OVERLAND FLOW PATH ASSESSMENT REPORT

PROPOSED DEVELOPMENT AT

Lot 7 DP 31708, No. 7 WENTWORTH PLACE, BELROSE



NORTHERN BEACHES COUNCIL (DA2019/0817)

> Our Ref: 5232 – FS 11 December 2019

J & F DESIGNS

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1. Introduction /Available Information

J & F Designs Consulting Engineers (J&F) have been commissioned to carry out a hydrological and Hydraulic investigation as part of the development application for the proposed development at 7 Wentworth Place, Belrose.

Council's records indicate that the proposed dwelling may be affected by a Council stormwater pipeline. As outlined in the Development Application Checklist, the applicant shall demonstrate compliance with Council's Warringah Building Over or Adjacent to Constructed Drainage Systems and Easements Technical Specification.

Council has requested a hydraulic study with HEC-RAS Model demonstrating that the 1 in 100 year stormwater overland flow for the pre-development and post-development overland flow is to be established for the subject site and adjoining properties. The consultant must clearly demonstrate that the proposed development doesn't exacerbate existing flooding conditions to the adjoining properties and within the subject site. The proposed finished floor level must be 500mm above the established 1 in 100 year overland flood level.

The purpose of the report is primarily to quantify the 1% AEP peak discharges and determine the flood/flow behaviour of the local catchment surrounding the property. The report also aims at determining the 1% AEP water level, overland flow path depth for the development and subsequently the floor levels for the proposed building at the subject site.

A plan outlining the indicative locations of Council's stormwater infrastructure was obtained from Northern Beaches /Warringah Council's website. Standard LiDAR data undertaken by the NSW Land Property Information (LPI) have been obtained for the upstream catchment area. Detailed Site Survey plan (Appendix 1) and Proposed Site Plan (Appendix 2) have been provided by the Applicant.

A site inspection was carried out on 5 December 2019, during which general drainage patterns of the catchment, the existing pit and 375mm diameter RCP pipe in front of no. 8 Wentworth Place, as well as the existing drainage easement through the adjoining property and natural depression of the land through the Wentworth Reserve area, were observed and recorded.

This Flood Investigation Report has been prepared in accordance with NSW Floodplain Development Manual (2015), Australian Rainfall and Runoff, Northern Beaches Council's Guidelines & Policies.

2. Existing Site / Catchment Description

The 786m2 site is located at the Cul-de-sac of Wentworth Place and contains a one-storey residence house, garage, sheds and inground pool at the rear of the site.

The proposal is to replace the existing house with a two-storey single residence. The site is bounded by Wentworth Reserve on the north side. There is a 375-mm diameter RCP burdened by the 1.83m wide Council drainage easement (J299158) at no.8 Wentworth Place, Belrose along the southern side boundary of the subject site.

The lot has a natural fall from the front (West) to the rear (East) of the site approximately 168.13m AHD to 167.20m AHD respectively. The average decline of the land west to east is approximately 1m. Refer to survey and site plans in Appendices 1 & 2.

The total catchment area draining through and possibly affecting the site is approximately 0.783 hectares of urbanised land (Figure 1). Figure 2 provides an overview of the general slope of the catchment. The total catchment has been divided into two main sub-catchment areas for the purpose of hydrological modeling (IL-CL) in DRAINS (Table 1).

Name	Area (ha)
Cat1	0.275
Cat2	0.508
Total	0.783

Table 1. Sub-catchment Area

Figure 1. Approximate upstream catchment area



Figure 2. The catchment covers 0.783ha of gently sloping terrain (exaggeration x 5)

3. Site Photos



Figure 3. 1943 Sydney suburbs - Ausimage © Sinclair Knight Merz 2007



Figure 4. Aerial photos (High Resolution) – NSW Imagery



Figure 5. Existing stormwater gully pit and low point can be seen in the cul-de-sac at the end of Wentworth Place, Belrose.



Figure 6. The low point within the existing layback and the natural depression of the land can be seen in the Wentworth Reserve.



Figure 7. Existing layback in front of the subject site and Wentworth Reserve – Low point can be seen and confirmed by the detailed land survey.



Figure 8. Existing layback in front of the subject site and Wentworth Reserve.



Figure 9. Existing timber fence on the northern site of property can be seen. Photo is taken from Wentworth Reserve from rear of the site to Wentworth Place.



Figure 10. Existing timber fence on the northern side of the property can be seen. The photo is taken from Wentworth Reserve, from the front of the site to the rear. Existing ground level slopes away from the site toward the reserve.



