Date 03/06/15 Levels

From GEORGES COVE MARINA

To

BACK SITE	INTER	FRONT SITE	RISE	FALL	REDUCED LEVEL	DISTANCE	NOTES
Arrive site 06:50							
TP9 - Soil sample							
07:15 - Easting - 0312081							
Northing - 6243360					EL. 6m +/- 4m		
Observations -							
SD-4 - sediment sample - 07:35							
Observations :- Estimated depth 3m.							
TP-1 - Moved, approx 20m south							
Easting/Northing. 312126/6243124							
El. 9m ±4m.							
Observations - 0.5m - clay							
2m - Grey carpet/ wet clay.							
TP2 - Easting/Northing 312122/6242991							
EL. 6 ± 5							
Observations 0.5m organic matter							

DISTANCE	NOTES
TP4 - Easting/Northing 08:10 311926/6243043	
Observations - dark organic matter at 0.5m	
El. 3mAHD ±7m	
SD-5 - Easting/Northing. 08:20 311927/6243043	
Observations - dark grey silt.	
- 2.5m below WL	
6mAHD ± 5m.	
* Relocated approx 20m SW due to access issues.	
TP5 - Easting/Northing. 08:30 311961/6243102	
8m ± 5m	
Obtained @ 2x150mL * 0.5m - landfill, plastic + pipes	
2m - clay + plastic.	

Date 03/06/15 Levels

From GCM

To

BACK SITE	INTER	FRONT SITE	RISE	FALL	REDUCED LEVEL	DISTANCE	NOTES
TP3 - Easting/Northing							SD2 - Not allowed to take GPS reading as the sample is over the other side of a steep bunded wall
311874/6243216							- Depth of sample - 4mbgl
El. 10mAHD ± 4m							
Obs Clay + [illegible]							TP7 - E/N - 10:10
							311918/6243420
SD6 - E/N							El. 9mAHD ± 4m
- 311899/6243226							Clayey Loam
Depth - 2m below WL							2 x 0.5m
- silty clay							2 x 2m
							QA.1 → obtained TP7 at approx 2m
SD2 - E/N							
- 311967/6243287							
El. 7m ± 4m							
depth to sample est 3.5mbgl							TP8 - E/N ~~10:25~~ 10:30
							311967/6243470 → QA.3
TP6 - E/N							SD3 El 7mAHD ± 6m 10:20
311837/6243368							Base of bund wall.
0.5m - gravel + loamy sand							pipe used to be connected to pump.
2m -							→ QA.2
El. 27mAHD ± 9							

Date 9/11/15 Levels

From GCM

To 9/11/15 GCM.

BACK SITE	INTER	FRONT SITE	RISE	FALL	REDUCED LEVEL	DISTANCE	NOTES
WAT - 8							SOIL SAMPLES
			1m	2m			TP-11 - 2.8m deep.
TEMP			22.7	22.0			- Sandy loam
EC			12469	11529			- dark brown
DO (mg/L)			37.77	~~12.76~~	12.76		~2.75m of fill material.
DO (%)			497.6	~~129.6~~	129.6		
pH			8.84	8.6			
ORP			-154.0	-206.6			TP-16 - Clay/sandy loam
Notes: Taken a QA at this point @ 1m depth.							- 1m depth to clay base
							- Lighter brown
							- Fill, composed of plastic, wire, sand
							TP-~~10~~ 12 - ~~A lot of fill~~
							TP-10 - No sample taken. Composed of brick. Mixed sandy material
							TP-13 - Fill to 1.76m, dark brown, silty loam sampled.
							PTO →

Date _____ Levels _____

From _____

BACK SITE	INTER	FRONT SITE	RISE	FALL	REDUCED LEVEL

9/11/15

To GCM.

DISTANCE	NOTES
	SOIL SAMPLES - CONT
	TP-14 - 3.2m deep to grey, sticky sand mass.
	- White granules present
	- Fill similar to site TP-11. (3.2m of fill until sand mass).
	TP-15 - Sample taken @ 3.30m deep
	- Clay/loam mix
	~~- Shale fragments~~
	- Tile fragments present in soil. Similar to ~~TP~~ top of TP-14.

Dredge pond water

Name	SC	Date	9/11/15
~~Bore~~	Wat-4S	Location	Georges Cove
Weather	Fine	Client	Benedict

SWL (m BTOC)		SWL (m BGL)		Well depth (m)	
Casing diameter		Purge volume (L)			

Time	Purged	Temp	EC	DO %	DO mg/L	pH	Redox
8am	—	22.4	12529	1005.2	77.28	8.39	-123.6
Wat 4-D		22.1	12608	457.2	35.35	8.18	-127.7

Purging method	
Sampling method	double check bailer

Easting		311934
Northing		6243181

Smell	Shallow - yellow, deep - dark brown
Colour	No sheens
Other	

Dredge water

Name	SC	Date	9/11/15
~~Bore~~	WAT5	Location	G.C.M.
Weather	fine	Client	Benedict

SWL (m BTOC)		SWL (m BGL)		Well depth (m)	
Casing diameter		Purge volume (L)			

	Time	Purged	Temp	EC	DO %	DO mg/L	pH	Redox
5-S	8:10	✓	24.1	12720	700.16	60.09	7.99	-139.2
5-D			22	12685	590.7	46.49	8.15	-147.2

Purging method	
Sampling method	

Easting		312049
Northing		6243185

Smell	as previous
Colour	
Other	

Dredge water

Name	SC	Date	S/C 9/11/15
~~Bore~~	Wat-6	Location	G.C.M.
Weather	fine	Client	Benedict

~~SWL (m BTOC)~~		SWL (m BGL)		Well depth (m)	
~~Casing diameter~~		Purge volume (L)			

	Time	Purged	Temp	EC	DO %	DO mg/L	pH	Redox
Wat6-S	8:20		23.5	12495	773.5	53.43	8.33	-140.9
Wat6-D			23	12520	279.5	27.81	8.32	-156.7

Purging method	double check
Sampling method	bailer

Easting		311971
Northing		6243361

Smell	as befor
Colour	
Other	

Dredge water

Name	SC	Date	~~8/6~~ 9/11/15
~~Bore~~	Wat 7	Location	C.C.M.
Weather	fine	Client	Benedict

