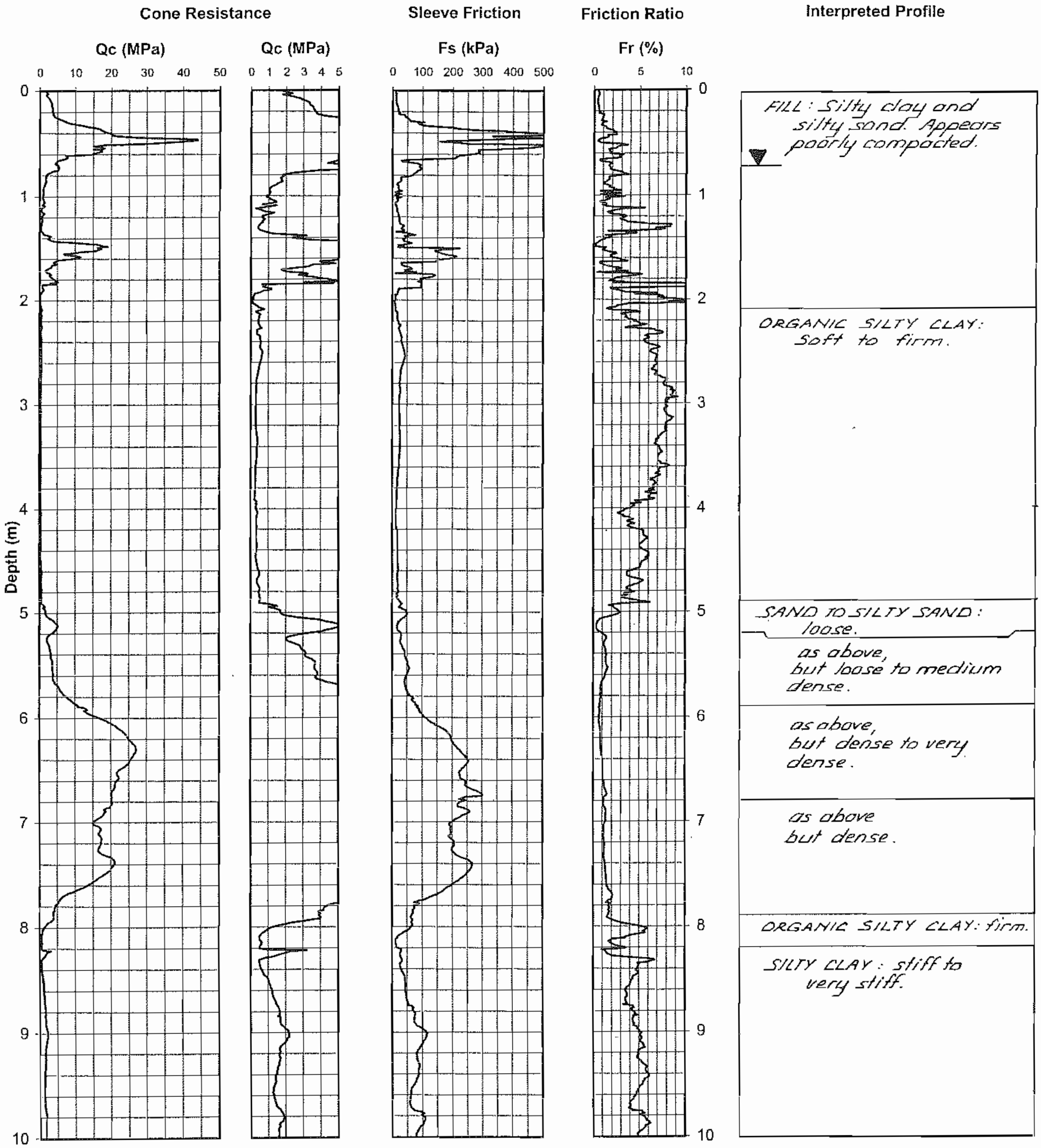
Jeffery and Katauskas Pty Ltd

CONSULTING GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

EFCP No. **807** 1/2

ELECTRICAL FRICTION CONE PENETROMETER TEST RESULTS

Client:	Cronulla Sharks				
Project:	Shark Park Redevelopment				
Location:	Captain Cook Drive, Woolooware, NSW.				
Job Ref.:	15009JTPcpt807	**RL Surface:** NA		**Data File:**	AP120934.H1
Test Date:	12/4/00	**Datum:** NA		**Operator:**	MK/PH



Interpreted by: M.K.
Checked by: PW

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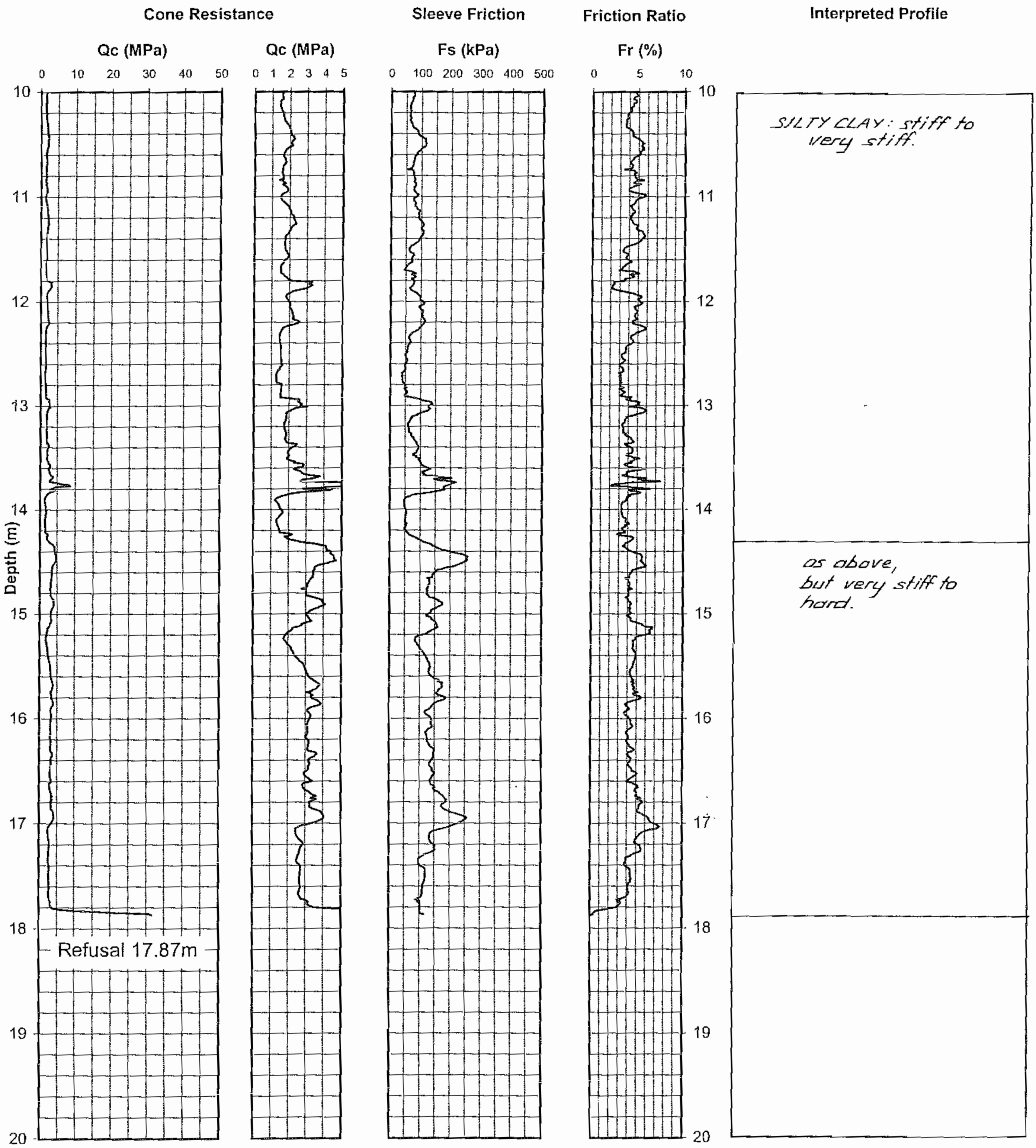
CONSULTING GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

EFCP No. **807** 2/2

ELECTRICAL FRICTION CONE PENETROMETER TEST RESULTS

Client:	Cronulla Sharks
Project:	Shark Park Redevelopment
Location:	Captain Cook Drive, Woolooware, NSW.

Job Ref.:	15009JTPcpt807	**RL Surface:**	NA	**Data File:**	AP120934.H1
Test Date:	12/4/00	**Datum:**	NA	**Operator:**	MK/PH



Interpreted by: M.K

Checked by: PW

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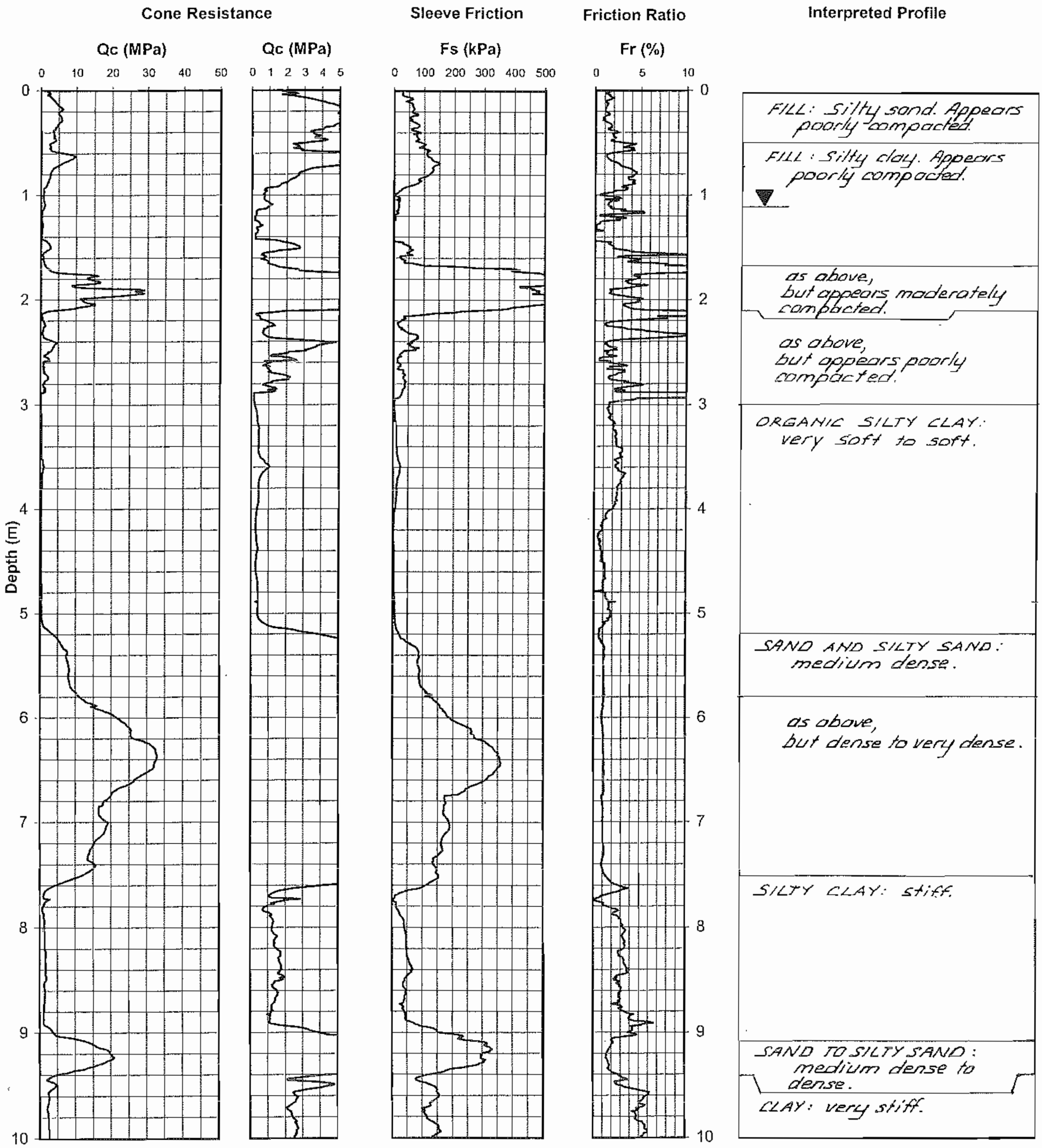
CONSULTING GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

EFCP No. **808** 1/2

ELECTRICAL FRICTION CONE PENETROMETER TEST RESULTS

Client:	Cronulla Sharks
Project:	Shark Park Redevelopment
Location:	Captain Cook Drive, Woolooware, NSW

Job Ref.:	15009JTPcpt808	**RL Surface:**	NA	**Data File:**	AP061530.H1
Test Date:	6/4/00	**Datum:**	NA	**Operator:**	MK/PH



Interpreted by: M.K.
Checked by: PW

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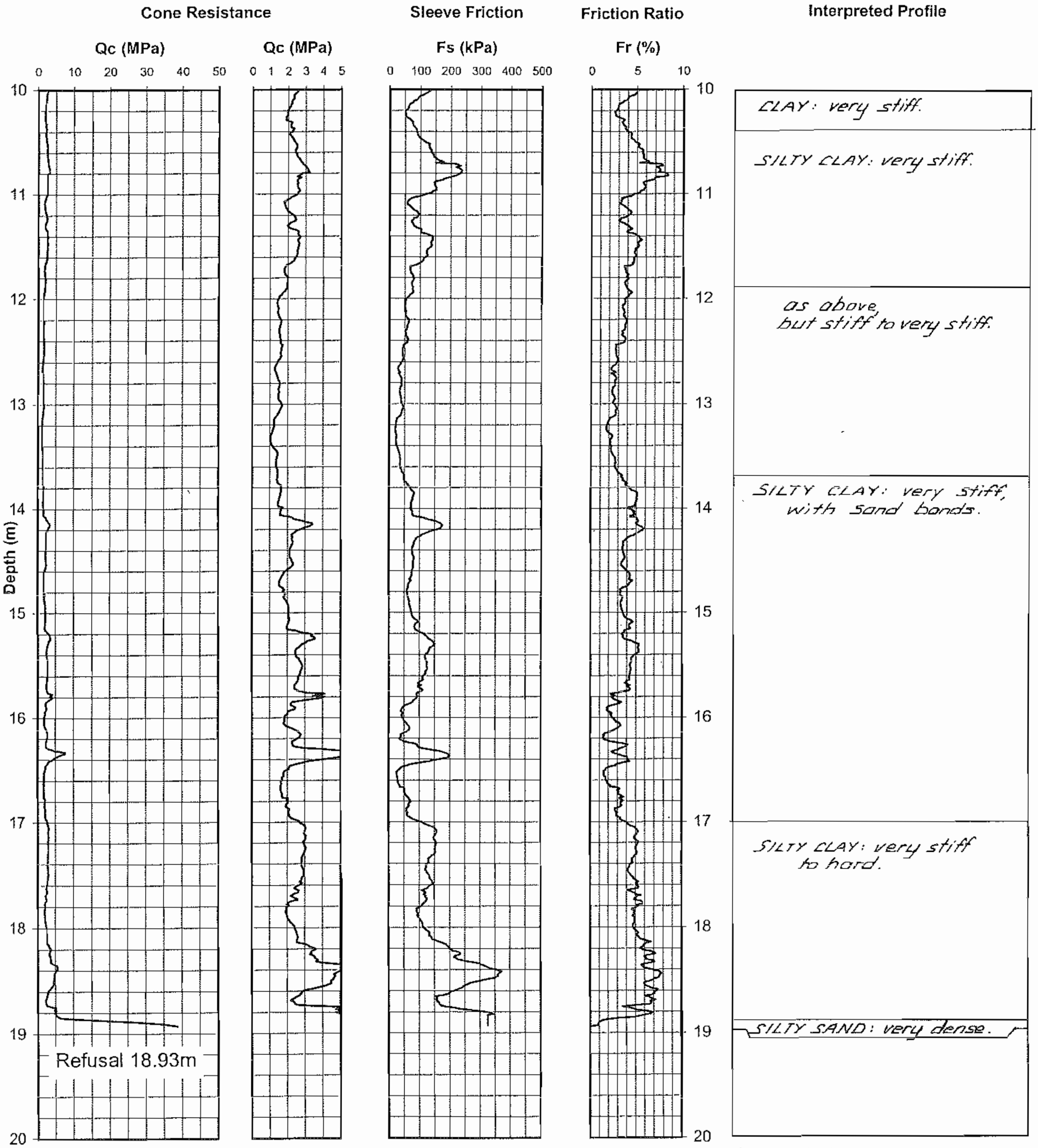
CONSULTING GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

EFCP No.
808
2/2

ELECTRICAL FRICTION CONE PENETROMETER TEST RESULTS

Client:	Cronulla Sharks				
Project:	Shark Park Redevelopment				
Location:	Captain Cook Drive, Woolooware, NSW				
Job Ref.:	15009JTPcpt808	**RL Surface:** NA		**Data File:**	AP061530.H1
Test Date:	6/4/00	**Datum:** NA		**Operator:**	MK/PH



Interpreted by: M.K.
Checked by: PW

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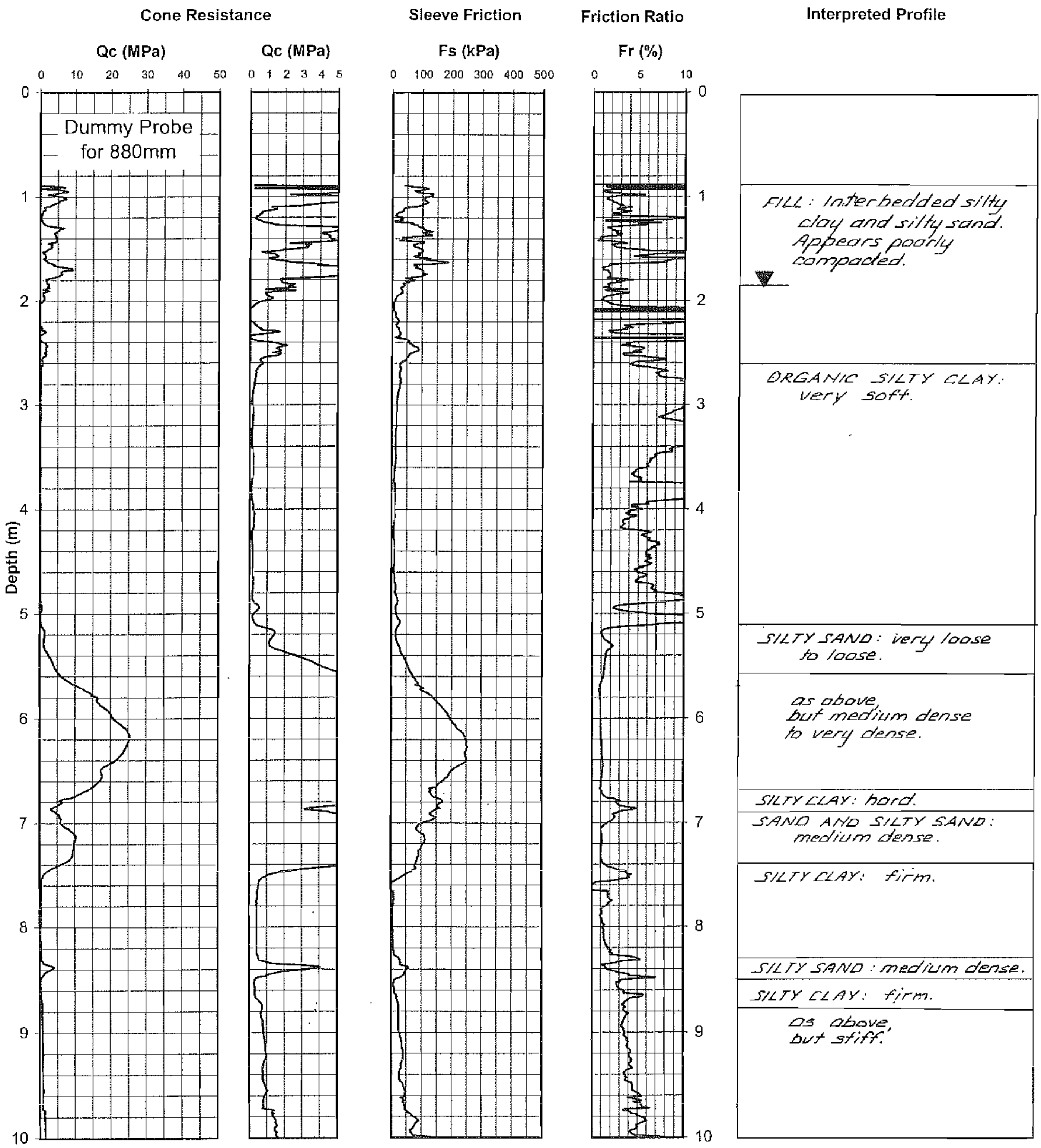
CONSULTING GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

EFCP No. **809**
1/2

ELECTRICAL FRICTION CONE PENETROMETER TEST RESULTS

Client:	Cronulla Sharks
Project:	Shark Park Redevelopment
Location:	Captain Cook Drive, Woolooware, NSW

Job Ref.:	15009JTPcpt809	**RL Surface:**	NA	**Data File:**	AP051052.H1
Test Date:	5/4/00	**Datum:**	NA	**Operator:**	MK/AK



Interpreted by: M.K.
Checked by: PW

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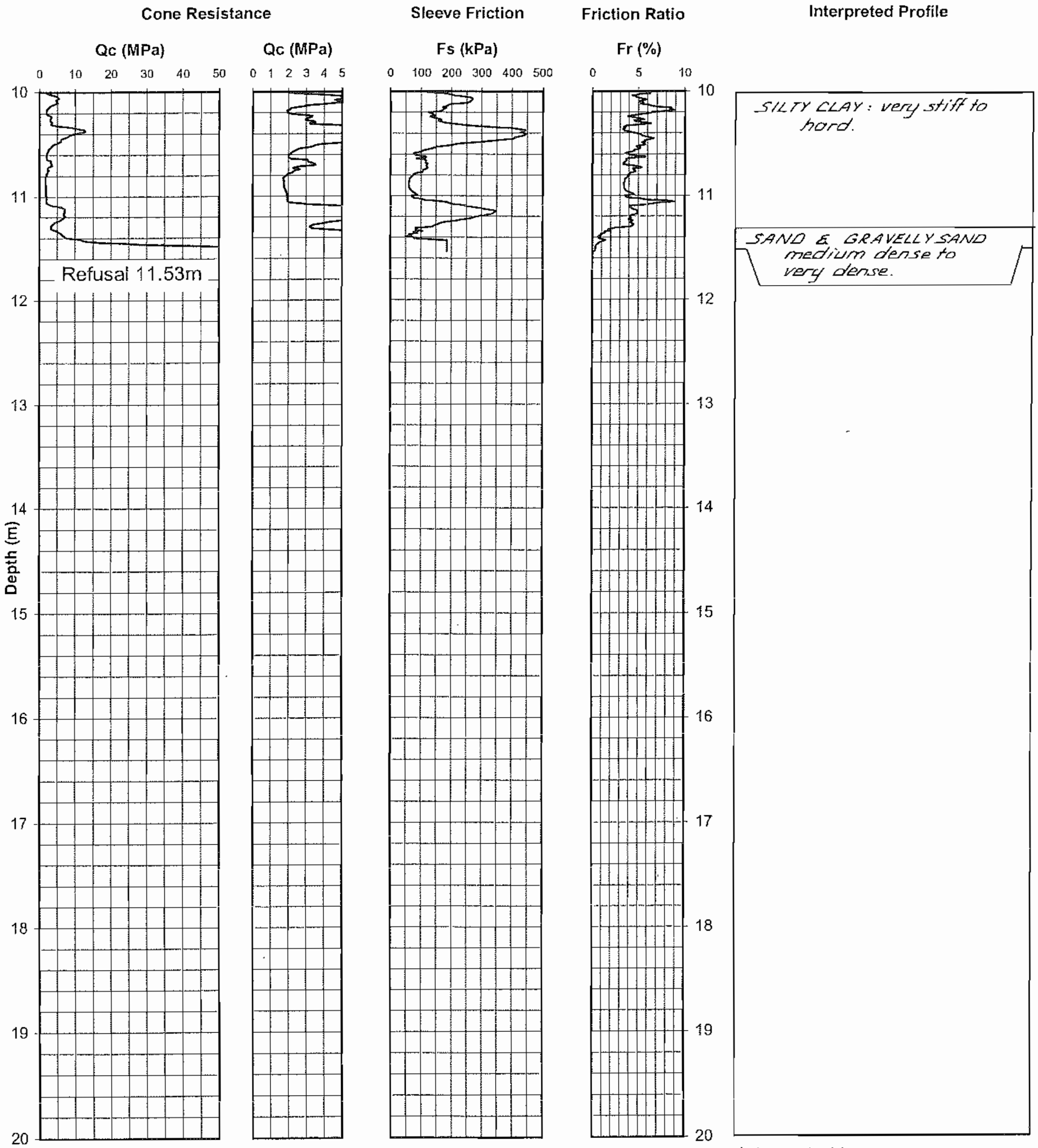
CONSULTING GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

EFCP No. **809** 2/2

ELECTRICAL FRICTION CONE PENETROMETER TEST RESULTS

Client:	Cronulla Sharks				
Project:	Shark Park Redevelopment				
Location:	Captain Cook Drive, Woolooware, NSW				
Job Ref.:	15009JTPcpt809	**RL Surface:** NA		**Data File:**	AP051052.H1
Test Date:	5/4/00	**Datum:** NA		**Operator:**	MK/AK



Interpreted by: M.K.
Checked by: PW

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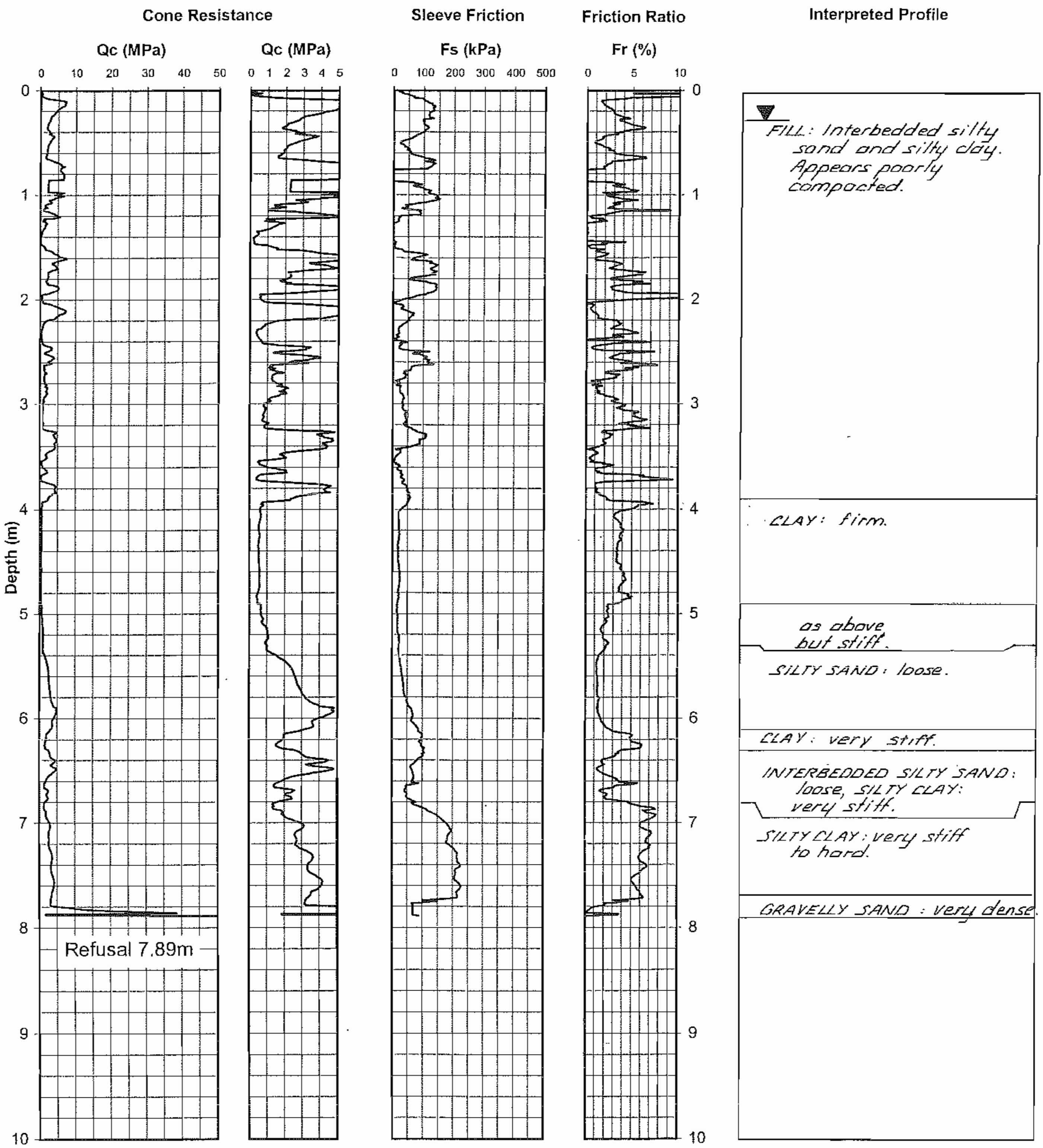
CONSULTING GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

EFCP No.
810
1/1

ELECTRICAL FRICTION CONE PENETROMETER TEST RESULTS

Client:	Cronulla Sharks
Project:	Shark Park Redevelopment
Location:	Captain Cook Drive, Woolooware, NSW

Job Ref.:	15009JTPcpt810	**RL Surface:**	NA	**Data File:**	AP061409.H1
Test Date:	6/4/00	**Datum:**	NA	**Operator:**	MK/PH



Interpreted by: M.K.
Checked by: PW

Jeffery and Katauskas Pty Ltd
CONSULTING GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

BOREHOLE LOG

Borehole No. **901** 1/1

Client: CRONULLA SUTHERLAND LEAGUES CLUB LIMITED
Project: CRONULLA SUTHERLAND LEAGUES CLUB REZONING PROPOSAL
Location: CRONULLA LEAGUES CLUB, CAPTAIN COOK DRIVE, WOOLOOWARE, NSW

Job No. 17119SP **Method:** SPIRAL AUGER JK550 **R.L. Surface:** ≅ 3.4m
Date: 9-9-02 **Datum:** AHD
Logged/Checked by: J.R./ASH

Groundwater Record	Field Tests	Depth (m)	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
		0		ASPHALTIC CONCRETE: 8mm.t. over FILL: Sandy gravel, fine to coarse grained igneous gravel, fine to coarse grained sand.	MC≅PL			
	N = 13 5,5,8			FILL: Gravelly sandy clay, medium plasticity, orange brown, fine to medium grained sandstone and igneous gravel.				0.0%CH4 20.9%02 APPEARS MODERATELY COMPACTED
	N > 6 2,6/ 150mm REFUSAL	1 – 2		FILL: Clayey gravelly sand, fine to coarse grained, mottled orange brown, grey and brown, fine to coarse grained sandstone gravel, with a trace of timber, glass, wire and concrete fragments.				0.0%CH4 20.8%02
AFTER 26 HRS	N = 3 3,2,1	3		FILL: Silty sand, fine to coarse grained, dark grey, with a trace of fine to coarse grained sandstone gravel, timber, metal and brick fragments.	M			APPEARS POORLY COMPACTED NO RETURN IN SPT
	N = 4 3,2,2	4	SM/SC	CLAYEY SILTY SAND: fine to medium grained, dark grey brown, with a trace of rootlets.	W	VL-L	-	ORGANIC ODOUR 0.0%CH4 20.8%O2
		5		as above, but grey brown, with a trace of rootlets and shell material.				0.0%CH4 20.8%02
		6		END OF BOREHOLE AT 6.0m				STANDPIPE INSTALLED
		7						

Jeffery and Katauskas Pty Ltd
CONSULTING GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

BOREHOLE LOG

Borehole No. **902** 1/1

Client: CRONULLA SUTHERLAND LEAGUES CLUB LIMITED
Project: CRONULLA SUTHERLAND LEAGUES CLUB REZONING PROPOSAL
Location: CRONULLA LEAGUES CLUB, CAPTAIN COOK DRIVE, WOOLOOWARE, NSW

Job No. 17119SP
Date: 9-9-02
Method: SPIRAL AUGER JK550
R.L. Surface: ≅ 3.4m
Datum: AHD
Logged/Checked by: J.R./ ASH

Groundwater Record	Field Tests	Depth (m)	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
		0		ASPHALTIC CONCRETE: 8mm.t., over FILL: Silty sandy gravel, fine to coarse grained, dark grey, igneous gravel.	D			0.0%CH4 20.9%O2
	N = 12 10,8,4			FILL: Silty sand, fine to medium grained, pale yellow brown.				APPEARS MODERATELY COMPACTED
		1		as above, but with rootlets and a trace of timber.				
	N = 12 2,9,3							0.0%CH4 20.9%O2
AFTER 4 HRS		2		FILL: Gravelly silty sand, fine to medium grained, brown.	M			
	N = 2 2,0,2	3		FILL: Silty sand, fine to medium grained, grey brown, with timber and a trace of sandstone gravel and clay nodules.	W			APPEARS POORLY COMPACTED 0.0%CH4 20.8%O2
	N = 2 1,1,1	4	SM	SILTY SAND: fine to medium grained, grey brown, with a trace of rootlets and shell material.	W	VL	-	AUGER REFUSAL AT 4.3m ON OBSTRUCTION IN FILL RE-DRILLED BOREHOLE 1m TO NORTH EAST (MARKED ON PLAN AS BH902A)
		5		as above, but yellow brown mottled grey with clay.				0.0%CH4 20.8%O2
		6		END OF BOREHOLE AT 6.0m				
		7						

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CONSULTING GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

Borehole No.
903 1/1

BOREHOLE LOG

Client: CRONULLA SUTHERLAND LEAGUES CLUB LIMITED
Project: CRONULLA SUTHERLAND LEAGUES CLUB REZONING PROPOSAL
Location: CRONULLA LEAGUES CLUB, CAPTAIN COOK DRIVE, WOOLOOWARE, NSW

Job No. 17119SP **Method:** SPIRAL AUGER JK550 **R.L. Surface:** ≅ 3.3m
Date: 9-9-02 **Datum:** AHD
Logged/Checked by: J.R./ ASH

Groundwater Record	SAMPLES (ES, U50, DB, DS)	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
			0			ASPHALTIC CONCRETE: 8mm.t., over FILL: Sandy gravel, fine to coarse grained igneous gravel, fine to coarse grained sand.	D			
		N = 12 6,5,7				FILL: Silty gravelly clay, medium plasticity, red brown mottled grey, fine to medium grained ironstone and sandstone gravel.	MC>PL			0.0%CH4 20.9%O2 APPEARS MODERATELY COMPACTED
		SPT 7/150mm REFUSAL	1							NO SAMPLE RECOVERY FROM SPT SAMPLER
AFTER 3.5 HRS			2			FILL: Gravelly clayey sand, fine to medium grained, mottled grey and brown, fine to coarse grained ironstone, igneous and sandstone gravel, with a trace of wire, glass, plastic and timber fragments.				
		N = 2 2,1,1	3							APPEARS POORLY COMPACTED
			4		OL	ORGANIC SILTY CLAY: low plasticity, grey brown, with rootlets.	MC>PL	(VS)	-	ORGANIC ODOUR
		N = 3 1,2,1	5		SC	CLAYEY SAND: fine to medium grained, grey brown, with a trace of rootlets and shell material.		VL		0.3%CH4 18.7%O2
			6			END OF BOREHOLE AT 6.0m				
			7							

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BOREHOLE LOG

Borehole No. **904** 1/1

Client: CRONULLA SUTHERLAND LEAGUES CLUB LIMITED
Project: CRONULLA SUTHERLAND LEAGUES CLUB REZONING PROPOSAL
Location: CRONULLA LEAGUES CLUB, CAPTAIN COOK DRIVE, WOOLOOWARE, NSW

Job No. 17119SP
Date: 9-9-02
Method: SPIRAL AUGER JK550
R.L. Surface: ≅ 3.0m
Datum: AHD
Logged/Checked by: J.R./ AJH

Groundwater Record	Field Tests	Depth (m)	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
		0		ASPHALTIC CONCRETE: 6mm.t over FILL: Silty gravelly sand, fine to medium grained, grey brown, fine to medium grained igneous gravel.	D			
	N = 6 9,4,2							0.0%CH4 20.8%O2
		1		FILL: Silty sand, fine to medium grained, grey mottled brown, with a trace of fine to medium grained igneous gravel.				APPEARS POORLY COMPACTED
	N = 6 2,2,4			as above, but with timber, ash, fine to coarse grained sandstone and shale gravel.				0.0%CH4 20.9%O2
		2						
▶	N = 1 1,1,0	3						1.0%CH4 19.1%O2 APPEARS TO BE MANGROVE TREES
				FILL: Organic matter, timber, roots and fabric.	W			
		4		FILL: Gravelly clayey sand, fine to medium grained, grey brown, fine to coarse grained sandstone gravel.				
	N = 1 1,0,1		SM	SILTY SAND: fine to medium grained, grey brown.	W	VL		0.2%CH4 18.9%O2
		5						ORGANIC ODOUR
				as above, but grey, with a trace of shell material.				0.2%CH4 19.4%O2
		6		END OF BOREHOLE AT 6.0m				STANDPIPE INSTALLED
		7						

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Borehole No. **905** 1/1

BOREHOLE LOG

Client: CRONULLA SUTHERLAND LEAGUES CLUB LIMITED
Project: CRONULLA SUTHERLAND LEAGUES CLUB REZONING PROPOSAL
Location: CRONULLA LEAGUES CLUB, CAPTAIN COOK DRIVE, WOOLOOWARE, NSW

Job No. 17119SP **Method:** SPIRAL AUGER JK550 **R.L. Surface:** ≅ 3.5m
Date: 10-9-02 **Datum:** AHD
Logged/Checked by: S.O.C./ ASH

Groundwater Record	Field Tests	Depth (m)	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
		0		ASPHALTIC CONCRETE: 8mm.t., over FILL: Gravelly sand, fine to medium grained, brown, fine to coarse grained igneous gravel.	D			
	N = 7 6,5,2			FILL: Sand, fine to medium grained, brown, with medium to coarse grained sandstone gravel and a trace of clay fines.				0.0%CH4 18.2%O2 APPEARS MODERATELY COMPACTED
	N = 14 5,8,6	1		FILL: Sand, fine to medium grained, light brown with a trace of ash, fine to medium grained shale and sandstone gravel and timber.				0.0%CH4 17.4%O2
		2		FILL: Organic silty sand, fine to medium grained, dark brown, with fine to coarse grained sandstone and timber fragments.				APPEARS MODERATELY TO WELL COMPACTED
				FILL: Silty sand, fine to medium grained, brown, with a trace of ash, fine to medium grained sandstone gravel and steel wire.				
	N > 8 2,3,5/ 10mm REFUSAL	3		FILL: Sandy organic matter, fine to medium grained sand, dark brown.	D-M			ORGANIC ODOUR 0.1%CH4 18.7%O2
				FILL: Organic matter, timber.				APPEARED TO BE MANGROVE TREES
▶	N = 11 1,4,7	4	SC/OL	ORGANIC CLAYEY SAND: fine to medium grained, light grey.	W	MD	-	0.4%CH4 18.7%O2
		5	CL	SILTY CLAY: medium plasticity, light brown mottled light grey, with a trace of fine to coarse grained sandstone gravel and fine to medium grained sand.	MC>PL	(VSt)	-	0.7%CH4 17.1%O2
		6		END OF BOREHOLE AT 6.0m				
		7						

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BOREHOLE LOG

Borehole No. **906** 1/1

Client: CRONULLA SUTHERLAND LEAGUES CLUB LIMITED
Project: CRONULLA SUTHERLAND LEAGUES CLUB REZONING PROPOSAL
Location: CRONULLA LEAGUES CLUB, CAPTAIN COOK DRIVE, WOOLOOWARE, NSW

Job No. 17119SP
Date: 9-9-02
Method: SPIRAL AUGER JK550
Logged/Checked by: J.R./AJH
R.L. Surface: ≅ 3.9m
Datum: AHD

Groundwater Record	Field Tests	Depth (m)	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
		0		ASPHALTIC CONCRETE: 8mm.t., over FILL: Silty gravelly sand, fine to medium grained, pale brown and brown, fine to medium grained sandstone and igneous gravel.	D			
	N > 8 5,8/ 100mm REFUSAL			FILL: Silty sand, fine to medium grained, pale grey mottled pale brown, with a trace of fine grained sandstone gravel.				0.0%CH4 20.9%O2 APPEARS MODERATELY TO WELL COMPACTED
	N = 16 13,8,8	1		as above, but mottled grey brown, with a trace of timber, fabric, glass, metal and brick fragments.				0.0%CH4 20.8%O2
ON COMPLETION		2		FILL: Silty clayey sand, fine to medium grained, dark grey, with a trace of ash, fine to medium grained sandstone gravel, metal and timber.	M			
DURING SPT	N = 6 2,3,3	3	SM	SILTY SAND: fine to medium grained, dark grey brown, with organic matter.	W	L	-	0.0%CH4 20.93%O2
		4	OL	ORGANIC SILTY SANDY CLAY: low to medium plasticity, grey mottled dark brown.	MC>PL	(St)		ORGANIC ODOUR
	N = 5 2,3,2		SM/SC	SILTY CLAYEY SAND: fine to medium grained, grey brown, with organic matter and shell fragments.	W	L		0.0%CH4 20.8%O2
		5	CL/SC	SILTY SANDY CLAY/SILTY CLAYEY SAND: low to medium plasticity, fine to coarse grained, grey mottled, pale yellow brown and pale grey.	MC>PL			0.3%CH4 20.7%O2
		6		END OF BOREHOLE AT 6.0m				
		7						

Samples: ES, U50, DB, DS; Graphic Log

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BOREHOLE LOG

Borehole No. **907** 1/1

Client: CRONULLA SUTHERLAND LEAGUES CLUB LIMITED
Project: CRONULLA SUTHERLAND LEAGUES CLUB REZONING PROPOSAL
Location: CRONULLA LEAGUES CLUB, CAPTAIN COOK DRIVE, WOOLOOWARE, NSW

Job No. 17119SP **Method:** SPIRAL AUGER JK550 **R.L. Surface:** ≅ 4.0m
Date: 9-9-02 **Datum:** AHD
Logged/Checked by: J.R./ASH

