APPENDIX D – SURFACE WATER DRAINAGE CALCULATION

Design Settings

Rainfall Methodology	FEH-22	Minimum Velocity (m/s)	1.00
Return Period (years)	100	Connection Type	Level Soffits
Additional Flow (%)	0	Minimum Backdrop Height (m)	0.200
CV	0.950	Preferred Cover Depth (m)	1.200
Time of Entry (mins)	5.00	Include Intermediate Ground	✓
Maximum Time of Concentration (mins)	30.00	Enforce best practice design rules	✓
Maximum Rainfall (mm/hr)	50.0		

Nodes

Name	Area (ha)	Cover Level (m)	Easting (m)	Northing (m)	Depth (m)
SA1	0.310	88.350	554102.536	237747.849	2.700

Simulation Settings

Rainfall Methodology	FEH-22	Analysis Speed	Normal	Additional Storage (m³/ha)	20.0	30 year (l/s)	4.3
Summer CV	0.950	Skip Steady State	✓	Check Discharge Rate(s)	✓	100 year (l/s)	5.8
Winter CV	0.950	Drain Down Time (mins)	10080	1 year (l/s)	1.5	Check Discharge Volume	x

Storm Durations

15	60	180	360	600	960	2160	4320	7200	10080
30	120	240	480	720	1440	2880	5760	8640	

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)	Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
2	0	0	0	100	0	0	0
30	0	0	0	100	40	0	0
30	35	0	0				

Pre-development Discharge Rate

Site Makeup	Greenfield	SPR	0.53	Betterment (%)	0
Greenfield Method	IH124	Region	6	QBar	1.8
Positively Drained Area (ha)	0.353	Growth Factor 1 year	0.85	Q 1 year (l/s)	1.5
SAAR (mm)	590	Growth Factor 30 year	2.40	Q 30 year (l/s)	4.3
Soil Index	5	Growth Factor 100 year	3.19	Q 100 year (l/s)	5.8

Node SA1 Online Depth/Flow Control

Flap Valve	x	Invert Level (m)	85.650	Design Flow (l/s)	0.1
Replaces Downstream Link	✓	Design Depth (m)	2.500		

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.001	0.000	2.500	0.000

Node SA1 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.25200	Porosity	0.95	Width (m)	3.000	Depth (m)	1.500
Side Inf Coefficient (m/hr)	0.25200	Invert Level (m)	85.650	Length (m)	38.000	Inf Depth (m)	
Safety Factor	2.0	Time to half empty (mins)	228	Slope (1:X)	1000.0		

Results for 2 year Critical Storm Duration. Lowest mass balance: 98.84%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
180 minute summer	SA1	124	85.908	0.258	19.3	26.4614	0.0000	OK

Link Event (Velocity)	US Node	Link	Outflow (l/s)	Discharge Vol (m³)
180 minute summer	SA1	Depth/Flow	0.0	0.0
180 minute summer	SA1	Infiltration	4.7	

Results for 30 year Critical Storm Duration. Lowest mass balance: 98.84%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
120 minute winter	SA1	116	86.424	0.774	40.7	83.5461	0.0000	OK

Link Event (Velocity)	US Node	Link	Outflow (l/s)	Discharge Vol (m³)
120 minute winter	SA1	Depth/Flow	0.0	0.0
120 minute winter	SA1	Infiltration	6.2	

Results for 30 year +35% CC Critical Storm Duration. Lowest mass balance: 98.84%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
180 minute winter	SA1	156	86.769	1.119	41.2	121.7402	0.0000	OK

Link Event (Velocity)	US Node	Link	Outflow (l/s)	Discharge Vol (m³)
180 minute winter	SA1	Depth/Flow	0.0	0.0
180 minute winter	SA1	Infiltration	7.1	

Results for 100 year Critical Storm Duration. Lowest mass balance: 98.84%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
120 minute winter	SA1	116	86.664	1.014	51.0	110.1236	0.0000	OK

Link Event (Velocity)	US Node	Link	Outflow (l/s)	Discharge Vol (m³)
120 minute winter	SA1	Depth/Flow	0.0	0.0
120 minute winter	SA1	Infiltration	6.8	

Results for 100 year +40% CC Critical Storm Duration. Lowest mass balance: 98.84%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
180 minute winter	SA1	172	88.129	2.479	53.1	166.1408	0.0000	OK

Link Event (Velocity)	US Node	Link	Outflow (l/s)	Discharge Vol (m³)
180 minute winter	SA1	Depth/Flow	0.0	0.0
180 minute winter	SA1	Infiltration	8.2	

