SINCLAIR KNIGHT MERZ

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URBAN DIGITAL ELEVATION MODELLING IN HIGH PRIORITY AREAS PROJECT:

USE OF HYDROLOGICALLY ENFORCED AND CONDITIONED DIGITAL ELEVATION MODELS FOR COASTAL INUNDATION MODELLING

- Version 1
- 8 September 2011

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Sinclair Knight Merz
ABN 37 001 024 095
Level 11, 452 Flinders Street, Melbourne 3000
Tel: +61 3 8668 3000
Fax: +61 3 8668 3001
Web: www.skmconsulting.com

A report to the Cooperative Research Centre for Spatial Information and Australian Government Department of Climate Change and Energy Efficiency.

Executive Summary

As part of the Urban Digital Elevation Modelling (UDEM) project, airborne LiDAR was acquired in partnership with State jurisdictions over priority coastal areas. These data sets were modified to produce hydrologically enforced and conditioned DEMs (Hydro-DEMs) to ensure that the DEM appropriately represented the natural water flow across the land surface to be suitable for coastal inundation studies.

The purpose of this report is to identify and qualitatively evaluate the benefits of the hydrological enforcement and conditioning processes in the context of creating hydro-DEMs for modelling coastal inundation due to selected sea level rise scenarios. The objectives are to understand the extent to which enforcement and conditioning improve the resultant inundation footprints and to determine under what circumstances the development of a Hydro-DEM is justified (and to what level or processing) when attempting to determine the inundation extents resulting from sea level rise and storm surge modelling scenarios. The key findings are:

1) Inundation modelled by the Hydro-DEM is most effective when examined at a sub-LGA scale

2) In order to be fit for Hydro-DEM generation, LiDAR DEM data needs to meet Intergovernmental Committee on Surveying and Mapping (ICSM) Accuracy Category 1 and Classification Level 3 as specified in the ICSM LiDAR Acquisition Specifications and Tender Template (http://www.icsm.gov.au/elevation/index.html).

3) Supplementary data (eg stormwater networks) would greatly improve accuracy in localised areas (eg. suburban) and it is recommended that available data sets be incorporated, where feasible, into the project methodology to provide an improved result.

Based on the key findings, recommendations are presented as a guideline for an appropriate methodology to follow to meet user requirements. The methodology adopted for the production of inundation polygons should be determined based on the scale and accuracy of the inundation mapping required. For smaller scale studies, over a local government area (LGA) for example, where a general overview is sufficient, a Standard DEM coupled with a simple bathtub inundation modelling approach is adequate. For detailed, larger scale inundation analysis of suburban and sub-LGA areas requiring reliable definition of inundation polygons defined down to the property/parcel level, a full Hydro-DEM incorporating pseudo drainage connections is recommended.

Contents

1. Introduction

1.1. Project Background

Australia's coastal zone is highly vulnerable to the potential impacts of climate change due to the concentration of Australia's population, and the exposure of natural and built assets in coastal areas. Around 85 per cent of Australians live within 50 km of the coast, 25 percent lives within three km, and almost six million people live in coastal areas outside the capital cities. Climate change is expected to impact on the coastal zone through sea level rise, increases in sea surface temperature, changes to ocean acidity levels, and changes in the frequency, intensity and location of mid-latitude storms and tropical cyclones.

In Australia, national, state and local governments are concerned about the risks and costs associated with potential damage to housing, infrastructure and natural ecosystems in vulnerable coastal areas. There is growing demand across all levels of government for an improved capacity to quantitatively assess risks to infrastructure, communities and natural systems from coastal inundation and other potential impacts of climate change. A key impediment to the development of this capacity has been the absence of high-resolution elevation data that enables an effective assessment of climate change risks and adequately informs investment decisions and adaptation efforts.

Over recent years there has been a dramatic increase in the acquisition of airborne LiDAR data for the purpose of producing high resolution DEMs for modelling coastal inundation. As part of the Urban Digital Elevation Modelling (UDEM) project, airborne LiDAR data was acquired in partnership with State jurisdictions over priority coastal areas, including Darwin, Perth, Adelaide, South East Queensland, Melbourne, Sydney and the NSW Central and Hunter Coast. Five of these data sets were modified to produce hydrologically enforced and conditioned DEMs (from here on referred to as Hydro-DEMs) with the objective of more realistically representing the natural water flow across the land surface to be suitable for coastal inundation studies.

The process of hydrological conditioning and enforcement are explained in more detail in Appendix B. These modifications result in surfaces that differ significantly from a standard DEM. A "hydro-conditioned" surface has sinks filled and may have water bodies flattened. This is necessary for flow modelling within and across large drainage basins. "Hydro-enforcement" extends this conditioning by requiring water bodies be levelled and streams flattened with the appropriate downhill gradient, and also by cutting through road crossings over streams (eg culvert locations) to allow a continuous flow path for water within the drainage. Both treatments result in a surface on which water behaves as it physically does in the real world, and both are invaluable for specific types of hydraulic and hydrologic (H&H) applications. Neither of these treatments is typical of a traditional DEM surface.

1.2. Project Purpose & Objectives

The purpose of this project has been to identify and qualitatively evaluate the benefits of the hydrological enforcement and conditioning processes in the context of creating hydro-DEMs for modelling coastal inundation due to selected sea level rise scenarios.

The project had two objectives. The first objective was to compare samples of standard DEMs and Hydro-DEMs using a range of sea level rise scenarios to understand the extent to which enforcement and conditioning improve the resultant inundation footprints.

A second objective has been to determine under what circumstances the development of a Hydro-DEM could be justified (and to what level or processing) when attempting to determine the inundation extents resulting from sea level rise and storm surge modelling scenarios.

To achieve these objectives, inundation extents derived from Hydro-DEMs have been compared to inundation extents derived from standard LiDAR DEMs. Based on the key findings, recommendations are presented as a guideline for an appropriate methodology to follow to meet user requirements.

2. Methodology overview

Airborne LiDAR produces high resolution elevation data which can be classified as ground or non-ground. The separation of ground and non-ground points means that elevation can be modelled as the bare earth (derived from ground points) or as a surface as seen from above (derived from a combination of ground and non-ground points); the bare earth model is most suited to hydrologic applications as it best represents the natural land surface.[1] However, there are often limitations to bare earth models caused by errors and anomalies in the LiDAR data. The presence of misclassifications of ground data causes anomalies and can impact the ability of the LiDAR DEM to accurately represent surface water flow. Without removal of anomalies and the enforcement of local drainage features, erroneous results will be produced when undertaking inundation modelling.

A series of LiDAR data sets were acquired from a cross-section of suppliers over the period from mid 2008 – mid 2010 to form the primary input data for the generation of inundation layers. The LiDAR data was then modified to remove anomalies and include natural water flow and drainage channels to create Hydro-DEMs. These datasets formed the basis for modelling coastal inundation.

2.1. Standard DEM Development

The standard DEM product was generated from the original LiDAR data for Hydro-DEM comparative purposes using a TIN process. This DEM is here on referred to as the standard DEM. The standard DEM product has not been altered to take into account hydrological processes.

2.2. Hydro-DEM Development

Hydro-DEMs (both hydrologically enforced and conditioned) were generated from the LiDAR ground points by filling in sinks and deriving stream patterns to ensure streams flow downhill. This includes creating pseudo-drainage lines to enforce flow through obstacles, such as roads[2].

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[1] Appendix A - Elevation representation
[2] Appendix B – Detailed Hydro-DEM methodology

2.3. Sea level rise scenarios

To complete the first objective the sea level rise scenarios were applied to both DEMs for the computation of inundation extents.

Three sea level rise scenarios (low, medium and high) were chosen from the Intergovernmental Panel on Climate Change (IPCC) projections. The low scenario (IPCC B1) represents sea level rise that is likely to be unavoidable. The medium scenario (IPCC A1F1) is in line with recent global emissions and observations of sea level rise. The high end scenario considers the possible high-end risk identified in 4th Assessment Report (AR4) and includes new evidence on icesheet dynamics published since 2006 and after AR4[3].

The inundation layers have been prepared by combining a sea level rise value with a nominal high astronomical tide (HAT) value for 5 sample coastal regions, see Table 2-1. The sample areas include Central and Hunter Coasts, Melbourne, Perth, South East Queensland and Sydney[4].

- **Table 2-1. Sea level rise scenarios for sample coastal regions**

Sea level Scenario	*Central & Hunter Coast*	*Melbourne*	*Perth*	*Gold Coast*	*Brisbane*	*Sydney*
Low (IPCC B1)	1.6 m	1.4 m	1.2 m	2.0 m	2.0 m	1.6 m
Medium (IPCC A1F1)	2.0 m	1.6 m	1.4 m	2.2 m	2.2 m	2.0 m
High (AR4)	2.2 m	2.0 m	1.8 m	2.6 m	2.6 m	2.2 m

Bathtub modelling was used to compute the inundation extent for each sea level rise scenario against both the Standard and Hydro-DEMs. This is a simplified approach to modelling inundation which consists of filling the model to a constant depth. Inundation is then assumed to occur at a constant elevation with no environmental factors other than the sea level rise scenarios list in Table 2-1 used to determine water levels. Sea connectivity is typically disregarded in this context as water flow is not being modelled.

[3] IPCC, 2007. *Climate Change 2007 Fourth Assessment Report*. Cambridge University Press.
[4] Appendix C – Sample area descriptions

3. Key findings

The benefits of Hydro-DEMS over Standard DEMs is dependent on the quality of the input data (as per finding (2) below); the nature of the landscape; and the scale at which the inundation layers are interpreted. This has been found by generating the bathtub inundation layers against the Standard DEM and the Hydro-DEM to assess the impact of the hydro-enforcement and conditioning on the resultant inundation model. The key findings from this process, are elaborated upon further within this section, and are listed as follows:

1) Sea level rise inundation modelled from the Hydro-DEM using a bathtub approach is only noticeable against inundation from a standard DEM when examined at the sub-local government area scale.

2) In order to be fit for Hydro-DEM generation, LiDAR data needs to meet appropriate specifications. Under the ICSM Guidelines and Specifications[5], the LiDAR data should adhere to ICSM fundamental accuracy Category 1, indicating a vertical accuracy of ± 0.3m @ 95% confidence (equivalent to 0.15m @ 68% confidence), and LiDAR point cloud classification level 3 (ground correction). This addresses the requirement for ground points to be correctly classified in complex landscapes over localised areas; with special attention paid near watercourses. LiDAR data of this quality will reduce the costs associated with producing Hydro-DEMs, improve the modelling results and maximise the value of the data for other uses. The LiDAR data supplied for this analysis was supplied as classification level 2 which fell short of the ideal specifications, although efforts were made to correct shortcomings.

3) Supplementary data, for example stormwater networks, will improve the quality of a Hydro-DEM. Whilst the assessment of this data was outside the scope of this project, it is worth noting that additional datasets, which provide information on water flow, improve the quality of Hydro-DEMs. These datasets are critical to improving hydraulic and hydrologic modelling for the computation of inundation scenarios which require a high accuracy within small areas (sub-local government).

[5] ICSM, 2008. Guidelines for Digital Elevation Data version 1.0, August 12, 49 pages; ICSM 2010, ICSM LiDAR acquisition specifications and tender template, version 1.0, October, 31 pages

3.1. Differences between inundation extents

At regional and LGA scales, there was little significant difference in the inundation extent mapped based on the Standard DEM and Hydro-DEM, as exemplified in Figure 3-1.[6] However, differences become apparent when examining sub-LGA areas.[7] Artificial flows across roads, culverts and underground storm water drains were modelled by hydrologic enforcement in the Hydro-DEM, whereas this was disregarded in the Standard DEM and as such differences in these localised areas were evident, as indicated in Figure 3-2.

- **Figure 3-2. Left - Remnants of existing vegetation in the ground model cause water blockages in the TINDEM (light blue) but the hydro-enforcement and conditioning process eliminates these anomalies; Right - Bridges not removed from the LiDAR data impede water flow in the TINDEM but after removal in the Hydro-DEM water is allowed to pass through.**

- **Figure 3-1. At regional and LGA scales, there was little significant difference in the inundation extent mapped based on the Standard DEM (blue) and Hydro-DEM (red). The Hydro-DEM is shown underneath, with any differences coming up as red on the map.**

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[6] Appendix D – Comparison of inundation extents derived from TINDEM and Hydro-DEM per sample area
[7] Appendix E – Comprehensive comparison of inundation extents derived from TINDEM and Hydro-DEM per LGA

Figure 3-2. Left - Remnants of existing vegetation in the ground model cause water blockages in the TINDEM (light blue) but the hydro-enforcement and conditioning process eliminates these anomalies; Right - Bridges not removed from the LiDAR data impede water flow in the TINDEM but after removal in the Hydro-DEM water is allowed to pass through.

This finding is supported by similar independent inundation studies commissioned by local government and state agencies which have produced visually consistent inundation products when viewed at a small scale; however differences become apparent when inspecting localised areas.[8]

3.2. LiDAR Accuracy and Classification Requirements

The quality of the classified LiDAR points is fundamental to accurately producing a Hydro-DEM. A high quality classified LiDAR product lessens the cost of creating a Hydro-DEM by easing the creation process so that it requires less manual intervention.

High quality classified LiDAR products are dependent upon the post-processing effort applied to the LiDAR points to correctly filter and classify the elevation data into ground and non-ground points. Differences in inundation layers will be more pronounced where there are obstructions to water flow caused by incomplete or poor classification of LiDAR points, ie. generally where non-ground points are incorrectly classified as ground points.

[8] Appendix F – Comparison to other inundation studies.

Classification errors give rise to elevation errors, which generally manifest themselves as elevation spikes in the DEM. These can lead to erroneous water flows.

This review used LiDAR data of varying standards from different suppliers; an issue this created was that the LiDAR data was not classified to the ICSM Specifications Level 3. This meant the LiDAR data was not at an ideal quality standard for computing sea level inundation for local government or smaller areas. It must be noted that the LiDAR datasets were within specification for the purposes for which it was acquired, however the level of processing required for sea level rise modelling has a more stringent specification than for other applications.

Another feature to note is that the ICSM Guidelines and Specifications require breaklines and flattening within a LiDAR DEM[9]. These two features can contribute to the quality of any subsequently produced Hydro-DEM. The breaklines are used to represent areas with sharp elevation drop-offs and flattening is used to fix elevations at a constant height around water features. Both these attributes can assist in producing a higher quality Hydro-DEM if used.

The requirements for the creation of Hydro-DEMs are listed in Table 3-1. In the Hydro-DEM, anomalies caused by incorrect point classification were removed from the source data and addressed during the hydro-conditioning and enforcement process. Although an iterative process was developed to undertake these tasks, there was a significant amount of manual intervention required to correct these point classification errors.

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[9] ICSM 2010, ICSM LiDAR acquisition specifications and tender template, version 1.0, November, 34 pages

▪ **Table 3-1. Surface representation requirements for coastal inundation modelling**

Surface	*Requirement for coastal inundation modelling*	*Project LiDAR data*	*Project method of meeting requirement*
Bridges and overpasses	Bridges and overpasses removed.	Not all bridges and overpasses removed.	Bridge surfaces lowered and replaced with logical stream-flow surface.
Buildings and vegetation	Buildings and vegetation removed from the surface.	Remnants of existing vegetation present.	Removed from the surface during condition and enforcement process through iteration. Gaps were cut through trees in the stream network effectively smoothing out the data.
Water bodies	Pulses reflecting off water ripples removed.	Artefacts present near water bodies.	Breaklines introduced along drainage channels to ensure no false dams or puddles represented in the model.
Culverts	Surface should reflect drainage features	Drainage through culverts not depicted.	Large concrete culverts easily identified from project aerial imagery were removed. Small culverts, such as concealed pipe culverts, were not modelled as there was no supplementary information determining the location of these pipes.
Sinks	Verification of sinks and depict as depressions.	Sinks present.	Sinks filled within specified tolerances by raising elevations.

The ICSM has developed guidelines for digital elevation data under the National Elevation Data Framework (NEDF). The ICSM guidelines recommend 4 categories of fundamental accuracies for elevation surveys – Category 1, Category 2, Category 3 and Special Order. LiDAR surveys must conform to ICSM Category 1 standard, indicating a vertical accuracy of ± 0.3m @ 95% confidence (or ± 0.15m @ 68% confidence) [10].

ICSM has also developed LiDAR acquisition specifications covering point cloud classification levels – level 0: undefined, level 1: automated and semi-automated classification, level 2: ground surface improvement, level 3: ground corrections and level 4: detailed classification correction[11]. The most appropriate category to fulfil requirements for accurate coastal inundation modelling is LiDAR point cloud classification level 3. This

[10] ICSM, 2008. Guidelines for Digital Elevation Data version 1.0, August 12, 49 pages.
[11] ICSM 2010, ICSM LiDAR acquisition specifications and tender template, version 1.0, November, 34 pages

addresses the need for ground points to be correctly classified in complex landscapes over localised areas; with special attention paid near watercourses. As part of this standard, detailed information on breaklines and the use of hydro-flattening also need to be included for the computation of coastal inundation. Higher accuracy and classification integrity within the source LiDAR data will lead to improved hydro-enforcement in the DEM, with significantly less effort being required in the conditioning process.

3.3. Supplementary Data Requirement

A shortcoming in the project methodology was that subjective assumptions based on visual interpretation of imagery needed to be made about where to locate water connections for the hydro-enforcement. Although this is adequate when the purpose is intended for inundation from coastal processes over a local government area, additional information would be required to implement more detailed modelling. Models over areas smaller than a suburb require supplementary data describing stormwater networks, including engineering diagrams, to enable the accurate modelling of water flow and drainage.

Supplementary data (eg stormwater networks) would greatly improve accuracy in small areas and it is recommended that available data sets be incorporated, where feasible, into the project methodology to provide an improved result.

4. DEM Recommendations for Coastal Inundation

All DEMs, regardless of product enhancement, can be used to model the impact of coastal inundation; however the result will vary depending on the type of processing methodology. Based on the key findings outlined in section 3, different levels of DEM pre- and post-processing can be used to meet specific user needs. These options are listed in Table 4-1.

- **Table 4-1. DEM processing options for modelling coastal inundation**

Option	*LiDAR Data Classification*	*Additional DEM Processing*	*Scale of Use*
1	ICSM Level 2	None	Regional or Statewide
2	ICSM Level 3	None	Regional or Statewide
3	ICSM Level 3	Water Flow Enabled	Statewide or Catchment
4	ICSM Level 3	Water Flow and Pseudo Channels Created Using Aerial Photography Interpretation	Local Government Area
5	ICSM Level 3	Water Flow and Pseudo Channels Created Using Detailed Storm Water Information	Sub-LGA

For a high quality DEM, especially used within options 3-5, breaklines at elevation drop-offs and hydro-flattening around water bodies would be required. The more localised the final coastal inundation product, the more detailed this information should be when creating the DEM.

Although all options presented above can be used to model coastal inundation extents using a bathtub approach, options 3-5 would provide benefits in supporting further hydraulic and hydrologic projects. It is already recognised that Hydro-DEMs are invaluable for hydraulic and hydrologic modelling activities and may be realised for coastal inundation modelling when integrated catchment and coastal flood modelling is developed. This is because the connectivity features of a Hydro-DEM are essential for computing the physical flow of water in the natural environment. In these scenarios sea connectivity is essential to the modelling of inundation extent.

The requirements and recommendations for each option in Table 4-1 are presented in Table 4-2. Each of the DEM options is aligned with a recommended scale of use and a coastal inundation modelling option.

Table 4-2. Comparison of inundation modelling options

	Option 1 *Regional and Statewide Scales*	***Option 2*** *Regional and Statewide Scales*	***Option 3*** *DEM Models Flow Catchment and Statewide Scales*	***Option 4*** *DEM Contains Pseudo-Channels Local Government Scale*	***Option 5*** *Storm Water Generated Pseudo-Channels Sub -Local Government or Suburb Scales*
Input Data					
LiDAR Data	Lvl2	Lvl3	Lvl3	Lvl3	Lvl3
Aerial Imagery	No	No	Yes	Yes	Yes
Stormwater Data	No	No	No	No	Yes
Output DEM	Standard DEM	Standard DEM	Hydro-Conditioned DEM	Hydro-Enforced and Conditioned DEM	Hydro-Enforced and Conditioned DEM (Higher Accuracy)
DEM Processing Method	No additional processing	No additional processing	Fill sinks to allow surface flow	Fill sinks to allow surface flow and enforce drainage by cutting and lowering elevations to create pseudo drainage connections	Fill sinks to allow surface flow and enforce drainage using detailed stormwater engineering plans to create pseudo drainage connections
Inundation Modelling Recommended	Bathtub	Bathtub	Bathtub or Hydro Modelling	Appropriate for accurately modelling coastal inundation with hydrologic connectivity or catchment flooding (or both combined).	
Pros and Cons					
DEM Post Processing	None Required	None Required	Less exhaustive than Options 4 and 5	Additional effort required to interpret and enforce connections	Expensive and time consuming making it only suitable for smaller study areas
Relative Accuracy	Lowest	DEM more accurate than Option 1	Inundation predictions more accurate than Option 2	Inundation connectivity more accurate than Option 3	Inundation and drainage channels more accurate than Option 4
Additional Applications	Options 2-5 provide additional high accuracy applications because the LiDAR data is classified to ICSM level 3.				
Required Budget	Progressively more funding and time is required to complete each additional option				

5. Conclusion

This report has reviewed the hydrological enforcement and conditioning process in the context of creating Hydro-DEMs for purposes of inundation studies due to sea level rise and storm induced events in coastal regions. All DEMs, regardless of product enhancement, can be used to model the impact of coastal inundation; however the result will vary depending upon the type of processing methodology. At regional and LGA scales, there was little significant difference in the inundation extent mapped based on the Standard DEM and Hydro-DEM. However, differences become apparent when examining sub-LGA areas.

The most appropriate category to fulfil requirements for coastal inundation modelling at sub-LGA scale is ICSM fundamental accuracy Category 1, indicating a vertical accuracy of ±0.3m @ 95% confidence, and LiDAR point cloud classification level 3, addressing the need for ground points to be correctly classified in complex landscapes over localised areas with special attention paid near watercourses. It is essential to Hydro-DEM generation that the LiDAR data fits required specifications, as this will reduce production costs, yield improvements in the modelling, and maximise the value of the Hydro-DEM data for other uses.

The methodology adopted for the production of inundation polygons should be determined based on the scale and accuracy of the inundation mapping required. For LGAs and larger areas where a general overview is likely sufficient, a standard DEM using a bathtub approach is recommended. For detailed inundation analysis at sub-LGA scale which requires accurate and reliable definition of inundation extents defined down the property/parcel level, a full Hydro-DEM incorporating pseudo drainage connections is recommended.

Glossary

A1FI	IPCC medium scenario is in line with recent global emissions and observations of sea level rise.
AR4	IPCC's 4th Assessment Report (IPCC, 2007. *Climate Change 2007 Fourth Assessment Report*. Cambridge University Press).
B1	IPCC low scenario represents sea level rise that is likely to be unavoidable.
Bathtub inundation	Bathtub modelling delineates inundation extents using water elevation level overlaid on ground elevation.
DEM	Digital Elevation Model - Typically used to describe elevation data that is gridded at a specified spacing as seen from above.
HAT	Highest Astronomical Tide Value.
Hydro-conditioned	A hydrologically conditioned a surface is achieved through post-processing of a DEM by filling some sinks, effectively smoothing the terrain data to remove anomalies.
Hydro-DEM	A hydrologically enforced and conditioned DEM represents the natural surface with all manmade structures removed or modified to ensure water flow.
Hydro-enforcement	A hydrologically enforced DEM extends hydro-conditioning by requiring water bodies be levelled and streams flattened with an appropriate downhill gradient, and also by cutting through man-made features and anomalies to allow a continuous flow path for water within drainage.
IPCC	Intergovernmental Panel on Climate Change.
LGA	Local Government Area.
LiDAR	Light Detection and Ranging is an optical technology which calculates the range to a target by measuring the time delay between transmission and detection of reflected laser pulses.
Standard DEM	A Digital Elevation Model generated from LiDAR 'ground' points formed using a TIN approach.
TIN	Triangular Irregular Network represents a continuous elevation surface created by using triangular surfaces to join points and lines, preserving the exact location of each elevation node.

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APPENDIX

- Version 1
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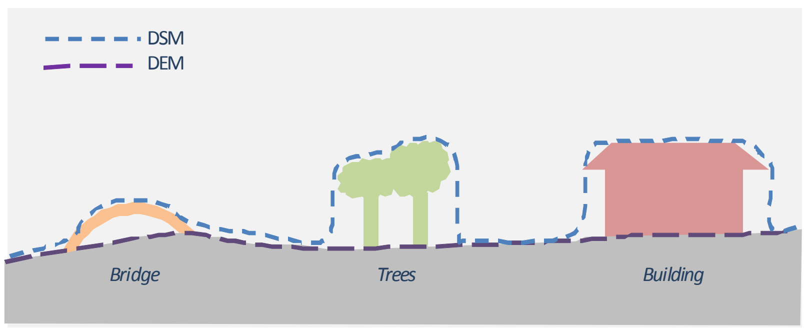
APPENDIX

- Version 1
- 9 September 2011

Sinclair Knight Merz
ABN 37 001 024 095
Level 11, 452 Flinders Street, Melbourne 3000
Tel: +61 3 8668 3000
Fax: +61 3 8668 3001
Web: www.skmconsulting.com

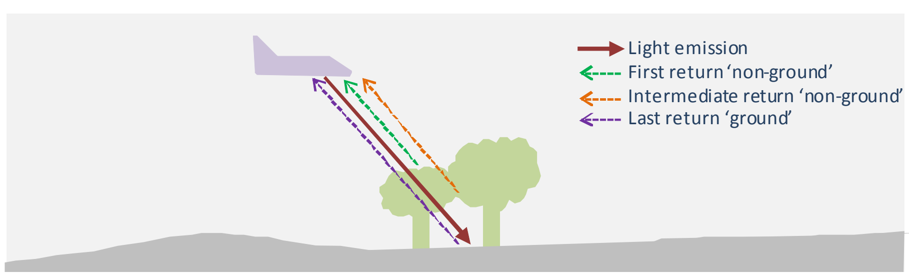
A. Elevation Representation

A Digital Elevation Model (DEM) is typically used to describe bare earth elevations that are gridded at a specified spacing. The term Digital Surface Model (DSM) is used to describe elevation data that includes buildings, vegetation and non ground features, see Figure A-1. Points and lines within DEMs or DSMs are joined by triangular surfaces to form a surface model. These are often referred to as a Triangular Irregular Network or a TIN.