~~SWL (m BTOC)~~		SWL (m BGL)		Well depth (m)	
~~Casing diameter~~		Purge volume (L)			

	Time	Purged	Temp	EC	DO %	DO mg/L	pH	Redox
Wat 7-	8:40		22.4	12490	206.6	17.65	8.87	-182.6
S								
7-D	~~0845~~		22.5	12513	218.9	17.05	8.64	-178.7

Purging method	
Sampling method	bailer

Easting		312010
Northing		6243284

Smell	"
Colour	
Other	

Dredge Pond

Name	S7	Date	9/11/15
~~Bore~~		Location	C.C.M.
Weather	fine	Client	Benedict

SWL (m BTOC)		SWL (m BGL)		Well depth (m)	
Casing diameter		Purge volume (L)			

	Time	Purged	Temp	EC	DO %	DO mg/L	pH	Redox
Wat 8-S	8.45		22.7	12469	497.6	37.77	8.84	-154
Wat 8-D			22	11529	129.6	12.76	8.6	-206.6

Purging method	
Sampling method	bailer

Easting		311891
Northing		6243366

Smell	"
Colour	
Other	

= QA1

Name	SC	Date	17/11/15
Bore	MP-3	Location	G.C.M.
Weather	overcast	Client	Benedicts

EMM

SWL (m BTOC)	2.43	~~SWL (m BGL)~~ stickup	~~2.43~~ 0.07	Well depth (m)	7
Casing diameter	50mm	Purge volume (L)	1.68	3.6 one well volume 10.9 (3)	

Time	Purged	Temp	EC	DO %	DO mg/L	pH	Redox
10	0	18.8	12448	11.79		8.1	-150
10:05	10	18.9	12148		11.71	8.22	418.7

Purging method	Submersible pump
Sampling method	"

Easting		
Northing		

Smell	Sulfur
Colour	
Other	

= QA

Name	SC	Date	17/11/15
Bore	MP4	Location	O.C.M.
Weather	flat	Client	Benedicts

SWL (m BTOC)	2.99	SWL (m BGL)	2.46	Well depth (m)	7.5
Casing diameter	50mm	Purge volume (L)		5 / 15	

Time	Purged	Temp	EC	DO %	DO mg/L	pH	Redox
10:50	10	20	14235		5.1	7.8	-190
10:53	15	19.2	13263		3.31	7.59	-167.7

Purging method	pump
Sampling method	

Easting		
Northing		

Smell	
Colour	
Other	

Name	S.C.	Date	17/11/15
Bore	MP5	Location	C.C.M.
Weather	fine	Client	Benedicts

SWL (m BTOC)	2.65	SWL (m BGL)	1.95	Well depth (m)	7.5
Casing diameter	50	Purge volume (L)		11 / 33	

Time	Purged	Temp	EC	DO %	DO mg/L	pH	Redox
12:30	25	19.2	1617		18.4	4.9	0.5
12:35	28	18.8	1520		17.93	36.9	5.75

Purging method	submersible pump
Sampling method	

Easting		
Northing		

Smell	
Colour	
Other	

Appendix D

Groundwater monitoring bore logs

PROJECT: BENEDICT SAND AND GRAVEL	BOREHOLE: BS1	SHEET 1 of 1

Surface elevation: 2.21m AHD

Borehole location: –

Date: 22–8–94

Drill type: Gemco

Logged by: N.L. Checked by: M.H.

Drilling method: Hollow stem auger

SOIL DESCRIPTION (GROUP NAME: colour; particle size; consistency; moisture content; structure; additional comments)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	WELL CONSTRUCTION	NOTES	SAMPLE INTERVALS
SILTY SAND: medium brown; sand medium fine; dry but with moist cohesive silt rich pods; poorly to moderately graded; no odours apparent	0.0				Concrete	
	1.0				Blank class 18, 50mm PVC casing	
Becoming saturated and darker grey brown in colour; presence of silt	2.0					BS1–1
Sand grade becoming coarse constituting up to 40% of stratum	3.0		SM		Machine slotted class 18, 50mm PVC screen	
	4.0					
	5.0					
	6.0					
	7.0				WD=7.66M	BS1–2
END OF BOREHOLE AT 7.66M target depth	8.0					
	9.0					
	10.0					

BENEDICT SAND AND GRAVEL
SAND EXTRACTION AT ECHO DAIRIES
MOOREBANK, N.S.W.

MONITORING WELL

DAMES & MOORE

29324–001–366

PROJECT: BENEDICT SAND AND GRAVEL	BOREHOLE: BS2	SHEET 1 of 1

Surface elevation: 2.47m AHD

Borehole location: –

Date: 22–8–94

Drill type: Gemco

Logged by: N.L. Checked by: M.H.

Drilling method: Hollow stem auger

SOIL DESCRIPTION (GROUP NAME: colour; particle size; consistency; moisture content; structure; additional comments)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	WELL CONSTRUCTION	NOTES	SAMPLE INTERVALS
SILTY SAND: brown; sand fine gravel; pods of silty material forming cohesive lumps; dry and loose; no odours detected	0.0				Concrete	
					Blank class 18, 50mm PVC casing	
as above but moist (not saturated)	1.0					
becoming saturated	2.0					BS1–1
	3.0					
Sand fraction becoming coarse and constituting 40–50% of stratum			SM			
	4.0				Machine slotted class 18, 50mm PVC screen	
	5.0					
	6.0					
	7.0					BS2–2
					WD=7.58M	
END OF BOREHOLE AT 7.75M target depth	8.0					
	9.0					
	10.0					

BENEDICT SAND AND GRAVEL
SAND EXTRACTION AT ECHO DAIRIES
MOOREBANK, N.S.W.

MONITORING WELL

DAMES & MOORE

29324–001–366

PROJECT: BENEDICT SAND AND GRAVEL	BOREHOLE: BS3	SHEET 1 of 1

Surface elevation: 2.56m AHD

Borehole location: –

Date: 22–8–94

Drill type: Gemco

Logged by: N.L. Checked by: M.H.

