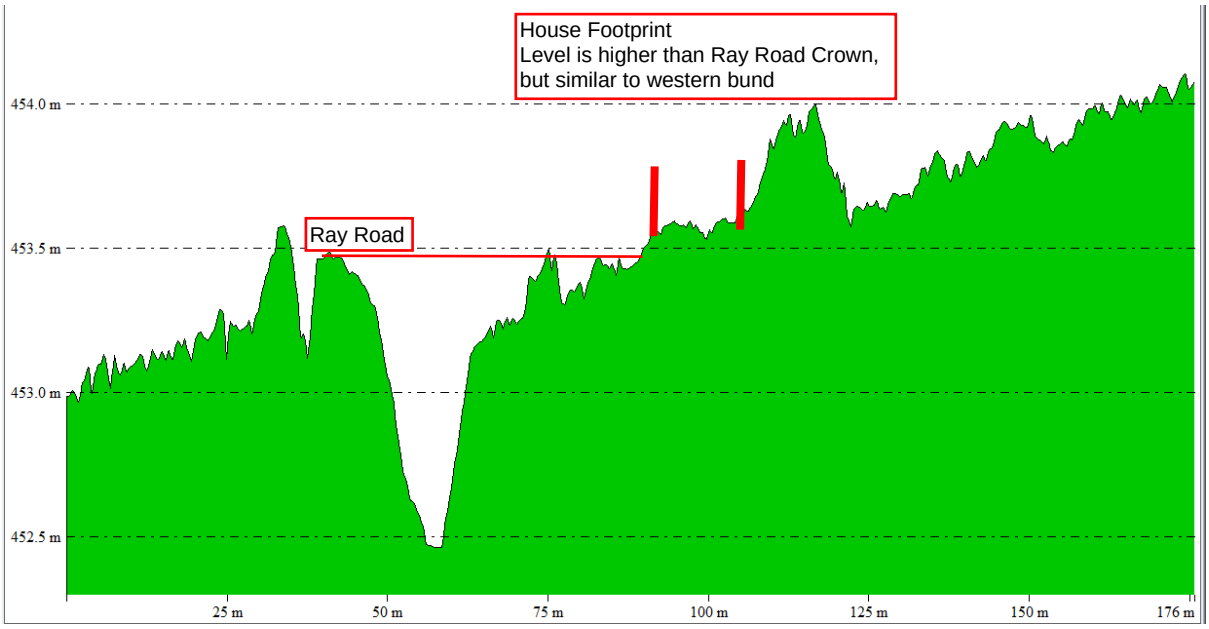




Eastern Drain Capacity:
Within Bank outside bitumen: 11m^3/s
To Road Crown: 20m^3/s

