Appendix B : Revised Civil Infrastructure Calculations & Supporting Information

Appendix B : Civil Infrastructure Calculations & Supporting Information

PROJECT: Development at Calmount Riad		JOB REF. 210175
SUBJECT: Surface Water Calculations - Unit 2 Permissible Site Discharge (CFI)		Calc. Sheet No. 1
Drawing ref. 210175-INFO1	Calculations by RTM / Checked by SVC	Date 01/11/2022

PERMISSIBLE SURFACE WATER DISCHARGE CALCULATIONS

Site Area

What is the CATCHMENT area?	0.87 Hectares (ha)	
What is the drained catchment area?	0.87 Hectares (ha)	Site is Less than 50 Hectares

Pre-Development Catchment Soil Characteristics

Are there different soil types present on the pre-developed site? **No**

Catchment (This refers to the entire site area)	1	
Area	0.87	Hectares (ha)
Drainage Group	2	Class
Depth to Impermeable Layers	2	Class
Permeability Group above Impermeable Layers	2	Class
Slope [c]	1	Class
SOIL Type	3	From FSR Table
[1]SOIL Index	0.40	

SOIL	SOIL Value	SPR
1	0.15	0.10
2	0.30	0.30
3	0.40	0.37
4	0.45	0.47
5	0.50	0.53

Site SOIL Index Value	0.40
Site SPR Value	0.37

Post-Development Catchment Characteristics

Is the development divided into sub-catchments?	No
What is the overall site area for catchment?	0.87 Hectares (ha)

Catchment 1	Area (m^2)	Runoff Coeff.	Effective Area (m^2)
Roofs - Type 1 (Traditional)	1727	1.00	1727.0
Roofs - Type 2 (Draining to SUDS features)	1748	0.70	1223.6
Green Roofs	0	0.70	0.0
Roads and Footpaths - Type 1 (Draining to gullies)	2183	0.80	1746.4
Roads and Footpaths - Type 2 (Draining to Suds features)	1749	0.70	1224.3
Paved Areas	0	0.80	0.0
Permeable Paving	868	0.50	434.0
Podium (extensive green roof)	0	0.50	0.0
Grassed Areas (Inc. Filter drains, tree pits, bio-retention areas & pitches)	438	0.37	162.1
Public Open Space (Non Contributary Landscaping)	0	0.37	0.0

Include Public Open Space in Effective Catchment Area?	No	Assumed open space area does not drain to surface water network
Effective Catchment Area	6517.4 m^2	
Effective Catchment Runoff Coefficient	0.75	

Long-Term Storage

Is long-term Storage provided? **No**

Permissible Site Discharge

What is the Standard Average Annual Rainfall (SAAR)?	700.0 mm	From Met Eireann, Co-ordinates 310000/230000
Is the overall site area less than 50 hectares?	Yes	
[5]$QBAR_{Rural}$ calculated for 50 ha and linearly interpolated for area of site	3.0 Litres/sec	
[7]Site Discharge =	1.7 Litres/sec	SDCC require 2l/s/ha = 14.2l/s for the site

Notes and Formulae

1. SOIL index value calculated from Flood Studies Report - The Classification of Soils from Winter Rainfall Acceptance Rate (Table 4.5).
2. SPR value calculated from GDSDS - Table 6.7.
3. Rainfall depth for 100 year return period, 6 hour duration with additional 10% for climate change.
4. Long-term storage Vol_{lts} (m^3) = Rainfall.Area.10.[(PIMP/100)(0.8.α)+(1-PIMP/100)(I.SPR)-SPR]. (GDSDS Section 6.7.3).
   Where long-term storage cannot be provided on-site due to ground conditions, Total Permissible Outflow is to be kept to $QBAR_{Rural}$
5. Total Permissible Outflow - $QBAR_{(Rural)}$ calculated in accordance with GDSDS - Regional Drainage Policies
   (Volume 2 - Chapter 6), i.e. $QBAR(m3/s)=0.00108x(Area)^{0.89}(SAAR)^{1.17}(SOIL)^{2.17}$ - For catchments greater than 50 hectares in area. Flow rates are linearly interpolated for areas smaller than 50hectares.
6. Where Total Permissible Outflow is less than 2.0l/s and not achievable, use 2.0 l/s or closest value possible.
7. QBAR multiplied by growth factors of 0.85 for 1 year, 2.1 for 30 year and 2.6 for 100 year return period events, from GDSDS Figure C2.

Appendix B : SuDS Calculations

PROJECT: Development at Ballymount Ave		JOB REF: 210175
SUBJECT: Surface Water Calculations - Roads Permissible Site Discharge (CFI)		Calc. Sheet No. 1
Drawing ref.: 210175 Info1	Calculations by: RTM / Checked by: SVC	Date: 01.11.22

PERMISSIBLE SURFACE WATER DISCHARGE CALCULATIONS

Site Area

What is the CATCHMENT area?	1.04	Hectares (ha)	
What is the drained catchment area?	1.04	Hectares (ha)	Site is Less than 50 Hectares

Pre-Development Catchment Soil Characteristics

Are there different soil types present on the pre-developed site? **No**

Catchment (This refers to the entire site area)	1	
Area	1.04	Hectares (ha)
Drainage Group	2	Class
Depth to Impermeable Layers	2	Class
Permeability Group above Impermeable Layers	2	Class
Slope [o]	1	Class
SOIL Type	3	From FSR Table
[1]SOIL Index	0.40	

SOIL	SOIL Value	SPR
1	0.15	0.10
2	0.30	0.30
3	0.40	0.37
4	0.45	0.47
5	0.50	0.53

Site SOIL Index Value	0.40
Site SPR Value	0.37

Post-Development Catchment Characteristics

Is the development divided into sub-catchments? **No**

What is the overall site area for catchment? 1.04 Hectares (ha)

Catchment 1	Area (m²)	Runoff Coeff.	Effective Area (m²)
Roofs - Type 1 (Traditional)	2293	1.00	2293.0
Roofs - Type 2 (Draining to SUDS features)	0	0.70	0.0
Green Roofs	0	0.70	0.0
Roads and Footpaths - Type 1 (Draining to gullies)	0	0.80	0.0
Roads and Footpaths - Type 2 (Draining to Suds features)	7524	0.70	5266.8
Paved Areas	0	0.80	0.0
Permeable Paving	0	0.50	0.0
Podium (extensive green roof)	0	0.50	0.0
Grassed Areas (inc. Filter drains, tree pits, bio-retention areas & pitches)	0	0.37	0.0
Public Open Space (Non Contributary Landscaping)	622	0.37	230.1

Include Public Open Space in Effective Catchment Area?	No	Assumed open space area does not drain to surface water network
Effective Catchment Area	7559.8	m²
Effective Catchment Runoff Coefficient	0.77	

Long-Term Storage

Is long-term Storage provided? **No**

Permissible Site Discharge

What is the Standard Average Annual Rainfall (SAAR)?	700.0	mm	From Met Eireann, Co-ordinates 310000/230000
Is the overall site area less than 50 hectares?	Yes		
[5]$QBAR_{Rural}$ calculated for 50 ha and linearly interpolated for area of site	3.6	Litres/sec	
[7]Site Discharge =	2.1	Litres/sec	SDCC require 2l/s/ha = 14.2l/s for the site