- **Figure A-1. Elevation can be represented as the bare earth on the ground (DEM) or as a surface as seen from above (DSM).**

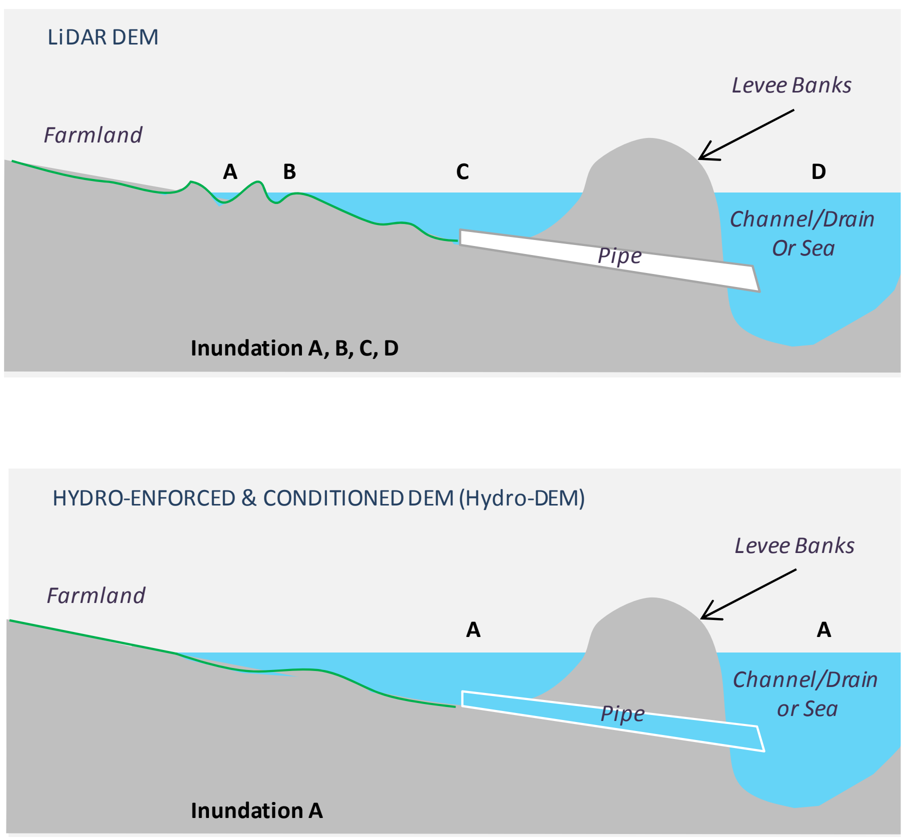
LiDAR is an optical technology which calculates the range to a target by measuring the time delay between transmission and detection of reflected laser pulses. A LiDAR first pulse measures the distance to the first object detected and the last pulse measures the distance to the last object detected; thus, it is possible to use first pulse measurements to derive a top of surface 'non-ground' model, and the last pulse measurements to derive a 'ground' model. The classification of 'ground' and 'non-ground' objects is often automatically post-processed by the data acquisition vendors. The quality of the surface representation is dependent on the LiDAR post processing system to correctly classify the laser profile strikes.



- **Figure A-2. A LiDAR first pulse measures the distance to the first object detected and the last pulse measures the distance to the last object detected; thus, it is possible to use first pulse measurements to derive a DSM 'non-ground' model, and the last pulse measurements to derive a topography DEM 'ground' model.**

B. Detailed Hydro-DEM methodology

It is natural for a DEM surface to have sinks or depressions, for example inland basins. In LiDAR this would be represented by single or multiple points which are surrounded by higher points. Some sinks, however, would be small anomalies as a result of the LiDAR technology which can cause problems when deriving stream networks by interrupting continuous water flow across the surface. A **hydro-conditioned** surface has sinks filled and may have water bodies flattened and is achieved through post-processing of the elevation data. **Hydro-enforcement** extends this conditioning by requiring water bodies be levelled and streams flattened with the appropriate downhill gradient, and also by cutting through man-made features, for example at road crossings over streams (culvert locations), to allow a continuous flow path for water within the drainage, see Figure B-1. The main difference between hydro-conditioning and hydro-enforcement is that the latter ensures connectivity.



- **Figure B-1. A Hydro-DEM not only considers natural features for hydrological connection but also takes into account the man-made structures in connectivity.**

In broad terms, the Hydro-DEM production methodology utilised a hybrid approach of applying TIN and ANUDEM based processes to ensure that hydrological stream enforcement was achieved whilst maintaining a metrically accurate DEM. The methodology is summaried below:

The basic process was to:

1) Create a regular DEM from raw LiDAR.

2) Force this DEM to flow by filling.

3) Derive a stream pattern from the above DEM.

4) Edit the stream pattern to be an accurate representation of the stream network aligned to high precision LiDAR as opposed to generalised cartographic streams. The editing process took into account imagery and any supplied cartographic streams. Direction these streams to flow downhill.

5) Create a new DEM using both LiDAR and the directioned streams to create an accurate flowing model. This was achieved through the use of ANUDEM software. This software, developed by the Australian National University uses a cell based mathematical model to create a surface, taking into account a given stream pattern.

6) Fill small noise from the DEM.

7) Ensure streams flow (the output of ANUDEM software should flow down the input streams but may not actually do so).

8) Create pseudo-drainage lines to make the entire DEM flow through obstacles such as roads.

9) Remove further noise using the same pseudo-drain method rather than filling which would raise elevations too much for purposes of inundation analysis.

QA

Steps 7 through 9 are repeated till a satisfactory result is achieved.

The main method of determining a satisfactory result was delineation of closed catchments via ESRI ArcGIS watershed analysis. All large closed catchments were investigated and as many smaller ones as possible within budget constraints.

Visual comparisons to mapping and imagery were used as well as visual inspection of derived hill shades.

Correction Issues

The following issues relate to methodology step 6 to 9 above.

a. **Noise removal**

Minor noise in the data was removed via a filling process of up to 0.2 metres which is the minimum difference between inundation polygon levels.

b. **Streams**

Streams, as derived from basic process step 4 and 5 above, were forced to flow where the original LiDAR did not have them doing so. Streams may not flow in a pure visual LiDAR model because of many reasons:

- Noise in the LiDAR returns. LiDAR accuracy is often quoted as 0.15 metres but it may bounce off the top of a tussock or the bottom of a puddle. For flow modelling purposes this is regarded as an error in source data.
- Occasional LiDAR returns from trees/bushes within the stream banks which filtering cannot determine. This is regarded as an error in source data.
- LiDAR returns from small road bridges that have not been removed in filtering. This is regarded as minor errors in original data processing as specifications for LiDAR usually require removal of bridge spans.
- Small dams along the stream. This is the real ground surface, yet water still flows down the stream, whether over the top or over a spillway or through a pipe bypass.

As we were simply after connectivity, cuts were made through all these obstructions and small noise removed with minor filling.

c. **Obstructions and Higher Levels of Data Noise**

After removal of minor noise and forcing the flow of actual streams, the remaining inconsistencies had to be addressed by subsequent processes.

It was considered undesirable to force interconnection by further filling. Many of these inconsistencies were LiDAR returns from small fences, landscaped gardens, road gutters, heavy grass, reeds, etc. Then there were large objects such as roads, small dams.

Interconnection was forced for these features by cutting through them with a pseudo-drain or culvert. Because an inundation polygon is defined as an area of land under a certain elevation it is not critical to know the exact path where rising sea levels would flow, only that it will be under water at a certain hypothesised sea level so long as there is any connection between an inundation polygon and the sea itself. Yet we attempted to cut through a logical line from the lowest point in the non-flowing catchment to a point past the obstruction that was equal to it or lower.

d. Dams and Levees

These are the most contentious of obstructions. It does not matter whether a dam or levee exists or not, if a piece of land is at an elevation below a certain hypothesised sea level it was deemed to be subject to inundation. The only question is whether it is physically connected to the sea or not. In the case of levees, imagery and the DEM itself were used to assess whether there was a connection.

A particular case is where there are obvious surface level drains across farmland heading to a major levee protected drain in low lying land. The small farm drains must go somewhere so there may be a pipe through which rainwater may pass to the major drain and hence to the sea.

Though there may be one, there is no proof that on the downhill side of the pipe there is a gravity forced flap gate to stop water from passing back up the pipe. There is also no evidence that this gate is completely waterproof, maintained or would be maintained if sea levels rose to a point where inside the major drain itself become the coast. Hence, this situation is treated as a two way flow and engineers, hydrologists and analysts can investigate the farmland as a potential problem. They can then ground truth and investigate the potential hazard and update the inundation polygon accordingly. For such an important dataset we took the most conservative approach. It was not considered part of this project to determine actual connectivity, only to model potential connectivity.

Many large dam walls were also breached to create connection based on assessment of the DEM and imagery. Nominally this should be at spillway level but may have been lower if water levels within the dam were low. Again this only affects connectivity. As many as possible small farm dams were breached as these were not considered any impediment to sea level rise.

e. Underground Storm Water Drains

It is important to note that by creating a connection that this does not imply that there would be any inundation water on the surface, only that water can pass between inundation polygons. To obtain a flow connection in the DEM, a constant slope groove one pixel wide was cut into the DEM where water would flow. In these places the DEM (and any inundation polygons) represent the underground drain rather than the land surface. To maintain this connectivity in vector format, the resultant polygons were buffered by another pixel form a single polygon rather than many single pixel polygons.

Thus, where an inundation polygon appears linear and is about six metres wide or less, it is quite possible that this represents an underground pathway for water and water may not be on the surface. In Figure B-2 and Figure B-3 a major drain is highlighted at the lower left corner. It flows into the creek at the right of the picture. A path was cut along the road from west to east to maintain connectivity, but inundation could only occur at the two drain ends.

- **Figure B-2.** The Western red arrow shows clearly a large entrance to an underground drain. The Eastern red arrow could be the exit point of the drain (this is difficult to clarify as the camera angle was from South West).

- **Figure B-3.** This is a mock up of a possible inundation polygon scenario. The thin part of the polygon is for connection purposes only, no water would be on the surface. Any such thin connecting lines should not be viewed as real surface inundation.

C. Sample area descriptions

Central and Hunter Coasts

The Central and Hunter coasts are representative of low lying developed areas along the NSW coast. Areas of agricultural land in low lying lands are interspersed by large tracts of native vegetation and urban development. Long coastal beaches are broken at frequent intervals by prominent head lands or large rivers that drain complex estuarine lake systems. Much of the urban development along this coast has occurred at strategic locations, such as river crossings or in the lee of coastal bluffs.

Melbourne

The central area of Melbourne is located at the northern end of Port Phillip Bay, at the mouth of the Yarra River. Port Phillip Bay, a semi-enclosed embayment, has a narrow entrance that constrains exchanges of marine water to Bass Strait. Much of the south and central areas of Melbourne have been built on low lying lands that required draining prior to development. The south eastern suburbs spread out along the eastern shore of the Bay, on similar low lying land that is separated by a narrow line of sand dunes, broken in regular intervals by minor creeks and drains.

Perth

The urban centre of Perth lies on a coastal plain and much of region was originally built on a series of freshwater wetlands. The metropolitan area has two major river systems; the first is made up of the Swan and Canning Rivers and the second is that of the Serpentine and Murray Rivers, which discharge into the Peel Estuary at Mandurah in the south. There are some large streams that flow to the Swan River or to the sea, but in general there is little flow to the sea. There are numerous basins and lakes.

South East Queensland

The South East Queensland region includes Brisbane and Gold Coast. The Brisbane CBD is located on the Brisbane River around 20 km upstream from where the river discharges into Morton Bay. The urban development of Brisbane spreads in all directions along the low lying flood plain of the Brisbane River valley between Moreton Bay in the east and Ipswich to the south west with many suburban creeks throughout the city. Away from the flood plains the city is hilly and undulating.

The topography of the Gold Coast consists of a coastal plain that includes rivers, bays, beaches and undulating hills. The area includes urban development, housing lakes and canals as well as remnant vegetation and agricultural areas. The Gold Coast has numerous drains often covered by bushes or too small to be depicted by LiDAR.

Sydney

Sydney's urban area is in a coastal basin. The coastal beaches are interspersed by rocky headlands with large cliff faces. The urban area is developed on gently rolling hills and estuarine lake systems occur where creeks and drains flow into the flatter coastal areas on the North Shore.

D. Comparison of inundation extents derived from Standard DEM and Hydro-DEM for each geographic region

Central Coast

- **Table D-1. HYDRO-DEM Standard DEM comparison for area and land parcels at inundation levels 1.6m, 2.0m and 2.2m on the Central Coast**

Inundation level	Analysis type	HYDRO-DEM	STDDEM	Difference	% Difference
1.6m	Total of discrete inundation areas (km^2)	3.846	12.978	-9.132	70%
	No. of discrete inundation areas	864	11031	-10167	92%
	Inundation area connected to sea (km^2)	149.484	140.418	9.066	6%
	Total number of land parcels affected	18351	16132	2219	12%
	No. of land parcels 100% covered	4862	4768	94	2%
	No. of land parcels covered 76% - 100%	3116	2814	302	10%
	No. of land parcels covered 51% - 75%	1927	1666	261	14%
	No. of land parcels covered26% - 50%	2472	2060	412	17%
	No. of land parcels covered < 25%	5974	4824	1150	19%
2.0m	Total of discrete inundation areas (km^2)	3.445	7.968	-4.523	57%
	No. of discrete inundation areas	702	8403	-7701	92%
	Inundation area connected to sea (km^2)	172.689	167.897	4.791	3%
	Total number of land parcels affected	22439	20848	1591	7%
	No. of land parcels 100% covered	10036	9905	131	1%
	No. of land parcels covered 76% - 100%	3037	2765	272	9%
	No. of land parcels covered 51% - 75%	1825	1654	171	9%
	No. of land parcels covered26% - 50%	2316	2125	191	8%
	No. of land parcels covered < 25%	5225	4399	826	16%
2.2m	Total of discrete inundation areas (km^2)	3.886	7.976	-4.09	51%
	No. of discrete inundation areas	791	8777	-7986	91%
	Inundation area connected to sea (km^2)	181.943	177.689	4.254	2%
	Total number of land parcels affected	24452	22982	1470	6%
	No. of land parcels 100% covered	11956	11880	76	1%
	No. of land parcels covered 76% - 100%	2993	2747	246	8%
	No. of land parcels covered 51% - 75%	1852	1718	134	7%
	No. of land parcels covered26% - 50%	2427	2203	224	9%
	No. of land parcels covered < 25%	5224	4434	790	15%

Melbourne

- **Table D-2. HYDRO-DEM STDDEM comparison for area and land parcels at inundation levels 1.4m, 1.6m and 2.0m on Melbourne**

Inundation level	Analysis type	HYDRO-DEM	STDDEM	Difference	% difference
1.4m	Total of discrete inundation areas (km^2)	12.943	32.489	-19.546	60%
	No. of discrete inundation areas	1159	14291	-13132	92%
	Inundation area connected to sea (km^2)	163.695	145.221	18.474	11%
	Total number of land parcels affected	8112	4412	3700	46%
	No. of land parcels 100% covered	716	550	166	23%
	No. of land parcels covered 76% - 100%	812	523	289	36%
	No. of land parcels covered 51% - 75%	596	344	252	42%
	No. of land parcels covered26% - 50%	1088	597	491	45%
	No. of land parcels covered < 25%	4900	2398	2502	51%
1.6m	Total of discrete inundation areas (km^2)	12.62	39.279	-26.659	68%
	No. of discrete inundation areas	1296	16211	-14915	92%
	Inundation area connected to sea (km^2)	195.244	169.273	25.971	13%
	Total number of land parcels affected	14379	7691	6688	47%
	No. of land parcels 100% covered	1741	1415	326	19%
	No. of land parcels covered 76% - 100%	1703	1096	607	36%
	No. of land parcels covered 51% - 75%	1141	646	495	43%
	No. of land parcels covered26% - 50%	2048	1060	988	48%
	No. of land parcels covered < 25%	7746	3474	4272	55%
2.0m	Total of discrete inundation areas (km^2)	12.24	37.464	-25.224	67%
	No. of discrete inundation areas	1273	15856	-14583	92%
	Inundation area connected to sea (km^2)	261.597	238.151	23.445	9%
	Total number of land parcels affected	31906	18884	13022	41%
	No. of land parcels 100% covered	10591	6757	3834	36%
	No. of land parcels covered 76% - 100%	4545	2675	1870	41%
	No. of land parcels covered 51% - 75%	2515	1541	974	39%
	No. of land parcels covered26% - 50%	3878	2283	1595	41%
	No. of land parcels covered < 25%	10377	5628	4749	46%

Perth

- **Table D-3. HYDRO-DEM STDDEM comparison for area and land parcels at inundation levels 1.2m, 1.4m and 1.8m on Perth**

Inundation level	Analysis type	Hydro-DEM	StdDEM	Difference	% difference
1.2m	Total of discrete inundation areas (km^2)	18.466	25.487	-7.021	28%
	No. of discrete inundation areas	1425	8523	-7098	83%
	Inundation area connected to sea (km^2)	53.299	50.507	2.793	5%
	Total number of land parcels affected	6210	5935	275	4%
	No. of land parcels 100% covered	146	158	-12	8%
	No. of land parcels covered 76% - 100%	440	452	-12	3%
	No. of land parcels covered 51% - 75%	433	376	57	13%
	No. of land parcels covered26% - 50%	1063	1048	15	1%
	No. of land parcels covered < 25%	4128	3901	227	5%
1.4m	Total of discrete inundation areas (km^2)	22.95	30.094	-7.144	24%
	No. of discrete inundation areas	1498	8023	-6525	81%
	Inundation area connected to sea (km^2)	63.766	60.08	3.686	6%
	Total number of land parcels affected	7043	6631	412	6%
	No. of land parcels 100% covered	259	292	-33	11%
	No. of land parcels covered 76% - 100%	679	670	9	1%
	No. of land parcels covered 51% - 75%	541	501	40	7%
	No. of land parcels covered26% - 50%	1529	1492	37	2%
	No. of land parcels covered < 25%	4035	3676	359	9%
1.8m	Total of discrete inundation areas (km^2)	30.434	38.359	-7.924	21%
	No. of discrete inundation areas	1717	10418	-8701	84%
	Inundation area connected to sea (km^2)	85.645	81.499	4.147	5%
	Total number of land parcels affected	9309	8783	526	6%
	No. of land parcels 100% covered	857	958	-101	11%
	No. of land parcels covered 76% - 100%	1167	1150	17	1%
	No. of land parcels covered 51% - 75%	802	754	48	6%
	No. of land parcels covered26% - 50%	2427	2398	29	1%
	No. of land parcels covered < 25%	4056	3523	533	13%

Gold Coast

▪ **Table D-4. HYDRO-DEM STDDEM comparison for area and land parcels at inundation levels 2.0m, 2.2m and 2.6m on Gold Coast**

Inundation level	Analysis type	Hydro-DEM	StdDEM	Difference	Percentage difference
2.0m	Total of discrete inundation areas (km^2)	5.74	14.782	-9.043	61%
	No. of discrete inundation areas	1058	6750	-5692	84%
	Inundation area connected to sea (km^2)	221.442	212.361	9.081	4%
	Total number of land parcels affected	34329	32383	1946	6%
	No. of land parcels 100% covered	4082	4379	-297	7%
	No. of land parcels covered 76% - 100%	3184	2773	411	13%
	No. of land parcels covered 51% - 75%	1832	1584	248	14%
	No. of land parcels covered26% - 50%	3256	2945	311	10%
	No. of land parcels covered < 25%	21975	20702	1273	6%
2.2m	Total of discrete inundation areas (km^2)	6.424	15.342	-8.918	58%
	No. of discrete inundation areas	988	5867	-4879	83%
	Inundation area connected to sea (km^2)	234.319	225.298	9.022	4%
	Total number of land parcels affected	39173	37146	2027	5%
	No. of land parcels 100% covered	6985	7353	-368	5%
	No. of land parcels covered 76% - 100%	3924	3442	482	12%
	No. of land parcels covered 51% - 75%	2243	1986	257	11%
	No. of land parcels covered26% - 50%	4328	3971	357	8%
	No. of land parcels covered < 25%	21693	20394	1299	6%
	Total of discrete inundation areas (km^2)				
2.6m	Total of discrete inundation areas (km^2)	5.345	15.389	-10.044	65%
	No. of discrete inundation areas	798	4909	-4111	84%
	Inundation area connected to sea (km^2)	258.966	248.856	10.11	4%
	Total number of land parcels affected	48725	46381	2344	5%
	No. of land parcels 100% covered	13497	14044	-547	4%
	No. of land parcels covered 76% - 100%	5820	5176	644	11%
	No. of land parcels covered 51% - 75%	2699	2335	364	13%
	No. of land parcels covered26% - 50%	6383	5941	442	7%
	No. of land parcels covered < 25%	20326	18885	1441	7%

Brisbane

■ **Table D-5. HYDRO-DEM STDDEM comparison for area and land parcels at inundation levels 2.0m, 2.2m and 2.6m on Brisbane**

Inundation level	Analysis type	Hydro-DEM	StdDEM	Difference	Percentage difference
2.0m	Total of discrete inundation areas (km^2)	2.111	11.365	-9.254	81%
	No. of discrete inundation areas	807	8173	-7366	90%
	Inundation area connected to sea (km^2)	146.78	137.712	9.068	6%
	Total number of land parcels affected	18051	15417	2634	15%
	No. of land parcels 100% covered	2983	3004	-21	1%
	No. of land parcels covered 76% - 100%	2379	2086	293	12%
	No. of land parcels covered 51% - 75%	1514	1302	212	14%
	No. of land parcels covered26% - 50%	2219	1687	532	24%
	No. of land parcels covered < 25%	8956	7338	1618	18%
2.2m	Total of discrete inundation areas (km^2)	2.643	11.206	-8.563	76%
	No. of discrete inundation areas	684	6786	-6102	90%
	Inundation area connected to sea (km^2)	160.298	151.937	8.361	5%
	Total number of land parcels affected	21593	18927	2666	12%
	No. of land parcels 100% covered	4593	4622	-29	1%
	No. of land parcels covered 76% - 100%	3235	2819	416	13%
	No. of land parcels covered 51% - 75%	1811	1562	249	14%
	No. of land parcels covered26% - 50%	2674	2123	551	21%
	No. of land parcels covered < 25%	9280	7801	1479	16%
2.6m	Total of discrete inundation areas (km^2)	2.107	6.964	-4.857	70%
	No. of discrete inundation areas	513	5196	-4683	90%
	Inundation area connected to sea (km^2)	186.744	181.984	4.76	3%
	Total number of land parcels affected	29261	26564	2697	9%
	No. of land parcels 100% covered	8722	8651	71	1%
	No. of land parcels covered 76% - 100%	4589	4053	536	12%
	No. of land parcels covered 51% - 75%	2455	2134	321	13%
	No. of land parcels covered26% - 50%	3476	2986	490	14%
	No. of land parcels covered < 25%	10019	8740	1279	13%

Sydney

■ **Table D-6. HYDRO-DEM STDDEM comparison for area and land parcels at inundation levels 1.6m, 2.0m and 2.2m on Sydney**

Inundation level	Analysis type	Hydro-DEM	StdDEM	Difference	Percentage difference
1.6m	Total of discrete inundation areas (km^2)	0.98	4.546	-3.566	78%
	No. of discrete inundation areas	337	3328	-2991	90%
	Inundation area connected to sea (km^2)	11.367	9.382	1.984	17%
	Total number of land parcels affected	8256	7010	1246	15%
	No. of land parcels 100% covered	199	87	112	56%
	No. of land parcels covered 76% - 100%	412	338	74	18%
	No. of land parcels covered 51% - 75%	440	353	87	20%
	No. of land parcels covered26% - 50%	924	700	224	24%
	No. of land parcels covered < 25%	6281	5532	749	12%
2.0m	Total of discrete inundation areas (km^2)	1.241	7.054	-5.814	82%
	No. of discrete inundation areas	219	3509	-3290	94%
	Inundation area connected to sea (km^2)	17.511	15.247	2.265	13%
	Total number of land parcels affected	11663	10278	1385	12%
	No. of land parcels 100% covered	724	544	180	25%
	No. of land parcels covered 76% - 100%	1160	1123	37	3%
	No. of land parcels covered 51% - 75%	923	844	79	9%
	No. of land parcels covered26% - 50%	1714	1455	259	15%
	No. of land parcels covered < 25%	7142	6312	830	12%
2.2m	Total of discrete inundation areas (km^2)	1.431	6.007	-4.576	76%
	No. of discrete inundation areas	174	3321	-3147	95%
	Inundation area connected to sea (km^2)	22.488	21.197	1.291	6%
	Total number of land parcels affected	13807	12854	953	7%
	No. of land parcels 100% covered	1429	1399	30	2%
	No. of land parcels covered 76% - 100%	1974	2036	-62	3%
	No. of land parcels covered 51% - 75%	1207	1152	55	5%
	No. of land parcels covered26% - 50%	2026	1753	273	13%
	No. of land parcels covered < 25%	7171	6514	657	9%

E. Comprehensive comparison of inundation extents derived from Standard DEM and Hydro-DEM for each geographic region per LGA

Central Coast

Table E-1. HYDRO-DEM STDDEM comparison for area and land parcels at inundation levels on Central Coast per LGA