Groundwater Record	Field Tests	Depth (m)	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
		0		ASPHALTIC CONCRETE: 8mm.t., over FILL: Sandy gravel, fine to coarse grained sub- angular igneous gravel, fine to medium grained sand.	D D-M			
	N = 9 3,4,5			FILL: Clayey gravelly sand, fine to coarse grained, pale brown, fine to medium grained igneous and sandstone gravel.	MC>PL			0.0%CH4 21.0%O2
		1		FILL: Silty clay, medium to high plasticity, grey mottled grey brown, with a trace of sand and rootlets, plastic, metal, timber and fine to coarse grained sandstone gravel.				APPEARS MODERATELY TO WELL COMPACTED
	N > 12 10,4,8/ 38mm REFUSAL	2						0.0%CH4 20.9%O2
AFTER 5 HRS ▼				FILL: Clayey gravelly sand, fine to coarse grained, dark grey brown, fine to coarse grained sandstone gravel, with a trace of timber, metal brick fragments and concrete gravel.	M			
▶ DURING SPT	N = 13 3,2,11	3						NO SAMPLE RECOVERED FROM SPT SAMPLER 0.0%CH4 20.8%O2
		4	OL	ORGANIC SILTY CLAY: low to medium plasticity, dark grey brown.	MC>PL	F-St		5.0%CH4 11.1%O2 NO RETURN ON SPT
	N = 3 2,1,2							
		5	SM/SC	SILTY CLAYEY SAND: fine to medium grained, grey, with a trace of organic matter and shell material.	W	(L)		
		6		END OF BOREHOLE AT 6.0m				
		7						

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CONSULTING GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

BOREHOLE LOG

Borehole No. **908** 1/1

Client: CRONULLA SUTHERLAND LEAGUES CLUB LIMITED
Project: CRONULLA SUTHERLAND LEAGUES CLUB REZONING PROPOSAL
Location: CRONULLA LEAGUES CLUB, CAPTAIN COOK DRIVE, WOOLOOWARE, NSW

Job No. 17119SP **Method:** SPIRAL AUGER JK550 **R.L. Surface:** ≅ 3.9m
Date: 10-9-02 **Datum:** AHD
Logged/Checked by: S.O.C./ASH

Groundwater Record	Field Tests	Depth (m)	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
		0		ASPHALTIC CONCRETE: 8mm.t., over FILL: Gravelly sand, fine to medium grained, brown, fine to medium grained igneous gravel.	D			
	N > 24 7,14,10/ 60mm END			FILL: Gravelly sand, fine to medium grained, light brown, medium to coarse grained sandstone gravel.	MC≅PL			0.0%CH4 20.8%O2
		1		FILL: Silty sandy clay, low plasticity, brown, with fine to medium grained igneous and sandstone gravel.	D-M			APPEARS WELL COMPACTED
	N = 16 5,7,9			FILL: Gravelly sand, fine to medium grained, light brown, with igneous and sandstone gravel.				0.9%CH4 8.4%O2
		2		FILL: Silty sandy clay, low plasticity, brown, fine to medium grained sand, with fine to medium grained concrete and sandstone gravel and a trace of rootlets.				
				FILL: Silty sand, fine to medium grained, dark brown.				
▷				FILL: Sandy organic matter, brown, timber, fibre and roots, fine to medium grained sand and with a trace of sandstone gravel.	W			
▼ AFTER 25 hrs	N = 22 7,11,11	3		FILL: Organic matter, brown, root fibres, with silt.				5.0%CH4 16.9%O2 APPEARS TO BE MANGROVE TREES
				FILL: Sand, fine to medium grained, light brown, with a trace of steel fragments.				ORGANIC ODOUR
		4	OL	ORGANIC SILTY CLAY: low plasticity, brown.	MC>PL	VS	-	
	N = 1 1,0,1							
		5	CL	SANDY CLAY: low plasticity, light grey and light brown, with a trace of fine to medium grained ironstone gravel.		(St)		
		6		END OF BOREHOLE AT 6.0m				
		7						

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CONSULTING GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

BOREHOLE LOG

Borehole No. **909** 1/1

Client: CRONULLA SUTHERLAND LEAGUES CLUB LIMITED
Project: CRONULLA SUTHERLAND LEAGUES CLUB REZONING PROPOSAL
Location: CRONULLA LEAGUES CLUB, CAPTAIN COOK DRIVE, WOOLOOWARE, NSW

Job No. 17119SP **Method:** SPIRAL AUGER JK550 **R.L. Surface:** ≅ 3.5m
Date: 10-9-02 **Datum:** AHD
Logged/Checked by: S.O.C./ASH

Groundwater Record	Field Tests	Depth (m)	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
		0		ASPHALTIC CONCRETE: 8mm.t., over FILL: Silty gravelly sand, fine to medium grained, light brown, fine to medium grained sandstone and igneous gravel.	M			
	N = 6 1,1,5			FILL: Silty clay, high plasticity, brown mottled light brown, with a trace of organic matter.	MC>PL			0.0%CH4 20.8%O2
		1		FILL: Silty sand, fine to medium grained, brown, with a trace of rootlets, and fine to medium grained sandstone and igneous gravel.	M			APPEARS POORLY COMPACTED
	N = 13 4,6,7	2		FILL: Silty clay, medium plasticity, light brown, with sand and a trace of ash, rootlets, fine to medium grained sandstone gravel and organic material.	MC>PL			0.0%CH4 20.8%O2 APPEARS MODERATELY COMPACTED
				FILL: Organic matter, timber, roots, fibre and ash, dark brown.	MC>PL			APPEARS TO BE MANGROVE TREES
AFTER 26 HRS	N = 6 5,3,3	3		as above, but with fine to medium grained brown sand.				0.1%CH4 20.8%O2 APPEARS POORLY COMPACTED
		4	SM	SILTY SAND: fine to medium grained, dark brown, with a trace of organic fibres and rootlets.	W	VL	-	ORGANIC ODOUR
	N = 2 0,0,2	5		as above, but fine grained, brown, with a trace of organic matter.				1.1%CH4 20.3%O2 SPT SUNK 300mm UNDER SELF WEIGHT AT START OF TEST
AFTER 5 MINS			CL	SANDY CLAY: low plasticity, light grey, with a trace of fine to medium grained ironstone gravel.	MC>PL	(St)		1.3%CH4 19.8%O2
		6		END OF BOREHOLE AT 6.0m				
		7						

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BOREHOLE LOG

Borehole No. **910** 1/1

Client: CRONULLA SUTHERLAND LEAGUES CLUB LIMITED
Project: CRONULLA SUTHERLAND LEAGUES CLUB REZONING PROPOSAL
Location: CRONULLA LEAGUES CLUB, CAPTAIN COOK DRIVE, WOOLOOWARE, NSW

Job No. 17119SP
Date: 11-9-02
Method: SPIRAL AUGER JK550
R.L. Surface: ≅ 2.1m
Datum: AHD
Logged/Checked by: S.O.C./ASH

Groundwater Record	Samples (ES, U50, DB, DS)	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
			0			FILL: Silty sand, fine to medium grained, brown, with fine to medium grained iron indurated sandstone gravel and a trace of timber fragments.	D			GRASS COVER
		N = 16 4,6,10								0.0%CH4 20.8%O2
ON COMPLETION			1			as above, but with occasional timber fragments.	M			APPEARS WELL COMPACTED
		N = 3 1,1,2				FILL: Silty clay, low plasticity, light grey mottled light brown.	MC>PL			0.2%CH4 20.4%O2
			2		OL	ORGANIC SILTY CLAY: low plasticity, grey with fibre, roots and occasional shell fragments.	MC>PL	(VS-S)	-	APPEARS POORLY COMPACTED ORGANIC ODOUR
		N = 1 0,0,1	3							0.0%CH4 20.8%O2 SPT SUNK 300mm UNDER SELF WEIGHT AT START OF TEST
					SP	SAND: fine to medium grained, brown.	W	MD		
		N = 17 10,11,6	4							0.0%CH4 20.8%O2
			5		CL	SANDY CLAY: low plasticity, light brown mottled light grey.	MC>PL	(VSt-H)		0.0%CH4 20.5%O2
			6			END OF BOREHOLE AT 6.0m				
			7							

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Borehole No. **911** 1/1

BOREHOLE LOG

Client: CRONULLA SUTHERLAND LEAGUES CLUB LIMITED
Project: CRONULLA SUTHERLAND LEAGUES CLUB REZONING PROPOSAL
Location: CRONULLA LEAGUES CLUB, CAPTAIN COOK DRIVE, WOOLOOWARE, NSW

Job No. 17119SP **Method:** SPIRAL AUGER JK550 **R.L. Surface:** N/A
Date: 11-9-02 **Datum:**
Logged/Checked by: S.O.C./ [signature]

Groundwater Record	Field Tests	Depth (m)	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
ON COMPLETION	N = 6 5,4,2	0		FILL: Gravelly sand, fine to medium grained, light brown, fine to medium grained sandstone and igneous gravel.	D			0.0%CH4 20.8%O2
				FILL: Sand, fine to medium grained, grey and brown, with a trace of clay fines.				APPEARS POORLY COMPACTED
	N = 1 2,0,1	1	SM	SILTY SAND: fine to medium grained, brown, with roots and organic fibres	W	VL	-	POSSIBLY FILL TO 2.0m DEPTH 1.2%CH4 20.4%O2
	SPT SUNK UNDER SELF WEIGHT	2	OL	ORGANIC SILTY CLAY: low plasticity, dark grey, with fibre, roots and timber fragments.	MC>PL	(VS-S)		ORGANIC ODOUR 0.3%CH4 20.1%O2
	N = 6 1,2,4	3.5	SC	CLAYEY SAND: fine to medium grained, light brown and light grey, with fine to coarse grained iron indurated sand bands.	W	L		0.5%CH4 20.8%O2 0.7%CH4 20.4%O2
		6		END OF BOREHOLE AT 6.0m				
		7						

Samples: ES, U50, DB, DS

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BOREHOLE LOG

Borehole No. 912 1/1

Client: CRONULLA SUTHERLAND LEAGUES CLUB LIMITED
Project: CRONULLA SUTHERLAND LEAGUES CLUB REZONING PROPOSAL
Location: CRONULLA LEAGUES CLUB, CAPTAIN COOK DRIVE, WOOLOOWARE, NSW

Job No. 17119SP **Method:** SPIRAL AUGER JK550 **R.L. Surface:** ≅ 1.9m
Date: 11-9-02 **Datum:** AHD
Logged/Checked by: S.O.C./ KSH

Groundwater Record	Field Tests	Depth (m)	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
		0		ASPHALTIC CONCRETE: 6mm.t., over FILL: Gravelly sand, fine to medium grained, brown.	D / MC<PL			
ON COMPLETION	N = 4 3,2,2			FILL: Clayey silt, low plasticity, grey.				0.2%CH4 20.4% APPEARS POORLY COMPACTED
	N = 24 11,18,6	1		FILL: Silty sand, fine to medium grained, grey, with occasional steel wire, plastic and medium to coarse grained sandstone gravel.	W			1.6%CH4 18.86%O2 APPEARS WELL COMPACTED
	N = 2 0,0,2	2	OL	ORGANIC SILTY CLAY: low plasticity, grey, with shells, fibre.	MC>PL	(S)	-	SULPHUR ODOUR 19.0%CH4 18.8%O2 SPT SUNK 300mm UNDER SELF WEIGHT AT START OF TEST
	N = 3 0,1,2	4	CL	SILTY CLAY: low plasticity, light brown, with occasional shells.	MC>PL	VS	20 20 10	7.0%CH4 19.9%O2 SPT SUNK 150mm UNDER SELF WEIGHT AT START OF TEST
				SILTY CLAY: low plasticity, dark grey, with occasional timber fragments.		(S)		1.7%CH4 20.4%O2
		6		END OF BOREHOLE AT 6.0m				
		7						

REPORT EXPLANATION NOTES

INTRODUCTION

These notes have been provided to amplify the geotechnical report in regard to classification methods, field procedures and certain matters relating to the Comments and Recommendations section. Not all notes are necessarily relevant to all reports.

The ground is a product of continuing natural and man-made processes and therefore exhibits a variety of characteristics and properties which vary from place to place and can change with time. Geotechnical engineering involves gathering and assimilating limited facts about these characteristics and properties in order to understand or predict the behaviour of the ground on a particular site under certain conditions. This report may contain such facts obtained by inspection, excavation, probing, sampling, testing or other means of investigation. If so, they are directly relevant only to the ground at the place where and time when the investigation was carried out.

DESCRIPTION AND CLASSIFICATION METHODS

The methods of description and classification of soils and rocks used in this report are based on Australian Standard 1726, the S.A.A. Site Investigation Code. In general, descriptions cover the following properties – soil or rock type, colour, structure, strength or density, and inclusions. Identification and classification of soil and rock involves judgement and the Company infers accuracy only to the extent that is common in current geotechnical practice.

Soil types are described according to the predominating particle size and behaviour as set out in the attached Unified Soil Classification Table qualified by the grading of other particles present (e.g. sandy clay) as set out below:

Soil Classification	Particle Size
Clay	less than 0.002mm
Silt	0.002 to 0.06mm
Sand	0.06 to 2mm
Gravel	2 to 60mm

Cohesive soils are classified on the basis of strength (consistency) either by use of hand penetrometer, laboratory testing or engineering examination. The strength terms are defined as follows.

Classification	Unconfined Compressive Strength kPa
Very Soft	less than 25
Soft	25 – 50
Firm	50 – 100
Stiff	100 - 200
Very Stiff	200 – 400
Hard	Greater than 400
Friable	Strength not attainable – soil crumbles.

Non-cohesive soils are classified on the basis of relative density, generally from the results of Standard Penetration Tests (S.P.T.) as below:

Relative Density	S.P.T. "N" Value (blows/300mm)
Very loose	less than 4
Loose	4 – 10
Medium dense	10 – 30
Dense	30 – 50
Very Dense	greater than 50

Rock types are classified by their geological names, together with descriptive terms regarding weathering, strength, defects, etc. Where relevant, further information regarding rock classification is given in the text of the report. In the Sydney Basin, "Shale" is used to describe thinly bedded to laminated siltstone.

SAMPLING

Sampling is carried out during drilling or from other excavations to allow engineering examination (and laboratory testing where required) of the soil or rock.

Disturbed samples taken during drilling provide information on plasticity, grain size, colour, moisture content, minor constituents and, depending upon the degree of disturbance, some information on strength and structure.

Undisturbed samples are taken by pushing a thin-walled sample tube, usually 50mm diameter (known as a U50), into the soil and withdrawing it with a sample of the soil contained in a relatively undisturbed state. Such samples yield information on structure and strength, and are necessary for laboratory determination of shear strength and compressibility. Undisturbed sampling is generally effective only in cohesive soils.

Details of the type and method of sampling used are given on the attached logs.

INVESTIGATION METHODS

The following is a brief summary of investigation methods currently adopted by the Company and some comments on their use and application. All except test pits, hand auger drilling and portable dynamic cone penetrometers require the use of a mechanical drilling rig which is commonly mounted on a truck chassis.

Test Pits – These are normally excavated with a backhoe or a tracked excavator, allowing close examination of the in situ soils if it is safe to descend into the pit. The depth of penetration is limited to about 3m for a backhoe and up to 6m for an excavator. Limitations of test pits are the problems associated with disturbance and difficulty of reinstatement and the consequent effects on close-by structures. Care must be taken if construction is to be carried out near test pit locations to either properly recompact the backfill during construction or to design and construct the structure so as not to be adversely affected by poorly compacted backfill at the test pit location.

Hand Auger Drilling – A borehole of 50 to 100mm diameter is advanced by manually operated equipment. Premature refusal of the hand augers can occur on a variety of materials such as hard clay, gravel or ironstone, and does not necessarily indicate rock level.

Continuous Spiral Flight Augers – The borehole is advanced using 75 to 115mm diameter continuous spiral flight augers, which are withdrawn at intervals to allow sampling and in situ testing. This is a relatively economical means of drilling in clays and in sands above the water table. Samples are returned to the surface by the flights or may be collected after withdrawal of the auger flights, but they can be very disturbed and may be contaminated. Information from the drilling (as distinct from specific sampling by S.P.T.s or undisturbed samples) is of relatively lower reliability due to remoulding, contamination or softening of samples by groundwater, or uncertainties as to the orginal depth of the samples. Augering below the groundwater table is of even lesser reliability than augering above the water table. Use can be made of a Tugsten Carbide (T.C.) bit for auger drilling into rock to indicate rock quality and continuity by variation in drilling resistance and from examination of recovered rock fragments.

Wash Boring – The borehole is usually advanced by a rotary bit, with water being pumped down the drill rods and returned up the annulus, carrying the drill cuttings. Only major changes in stratification can be determined from the cuttings, together with some information from "feel" and rate of penetration.

Mud Stabilised Drilling – Either Wash Boring or Continuous Core Drilling can use drilling mud as a circulating fluid to stabilise the borehole. The term "mud" encompasses a range of products ranging from bentonite to polymers such as Revert or Biogel. The mud tends to mask the cuttings and reliable identification is only possible from intermittent intact sampling (e.g. from S.P.T. and U50 samples) or from rock coring, etc.

Continuous Core Drilling – A continuous core sample is obtained using a diamond tipped core barrel. Provided full core recovery is achieved (which is not always possible in very weak rocks and granular soils), this technique provides a very reliable (but relatively expensive) method of investigation. In rocks, an N.M.L.C. triple tube core barrel, which gives a core of about 50mm diameter, is usually used with water flush. The length of core recovered is compared to the length drilled and any length not recovered is shown as CORE LOSS. The location of losses are determined on site by the supervising engineer; where the location is uncertain, the loss is placed at the top end of the drill run.

Standard Penetration Tests – Standard Penetration Tests (S.P.T.) are used mainly in non-cohesive soils, but can also be used in cohesive soils as a means of indicating density or strength and also of obtaining a relatively undisturbed sample. The test procedure is described in Australian Standard 1289, "Methods of Testing Soils for Engineering Purposes" – Test F3.1.

The test is carried out in a borehole by driving a 50mm diameter split sample tube with a tapered shoe, under the impact of a 63kg hammer with a free fall of 760mm. It is normal for the tube to be driven in three successive 150mm increments and the 'N' value is taken as the number of blows for the last 300mm. In dense sands, very hard clays or weak rock, the full 450mm penetration may not be practicable and the test is discontinued.

The test results are reported in the following form:

- In the case where full penetration is obtained with successive blow counts for each 150mm of, say, 4, 6 and 7 blows, as

  N = 13
  4, 6, 7

- In a case where the test is discontinued short of full penetration, say after 15 blows for the first 150mm and 30 blows for the next 40mm, as

  N > 30
  15, 30/40mm

The results of the test can be related empirically to the engineering properties of the soil.

Occasionally, the drop hammer is used to drive 50mm diameter thin walled sample tubes (U50) in clays. In such circumstances, the test results are shown on the borehole logs in brackets.

A modification to the S.P.T. test is where the same driving system is used with a solid 60° tipped steel cone of the same diameter as the S.P.T. hollow sampler. The solid cone can be continuously driven for some distance in soft clays or loose sands, or may be used where damage would otherwise occur to the S.P.T. The results of this Dynamic Cone Penetration Test are shown as "N_C" on the borehole logs, together with the number of blows per 150mm penetration.

Static Cone Penetrometer Testing and Interpretation – Cone penetrometer testing (sometimes referred to as a Dutch Cone) described in this report has been carried out using an Electronic Friction Cone Penetrometer (E.F.C.P.). The test is described in Australian Standard 1289, Test F5.1.

In the tests, a 35mm diameter rod with a conical tip is pushed continuously into the soil, the reaction being provided by a specially designed truck or rig which is fitted with an hydraulic ram system. Measurements are made of the end bearing resistance on the cone and the frictional resistance on a separate 134mm long sleeve, immediately behind the cone. Transducers in the tip of the assembly are electrically connected by wires passing through the centre of the push rods to an amplifier and recorder unit mounted on the control truck.

As penetration occurs (at a rate of approximately 20mm per second) the information is output on continuous chart recorders. The plotted results given in this report have been copied from the original records.

The information provided on the charts comprises:

- Cone resistance – the actual end bearing force divided by the cross sectional area of the cone – expressed in MPa.
- Sleeve friction – the frictional force on the sleeve divided by the surface area – expressed in kPa.
- Friction ratio – the ratio of sleeve friction to cone resistance, expressed as a percentage.

There are two scales available for measurement of cone resistance. The lower (A) scale (0 to 5 MPa) is used in softer soils where increased sensitivity is required. The main (B) scale has a range of 0 to 50 MPa.

The ratios of the sleeve resistance to cone resistance will vary with the type of soil encountered, with higher relative friction in clays than in sands. Friction ratios of 1% to 2% are commonly encountered in sands and occasionally very soft clays, rising to 4% to 10% in stiff clays and peats. Soil descriptions based on friction ratios are only inferred and must not be considered as exact.

Correlations between E.F.C.P. and S.P.T. values can be developed for both sands and clays but may be site specific.

Interpretation of E.F.C.P. values can be made to empirically derive modulus or compressibility values to allow calculation of foundation settlements.

Stratification can be inferred from the cone and friction traces and from experience and information from nearby boreholes etc. Where shown, this information is presented for general guidance, but must be regarded as interpretive. The test method provides a continuous profile of engineering properties but, where precise information on soil classification is required, direct drilling and sampling may be preferable.

Portable Dynamic Cone Penetrometers – Portable Dynamic Cone Penetrometer tests are carried out by driving a rod into the ground with a falling weight hammer and measuring the blows for successive 100mm increments of penetration.

Two relatively similar tests are used:

- Cone penetrometer (commonly known as the Scala Penetrometer) – a 16mm rod with a 20mm diameter cone end is driven with a 9kg hammer dropping 510mm (A.S. 1289, Test F3.2). The test was developed initially for pavement subgrade investigations, and correlations of the test results with California Bearing Ratio have been published by various Road Authorities.
- Perth sand penetrometer – a 16mm diameter flat ended rod is driven with a 9kg hammer, dropping 600mm (A.S. 1289, Test F3.3). This test was developed for testing the density of sands (originating in Perth) and is mainly used in granular soils and filling.

LOGS

The borehole or test pit logs presented herein are an engineering and/or geological interpretation of the subsurface conditions, and their reliability will depend to some extent on the frequency of sampling and the method of drilling or excavation. Ideally, continuous undisturbed sampling or core drilling will enable the most reliable assessment, but is not always practicable or possible to justify on economic grounds. In any case, the boreholes or test pits represent only a very small sample of the total subsurface conditions.

The attached explanatory notes define the terms and symbols used in preparation of the logs.

Interpretation of the information shown on the logs, and its application to design and construction, should therefore take into account the spacing of boreholes or test pits, the method of drilling or excavation, the frequency of sampling and testing and the possibility of other than "straight line" variations between the boreholes or test pits. Subsurface conditions between boreholes or test pits may vary significantly from conditions encountered at the borehole or test pit locations.

GROUNDWATER

Where groundwater levels are measured in boreholes, there are several potential problems:

- Although groundwater may be present, in low permeability soils it may enter the hole slowly or perhaps not at all during the time it is left open.
- A localised perched water table may lead to an erroneous indication of the true water table.
- Water table levels will vary from time to time with seasons or recent weather changes and may not be the same at the time of construction.
- The use of water or mud as a drilling fluid will mask any groundwater inflow. Water has to be blown out of the hole and drilling mud must be washed out of the hole or "reverted" chemically if water observations are to be made.

More reliable measurements can be made by installing standpipes which are read after stabilising at intervals ranging from several days to perhaps weeks for low permeability soils. Piezometers, sealed in a particular stratum, may be advisable in low permeability soils or where there may be interference from perched water tables or surface water.

FILL

The presence of fill materials can often be determinted only by the inclusion of foreign objects (e.g. bricks, steel etc.) or by distinctly unusual colour, texture or fabric. Indentification of the extent of fill materials will also depend on investigation methods and frequency. Where natural soils similar to those at the site are used for fill, it may be difficult with limited testing and sampling to reliably determine the extent of the fill.

The presence of fill materials is usually regarded with caution as the possible variation in density, strength and material type is much greater than with natural soil deposits. Consequently, there is an increased risk of adverse engineering characteristics or behaviour. If the volume and quality of fill is of importance to a project, then frequent test pit excavations are preferable to boreholes.

LABORATORY TESTING

Laboratory testing is normally carried out in accordance with Australian Standard 1289 "Methods of Testing Soil for Engineering Purposes." Details of the test procedure used are given on the individual report forms and the attached explanatory notes summarise important aspects of the Laboratory Test Procedures adopted.

ENGINEERING REPORTS

Engineering reports are prepared by qualifed personnel and are based on the information obtained and on current engineering standards of interpretation and analysis. Where the report has been prepared for a specific design proposal (e.g. a three storey building) the information and interpretation may not be relevant if the design proposal is changed (e.g. to a twenty storey building). If this happens, the Company will be pleased to review the report and the sufficiency of the investigation work.

Every care is taken with the report as it relates to interpretation of subsurface conditions, discussion of geotechnical aspects and recommendations or suggestions for design and construction. However, the Company cannot always anticipate or assume responsibility for:

- unexpected variations in ground conditions – the potential for this will be partially dependent on borehole spacing and sampling frequency as well as investigation technique.
- changes in policy or interpretation of policy by statutory authorities.
- the actions of persons or contractors responding to commercial pressures.

If these occur, the Company will be pleased to assist with investigation or advice to resolve any problems occurring.

SITE ANOMALIES

In the event that conditions encountered on site during construction appear to vary from those which were expected from the information contained in the report, the Company requests that it immediately be notified. Most problems are much more readily resolved when conditions are exposed than at some later stage, well after the event.

REPRODUCTION OF INFORMATION FOR CONTRACTUAL PURPOSES

Attention is drawn to the document "Guidelines for the Provision of Geotechnical Information in Tender Documents", published by the Institution of Engineers, Australia. Where information obtained from this investigation is provided for tendering purposes, it is recommended that all information, including the written report and discussion, be made available. In circumstances where the discussion or comments section is not relevant to the contractual situation, it may be appropriate to prepare a specially edited document. The Company would be pleased to assist in this regard and/or to make additional report copies available for contract purposes at a nominal charge.

REVIEW OF DESIGN

Where major civil or structural developments are proposed or where only a limited investigation has been completed or where the geotechnical conditions/constraints are quite complex, it is prudent to have a joint design review which involves a senior geotechnical engineer. We would be happy to assist in this regard as an extension of our investigation commission.

SITE INSPECTION

The Company will always be pleased to provide engineering inspection services for geotechnical aspects of work to which this report is related.

Requirements could range from:

i) a site visit to confirm that conditions exposed are no worse than those interpreted, to
ii) a visit to assist the contractor or other site personnel in identifying various soil/rock types such as appropriate footing or pier founding depths, or
iii) full-time engineering presence on site.

SEPTEMBER, 1990

Jeffery and Katauskas Pty Ltd
CONSULTING GEOTECHNICAL & ENVIRONMENTAL ENGINEERS

GRAPHIC LOG SYMBOLS FOR SOILS AND ROCKS

SOIL

- FILL
- TOPSOIL
- CLAY (CL, CH)
- SILT (ML, MH)
- SAND (SP, SW)
- GRAVEL (GP, GW)
- SANDY CLAY (CL, CH)
- SILTY CLAY (CL, CH)
- CLAYEY SAND (SC)
- SILTY SAND (SM)
- GRAVELLY CLAY (CL, CH)
- CLAYEY GRAVEL (GC)
- SANDY SILT (ML)
- PEAT AND ORGANIC SOILS

ROCK

- CONGLOMERATE
- SANDSTONE
- SHALE
- SILTSTONE, MUDSTONE, CLAYSTONE
- LIMESTONE
- PHYLLITE, SCHIST
- TUFF
- GRANITE, GABBRO
- DOLERITE, DIORITE
- BASALT, ANDESITE
- QUARTZITE

DEFECTS AND INCLUSIONS

- CLAY SEAM
- SHEARED OR CRUSHED SEAM
- BRECCIATED OR SHATTERED SEAM/ZONE
- IRONSTONE GRAVEL
- ORGANIC MATERIAL

OTHER MATERIALS

- CONCRETE
- BITUMINOUS CONCRETE, COAL
- COLLUVIUM

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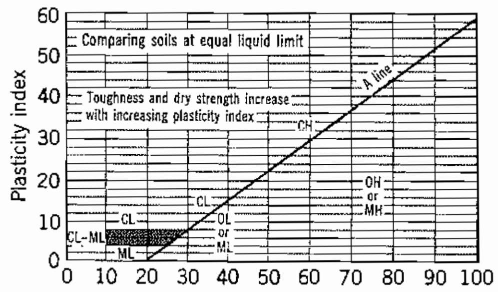
UNIFIED SOIL CLASSIFICATION TABLE

Major Divisions			Field Identification Procedures (Excluding particles larger than 75 μm and basing fractions on estimated weights)	Group Symbols[a]	Typical Names	Information Required for Describing Soils	Laboratory Classification Criteria
Coarse-grained soils: More than half of material is *larger* than 75 μm sieve size[b] (The 75 μm sieve size is about the smallest particle visible to naked eye)	Gravels: More than half of coarse fraction is larger than 4 mm sieve size	Clean gravels (little or no fines)	Wide range in grain size and substantial amounts of all intermediate particle sizes	*GW*	Well graded gravels, gravel-sand mixtures, little or no fines	Give typical name; indicate approximate percentages of sand and gravel; maximum size; angularity, surface condition, and hardness of the coarse grains; local or geologic name and other pertinent descriptive information; and symbols in parentheses	$C_U = \frac{D_{60}}{D_{10}}$ Greater than 4; $C_C = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ Between 1 and 3
			Predominantly one size or a range of sizes with some intermediate sizes missing	*GP*	Poorly graded gravels, gravel-sand mixtures, little or no fines		Not meeting all gradation requirements for *GW*
		Gravels with fines (appreciable amount of fines)	Nonplastic fines (for identification procedures see *ML* below)	*GM*	Silty gravels, poorly graded gravel-sand-silt mixtures	For undisturbed soils add information on stratification, degree of compactness, cementation, moisture conditions and drainage characteristics	Atterberg limits below "A" line, or *PI* less than 4 (Above "A" line with *PI* between 4 and 7 are *borderline* cases requiring use of dual symbols)
			Plastic fines (for identification procedures, see *CL* below)	*GC*	Clayey gravels, poorly graded gravel-sand-clay mixtures		Atterberg limits above "A" line, with *PI* greater than 7
	Sands: More than half of coarse fraction is smaller than 4 mm sieve size	Clean sands (little or no fines)	Wide range in grain sizes and substantial amounts of all intermediate particle sizes	*SW*	Well graded sands, gravelly sands, little or no fines	Example: *Silty sand*, gravelly; about 20% hard, angular gravel particles 12 mm maximum size; rounded and subangular sand grains coarse to fine, about 15% non-plastic fines with low dry strength; well compacted and moist in place; alluvial sand; (*SM*)	$C_U = \frac{D_{60}}{D_{10}}$ Greater than 6; $C_C = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ Between 1 and 3
			Predominantly one size or a range of sizes with some intermediate sizes missing	*SP*	Poorly graded sands, gravelly sands, little or no fines		Not meeting all gradation requirements for *SW*
		Sands with fines (appreciable amount of fines)	Nonplastic fines (for identification procedures, see *ML* below)	*SM*	Silty sands, poorly graded sand-silt mixtures		Atterberg limits below "A" line or *PI* less than 5 (Above "A" line with *PI* between 4 and 7 are *borderline* cases requiring use of dual symbols)
			Plastic fines (for identification procedures, see *CL* below)	*SC*	Clayey sands, poorly graded sand-clay mixtures		Atterberg limits below "A" line with *PI* greater than 7

Laboratory classification criteria (coarse-grained soils): Determine percentages of gravel and sand from grain size curve. Depending on percentage of fines (fraction smaller than 75 μm sieve size) coarse grained soils are classified as follows: Less than 5% *GW, GP, SW, SP*; More than 12% *GM, GC, SM, SC*; 5% to 12% *Borderline* cases requiring use of dual symbols.

Use grain size curve in identifying the fractions as given under field identification.

Major Divisions		Identification Procedures on Fraction Smaller than 380 μm Sieve Size: Dry Strength (crushing characteristics)	Dilatancy (reaction to shaking)	Toughness (consistency near plastic limit)	Group Symbols	Typical Names	Information Required for Describing Soils
Fine-grained soils: More than half of material is *smaller* than 75 μm sieve size	Silts and clays liquid limit less than 50	None to slight	Quick to slow	None	*ML*	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands with slight plasticity	Give typical name; indicate degree and character of plasticity, amount and maximum size of coarse grains; colour in wet condition, odour if any, local or geologic name, and other pertinent descriptive information, and symbol in parentheses
		Medium to high	None to very slow	Medium	*CL*	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays	
		Slight to medium	Slow	Slight	*OL*	Organic silts and organic silt-clays of low plasticity	For undisturbed soils add information on structure, stratification, consistency in undisturbed and remoulded states, moisture and drainage conditions
	Silts and clays liquid limit greater than 50	Slight to medium	Slow to none	Slight to medium	*MH*	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts	
		High to very high	None	High	*CH*	Inorganic clays of high plasticity, fat clays	Example: *Clayey silt*, brown; slightly plastic; small percentage of fine sand; numerous vertical root holes; firm and dry in place; loess; (*ML*)
		Medium to high	None to very slow	Slight to medium	*OH*	Organic clays of medium to high plasticity	
Highly Organic Soils		Readily identified by colour, odour, spongy feel and frequently by fibrous texture			*Pt*	Peat and other highly organic soils	



Plasticity chart
for laboratory classification of fine grained soils

NOTE: 1) Soils possessing characteristics of two groups are designated by combinations of group symbols (e.g. GW-GC, well graded gravel-sand mixture with clay fines).

2) Soils with liquid limits of the order of 35 to 50 may be visually classified as being of medium plasticity.

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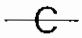
LOG SYMBOLS

LOG COLUMN	SYMBOL	DEFINITION
Groundwater Record		Standing water level. Time delay following completion of drilling may be shown.
		Extent of borehole collapse shortly after drilling.
		Groundwater seepage into borehole or excavation noted during drilling or excavation.
Samples	ES	Soil sample taken over depth indicated, for environmental analysis.
	U50	Undisturbed 50mm diameter tube sample taken over depth indicated.
	DB	Bulk disturbed sample taken over depth indicated.
	DS	Small disturbed bag sample taken over depth indicated.
Field Tests	N = 17 4, 7, 10	Standard Penetration Test (SPT) performed between depths indicated by lines. Individual figures show blows per 150mm penetration. 'R' as noted below.
	N_c = 5 7 3R	Solid Cone Penetration Test (SCPT) performed between depths indicated by lines. Individual figures show blows per 150mm penetration for 60 degree solid cone driven by SPT hammer. 'R' refers to apparent hammer refusal within the corresponding 150mm depth increment.
	VNS = 25	Vane shear reading in kPa of Undrained Shear Strength.
	PID = 100	Photoionisation detector reading in ppm (Soil sample headspace test).
Moisture Condition (Cohesive Soils)	MC>PL	Moisture content estimated to be greater than plastic limit.
	MC≈PL	Moisture content estimated to be approximately equal to plastic limit.
	MC<PL	Moisture content estimated to be less than plastic limit.
(Cohesionless Soils)	D	DRY - runs freely through fingers.
	M	MOIST - does not run freely but no free water visible on soil surface.
	W	WET - free water visible on soil surface.
Strength (Consistency) Cohesive Soils	VS	VERY SOFT - Unconfined compressive strength less than 25kPa
	S	SOFT - Unconfined compressive strength 25-50kPa
	F	FIRM - Unconfined compressive strength 50-100kPa
	St	STIFF - Unconfined compressive strength 100-200kPa
	VSt	VERY STIFF - Unconfined compressive strength 200-400kPa
	H	HARD - Unconfined compressive strength greater than 400kPa
	( )	Bracketed symbol indicates estimated consistency based on tactile examination or other tests.
Density Index/ Relative Density (Cohesionless Soils)		**Density Index (I_D) Range (%)** — **SPT 'N' Value Range (Blows/300mm)**
	VL	Very Loose — <15 — 0-4
	L	Loose — 15-35 — 4-10
	MD	Medium Dense — 35-65 — 10-30
	D	Dense — 65-85 — 30-50
	VD	Very Dense — >85 — >50
	( )	Bracketed symbol indicates estimated density based on ease of drilling or other tests.
Hand Penetrometer Readings	300 250	Numbers indicate individual test results in kPa on representative undisturbed material unless noted otherwise.
Remarks	'V' bit	Hardened steel 'V' shaped bit.
	'TC' bit	Tungsten carbide wing bit.
	T 60	Penetration of auger string in mm under static load of rig applied by drill head hydraulics without rotation of augers.

Ref: Log Symbols
August 2001

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LOG SYMBOLS

ROCK MATERIAL WEATHERING CLASSIFICATION

TERM	SYMBOL	DEFINITION
Residual Soil	RS	Soil developed on extremely weathered rock; the mass structure and substance fabric are no longer evident; there is a large change in volume but the soil has not been significantly transported.
Extremely weathered rock	XW	Rock is weathered to such an extent that it has "soil" properties, ie it either disintegrates or can be remoulded, in water.
Distinctly weathered rock	DW	Rock strength usually changed by weathering. The rock may be highly discoloured, usually by ironstaining. Porosity may be increased by leaching, or may be decreased due to deposition of weathering products in pores.
Slightly weathered rock	SW	Rock is slightly discoloured but shows little or no change of strength from fresh rock.
Fresh rock	FR	Rock shows no sign of decomposition or staining.

ROCK STRENGTH

Rock strength is defined by the Point Load Strength Index (Is 50) and refers to the strength of the rock substance in the direction normal to the bedding. The test procedure is described by the International Journal of Rock Mechanics, Mining, Science and Geomechanics. Abstract Volume 22, No 2, 1985.

TERM	SYMBOL	Is (50) MPa	FIELD GUIDE
Extremely Low:	EL		Easily remoulded by hand to a material with soil properties.
		0.03	
Very Low:	VL		May be crumbled in the hand. Sandstone is "sugary" and friable.
		0.1	
Low:	L		A piece of core 150mm long x 50mm dia. may be broken by hand and easily scored with a knife. Sharp edges of core may be friable and break during handling.
		0.3	
Medium Strength:	M		A piece of core 150mm long x 50mm dia. can be broken by hand with difficulty. Readily scored with knife.
		1	
High:	H		A piece of core 150mm long x 50mm dia. core cannot be broken by hand, can be slightly scratched or scored with knife; rock rings under hammer.
		3	
Very High:	VH		A piece of core 150mm long x 50mm dia. may be broken with hand-held pick after more than one blow. Cannot be scratched with pen knife; rock rings under hammer.
		10	
Extremely High:	EH		A piece of core 150mm long x 50mm dia. is very difficult to break with hand-held hammer. Rings when struck with a hammer.

ABBREVIATIONS USED IN DEFECT DESCRIPTION

ABBREVIATION	DESCRIPTION	NOTES
Be	Bedding Plane Parting	Defect orientations measured relative to the normal to the long core axis (ie relative to horizontal for vertical holes)
CS	Clay Seam	
J	Joint	
P	Planar	
Un	Undulating	
S	Smooth	
R	Rough	
IS	Ironstained	
XWS	Extremely Weathered Seam	
Cr	Crushed Seam	
60t	Thickness of defect in millimetres	

TOYOTA PARK UPGRADE

FOR CRONULLA SUTHERLAND LEAGUES CLUB LIMITED

FLOOD STUDY

Final

Distribution: DBL Property: Mr. BS (1=number of sets)
K&P:: PK - (1=number of sets)

Client		Client's representative			
DBL Property		Mr. Brendan Seage			
Project Flood Study for proposed upgrading of Toyota Park for Cronulla Sutherland Leagues Club Limited		Project No 891			
Authors: Pavel Kozarovski		Date: 27 March 2007 Approved by: PK			
Revision	Description	By	Checked	Approved	Date
Key words: Stormwater, flooding, flood hazard.		Classification ☐ Open ☐ Internal ☒ Proprietary			

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1. EXECUTIVE SUMMARY

The area around Toyota Park is affected by flood flows. Large quantities of water would flow from the Golf Course onto Captain Cook Drive and than onto the Toyota Park area.

High velocities and excessive water depths would make some areas extremely hazardous during the 1 in 100 year design flood. Captain Cook Drive and the footpaths would be submerged with depths exceeding 0.8 m and velocities in exceeding 1.4 m/s. It would be hazardous to wade through such a torrent. All existing premises have available areas above the PMF levels which can be considered as safe evacuation points. A Site Emergency Response Flood Plan must be incorporated into the Crowd Management Plan, incorporating procedures how to recognise the flooding (weather monitoring and relying on severe weather warning from the Bureau of Meteorology) and in a case of an overland flow, people must be kept within the premises until the flood is gone.

Half of the Western Carpark closer to Captain Cook Drive could become a hazardous area, with additional danger to cars. Cars can start floating when the depths of water exceed 300 mm. Barriers can prevent cars being washed away.

The passage way between the old gym and the western Grandstand is another area with extremely high hazard. People can be washed away into the tidal channel. Handrails along the channel could prevent people being washed away, however the area would remain dangerous. A wire mesh fence already exists along the east side of the channel.

As the area is affected by flooding the development must be in accordance with the Council's Flood Risk Management DCP. The direct consequence is that the floor levels in proposed buildings in the upgrade must be set 500 mm above the 100 year flood level. The relevant flood levels for definition of floor levels for various stages are:

Stage 1 – Node "NewGym_2"; 100 y FL = 2.67 m AHD
Stage 2 – Node "CC_13"; 100 y FL = 2.78 m AHD
Stage 3 – Node "OldGym_2"; 100 y FL = 2.64 m AHD
Stage 4 – Node "CC_9", 100 y FL = 2.77 m AHD

The new bridge – pedestrian access envisaged in Stage 4 would be located in a high flood hazard precinct and in accordance with the Council's DCP any new work in high flood hazard precinct would be scrutinised. However, it can be categorised as an extension to the existing footpath aiming at minimising the pedestrian exposure to the traffic, while maintaining an identical risk as the existing footpath.

The proposed 4 stages would not have any significant impact on flood levels and flood behaviour. The prescriptive flood hazard management controls must be incorporated in the Club's operating manual and QA procedures.

Flood Maps, Flood Hazard Maps and Flood Risk Precincts are presented in a separate volume for the 5year, 100year and Probable Maximum Floods.

2. INTRODUCTION

The Cronulla Sutherland District Rugby League Football Club has been recently successful in obtaining a Federal Government Grant to make a range of improvements to Toyota Park. The improvements are based on 3 stages (four stages were used in this study for clarity, providing that Stage 3 and 4 are combined into Stage 3):

Stage 1, new Gym and an office above;
Stage 2, New Southern Grandstand
Stage 3, Upgrade of the Western (ET) Stand and
Stage 4, Upgrade of the access at the South West Corner including an extension of the bridge for improved pedestrian access. Upgrade of access from the western end of the ground, including an extension of the bridge at the SW corner for improved pedestrian access.

DBL Property have been engaged by the Cronulla Sutherland Leagues Club (Sharks) as an independent Project Manager overseeing the redevelopment of the Sharks Toyota Park facility. DBL Property commissioned a group of consultants to facilitate and review all aspects of the proposed upgrade. Kozarovski and Partners have been engaged to prepare a flood study utilising the previous work of SMEC Australia and DHI Water and Environment.

3. SITE DESCRIPTION

The subject site is located between Woolooware Bay and the Woolooware Golf Course, extending east and west of the existing tidal channel. The site has been created some 30 years ago by a landfill of building and domestic refuse.