Notes and Formulae

1. SOIL index value calculated from Flood Studies Report - The Classification of Soils from Winter Rainfall Acceptance Rate (Table 4.5).
2. SPR value calculated from GDSDS - Table 6.7.
3. Rainfall depth for 100 year return period, 6 hour duration with additional 10% for climate change.
4. Long-term storage Vol_{ls} (m^3) = Rainfall Area 10.[(PIMP/100)(0.8 α)+(1-PIMP/100)(β.SPR)-SPR]. (GDSDS Section 6.7.3).
   Where long-term storage cannot be provided on-site due to ground conditions, Total Permissible Outflow is to be kept to $QBAR_{(Rural)}$.
5. Total Permissible Outflow - $QBAR_{(Rural)}$ calculated in accordance with GDSDS - Regional Drainage Policies
   (Volume 2 - Chapter 6), i.e. $QBAR(m3/s)=0.00108x(Area)^{0.89}(SAAR)^{1.17}(SOIL)^{2.17}$ - For catchments greater than 50 hectares in area, Flow rates are linearly interpolated for areas smaller than 50hectares.
6. Where Total Permissible Outflow is less than 2.0l/s and not achievable, use 2.0 l/s or closest value possible.
7. QBAR multiplied by growth factors of 0.85 for 1 year, 2.1 for 30 year and 2.6 for 100 year return period events, from GDSDS Figure C2.

TITLE		Job Reference	
Warehousing and Logistics Development at Calmount Road Clarification of Further Information		210175	
SUBJECT		Calc. Sheet No.	
Swale Channel 1 Unit 2		1	
DRAWING NUMBER	Calculations by	Checked by	Date
210175-DBFL-SW-SP-DR-C-1300	RTM	SVC	15.11.22

INPUT DATA

Side Slopes	4.0	1 in ....
Bottom width (W)	0.50	m
Depth to Invert (D)	0.15	m
Length (L)	70.9	m
Slope (S)	1418	1 in ....
Manning's Coefficient (n)	0.030	
Subgrade Infiltration Rate per hour	5.000	mm/hr
Subgrade Infiltration Rate (f)	0.001388889	mm/s

TREATMENT VOLUME

Total Plan Area of Swale	123.1	m^2	
[1]Depth of Subgrade Treatment	0.20	m	
Total Swale Treatment Volume (V_T)	24.630	m^3	Provided Treatment Volume

STORAGE VOLUME

Max. Length of Storage within Swale	70.9	m
Swale Storage Volume per 71m Length	8.84	m^3
Swale Storage Volume (V)	8.84	m^3

INFILTRATION/ INTERCEPTION VOLUME

Total Swale Infiltration Rate	0.15	l/s	
[3]Total Swale Infiltration Volume	3.220	m^3	Provided Interception Volume

FLOW

Maximum Swale Flow at Outlet	30.4	l/s
Maximum Swale Velocity at Outlet	0.18	m/s
[3]Typical Swale Retention Time	0.107	hr

Notes:

1 Assume 200mm of topsoil.

2 Volume calculated using 6 hour storm event.

3 Swale retention time depends on outlet control, refer to WINDES Model.

Total Swale Infiltration = $P \cdot L \cdot f$

where:

P = Wetted Perimeter
L = Length
f = Subgrade infiltration rate

Total Swale Flow = $1/n.AR^{2/3}S^{1/2}$

where:

A = Area of flow
P = Wetted perimeter
R = A/P
n = Manning's Coefficient
s = Slope

Table: 1

Material	Infiltration Rate (m/hr)
Gravel	10 - 1000
Sand	0.1 - 100
Loamy sand	0.01 - 1
Sandy loam	0.05 - 0.5
Loam	0.001 - 0.1
Silt loam	0.0005 - 0.005
Chalk	0.001 - 100
Sandy clay loam	0.001 - 0.01
Silty clay loam	0.00005 - 0.005
Clay	< 0.0001
Till	0.00001 - 0.01
Rock	0.00001 - 1
Cutoff point for most infiltration drainage systems = 0.001 mm/hr Source: Microdrainage	

TITLE Warehousing and Logistics Development at Calmount Road Clarification of Further Information		Job Reference 210175	
SUBJECT **Swale Channel 2 Unit 2**		Calc. Sheet No. 1	
DRAWING NUMBER 210175-DBFL-SW-SP-DR-C-1300	Calculations by RTM	Checked by SVC	Date 15.11.22

INPUT DATA

Side Slopes	4.0	1 in ....
Bottom width (W)	0.50	m
Depth to Invert (D)	0.15	m
Length (L)	12.5	m
Slope (S)	66	1 in ....
Manning's Coefficient (n)	0.030	
Subgrade Infiltration Rate per hour	5.000	mm/hr
Subgrade Infiltration Rate (f)	0.001388889	mm/s

TREATMENT VOLUME

Total Plan Area of Swale	21.7	m^2	
[1]Depth of Subgrade Treatment	0.20	m	
Total Swale Treatment Volume (V_T)	4.342	m^3	Provided Treatment Volume

STORAGE VOLUME

Max. Length of Storage within Swale	9.9	m	
Swale Storage Volume per 10m Length	0.67	m^3	
Swale Storage Volume (V)	0.67	m^3	

INFILTRATION/ INTERCEPTION VOLUME

Total Swale Infiltration Rate	0.01	l/s	
[3]Total Swale Infiltration Volume	0.317	m^3	Provided Interception Volume

FLOW

Maximum Swale Flow at Outlet	140.9	l/s
Maximum Swale Velocity at Outlet	0.85	m/s
[3]Typical Swale Retention Time	0.004	hr

Notes:

1 Assume 200mm of topsoil.

2 Volume calculated using 6 hour storm event.

3 Swale retention time depends on outlet control, refer to WINDES Model.

Total Swale Infiltration = $P \cdot L \cdot f$

where:

P = Wetted Perimeter
L = Length
f = Subgrade infiltration rate

Total Swale Flow = $1/n.AR^{2/3}S^{1/2}$

where:

A = Area of flow
P = Wetted perimeter
R = A/P
n = Manning's Coefficient
s = Slope

Table: 1

Material	Infiltration Rate (m/hr)
Gravel	10 - 1000
Sand	0.1 - 100
Loamy sand	0.01 - 1
Sandy loam	0.05 - 0.5
Loam	0.001 - 0.1
Silt loam	0.0005 - 0.005
Chalk	0.001 - 100
Sandy clay loam	0.001 - 0.01
Silty clay loam	0.00005 - 0.005
Clay	< 0.0001
Till	0.00001 - 0.01
Rock	0.00001 - 1
Cutoff point for most infiltration drainage systems = 0.001 mm/hr Source: Microdrainage	

TITLE		Job Reference	
Warehousing and Logistics Development at Calmount Road Clarification of Further Information		210175	
SUBJECT		Calc. Sheet No.	
Swale Channel 3 Unit 2		1	
DRAWING NUMBER	Calculations by	Checked by	Date
210175-DBFL-SW-SP-DR-C-1300	RTM	SVC	15.11.22