Inundation level	Analysis type	LGA	Hydro-DEM	STDDEM	Difference	Percentage difference
1.6m	Discrete inundated areas (sq km)					
		CESSNOCK	0	0.017	-0.017	100%
		GOSFORD	0	0	0	0%
		LAKE MACQUARIE	0.219	3.056	-2.837	93%
		MAITLAND	0.774	0.775	-0.001	0%
		NEWCASTLE	0.893	2.461	-1.568	64%
		PORT STEPHENS	1.802	3.778	-1.976	52%
		WYONG	0.157	2.89	-2.733	95%
1.6m	No. of discrete inundated areas					
		CESSNOCK	0	1	-1	100%
		GOSFORD	0	0	0	0%
		LAKE MACQUARIE	67	1935	-1868	97%
		MAITLAND	5	21	-16	76%
		NEWCASTLE	354	3545	-3191	90%
		PORT STEPHENS	337	2375	-2038	86%
		WYONG	101	3158	-3057	97%
1.6m	Inundation areas connected to the sea (sq km)					
		CESSNOCK	0.065	0.048	0.017	26%
		GOSFORD	0.007	0.007	0	0%
		LAKE MACQUARIE	29.186	26.204	2.982	10%
		MAITLAND	0	0	0	0%
		NEWCASTLE	48.034	46.661	1.373	3%
		PORT STEPHENS	49.342	47.39	1.952	4%
		WYONG	22.851	20.108	2.742	12%
1.6m	Total number of land parcels affected					
		CESSNOCK	1	1	0	0%
		GOSFORD	0	0	0	0%
		LAKE MACQUARIE	9469	8631	838	9%
		MAITLAND	0	0	0	0%

Inundation level	Analysis type	LGA	Hydro-DEM	STDDEM	Difference	Percentage difference
		NEWCASTLE	2478	2027	451	18%
		PORT STEPHENS	647	532	115	18%
		WYONG	5756	4941	815	14%
1.6m	No. of land parcels 100% inundated					
		CESSNOCK	0	0	0	0%
		GOSFORD	0	0	0	0%
		LAKE MACQUARIE	3091	3104	13	0%
		MAITLAND	0	0	0	0%
		NEWCASTLE	718	634	84	12%
		PORT STEPHENS	72	71	1	1%
		WYONG	981	959	22	2%
1.6m	No. of land parcels 75-100% inundated					
		CESSNOCK	0	0	0	0%
		GOSFORD	0	0	0	0%
		LAKE MACQUARIE	1358	1220	138	10%
		MAITLAND	0	0	0	0%
		NEWCASTLE	457	402	55	12%
		PORT STEPHENS	216	203	13	6%
		WYONG	1085	989	96	9%
1.6m	No. of land parcels 51-75% inundated					
		CESSNOCK	0	0	0	0%
		GOSFORD	0	0	0	0%
		LAKE MACQUARIE	881	781	100	11%
		MAITLAND	0	0	0	0%
		NEWCASTLE	242	205	37	15%
		PORT STEPHENS	89	71	18	20%
		WYONG	715	609	106	15%
1.6m	No. of land parcels 26-50% inundated					
		CESSNOCK	0	0	0	0%
		GOSFORD	0	0	0	0%
		LAKE MACQUARIE	1229	1063	166	14%
		MAITLAND	0	0	0	0%
		NEWCASTLE	277	207	70	25%
		PORT STEPHENS	73	56	17	23%
		WYONG	893	734	159	18%
1.6m	No. of land parcels less than 25% inundated					
		CESSNOCK	1	1	0	0%
		GOSFORD	0	0	0	0%

Inundation level	Analysis type	LGA	Hydro-DEM	STDDEM	Difference	Percentage difference
		LAKE MACQUARIE	2910	2463	447	15%
		MAITLAND	0	0	0	0%
		NEWCASTLE	784	579	205	26%
		PORT STEPHENS	197	131	66	34%
		WYONG	2082	1650	432	21%
2.0m						
2.0m	Discrete inundated areas (sq km)					
		CESSNOCK	0	0	0	0%
		GOSFORD	0	0	0	0%
		LAKE MACQUARIE	0.206	1.52	-1.315	86%
		MAITLAND	0.851	0.85	0	0%
		NEWCASTLE	1.267	2.285	-1.018	45%
		PORT STEPHENS	0.965	2.212	-1.247	56%
		WYONG	0.157	1.1	-0.943	86%
2.0m	No. of discrete inundated areas					
		CESSNOCK	0	0	0	0%
		GOSFORD	0	0	0	0%
		LAKE MACQUARIE	29	1387	-1358	98%
		MAITLAND	3	5	-2	40%
		NEWCASTLE	236	1864	-1628	87%
		PORT STEPHENS	355	3028	-2673	88%
		WYONG	80	2130	-2050	96%
2.0m	Inundation areas connected to the sea (sq km)					
		CESSNOCK	0.069	0.069	0	0%
		GOSFORD	0.007	0.007	0	0%
		LAKE MACQUARIE	34.635	33.094	1.542	4%
		MAITLAND	0	0	0	0%
		NEWCASTLE	53.885	52.859	1.026	2%
		PORT STEPHENS	54.844	53.692	1.153	2%
		WYONG	29.247	28.177	1.071	4%
2.0m	Total number of land parcels affected					
		CESSNOCK	2	1	1	50%
		GOSFORD	0	0	0	0%
		LAKE MACQUARIE	10805	10418	387	4%
		MAITLAND	0	0	0	0%
		NEWCASTLE	3431	3057	374	11%
		PORT STEPHENS	809	727	82	10%
		WYONG	7392	6645	747	10%

Inundation level	Analysis type	LGA	Hydro-DEM	STDDEM	Difference	Percentage difference
2.0m	No. of land parcels 100% inundated					
		CESSNOCK	0	0	0	0%
		GOSFORD	0	0	0	0%
		LAKE MACQUARIE	5297	5334	37	1%
		MAITLAND	0	0	0	0%
		NEWCASTLE	1761	1765	4	0%
		PORT STEPHENS	182	178	4	2%
		WYONG	2796	2628	168	6%
2.0m	No. of land parcels 75-100% inundated					
		CESSNOCK	0	0	0	0%
		GOSFORD	0	0	0	0%
		LAKE MACQUARIE	1153	1077	76	7%
		MAITLAND	0	0	0	0%
		NEWCASTLE	444	378	66	15%
		PORT STEPHENS	232	224	8	3%
		WYONG	1208	1086	122	10%
2.0m	No. of land parcels 51-75% inundated					
		CESSNOCK	0	0	0	0%
		GOSFORD	0	0	0	0%
		LAKE MACQUARIE	797	744	53	7%
		MAITLAND	0	0	0	0%
		NEWCASTLE	254	207	47	19%
		PORT STEPHENS	107	95	12	11%
		WYONG	667	608	59	9%
2.0m	No. of land parcels 26-50% inundated					
		CESSNOCK	0	0	0	0%
		GOSFORD	0	0	0	0%
		LAKE MACQUARIE	1108	1060	48	4%
		MAITLAND	0	0	0	0%
		NEWCASTLE	255	212	43	17%
		PORT STEPHENS	77	63	14	18%
		WYONG	876	790	86	10%
2.0m	No. of land parcels less than 25% inundated					
		CESSNOCK	2	1	1	50%
		GOSFORD	0	0	0	0%
		LAKE MACQUARIE	2450	2203	247	10%
		MAITLAND	0	0	0	0%
		NEWCASTLE	717	495	222	31%

Inundation level	Analysis type	LGA	Hydro-DEM	STDDEM	Difference	Percentage difference
		PORT STEPHENS	211	167	44	21%
		WYONG	1845	1533	312	17%
2.2m						
2.2m	Discrete inundated areas (sq km					
		CESSNOCK	0	0	0	0%
		GOSFORD	0	0	0	0%
		LAKE MACQUARIE	0.091	0.712	-0.62	87%
		MAITLAND	0.863	0.863	0	0%
		NEWCASTLE	1.348	2.541	-1.192	47%
		PORT STEPHENS	1.466	3.021	-1.556	51%
		WYONG	0.118	0.839	-0.721	86%
2.2m	No. of discrete inundated areas					
		CESSNOCK	0	3	-3	100%
		GOSFORD	0	0	0	0%
		LAKE MACQUARIE	42	1261	-1219	97%
		MAITLAND	3	3	0	0%
		NEWCASTLE	198	1600	-1402	88%
		PORT STEPHENS	434	3351	-2917	87%
		WYONG	115	2560	-2445	96%
2.2m	Inundation areas connected to the sea (sq km)					
		CESSNOCK	0.072	0.072	0	0%
		GOSFORD	0.007	0.007	0	0%
		LAKE MACQUARIE	36.838	35.978	0.86	2%
		MAITLAND	0	0	0	0%
		NEWCASTLE	56.059	54.835	1.224	2%
		PORT STEPHENS	57.079	55.739	1.34	2%
		WYONG	31.887	31.058	0.829	3%
2.2m	Total number of land parcels affected					
		CESSNOCK	2	1	1	50%
		GOSFORD	0	0	0	0%
		LAKE MACQUARIE	11254	10952	302	3%
		MAITLAND	0	0	0	0%
		NEWCASTLE	4185	3427	758	18%
		PORT STEPHENS	861	765	96	11%
		WYONG	8150	7837	313	4%
2.2m	No. of land parcels 100% inundated					
		CESSNOCK	0	0	0	0%
		GOSFORD	0	0	0	0%

Inundation level	Analysis type	LGA	Hydro-DEM	STDDEM	Difference	Percentage difference
		LAKE MACQUARIE	5870	5891	21	0%
		MAITLAND	0	0	0	0%
		NEWCASTLE	2195	2067	128	6%
		PORT STEPHENS	252	248	4	2%
		WYONG	3637	3674	37	1%
2.2m	No. of land parcels 75-100% inundated					
		CESSNOCK	0	0	0	0%
		GOSFORD	0	0	0	0%
		LAKE MACQUARIE	1091	1056	35	3%
		MAITLAND	0	0	0	0%
		NEWCASTLE	551	405	146	26%
		PORT STEPHENS	236	219	17	7%
		WYONG	1117	1067	50	4%
2.2m	No. of land parcels 51-75% inundated					
		CESSNOCK	0	0	0	0%
		GOSFORD	0	0	0	0%
		LAKE MACQUARIE	810	770	40	5%
		MAITLAND	0	0	0	0%
		NEWCASTLE	283	206	77	27%
		PORT STEPHENS	86	75	11	13%
		WYONG	673	667	6	1%
2.2m	No. of land parcels 26-50% inundated					
		CESSNOCK	0	0	0	0%
		GOSFORD	0	0	0	0%
		LAKE MACQUARIE	1125	1080	45	4%
		MAITLAND	0	0	0	0%
		NEWCASTLE	352	240	112	32%
		PORT STEPHENS	99	83	16	16%
		WYONG	851	800	51	6%
2.2m	No. of land parcels less than 25% inundated					
		CESSNOCK	2	1	1	50%
		GOSFORD	0	0	0	0%
		LAKE MACQUARIE	2358	2155	203	9%
		MAITLAND	0	0	0	0%
		NEWCASTLE	804	509	295	37%
		PORT STEPHENS	188	140	48	26%
		WYONG	1872	1629	243	13%

Melbourne

- **Table E-2. HYDRO-DEM STDDEM comparison for area and land parcels at inundation levels 1.4m, 1.6m and 2.0m on Melbourne per LGA**

Inundation level	Analysis type	LGA	HydroDEM	STDDEM	Difference	Percentage difference
1.4m	Discrete inundated areas (sq km)					
		Bass Coast	2.429	2.296	0.132	5%
		Bayside	0.001	0.008	-0.007	86%
		Boroondara	0	0.107	-0.107	100%
		Brimbank	0	0	0	0%
		Cardinia	0.195	2.259	-2.063	91%
		Casey	0.101	2.395	-2.294	96%
		Frankston	0.068	2.36	-2.293	97%
		Greater Dandenong	0.132	0.194	-0.062	32%
		Greater Geelong	3.929	8.351	-4.422	53%
		Hobsons Bay	0.125	0.579	-0.454	78%
		Kingston	0.962	5.009	-4.047	81%
		Maribyrnong	0.001	0.039	-0.038	97%
		Melbourne	0.759	0.943	-0.184	20%
		Moonee Valley	0.005	0.018	-0.013	72%
		Mornington Peninsula	0.183	0.809	-0.626	77%
		Port Phillip	0.254	0.461	-0.207	45%
		Queenscliffe	0.026	0.1	-0.074	74%
		Stonnington	0.008	0.03	-0.022	73%
		Surf Coast	1.302	3.628	-2.327	64%
		Wyndham	2.441	2.782	-0.341	12%
		Yarra	0	0.097	-0.097	100%
1.4m	No. of discrete inundated areas					
		Bass Coast	60	1309	-1249	95%
		Bayside	3	28	-25	89%
		Boroondara	0	19	-19	100%
		Brimbank	0	0	0	0%
		Cardinia	127	2688	-2561	95%
		Casey	74	1556	-1482	95%
		Frankston	22	377	-355	94%
		Greater Dandenong	67	217	-150	69%
		Greater Geelong	235	2551	-2316	91%
		Hobsons Bay	41	570	-529	93%

Inundation level	Analysis type	LGA	HydroDEM	STDDEM	Difference	Percentage difference
		Kingston	118	1074	-956	89%
		Maribyrnong	2	60	-58	97%
		Melbourne	107	496	-389	78%
		Moonee Valley	2	16	-14	88%
		Mornington Peninsula	107	1764	-1657	94%
		Port Phillip	52	485	-433	89%
		Queenscliffe	15	158	-143	91%
		Stonnington	4	18	-14	78%
		Surf Coast	14	259	-245	95%
		Wyndham	132	725	-593	82%
		Yarra	0	5	-5	100%
1.4m	Inundation areas connected to the sea (sq km)					
		Bass Coast	13.045	12.876	0.169	1%
		Bayside	0.797	0.779	0.018	2%
		Boroondara	0.177	0.061	0.116	65%
		Brimbank	0.008	0.008	0	0%
		Cardinia	8.424	7.129	1.295	15%
		Casey	20.019	18.062	1.957	10%
		Frankston	2.52	0.263	2.257	90%
		Greater Dandenong	0.141	0.001	0.14	99%
		Greater Geelong	75.303	70.584	4.719	6%
		Hobsons Bay	6.695	6.19	0.505	8%
		Kingston	4.723	0.912	3.812	81%
		Maribyrnong	0.366	0.328	0.038	10%
		Melbourne	0.684	0.544	0.14	20%
		Moonee Valley	0.127	0.107	0.02	16%
		Mornington Peninsula	18.97	18.561	0.409	2%
		Port Phillip	0.812	0.675	0.137	17%
		Queenscliffe	1.513	1.48	0.033	2%
		Stonnington	0.14	0.114	0.026	19%
		Surf Coast	3.429	1.107	2.323	68%
		Wyndham	5.508	5.25	0.258	5%
		Yarra	0.292	0.19	0.102	35%
1.4m	Total number of land parcels affected					
		Bass Coast	116	96	20	17%
		Bayside	63	35	28	44%
		Boroondara	96	51	45	47%
		Brimbank	3	3	0	0%

Inundation level	Analysis type	LGA	HydroDEM	STDDEM	Difference	Percentage difference
		Cardinia	183	76	107	58%
		Casey	238	98	140	59%
		Frankston	856	145	711	83%
		Greater Dandenong	41	0	41	100%
		Greater Geelong	1860	1471	389	21%
		Hobsons Bay	533	401	132	25%
		Kingston	1380	246	1134	82%
		Maribyrnong	70	58	12	17%
		Melbourne	249	205	44	18%
		Moonee Valley	95	66	29	31%
		Mornington Peninsula	829	622	207	25%
		Port Phillip	506	41	465	92%
		Queenscliffe	742	651	91	12%
		Stonnington	71	60	11	15%
		Surf Coast	57	17	40	70%
		Wyndham	103	81	22	21%
		Yarra	78	26	52	67%
1.4m	No. of land parcels 100% inundated					
		Bass Coast	1	1	0	0%
		Bayside	3	3	0	0%
		Boroondara	0	0	0	0%
		Brimbank	0	0	0	0%
		Cardinia	0	0	0	0%
		Casey	2	0	2	100%
		Frankston	60	0	60	100%
		Greater Dandenong	0	0	0	0%
		Greater Geelong	225	214	11	5%
		Hobsons Bay	38	33	5	13%
		Kingston	56	3	53	95%
		Maribyrnong	0	0	0	0%
		Melbourne	2	1	1	50%
		Moonee Valley	0	0	0	0%
		Mornington Peninsula	5	5	0	0%
		Port Phillip	20	1	19	95%
		Queenscliffe	301	287	14	5%
		Stonnington	0	0	0	0%
		Surf Coast	0	0	0	0%
		Wyndham	0	0	0	0%

Inundation level	Analysis type	LGA	HydroDEM	STDDEM	Difference	Percentage difference
		Yarra	1	1	0	0%
1.4m	No. of land parcels 75-100% inundated					
		Bass Coast	0	0	0	0%
		Bayside	6	5	1	17%
		Boroondara	3	1	2	67%
		Brimbank	0	0	0	0%
		Cardinia	0	0	0	0%
		Casey	22	1	21	95%
		Frankston	88	5	83	94%
		Greater Dandenong	0	0	0	0%
		Greater Geelong	239	214	25	10%
		Hobsons Bay	73	64	9	12%
		Kingston	124	20	104	84%
		Maribyrnong	0	0	0	0%
		Melbourne	19	18	1	5%
		Moonee Valley	3	1	2	67%
		Mornington Peninsula	21	20	1	5%
		Port Phillip	33	6	27	82%
		Queenscliffe	167	156	11	7%
		Stonnington	1	1	0	0%
		Surf Coast	2	1	1	50%
		Wyndham	3	2	1	33%
		Yarra	4	3	1	25%
1.4m	No. of land parcels 51-75% inundated					
		Bass Coast	5	5	0	0%
		Bayside	2	2	0	0%
		Boroondara	1	1	0	0%
		Brimbank	0	0	0	0%
		Cardinia	2	0	2	100%
		Casey	12	3	9	75%
		Frankston	80	6	74	93%
		Greater Dandenong	0	0	0	0%
		Greater Geelong	148	123	25	17%
		Hobsons Bay	61	56	5	8%
		Kingston	101	19	82	81%
		Maribyrnong	3	3	0	0%
		Melbourne	17	9	8	47%
		Moonee Valley	1	1	0	0%

Inundation level	Analysis type	LGA	HydroDEM	STDDEM	Difference	Percentage difference
		Mornington Peninsula	31	27	4	13%
		Port Phillip	44	8	36	82%
		Queenscliffe	73	71	2	3%
		Stonnington	3	3	0	0%
		Surf Coast	4	0	4	100%
		Wyndham	8	7	1	13%
		Yarra	3	3	0	0%
1.4m	No. of land parcels 26-50% inundated					
		Bass Coast	18	15	3	17%
		Bayside	7	2	5	71%
		Boroondara	5	2	3	60%
		Brimbank	0	0	0	0%
		Cardinia	24	14	10	42%
		Casey	40	23	17	43%
		Frankston	158	42	116	73%
		Greater Dandenong	0	0	0	0%
		Greater Geelong	208	171	37	18%
		Hobsons Bay	84	63	21	25%
		Kingston	141	22	119	84%
		Maribyrnong	14	12	2	14%
		Melbourne	43	34	9	21%
		Moonee Valley	4	4	0	0%
		Mornington Peninsula	134	97	37	28%
		Port Phillip	80	11	69	86%
		Queenscliffe	68	46	22	32%
		Stonnington	16	16	0	0%
		Surf Coast	8	0	8	100%
		Wyndham	27	22	5	19%
		Yarra	14	7	7	50%
1.4m	No. of land parcels less than 25% inundated					
		Bass Coast	92	75	17	18%
		Bayside	45	23	22	49%
		Boroondara	87	47	40	46%
		Brimbank	3	3	0	0%
		Cardinia	157	62	95	61%
		Casey	162	71	91	56%
		Frankston	470	92	378	80%
		Greater Dandenong	41	0	41	100%

Inundation level	Analysis type	LGA	HydroDEM	STDDEM	Difference	Percentage difference
		Greater Geelong	1040	749	291	28%
		Hobsons Bay	277	185	92	33%
		Kingston	958	182	776	81%
		Maribyrnong	53	43	10	19%
		Melbourne	168	143	25	15%
		Moonee Valley	87	60	27	31%
		Mornington Peninsula	638	473	165	26%
		Port Phillip	329	15	314	95%
		Queenscliffe	133	91	42	32%
		Stonnington	51	40	11	22%
		Surf Coast	43	16	27	63%
		Wyndham	65	50	15	23%
		Yarra	56	12	44	79%
1.6m	Discrete inundated areas (sq km)					
		Bass Coast	2.771	3.011	-0.239	8%
		Bayside	0.002	0.016	-0.014	89%
		Boroondara	0	0.121	-0.121	100%
		Brimbank	0	0	0	0%
		Cardinia	0.185	2.27	-2.085	92%
		Casey	0.086	4.032	-3.946	98%
		Frankston	0.18	2.994	-2.814	94%
		Greater Dandenong	0.175	0.355	-0.18	51%
		Greater Geelong	4.722	9.386	-4.664	50%
		Hobsons Bay	0.28	0.745	-0.465	62%
		Kingston	0.437	5.628	-5.191	92%
		Maribyrnong	0.006	0.071	-0.065	92%
		Melbourne	0.739	1.054	-0.315	30%
		Moonee Valley	0.005	0.027	-0.021	79%
		Mornington Peninsula	0.332	1.379	-1.047	76%
		Port Phillip	0.383	0.616	-0.233	38%
		Queenscliffe	0.019	0.042	-0.024	56%
		Stonnington	0.011	0.047	-0.036	77%
		Surf Coast	0.774	4.465	-3.691	83%
		Wyndham	1.489	2.898	-1.409	49%
		Yarra	0	0.101	-0.101	100%
1.6m	No. of discrete inundated areas					
		Bass Coast	59	1171	-1112	95%
		Bayside	3	62	-59	95%

Inundation level	Analysis type	LGA	HydroDEM	STDDEM	Difference	Percentage difference
		Boroondara	0	14	-14	100%
		Brimbank	0	0	0	0%
		Cardinia	138	3023	-2885	95%
		Casey	71	2229	-2158	97%
		Frankston	39	601	-562	94%
		Greater Dandenong	75	284	-209	74%
		Greater Geelong	237	2210	-1973	89%
		Hobsons Bay	58	641	-583	91%
		Kingston	99	1595	-1496	94%
		Maribyrnong	4	102	-98	96%
		Melbourne	106	609	-503	83%
		Moonee Valley	2	32	-30	94%
		Mornington Peninsula	152	1887	-1735	92%
		Port Phillip	64	605	-541	89%
		Queenscliffe	13	140	-127	91%
		Stonnington	4	21	-17	81%
		Surf Coast	15	395	-380	96%
		Wyndham	165	680	-515	76%
		Yarra	0	6	-6	100%
1.6m	Inundation areas connected to the sea (sq km)					
		Bass Coast	14.631	14.361	0.269	2%
		Bayside	0.89	0.858	0.032	4%
		Boroondara	0.191	0.062	0.129	67%
		Brimbank	0.011	0.011	0	0%
		Cardinia	15.67	14.092	1.578	10%
		Casey	24.412	20.928	3.484	14%
		Frankston	2.954	0.288	2.666	90%
		Greater Dandenong	0.223	0.001	0.222	100%
		Greater Geelong	81.88	75.843	6.037	7%
		Hobsons Bay	7.531	6.982	0.55	7%
		Kingston	6.889	2.093	4.796	70%
		Maribyrnong	0.476	0.426	0.05	11%
		Melbourne	1.264	1.058	0.206	16%
		Moonee Valley	0.153	0.128	0.025	16%
		Mornington Peninsula	21.451	20.774	0.676	3%
		Port Phillip	1.179	1.087	0.092	8%
		Queenscliffe	1.8	1.801	-0.001	0%
		Stonnington	0.158	0.116	0.041	26%

Inundation level	Analysis type	LGA	HydroDEM	STDDEM	Difference	Percentage difference
		Surf Coast	4.857	1.228	3.628	75%
		Wyndham	8.327	6.939	1.388	17%
		Yarra	0.3	0.195	0.104	35%
1.6m	Total number of land parcels affected					
		Bass Coast	136	106	30	22%
		Bayside	81	43	38	47%
		Boroondara	97	51	46	47%
		Brimbank	5	5	0	0%
		Cardinia	217	87	130	60%
		Casey	288	120	168	58%
		Frankston	1279	157	1122	88%
		Greater Dandenong	58	0	58	100%
		Greater Geelong	2333	1940	393	17%
		Hobsons Bay	769	636	133	17%
		Kingston	5183	1415	3768	73%
		Maribyrnong	95	74	21	22%
		Melbourne	453	353	100	22%
		Moonee Valley	96	68	28	29%
		Mornington Peninsula	973	714	259	27%
		Port Phillip	998	739	259	26%
		Queenscliffe	1023	1025	2	0%
		Stonnington	71	61	10	14%
		Surf Coast	80	19	61	76%
		Wyndham	127	95	32	25%
		Yarra	78	26	52	67%
1.6m	No. of land parcels 100% inundated					
		Bass Coast	1	1	0	0%
		Bayside	3	3	0	0%
		Boroondara	0	0	0	0%
		Brimbank	0	0	0	0%
		Cardinia	0	0	0	0%
		Casey	8	0	8	100%
		Frankston	120	4	116	97%
		Greater Dandenong	0	0	0	0%
		Greater Geelong	422	422	0	0%
		Hobsons Bay	149	139	10	7%
		Kingston	336	167	169	50%
		Maribyrnong	0	0	0	0%

