MEMORANDUM

Camellia Recycling Centre - Alternative Design #1 Flood Model

PREPARED FOR:	Veolia Environmental Services
PREPARED BY:	Mark Favetta
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REVISION NO.:	0
APPROVED BY:	Christine Hodgkiss

1 Background

This Technical Memorandum considers an alternative site design with no *overland flow collection grate* and no *flood relief channel*. Similar to the report (CH2M HILL, 2013a), this technical memorandum discusses resultant flood impacts, mitigation measures, floodplain risk management and planning.

Summary of flooding assessment completed to date

The *Camellia Recycling Centre (CRC) Flood Study Rev 1* (CH2M HILL, 2013a) was submitted to the NSW Department of Planning and Environment (DoPE) as part of the *CRC Response to Submissions Report* (CH2M HILL, 2013b). The Flood Study investigated flooding and stormwater at 37 Grand Ave, Camellia and demonstrated that the development complies with Parramatta City Council's floodplain risk management planning controls.

The proposed development described in CH2M HILL (2013a) identifies that:

- The development is designed to comply with Parramatta City Council Local Floodplain Risk Management Policy and Draft Design Development guidelines.
- The Finished Floor Level (FFL) is RL 4.13m AHD (0.5m above the 100 year ARI level 3.63m AHD).
- In general driveways at the Site are located at or above RL 3.43m (0.2m less than 100 year ARI) with the exception of the entrance to the Site that ramps up to the FFL from road level.
- The following flood mitigation measures were previously proposed at the Site:
  - *Overland Flow Collection Grate* to collect overland flows directed towards the Site from Grand Avenue.
  - *Flood Relief Channel (bypass channel)* which will be connected to the overland flow collection grate and convey overland flows along the eastern Site boundary.
  - *A series of one-way flow valves or one-way flow flap gates* at the outlet of the channel to prevent water entering the channel from Parramatta River.

Why is an alternative design being considered?

During the planning review period, concern was raised regarding the elevated health, safety and environmental risks identified in CH2M HILL (2103a) associated with (1) construction of the proposed flood mitigation measures; and (2) residual elevated environmental risks based on the proposed flood relief channel being located within the contaminated fill.

In discussions between DoPI, Council and Veolia, it was agreed that in principle: a development solution that avoids excavation where possible would result in reduced health, safety and environmental risks, however the trade-off would be possible local flood impacts.

Council advised that future drainage works on Grand Avenue are currently under investigation by Council. It is anticipated that any local flood impacts can be managed by the road regarding and will therefore be interim. It is understood that future drainage works may be implemented in 2016/17, subject to Council budget approvals.

What additional documentation has been recommended interested parties?

Updated flood mapping (reflecting alternative design #1), and a flood emergency response plan was requested at the meeting held between DoPI and Council on 22 June 2015.

2 Site features

Alternative design #1 is similar to the proposed development described in CH2M HILL (2013a), however the following features are proposed to be changed.

- Overland flow collection grate – no longer proposed.
- Flood relief channel (bypass channel) – no longer proposed.
- Berm at front of Site – installed to preclude local catchment flows up to the 1 in 20 year ARI from entering the Site. The berm level is RL 3.76 mAHD.
- Site drainage – designed to drain towards Parramatta River where possible. The connection to the Parramatta River will include a series of one-way flow valves or one-way flow flap gates at the outlet of the channel to prevent water entering the channel from Parramatta River.
- Site Levels – have been retained from the proposed development design runs presented in CH2M HILL (2013a), however a "berm" at the Grand Ave street frontage has been included.

It is anticipated that all other features will remain as described in CH2M HILL (2013a).

The berm[1] prevents smaller more frequent storm events up to the 1 in 20 year ARI from entering the Site.

3 Hydraulic Model

3.1 Model development

3.1.1 Initial "dummy" design run

An initial "dummy" design run was setup to calculate the required "berm" level to prevent ingress of the 20 year ARI at the Grand Avenue Street frontage. The initial design run involved raising ground levels that, such that all Site elevations were at level sufficiently above flood waters (in effect creating a "dummy" flood defence around the entire Site).

[1] A berm was initially suggested by Council during a telecon with Mr Jim Tsom on 9 March 2015, where Council described their future intention to capture and contain flood flows up to the 1 in 20 year ARI storm event within the roadway along Grand Avenue.

The initial design run was run for two 20 year ARI scenarios:

1. the 20 year ARI 12 hour storm – this storm results greatest volume discharged for the spectrum of ARR storms (measured at the low point of Grand Avenue); and
2. the 20 year ARI 25 min storm – this storm results in greatest peak flow-rate discharged for the spectrum of ARR storms (measured at the low point of Grand Avenue).

This "dummy" design run confirmed that the peak water level at the Grand Avenue street frontage (southern Site boundary) occurs during the 20 year ARI 25 min storm. [2] The peak water level reached at this location is RL 3.76 m AHD.

3.1.2 Alternative design #1

Based on the initial "dummy" design run, the following Site features were then incorporated into the 1D/2D model:

- The "berm" at the Grand Avenue street frontage (southern Site boundary) was represented by a Z-line to define the "berm" level of RL 3.76m AHD;
- A grated drainage pit was included at the lowest point of the Site in the north-east corner. The 3600 x 900 mm pit drains via four 600 mm pipes to Parramatta River via a one-way valve to prevent backflow.

Note: features removed are described in Section 2 Site features (above).

Alternative design #1 was run for the following scenarios:

- **Peak local catchment/subcatchment flow.** 20 year ARI 100 year ARI 25 minute critical duration storm in local catchment with low river water level.
- **Peak river water level.** 20 year ARI [3] and 100 year ARI 9 hour peak water level in river coinciding with 20 year ARI and 100 year ARI (respectively) 12 hour storm in local catchment.

3.2 Results

This section presents results of the 1D/2D design-case modelling of *alternative design #1* (water levels, depth, velocity and hazard) and compares results with the 1D/2D base-case modelling presented in CH2M (2013a) (impact maps, once dry now wet and once wet now dry).

Flood maps

Flood maps have been prepared and are included in as **Attachment A**.

Note: Flood depths shown within the Site in the 20 year ARI are the result of rainfall runoff generated inside the Site boundary, including rain falling on the building roof. In reality Site drainage would capture roof runoff and direct it to storage tanks. Site drainage would also be designed to manage up to the 1 in 100 year ARI.