Figure 11. The existing stormwater pit in front of no.8 can be seen. The existing driveway at numbers 8 and 9 constructed with a crest level above the top of kerb. Therefore the overland flow will remain within the road reserve along the kerb and gutter.

4. Drainage Description

Drainage infrastructure information (Figure 12) has been obtained from the Northern Beaches Council's Online Planning Maps.



Figure 12. Council's Online Planning Maps – Stormwater Map

The drainage system of pits and pipes in the catchment is generally designed for 20% AEP storm to 5% AEP storm with larger storms overflowing to the street flowing towards the low point in the catchment area. Surface runoff is collected via kerb and gutter throughout Wentworth Place and ponds in the cul-de-sac over the existing stormwater pit which is connected to the drainage line in The Esplanade via a 375mm diameter RCP through the Council's drainage easement at No. 8 Wentworth Place and No. 16 The Esplanade. (Figure 12).

Once the 375mm diameter pipe flows at capacity or the drainage system is subject to blockage the flows will pond within the cul-de-sac up to the top of the layback at the low point in front of Wentworth Reserve and flows through the reserve.

5. Hydrology Analysis (DRAINS)

The latest depths, intensities and temporal patterns were obtained from the BOM I-F-D site and the ARR Data Hub. Subsequently, this data was inserted into DRAINS for modeling purposes.

Hydrological calculations were carried out using DRAINS software. The DRAINS input layout including overland routes and associated sub-catchments are illustrated below. The DRAINS calculation demonstrates that the flow behavior assuming the existing pit and pipe are 100% blocked at Wentworth Place (for more details refer to the DRAINS model).

• DRAINS Model Input Layout

The drains model was prepared using the survey information for the drainage system and catchment area. Where detailed survey was unavailable the catchment boundaries were

determined using the Drainage asset data from the Council and contour maps generated by LiDAR data.



Figure 13. DRAINS Model Input Layout (Assuming pit and Pipe are 100% blocked)

• DRAINS Model Analysis Result



Figure 14. DRAINS Model input layout & Analysis Result - 1% AEP

The following DRAINS hydrographs were utilised to generate the hydrograph flow for boundary conditions in Unsteady Flow modeling in HEC-RAS.



Figure 15. Maximum flow for 1% AEP 10 min burst Storm 7, Qmax = 0.465m3/s

The 0.465m3/s flow rate was used in the upstream cross-sections of the proposed development in HEC-RAS modeling.

Overland Flow Path Investigation Assessment & Report

6. Hydraulic Analysis

Cross-sections have been interpolated through the Wentworth Reserve and the subject site and hydraulic analysis using HEC-RAS (Ver. 5.0.6) has been performed in order to determine the theoretical 1% year ARI water levels for this area.

The attached HEC-RAS Section Locality Plan (Appendix 5) shows the cross-sections used in the computer model. The same set of cross-sections is used for analysis in pre and post-development conditions. The analysis results, critical cross-sections and long section of the main channels are provided in Appendix 6 (All results obtained from HEC-RAS Program).

The overland flow path is analysed by using the mixed flow regime. We provided one main river line with main cross-sections approximately every 2m meters parallel to the overland flow path and contour of land over the existing natural depression of the land in the Wentworth Reserve and used Q = 0.465m3/s for the surface flow rate.

The cross-sections were taken at the critical sections over the overland flow path and the dwelling, to determine the effect of the development on the flood-prone land. The overland flow path remains within the reserve therefore there will not be any adverse effect on the development.

Please note it is assumed that the existing pit and pipe are 100% blocked and the entire overland flow of 0.465 m3/sec reaching the cul-de-sac area. This is a conservative approach.

The main input parameters and conditions of the model are as follow:

- Flow Rate: Q = 0.465 m3/sec
- Flow Regime: Mixed;
- Boundary Conditions: Critical Depth (for both upstream and downstream);
- Manning's n Value: 0.030 and 0.033
- Contraction Coefficient: 0.1; and
- Expansion Coefficient: 0.3.
- The existing Structures including houses and out-buildings were modeled as obstruction blocks in respective cross-sections that cut the structures

The analysis results including flow summary table, critical cross-sections and long-section of the main channel are presented in Appendix 6.

7. Analysis Results

The subject site is burdened by Wentworth Reserve on the North and a drainage easement at no. 8 Wentworth Place along the Southern boundary, the natural depression of the land and local overland flow path is through the reserve. The overland flow inundates part of the cul-de-sac and Wentworth Reserve area at Wentworth Place during 1% AEP storm events. The peak overland flow for 1% AEP storm event is approximately 0.465 m3/sec. It is demonstrated that the overland flow does not impact the subject site. Therefore the proposed development doesn't exacerbate existing flooding conditions to the adjoining properties and within the subject site.