Inundation level	Analysis type	LGA	HydroDEM	STDDEM	Difference	Percentage difference
		Melbourne	45	47	2	4%
		Moonee Valley	0	0	0	0%
		Mornington Peninsula	13	13	0	0%
		Port Phillip	118	92	26	22%
		Queenscliffe	520	522	2	0%
		Stonnington	0	0	0	0%
		Surf Coast	0	0	0	0%
		Wyndham	2	2	0	0%
		Yarra	1	1	0	0%
1.6m	No. of land parcels 75-100% inundated					
		Bass Coast	2	2	0	0%
		Bayside	7	6	1	14%
		Boroondara	3	1	2	67%
		Brimbank	0	0	0	0%
		Cardinia	7	6	1	14%
		Casey	35	9	26	74%
		Frankston	169	5	164	97%
		Greater Dandenong	0	0	0	0%
		Greater Geelong	358	333	25	7%
		Hobsons Bay	117	118	1	1%
		Kingston	498	145	353	71%
		Maribyrnong	3	1	2	67%
		Melbourne	60	55	5	8%
		Moonee Valley	3	2	1	33%
		Mornington Peninsula	36	28	8	22%
		Port Phillip	182	164	18	10%
		Queenscliffe	201	204	3	1%
		Stonnington	1	1	0	0%
		Surf Coast	7	1	6	86%
		Wyndham	7	8	1	13%
		Yarra	4	3	1	25%
1.6m	No. of land parcels 51-75% inundated					
		Bass Coast	6	6	0	0%
		Bayside	5	2	3	60%
		Boroondara	1	1	0	0%
		Brimbank	0	0	0	0%
		Cardinia	11	6	5	45%
		Casey	22	5	17	77%

Inundation level	Analysis type	LGA	HydroDEM	STDDEM	Difference	Percentage difference
		Frankston	112	14	98	88%
		Greater Dandenong	0	0	0	0%
		Greater Geelong	181	174	7	4%
		Hobsons Bay	69	54	15	22%
		Kingston	372	91	281	76%
		Maribyrnong	7	5	2	29%
		Melbourne	49	41	8	16%
		Moonee Valley	3	0	3	100%
		Mornington Peninsula	73	56	17	23%
		Port Phillip	138	106	32	23%
		Queenscliffe	64	68	4	6%
		Stonnington	5	3	2	40%
		Surf Coast	2	1	1	50%
		Wyndham	20	13	7	35%
		Yarra	3	3	0	0%
1.6m	No. of land parcels 26-50% inundated					
		Bass Coast	22	21	1	5%
		Bayside	8	2	6	75%
		Boroondara	5	2	3	60%
		Brimbank	0	0	0	0%
		Cardinia	33	24	9	27%
		Casey	50	29	21	42%
		Frankston	222	43	179	81%
		Greater Dandenong	0	0	0	0%
		Greater Geelong	314	250	64	20%
		Hobsons Bay	114	79	35	31%
		Kingston	725	185	540	74%
		Maribyrnong	16	14	2	13%
		Melbourne	82	52	30	37%
		Moonee Valley	4	4	0	0%
		Mornington Peninsula	171	115	56	33%
		Port Phillip	164	133	31	19%
		Queenscliffe	62	68	6	9%
		Stonnington	16	16	0	0%
		Surf Coast	7	2	5	71%
		Wyndham	25	19	6	24%
		Yarra	14	7	7	50%
1.6m	No. of land parcels less than 25% inundated					

Inundation level	Analysis type	LGA	HydroDEM	STDDEM	Difference	Percentage difference
		Bass Coast	105	76	29	28%
		Bayside	58	30	28	48%
		Boroondara	88	47	41	47%
		Brimbank	5	5	0	0%
		Cardinia	166	51	115	69%
		Casey	173	77	96	55%
		Frankston	656	91	565	86%
		Greater Dandenong	58	0	58	100%
		Greater Geelong	1058	761	297	28%
		Hobsons Bay	320	246	74	23%
		Kingston	3252	827	2425	75%
		Maribyrnong	69	54	15	22%
		Melbourne	217	158	59	27%
		Moonee Valley	86	62	24	28%
		Mornington Peninsula	680	502	178	26%
		Port Phillip	396	244	152	38%
		Queenscliffe	176	163	13	7%
		Stonnington	49	41	8	16%
		Surf Coast	64	15	49	77%
		Wyndham	73	53	20	27%
		Yarra	56	12	44	79%
2.0m	Discrete inundated areas (sq km)					
		Bass Coast	3.376	4.182	-0.806	19%
		Bayside	0.001	0.033	-0.032	98%
		Boroondara	0	0.058	-0.058	100%
		Brimbank	0	0	0	0%
		Cardinia	0.223	1.497	-1.274	85%
		Casey	0.159	0.979	-0.82	84%
		Frankston	0.282	1.93	-1.648	85%
		Greater Dandenong	0.227	1.434	-1.206	84%
		Greater Geelong	3.705	9.302	-5.598	60%
		Hobsons Bay	0.324	0.981	-0.656	67%
		Kingston	0.216	9.068	-8.852	98%
		Maribyrnong	0.008	0.082	-0.074	90%
		Melbourne	0.772	1.317	-0.545	41%
		Moonee Valley	0.011	0.041	-0.03	73%
		Mornington Peninsula	0.41	3.249	-2.839	87%
		Port Phillip	0.176	0.581	-0.405	70%

Inundation level	Analysis type	LGA	HydroDEM	STDDEM	Difference	Percentage difference
		Queenscliffe	0.044	0.083	-0.039	47%
		Stonnington	0.019	0.074	-0.055	74%
		Surf Coast	0.786	1.16	-0.374	32%
		Wyndham	1.479	1.391	0.088	6%
		Yarra	0	0.001	-0.001	100%
2.0m	No. of discrete inundated areas					
		Bass Coast	46	1356	-1310	97%
		Bayside	2	45	-43	96%
		Boroondara	0	10	-10	100%
		Brimbank	1	0	1	100%
		Cardinia	145	3281	-3136	96%
		Casey	93	1286	-1193	93%
		Frankston	42	646	-604	93%
		Greater Dandenong	80	824	-744	90%
		Greater Geelong	209	1881	-1672	89%
		Hobsons Bay	59	784	-725	92%
		Kingston	40	1366	-1326	97%
		Maribyrnong	6	71	-65	92%
		Melbourne	85	863	-778	90%
		Moonee Valley	5	67	-62	93%
		Mornington Peninsula	190	1441	-1251	87%
		Port Phillip	88	757	-669	88%
		Queenscliffe	12	82	-70	85%
		Stonnington	3	15	-12	80%
		Surf Coast	15	234	-219	94%
		Wyndham	155	861	-706	82%
		Yarra	0	3	-3	100%
2.0m	Inundation areas connected to the sea (sq km)					
		Bass Coast	18.913	18.191	0.722	4%
		Bayside	1.091	1.058	0.033	3%
		Boroondara	0.232	0.165	0.066	29%
		Brimbank	0.02	0.02	0	0%
		Cardinia	28.442	27.756	0.685	2%
		Casey	32.844	32.204	0.64	2%
		Frankston	5.23	3.746	1.485	28%
		Greater Dandenong	1.268	0.109	1.158	91%
		Greater Geelong	95.144	89.598	5.546	6%
		Hobsons Bay	9.834	9.14	0.693	7%

Inundation level	Analysis type	LGA	HydroDEM	STDDEM	Difference	Percentage difference
		Kingston	12.757	4.095	8.663	68%
		Maribyrnong	0.844	0.782	0.062	7%
		Melbourne	3.478	3.094	0.383	11%
		Moonee Valley	0.289	0.258	0.031	11%
		Mornington Peninsula	26.344	23.617	2.727	10%
		Port Phillip	3.311	3.029	0.282	9%
		Queenscliffe	2.236	2.212	0.023	1%
		Stonnington	0.181	0.121	0.06	33%
		Surf Coast	6.336	5.963	0.373	6%
		Wyndham	12.486	12.679	-0.193	2%
		Yarra	0.318	0.314	0.004	1%
2.0m	Total number of land parcels affected					
		Bass Coast	231	190	41	18%
		Bayside	136	118	18	13%
		Boroondara	98	88	10	10%
		Brimbank	6	6	0	0%
		Cardinia	289	205	84	29%
		Casey	451	359	92	20%
		Frankston	3175	1183	1992	63%
		Greater Dandenong	92	7	85	92%
		Greater Geelong	3489	3180	309	9%
		Hobsons Bay	1893	1773	120	6%
		Kingston	11829	3462	8367	71%
		Maribyrnong	212	161	51	24%
		Melbourne	1216	990	226	19%
		Moonee Valley	107	75	32	30%
		Mornington Peninsula	1443	1031	412	29%
		Port Phillip	5321	4252	1069	20%
		Queenscliffe	1240	1237	3	0%
		Stonnington	72	61	11	15%
		Surf Coast	118	55	63	53%
		Wyndham	484	438	46	10%
		Yarra	81	78	3	4%
2.0m	No. of land parcels 100% inundated					
		Bass Coast	1	1	0	0%
		Bayside	6	6	0	0%
		Boroondara	0	0	0	0%
		Brimbank	0	0	0	0%

Inundation level	Analysis type	LGA	HydroDEM	STDDEM	Difference	Percentage difference
		Cardinia	1	1	0	0%
		Casey	27	27	0	0%
		Frankston	974	473	501	51%
		Greater Dandenong	3	0	3	100%
		Greater Geelong	1222	1219	3	0%
		Hobsons Bay	550	553	3	1%
		Kingston	4619	1370	3249	70%
		Maribyrnong	8	5	3	38%
		Melbourne	297	297	0	0%
		Moonee Valley	2	2	0	0%
		Mornington Peninsula	125	111	14	11%
		Port Phillip	1774	1697	77	4%
		Queenscliffe	922	929	7	1%
		Stonnington	1	1	0	0%
		Surf Coast	1	1	0	0%
		Wyndham	46	53	7	13%
		Yarra	1	1	0	0%
2.0m	No. of land parcels 75-100% inundated					
		Bass Coast	15	15	0	0%
		Bayside	17	17	0	0%
		Boroondara	3	2	1	33%
		Brimbank	0	0	0	0%
		Cardinia	36	35	1	3%
		Casey	74	74	0	0%
		Frankston	565	197	368	65%
		Greater Dandenong	10	0	10	100%
		Greater Geelong	550	528	22	4%
		Hobsons Bay	304	279	25	8%
		Kingston	1629	460	1169	72%
		Maribyrnong	26	18	8	31%
		Melbourne	160	150	10	6%
		Moonee Valley	5	2	3	60%
		Mornington Peninsula	120	84	36	30%
		Port Phillip	803	600	203	25%
		Queenscliffe	158	149	9	6%
		Stonnington	0	0	0	0%
		Surf Coast	14	8	6	43%
		Wyndham	52	52	0	0%

Inundation level	Analysis type	LGA	HydroDEM	STDDEM	Difference	Percentage difference
		Yarra	4	4	0	0%
2.0m	No. of land parcels 51-75% inundated					
		Bass Coast	27	25	2	7%
		Bayside	14	12	2	14%
		Boroondara	2	2	0	0%
		Brimbank	0	0	0	0%
		Cardinia	35	35	0	0%
		Casey	40	36	4	10%
		Frankston	289	102	187	65%
		Greater Dandenong	4	0	4	100%
		Greater Geelong	244	242	2	1%
		Hobsons Bay	182	173	9	5%
		Kingston	835	270	565	68%
		Maribyrnong	20	16	4	20%
		Melbourne	123	84	39	32%
		Moonee Valley	2	3	1	33%
		Mornington Peninsula	133	94	39	29%
		Port Phillip	452	353	99	22%
		Queenscliffe	47	48	1	2%
		Stonnington	6	5	1	17%
		Surf Coast	11	2	9	82%
		Wyndham	50	41	9	18%
		Yarra	3	3	0	0%
2.0m	No. of land parcels 26-50% inundated					
		Bass Coast	56	48	8	14%
		Bayside	21	12	9	43%
		Boroondara	7	7	0	0%
		Brimbank	0	0	0	0%
		Cardinia	45	37	8	18%
		Casey	81	78	3	4%
		Frankston	392	138	254	65%
		Greater Dandenong	11	1	10	91%
		Greater Geelong	356	303	53	15%
		Hobsons Bay	265	238	27	10%
		Kingston	1461	588	873	60%
		Maribyrnong	39	35	4	10%
		Melbourne	145	118	27	19%
		Moonee Valley	11	8	3	27%

Inundation level	Analysis type	LGA	HydroDEM	STDDEM	Difference	Percentage difference
		Mornington Peninsula	224	136	88	39%
		Port Phillip	655	434	221	34%
		Queenscliffe	41	40	1	2%
		Stonnington	16	16	0	0%
		Surf Coast	14	7	7	50%
		Wyndham	31	32	1	3%
		Yarra	22	21	1	5%
2.0m	No. of land parcels less than 25% inundated					
		Bass Coast	132	101	31	23%
		Bayside	78	71	7	9%
		Boroondara	86	77	9	10%
		Brimbank	6	6	0	0%
		Cardinia	172	97	75	44%
		Casey	229	144	85	37%
		Frankston	955	273	682	71%
		Greater Dandenong	64	6	58	91%
		Greater Geelong	1117	888	229	21%
		Hobsons Bay	592	530	62	10%
		Kingston	3285	774	2511	76%
		Maribyrnong	119	87	32	27%
		Melbourne	491	341	150	31%
		Moonee Valley	87	60	27	31%
		Mornington Peninsula	841	606	235	28%
		Port Phillip	1637	1168	469	29%
		Queenscliffe	72	71	1	1%
		Stonnington	49	39	10	20%
		Surf Coast	78	37	41	53%
		Wyndham	305	260	45	15%
		Yarra	51	49	2	4%

Perth

▪ **Table E-3. HYDRO-DEM STDDEM comparison for area and land parcels at inundation levels on Perth per LGA**

INUNDATION LEVEL	ANALYSIS TYPE	LGA	Hydro-DEM	STDDEM	DIFFERENCE	% DIFFERENCE
1.2m	Discrete inundated areas (sq km)					
		CITY OF BAYSWATER	0.187	0.192	-0.006	3%
		CITY OF BELMONT	0.054	0.135	-0.081	60%
		CITY OF CANNING	0.048	0.135	-0.087	65%
		CITY OF COCKBURN	1.775	2.102	-0.327	16%
		CITY OF FREMANTLE	0.004	0.035	-0.03	87%
		CITY OF GOSNELLS	0.006	0.026	-0.021	78%
		CITY OF MANDURAH	4.358	5.936	-1.578	27%
		CITY OF MELVILLE	0.001	0.006	-0.005	83%
		CITY OF NEDLANDS	0.002	0.007	-0.006	75%
		CITY OF PERTH	0.062	0.09	-0.028	31%
		CITY OF ROCKINGHAM	1.577	2.593	-1.016	39%
		CITY OF SOUTH PERTH	0.024	0.037	-0.013	35%
		CITY OF STIRLING	0.011	0.023	-0.012	51%
		CITY OF SUBIACO	0	0.001	-0.001	100%
		CITY OF SWAN	0.026	0.124	-0.098	79%
		SHIRE OF MURRAY	1.444	4.612	-3.168	69%
		SHIRE OF PEPPERMINT GROVE	0	0	0	0%
		SHIRE OF SERPENTINE-JARRAHDALE	0.018	0.029	-0.011	37%
		SHIRE OF WAROONA	8.505	8.952	-0.447	5%
		TOWN OF BASSENDEAN	0.001	0.039	-0.038	97%
		TOWN OF CAMBRIDGE	0	0.001	-0.001	100%
		TOWN OF CLAREMONT	0.111	0.124	-0.013	11%
		TOWN OF COTTESLOE	0	0	0	0%
		TOWN OF EAST FREMANTLE	0	0	0	0%
		TOWN OF KWINANA	0.241	0.264	-0.023	9%
		TOWN OF MOSMAN PARK	0	0.001	-0.001	100%
		TOWN OF VICTORIA PARK	0.012	0.019	-0.008	41%
		TOWN OF VINCENT	0	0.002	-0.002	100%
1.2m	No. of discrete inundated areas					
		CITY OF BAYSWATER	10	41	-31	76%
		CITY OF BELMONT	5	40	-35	88%
		CITY OF CANNING	9	101	-92	91%

INUNDATION LEVEL	ANALYSIS TYPE	LGA	Hydro-DEM	STDDEM	DIFFERENCE	% DIFFERENCE
		CITY OF COCKBURN	125	380	-255	67%
		CITY OF FREMANTLE	14	60	-46	77%
		CITY OF GOSNELLS	3	52	-49	94%
		CITY OF MANDURAH	248	1248	-1000	80%
		CITY OF MELVILLE	5	29	-24	83%
		CITY OF NEDLANDS	4	22	-18	82%
		CITY OF PERTH	18	106	-88	83%
		CITY OF ROCKINGHAM	221	1060	-839	79%
		CITY OF SOUTH PERTH	25	60	-35	58%
		CITY OF STIRLING	5	30	-25	83%
		CITY OF SUBIACO	0	9	-9	100%
		CITY OF SWAN	26	234	-208	89%
		SHIRE OF MURRAY	454	3523	-3069	87%
		SHIRE OF PEPPERMINT GROVE	0	0	0	0%
		SHIRE OF SERPENTINE-JARRAHDALE	17	129	-112	87%
		SHIRE OF WAROONA	165	1236	-1071	87%
		TOWN OF BASSENDEAN	2	24	-22	92%
		TOWN OF CAMBRIDGE	0	9	-9	100%
		TOWN OF CLAREMONT	1	15	-14	93%
		TOWN OF COTTESLOE	0	4	-4	100%
		TOWN OF EAST FREMANTLE	0	3	-3	100%
		TOWN OF KWINANA	87	159	-72	45%
		TOWN OF MOSMAN PARK	0	5	-5	100%
		TOWN OF VICTORIA PARK	9	62	-53	85%
		TOWN OF VINCENT	0	5	-5	100%
1.2m	Inundation areas connected to the sea (sq km)					
		CITY OF BAYSWATER	0.745	0.819	-0.074	9%
		CITY OF BELMONT	0.738	0.724	0.014	2%
		CITY OF CANNING	2.25	2.322	-0.072	3%
		CITY OF COCKBURN	0.433	0.881	-0.448	51%
		CITY OF FREMANTLE	0.437	0.515	-0.078	15%
		CITY OF GOSNELLS	0.261	0.232	0.029	11%
		CITY OF MANDURAH	9.17	9.178	-0.008	0%
		CITY OF MELVILLE	0.466	0.452	0.014	3%
		CITY OF NEDLANDS	0.136	0.134	0.002	1%
		CITY OF PERTH	0.555	0.492	0.063	11%
		CITY OF ROCKINGHAM	4.67	3.884	0.786	17%
		CITY OF SOUTH PERTH	0.582	0.528	0.054	9%

INUNDATION LEVEL	ANALYSIS TYPE	LGA	Hydro-DEM	STDDEM	DIFFERENCE	% DIFFERENCE
		CITY OF STIRLING	0.09	0.09	-0.001	1%
		CITY OF SUBIACO	0.102	0.1	0.002	2%
		CITY OF SWAN	2.062	1.774	0.288	14%
		SHIRE OF MURRAY	27.53	25.379	2.151	8%
		SHIRE OF PEPPERMINT GROVE	0.037	0.042	-0.005	11%
		SHIRE OF SERPENTINE-JARRAHDALE	0.016	0	0.016	100%
		SHIRE OF WAROONA	1.676	1.573	0.103	6%
		TOWN OF BASSENDEAN	0.539	0.498	0.041	8%
		TOWN OF CAMBRIDGE	0.068	0.069	-0.001	1%
		TOWN OF CLAREMONT	0.037	0.039	-0.002	5%
		TOWN OF COTTESLOE	0.061	0.065	-0.005	7%
		TOWN OF EAST FREMANTLE	0.088	0.117	-0.029	25%
		TOWN OF KWINANA	0.183	0.18	0.003	1%
		TOWN OF MOSMAN PARK	0.097	0.106	-0.009	9%
		TOWN OF VICTORIA PARK	0.243	0.284	-0.04	14%
		TOWN OF VINCENT	0.028	0.029	-0.001	4%
1.2m	Total number of land parcels affected					
		CITY OF BAYSWATER	122	120	2	2%
		CITY OF BELMONT	233	211	22	9%
		CITY OF CANNING	217	210	7	3%
		CITY OF COCKBURN	92	113	21	19%
		CITY OF FREMANTLE	90	91	1	1%
		CITY OF GOSNELLS	20	20	0	0%
		CITY OF MANDURAH	2728	2686	42	2%
		CITY OF MELVILLE	84	69	15	18%
		CITY OF NEDLANDS	90	86	4	4%
		CITY OF PERTH	82	75	7	9%
		CITY OF ROCKINGHAM	111	80	31	28%
		CITY OF SOUTH PERTH	57	46	11	19%
		CITY OF STIRLING	3	3	0	0%
		CITY OF SUBIACO	7	6	1	14%
		CITY OF SWAN	252	210	42	17%
		SHIRE OF MURRAY	1593	1519	74	5%
		SHIRE OF PEPPERMINT GROVE	12	15	3	20%
		SHIRE OF SERPENTINE-JARRAHDALE	11	0	11	100%
		SHIRE OF WAROONA	41	30	11	27%
		TOWN OF BASSENDEAN	193	160	33	17%
		TOWN OF CAMBRIDGE	1	1	0	0%

INUNDATION LEVEL	ANALYSIS TYPE	LGA	Hydro-DEM	STDDEM	DIFFERENCE	% DIFFERENCE
		TOWN OF CLAREMONT	67	70	3	4%
		TOWN OF COTTESLOE	6	6	0	0%
		TOWN OF EAST FREMANTLE	29	31	2	6%
		TOWN OF KWINANA	23	23	0	0%
		TOWN OF MOSMAN PARK	32	32	0	0%
		TOWN OF VICTORIA PARK	16	24	8	33%
		TOWN OF VINCENT	14	14	0	0%
1.2m	No. of land parcels 100% inundated					
		CITY OF BAYSWATER	4	5	1	20%
		CITY OF BELMONT	32	32	0	0%
		CITY OF CANNING	21	33	12	36%
		CITY OF COCKBURN	0	0	0	0%
		CITY OF FREMANTLE	1	6	5	83%
		CITY OF GOSNELLS	0	0	0	0%
		CITY OF MANDURAH	31	30	1	3%
		CITY OF MELVILLE	2	1	1	50%
		CITY OF NEDLANDS	4	3	1	25%
		CITY OF PERTH	5	4	1	20%
		CITY OF ROCKINGHAM	0	0	0	0%
		CITY OF SOUTH PERTH	1	0	1	100%
		CITY OF STIRLING	0	0	0	0%
		CITY OF SUBIACO	0	0	0	0%
		CITY OF SWAN	2	2	0	0%
		SHIRE OF MURRAY	19	23	4	17%
		SHIRE OF PEPPERMINT GROVE	2	2	0	0%
		SHIRE OF SERPENTINE-JARRAHDALE	0	0	0	0%
		SHIRE OF WAROONA	0	0	0	0%
		TOWN OF BASSENDEAN	18	12	6	33%
		TOWN OF CAMBRIDGE	0	0	0	0%
		TOWN OF CLAREMONT	1	1	0	0%
		TOWN OF COTTESLOE	0	0	0	0%
		TOWN OF EAST FREMANTLE	0	0	0	0%
		TOWN OF KWINANA	0	0	0	0%
		TOWN OF MOSMAN PARK	3	3	0	0%
		TOWN OF VICTORIA PARK	0	1	1	100%
		TOWN OF VINCENT	0	0	0	0%
1.2m	No. of land parcels 75-100% inundated					
		CITY OF BAYSWATER	14	17	3	18%

INUNDATION LEVEL	ANALYSIS TYPE	LGA	Hydro-DEM	STDDEM	DIFFERENCE	% DIFFERENCE
		CITY OF BELMONT	32	31	1	3%
		CITY OF CANNING	51	51	0	0%
		CITY OF COCKBURN	4	11	7	64%
		CITY OF FREMANTLE	10	15	5	33%
		CITY OF GOSNELLS	3	3	0	0%
		CITY OF MANDURAH	128	130	2	2%
		CITY OF MELVILLE	11	7	4	36%
		CITY OF NEDLANDS	6	9	3	33%
		CITY OF PERTH	4	2	2	50%
		CITY OF ROCKINGHAM	3	2	1	33%
		CITY OF SOUTH PERTH	8	7	1	13%
		CITY OF STIRLING	0	0	0	0%
		CITY OF SUBIACO	0	0	0	0%
		CITY OF SWAN	17	13	4	24%
		SHIRE OF MURRAY	99	100	1	1%
		SHIRE OF PEPPERMINT GROVE	2	2	0	0%
		SHIRE OF SERPENTINE-JARRAHDALE	0	0	0	0%
		SHIRE OF WAROONA	3	3	0	0%
		TOWN OF BASSENDEAN	32	25	7	22%
		TOWN OF CAMBRIDGE	0	0	0	0%
		TOWN OF CLAREMONT	1	1	0	0%
		TOWN OF COTTESLOE	1	1	0	0%
		TOWN OF EAST FREMANTLE	5	13	8	62%
		TOWN OF KWINANA	1	1	0	0%
		TOWN OF MOSMAN PARK	0	4	4	100%
		TOWN OF VICTORIA PARK	3	2	1	33%
		TOWN OF VINCENT	2	2	0	0%
1.2m	No. of land parcels 51-75% inundated					
		CITY OF BAYSWATER	14	14	0	0%
		CITY OF BELMONT	26	22	4	15%
		CITY OF CANNING	39	34	5	13%
		CITY OF COCKBURN	5	12	7	58%
		CITY OF FREMANTLE	8	3	5	63%
		CITY OF GOSNELLS	4	3	1	25%
		CITY OF MANDURAH	140	128	12	9%
		CITY OF MELVILLE	15	13	2	13%
		CITY OF NEDLANDS	7	5	2	29%
		CITY OF PERTH	1	5	4	80%

