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1. **INTRODUCTION**

1.1 **Report Details**

This report has been commissioned by Anna Lugeo Nominees in relation to their property at 321 Old Dandenong Road, Dingley.

1.2 **Report Author Details**

Details of the report authors are provided below.

1.2.1 **Names and Address of the Authors**

Andrew Glen Prout  
and  
Paul William Clemson

Suite 5, Level 34  
360 Elizabeth Street,  
Melbourne VIC 3000

1.2.2 **Qualifications**

**Andrew Glen Prout** has the following qualifications and professional memberships:

- **Education**  
  Bachelor of Engineering (Civil), Swinburne Institute of Technology, 1984  
  Postgraduate Diploma in Management Studies, Melbourne University, 1992.

- **Registrations/Affiliations**  
  Member, Institution of Engineers, Australia  
  Member, College of Civil Engineers, I.E. Aust.

**Paul William Clemson** has the following qualifications and professional memberships:

- **Education**  
  Bachelor of Engineering (Civil), Monash University, 2006
1.2.3 Experience and Expertise of the Authors

Andrew Prout is a Senior Principal Engineer in the Melbourne branch of Engeny. Andrew has over 35 years professional experience both in the consulting engineering field and with government and semi-government authorities. Andrew is a leader in the surface water management field, having updated Melbourne Water's Drainage Design Guide and having lectured at university level. Andrew started his career as a trainee engineer at the Dandenong Valley Authority in 1982 and his work at the Dandenong Valley Authority (DVA) included preparation of Drainage Schemes (now referred to as Development Services Schemes (DSS)) and after graduation in 1984 again worked at the DVA from 1986 to 1992 undertaking flood studies, designs and preparation of drainage schemes. Since 1992 Andrew has worked as a consultant and has undertaken numerous flood studies. Andrew has also been involved as a principal designer, EES surface water study manager, proof engineer or verifying engineer for most major transport projects in Victoria, including City Link, Eastlink, Peninsula Link, Monash upgrade, M80 upgrade, Goulburn Valley Highway Duplication and Princes Highway Duplication. He has undertaken expert witness work and produced scores of expert reports for a number of clients, including Melbourne Water, Southern Rural Water, Goulburn Murray Water, VicRoads, Councils and landowners.

A CV with more details regarding Andrew's experience is included in Appendix A.

Paul Clemson is a Principal Engineer with Engeny with flood study, drainage design and infrastructure experience. Paul is highly skilled and experienced in urban drainage and flood modelling. Paul's skills and experience include detailed 1 and 2 dimensional modelling of existing drainage systems for Melbourne Water and numerous councils and other clients. This has included extensive hydrologic and hydraulic modelling and verification to actual flood behaviour. Paul is a leading user of RORB hydrologic models and TUFLOW hydraulic models to replicate the performance of drainage systems and overland flow patterns.

Paul has contributed to this report. A CV with more details regarding Paul's experience is included in Appendix B.

1.3 Report Revision

A previous version of this report was prepared by Engeny in December 2018 and provided as a submission for the Mordialloc Bypass Project Environment Effects Statement (EES) Inquiry. After the previous report was completed Engeny received additional information from Melbourne Water. This additional information included revised flood flow information. The revised flood flow information has been used in the flood modelling and flood mapping in this February 2019 version of the report.

The overall effect of the revisions has been the use of increased peak flood flows. This change has resulted in no substantive change to the conclusions of our report. There are detailed changes to the flood maps and flood flows compared with the December 2018 report.
In reissuing this report we considered the Planning Panels Victoria Guide to Expert Evidence and the option of issuing an addenda report, rather than reissuing this report. On reflection we considered the following points in deciding to issue a new version of our report:

- We understand that the EES is being considered by a Committee, rather than a Planning Panel.
- We have not prepared the proposed planning scheme amendment.
- We considered that it would be easier for the Committee to have one report with the latest flood maps, rather than having to move between two reports with some of the flood maps being superseded, but not marked as superseded.
2. **REFERENCE DOCUMENTS**

Documents provided to Engeny referred to in this report included documents received from Anna Lugeo Nominees as listed below:

- Site survey plan.

We also referred to the following information in preparing this report:

- Google Maps
- Flood information provided by Melbourne Water, including revised information received on 24 January 2019
- 2006-07 LiDAR aerial survey data.
3. **SUBJECT SITE**

3.1 **Location**

The site that is the subject of this report is 321 Old Dandenong Road, Dingley. The location of the site is shown in Figure 3-1. The figure also shows the alignment of nearby watercourses / open drains, including the Old Dandenong Rd Drain that traverses the site, as well as the public acquisition overlay that relates to the Mordialloc Bypass. The subject site is located on the west side of the proposed Mordialloc Bypass.

![Figure 3-1 Locality Plan](image)
3.2 Planning Scheme

A Planning Report was generated by Engeny on 11 December 2018 from the Planning Schemes on line web site. A copy of this report is provided as Appendix C.

The subject site is zoned as Green Wedge.

There are no flood related zones or overlays in the Planning Scheme that affect any of the subject site.

3.3 Site Visit

Engeny’s Andrew Prout attended the site and surrounding area on Wednesday 5 December 2018.

During the site visit Andrew visited the following areas:

- The subject site (321 Old Dandenong Road)
- Old Dandenong Road
- Centre Dandenong Road
- Boundary Road
- Garden Boulevard and the surrounding area, downstream of the subject site

A selection of photographs taken during the site visit is shown on the following pages.
Figure 3-2  Old Dandenong Rd Drain near southern boundary of 321 Old Dandenong Road, looking south

Figure 3-3  Old Dandenong Rd Drain on left near centre of 321 Old Dandenong Road, looking south
Figure 3-4  321 Old Dandenong Road looking north-east to high side of Old Dandenong Rd Drain

Figure 3-5  321 Old Dandenong Road panorama looking south east

Figure 3-5 shows high ground on the right behind the two large trees, which is on the adjacent site to the south.

Figure 3-5 also shows bare high ground that is on the subject site.
Figure 3-6  Boundary Road on the western boundary of 321 Old Dandenong Road looking north

Figure 3-7  Old Dandenong Rd Drain culvert under Centre Dandenong Road
Figure 3-8  Old Dandenong Rd Drain looking north across Centre Dandenong Road

Figure 3-9  Old Dandenong Rd Drain in Redwood Gardens Estate, looking north from Garden Boulevard
Figure 3-10 shows that the Garden Boulevard culvert is much larger than Centre Dandenong Road culvert (shown in Figure 3-7). Note that flood modelling exhibited with EES shows the 1 % AEP flood extent through Redwood Gardens being contained within the Melbourne Water channel.

Figure 3-11 Old Dandenong Rd Drain downstream of Garden Boulevard
3.4 **Melbourne Water Catchment / Drain**

The subject site is within the Old Dandenong Road Drain catchment. The Old Dandenong Road Drain flows through the subject site and is an open man-made drainage channel.

The subject site is not within the catchment of a Melbourne Water Development Services Scheme.
4. ASSESSMENT

4.1 Existing Flooding Information

The subject site is located adjacent to the proposed Mordialloc Bypass Road.

An EES has been exhibited for the proposed Mordialloc Bypass Road. The EES includes a surface water section and within this section flood mapping has been shown, including flood mapping of the subject site. The flood mapping is intended to show existing flooding conditions for the 1 % annual exceedance probability (AEP) event, also referred to as the 100 year ARI event.

The Major Road Projects Authority informed Engeny that the flood mapping of the site was based on a flood model provided by Melbourne Water to the Mordialloc Bypass project team. Engeny requested a copy of the flood model from the Major Road Projects Authority, but was advised that the model would not be provided and that Melbourne Water should be contacted to request the flood model.

Engeny subsequently requested a copy of the flood model from Melbourne Water but was advised that the flood model would not be provided for investigations on behalf of a private land owner.