Drilling method: Hollow stem auger

SOIL DESCRIPTION (GROUP NAME: colour; particle size; consistency; moisture content; structure; additional comments)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	WELL CONSTRUCTION	NOTES	SAMPLE INTERVALS
SILTY SAND: dark brown; sand fine; loose; silt forms cohesive pods; dry; no odours detected	0.0				Concrete Blank class 18, 50mm PVC casing	
	1.0					
becoming moist	2.0				Machine slotted class 18, 50mm PVC screen	BS3–1
	3.0		SM			
silty sand; grey black; trace of coarse sand but otherwise fine;	4.0					
	5.0					
	6.0					
	7.0				PVC PLUG WD=6.75M	BS3–2
END OF BOREHOLE AT 7.0M target depth	8.0					
	9.0					
	10.0					

BENEDICT SAND AND GRAVEL
SAND EXTRACTION AT ECHO DAIRIES
MOOREBANK, N.S.W.

MONITORING WELL

DAMES & MOORE

29324–001–366

PROJECT: BENEDICT SAND AND GRAVEL	BOREHOLE: BS4	SHEET 1 of 1

Surface elevation: 2.95m AHD

Borehole location: –

Date: 23–8–94

Drill type: Gemco

Logged by: N.L. Checked by: M.H.

Drilling method: Hollow stem auger

SOIL DESCRIPTION (GROUP NAME: colour; particle size; consistency; moisture content; structure; additional comments)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	WELL CONSTRUCTION	NOTES	SAMPLE INTERVALS
SAND: brown; fine; poorly graded; loose; dry; no odour detected; silty bands present	0.0				Concrete	
	1.0				Blank class 18, 50mm PVC casing	
becoming moist and slightly cohesive and darker in colour	2.0					BS4–1
sand becoming medium grained	3.0		SP/ SM			
					Machine slotted class 18, 50mm PVC screen	
	4.0					
	5.0					
	6.0					
	7.0					BS4–2
					PVC plug WD = 7.35m	
END OF BOREHOLE AT 7.5M target depth	8.0					
	9.0					
	10.0					

BENEDICT SAND AND GRAVEL
SAND EXTRACTION AT ECHO DAIRIES
MOOREBANK, N.S.W.

MONITORING WELL

DAMES & MOORE

29324–001–366

PROJECT: BENEDICT SAND AND GRAVEL	BOREHOLE: BS5	SHEET 1 of 1

Surface elevation: 2.45m AHD

Borehole location: –

Date: 23–8–94

Drill type: Gemco

Logged by: N.L. Checked by: M.H.

Drilling method: Hollow stem auger

SOIL DESCRIPTION (GROUP NAME: colour; particle size; consistency; moisture content; structure; additional comments)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	WELL CONSTRUCTION	NOTES	SAMPLE INTERVALS
SANDY SILT: rusty brown; loose; cohesive; sand fine; silt low plasticity and slightly moist	0.0		ML		Concrete; Blank Class 18 50mm, PVC casing	
	1.0					
as above but becoming moist						BS5–1
becoming saturated and slightly more sandy; silty sands; grey brown; medium plasticity	2.0		SM			
	3.0				Machine Slotted Class 18, 50mm PVC Screen	
slightly lighter brown in colour	4.0					
	5.0					
	6.0				PVC PLUG	
	7.0					BS5–2
END OF BOREHOLE AT 7.5M target depth	8.0					
	9.0					
	10.0					

BENEDICT SAND AND GRAVEL
SAND EXTRACTION AT ECHO DAIRIES
MOOREBANK, N.S.W.

MONITORING WELL

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PROJECT: BENEDICT SAND AND GRAVEL	BOREHOLE: BS6	SHEET 1 of 1

Surface elevation: 1.64m AHD

Borehole location: –

Date: 23–8–94

Drill type: Gemco

Logged by: N.L. Checked by: M.H.

Drilling method: Hollow stem auger

SOIL DESCRIPTION (GROUP NAME: colour; particle size; consistency; moisture content; structure; additional comments)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	WELL CONSTRUCTION	NOTES	SAMPLE INTERVALS
SILTY CLAY: dark brown; soft to firm; moist; slight odour	0.0		CL		Concrete; Blank class 18, 50mm, PVC casing	
sandy silts; grey brown; saturated at 1m; grey brown; saturated; sand medium fine; cohesive; no particular odours	1.0		ML			
	2.0				Machine slotted class 18, 50mm PVC screen	BS6–1
Sand content becoming greater and constituting up to 30% of stratum	3.0					
	4.0					
	5.0					
	6.0					
	7.0				PVC plug	BS6–2
END OF BOREHOLE AT 7.0M target depth	8.0					
	9.0					
	10.0					

BENEDICT SAND AND GRAVEL
SAND EXTRACTION AT ECHO DAIRIES
MOOREBANK, N.S.W.

MONITORING WELL

DAMES & MOORE

29324–001–366

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Appendix D

Flood study

Georges Cove Marina
Modifications to Development Concept
Flood Impact Assessment

7 January 2015 Version 11

EXECUTIVE SUMMARY

The Georges Cove Marina was approved by the JRPP and Liverpool City Council consisting of a marina basin, marina building, marina clubhouse building, carparking and access road. The approved land levels are presented on Figure 2. Detailed studies for the marina demonstrated that this development would not cause any significant impacts on flood behaviour. The relevant flood levels identified were:-

- 20 yr ARI RL 4.6 to 4.7m AHD
- 100 yr ARI RL 5.5 to 5.6m AHD
- PMF RL 10.2m AHD
- Flood Planning Level RL 6.1m AHD (100yr + 0.5m)

It is proposed to incorporate apartments and terraces within the form and footprint of the approved marina building and marina clubhouse building (refer Figure 1). The landform under the terraces and apartments would be raised to RL 6.3m AHD and the landform at RL 1.65m would be extended from 84m to 132.5m to compensate for any reduction in flood flow area (refer Figure 3). Given that there would be no change to the form or footprint of the buildings, this modification would ensure there would be no adverse impact on flooding behaviour. In this modified landform there would be a net cut over the marina area of approximately 24,853 m3 thereby providing extra flood storage rather than any loss of storage.

The NSW government Floodplain Development Manual (FDM) and Liverpool Council's LEP recognize that flood planning is a merits based assessment which minimizes flood related risks to personal safety and property damages. The proposed residential component achieves these objectives.