INUNDATION LEVEL	ANALYSIS TYPE	LGA	Hydro-DEM	STDDEM	DIFFERENCE	% DIFFERENCE
		CITY OF ROCKINGHAM	9	2	7	78%
		CITY OF SOUTH PERTH	7	4	3	43%
		CITY OF STIRLING	0	0	0	0%
		CITY OF SUBIACO	1	1	0	0%
		CITY OF SWAN	29	17	12	41%
		SHIRE OF MURRAY	81	78	3	4%
		SHIRE OF PEPPERMINT GROVE	0	0	0	0%
		SHIRE OF SERPENTINE-JARRAHDALE	0	0	0	0%
		SHIRE OF WAROONA	3	3	0	0%
		TOWN OF BASSENDEAN	23	15	8	35%
		TOWN OF CAMBRIDGE	0	0	0	0%
		TOWN OF CLAREMONT	4	4	0	0%
		TOWN OF COTTESLOE	0	0	0	0%
		TOWN OF EAST FREMANTLE	5	3	2	40%
		TOWN OF KWINANA	1	1	0	0%
		TOWN OF MOSMAN PARK	5	4	1	20%
		TOWN OF VICTORIA PARK	0	0	0	0%
		TOWN OF VINCENT	2	2	0	0%
1.2m	No. of land parcels 26-50% inundated					
		CITY OF BAYSWATER	18	18	0	0%
		CITY OF BELMONT	34	41	7	17%
		CITY OF CANNING	31	33	2	6%
		CITY OF COCKBURN	42	49	7	14%
		CITY OF FREMANTLE	8	9	1	11%
		CITY OF GOSNELLS	3	3	0	0%
		CITY OF MANDURAH	521	498	23	4%
		CITY OF MELVILLE	15	22	7	32%
		CITY OF NEDLANDS	5	5	0	0%
		CITY OF PERTH	13	11	2	15%
		CITY OF ROCKINGHAM	25	17	8	32%
		CITY OF SOUTH PERTH	12	11	1	8%
		CITY OF STIRLING	0	0	0	0%
		CITY OF SUBIACO	2	2	0	0%
		CITY OF SWAN	38	31	7	18%
		SHIRE OF MURRAY	229	230	1	0%
		SHIRE OF PEPPERMINT GROVE	3	3	0	0%
		SHIRE OF SERPENTINE-JARRAHDALE	0	0	0	0%
		SHIRE OF WAROONA	11	8	3	27%

INUNDATION LEVEL	ANALYSIS TYPE	LGA	Hydro-DEM	STDDEM	DIFFERENCE	% DIFFERENCE
		TOWN OF BASSENDEAN	28	27	1	4%
		TOWN OF CAMBRIDGE	0	0	0	0%
		TOWN OF CLAREMONT	4	4	0	0%
		TOWN OF COTTESLOE	2	2	0	0%
		TOWN OF EAST FREMANTLE	3	5	2	40%
		TOWN OF KWINANA	7	9	2	22%
		TOWN OF MOSMAN PARK	6	6	0	0%
		TOWN OF VICTORIA PARK	1	1	0	0%
		TOWN OF VINCENT	5	5	0	0%
1.2m	No. of land parcels less than 25% inundated					
		CITY OF BAYSWATER	72	66	6	8%
		CITY OF BELMONT	109	85	24	22%
		CITY OF CANNING	75	59	16	21%
		CITY OF COCKBURN	41	41	0	0%
		CITY OF FREMANTLE	63	58	5	8%
		CITY OF GOSNELLS	10	11	1	9%
		CITY OF MANDURAH	1908	1900	8	0%
		CITY OF MELVILLE	41	26	15	37%
		CITY OF NEDLANDS	68	64	4	6%
		CITY OF PERTH	59	53	6	10%
		CITY OF ROCKINGHAM	74	59	15	20%
		CITY OF SOUTH PERTH	29	24	5	17%
		CITY OF STIRLING	3	3	0	0%
		CITY OF SUBIACO	4	3	1	25%
		CITY OF SWAN	166	147	19	11%
		SHIRE OF MURRAY	1165	1088	77	7%
		SHIRE OF PEPPERMINT GROVE	5	8	3	38%
		SHIRE OF SERPENTINE-JARRAHDALE	11	0	11	100%
		SHIRE OF WAROONA	24	16	8	33%
		TOWN OF BASSENDEAN	92	81	11	12%
		TOWN OF CAMBRIDGE	1	1	0	0%
		TOWN OF CLAREMONT	57	60	3	5%
		TOWN OF COTTESLOE	3	3	0	0%
		TOWN OF EAST FREMANTLE	16	10	6	38%
		TOWN OF KWINANA	14	12	2	14%
		TOWN OF MOSMAN PARK	18	15	3	17%
		TOWN OF VICTORIA PARK	12	20	8	40%
		TOWN OF VINCENT	5	5	0	0%

INUNDATION LEVEL	ANALYSIS TYPE	LGA	Hydro-DEM	STDDEM	DIFFERENCE	% DIFFERENCE
1.4m						
1.4m	Discrete inundated areas (sq km)					
		CITY OF BAYSWATER	0.178	0.186	-0.009	5%
		CITY OF BELMONT	0.03	0.177	-0.147	83%
		CITY OF CANNING	0.058	0.035	0.023	39%
		CITY OF COCKBURN	2.053	2.283	-0.231	10%
		CITY OF FREMANTLE	0.007	0.086	-0.078	91%
		CITY OF GOSNELLS	0.001	0.022	-0.021	96%
		CITY OF MANDURAH	5.266	6.483	-1.216	19%
		CITY OF MELVILLE	0.008	0.019	-0.012	61%
		CITY OF NEDLANDS	0.003	0.028	-0.025	90%
		CITY OF PERTH	0.06	0.114	-0.054	48%
		CITY OF ROCKINGHAM	2.769	3.977	-1.209	30%
		CITY OF SOUTH PERTH	0.037	0.066	-0.029	44%
		CITY OF STIRLING	0.022	0.031	-0.009	29%
		CITY OF SUBIACO	0	0.003	-0.003	100%
		CITY OF SWAN	0.023	0.155	-0.132	85%
		SHIRE OF MURRAY	1.399	4.892	-3.493	71%
		SHIRE OF PEPPERMINT GROVE	0	0	0	0%
		SHIRE OF SERPENTINE-JARRAHDALE	0.043	0.073	-0.029	40%
		SHIRE OF WAROONA	10.526	10.915	-0.389	4%
		TOWN OF BASSENDEAN	0.002	0.025	-0.023	91%
		TOWN OF CAMBRIDGE	0	0.004	-0.004	100%
		TOWN OF CLAREMONT	0.13	0.144	-0.014	10%
		TOWN OF COTTESLOE	0	0.005	-0.005	100%
		TOWN OF EAST FREMANTLE	0	0.003	-0.003	100%
		TOWN OF KWINANA	0.324	0.345	-0.021	6%
		TOWN OF MOSMAN PARK	0	0.001	-0.001	100%
		TOWN OF VICTORIA PARK	0.012	0.02	-0.008	39%
		TOWN OF VINCENT	0	0	0	0%
1.4m	No. of discrete inundated areas					
		CITY OF BAYSWATER	12	57	-45	79%
		CITY OF BELMONT	7	45	-38	84%
		CITY OF CANNING	12	107	-95	89%
		CITY OF COCKBURN	120	361	-241	67%
		CITY OF FREMANTLE	17	68	-51	75%
		CITY OF GOSNELLS	1	38	-37	97%

INUNDATION LEVEL	ANALYSIS TYPE	LGA	Hydro-DEM	STDDEM	DIFFERENCE	% DIFFERENCE
		CITY OF MANDURAH	260	1055	-795	75%
		CITY OF MELVILLE	9	77	-68	88%
		CITY OF NEDLANDS	4	30	-26	87%
		CITY OF PERTH	17	109	-92	84%
		CITY OF ROCKINGHAM	285	1084	-799	74%
		CITY OF SOUTH PERTH	37	107	-70	65%
		CITY OF STIRLING	9	17	-8	47%
		CITY OF SUBIACO	0	12	-12	100%
		CITY OF SWAN	23	214	-191	89%
		SHIRE OF MURRAY	415	2942	-2527	86%
		SHIRE OF PEPPERMINT GROVE	0	0	0	0%
		SHIRE OF SERPENTINE-JARRAHDALE	22	203	-181	89%
		SHIRE OF WAROONA	166	1304	-1138	87%
		TOWN OF BASSENDEAN	2	35	-33	94%
		TOWN OF CAMBRIDGE	0	11	-11	100%
		TOWN OF CLAREMONT	1	7	-6	86%
		TOWN OF COTTESLOE	0	6	-6	100%
		TOWN OF EAST FREMANTLE	0	10	-10	100%
		TOWN OF KWINANA	93	162	-69	43%
		TOWN OF MOSMAN PARK	0	4	-4	100%
		TOWN OF VICTORIA PARK	8	52	-44	85%
		TOWN OF VINCENT	0	1	-1	100%
1.4m	Inundation areas connected to the sea (sq km)					
		CITY OF BAYSWATER	0.851	0.929	-0.078	8%
		CITY OF BELMONT	0.86	0.768	0.092	11%
		CITY OF CANNING	2.461	2.604	-0.142	5%
		CITY OF COCKBURN	0.467	0.916	-0.449	49%
		CITY OF FREMANTLE	0.562	0.616	-0.055	9%
		CITY OF GOSNELLS	0.323	0.302	0.021	6%
		CITY OF MANDURAH	10.552	10.503	0.049	0%
		CITY OF MELVILLE	0.573	0.536	0.036	6%
		CITY OF NEDLANDS	0.184	0.179	0.005	3%
		CITY OF PERTH	0.812	0.749	0.063	8%
		CITY OF ROCKINGHAM	5.672	4.68	0.992	17%
		CITY OF SOUTH PERTH	0.74	0.659	0.081	11%
		CITY OF STIRLING	0.099	0.106	-0.007	6%
		CITY OF SUBIACO	0.125	0.121	0.004	3%
		CITY OF SWAN	2.604	2.227	0.378	15%

INUNDATION LEVEL	ANALYSIS TYPE	LGA	Hydro-DEM	STDDEM	DIFFERENCE	% DIFFERENCE
		SHIRE OF MURRAY	33.064	30.454	2.61	8%
		SHIRE OF PEPPERMINT GROVE	0.042	0.046	-0.004	8%
		SHIRE OF SERPENTINE-JARRAHDALE	0.053	0.058	-0.005	9%
		SHIRE OF WAROONA	2.056	1.898	0.158	8%
		TOWN OF BASSENDEAN	0.602	0.574	0.027	5%
		TOWN OF CAMBRIDGE	0.079	0.087	-0.008	9%
		TOWN OF CLAREMONT	0.041	0.042	-0.001	3%
		TOWN OF COTTESLOE	0.072	0.076	-0.003	4%
		TOWN OF EAST FREMANTLE	0.129	0.153	-0.025	16%
		TOWN OF KWINANA	0.203	0.199	0.004	2%
		TOWN OF MOSMAN PARK	0.106	0.112	-0.006	6%
		TOWN OF VICTORIA PARK	0.396	0.444	-0.049	11%
		TOWN OF VINCENT	0.038	0.042	-0.003	8%
1.4m	Total number of land parcels affected					
		CITY OF BAYSWATER	131	138	7	5%
		CITY OF BELMONT	255	218	37	15%
		CITY OF CANNING	254	282	28	10%
		CITY OF COCKBURN	94	114	20	18%
		CITY OF FREMANTLE	107	99	8	7%
		CITY OF GOSNELLS	22	21	1	5%
		CITY OF MANDURAH	2948	2879	69	2%
		CITY OF MELVILLE	150	87	63	42%
		CITY OF NEDLANDS	95	92	3	3%
		CITY OF PERTH	115	92	23	20%
		CITY OF ROCKINGHAM	153	80	73	48%
		CITY OF SOUTH PERTH	84	56	28	33%
		CITY OF STIRLING	3	3	0	0%
		CITY OF SUBIACO	11	9	2	18%
		CITY OF SWAN	272	232	40	15%
		SHIRE OF MURRAY	1830	1748	82	4%
		SHIRE OF PEPPERMINT GROVE	15	15	0	0%
		SHIRE OF SERPENTINE-JARRAHDALE	12	3	9	75%
		SHIRE OF WAROONA	44	30	14	32%
		TOWN OF BASSENDEAN	225	198	27	12%
		TOWN OF CAMBRIDGE	1	1	0	0%
		TOWN OF CLAREMONT	71	72	1	1%
		TOWN OF COTTESLOE	7	7	0	0%
		TOWN OF EAST FREMANTLE	40	40	0	0%

INUNDATION LEVEL	ANALYSIS TYPE	LGA	Hydro-DEM	STDDEM	DIFFERENCE	% DIFFERENCE
		TOWN OF KWINANA	23	23	0	0%
		TOWN OF MOSMAN PARK	33	35	2	6%
		TOWN OF VICTORIA PARK	50	57	7	12%
		TOWN OF VINCENT	14	16	2	13%
1.4m	No. of land parcels 100% inundated					
		CITY OF BAYSWATER	6	6	0	0%
		CITY OF BELMONT	36	36	0	0%
		CITY OF CANNING	34	43	9	21%
		CITY OF COCKBURN	0	1	1	100%
		CITY OF FREMANTLE	9	15	6	40%
		CITY OF GOSNELLS	1	1	0	0%
		CITY OF MANDURAH	57	62	5	8%
		CITY OF MELVILLE	4	4	0	0%
		CITY OF NEDLANDS	5	3	2	40%
		CITY OF PERTH	8	6	2	25%
		CITY OF ROCKINGHAM	0	0	0	0%
		CITY OF SOUTH PERTH	2	3	1	33%
		CITY OF STIRLING	0	0	0	0%
		CITY OF SUBIACO	0	0	0	0%
		CITY OF SWAN	5	4	1	20%
		SHIRE OF MURRAY	52	60	8	13%
		SHIRE OF PEPPERMINT GROVE	4	3	1	25%
		SHIRE OF SERPENTINE-JARRAHDALE	0	0	0	0%
		SHIRE OF WAROONA	0	0	0	0%
		TOWN OF BASSENDEAN	28	27	1	4%
		TOWN OF CAMBRIDGE	0	0	0	0%
		TOWN OF CLAREMONT	2	1	1	50%
		TOWN OF COTTESLOE	0	0	0	0%
		TOWN OF EAST FREMANTLE	1	7	6	86%
		TOWN OF KWINANA	0	0	0	0%
		TOWN OF MOSMAN PARK	3	3	0	0%
		TOWN OF VICTORIA PARK	2	6	4	67%
		TOWN OF VINCENT	0	0	0	0%
1.4m	No. of land parcels 75-100% inundated					
		CITY OF BAYSWATER	16	18	2	11%
		CITY OF BELMONT	35	37	2	5%
		CITY OF CANNING	63	69	6	9%
		CITY OF COCKBURN	4	13	9	69%

INUNDATION LEVEL	ANALYSIS TYPE	LGA	Hydro-DEM	STDDEM	DIFFERENCE	% DIFFERENCE
		CITY OF FREMANTLE	16	13	3	19%
		CITY OF GOSNELLS	4	4	0	0%
		CITY OF MANDURAH	196	188	8	4%
		CITY OF MELVILLE	22	15	7	32%
		CITY OF NEDLANDS	9	12	3	25%
		CITY OF PERTH	6	7	1	14%
		CITY OF ROCKINGHAM	6	2	4	67%
		CITY OF SOUTH PERTH	11	9	2	18%
		CITY OF STIRLING	0	0	0	0%
		CITY OF SUBIACO	1	0	1	100%
		CITY OF SWAN	35	21	14	40%
		SHIRE OF MURRAY	171	179	8	4%
		SHIRE OF PEPPERMINT GROVE	0	1	1	100%
		SHIRE OF SERPENTINE-JARRAHDALE	0	0	0	0%
		SHIRE OF WAROONA	6	6	0	0%
		TOWN OF BASSENDEAN	41	31	10	24%
		TOWN OF CAMBRIDGE	0	0	0	0%
		TOWN OF CLAREMONT	3	5	2	40%
		TOWN OF COTTESLOE	1	1	0	0%
		TOWN OF EAST FREMANTLE	15	11	4	27%
		TOWN OF KWINANA	1	1	0	0%
		TOWN OF MOSMAN PARK	3	6	3	50%
		TOWN OF VICTORIA PARK	11	19	8	42%
		TOWN OF VINCENT	3	3	0	0%
1.4m	No. of land parcels 51-75% inundated					
		CITY OF BAYSWATER	16	16	0	0%
		CITY OF BELMONT	30	16	14	47%
		CITY OF CANNING	30	36	6	17%
		CITY OF COCKBURN	7	12	5	42%
		CITY OF FREMANTLE	6	5	1	17%
		CITY OF GOSNELLS	3	4	1	25%
		CITY OF MANDURAH	178	168	10	6%
		CITY OF MELVILLE	12	16	4	25%
		CITY OF NEDLANDS	5	5	0	0%
		CITY OF PERTH	8	7	1	13%
		CITY OF ROCKINGHAM	11	3	8	73%
		CITY OF SOUTH PERTH	14	6	8	57%
		CITY OF STIRLING	0	0	0	0%

INUNDATION LEVEL	ANALYSIS TYPE	LGA	Hydro-DEM	STDDEM	DIFFERENCE	% DIFFERENCE
		CITY OF SUBIACO	1	2	1	50%
		CITY OF SWAN	34	39	5	13%
		SHIRE OF MURRAY	130	126	4	3%
		SHIRE OF PEPPERMINT GROVE	1	2	1	50%
		SHIRE OF SERPENTINE-JARRAHDALE	0	0	0	0%
		SHIRE OF WAROONA	2	1	1	50%
		TOWN OF BASSENDEAN	24	16	8	33%
		TOWN OF CAMBRIDGE	0	0	0	0%
		TOWN OF CLAREMONT	2	1	1	50%
		TOWN OF COTTESLOE	0	0	0	0%
		TOWN OF EAST FREMANTLE	1	1	0	0%
		TOWN OF KWINANA	2	2	0	0%
		TOWN OF MOSMAN PARK	5	3	2	40%
		TOWN OF VICTORIA PARK	12	6	6	50%
		TOWN OF VINCENT	4	5	1	20%
1.4m	No. of land parcels 26-50% inundated					
		CITY OF BAYSWATER	20	23	3	13%
		CITY OF BELMONT	49	47	2	4%
		CITY OF CANNING	33	30	3	9%
		CITY OF COCKBURN	45	47	2	4%
		CITY OF FREMANTLE	12	11	1	8%
		CITY OF GOSNELLS	3	1	2	67%
		CITY OF MANDURAH	811	796	15	2%
		CITY OF MELVILLE	19	16	3	16%
		CITY OF NEDLANDS	7	4	3	43%
		CITY OF PERTH	18	14	4	22%
		CITY OF ROCKINGHAM	30	19	11	37%
		CITY OF SOUTH PERTH	18	13	5	28%
		CITY OF STIRLING	0	0	0	0%
		CITY OF SUBIACO	3	3	0	0%
		CITY OF SWAN	36	24	12	33%
		SHIRE OF MURRAY	352	370	18	5%
		SHIRE OF PEPPERMINT GROVE	2	1	1	50%
		SHIRE OF SERPENTINE-JARRAHDALE	0	0	0	0%
		SHIRE OF WAROONA	10	9	1	10%
		TOWN OF BASSENDEAN	27	22	5	19%
		TOWN OF CAMBRIDGE	0	0	0	0%
		TOWN OF CLAREMONT	6	7	1	14%

INUNDATION LEVEL	ANALYSIS TYPE	LGA	Hydro-DEM	STDDEM	DIFFERENCE	% DIFFERENCE
		TOWN OF COTTESLOE	3	3	0	0%
		TOWN OF EAST FREMANTLE	4	4	0	0%
		TOWN OF KWINANA	9	10	1	10%
		TOWN OF MOSMAN PARK	4	6	2	33%
		TOWN OF VICTORIA PARK	7	12	5	42%
		TOWN OF VINCENT	4	3	1	25%
1.4m	No. of land parcels less than 25% inundated					
		CITY OF BAYSWATER	73	75	2	3%
		CITY OF BELMONT	105	82	23	22%
		CITY OF CANNING	94	104	10	10%
		CITY OF COCKBURN	38	41	3	7%
		CITY OF FREMANTLE	64	55	9	14%
		CITY OF GOSNELLS	11	11	0	0%
		CITY OF MANDURAH	1706	1665	41	2%
		CITY OF MELVILLE	93	36	57	61%
		CITY OF NEDLANDS	69	68	1	1%
		CITY OF PERTH	75	58	17	23%
		CITY OF ROCKINGHAM	106	56	50	47%
		CITY OF SOUTH PERTH	39	25	14	36%
		CITY OF STIRLING	3	3	0	0%
		CITY OF SUBIACO	6	4	2	33%
		CITY OF SWAN	162	144	18	11%
		SHIRE OF MURRAY	1125	1013	112	10%
		SHIRE OF PEPPERMINT GROVE	8	8	0	0%
		SHIRE OF SERPENTINE-JARRAHDALE	12	3	9	75%
		SHIRE OF WAROONA	26	14	12	46%
		TOWN OF BASSENDEAN	105	102	3	3%
		TOWN OF CAMBRIDGE	1	1	0	0%
		TOWN OF CLAREMONT	58	58	0	0%
		TOWN OF COTTESLOE	3	3	0	0%
		TOWN OF EAST FREMANTLE	19	17	2	11%
		TOWN OF KWINANA	11	10	1	9%
		TOWN OF MOSMAN PARK	18	17	1	6%
		TOWN OF VICTORIA PARK	18	14	4	22%
		TOWN OF VINCENT	3	5	2	40%
1.8m	Discrete inundated areas (sq km)					
		CITY OF BAYSWATER	0.195	0.213	-0.018	8%
		CITY OF BELMONT	0.04	0.218	-0.178	81%

INUNDATION LEVEL	ANALYSIS TYPE	LGA	Hydro-DEM	STDDEM	DIFFERENCE	% DIFFERENCE
		CITY OF CANNING	0.032	0.096	-0.064	67%
		CITY OF COCKBURN	2.557	2.687	-0.129	5%
		CITY OF FREMANTLE	0.044	0.077	-0.033	43%
		CITY OF GOSNELLS	0.004	0.012	-0.007	62%
		CITY OF MANDURAH	6.869	7.478	-0.609	8%
		CITY OF MELVILLE	0.006	0.016	-0.01	63%
		CITY OF NEDLANDS	0.005	0.007	-0.002	32%
		CITY OF PERTH	0.072	0.156	-0.084	54%
		CITY OF ROCKINGHAM	4.457	6.505	-2.048	31%
		CITY OF SOUTH PERTH	0.112	0.15	-0.038	26%
		CITY OF STIRLING	0.037	0.042	-0.005	13%
		CITY OF SUBIACO	0	0	0	0%
		CITY OF SWAN	0.016	0.073	-0.056	78%
		SHIRE OF MURRAY	1.341	5.459	-4.117	75%
		SHIRE OF PEPPERMINT GROVE	0	0	0	0%
		SHIRE OF SERPENTINE-JARRAHDALE	0.024	0.081	-0.057	71%
		SHIRE OF WAROONA	13.873	14.214	-0.341	2%
		TOWN OF BASSENDEAN	0.004	0.039	-0.035	89%
		TOWN OF CAMBRIDGE	0.001	0.004	-0.003	75%
		TOWN OF CLAREMONT	0.166	0.173	-0.007	4%
		TOWN OF COTTESLOE	0	0.001	-0.001	100%
		TOWN OF EAST FREMANTLE	0	0	0	0%
		TOWN OF KWINANA	0.519	0.571	-0.052	9%
		TOWN OF MOSMAN PARK	0	0.002	-0.002	100%
		TOWN OF VICTORIA PARK	0.058	0.084	-0.026	31%
		TOWN OF VINCENT	0.001	0.001	0	0%
1.8m	No. of discrete inundated areas					
		CITY OF BAYSWATER	8	45	-37	82%
		CITY OF BELMONT	9	35	-26	74%
		CITY OF CANNING	14	159	-145	91%
		CITY OF COCKBURN	154	350	-196	56%
		CITY OF FREMANTLE	32	100	-68	68%
		CITY OF GOSNELLS	2	22	-20	91%
		CITY OF MANDURAH	278	989	-711	72%
		CITY OF MELVILLE	6	92	-86	93%
		CITY OF NEDLANDS	4	15	-11	73%
		CITY OF PERTH	17	53	-36	68%
		CITY OF ROCKINGHAM	443	2174	-1731	80%

INUNDATION LEVEL	ANALYSIS TYPE	LGA	Hydro-DEM	STDDEM	DIFFERENCE	% DIFFERENCE
		CITY OF SOUTH PERTH	30	219	-189	86%
		CITY OF STIRLING	9	16	-7	44%
		CITY OF SUBIACO	0	3	-3	100%
		CITY OF SWAN	17	196	-179	91%
		SHIRE OF MURRAY	346	4301	-3955	92%
		SHIRE OF PEPPERMINT GROVE	0	0	0	0%
		SHIRE OF SERPENTINE-JARRAHDALE	15	224	-209	93%
		SHIRE OF WAROONA	206	1083	-877	81%
		TOWN OF BASSENDEAN	5	13	-8	62%
		TOWN OF CAMBRIDGE	2	16	-14	88%
		TOWN OF CLAREMONT	1	5	-4	80%
		TOWN OF COTTESLOE	0	2	-2	100%
		TOWN OF EAST FREMANTLE	0	1	-1	100%
		TOWN OF KWINANA	116	265	-149	56%
		TOWN OF MOSMAN PARK	0	4	-4	100%
		TOWN OF VICTORIA PARK	18	63	-45	71%
		TOWN OF VINCENT	1	6	-5	83%
1.8m	Inundation areas connected to the sea (sq km)					
		CITY OF BAYSWATER	1.071	1.17	-0.099	8%
		CITY OF BELMONT	1.014	0.912	0.102	10%
		CITY OF CANNING	2.87	2.945	-0.075	3%
		CITY OF COCKBURN	0.629	0.989	-0.36	36%
		CITY OF FREMANTLE	0.858	0.993	-0.136	14%
		CITY OF GOSNELLS	0.469	0.455	0.013	3%
		CITY OF MANDURAH	12.851	12.757	0.095	1%
		CITY OF MELVILLE	0.952	0.893	0.059	6%
		CITY OF NEDLANDS	0.375	0.387	-0.012	3%
		CITY OF PERTH	1.189	1.106	0.083	7%
		CITY OF ROCKINGHAM	7.999	6.423	1.576	20%
		CITY OF SOUTH PERTH	1.266	1.072	0.195	15%
		CITY OF STIRLING	0.133	0.137	-0.004	3%
		CITY OF SUBIACO	0.185	0.183	0.001	1%
		CITY OF SWAN	3.589	3.309	0.28	8%
		SHIRE OF MURRAY	44.344	42.059	2.285	5%
		SHIRE OF PEPPERMINT GROVE	0.049	0.052	-0.003	5%
		SHIRE OF SERPENTINE-JARRAHDALE	0.574	0.606	-0.032	5%
		SHIRE OF WAROONA	2.961	2.76	0.201	7%
		TOWN OF BASSENDEAN	0.71	0.677	0.033	5%