River water levels

A summary of river water levels is presented in Table 1.

[2] "Dummy" design runs were modelled with a low river water level.

[3] The 20 year ARI Peak river water level was not modelled in CH2M (2013a). A baseline model run was undertaken as part of this investigation.

Table 1 Calculated Peak Flood Level (mAHD) in Parramatta River

Section	20 year ARI (9 hour)				100 year ARI (9 hour)				PMF (4 hour)			
	LPR-FRMS	CRC-FS Base case^	CRC-FS Design case^	CRC-FS Alt. design #1	LPR-FRMS	CRC-FS Base case^	CRC-FS Design case^	CRC-FS Alt. design #1	LPR-FRMS	CRC-FS Base case#	CRC-FS Design case#	CRC-FS Alt. design #1#
	M	I	I	I	M	I	I	I	M	M	M	I
6304	3.16	3.17	3.17	3.17	3.70	3.67	3.67	3.67	7.30	7.30	7.30	7.30
6387	3.13	3.15	3.15	3.15	3.67	3.66	3.66	3.66	6.12	6.12	6.12	6.12
6478*	*3.09*	3.05	3.09	3.09	*3.62*	3.56	3.60	3.60	*6.06*	*6.06*	*6.06*	*6.06*
6598	3.04	3.04	3.04	3.04	3.57	3.55	3.55	3.55	6.00	6.00	6.00	6.00
6775	2.92	2.92	2.92	2.92	3.44	3.41	3.41	3.41	5.79	5.79	5.79	5.79

Notes

M Based on data extracted from MIKE11 hydraulic model (SKM, 2005b).

I Results computed using ISIS 1D/2D model with rainfall on grid.

* Interpolated section located at upstream of Site boundary added to base-case and design case, section not available in LPR-FRMS.

^ Combined with local catchment peak water level 12 hour event.

PMF LPR-FS results have been accepted as CRC-FS cross-section flow results. It was not possible to run a combined 1D/2D PMF event using the 20 year ARI & 100 year ARI 1D/2D model setup. Model setup was suitable for events up to the 100 year ARI that have part of the floodplain located clear of the PMF.

italic Values shown in italics are based on average between upstream and downstream sections.

3.62 Values shown in shaded boxes are selected as 100 year ARI and PMF flood planning levels for Veolia CRC.

Discussion

Flood behaviour and flood impacts for the 20 year ARI and 100 year ARI are described below for *Alternative design #1*. It is noted that water level impacts are similar being between 0.02 – 0.10m in both cases at Grand Avenue (southern boundary).

- In the **20 year ARI *peak local catchment/subcatchment flow* event**, water conveyed eastward along Grand Avenue directed towards the Parramatta River does not spill over the "berm" (at the front of the Site) and enter the Site. River water levels do not reach a level high enough to enter the Site.

  There is a flood level impact on Grand Avenue of approximately +0.02m - 0.1m. An impact is shown at the *'Concrete Recyclers'* facility[4] where the existing wall will be repaired. If the wall is modelled as repaired in the base case there is no impact.

  There is no significant change to areas on the floodplain that were once dry and are now wet; or areas that were once wet and are now dry. [5]

- In the **20 year ARI *peak river water level* event**, water conveyed eastward along Grand Avenue directed towards the Parramatta River does not spill over the "berm" (at the front of the Site) and enter the Site. River water levels do not reach a level high enough to enter the Site.

[4] The 'Concrete Recyclers' facility is the parcel of land located adjacent to the western Site boundary. A wall between the CRC Site and the "Concrete Recyclers" contains water originating from the "Concrete Recyclers" has been included in the 2D model to eliminate flow between the two sites. This wall is partially in place currently, however in a state of disrepair and will be reinstated as part of the CRC works.

[5] These maps were previously requested by Council.

There is a flood level impact on Grand Avenue of approximately +0.02m - 0.1m. An impact is shown at the *'Concrete Recyclers'* facility where the existing wall will be repaired. If the wall is modelled as repaired in the base case there is no impact.

There is no significant change to areas on the floodplain that were once dry and are now wet; or areas that were once wet and are now dry.

- In the **100 year ARI *peak local catchment/subcatchment flow* event**, water conveyed eastward along Grand Avenue that is flowing in a direction towards the Parramatta River spills over the "berm" along the Southern Boundary and enters the Site. Flood waters that enter the Site from Grand Avenue are temporarily contained around the building footprint, before draining to the Parramatta River (via the Site drainage system). In this scenario, the Site effectively behaves as a shallow detention basin which reaches a maximum water level of RL 3.55m AHD. River water levels do not reach a level high enough to enter the Site. It is noted that Site drainage will manage events up to the 100 year ARI.

  There is a flood level impact on Grand Avenue of approximately +0.02m - 0.1m. There is also an impact at the *'Concrete Recyclers'* facility of up to >0.50m where the existing wall will be repaired. If the wall is modelled as repaired in the base case there is no impact.

  There is no significant change to areas on the floodplain that were once dry and are now wet; or areas that were once wet and are now dry.

- In the **100 year ARI *peak river water level* event**, water conveyed eastward along Grand Avenue flowing in a direction towards the Parramatta River spills over the "berm" and enters the Site. Flood waters that enter the Site from Grand Avenue are temporarily contained around the building footprint, before draining to the Parramatta River (via the Site drainage system). In this scenario, the Site effectively behaves as a shallow detention basin which reaches a maximum water level of RL 3.55m AHD. It is noted that Site drainage will manage events up to the 100 year ARI. Similar to previous design runs described in CH2M (2013a), the "berm" located at the rear of the Site precludes river flood waters from entering the Site via the rear boundary.

  There is a flood level impact on Grand Avenue of approximately +0.02m - 0.1m. There is also an impact at the *'Concrete Recyclers'* facility of up to >0.50m where the existing wall will be repaired. If the wall is modelled as repaired in the base case there is no impact.

  There is no significant change to areas on the floodplain that were once dry and are now wet; or areas that were once wet and are now dry.