The approved marina development provides a platform for the proposed residential component which is above the 100yr flood level and is not subject to any flood flows. According to Council's flood policy, it is nominated as Low Flood Hazard Category and residential uses are permitted within this category subject to the main issues discussed below.

The minimum floor level of the apartments would be RL 10.4m which would be 200mm above the PMF level. The apartments would not be flood affected.

The three level terraces would have a minimum floor level of RL 6.3m and internal access to a floor at RL 12.5m well above the PMF level.

All residents would have carparking flood protected to a level of RL 6.3m which is 200mm above the flood planning level.

All residents would have pedestrian and vehicle access to an evacuation route above the 100yr flood level to external areas above the PMF level. If this is not available for some reason, all residents have internal access to floor levels above the PMF level.

The residential buildings would be certified as structurally sound to withstand the hydraulic load of the PMF flood.

As such, the proposed residential component in the approved marina development would exceed the personal safety and property damage objectives and criteria used to typically approve residential development on the floodplain in the following ways:-

- the approved marina provides a platform for residential development which is above the 100yr flood level, has easy evacuation and no hydraulic hazard and hence would be classified as a Low Flood Hazard category in terms of Council's DCP Flood Planning Matrix – in this hazard category, residential development is allowable;
- all apartments are not flood affected;
- all terraces have minimum floor levels 200mm above the Flood Planning Level;
- all terraces have internal access to floor levels above the PMF level;
- all residents have access to an evacuation route to external areas 200mm above the 100yr flood level;
- the building would be unaffected by significant structural damages up to the PMF level which is beyond the requirement for detached residences on the floodplain.

The proposed residential component is considered an appropriate development as it conforms to all the flood related objectives and guidelines according to a merits based assessment as recommended by the NSW government and Liverpool Council flood policies.

1. Introduction

It is proposed to modify the Georges Cove Marina development to incorporate residential apartments and terraces in part of the proposed marina building and marina club house building envelopes. Parking for the residents would be accommodated in a two level enclosed basement carpark. This report supports the application with an assessment of flood impacts. We were responsible for the formulation of the Council and JRPP approved flood assessment for the marina development.

2. Flood Characteristics

The predicted flood levels for the marina site are:-

- 20 yr ARI RL 4.6 to 4.7m AHD
- 100 yr ARI RL 5.5 to 5.6m AHD
- PMF RL 10.2m AHD
- Flood Planning Level RL 6.1m AHD

The marina site is located in a flood storage area and not within a floodway.

3. Proposed Modification

The proposed residences would be located within the proposed marina building and marina club house building footprints (refer Figure 1). Terraces (three storey) would be located within the marina club house

building while the apartments would be located in part of the marina (and dry storage) building footprint. There would be four storeys of apartments.

The proposed floor levels for these dwellings would be:-

- apartments – RL 10.4 to 20.0m AHD
- terraces - RL 6.3 to 12.5m AHD

The carparking for the marina users would be as per the original marina approval. It would consist of the carparks A and B in south eastern area and an open two level parking structure under the southern area of the marina building between D and F on Figure 1.

The carparking for the residents would be located in an enclosed two level basement carpark up to a level of RL 6.3m under the northern section of the marina building between locations B to D on Figure 1.

All the apartments would be located above the PMF level. The terraces would have a ground floor level approximately 200mm above the flood planning level with internal access to a floor level at RL 12.5m AHD which is approximately 2.3m above the PMF level. These dwellings have floor levels above the normal levels required for flood protection.

The terraces would have at grade parking at RL 6.3m AHD which is 200mm above the flood planning level.

Access to the basement carparking for the apartment owners would be available at location C on Figure 1 at a level of RL 6.3m AHD (200mm above the flood planning level). This carpark ramp would be fully enclosed and lead down to the enclosed basement levels for parking.

The carpark road entry and exit would have a level of RL 6.3m AHD from location A to E on Figure 1 which is 200mm above the flood planning level. The carpark exit would be located on a suspended deck extended from the building to provide a bridge back to the land levels at RL 6.3m near the carpark entry. This would provide all entries and exits to the marina buildings and residences at RL 6.3m AHD (200mm above the flood planning level). A secondary road adjacent to this main entry road to the marina buildings would ramp down from RL 6.3 to RL 1.65m AHD between locations C & D on Figure 1. Between locations D and F, the secondary road would be at a level of RL 1.65m AHD for a distance of 132.5m adjacent to the marina building as approved in the marina development. This road would extend easterly to provide access to the carparks A and B in the south eastern area of the marina. The proposed ground levels for this modification are presented on Figure 3.

4. Flood Impact Assessment

4.1 Flow Paths and Levels

The flood flow area as defined by the Cardno flood modeling would be retained even though the land mass would be raised for the residential areas. This flow area would be retained by extending the area at RL 1.65m under the marina building from 84m to 132.5m. The proposed land mass levels in the building areas would be:-

- there would be no 100 yr flood flow area between A to D on Figure 1; and

- a compensatory flood flow area would be created by extending the area at RL 1.65m AHD from D to F on Figure 1 over a distance of 132.5m.

The marina flood modelling by Cardno used a length of 60m at RL 1.65m to verify that there would be no adverse flood impacts due to the development. This was subsequently increased to 84m to generate extra cut to offset extra fill associated with the access bridge modification approval (see Section 4.2).

The proposed modifications for the residential development match the flood flow areas and maintain a significant net cut (extra flood storage) in comparison to the Cardno flood modelling and hence have no adverse impacts on flood behaviour.

4.2 Flood Flow Area

As mentioned in Section 4.1, the flood flow area allowed at RL 1.65m under the southern end of the marina building has been approved at 84m long rather than the 60m used in the Cardno flood modelling. The approved marina therefore provides an additional flood flow area 24m wide over a flood level range from RL 1.65 to 4.6m. A further additional distance of 48.5m at RL 1.65m AHD is proposed to offset the raising of the landform for the residential component. The overall length at RL 1.65m AHD would be 132.5m.

4.3 Balanced Cut and Fill

The cut and fill assessment over the site by Matthew Freeburn Surveyors established that the approved marina would result in a net cut of 19,383m³ (refer Figure 2).