INPUT DATA

Side Slopes	4.0	1 in ....
Bottom width (W)	0.50	m
Depth to Invert (D)	0.15	m
Length (L)	14.4	m
Slope (S)	33	1 in ....
Manning's Coefficient (n)	0.030	
Subgrade Infiltration Rate per hour	5.000	mm/hr
Subgrade Infiltration Rate (f)	0.001388889	mm/s

TREATMENT VOLUME

Total Plan Area of Swale	25.0	m^2	
[1]Depth of Subgrade Treatment	0.20	m	
Total Swale Treatment Volume (V_T)	5.002	m^3	Provided Treatment Volume

STORAGE VOLUME

Max. Length of Storage within Swale	5.0	m
Swale Storage Volume per 5m Length	0.33	m^3
Swale Storage Volume (V)	0.99	m^3

INFILTRATION/ INTERCEPTION VOLUME

Total Swale Infiltration Rate	0.01	l/s	
[3]Total Swale Infiltration Volume	0.148	m^3	Provided Interception Volume

FLOW

Maximum Swale Flow at Outlet	199.3	l/s
Maximum Swale Velocity at Outlet	1.21	m/s
[3]Typical Swale Retention Time	0.003	hr

Notes:

1 Assume 200mm of topsoil.

2 Volume calculated using 6 hour storm event.

3 Swale retention time depends on outlet control, refer to WINDES Model.

Total Swale Infiltration = $P \cdot L \cdot f$

where:

P = Wetted Perimeter
L = Length
f = Subgrade infiltration rate

Total Swale Flow = $1/n.AR^{2/3}S^{1/2}$

where:

A = Area of flow
P = Wetted perimeter
R = A/P
n = Manning's Coefficient
s = Slope

Table: 1

Material	Infiltration Rate (m/hr)
Gravel	10 - 1000
Sand	0.1 - 100
Loamy sand	0.01 - 1
Sandy loam	0.05 - 0.5
Loam	0.001 - 0.1
Silt loam	0.0005 - 0.005
Chalk	0.001 - 100
Sandy clay loam	0.001 - 0.01
Silty clay loam	0.00005 - 0.005
Clay	< 0.0001
Till	0.00001 - 0.01
Rock	0.00001 - 1
Cutoff point for most infiltration drainage systems = 0.001 mm/hr Source: Microdrainage	

TITLE		Job Reference	
Warehousing and Logistics Development at Calmount Road Clarification of Further Information		210175	
SUBJECT		Calc. Sheet No.	
Swale Channel 4 Unit 2		1	
DRAWING NUMBER	Calculations by	Checked by	Date
210175-DBFL-SW-SP-DR-C-1300	RTM	SVC	15.11.22

INPUT DATA

Side Slopes	4.0	1 in ....
Bottom width (W)	0.50	m
Depth to Invert (D)	0.15	m
Length (L)	17.8	m
Slope (S)	47	1 in ....
Manning's Coefficient (n)	0.030	
Subgrade Infiltration Rate per hour	5.000	mm/hr
Subgrade Infiltration Rate (f)	0.001388889	mm/s

TREATMENT VOLUME

Total Plan Area of Swale	30.9	m^2	
[1]Depth of Subgrade Treatment	0.20	m	
Total Swale Treatment Volume (V_T)	6.183	m^3	Provided Treatment Volume

STORAGE VOLUME

Max. Length of Storage within Swale	7.1	m
Swale Storage Volume per 7m Length	0.48	m^3
Swale Storage Volume (V)	1.43	m^3

INFILTRATION/ INTERCEPTION VOLUME

Total Swale Infiltration Rate	0.01	l/s	
[3]**Total Swale Infiltration Volume**	0.236	m^3	Provided Interception Volume

FLOW

Maximum Swale Flow at Outlet	167.0	l/s
Maximum Swale Velocity at Outlet	1.01	m/s
[3]**Typical Swale Retention Time**	0.005	hr

Notes:

1 Assume 200mm of topsoil.

2 Volume calculated using 6 hour storm event.

3 Swale retention time depends on outlet control, refer to WINDES Model.

Total Swale Infiltration = $P \cdot L \cdot f$

where:

P = Wetted Perimeter
L = Length
f = Subgrade infiltration rate

Total Swale Flow = $1/n.AR^{2/3}S^{1/2}$

where:

A = Area of flow
P = Wetted perimeter
R = A/P
n = Manning's Coefficient
s = Slope

Table: 1

Material	Infiltration Rate (m/hr)
Gravel	10 - 1000
Sand	0.1 - 100
Loamy sand	0.01 - 1
Sandy loam	0.05 - 0.5
Loam	0.001 - 0.1
Silt loam	0.0005 - 0.005
Chalk	0.001 - 100
Sandy clay loam	0.001 - 0.01
Silty clay loam	0.00005 - 0.005
Clay	< 0.0001
Till	0.00001 - 0.01
Rock	0.00001 - 1
Cutoff point for most infiltration drainage systems = 0.001 mm/hr Source: Microdrainage	

TITLE Warehousing and Logistics Development at Calmount Road Clarification of Further Information		Job Reference 210175	
SUBJECT **Swale Channel 5 Unit 2**		Calc. Sheet No. 1	
DRAWING NUMBER 210175-DBFL-SW-SP-DR-C-1300	Calculations by RTM	Checked by SVC	Date 15.11.22

INPUT DATA

Side Slopes	4.0	1 in ....
Bottom width (W)	0.50	m
Depth to Invert (D)	0.15	m
Length (L)	64.2	m
Slope (S)	97	1 in ....
Manning's Coefficient (n)	0.030	
Subgrade Infiltration Rate per hour	5.000	mm/hr
Subgrade Infiltration Rate (f)	0.001388889	mm/s

TREATMENT VOLUME

Total Plan Area of Swale	111.5	m^2	
[1]Depth of Subgrade Treatment	0.20	m	
Total Swale Treatment Volume (V_T)	22.302	m^3	Provided Treatment Volume

STORAGE VOLUME

Max. Length of Storage within Swale	14.6	m
Swale Storage Volume per 15m Length	0.98	m^3
Swale Storage Volume (V)	3.93	m^3

INFILTRATION/ INTERCEPTION VOLUME

Total Swale Infiltration Rate	0.02	l/s	
[3]Total Swale Infiltration Volume	0.480	m^3	Provided Interception Volume

FLOW

Maximum Swale Flow at Outlet	116.3	l/s
Maximum Swale Velocity at Outlet	0.70	m/s
[3]Typical Swale Retention Time	0.025	hr

Notes:

1 Assume 200mm of topsoil.

2 Volume calculated using 6 hour storm event.

3 Swale retention time depends on outlet control, refer to WINDES Model.

Total Swale Infiltration = $P \cdot L \cdot f$

where:

P = Wetted Perimeter
L = Length
f = Subgrade infiltration rate

Total Swale Flow = $1/n.AR^{2/3}S^{1/2}$

where:

A = Area of flow
P = Wetted perimeter
R = A/P
n = Manning's Coefficient
s = Slope

Table: 1

Material	Infiltration Rate (m/hr)
Gravel	10 - 1000
Sand	0.1 - 100
Loamy sand	0.01 - 1
Sandy loam	0.05 - 0.5
Loam	0.001 - 0.1
Silt loam	0.0005 - 0.005
Chalk	0.001 - 100
Sandy clay loam	0.001 - 0.01
Silty clay loam	0.00005 - 0.005
Clay	< 0.0001
Till	0.00001 - 0.01
Rock	0.00001 - 1
Cutoff point for most infiltration drainage systems = 0.001 mm/hr Source: Microdrainage	