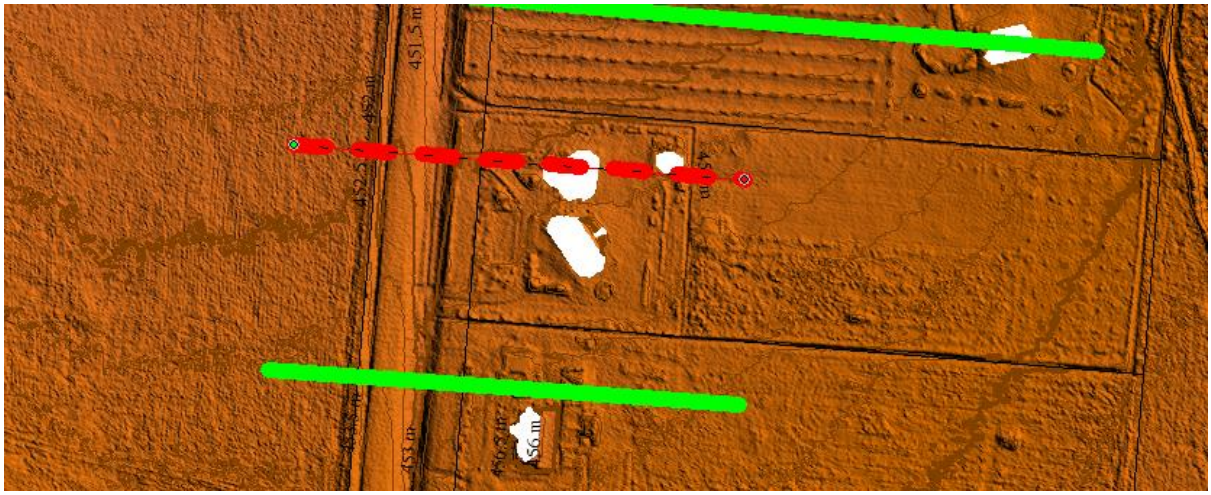
Lot 63 RP851422

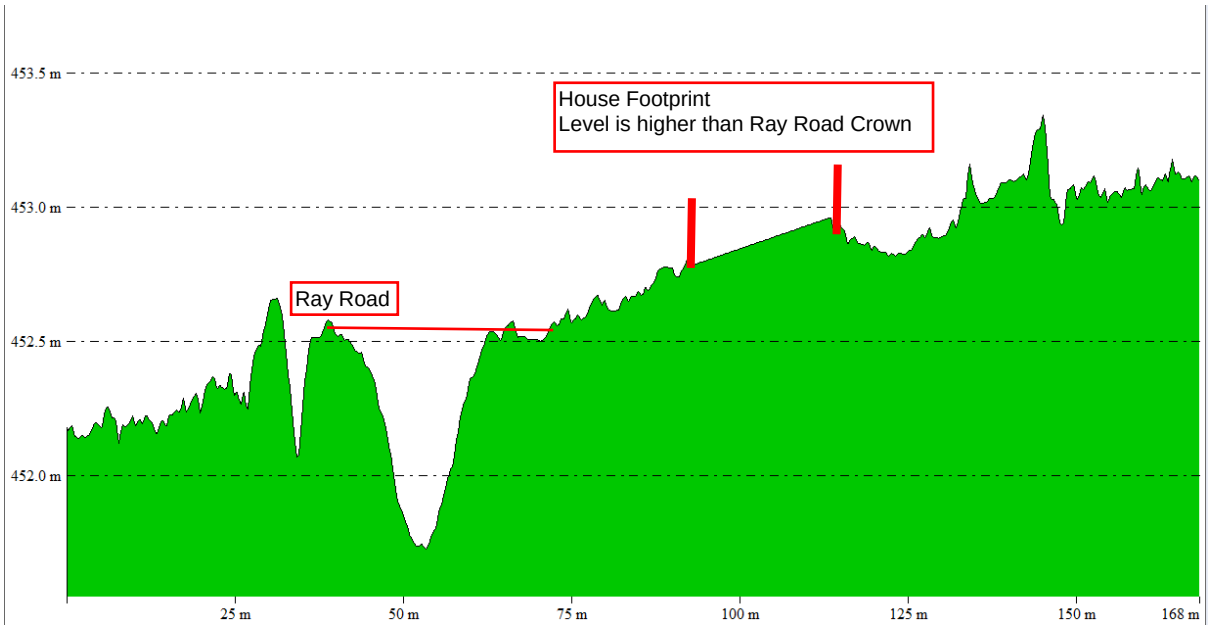




Eastern Drain Capacity:
Within Bank outside bitumen: 7.5m^3/s
To Road Crown: 15m^3/s