The access bridge modification approval for the site in the Land and Environment Court was reviewed by Cardno in terms of its flood impacts and extra fill in the floodplain. Cardno established in their report dated 23 May 2014 that there were no adverse impacts on flooding but it added 2820m³ of fill in the floodplain.

The cut of 19,383m³ in the floodplain generated by the marina readily compensates for the 2820m³ of fill added by the access bridge modification leaving an overall net cut of 16,563 m³. As such there is no adverse impact on flood behaviour.

The further modification proposed in Section 4.2 of raising the level of ground for the proposed residential component would introduce both fill to raise the landform and cut to extend the area at RL 1.65m so that the result is a net cut of 18,393m3.

The basement for the section of the marina building between D and F would extend down to RL 0.9m providing additional cut of 0.75m under the 132.5m length of this section of the building. This would extend the cut volume by 6,460m3 to an overall net cut of 24,853m3.

4.4 Flood Behaviour

The proposed residences would be accommodated within the general form of the approved marina buildings and as such, will not have an adverse impact on flood behaviour.

4.5 Flood Risk

The proposed residences have pedestrian and vehicular access at a level of RL 6.3m AHD which is 700mm above the 100r ARI flood level and 200mm above the flood planning level. This is an improved protection compared with most new residential developments on NSW floodplains.

The improvements for this development compared with normal detached residences are:-

- apartments are all located above the PMF level;
- terraces have internal access to a floor level above the PMF level;
- buildings can be designed to structurally withstand PMF flood levels; and
- there is access from the site in the event of an evacuation and access to the site for emergency vehicles in a 100yr ARI flood.

In these ways, the proposed residences have less flood risk than the normal residences within NSW floodplains.

5. Conformance to Flood Policy

5.1 NSW Government Flood Policy

The NSW Government's Flood Prone Land Policy and Floodplain Development Manual support the wise and rational development of flood prone land. The policy acknowledges that flood prone land is a valuable resource that should not be sterilised by unnecessarily precluding its development and that development should be treated on its merits rather than through the application of rigid and prescriptive criteria.

The aim of the policy is to appropriately manage the risk to personal safety and damages from floods. These aims are adopted in the Liverpool Local Environmental Plan 2008. The way in which the proposed development conforms to these aims or objectives is discussed in Section 5.2.

5.2 Liverpool LEP 2008

5.2.1 LEP Objectives for Flood Planning

The Liverpool Local Environmental Plan 2008 (LEP) specifies the following four objectives of flood planning. These four objectives are listed below along with a discussion as to how the proposed development conforms to these objectives.

a) to maintain the existing flood regime and flow conveyance capacity

This has been achieved by locating the marina building outside of the major flood flow conveyance area and allowing the flood storage area to the south west of the marina to continue to operate.

b) to avoid significant adverse impacts on flood behaviour

This has been achieved by successfully achieving objective (a) and by ensuring that there was no loss of flood storage. In fact, the proposed development would beneficially add an extra 18,393m³ of flood storage.

Detailed flood modelling by Cardno has established that the proposed development would not adversely impact on flood behavior.

c) to limit uses to those compatible with flow conveyance function and flood hazard

Because the proposed development would not cause a significant adverse impact on flood behaviour, it therefore must be compatible with flow conveyance. Cardno has reaffirmed that the proposed development is not located in a floodway which has a high conveyance function.

The approved marina establishes a platform for the proposed residential development which is categorized as a Low Flood Hazard allowing residential development. The design of the residential component ensures that they are compatible with the flood hazard. The residences have a rising flood evacuation route via road above the 100yr flood level to areas above the PMF flood level. As a fall back, they also have internal access to floor levels above the PMF level. In addition, the building can be designed to withstand the hydraulic load for floods up to the PMF. This is a characteristic beyond that possible for a typical two storey detached house.

The compatibility to flood hazard is assessed in terms of risk to personal safety and flood damages. It is evident that the proposed development is compatible because it provides a level of security or risk management beyond that which are achieved by typical houses allowable within the Liverpool DCP flood planning matrix.

This is why the NSW government's Floodplain Development Manual recommends assessment of a merit basis because not all developments are the same and some developments in high flood hazard areas can conform to the flood planning objectives irrespective of the flood hazard classification.

d) to minimize the risk to human life and damage to property from flooding

As discussed for objective c), the proposed residential development achieves this objective better than most other developments in the floodplain by:-

- having all the apartments located above the PMF flood level;
- having all terraces with internal access to a floor level above the PMF level;
- building design to withstand the hydraulic load up to a PMF;
- rising vehicular and pedestrian access to external areas above the PMF level.

5.2.2 LEP Development Consent

The Liverpool LEP requires satisfaction of six requirements prior to giving development consent to residential development in a flood planning area. The following discussion demonstrates how the proposed residential development conforms to these requirements.

5.2.2.1 Flood Behaviour and Adjacent Property

a) will not adversely affect flood behaviour and increase the potential for flooding to detrimentally affect other development or properties

The detailed flood impact assessment undertaken by Cardno established that the proposed development would not adversely impact flood behaviour and would not adversely impact on the flood behaviour on adjacent properties (refer to Figures 4-1 to 4-8 in Cardno report).

5.2.2.2 Flow Distributions and Velocities

b) *will not significantly alter flow distributions and velocities to the detriment of other properties or the environment*

The proposed marina structures are located outside the main flood flow areas and are located in a flood storage area with low velocities. As such, there is no adverse impact on flood flow distributions and velocities (refer to Figures 3-8 and 3-18 in the Cardno report and in the responses in Section 5.1).

5.2.2.3 Safe Occupation and Evacuation

c) *will enable the safe occupation and evacuation of the land*

The proposed marina will have an approved safe emergency response flood plan. It meets all the Government requirements for floor and car parking levels, rising evacuation routes, more than adequate warning times, dedicated and trained staff to manage the evacuation plan and a fallback option of vertical evacuation in the main building to levels significantly above the PMF level. The proposed development meets all the requirements of the NSW Government's Floodplain Development Manual and the Council's LEP and DCP for flooding. As such it is considered to enable safe occupation and evacuation.

5.2.2.4 Adverse Environmental Impacts

d) *will not have a significant detrimental effect on the environment or cause avoidable erosion, siltation, destruction of riparian vegetation or a reduction in the stability of any riverbank or watercourse*

The proposed marina development has been approved because the environmental impacts were acceptable.