TITLE		Job Reference	
Logistics and Warehousing Development at Calmount Road		210175	
SUBJECT		Calc. Sheet No.	
Bioretention Area (Unit 2)		1	
DRAWING NUMBER	Calculations by	Checked by	Date
210175-DBFL-SW-SP-DR-C-1300	RTM	SVC	15.11.2022

INPUT DATA

Effective Impermeable Area for Treatment (A)	1,100.0	m^2
[1]Filter Bed Depth (L)	1.500	m
Coefficient of Permeability of Filter Medium (k)	0.000002	m/s
[2]Average Height of Water above Filter Bed (h)	0.010	m
Time Required for Percolation (t)	48.0	hr

BIORETENTION AREA

Minimum Surface Area of Bioretention Area to Treat Impermeable Area(Af)	37.9	m^2	**Provided Area**	330 m^2

TREATMENT VOLUME

[3]Treatment Volume Required(V_T)	13.2	m^3	Provided Treatment Volume

INTERCEPTION VOLUME

Subgrade Infiltration Rate per hour	5.0	mm/hr	
Subgrade Infiltration Rate (*f*)	0.001	mm/s	
[4]Subgrade Infiltration Volume	42.599	m^3	Provided Interception Volume

STORAGE VOLUME IN STONE BELOW

Storage Volume	99.0	m^3	Provided Storage Volume

Notes:

1 Filter Bed depth typically between 1.2 and 1.5m

2 h = Half maximum height, where hmax <=2m

3 Treatment Volume Vt (m^3) = Impermeable Area (ha) x 15mm x 10 x 80% (GDSDS Section 6.3.1.2.1).

4 Volume calculated using 6 hour storm event.

Area of Bioretention Filter Bed = $\frac{V_T \cdot L}{k(h+L)t}$

Table: 1

Material	Infiltration Rate (m/s)
Source: SUDS Manual Section 25-1	
Silty Loam	0.000002
Sand	0.000000028 - 0.000028
Loamy sand	0.0000000028 - 0.00000028
Sandy loam	0.000000014 - 0.00000014
Loam	0.00000000028 - 0.000000028
Silty Loam	0.00000000014 - 0.0000000014

TITLE	Job Reference	
Warehousing and Logistics Development at Calmount Road	210175	
SUBJECT	Calc. Sheet No.	
Permeable Paving Design - Unit 2	1	
DRAWING NUMBER	Calculations by	Checked by	Date
210175-DBFL-SW-SP-DR-C-1300	RTM	SVC	15.11.22

DBFL

FLAT SITES

INPUT DATA

Pavement Area (A)	826.5	m^2
Pavement Perimeter (P)	159.3	m
Sub-base Depth (d)	0.400	m
[1]Sub-base Voids Ratio (η)	0.30	
Sub-base Infiltration Rate per hour	1000	mm/hr
Sub-base Infiltration Rate (k)	0.278	mm/s
Subgrade Infiltration Rate per hour	5.0	mm/hr
Subgrade Infiltration Rate (*f*)	0.001	mm/s

VOLUME (STORAGE AND TREATMENT)

Permeable Paving Storage Volume per m^2	0.120	m^3/m^2
Total Permeable Paving Storage Volume	99.2	m^3

INFILTRATION / INTERCEPTION VOLUME

			5mm SURFACE INTERCEPTION
Approx. Permeable Paving Infiltration per m^2	0.001	l/s/m^2	5.03 m^3
[2]Total Permeable Paving Infiltration Rate	1.236	l/s	
[3]Total Permeable Paving Infiltration Volume	26.7	m^3	

FLOW

Average Distance between Outlet Drains	6.0	m	Assumed one outlet per house
Flow Velocity through Permeable Paving	0.000038	m/s	
Trench Retention Time	44.2	hr	

TITLE	Job Reference
Warehousing and Logistics Development at Calmount Road	210175
SUBJECT	Calc. Sheet No.
Permeable Paving Design - Unit 2	1
DRAWING NUMBER	Calculations by / Checked by / Date
210175-DBFL-SW-SP-DR-C-1300	RTM / SVC / 15.11.22

Notes:

1 Sub-base material has a void ratio of approximately 30%, source 'BRE Digest 365'.

2 Wetted perimeter assuming 50% of trench depth, source 'BRE Digest 365'.

3 Volume calculated using 6 hour storm event.

4 For Paving on slopes includes Infiltration, provide 500mmx500mm trenches at 10m centres along slope with 1000mmx500mm at base of slope. source 'Formpave - Aquaflow Permeable Paving System'.

Table: 1

Material	void Ratio, η
Clean stone	0.40 - 0.50
Uniform gravel	0.30 - 0.40
Graded sand or gravel	0.20 - 0.30
Source: The SUDS manual, Published by CIRIA.	

Table: 2

Pavement Type	Effective Depth (m)
Car-Parking	0.40
Footpath	0.20
Effective Depths are provided from source 'Formpave - Aquaflow Permeable Paving System' and may subject to change as per site requirement.	

Total Permeable Paving Outflow:

$= A . k . i$

where:

A = Cross Sectional Area of Subbase
k = Subbase Infiltration Rate
i = Hydraulic Gradient

Hydraulic gradient has been assumed as the pavement gradient with an additional 250mm fall per 100m length.

Table: 3

Material	Infiltration Rate (m/hr)
Gravel	10 - 1000
Sand	0.1 - 100
Loamy sand	0.01 - 1
Sandy loam	0.05 - 0.5
Loam	0.001 - 0.1
Silt loam	0.0005 - 0.005
Chalk	0.001 - 100
Sandy clay loam	0.001 - 0.01
Silty clay loam	0.00005 - 0.005
Clay	< 0.0001
Till	0.00001 - 0.01
Rock	0.00001 - 1
Cutoff point for most infiltration drainage systems = 0.001 mm/hr Source: Microdrainage	

Total Trench Infiltration:

$= 1/2 \; D . L . f$

where:

L = Length
D = Depth to Invert
f = Subgrade infiltration rate

TITLE	Job Reference	
Development at Ballymount Ave (CFI)	210175	
SUBJECT	Calc. Sheet No.	
Interception/Treatment Volume Summary	1	
DRAWING NUMBER	Calculations by	Checked by	Date
210175-DBFL-SW-SP-DR-C-1300	RTM	SVC	18/11/2022

INPUT DATA

Interception Volume Required	217.4	m^3
Treatment Volume Required	652.3	m^3

Catchment	Interception Volumes		Treatment Volumes	
Swales	10.1	m^3	271.1	m^3
Bio-Retention	136.1	m^3	30.3	m^3
Permeable Paving	223.5	m^3	831.8	m^3
Rain Gardens	3.0	m^3	12.0	m^3
Green Roofs	6.1	m^3	224.5	m^3
Tree Pits		m^3		m^3
Stormtech Isolator Row		m^3		m^3
Total Volumes Provided	378.9	m^3	1369.7	m^3
Check Provided Volumes are greater than Required Volumes	PASS		PASS	