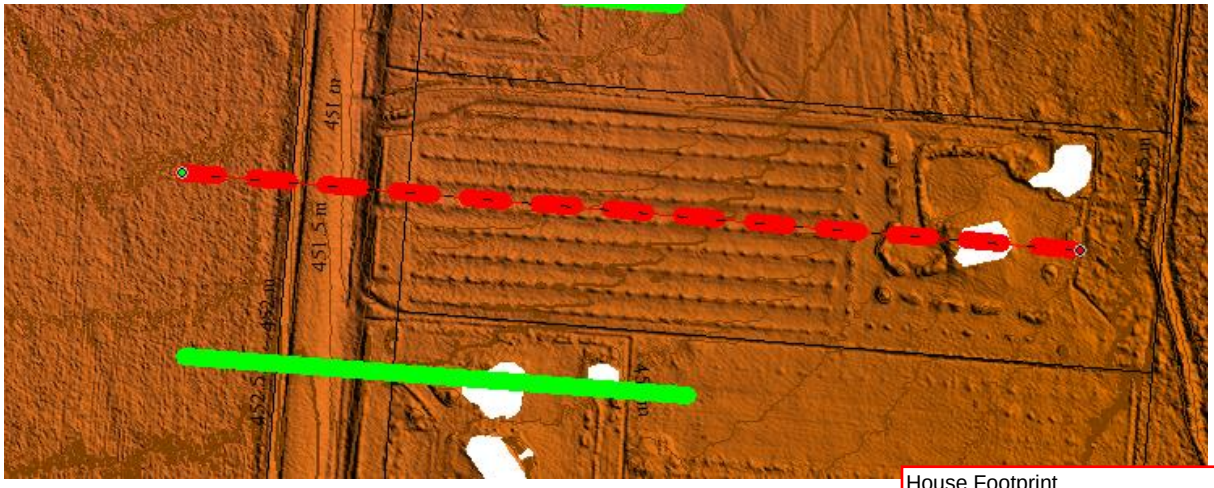
Lot 62 RP851422



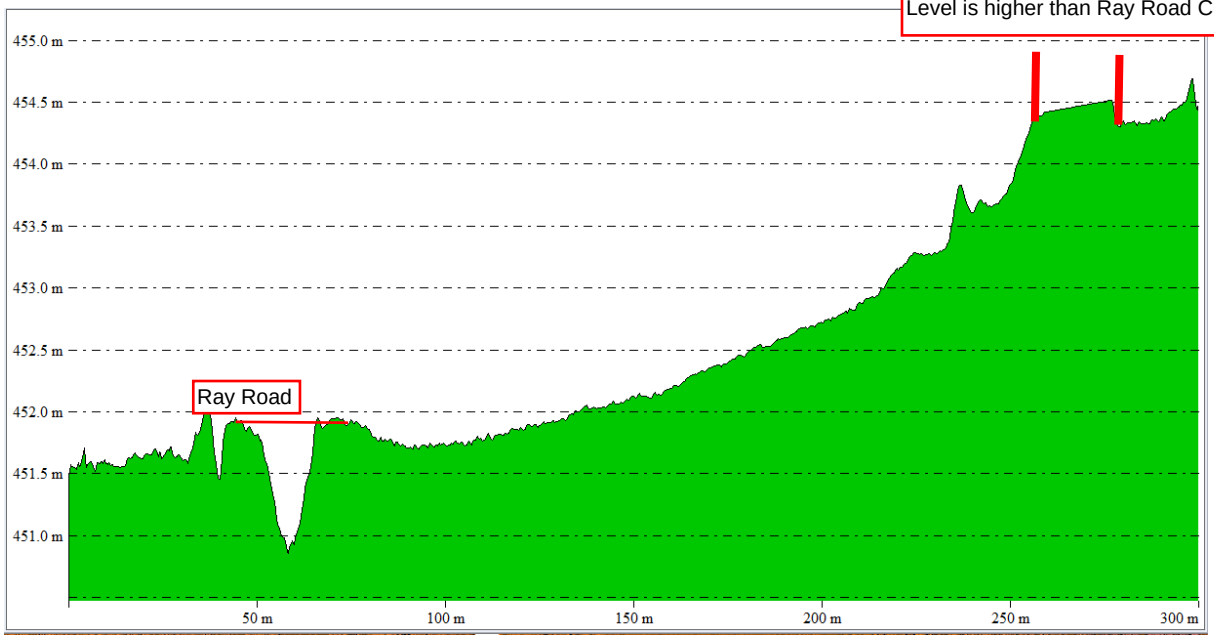


Eastern Drain Capacity:
Within Bank outside bitumen: 6.5m^3/s
To Road Crown: 12.6m^3/s