Analysis of flood conditions for this development has shown that:

- In general, there are no changes in flood conditions within the subject site boundary and neighbouring properties, upstream and downstream of the subject site due to the proposed development.
- The result demonstrates that the site will not be inundated by overland flow during 1% AEP storm events.
- The flow depth varies through the reserve up to 0.15 m deep.

It should be noted that this flood study takes a conservative approach in assuming that the underground drainage system associated with the flow path is 100% blocked. Additionally, no allowance has been made in these calculations for the properties within the catchment that may have installed On-Site Detention systems or Rainwater re-use tanks. This conservative assessment means that it is likely that flows at the site could be potentially considerably less.

8. Recommendations

The flood levels at various locations have been calculated (Appendix 5). The maximum flood level near the proposed building in the reserve area (RS 29.00) has been used for the planning of floor levels for the proposed development. The maximum flood level is 167.72m AHD. The flood depth at this location is approximately 90mm in the reserve area. therefore it is recommended the minimum habitable finished floor levels be set at or above 1% AEP flood level plus 300mm freeboard and minimum non-habitable finished floor levels garage and patio infront be set at or above 1% AEP flood level plus 150mm freeboard. In particular:

- Minimum habitable floor level for the proposed building to be set at/or above RL168.02m AHD
- Minimum non-habitable floor levels (garage and patio) to be set at/or above RL167.87m AHD.

In addition to ensuring that the proposed development is not inundated as a result of ponding from upstream flows, it is necessary to ensure that:

- The boundary levels in front and driveway crest to be constructed at least 300mm above the existing invert level of gutter or 150mm above the existing kerb levels in Wentworth Place to ensure no overland flow can overtop the driveway crest and front boundary into the subject site.
- The existing boundary levels on the northern side to remain the same.
- There are sufficient waterway areas along both side boundaries to carry overland flow from the front to the rear of the dwelling. Construct a 0.5m wide dish drain along both side boundaries (Figure 16).



Figure 16. Dish drain details - 500mm wide and 50mm deep

• Any portion of the building or structure lower than the minimum FPL to be built from flood compatible materials

9. Conclusion

The proposed development at no. 7 Wentworth Place, Belrose will not take up significant flood storage capacity or create obstructions to flood flows and so will not increase flood risks for existing properties or elsewhere within the flood plain.

It is extremely important that the minimum Finished Floor Levels (FFL) of the proposed development to be followed according to the recommendations as well as the boundary levels in front and driveway crest be constructed at least 300mm above the existing invert level of gutter or 150mm above the existing kerb levels in Wentworth Place to ensure no overland flow can overtop the driveway crest and front boundary into the subject site.

10.Declaration

The undersigned has no objection of supporting the above-mentioned development, as long as all the details mentioned above are to be followed during the construction. If all details are followed, there will not be any adverse effects on the development or adjoining properties. The study demonstrates that the flow path will not be adversely affected by the proposal.

Prior to any changes, the builder should contact the Council and undersigned for a discussion.

This Overland Flow Path study report and accompanying drawings and calculations are to be approved by Principal Certifying Authority (PCA), prior to any works commencing on site.

11.Appendix

Appendix 1 - Detailed survey plan

Appendix 2 - Architectural Plans

Appendix 3 - HEC-RAS Section Locality Plan and Analysis Results

Please Note:

DRAINS and HEC-RAS files and models will be provided upon request.