Appendix B : Microdrainage Calculations

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for UNIT 2

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - Scotland and Ireland

Return Period (years)	2	PIMP (%)	75
M5-60 (mm)	17.500	Add Flow / Climate Change (%)	0
Ratio R	0.276	Minimum Backdrop Height (m)	0.000
Maximum Rainfall (mm/hr)	150	Maximum Backdrop Height (m)	0.000
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	0.750
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Inverts

Network Design Table for UNIT 2

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S3.000	17.409	0.210	82.9	0.034	4.00	0.0	0.150	o	225	Pipe/Conduit	
S3.001	12.117	0.180	67.3	0.000	0.00	0.0	0.150	o	225	Pipe/Conduit	
S3.002	42.717	0.310	137.8	0.124	0.00	0.0	0.150	o	225	Pipe/Conduit	
S4.000	25.772	0.170	151.6	0.050	4.00	0.0	0.150	o	225	Pipe/Conduit	
S3.003	28.017	0.130	215.5	0.048	0.00	0.0	0.150	o	225	Pipe/Conduit	
S3.004	13.774	0.070	196.8	0.019	0.00	0.0	0.150	o	225	Pipe/Conduit	
S3.005	14.428	0.090	160.3	0.052	0.00	0.0	0.600	o	300	Pipe/Conduit	
S5.000	6.155	0.050	123.1	0.061	4.00	0.0	0.150	o	225	Pipe/Conduit	
S3.006	22.102	0.080	276.3	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S6.000	27.433	0.120	228.6	0.031	4.00	0.0	0.150	o	225	Pipe/Conduit	
S6.001	2.539	0.020	127.0	0.005	0.00	0.0	0.150	o	225	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S3.000	56.19	4.17	61.700	0.034	0.0	0.0	0.0	1.68	66.8	5.1
S3.001	55.70	4.28	61.490	0.034	0.0	0.0	0.0	1.87	74.3	5.1
S3.002	53.38	4.83	61.310	0.158	0.0	0.0	0.0	1.29	51.5	22.8
S4.000	55.40	4.35	61.170	0.050	0.0	0.0	0.0	1.23	49.0	7.4
S3.003	51.63	5.29	61.000	0.255	0.0	0.0	0.0	1.03	40.8	35.7
S3.004	50.86	5.50	60.870	0.274	0.0	0.0	0.0	1.08	42.8	37.7
S3.005	50.18	5.69	60.800	0.326	0.0	0.0	0.0	1.24	87.6	44.2
S5.000	56.64	4.07	60.760	0.061	0.0	0.0	0.0	1.37	54.5	9.3
S3.006	48.88	6.08	60.710	0.386	0.0	0.0	0.0	0.94	66.5	51.1
S6.000	54.92	4.46	61.320	0.031	0.0	0.0	0.0	1.00	39.6	4.6
S6.001	54.79	4.49	61.200	0.036	0.0	0.0	0.0	1.35	53.7	5.3

Network Design Table for UNIT 2

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S7.000	20.401	0.200	102.0	0.034	4.00	0.0	0.150	o	225	Pipe/Conduit	
S8.000	3.644	0.130	28.0	0.078	4.00	0.0	0.150	o	225	Pipe/Conduit	
S7.001	59.023	0.390	151.3	0.077	0.00	0.0	0.150	o	225	Pipe/Conduit	
S9.000	9.093	0.140	65.0	0.034	4.00	0.0	0.150	o	225	Pipe/Conduit	
S7.002	18.581	0.120	154.8	0.037	0.00	0.0	0.150	o	225	Pipe/Conduit	
S7.003	51.097	0.010	5109.7	0.018	0.00	0.0	0.150	o	450	Pipe/Conduit	
S3.007	10.266	0.010	1026.6	0.000	0.00	0.0	0.150	o	450	Pipe/Conduit	
S3.008	18.897	0.100	189.0	0.000	0.00	0.0	0.150	o	225	Pipe/Conduit	
S3.009	17.736	0.090	197.1	0.000	0.00	0.0	0.150	o	225	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S7.000	55.95	4.23	61.470	0.034	0.0	0.0	0.0	1.51	60.1	5.1
S8.000	56.89	4.02	61.400	0.078	0.0	0.0	0.0	2.92	116.2	12.0
S7.001	52.62	5.02	61.270	0.189	0.0	0.0	0.0	1.23	49.0	26.9
S9.000	56.62	4.08	61.020	0.034	0.0	0.0	0.0	1.90	75.7	5.2
S7.002	51.66	5.28	60.880	0.260	0.0	0.0	0.0	1.22	48.5	36.3
S7.003	43.35	8.08	60.760	0.278	0.0	0.0	0.0	0.30	48.3	36.3
S3.007	42.79	8.33	60.630	0.700	0.0	0.0	0.0	0.71	112.8	81.1
S3.008	55.68	4.29	60.620	0.000	1.7	0.0	0.0	1.10	43.7	1.7
S3.009	55.73	4.27	60.520	0.000	1.7	0.0	0.0	1.08	42.8	1.7

Manhole Schedules for UNIT 2

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdrop (mm)
U2 - 3.9	62.450	0.750	Open Manhole	1200	S3.000	61.700	225				
U2 - 3.8	62.450	0.960	Open Manhole	1200	S3.001	61.490	225	S3.000	61.490	225	
U2 - 3.7(SWA)	62.350	1.040	Open Manhole	1200	S3.002	61.310	225	S3.001	61.310	225	
U2 - 3.6.1	62.370	1.200	Open Manhole	1200	S4.000	61.170	225				
U2 - 3.6(SWA)	62.320	1.320	Open Manhole	1200	S3.003	61.000	225	S3.002	61.000	225	
								S4.000	61.000	225	
U2 - 3.5(SWA)	62.300	1.430	Open Manhole	1200	S3.004	60.870	225	S3.003	60.870	225	
U2 - 3.4(BRA)	62.250	1.450	Open Manhole	1200	S3.005	60.800	300	S3.004	60.800	225	
U2 - 3.3.1(SWA)	62.300	1.540	Open Manhole	1200	S5.000	60.760	225				
U2 - 3.3(BRA)	62.250	1.540	Open Manhole	1200	S3.006	60.710	300	S3.005	60.710	300	
								S5.000	60.710	225	
U2 - 3.2	62.700	1.380	Open Manhole	1200	S6.000	61.320	225				
U2 - 3.1	62.470	1.270	Open Manhole	1200	S6.001	61.200	225	S6.000	61.200	225	
U2 - 6.1	62.450	0.980	Open Manhole	1200	S7.000	61.470	225				
U2 - 7	62.400	1.000	Open Manhole	1200	S8.000	61.400	225				
U2 - 6	62.450	1.180	Open Manhole	1200	S7.001	61.270	225	S7.000	61.270	225	
								S8.000	61.270	225	
U2 - 5.1	62.450	1.430	Open Manhole	1200	S9.000	61.020	225				
U2 - 5	62.350	1.470	Open Manhole	1200	S7.002	60.880	225	S7.001	60.880	225	
								S9.000	60.880	225	
U2 - 4	63.000	2.240	Open Manhole	1350	S7.003	60.760	450	S7.002	60.760	225	
U2 - 3(ATTN)	62.520	1.890	Open Manhole	1350	S3.007	60.630	450	S3.006	60.630	300	
								S6.001	61.180	225	325
								S7.003	60.750	450	120
U2 - 2(HB)	62.460	1.840	Open Manhole	1350	S3.008	60.620	225	S3.007	60.620	450	
U2 - 1	62.370	1.850	Open Manhole	1200	S3.009	60.520	225	S3.008	60.520	225	
U2 -	61.850	1.420	Open Manhole	0		OUTFALL		S3.009	60.430	225	