Lot 61 RP851422

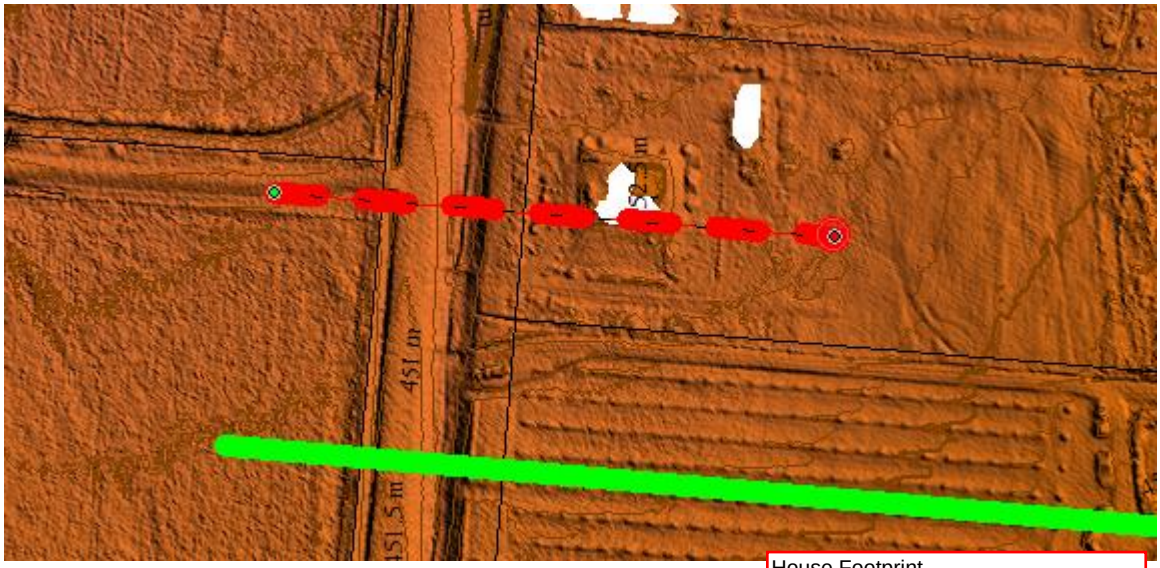


House Footprint
Level is higher than Ray Road Crown

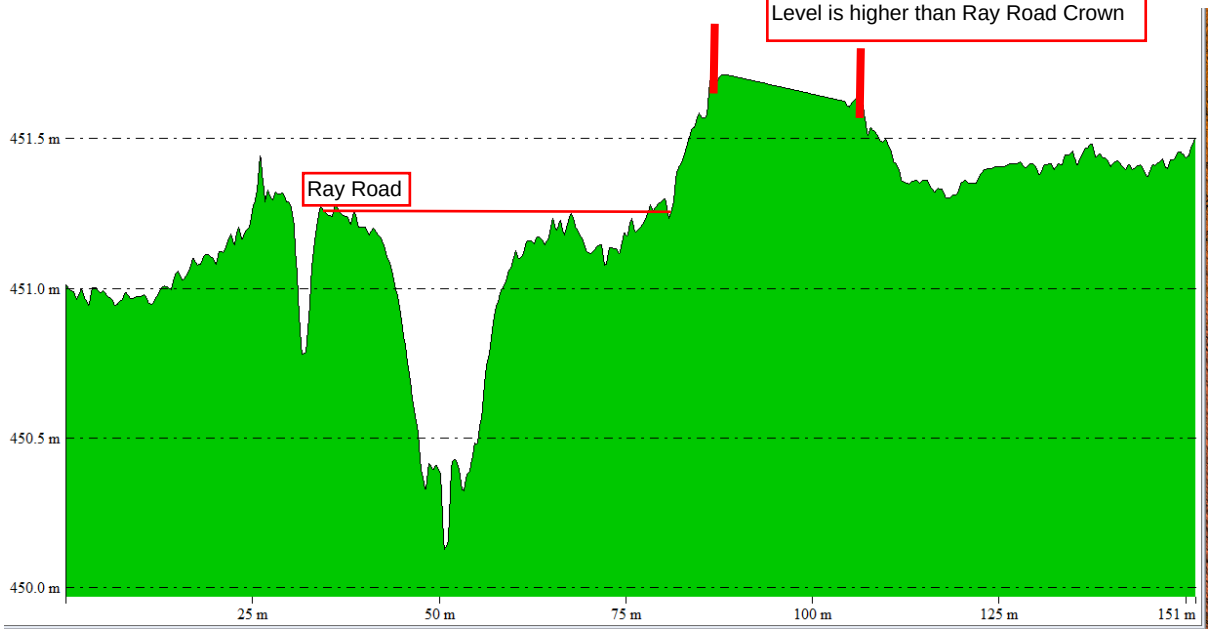


Eastern Drain Capacity:
Within Bank outside bitumen: 9.3m^3/s
To Road Crown: 19.4m^3/s