On 6 December 2018 Melbourne Water did however provide an extract of flooding information covering the subject site and surrounding properties, including the 1 % AEP flood extent, 1 % AEP flood level contours and 1 % AEP peak overland flow rates. Given that there are no underground drains through the subject site Engeny considered that the overland flow values represented all of the flood flow. Appendix D provides a copy of this information. Melbourne Water also provided a copy of Mordialloc Settlement Drain Flood Mapping Final Report (GHD, 2013), which provides details of the development of the flood model that covers the site. The GHD report is 368 pages in length and has therefore not been included as an appendix of this report.

In January 2019 Engeny requested flood information that covered a larger extent than that received in December. This additional information was received in an email dated 24 January 2019 and is supplied in Appendix E. Upon review of this information we found that:

- The flood extent and flood levels were unchanged compared with the information received on 6 December 2018.

- Additional flow information included a figure showing the total flow for a 1 % AEP event, which included asset flow and was higher than the flows used in our December 2018 report.

Given the additional information we considered that it was important to rerun all of our flood models and produce revised flood maps.
Most of the Melbourne Water drainage system within the area of interest for the EES has flood mapping that is also included in the Planning Scheme. For the subject property and for Old Dandenong Road Drain, there are no flood overlays or zones in the Planning Scheme (as evidenced in the Planning report in Appendix C).

The flood mapping information provided by Melbourne Water and the flood mapping in the EES shows significant flooding across the subject site and flowing downstream to Centre Dandenong Road and significant flooding across Centre Dandenong Road. The flood mapping in the EES shows the 1 % AEP flood being contained within the constructed drainage channel through Redwood Gardens Estate downstream of Centre Dandenong Road (this drainage channel is shown in photographs in Figure 3-9, Figure 3-10 and Figure 3-11). The flood mapping exhibited in the Mordialloc Bypass EES in the vicinity of the subject site is shown in Appendix F.

4.2 Revised Assessment of Flooding for the Subject Site

Information in Mordialloc Settlement Drain Flood Mapping Final Report (GHD, 2013) identifies that the flood modelling for the site, as provided by Melbourne Water and shown in the Mordialloc Bypass EES, used LiDAR data (aerial laser survey data) and ground survey of the Old Dandenong Road Drain. The date that the ground survey was captured for the Old Dandenong Road Drain is not stated by the GHD report. While the GHD report does not state the date that the LiDAR data was captured, the LiDAR data capture in this area prior to the 2013 flood modelling was part of the 2006-7 Port Phillip & Western Port LiDAR Project.

Lugeo Anna Nominees provided Engeny with ground survey data for 321 Old Dandenong Road. This survey was captured on 16 May 2017 by JCA Land Consultants. Appendix G provides a copy of the ground survey plans.

Engeny's comparison of the 2017 ground survey with the 2006-7 Port Phillip & Western Port LiDAR identified that there have been some significant changes to terrain within 321 Old Dandenong Road between 2006-07 and 2017. The comparison identifies that surface levels on the site are generally higher in 2017 compared to 2006-07. Figure 4-1 provides a comparison between the surface levels defined by 2017 survey and 2006-07 LiDAR.
The differences between the 2017 survey and 2006-07 LiDAR mean that the flood mapping as provided by Melbourne Water and as shown in the Mordialloc Bypass EES may not be an accurate representation of the flood prone land of 321 Dandenong Road.

Engeny has therefore developed a flood model for the subject site. The Melbourne Water flood model and flood modelling for the Mordialloc Bypass EES was developed using modelling software TUFLOW, a two-dimensional flood modelling package. Engeny’s flood model has also used TUFLOW.

Engeny’s TUFLOW model has used the peak 1 % AEP total flows provided by Melbourne Water in January 2019. Two scenarios have been developed, which are:

- Model terrain defined by 2006-07 LiDAR only: this scenario has been modelled to compare the results to the 1 % AEP flood extent provided by Melbourne Water in order to validate the setup of Engeny’s model.
Model terrain defined by 2017 ground survey within 321 Old Dandenong Road and 2006-07 LiDAR in the remainder of the model: this scenario has been modelled to determine an updated representation of flood behaviour of the subject site based on the most currently available terrain data.

The 1 % AEP flow rates applied to both model scenarios are the same and are from the information provided by Melbourne Water in January 2019.

Appendix H provides a copy of the flood maps produced for each of the scenarios. Appendix H also provides a flood difference map, which shows the difference in flood depth between the two scenarios.

The modelling results for the scenario in which the model terrain is defined by 2006-07 LiDAR only are very close to the Melbourne Water 1 % AEP flood extent. This validates the setup of Engeny's flood model.

The modelling results for the scenario in which model terrain is defined by 2017 ground survey within 321 Old Dandenong Road and 2006-07 LiDAR in the remainder of the model show that some areas of the site that were shown to be flooded in the Mordialloc Bypass EES and the Melbourne Water flood information are now not flood prone. This is due to the change in surface levels that has occurred on the site between the capture of the 2006-07 LiDAR and the 2017 ground survey.

4.3 Flooding with the Mordialloc Bypass

The available flood information indicates that the existing Old Dandenong Road Drain either side of Centre Dandenong Road and the culvert under Centre Dandenong Road do not currently have the capacity to contain the 1 % AEP flow. This means that under existing conditions significant flooding can occur in a 1 % AEP event across the land that covers the alignment of the Mordialloc Bypass and across Centre Dandenong Road.

To manage this flooding and to meet required design standards for the Mordialloc Bypass we expect that:

- The Old Dandenong Road Drain culvert under Centre Dandenong Road will be increased in size to cater for the 1 % AEP peak flow and to mitigate flooding across Centre Dandenong Road. We would expect that the culvert size would change from the size shown in the photograph in Figure 3-7 to a size similar to the existing Garden Boulevard culvert as shown in Figure 3-10.

- Part of the Mordialloc Bypass works would be to construct a defined drainage channel where Old Dandenong Road Drain is contained within the Mordialloc Bypass Right of Way in the vicinity of Centre Dandenong Road.

- The construction of the Mordialloc Bypass will not adversely impact flooding of 321 Old Dandenong Road.
4.4 Ultimate Flood Management on the Subject Site

It is expected that future flooding within the subject property will not be defined by the mapping exhibited in the Mordialloc Bypass EES. It is expected that future flooding of 321 Old Dandenong Road will be defined by works on the Old Dandenong Road Drain similar to the works that are expected on the drain as part of the Mordialloc Bypass Road and similar to the works that have been undertaken through Redwood Gardens in order to contain the 1 % AEP to a dedicated drainage reserve with a channel with improved flood conveyance compared to existing conditions.
5. CONCLUSIONS

From this report we wish for the Committee to note the following conclusions from this report:

1. The subject site (321 Old Dandenong Road) is located on the Old Dandenong Road Drain on the west side of the proposed Mordialloc Bypass.

2. Downstream of the subject site the Old Dandenong Road Drain flows through the Mordialloc Bypass Right of Way, across Centre Dandenong Road and then downstream into a formed floodway through Redwood Gardens Estate.

3. The Old Dandenong Road Drain floodway through Redwood Gardens Estate contains the 1% AEP flood flow.

4. The EES shows an existing conditions flood map that shows significant flooding across the subject site on the south side of Old Dandenong Road Drain for a 1% AEP flood.

5. The flood map exhibited with the EES was produced using a flood model developed on behalf of Melbourne Water in 2013 and uses LiDAR terrain data that is likely to have been captured in 2006/07, and possibly ground survey of the Old Dandenong Road Drain, for which the capture date is unknown.

6. Survey from 2017 shows the terrain on the subject site has been altered since the 2006-07 LiDAR data capture.

7. Revised flood modelling undertaken by Engeny found that some areas of the site that were shown to be flooded in the Mordialloc Bypass EES and the Melbourne Water flood information are now not flood prone. This is due to the change in surface levels that has occurred on the site between the capture of the 2006-07 LiDAR and the 2017 ground survey.

8. Construction of the Mordialloc Bypass is expected to require an upgrade of the Old Dandenong Road Drain culvert under Centre Dandenong Road and the Old Dandenong Road Drain channel within the Mordialloc Bypass Right of Way.