INUNDATION LEVEL	ANALYSIS TYPE	LGA	Hydro-DEM	STDDEM	DIFFERENCE	% DIFFERENCE
		TOWN OF CAMBRIDGE	0.136	0.154	-0.018	12%
		TOWN OF CLAREMONT	0.048	0.05	-0.002	3%
		TOWN OF COTTESLOE	0.11	0.116	-0.005	5%
		TOWN OF EAST FREMANTLE	0.203	0.22	-0.017	8%
		TOWN OF KWINANA	0.246	0.24	0.006	2%
		TOWN OF MOSMAN PARK	0.117	0.121	-0.005	4%
		TOWN OF VICTORIA PARK	0.641	0.656	-0.014	2%
		TOWN OF VINCENT	0.055	0.057	-0.002	3%
1.8m	Total number of land parcels affected					
		CITY OF BAYSWATER	176	150	26	15%
		CITY OF BELMONT	288	265	23	8%
		CITY OF CANNING	486	496	10	2%
		CITY OF COCKBURN	99	115	16	14%
		CITY OF FREMANTLE	218	279	61	22%
		CITY OF GOSNELLS	27	24	3	11%
		CITY OF MANDURAH	3589	3511	78	2%
		CITY OF MELVILLE	383	303	80	21%
		CITY OF NEDLANDS	109	111	2	2%
		CITY OF PERTH	163	141	22	13%
		CITY OF ROCKINGHAM	307	213	94	31%
		CITY OF SOUTH PERTH	293	206	87	30%
		CITY OF STIRLING	3	3	0	0%
		CITY OF SUBIACO	24	24	0	0%
		CITY OF SWAN	337	274	63	19%
		SHIRE OF MURRAY	2173	2081	92	4%
		SHIRE OF PEPPERMINT GROVE	16	16	0	0%
		SHIRE OF SERPENTINE-JARRAHDALE	16	11	5	31%
		SHIRE OF WAROONA	49	38	11	22%
		TOWN OF BASSENDEAN	256	215	41	16%
		TOWN OF CAMBRIDGE	1	1	0	0%
		TOWN OF CLAREMONT	72	72	0	0%
		TOWN OF COTTESLOE	7	7	0	0%
		TOWN OF EAST FREMANTLE	60	70	10	14%
		TOWN OF KWINANA	23	23	0	0%
		TOWN OF MOSMAN PARK	37	37	0	0%
		TOWN OF VICTORIA PARK	94	95	1	1%
		TOWN OF VINCENT	19	18	1	5%
1.8m	No. of land parcels 100% inundated					

INUNDATION LEVEL	ANALYSIS TYPE	LGA	Hydro-DEM	STDDEM	DIFFERENCE	% DIFFERENCE
		CITY OF BAYSWATER	8	10	2	20%
		CITY OF BELMONT	41	39	2	5%
		CITY OF CANNING	61	74	13	18%
		CITY OF COCKBURN	1	2	1	50%
		CITY OF FREMANTLE	55	72	17	24%
		CITY OF GOSNELLS	3	2	1	33%
		CITY OF MANDURAH	228	236	8	3%
		CITY OF MELVILLE	25	20	5	20%
		CITY OF NEDLANDS	7	5	2	29%
		CITY OF PERTH	23	26	3	12%
		CITY OF ROCKINGHAM	46	49	3	6%
		CITY OF SOUTH PERTH	24	15	9	38%
		CITY OF STIRLING	0	0	0	0%
		CITY OF SUBIACO	1	1	0	0%
		CITY OF SWAN	15	13	2	13%
		SHIRE OF MURRAY	207	279	72	26%
		SHIRE OF PEPPERMINT GROVE	4	3	1	25%
		SHIRE OF SERPENTINE-JARRAHDALE	0	0	0	0%
		SHIRE OF WAROONA	0	0	0	0%
		TOWN OF BASSENDEAN	53	42	11	21%
		TOWN OF CAMBRIDGE	0	0	0	0%
		TOWN OF CLAREMONT	4	5	1	20%
		TOWN OF COTTESLOE	0	0	0	0%
		TOWN OF EAST FREMANTLE	12	16	4	25%
		TOWN OF KWINANA	0	0	0	0%
		TOWN OF MOSMAN PARK	3	5	2	40%
		TOWN OF VICTORIA PARK	35	42	7	17%
		TOWN OF VINCENT	2	2	0	0%
1.8m	No. of land parcels 75-100% inundated					
		CITY OF BAYSWATER	19	23	4	17%
		CITY OF BELMONT	48	48	0	0%
		CITY OF CANNING	92	104	12	12%
		CITY OF COCKBURN	5	13	8	62%
		CITY OF FREMANTLE	42	58	16	28%
		CITY OF GOSNELLS	5	5	0	0%
		CITY OF MANDURAH	355	348	7	2%
		CITY OF MELVILLE	34	30	4	12%
		CITY OF NEDLANDS	15	17	2	12%

INUNDATION LEVEL	ANALYSIS TYPE	LGA	Hydro-DEM	STDDEM	DIFFERENCE	% DIFFERENCE
		CITY OF PERTH	17	15	2	12%
		CITY OF ROCKINGHAM	37	25	12	32%
		CITY OF SOUTH PERTH	34	34	0	0%
		CITY OF STIRLING	0	0	0	0%
		CITY OF SUBIACO	3	3	0	0%
		CITY OF SWAN	58	55	3	5%
		SHIRE OF MURRAY	301	290	11	4%
		SHIRE OF PEPPERMINT GROVE	0	1	1	100%
		SHIRE OF SERPENTINE-JARRAHDALE	0	0	0	0%
		SHIRE OF WAROONA	6	6	0	0%
		TOWN OF BASSENDEAN	47	34	13	28%
		TOWN OF CAMBRIDGE	0	0	0	0%
		TOWN OF CLAREMONT	2	2	0	0%
		TOWN OF COTTESLOE	1	1	0	0%
		TOWN OF EAST FREMANTLE	12	10	2	17%
		TOWN OF KWINANA	1	1	0	0%
		TOWN OF MOSMAN PARK	3	4	1	25%
		TOWN OF VICTORIA PARK	23	17	6	26%
		TOWN OF VINCENT	5	5	0	0%
1.8m	No. of land parcels 51-75% inundated					
		CITY OF BAYSWATER	28	19	9	32%
		CITY OF BELMONT	29	27	2	7%
		CITY OF CANNING	42	42	0	0%
		CITY OF COCKBURN	16	22	6	27%
		CITY OF FREMANTLE	30	29	1	3%
		CITY OF GOSNELLS	3	3	0	0%
		CITY OF MANDURAH	286	270	16	6%
		CITY OF MELVILLE	28	23	5	18%
		CITY OF NEDLANDS	2	3	1	33%
		CITY OF PERTH	22	24	2	8%
		CITY OF ROCKINGHAM	30	23	7	23%
		CITY OF SOUTH PERTH	21	11	10	48%
		CITY OF STIRLING	0	0	0	0%
		CITY OF SUBIACO	3	4	1	25%
		CITY OF SWAN	36	29	7	19%
		SHIRE OF MURRAY	166	167	1	1%
		SHIRE OF PEPPERMINT GROVE	2	2	0	0%
		SHIRE OF SERPENTINE-JARRAHDALE	0	0	0	0%

INUNDATION LEVEL	ANALYSIS TYPE	LGA	Hydro-DEM	STDDEM	DIFFERENCE	% DIFFERENCE
		SHIRE OF WAROONA	7	6	1	14%
		TOWN OF BASSENDEAN	24	23	1	4%
		TOWN OF CAMBRIDGE	0	0	0	0%
		TOWN OF CLAREMONT	1	3	2	67%
		TOWN OF COTTESLOE	1	1	0	0%
		TOWN OF EAST FREMANTLE	2	1	1	50%
		TOWN OF KWINANA	3	4	1	25%
		TOWN OF MOSMAN PARK	5	5	0	0%
		TOWN OF VICTORIA PARK	11	8	3	27%
		TOWN OF VINCENT	3	3	0	0%
1.8m	No. of land parcels 26-50% inundated					
		CITY OF BAYSWATER	32	28	4	13%
		CITY OF BELMONT	63	49	14	22%
		CITY OF CANNING	50	60	10	17%
		CITY OF COCKBURN	40	37	3	8%
		CITY OF FREMANTLE	22	34	12	35%
		CITY OF GOSNELLS	4	5	1	20%
		CITY OF MANDURAH	1346	1363	17	1%
		CITY OF MELVILLE	52	35	17	33%
		CITY OF NEDLANDS	11	11	0	0%
		CITY OF PERTH	29	23	6	21%
		CITY OF ROCKINGHAM	39	36	3	8%
		CITY OF SOUTH PERTH	47	28	19	40%
		CITY OF STIRLING	0	0	0	0%
		CITY OF SUBIACO	4	3	1	25%
		CITY OF SWAN	59	59	0	0%
		SHIRE OF MURRAY	535	541	6	1%
		SHIRE OF PEPPERMINT GROVE	1	1	0	0%
		SHIRE OF SERPENTINE-JARRAHDALE	1	2	1	50%
		SHIRE OF WAROONA	10	9	1	10%
		TOWN OF BASSENDEAN	32	29	3	9%
		TOWN OF CAMBRIDGE	0	0	0	0%
		TOWN OF CLAREMONT	18	16	2	11%
		TOWN OF COTTESLOE	3	4	1	25%
		TOWN OF EAST FREMANTLE	4	4	0	0%
		TOWN OF KWINANA	10	9	1	10%
		TOWN OF MOSMAN PARK	9	5	4	44%
		TOWN OF VICTORIA PARK	4	4	0	0%

INUNDATION LEVEL	ANALYSIS TYPE	LGA	Hydro-DEM	STDDEM	DIFFERENCE	% DIFFERENCE
		TOWN OF VINCENT	3	5	2	40%
1.8m	No. of land parcels less than 25% inundated					
		CITY OF BAYSWATER	89	70	19	21%
		CITY OF BELMONT	107	102	5	5%
		CITY OF CANNING	241	216	25	10%
		CITY OF COCKBURN	37	41	4	10%
		CITY OF FREMANTLE	69	86	17	20%
		CITY OF GOSNELLS	12	9	3	25%
		CITY OF MANDURAH	1374	1294	80	6%
		CITY OF MELVILLE	244	195	49	20%
		CITY OF NEDLANDS	74	75	1	1%
		CITY OF PERTH	72	53	19	26%
		CITY OF ROCKINGHAM	155	80	75	48%
		CITY OF SOUTH PERTH	167	118	49	29%
		CITY OF STIRLING	3	3	0	0%
		CITY OF SUBIACO	13	13	0	0%
		CITY OF SWAN	169	118	51	30%
		SHIRE OF MURRAY	964	804	160	17%
		SHIRE OF PEPPERMINT GROVE	9	9	0	0%
		SHIRE OF SERPENTINE-JARRAHDALE	15	9	6	40%
		SHIRE OF WAROONA	26	17	9	35%
		TOWN OF BASSENDEAN	100	87	13	13%
		TOWN OF CAMBRIDGE	1	1	0	0%
		TOWN OF CLAREMONT	47	46	1	2%
		TOWN OF COTTESLOE	2	1	1	50%
		TOWN OF EAST FREMANTLE	30	39	9	23%
		TOWN OF KWINANA	9	9	0	0%
		TOWN OF MOSMAN PARK	17	18	1	6%
		TOWN OF VICTORIA PARK	21	24	3	13%
		TOWN OF VINCENT	6	3	3	50%

SKM

Gold Coast

Table E-4. HYDRO-DEM STDDEM comparison for area and land parcels at inundation levels on Gold Coast per LGA

INUNDATION LEVEL	ANALYSIS TYPE	LGA	Hydro-DEM	STDDEM	DIFFERENCE	PERCENTAGE DIFFERENCE
2.0m	Discrete inundated areas (sq km					
		GOLD COAST CITY	5.738	14.469	-8.732	60%
		LOGAN CITY	0.002	0.313	-0.311	99%
		REDLAND CITY	0	0	0	0%
2.0m	No. of discrete inundated areas					
		GOLD COAST CITY	1052	6619	-5567	84%
		LOGAN CITY	5	185	-180	97%
		REDLAND CITY	1	0	1	100%
2.0m	Inundation areas connected to the sea (sq km)					
		GOLD COAST CITY	216.625	208.005	8.62	4%
		LOGAN CITY	1.837	1.376	0.461	25%
		REDLAND CITY	2.98	2.98	0	0%
2.0m	Total number of land parcels affected					
		GOLD COAST CITY	34237	32301	1936	6%
		LOGAN CITY	85	75	10	12%
		REDLAND CITY	7	7	0	0%
2.0m	No. of land parcels 100% inundated					
		GOLD COAST CITY	4079	4380	301	7%
		LOGAN CITY	0	0	0	0%
		REDLAND CITY	0	0	0	0%
2.0m	No. of land parcels 75-100% inundated					
		GOLD COAST CITY	3183	2769	414	13%
		LOGAN CITY	2	1	1	50%
		REDLAND CITY	2	2	0	0%
2.0m	No. of land parcels 51-75% inundated					
		GOLD COAST CITY	1820	1575	245	13%
		LOGAN CITY	11	8	3	27%
		REDLAND CITY	1	1	0	0%
2.0m	No. of land parcels 26-50% inundated					
		GOLD COAST CITY	3242	2933	309	10%
		LOGAN CITY	11	9	2	18%
		REDLAND CITY	3	3	0	0%
2.0m	No. of land parcels less than 25% inundated					

INUNDATION LEVEL	ANALYSIS TYPE	LGA	Hydro-DEM	STDDEM	DIFFERENCE	PERCENTAGE DIFFERENCE
		GOLD COAST CITY	21913	20644	1269	6%
		LOGAN CITY	61	57	4	7%
		REDLAND CITY	1	1	0	0%
2.2m						
2.2m	Discrete inundated areas (sq km)					
		GOLD COAST CITY	6.422	15.186	-8.764	58%
		LOGAN CITY	0.002	0.156	-0.154	99%
		REDLAND CITY	0	0	0	0%
2.2m	No. of discrete inundated areas					
		GOLD COAST CITY	981	5736	-4755	83%
		LOGAN CITY	7	181	-174	96%
		REDLAND CITY	0	1	-1	100%
2.2m	Inundation areas connected to the sea (sq km)					
		GOLD COAST CITY	229.269	220.532	8.737	4%
		LOGAN CITY	2.062	1.777	0.285	14%
		REDLAND CITY	2.989	2.989	0	0%
2.2m	Total number of land parcels affected					
		GOLD COAST CITY	39073	37057	2016	5%
		LOGAN CITY	93	82	11	12%
		REDLAND CITY	7	7	0	0%
2.2m	No. of land parcels 100% inundated					
		GOLD COAST CITY	6980	7345	365	5%
		LOGAN CITY	1	1	0	0%
		REDLAND CITY	0	0	0	0%
2.2m	No. of land parcels 75-100% inundated					
		GOLD COAST CITY	3921	3444	477	12%
		LOGAN CITY	5	3	2	40%
		REDLAND CITY	2	2	0	0%
2.2m	No. of land parcels 51-75% inundated					
		GOLD COAST CITY	2230	1973	257	12%
		LOGAN CITY	12	12	0	0%
		REDLAND CITY	1	1	0	0%
2.2m	No. of land parcels 26-50% inundated					
		GOLD COAST CITY	4313	3958	355	8%
		LOGAN CITY	12	10	2	17%
		REDLAND CITY	3	3	0	0%
2.2m	No. of land parcels less than 25% inundated					
		GOLD COAST CITY	21629	20337	1292	6%

INUNDATION LEVEL	ANALYSIS TYPE	LGA	Hydro-DEM	STDDEM	DIFFERENCE	PERCENTAGE DIFFERENCE
		LOGAN CITY	63	56	7	11%
		REDLAND CITY	1	1	0	0%
2.6m	Discrete inundated areas (sq km)					
		GOLD COAST CITY	5.342	15.187	-9.845	65%
		LOGAN CITY	0.004	0.202	-0.198	98%
		REDLAND CITY	0	0	0	0%
2.6m	No. of discrete inundated areas					
		GOLD COAST CITY	796	4818	-4022	83%
		LOGAN CITY	2	129	-127	98%
		REDLAND CITY	0	1	-1	100%
2.6m	Inundation areas connected to the sea (sq km)					
		GOLD COAST CITY	253.457	243.662	9.795	4%
		LOGAN CITY	2.506	2.192	0.314	13%
		REDLAND CITY	3.003	3.003	0	0%
2.6m	Total number of land parcels affected					
		GOLD COAST CITY	48605	46277	2328	5%
		LOGAN CITY	113	97	16	14%
		REDLAND CITY	7	7	0	0%
2.6m	No. of land parcels 100% inundated					
		GOLD COAST CITY	13493	14042	549	4%
		LOGAN CITY	3	3	0	0%
		REDLAND CITY	0	0	0	0%
2.6m	No. of land parcels 75-100% inundated					
		GOLD COAST CITY	5805	5164	641	11%
		LOGAN CITY	14	9	5	36%
		REDLAND CITY	2	2	0	0%
2.6m	No. of land parcels 51-75% inundated					
		GOLD COAST CITY	2681	2317	364	14%
		LOGAN CITY	17	17	0	0%
		REDLAND CITY	1	1	0	0%
2.6m	No. of land parcels 26-50% inundated					
		GOLD COAST CITY	6365	5928	437	7%
		LOGAN CITY	15	10	5	33%
		REDLAND CITY	3	3	0	0%
2.6m	No. of land parcels less than 25% inundated					
		GOLD COAST CITY	20261	18826	1435	7%
		LOGAN CITY	64	58	6	9%
		REDLAND CITY	1	1	0	0%

Brisbane

▪ **Table E-5. HYDRO-DEM STDDEM comparison for area and land parcels at inundation levels on Brisbaneper LGA**

INUNDATION LEVEL	ANALYSIS TYPE	LGA	Hydro-DEM	STDDEM	DIFFERENCE	PERCENTAGE DIFFERENCE
2.0m	Discrete inundated areas (sq km)					
		BRISBANE CITY	1.729	8.149	-6.419	79%
		LOGAN CITY	0.034	1.376	-1.342	97%
		MORETON BAY REGIONAL	0.326	0.975	-0.649	67%
		REDLAND CITY	0.022	0.866	-0.844	97%
2.0m	No. of discrete inundated areas					
		BRISBANE CITY	645	5599	-4954	88%
		LOGAN CITY	25	422	-397	94%
		MORETON BAY REGIONAL	68	1141	-1073	94%
		REDLAND CITY	69	1034	-965	93%
2.0m	Inundation areas connected to the sea (sq km)					
		BRISBANE CITY	63.644	57.589	6.055	10%
		LOGAN CITY	8.466	6.919	1.547	18%
		MORETON BAY REGIONAL	33.243	32.561	0.682	2%
		REDLAND CITY	41.428	40.644	0.784	2%
2.0m	Total number of land parcels affected					
		BRISBANE CITY	9389	7538	1851	20%
		LOGAN CITY	308	219	89	29%
		MORETON BAY REGIONAL	2188	1824	364	17%
		REDLAND CITY	6161	5838	323	5%
2.0m	No. of land parcels 100% inundated					
		BRISBANE CITY	1478	1499	21	1%
		LOGAN CITY	1	0	1	100%
		MORETON BAY REGIONAL	107	106	1	1%
		REDLAND CITY	1399	1402	3	0%
2.0m	No. of land parcels 75-100% inundated					
		BRISBANE CITY	1606	1380	226	14%
		LOGAN CITY	23	18	5	22%
		MORETON BAY REGIONAL	296	254	42	14%
		REDLAND CITY	451	430	21	5%
2.0m	No. of land parcels 51-75% inundated					

INUNDATION LEVEL	ANALYSIS TYPE	LGA	Hydro-DEM	STDDEM	DIFFERENCE	PERCENTAGE DIFFERENCE
		BRISBANE CITY	981	815	166	17%
		LOGAN CITY	40	36	4	10%
		MORETON BAY REGIONAL	131	117	14	11%
		REDLAND CITY	361	334	27	7%
2.0m	No. of land parcels 26-50% inundated					
		BRISBANE CITY	1336	983	353	26%
		LOGAN CITY	47	37	10	21%
		MORETON BAY REGIONAL	205	127	78	38%
		REDLAND CITY	631	540	91	14%
2.0m	No. of land parcels less than 25% inundated					
		BRISBANE CITY	3988	2861	1127	28%
		LOGAN CITY	197	128	69	35%
		MORETON BAY REGIONAL	1449	1220	229	16%
		REDLAND CITY	3319	3132	187	6%
2.2m	Discrete inundated areas (sq km)					
		BRISBANE CITY	2.298	8.075	-5.777	72%
		LOGAN CITY	0.032	1.331	-1.299	98%
		MORETON BAY REGIONAL	0.278	1.093	-0.814	75%
		REDLAND CITY	0.034	0.706	-0.672	95%
2.2m	No. of discrete inundated areas					
		BRISBANE CITY	546	4413	-3867	88%
		LOGAN CITY	26	435	-409	94%
		MORETON BAY REGIONAL	56	983	-927	94%
		REDLAND CITY	56	959	-903	94%
2.2m	Inundation areas connected to the sea (sq km)					
		BRISBANE CITY	72.083	66.679	5.404	7%
		LOGAN CITY	9.416	7.956	1.459	16%
		MORETON BAY REGIONAL	35.475	34.608	0.867	2%
		REDLAND CITY	43.325	42.694	0.631	1%
2.2m	Total number of land parcels affected					
		BRISBANE CITY	11498	9521	1977	17%
		LOGAN CITY	321	244	77	24%
		MORETON BAY REGIONAL	2712	2299	413	15%
		REDLAND CITY	7054	6857	197	3%
2.2m	No. of land parcels 100% inundated					

INUNDATION LEVEL	ANALYSIS TYPE	LGA	Hydro-DEM	STDDEM	DIFFERENCE	PERCENTAGE DIFFERENCE
		BRISBANE CITY	2551	2585	34	1%
		LOGAN CITY	1	1	0	0%
		MORETON BAY REGIONAL	218	218	0	0%
		REDLAND CITY	1822	1825	3	0%
2.2m	No. of land parcels 75-100% inundated					
		BRISBANE CITY	2172	1799	373	17%
		LOGAN CITY	29	27	2	7%
		MORETON BAY REGIONAL	338	291	47	14%
		REDLAND CITY	696	694	2	0%
2.2m	No. of land parcels 51-75% inundate					
		BRISBANE CITY	1137	934	203	18%
		LOGAN CITY	49	43	6	12%
		MORETON BAY REGIONAL	178	146	32	18%
		REDLAND CITY	446	439	7	2%
2.2m	No. of land parcels 26-50% inundated					
		BRISBANE CITY	1526	1120	406	27%
		LOGAN CITY	60	49	11	18%
		MORETON BAY REGIONAL	288	206	82	28%
		REDLAND CITY	800	748	52	7%
2.2m	No. of land parcels less than 25% inundated					
		BRISBANE CITY	4112	3083	1029	25%
		LOGAN CITY	182	124	58	32%
		MORETON BAY REGIONAL	1690	1438	252	15%
		REDLAND CITY	3290	3151	139	4%
2.6m	Discrete inundated areas (sq km)					
		BRISBANE CITY	1.625	5.039	-3.414	68%
		LOGAN CITY	0.034	0.412	-0.378	92%
		MORETON BAY REGIONAL	0.402	0.741	-0.339	46%
		REDLAND CITY	0.046	0.772	-0.725	94%
2.6m	No. of discrete inundated areas					
		BRISBANE CITY	405	3467	-3062	88%
		LOGAN CITY	25	461	-436	95%
		MORETON BAY REGIONAL	40	661	-621	94%
		REDLAND CITY	43	608	-565	93%
2.6m	Inundation areas connected to the sea (sq km)					

INUNDATION LEVEL	ANALYSIS TYPE	LGA	Hydro-DEM	STDDEM	DIFFERENCE	PERCENTAGE DIFFERENCE
		BRISBANE CITY	89.075	85.849	3.226	4%
		LOGAN CITY	11.146	10.687	0.459	4%
		MORETON BAY REGIONAL	39.74	39.334	0.405	1%
		REDLAND CITY	46.784	46.114	0.67	1%
2.6m	Total number of land parcels affected					
		BRISBANE CITY	15463	13464	1999	13%
		LOGAN CITY	360	318	42	12%
		MORETON BAY REGIONAL	4445	4077	368	8%
		REDLAND CITY	8991	8696	295	3%
2.6m	No. of land parcels 100% inundated					
		BRISBANE CITY	5131	5037	94	2%
		LOGAN CITY	2	2	0	0%
		MORETON BAY REGIONAL	723	715	8	1%
		REDLAND CITY	2856	2897	41	1%
2.6m	No. of land parcels 75-100% inundated					
		BRISBANE CITY	2919	2503	416	14%
		LOGAN CITY	46	48	2	4%
		MORETON BAY REGIONAL	739	672	67	9%
		REDLAND CITY	894	829	65	7%
2.6m	No. of land parcels 51-75% inundated					
		BRISBANE CITY	1383	1153	230	17%
		LOGAN CITY	52	44	8	15%
		MORETON BAY REGIONAL	383	331	52	14%
		REDLAND CITY	636	605	31	5%
2.6m	No. of land parcels 26-50% inundated					
		BRISBANE CITY	1714	1355	359	21%
		LOGAN CITY	68	63	5	7%
		MORETON BAY REGIONAL	563	492	71	13%
		REDLAND CITY	1131	1076	55	5%
2.6m	No. of land parcels less than 25% inundated					
		BRISBANE CITY	4316	3416	900	21%
		LOGAN CITY	192	161	31	16%
		MORETON BAY REGIONAL	2037	1867	170	8%
		REDLAND CITY	3474	3289	185	5%