The site can be divided into four main hydrological parts:

- The Toyota Park, Shark's playing field which drains to the tidal channel;
- The club's building which drains towards Captain Cook Drive's drainage system, eventually discharging to the tidal channel;
- The carpark adjacent to the club's building. Approximately one third of the bitumen covered carpark area drains towards Captain Cook Drive, one third discharges to Woolooware Bay as a diffuse outflow through grassed buffer located to the east of the site and one third drains through a 150 mm diameter pipe directly to the Bay as concentrated flow;
- The playing fields to the west of the tidal channel, including the car park. Most of the carpark drains towards Captain Cook Drive, where the runoff is intercepted by a series of pits and pipes and disposed to the West Lane between playing fields and the Solander Playing Fields. The Lane drains to Woolooware Bay via a stormwater drainage system. Most of the playing fields drain towards Woolooware Bay, with some area draining to the tidal channel.

4. HYDROLOGY

There is an open, tidal channel to the west of Toyota Park. The channel is 5 to 6 m wide and approximately 1.5 m deep. It drains a significant catchment area of approximately 250 ha. The catchment boundaries were defined using the 1:4000 ortho-photo maps (Drawing C-01). 156 ha are estimated as the pervious fraction of the catchment with the remaining 97 ha (38%) as impervious. The bulk of the runoff from the catchment is discharged into the Golf Course area, which acts as a temporary flood storage.

The design flood discharge hydrographs were estimated using MikeStorm, a hydrological/hydraulic model developed by the Danish Hydraulic Institute.

The model layout is shown on Figure 1, and the basic model parameter values are given in Table 1. The 60 minute design storm duration produced the highest peak discharge values. The estimated peak discharge values for 1 in 5, 1in 10, 1in 20, 1 in 50 and 1 in 100 year ARI storm events are summarised in Table 2 for existing catchment conditions.

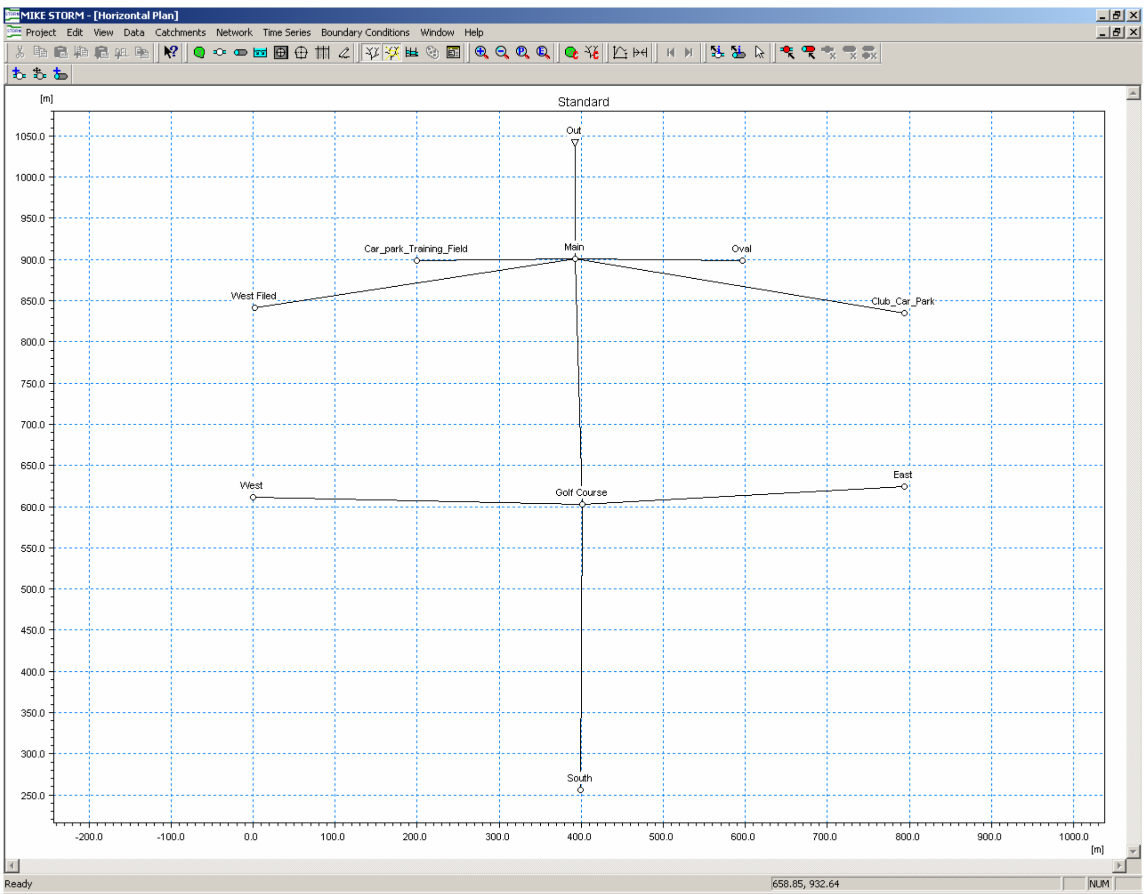


Figure 1 Hydrological model layout

Table 1 Hydrological model parameter values

				Impervious		Soil Permeability		
Catchment	Area (ha)	Length (m)	Slope (%)	Steep	Flat	Low	Medium	High
'East'	38.8	400	4	20	20	0	30	30
'South'	113.1	800	5	30	20	0	25	25
'West'	31.4	800	4	30	20	0	25	25
'Golf Course'	62.8	720	1.9	7	5	0	44	44
Sharks East	1	200	1	40	40	0	20	0
'Oval'	1.23	200	1	20	10	0	70	0
'West Field'	1.9	200	1	0	0	0	100	0
Sharks West	1.7	200	1	0	33	0	67	0

Table 2 Peak discharge values (m3/s)

	5y	10y	20y	50y	100y	PMF
East	11.032	13.149	15.972	18.246	22.428	67.284
South	29.349	34.989	42.557	48.861	61.381	184.143
West	7.865	9.387	11.433	13.154	16.673	50.019
Golf Course	8.755	10.82	13.72	16.434	25.052	75.156
Sharks East	0.366	0.426	0.505	0.566	0.649	1.947
Sharks Oval	0.361	0.43	0.52	0.594	0.72	2.16
West Field	0.435	0.527	0.651	0.763	0.993	2.979
Sharks West	0.497	0.591	0.715	0.818	0.991	2.973

5. HYDRAULIC MODELLIING

MikeStorm, an unsteady, quasi-two dimensional hydraulic model developed by the Danish Hydraulic Institute (DHI) was used to simulate the flood behaviour for existing and proposed conditions.

Quasi two dimensional models need a conceptual definition of flow paths in order to simulate the flow distribution accurately. The envisaged flow paths were defined by a careful examination of survey information and several site visits. The layout of the envisaged flow network is shown on Figure 2.

The cross sections for the flow paths were extracted from a detailed survey prepared by Rygate & Company Pty. Limited.

The two box culverts under Captain Cook Drive are located between Nodes "Golf Course" and "Main_1". The tidal Channel extends from node "Main_1" to Main_7". Two existing bridges along the channel are located between nodes "Main_3" and between "Main_5" and "Main_6".

The following nodes are relevant for definition of the flood levels for each stage:

Stage 1 – Node "NewGym_2";
Stage 2 – Node "CC_13";
Stage 3 – Node "OldGym_2"
Stage 4 – Node "CC_9"

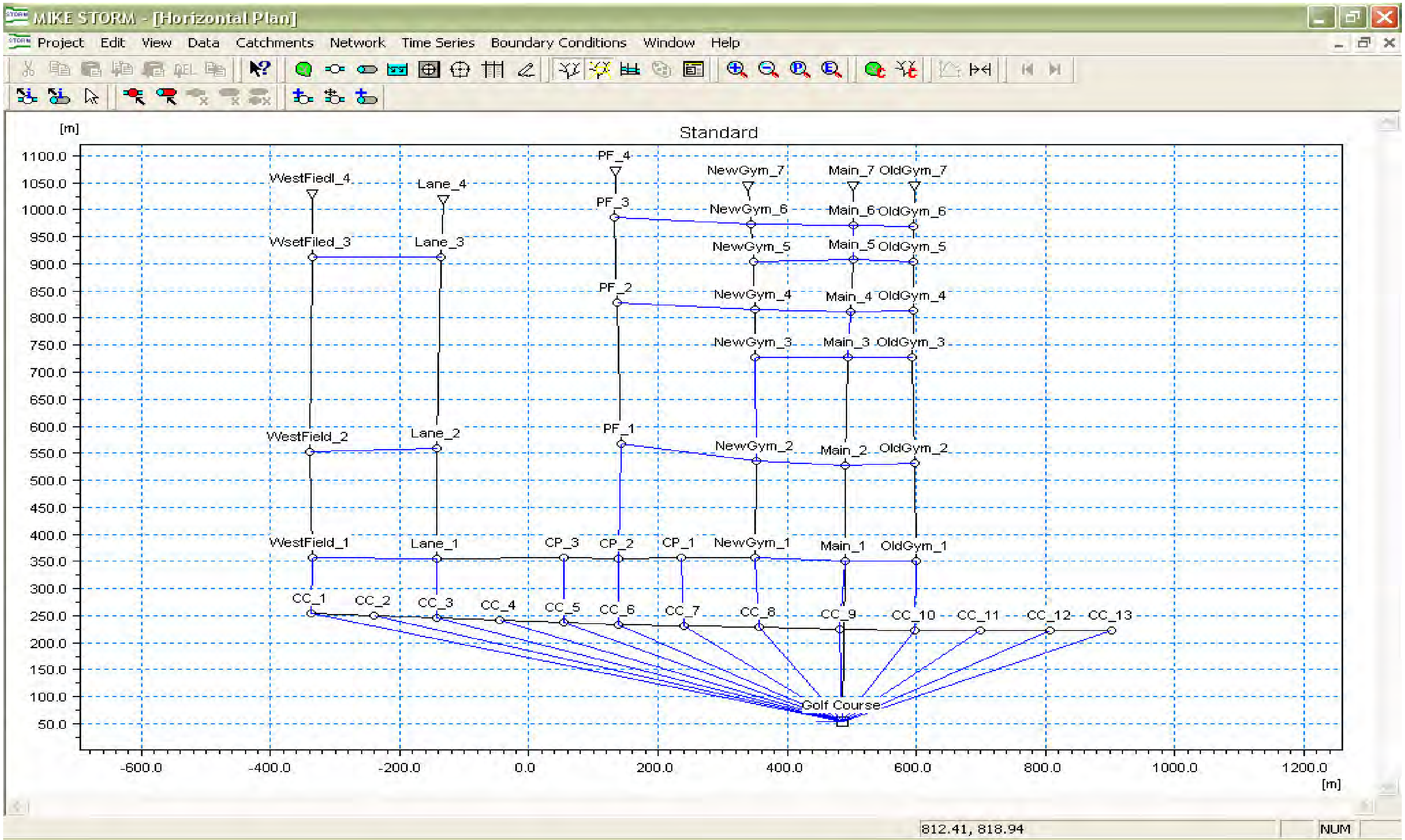


Figure 2 MikeStorm Model Layout

6. RESULTS

Design flood hydrographs ere entered into MikeStorm as an upstream boundary condition and the elevated king tide level of 1.9 m AHD was applied as downstream conditions at all outlet points.

The joint probability of coincident peak king tide and peak runoff is very small, however, the two coinciding peaks were used for flood simulation to remain on a conservative side.

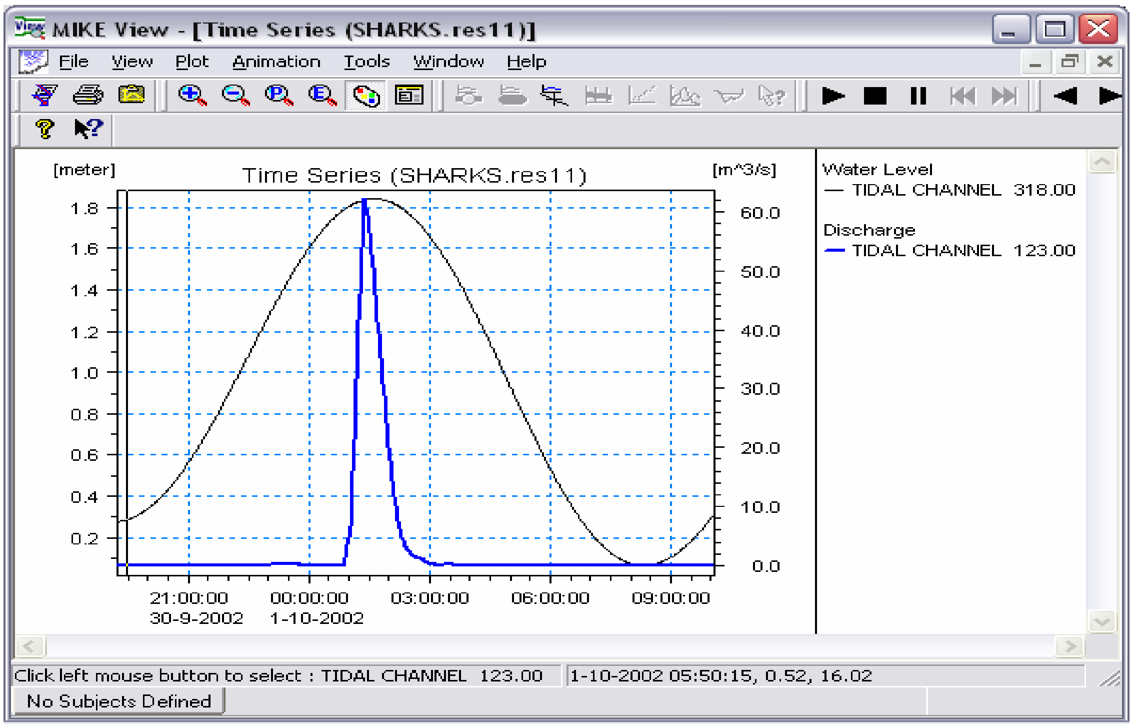


Figure 3, 100 year discharge hydrograph and a king tide

2 x 2.4x1.2 m box culvert is located under Captain Cook Drive. The calculated capacity of the culvert is relatively small when compared to the magnitude of overland flow during the 100 year flood. The reduced culvert capacity is due to the backwater effect from the tidal channel.

The 100 year ARI flood profile along the tidal channel is shown on Figure 4. It should be considered as a conservative estimate of the 100 year flood levels because of the coincidence between the elevated sea level (peak at R.L. 1.8 m AHD) and the peak discharge. It can be seen from the profile that the conservative estimates of the 100 year flood levels are at or below R.L. 2.7 m AHD downstream of Captain Cook Drive. The 100 year flood contour map is shown on drawing C-01 for existing conditions and on drawing C-02 for proposed conditions. The print out of the flood levels is given in Table 4 for existing and proposed conditions. It can be seen from the table that the proposed works will not cause any significant increase in flood levels. The maximum increase in flood levels of 96 mm is at Node OldGym_5 caused by the new entrance gate at the existing concrete bridge. This increase is localised only. The increase at other locations varies between 0 and 20 mm which is considered as negligible. The 100 year flood level increase at the Golf course is 12 mm, however, if the old gym building is demolished, the flood level increase would be only 4 mm. The increase in flood level along Captain Cook Drive would be in the range of some 20 mm, and with the old gym demolished it would reduce to some 4 mm.

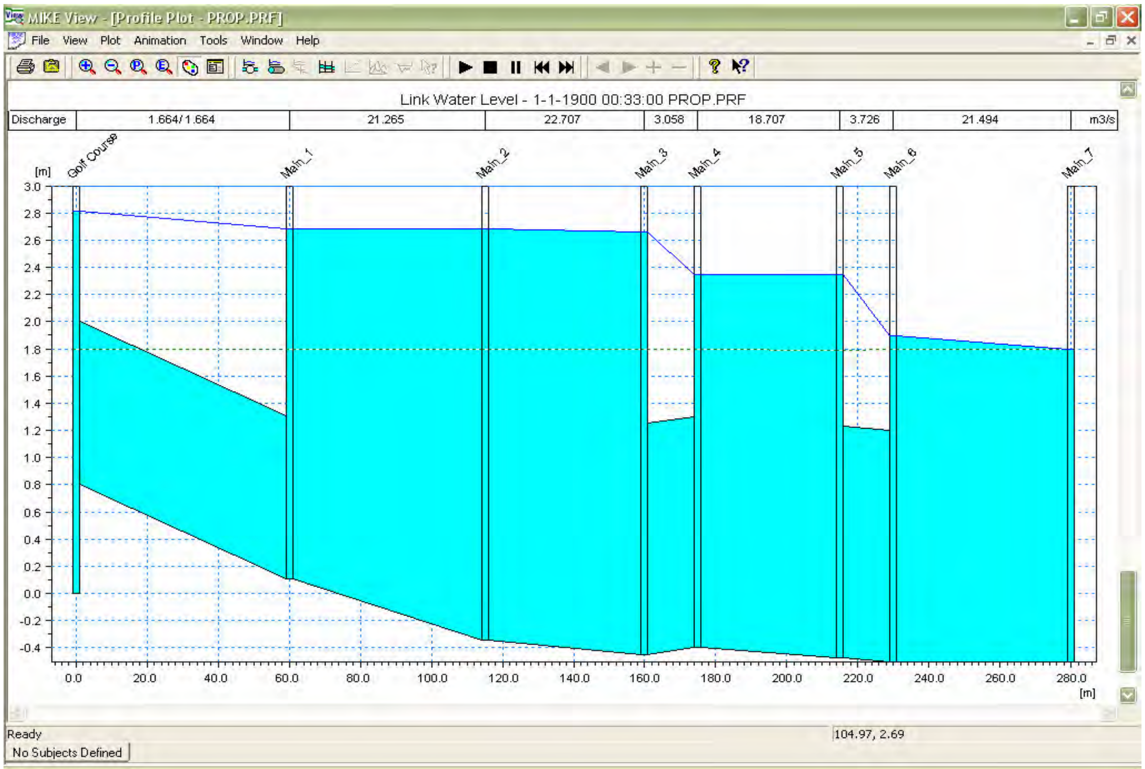


Figure 4, 100 year flood profile along the tidal channel.
Note: Captain Cook Drive is located between Nodes "Golf Course" and "Main_1"

The 100 year flood profile along Captain Cook Drive is shown on Figure 5.

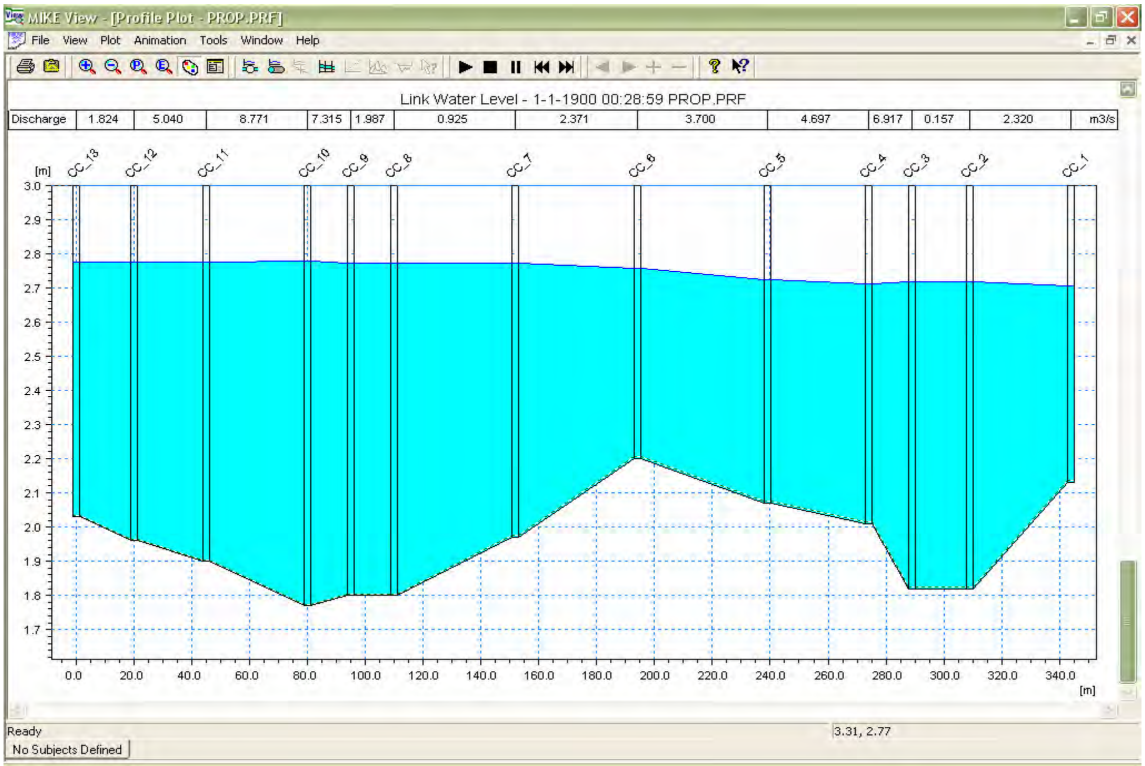


Figure 5, 100 year flood profile along Captain Cook Drive
Note: Node "CC_13" is the relevant node for flood levels at the Southern Stand (100yFL=2.78 m AHD)

The extreme flood was simulated by using a combination of a king tide with 4 times the 100 year flood hydrograph. This is a very conservative assumption and the resulting flood profile along the tidal channel is shown on Figure 6. The extreme flood levels downstream of Captain Cook Drive are at R.L. of 3.0 m AHD, which is some 300 mm above the 1 in 100 year flood level.

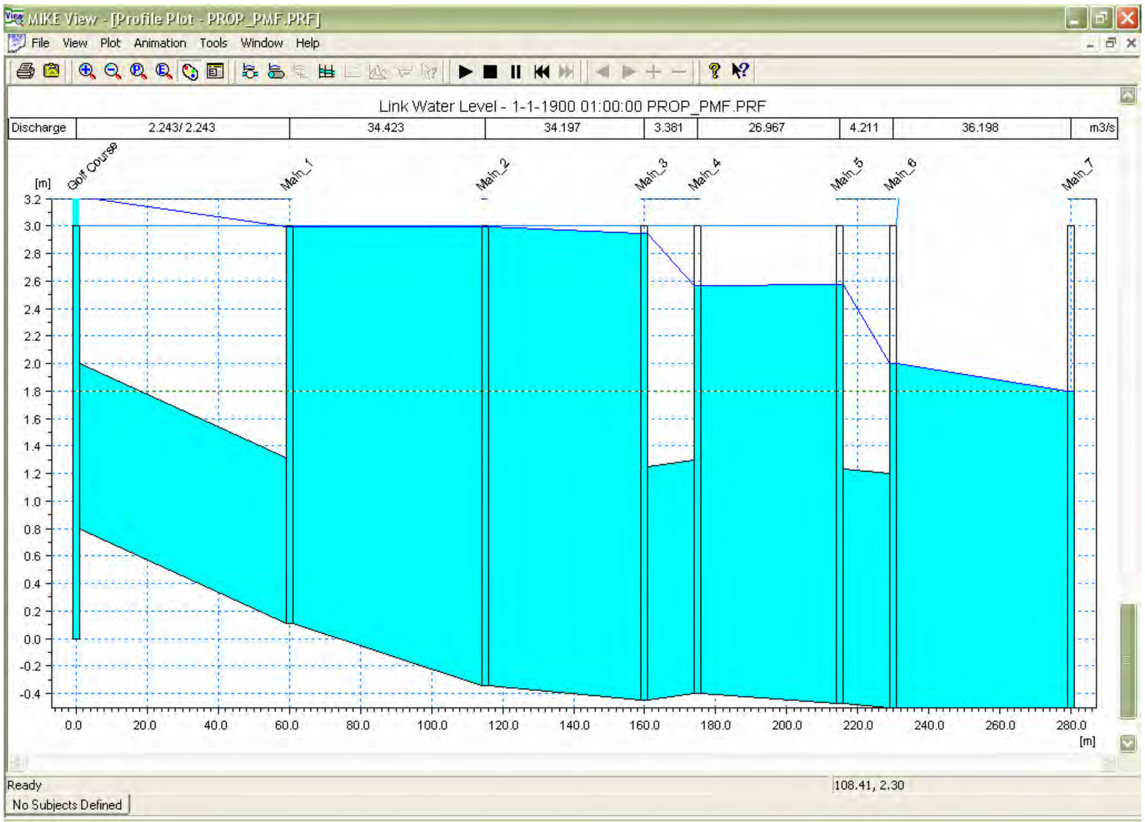


Figure 6, Extreme Flood profile along the tidal channel

The extreme flood profile along Captain Cook Drive is shown on Figure 7. The flood level at Node “CC_13” is 3.178m AHD which is some 400 mm above the 1 in 100 year flood level.

The relevant flood levels for definition of floor levels for various stages are (m AHD):

Stage	Node	5% AEP Flood	1% AEP Flood	PMF
1	NewGym_2	2.41	2.636	3.127
2	CC_13	2.546	2.784	3.42
3	OldGym_2	2.397	2.622	3.117

Hydraulic model results for existing conditions are given in Table 3. The proposed works would result in an increase in flood levels. In order to attenuate the impact it is necessary to widen the overland flow path in the vicinity of the concrete bridge and also to enlarge the opening under the concrete bridge as shown on Drawing C-03. The hydraulic model results for proposed conditions are given in Table 4, while the differences are given in Table 5.

Table 3, Flood Levels for existing conditions (m AHD)

Node			EXISTING			
	5Y	10Y	20Y	50Y	100Y	PMF
CC_1	2.34	2.414	2.502	2.569	2.711	3.344
CC_10	2.506	2.544	2.602	2.649	2.778	3.413
CC_11	2.502	2.541	2.598	2.646	2.774	3.407
CC_12	2.51	2.546	2.606	2.654	2.785	3.422
CC_13	2.509	2.546	2.605	2.654	2.784	3.42
CC_2	2.431	2.466	2.508	2.568	2.718	3.343

Node			EXISTING			
	5Y	10Y	20Y	50Y	100Y	PMF
CC_3	2.368	2.432	2.512	2.569	2.718	3.344
CC_4	2.404	2.463	2.532	2.587	2.715	3.341
CC_5	2.419	2.479	2.54	2.593	2.723	3.341
CC_6	2.478	2.523	2.58	2.624	2.746	3.35
CC_7	2.499	2.537	2.593	2.64	2.765	3.37
CC_8	2.499	2.538	2.594	2.64	2.767	3.389
CC_9	2.499	2.538	2.594	2.641	2.769	3.397
CP_1	2.472	2.513	2.562	2.601	2.7	3.187
CP_1	2.472	2.513	2.562	2.601	2.7	3.187
CP_2	2.452	2.5	2.551	2.585	2.693	3.188
CP_3	2.386	2.446	2.501	2.551	2.674	3.19
Golf	2.555	2.593	2.649	2.698	2.829	3.495
Lane_1	2.304	2.366	2.442	2.502	2.637	3.193
Lane_2	2.242	2.297	2.363	2.414	2.543	3.055
Lane_3	2.026	2.077	2.141	2.189	2.319	2.838
Lane_4	1.814	1.814	1.814	1.814	1.9	2.4
Main_1	2.42	2.454	2.504	2.541	2.653	3.157
Main_2	2.402	2.435	2.483	2.519	2.627	3.117
Main_3	2.383	2.414	2.46	2.494	2.596	3.056
Main_4	2.154	2.184	2.227	2.264	2.361	2.756
Main_5	2.155	2.184	2.228	2.265	2.361	2.756
Main_6	1.853	1.859	1.871	1.883	1.993	2.515
Main_7	1.814	1.814	1.814	1.814	1.9	2.4
NewGym_1	2.457	2.491	2.542	2.581	2.689	3.166
NewGym_2	2.41	2.443	2.491	2.527	2.636	3.127
NewGym_3	2.304	2.321	2.349	2.374	2.454	2.837
NewGym_4	2.183	2.215	2.262	2.3	2.399	2.785
NewGym_5	2.163	2.194	2.237	2.274	2.371	2.729
NewGym_6	1.866	1.877	1.908	1.933	2.086	2.622
NewGym_7	1.814	1.814	1.814	1.814	1.9	2.4
OldGym_1	2.422	2.455	2.503	2.539	2.649	3.151
OldGym_2	2.397	2.43	2.479	2.515	2.622	3.117
OldGym_3	2.209	2.238	2.282	2.285	2.38	2.782
OldGym_4	2.174	2.204	2.249	2.29	2.386	2.788
OldGym_5	2.081	2.109	2.149	2.186	2.275	2.659
OldGym_6	1.954	1.967	1.988	2.007	2.103	2.576
OldGym_7	1.814	1.814	1.814	1.814	1.9	2.4
PF_1	2.431	2.431	2.431	2.442	2.5	2.893
PF_2	2.505	2.505	2.505	2.505	2.505	2.838
PF_3	2.165	2.165	2.165	2.165	2.165	2.568
PF_4	1.814	1.814	1.814	1.814	1.9	2.4
SEA	1.814	1.814	1.814	1.814	1.9	2.4
WESTFIELD_1	2.304	2.37	2.447	2.507	2.632	3.177
WESTFIELD_2	2.244	2.299	2.366	2.417	2.552	3.064
WESTFIELD_3	2.012	2.056	2.109	2.148	2.259	2.713
WESTFIELD_4	1.814	1.814	1.814	1.814	1.9	2.4

Table 4, Design Flood Levels for proposed conditions (m AHD)

Node			PROPOSED			
	5Y	10Y	20Y	50Y	100Y	PMF
CC_1	2.291	2.378	2.473	2.545	2.695	3.352
CC_10	2.479	2.522	2.583	2.635	2.772	3.436
CC_11	2.497	2.518	2.579	2.632	2.768	3.431
CC_12	2.504	2.525	2.587	2.64	2.778	3.443
CC_13	2.502	2.524	2.586	2.639	2.777	3.441
CC_2	2.414	2.448	2.493	2.544	2.702	3.352
CC_3	2.316	2.399	2.485	2.546	2.702	3.352
CC_4	2.362	2.437	2.508	2.565	2.699	3.349
CC_5	2.376	2.454	2.516	2.57	2.707	3.349
CC_6	2.445	2.491	2.552	2.602	2.73	3.361
CC_7	2.468	2.511	2.571	2.623	2.752	3.385
CC_8	2.47	2.512	2.572	2.625	2.757	3.406
CC_9	2.469	2.512	2.573	2.625	2.761	3.418
CP_1	2.398	2.441	2.498	2.549	2.669	3.185
CP_1	2.398	2.441	2.498	2.549	2.669	3.185
CP_2	2.398	2.442	2.501	2.547	2.664	3.187
CP_3	2.337	2.418	2.475	2.524	2.653	3.188
Golf	2.542	2.579	2.634	2.685	2.819	3.506
Lane_1	2.248	2.33	2.413	2.474	2.617	3.193
Lane_2	2.187	2.266	2.337	2.39	2.526	3.055
Lane_3	1.991	2.046	2.116	2.167	2.303	2.839
Lane_4	1.814	1.814	1.814	1.814	1.9	2.4
Main_1	2.308	2.351	2.409	2.461	2.578	3.131
Main_2	2.277	2.321	2.377	2.427	2.541	3.089
Main_3	2.229	2.269	2.322	2.367	2.483	2.993
Main_4	2.086	2.118	2.163	2.202	2.322	2.76
Main_5	2.086	2.119	2.164	2.203	2.323	2.761
Main_6	1.889	1.9	1.917	1.933	2.036	2.544
Main_7	1.814	1.814	1.814	1.814	1.9	2.4
NewGym_1	2.405	2.449	2.505	2.558	2.671	3.187
NewGym_2	2.323	2.373	2.434	2.475	2.567	3.147
NewGym_3	2.204	2.243	2.28	2.309	2.399	2.798
NewGym_4	2.095	2.127	2.176	2.218	2.348	2.763
NewGym_5	2.09	2.122	2.169	2.207	2.332	2.714
NewGym_6	1.89	1.903	1.922	1.941	2.052	2.619
NewGym_7	1.814	1.814	1.814	1.814	1.9	2.4
OldGym_1	2.306	2.348	2.405	2.456	2.572	3.118
OldGym_2	2.283	2.325	2.379	2.429	2.544	3.086
OldGym_3	2.109	2.146	2.198	2.239	2.355	2.838
OldGym_4	2.111	2.147	2.2	2.24	2.357	2.839
OldGym_5	2.035	2.067	2.112	2.15	2.262	2.699
OldGym_6	1.935	1.95	1.973	1.992	2.094	2.587
OldGym_7	1.814	1.814	1.814	1.814	1.9	2.4
PF_1	2.431	2.431	2.431	2.431	2.477	2.884
PF_2	2.505	2.505	2.505	2.505	2.505	2.829
PF_3	2.165	2.165	2.165	2.165	2.165	2.561
PF_4	1.814	1.814	1.814	1.814	1.9	2.4
SEA	1.814	1.814	1.814	1.814	1.9	2.4
WESTFIELD_1	2.249	2.334	2.418	2.48	2.614	3.179
WESTFIELD_2	2.189	2.268	2.34	2.394	2.534	3.064

Table 5, Differences between proposed and existing conditions

			Difference (m)			
Node	5Y	10Y	20Y	50Y	100Y	PMF
CC_1	-0.049	-0.036	-0.029	-0.024	-0.016	0.008
CC_10	-0.027	-0.022	-0.019	-0.014	-0.006	0.023
CC_11	-0.005	-0.023	-0.019	-0.014	-0.006	0.024
CC_12	-0.006	-0.021	-0.019	-0.014	-0.007	0.021
CC_13	-0.007	-0.022	-0.019	-0.015	-0.007	0.021
CC_2	-0.017	-0.018	-0.015	-0.024	-0.016	0.009
CC_3	-0.052	-0.033	-0.027	-0.023	-0.016	0.008
CC_4	-0.042	-0.026	-0.024	-0.022	-0.016	0.008
CC_5	-0.043	-0.025	-0.024	-0.023	-0.016	0.008
CC_6	-0.033	-0.032	-0.028	-0.022	-0.016	0.011
CC_7	-0.031	-0.026	-0.022	-0.017	-0.013	0.015
CC_8	-0.029	-0.026	-0.022	-0.015	-0.01	0.017
CC_9	-0.03	-0.026	-0.021	-0.016	-0.008	0.021
CP_1	-0.074	-0.072	-0.064	-0.052	-0.031	-0.002
CP_1	-0.074	-0.072	-0.064	-0.052	-0.031	-0.002
CP_2	-0.054	-0.058	-0.05	-0.038	-0.029	-0.001
CP_3	-0.049	-0.028	-0.026	-0.027	-0.021	-0.002
Golf	-0.013	-0.014	-0.015	-0.013	-0.01	0.011
Lane_1	-0.056	-0.036	-0.029	-0.028	-0.02	0
Lane_2	-0.055	-0.031	-0.026	-0.024	-0.017	0
Lane_3	-0.035	-0.031	-0.025	-0.022	-0.016	0.001
Lane_4	0	0	0	0	0	0
Main_1	-0.112	-0.103	-0.095	-0.08	-0.075	-0.026
Main_2	-0.125	-0.114	-0.106	-0.092	-0.086	-0.028
Main_3	-0.154	-0.145	-0.138	-0.127	-0.113	-0.063
Main_4	-0.068	-0.066	-0.064	-0.062	-0.039	0.004
Main_5	-0.069	-0.065	-0.064	-0.062	-0.038	0.005
Main_6	0.036	0.041	0.046	0.05	0.043	0.029
Main_7	0	0	0	0	0	0
NewGym_1	-0.052	-0.042	-0.037	-0.023	-0.018	0.021
NewGym_2	-0.087	-0.07	-0.057	-0.052	-0.069	0.02
NewGym_3	-0.1	-0.078	-0.069	-0.065	-0.055	-0.039
NewGym_4	-0.088	-0.088	-0.086	-0.082	-0.051	-0.022
NewGym_5	-0.073	-0.072	-0.068	-0.067	-0.039	-0.015
NewGym_6	0.024	0.026	0.014	0.008	-0.034	-0.003
NewGym_7	0	0	0	0	0	0
OldGym_1	-0.116	-0.107	-0.098	-0.083	-0.077	-0.033
OldGym_2	-0.114	-0.105	-0.1	-0.086	-0.078	-0.031
OldGym_3	-0.1	-0.092	-0.084	-0.046	-0.025	0.056
OldGym_4	-0.063	-0.057	-0.049	-0.05	-0.029	0.051
OldGym_5	-0.046	-0.042	-0.037	-0.036	-0.013	0.04
OldGym_6	-0.019	-0.017	-0.015	-0.015	-0.009	0.011
OldGym_7	0	0	0	0	0	0
PF_1	0	0	0	-0.011	-0.023	-0.009
PF_2	0	0	0	0	0	-0.009
PF_3	0	0	0	0	0	-0.007
PF_4	0	0	0	0	0	0
SEA	0	0	0	0	0	0
WESTFIELD_1	-0.055	-0.036	-0.029	-0.027	-0.018	0.002
WESTFIELD_2	-0.055	-0.031	-0.026	-0.023	-0.018	0

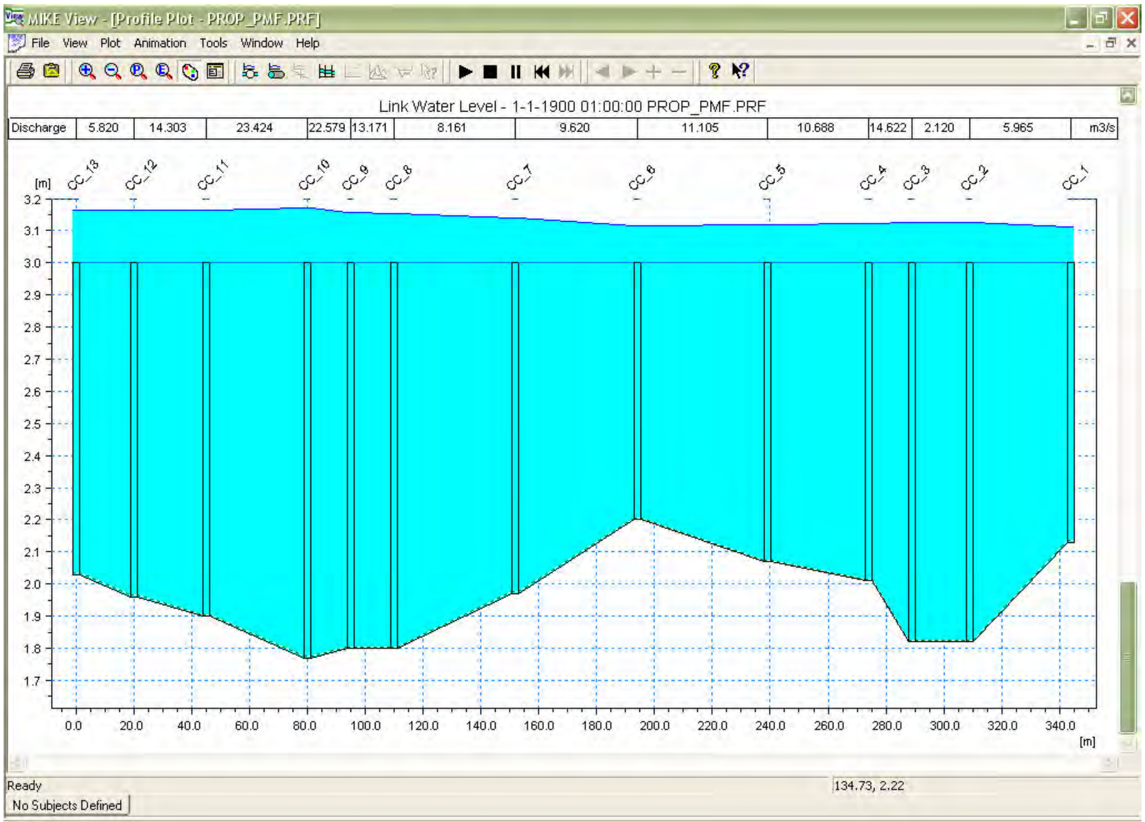


Figure 7, Extreme Flood Profile along Captain Cook Drive

7. HYDRAULIC FLOOD HAZARD CATEGORISATION

The hydraulic hazard categorisation was defined using the depth by velocity product. If the product exceeds a value of 0.4 m2/s the hydraulic hazard is considered as high. The assessment is shown in table 3 below. Toyota Park playing fields were not incorporated into the hydraulic model. Water can enter the playing fields through the tunnel. The water level at Node “Old Gym_3” can be used to define the 100 year flood levels inside Toyota Park. The flood level at Node OldGym_3 is 2.48 m AHD, while the lowest ground level is some 2.23 m AHD, resulting in a maximum depth of inundation of some 250 mm. Velocity is zero, so the hydraulic flood hazard for Toyota Park playing field is low.

The 100 year flood levels for existing and proposed conditions are given in Table 6.