4 Floodplain Risk Management Planning

4.1 Planning and Design

Table 2 Planning and design features

Planning and design feature	Description of feature with reference to CH2M (2013a)
Floor Level	Floor level will remain at RL 4.13mAHD as described in CH2M HILL (2013a). It is noted that the peak flood level within the Site during the 100 year ARI is RL 3.55mAHD. The proposed floor level is greater than 0.50m above this level.
Building Components & Method	Building components & method planning and design features do not deviate from the description in CH2M HILL (2013a).
Structural Soundness	Structural soundness design features do not deviate from the description in CH2M HILL (2013a).
Flood Affectation	The preparation of the CRC-Flood Study (CH2M HILL, 2013a) and this technical memorandum satisfactorily address Lower Parramatta River Floodplain Risk Management Study (LFRMP) requirements for an Engineers Report.
Car Parking & Driveway Access	Car parking & driveway access features do not deviate from the description in CH2M HILL (2013a), with the exception of the Site entry. At the Site entry, vehicular traffic will be required to drive over a "berm" which will be constructed to a top level of RL 3.76mAHD. In the 100 year ARI water will spill over the "berm" into the Site. The maximum depth on the top of the berm in the 100 year ARI is 0.06m.
Evacuation	Evacuation features do not deviate from the description in CH2M HILL (2013a). Further details regarding evacuation are described in the CRC Flood Emergency Response Plan (CH2M HILL, 2015).
Management and Design	Management and Design features do not deviate from the description in CH2M HILL (2013a).

5 Conclusion

This Technical Memorandum considers an alternative site design with no *overland flow collection grate* and no *flood relief channel*. A "berm" set at RL 3.76m AHD at the Grand Avenue street frontage (southern boundary) has been included in the model to prevent smaller more frequent storm events from entering the Site.

The proposed changes described in this technical memorandum will result in local flood impacts of approximately 0.02 – 0.10m during the 20 year and 100 year ARI.

The proposed development complies with Council's floodplain risk management and planning controls. Additional information on flood emergency response planning can be found in CH2M (2015).

6 References

CH2M HILL (2013a), Camellia Recycling Centre – Flood Study, Revision 1, prepared for Veolia Environmental Services.

CH2M HILL (2013b), Camellia Recycling Centre – Response to Submissions Report, Prepared for Veolia Environmental Services, December 2013.

CH2M HILL (2014), Camellia Recycling Centre – Flood Study Rev 1, Response to Request for Additional Information.

CH2M HILL (2015), Camellia Recycling Centre – Flood Emergency Response Plan, Rev 0.

Parramatta City Council, Local Floodplain Risk Management Policy, June 2006.

SKM (2005a), Lower Parramatta River: Floodplain Risk Management Study and Plan, Volume 1 – Main Report, Draft, Jan 2005.

SKM (2005b), Lower Parramatta River: Floodplain Risk Management Study – Flood Study Review, Final, May 2005.

Attachment A

Flood Maps

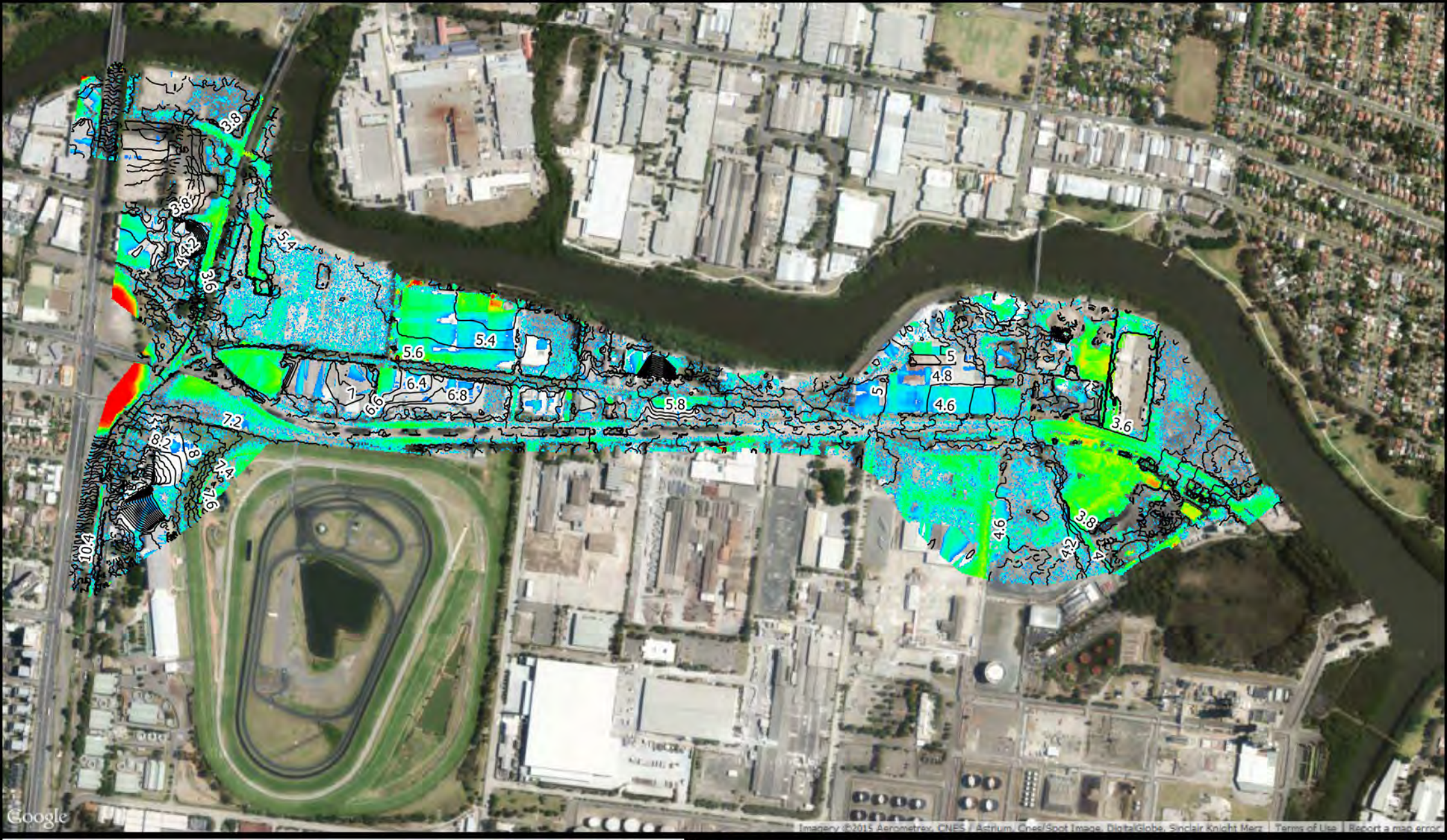
20 year ARI

Legend

<-0.5	-0.1 - -0.02	0.2 - 0.3
-0.5 - -0.3	-0.02 - 0.02	0.3 - 0.5
-0.3 - -0.2	0.02 - 0.1	0.5 +
-0.2 - -0.1	0.1 - 0.2	