5.2.2.5 Sustainable Flood Related Social and Economic Costs

e) *will not be likely to result in unsustainable social and economic costs to the flood affected community or general community as a consequence of flooding*

The proposed marina has been designed to minimize the potential flood related damages in terms of the building form, materials selection and adopted floor levels. Also, flood safety has been an important design principle. The proposed development is in accord with the NSW Government Floodplain Development Manual and thus, along with the above design approach, ensures that the development offers a sustainable approach to the social and economic costs of the local and general community. Importantly, it does not require significant additional flood related infrastructure or resources to support the proposed development.

5.2.2.6 Compatible with Flood Flow and Hazard

f) if located in the floodway, will be compatible with the flow of flood waters and with any flood hazard on that floodway

The development is not located within a floodway however it still is compatible with the flood flow and hazard. The buildings have been specifically located west of the main flood flows and designed to comply with its flood hazard and the associated requirements of Council's LEP and DCP as discussed in Section 4.

6. Liverpool DCP

6.1 Merits Based Approach

The Liverpool DCP identifies in Section 9 the NSW government Floodplain Development Manual 2005 which emphases a merit based approach to floodprone land planning. It recognizes that it is about risk management in terms of personal safety and flood damages. The aim is to minimize these risks within acceptable bounds and the flood planning level (100yr flood level plus 0.5m freeboard) is recommended as the acceptable bound for management of flood damages and the need for adequate evacuation above the PMF level for personal safety.

The DCP is a guideline document prepared for a broad range of developments. The flood planning matrix takes these broad landuses and provides guidelines for acceptable landuses in three flood hazard categories. The aim is to achieve the above objectives.

The approved marina establishes a platform for the residential component which is above the flood planning level and hence is defined as a Low Flood Hazard category. Residential development is allowable in this flood hazard category.

However, this guideline cannot cover all types of development and hence it is recognized that all development should be considered on its merits as to how it conforms to the flood planning objectives. The nine objectives are listed in Section 9 of the DCP. In Section 6.2 there is discussion as to how the proposed development on its merits conforms to the flood planning objectives in the DCP.

6.2 Flood Planning Objectives

a) to minimize the potential impact of development and other activity upon the aesthetic, recreational and ecological value of the waterways corridors.

The residential component will be incorporated within the form and footprint of the approved marina buildings. The marina approval already met this requirement and hence the residential component would conform to this objective.

b) to ensure essential services and landuses are planned in recognition of all potential floods.

There are no essential services for the broad community incorporated into the development however the proposed residential component of the development has been planned in recognition of all potential floods.

c) *to reduce the risk to human life and damage to property caused by flooding through controlling development on land affected by potential floods*

The proposed residential component of the development complies with this objective and goes further by reducing the flood risks to below that normally accepted in floodplains in the following manner:-

- all apartments have flood levels above the PMF level;
- the terraces have internal access to floor levels above the PMF level;
- the minimum habitable floor levels for the terraces are 200mm above the normally accepted flood planning level (100yr flood level plus 0.5m freeboard);
- all dwellings have pedestrian and vehicular access on routes above the 100yr flood level to areas external to the site above the PMF; and
- the buildings will be designed to withstand the hydraulic forces due to a PMF flood.

As such, the proposed residential component readily conforms to this objective.

d) *to ensure that the economic and social costs which may arise from damage to property due to flood is minimized and is not greater than that which can be reasonably managed by the property owner and general community.*

Because the proposed residential component is designed to be beyond that typically conforming development (as described above for c)), the economic and social costs are minimised beyond that normally acceptable.

As such, the proposed residential component conforms to this objective.

e) *to limit developments with high sensitivity to flood risk (eg critical public utilities) to land with minimal risk from flooding*

The proposed residential development does not contain high sensitive landuses and hence conforms to this objective.

f) *to prevent intensification of inappropriate use of land within high flood risk areas or floodways.*

The proposed residential component is not to be located in a floodway. The residential component will be located on an approved platform above the flood planning level. On this basis, it is nominated in Council's DCP as a low flood risk category where the risk of damages is low.

The residential development is not considered an inappropriate development given the low flood velocities and the design components which, on a merits based assessment, reduce the risk below that typical accepted for residential developments. The reasons for this lower flood risk are described above.

As such, the proposed residential component conforms to this objective.

g) *to permit development with a lower sensitivity to the flood hazard to be located within the floodplain, subject to appropriate design and siting controls.*

The proposed residential component conforms to this objective because the residential development is located in a low flood hazard zone. The access to the site will not be overtopped by the 100yr flood and the majority of the residential floors will be at or above the PMF level. The lowest residential floor level will be at least 700mm above the 100yr flood level.

As such, the residential component is an appropriate landuse given the low flood hazard and the appropriate design and siting controls.

h) to ensure that development should not detrimentally increase the potential flood affectation on other development or properties either individually or in combination with the cumulative impact of development that is likely to occur in the same floodplain.

The proposed residential component is to be located within the form and footprint of the approved marina buildings. As such, the proposed residential component would have no significant adverse impacts on flood behaviour over adjacent properties and thereby conforms to this objective.

i) to ensure that development does not prejudice the economic viability of any Voluntary Acquisition Scheme.

The proposed residential component would not affect or prejudice the economic viability of a voluntary acquisition scheme.

In summary, the proposed residential component conforms to all the Council's DCP flood planning objectives and hence based on a merits based approach as recommended in the NSW government Floodplain Development Manual and Council's DCP, the development should be permitted.

7. Section 117 Directions

The marina development is located on land zoned Recreation, Direction 15 – Flood Prone Land issued under the Section 117 Ministerial Directions does not allow an amendment to the LEP from Recreation land to permit the proposed residential component (Clause (2)). However, the Direction does allow the it if it can be argued that the inconsistency is of a minor significance (Clause 6(b)).

The significance is measured in terms of its impact on the objectives of the planning of floodprone land. These are outlined in the Clauses (1) to (5) excluding Clause (2). The degree to which the rezoning would conform to these clauses is discussed as follows:-

(1) shall be consistent with the NSW Flood Prone Land Policy and principles of the Floodplain Development Manual 2005

The proposed residential component does conform to these documents/policies in that it minimizes the potential flood risk to personal safety and property damages. It is to be located in a low flood risk area as per the Council DCP which is compatible with residential development.