9. It is expected that future flooding of 321 Old Dandenong Road will be defined by works on the Old Dandenong Road Drain similar to the works that are expected on the drain as part of the Mordialloc Bypass Road and similar to the works that have been undertaken through Redwood Gardens Road in order to contain the 1% AEP flow to a dedicated drainage reserve with a channel with improved flood conveyance compared to existing conditions.
We ask that the Committee acknowledge these issues in their report and report that:

(1) The Mordialloc Bypass will need to adequately upgrade Old Dandenong Road Drain in the vicinity of Centre Dandenong Drain in consultation with Melbourne Water to prevent flooding of the Mordialloc Bypass Road and Centre Dandenong Road and to adequately cater for the drainage of upstream properties, and

(2) The flood map exhibited with the EES for Old Dandenong Road Drain through 321 Centre Dandenong Road is not the “final word” in relation to the flooding of that property.
6. **STATEMENT**

We have made all the inquiries that we believe are desirable and appropriate at this time and that no matters of significance which I regard as relevant have to our knowledge been withheld from the Committee.

We have read the Planning Panels Victoria Practice Note G2 - Guide to Expert Evidence and agree to be bound by it.

Andrew Prout
BE Civil, PDMS, MIE Aust.

Paul Clemson
BE Civil
APPENDIX A

Andrew Prout CV
Andrew Prout
Senior Principal Water Resources Engineer
BE(Civil), PDMS, MIEAust

SUMMARY

Andrew established Engeny Water Management in Victoria and has gained more than 35 years professional experience both in the consulting engineering field and with government and semi-government authorities. Andrew is a leader in the surface water management field, having updated Melbourne Water’s Drainage Design Guide and having lectured at university level. He has undertaken a number of drainage and flood studies as well as water conservation studies and projects to minimise the overall environmental footprints of projects. This included being Project Director for the Werribee Plains Urban Water Conservation Study for the Australian Conservation Foundation.

Andrew has undertaken projects for a wide range of clients, including Councils, Melbourne Water, Catchment Management Authorities, Water Authorities, VicRoads, VicTrack and many public companies and land owners. He has also done work related to water issues for numerous major projects including Principal Surface Water designer or Peer Reviewer for Eastlink, Peninsula Link, Monash Upgrade, City Link as well as work on Federation Square, various windfarms, landfills, quarries and mines. His work has taken projects through all stages from studies to designs and construction.

Andrew has done a significant amount of work for local Councils over the last 20 years. This has included strategic drainage studies, preparation of drainage design guides, expert witness services, preparation of Development Contribution Plans and flood mapping. This work has covered most of the municipalities in Greater Melbourne, as well as a number of rural Victorian Councils, including Ballarat, Geelong, Corangamite, Warrnambool, Moyne, Moira, Bass Coast, Surf Coast and South Gippsland and some Councils in New South Wales and Queensland. He has spoken at conferences, made a number of professional presentations and been active in debates in the industry on topics such as water conservation, climate change impacts on water systems, urban flooding and catchment management.

Andrew started his career at the Dandenong Valley Authority in the early 1980s and also worked for Melbourne Water before entering consulting in the early 1990s.

Andrew has extensive experience with Melbourne Water work and contributed to Engeny obtaining positions on two select panels for Melbourne Water work. Andrew has prepared and / or reviewed numerous Melbourne Water Development Services Schemes. He has also undertaken flood studies, detailed designs and construction superintendence for many Melbourne Water surface water projects. His work for Melbourne Water has included expert advice, reports and evidence.

Andrew has provided professional advice to a wide variety of clients in a range of forums, including VCAT, Panel Hearings and court proceedings. His work in this area and in regional Victoria is summarised on the following pages.
KEY AREAS OF EXPERTISE

- Flood mapping and Flood Mitigation
- Flood hazards and impacts on developments
- Coastal flooding and climate change impacts
- Wetlands and waterways
- Stormwater harvesting and water reuse
- Stormwater management and Water Sensitive Urban Design
- Drainage and stormwater treatment master planning and drainage schemes
- Drainage, wetlands and retarding basin detailed design
- Drainage, wetlands and retarding basin construction superintendence
- Surface water management for quarries and landfills
- EES and EIS work in relation to surface water, erosion and catchments

EXPERIENCE

Advice regarding Australian Rainfall and Runoff 2016 – VicRoads: In 2017 Andrew and his colleague Glenn Ottrey provided high level advice to VicRoads regarding the implications of the 2016 release of Australian Rainfall and Runoff and how this would impact on the AustRoads Design Guide in relation to drainage and flooding.

Nell Street, Greensborough - expert drainage report for City of Banyule via Minter Ellison: Andrew prepared a detailed expert report related to flooding and on site drainage for this project. The work included a site assessment and review of numerous documents in relation to the existing buildings, Council drainage, flood damage and the applicants Statement of Claim. Engeny reviewed witness reports, rainfall data, flood modelling, the design and construction of on-site works and photographs.

Victorian Flood Review, Melbourne Water: Andrew was engaged by Melbourne Water in 2015 / 16 to prepare a report that documented the roles of Melbourne Water and the Bureau of Meteorology in flood prediction and forecasting. The work involved liaison with Melbourne Water, Bureau of Meteorology, VicSES and production of a report in response to a recommendation from the Victorian Flood Review prepared by Neil Comrie.

Kohinoor Place Drainage and Flood Assessment for City of Ballarat: Andrew assessed local Council and private drainage systems and issues associated with the construction of a house in Kohinoor Place in Redan for the City of Ballarat in 2015. The work included a site visit, assessment of storm events, calculations and provision of advice on the adequacy of drainage systems and the effectiveness of recent works. Engeny produced an expert witness report that assisted the parties to resolve the issues.

Banyule Flood Mapping and Special Building Overlays, City of Banyule: Andrew and his colleague Paul Clemson have provided the City of Banyule with detailed advice regarding flood mapping of the flow paths associated with all of Councils drainage system. In addition to the flood mapping done by Paul and the team, detailed written advice in 2014 regarding how to determine process flood mapping results and options for using the results to control building and planning processes. Andrew presented the outcome of Engeny’s work to a Planning Panel, which approved the introduction of the SBOs.
Ballarat West PSP and DCP: City of Ballarat: Andrew and the team at Engeny were part of a large team that produced the Ballarat West Precinct Structure Plan and Development Contributions Plan for 1000 hectares in Ballarat. The work included catchment modelling for flooding and water quality and development of a master plan for development of the area. Andrew also prepared cost estimates for the works and produced an Expert Witness report for the Panel hearing for the Development Contributions Plan.

Marchington Avenue, Mornington, Flooding Related Expert Witness Report, Melbourne Water: In 2012 Andrew and his colleague Maria Verrocchi prepared a report related to a proposed residential development adjacent to Tanti Creek in Mornington. The report clearly described the flood hazards related to one of the proposed dwellings in terms of the Land Subject to Inundation and Floodway Overlays. Andrew presented the report at VCAT and Melbourne Water obtained a successful outcome.

Kerang / Dingwall Flooding Expert Witness project – Goulburn Murray Water: In 2013 Andrew undertook a detailed assessment of complex flooding patterns that occurred in 2011. The flooding was related to the catchments of the Loddon River and Wandella Creek and the interaction of the flood with the large floodplains and various infrastructure including roads, bridges, embankments, irrigation channels and syphons. Andrew also oversaw complex 2D flood modelling of the actual flood behaviour undertaken by his colleague Scott Dunn.

Toora Coastal Flood Risk Report, South Gippsland Shire: Andrew undertook a site review and prepared an Expert report for the South Gippsland Shire for a VCAT hearing in relation to six proposed dwellings in the Grip Road area in Toora. The report covered issues including local drainage and flooding, coastal flooding, sea level rise, climate change, wastewater disposal and related issues. Andrew gave evidence at VCAT which contributed to a successful outcome for the Shire and a report that has been referenced in various hearings and publications since the hearing.

Maribyrnong River Flood Hazard Report, Melbourne Water: In 2009 Andrew was engaged by Melbourne Water to provide a comprehensive report on flood hazards in the Maribyrnong Township in response to a development application. Andrew prepared a detailed report that covered historic flooding since 1870, flood warning systems and flood hazards and also provided expert witness services at a VCAT hearing. The work undertaken by Andrew was influential in a successful outcome for Melbourne Water.