Design Settings

Rainfall Methodology	FEH-22	Minimum Velocity (m/s)	1.00
Return Period (years)	100	Connection Type	Level Soffits
Additional Flow (%)	0	Minimum Backdrop Height (m)	0.200
CV	0.950	Preferred Cover Depth (m)	1.200
Time of Entry (mins)	5.00	Include Intermediate Ground	✓
Maximum Time of Concentration (mins)	30.00	Enforce best practice design rules	✓
Maximum Rainfall (mm/hr)	50.0		

Nodes

Name	Area (ha)	Cover Level (m)	Easting (m)	Northing (m)	Depth (m)
SA2	0.118	90.850	554102.536	237747.849	2.500

Simulation Settings

Rainfall Methodology	FEH-22	Analysis Speed	Normal	Additional Storage (m³/ha)	20.0	30 year (l/s)	4.3
Summer CV	0.950	Skip Steady State	✓	Check Discharge Rate(s)	✓	100 year (l/s)	5.8
Winter CV	0.950	Drain Down Time (mins)	10080	1 year (l/s)	1.5	Check Discharge Volume	x

Storm Durations

15	60	180	360	600	960	2160	4320	7200	10080
30	120	240	480	720	1440	2880	5760	8640	

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)	Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
2	0	0	0	100	0	0	0
30	0	0	0	100	40	0	0
30	35	0	0				

Pre-development Discharge Rate

Site Makeup	Greenfield	SPR	0.53	Betterment (%)	0
Greenfield Method	IH124	Region	6	QBar	1.8
Positively Drained Area (ha)	0.353	Growth Factor 1 year	0.85	Q 1 year (l/s)	1.5
SAAR (mm)	590	Growth Factor 30 year	2.40	Q 30 year (l/s)	4.3
Soil Index	5	Growth Factor 100 year	3.19	Q 100 year (l/s)	5.8

Node SA2 Online Depth/Flow Control

Flap Valve	x	Invert Level (m)	88.350	Design Flow (l/s)	0.1
Replaces Downstream Link	✓	Design Depth (m)	2.500		

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.001	0.000	2.500	0.000

Node SA2 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.06480	Porosity	0.95	Width (m)	5.000	Depth (m)	1.500
Side Inf Coefficient (m/hr)	0.06480	Invert Level (m)	88.350	Length (m)	38.000	Inf Depth (m)	
Safety Factor	2.0	Time to half empty (mins)	312	Slope (1:X)	1000.0		

Results for 2 year Critical Storm Duration. Lowest mass balance: 98.18%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
180 minute summer	SA2	124	88.431	0.081	7.4	11.2152	0.0000	OK

Link Event (Velocity)	US Node	Link	Outflow (l/s)	Discharge Vol (m³)
180 minute summer	SA2	Depth/Flow	0.0	0.0
180 minute summer	SA2	Infiltration	1.8	

Results for 30 year Critical Storm Duration. Lowest mass balance: 98.18%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
180 minute winter	SA2	172	88.558	0.208	11.6	34.3755	0.0000	OK

Link Event (Velocity)	US Node	Link	Outflow (l/s)	Discharge Vol (m³)
180 minute winter	SA2	Depth/Flow	0.0	0.0
180 minute winter	SA2	Infiltration	1.9	

Results for 30 year +35% CC Critical Storm Duration. Lowest mass balance: 98.18%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
180 minute winter	SA2	176	88.650	0.300	15.7	50.9569	0.0000	OK

Link Event (Velocity)	US Node	Link	Outflow (l/s)	Discharge Vol (m³)
180 minute winter	SA2	Depth/Flow	0.0	0.0
180 minute winter	SA2	Infiltration	1.9	

Results for 100 year Critical Storm Duration. Lowest mass balance: 98.18%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
180 minute winter	SA2	176	88.621	0.271	14.4	45.7125	0.0000	OK

Link Event (Velocity)	US Node	Link	Outflow (l/s)	Discharge Vol (m³)
180 minute winter	SA2	Depth/Flow	0.0	0.0
180 minute winter	SA2	Infiltration	1.9	

Results for 100 year +40% CC Critical Storm Duration. Lowest mass balance: 98.18%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
240 minute winter	SA2	232	88.753	0.403	16.4	69.7785	0.0000	OK

Link Event (Velocity)	US Node	Link	Outflow (l/s)	Discharge Vol (m³)
240 minute winter	SA2	Depth/Flow	0.0	0.0
240 minute winter	SA2	Infiltration	2.0	