Table 6, Hydraulic Hazard Categorisation

From	To	Q (m3/s)	V (m/s)	Depth (m)	V x D	Hydraulic Hazard	Comment
Golf	CC_1	5.058	0.544	0.310	0.169	Low	
Golf	CC_1	4.666	0.544	0.390	0.212	Low	
Golf	CC_2	2.164	0.515	0.560	0.288	Low	
Golf	CC_3	5.925	0.515	0.460	0.237	Low	
Golf	CC_4	2.218	0.528	0.560	0.296	Low	
Golf	CC_6	5.617	0.284	0.360	0.102	Low	
Golf	CC_5	9.823	0.682	0.360	0.246	Low	
Golf	CC_7	7.138	0.333	0.510	0.170	Low	
Golf	CC_8	6.758	0.358	0.590	0.211	Low	
Golf	CC_9	3.180	0.353	0.600	0.212	Low	
Golf	CC_10	5.520	0.329	0.560	0.184	Low	
Golf	CC_12	3.216	0.314	0.410	0.129	Low	
Golf	CC_11	3.731	0.311	0.480	0.149	Low	
Golf	CC_13	1.825	0.315	0.290	0.091	Low	
CC_1	WestField_1	12.05	0.323	0.746	0.241	Low	
CC_5	CP_3	8.841	0.319	0.504	0.161	Low	
CC_6	CP_2	4.349	0.248	0.417	0.104	Low	
CC_7	CP_1	5.692	0.322	0.421	0.136	Low	
CC_8	NewGym_1	8.847	0.363	0.872	0.316	Low	
CC_9	Main_1	8.288	0.499	0.922	0.460	High	Pedestrian access, entrance point
CC_10	OldGym_1	6.455	0.483	1.029	0.497	High	
Lane_1	WestField_1	2.936	0.111	0.697	0.077	Low	
Lane_2	WestField_2	-7.057	0.273	0.518	0.141	Low	
Lane_3	WsetFiled_3	3.811	0.202	0.378	0.076	Low	
OldGym_1	Main_1	-2.588	0.091	1.138	0.104	Low	
Main_1	NewGym_1	-8.375	0.427	0.784	0.335	Low	
OldGym_2	Main_2	-3.846	0.187	0.824	0.154	Low	
Main_2	NewGym_2	-5.288	0.258	0.586	0.151	Low	
OldGym_3	Main_3	-4.732	1.066	0.592	0.631	High	Proximity to deep, high velocity flow
Main_3	NewGym_3	6.871	0.754	0.608	0.458	High	
OldGym_4	Main_4	3.211	0.361	0.593	0.214	Low	
Main_4	NewGym_4	-4.391	0.369	0.397	0.146	Low	
OldGym_5	Main_5	-7.330	0.996	0.736	0.733	High	Proximity to high velocity flow
Main_5	NewGym_5	1.477	0.249	0.297	0.074	Low	
OldGym_6	Main_6	7.617	0.515	0.591	0.305	Low	
Main_6	NewGym_6	-3.977	2.790	0.048	0.133	Low	
Main_3	Main_4	8.047	0.640	1.258	0.805	High	
Main_5	Main_6	6.175	1.129	0.547	0.617	High	
NewGym_2	NewGym_3	0.050	0.152	0.008	0.001	Low	
CC_3	Lane_1	12.70	0.444	0.816	0.363	Low	
CP_2	PF_1	0.809	0.726	0.186	0.135	Low	
Golf	High School	6.130	1.202	0.510	0.613	High	
CP_2	PF_1	0.000	0.000	0.000	0.000	Low	
NewGym_2	PF_1	-0.813	0.105	0.258	0.027	Low	
NewGym_4	PF_2	0.000	0.000	0.000	0.000	Low	
NewGym_6	PF_3	0.000	0.000	0.000	0.000	Low	
WestFiled_3	WestField_4	11.68	1.640	0.480	0.787	High	
WestField_2	WsetFiled_3	7.867	1.074	0.561	0.603	High	
WestField_1	WestField_2	14.94	1.296	0.700	0.907	High	
PF_3	PF_4	0.010	0.015	0.100	0.002	Low	

From	To	Q (m3/s)	V (m/s)	Depth (m)	V x D	Hydraulic Hazard	Comment
PF_2	PF_3	0.001	0.071	0.005	0.000	Low	
PF_1	PF_2	0.000	-0.04	0.156	0.006	Low	
OldGym_6	OldGym_7	10.26	1.409	0.780	1.099	High	This is a high hazard corridor with excessive depths of water and high velocities.
OldGym_5	OldGym_6	17.88	2.378	0.776	1.844	High	
OldGym_4	OldGym_5	10.55	1.475	0.776	1.144	High	
OldGym_3	OldGym_4	13.76	1.917	0.613	1.175	High	
OldGym_2	OldGym_3	9.026	2.349	0.844	1.984	High	
OldGym_1	OldGym_2	6.161	0.971	1.158	1.124	High	
NewGym_6	NewGym_7	0.842	0.830	0.251	0.208	Low	
NewGym_5	NewGym_6	4.819	1.228	0.325	0.399	Low	
NewGym_4	NewGym_5	3.342	0.384	0.486	0.187	Low	
NewGym_3	NewGym_4	7.733	1.010	0.486	0.491	High	Proximity to deep, high velocity flow path
NewGym_1	CP_1	-6.762	-0.97	0.900	0.873	High	
NewGym_1	NewGym_2	5.338	0.748	0.900	0.673	High	
Main_6	Main_7	21.49	1.095	2.398	2.626	High	
Main_5	Main_6	3.726	1.186	2.817	3.341	High	
Main_4	Main_5	18.71	0.767	2.817	2.161	High	
Main_3	Main_4	3.058	0.956	3.108	2.972	High	
Main_2	Main_3	22.71	0.825	3.108	2.564	High	
Main_1	Main_2	21.27	0.865	3.026	2.618	High	
Lane_3	Lane_4	27.60	2.031	0.940	1.909	High	
Lane_2	Lane_3	31.42	2.348	0.978	2.295	High	
Lane_1	Lane_2	24.39	1.465	0.978	1.432	High	
Golf	Main_1	2.834	1.740	2.574	4.478	High	
CP_3	Lane_1	14.76	1.021	0.787	0.804	High	Cars would float, barriers should be installed to prevent cars being washed away
CP_2	CP_3	6.329	0.866	0.559	0.484	High	
CP_1	CP_2	-1.51	-0.63	0.436	0.274	Low	
Golf	Main_1	2.834	1.740	2.574	4.478	High	
CC_9	CC_8	-2.164	-0.79	0.972	0.766	High	Highly hazardous pedestrian access during game days. If Bureau of Meteorology severe weather warning is on, or severe storms are in progress visitors should be kept within the premises until the danger is gone.
CC_8	CC_7	-4.540	-1.14	0.972	1.113	High	
CC_7	CC_6	2.372	-1.14	0.801	0.913	High	
CC_6	CC_5	3.702	1.013	0.654	0.662	High	
CC_5	CC_4	4.703	1.003	0.702	0.704	High	
CC_4	CC_3	6.929	1.057	0.896	0.948	High	
CC_13	CC_12	-1.058	-0.26	0.896	0.233	High	
CC_12	CC_11	2.321	0.307	0.896	0.275	High	
CC_11	CC_10	1.825	-0.95	0.815	0.771	High	
CC_10	CC_9	5.040	0.555	0.876	0.486	High	
CC_3	CC_2	8.772	0.840	1.009	0.847	Low	
CC_2	CC_1	7.316	0.658	1.009	0.664	Low	

8. FLOOD RISK PRECINCTS

The entire area surrounding the Toyota Park and the playing fields can be divided into three major Flood Risk Precincts using the hydraulic flood categorisation and the recommendations in the Council's Flood Risk Management DCP.

These are summarised in Table 5.

Table 5, Toyota Park Flood Risk Precincts

Location	Affected by 100 y Flood ?	Hydraulic Hazard	Evacuation to high ground possible ?	Flood Risk Precinct
Eastern Grand Stand	No	Low	Not applicable	Low
Southern Grand Stand	No	Low	Yes	Low
Western Grand Stand	No	Low	Yes	Low
Western Grand Stand Tunnel	Yes	High (high depth)	Yes	Medium
Toyota Park	Yes	Low	Yes	Medium
Captain Cook Drive	Yes	High	Yes	High
Southern half of the Western Carpark	Yes	High	Difficult	High
Northern half of the Western Carpark	Yes	Low	Difficult	Medium
Playing Fields	Yes	Low	Difficult	Medium
Stage 1, Gym	Yes	Low	Yes	Medium
Stage 2	Yes	Low	Yes	Medium
Stage 3	Yes	High	Yes	Medium
Stage 4	Yes	High	Difficult	High

9. PRESCRIPTIVE CONTROLS FOR THE PROPOSED DEVELOPMENTS

9.1 Stage 1, New Gym

The land use for this development was classified as "Commercial or Industrial" in consultation with the Council. The hydraulic hazard is low and the Flood Risk Precinct is medium. The prescribed controls from schedule 3 of the Councils FRM DCP are addressed below.

Floor levels, the prescriptive controls are: 2, 4 and 6.
2) The 100 year flood level is 2.64 m AHD and the minimum floor level must be set 500 mm higher at R.L. 3.14 m AHD. The floor level of the building is proposed at RL 3.24m AHD.
4) There are no non-habitable areas, therefore this control does not apply;
6) The lowest existing ground levels at this site are around R.L. 2.4 m AHD, and the lowest habitable floor level would be a maximum of 840 mm above the finished ground levels, therefore this control is not applicable.

Building components and method, the prescriptive controls are: 1.
1) The proposed foundations and the structure between the floor level and the finished ground level is a concrete slab. Concrete slab is flood compatible material.

Structural soundness, the prescriptive controls are: 1.

1) The structural report will be submitted with a construction certificate, certifying that the proposed concrete structure will be able to withstand the forces of floodwaters, debris and buoyancy up to and including a 1% AEP flood plus 500 mm freeboard.

Flood effects, the prescriptive controls are: 1.
1) The cumulative impact of the proposed four stages on flood levels is negligible, with the highest increase of 96 mm at node OldGym_5, with the remaining flood levels remaining the within 20 mm of 100 year flood levels for existing conditions (see drawing C-01 and C-02). There are no habitable dwelling near node OldGym_5. It can be concluded that the proposed development will not have a significant impact on flood levels nor on flood behaviour during the 1% AEP design flood event.

Carparking and driveway access, the prescriptive controls are: 1, 3, 5, 6, 7 and 8.
No new carparking or driveways are proposed as a part of this development and the existing levels are being maintained. The existing carparking facilities are assessed below.
1) The existing surface levels of the open car park are below the 1% AEP flood levels, however, they continuously increase from the point of entry (Captain Cook Drive), therefore this conditions is satisfied.
3) No garages or enclosed parking are proposed;
5) The existing surface levels are well below the 1% AEP flood levels, exceeding the prescribed maximum depth of 300 mm, however, the levels are always higher than the levels of Captain Cook Drive at the point of entry. The depth of flow in Captain Cook Drive is approximately 1.0m, while the depth of flow at the carpark varies between 200-700.
6) No enclosed carparking is proposed;
7) A railing fence is recommended along the tidal channel to act as vehicle barrier to prevent floating vehicles leaving the site;
8) No enclosed carparking is proposed.

Evacuation, the prescriptive controls are: 1, 2, 3 and 4.
1) Reliable access for pedestrians or vehicles can not be provided, because Captain Cook Drive would be 1 m under water during the 1%AEP Flood event. The proposal is a gym for players only, which can be classified as residential land use, in which case this control is not applicable;
2) The proposed building is a two storey building and evacuation to higher ground would be simply to go up to the second floor. Furthermore, the flood level for the extreme flood is only 300 mm above the 1% AEP flood level, making the proposed ground floor safe even during the extreme flood event;
3) The evacuation to higher level is safe and easy and does not require the assistance from SES. Furthermore, the proposed ground floor level is some 200 mm above the PMF level, so the only required procedure during the large and extreme floods would be to keep the occupants inside until the flood event is over. Simple signs at the doors advising that the everyone should remain inside in a case of an overland flow, would be sufficient for this purpose. The FTC building can become a place of refuge for people in the carpark or on the training field in the event of a large flood.

4) There is no existing flood evacuation strategy for the area and there is no a floodplain management plan, however, should these become available the club management must adopt these by modifying or adding the appropriate signage.

Management and design, the prescriptive controls are: 3 and 5.
3) There is no other floor level lower than the 1% AEP flood level plus 500 mm freeboard, demonstrating a compliance with this requirement;
5) No storage space is available below the lowest habitable floor level.

9.2 Stage 2

The land use for this development is for proposed grandstand and was classified as "Commercial or Industrial" in consultation with the Council. The hydraulic hazard is low and the Flood Risk Precinct is medium. The prescribed controls from schedule 3 of the Councils FRM DCP are addressed below.

Floor levels, the prescriptive controls are: 2, 4 and 6.
2) The 100 year flood level is 2.78 m AHD and the minimum floor level must be set 500 mm higher at R.L. 3.28 m AHD. The proposed ground floor level on the grandstand is RL 3.31m., and RL on the concourse to the north of the grandstand is at RL 3.5m.
4) The keg storeroom floor level is at R.L. 2.5, and is dedicated for storing beer kegs. These could not be damaged by water. The ticket office is also with a floor level at R.L. 2.5 m AHD, which is determined by the existing footpath levels.
6) The lowest existing ground levels at this site are around R.L. 2.2 m AHD, and the highest floor level would be 3.5 m, so the maximum floor level elevation would be less than 1.3 m, therefore this control is not applicable.

Building components and method, the prescriptive controls are: 1.
1) The proposed foundations and the structure between the floor level and the finished ground level is concrete. Concrete is flood compatible material.

Structural soundness, the prescriptive controls are: 1.
1) The structural report will be submitted with a construction certificate, certifying that the proposed concrete structure will be able to withstand the forces of floodwaters, debris and buoyancy up to and including a 1% AEP flood plus 500 mm freeboard.

Flood effects, the prescriptive controls are: 1.
1) The cumulative impact of the four proposed stages on flood levels is negligible, as described in Flood effects for Stage 1.

Carparking and driveway access, the prescriptive controls are: 1, 3, 5, 6, 7 and 8.
No new carparking or driveways are proposed as a part of this development. The existing carparking facilities are assessed below.
1) The existing surface levels of the open carparking to the West are below the 1% AEP flood levels, however, they continuously increase from the point of entry (Captain Cook Drive), therefore this conditions is satisfied; The surface levels of the open carpark to the East are above the PMF level;
3) No garages are proposed;
5) The existing West carpark surface levels are well below the 1% AEP flood levels, exceeding the prescribed maximum depth of 300 mm, however, the depth in the driveway is less than the depth in Captain Cook Drive;
6) Enclosed carparking is not proposed;

7) A railing fence is recommended along the tidal channel to act as vehicle barrier to prevent floating vehicles leaving the site;
8) No enclosed carparking is proposed.

Evacuation, the prescriptive controls are: 1, 2, 3 and 4.
1) Reliable access for pedestrians would be available within the premises as the proposed floor levels are above the PMF level of 3.178 m AHD;
2) The proposed minimum habitable floor level is above the PMF level, therefore evacuation would not be required;
3) The stand level is above the PMF level and does not require the assistance from SES. The only required procedure during the large and extreme floods would be to keep the visitors inside until the flood event is over. Simple signs at the exits advising that the visitors should remain inside in a case of an overland flow, would be sufficient for this purpose.
4) There is no existing flood evacuation strategy for the area nor is there any existing floodplain management plan, however, should these become available the club management must incorporate these by modifying or adding the appropriate signage.

Management and design, the prescriptive controls are: 3 and 5.
3) As mentioned above the beer kegs are flood resistant, and no other materials or goods susceptible to flood damage must be stored. The goods in the ticket office could be lifted 1.2 m above the floor level, which is higher than the PMF level;
5) Storage of materials which may cause pollution or be potentially hazardous during any flood must not be allowed in the keg room or in the ticket office. These controls (3 and 5) must be incorporated in the Club's operating manual and QA procedures or similar.

9.3 Stage 3

This Stage of works applies to improvements to an existing facility viz. the ET Grandstand, with some upgrade works including new lift attached to outside of the Building for disabled access to upper floors. All other works are confined to the footprint of the existing structure. Even though the existing facilities are not residential, the controls for "Concessional Development" were adopted. The hydraulic hazard is high and the Flood Risk Precinct is medium. The prescribed controls from schedule 3 of the Councils FRM DCP are addressed below.

Floor levels, the prescriptive controls are: 5 and 6.
5) No extension works are proposed but the lift, with an area less than 4 m2, and the west wall of the ET stand are proposed to extend out some 22.5m2.
6) No additional walls/enclosement of existing areas under the habitable floor areas are proposed.

Building components and method, the prescriptive controls are: 1.
1) The existing foundations and the structure between the floor level and the finished ground level are made of concrete or bricks. Concrete and bricks are considered as flood compatible materials.

Structural soundness, the prescriptive controls are: 1.

1) The structural report will be submitted with a construction certificate, certifying that the proposed concrete structure will be able to withstand the forces of floodwaters, debris and buoyancy up to and including a 1% AEP flood plus 500 mm freeboard.

Flood effects, the prescriptive controls are: 1.
1) The cumulative impact of the proposed upgrade would result in a maximum increase in flood levels of up to 20 mm along Captain Cook ,which was considered as significant. In order to offset the impact it would be necessary to enlarge the opening under the existing concrete bridge and widen the overland flow path area next to the bridge by 1 m. With these works carried out the impact of the proposed extension would be zero.

Carparking and driveway access, the prescriptive controls are: 6, 7 and 8.
No new carparking or driveways are proposed as a part of this development.

Evacuation, the prescriptive controls are: 2, 3 and 4.
2) A reliable access is available from the lowest habitable floor level at R.L. 1.96 m AHD to higher levels within the same structure to levels above the PMF level of 2.96 m AHD.
3) Signage must be provided directing the occupants/visitors to higher than the PMF level areas. Signs must also be provided advising that in a case of visible flood flows the occupants/visitors must remain inside until the flood event is over.
4) There is no an existing flood evacuation strategy for the area nor is there any existing floodplain management plan, however, should these become available the club management must incorporate these by modifying or adding the appropriate signage.

Management and design, the prescriptive controls are: 2, 3 and 5.
2) Site Emergency Response Flood Plan must be prepared for the entire area as a part of the crowd management plan;
3) No new goods prone to flood damage are to be stored in areas below R.L. 3.12 m AHD. It must be noted that there are already kitchens / bars / servery operating on ground floor.
5) No storage of materials below the design floor level (3.12 m AHD) which may cause pollution or be potentially hazardous is allowed. These controls (3 and 5) must be incorporated in the Club's management protocol, as a QA procedure or similar.

9.4 Stage 4, extension of the existing culverts, upgrade of the timber footbridge and new access point at the existing concrete bridge at north-west entry

The proposed extension of the existing culverts is required to provide a safe pedestrian access during game day events. Significant depths and flow velocities are expected during 1% AEP flood event resulting in high hydraulic hazard categorisation and high flood risk precinct. This is a specific structure which must follow the levels of Captain Cook Drive. The hydraulic hazard and the flood risk precinct for the proposed structure would be identical to the existing while reducing the traffic hazard and minimising the pedestrian exposure to traffic.

There would be no impact of the proposed extension on flood behaviour (Table 4), and the structure would be made of concrete capable of withstanding the forces from debris, buoyancy and flood flows.

As this is a very specific structure we could not determine the land use category or the controls which must be applied.

The existing timber footbridge is proposed to be replaced by a steel bridge at a slightly higher level.

The existing concrete bridge at the north-west entry (downstream of the timber footbridge) would remain with some additional works to help control the crowd flow during game days.

10. CONCEPTUAL CROWD MANAGEMENT PLAN DURING FLOOD EVENTS

The oval is a crowd attraction area which results in an influx of people, especially during main event game days. Minor games at Toyota Park, and junior games, Oztag and training events on the western playing fields also occur on the site.

The floods in this area are caused by relatively short duration storm events. In a case of an overland flow, the depth of water on parts of the carpark can increase from zero to approximately 0.8m to 1.0m in 20 minutes. It is possible that people and cars could be caught inside the inundated areas and exposed to a high flood hazard. A Crowd Management Plan would need to be prepared that addresses a number of scenarios, one of which would be flood events, covered under a **Site Emergency Response Flood Plan.**

The **Site Emergency Response Flood Plan** would describe actions aimed to:

- Minimize the number of people and cars which might be caught in the middle of inundated areas;
- Prevent people and cars being swept into areas of deeper water and/or with higher velocities;
- Direct people to safe refuge locations.

Safe refuge locations are:

- The Club Building and the car park associated with the Club Building;
- The high stand areas of the oval;
- The far western training field;
- The New Gym Building.

Flood depth indicators must be placed:

- Along the footpath of Captain Cook Drive;
- On each landscaping island of the western car park area;
- At 20 m intervals along the fence on the west side of the tidal channel ;
- At 10 m intervals along the service road between the tidal channel and the ET Stand / main oval, from Captain Cook Drive to north of the north-west entry;
- On each side of the foot bridges.

Flood evacuation plaques should be placed at strategic locations identifying the closest flood refuge location (see Drawing C-02).

An Example of Flood Evacuation Advise Plaque is given on Figure 8.

Flood emergency action plan should be instigated in an event of a severe weather warning issued by the Bureau of Meteorology for the local area. There must be several stages in the plan:

- Stage 1, Bureau of Meteorology issues a severe weather warning for the local area ➔ start with the emergency action plan;
- Stage 2, Severe thunderstorm begins with a very intensive rain ➔ Inform the people within the area, including the oval that because a severe thunderstorm is currently underway, it might be followed by a flood;
- Stage 3, Ponding of flood waters can be observed in the Golf Course Area ➔ Inform the people that it is very likely that flooding of Captain Cook Drive is likely and that people are required not to leave the Oval until advised.
- Stage 4, Overland flow is observed over Captain Cook Drive ➔ Inform the people that flooding is underway, and that everyone in the vicinity of the club grounds must evacuate in accordance with the flood evacuation signs placed at strategic locations. In general the advice given to people would depend on the area people are caught in:
  - people caught in the vicinity of the club building must either evacuate to the eastern side car park area or towards the Leagues Club building,
  - people caught on the Leagues Club side of Captain Cook Drive must evacuate towards the eastern car park,
  - people caught within the compounds of the Oval must evacuate to the higher grounds within the oval;
  - People caught on the western side of Captain Cook Drive must evacuate towards the far western training field,
  - People caught in the western carpark area must evacuate to the far western training field,
  - People in the vicinity of the new Gym must evacuate to inside the New Gym building if open and to the far western training field.
  - It must be categorically forbidden to remove cars from the western car park, because it will prolong the exposure to flood hazard, which might result in drowning,
  - The flood action plan must prevent people wading into deeper areas, and avoid by any means crossing the tide channel.
- Stage 5, overland flow seized, severe weather warning is off ➔ announce that flood danger is over and that people are free to leave.

A Crowd Management Plan could be required as part of Development Consent.

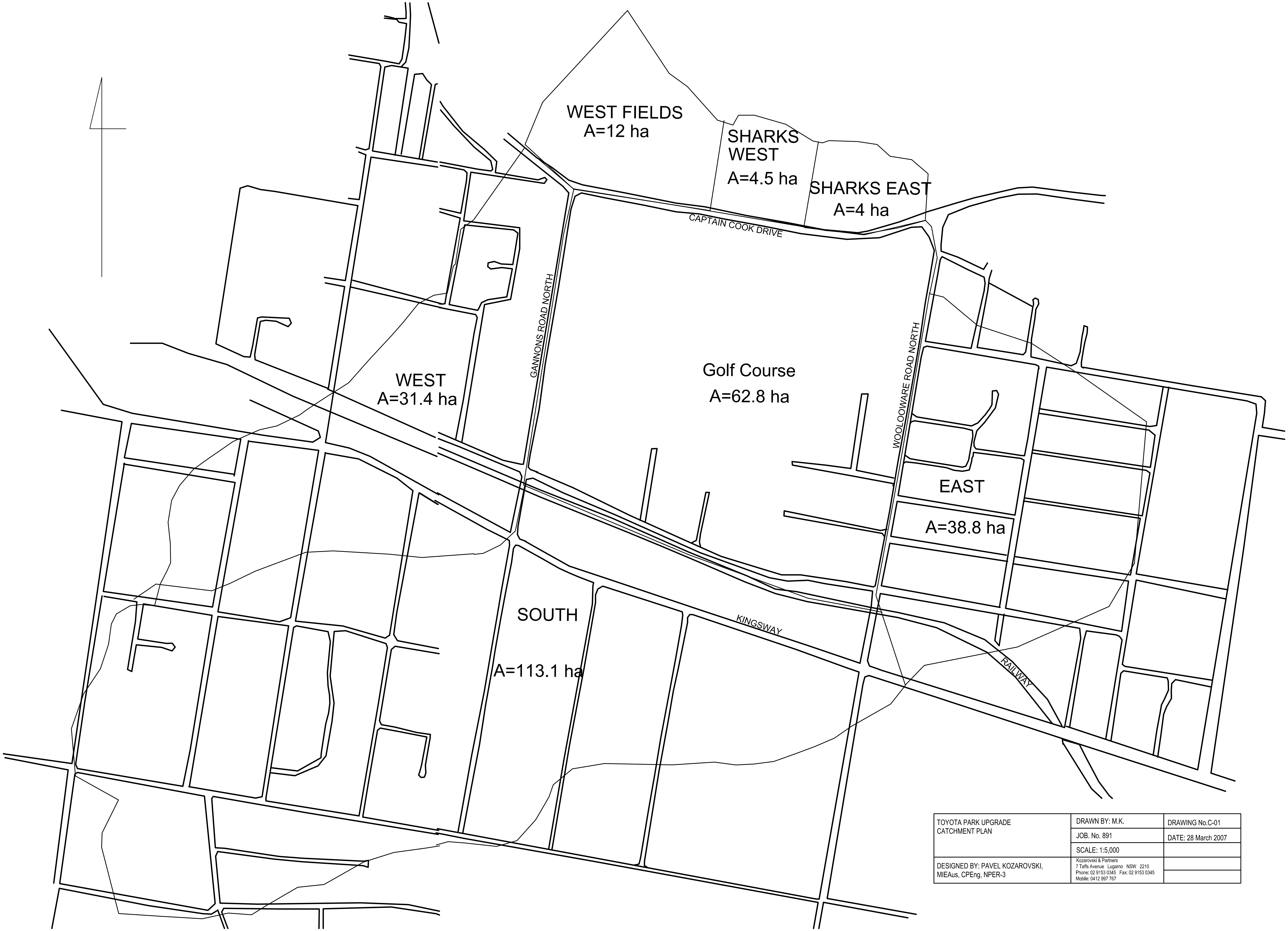
11. CONCLUSION

The area around Toyota Park is affected by flood flows. Large quantities of water would flow from the Golf Course onto Captain Cook Drive and then onto the Toyota Park area in a 100 year flood event.

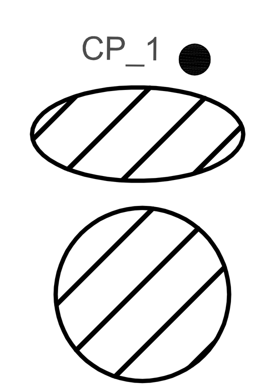
High velocities and excessive water depths would make some areas extremely hazardous during the 1 in 100 year design flood. Captain Cook Drive and its footpaths would be submerged with depths at the tidal channel crossing exceeding 0.8 m and velocities exceeding

1.4 m/s. It would be hazardous to wade through such a torrent. All existing premises have available areas above the PMF levels which can be considered as safe evacuation points. A Site Emergency Response Flood Plan must be incorporated into the Crowd Management Plan, incorporating procedures how to recognise a flood (weather monitoring and relying on severe weather warning from the Bureau of Meteorology) and in a case of a flood, procedures how to keep people within the premises until the flood is gone.

The proposed development would not have any significant impact on flood levels and flood behaviour, providing the proposed works for impact attenuation are executed. The prescriptive flood hazard management controls must be incorporated in the Club's operating manual and QA procedures.



TOYOTA PARK UPGRADE CATCHMENT PLAN	DRAWN BY: M.K.	DRAWING No.C-01
	JOB. No. 891	DATE: 28 March 2007
	SCALE: 1:5,000	
DESIGNED BY: PAVEL KOZAROVSKI, MIEAus, CPEng, NPER-3	Kozarovski & Partners 7 Taffs Avenue Lugarno NSW 2210 Phone: 02 9153 0345 Fax: 02 9153 0345 Mobile: 0412 997 767	



HYDRAULIC MODEL CALCULATION POINT

ANTICIPATED CROWD CONCENTRATION AREA

FLOOD EVACUATION AREA

SITE AND HYDRAULIC MODEL LAYOUT FLOOD EMWRGENCY CROWD MANAGEMENT	DRAWN BY: M.K.	DRAWING C-02
	JOB. No. 891	DATE: 23/03/2007
DESIGNED BY: PAVEL KOZAROVSKI, MIEAus, CPEng, NPER-3	Kozarovski & Partners 7 Taffs Avenue Lugarno NSW 2210 Phone: 02 9153 0345 Fax: 02 9153 0345 Mobile: 0412 997 767	

PROPOSED CONDITIONS	DRAWN BY: M.K.	DRAWING C-03
	JOB. No. 891	DATE: 23/03/2007
	SCALE: 1:1,000	
DESIGNED BY: PAVEL KOZAROVSKI, MIEAus, CPEng, NPER-3	Kozarovski & Partners 7 Taffs Avenue Lugarno NSW 2210 Phone: 02 9153 0345 Fax: 02 9153 0345 Mobile: 0412 997 767	

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Date: 17 March 2009
J. No. 1404

DBL Property
Mr. Andre Durbidge

Dear Mr. Durbidge,

Toyota Park East Redevelopment
Impact of climate change on flood levels in Captain Cook Drive

Kozarovski and Partners were engaged by DBL Property to undertake a flood study and a flood hazard minimisation study for the upgrade of Toyota Park. A tidal channel is located between Toyota Park and the training fields, draining a large catchment area. The tailwater level of 1.9 m AHD was used as a downstream boundary condition, as advised by the Council.

During our meeting with the Sutherland Shire Council's Engineer Dr. Guy Amos on 26th of February 2009 regarding the proposed Toyota Park East redevelopment we were advised that the elevated sea levels might affect the flood levels from the abovementioned flood study and that a sensitivity analysis should be undertaken to determine the flood levels at Captain Cooke Drive in the vicinity of the existing club building. A design tide level of 2.21 m AHD was specified in the subsequent e-mail from Dr. Amos of 26th of February 2009 as a conservative sea level due to climate change. I incorporated the specified level into the MikeStorm model and the resulting 100 year flood levels are given in Table 1 below.

It can be seen from the results that the impact of the sea level rise decreases with the distance from the Bay. The resulting increase in 100 year design flood levels in the vicinity of Captain Cook Drive is between 15 to 19 mm. Node CC_13 is the relevant node for determination of the floor levels for the proposed re-development at Toyota Park East.

It is recommended to increase the design 100 year flood level at node CC_13 from R.L. 2.77 m AHD by 100 mm to R.L. 2.87 m AHD for determination of floor levels and basement carpark driveway entry levels, to remain on a conservative side.

Table 1, 100 year design flood levels

Node	100y_pr	100y_Climate_change	Difference
CC_1	2.707	2.7238	0.0168
CC_10	2.7749	2.7925	0.0176
CC_11	2.7726	2.7903	0.0177
CC_12	2.772	2.7898	0.0178
CC_13	**2.7717**	**2.7895**	**0.0178**
CC_2	2.7141	2.7316	0.0175
CC_3	2.7142	2.732	0.0178
CC_4	2.7108	2.7287	0.0179
CC_5	2.7194	2.735	0.0156
CC_6	2.7418	2.7569	0.0151
CC_7	2.759	2.7755	0.0165
CC_8	2.7611	2.7789	0.0178
CC_9	2.7636	2.7817	0.0181
CP_1	2.6894	2.7021	0.0127
CP_2	2.6907	2.7035	0.0128
CP_3	2.6704	2.6863	0.0159
Golf_1	2.8244	2.8383	0.0139
Lane_1	2.6343	2.652	0.0177
Lane_2	2.5406	2.5593	0.0187
Lane_3	2.316	2.3408	0.0248
Lane_4	1.9	2.21	0.31
Main_1	2.5852	2.6246	0.0394
Main_2	2.5368	2.5843	0.0475
Main_3	2.4644	2.5243	0.0599
Main_4	2.4493	2.5125	0.0632
Main_5	2.3807	2.463	0.0823
Main_6	1.9061	2.1846	0.2785
Main_7	1.9	2.21	0.31
NewGym_1	2.6384	2.6664	0.028
NewGym_2	2.5532	2.5976	0.0444
NewGym_3	2.4387	2.4976	0.0589
NewGym_4	2.4401	2.4989	0.0588
NewGym_5	2.3887	2.4505	0.0618
NewGym_6	2.0697	2.3001	0.2304
NewGym_7	1.9	2.21	0.31
OldGym_1	1.8674	1.8679	0.0005
OldGym_2	2.605	2.605	0
OldGym_3	1.9141	2.201	0.2869
OldGym_4	1.9085	2.2013	0.2928
OldGym_5	1.9177	2.2024	0.2847

Node	100y_pr	100y_Climate_change	Difference
OldGym_6	1.9102	2.1996	0.2894
OldGym_7	1.9	2.21	0.31
PF_1	2.4926	2.5257	0.0331
PF_2	2.505	2.5232	0.0182
PF_3	2.1654	2.21	0.0446
PF_4	1.9	2.21	0.31
WESTFIELD_1	2.6294	2.6468	0.0174
WESTFIELD_2	2.5488	2.5679	0.0191
WESTFIELD_3	2.258	2.3302	0.0722
WESTFIELD_4	1.9	2.21	0.31

Pavel Kozarovski, MIE Aust, CPEng, NPER-3

DBL Property

Toyota Park

Toyota Park East Redevelopment

Site Stormwater Assessment

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DBL Property

Toyota Park

Toyota Park East Redevelopment

Site Stormwater Assessment

Author	Bruce Caldwell	[signature]
Checker	Gustavo Pereira	[signature]
Approver	Neil McMillan	[signature]
Report No	DN00025 Rev A	
Date	05 March 2009	

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Appendices

Appendix A: Existing Condition – DRAINS Model Input and Output
Appendix B: Proposed Condition Option 1 – DRAINS Model Input and Output
Appendix C: Proposed Condition Option 2 – DRAINS Model Input and Output
Appendix D: Charts of Comparison of Peak Flow – Existing and Option 2 with OSD

Drawings

Drawing SCK001 – Stormwater Layout Plan
Drawing SCK002 – Northern Site Area Typical Section Showing Proposed Drainage

1 INTRODUCTION

Hyder Consulting has been commissioned by DBL Property to carry out this concept stormwater assessment in support of a redevelopment proposal for the eastern portion of Toyota Park, Captain Cook Drive, Sutherland. The existing site is shown in Figure 1.

The assessment is limited to the development of a concept surface stormwater system layout for the site.

Figure 1: Existing Site Location (*"AUSIMAGE © Sinclair Knight Merz Pty Ltd 2008"*)

2 SITE DESCRIPTION

The Figure 1 aerial photograph shows the site which currently accommodates the existing Toyota Park eastern open car park and leagues club. The site is bounded by Captain Cook Drive to south, Woolooware Road North to the east, Woolooware Bay to the north and the main Toyota Park playing field to the west.

As indicated in Figure 2 a significant portion of the site grades to Woolooware Bay, with the remainder grading to Captain Cook Drive.

The site is almost fully impervious. Underground pit and pipe stormwater systems convey minor flows northward into the Bay, and southward connecting into the Captain Cook Drive stormwater system. There is no kerb and gutter system along the northern car park boundary, and the northern area flows that exceed or by pass the minor drainage system would continue overland into the Bay.

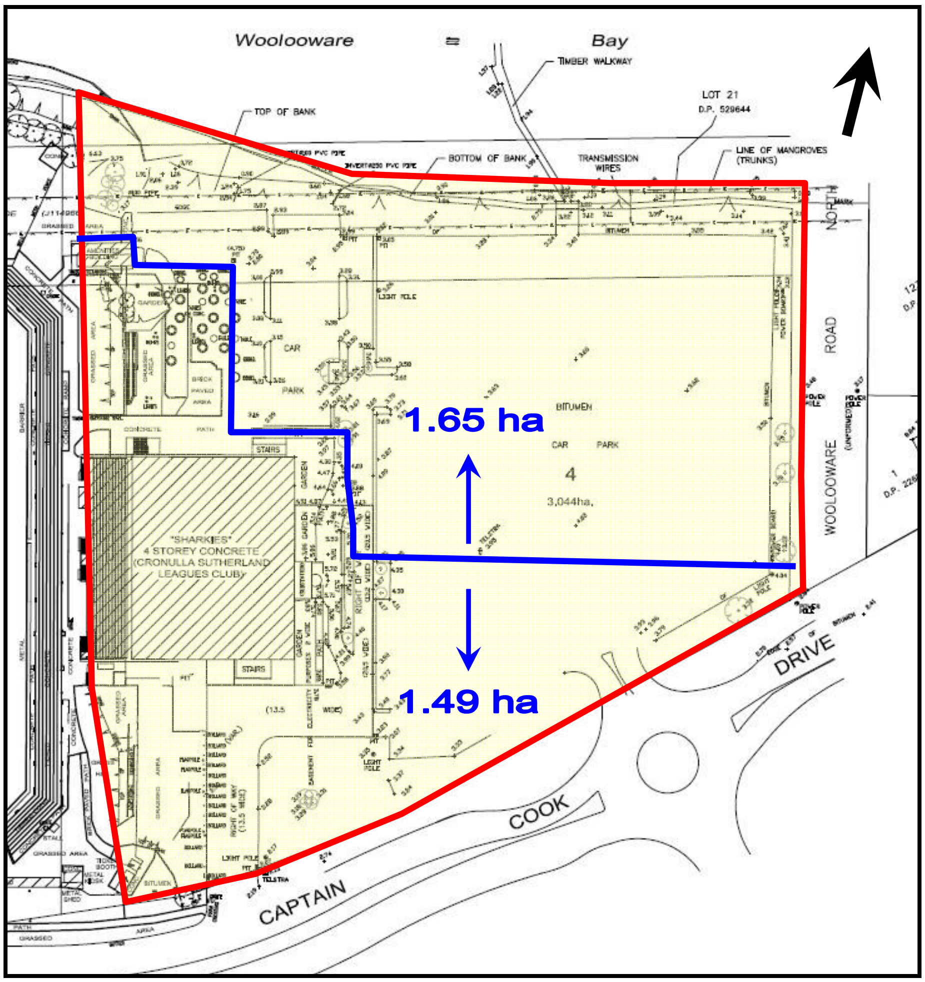


Figure 2: Exiting Site Surface Runoff Direction

3 DATA BASE

The following form the data base for this assessment and report:

- Bureau of Meteorology design rainfall data calculated for the Sutherland Shire Council area.
- Site inspection during the course of this study.
- The Institute of Engineers Australian (2000), Australian Rainfall and Runoff Volume 1 A Guide for Flood Estimation.
- Site Survey prepared by Rygate & Company Pty Ltd Reference No. 73380 Dated September 2008.
- Architectural concept plans prepared by Noxon Giffen Pty Ltd Architects (Project No. 0814 Dwgs A08 – A14, A22 and L01 issue C).
- "Flood Study for proposed upgrading on Toyota Park for Cronulla Sutherland Leagues Club Limited" prepared by Kozarovski and Partners (Project No 891 dated 27 March 2007).
- "Stormwater drainage and water quality strategy for proposed re-zoning of the Sharks eastern side" report prepared by DHI Water and Environment (Project No 50139 dated 02 October 2002).
- "Report on Stormwater Drainage and Water Quality Strategy" prepared by SMEC Australia Pty Ltd (Doc No 31226.067 dated March 2002).
- Sutherland Shire Development Control Plan 2006.

4 EXISTING DRAINAGE CONDITIONS

4.1 Assessment Methodology

DRAINS software was used to develop a rainfall runoff model for the site. The model has been used to quantify site flows that discharge to Woolooware Bay and Captain Cook Drive. The model includes the following:

- Design rainfall IFD data calculated using the Bureau of Meteorology methodology for Sutherland Shire Council area;
- Paved area depression storage = 1mm;
- Supplementary area depression storage = 1mm;
- Pervious area depression storage = 5mm;
- Antecedent moisture content = 3 (rather wet);
- Soil type = 3 (slow infiltration rates).

The existing site sub-catchment areas (outlined in Figure 3) and impervious fractions were determined based on site survey, aerial photography and site inspection.

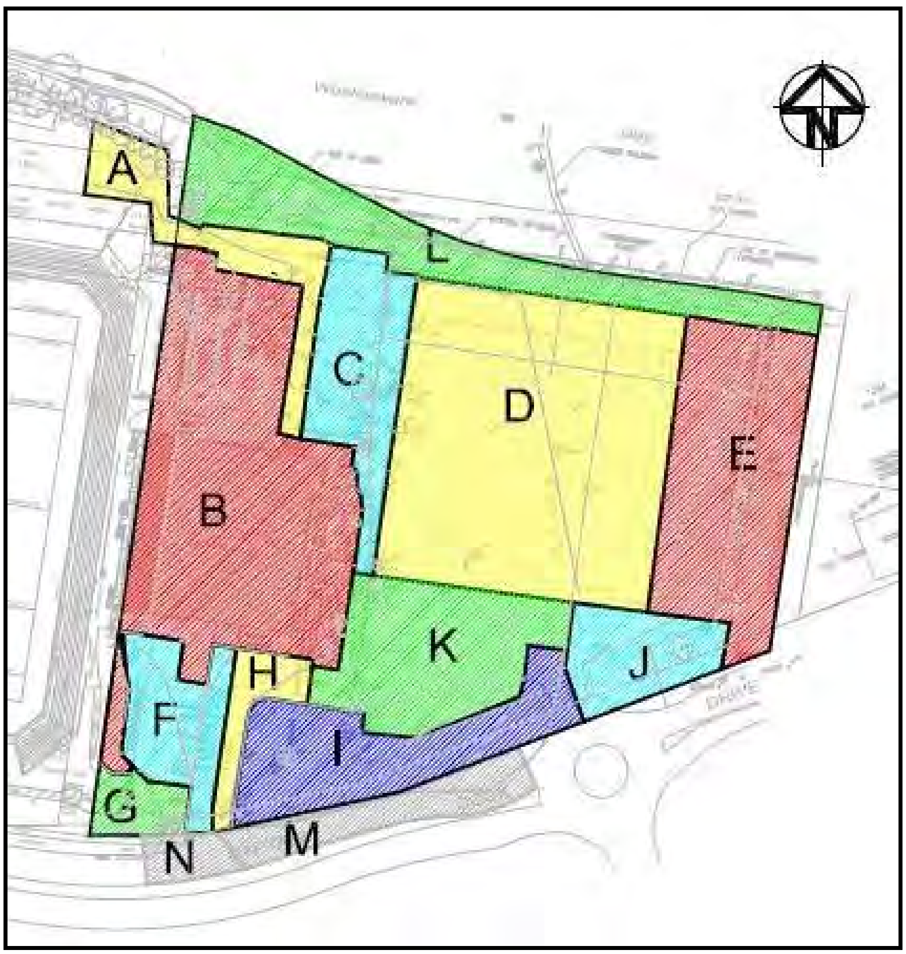


Figure 3: Existing Site Sub-catchment Areas

4.2 Results

The modelling results indicate that the peak 10 year and 100 year average recurrence interval (ARI) flows discharging from the site to Woolooware Bay are $0.70m^3/s$ and $1.01m^3/s$ respectively, with 10 year and 100 year ARI flows discharging from the site to Captain Cook Drive of $0.61m^3/s$ and $0.91m^3/s$ respectively.

DRAINS modelling data and results are included in Appendix A.

5 PROPOSED REDEVELOPMENT DRAINAGE

The proposed redevelopment is outlined in Figure 4 and includes retaining the existing club area and the construction of a supermarket, hotel, retail area, residential buildings and underground carpark.

Figure 4: Proposed Redevelopment Layout

5.1 Assessment Methodology

The existing conditions DRAINS model was adjusted to represent the proposed redevelopment. The proposed sub-catchment areas are indicated in Figure 5. Two stormwater configurations (referred to as Option1 and Option 2) have been assessed.

Option 1 – is based on the entire site discharging southwards (except sub-area A) to Captain Cook Drive. Drains model data for Option 1 is included in Appendix B.

Option 2 – is based on approximately replicating existing site discharges to Woolooware Bay and Captain Cook Drive. The proposed sub-catchment areas A, B, F and N discharge to the

Woolooware Bay (total of 1.38 ha) and the remaining areas discharge to Captain Cook Drive (total of 1.76 ha). On-site detention (OSD) was subsequently included in the model to limit flows that discharge to Captain Cook Drive to no greater than existing. The assessment has been carried out for 2 year, 10 year and 100 year ARI events for all durations from 5 minute to 3 hours.