Sydney

■ **Table E-6. HYDRO-DEM STDDEM comparison for area and land parcels at inundation levels on Sydney per LGA**

INUNDATION LEVEL	ANALYSIS TYPE	LGA	Hydro-DEM	STDDEM	DIFFERENCE	PERCENTAGE DIFFERENCE
1.6m	Discrete inundated areas (sq km)					
		ASHFIELD	0	0.006	-0.006	100%
		BOTANY BAY	0	0.407	-0.407	100%
		BURWOOD	0	0	0	0%
		CANADA BAY	0	0.081	-0.081	100%
		CANTERBURY	0.011	0.039	-0.028	72%
		CITY OF AUBURN	0	0.413	-0.413	100%
		CITY OF KOGARAH	0	0.04	-0.04	100%
		HUNTERS HILL	0	0	0	0%
		HURSTVILLE	0.01	0	0.01	95%
		KU-RING-GAI	0	0.018	-0.018	100%
		LANE COVE	0	0.003	-0.003	100%
		LEICHHARDT	0	0.027	-0.027	100%
		MANLY	0	0.19	-0.19	100%
		MARRICKVILLE	0	0.373	-0.373	100%
		MOSMAN	0	0.003	-0.003	100%
		NORTH SYDNEY	0	0.008	-0.008	100%
		PARRAMATTA	0.006	0.06	-0.053	90%
		PITTWATER	0.679	0.724	-0.045	6%
		RANDWICK	0	0.006	-0.006	100%
		ROCKDALE	0	0.532	-0.532	100%
		RYDE	0	0.048	-0.048	100%
		STRATHFIELD	0.001	0.009	-0.008	89%
		SUTHERLAND SHIRE	0.273	1.195	-0.921	77%
		SYDNEY	0	0.043	-0.043	100%
		WARRINGAH	0	0.288	-0.288	100%
		WAVERLEY	0	0	0	0%
		WILLOUGHBY	0	0.018	-0.018	100%
		WOOLLAHRA	0	0.017	-0.017	100%
1.6m	No. of discrete inundated areas					
		ASHFIELD	0	15	-15	100%
		BOTANY BAY	0	120	-120	100%
		BURWOOD	0	0	0	0%

INUNDATION LEVEL	ANALYSIS TYPE	LGA	Hydro-DEM	STDDEM	DIFFERENCE	PERCENTAGE DIFFERENCE
		CANADA BAY	0	170	-170	100%
		CANTERBURY	1	38	-37	97%
		CITY OF AUBURN	1	123	-122	99%
		CITY OF KOGARAH	0	58	-58	100%
		HUNTERS HILL	0	9	-9	100%
		HURSTVILLE	1	4	-3	75%
		KU-RING-GAI	0	43	-43	100%
		LANE COVE	0	16	-16	100%
		LEICHHARDT	0	36	-36	100%
		MANLY	0	68	-68	100%
		MARRICKVILLE	0	101	-101	100%
		MOSMAN	0	23	-23	100%
		NORTH SYDNEY	0	25	-25	100%
		PARRAMATTA	4	138	-134	97%
		PITTWATER	310	779	-469	60%
		RANDWICK	0	13	-13	100%
		ROCKDALE	0	259	-259	100%
		RYDE	0	48	-48	100%
		STRATHFIELD	1	21	-20	95%
		SUTHERLAND SHIRE	19	850	-831	98%
		SYDNEY	0	82	-82	100%
		WARRINGAH	0	276	-276	100%
		WAVERLEY	0	0	0	0%
		WILLOUGHBY	0	46	-46	100%
		WOOLLAHRA	0	33	-33	100%
1.6m	Inundation areas connected to the sea (sq km)					
		ASHFIELD	0.082	0.067	0.015	18%
		BOTANY BAY	0.323	0.179	0.144	45%
		BURWOOD	0	0	0	0%
		CANADA BAY	0.557	0.523	0.034	6%
		CANTERBURY	0.184	0.149	0.035	19%
		CITY OF AUBURN	1.07	1.021	0.049	5%
		CITY OF KOGARAH	0.461	0.402	0.06	13%
		HUNTERS HILL	0.117	0.122	-0.006	5%
		HURSTVILLE	0.03	0.025	0.004	15%
		KU-RING-GAI	0.135	0.083	0.052	39%
		LANE COVE	0.13	0.095	0.035	27%
		LEICHHARDT	0.125	0.058	0.066	53%

INUNDATION LEVEL	ANALYSIS TYPE	LGA	Hydro-DEM	STDDEM	DIFFERENCE	PERCENTAGE DIFFERENCE
		MANLY	0.307	0.138	0.169	55%
		MARRICKVILLE	0.183	0.176	0.007	4%
		MOSMAN	0.096	0.092	0.004	4%
		NORTH SYDNEY	0.067	0.059	0.008	12%
		PARRAMATTA	0.263	0.199	0.064	24%
		PITTWATER	0.34	0.205	0.134	40%
		RANDWICK	0.235	0.233	0.003	1%
		ROCKDALE	0.974	0.812	0.162	17%
		RYDE	0.259	0.158	0.102	39%
		STRATHFIELD	0.106	0.076	0.03	28%
		SUTHERLAND SHIRE	3.668	3.432	0.236	6%
		SYDNEY	0.163	0.141	0.022	13%
		WARRINGAH	1.109	0.646	0.463	42%
		WAVERLEY	0.022	0.032	-0.011	34%
		WILLOUGHBY	0.185	0.148	0.038	20%
		WOOLLAHRA	0.176	0.11	0.066	38%
1.6m	Total number of land parcels affected					
		ASHFIELD	119	111	8	7%
		BOTANY BAY	132	108	24	18%
		BURWOOD	0	0	0	0%
		CANADA BAY	554	578	24	4%
		CANTERBURY	276	187	89	32%
		CITY OF AUBURN	65	60	5	8%
		CITY OF KOGARAH	881	846	35	4%
		HUNTERS HILL	378	393	15	4%
		HURSTVILLE	178	172	6	3%
		KU-RING-GAI	31	16	15	48%
		LANE COVE	244	224	20	8%
		LEICHHARDT	374	277	97	26%
		MANLY	236	267	31	12%
		MARRICKVILLE	134	145	11	8%
		MOSMAN	173	169	4	2%
		NORTH SYDNEY	317	332	15	5%
		PARRAMATTA	274	116	158	58%
		PITTWATER	198	128	70	35%
		RANDWICK	68	50	18	26%
		ROCKDALE	426	189	237	56%
		RYDE	361	310	51	14%

INUNDATION LEVEL	ANALYSIS TYPE	LGA	Hydro-DEM	STDDEM	DIFFERENCE	PERCENTAGE DIFFERENCE
		STRATHFIELD	59	11	48	81%
		SUTHERLAND SHIRE	1403	1272	131	9%
		SYDNEY	249	176	73	29%
		WARRINGAH	365	158	207	57%
		WAVERLEY	45	64	19	30%
		WILLOUGHBY	279	280	1	0%
		WOOLLAHRA	456	382	74	16%
1.6m	No. of land parcels 100% inundated					
		ASHFIELD	1	0	1	100%
		BOTANY BAY	8	3	5	63%
		BURWOOD	0	0	0	0%
		CANADA BAY	7	7	0	0%
		CANTERBURY	8	2	6	75%
		CITY OF AUBURN	4	4	0	0%
		CITY OF KOGARAH	23	6	17	74%
		HUNTERS HILL	5	5	0	0%
		HURSTVILLE	0	0	0	0%
		KU-RING-GAI	0	0	0	0%
		LANE COVE	0	0	0	0%
		LEICHHARDT	10	0	10	100%
		MANLY	2	0	2	100%
		MARRICKVILLE	9	11	2	18%
		MOSMAN	1	0	1	100%
		NORTH SYDNEY	0	2	2	100%
		PARRAMATTA	10	0	10	100%
		PITTWATER	1	0	1	100%
		RANDWICK	0	0	0	0%
		ROCKDALE	34	18	16	47%
		RYDE	10	9	1	10%
		STRATHFIELD	6	0	6	100%
		SUTHERLAND SHIRE	12	6	6	50%
		SYDNEY	21	0	21	100%
		WARRINGAH	2	0	2	100%
		WAVERLEY	0	0	0	0%
		WILLOUGHBY	2	0	2	100%
		WOOLLAHRA	21	14	7	33%
1.6m	No. of land parcels 75-100% inundated					
		ASHFIELD	5	2	3	60%

INUNDATION LEVEL	ANALYSIS TYPE	LGA	Hydro-DEM	STDDEM	DIFFERENCE	PERCENTAGE DIFFERENCE
		BOTANY BAY	31	33	2	6%
		BURWOOD	0	0	0	0%
		CANADA BAY	39	37	2	5%
		CANTERBURY	17	13	4	24%
		CITY OF AUBURN	0	1	1	100%
		CITY OF KOGARAH	25	29	4	14%
		HUNTERS HILL	18	18	0	0%
		HURSTVILLE	2	3	1	33%
		KU-RING-GAI	0	0	0	0%
		LANE COVE	6	5	1	17%
		LEICHHARDT	19	12	7	37%
		MANLY	9	6	3	33%
		MARRICKVILLE	22	13	9	41%
		MOSMAN	2	1	1	50%
		NORTH SYDNEY	12	16	4	25%
		PARRAMATTA	3	2	1	33%
		PITTWATER	5	4	1	20%
		RANDWICK	4	2	2	50%
		ROCKDALE	52	34	18	35%
		RYDE	13	11	2	15%
		STRATHFIELD	6	0	6	100%
		SUTHERLAND SHIRE	51	49	2	4%
		SYDNEY	23	10	13	57%
		WARRINGAH	16	11	5	31%
		WAVERLEY	0	1	1	100%
		WILLOUGHBY	7	6	1	14%
		WOOLLAHRA	26	19	7	27%
1.6m	No. of land parcels 51-75% inundated					
		ASHFIELD	9	7	2	22%
		BOTANY BAY	13	7	6	46%
		BURWOOD	0	0	0	0%
		CANADA BAY	39	35	4	10%
		CANTERBURY	16	8	8	50%
		CITY OF AUBURN	5	6	1	17%
		CITY OF KOGARAH	39	41	2	5%
		HUNTERS HILL	12	14	2	14%
		HURSTVILLE	6	4	2	33%
		KU-RING-GAI	0	0	0	0%

INUNDATION LEVEL	ANALYSIS TYPE	LGA	Hydro-DEM	STDDEM	DIFFERENCE	PERCENTAGE DIFFERENCE
		LANE COVE	15	11	4	27%
		LEICHHARDT	30	27	3	10%
		MANLY	4	4	0	0%
		MARRICKVILLE	15	18	3	17%
		MOSMAN	4	3	1	25%
		NORTH SYDNEY	6	12	6	50%
		PARRAMATTA	10	6	4	40%
		PITTWATER	4	5	1	20%
		RANDWICK	2	0	2	100%
		ROCKDALE	61	30	31	51%
		RYDE	8	8	0	0%
		STRATHFIELD	5	1	4	80%
		SUTHERLAND SHIRE	59	61	2	3%
		SYDNEY	18	11	7	39%
		WARRINGAH	17	8	9	53%
		WAVERLEY	0	0	0	0%
		WILLOUGHBY	27	11	16	59%
		WOOLLAHRA	16	15	1	6%
1.6m	No. of land parcels 26-50% inundated					
		ASHFIELD	15	10	5	33%
		BOTANY BAY	21	21	0	0%
		BURWOOD	0	0	0	0%
		CANADA BAY	101	87	14	14%
		CANTERBURY	28	22	6	21%
		CITY OF AUBURN	4	1	3	75%
		CITY OF KOGARAH	93	83	10	11%
		HUNTERS HILL	32	42	10	24%
		HURSTVILLE	13	10	3	23%
		KU-RING-GAI	1	0	1	100%
		LANE COVE	15	21	6	29%
		LEICHHARDT	40	26	14	35%
		MANLY	10	10	0	0%
		MARRICKVILLE	21	19	2	10%
		MOSMAN	13	23	10	43%
		NORTH SYDNEY	37	28	9	24%
		PARRAMATTA	23	11	12	52%
		PITTWATER	16	3	13	81%
		RANDWICK	5	2	3	60%

INUNDATION LEVEL	ANALYSIS TYPE	LGA	Hydro-DEM	STDDEM	DIFFERENCE	PERCENTAGE DIFFERENCE
		ROCKDALE	86	17	69	80%
		RYDE	41	35	6	15%
		STRATHFIELD	7	2	5	71%
		SUTHERLAND SHIRE	163	125	38	23%
		SYDNEY	22	20	2	9%
		WARRINGAH	51	19	32	63%
		WAVERLEY	4	2	2	50%
		WILLOUGHBY	10	34	24	71%
		WOOLLAHRA	54	26	28	52%
1.6m	No. of land parcels less than 25% inundated					
		ASHFIELD	89	92	3	3%
		BOTANY BAY	59	44	15	25%
		BURWOOD	0	0	0	0%
		CANADA BAY	368	412	44	11%
		CANTERBURY	207	142	65	31%
		CITY OF AUBURN	52	48	4	8%
		CITY OF KOGARAH	701	687	14	2%
		HUNTERS HILL	311	314	3	1%
		HURSTVILLE	157	155	2	1%
		KU-RING-GAI	30	16	14	47%
		LANE COVE	208	187	21	10%
		LEICHHARDT	275	212	63	23%
		MANLY	211	247	36	15%
		MARRICKVILLE	67	84	17	20%
		MOSMAN	153	142	11	7%
		NORTH SYDNEY	262	274	12	4%
		PARRAMATTA	228	97	131	57%
		PITTWATER	172	116	56	33%
		RANDWICK	57	46	11	19%
		ROCKDALE	193	90	103	53%
		RYDE	289	247	42	15%
		STRATHFIELD	35	8	27	77%
		SUTHERLAND SHIRE	1118	1031	87	8%
		SYDNEY	165	135	30	18%
		WARRINGAH	279	120	159	57%
		WAVERLEY	41	61	20	33%
		WILLOUGHBY	233	229	4	2%
		WOOLLAHRA	339	308	31	9%

INUNDATION LEVEL	ANALYSIS TYPE	LGA	Hydro-DEM	STDDEM	DIFFERENCE	PERCENTAGE DIFFERENCE
2.0m						
2.0m	Discrete inundated areas (sq km)					
		ASHFIELD	0	0.003	-0.003	100%
		BOTANY BAY	0	1.025	-1.025	100%
		BURWOOD	0	0	0	0%
		CANADA BAY	0	0.133	-0.133	100%
		CANTERBURY	0.012	0.017	-0.005	32%
		CITY OF AUBURN	0	0.43	-0.429	100%
		CITY OF KOGARAH	0	0.041	-0.041	100%
		HUNTERS HILL	0	0	0	0%
		HURSTVILLE	0.011	0.001	0.01	93%
		KU-RING-GAI	0	0.01	-0.01	100%
		LANE COVE	0	0.002	-0.002	100%
		LEICHHARDT	0	0.064	-0.064	100%
		MANLY	0	0.324	-0.324	100%
		MARRICKVILLE	0	0.648	-0.648	100%
		MOSMAN	0	0.01	-0.01	100%
		NORTH SYDNEY	0	0.009	-0.009	100%
		PARRAMATTA	0.007	0.109	-0.103	94%
		PITTWATER	0.962	1.299	-0.338	26%
		RANDWICK	0	0.014	-0.014	100%
		ROCKDALE	0	0.939	-0.939	100%
		RYDE	0	0.048	-0.048	100%
		STRATHFIELD	0.001	0.02	-0.019	94%
		SUTHERLAND SHIRE	0.248	1.239	-0.991	80%
		SYDNEY	0	0.107	-0.107	100%
		WARRINGAH	0	0.5	-0.5	100%
		WAVERLEY	0	0	0	0%
		WILLOUGHBY	0	0.023	-0.023	100%
		WOOLLAHRA	0	0.038	-0.038	100%
2.0m	No. of discrete inundated areas					
		ASHFIELD	0	18	-18	100%
		BOTANY BAY	0	174	-174	100%
		BURWOOD	0	0	0	0%
		CANADA BAY	0	151	-151	100%
		CANTERBURY	1	34	-33	97%
		CITY OF AUBURN	1	151	-150	99%

INUNDATION LEVEL	ANALYSIS TYPE	LGA	Hydro-DEM	STDDEM	DIFFERENCE	PERCENTAGE DIFFERENCE
		CITY OF KOGARAH	0	23	-23	100%
		HUNTERS HILL	0	9	-9	100%
		HURSTVILLE	1	5	-4	80%
		KU-RING-GAI	0	43	-43	100%
		LANE COVE	0	18	-18	100%
		LEICHHARDT	0	107	-107	100%
		MANLY	0	64	-64	100%
		MARRICKVILLE	0	92	-92	100%
		MOSMAN	0	26	-26	100%
		NORTH SYDNEY	0	32	-32	100%
		PARRAMATTA	2	92	-90	98%
		PITTWATER	195	728	-533	73%
		RANDWICK	0	34	-34	100%
		ROCKDALE	0	304	-304	100%
		RYDE	0	83	-83	100%
		STRATHFIELD	1	28	-27	96%
		SUTHERLAND SHIRE	18	815	-797	98%
		SYDNEY	0	157	-157	100%
		WARRINGAH	0	277	-277	100%
		WAVERLEY	0	0	0	0%
		WILLOUGHBY	0	35	-35	100%
		WOOLLAHRA	0	72	-72	100%
2.0m	Inundation areas connected to the sea (sq km)					
		ASHFIELD	0.193	0.187	0.006	3%
		BOTANY BAY	0.444	0.295	0.149	34%
		BURWOOD	0	0	0	0%
		CANADA BAY	1.092	1.067	0.025	2%
		CANTERBURY	0.364	0.336	0.028	8%
		CITY OF AUBURN	1.414	1.348	0.066	5%
		CITY OF KOGARAH	0.701	0.649	0.053	7%
		HUNTERS HILL	0.189	0.193	-0.004	2%
		HURSTVILLE	0.041	0.037	0.004	9%
		KU-RING-GAI	0.156	0.116	0.04	26%
		LANE COVE	0.165	0.133	0.032	20%
		LEICHHARDT	0.266	0.163	0.102	39%
		MANLY	0.5	0.223	0.278	55%
		MARRICKVILLE	0.346	0.341	0.005	1%
		MOSMAN	0.155	0.152	0.004	3%

INUNDATION LEVEL	ANALYSIS TYPE	LGA	Hydro-DEM	STDDEM	DIFFERENCE	PERCENTAGE DIFFERENCE
		NORTH SYDNEY	0.147	0.134	0.013	9%
		PARRAMATTA	0.413	0.354	0.058	14%
		PITTWATER	0.663	0.413	0.25	38%
		RANDWICK	0.286	0.289	-0.002	1%
		ROCKDALE	1.551	1.333	0.219	14%
		RYDE	0.398	0.324	0.074	19%
		STRATHFIELD	0.137	0.101	0.036	27%
		SUTHERLAND SHIRE	5.338	5.259	0.079	1%
		SYDNEY	0.31	0.292	0.019	6%
		WARRINGAH	1.725	1.084	0.641	37%
		WAVERLEY	0.029	0.043	-0.013	31%
		WILLOUGHBY	0.234	0.198	0.036	15%
		WOOLLAHRA	0.252	0.184	0.068	27%
2.0m	Total number of land parcels affected					
		ASHFIELD	238	226	12	5%
		BOTANY BAY	176	150	26	15%
		BURWOOD	0	0	0	0%
		CANADA BAY	843	829	14	2%
		CANTERBURY	360	303	57	16%
		CITY OF AUBURN	73	70	3	4%
		CITY OF KOGARAH	1026	982	44	4%
		HUNTERS HILL	444	459	15	3%
		HURSTVILLE	193	193	0	0%
		KU-RING-GAI	35	20	15	43%
		LANE COVE	296	270	26	9%
		LEICHHARDT	469	366	103	22%
		MANLY	330	321	9	3%
		MARRICKVILLE	252	260	8	3%
		MOSMAN	206	195	11	5%
		NORTH SYDNEY	432	430	2	0%
		PARRAMATTA	325	176	149	46%
		PITTWATER	349	271	78	22%
		RANDWICK	79	57	22	28%
		ROCKDALE	731	420	311	43%
		RYDE	441	411	30	7%
		STRATHFIELD	78	13	65	83%
		SUTHERLAND SHIRE	2518	2506	12	0%
		SYDNEY	346	254	92	27%

INUNDATION LEVEL	ANALYSIS TYPE	LGA	Hydro-DEM	STDDEM	DIFFERENCE	PERCENTAGE DIFFERENCE
		WARRINGAH	548	243	305	56%
		WAVERLEY	51	66	15	23%
		WILLOUGHBY	315	317	2	1%
		WOOLLAHRA	528	481	47	9%
2.0m	No. of land parcels 100% inundated					
		ASHFIELD	21	23	2	9%
		BOTANY BAY	90	83	7	8%
		BURWOOD	0	0	0	0%
		CANADA BAY	40	40	0	0%
		CANTERBURY	24	23	1	4%
		CITY OF AUBURN	5	5	0	0%
		CITY OF KOGARAH	39	25	14	36%
		HUNTERS HILL	6	6	0	0%
		HURSTVILLE	0	0	0	0%
		KU-RING-GAI	0	0	0	0%
		LANE COVE	2	1	1	50%
		LEICHHARDT	12	0	12	100%
		MANLY	7	3	4	57%
		MARRICKVILLE	43	35	8	19%
		MOSMAN	4	3	1	25%
		NORTH SYDNEY	7	11	4	36%
		PARRAMATTA	11	1	10	91%
		PITTWATER	19	20	1	5%
		RANDWICK	0	0	0	0%
		ROCKDALE	152	93	59	39%
		RYDE	18	16	2	11%
		STRATHFIELD	6	0	6	100%
		SUTHERLAND SHIRE	103	99	4	4%
		SYDNEY	34	8	26	76%
		WARRINGAH	49	21	28	57%
		WAVERLEY	0	0	0	0%
		WILLOUGHBY	3	1	2	67%
		WOOLLAHRA	27	27	0	0%
2.0m	No. of land parcels 75-100% inundated					
		ASHFIELD	20	30	10	33%
		BOTANY BAY	24	28	4	14%
		BURWOOD	0	0	0	0%
		CANADA BAY	92	85	7	8%

INUNDATION LEVEL	ANALYSIS TYPE	LGA	Hydro-DEM	STDDEM	DIFFERENCE	PERCENTAGE DIFFERENCE
		CANTERBURY	30	26	4	13%
		CITY OF AUBURN	6	6	0	0%
		CITY OF KOGARAH	97	105	8	8%
		HUNTERS HILL	29	30	1	3%
		HURSTVILLE	9	11	2	18%
		KU-RING-GAI	0	0	0	0%
		LANE COVE	9	8	1	11%
		LEICHHARDT	45	38	7	16%
		MANLY	23	9	14	61%
		MARRICKVILLE	45	55	10	18%
		MOSMAN	5	2	3	60%
		NORTH SYDNEY	36	40	4	10%
		PARRAMATTA	10	9	1	10%
		PITTWATER	29	29	0	0%
		RANDWICK	4	2	2	50%
		ROCKDALE	110	76	34	31%
		RYDE	18	19	1	5%
		STRATHFIELD	13	1	12	92%
		SUTHERLAND SHIRE	369	415	46	11%
		SYDNEY	35	25	10	29%
		WARRINGAH	50	34	16	32%
		WAVERLEY	0	1	1	100%
		WILLOUGHBY	8	8	0	0%
		WOOLLAHRA	45	31	14	31%
2.0m	No. of land parcels 51-75% inundated					
		ASHFIELD	36	36	0	0%
		BOTANY BAY	8	5	3	38%
		BURWOOD	0	0	0	0%
		CANADA BAY	93	86	7	8%
		CANTERBURY	26	17	9	35%
		CITY OF AUBURN	7	7	0	0%
		CITY OF KOGARAH	71	71	0	0%
		HUNTERS HILL	27	28	1	4%
		HURSTVILLE	7	4	3	43%
		KU-RING-GAI	0	0	0	0%
		LANE COVE	19	19	0	0%
		LEICHHARDT	30	28	2	7%
		MANLY	12	8	4	33%

INUNDATION LEVEL	ANALYSIS TYPE	LGA	Hydro-DEM	STDDEM	DIFFERENCE	PERCENTAGE DIFFERENCE
		MARRICKVILLE	18	13	5	28%
		MOSMAN	11	18	7	39%
		NORTH SYDNEY	26	21	5	19%
		PARRAMATTA	14	14	0	0%
		PITTWATER	22	28	6	21%
		RANDWICK	3	0	3	100%
		ROCKDALE	76	34	42	55%
		RYDE	25	21	4	16%
		STRATHFIELD	3	0	3	100%
		SUTHERLAND SHIRE	254	277	23	8%
		SYDNEY	30	27	3	10%
		WARRINGAH	44	33	11	25%
		WAVERLEY	1	0	1	100%
		WILLOUGHBY	29	19	10	34%
		WOOLLAHRA	30	30	0	0%
2.0m	No. of land parcels 26-50% inundated					
		ASHFIELD	52	51	1	2%
		BOTANY BAY	8	9	1	11%
		BURWOOD	0	0	0	0%
		CANADA BAY	195	186	9	5%
		CANTERBURY	45	41	4	9%
		CITY OF AUBURN	6	6	0	0%
		CITY OF KOGARAH	150	128	22	15%
		HUNTERS HILL	51	54	3	6%
		HURSTVILLE	15	12	3	20%
		KU-RING-GAI	1	0	1	100%
		LANE COVE	28	26	2	7%
		LEICHHARDT	78	58	20	26%
		MANLY	31	25	6	19%
		MARRICKVILLE	22	24	2	8%
		MOSMAN	31	25	6	19%
		NORTH SYDNEY	68	51	17	25%
		PARRAMATTA	29	11	18	62%
		PITTWATER	55	43	12	22%
		RANDWICK	5	8	3	38%
		ROCKDALE	117	53	64	55%
		RYDE	66	73	7	10%
		STRATHFIELD	14	5	9	64%