(3)(a) does not permit development in floodways.

The residential component would not be located within a floodway.

(3)(b) not permit significant flood impacts to flood planning areas

The residential component is within the form and footprint of buildings which have been demonstrated not to have a significant adverse impact on flooding in the flood planning area.

(3)(c) not permit a significant increase in the development of that land.

The residential component would be located within the form and footprint of the approved marina development. As such, it would not be a significant increase in development of the site.

(3)(d) not permit substantially increased government spending on flood mitigation measures, infrastructure and services.

The residential component does not require government spending on flood mitigation measures, infrastructure and services. It will contain a design which goes beyond the normally acceptable flood planning for residential development.

(3)(e) not permit development without consent.

The residential component would require development consent.

(4) not impose flood related development controls above the residential flood planning level.

No controls are required which are above the residential flood planning level.

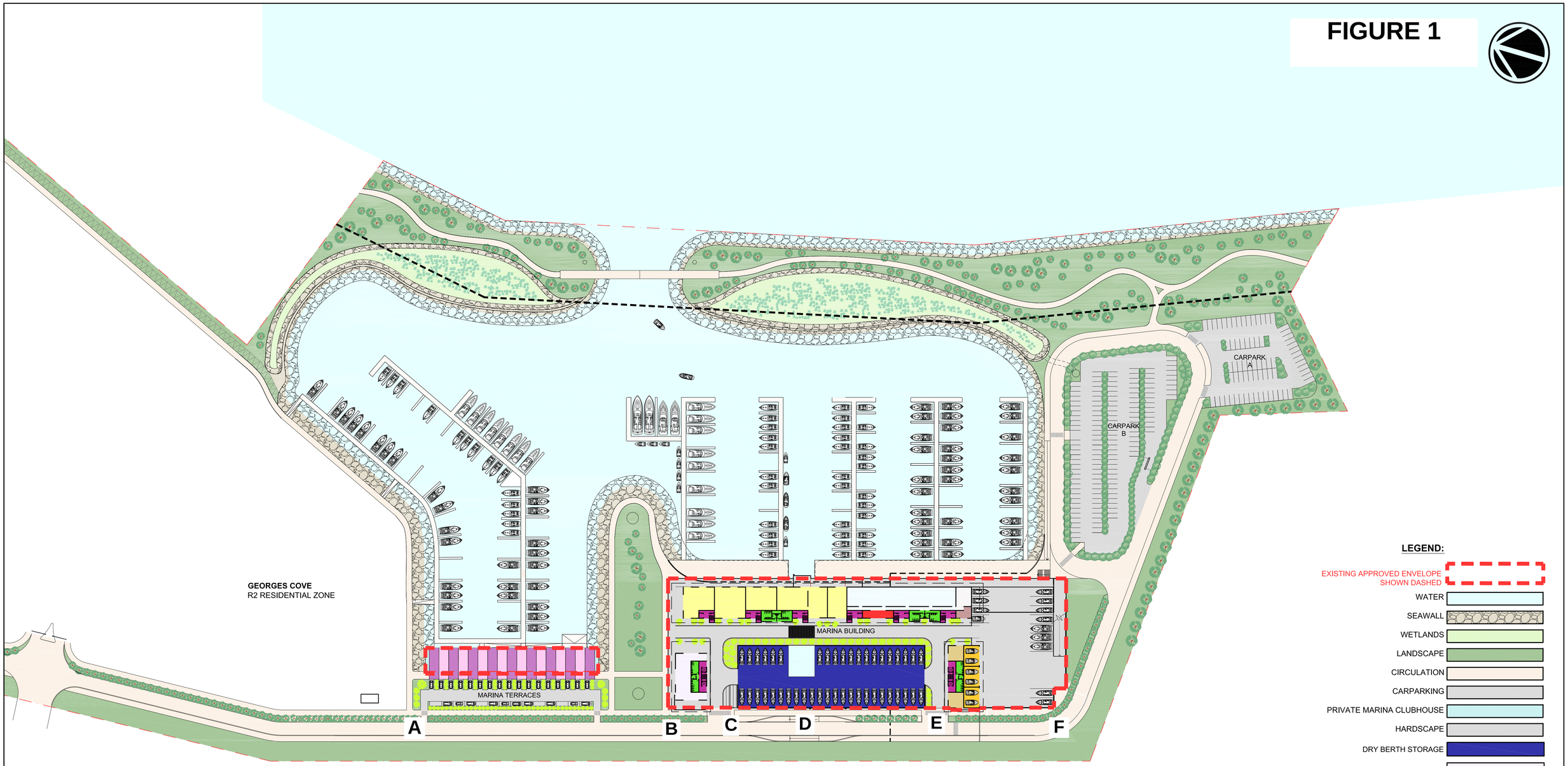
(5) not determine a flood planning level that is inconsistent with the Floodplain Development Manual 2005.

This is not required for the proposed residential component.

In summary, the proposed amendment to the LEP to allow a residential component in the approved marina development would comply with the NSW government policy and the Council's LEP and DCP in terms of development of floodprone land. For the Ministerial Direction 15 (Section 117), it would comply in terms of development of floodprone land because it would represent an inconsistency of minor significance in terms of flood planning and flood risk management which is allowable under the Direction.

MARK TOOKER
Project Director

FIGURE 1



LEGEND:

- EXISTING APPROVED ENVELOPE SHOWN DASHED
- WATER
- SEAWALL
- WETLANDS
- LANDSCAPE
- CIRCULATION
- CARPARKING
- PRIVATE MARINA CLUBHOUSE
- HARDSCAPE
- DRY BERTH STORAGE
- BOAT DEALERSHIP SHOP
- WORKSHOPS
- AMENITIES
- LIFT CORE
- CAFE / RESTAURANT
- FLEXIBLE FUNCTION SPACE
- FOYER / LOBBY
- LOADING DOCK
- KITCHEN
- ANCILLARY MARINE

PLAN - Site & Ground Level

1:1000 @ A1; 1:2000 @ A3

MFA

MICHEAL FOUNTAIN ARCHITECTS PTY. LTD.
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ISSUE	REV	AMENDMENTS	DATE
E		ISSUED FOR REVIEW	20/10/14
F		ISSUED FOR REVIEW	09/12/14
G		ISSUED FOR REVIEW	19/12/14

ISSUE	REV	AMENDMENTS	DATE

DRAFT

CLIENT
Benedict Industries Pty. Ltd.