0 200 400 600 800 m

Design Impact 20yr 25minLocal LowFlowRiver event

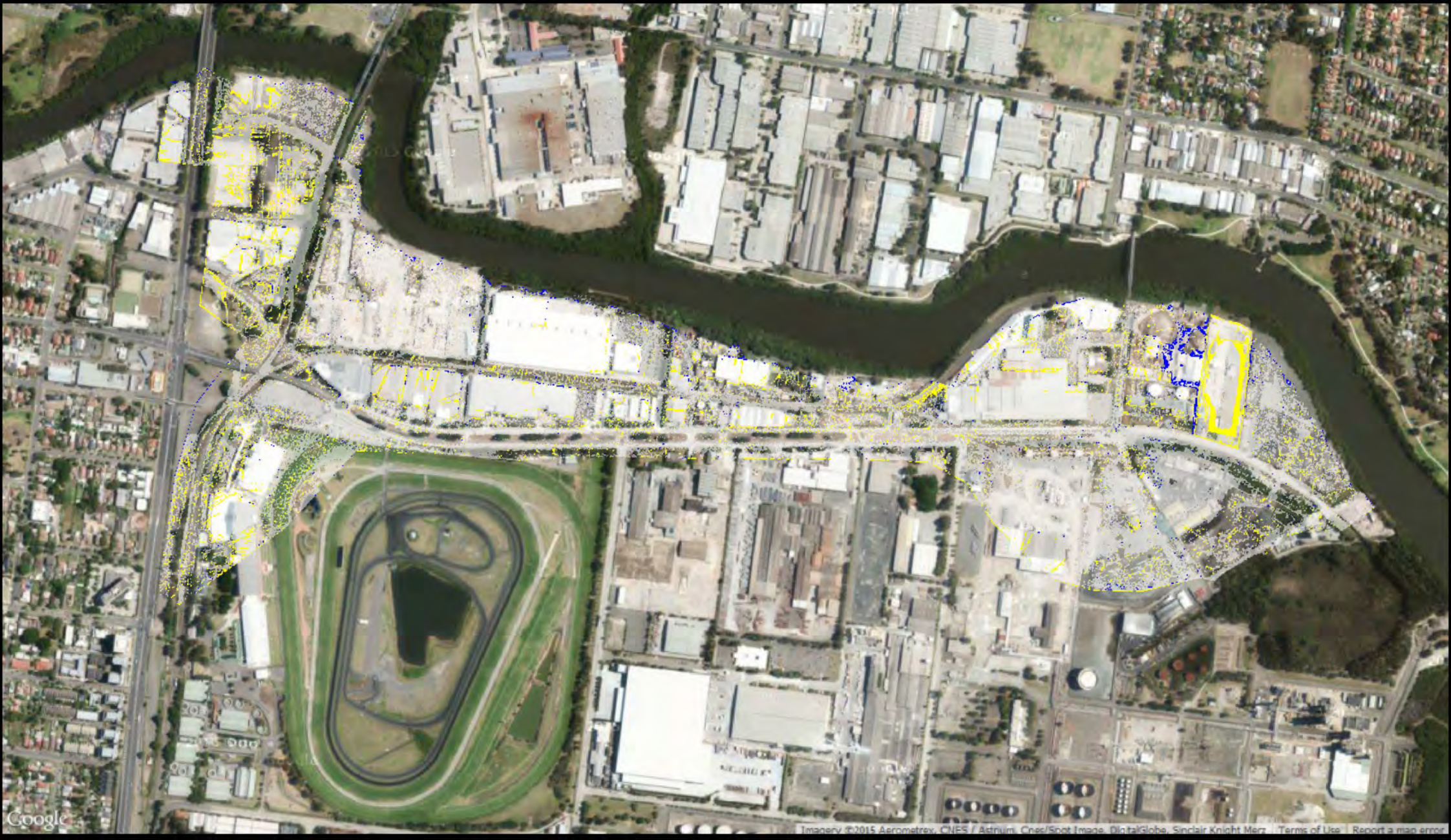


Legend

- 0.01 - 0.05
- 0.05 - 0.1
- 0.1 - 0.2
- 0.2 - 0.4
- 0.4 - 0.6
- 0.6 - 0.8
- 0.8 - 1.0
- 1.0 - 1.5
- 1.5 - 2.0
- 2.0 - 6.0
- Water Level