Design Settings

Rainfall Methodology	FEH-22	Minimum Velocity (m/s)	1.00
Return Period (years)	100	Connection Type	Level Soffits
Additional Flow (%)	0	Minimum Backdrop Height (m)	0.200
CV	0.950	Preferred Cover Depth (m)	1.200
Time of Entry (mins)	5.00	Include Intermediate Ground	✓
Maximum Time of Concentration (mins)	30.00	Enforce best practice design rules	✓
Maximum Rainfall (mm/hr)	50.0		

Nodes

Name	Area (ha)	Cover Level (m)	Easting (m)	Northing (m)	Depth (m)
SA3	0.151	90.850	554102.536	237747.849	2.850

Simulation Settings

Rainfall Methodology	FEH-22	Analysis Speed	Normal	Additional Storage (m³/ha)	20.0	30 year (l/s)	4.3
Summer CV	0.950	Skip Steady State	✓	Check Discharge Rate(s)	✓	100 year (l/s)	5.8
Winter CV	0.950	Drain Down Time (mins)	10080	1 year (l/s)	1.5	Check Discharge Volume	x

Storm Durations

15	60	180	360	600	960	2160	4320	7200	10080
30	120	240	480	720	1440	2880	5760	8640	

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)	Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
2	0	0	0	100	0	0	0
30	0	0	0	100	40	0	0
30	35	0	0				

Pre-development Discharge Rate

Site Makeup	Greenfield	SPR	0.53	Betterment (%)	0
Greenfield Method	IH124	Region	6	QBar	1.8
Positively Drained Area (ha)	0.353	Growth Factor 1 year	0.85	Q 1 year (l/s)	1.5
SAAR (mm)	590	Growth Factor 30 year	2.40	Q 30 year (l/s)	4.3
Soil Index	5	Growth Factor 100 year	3.19	Q 100 year (l/s)	5.8

Node SA3 Online Depth/Flow Control

Flap Valve	x	Invert Level (m)	88.000	Design Flow (l/s)	0.1
Replaces Downstream Link	✓	Design Depth (m)	2.500		

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.001	0.000	2.500	0.000

Node SA3 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.02340	Porosity	0.95	Width (m)	4.000	Depth (m)	1.500
Side Inf Coefficient (m/hr)	0.02340	Invert Level (m)	88.000	Length (m)	30.500	Inf Depth (m)	
Safety Factor	2.0	Time to half empty (mins)	1830	Slope (1:X)	1000.0		

Results for 2 year Critical Storm Duration. Lowest mass balance: 98.83%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
480 minute winter	SA3	456	88.256	0.256	3.3	27.8106	0.0000	OK

Link Event (Velocity)	US Node	Link	Outflow (l/s)	Discharge Vol (m³)
480 minute winter	SA3	Depth/Flow	0.0	0.0
480 minute winter	SA3	Infiltration	0.5	

Results for 30 year Critical Storm Duration. Lowest mass balance: 98.83%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
480 minute winter	SA3	472	88.595	0.595	6.9	67.0014	0.0000	OK

Link Event (Velocity)	US Node	Link	Outflow (l/s)	Discharge Vol (m³)
480 minute winter	SA3	Depth/Flow	0.0	0.0
480 minute winter	SA3	Infiltration	0.5	

Results for 30 year +35% CC Critical Storm Duration. Lowest mass balance: 98.83%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
720 minute winter	SA3	705	88.834	0.834	6.6	94.6132	0.0000	OK

Link Event (Velocity)	US Node	Link	Outflow (l/s)	Discharge Vol (m³)
720 minute winter	SA3	Depth/Flow	0.0	0.0
720 minute winter	SA3	Infiltration	0.6	

Results for 100 year Critical Storm Duration. Lowest mass balance: 98.83%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
480 minute winter	SA3	472	88.749	0.749	8.5	84.7894	0.0000	OK

Link Event (Velocity)	US Node	Link	Outflow (l/s)	Discharge Vol (m³)
480 minute winter	SA3	Depth/Flow	0.0	0.0
480 minute winter	SA3	Infiltration	0.6	

Results for 100 year +40% CC Critical Storm Duration. Lowest mass balance: 98.83%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
720 minute winter	SA3	705	89.087	1.087	8.4	124.0603	0.0000	OK

Link Event (Velocity)	US Node	Link	Outflow (l/s)	Discharge Vol (m³)
720 minute winter	SA3	Depth/Flow	0.0	0.0
720 minute winter	SA3	Infiltration	0.6	