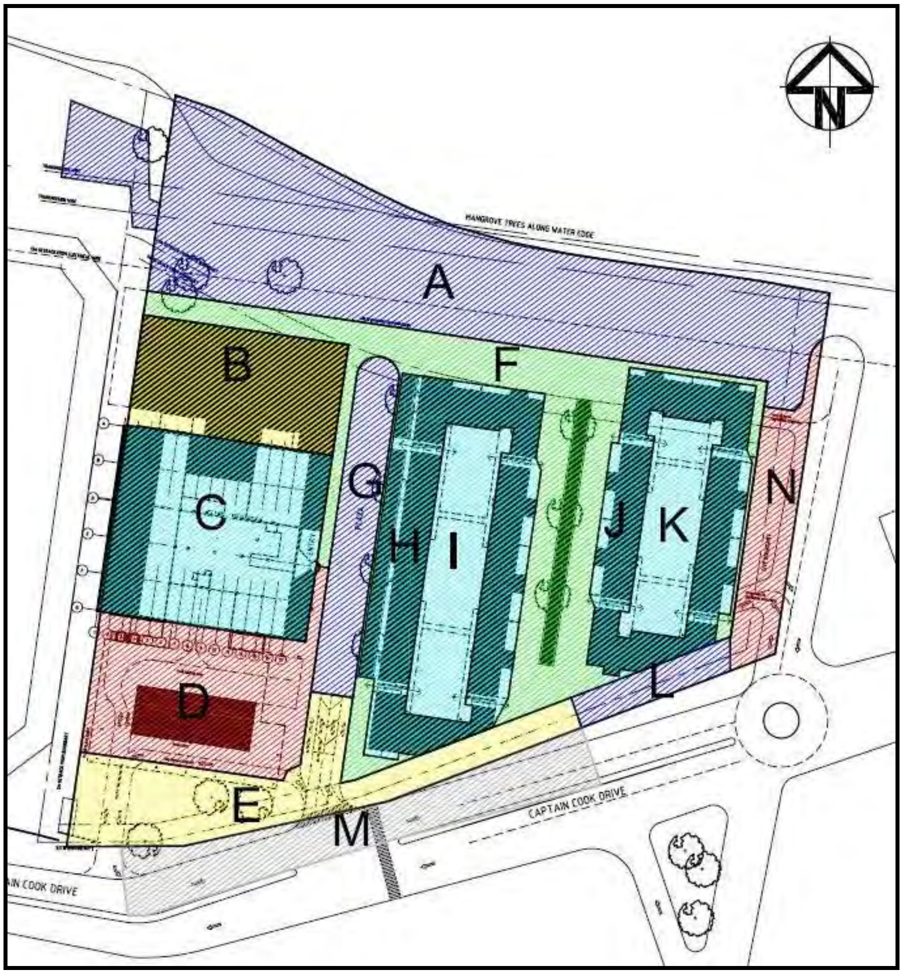


Figure 5: Proposed Redevelopment Sub-catchment Areas

5.2 Results

Table 1 compares 100 year ARI peak flows that discharge from the site for existing and proposed development Options 1 and 2.

The tabulated flows indicate that:

- Option 1 would result in significantly reduced discharges to Woolooware Bay, however increased discharges southward from the site towards Captain Cook Drive. Proposed OSD on sub-areas H/I and J/K is not reported since it was found inadequate (to limit flows to no greater than existing conditions);
- Option 2 would also result in reduced discharges to Woolooware Bay and increased discharges southward from the site towards Captain Cook Drive. However the provision of OSD on sub-catchment areas H/I and J/K was found to adequately limit flows towards Captain Cook Drive (to no greater than existing conditions). For this Option 2, a range of

existing condition flow comparisons have been plotted (see Appendix D) which indicate that the modelled OSD of approximately 450m^3 (with constricted outflows) would be adequate.

Table 1: 100 Year ARI Site Flows (m^3/s)

Location		**Development Condition** (Model Label)			
		Existing Condition	**Option 1**	**Option 2**	
			No OSD	**No OSD**	**With OSD**
North of Site to Woolooware Bay		1.01 (OF129)	0.47 (OF151)	0.84 (OF229)	0.84 (OF229)
South of Site towards Captain Cook Drive	**West**	0.85 (OF135)	1.56 (OF149)	1.16 (OF238)	0.80 (OF238)
	East	0.07 (OF2)	0.03 (OF143)	0.03 (OF236)	0.03 (OF236)

DRAINS modelling data and results for Options 1 and 2 are included in Appendices B and C respectively.

6 COMMENTS AND CONCLUSIONS

It is proposed that low flow discharges to Woolooware Bay would be via the existing outlets systems, with surcharge flows managed through a flow distribution system before leaving the site.

Should the proposed model Option 1 be considered further, then it is understood that dedicated stormwater system would be provided through the southern site area to convey flows directly in the nearby western open channel. It is noted that flow increases into the channel may be unacceptable to Council, and the impact of this option (without OSD) requires quantifying. This option is not considered the preferred option at this time.

Option 2, with the provision of OSD to limit flows to no greater than existing, would enable a proposed site stormwater system to connect into the existing Captain Cook Drive stormwater system. The attached design Drawings C001 & C002 are based on the current DRAINS modelling for development Option 2. Option 2 is considered to be the preferred option based on this study.

In a meeting with Sutherland Shire Council, attended by Guy Amos, no concerns were identified in relation to Option 2. Additional modelling will be required to satisfy the Council requirements to allow outfall to their stormwater drainage system, but based on the strategy tabled, this is not considered an issue.

In reference to the issue of climate change, this report has been based on the latest rainfall parameters available at this stage of the design. These parameters will be revisited at later stage in the design as necessary to provide an up to date design. Please refer to Section 3 for the design data used.

In direct reference to Sections 14 and 15 of Schedule 8 of the LEP, the following objectives have been achieved:

- Reduction of stormwater runoff by minimising the area of impervious surfaces;
- Stormwater discharge to have a dispersed pattern of flow, with only the existing discharge points being utilised;
- The stormwater retention and absorption within the site will be maximised with this option;

In direct reference to other points raised in Sections 14 and 15 of Schedule 8 of the LEP, but not yet fully resolved are listed below:

- An integrated water, stormwater and landscaping solution to provide efficiency will be a primary outcome of the design of the development;
- Water quality issues relating to disposal of stormwater, in particular the reduction of rubbish within and reduction of suspended solids and nutrients from is to be shown to be adequately managed in the next stage of the Development Application.

Appendix A

Existing Condition - DRAINS Model Input and Output

Input Data

2 year ARI Results

10 year ARI Results

100 year ARI Results

Drains Input Data – Existing Conditions

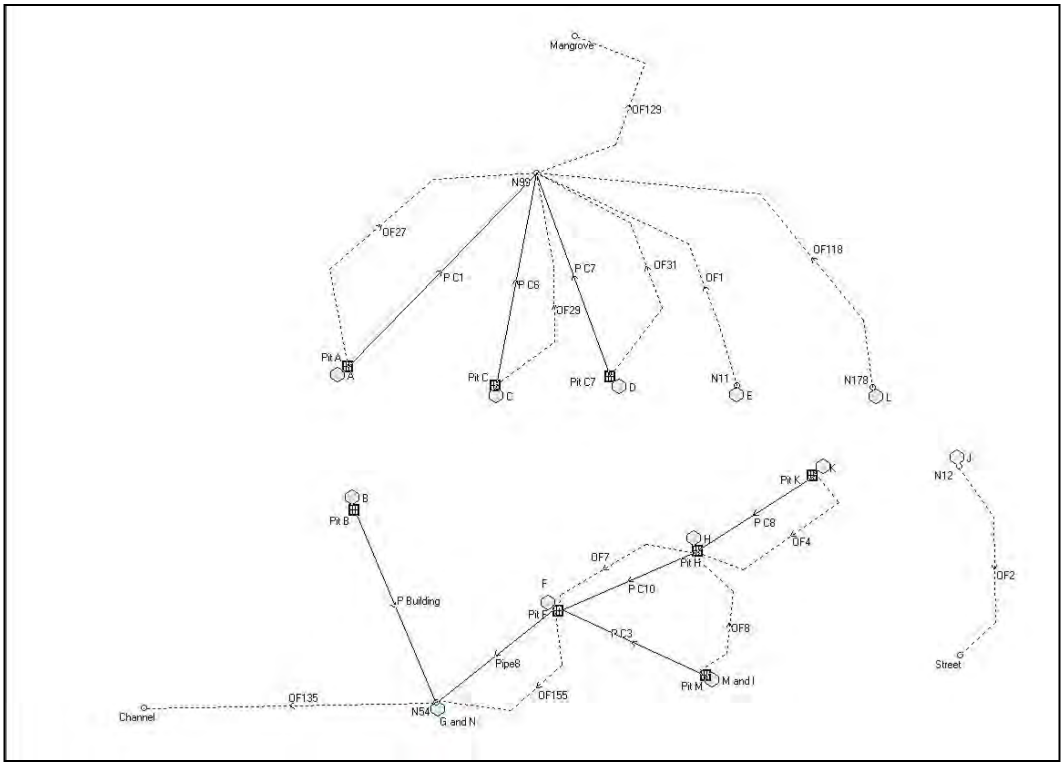


Figure A1 – Existing Condition - Drains Input Labels

DRAINS Model Name and File Path **F:\AA002350\D-Calculations\Stormwater\Drains\Results\Existing Existing - 09-02-23**

DRAINS Version: 2008.11 -November 2008

Modeller's Name: Gustavo Pereira

Description: Toyota Park

PIT / NODE DETAILS			Version 9											
Name	Type	Family	Size	Ponding Volume (cu.m)	Pressure Change Coeff. Ku	Surface Elev (m)	Max Pond Depth (m)	Base Inflow (cu.m/s)	Blocking Factor	x	y	Bolt-dd lid	id	Part Full Shock Loss
Pit A	Sag	TOYOTA -	450x450 g	1	5	2.7	0.17	0	0.5	332253	6256255.2	No	4	1 x Ku
N99	Node					0		0		332309.3	6256313.1		4E+07	
Pit B	OnGrade	DUMMY U	UNLIMITED INLET		0	3.5		0	0.2	332254.9	6256212.6	No	11	1 x Ku
N54	Node					2		0		332279.4	6256155.1		158	
Pit M	Sag	TOYOTA -	1.0m Lintel	1	5	2.11	0.1	0	0.5	332359.7	6256163.2	No	20	1 x Ku
Pit F	Sag	TOYOTA -	1.6m Lintel	1	1	2.11	0.15	0	0.5	332315.7	6256182.5	No	16	1 x Ku
N11	Node					3.41		0		332369.1	6256249.8		24	
Pit C	Sag	TOYOTA -	450x450 g	1	5	2.95	0.4	0	0.5	332297.2	6256249.8	No	30	1 x Ku
Pit C7	Sag	TOYOTA -	450x450 g	5	5	3.05	0.17	0	0.5	332331.2	6256252.5	No	35	1 x Ku
Pit K	Sag	TOYOTA -	1.6m Lintel	3	5	3.23	0.11	0	0.5	332391.5	6256222.9	No	39	1 x Ku
Pit H	Sag	TOYOTA -	1.6m Lintel	1	1.5	2.07	0.15	0	0.5	332357.3	6256200.4	No	56	1 x Ku
Street	Node					2.6		0		332435.4	6256169.2		71	
N12	Node					3		0		332435.2	6256225.6		27	
N178	Node					3		0		332409.4	6256249		8E+07	
Mangrove	Node							0		332320.7	6256354.1		8E+07	
Channel	Node					0		0		332192.2	6256153.4		8E+07	

DETENTION BASIN DETAILS														
Name	Elev	Surf. Area	Init Vol. (cu	Outlet Type	K	Dia(mm)	Centre RL	Pit Fami	Pit Type	x	y	HED	Crest R	Crest Len	id

SUB-CATCHMENT DETAILS																		
Name	Pit or Node	Total Area (ha)	Paved Area %	Grass Area %	Supp Area %	Paved Time (min)	Grass Time (min)	Supp Time (min)	Paved Length (m)	Grass Length (m)	Supp Length (m)	Paved Slope(%	Grass Slope %	Supp Slope %	Paved Rough	Grass Rough	Supp Rough	Lag Time or Factor
A	Pit A	0.138	56	44	0	5	18	0										0
B	Pit B	0.649	72	28	0	5	15	0										0
G and N	N54	0.084	100	0	0	5	0	0										0
M and I	Pit M	0.337	25	75	0	6	15	0										0
F	Pit F	0.13	30	70	0	7	10	0										0
E	N11	0.359	89	11	0	8	23	0										0
C	Pit C	0.185	100	0	0	7	0	0										0
D	Pit C7	0.745	100	0	0	5	0	0										0
K	Pit K	0.254	100	0	0	6	0	0										0
H	Pit H	0.059	100	0	0	4	0	0										0
J	N12	0.116	56	44	0	6	13	0										0

L	N178	0.2818	0	100	0	0	5	0										0
PIPE DETAILS																		
Name	From	To	Length	U/S IL	D/S IL	Slope	Type	Dia	I.D.	Rough	Pipe Is	No. Pip	Chg Fro	At Chg	Chg	RI	Chg	RL
			(m)	(m)	(m)	(%)		(mm)	(mm)						(m)	(m)	(m)	(m)
P C1	Pit A	N99	20	2.1	1.8	1.5	uPVC, und	250	242	0.03	New	1	Pit A	0				
P Building	Pit B	N54	72	2.5	1	2.08	Concrete, r	450	450	0.3	New	1	Pit B	0				
P C3	Pit M	Pit F	14	1.1	0.96	1	Concrete, u	450	450	0.3	New	1	Pit M	0				
Pipe8	Pit F	N54	14.26	0.75	0.736	0.1	Box Culver	0.9W x 0.6H		0.3	Existing	1	Pit F	0				
P C6	Pit C	N99	15	2.35	2.125	1.5	uPVC, und	250	242	0.03	New	1	Pit C	0				
P C7	Pit C7	N99	15	2.65	2.425	1.5	uPVC, und	250	242	0.03	New	1	Pit C7	0				
P C8	Pit K	Pit H	46	2.17	0.79	3	Concrete, r	525	525	0.3	New	1	Pit K	0				
P C10	Pit H	Pit F	16	0.77	0.754	0.1	Concrete, r	525	525	0.3	New	1	Pit H	0				
DETAILS of SERVICES CROSSING PIPES																		
Pipe	Chg	Bottom	Height of S	Chg	Bottom	Height of S	Chg	Bottom	Height o	etc								
	(m)	Elev (m)	(m)	(m)	Elev (m)	(m)	(m)	Elev (m)	(m)	etc								
CHANNEL DETAILS																		
Name	From	To	Type	Length	U/S IL	D/S IL	Slope	Base Wi	L.B. Slop	R.B. Slope	Manning	Depth	Roofed					
				(m)	(m)	(m)	(%)	(m)	(1:?)	(1:?)	n	(m)						
OVERFLOW ROUTE DETAILS																		
Name	From	To	Travel	Spill	Crest	Weir	Cross	Safe De	SafeDep	Safe	Bed	D/S Area		id				
			Time	Level	Length	Coeff. C	Section	Major St	Minor St	DxV	Slope	Contributing						
			(min)	(m)	(m)			(m)	(m)	(sq.m/sec)	(%)	%						
OF27	Pit A	N99	0.1				Dummy us	0.2	0.05	0.6	1	0		206				
OF129	N99	Mangrove	0.1				Dummy us	0.2	0.05	0.6	1	0		7.8E+07				
OF135	N54	Channel	0.1				Dummy us	0.2	0.05	0.6	1	0		7.8E+07				
OF8	Pit M	Pit H	0.1				8 m wide r	0.3	0.15	0.4	1	0		112				
OF155	Pit F	N54	0.1				Dummy us	0.2	0.05	0.6	1	0		9.3E+07				
OF1	N11	N99	5				Dummy us	0.2	0.05	0.6	1	0		105				
OF29	Pit C	N99	0.1				Dummy us	0.2	0.05	0.6	1	0		208				
OF31	Pit C7	N99	0.1				Dummy us	0.2	0.05	0.6	1	0		210				
OF4	Pit K	Pit H	3				Pathway 4	0.3	0.15	0.6	1	0		108				
OF7	Pit H	Pit F	0.1				Pathway 4	0.3	0.15	0.6	1	0		111				
OF2	N12	Street	3				Dummy us	0.2	0.05	0.6	1	0		106				
OF118	N178	N99	0.1				Dummy us	0.2	0.05	0.6	1	0		7.8E+07				

Drains 2 year ARI Result – Existing Condition

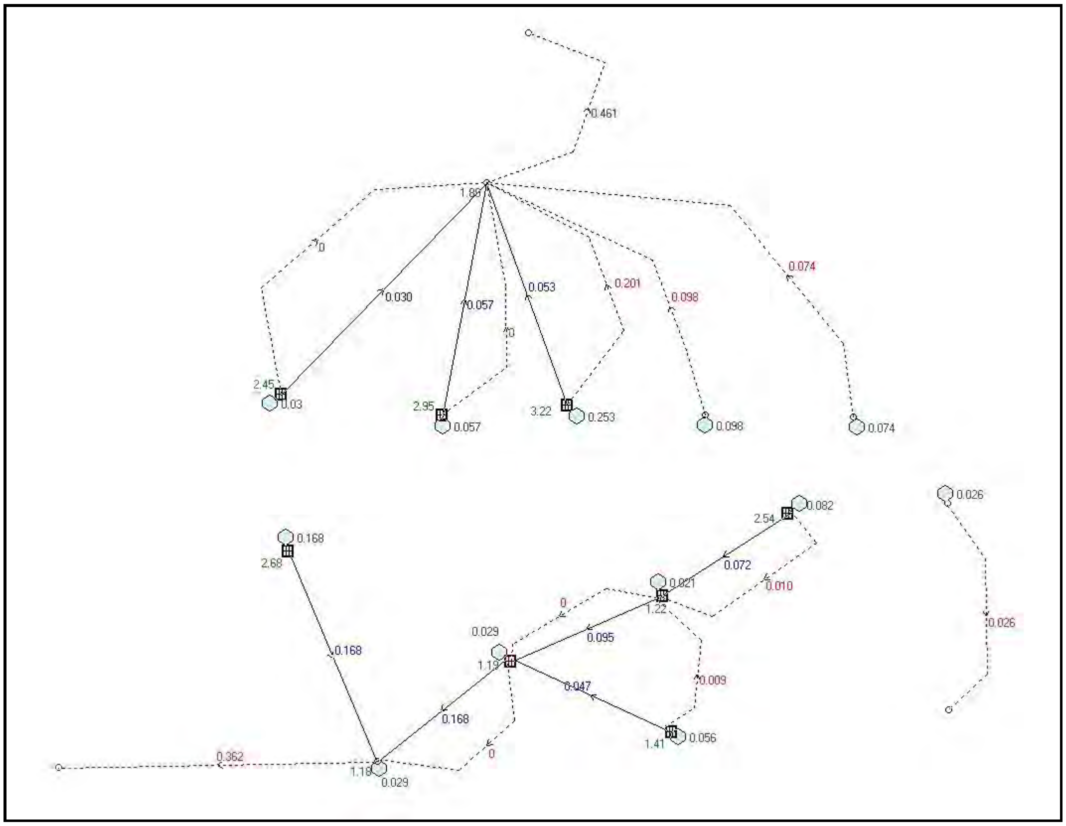


Figure A2 – Existing Condition - Drains 2 Year Output

DRAINS Model Name and File Path **F:\AA002350\D-Calculations\Stormwater\Drains\Results\Existing Existing - 09-02-23**

DRAINS Version: 2008.11 -November 2008

Modeller's Name: Gustavo Pereira

Description: Toyota Park

DRAINS results prepared 23 February, 2009 from Version 2008.11

PIT / NODE DETAILS				Version 8			
Name	Max HGL	Max Pond HGL	Max Surfac Flow Arrivi (cu.m/s)	Max Pond Volume (cu.m)	Min Freeboard (m)	Overflow (cu.m/s)	Constraint
Pit A	2.45	2.77	0.03	0.2	0.25	0	None
N99	1.89		0.324				
Pit B	2.68		0.168		0.82		None
N54	1.18		0.029				
Pit M	1.41	2.21	0.056	0.9	0.7	0.009	None
Pit F	1.19	2.16	0.029	0.2	0.92	0	None
Pit C	2.95	3	0.057	0	0	0	Outlet System
Pit C7	3.22	3.22	0.253	5	-0.17	0.201	Outlet System
Pit K	2.54	3.34	0.082	1.7	0.69	0.01	None
Pit H	1.22	2.11	0.024	0.1	0.85	0	None

SUB-CATCHMENT DETAILS							
Name	Max Flow Q (cu.m/s)	Paved Max Q (cu.m/s)	Grassed Max Q (cu.m/s)	Paved Tc (min)	Grassed Tc (min)	Supp. Tc (min)	Due to Storm
A	0.03	0.025	0.007	5	18	0	AR&R 2 year, 30 minutes storm, average 58 mm/h, Zone 1
B	0.168	0.159	0.02	5	15	0	AR&R 2 year, 20 minutes storm, average 71.1 mm/h, Zone 1
G and N	0.029	0.029	0	5	0	0	AR&R 2 year, 20 minutes storm, average 71.1 mm/h, Zone 1
M and I	0.056	0.025	0.041	6	15	0	AR&R 2 year, 2 hours storm, average 25.7 mm/h, Zone 1
F	0.029	0.011	0.02	7	10	0	AR&R 2 year, 2 hours storm, average 25.7 mm/h, Zone 1
E	0.098	0.096	0.003	8	23	0	AR&R 2 year, 20 minutes storm, average 71.1 mm/h, Zone 1
C	0.057	0.057	0	7	0	0	AR&R 2 year, 20 minutes storm, average 71.1 mm/h, Zone 1
D	0.253	0.253	0	5	0	0	AR&R 2 year, 20 minutes storm, average 71.1 mm/h, Zone 1
K	0.082	0.082	0	6	0	0	AR&R 2 year, 20 minutes storm, average 71.1 mm/h, Zone 1
H	0.021	0.021	0	4	0	0	AR&R 2 year, 5 minutes storm, average 126 mm/h, Zone 1
J	0.026	0.02	0.007	6	13	0	AR&R 2 year, 30 minutes storm, average 58 mm/h, Zone 1

L	0.074	0	0.074	0	5	0	AR&R 2 year, 2 hours storm, average 25.7 mm/h, Zone 1	
Outflow Volumes for Total Catchment (2.38 impervious + 0.96 pervious = 3.34 total ha)								
Storm	Total Rainf	Total Runo	Impervious	Pervious Runoff				
	cu.m	cu.m (Runo	cu.m (Runo	cu.m (Runoff %)				
AR&R 2 ye	350.47	236.92 (67	226.03 (90	10.89 (10.8%)				
AR&R 2 ye	536.83	401.79 (74	358.87 (93	42.92 (27.8%)				
AR&R 2 ye	791.06	629.57 (79	540.10 (95	89.48 (39.4%)				
AR&R 2 ye	967.96	778.85 (80	666.20 (96	112.65 (40.5%)				
AR&R 2 ye	1315.09	1074.64 (8	913.64 (97	161.00 (42.6%)				
AR&R 2 ye	1715.63	1402.93 (8	1199.16 (9	203.78 (41.4%)				
AR&R 2 ye	1972.64	1611.47 (8	1382.35 (9	229.13 (40.4%)				
PIPE DETAILS								
Name	Max Q	Max V	Max U/S	Max D/S	Due to Storm			
	(cu.m/s)	(m/s)	HGL (m)	HGL (m)				
P C1	0.03	1.9	2.191	1.891	AR&R 2 year, 30 minutes storm, average 58 mm/h, Zone 1			
P Building	0.168	2.8	2.68	1.18	AR&R 2 year, 20 minutes storm, average 71.1 mm/h, Zone 1			
P C3	0.047	1.7	1.206	1.192	AR&R 2 year, 20 minutes storm, average 71.1 mm/h, Zone 1			
Pipe8	0.168	0.4	1.182	1.18	AR&R 2 year, 30 minutes storm, average 58 mm/h, Zone 1			
P C6	0.057	2.3	2.479	2.254	AR&R 2 year, 20 minutes storm, average 71.1 mm/h, Zone 1			
P C7	0.053	2.2	2.774	2.549	AR&R 2 year, 5 minutes storm, average 126 mm/h, Zone 1			
P C8	0.072	2.8	2.262	1.216	AR&R 2 year, 20 minutes storm, average 71.1 mm/h, Zone 1			
P C10	0.095	0.5	1.196	1.192	AR&R 2 year, 30 minutes storm, average 58 mm/h, Zone 1			
CHANNEL DETAILS								
Name	Max Q	Max V	Chainage	Max	Due to Storm			
	(cu.m/s)	(m/s)	(m)	HGL (m)				
OVERFLOW ROUTE DETAILS								
Name	Max Q U/S	Max Q D/S	Safe Q	Max D	Max DxV	Max Width	Max V	Due to Storm
OF27	0	0	0.256	0	0	0	0	
OF129	0.461	0.461	0.256	0.063	0.05	16.66	0.78	AR&R 2 year, 30 minutes storm, average 58 mm/h, Zone 1
OF135	0.362	0.362	0.256	0.057	0.04	15.41	0.73	AR&R 2 year, 30 minutes storm, average 58 mm/h, Zone 1
OF8	0.009	0.009	0.238	0.054	0.04	0.45	0.71	AR&R 2 year, 2 hours storm, average 25.7 mm/h, Zone 1
OF155	0	0	0.256	0	0	0	0	
OF1	0.098	0.098	0.256	0.035	0.02	10.91	0.5	AR&R 2 year, 20 minutes storm, average 71.1 mm/h, Zone 1

OF29	0	0	0.256	0	0	0	0	
OF31	0.201	0.201	0.256	0.045	0.03	13.07	0.61	AR&R 2 year, 20 minutes storm, average 71.1 mm/h, Zone 1
OF4	0.01	0.01	0.565	0.034	0.01	1.36	0.44	AR&R 2 year, 20 minutes storm, average 71.1 mm/h, Zone 1
OF7	0	0	0.565	0	0	0	0	
OF2	0.026	0.026	0.256	0.021	0.01	7.03	0.35	AR&R 2 year, 30 minutes storm, average 58 mm/h, Zone 1
OF118	0.074	0.074	0.256	0.031	0.01	10.2	0.46	AR&R 2 year, 2 hours storm, average 25.7 mm/h, Zone 1
DETENTION BASIN DETAILS								
Name	Max WL	MaxVol	Max Q	Max Q	Max Q			
			Total	Low Level	High Level			
CONTINUITY CHECK for AR&R 2 year, 2 hours storm, average 25.7 mm/h, Zone 1								
Node	Inflow	Outflow	Storage Ch	Difference				
	(cu.m)	(cu.m)	(cu.m)	%				
Pit A	51.81	51.81	0	0				
N99	750.04	750.04	0	0				
Pit B	274.05	274.05	0	0				
N54	609.2	609.2	0	0				
Pit M	96.06	96.06	0	0				
Pit F	292.82	292.82	0	0				
N11	169.38	169.38	0	0				
Pit C	93.24	93.22	0	0				
Pit C7	375.48	375.4	0	0				
Pit K	128.02	128.01	0	0				
Pit H	160.84	160.84	0	0				
Street	43.58	43.58	0	0				
N12	43.58	43.58	0	0				
N178	60.23	60.23	0	0				
Mangrove	750.04	750.04	0	0				
Channel	609.2	609.2	0	0				
Run Log for Existing run at 09:53:45 on 23/2/2009								
No water upwelling from any pit.								
Freeboard was less than 0.15m at Pit C7, Pit C								
The maximum flow exceeded the safe value in the following overflow routes: OF135, OF129								

Drains 10 year ARI Result – Existing Condition

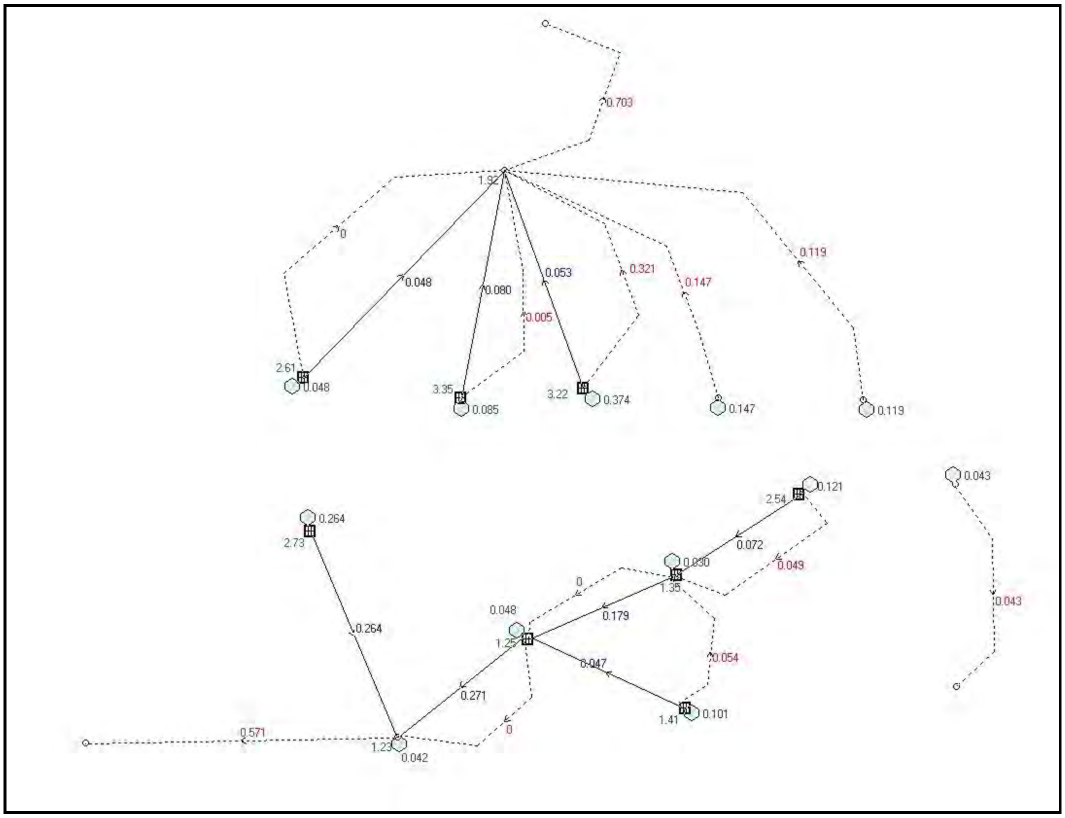


Figure A3 – Existing Condition - Drains 10 Year Output

DRAINS Model Name and File Path **F:\AA002350\D-Calculations\Stormwater\Drains\Results\Existing Existing - 09-02-23**

DRAINS Version: 2008.11 -November 2008

Modeller's Name: Gustavo Pereira

Description: Toyota Park

DRAINS results prepared 23 February, 2009 from Version 2008.11

PIT / NODE DETAILS				Version 8			
Name	Max HGL	Max Pond HGL	Max Surface Flow Arriving (cu.m/s)	Max Pond Volume (cu.m)	Min Freeboard (m)	Overflow (cu.m/s)	Constraint
Pit A	2.61	2.8	0.048	0.3	0.09	0	None
N99	1.92		0.524				
Pit B	2.73		0.264		0.77		None
N54	1.23		0.042				
Pit M	1.41	2.21	0.101	1	0.7	0.054	None
Pit F	1.25	2.19	0.048	0.2	0.86	0	None
Pit C	3.35	3.35	0.085	0	-0.4	0.005	Outlet System
Pit C7	3.22	3.22	0.374	5	-0.17	0.321	Outlet System
Pit K	2.54	3.34	0.121	2.6	0.69	0.049	None
Pit H	1.35	2.21	0.109	0.3	0.72	0	None

SUB-CATCHMENT DETAILS							
Name	Max Flow Q (cu.m/s)	Paved Max Q (cu.m/s)	Grassed Max Q (cu.m/s)	Paved Tc (min)	Grassed Tc (min)	Supp. Tc (min)	Due to Storm
A	0.048	0.036	0.015	5	18	0	AR&R 10 year, 1 hour storm, average 59.8 mm/h, Zone 1
B	0.264	0.224	0.046	5	15	0	AR&R 10 year, 30 minutes storm, average 87 mm/h, Zone 1
G and N	0.042	0.042	0	5	0	0	AR&R 10 year, 20 minutes storm, average 105 mm/h, Zone 1
M and I	0.101	0.036	0.068	6	15	0	AR&R 10 year, 1 hour storm, average 59.8 mm/h, Zone 1
F	0.048	0.017	0.031	7	10	0	AR&R 10 year, 30 minutes storm, average 87 mm/h, Zone 1
E	0.147	0.142	0.006	8	23	0	AR&R 10 year, 20 minutes storm, average 105 mm/h, Zone 1
C	0.085	0.085	0	7	0	0	AR&R 10 year, 20 minutes storm, average 105 mm/h, Zone 1
D	0.374	0.374	0	5	0	0	AR&R 10 year, 20 minutes storm, average 105 mm/h, Zone 1
K	0.121	0.121	0	6	0	0	AR&R 10 year, 20 minutes storm, average 105 mm/h, Zone 1
H	0.03	0.03	0	4	0	0	AR&R 10 year, 20 minutes storm, average 105 mm/h, Zone 1
J	0.043	0.03	0.014	6	13	0	AR&R 10 year, 30 minutes storm, average 87 mm/h, Zone 1

L	0.119	0	0.119	0	5	0	AR&R 10 year, 2 hours storm, average 38.9 mm/h, Zone 1

Outflow Volumes for Total Catchment (2.38 impervious + 0.96 pervious = 3.34 total ha)

Storm	Total Rainf	Total Runo	Impervious	Pervious Runoff
	cu.m	cu.m (Runo	cu.m (Runo	cu.m (Runoff %)
AR&R 10 y	500.67	382.08 (76	333.10 (93	48.98 (34.1%)
AR&R 10 y	778.82	641.76 (82	531.37 (95	110.39 (49.4%)
AR&R 10 y	1168.23	1003.97 (8	808.95 (97	195.02 (58.1%)
AR&R 10 y	1451.94	1259.89 (8	1011.19 (9	248.70 (59.6%)
AR&R 10 y	1996	1749.84 (8	1399.02 (9	350.82 (61.2%)
AR&R 10 y	2596.81	2278.44 (8	1827.29 (9	451.16 (60.5%)
AR&R 10 y	2973.98	2603.71 (8	2096.16 (9	507.55 (59.4%)

PIPE DETAILS

Name	Max Q	Max V	Max U/S	Max D/S	Due to Storm
	(cu.m/s)	(m/s)	HGL (m)	HGL (m)	
P C1	0.048	2.2	2.217	1.917	AR&R 10 year, 30 minutes storm, average 87 mm/h, Zone 1
P Building	0.264	3.2	2.73	1.23	AR&R 10 year, 30 minutes storm, average 87 mm/h, Zone 1
P C3	0.047	1	1.254	1.254	AR&R 10 year, 5 minutes storm, average 180 mm/h, Zone 1
Pipe8	0.271	0.6	1.235	1.23	AR&R 10 year, 2 hours storm, average 38.9 mm/h, Zone 1
P C6	0.08	2.4	2.513	2.288	AR&R 10 year, 20 minutes storm, average 105 mm/h, Zone 1
P C7	0.053	2.2	2.774	2.549	AR&R 10 year, 5 minutes storm, average 180 mm/h, Zone 1
P C8	0.072	2.8	2.262	1.351	AR&R 10 year, 5 minutes storm, average 180 mm/h, Zone 1
P C10	0.179	0.8	1.298	1.254	AR&R 10 year, 2 hours storm, average 38.9 mm/h, Zone 1

CHANNEL DETAILS

Name	Max Q	Max V	Chainage	Max	Due to Storm
	(cu.m/s)	(m/s)	(m)	HGL (m)	

OVERFLOW ROUTE DETAILS

Name	Max Q U/S	Max Q D/S	Safe Q	Max D	Max DxV	Max Width	Max V	Due to Storm
OF27	0	0	0.256	0	0	0	0	
OF129	0.703	0.703	0.256	0.075	0.07	19	0.88	AR&R 10 year, 30 minutes storm, average 87 mm/h, Zone 1
OF135	0.571	0.571	0.256	0.07	0.06	17.92	0.81	AR&R 10 year, 30 minutes storm, average 87 mm/h, Zone 1
OF8	0.054	0.054	0.238	0.096	0.09	1.83	0.9	AR&R 10 year, 1 hour storm, average 59.8 mm/h, Zone 1
OF155	0	0	0.256	0	0	0	0	
OF1	0.147	0.147	0.256	0.04	0.02	11.99	0.57	AR&R 10 year, 20 minutes storm, average 105 mm/h, Zone 1
OF29	0.005	0.005	0.256	0.011	0	3.74	0.23	AR&R 10 year, 20 minutes storm, average 105 mm/h, Zone 1

OF31	0.321	0.321	0.256	0.054	0.04	14.87	0.71	AR&R 10 year, 20 minutes storm, average 105 mm/h, Zone 1
OF4	0.049	0.049	0.565	0.061	0.04	2.46	0.65	AR&R 10 year, 20 minutes storm, average 105 mm/h, Zone 1
OF7	0	0	0.565	0	0	0	0	
OF2	0.043	0.043	0.256	0.026	0.01	8.53	0.39	AR&R 10 year, 30 minutes storm, average 87 mm/h, Zone 1
OF118	0.119	0.119	0.256	0.037	0.02	11.45	0.52	AR&R 10 year, 2 hours storm, average 38.9 mm/h, Zone 1
DETENTION BASIN DETAILS								
Name	Max WL	MaxVol	Max Q	Max Q	Max Q			
			Total	Low Level	High Level			
CONTINUITY CHECK for AR&R 10 year, 20 minutes storm, average 105 mm/h, Zone 1								
Node	Inflow	Outflow	Storage Ch	Difference				
	(cu.m)	(cu.m)	(cu.m)	%				
Pit A	38.28	38.28	0	0				
N99	529.66	529.66	0	0				
Pit B	195.4	195.4	0	0				
N54	441.83	441.83	0	0				
Pit M	79.45	79.45	0	0				
Pit F	217.87	217.87	0	0				
N11	116.23	116.23	0	0				
Pit C	62.9	62.89	0	0				
Pit C7	253.3	253.29	0	0				
Pit K	86.36	86.36	0	0				
Pit H	129.53	129.53	0	0				
Street	32.45	32.45	0	0				
N12	32.45	32.45	0	0				
N178	58.97	58.97	0	0				
Mangrove	529.66	529.66	0	0				
Channel	441.83	441.83	0	0				

Run Log for Existing run at 09:57:04 on 23/2/2009

No water upwelling from any pit.
Freeboard was less than 0.15m at Pit C7, Pit C, Pit A
The maximum flow exceeded the safe value in the following overflow routes: OF135, OF129, OF31

Drains 100 year ARI Results – Existing Condition

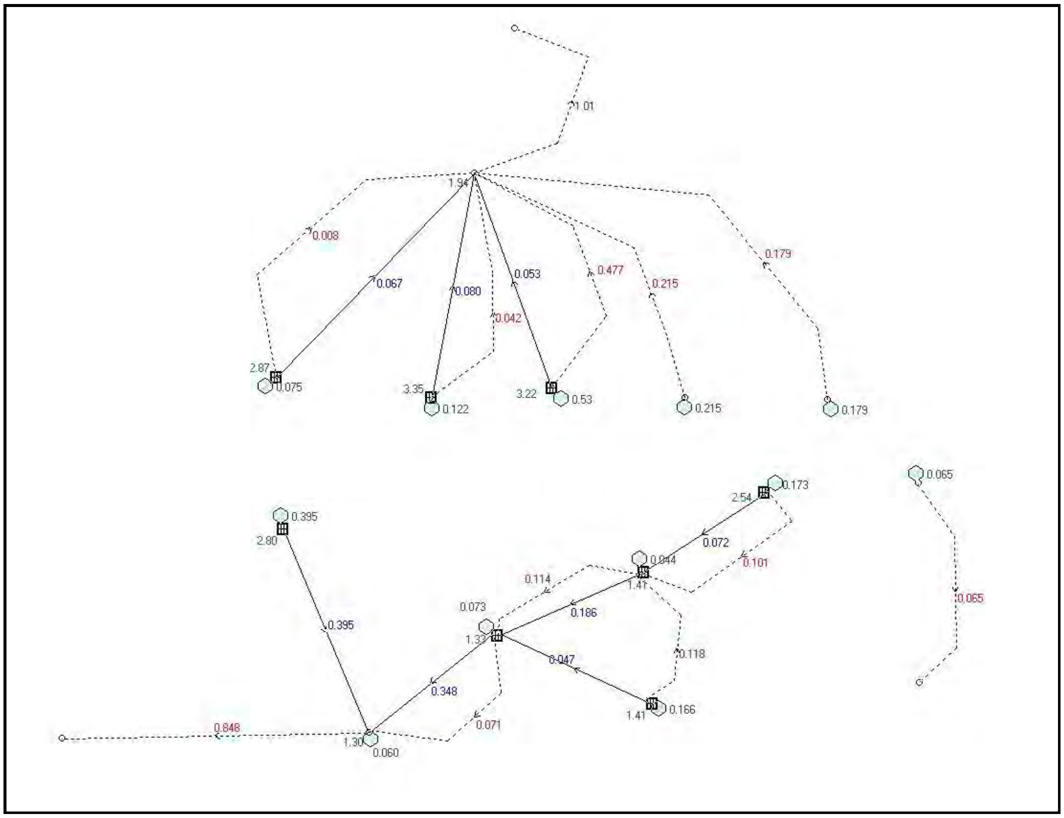


Figure A4 – Existing Condition - Drains 100 Year Output

DRAINS Model Name and File Path **F:\AA002350\D-Calculations\Stormwater\Drains\Results\Existing Existing - 09-02-23**

DRAINS Version: 2008.11 -November 2008

Modeller's Name: Gustavo Pereira

Description: Toyota Park

DRAINS results prepared 23 February, 2009 from Version 2008.11

PIT / NODE DETAILS				Version 8			
Name	Max HGL	Max Pond HGL	Max Surfac Flow Arrivii (cu.m/s)	Max Pond Volume (cu.m)	Min Freeboard (m)	Overflow (cu.m/s)	Constraint
Pit A	2.87	2.87	0.075	0.4	-0.17	0.008	Outlet System
N99	1.94		0.81				
Pit B	2.8		0.395		0.7		None
N54	1.3		0.118				
Pit M	1.41	2.21	0.166	1	0.7	0.118	None
Pit F	1.33	2.26	0.186	0.4	0.78	0.071	None
Pit C	3.35	3.35	0.122	0.2	-0.4	0.042	Outlet System
Pit C7	3.22	3.22	0.53	5	-0.17	0.477	Outlet System
Pit K	2.54	3.34	0.173	3	0.69	0.101	None
Pit H	1.41	2.22	0.228	0.9	0.66	0.114	None

SUB-CATCHMENT DETAILS							
Name	Max Flow Q (cu.m/s)	Paved Max Q (cu.m/s)	Grassed Max Q (cu.m/s)	Paved Tc (min)	Grassed Tc (min)	Supp. Tc (min)	Due to Storm
A	0.075	0.052	0.025	5	18	0	AR&R 100 year, 1 hour storm, average 92.7 mm/h, Zone 1
B	0.395	0.313	0.082	5	15	0	AR&R 100 year, 1 hour storm, average 92.7 mm/h, Zone 1
G and N	0.06	0.06	0	5	0	0	AR&R 100 year, 20 minutes storm, average 160 mm/h, Zone 1
M and I	0.166	0.052	0.113	6	15	0	AR&R 100 year, 1 hour storm, average 92.7 mm/h, Zone 1
F	0.073	0.025	0.048	7	10	0	AR&R 100 year, 30 minutes storm, average 134 mm/h, Zone 1
E	0.215	0.206	0.011	8	23	0	AR&R 100 year, 20 minutes storm, average 160 mm/h, Zone 1
C	0.122	0.122	0	7	0	0	AR&R 100 year, 20 minutes storm, average 160 mm/h, Zone 1
D	0.53	0.53	0	5	0	0	AR&R 100 year, 20 minutes storm, average 160 mm/h, Zone 1
K	0.173	0.173	0	6	0	0	AR&R 100 year, 20 minutes storm, average 160 mm/h, Zone 1
H	0.044	0.044	0	4	0	0	AR&R 100 year, 5 minutes storm, average 266 mm/h, Zone 1
J	0.065	0.042	0.024	6	13	0	AR&R 100 year, 30 minutes storm, average 134 mm/h, Zone 1