Lockerbie Property Kalkallo, Surface Water Master Plan, Stockland. Andrew has been working with Stockland and National Pacific on a significant master planning project for the future urban development of over 1100 hectares in the Kalkallo area. The work involved consultation with the landowners, the Growth Area Authority, Melbourne Water, Council and other consultants. The master planning focussed on the drainage, wetlands and retarding basin components of a Structure Plan for the overall development as well as a creek corridor master plan for Merri Creek.
Powling Street Wetland, Port Fairy, community group: In 2013 / 14 Andrew represented a local community group in relation to a proposed residential subdivision adjacent to a sensitive wetland. Andrew provided advice, undertook a site visit and prepared a report regarding local flooding, coastal inundation and water quality issues. Andrew represented the community group at a VCAT hearing and the hearing resulted in a reduction in the subdivision that had been proposed.

Botanic Ridge Estate, City of Casey: In 2013 / 14 Andrew represented the City of Casey in relation to the Botanic Ridge Estate in Cranbourne. Andrew assessed the effectiveness of construction control measures, stormwater harvesting, stormwater treatment and flood control works for the Estate and impacts on the downstream property. Andrew produced a detailed report that considered reports from other parties and made recommendations to resolve the issues.

Sunshine North Industrial Estate Drainage review, Brimbank City Council: In 2013 / 14 Andrew undertook a review of the constructed drainage systems in this estate. A number of the drainage pipes were found to be damaged prior to handover to Council. Andrew reviewed CCTV footage, drainage design plans, contracts and specifications and provided an Expert Report to Council on the issues and how to manage them.

Bungower Road Kennels, Moorooduc for landowner: In 2013 / 14 Andrew prepared a report related to the suitability of the site for a proposed kennel development in relation to the land capability for wastewater disposal as well as stormwater harvesting and drainage requirements. Andrew prepared a report and made a presentation at VCAT that assisted the applicant to obtain a permit.

Maribyrnong River LSIO rezoning, Keilor, Melbourne Water: In 2012 Andrew undertook an independent review of a proposed Land Subject to Inundation Overlay for Melbourne Water along the Maribyrnong River in Keilor and Calder Park. Andrew’s report assisted Melbourne Water to effectively negotiate all issues with an adjacent landowner.

O’Gradys Ridge Road Dam Break Expert Report, Southern Rural Water: In 2013 Andrew investigated the circumstances related to the failure of a large licensed farm dam. Andrew visited the site, assessed the role of Southern Rural Water, documented the downstream consequences of the dam failure and completed a risk assessment and a report.

Werribee Flood Expert Report, Southern Rural Water: In 2012 / 13 Andrew studied flooding patterns in the Werribee East area associated with a severe storm in February 2011. Andrew oversaw work by his colleague Glenn Ottrey that included detailed hydrologic and 2D hydraulic modelling of the flooding behaviour for a range of scenarios. Andrew and Glenn’s work was able to demonstrate how recent works had effected flooding in some locations and not in others. Andrew produced reports that assisted all parties to reach agreement where recent works had worsened flooding patterns and to defend claims where there has been no change in flooding.
Keysborough Expert Witness Report, landowner: In 2011 / 12 Andrew investigated the drainage issues associated with an industrial development in Keysborough South. This work included review of recent developments, Melbourne Water Drainage Scheme, temporary retarding and stormwater treatment works and the downstream system. Andrew produced a comprehensive report and appeared at hearings at VCAT.

Sheyna Drive Subdivision, Numurkah, Shire of Moira: In 2013 Andrew prepared a report regarding a proposed residential subdivision on flood prone land in Numurkah. Andrew reviewed the flooding of the site in 2012 and flood mapping of the area, as well as drainage patterns, the effect of irrigation infrastructure and the potential risks and issues associated with the proposed subdivision. Andrew obtained information from the Goulburn Broken CMA and Council. Andrew presented his report at VCAT and his evidence assisted Council in having the subdivision refused.

Modella Poultry Farm surface water report, landowner: In 2012 Andrew and his colleague Maria Verrocchi prepared a report related to surface water issues for a proposed poultry farm in Modella in the Koo Wee Rup district. Andrew presented the report at VCAT.

Tyers Street, Portland, Drainage Expert Witness Report, multiple parties: Andrew was engaged by a number of briefing parties to investigate urban flooding in Portland in Victoria and to recommend flood alleviation works to mitigate the flood risk for commercial properties in Portland. This 2010 report recommended a highly efficient, cost effective solution to the existing flooding problem, which was adopted by all parties.

Melbourne Water Drainage Scheme Reviews, Melbourne Water. Andrew has been project director for a number of drainage scheme reviews for Melbourne Water, including hydrologic modelling, stormwater quality modelling and development and costing for drainage infrastructure for proposed urban areas.

City of Knox, City wide drainage strategy: Andrew was Project Director for this municipality wide study into all aspects of the Council drainage system. The study assessed flooding risks, drain capacities and opportunities for Water Sensitive Design. Outputs included overland flow maps, capital works program and recommended planning scheme amendments and funding scheme.

City of Maribyrnong and City of Moreland Drainage Strategies: Responsible for management of these projects which involved preparation of a comprehensive strategy to enable Council to identify drainage problems and prioritise a capital works program to resolve all problems, including flooding and water quality related works. Information was supplied in MapInfo format including maps, reports, calculations and photographs.

Stormwater Drainage Strategies for Councils: Andrew developed methodologies and undertook comprehensive municipality wide strategies for a number of councils in greater Melbourne. The strategies included risk based drainage flooding mapping and works programs as well as water sensitive design programs of works, funding advice, design guides and planning advice. Andrew has done studies of this type for many Councils including Darebin, Glen Eira, Manningham, Monash, Whitehorse and Stonnington.
Monash Flood Management Plan, Melbourne Water: Andrew was responsible for overseeing this project. The work included workshops, identifying flooding hot spots and developing a detailed action plan for Council, Melbourne Water and VicSES. Andrew brought his decades of experience in the area and working relationships to the project and contributed to a comprehensive plan for managing flood risks in the City of Monash.

Geelong Racecourse stormwater harvesting, Racing Victoria: Andrew developed this project with Racing Victoria and was Project Director for the completed study that identified a low cost and viable source of water for the racecourse by harvesting stormwater. Andrew then followed up with the detailed design and implementation of the works that provide over 70ML/annum of water to irrigate the racecourse. Major regional racecourses are important employers and are required for a viable training and racing industry. The Geelong project led to similar studies that Andrew undertook at Ballarat and Bendigo Racecourses.

Water Sensitive Road Drainage Scheme, Bandiana Link Road, VicRoads: Andrew has undertaken work for VicRoads in Wodonga to develop a water sensitive road design system for the Bandiana Link Road and to prepare a cost apportionment scheme to obtain contributions from all benefitting landowners. The results of the study have been used in negotiations with benefitting landowners to offset the value of the works built by VicRoads against the land acquisition compensation.

Surface Water assessment, Crowlands Windfarm: Andrew undertook a detailed surface water assessment of the proposed Crowlands windfarm in the Pyrenees in north western Victoria. His work included a site assessment, input to the windfarm design, assessment of erosion risks, concept design of waterway crossings (including the Wimmera River) and erosion control works and a detailed report.

Merri River and Russell Creek flood studies, Warrnambool, Glenelg Hopkins CMA and Shire of Warrnambool: Andrew was project manager for this flood study and undertook hydrologic modelling and hydraulic modelling, as well as producing the flood study report and recommendations.

Moyne River Flood Study, Port Fairy, Glenelg Hopkins CMA and Shire of Moyne: Andrew was project manager for this flood study and undertook hydrologic modelling and hydraulic modelling, as well as producing the flood study report and recommendations.

Shire of Moira Drainage Strategy: Andrew was project manager for a comprehensive drainage strategy for Council that included consideration of drainage patterns and urban pollutant loads and management for towns including Numurkah, Nathalia, Cobram, Katamatite, Katunga and Waia.