0 200 400 600 800 m

Maximum Depth (m) Design_20yr_25min_LowFlow



Legend

- Once Wet now Dry
- Once Dry now Wet
- Extent of maximum basecase flooding

0 200 400 600 800 m

Comparison of Wet and Dry Cells
20yr_25min_LowFlow

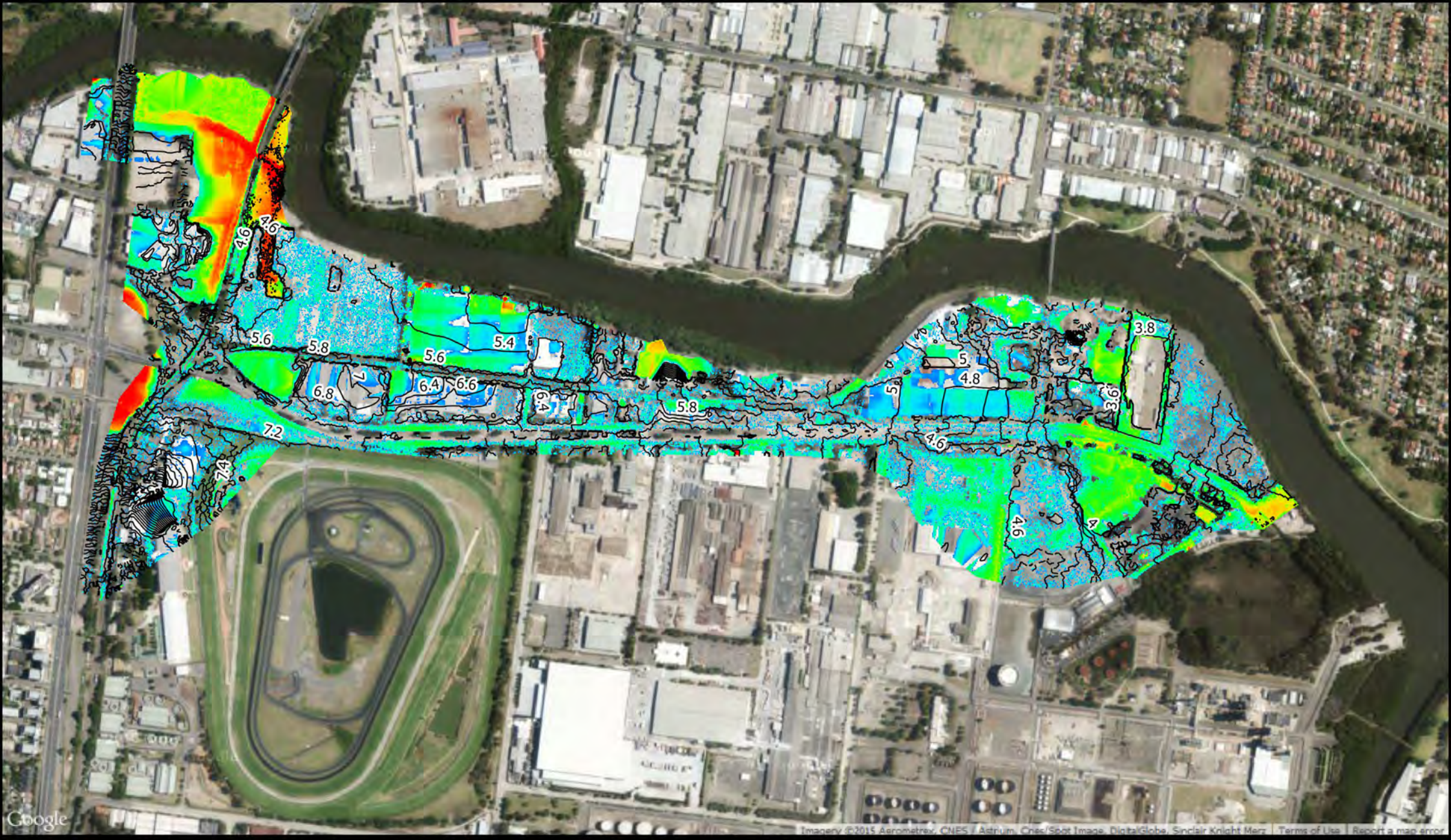
100 year ARI

Legend

<-0.5	-0.1 - -0.02	0.2 - 0.3
-0.5 - -0.3	-0.02 - 0.02	0.3 - 0.5
-0.3 - -0.2	0.02 - 0.1	0.5 +
-0.2 - -0.1	0.1 - 0.2	

0 200 400 600 800 m

Design Impact 100yr 12hrLocal 9hrRiver event

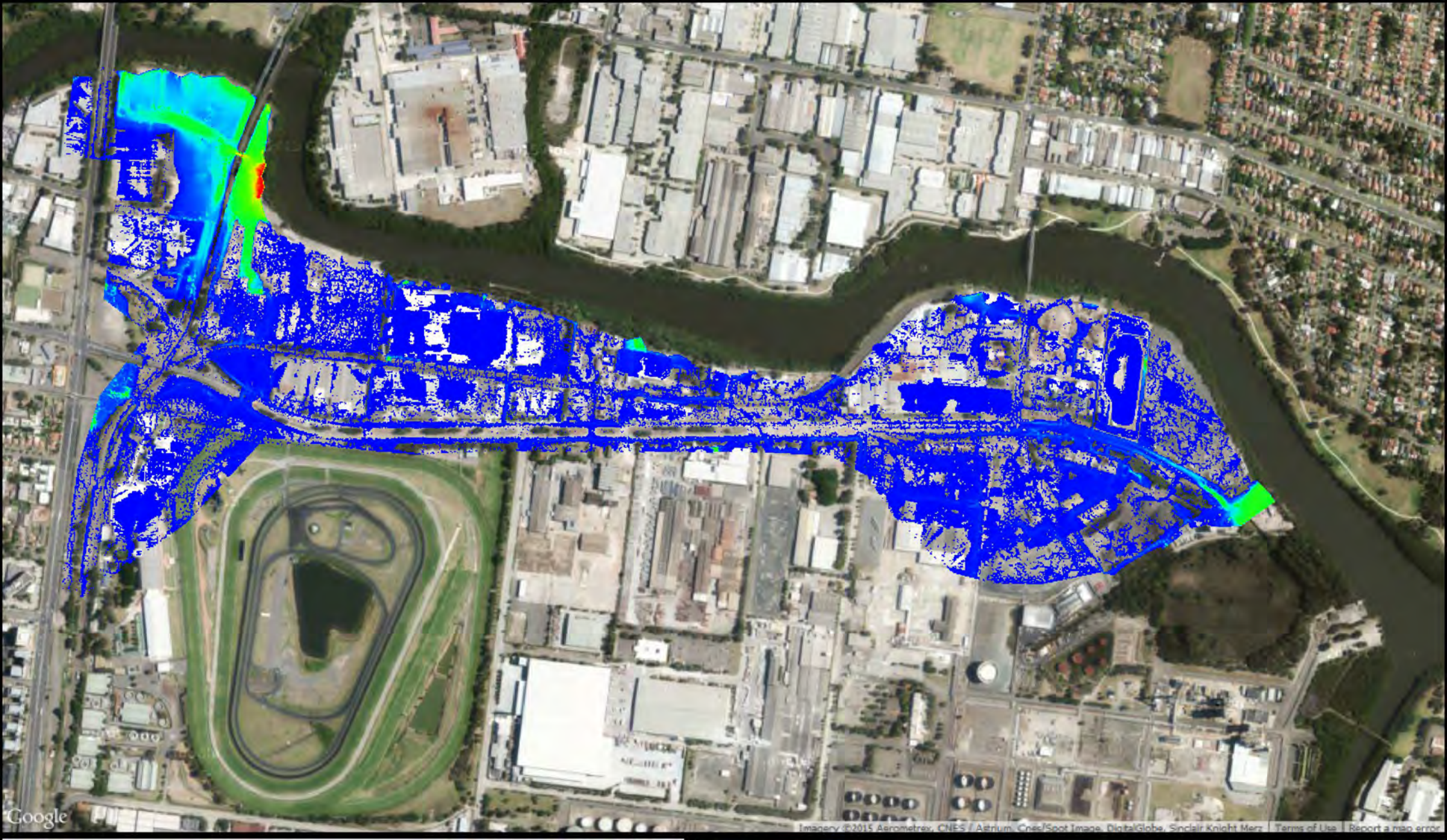


Legend

0.01 - 0.05	0.2 - 0.4	1.0 - 1.5
0.05 - 0.1	0.4 - 0.6	1.5 - 2.0
0.1 - 0.2	0.6 - 0.8	2.0 - 6.0
	0.8 - 1.0	