INUNDATION LEVEL	ANALYSIS TYPE	LGA	Hydro-DEM	STDDEM	DIFFERENCE	PERCENTAGE DIFFERENCE
		SUTHERLAND SHIRE	418	410	8	2%
		SYDNEY	31	23	8	26%
		WARRINGAH	95	44	51	54%
		WAVERLEY	3	3	0	0%
		WILLOUGHBY	19	32	13	41%
		WOOLLAHRA	83	53	30	36%
2.0m	No. of land parcels less than 25% inundated					
		ASHFIELD	109	86	23	21%
		BOTANY BAY	46	25	21	46%
		BURWOOD	0	0	0	0%
		CANADA BAY	423	432	9	2%
		CANTERBURY	235	196	39	17%
		CITY OF AUBURN	49	46	3	6%
		CITY OF KOGARAH	669	653	16	2%
		HUNTERS HILL	331	341	10	3%
		HURSTVILLE	162	166	4	2%
		KU-RING-GAI	34	20	14	41%
		LANE COVE	238	216	22	9%
		LEICHHARDT	304	242	62	20%
		MANLY	257	276	19	7%
		MARRICKVILLE	124	133	9	7%
		MOSMAN	155	147	8	5%
		NORTH SYDNEY	295	307	12	4%
		PARRAMATTA	261	141	120	46%
		PITTWATER	224	151	73	33%
		RANDWICK	67	47	20	30%
		ROCKDALE	276	164	112	41%
		RYDE	314	282	32	10%
		STRATHFIELD	42	7	35	83%
		SUTHERLAND SHIRE	1374	1305	69	5%
		SYDNEY	216	171	45	21%
		WARRINGAH	310	111	199	64%
		WAVERLEY	47	62	15	24%
		WILLOUGHBY	256	257	1	0%
		WOOLLAHRA	343	340	3	1%
2.2m						
2.2m	Discrete inundated areas (sq km)					

INUNDATION LEVEL	ANALYSIS TYPE	LGA	Hydro-DEM	STDDEM	DIFFERENCE	PERCENTAGE DIFFERENCE
		ASHFIELD	0	0.003	-0.003	100%
		BOTANY BAY	0	0.304	-0.304	100%
		BURWOOD	0	0	0	0%
		CANADA BAY	0	0.161	-0.161	100%
		CANTERBURY	0.012	0.019	-0.007	38%
		CITY OF AUBURN	0	0.45	-0.449	100%
		CITY OF KOGARAH	0	0.04	-0.04	100%
		HUNTERS HILL	0	0	0	0%
		HURSTVILLE	0.012	0.001	0.011	93%
		KU-RING-GAI	0	0.013	-0.013	100%
		LANE COVE	0	0.003	-0.003	100%
		LEICHHARDT	0	0.108	-0.108	100%
		MANLY	0	0.056	-0.056	100%
		MARRICKVILLE	0	0.537	-0.537	100%
		MOSMAN	0	0.003	-0.003	100%
		NORTH SYDNEY	0	0.014	-0.014	100%
		PARRAMATTA	0.007	0.125	-0.118	94%
		PITTWATER	1.139	1.431	-0.291	20%
		RANDWICK	0	0.02	-0.02	100%
		ROCKDALE	0	0.944	-0.944	100%
		RYDE	0	0.05	-0.05	100%
		STRATHFIELD	0.002	0.029	-0.027	92%
		SUTHERLAND SHIRE	0.258	1.404	-1.146	82%
		SYDNEY	0	0.141	-0.141	100%
		WARRINGAH	0	0.069	-0.069	100%
		WAVERLEY	0	0	0	0%
		WILLOUGHBY	0	0.024	-0.024	100%
		WOOLLAHRA	0	0.057	-0.057	100%
2.2m	No. of discrete inundated areas					
		ASHFIELD	0	11	-11	100%
		BOTANY BAY	0	170	-170	100%
		BURWOOD	0	0	0	0%
		CANADA BAY	0	135	-135	100%
		CANTERBURY	1	51	-50	98%
		CITY OF AUBURN	1	151	-150	99%
		CITY OF KOGARAH	0	21	-21	100%
		HUNTERS HILL	0	5	-5	100%
		HURSTVILLE	1	4	-3	75%

INUNDATION LEVEL	ANALYSIS TYPE	LGA	Hydro-DEM	STDDEM	DIFFERENCE	PERCENTAGE DIFFERENCE
		KU-RING-GAI	0	40	-40	100%
		LANE COVE	0	22	-22	100%
		LEICHHARDT	0	111	-111	100%
		MANLY	0	42	-42	100%
		MARRICKVILLE	0	63	-63	100%
		MOSMAN	0	20	-20	100%
		NORTH SYDNEY	0	34	-34	100%
		PARRAMATTA	2	136	-134	99%
		PITTWATER	153	565	-412	73%
		RANDWICK	0	27	-27	100%
		ROCKDALE	0	246	-246	100%
		RYDE	0	66	-66	100%
		STRATHFIELD	1	36	-35	97%
		SUTHERLAND SHIRE	14	761	-747	98%
		SYDNEY	0	282	-282	100%
		WARRINGAH	0	255	-255	100%
		WAVERLEY	1	1	0	0%
		WILLOUGHBY	0	24	-24	100%
		WOOLLAHRA	0	101	-101	100%
2.2m	Inundation areas connected to the sea (sq km)					
		ASHFIELD	0.259	0.247	0.011	4%
		BOTANY BAY	1.538	1.459	0.079	5%
		BURWOOD	0	0	0	0%
		CANADA BAY	1.35	1.349	0.001	0%
		CANTERBURY	0.454	0.424	0.031	7%
		CITY OF AUBURN	1.67	1.565	0.105	6%
		CITY OF KOGARAH	0.788	0.735	0.053	7%
		HUNTERS HILL	0.216	0.22	-0.004	2%
		HURSTVILLE	0.045	0.043	0.003	6%
		KU-RING-GAI	0.168	0.127	0.041	25%
		LANE COVE	0.184	0.153	0.031	17%
		LEICHHARDT	0.381	0.269	0.112	29%
		MANLY	0.593	0.584	0.009	2%
		MARRICKVILLE	0.529	0.699	-0.17	24%
		MOSMAN	0.196	0.195	0.001	0%
		NORTH SYDNEY	0.185	0.173	0.012	7%
		PARRAMATTA	0.489	0.421	0.068	14%
		PITTWATER	1.134	0.816	0.319	28%

INUNDATION LEVEL	ANALYSIS TYPE	LGA	Hydro-DEM	STDDEM	DIFFERENCE	PERCENTAGE DIFFERENCE
		RANDWICK	0.315	0.316	-0.001	0%
		ROCKDALE	1.918	1.89	0.027	1%
		RYDE	0.492	0.419	0.073	15%
		STRATHFIELD	0.158	0.116	0.042	26%
		SUTHERLAND SHIRE	6.274	6.169	0.105	2%
		SYDNEY	0.512	0.487	0.025	5%
		WARRINGAH	2.035	1.8	0.235	12%
		WAVERLEY	0.034	0.048	-0.014	29%
		WILLOUGHBY	0.258	0.222	0.036	14%
		WOOLLAHRA	0.314	0.253	0.061	19%
2.2m	Total number of land parcels affected					
		ASHFIELD	288	266	22	8%
		BOTANY BAY	198	182	16	8%
		BURWOOD	0	0	0	0%
		CANADA BAY	1001	1034	33	3%
		CANTERBURY	414	351	63	15%
		CITY OF AUBURN	75	74	1	1%
		CITY OF KOGARAH	1078	1025	53	5%
		HUNTERS HILL	462	470	8	2%
		HURSTVILLE	204	201	3	1%
		KU-RING-GAI	36	20	16	44%
		LANE COVE	304	283	21	7%
		LEICHHARDT	546	405	141	26%
		MANLY	437	468	31	7%
		MARRICKVILLE	343	420	77	18%
		MOSMAN	216	212	4	2%
		NORTH SYDNEY	452	450	2	0%
		PARRAMATTA	363	232	131	36%
		PITTWATER	756	668	88	12%
		RANDWICK	84	63	21	25%
		ROCKDALE	985	890	95	10%
		RYDE	494	458	36	7%
		STRATHFIELD	84	15	69	82%
		SUTHERLAND SHIRE	2843	2789	54	2%
		SYDNEY	518	423	95	18%
		WARRINGAH	694	537	157	23%
		WAVERLEY	52	68	16	24%
		WILLOUGHBY	333	332	1	0%

INUNDATION LEVEL	ANALYSIS TYPE	LGA	Hydro-DEM	STDDEM	DIFFERENCE	PERCENTAGE DIFFERENCE
		WOOLLAHRA	567	529	38	7%
2.2m	No. of land parcels 100% inundated					
		ASHFIELD	44	52	8	15%
		BOTANY BAY	116	113	3	3%
		BURWOOD	0	0	0	0%
		CANADA BAY	90	91	1	1%
		CANTERBURY	30	30	0	0%
		CITY OF AUBURN	5	5	0	0%
		CITY OF KOGARAH	53	44	9	17%
		HUNTERS HILL	7	7	0	0%
		HURSTVILLE	0	0	0	0%
		KU-RING-GAI	0	0	0	0%
		LANE COVE	3	3	0	0%
		LEICHHARDT	17	6	11	65%
		MANLY	24	24	0	0%
		MARRICKVILLE	71	132	61	46%
		MOSMAN	4	3	1	25%
		NORTH SYDNEY	8	11	3	27%
		PARRAMATTA	14	4	10	71%
		PITTWATER	113	103	10	9%
		RANDWICK	0	0	0	0%
		ROCKDALE	263	253	10	4%
		RYDE	23	20	3	13%
		STRATHFIELD	9	0	9	100%
		SUTHERLAND SHIRE	313	312	1	0%
		SYDNEY	99	70	29	29%
		WARRINGAH	79	78	1	1%
		WAVERLEY	0	0	0	0%
		WILLOUGHBY	3	2	1	33%
		WOOLLAHRA	39	35	4	10%
2.2m	No. of land parcels 75-100% inundate					
		ASHFIELD	33	41	8	20%
		BOTANY BAY	16	15	1	6%
		BURWOOD	0	0	0	0%
		CANADA BAY	127	120	7	6%
		CANTERBURY	42	31	11	26%
		CITY OF AUBURN	9	9	0	0%
		CITY OF KOGARAH	114	125	11	9%

INUNDATION LEVEL	ANALYSIS TYPE	LGA	Hydro-DEM	STDDEM	DIFFERENCE	PERCENTAGE DIFFERENCE
		HUNTERS HILL	33	32	1	3%
		HURSTVILLE	11	12	1	8%
		KU-RING-GAI	0	0	0	0%
		LANE COVE	10	8	2	20%
		LEICHHARDT	54	51	3	6%
		MANLY	34	36	2	6%
		MARRICKVILLE	46	60	14	23%
		MOSMAN	6	9	3	33%
		NORTH SYDNEY	47	48	1	2%
		PARRAMATTA	14	14	0	0%
		PITTWATER	209	239	30	13%
		RANDWICK	4	2	2	50%
		ROCKDALE	151	142	9	6%
		RYDE	24	26	2	8%
		STRATHFIELD	10	1	9	90%
		SUTHERLAND SHIRE	748	795	47	6%
		SYDNEY	70	68	2	3%
		WARRINGAH	91	91	0	0%
		WAVERLEY	0	1	1	100%
		WILLOUGHBY	14	10	4	29%
		WOOLLAHRA	58	51	7	12%
2.2m	No. of land parcels 51-75% inundated					
		ASHFIELD	56	36	20	36%
		BOTANY BAY	6	9	3	33%
		BURWOOD	0	0	0	0%
		CANADA BAY	116	116	0	0%
		CANTERBURY	23	27	4	15%
		CITY OF AUBURN	6	5	1	17%
		CITY OF KOGARAH	78	75	3	4%
		HUNTERS HILL	28	33	5	15%
		HURSTVILLE	6	6	0	0%
		KU-RING-GAI	0	0	0	0%
		LANE COVE	25	24	1	4%
		LEICHHARDT	39	26	13	33%
		MANLY	23	23	0	0%
		MARRICKVILLE	21	27	6	22%
		MOSMAN	22	31	9	29%
		NORTH SYDNEY	30	24	6	20%

INUNDATION LEVEL	ANALYSIS TYPE	LGA	Hydro-DEM	STDDEM	DIFFERENCE	PERCENTAGE DIFFERENCE
		PARRAMATTA	21	17	4	19%
		PITTWATER	86	88	2	2%
		RANDWICK	5	0	5	100%
		ROCKDALE	110	108	2	2%
		RYDE	34	33	1	3%
		STRATHFIELD	6	0	6	100%
		SUTHERLAND SHIRE	291	292	1	0%
		SYDNEY	49	39	10	20%
		WARRINGAH	65	55	10	15%
		WAVERLEY	1	0	1	100%
		WILLOUGHBY	23	19	4	17%
		WOOLLAHRA	37	39	2	5%
2.2m	No. of land parcels 26-50% inundated					
		ASHFIELD	44	42	2	5%
		BOTANY BAY	17	10	7	41%
		BURWOOD	0	0	0	0%
		CANADA BAY	245	251	6	2%
		CANTERBURY	61	55	6	10%
		CITY OF AUBURN	12	11	1	8%
		CITY OF KOGARAH	170	140	30	18%
		HUNTERS HILL	55	56	1	2%
		HURSTVILLE	20	15	5	25%
		KU-RING-GAI	1	0	1	100%
		LANE COVE	36	36	0	0%
		LEICHHARDT	103	78	25	24%
		MANLY	51	51	0	0%
		MARRICKVILLE	31	45	14	31%
		MOSMAN	29	17	12	41%
		NORTH SYDNEY	69	56	13	19%
		PARRAMATTA	35	23	12	34%
		PITTWATER	80	61	19	24%
		RANDWICK	6	10	4	40%
		ROCKDALE	161	120	41	25%
		RYDE	81	83	2	2%
		STRATHFIELD	19	6	13	68%
		SUTHERLAND SHIRE	397	340	57	14%
		SYDNEY	65	53	12	18%
		WARRINGAH	113	92	21	19%

INUNDATION LEVEL	ANALYSIS TYPE	LGA	Hydro-DEM	STDDEM	DIFFERENCE	PERCENTAGE DIFFERENCE
		WAVERLEY	3	3	0	0%
		WILLOUGHBY	24	32	8	25%
		WOOLLAHRA	98	66	32	33%
2.2m	No. of land parcels less than 25% inundated					
		ASHFIELD	111	95	16	14%
		BOTANY BAY	43	35	8	19%
		BURWOOD	0	0	0	0%
		CANADA BAY	423	456	33	7%
		CANTERBURY	258	208	50	19%
		CITY OF AUBURN	43	44	1	2%
		CITY OF KOGARAH	663	641	22	3%
		HUNTERS HILL	339	342	3	1%
		HURSTVILLE	167	168	1	1%
		KU-RING-GAI	35	20	15	43%
		LANE COVE	230	212	18	8%
		LEICHHARDT	333	244	89	27%
		MANLY	305	334	29	9%
		MARRICKVILLE	174	156	18	10%
		MOSMAN	155	152	3	2%
		NORTH SYDNEY	298	311	13	4%
		PARRAMATTA	279	174	105	38%
		PITTWATER	268	177	91	34%
		RANDWICK	69	51	18	26%
		ROCKDALE	300	267	33	11%
		RYDE	332	296	36	11%
		STRATHFIELD	40	8	32	80%
		SUTHERLAND SHIRE	1094	1050	44	4%
		SYDNEY	235	193	42	18%
		WARRINGAH	346	221	125	36%
		WAVERLEY	48	64	16	25%
		WILLOUGHBY	269	269	0	0%
		WOOLLAHRA	335	338	3	1%

F. Comparison to other inundation studies

Local government and numerous state government agencies have also been generating inundation products using standard and modified LiDAR DEMs. A visual comparison was made to known published results from other inundation studies. No detailed or metadata search has been conducted in these comparisons.

Melbourne

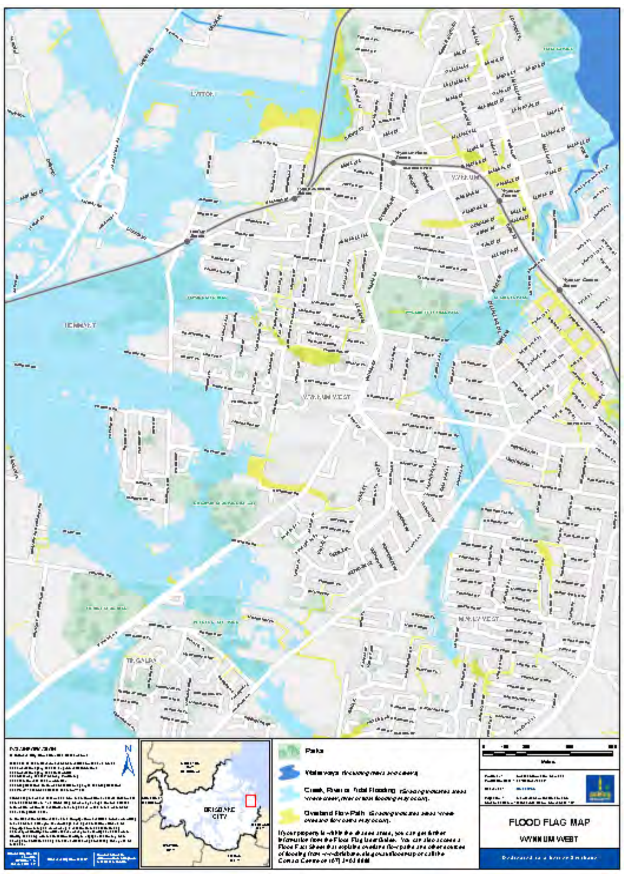
In Victoria, the Victorian State Government released the Victorian Coastal Strategy 2008 stating that a minimum of 0.8m sea level rise along the Victorian coastline should be considered for planning based on IPCC AR4. To investigate potential sites of inundation, the Department of Sustainability and Environment and the Department of Planning and Community Development led by the Future Coasts Program team in conjunction with the CSIRO and University of Tasmania have developed a state-wide coastal climate change assessment data. The DEM input data was sourced from the same LiDAR. Although substantial quality checks were completed in assessment of the LiDAR DEM, only metric uncertainty was assessed and spatial structure and connectivity was disregarded, ie. the DEM was not hydrologically enforced and conditioned. The inundation model implemented was based on a ‘bath tub’ model, however in addition to the DEM, the model considered coastal inputs such as sea level rise estimates, storm tides and wind factors.

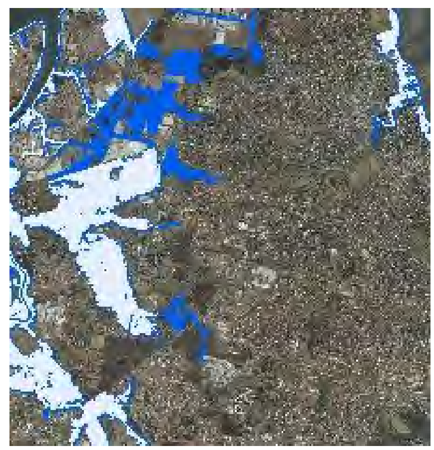
Based on a sample region, the results of the Victorian Government’s are visually consistent with the findings in the UDEM project, see Figure F-1.

- **Figure F-1. Victorian Government's storrm surge inundation projections(left) and UDEM project's projections 1.4 m?? (right) are visually consistent. (www.portphillip.vic.gov.au/default/Storm_Surge_Inundation_Maps_1.pdf, www.portphillip.vic.gov.au/default/Storm_Surge_Inundation_Maps_2.pdf)**

Brisbane

Brisbane City Council has produced a flood map for the municipality indicating potential flooding area based on average recurrence intervals (ARI) frequency at 5, 20, 50 and 100 years and includes flooding occurring from river, storm tide and overland flow. The flood layer over a sample area, Wynnum West, is visually consistent with the inundation results; the DEM used in the Brisbane City Council has not been identified specifically within their flood flag map portal. http://www.brisbane.qld.gov.au/community-support/emergency-management/flooding/flood-flag-map/index.htm

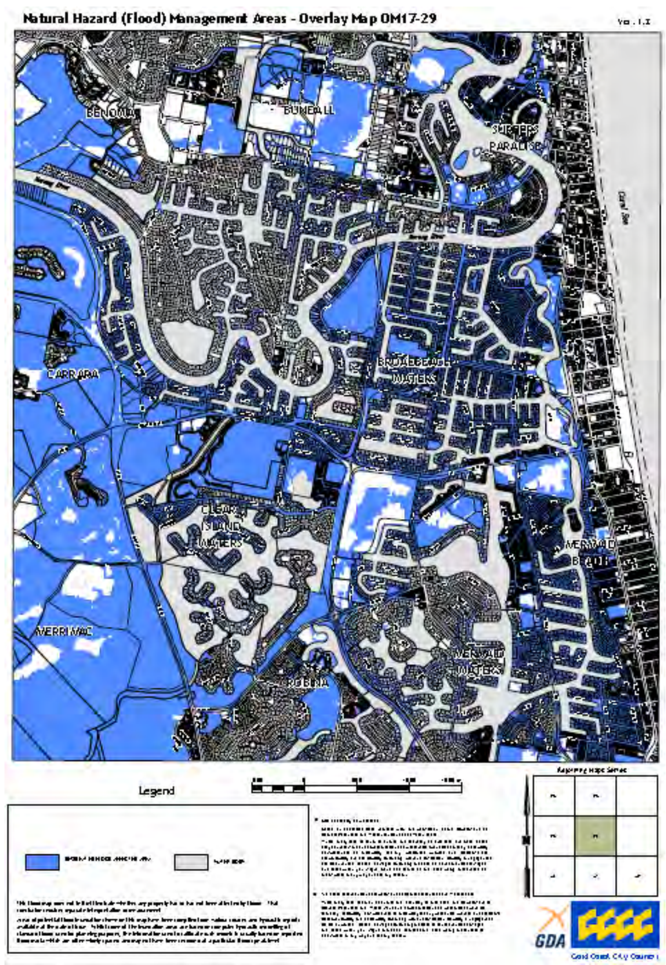




- **Figure F-2. Brisbane City Council flood map (www.brisbane.qld.gov.au/community-support/emergency-management/flooding/flood-flag-map/index.htm)**

Gold Coast

Gold Coast City Council developed Natural Hazard (Flood) Management Area overlays to assist in flood management for planning purposes. The overlap maps over the suburb of Carrara is consistent with the findings of this project.

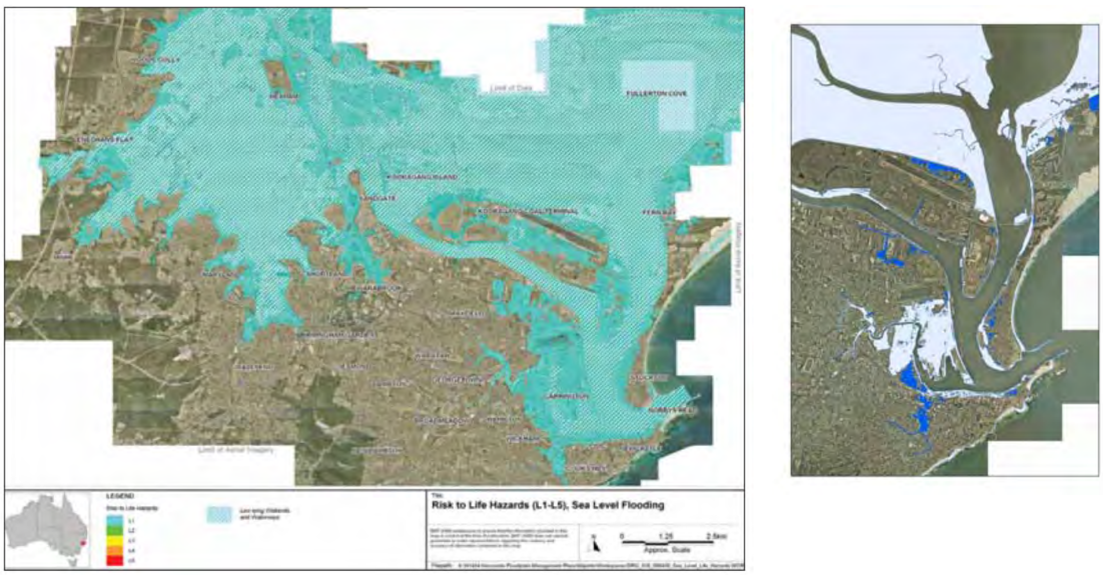


■ **Figure F-3. Gold Coast City Council Natural Hazard (Flood) Management Areas overlap map (www.goldcoast.qld.gov.au/gcplanningscheme_0110/maps_overlay_om17.html)**

There is additional QLd data now available at:- http://www.derm.qld.gov.au/environmental_management/coast_and_oceans/coastal_management/maps/index.html

Newcastle, Central Coast

Newcastle City Council have produced sea level flooding information for the municipality and developed maps to identify regions prone to numerous types of flood events, including ocean flooding, flash flooding and river flooding. The area modelled by the Newcastle City Council is in general encompassing a larger region than the inundation modelled for the UDEM project.



- **Figure F-4. City of Newcastle flood map (NCRA, page 78).**