Blackburn Creek rehabilitation, Melbourne Water: Andrew was Project Director for the design and superintendent for the construction of two stages of waterway rehabilitation works on Blackburn Creek.
Surface Water study for Nowingi waste facility EES, Office of Major Projects: Andrew was project manager for the surface water study for the proposed long term waste facility at Nowingi. Andrew prepared the EES specialist report and an Expert witness statement and gave evidence to the Panel hearing. The study covered issues including flooding risk, water balance and risk of surface water discharges from the site.

Baddaginnie Flood Study, Office of Major Projects: Andrew was Project Manager for this flood study in central Victoria. The project involved hydrology and hydraulic modelling for four creeks north of Violet Town and south of Baddaginnie. Andrew also undertook significant public consultation, including presentations at public meetings and briefing of Ministerial advisers and his work was central to Government decisions that the site was not appropriate for use for a long term waste facility due to flooding risks.

Dickson and Lyneham Wetlands, ACT Government: Andrew was Project Director for the design, approvals and then construction of two major wetlands in the northern suburbs of Canberra in 2009 and 2010. The wetlands will play a vital role in stormwater treatment and harvesting approximately 400 ML/annum of stormwater for use in open space irrigation. Andrew has overseen the preparation of the Final Sketch Plans, flood study, water treatment and water harvesting modelling and has developed a number of the technical solutions for this project. Andrew has also had a leading role in the agency and public consultation for the projects and the approval process.

Surface Water Study for Environmental Effects Statement for Mount Shamrock Quarry Extension: Andrew completed the surface water EES report and made an Expert Witness statement and presentation to the panel assessing the EES. Andrew’s work related to the site water balance, surface water quality, interaction of surface water and groundwater, discharge licensing and flooding risks.

Ruffey Creek rehabilitation, Melbourne Water: Andrew was Project Director for the design and superintendent for the construction of works on Ruffey Creek in Doncaster in 2007/08. The creek was deeply incised and in poor condition. The works included rock work, batter works, planting and an off stream wetland.

Dollar Wind Farm Expert Witness Report and Presentation, Southern Hydro: Andrew was peer reviewer for the civil design study for the Dollar Wind Farm in South Gippsland for Southern Hydro. His report related to surface water management and erosion control for the proposed development of the wind turbine project. Andrew made a presentation and was cross examined at the panel hearing in Foster in 2005.

Spindrift Avenue waterway impact report, landowner: In 2010 Andrew prepared an expert witness report and assisted a landowner in mediation in relation to development and works on a property in Spindrift Avenue, Flinders.

Lower Stony Creek VCAT report, Melbourne Water. Andrew represented Melbourne Water in relation to filling and realignment of Lower Stony Creek in Tottenham. Andrew’s role included briefing of Melbourne Water’s barrister on technical issues, preparation of reports and maps and appearances at VCAT hearings.
Lower Stony Creek Flood Impact Study, Melbourne Water. Andrew was project manager for a flood study that analysed the flooding impact of recent fill and creek alignment works on Stony Creek in Tottenham.

Lower Stony Creek Waterway Design, Melbourne Water. To mitigate the effects of recent filling and realignment of the creek a design was prepared to reduce the flooding impact, stabilise the creek, improve the creek environment and to allow for access across the creek.

Yarra River Flood report, City of Boroondara: Andrew investigated the flooding risks associated with a property in Coppin Grove, Hawthorn. The property is adjacent to the Yarra River and the owner had made an application to Council for a Planning Permit for dwellings on the high part of the site. Andrew prepared a flood risk report in accordance with the Planning and Environment Act to assist Council in deciding on the limit of residential development, the location of a path and the extent of Council’s Public Acquisition Overlay.

Flood Risk Report, Jacksons Creek: In 2002 Andrew prepared a flood risk report in relation to a proposed supermarket adjacent to Jacksons Creek in Gisborne. The report was prepared for the owner of a nearby supermarket as part of their submission to VCAT.

Drainage Design Guide, Melbourne Water: Andrew was personally responsible for reviewing the previous design guides and rewriting them to produce the current Melbourne Water Drainage Design Guide. This guide is the industry standard for drainage throughout the greater Melbourne area.

Development Contributions Plan, City of Monash: Andrew prepared the City of Monash’s Development Contribution Plan (DCP) for drainage works and worked with Council manager’s to obtain approval from the Department of Infrastructure (now DPCD) to the DCP. The DCP meets all of the requirements of the Planning and Environment Act and could provide Council with substantial funds every year towards the cost of drainage improvement works.

Porter Street Retarding Basin, Manningham City Council: Andrew analysed the drainage in the catchment in relation to a proposed subdivision on land in Porter Street, Templestowe. Part of the site was low lying and flood prone. Andrew made a presentation to VCAT that resulted in a retarding basin being set aside as part of the subdivision.

Wensleydale Coal Mine, Winchelsea, Victoria: The project involved risk assessment and design of stabilisation works for this disused mine in south-west Victoria. Severe erosion of the creek through the site occurred following a flood in 1995. Andrew developed a site management plan and detailed design of major stabilisation works.

Waterway Condition Assessment, Melbourne Water: Manager of waterway condition assessment studies for the Bunyip River, Tarago River, King Parrot Creek and Woori Yallock Creek catchments.

Dromana Flood Study: Andrew was project director for this project for the Mornington Peninsula Shire in Victoria. The flood mapping was done with the 2D flood model TUFLOW. Scenarios modelled included a range of storms as well as potential climate change scenarios considering sea level rise and increases in rainfall intensity. Andrew provided a report and policy advice on the implications of the study results.
Gunbower Forest Watering, Goulburn Broken CMA and Goulburn Murray Water: Andrew undertook technical and peer reviews for the design of the water diversion scheme to provide additional environmental water for the Gunbower Forest.

Racecourse Lake / Murray Valley Highway irrigation channel technical review, Goulburn Murray Water: Andrew oversaw hydraulic analysis and recommendations to improve channel capacity without impacting on flooding patterns for this irrigation system between Kerang and Swan Hill.

Lake Mokoan alternative water supply, Goulburn Murray Water: Andrew undertook technical reviews of proposed channel and pipe works to provide irrigation water to customers following the decommissioning of Lake Mokoan near Benalla.

Hattah Lakes environmental watering, Mallee CMA: Andrew developed concepts for water diversions for Hattah Lakes including channel works and regulating structures to provide environmental watering that would closely replicate flow patterns prior to regulation of flows in the Murray River catchment.

Surface Water Study for Learmonth Saleyards and abattoir for the City of Ballarat. This work included a flood study, drainage study and design of surface water quality management systems. Andrew’s work included an expert report and appearance at a Panel Hearing.

PROFESSIONAL HISTORY

2010 - present
Senior Principal Engineer, Engeny Water Management, Melbourne

2003 - 2010
Principal Water Surface Engineer, URS Australia Pty Ltd

2002 - 2003
Business Development Manager, Waterways & Water Resources, GHD Pty Ltd

2001 - 2002
Manager of Water Resources, Egis Consulting Australia Southern Region

1997 - 2001
Principal Engineer, Hyder Consulting

1994 - 1996
Senior Project Manager, Sinclair Knight Merz

1992 - 1994
Consulting Engineer, AGP Consulting

Part-time Lecturer, Swinburne University

1990 - 1992
Works Program Engineer, Dandenong Valley and Western Port Authority

1986 - 1989
Planning and Investigation Engineer, Dandenong Valley Authority

1984 - 1986
Planning Engineer, Port of Melbourne Authority

1982 - 1984
Dandenong Valley Authority

EDUCATION

1992
Postgraduate Diploma in Management Studies, Melbourne University

1984
Bachelor of Engineering (Civil), Swinburne Institute of Technology

REGISTRATIONS / AFFILIATION

Member, Institution of Engineers, Australia
APPENDIX B

Paul Clemson CV
Paul Clemson
Principal Water Resources Engineer
BEng (Civil) (Hons)

SUMMARY

Paul is a principal water resources engineer with twelve years of experience in the water industry. Paul has extensive experience on a diverse range of projects including flood mapping, stormwater drainage and quality studies, potable water supply network planning, recycled water design and sewer network planning and design.