0 200 400 600 800 m

Maximum Depth (m) Design_100yr_12hr_9hr

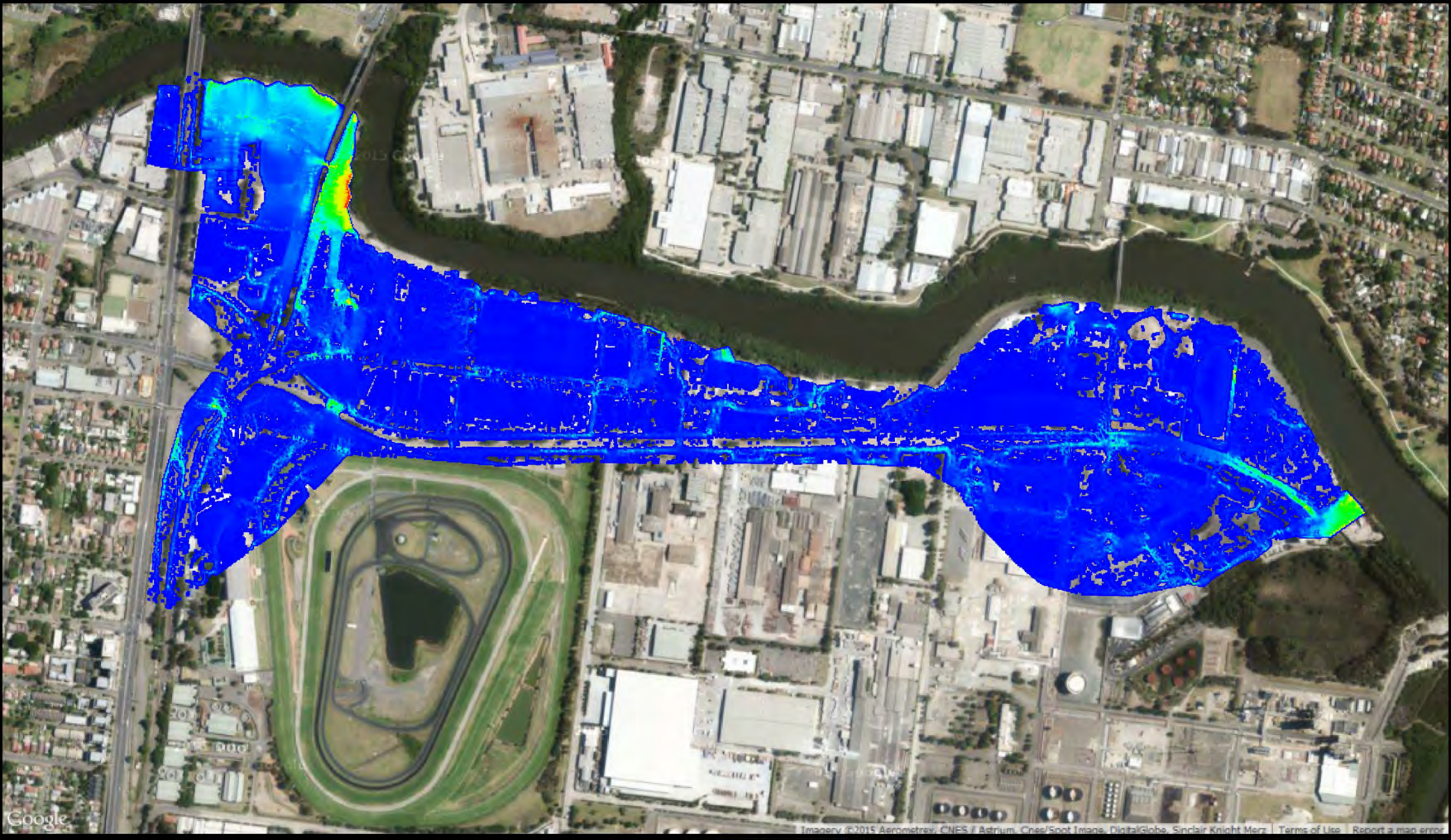


Legend

- 0
- 0 - 0.1
- 0.1 - 0.2
- 0.2 - 0.3
- 0.3 - 0.4
- 0.4 - 1.0
- 1.0 - 2.0
- 2.0 - 3.0
- 3.0 - 4.0
- 4.0 +

0 200 400 600 800 m

Hazard Design_100yr_12hr_9hr



Legend

0	0.2 - 0.3	0.6 - 0.7	1.0 - 2.0
0 - 0.1	0.3 - 0.4	0.7 - 0.8	2.0 - 3.0
0.1 - 0.2	0.4 - 0.5	0.8 - 0.9	3.0 - 4.0
	0.5 - 0.6	0.9 - 1.0	4.0 +