Design Settings

Rainfall Methodology	FEH-22	Minimum Velocity (m/s)	1.00
Return Period (years)	100	Connection Type	Level Soffits
Additional Flow (%)	0	Minimum Backdrop Height (m)	0.200
CV	0.950	Preferred Cover Depth (m)	1.200
Time of Entry (mins)	5.00	Include Intermediate Ground	✓
Maximum Time of Concentration (mins)	30.00	Enforce best practice design rules	✓
Maximum Rainfall (mm/hr)	50.0		

Nodes

Name	Area (ha)	Cover Level (m)	Easting (m)	Northing (m)	Depth (m)
SA4	0.070	90.850	554102.536	237747.849	2.850

Simulation Settings

Rainfall Methodology	FEH-22	Analysis Speed	Normal	Additional Storage (m³/ha)	20.0	30 year (l/s)	4.3
Summer CV	0.950	Skip Steady State	✓	Check Discharge Rate(s)	✓	100 year (l/s)	5.8
Winter CV	0.950	Drain Down Time (mins)	10080	1 year (l/s)	1.5	Check Discharge Volume	x

Storm Durations

15	60	180	360	600	960	2160	4320	7200	10080
30	120	240	480	720	1440	2880	5760	8640	

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)	Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
2	0	0	0	100	0	0	0
30	0	0	0	100	40	0	0
30	35	0	0				

Pre-development Discharge Rate

Site Makeup	Greenfield	SPR	0.53	Betterment (%)	0
Greenfield Method	IH124	Region	6	QBar	1.8
Positively Drained Area (ha)	0.353	Growth Factor 1 year	0.85	Q 1 year (l/s)	1.5
SAAR (mm)	590	Growth Factor 30 year	2.40	Q 30 year (l/s)	4.3
Soil Index	5	Growth Factor 100 year	3.19	Q 100 year (l/s)	5.8

Node SA4 Online Depth/Flow Control

Flap Valve	x	Invert Level (m)	88.000	Design Flow (l/s)	0.1
Replaces Downstream Link	✓	Design Depth (m)	2.500		

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.001	0.000	2.500	0.000

Node SA4 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.10440	Porosity	0.95	Width (m)	4.000	Depth (m)	1.500
Side Inf Coefficient (m/hr)	0.10440	Invert Level (m)	88.000	Length (m)	15.000	Inf Depth (m)	
Safety Factor	2.0	Time to half empty (mins)	308	Slope (1:X)	1000.0		

Results for 2 year Critical Storm Duration. Lowest mass balance: 97.25%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
180 minute summer	SA4	128	88.131	0.131	4.4	7.1145	0.0000	OK

Link Event (Velocity)	US Node	Link	Outflow (l/s)	Discharge Vol (m³)
180 minute summer	SA4	Depth/Flow	0.0	0.0
180 minute summer	SA4	Infiltration	0.9	

Results for 30 year Critical Storm Duration. Lowest mass balance: 97.25%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
180 minute winter	SA4	172	88.373	0.373	6.9	20.9937	0.0000	OK

Link Event (Velocity)	US Node	Link	Outflow (l/s)	Discharge Vol (m³)
180 minute winter	SA4	Depth/Flow	0.0	0.0
180 minute winter	SA4	Infiltration	1.1	

Results for 30 year +35% CC Critical Storm Duration. Lowest mass balance: 97.25%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
180 minute winter	SA4	176	88.540	0.540	9.3	30.6288	0.0000	OK

Link Event (Velocity)	US Node	Link	Outflow (l/s)	Discharge Vol (m³)
180 minute winter	SA4	Depth/Flow	0.0	0.0
180 minute winter	SA4	Infiltration	1.2	

Results for 100 year Critical Storm Duration. Lowest mass balance: 97.25%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
180 minute winter	SA4	176	88.487	0.487	8.6	27.5529	0.0000	OK

Link Event (Velocity)	US Node	Link	Outflow (l/s)	Discharge Vol (m³)
180 minute winter	SA4	Depth/Flow	0.0	0.0
180 minute winter	SA4	Infiltration	1.1	

Results for 100 year +40% CC Critical Storm Duration. Lowest mass balance: 97.25%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
240 minute winter	SA4	232	88.730	0.730	9.7	41.5583	0.0000	OK

Link Event (Velocity)	US Node	Link	Outflow (l/s)	Discharge Vol (m³)
240 minute winter	SA4	Depth/Flow	0.0	0.0
240 minute winter	SA4	Infiltration	1.3	