As a principal engineer with Engeny, Paul is involved in a technical and project management role on studies delivered for Melbourne Water, local councils and development industry clients.

Paul has extensive experience in hydraulic modelling including stormwater (1D and 2D), water supply and sewer networks. Paul has expertise in the use of hydrologic and hydraulic modelling software packages including TUFLOW, HEC-RAS, RORB, DRAINS, MUSIC, InfoWorks CS, H20Map and GIS packages MapInfo, QGIS and GeoMedia.

KEY AREAS OF EXPERTISE

◦ Hydrological / hydraulic modelling and flood mapping
◦ Urban stormwater planning and design
◦ Water sensitive urban design
◦ Integrated water management
◦ Spatial data analysis (GIS).

EXPERIENCE

2010 - present
Senior Water Resources Engineer, Engeny, Melbourne

Banyule Municipality Flood Mapping and SBO Implementation, Banyule City Council: Paul lead Engeny’s successful delivery of flood mapping for the entire Banyule City Council municipality. This work included the production of 5 year and 100 year ARI flood extents for each catchment and the development of concept level mitigation options to address flood risk for existing conditions. Engeny undertook a cost-benefit rating analysis of the mitigation options to derive a prioritised list of works across the municipality.

Following on from the flood mapping stage of the study, Paul supported Council with the successful implementation a Special Building Overlay (SBO) for flood prone areas across the entire municipality in response to the flood modelling. This assistance included the development of the SBO from flood modelling results including an innovative approach to flood extent filtering, individual assessment of community submissions in response to the proposed planning scheme amendment and the preparation of an expert witness report for the planning panel hearing.
Arden Macaulay Precinct, Melbourne Water, City of Melbourne, Victorian Planning Authority, City West Water: Paul was the project manager and undertook key technical work in the preparation of the flooding and drainage strategy and integrated water management strategy for the Arden Macaulay Precinct. The Arden Macaulay Precinct is one of the largest urban renewal projects in Australia. The objectives of Engeny’s work was to work with stakeholders to:

- Allow intensive development of the Arden Macaulay Precinct to occur
- Achieve appropriate flood protection standards for the precinct
- Assess the reliability and benefits of an alternative water supply
- Seize the potential to improve the amenity and public use of Moonee Ponds Creek.

Engeny’s study included the following tasks to meet these objectives:

- Development of an understanding of the existing conditions and year 2100 (including climate change) scenario flooding within the precinct through updated two dimensional (TUFLOW) hydraulic modelling
- Communicating the existing conditions and year 2100 scenario flooding outputs with key stakeholders, including preparation of video simulations and easy to understand flood maps
- Identification of a range of potential flood mitigation works in collaboration with key stakeholders
- Assessment of an alternative water supply, through investigation of rainwater harvesting, stormwater harvesting and creek flow extraction, including water balance modelling and hydraulic modelling to determine the benefits that harvesting stormwater has on flooding within the precinct
- Undertaking detailed investigations (including hydraulic modelling) for a selection of the flood mitigation works and refining the works in order to achieve required flooding standards
- Provision of advice on infrastructure required for the flood mitigation and alternative water supply works
- Clear and concise reporting, including flood maps.

Cranbourne Town Centre Flood Mapping, City of Casey: Paul project managed and provided key technical input for flood modelling of three catchments covering the Cranbourne Town Centre. Engeny undertook a detailed review of available information, conducted hydrological modelling of each catchment and flood mapped the study area for ARIs ranging from 5 years to 500 years. Flood mapping was produced for existing conditions and a projected future development scenario, assuming lots of a certain size would subdivide as has been the case over the last 10 years. Engeny used the outputs from the flood mapping to identify key flooding hotspots in the study area to assist the City of Casey with capital works prioritisation.
**Humes Main Drain Flood Mapping, Melbourne Water:** Paul was Engeny’s project manager for the delivery of the Humes Main Drain Catchment (with the City of Wyndham) Flood Mapping project on behalf of Melbourne Water. The flood mapping study was a joint project between Melbourne Water’s flood mapping and development services teams. The project was undertaken using both ARR2016 (soon after its release) and ARR1987 methodologies in order to analyse the differences between the outputs obtained. The project was a great learning experience for both Melbourne Water and Engeny in terms of gaining an understanding of the changes required in the approach to Melbourne Water flood mapping projects to bring them in-line with ARR2016.

**Flood Mapping Projects (various), Mornington Peninsula Shire Council:** Paul has undertaken project management and project engineer roles for the development of RORB hydrological and TUFLOW hydraulic models across a number of small to large catchments for the Shire including McCrae, Mount Martha, Gregory Street Drain, Tootgarook Swamp, Balnarring to Point Leo, Olivers Creek, Dromana and Safety Beach catchments. The outputs from these studies have included flood maps showing flood extents for all of the Shire’s assets and development of flood mitigation strategies to reduce flood risks in the catchments.

**Lower Werribee Drains Flood Mapping, Melbourne Water:** Paul project managed and provided key technical input in the Lower Werribee Drains catchments flood mapping study. The scope of Engeny’s study included a thorough review of available data, development of validated hydrological models for each catchment (RORB), development of a hydraulic model (TUFLOW) including existing underground drainage and production of flood extents and other GIS deliverables for a range of flood extents and a climate change scenario.

**Victory Road Drainage Design, City of Kingston:** Paul undertook the preliminary design of a new drainage pipeline on Victory Road in Clarinda. The purpose of the pipe is to cater for runoff from the proposed capped Victory Road Landfill and the pipe will receive flow from three detention ponds within the landfill. The pipe alignment was complicated by existing sewer assets and a connection into the Clayton Main Drain. Engeny investigated various options for consideration by council, undertook hydraulic modelling of the pipeline to account for high tail water levels in the main drain and developed preliminary design plans.

**Deals Road Drainage Scheme, City of Kingston:** Paul project managed and delivered the majority of technical work for the development of the Deals Road Drainage Scheme. The scheme’s catchment is dominated by a series of landfills in various stages of development and as the sites are filled and then capped, a drainage system will be required to accommodate the additional runoff this process creates. Paul undertook a detailed review of available data and previous studies, development of a hydrological model of the catchment (RORB), development of several scenarios in a hydraulic model (TUFLOW) and the preparation of design plans and layout plans to clearly communicate the proposed drainage scheme and the key assumptions made in the preparation of
the design. Hydraulic modelling included modification of the catchment terrain to replicate future clay capping of landfills, proposed retarding basins and the future Dingley Bypass.

**City of Monash Flood Management Plan, Melbourne Water & City of Monash:** Paul undertook project management responsibilities for this project which involved organising and facilitating workshops with Council, Melbourne Water and other key stakeholders to identify gaps and issues with regards to flood management within the City of Monash. With a detailed knowledge of the municipality, an action plan was devised to address the deficiencies and document a Flood Management Plan to be adopted for the following five years.

**Sunbury Growth Area Development Services Scheme, Melbourne Water:**
Paul project managed and undertook key technical works for the preparation of developer services schemes (DSS) as part of extensive growth planned in Sunbury. This project required a range of skills and capabilities, including knowledge of Melbourne Water's DSS principles, understanding of Melbourne Water's DSS costing spreadsheet, hydrologic modelling, stormwater quality modelling, stakeholder consultation, catchment planning and knowledge of the impact of development on sensitive downstream waterways. A unique aspect of the Sunbury DSS was the innovative works included to protect steep tributaries that are highly sensitive to erosion.

**Development Services Scheme Engineering Reviews, Melbourne Water:**
Paul has led Engeny's work with Melbourne Water to review an extensive range of development services schemes. The reviews involve analysing and amending drainage, waterway and water quality treatment works identified to provide the most effective and environmentally sound stormwater management for areas of increased development planned through the Melbourne 2030 Strategy. The emphasis of the scheme reviews is to ensure that works recommended are practical and take into account local constraints and opportunities. The outputs of the scheme reviews include layout plans, costing of each component and the scheme and reporting. Engeny’s responsibilities have also included working with relevant stakeholders, including local councils and other asset owners.