0 200 400 600 800 m

Maximum Velocity (m/s) Design_100yr_12hr_9hr

Legend

- Once Wet now Dry
- Once Dry now Wet
- Extent of maximum basecase flooding

0 200 400 600 800 m

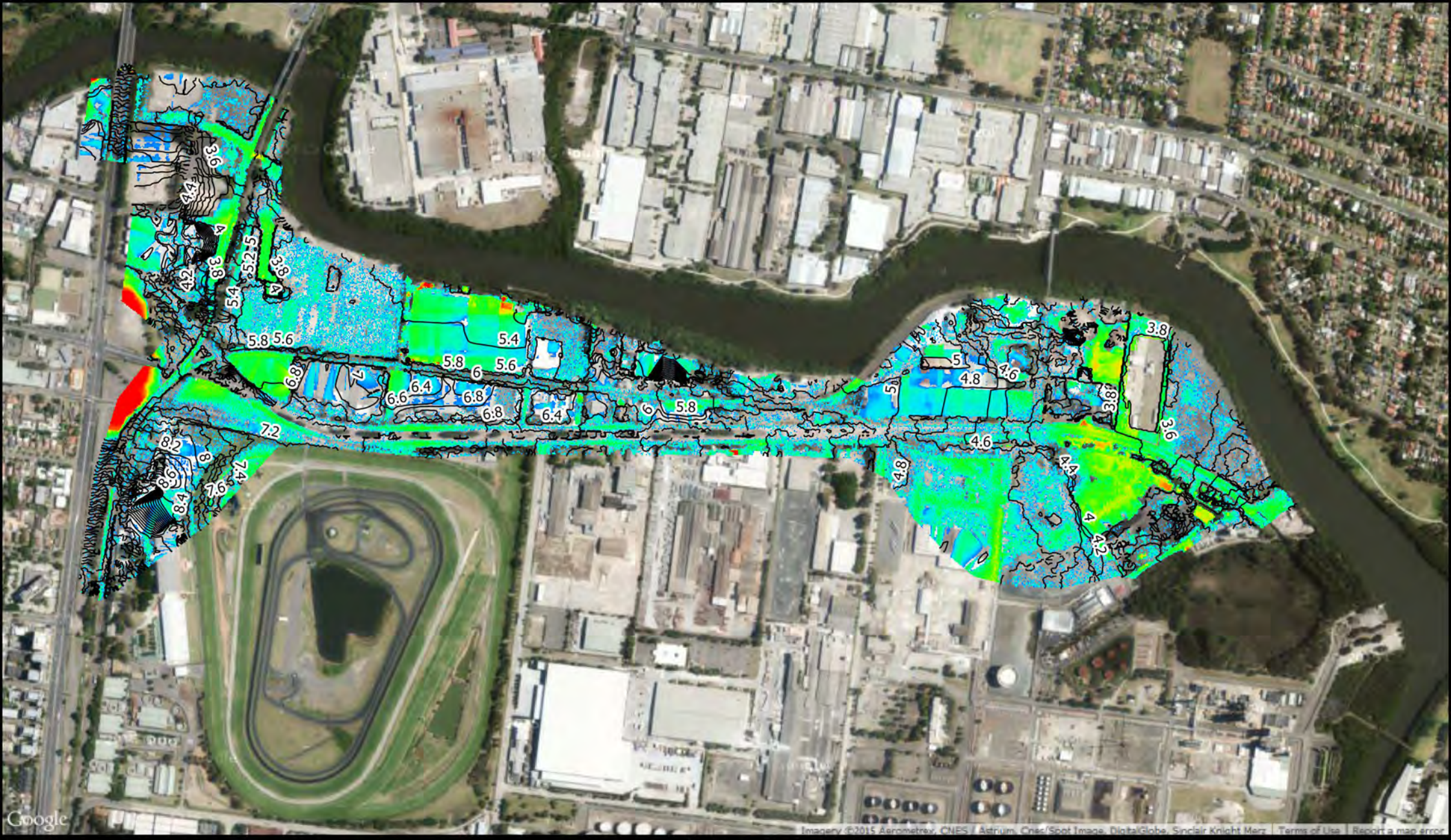
Comparison of Wet and Dry Cells
100yr_12hr_9hr