L	0.179	0	0.179	0	5	0	AR&R 100 year, 20 minutes storm, average 160 mm/h, Zone 1	
Outflow Volumes for Total Catchment (2.38 impervious + 0.96 pervious = 3.34 total ha)								
Storm	Total Rainf	Total Runo	Impervious	Pervious Runoff				
	cu.m	cu.m (Runo	cu.m (Runo	cu.m (Runoff %)				
AR&R 100	739.88	620.14 (83	503.61 (95	116.52 (54.8%)				
AR&R 100	1162.67	1024.02 (8	804.99 (97	219.03 (65.6%)				
AR&R 100	1780.16	1612.03 (9	1245.16 (9	366.87 (71.8%)				
AR&R 100	2236.33	2040.83 (9	1570.32 (9	470.51 (73.3%)				
AR&R 100	3094.14	2844.31 (9	2181.79 (9	662.52 (74.6%)				
AR&R 100	4025.39	3703.92 (9	2845.61 (9	858.32 (74.3%)				
AR&R 100	4596.15	4216.94 (9	3252.47 (9	964.47 (73.1%)				
PIPE DETAILS								
Name	Max Q	Max V	Max U/S	Max D/S	Due to Storm			
	(cu.m/s)	(m/s)	HGL (m)	HGL (m)				
P C1	0.067	2.4	2.242	1.942	AR&R 100 year, 1 hour storm, average 92.7 mm/h, Zone 1			
P Building	0.395	3.5	2.8	1.3	AR&R 100 year, 1 hour storm, average 92.7 mm/h, Zone 1			
P C3	0.047	0.6	1.33	1.33	AR&R 100 year, 5 minutes storm, average 266 mm/h, Zone 1			
Pipe8	0.348	0.7	1.306	1.3	AR&R 100 year, 10 minutes storm, average 209 mm/h, Zone 1			
P C6	0.08	2.4	2.513	2.288	AR&R 100 year, 5 minutes storm, average 266 mm/h, Zone 1			
P C7	0.053	2.2	2.774	2.549	AR&R 100 year, 5 minutes storm, average 266 mm/h, Zone 1			
P C8	0.072	2.8	2.262	1.408	AR&R 100 year, 5 minutes storm, average 266 mm/h, Zone 1			
P C10	0.186	0.9	1.351	1.33	AR&R 100 year, 10 minutes storm, average 209 mm/h, Zone 1			
CHANNEL DETAILS								
Name	Max Q	Max V	Chainage	Max	Due to Storm			
	(cu.m/s)	(m/s)	(m)	HGL (m)				
OVERFLOW ROUTE DETAILS								
Name	Max Q U/S	Max Q D/S	Safe Q	Max D	Max DxV	Max Width	Max V	Due to Storm
OF27	0.008	0.008	7.665	0.014	0	4.64	0.24	AR&R 100 year, 1 hour storm, average 92.7 mm/h, Zone 1
OF129	1.008	1.008	7.665	0.088	0.08	21.51	0.95	AR&R 100 year, 30 minutes storm, average 134 mm/h, Zone 1
OF135	0.848	0.848	7.665	0.081	0.07	20.25	0.92	AR&R 100 year, 30 minutes storm, average 134 mm/h, Zone 1
OF8	0.118	0.118	1.19	0.122	0.12	2.69	1	AR&R 100 year, 1 hour storm, average 92.7 mm/h, Zone 1
OF155	0.071	0.071	7.665	0.031	0.01	10.2	0.45	AR&R 100 year, 20 minutes storm, average 160 mm/h, Zone 1
OF1	0.215	0.215	7.665	0.046	0.03	13.25	0.63	AR&R 100 year, 20 minutes storm, average 160 mm/h, Zone 1
OF29	0.042	0.042	7.665	0.026	0.01	8.53	0.39	AR&R 100 year, 20 minutes storm, average 160 mm/h, Zone 1

OF31	0.477	0.477	7.665	0.064	0.05	16.84	0.78	AR&R 100 year, 20 minutes storm, average 160 mm/h, Zone 1
OF4	0.101	0.101	1.931	0.08	0.06	3.21	0.79	AR&R 100 year, 20 minutes storm, average 160 mm/h, Zone 1
OF7	0.114	0.114	1.931	0.084	0.07	3.36	0.8	AR&R 100 year, 20 minutes storm, average 160 mm/h, Zone 1
OF2	0.065	0.065	7.665	0.03	0.01	10.02	0.43	AR&R 100 year, 30 minutes storm, average 134 mm/h, Zone 1
OF118	0.179	0.179	7.665	0.044	0.03	12.71	0.59	AR&R 100 year, 20 minutes storm, average 160 mm/h, Zone 1

DETENTION BASIN DETAILS

Name	Max WL	MaxVol	Max Q Total	Max Q Low Level	Max Q High Level

CONTINUITY CHECK for AR&R 100 year, 1 hour storm, average 92.7 mm/h, Zone 1

Node	Inflow (cu.m)	Outflow (cu.m)	Storage Ch (cu.m)	Difference %
Pit A	112.66	112.56	0	0.1
N99	1481.4	1481.38	0	0
Pit B	553.84	553.84	0	0
N54	1268.22	1268.22	0	0
Pit M	251.59	251.59	0	0
Pit F	637.36	637.35	0	0
N11	320.07	320.07	0	0
Pit C	169.64	169.88	0	-0.1
Pit C7	683.16	683.14	0	0
Pit K	232.92	232.92	0	0
Pit H	399.53	399.53	0	0
Street	94.82	94.82	0	0
N12	94.82	94.82	0	0
N178	195.74	195.74	0	0
Mangrove	1481.38	1481.38	0	0
Channel	1268.22	1268.22	0	0

Run Log for Existing run at 10:00:13 on 23/2/2009

No water upwelling from any pit.
Freeboard was less than 0.15m at Pit C7, Pit C, Pit A

Appendix B

Proposed Condition Option 1 - DRAINS Model Input and Output

Input Data

10 year ARI Results

100 year ARI Results

Drains Input Data – Proposed Condition Option 1

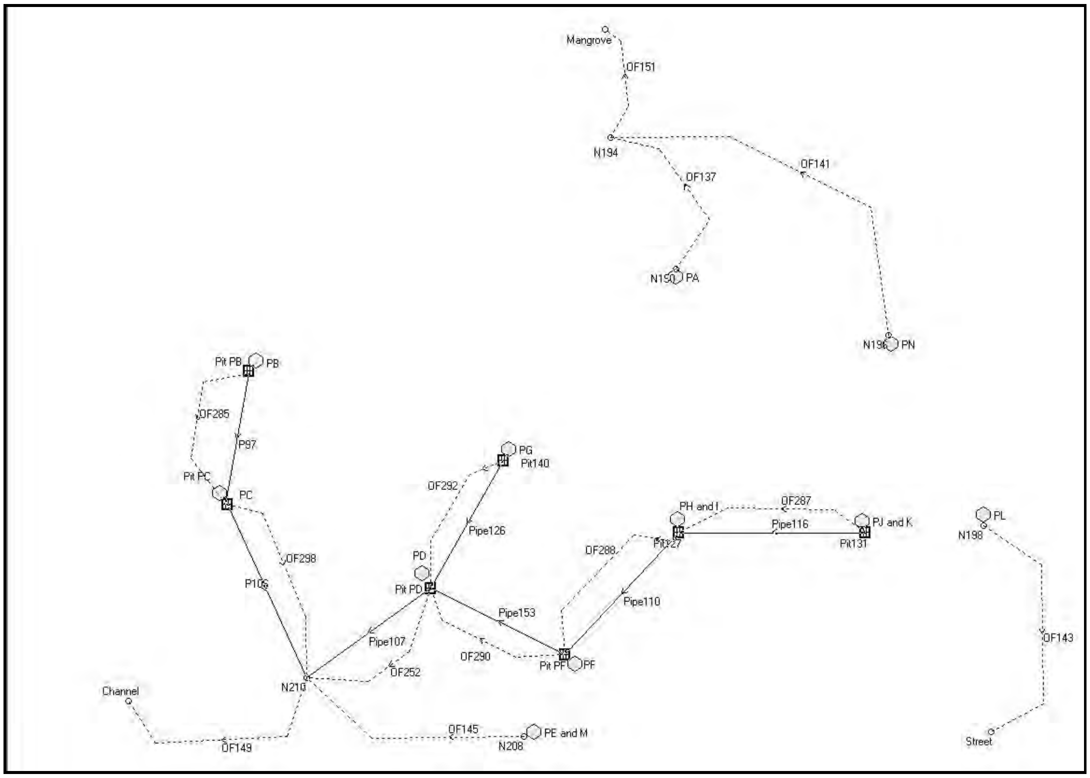


Figure B1 – Proposed Condition Option 1 - Drains Input Labels

DRAINS Model Name and File Path **F:\AA002350\D-Calculations\Stormwater\Drains\Results\Option 1**
Option 1 - 09-02-23

DRAINS Version: 2008.11 -November 2008
Modeller's Name: Gustavo Pereira
Description: Toyota Park

PIT / NODE DETAILS			Version 9															
Name	Type	Family	Size	Ponding Volume (cu.m)	Pressure Change Coeff. Ku	Surface Elev (m)	Max Pond Depth (m)	Base Inflow (cu.m/s)	Blocking Factor	x	y	Bolt-down lid	id	Part Full Shock Loss				
N190	Node					3		0		332583.8	6256277		8E+07					
N194	Node					2		0		332567.9	6256308.9		8E+07					
N196	Node					3		0		332635.3	6256261		8E+07					
N198	Node					5		0		332658.3	6256215		8E+07					
Street	Node					3		0		332660.1	6256165		8E+07					
N208	Node					2.5		0		332546.8	6256163.9		8E+07					
Pit131	OnGrade	DUMMY U	UNLIMITED INLET		5	5		0	0.2	332629.5	6256213.2	No	8E+07	1 x Ku				
Pit127	OnGrade	DUMMY U	UNLIMITED INLET		1.5	5		0	0.2	332584.3	6256213.2	No	8E+07	1 x Ku				
Pit PF	OnGrade	DUMMY U	UNLIMITED INLET		1.5	5		0	0.2	332556.7	6256183.8	No	1E+08	1 x Ku				
Pit PD	OnGrade	DUMMY U	UNLIMITED INLET		2.5	3.5		0	0.2	332524.1	6256199.8	No	8E+07	1 x Ku				
N210	Node					2.5		0		332494.1	6256178.1		8E+07					
Pit140	OnGrade	DUMMY U	UNLIMITED INLET		5	4.5		0	0.2	332541.8	6256230.8	No	8E+07	1 x Ku				
Channel	Node							0		332450.9	6256172.5		8E+07					
Mangrove	Node					0		0		332566.6	6256335.3		8E+07					
Pit PB	OnGrade	DUMMY U	UNLIMITED INLET		0	4.2		0	0.5	332480	6256252.3	No	1E+08	1 x Ku				
Pit PC	OnGrade	DUMMY U	UNLIMITED INLET		0	3.5		0	0.2	332474.8	6256220.2	No	8E+07	1 x Ku				
DETENTION BASIN DETAILS																		
Name	Elev	Surf. Area	Init Vol. (cu	Outlet Type	K	Dia(mm)	Centre RL	Pit Fami	Pit Type	x	y	HED	Crest R	Crest Len	id			
SUB-CATCHMENT DETAILS																		
Name	Pit or Node	Total Area (ha)	Paved Area %	Grass Area %	Supp Area %	Paved Time (min)	Grass Time (min)	Supp Time (min)	Paved Length (m)	Grass Length (m)	Supp Length (m)	Paved Slope(%	Grass Slope %	Supp Slope %	Paved Rough	Grass Rough	Supp Rough	Lag Time or Factor
PA	N190	0.7435	0	100	0	5	10	0										0
PN	N196	0.105	50	50	0	7	12	0										0
PL	N198	0.0434	0	100	0	0	7	0										0
PE and M	N208	0.445	65	35	0	5	15	0										0
PJ and K	Pit131	0.3226	65	35	0	5	21	0										0
PH and I	Pit127	0.4429	70	30	0	5	21	0										0
PF	Pit PF	0.4	100	0	0	5	20	0										0
PD	Pit PD	0.262	100	0	0	5	0	0										0
PG	Pit140	0.118	100	0	0	8	0	0										0
PB	Pit PB	0.19	100	0	0	5	0	0										0
PC	Pit PC	0.326	100	0	0	5	0	0										0

PIPE DETAILS																		
Name	From	To	Length	U/S IL	D/S IL	Slope	Type	Dia	I.D.	Rough	Pipe Is	No. Pi	Chg Fr	At Chg	Chg	Rl	Chg	RL
			(m)	(m)	(m)	(%)		(mm)	(mm)						(m)	(m)	(m)	(m)
Pipe116	Pit131	Pit127	60	3.9	3.3	1	Concrete, u	525	525	0.3	New	1	Pit131	0				
Pipe110	Pit127	Pit PF	35	3.3	2.5	2.29	Concrete, u	600	600	0.3	New	1	Pit127	0				
Pipe153	Pit PF	Pit PD	20	2.5	2.3	1	Concrete, u	600	600	0.3	New	1	Pit PF	0				
Pipe107	Pit PD	N210	45	2	1.325	1.5	Concrete, u	675	675	0.3	New	1	Pit PD	0				
Pipe126	Pit140	Pit PD	40	3.5	2.5	2.5	Concrete, u	450	450	0.3	New	1	Pit140	0				
P97	Pit PB	Pit PC	30	2.55	2.1	1.5	Concrete, u	300	300	0.3	New	1	Pit PB	0				
P106	Pit PC	N210	72	2.5	1	2.08	Concrete, r	450	450	0.3	New	1	Pit PC	0				
DETAILS of SERVICES CROSSING PIPES																		
Pipe	Chg	Bottom	Height of S	Chg	Bottom	Height of S	Chg	Bottom	Height o	etc								
	(m)	Elev (m)	(m)	(m)	Elev (m)	(m)	(m)	Elev (m)	(m)	etc								
CHANNEL DETAILS																		
Name	From	To	Type	Length	U/S IL	D/S IL	Slope	Base Wi	L.B. Slop	R.B. Slope	Manning	Depth	Roofed					
				(m)	(m)	(m)	(%)	(m)	(1:?)	(1:?)	n	(m)						
OVERFLOW ROUTE DETAILS																		
Name	From	To	Travel	Spill	Crest	Weir	Cross	Safe De	SafeDep	Safe	Bed	D/S Area		id				
			Time	Level	Length	Coeff. C	Section	Major St	Minor St	DxV	Slope	Contributing						
			(min)	(m)	(m)			(m)	(m)	(sq.m/sec)	(%)	%						
OF137	N190	N194	0.1				Dummy us	0.2	0.05	0.6	1	0		7.8E+07				
OF151	N194	Mangrove	0.1				Dummy us	0.2	0.05	0.6	1	0		7.8E+07				
OF141	N196	N194	0.1				Dummy us	0.2	0.05	0.6	1	0		7.8E+07				
OF143	N198	Street	0.1				Dummy us	0.2	0.05	0.6	1	0		7.8E+07				
OF145	N208	N210	0.1				Dummy us	0.2	0.05	0.6	1	0		7.8E+07				
OF287	Pit131	Pit127	0.1				Dummy us	0.2	0.05	0.6	1	0		2.3E+08				
OF288	Pit127	Pit PF	0.1				Dummy us	0.2	0.05	0.6	1	0		2.3E+08				
OF290	Pit PF	Pit PD	0.1				Dummy us	0.2	0.05	0.6	1	0		2.3E+08				
OF252	Pit PD	N210	0.1				Dummy us	0.2	0.05	0.6	1	0		1.4E+08				
OF149	N210	Channel	0.1				Dummy us	0.2	0.05	0.6	1	0		7.8E+07				
OF292	Pit140	Pit PD	0.1				Dummy us	0.2	0.05	0.6	1	0		2.3E+08				
OF285	Pit PB	Pit PC	0.1				Dummy us	0.2	0.05	0.6	1	0		2.3E+08				
OF298	Pit PC	N210	0.1				Dummy us	0.2	0.05	0.6	1	0		2.3E+08				

Drains 10 year ARI Results – Proposed Condition – Option 1

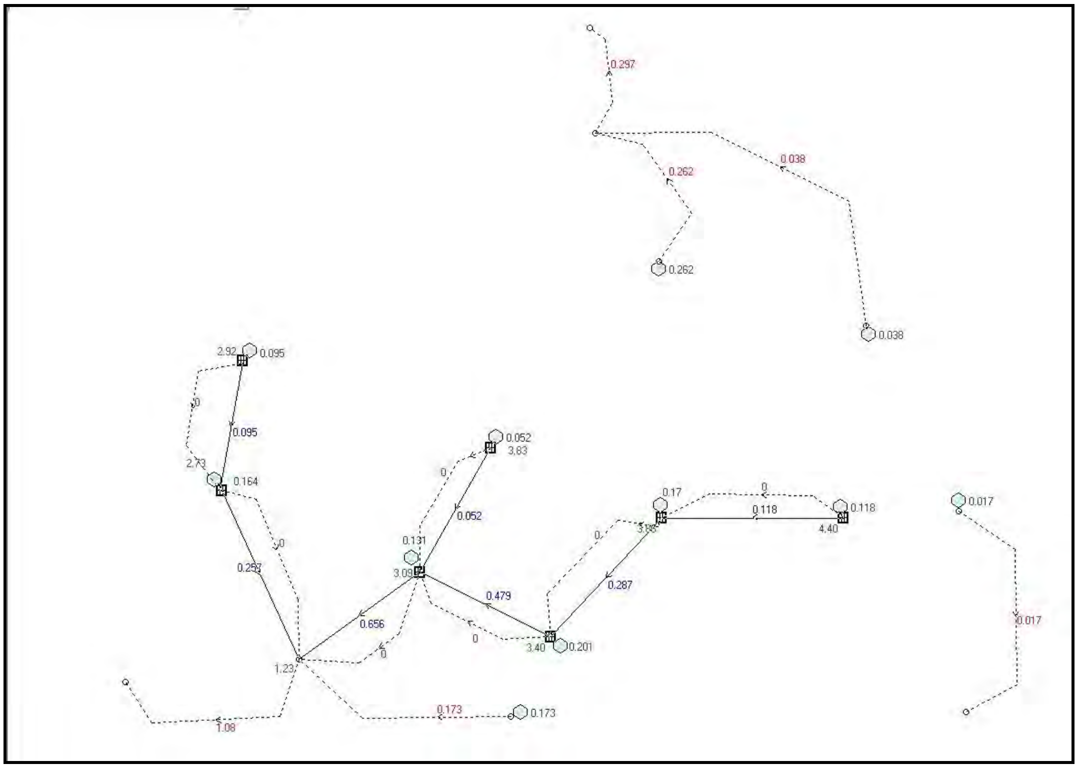


Figure B2 – Proposed Condition Option 1- Drains 10 Year Output

DRAINS Model Name and File Path **F:\AA002350\D-Calculations\Stormwater\Drains\Results\Option 1**

Option 1 - 09-02-23

DRAINS Version: 2008.11 -November 2008

Modeller's Name: Gustavo Pereira

Description: Toyota Park

DRAINS results prepared 25 February, 2009 from Version 2008.11							
PIT / NODE DETAILS				Version 8			
Name	Max HGL	Max Pond HGL	Max Surfac Flow Arrivi (cu.m/s)	Max Pond Volume (cu.m)	Min Freeboard (m)	Overflow (cu.m/s)	Constraint
Pit131	4.4		0.118		0.6	0	None
Pit127	3.86		0.17		1.14	0	None
Pit PF	3.4		0.201		1.6	0	None
Pit PD	3.09		0.131		0.41	0	None
N210	1.23		0.173				
Pit140	3.83		0.052		0.67	0	None
Pit PB	2.92		0.095		1.28	0	None
Pit PC	2.73		0.164		0.77	0	None
SUB-CATCHMENT DETAILS							
Name	Max Flow Q (cu.m/s)	Paved Max Q (cu.m/s)	Grassed Max Q (cu.m/s)	Paved Tc (min)	Grassed Tc (min)	Supp. Tc (min)	Due to Storm
PA	0.262	0	0.262	5	10	0	AR&R 10 year, 2 hours storm, average 38.9 mm/h, Zone 1
PN	0.038	0.023	0.015	7	12	0	AR&R 10 year, 30 minutes storm, average 87 mm/h, Zone 1
PL	0.017	0	0.017	0	7	0	AR&R 10 year, 2 hours storm, average 38.9 mm/h, Zone 1
PE and M	0.173	0.138	0.039	5	15	0	AR&R 10 year, 30 minutes storm, average 87 mm/h, Zone 1
PJ and K	0.118	0.1	0.023	5	21	0	AR&R 10 year, 30 minutes storm, average 87 mm/h, Zone 1
PH and I	0.17	0.148	0.027	5	21	0	AR&R 10 year, 30 minutes storm, average 87 mm/h, Zone 1
PF	0.201	0.201	0	5	20	0	AR&R 10 year, 20 minutes storm, average 105 mm/h, Zone 1
PD	0.131	0.131	0	5	0	0	AR&R 10 year, 20 minutes storm, average 105 mm/h, Zone 1
PG	0.052	0.052	0	8	0	0	AR&R 10 year, 20 minutes storm, average 105 mm/h, Zone 1
PB	0.095	0.095	0	5	0	0	AR&R 10 year, 20 minutes storm, average 105 mm/h, Zone 1
PC	0.164	0.164	0	5	0	0	AR&R 10 year, 20 minutes storm, average 105 mm/h, Zone 1

Outflow Volumes for Total Catchment (2.16 impervious + 1.24 pervious = 3.40 total ha)

Storm	Total Rainf	Total Runo	Impervious	Pervious Runoff
	cu.m	cu.m (Run	cu.m (Run	cu.m (Runoff %)
AR&R 10 y	509.77	363.65 (71	302.05 (93	61.60 (33.1%)
AR&R 10 y	792.97	623.24 (78	481.84 (95	141.40 (48.8%)
AR&R 10 y	1189.46	985.53 (82	733.55 (97	251.97 (58.0%)
AR&R 10 y	1478.33	1238.33 (8	916.94 (97	321.39 (59.5%)
AR&R 10 y	2032.27	1722.60 (8	1268.61 (9	453.99 (61.2%)
AR&R 10 y	2643.99	2240.79 (8	1656.97 (9	583.83 (60.5%)
AR&R 10 y	3028.02	2557.79 (8	1900.74 (9	657.05 (59.4%)

PIPE DETAILS

Name	Max Q	Max V	Max U/S	Max D/S	Due to Storm
	(cu.m/s)	(m/s)	HGL (m)	HGL (m)	
Pipe116	0.118	2	4.069	3.856	AR&R 10 year, 30 minutes storm, average 87 mm/h, Zone 1
Pipe110	0.287	3.3	3.506	3.398	AR&R 10 year, 30 minutes storm, average 87 mm/h, Zone 1
Pipe153	0.479	1.7	3.179	3.094	AR&R 10 year, 20 minutes storm, average 105 mm/h, Zone 1
Pipe107	0.656	3.5	2.347	1.672	AR&R 10 year, 20 minutes storm, average 105 mm/h, Zone 1
Pipe126	0.052	2.4	3.587	3.094	AR&R 10 year, 20 minutes storm, average 105 mm/h, Zone 1
P97	0.095	1.3	2.916	2.727	AR&R 10 year, 20 minutes storm, average 105 mm/h, Zone 1
P106	0.257	3.2	2.727	1.227	AR&R 10 year, 20 minutes storm, average 105 mm/h, Zone 1

CHANNEL DETAILS

Name	Max Q	Max V	Chainage	Max	Due to Storm
	(cu.m/s)	(m/s)	(m)	HGL (m)	

OVERFLOW ROUTE DETAILS

Name	Max Q U/S	Max Q D/S	Safe Q	Max D	Max DxV	Max Width	Max V	Due to Storm
OF137	0.262	0.262	0.256	0.051	0.03	14.15	0.65	AR&R 10 year, 2 hours storm, average 38.9 mm/h, Zone 1
OF151	0.297	0.297	0.256	0.053	0.04	14.69	0.68	AR&R 10 year, 2 hours storm, average 38.9 mm/h, Zone 1
OF141	0.038	0.038	0.256	0.025	0.01	8.23	0.38	AR&R 10 year, 30 minutes storm, average 87 mm/h, Zone 1
OF143	0.017	0.017	0.256	0.018	0.01	5.84	0.32	AR&R 10 year, 2 hours storm, average 38.9 mm/h, Zone 1
OF145	0.173	0.173	0.256	0.043	0.03	12.53	0.59	AR&R 10 year, 30 minutes storm, average 87 mm/h, Zone 1
OF287	0	0	0.256	0	0	0	0	
OF288	0	0	0.256	0	0	0	0	

OF290	0	0	0.256	0	0	0	0	
OF252	0	0	0.256	0	0	0	0	
OF149	1.077	1.077	0.256	0.09	0.09	22.05	0.97	AR&R 10 year, 20 minutes storm, average 105 mm/h, Zone 1
OF292	0	0	0.256	0	0	0	0	
OF285	0	0	0.256	0	0	0	0	
OF298	0	0	0.256	0	0	0	0	
DETENTION BASIN DETAILS								
Name	Max WL	MaxVol	Max Q	Max Q	Max Q			
			Total	Low Level	High Level			
CONTINUITY CHECK for AR&R 10 year, 2 hours storm, average 38.9 mm/h, Zone 1								
Node	Inflow	Outflow	Storage Ch	Difference				
	(cu.m)	(cu.m)	(cu.m)	%				
N190	350.28	350.28	0	0				
N194	415.3	415.3	0	0				
N196	65.03	65.03	0	0				
N198	20.48	20.48	0	0				
Street	20.48	20.48	0	0				
N208	295.33	295.33	0	0				
Pit131	213.98	213.98	0	0				
Pit127	514.34	514.34	0	0				
Pit PF	821.55	821.54	0	0				
Pit PD	1113.38	1113.54	0	0				
N210	1805.16	1805.16	0	0				
Pit140	90.62	90.62	0	0				
Channel	1805.16	1805.16	0	0				
Mangrove	415.3	415.3	0	0				
Pit PB	145.92	145.92	0	0				
Pit PC	396.29	396.29	0	0				

Run Log for Option 1 run at 14:48:35 on 25/2/2009

No water upwelling from any pit. Freeboard was adequate at all pits.
The maximum flow exceeded the safe value in the following overflow routes: OF151, OF149, OF137

Drains 100 year ARI Results – Proposed Condition – Option 1

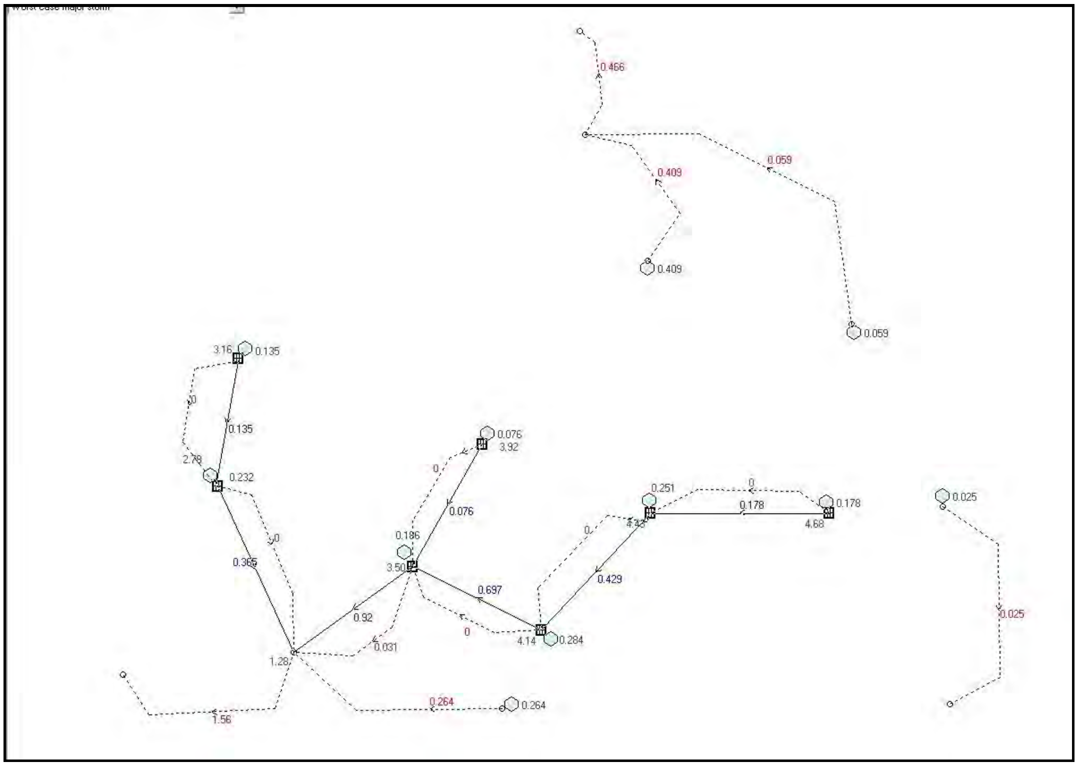


Figure B3 – Proposed Condition Option 1- Drains 100 Year Output

DRAINS Model Name and File Path **F:\AA002350\D-Calculations\Stormwater\Drains\Results\Option 1**
Option 1 - 09-02-23

DRAINS Version: 2008.11 -November 2008
Modeller's Name: Gustavo Pereira
Description: Toyota Park

DRAINS results prepared 25 February, 2009 from Version 2008.11							
PIT / NODE DETAILS				Version 8			
Name	Max HGL	Max Pond HGL	Max Surfac Flow Arrivi (cu.m/s)	Max Pond Volume (cu.m)	Min Freeboard (m)	Overflow (cu.m/s)	Constraint
Pit131	4.68		0.178		0.32	0	None
Pit127	4.43		0.251		0.57	0	None
Pit PF	4.14		0.284		0.86	0	None
Pit PD	3.5		0.186		0	0.031	Outlet System
N210	1.28		0.281				
Pit140	3.92		0.076		0.58	0	None
Pit PB	3.16		0.135		1.04	0	None
Pit PC	2.78		0.232		0.72	0	None

SUB-CATCHMENT DETAILS							
Name	Max Flow Q (cu.m/s)	Paved Max Q (cu.m/s)	Grassed Max Q (cu.m/s)	Paved Tc (min)	Grassed Tc (min)	Supp. Tc (min)	Due to Storm
PA	0.409	0	0.409	5	10	0	AR&R 100 year, 20 minutes storm, average 160 mm/h, Zone 1
PN	0.059	0.033	0.026	7	12	0	AR&R 100 year, 30 minutes storm, average 134 mm/h, Zone 1
PL	0.025	0	0.025	0	7	0	AR&R 100 year, 20 minutes storm, average 160 mm/h, Zone 1
PE and M	0.264	0.194	0.07	5	15	0	AR&R 100 year, 1 hour storm, average 92.7 mm/h, Zone 1
PJ and K	0.178	0.141	0.044	5	21	0	AR&R 100 year, 1 hour storm, average 92.7 mm/h, Zone 1
PH and I	0.251	0.208	0.052	5	21	0	AR&R 100 year, 1 hour storm, average 92.7 mm/h, Zone 1
PF	0.284	0.284	0	5	20	0	AR&R 100 year, 20 minutes storm, average 160 mm/h, Zone 1
PD	0.186	0.186	0	5	0	0	AR&R 100 year, 20 minutes storm, average 160 mm/h, Zone 1
PG	0.076	0.076	0	8	0	0	AR&R 100 year, 20 minutes storm, average 160 mm/h, Zone 1
PB	0.135	0.135	0	5	0	0	AR&R 100 year, 20 minutes storm, average 160 mm/h, Zone 1
PC	0.232	0.232	0	5	0	0	AR&R 100 year, 20 minutes storm, average 160 mm/h, Zone 1

Outflow Volumes for Total Catchment (2.16 impervious + 1.24 pervious = 3.40 total ha)

Storm	Total Rainf	Total Runo	Impervious	Pervious Runoff
	cu.m	cu.m (Run	cu.m (Run	cu.m (Runoff %)
AR&R 100	753.32	605.61 (80	456.67 (95	148.94 (54.1%)
AR&R 100	1183.79	1011.88 (8	729.95 (97	281.93 (65.2%)
AR&R 100	1812.51	1602.99 (8	1129.09 (9	473.89 (71.6%)
AR&R 100	2276.96	2032.17 (8	1423.95 (9	608.22 (73.2%)
AR&R 100	3150.36	2835.67 (9	1978.43 (9	857.24 (74.5%)
AR&R 100	4098.53	3691.25 (9	2580.38 (9	1110.87 (74.2%)
AR&R 100	4679.67	4197.72 (8	2949.28 (9	1248.44 (73.1%)

PIPE DETAILS

Name	Max Q (cu.m/s)	Max V (m/s)	Max U/S HGL (m)	Max D/S HGL (m)	Due to Storm
Pipe116	0.178	0.8	4.505	4.434	AR&R 100 year, 1 hour storm, average 92.7 mm/h, Zone 1
Pipe110	0.429	1.5	4.258	4.14	AR&R 100 year, 1 hour storm, average 92.7 mm/h, Zone 1
Pipe153	0.697	2.5	3.675	3.5	AR&R 100 year, 1 hour storm, average 92.7 mm/h, Zone 1
Pipe107	0.92	3.8	2.432	1.757	AR&R 100 year, 1 hour storm, average 92.7 mm/h, Zone 1
Pipe126	0.076	2.6	3.607	3.5	AR&R 100 year, 20 minutes storm, average 160 mm/h, Zone 1
P97	0.135	1.9	3.156	2.781	AR&R 100 year, 20 minutes storm, average 160 mm/h, Zone 1
P106	0.365	3.5	2.781	1.281	AR&R 100 year, 20 minutes storm, average 160 mm/h, Zone 1

CHANNEL DETAILS

Name	Max Q (cu.m/s)	Max V (m/s)	Chainage (m)	Max HGL (m)	Due to Storm

OVERFLOW ROUTE DETAILS

Name	Max Q U/S	Max Q D/S	Safe Q	Max D	Max DxV	Max Width	Max V	Due to Storm
OF137	0.409	0.409	7.665	0.061	0.05	16.12	0.74	AR&R 100 year, 20 minutes storm, average 160 mm/h, Zone 1
OF151	0.466	0.466	7.665	0.063	0.05	16.66	0.78	AR&R 100 year, 20 minutes storm, average 160 mm/h, Zone 1
OF141	0.059	0.059	7.665	0.029	0.01	9.73	0.41	AR&R 100 year, 30 minutes storm, average 134 mm/h, Zone 1
OF143	0.025	0.025	7.665	0.021	0.01	7.03	0.34	AR&R 100 year, 20 minutes storm, average 160 mm/h, Zone 1
OF145	0.264	0.264	7.665	0.051	0.03	14.15	0.66	AR&R 100 year, 1 hour storm, average 92.7 mm/h, Zone 1
OF287	0	0	7.665	0	0	0	0	
OF288	0	0	7.665	0	0	0	0	

OF290	0	0	7.665	0	0	0	0	
OF252	0.031	0.031	7.665	0.023	0.01	7.63	0.35	AR&R 100 year, 20 minutes storm, average 160 mm/h, Zone 1
OF149	1.559	1.559	7.665	0.105	0.11	24.92	1.07	AR&R 100 year, 20 minutes storm, average 160 mm/h, Zone 1
OF292	0	0	7.665	0	0	0	0	
OF285	0	0	7.665	0	0	0	0	
OF298	0	0	7.665	0	0	0	0	
DETENTION BASIN DETAILS								
Name	Max WL	MaxVol	Max Q	Max Q	Max Q			
			Total	Low Level	High Level			
CONTINUITY CHECK for AR&R 100 year, 1 hour storm, average 92.7 mm/h, Zone 1								
Node	Inflow	Outflow	Storage Ch	Difference				
	(cu.m)	(cu.m)	(cu.m)	%				
N190	514.61	514.61	0	0				
N194	599.04	599.04	0	0				
N196	84.43	84.43	0	0				
N198	30.1	30.1	0	0				
Street	30.1	30.1	0	0				
N208	372.67	372.67	0	0				
Pit131	269.87	269.87	0	0				
Pit127	645.42	645.47	0	0				
Pit PF	1012.27	1012.4	0	0				
Pit PD	1360.86	1360.91	0	0				
N210	2206.75	2206.75	0	0				
Pit140	108.21	108.21	0	0				
Channel	2206.75	2206.75	0	0				
Mangrove	599.04	599.04	0	0				
Pit PB	174.23	174.23	0	0				
Pit PC	473.17	473.17	0	0				

Run Log for Option 1 run at 14:49:01 on 25/2/2009

No water upwelling from any pit.
Freeboard was less than 0.15m at Pit PD

Appendix C

Proposed Condition Option 2 - DRAINS Model Input and Output

Proposed – without OSD

Input Data

10 year ARI Results

100 year ARI Results

Proposed – with OSD

Input Data

2 year ARI Results

10 year ARI Results

100 year ARI Results

Drains Input Data – Proposed Condition Option 2 – No OSD

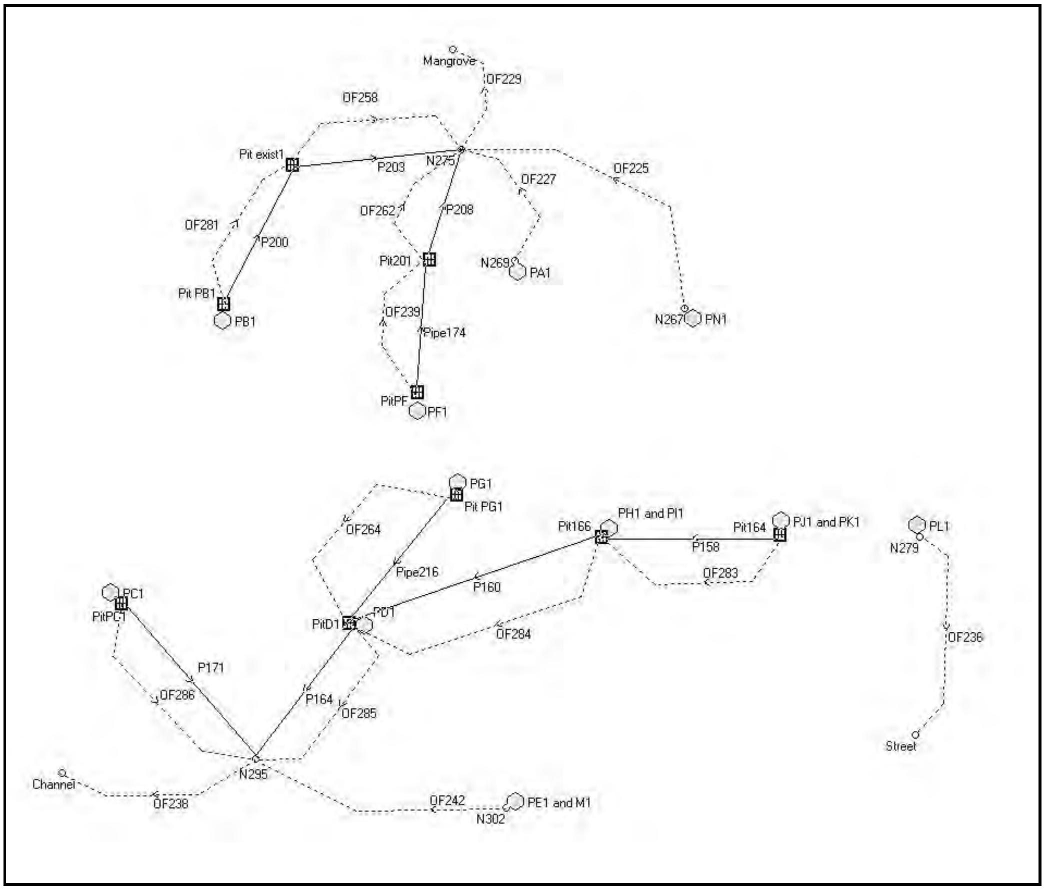


Figure C1 – Proposed Condition Option 2– No OSD - Drains Input Labels

DRAINS Model Name and File Path **F:\AA002350\D-Calculations\Stormwater\Drains\Results\Option 2**

Option 2 - no OSD - 09-02-23

DRAINS Version: 2008.11 -November 2008

Modeller's Name: Gustavo Pereira

Description: Toyota Park

PIT / NODE DETAILS			Version 9															
Name	Type	Family	Size	Ponding Volume (cu.m)	Pressure Change Coeff. Ku	Surface Elev (m)	Max Pond Depth (m)	Base Inflow (cu.m/s)	Blocking Factor	x	y	Bolt-down lid	id	Part Full Shock Loss				
N267	Node					3		0		332827.2	6256308.4		1E+08					
N269	Node					3		0		332776.4	6256322.9		1E+08					
Mangrove	Node					0		0		332758	6256385.8		1E+08					
N279	Node					5		0		332897.5	6256240.2		1E+08					
Street	Node					3		0		332896.2	6256180.9		1E+08					
Pit164	OnGrade	DUMMY U	UNLIMITED INLET		5	5		0	0.2	332855.8	6256240.8	No	1E+08	1 x Ku				
Pit166	OnGrade	DUMMY U	UNLIMITED INLET		1.5	5		0	0.2	332802.4	6256240.2	No	1E+08	1 x Ku				
PitD1	OnGrade	DUMMY U	UNLIMITED INLET		2.5	3.5		0	0.2	332726.8	6256214.5	No	1E+08	1 x Ku				
N295	Node					2.5		0		332698.8	6256173.7		1E+08					
PitPF	OnGrade	DUMMY U	UNLIMITED INLET		1.5	5		0	0.2	332747.4	6256283.5	No	1E+08	1 x Ku				
Pit201	Sag	TOYOTA -	450x450 g	1	5	2.95	0.4	0	0.5	332750.9	6256323.3	No	2E+08	1 x Ku				
N275	Node					2		0		332760.4	6256356.1		1E+08					
PitPC1	OnGrade	DUMMY U	UNLIMITED INLET		0	3.5		0	0.2	332658.8	6256220.3	No	1E+08	1 x Ku				
Channel	Node							0		332640.8	6256169.5		1E+08					
N302	Node					2.5		0		332773.7	6256159.1		1E+08					
Pit PB1	OnGrade	DUMMY U	UNLIMITED INLET		0	4.2		0	0.2	332689.4	6256309.9	No	2E+08	1 x Ku				
Pit exist1	Sag	TOYOTA -	450x450 g	1	1.5	2.7	0.17	0	0.5	332709.9	6256351.6	No	2E+08	1 x Ku				
Pit PG1	OnGrade	DUMMY U	UNLIMITED INLET		5	4.25		0	0.2	332759.1	6256252.9	No	2E+08	1 x Ku				
DETENTION BASIN DETAILS																		
Name	Elev	Surf. Area	Init Vol. (cu	Outlet Type	K	Dia(mm)	Centre RL	Pit Fami	Pit Type	x	y	HED	Crest R	Crest Len	id			
SUB-CATCHMENT DETAILS																		
Name	Pit or Node	Total Area (ha)	Paved Area %	Grass Area %	Supp Area %	Paved Time (min)	Grass Time (min)	Supp Time (min)	Paved Length (m)	Grass Length (m)	Supp Length (m)	Paved Slope(%	Grass Slope %	Supp Slope %	Paved Rough	Grass Rough	Supp Rough	Lag Time or Factor
PN1	N267	0.105	50	50	0	7	12	0										0
PA1	N269	0.7435	0	100	0	5	10	0										0
PL1	N279	0.0434	0	100	0	0	7	0										0
PJ1 and PI	Pit164	0.3226	65	35	0	5	21	0										0
PH1 and P	Pit166	0.4429	70	30	0	5	21	0										0
PD1	PitD1	0.262	100	0	0	5	0	0										0
PF1	PitPF	0.4	100	0	0	6	20	0										0
PC1	PitPC1	0.326	100	0	0	5	0	0										0
PE1 and M	N302	0.445	65	35	0	5	15	0										0