**Ryans Creek Rehabilitation Detailed Design, City of Melton:** Paul project managed and technical work in the detailed design of rehabilitation works for Ryans Creek in Melton. Ryans Creek consists of a winding grassed floodway with a concrete lined channel in the invert and stormwater drains flowing into the creek from both sides via concrete lined channels. The key aspect of the design was the removal of the existing concrete channel, which will be replaced with a natural vegetated pilot channel, as well as improvement of outlets to the creek and the construction of a rock chute within a steep section of the waterway. Paul undertook modelling (CHUTE, HECRAS and MUSIC) and design work to ensure that the project objectives for various stakeholders were met.

Paul's efforts in corresponding with City of Melton and Melbourne Water throughout the project, as well as strong skills in design, resulted in Melbourne Water’s response on the first issue of design drawings having no comments on
the civil works. The design works were completed within a tight time frame (less than 10 weeks from approval to proceed) in order to assist City of Melton with scheduling the constructions works within the low rainfall period.

**Troops Road North Wetland and Retarding Basin Functional Design, Melbourne Water:** Paul project managed and undertook technical works for functional design of the Troops Road North Wetland and Retarding Basin system as part of the Leakes Road Development Services Scheme (DSS). Paul's work ensured that the assets fit within the allocated land-take for the stormwater assets in the PSP, ensured that the assets are designed and will function in accordance with their intent in the DSS and ensured that the appropriate level of service with respect to flood protection, conveyance and water quality will be provided. Engeny developed a two dimensional hydraulic model (TUFLOW) to analyse the complex hydraulics of the site, which include waterway crossings of a railway and major freeway. The functional design has provided works that are suitable for the complex hydraulics, satisfy environmental requirements including protection of existing vegetation and meet best practice water quality objectives.

**Plumpton Road Wetland and Frog Pond Functional Design, Melbourne Water:** Paul project managed and undertook technical work for the functional design of a wetland and a Growling Grass Frog (GGF) pond system as part of the Plumpton Road Development Services Scheme (DSS). The functional design has been used as a demonstration of how an integrated design between a stormwater quality asset and a habitat asset can achieve multiple benefits within a GGF corridor. The design work has been undertaken in consultation with both Melbourne Water and DEWLP and has helped to satisfy the requirements of both stakeholders. The wetland design was developed in accordance with the DRAFT Design, Construction and Establishment of Constructed Wetlands: Design Manual (MWC 2014) and informed by WSUD Engineering Procedures: Stormwater (Melbourne Water, 2005). The Growling Grass Frog ponds have been designed in accordance with DELWP requirements and Melbourne Water's draft guidelines. An options analysis was undertaken to determine the optimum arrangement for the frog ponds, including an analysis of the benefits of including a single large pond or two medium sized ponds.

**Yarragon Flood Modelling and Drainage Strategy, Baw Baw Shire Council:** Paul project managed and undertook the majority of technical work for this study, which involved a comprehensive analysis of the Yarragon drainage system based on a range of information, including the results of a 2D hydraulic model produced as part of the project. Paul facilitated two community consultations with residents from Yarragon and other key stakeholders, while a comprehensive collation and review of drainage data formed vital inputs to study. A series of structural and non-structural measures were identified to improve the management and performance of the Yarragon drainage system. The hydraulic model was used to assess the feasibility of future development in Yarragon and to identify works to control the impact of future development on the township.
Brandon Park Reserve Retarding Basin Design Review, City of Monash: The study involved the development of a hydrological (RORB) and two-dimensional hydraulic model (TUFLOW) model build for a catchment before and after the construction of a retarding basin and determining flood extents for design and recorded rainfall events. This allowed Council to gain an understanding of the change in hydraulic performance of the drainage network and flood extents due to the construction of a retarding basin. Additional work involved identification and modelling design refinements to improve the performance of the system.

Mallia Drive Dam Break Analysis, Esler & Associates: The study involved development of a TUFLOW model including a proposed retarding basin, with the model set up to simulate the dynamic failure of a dam wall in storm events up to the probable maximum flood. Key outputs included flood maps and video animations showing differences in flood extents and depths due to the failure of the dam wall compared to the existing scenario.

Hazeldean Road Retarding Basin Detailed Design, Baw Baw Shire Council: Paul project managed and undertook technical works as part of the detailed design for a retarding basin and open channel drainage system adjacent to Hazeldean Road, Yarragon. The design followed previous work undertaken by Engeny at Yarragon that identified the magnitude of an existing flooding problem for a residential development located adjacent to Hazeldean Road. The design objectives for this project were to mitigate the existing flooding problem and to allow future development in the area by intercepting and retarding overland flow. The design included a series of drop structures to reduce flow velocity within the open channel and a retarding basin outlet arrangement that reduced peak catchment flows whilst avoiding impact to a gas transmission pipeline located near the outlet.

Randwick Avenue Bioretention Design, Urban Design Management: Paul project managed and undertook the design of a bioretention system as part of Stage 1 of the Randwick Avenue development in Bacchus Marsh. Engeny's design was in accordance with WSUD Engineering Procedures (CSIRO/Melbourne Water, 2005), Constructed Wetlands Guidelines (Melbourne Water, 2010) and Infrastructure Design Manual Version 4.2 (November 2013). Engeny's tasks included water quality modelling (MUSIC), design calculations of bioretention system key parameters and plans to indicate how the proposed asset will fit within the creek corridor.

Dunes Drain Floodway Design, WBCM: Paul was the project manager and project engineer for a design of the Dunes Drain. The drain was designed as a 100 year ARI floodway, and satisfied Melbourne Water requirements including freeboard, safety requirements in terms of maximum velocities and flow depths, maintenance access and environmental considerations. The design included three rock chutes in order to slow down flow along the steep floodway. Melbourne Water provided approval of Engeny's design.
EJ Whitten Bridge Water Sensitive Road Design, VicRoads: Responsibilities included the project management of a study analysing the current bridge drainage and the impacts of the proposed widening of the bridge on drainage and water quality. The project involved hydraulic calculations of pit and pipe capacities to determine whether overland flows on the bridge are acceptable and development of water sensitive road design options to treat runoff from the expanded bridge deck.

Merri Creek Bike Trail Hydraulic Assessment, City of Moreland: This project analysed changes to flooding of Merri Creek due to the proposed elevation of the shared bicycle / pedestrian path to improve cyclist and pedestrian safety. Responsibilities included modification of existing HEC-RAS model to take into account the potential blockage from the proposed bike path, field inspections, collation of results and documentation to be provided to Melbourne Water on behalf of Council to seek approval for the works.

Colac-Ballarat Road Drainage Impact Assessment, VicRoads: The study involved an assessment of drainage performance in a rural area before and after a proposed development. A RORB model and TUFLOW model were developed to provide flood maps showing changes to flood extents and provide VicRoads with advice to help base their approval or rejection of the development.

Copelands Road Drainage Strategy, Baw Baw Shire Council: The study investigated the requirements for stormwater works for proposed residential development in the Copelands Road catchment, east of Warragul. Tasks conducted included hydrological (RORB) and MUSIC modelling to ensure that adequate flow retardation is provided by the development, as well as concept design of wetland and retarding basins. Responsibilities also included meetings with Council and developers.

Capital Avenue Overland Flow Investigation, City of Monash: This project looked at high level options to improve flooding at a known problem area for Council, where a Melbourne Water pipe track crosses Capital Avenue. Work involved reviewing plans provided by Melbourne Water, site visit with council to discuss options and a report to provide council with advice on how the drainage situation could be improved.

Mosaic Stage 5 Wetland Safety Audit, Meinhardt Infrastructure and Environment: Project involved review of design plans for proposed wetlands and sedimentation ponds to assess whether Melbourne Water Guidelines and Royal Lifesaving Guidelines are satisfied.