Lot 60 RP851422

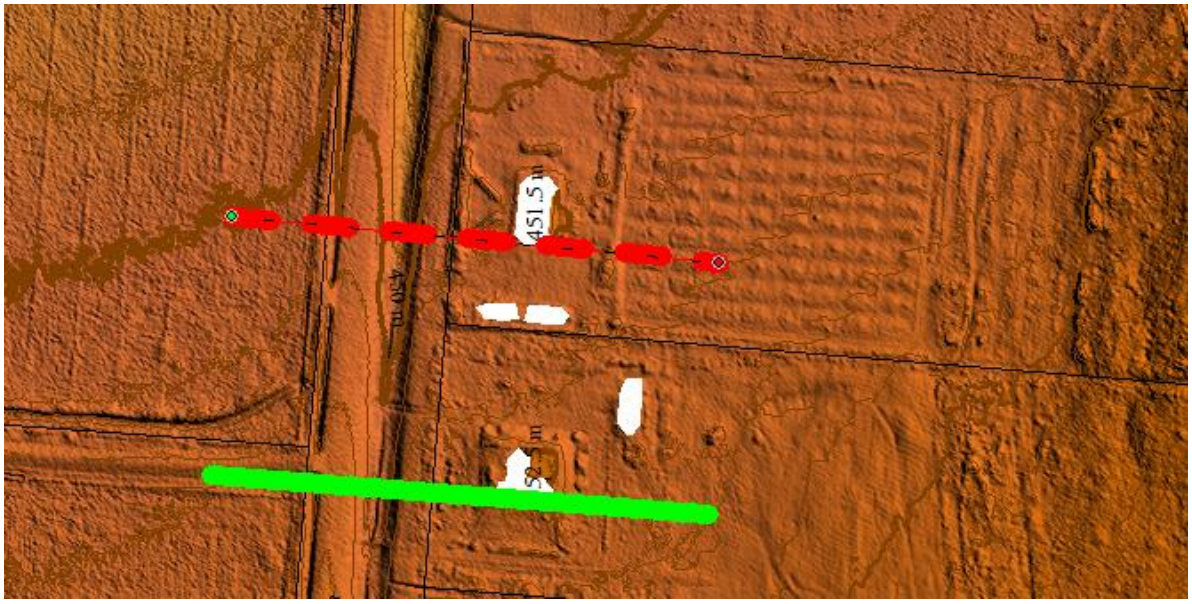


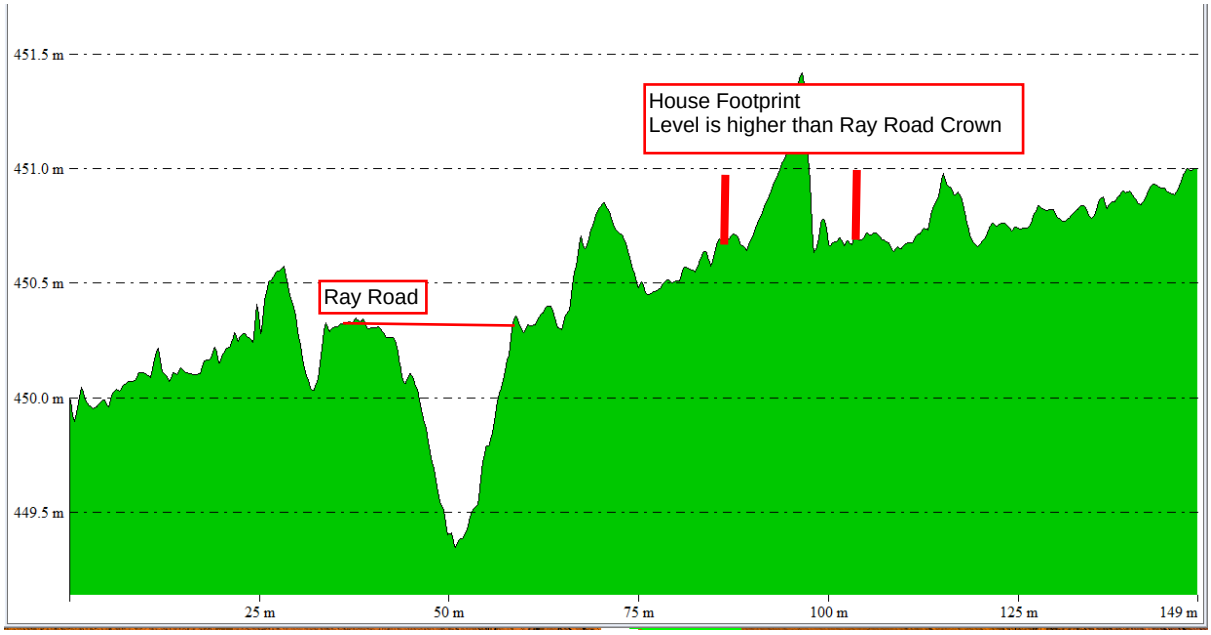
House Footprint
Level is higher than Ray Road Crown



Eastern Drain Capacity:
Within Bank outside bitumen: 10.8m^3/s
To Road Crown: 16.1m^3/s