PB1	Pit PB1	0.19	100	0	0	5	0	0										0
PG1	Pit PG1	0.118	100	0	0	6	0	0										0
PIPE DETAILS																		
Name	From	To	Length	U/S IL	D/S IL	Slope	Type	Dia	I.D.	Rough	Pipe Is	No. Pip	Chg Fro	At Chg	Chg	Rl	Chg	RL
			(m)	(m)	(m)	(%)		(mm)	(mm)						(m)	(m)	(m)	(m)
P158	Pit164	Pit166	60	3.9	3.3	1	Concrete, u	450	450	0.3	New	1	Pit164	0				
P160	Pit166	PitD1	35	3.3	2.5	2.29	Concrete, u	525	525	0.3	New	1	Pit166	0				
P164	PitD1	N295	45	2	1.325	1.5	Concrete, u	600	600	0.3	New	1	PitD1	0				
Pipe174	PitPF	Pit201	20	2.65	2.35	1.5	Concrete, u	375	375	0.3	New	1	PitPF	0				
P208	Pit201	N275	15	2.35	2.125	1.5	uPVC, und	250	242	0.03	New	1	Pit201	0				
P171	PitPC1	N295	72	2.5	1	2.08	Concrete, r	450	450	0.3	New	1	PitPC1	0				
P200	Pit PB1	Pit exist1	30	2.55	2.1	1.5	Concrete, u	300	300	0.3	New	1	Pit PB1	0				
P203	Pit exist1	N275	20	2.1	1.8	1.5	uPVC, und	250	242	0.03	New	1	Pit exist	0				
Pipe216	Pit PG1	PitD1	20	3	2.8	1	Concrete, u	300	300	0.3	New	1	Pit PG1	0				
DETAILS of SERVICES CROSSING PIPES																		
Pipe	Chg	Bottom	Height of S	Chg	Bottom	Height of S	Chg	Bottom	Height o	etc								
	(m)	Elev (m)	(m)	(m)	Elev (m)	(m)	(m)	Elev (m)	(m)	etc								
CHANNEL DETAILS																		
Name	From	To	Type	Length	U/S IL	D/S IL	Slope	Base Wi	L.B. Slop	R.B. Slope	Manning	Depth	Roofed					
				(m)	(m)	(m)	(%)	(m)	(1:?)	(1:?)	n	(m)						
OVERFLOW ROUTE DETAILS																		
Name	From	To	Travel	Spill	Crest	Weir	Cross	Safe De	SafeDep	Safe	Bed	D/S Area		id				
			Time	Level	Length	Coeff. C	Section	Major St	Minor St	DxV	Slope	Contributing						
			(min)	(m)	(m)			(m)	(m)	(sq.m/sec)	(%)	%						
OF225	N267	N275	0.1				Dummy us	0.2	0.05	0.6	1	0		1.2E+08				
OF227	N269	N275	0.1				Dummy us	0.2	0.05	0.6	1	0		1.2E+08				
OF236	N279	Street	0.1				Dummy us	0.2	0.05	0.6	1	0		1.2E+08				
OF283	Pit164	Pit166	0.1				Dummy us	0.2	0.05	0.6	1	0		2.3E+08				
OF284	Pit166	PitD1	0.1				Dummy us	0.2	0.05	0.6	1	0		2.3E+08				
OF285	PitD1	N295	0.1				Dummy us	0.2	0.05	0.6	1	0		2.3E+08				
OF238	N295	Channel	0.1				Dummy us	0.2	0.05	0.6	1	0		1.2E+08				
OF239	PitPF	Pit201	0.1				Dummy us	0.2	0.05	0.6	1	0		1.2E+08				
OF262	Pit201	N275	0.1				Dummy us	0.2	0.05	0.6	1	0		2.1E+08				
OF229	N275	Mangrove	0.1				Dummy us	0.2	0.05	0.6	1	0		1.2E+08				
OF286	PitPC1	N295	0.1				Dummy us	0.2	0.05	0.6	1	0		2.3E+08				
OF242	N302	N295	0.1				Dummy us	0.2	0.05	0.6	1	0		1.2E+08				
OF281	Pit PB1	Pit exist1	0.1				Dummy us	0.2	0.05	0.6	1	0		2.3E+08				
OF258	Pit exist1	N275	0.1				Dummy us	0.2	0.05	0.6	1	0		2.1E+08				
OF264	Pit PG1	PitD1	0.1				Dummy us	0.2	0.05	0.6	1	0		2.3E+08				

Drains 10 year ARI Results – Proposed Condition Option 2 – No OSD

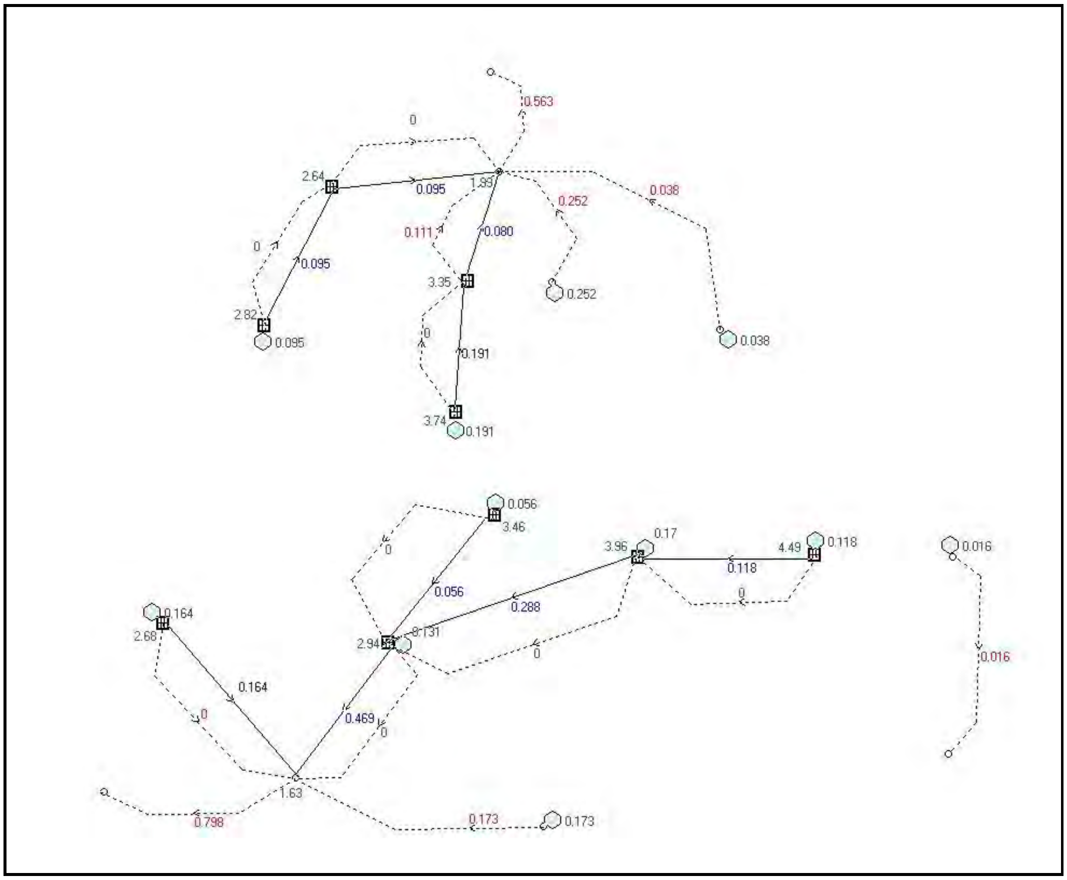


Figure C2 – Proposed Condition Option 2– No OSD - Drains 10 Year Results

DRAINS Model Name and File Path **F:\AA002350\D-Calculations\Stormwater\Drains\Results\Option 2**
Option 2 - no OSD - 09-02-23

DRAINS Version: 2008.11 -November 2008
Modeller's Name: Gustavo Pereira
Description: Toyota Park

DRAINS results prepared 23 February, 2009 from Version 2008.11							
PIT / NODE DETAILS				Version 8			
Name	Max HGL	Max Pond HGL	Max Surfac Flow Arrivi (cu.m/s)	Max Pond Volume (cu.m)	Min Freeboard (m)	Overflow (cu.m/s)	Constraint
Pit164	4.49		0.118		0.51	0	None
Pit166	3.96		0.17		1.04	0	None
PitD1	2.94		0.131		0.56	0	None
N295	1.63		0.173				
PitPF	3.74		0.191		1.26	0	None
Pit201	3.35	3.35	0	1	-0.4	0.111	Outlet System
N275	1.99		0.393				
PitPC1	2.68		0.164		0.82	0	None
Pit PB1	2.82		0.095		1.38	0	None
Pit exist1	2.64	2.7	0	0	0.06	0	None
Pit PG1	3.46		0.056		0.79	0	None
SUB-CATCHMENT DETAILS							
Name	Max Flow Q (cu.m/s)	Paved Max Q (cu.m/s)	Grassed Max Q (cu.m/s)	Paved Tc (min)	Grassed Tc (min)	Supp. Tc (min)	Due to Storm
PN1	0.038	0.023	0.015	7	12	0	AR&R 10 year, 30 minutes storm, average 87 mm/h, Zone 1
PA1	0.262	0	0.262	5	10	0	AR&R 10 year, 2 hours storm, average 38.9 mm/h, Zone 1
PL1	0.017	0	0.017	0	7	0	AR&R 10 year, 2 hours storm, average 38.9 mm/h, Zone 1
PJ1 and PI	0.118	0.1	0.023	5	21	0	AR&R 10 year, 30 minutes storm, average 87 mm/h, Zone 1
PH1 and P	0.17	0.148	0.027	5	21	0	AR&R 10 year, 30 minutes storm, average 87 mm/h, Zone 1
PD1	0.131	0.131	0	5	0	0	AR&R 10 year, 20 minutes storm, average 105 mm/h, Zone 1
PF1	0.191	0.191	0	6	20	0	AR&R 10 year, 20 minutes storm, average 105 mm/h, Zone 1
PC1	0.164	0.164	0	5	0	0	AR&R 10 year, 20 minutes storm, average 105 mm/h, Zone 1
PE1 and M	0.173	0.138	0.039	5	15	0	AR&R 10 year, 30 minutes storm, average 87 mm/h, Zone 1
PB1	0.095	0.095	0	5	0	0	AR&R 10 year, 20 minutes storm, average 105 mm/h, Zone 1
PG1	0.056	0.056	0	6	0	0	AR&R 10 year, 20 minutes storm, average 105 mm/h, Zone 1

Outflow Volumes for Total Catchment (2.16 impervious + 1.24 pervious = 3.40 total ha)

Storm	Total Rainf	Total Runo	Impervious	Pervious Runoff
	cu.m	cu.m (Run	cu.m (Run	cu.m (Runoff %)
AR&R 10 y	509.77	363.64 (71	302.05 (93	61.59 (33.1%)
AR&R 10 y	792.97	623.24 (78	481.84 (95	141.40 (48.8%)
AR&R 10 y	1189.46	985.52 (82	733.55 (97	251.97 (58.0%)
AR&R 10 y	1478.33	1238.33 (8	916.94 (97	321.39 (59.5%)
AR&R 10 y	2032.27	1722.60 (8	1268.61 (9	453.99 (61.2%)
AR&R 10 y	2643.99	2240.79 (8	1656.97 (9	583.83 (60.5%)
AR&R 10 y	3028.02	2557.80 (8	1900.76 (9	657.05 (59.4%)

PIPE DETAILS

Name	Max Q	Max V	Max U/S	Max D/S	Due to Storm
	(cu.m/s)	(m/s)	HGL (m)	HGL (m)	
P158	0.118	2	4.082	3.956	AR&R 10 year, 30 minutes storm, average 87 mm/h, Zone 1
P160	0.288	3.4	3.519	2.943	AR&R 10 year, 30 minutes storm, average 87 mm/h, Zone 1
P164	0.469	3.3	2.304	1.629	AR&R 10 year, 20 minutes storm, average 105 mm/h, Zone 1
Pipe174	0.191	1.7	3.508	3.35	AR&R 10 year, 20 minutes storm, average 105 mm/h, Zone 1
P208	0.08	2.4	2.513	2.288	AR&R 10 year, 20 minutes storm, average 105 mm/h, Zone 1
P171	0.164	2.8	2.677	1.629	AR&R 10 year, 20 minutes storm, average 105 mm/h, Zone 1
P200	0.095	1.4	2.825	2.637	AR&R 10 year, 20 minutes storm, average 105 mm/h, Zone 1
P203	0.095	2.5	2.308	1.989	AR&R 10 year, 20 minutes storm, average 105 mm/h, Zone 1
Pipe216	0.056	1.7	3.144	2.944	AR&R 10 year, 20 minutes storm, average 105 mm/h, Zone 1

CHANNEL DETAILS

Name	Max Q	Max V	Chainage	Max	Due to Storm
	(cu.m/s)	(m/s)	(m)	HGL (m)	

OVERFLOW ROUTE DETAILS

Name	Max Q U/S	Max Q D/S	Safe Q	Max D	Max DxV	Max Width	Max V	Due to Storm
OF225	0.038	0.038	0.256	0.025	0.01	8.23	0.38	AR&R 10 year, 30 minutes storm, average 87 mm/h, Zone 1
OF227	0.262	0.262	0.256	0.051	0.03	14.15	0.65	AR&R 10 year, 2 hours storm, average 38.9 mm/h, Zone 1
OF236	0.017	0.017	0.256	0.018	0.01	5.84	0.32	AR&R 10 year, 2 hours storm, average 38.9 mm/h, Zone 1
OF283	0	0	0.256	0	0	0	0	
OF284	0	0	0.256	0	0	0	0	
OF285	0	0	0.256	0	0	0	0	
OF238	0.798	0.798	0.256	0.079	0.07	19.9	0.9	AR&R 10 year, 20 minutes storm, average 105 mm/h, Zone 1
OF239	0	0	0.256	0	0	0	0	

OF262	0.111	0.111	0.256	0.036	0.02	11.27	0.51	AR&R 10 year, 20 minutes storm, average 105 mm/h, Zone 1
OF229	0.563	0.563	0.256	0.069	0.06	17.74	0.82	AR&R 10 year, 30 minutes storm, average 87 mm/h, Zone 1
OF286	0	0	0.256	0	0	0	0	
OF242	0.173	0.173	0.256	0.043	0.03	12.53	0.59	AR&R 10 year, 30 minutes storm, average 87 mm/h, Zone 1
OF281	0	0	0.256	0	0	0	0	
OF258	0	0	0.256	0	0	0	0	
OF264	0	0	0.256	0	0	0	0	
DETENTION BASIN DETAILS								
Name	Max WL	MaxVol	Max Q Total	Max Q Low Level	Max Q High Level			

CONTINUITY CHECK for AR&R 10 year, 2 hours storm, average 38.9 mm/h, Zone 1

Node	Inflow (cu.m)	Outflow (cu.m)	Storage Ch (cu.m)	Difference %
N267	65.03	65.03	0	0
N269	350.28	350.28	0	0
Mangrove	868.35	868.35	0	0
N279	20.48	20.48	0	0
Street	20.48	20.48	0	0
Pit164	213.98	213.98	0	0
Pit166	514.34	514.37	0	0
PitD1	806.21	806.28	0	0
N295	1351.97	1351.97	0	0
PitPF	307.2	307.2	0	0
Pit201	307.2	307.12	0	0
N275	868.35	868.35	0	0
PitPC1	250.37	250.37	0	0
Channel	1351.97	1351.97	0	0
N302	295.33	295.33	0	0
Pit PB1	145.92	145.92	0	0
Pit exist1	145.92	145.92	0	0
Pit PG1	90.62	90.62	0	0

Run Log for Opt 2 run at 10:38:57 on 23/2/2009

Upwelling occurred at Pit201
Freeboard was less than 0.15m at Pit exist1
The maximum flow exceeded the safe value in the following overflow routes: OF238, OF229, OF227

Drains 100 year ARI Results – Proposed Condition – No OSD

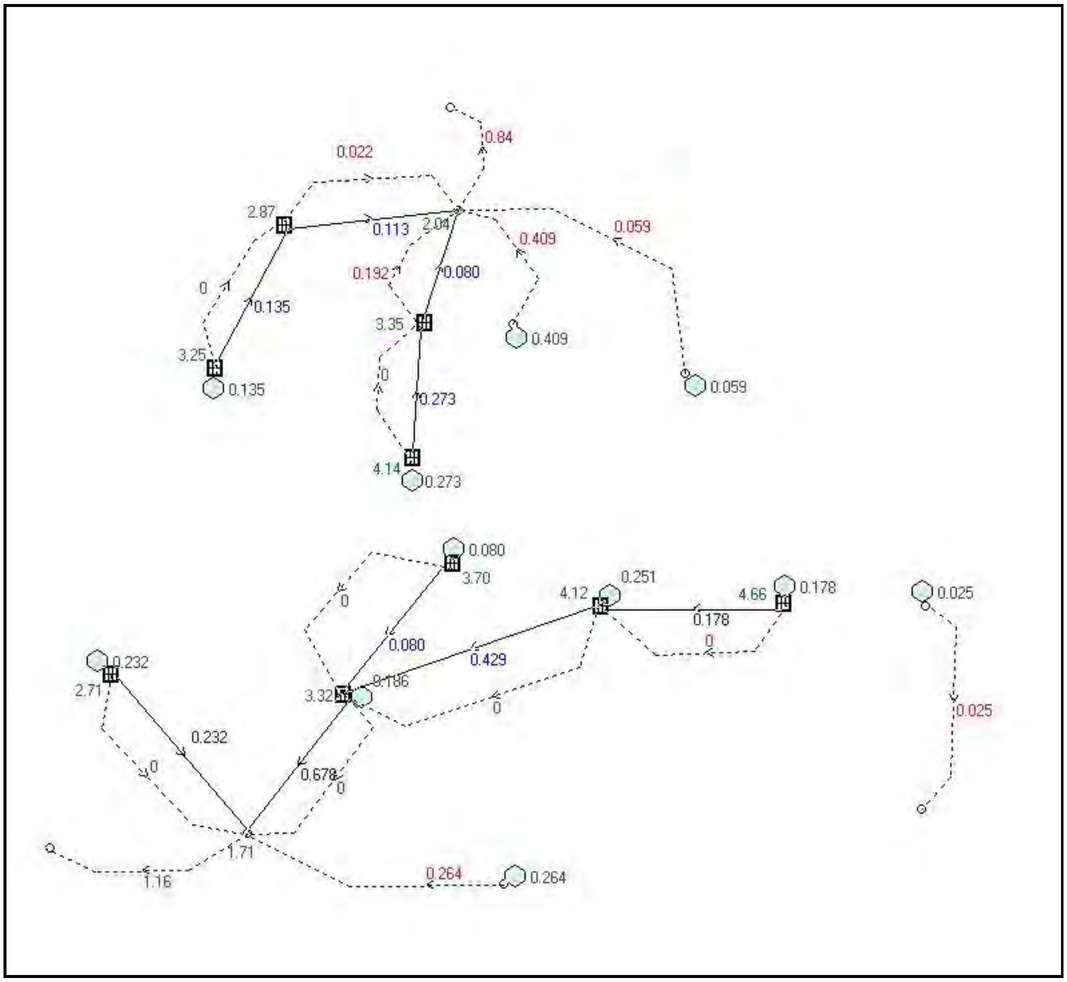


Figure C3 – Proposed Condition Option 2– No OSD - Drains 100 Year Results

DRAINS Model Name and File Path **F:\AA002350\D-Calculations\Stormwater\Drains\Results\Option 2**
Option 2 - no OSD - 09-02-23

DRAINS Version: 2008.11 -November 2008
Modeller's Name: Gustavo Pereira
Description: Toyota Park

DRAINS results prepared 23 February, 2009 from Version 2008.11								
PIT / NODE DETAILS				Version 8				
Name	Max HGL	Max Pond	Max Surfac	Max Pond	Min	Overflow	Constraint	
		HGL	Flow Arrivi	Volume	Freeboard	(cu.m/s)		
			(cu.m/s)	(cu.m)	(m)			
Pit164	4.66		0.178		0.34	0	None	
Pit166	4.12		0.251		0.88	0	None	
PitD1	3.32		0.186		0.18	0	None	
N295	1.71		0.264					
PitPF	4.14		0.273		0.86	0	None	
Pit201	3.35	3.35	0	1	-0.4	0.192	Outlet System	
N275	2.04		0.647					
PitPC1	2.71		0.232		0.79	0	None	
Pit PB1	3.25		0.135		0.95	0	None	
Pit exist1	2.87	2.87	0	0	-0.17	0.022	Outlet System	
Pit PG1	3.7		0.08		0.55	0	None	
SUB-CATCHMENT DETAILS								
Name	Max	Paved	Grassed	Paved	Grassed	Supp.	Due to Storm	
	Flow Q	Max Q	Max Q	Tc	Tc	Tc		
	(cu.m/s)	(cu.m/s)	(cu.m/s)	(min)	(min)	(min)		
PN1	0.059	0.033	0.026	7	12	0	AR&R 100 year, 30 minutes storm, average 134 mm/h, Zone 1	
PA1	0.409	0	0.409	5	10	0	AR&R 100 year, 20 minutes storm, average 160 mm/h, Zone 1	
PL1	0.025	0	0.025	0	7	0	AR&R 100 year, 20 minutes storm, average 160 mm/h, Zone 1	
PJ1 and PI	0.178	0.141	0.044	5	21	0	AR&R 100 year, 1 hour storm, average 92.7 mm/h, Zone 1	
PH1 and P	0.251	0.208	0.052	5	21	0	AR&R 100 year, 1 hour storm, average 92.7 mm/h, Zone 1	
PD1	0.186	0.186	0	5	0	0	AR&R 100 year, 20 minutes storm, average 160 mm/h, Zone 1	
PF1	0.273	0.273	0	6	20	0	AR&R 100 year, 20 minutes storm, average 160 mm/h, Zone 1	
PC1	0.232	0.232	0	5	0	0	AR&R 100 year, 20 minutes storm, average 160 mm/h, Zone 1	
PE1 and M	0.264	0.194	0.07	5	15	0	AR&R 100 year, 1 hour storm, average 92.7 mm/h, Zone 1	
PB1	0.135	0.135	0	5	0	0	AR&R 100 year, 20 minutes storm, average 160 mm/h, Zone 1	
PG1	0.08	0.08	0	6	0	0	AR&R 100 year, 20 minutes storm, average 160 mm/h, Zone 1	

Outflow Volumes for Total Catchment (2.16 impervious + 1.24 pervious = 3.40 total ha)				
Storm	Total Rainf	Total Runo	Impervious	Pervious Runoff
	cu.m	cu.m (Run	cu.m (Run	cu.m (Runoff %)
AR&R 100	753.32	605.61 (80	456.67 (95	148.94 (54.1%)
AR&R 100	1183.79	1011.89 (8	729.96 (97	281.93 (65.2%)
AR&R 100	1812.51	1602.98 (8	1129.09 (9	473.89 (71.6%)
AR&R 100	2276.96	2032.17 (8	1423.95 (9	608.22 (73.2%)
AR&R 100	3150.36	2835.66 (9	1978.43 (9	857.24 (74.5%)
AR&R 100	4098.53	3691.23 (9	2580.37 (9	1110.86 (74.2%)
AR&R 100	4679.67	4197.72 (8	2949.28 (9	1248.44 (73.1%)

PIPE DETAILS					
Name	Max Q	Max V	Max U/S	Max D/S	Due to Storm
	(cu.m/s)	(m/s)	HGL (m)	HGL (m)	
P158	0.178	1.3	4.275	4.115	AR&R 100 year, 1 hour storm, average 92.7 mm/h, Zone 1
P160	0.429	3.8	3.573	3.317	AR&R 100 year, 1 hour storm, average 92.7 mm/h, Zone 1
P164	0.678	3.5	2.384	1.709	AR&R 100 year, 1 hour storm, average 92.7 mm/h, Zone 1
Pipe174	0.273	2.5	3.671	3.35	AR&R 100 year, 20 minutes storm, average 160 mm/h, Zone 1
P208	0.08	2.4	2.514	2.289	AR&R 100 year, 20 minutes storm, average 160 mm/h, Zone 1
P171	0.232	3.1	2.714	1.709	AR&R 100 year, 20 minutes storm, average 160 mm/h, Zone 1
P200	0.135	1.9	3.248	2.87	AR&R 100 year, 20 minutes storm, average 160 mm/h, Zone 1
P203	0.113	2.5	2.41	2.04	AR&R 100 year, 20 minutes storm, average 160 mm/h, Zone 1
Pipe216	0.08	1.1	3.397	3.317	AR&R 100 year, 20 minutes storm, average 160 mm/h, Zone 1

CHANNEL DETAILS					
Name	Max Q	Max V	Chainage	Max	Due to Storm
	(cu.m/s)	(m/s)	(m)	HGL (m)	

OVERFLOW ROUTE DETAILS								
Name	Max Q U/S	Max Q D/S	Safe Q	Max D	Max DxV	Max Width	Max V	Due to Storm
OF225	0.059	0.059	7.665	0.029	0.01	9.73	0.41	AR&R 100 year, 30 minutes storm, average 134 mm/h, Zone 1
OF227	0.409	0.409	7.665	0.061	0.05	16.12	0.74	AR&R 100 year, 20 minutes storm, average 160 mm/h, Zone 1
OF236	0.025	0.025	7.665	0.021	0.01	7.03	0.34	AR&R 100 year, 20 minutes storm, average 160 mm/h, Zone 1
OF283	0	0	7.665	0	0	0	0	
OF284	0	0	7.665	0	0	0	0	
OF285	0	0	7.665	0	0	0	0	
OF238	1.16	1.16	7.665	0.093	0.09	22.59	0.99	AR&R 100 year, 1 hour storm, average 92.7 mm/h, Zone 1
OF239	0	0	7.665	0	0	0	0	

OF262	0.192	0.192	7.665	0.044	0.03	12.89	0.61	AR&R 100 year, 20 minutes storm, average 160 mm/h, Zone 1
OF229	0.84	0.84	7.665	0.081	0.07	20.25	0.91	AR&R 100 year, 30 minutes storm, average 134 mm/h, Zone 1
OF286	0	0	7.665	0	0	0	0	
OF242	0.264	0.264	7.665	0.051	0.03	14.15	0.66	AR&R 100 year, 1 hour storm, average 92.7 mm/h, Zone 1
OF281	0	0	7.665	0	0	0	0	
OF258	0.022	0.022	7.665	0.02	0.01	6.74	0.32	AR&R 100 year, 20 minutes storm, average 160 mm/h, Zone 1
OF264	0	0	7.665	0	0	0	0	
DETENTION BASIN DETAILS								
Name	Max WL	MaxVol	Max Q Total	Max Q Low Level	Max Q High Level			

CONTINUITY CHECK for AR&R 100 year, 1 hour storm, average 92.7 mm/h, Zone 1

Node	Inflow (cu.m)	Outflow (cu.m)	Storage Ch (cu.m)	Difference %
N267	84.43	84.43	0	0
N269	514.61	514.61	0	0
Mangrove	1140.26	1140.26	0	0
N279	30.1	30.1	0	0
Street	30.1	30.1	0	0
Pit164	269.87	269.87	0	0
Pit166	645.42	645.48	0	0
PitD1	993.94	994	0	0
N295	1665.61	1665.62	0	0
PitPF	366.8	366.8	0	0
Pit201	366.8	367.06	0	-0.1
N275	1140.26	1140.26	0	0
PitPC1	298.94	298.94	0	0
Channel	1665.62	1665.62	0	0
N302	372.67	372.67	0	0
Pit PB1	174.23	174.23	0	0
Pit exist1	174.23	174.16	0	0
Pit PG1	108.21	108.21	0	0

Run Log for Opt 2 run at 10:41:58 on 23/2/2009

Upwelling occurred at Pit201, Pit exist1

Drains Input Data – Proposed Condition Option 2 with OSD

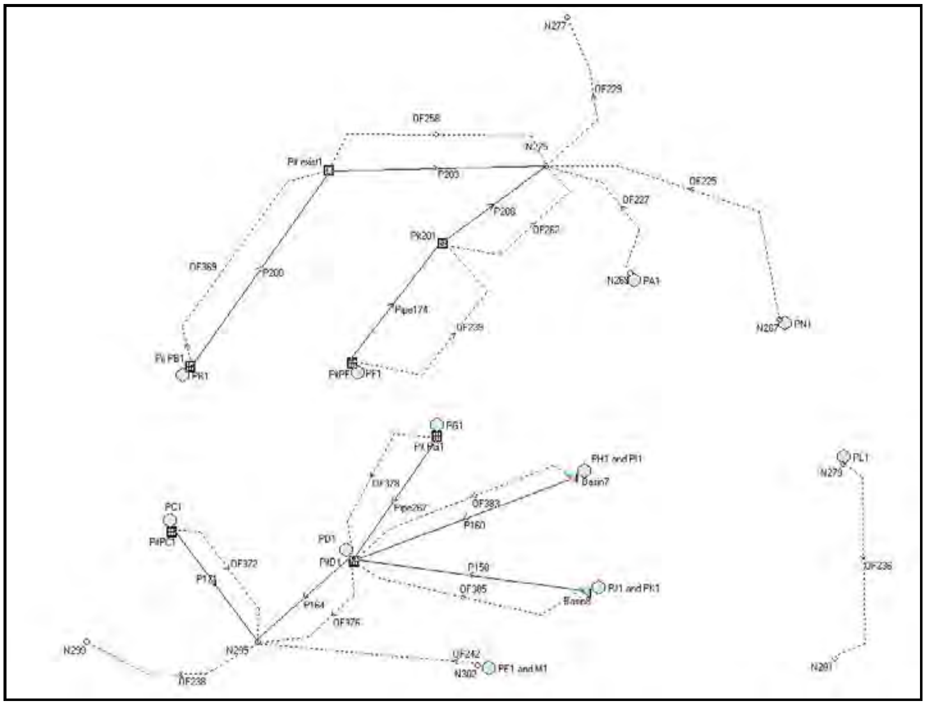


Figure C4 – Proposed Condition Option 2 with OSD - Drains Input Labels

DRAINS Model Name and File Path **F:\AA002350\D-Calculations\Stormwater\Drains\Results\Option 2**
Option 2 - OSD - 09-02-23

DRAINS Version: 2008.11 -November 2008

Modeller's Name: Gustavo Pereira

Description: Toyota Park

PIT / NODE DETAILS			Version 9															
Name	Type	Family	Size	Ponding Volume (cu.m)	Pressure Change Coeff. Ku	Surface Elev (m)	Max Pond Depth (m)	Base Inflow (cu.m/s)	Blocking Factor	x	y	Bolt-down lid	id	Part Full Shock Loss				
N267	Node					3		0		332851.1	6256296.2		1E+08					
N269	Node					3		0		332792.8	6256314.8		1E+08					
N277	Node					0		0		332768.7	6256413.8		1E+08					
N279	Node					5		0		332875.5	6256240.5		1E+08					
N281	Node					3		0		332872.3	6256164.9		1E+08					
PitPF	OnGrade	DUMMY U	UNLIMITED INLET		1.5	5		0	0.2	332685	6256279.6	No	1E+08	1 x Ku				
Pit201	Sag	TOYOTA -	450x450 gr	1	5	2.95	0.4	0	0.5	332720.2	6256326.2	No	2E+08	1 x Ku				
N275	Node					2		0		332760.4	6256356.1		1E+08					
PitPC1	OnGrade	DUMMY U	UNLIMITED INLET		0	3.5		0	0.2	332614.9	6256214.1	No	1E+08	1 x Ku				
N295	Node					2.5		0		332648.2	6256171.5		1E+08					
N299	Node							0		332581.7	6256171.5		1E+08					
N302	Node					2.5		0		332733.5	6256162.3		1E+08					
Pit PB1	OnGrade	DUMMY U	UNLIMITED INLET		0	4.2		0	0.2	332622.1	6256278	No	2E+08	1 x Ku				
Pit exist1	Sag	TOYOTA -	450x450 gr	1	1.5	2.7	0.17	0	0.5	332676.2	6256354.3	No	2E+08	1 x Ku				
PitD1	OnGrade	DUMMY U	UNLIMITED INLET		2.5	5.5		0	0.2	332685.6	6256202.7	No	1E+08	1 x Ku				
Pit PG1	OnGrade	DUMMY U	UNLIMITED INLET		4	5.5		0	0.2	332717.9	6256251.3	No	2E+08	1 x Ku				
DETENTION BASIN DETAILS																		
Name	Elev	Surf. Area	Init Vol. (cu	Outlet Type	K	Dia(mm)	Centre RL	Pit Fami	Pit Type	x	y	HED	Crest R	Crest Len	id			
Basin8	5.05	375	0	Orifice		250	5.175			332775.9	6256190.7	No			2.24E+08			
	5.55	375																
Basin7	5.05	475	0	Orifice		250	5.175			332770.8	6256235.1	No			2.24E+08			
	5.55	475																
SUB-CATCHMENT DETAILS																		
Name	Pit or Node	Total Area (ha)	Paved Area %	Grass Area %	Supp Area %	Paved Time (min)	Grass Time (min)	Supp Time (min)	Paved Length (m)	Grass Length (m)	Supp Length (m)	Paved Slope(%	Grass Slope %	Supp Slope %	Paved Rough	Grass Rough	Supp Rough	Lag Time or Factor
PN1	N267	0.105	50	50	0	7	12	0										0
PA1	N269	0.7435	0	100	0	5	10	0										0
PL1	N279	0.0434	0	100	0	0	7	0										0
PF1	PitPF	0.4	100	0	0	6	20	0										0
PC1	PitPC1	0.326	100	0	0	5	0	0										0
PE1 and M	N302	0.445	65	35	0	5	15	0										0
PB1	Pit PB1	0.19	100	0	0	5	0	0										0
PJ1 and Pl	Basin8	0.3226	65	35	0	5	21	0										0

PD1	PitD1	0.262	100	0	0	5	0	0										0
PG1	Pit PG1	0.118	100	0	0	6	0	0										0
PH1 and P	Basin7	0.4429	70	30	0	5	21	0										0
PIPE DETAILS																		
Name	From	To	Length	U/S IL	D/S IL	Slope	Type	Dia	I.D.	Rough	Pipe Is	No. Pip	Chg Fro	At Chg	Chg	RI	Chg	RL
			(m)	(m)	(m)	(%)		(mm)	(mm)						(m)	(m)	(m)	(m)
Pipe174	PitPF	Pit201	20	2.65	2.35	1.5	Concrete, u	375	375	0.3	New	1	PitPF	0				
P208	Pit201	N275	15	2.35	2.125	1.5	uPVC, und	250	242	0.03	New	1	Pit201	0				
P171	PitPC1	N295	72	2.5	1	2.08	Concrete, r	450	450	0.3	New	1	PitPC1	0				
P200	Pit PB1	Pit exist1	30	2.55	2.1	1.5	Concrete, u	300	300	0.3	New	1	Pit PB1	0				
P203	Pit exist1	N275	20	2.1	1.8	1.5	uPVC, und	250	242	0.03	New	1	Pit exist	0				
P158	Basin8	PitD1	95	5.05	3.625	1.5	Concrete, u	450	450	0.3	NewFixed	1	Basin8	0				
P164	PitD1	N295	45	2	1.325	1.5	Concrete, u	600	600	0.3	New	1	PitD1	0				
Pipe267	Pit PG1	Basin7	20	3	2.8	1	Concrete, u	300	300	0.3	NewFixed	1	Pit PG1	0				
P160	Basin7	PitD1	35	5.05	4.525	1.5	Concrete, u	450	450	0.3	NewFixed	1	Basin7	0				
DETAILS of SERVICES CROSSING PIPES																		
Pipe	Chg	Bottom	Height of S	Chg	Bottom	Height of S	Chg	Bottom	Height o	etc								
	(m)	Elev (m)	(m)	(m)	Elev (m)	(m)	(m)	Elev (m)	(m)	etc								
CHANNEL DETAILS																		
Name	From	To	Type	Length	U/S IL	D/S IL	Slope	Base Wi	L.B. Slop	R.B. Slope	Manning	Depth	Roofed					
				(m)	(m)	(m)	(%)	(m)	(1:?)	(1:?)	n	(m)						
OVERFLOW ROUTE DETAILS																		
Name	From	To	Travel	Spill		Weir	Cross	Safe De	SafeDep	Safe	Bed	D/S Area		id				
			Time	Level	Length	Coeff. C	Section	Major St	Minor St	DxV	Slope	Contributing						
			(min)	(m)	(m)			(m)	(m)	(sq.m/sec)	(%)	%						
OF225	N267	N275	0.1				Dummy us	0.2	0.05	0.6	1	0		1.2E+08				
OF227	N269	N275	0.1				Dummy us	0.2	0.05	0.6	1	0		1.2E+08				
OF236	N279	N281	0.1				Dummy us	0.2	0.05	0.6	1	0		1.2E+08				
OF239	PitPF	Pit201	0.1				Dummy us	0.2	0.05	0.6	1	0		1.2E+08				
OF262	Pit201	N275	0.1				Dummy us	0.2	0.05	0.6	1	0		2.1E+08				
OF229	N275	N277	0.1				Dummy us	0.2	0.05	0.6	1	0		1.2E+08				
OF372	PitPC1	N295	0.1				Dummy us	0.2	0.05	0.6	1	0		2.5E+08				
OF238	N295	N299	0.1				Dummy us	0.2	0.05	0.6	1	0		1.2E+08				
OF242	N302	N295	0.1				Dummy us	0.2	0.05	0.6	1	0		1.2E+08				
OF369	Pit PB1	Pit exist1	0.1				Dummy us	0.2	0.05	0.6	1	0		2.5E+08				
OF258	Pit exist1	N275	0.1				Dummy us	0.2	0.05	0.6	1	0		2.1E+08				
OF385	Basin8	PitD1	0.1	5.55	2	1.6	Dummy us	0.2	0.05	0.6	1	0		2.5E+08				
OF376	PitD1	N295	0.1				Dummy us	0.2	0.05	0.6	1	0		2.5E+08				
OF378	Pit PG1	PitD1	0.1				Dummy us	0.2	0.05	0.6	1	0		2.5E+08				
OF383	Basin7	PitD1	0.1	5.55	2	1.6	Dummy us	0.2	0.05	0.6	1	0		2.5E+08				

Drains 2 year ARI Results – Proposed Condition with OSD

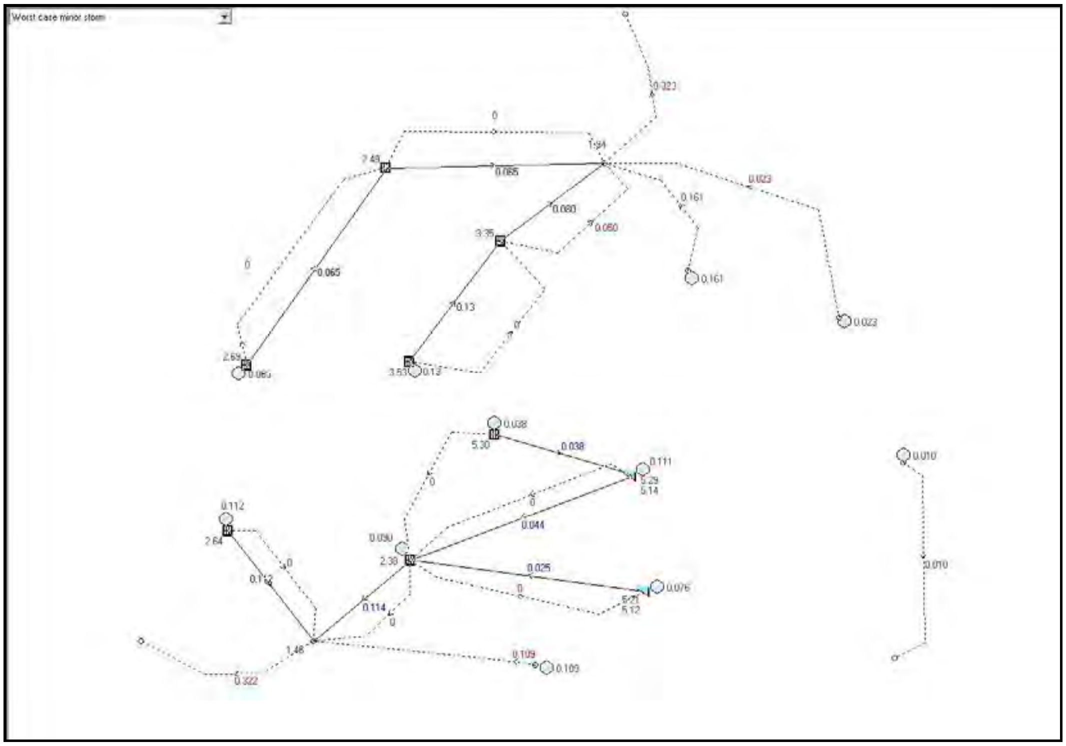


Figure C5 – Proposed Condition Option 2 with OSD - Drains 2 Year Results

DRAINS Model Name and File Path **F:\AA002350\D-Calculations\Stormwater\Drains\Results\Option 2**
Option 2 - OSD - 09-02-23

DRAINS Version: 2008.11 -November 2008
Modeller's Name: Gustavo Pereira
Description: Toyota Park