PROJECT
Georges Cove Marina
Newbridge Road
Moorebank NSW 2170

PRINTED: Dec 19, 2014 - 4:29pm
\\MFA01\Projects\MOOREBANK MARINA\Cadwork\Drawings\020_Superceded_09122014\SK-001- SITE PLAN DAN EDIT.dwg

DRAWING
PLAN
Site & Ground Level

DRAWN	CHKD	APPROVED
DS		
SCALE 1 : 1000 @ A1, 1: 2000 @ A3	DATE 19/12/14	CAD FILE No

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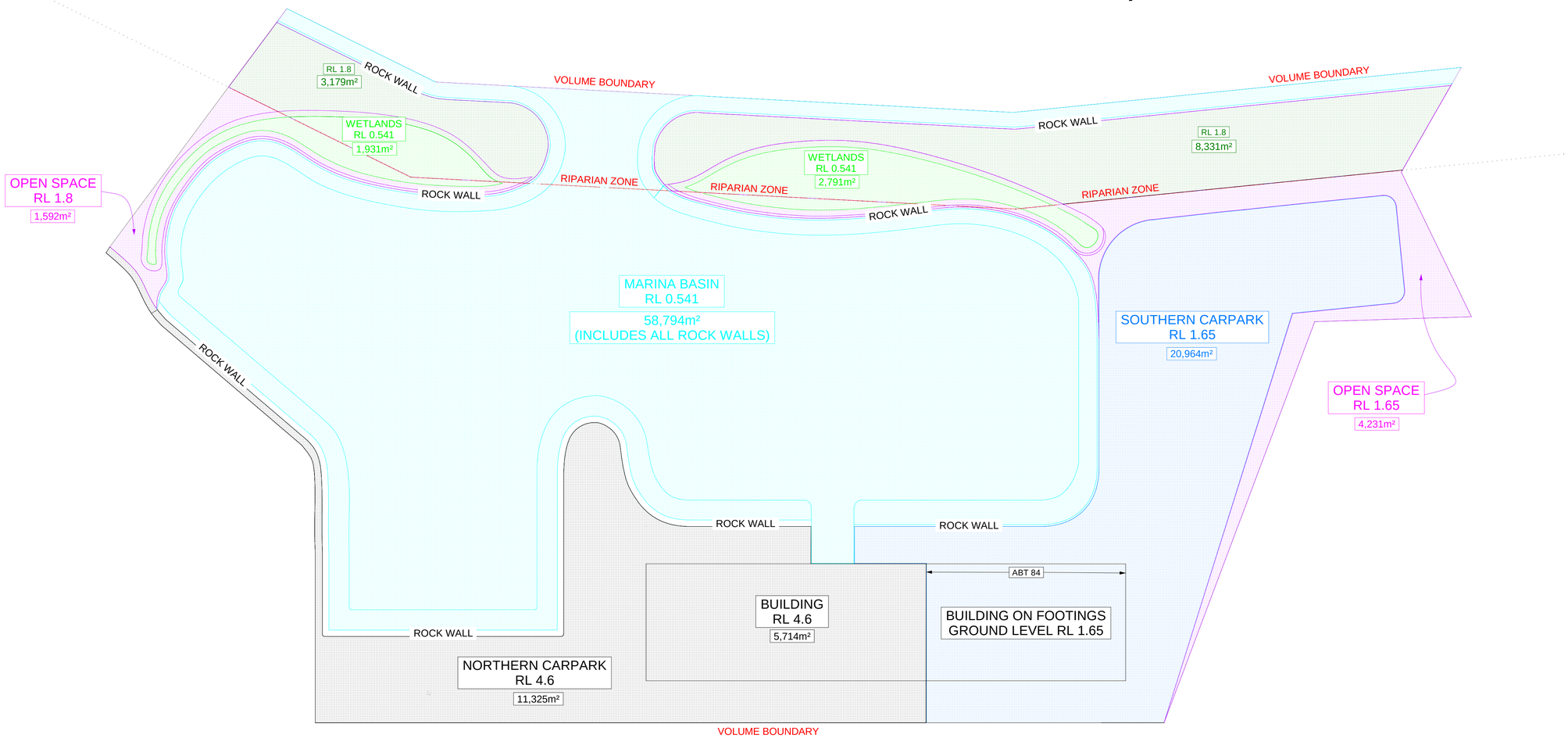
FIGURE 2

VOLUME OF DESIGN IN RELATION TO RL 1.9m IN RIPARIAN ZONE (MEAN HEIGHT TAKEN FROM SURVEY PLAN DATED 06-08-12) AND RL 1.65m FOR THE REST OF THE LOT. THE TOTAL IS CUT 19,383m³



APPROVED MARINA GROUND LEVELS

AMENDMENTS

- 03-08-12 MEAN NATURAL SURFACE LEVEL OF 1.9m TAKEN FOR RIPARIAN ZONE.
- 04-09-12 AREAS ADDED TO PLAN.
- 14-10-14 APPROVED MARINA DESIGN AND LEVELS - NEW CUT VOLUME AS SHOWN.

Client: BENEDICT SAND & GRAVEL	Project: PLAN SHOWING VOLUME OF CUT IN RELATION TO DESIGN OVER LOT 7 IN DP 1065574	FREEBURN SURVEYING	MATTHEW FREEBURN LAND, ENGINEERING & MINING SURVEYOR SUITE 2, FIRST FLOOR, "SURVEYOR HOUSE" 2 CASTLEREAGH STREET PENRITH 2750	Telephone 02 4721 2289 Fax 02 4721 5646 email matthew@freeburnsurveyors.com	Date: 30-08-12	Ref: 23848	Sheet 1 of 1
					Scale 1: 1000	Datum: AHD	Contour: N/A
					Surveyor: CD	Drawn By: CD	Checked: MF
					Stored - 23848_MARINA VOLUMES 14-10-14		A1 SHEET