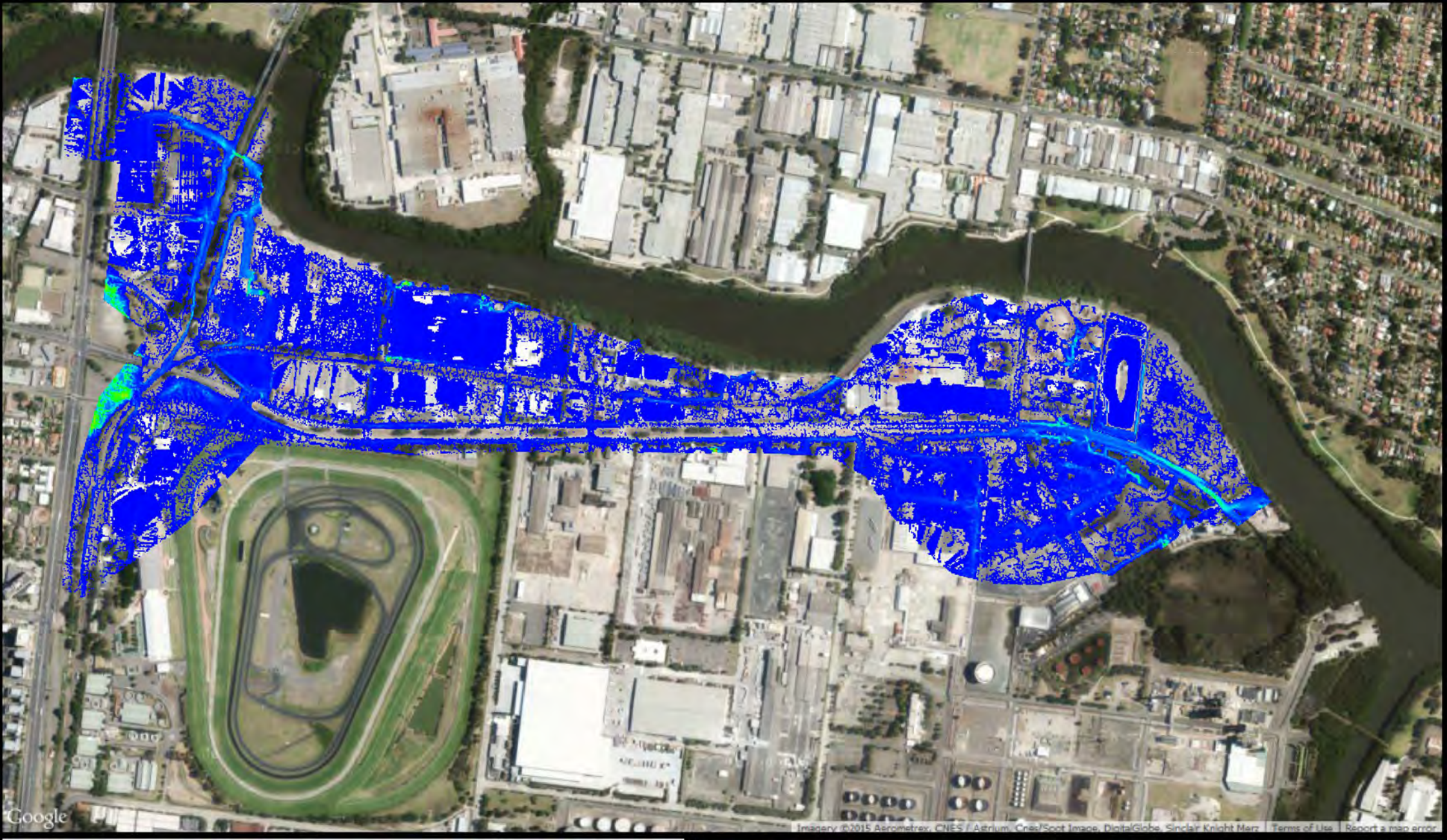
Legend

<-0.5	-0.1 - -0.02	0.2 - 0.3
-0.5 - -0.3	-0.02 - 0.02	0.3 - 0.5
-0.3 - -0.2	0.02 - 0.1	0.5 +
-0.2 - -0.1	0.1 - 0.2	

0 200 400 600 800 m

Design Impact 100yr 25minLocal LowFlowRiver event


Legend
0.01 - 0.05
0.05 - 0.1
0.1 - 0.2
0.2 - 0.4
0.4 - 0.6
0.6 - 0.8
0.8 - 1.0
1.0 - 1.5
1.5 - 2.0
2.0 - 6.0
0
200
400
600
800 m
Maximum Depth (m) Design_100yr_25min_LowFlow
Google

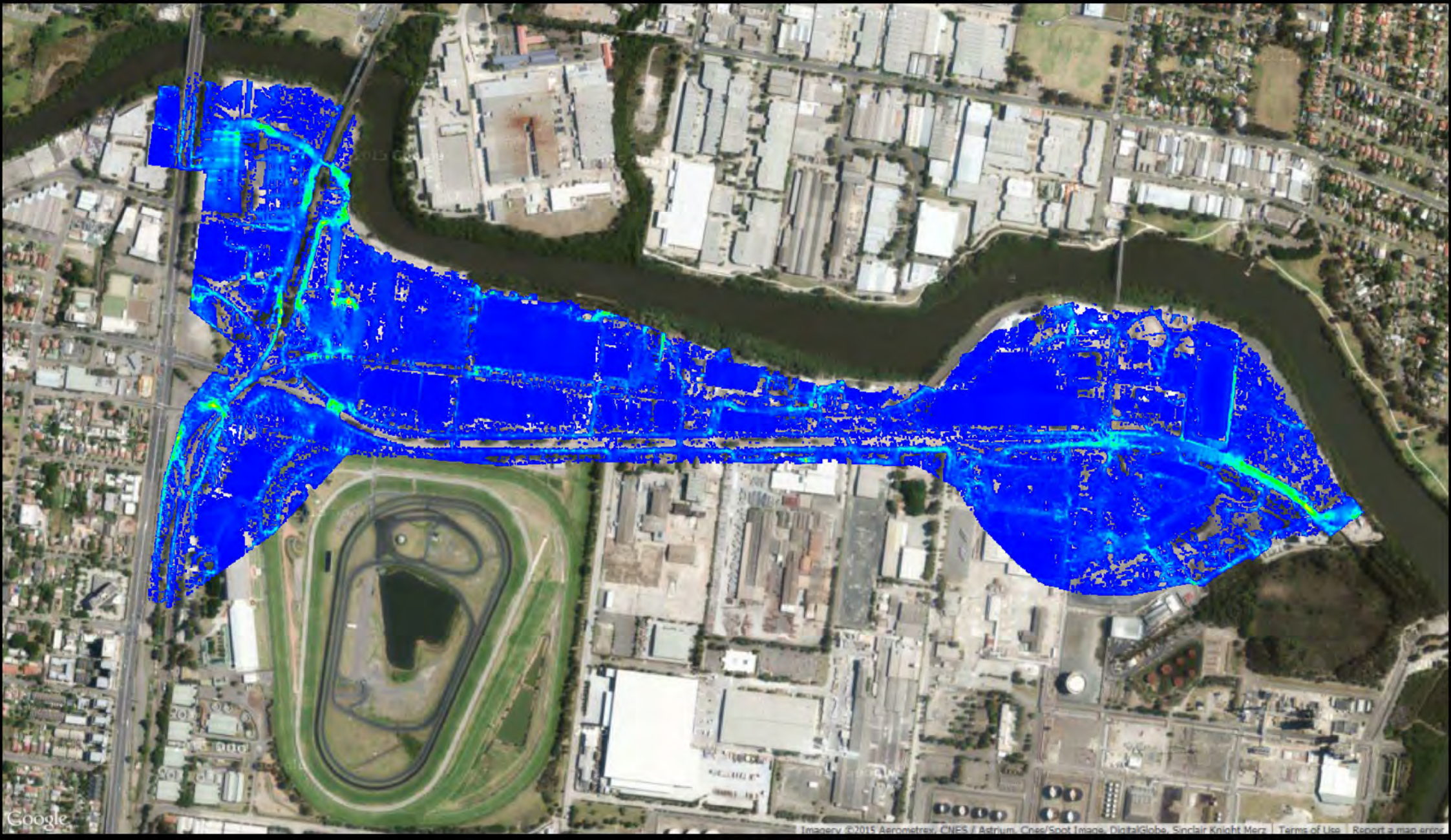


Legend

0	0.2 - 0.3	2.0 - 3.0
0 - 0.1	0.3 - 0.4	3.0 - 4.0
0.1 - 0.2	0.4 - 1.0	4.0 +
	1.0 - 2.0	

0 200 400 600 800 m

Hazard Design_100yr_25min_LowFlow



Legend

0	0.2 - 0.3	0.6 - 0.7	1.0 - 2.0
0 - 0.1	0.3 - 0.4	0.7 - 0.8	2.0 - 3.0
0.1 - 0.2	0.4 - 0.5	0.8 - 0.9	3.0 - 4.0
	0.5 - 0.6	0.9 - 1.0	4.0 +

0 200 400 600 800 m

Maximum Velocity (m/s) Design_100yr_25min_LowFlow

Legend

- Once Wet now Dry
- Once Dry now Wet
- Extent of maximum basecase flooding

0 200 400 600 800 m

Comparison of Wet and Dry Cells
100yr_25min_LowFlow