DRAINS results prepared 23 February, 2009 from Version 2008.11							
PIT / NODE DETAILS				Version 8			
Name	Max HGL	Max Pond HGL	Max Surfac Flow Arrivi (cu.m/s)	Max Pond Volume (cu.m)	Min Freeboard (m)	Overflow (cu.m/s)	Constraint
PitPF	3.53		0.13		1.47	0	None
Pit201	3.35	3.35	0	0.2	-0.4	0.05	Outlet System
N275	1.94		0.194				
PitPC1	2.64		0.112		0.86	0	None
N295	1.46		0.109				
Pit PB1	2.69		0.065		1.51	0	None
Pit exist1	2.49	2.7	0	0	0.21	0	None
PitD1	2.38		0.09		3.12	0	None
Pit PG1	5.3		0.038		0.2	0	None
SUB-CATCHMENT DETAILS							
Name	Max Flow Q (cu.m/s)	Paved Max Q (cu.m/s)	Grassed Max Q (cu.m/s)	Paved Tc (min)	Grassed Tc (min)	Supp. Tc (min)	Due to Storm
PN1	0.023	0.016	0.008	7	12	0	AR&R 2 year, 30 minutes storm, average 58 mm/h, Zone 1
PA1	0.161	0	0.161	5	10	0	AR&R 2 year, 2 hours storm, average 25.7 mm/h, Zone 1
PL1	0.01	0	0.01	0	7	0	AR&R 2 year, 2 hours storm, average 25.7 mm/h, Zone 1
PF1	0.13	0.13	0	6	20	0	AR&R 2 year, 20 minutes storm, average 71.7 mm/h, Zone 1
PC1	0.112	0.112	0	5	0	0	AR&R 2 year, 20 minutes storm, average 71.7 mm/h, Zone 1
PE1 and M	0.109	0.092	0.019	5	15	0	AR&R 2 year, 30 minutes storm, average 58 mm/h, Zone 1
PB1	0.065	0.065	0	5	0	0	AR&R 2 year, 20 minutes storm, average 71.7 mm/h, Zone 1
PJ1 and PI	0.076	0.072	0.009	5	21	0	AR&R 2 year, 20 minutes storm, average 71.7 mm/h, Zone 1
PD1	0.09	0.09	0	5	0	0	AR&R 2 year, 20 minutes storm, average 71.7 mm/h, Zone 1
PG1	0.038	0.038	0	6	0	0	AR&R 2 year, 20 minutes storm, average 71.7 mm/h, Zone 1
PH1 and P	0.111	0.106	0.011	5	21	0	AR&R 2 year, 20 minutes storm, average 71.7 mm/h, Zone 1

Outflow Volumes for Total Catchment (2.16 impervious + 1.24 pervious = 3.40 total ha)								
Storm	Total Rainf	Total Runo	Impervious	Pervious Runoff				
	cu.m	cu.m (Run	cu.m (Run	cu.m (Runoff %)				
AR&R 2 ye	356.84	217.18 (60	204.96 (90	12.22 (9.4%)				
AR&R 2 ye	546.58	379.63 (69	325.42 (93	54.21 (27.2%)				
AR&R 2 ye	812.23	612.00 (75	494.07 (95	117.93 (39.8%)				
AR&R 2 ye	985.55	749.71 (76	604.10 (96	145.61 (40.5%)				
AR&R 2 ye	1338.99	1036.83 (7	828.48 (97	208.34 (42.6%)				
AR&R 2 ye	1746.8	1350.96 (7	1087.38 (9	263.58 (41.3%)				
AR&R 2 ye	2008.48	1550.10 (7	1253.50 (9	296.60 (40.4%)				
PIPE DETAILS								
Name	Max Q	Max V	Max U/S	Max D/S	Due to Storm			
	(cu.m/s)	(m/s)	HGL (m)	HGL (m)				
Pipe174	0.13	1.2	3.425	3.35	AR&R 2 year, 20 minutes storm, average 71.7 mm/h, Zone 1			
P208	0.08	2.4	2.513	2.288	AR&R 2 year, 20 minutes storm, average 71.7 mm/h, Zone 1			
P171	0.112	2.6	2.642	1.46	AR&R 2 year, 20 minutes storm, average 71.7 mm/h, Zone 1			
P200	0.065	2	2.689	2.49	AR&R 2 year, 20 minutes storm, average 71.7 mm/h, Zone 1			
P203	0.065	2.4	2.24	1.94	AR&R 2 year, 20 minutes storm, average 71.7 mm/h, Zone 1			
P158	0.025	1.7	5.117	3.692	AR&R 2 year, 2 hours storm, average 25.7 mm/h, Zone 1			
P164	0.114	2.4	2.135	1.46	AR&R 2 year, 1 hour storm, average 39.4 mm/h, Zone 1			
Pipe267	0.038	0.5	5.287	5.285	AR&R 2 year, 20 minutes storm, average 71.7 mm/h, Zone 1			
P160	0.044	1.9	5.141	4.616	AR&R 2 year, 2 hours storm, average 25.7 mm/h, Zone 1			
CHANNEL DETAILS								
Name	Max Q	Max V	Chainage	Max	Due to Storm			
	(cu.m/s)	(m/s)	(m)	HGL (m)				
OVERFLOW ROUTE DETAILS								
Name	Max Q U/S	Max Q D/S	Safe Q	Max D	Max DxV	Max Width	Max V	Due to Storm
OF225	0.023	0.023	0.256	0.02	0.01	6.74	0.33	AR&R 2 year, 30 minutes storm, average 58 mm/h, Zone 1
OF227	0.161	0.161	0.256	0.042	0.02	12.35	0.57	AR&R 2 year, 2 hours storm, average 25.7 mm/h, Zone 1
OF236	0.01	0.01	0.256	0.015	0	4.94	0.28	AR&R 2 year, 2 hours storm, average 25.7 mm/h, Zone 1
OF239	0	0	0.256	0	0	0	0	
OF262	0.05	0.05	0.256	0.027	0.01	9.13	0.4	AR&R 2 year, 20 minutes storm, average 71.7 mm/h, Zone 1
OF229	0.323	0.323	0.256	0.055	0.04	15.05	0.69	AR&R 2 year, 30 minutes storm, average 58 mm/h, Zone 1

OF372	0	0	0.256	0	0	0	0	
OF238	0.322	0.322	0.256	0.055	0.04	15.05	0.69	AR&R 2 year, 30 minutes storm, average 58 mm/h, Zone 1
OF242	0.109	0.109	0.256	0.036	0.02	11.27	0.5	AR&R 2 year, 30 minutes storm, average 58 mm/h, Zone 1
OF369	0	0	0.256	0	0	0	0	
OF258	0	0	0.256	0	0	0	0	
OF385	0	0	0.256	0	0	0	0	
OF376	0	0	0.256	0	0	0	0	
OF378	0	0	0.256	0	0	0	0	
OF383	0	0	0.256	0	0	0	0	

DETENTION BASIN DETAILS

Name	Max WL	MaxVol	Max Q Total	Max Q Low Level	Max Q High Level
Basin8	5.21	59.1	0.025	0.025	0
Basin7	5.29	112.8	0.044	0.044	0

CONTINUITY CHECK for AR&R 2 year, 2 hours storm, average 25.7 mm/h, Zone 1

Node	Inflow (cu.m)	Outflow (cu.m)	Storage Ch (cu.m)	Difference %
N267	37.61	37.61	0	0
N269	158.15	158.15	0	0
N277	492.92	492.92	0	0
N279	9.26	9.26	0	0
N281	9.26	9.26	0	0
PitPF	201.6	201.6	0	0
Pit201	201.6	201.39	0	0.1
N275	492.92	492.92	0	0
PitPC1	164.3	164.3	0	0
N295	807.53	807.44	0	0
N299	807.34	807.34	0	0
N302	178.81	178.81	0	0
Pit PB1	95.76	95.76	0	0
Pit exist1	95.76	95.76	0	0
Basin8	129.59	115.56	14.35	-0.3
PitD1	464.5	464.41	0	0
Pit PG1	59.47	59.47	0	0
Basin7	243.83	216.89	27.37	-0.2

Run Log for Opt 2 run at 14:02:17 on 23/2/2009

Upwelling occurred at Pit201
The maximum flow exceeded the safe value in the following overflow routes: OF238, OF229

Drains 10 year ARI Result – Proposed Condition Option 2 with OSD

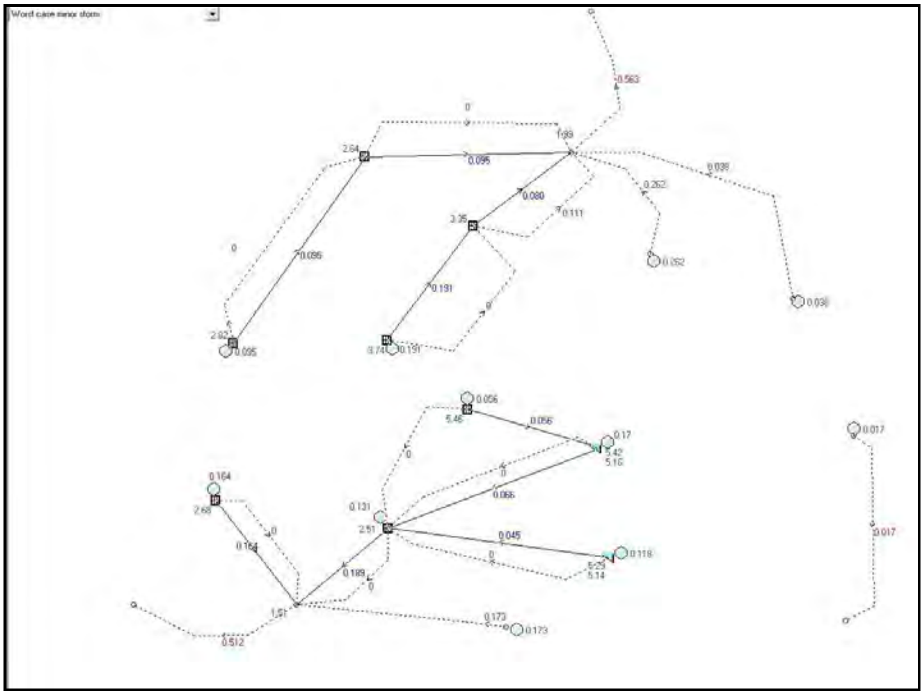


Figure C5 – Proposed Condition Option 2 with OSD - Drains 10 Year Results

DRAINS Model Name and File Path **F:\AA002350\D-Calculations\Stormwater\Drains\Results\Option 2**
Option 2 - OSD - 09-02-23

DRAINS Version: 2008.11 -November 2008

Modeller's Name: Gustavo Pereira

Description: Toyota Park

DRAINS results prepared 23 February, 2009 from Version 2008.11

PIT / NODE DETAILS				Version 8			
Name	Max HGL	Max Pond HGL	Max Surfac Flow Arrivi (cu.m/s)	Max Pond Volume (cu.m)	Min Freeboard (m)	Overflow (cu.m/s)	Constraint
PitPF	3.74		0.191		1.26	0	None
Pit201	3.35	3.35	0	1	-0.4	0.111	Outlet System
N275	1.99		0.393				
PitPC1	2.68		0.164		0.82	0	None
N295	1.51		0.173				
Pit PB1	2.82		0.095		1.38	0	None
Pit exist1	2.64	2.7	0	0	0.06	0	None
PitD1	2.51		0.131		2.99	0	None
Pit PG1	5.46		0.056		0.04	0	None
SUB-CATCHMENT DETAILS							
Name	Max Flow Q (cu.m/s)	Paved Max Q (cu.m/s)	Grassed Max Q (cu.m/s)	Paved Tc (min)	Grassed Tc (min)	Supp. Tc (min)	Due to Storm
PN1	0.038	0.023	0.015	7	12	0	AR&R 10 year, 30 minutes storm, average 87 mm/h, Zone 1
PA1	0.262	0	0.262	5	10	0	AR&R 10 year, 2 hours storm, average 38.9 mm/h, Zone 1
PL1	0.017	0	0.017	0	7	0	AR&R 10 year, 2 hours storm, average 38.9 mm/h, Zone 1
PF1	0.191	0.191	0	6	20	0	AR&R 10 year, 20 minutes storm, average 105 mm/h, Zone 1
PC1	0.164	0.164	0	5	0	0	AR&R 10 year, 20 minutes storm, average 105 mm/h, Zone 1
PE1 and M	0.173	0.138	0.039	5	15	0	AR&R 10 year, 30 minutes storm, average 87 mm/h, Zone 1
PB1	0.095	0.095	0	5	0	0	AR&R 10 year, 20 minutes storm, average 105 mm/h, Zone 1
PJ1 and PI	0.118	0.1	0.023	5	21	0	AR&R 10 year, 30 minutes storm, average 87 mm/h, Zone 1
PD1	0.131	0.131	0	5	0	0	AR&R 10 year, 20 minutes storm, average 105 mm/h, Zone 1
PG1	0.056	0.056	0	6	0	0	AR&R 10 year, 20 minutes storm, average 105 mm/h, Zone 1
PH1 and P	0.17	0.148	0.027	5	21	0	AR&R 10 year, 30 minutes storm, average 87 mm/h, Zone 1

Outflow Volumes for Total Catchment (2.16 impervious + 1.24 pervious = 3.40 total ha)

Storm	Total Rainf	Total Runo	Impervious	Pervious Runoff
	cu.m	cu.m (Run	cu.m (Run	cu.m (Runoff %)
AR&R 10 y	509.77	363.65 (71	302.05 (93	61.60 (33.1%)
AR&R 10 y	792.97	623.24 (78	481.84 (95	141.40 (48.8%)
AR&R 10 y	1189.46	985.53 (82	733.55 (97	251.98 (58.0%)
AR&R 10 y	1478.33	1238.33 (8	916.94 (97	321.39 (59.5%)
AR&R 10 y	2032.27	1722.60 (8	1268.61 (9	453.99 (61.2%)
AR&R 10 y	2643.99	2240.79 (8	1656.97 (9	583.83 (60.5%)
AR&R 10 y	3028.02	2557.80 (8	1900.75 (9	657.05 (59.4%)

PIPE DETAILS

Name	Max Q	Max V	Max U/S	Max D/S	Due to Storm
	(cu.m/s)	(m/s)	HGL (m)	HGL (m)	
Pipe174	0.191	1.7	3.508	3.35	AR&R 10 year, 20 minutes storm, average 105 mm/h, Zone 1
P208	0.08	2.4	2.513	2.288	AR&R 10 year, 20 minutes storm, average 105 mm/h, Zone 1
P171	0.164	2.8	2.677	1.509	AR&R 10 year, 20 minutes storm, average 105 mm/h, Zone 1
P200	0.095	1.4	2.824	2.637	AR&R 10 year, 20 minutes storm, average 105 mm/h, Zone 1
P203	0.095	2.5	2.308	1.989	AR&R 10 year, 20 minutes storm, average 105 mm/h, Zone 1
P158	0.045	1.9	5.142	3.717	AR&R 10 year, 2 hours storm, average 38.9 mm/h, Zone 1
P164	0.189	2.6	2.184	1.509	AR&R 10 year, 1 hour storm, average 59.8 mm/h, Zone 1
Pipe267	0.056	0.8	5.423	5.421	AR&R 10 year, 20 minutes storm, average 105 mm/h, Zone 1
P160	0.066	2.1	5.164	4.639	AR&R 10 year, 2 hours storm, average 38.9 mm/h, Zone 1

CHANNEL DETAILS

Name	Max Q	Max V	Chainage	Max	Due to Storm
	(cu.m/s)	(m/s)	(m)	HGL (m)	

OVERFLOW ROUTE DETAILS

Name	Max Q U/S	Max Q D/S	Safe Q	Max D	Max DxV	Max Width	Max V	Due to Storm
OF225	0.038	0.038	0.256	0.025	0.01	8.23	0.38	AR&R 10 year, 30 minutes storm, average 87 mm/h, Zone 1
OF227	0.262	0.262	0.256	0.051	0.03	14.15	0.65	AR&R 10 year, 2 hours storm, average 38.9 mm/h, Zone 1
OF236	0.017	0.017	0.256	0.018	0.01	5.84	0.32	AR&R 10 year, 2 hours storm, average 38.9 mm/h, Zone 1
OF239	0	0	0.256	0	0	0	0	
OF262	0.111	0.111	0.256	0.036	0.02	11.27	0.51	AR&R 10 year, 20 minutes storm, average 105 mm/h, Zone 1
OF229	0.563	0.563	0.256	0.069	0.06	17.74	0.82	AR&R 10 year, 30 minutes storm, average 87 mm/h, Zone 1
OF372	0	0	0.256	0	0	0	0	

OF238	0.512	0.512	0.256	0.066	0.05	17.2	0.8	AR&R 10 year, 1 hour storm, average 59.8 mm/h, Zone 1
OF242	0.173	0.173	0.256	0.043	0.03	12.53	0.59	AR&R 10 year, 30 minutes storm, average 87 mm/h, Zone 1
OF369	0	0	0.256	0	0	0	0	
OF258	0	0	0.256	0	0	0	0	
OF385	0	0	0.256	0	0	0	0	
OF376	0	0	0.256	0	0	0	0	
OF378	0	0	0.256	0	0	0	0	
OF383	0	0	0.256	0	0	0	0	

DETENTION BASIN DETAILS

Name	Max WL	MaxVol	Max Q Total	Max Q Low Level	Max Q High Level
Basin8	5.29	90.1	0.045	0.045	0
Basin7	5.42	177.9	0.066	0.066	0

CONTINUITY CHECK for AR&R 10 year, 2 hours storm, average 38.9 mm/h, Zone 1

Node	Inflow (cu.m)	Outflow (cu.m)	Storage Ch (cu.m)	Difference %
N267	65.03	65.03	0	0
N269	350.28	350.28	0	0
N277	868.31	868.31	0	0
N279	20.48	20.48	0	0
N281	20.48	20.48	0	0
PitPF	307.2	307.2	0	0
Pit201	307.2	307.09	0	0
N275	868.31	868.31	0	0
PitPC1	250.37	250.37	0	0
N295	1302	1301.89	0	0
N299	1301.77	1301.77	0	0
N302	295.33	295.33	0	0
Pit PB1	145.92	145.92	0	0
Pit exist1	145.92	145.92	0	0
Basin8	213.98	197.27	17.05	-0.2
PitD1	756.42	756.31	0	0
Pit PG1	90.62	90.62	0	0
Basin7	390.99	357.94	33.45	-0.1

Run Log for Opt 2 run at 13:59:40 on 23/2/2009

Upwelling occurred at Pit201
Freeboard was less than 0.15m at Pit PG1, Pit exist1
The maximum flow exceeded the safe value in the following overflow routes: OF238, OF229, OF227

Drains 100 year ARI Result – Proposed Condition Option 2 with OSD

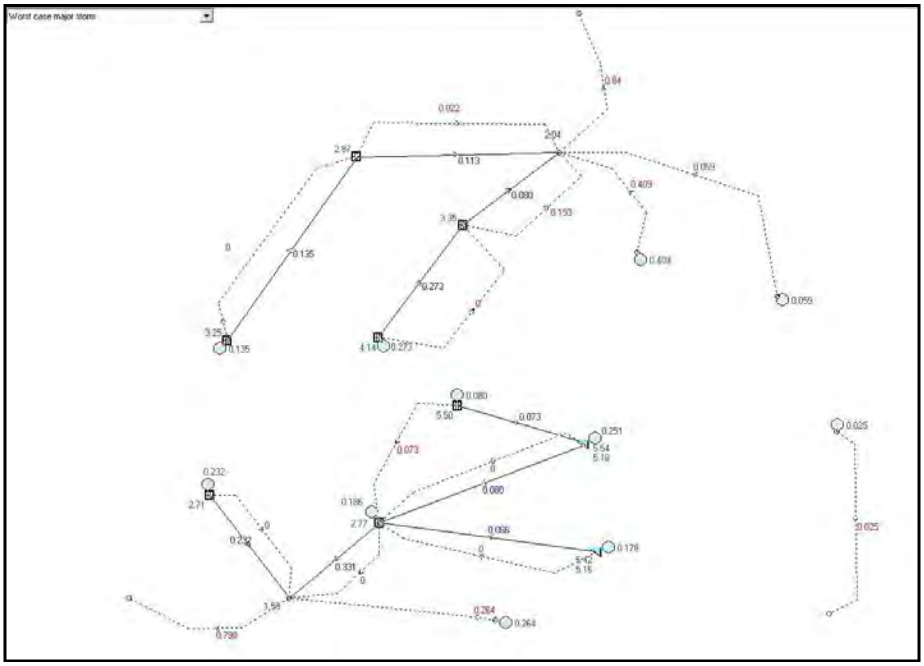


Figure C6 – Proposed Condition Option 2 with OSD - Drains 100 Year Results

DRAINS Model Name and File Path **F:\AA002350\D-Calculations\Stormwater\Drains\Results\Option 2**
Option 2 - OSD - 09-02-23

DRAINS Version: 2008.11 -November 2008
Modeller's Name: Gustavo Pereira
Description: Toyota Park

DRAINS results prepared 23 February, 2009 from Version 2008.11

PIT / NODE DETAILS				Version 8			
Name	Max HGL	Max Pond HGL	Max Surfac Flow Arrivi (cu.m/s)	Max Pond Volume (cu.m)	Min Freeboard (m)	Overflow (cu.m/s)	Constraint
PitPF	4.14		0.273		0.86	0	None
Pit201	3.35	3.35	0	1	-0.4	0.193	Outlet System
N275	2.04		0.647				
PitPC1	2.71		0.232		0.79	0	None
N295	1.58		0.264				
Pit PB1	3.25		0.135		0.95	0	None
Pit exist1	2.87	2.87	0	0	-0.17	0.022	Outlet System
PitD1	2.77		0.207		2.73	0	None
Pit PG1	5.5		0.08		0	0.073	Outlet System

SUB-CATCHMENT DETAILS							
Name	Max Flow Q (cu.m/s)	Paved Max Q (cu.m/s)	Grassed Max Q (cu.m/s)	Paved Tc (min)	Grassed Tc (min)	Supp. Tc (min)	Due to Storm
PN1	0.059	0.033	0.026	7	12	0	AR&R 100 year, 30 minutes storm, average 134 mm/h, Zone 1
PA1	0.409	0	0.409	5	10	0	AR&R 100 year, 20 minutes storm, average 160 mm/h, Zone 1
PL1	0.025	0	0.025	0	7	0	AR&R 100 year, 20 minutes storm, average 160 mm/h, Zone 1
PF1	0.273	0.273	0	6	20	0	AR&R 100 year, 20 minutes storm, average 160 mm/h, Zone 1
PC1	0.232	0.232	0	5	0	0	AR&R 100 year, 20 minutes storm, average 160 mm/h, Zone 1
PE1 and M	0.264	0.194	0.07	5	15	0	AR&R 100 year, 1 hour storm, average 92.7 mm/h, Zone 1
PB1	0.135	0.135	0	5	0	0	AR&R 100 year, 20 minutes storm, average 160 mm/h, Zone 1
PJ1 and PI	0.178	0.141	0.044	5	21	0	AR&R 100 year, 1 hour storm, average 92.7 mm/h, Zone 1
PD1	0.186	0.186	0	5	0	0	AR&R 100 year, 20 minutes storm, average 160 mm/h, Zone 1
PG1	0.08	0.08	0	6	0	0	AR&R 100 year, 20 minutes storm, average 160 mm/h, Zone 1
PH1 and P	0.251	0.208	0.052	5	21	0	AR&R 100 year, 1 hour storm, average 92.7 mm/h, Zone 1

Outflow Volumes for Total Catchment (2.16 impervious + 1.24 pervious = 3.40 total ha)								
Storm	Total Rainf	Total Runo	Impervious	Pervious Runoff				
	cu.m	cu.m (Run	cu.m (Run	cu.m (Runoff %)				
AR&R 100	753.32	605.61 (80	456.67 (95	148.94 (54.1%)				
AR&R 100	1183.79	1011.88 (8	729.95 (97	281.93 (65.2%)				
AR&R 100	1812.51	1602.99 (8	1129.09 (9	473.89 (71.6%)				
AR&R 100	2276.96	2032.17 (8	1423.95 (9	608.22 (73.2%)				
AR&R 100	3150.36	2835.66 (9	1978.43 (9	857.24 (74.5%)				
AR&R 100	4098.53	3691.24 (9	2580.37 (9	1110.87 (74.2%)				
AR&R 100	4679.67	4197.73 (8	2949.29 (9	1248.44 (73.1%)				
PIPE DETAILS								
Name	Max Q	Max V	Max U/S	Max D/S	Due to Storm			
	(cu.m/s)	(m/s)	HGL (m)	HGL (m)				
Pipe174	0.273	2.5	3.67	3.35	AR&R 100 year, 20 minutes storm, average 160 mm/h, Zone 1			
P208	0.08	2.4	2.514	2.289	AR&R 100 year, 20 minutes storm, average 160 mm/h, Zone 1			
P171	0.232	3.1	2.714	1.576	AR&R 100 year, 20 minutes storm, average 160 mm/h, Zone 1			
P200	0.135	1.9	3.248	2.87	AR&R 100 year, 20 minutes storm, average 160 mm/h, Zone 1			
P203	0.113	2.5	2.41	2.04	AR&R 100 year, 20 minutes storm, average 160 mm/h, Zone 1			
P158	0.066	2.1	5.164	3.739	AR&R 100 year, 1 hour storm, average 92.7 mm/h, Zone 1			
P164	0.331	3	2.251	1.576	AR&R 100 year, 2 hours storm, average 60.3 mm/h, Zone 1			
Pipe267	0.073	1	5.501	5.544	AR&R 100 year, 20 minutes storm, average 160 mm/h, Zone 1			
P160	0.08	2.1	5.179	4.654	AR&R 100 year, 2 hours storm, average 60.3 mm/h, Zone 1			
CHANNEL DETAILS								
Name	Max Q	Max V	Chainage	Max	Due to Storm			
	(cu.m/s)	(m/s)	(m)	HGL (m)				
OVERFLOW ROUTE DETAILS								
Name	Max Q U/S	Max Q D/S	Safe Q	Max D	Max DxV	Max Width	Max V	Due to Storm
OF225	0.059	0.059	7.665	0.029	0.01	9.73	0.41	AR&R 100 year, 30 minutes storm, average 134 mm/h, Zone 1
OF227	0.409	0.409	7.665	0.061	0.05	16.12	0.74	AR&R 100 year, 20 minutes storm, average 160 mm/h, Zone 1
OF236	0.025	0.025	7.665	0.021	0.01	7.03	0.34	AR&R 100 year, 20 minutes storm, average 160 mm/h, Zone 1
OF239	0	0	7.665	0	0	0	0	
OF262	0.193	0.193	7.665	0.044	0.03	12.89	0.61	AR&R 100 year, 20 minutes storm, average 160 mm/h, Zone 1
OF229	0.84	0.84	7.665	0.081	0.07	20.25	0.91	AR&R 100 year, 30 minutes storm, average 134 mm/h, Zone 1

OF372	0	0	7.665	0	0	0	0	
OF238	0.798	0.798	7.665	0.079	0.07	19.9	0.9	AR&R 100 year, 1 hour storm, average 92.7 mm/h, Zone 1
OF242	0.264	0.264	7.665	0.051	0.03	14.15	0.66	AR&R 100 year, 1 hour storm, average 92.7 mm/h, Zone 1
OF369	0	0	7.665	0	0	0	0	
OF258	0.022	0.022	7.665	0.02	0.01	6.74	0.32	AR&R 100 year, 20 minutes storm, average 160 mm/h, Zone 1
OF385	0	0	7.665	0	0	0	0	
OF376	0	0	7.665	0	0	0	0	
OF378	0.073	0.073	7.665	0.031	0.01	10.2	0.46	AR&R 100 year, 2 hours storm, average 60.3 mm/h, Zone 1
OF383	0	0	7.665	0	0	0	0	

DETENTION BASIN DETAILS

Name	Max WL	MaxVol	Max Q Total	Max Q Low Level	Max Q High Level
Basin8	5.42	140.4	0.066	0.066	0
Basin7	5.54	237	0.08	0.08	0

CONTINUITY CHECK for AR&R 100 year, 1 hour storm, average 92.7 mm/h, Zone 1

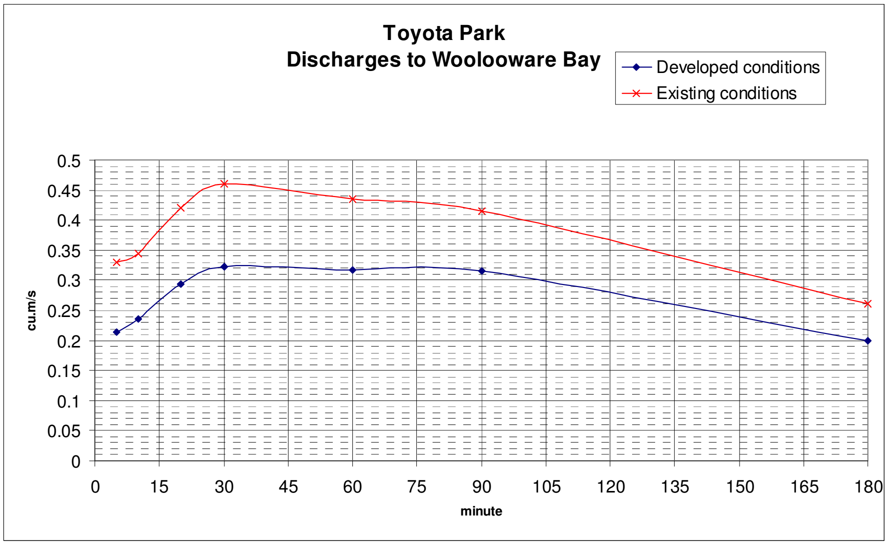
Node	Inflow (cu.m)	Outflow (cu.m)	Storage Cl (cu.m)	Difference %
N267	84.43	84.43	0	0
N269	514.61	514.61	0	0
N277	1140.22	1140.22	0	0
N279	30.1	30.1	0	0
N281	30.1	30.1	0	0
PitPF	366.8	366.8	0	0
Pit201	366.8	367.05	0	-0.1
N275	1140.22	1140.22	0	0
PitPC1	298.94	298.94	0	0
N295	1583.41	1583.16	0	0
N299	1582.9	1582.9	0	0
N302	372.67	372.67	0	0
Pit PB1	174.23	174.23	0	0
Pit exist1	174.23	174.12	0	0.1
Basin8	269.87	242.01	28.03	-0.1
PitD1	912.06	911.8	0	0
Pit PG1	108.21	108.15	0	0.1
Basin7	405.3	351.4	54.19	-0.1

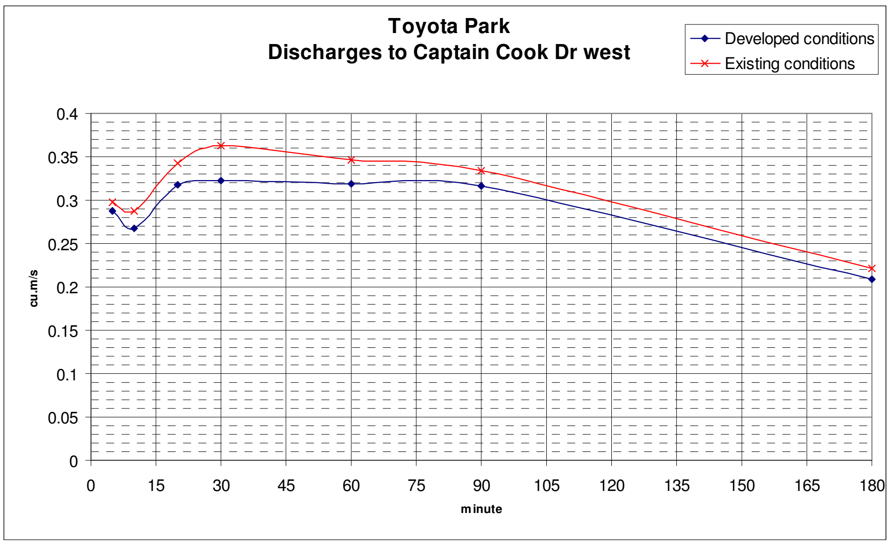
Run Log for Opt 2 run at 13:57:50 on 23/2/2009

Upwelling occurred at Pit PG1, Pit201, Pit exist1

Appendix D

Charts of Comparison of Peak Flow - Existing and Option 2 with OSD





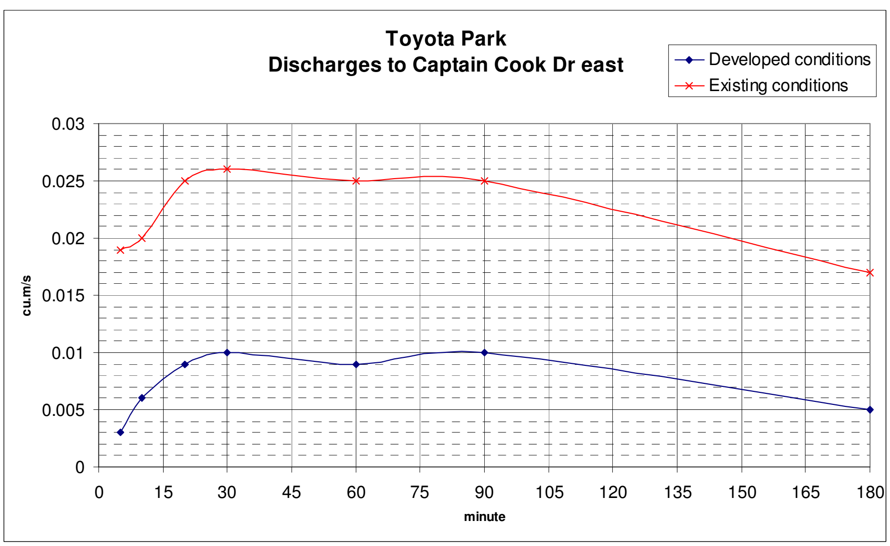
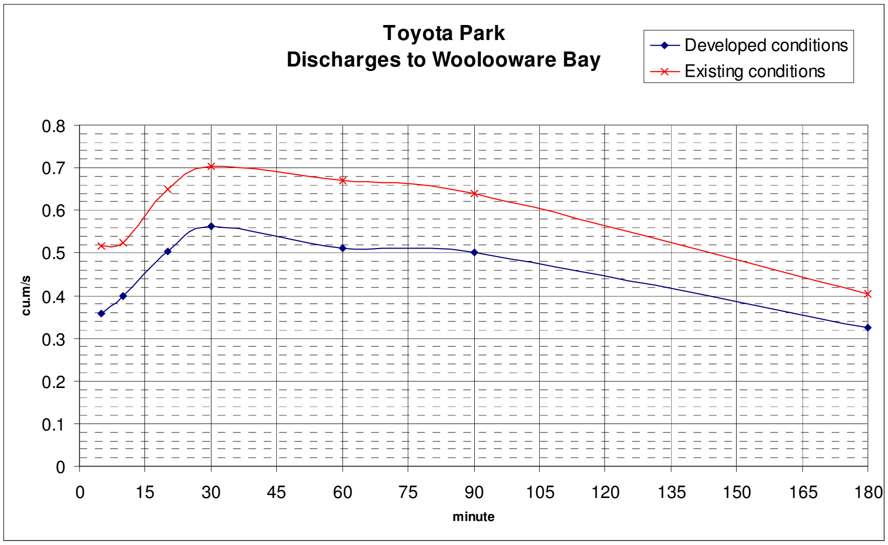
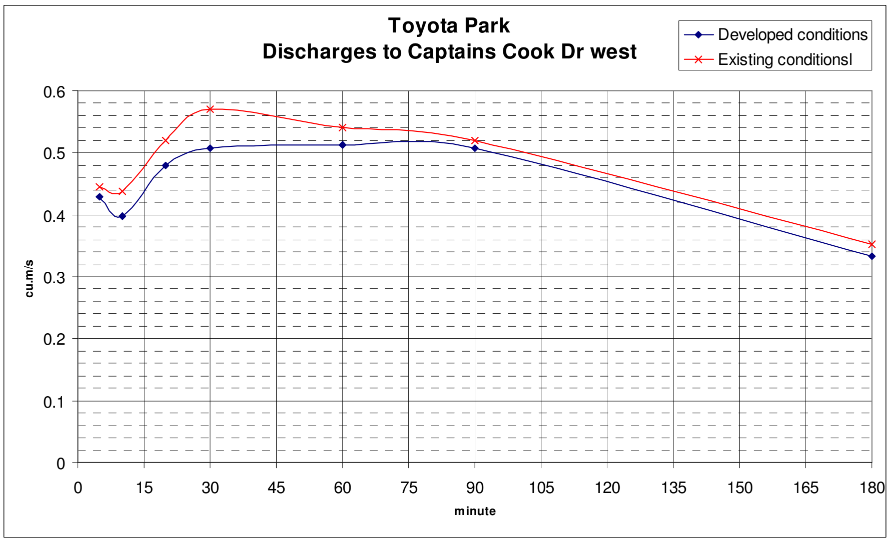


Figure D1 – 2 year ARI Flow Comparison





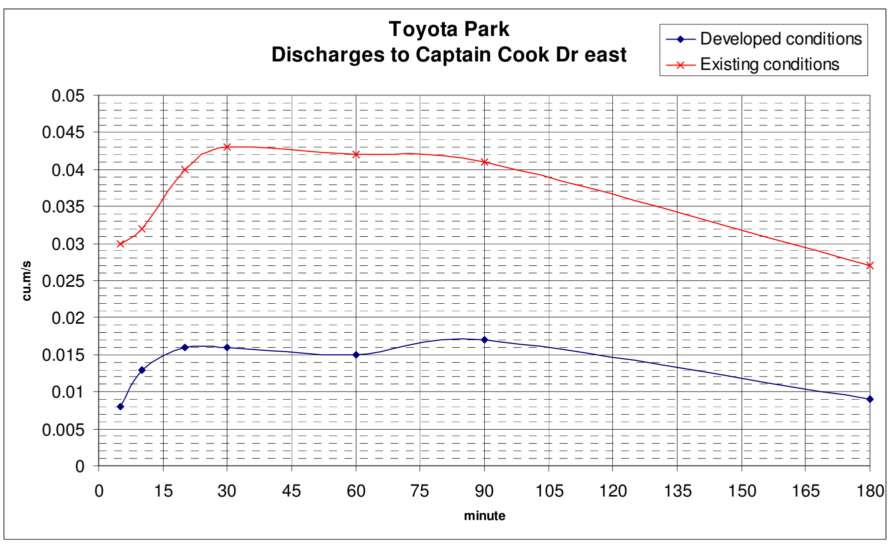
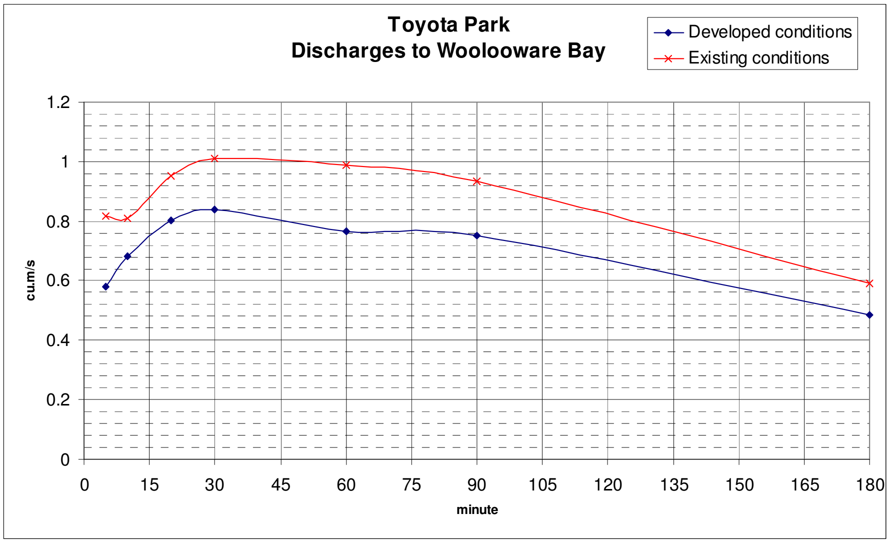
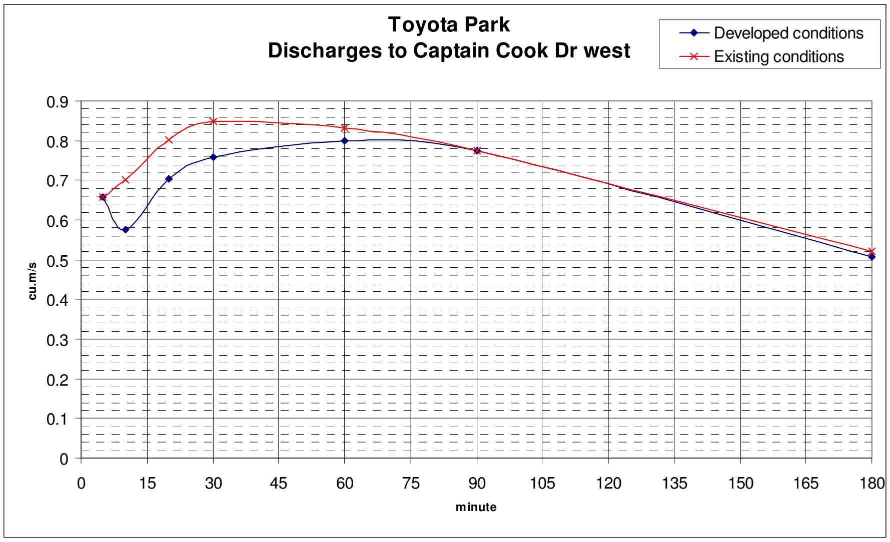


Figure D2 – 10 year ARI Flow Comparison





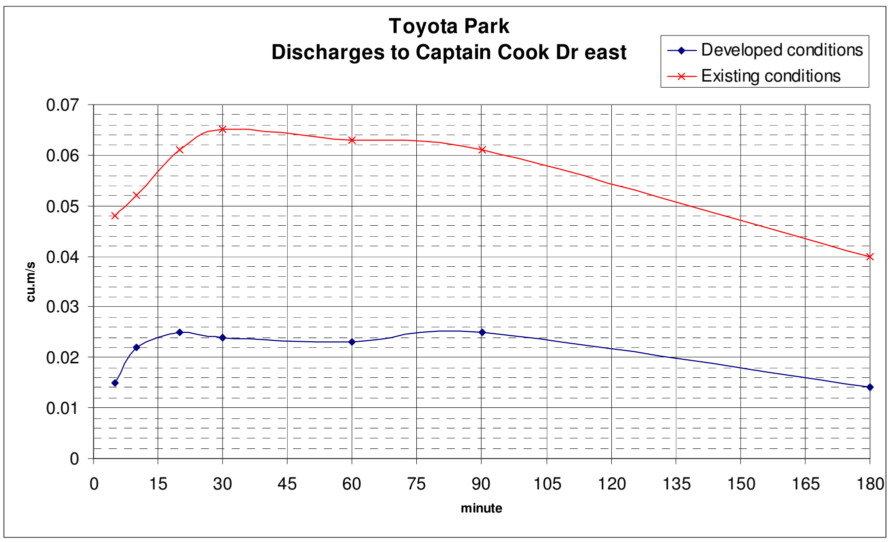


Figure D3 – 100 year ARI Flow Comparison

Drawings

Drawing No. SKC001 – Proposed Stormwater Plan

Drawing No. SKC002 – Northern Site Area Typical Section Showing Proposed Drainage

Issue	Description	Drwn	Ckd.	Appd.	Date
P1	FOR INFORMATION	GP	BC	NMcM	27.02.09

100mm on Original

Client: DBL PROPERTY

Status: **PRELIMINARY**
NOT TO BE USED FOR CONSTRUCTION

		Current Issue Signatures	
Scales	1:500	Drawn	GP
Original Size	A1	Designed	GP
Height Datum	AHD	Checked	BC
Grid		Approved	NMcM

Project: TOYOTA PARK
EAST REDEVELOPMENT

Title: STORMWATER LAYOUT
PLAN

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Drawing No.	Project No.	Issue
SKC001	AA002350	P1