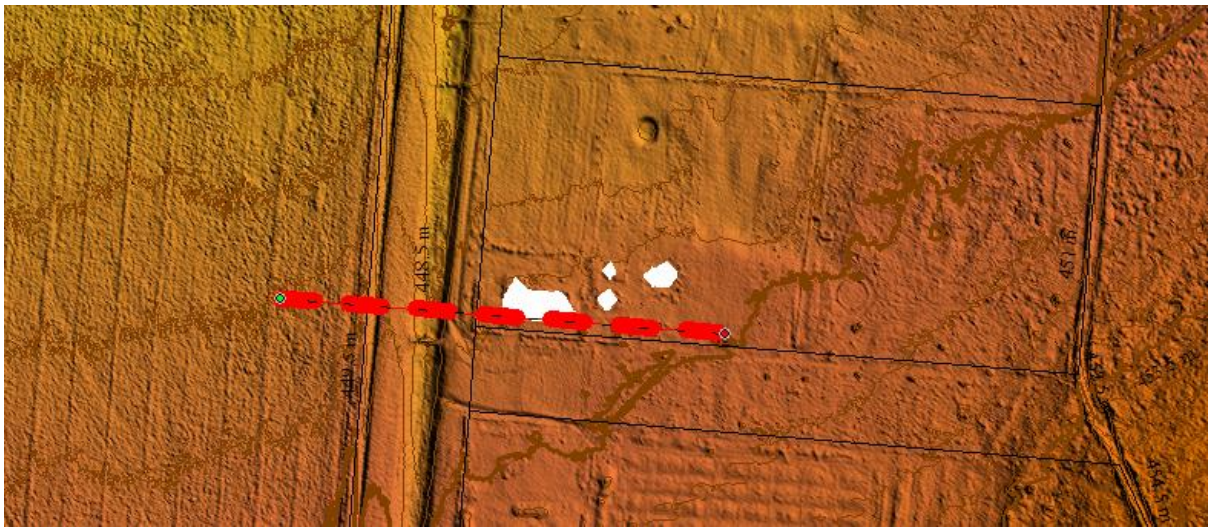
Lot 59 RP851422

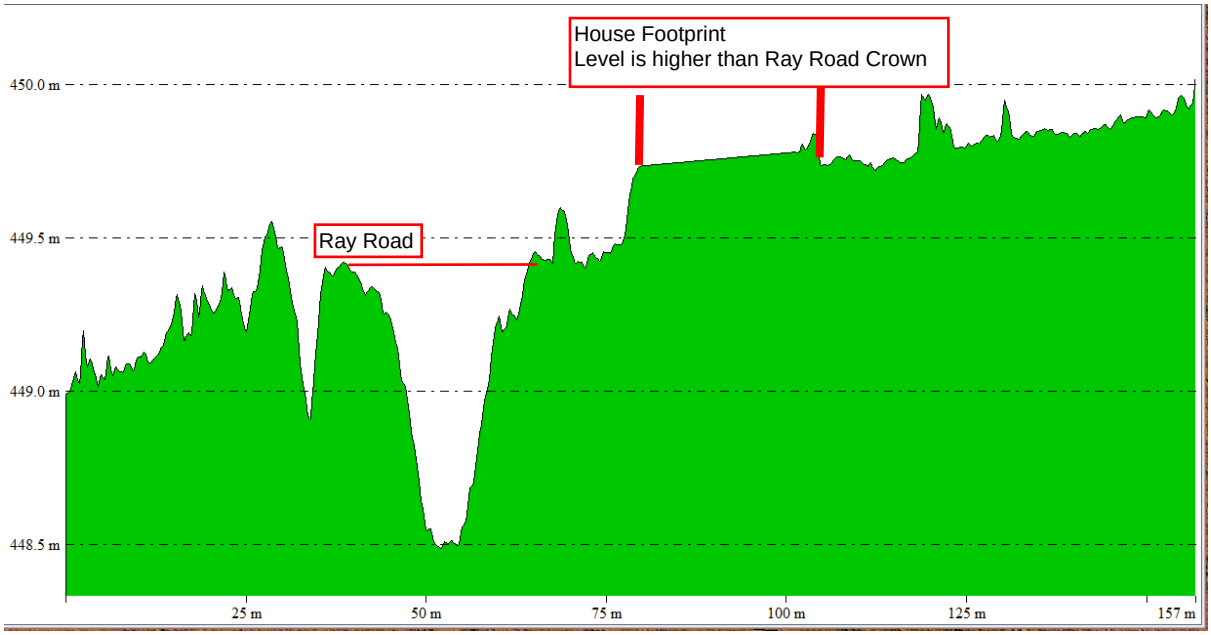




Eastern Drain Capacity:
Within Bank outside bitumen: 10.9m^3/s
To Road Crown: 13.3m^3/s