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
U2 - 3.9	709730.922	730445.022	709730.922	730445.022	Required	
U2 - 3.8	709723.869	730460.938	709723.869	730460.938	Required	
U2 - 3.7(SWA)	709712.362	730457.141	709712.362	730457.141	Required	
U2 - 3.6.1	709684.354	730416.789	709684.354	730416.789	Required	
U2 - 3.6(SWA)	709673.221	730440.033	709673.221	730440.033	Required	

Manhole Schedules for UNIT 2

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
U2 - 3.5(SWA)	709645.814	730434.215	709645.814	730434.215	Required	
U2 - 3.4(BRA)	709632.187	730432.210	709632.187	730432.210	Required	
U2 - 3.3.1(SWA)	709630.630	730411.867	709630.630	730411.867	Required	
U2 - 3.3(BRA)	709632.329	730417.783	709632.329	730417.783	Required	
U2 - 3.2	709663.735	730387.734	709663.735	730387.734	Required	
U2 - 3.1	709651.913	730412.489	709651.913	730412.489	Required	
U2 - 6.1	709745.401	730416.489	709745.401	730416.489	Required	
U2 - 7	709756.865	730401.007	709756.865	730401.007	Required	
U2 - 6	709754.504	730398.231	709754.504	730398.231	Required	
U2 - 5.1	709701.664	730381.573	709701.664	730381.573	Required	
U2 - 5	709701.393	730372.484	709701.393	730372.484	Required	
U2 - 4	709682.833	730371.587	709682.833	730371.587	Required	
U2 - 3(ATTN)	709654.073	730413.822	709654.073	730413.822	Required	
U2 - 2(HB)	709663.473	730417.950	709663.473	730417.950	Required	
U2 - 1	709672.622	730434.484	709672.622	730434.484	Required	
U2 -	709665.200	730450.592			No Entry	

PIPELINE SCHEDULES for UNIT 2

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S3.000	o	225	U2 - 3.9	62.450	61.700	0.525	Open Manhole	1200
S3.001	o	225	U2 - 3.8	62.450	61.490	0.735	Open Manhole	1200
S3.002	o	225	U2 - 3.7(SWA)	62.350	61.310	0.815	Open Manhole	1200
S4.000	o	225	U2 - 3.6.1	62.370	61.170	0.975	Open Manhole	1200
S3.003	o	225	U2 - 3.6(SWA)	62.320	61.000	1.095	Open Manhole	1200
S3.004	o	225	U2 - 3.5(SWA)	62.300	60.870	1.205	Open Manhole	1200
S3.005	o	300	U2 - 3.4(BRA)	62.250	60.800	1.150	Open Manhole	1200
S5.000	o	225	U2 - 3.3.1(SWA)	62.300	60.760	1.315	Open Manhole	1200
S3.006	o	300	U2 - 3.3(BRA)	62.250	60.710	1.240	Open Manhole	1200
S6.000	o	225	U2 - 3.2	62.700	61.320	1.155	Open Manhole	1200
S6.001	o	225	U2 - 3.1	62.470	61.200	1.045	Open Manhole	1200
S7.000	o	225	U2 - 6.1	62.450	61.470	0.755	Open Manhole	1200
S8.000	o	225	U2 - 7	62.400	61.400	0.775	Open Manhole	1200
S7.001	o	225	U2 - 6	62.450	61.270	0.955	Open Manhole	1200
S9.000	o	225	U2 - 5.1	62.450	61.020	1.205	Open Manhole	1200

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S3.000	17.409	82.9	U2 - 3.8	62.450	61.490	0.735	Open Manhole	1200
S3.001	12.117	67.3	U2 - 3.7(SWA)	62.350	61.310	0.815	Open Manhole	1200
S3.002	42.717	137.8	U2 - 3.6(SWA)	62.320	61.000	1.095	Open Manhole	1200
S4.000	25.772	151.6	U2 - 3.6(SWA)	62.320	61.000	1.095	Open Manhole	1200
S3.003	28.017	215.5	U2 - 3.5(SWA)	62.300	60.870	1.205	Open Manhole	1200
S3.004	13.774	196.8	U2 - 3.4(BRA)	62.250	60.800	1.225	Open Manhole	1200
S3.005	14.428	160.3	U2 - 3.3(BRA)	62.250	60.710	1.240	Open Manhole	1200
S5.000	6.155	123.1	U2 - 3.3(BRA)	62.250	60.710	1.315	Open Manhole	1200
S3.006	22.102	276.3	U2 - 3(ATTN)	62.520	60.630	1.590	Open Manhole	1350
S6.000	27.433	228.6	U2 - 3.1	62.470	61.200	1.045	Open Manhole	1200
S6.001	2.539	127.0	U2 - 3(ATTN)	62.520	61.180	1.115	Open Manhole	1350
S7.000	20.401	102.0	U2 - 6	62.450	61.270	0.955	Open Manhole	1200
S8.000	3.644	28.0	U2 - 6	62.450	61.270	0.955	Open Manhole	1200
S7.001	59.023	151.3	U2 - 5	62.350	60.880	1.245	Open Manhole	1200
S9.000	9.093	65.0	U2 - 5	62.350	60.880	1.245	Open Manhole	1200

PIPELINE SCHEDULES for UNIT 2

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S7.002	o	225	U2 - 5	62.350	60.880	1.245	Open Manhole	1200
S7.003	o	450	U2 - 4	63.000	60.760	1.790	Open Manhole	1350
S3.007	o	450	U2 - 3(ATTN)	62.520	60.630	1.440	Open Manhole	1350
S3.008	o	225	U2 - 2(HB)	62.460	60.620	1.615	Open Manhole	1350
S3.009	o	225	U2 - 1	62.370	60.520	1.625	Open Manhole	1200

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S7.002	18.581	154.8	U2 - 4	63.000	60.760	2.015	Open Manhole	1350
S7.003	51.097	5109.7	U2 - 3(ATTN)	62.520	60.750	1.320	Open Manhole	1350
S3.007	10.266	1026.6	U2 - 2(HB)	62.460	60.620	1.390	Open Manhole	1350
S3.008	18.897	189.0	U2 - 1	62.370	60.520	1.625	Open Manhole	1200
S3.009	17.736	197.1	U2 -	61.850	60.430	1.195	Open Manhole	0

Free Flowing Outfall Details for UNIT 2

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
S3.009	U2 -	61.850	60.430	60.420	0	0

Simulation Criteria for UNIT 2

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 1 Number of Storage Structures 3 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model		FSR	Profile Type Summer
Return Period (years)		2	Cv (Summer) 0.750
Region	Scotland and Ireland		Cv (Winter) 0.840
M5-60 (mm)		17.500	Storm Duration (mins) 30
Ratio R		0.276	