Underbank Farm, Kataland: The study involved a surface water investigation for a large development in Bacchus Marsh. Key tasks included 1-D hydraulic modelling to produce flood extents for internal and adjacent waterways, identification of WSUD measures to achieve Best Management water quality objectives and reporting of suitable quality and detail to submit to Council and regulatory authorities for approval.
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<th>2006 - 2010</th>
<th>Engineer, MWH, Melbourne</th>
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**Highlands Estate Raingarden Testing, Stockland**: The study including field testing of filter media hydraulic conductivity rates to determine whether rates are in the desired range as well as a general assessment of raingardens in order to provide recommendations on whether the raingarden was ready for handover to Council.

Employed in the Network Planning Group gaining experience on a wide variety of hydraulic modelling, planning and design projects for sewer, water supply and recycled water systems. While employed with MWH, Paul spent time on secondments at South East Water Limited (Victoria), Gladstone Regional Council (Queensland) and the Utility Services Alliance (capital works delivery alliance incorporating South East Water, Thiess Services, Siemens Limited and MWH).

**EDUCATION**

| 2006         | Bachelor of Engineering (Civil) (Hons), Monash University, Melbourne |
APPENDIX C

Planning Report
PROPERTY DETAILS
Address: 321 OLD DANDENONG ROAD DINGLEY VILLAGE 3172
Lot and Plan Number: Plan PC370984
Standard Parcel Identifier (SPI): PC370984
Local Government Area (Council): KINGSTON
Council Property Number: 454488
Planning Scheme: Kingston
Directory Reference: Melway 88 A2

UTILITIES
Rural Water Corporation: Southern Rural Water
Melbourne Water Retailer: South East Water
Melbourne Water: inside drainage boundary
Power Distributor: UNITED ENERGY

STATE ELECTORATES
Legislative Council: SOUTH-EASTERN METROPOLITAN
Legislative Assembly: CLARINDA

UTILITIES
Rural Water Corporation: Southern Rural Water
Melbourne Water Retailer: South East Water
Melbourne Water: inside drainage boundary
Power Distributor: UNITED ENERGY

STATE ELECTORATES
Legislative Council: SOUTH-EASTERN METROPOLITAN
Legislative Assembly: CLARINDA

Planning Zones
GREEN WEDGE ZONE (GWZ)
GREEN WEDGE ZONE - SCHEDULE 2 (GWZ2)

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Notwithstanding this disclaimer, a vendor may rely on the information in this report for the purpose of a statement that land is in a bushfire prone area as required by section 32C (b) of the Sale of Land 1962 (Vic).
Planning Overlay

DETAILED ESNH AND DEVELOPMENT OVERLAY (DDO)
DETAILED ESNH AND DEVELOPMENT OVERLAY - SCHEDULE 5 (DDO5)

Note: due to overlaps, some overlays may not be visible, and some colours may not match those in the legend.
Planning Overlays

OTHER OVERLAYS
Other overlays in the vicinity not directly affecting this land

AIRPORT ENVIRONS OVERLAY (AEO)
HERITAGE OVERLAY (HO)
LAND SUBJECT TO INUNDATION OVERLAY (LSIO)
PUBLIC ACQUISITION OVERLAY (PAO)
SPECIAL BUILDING OVERLAY (SBO)

Note: due to overlaps, some overlays may not be visible, and some colours may not match those in the legend.

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Areas of Aboriginal Cultural Heritage Sensitivity

All or part of this property is an ‘area of cultural heritage sensitivity’.

‘Areas of cultural heritage sensitivity’ are defined under the Aboriginal Heritage Regulations 2018, and include registered Aboriginal cultural heritage places and land form types that are generally regarded as more likely to contain Aboriginal cultural heritage.

Under the Aboriginal Heritage Regulations 2018, ‘areas of cultural heritage sensitivity’ are one part of a two part trigger which require a ‘cultural heritage management plan’ be prepared where a listed ‘high impact activity’ is proposed.

If a significant land use change is proposed (for example, a subdivision into 3 or more lots), a cultural heritage management plan may be triggered. One or two dwellings, works ancillary to a dwelling, services to a dwelling, alteration of buildings and minor works are examples of works exempt from this requirement.

Under the Aboriginal Heritage Act 2006, where a cultural heritage management plan is required, planning permits, licences and work authorities cannot be issued unless the cultural heritage management plan has been approved for the activity.

For further information about whether a Cultural Heritage Management Plan is required go to [http://www.aav.nrms.net.au/aavQuestion1.aspx](http://www.aav.nrms.net.au/aavQuestion1.aspx)

Further Planning Information

Planning scheme data last updated on 5 December 2018.

A planning scheme sets out policies and requirements for the use, development and protection of land. This report provides information about the zone and overlay provisions that apply to the selected land. Information about the State and local policy, particular, general and operational provisions of the local planning scheme that may affect the use of this land can be obtained by contacting the local council or by visiting https://www.planning.vic.gov.au

This report is NOT a Planning Certificate issued pursuant to Section 199 of the Planning and Environment Act 1987. It does not include information about exhibited planning scheme amendments, or zonings that may abut the land. To obtain a Planning Certificate go to Titles and Property Certificates at Landata - https://www.landata.vic.gov.au

For details of surrounding properties, use this service to get the Reports for properties of interest.

To view planning zones, overlay and heritage information in an interactive format visit http://mapshare.maps.vic.gov.au/vicplan

For other information about planning in Victoria visit https://www.planning.vic.gov.au

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Notwithstanding this disclaimer, a vendor may rely on the information in this report for the purpose of a statement that land is in a bushfire prone area as required by section 32C (b) of the Sale of Land 1962 (Vic).
This property is not in a designated bushfire prone area. No special bushfire construction requirements apply. Planning provisions may apply.

Designated bushfire prone areas as determined by the Minister for Planning are in effect from 8 September 2011 and amended from time to time.

The Building Regulations 2018 through application of the Building Code of Australia, apply bushfire protection standards for building works in designated bushfire prone areas.

Designated bushfire prone areas maps can be viewed on VicPlan at [http://mapshare.maps.vic.gov.au/vicplan](http://mapshare.maps.vic.gov.au/vicplan) or at the relevant local council.

Note: prior to 8 September 2011, the whole of Victoria was designated as bushfire prone area for the purposes of the building control system.

Further information about the building control system and building in bushfire prone areas can be found on the Victorian Building Authority website [www.vba.vic.gov.au](http://www.vba.vic.gov.au).


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APPENDIX D

Melbourne Water December 2018
Flood Information
APPENDIX E

Melbourne Water January 2019
Flood Information
Hi Paul,

Thank you for your email of 22 January 2019. Please see below screenshots of total, asset and overland flows.
Total Flow

Please let me know if you have any questions.

Kind Regards,
APPENDIX F

Mordialloc Bypass EES Flood Information Relevant to 321 Old Dandenong Road
5.3 Existing extent of flooding in the 1% AEP flood event (Map 1 of 7)
5.3 Existing extent of flooding in the 1% AEP flood event (Map 2 of 7)
APPENDIX G

2017 Survey Plans
APPENDIX H

Engeny Revised Flood Maps
321 Old Dandenong Road

Flood Depth Map
Validation of flood model to
Melbourne Water 1% AEP Flood
Extent based on 2006/07 terrain data

Job Number: V1280_001
Revision: 1
Drawn: HT
Checked: AP
Date: 12/2/2019
Flood Depth Difference Map between 2017 terrain compared to 2006/07 terrain.

321 Old Dandenong Road

Legend

- Flood Map Extent
- Site Boundary
- Property Boundary

Depth Difference (m)
- Depth reduction greater than 1.00 m
- Depth reduction between 1.00 m and 0.50 m
- Depth reduction between 0.50 m and 0.03 m
- No change in depth (Depth between -0.03 m and 0.03 m)
- Depth increase between 0.03 m and 0.50 m
- Depth increase between 0.50 m to 1.00 m
- Depth increase greater than 1.00 m

Wet Dry Cells
- Decrease in Flood Extent
- Increase in Flood Extent

Scale in metres (1:2,000 & A3)
Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia
Vertical Datum: Australia Height Datum
Grid: Map Grid of Australia, Zone 55

Job Number: V1280_001
Revision: 1
Drawn: HT
Checked: AP
Date: 13/2/2019