SITE PLAN & ANALYSIS

CLIENT DETAILS:				P	LAN REVISION	SIGNATURE:	DATE:			
Mr Daniel Legovich		ISSUE BY DATE		DATE	DESCRIPTION	SITE NOTES	ORIENTATION			
Ms Kimberley Legovich			A JV 2.4.19		2.4.19	Tender Plans	-FINAL LOCATION OF AC DUCTS MAY BE ALTERED			
SITE ADDRESS: No. 7, Lot 10, DP 31708 Wentworth Place, Belrose 2085		В	PA	29.4.19	Presentation Plans	ON SITE DUE TO CONSTRUCTION CONSTRAINTS		BetterBuilt		
		2085	С	MS	614.5.19	PP Meeting - Variation 1	-SEWER AT REAR BEHIND POOL	E T	Homes	
		2000	D	JV	23.5.19	Submission Plans	-DETACHED RAINWATER TANKS ALONG		nomes	
HOUSE NAME:		E	JV	28.6.19	Hydraulics Added	FOR POSITIONING.	www.dialbeforeyoudig.com.au	LICENCE NUMBER 244242C		
Astoria 39R		F	JV	22.7.19	Variation 2	-STORMWATER AS PER HYDRAULIC DETAIL	SITE INDUCTION	SURVEY KEY		
FACADE	JOB #	WIND	G				SW19151-A-S1 & SW19151-A-S2	Before entering site please review and make	ET : Electric Turret	
Traditional	0401-TUR	N2	н				1	yourself familiar with Emergency Contacts. Site	LP : Light Pole LIN : Lintel	
GARAGE HAND	SCALE	SITE					1	Specific Hazards and the Site Specific Induction	PP : Power Pole SLH : Sewer Lamphole WC : Water Connection 2 SMH : Sewer Manhole 0	
RH	1:200	Ρ					1	Sign.	WM : Water Meter SMS : Sewer Maint. Shaft •	
LEVELS	SHEET	SOIL	ĸ				-	If you have any trouble understanding this	GM : Gas Meter a TEL : Telecom Pit SV : Stop Valve PC · Pram Crossing	
Double	2 of 11	M			-		-	instruction, contact the Site Supervisor or	HYD : Hydrant K VC : Vehicle Crossing	
Double	Emergency Contact Number located on the sign, SWP: Stormwater Pit 🕞 DH&W:Drillicle & Wing P									
© copyright. ALL RIGHT RESERVED. UNDER THE PROVISIONS OF THE COPYRIGHT ACT 1968, THIS PLAN IS OWNED BY AND INTENDED FOR THE EXCLUSIVE USE OF BETTER BUILT HOMES PTY LTD										
Contact: [P] 1300 100 922 [W] www.betterbuilthomes.com.au [FB] Better Built Homes Sydney										

APPENDIX 3: PRE & POST HEC-RAS ANALYSIS RESULTS



• HEC-RAS Geometric Data - Pre and Post Development

HEC-RAS P	lan: Plan 01 F	River: WR Rea	ach: WR Prof	ile: 1% AEP 10	00% PIPE						
Reach	River Sta	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
		(m3/s)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m2)	(m)	
WR	36	0.47	167.93	168.07	168.07	168.11	0.021524	0.85	0.55	7.54	1.01
WR	34.250*	0.47	167.85	167.96	167.99	168.04	0.071003	1.27	0.37	6.76	1.74
WR	32.500*	0.47	167.78	167.88	167.90	167.94	0.043076	1.00	0.46	8.45	1.36
WR	30.750*	0.47	167.70	167.79	167.81	167.85	0.055147	1.08	0.43	8.78	1.52
WR	29	0.47	167.62	167.71	167.72	167.76	0.046089	1.01	0.47	9.44	1.40
WR	27.250*	0.47	167.59	167.67	167.68	167.72	0.043308	0.96	0.49	10.18	1.35
WR	25.500*	0.47	167.56	167.63	167.64	167.68	0.045089	0.95	0.50	10.89	1.37
WR	23.750*	0.47	167.52	167.59	167.61	167.64	0.052316	0.97	0.48	11.47	1.45
WR	22	0.47	167.49	167.55	167.57	167.61	0.068988	1.03	0.45	11.64	1.64
WR	20.333*	0.47	167.46	167.56	167.55	167.58	0.011662	0.58	0.82	13.82	0.73
WR	18.667*	0.47	167.44	167.54		167.56	0.009559	0.54	0.88	13.94	0.66
WR	17	0.47	167.41	167.51	167.51	167.53	0.024243	0.71	0.66	13.29	1.01
WR	15.333*	0.47	167.35	167.44	167.44	167.47	0.044998	0.84	0.55	13.89	1.33
WR	13.667*	0.47	167.30	167.38	167.38	167.40	0.032430	0.74	0.63	15.07	1.14
WR	12	0.47	167.24	167.31	167.32	167.34	0.044702	0.80	0.59	15.93	1.31
WR	10.000*	0.47	167.17	167.25	167.26	167.31	0.126405	1.11	0.42	14.87	2.09
WR	8.000*	0.47	167.11	167.21	167.21	167.24	0.027142	0.65	0.71	17.04	1.03
WR	6	0.47	167.04	167.16	167.16	167.18	0.030573	0.70	0.64	14.72	1.09

• Table – Pre and Post Development (1% AEP assuming 100% blocked pipe)



• Pre & Post Development Long-Section (1% AEP assuming 100% blocked pipe)



• Pre & Post Development Overland Flow 3D Perspective



1 cm Horiz. = 4 m 1 cm Vert. = 0.4 m



1 cm Horiz. = 4 m 1 cm Vert. = 0.4 m