Online Controls for UNIT 2

Hydro-Brake® Optimum Manhole: U2 - 2(HB), DS/PN: S3.008, Volume (m³): 4.1

Unit Reference	MD-SHE-0061-1700-1070-1700
Design Head (m)	1.070
Design Flow (l/s)	1.7
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	61
Invert Level (m)	60.620
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.070	1.7	Kick-Flo®	0.540	1.3
Flush-Flo™	0.268	1.5	Mean Flow over Head Range	-	1.4

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	1.3	0.800	1.5	2.000	2.3	4.000	3.1	7.000	4.0
0.200	1.5	1.000	1.6	2.200	2.4	4.500	3.3	7.500	4.2
0.300	1.5	1.200	1.8	2.400	2.5	5.000	3.5	8.000	4.3
0.400	1.5	1.400	1.9	2.600	2.5	5.500	3.6	8.500	4.4
0.500	1.4	1.600	2.0	3.000	2.7	6.000	3.8	9.000	4.5
0.600	1.3	1.800	2.2	3.500	2.9	6.500	3.9	9.500	4.7

Storage Structures for UNIT 2

Tank or Pond Manhole: U2 - 3.4(BRA), DS/PN: S3.005

Invert Level (m) 60.800

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	0.0	1.299	0.0	1.300	164.5	1.450	164.5

Tank or Pond Manhole: U2 - 3.3(BRA), DS/PN: S3.006

Invert Level (m) 60.710

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	0.0	1.389	0.0	1.390	164.5	1.540	164.5

Tank or Pond Manhole: U2 - 3(ATTN), DS/PN: S3.007

Invert Level (m) 60.630

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	500.0	1.059	500.0	1.060	0.0

Summary of Critical Results by Maximum Level (Rank 1) for UNIT 2

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 1 Number of Storage Structures 3 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model		FSR M5-60 (mm) 17.500 Cv (Summer)	0.750
Region	Scotland and Ireland	Ratio R 0.276 Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	OFF
DVD Status	ON
Inertia Status	ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	100
Climate Change (%)	20

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
S3.000	U2 - 3.9	15 Winter	100	+20%	100/15 Summer				62.367
S3.001	U2 - 3.8	15 Winter	100	+20%	100/15 Summer				62.351
S3.002	U2 - 3.7(SWA)	15 Winter	100	+20%	100/15 Summer				62.341
S4.000	U2 - 3.6.1	15 Winter	100	+20%	100/15 Summer				62.129
S3.003	U2 - 3.6(SWA)	15 Winter	100	+20%	100/15 Summer				62.097
S3.004	U2 - 3.5(SWA)	2880 Winter	100	+20%	100/15 Summer				61.661
S3.005	U2 - 3.4(BRA)	2880 Winter	100	+20%	100/15 Summer				61.660
S5.000	U2 - 3.3.1(SWA)	2880 Winter	100	+20%	100/15 Summer				61.659
S3.006	U2 - 3.3(BRA)	2880 Winter	100	+20%	100/15 Summer				61.659
S6.000	U2 - 3.2	2880 Winter	100	+20%	100/960 Winter				61.658
S6.001	U2 - 3.1	2880 Winter	100	+20%	100/600 Winter				61.658
S7.000	U2 - 6.1	15 Winter	100	+20%	100/15 Summer				62.173
S8.000	U2 - 7	15 Winter	100	+20%	100/15 Summer				62.221
S7.001	U2 - 6	15 Winter	100	+20%	100/15 Summer				62.154
S9.000	U2 - 5.1	2880 Winter	100	+20%	100/15 Summer				61.659
S7.002	U2 - 5	2880 Winter	100	+20%	100/15 Summer				61.659
S7.003	U2 - 4	2880 Winter	100	+20%	100/180 Winter				61.658
S3.007	U2 - 3(ATTN)	2880 Winter	100	+20%	100/120 Summer				61.658
S3.008	U2 - 2(HB)	2880 Winter	100	+20%	100/15 Summer				61.694
S3.009	U2 - 1	2880 Winter	100	+20%					60.551

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
S3.000	U2 - 3.9	0.442	0.000	0.21			11.9	FLOOD RISK	
S3.001	U2 - 3.8	0.636	0.000	0.28			16.6	FLOOD RISK	
S3.002	U2 - 3.7(SWA)	0.806	0.000	0.89			43.0	FLOOD RISK	
S4.000	U2 - 3.6.1	0.734	0.000	0.34			14.9	FLOOD RISK	

Summary of Critical Results by Maximum Level (Rank 1) for UNIT 2

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
S3.003	U2 - 3.6(SWA)	0.872	0.000	1.88			69.8	FLOOD RISK	
S3.004	U2 - 3.5(SWA)	0.566	0.000	0.12			4.3	SURCHARGED	
S3.005	U2 - 3.4(BRA)	0.560	0.000	0.07			5.1	SURCHARGED	
S5.000	U2 - 3.3.1(SWA)	0.674	0.000	0.03			1.0	SURCHARGED	
S3.006	U2 - 3.3(BRA)	0.649	0.000	0.10			6.0	SURCHARGED	
S6.000	U2 - 3.2	0.113	0.000	0.01			0.5	SURCHARGED	
S6.001	U2 - 3.1	0.233	0.000	0.02			0.6	SURCHARGED	
S7.000	U2 - 6.1	0.478	0.000	0.22			11.5	FLOOD RISK	
S8.000	U2 - 7	0.596	0.000	0.49			24.8	FLOOD RISK	
S7.001	U2 - 6	0.659	0.000	1.26			58.9	FLOOD RISK	
S9.000	U2 - 5.1	0.414	0.000	0.01			0.6	SURCHARGED	
S7.002	U2 - 5	0.554	0.000	0.10			4.2	SURCHARGED	
S7.003	U2 - 4	0.448	0.000	0.04			4.5	SURCHARGED	
S3.007	U2 - 3(ATTN)	0.578	0.000	0.03			2.7	SURCHARGED	
S3.008	U2 - 2(HB)	0.849	0.000	0.04			1.7	SURCHARGED	
S3.009	U2 - 1	-0.194	0.000	0.05			1.7	OK	

User Inputs

Chamber Model:	SC-740
Outlet Control Structure:	Yes
Project Name:	Calmount Unit 2
Engineer:	N/A
Project Location:	
Measurement Type:	Metric
Required Storage Volume:	500.01 cubic meters.
Stone Porosity:	40%
Stone Foundation Depth:	153 mm.
Stone Above Chambers:	153 mm.
Average Cover Over Chambers:	458 mm.
Design Constraint Dimensions:	(25.00 m. x 55.01 m.)