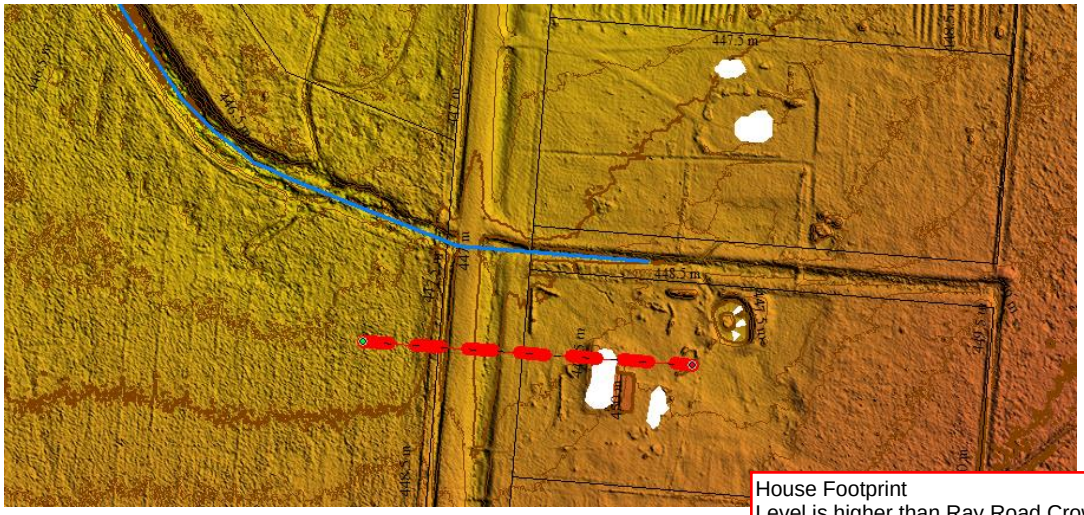
Lot 37 RP851422



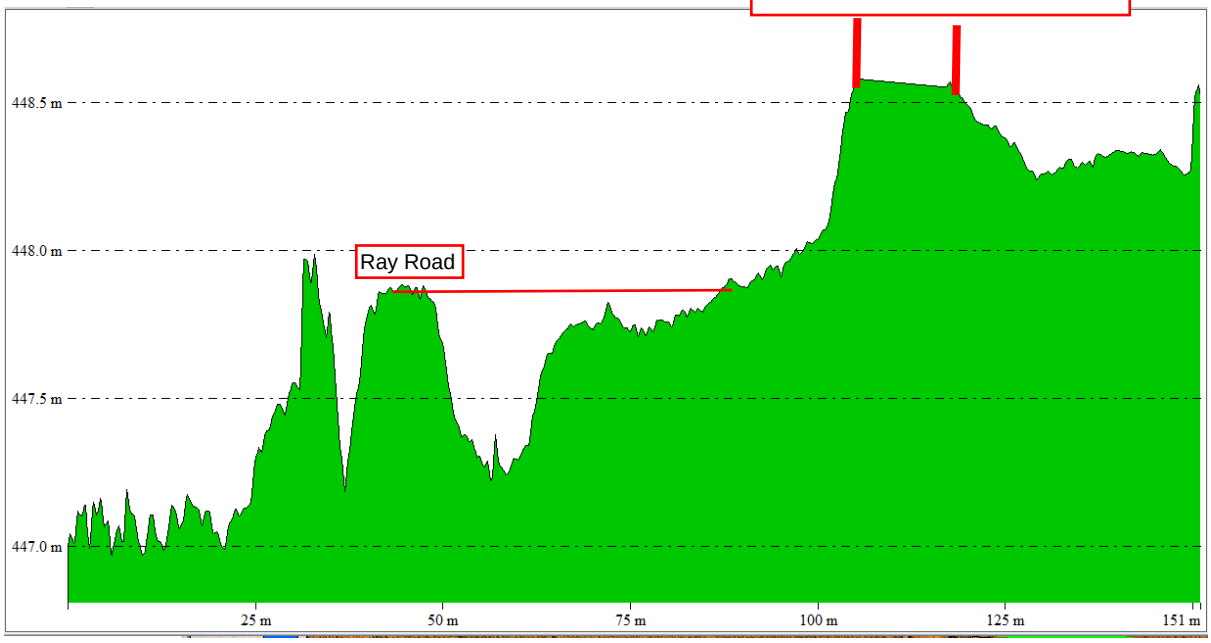


Eastern Drain Capacity:
Within Bank outside bitumen: 10.8m^3/s
To Road Crown: 16.2m^3/s

Lot 36 RP851422



House Footprint
Level is higher than Ray Road Crown



Eastern Drain Capacity:
Within Bank outside bitumen: 6.9m^3/s
To Road Crown: 10.5m^3/s