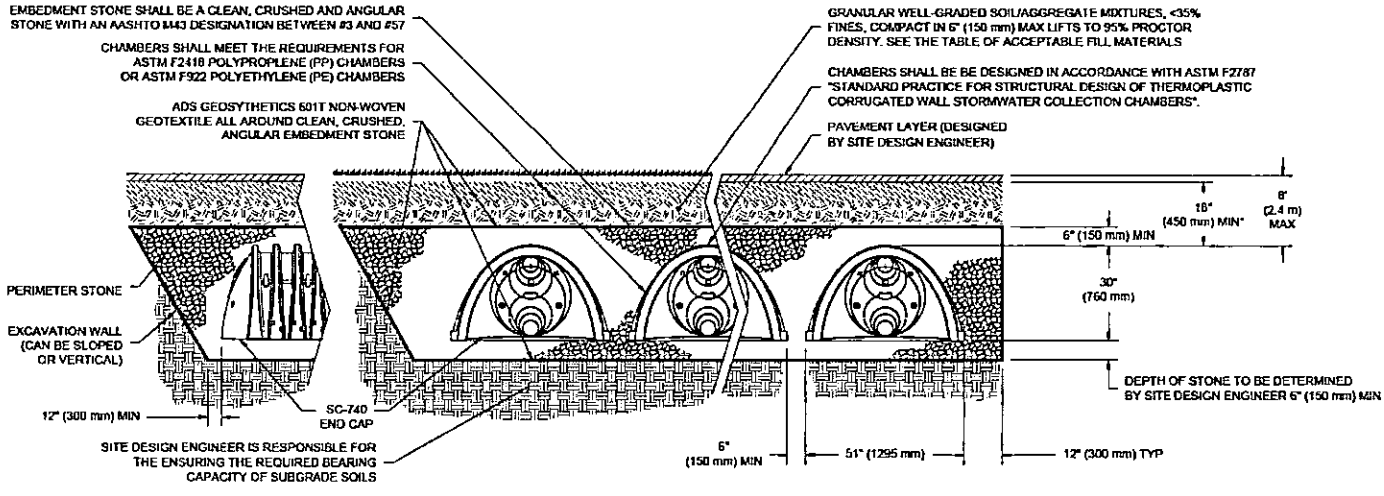
Results

System Volume and Bed Size

Installed Storage Volume:	512.05 cubic meters.
Storage Volume Per Chamber:	1.30 cubic meters.
Number of Chambers Required:	227
Number of End Caps Required:	20
Chamber Rows:	10
Maximum Length:	52.36 m.
Maximum Width:	15.12 m.
Approx. Bed Size Required:	785.11 square meters.

System Components

Amount Of Stone Required:	543 cubic meters
Volume of Excavation (Not Including Fill):	838 cubic meters
Total Non-woven Geotextile Required:	2060 square meters
Woven Geotextile Required (excluding Isolator Row):	60 square meters
Woven Geotextile Required (Isolator Row):	93 square meters
Total Woven Geotextile Required:	152 square meters
Impervious Liner Required:	0 square meters



*MINIMUM COVER TO BOTTOM OF FLEXIBLE PAVEMENT. FOR UNPAVED INSTALLATIONS WHERE RUTTING FROM VEHICLES MAY OCCUR, INCREASE COVER TO 24" (600 mm).

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for ROADS

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - Scotland and Ireland

Return Period (years)	2	PIMP (%)	77
M5-60 (mm)	17.500	Add Flow / Climate Change (%)	0
Ratio R	0.276	Minimum Backdrop Height (m)	0.000
Maximum Rainfall (mm/hr)	150	Maximum Backdrop Height (m)	0.000
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	0.000
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	0.75
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Inverts

Network Design Table for ROADS

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
P1.000	37.183	0.190	195.7	0.051	4.00	0.0	0.600	o	225	Pipe/Conduit	
P1.001	63.519	0.320	198.5	0.054	0.00	0.0	0.600	o	225	Pipe/Conduit	
P2.000	65.003	0.330	197.0	0.126	4.00	0.0	0.600	o	300	Pipe/Conduit	
P2.001	85.863	0.430	199.7	0.122	0.00	0.0	0.600	o	300	Pipe/Conduit	
P1.002	34.538	0.180	191.9	0.085	0.00	0.0	0.600	o	300	Pipe/Conduit	
P1.003	28.612	0.150	190.7	0.052	0.00	0.0	0.600	o	300	Pipe/Conduit	
P1.004	30.094	0.150	200.6	0.042	0.00	0.0	0.600	o	300	Pipe/Conduit	
P1.005	29.133	0.150	194.2	0.102	0.00	0.0	0.600	o	750	Pipe/Conduit	
P3.000	21.782	0.100	217.8	0.019	4.00	0.0	0.600	o	225	Pipe/Conduit	
P3.001	89.074	0.510	174.7	0.156	0.00	0.0	0.600	o	225	Pipe/Conduit	
P3.002	7.731	0.040	193.3	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
P1.006	3.133	0.020	156.7	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
P1.000	54.05	4.67	62.500	0.051	0.0	0.0	0.0	0.93	37.0	7.4
P1.001	49.78	5.81	62.310	0.105	0.0	0.0	0.0	0.92	36.8	14.1
P2.000	52.82	4.97	59.670	0.126	0.0	0.0	0.0	1.12	78.9	18.1
P2.001	48.32	6.26	59.340	0.249	0.0	0.0	0.0	1.11	78.4	32.5
P1.002	46.79	6.77	58.910	0.439	0.0	0.0	0.0	1.13	80.0	55.6
P1.003	45.62	7.19	58.730	0.491	0.0	0.0	0.0	1.13	80.2	60.7
P1.004	44.43	7.64	58.580	0.534	0.0	0.0	0.0	1.11	78.2	64.2
P1.005	43.83	7.89	58.430	0.636	0.0	0.0	0.0	2.00	885.6	75.5
P3.000	55.12	4.41	60.430	0.019	0.0	0.0	0.0	0.88	35.1	2.9
P3.001	49.42	5.92	60.330	0.176	0.0	0.0	0.0	0.99	39.2	23.5
P3.002	48.97	6.05	59.820	0.176	0.0	0.0	0.0	0.94	37.3	23.5
P1.006	56.75	4.05	58.280	0.000	2.1	0.0	0.0	1.04	41.4	2.1

Manhole Schedules for ROADS

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdrop (mm)
S7	65.520	3.020	Open Manhole	1200	P1.000	62.500	225				
S6	64.440	2.130	Open Manhole	1200	P1.001	62.310	225	P1.000	62.310	225	
S5.2	61.100	1.430	Open Manhole	1200	P2.000	59.670	300				
S5.1	62.000	2.660	Open Manhole	1200	P2.001	59.340	300	P2.000	59.340	300	
S5	64.000	5.090	Open Manhole	1200	P1.002	58.910	300	P1.001	61.990	225	3005
								P2.001	58.910	300	
S4	63.380	4.650	Open Manhole	1200	P1.003	58.730	300	P1.002	58.730	300	
S3	61.800	3.220	Open Manhole	1200	P1.004	58.580	300	P1.003	58.580	300	
S2(ATTN)	61.000	2.570	Open Manhole	1800	P1.005	58.430	750	P1.004	58.430	300	
S1.2.1	62.250	1.820	Open Manhole	1200	P3.000	60.430	225				
S1.2	62.250	1.920	Open Manhole	1200	P3.001	60.330	225	P3.000	60.330	225	
S1.1	61.250	1.430	Open Manhole	1200	P3.002	59.820	225	P3.001	59.820	225	
S1(HB)	61.250	2.970	Open Manhole	1800	P1.006	58.280	225	P1.005	58.280	750	
								P3.002	59.780	225	1500
S	61.250	2.990	Open Manhole	0		OUTFALL		P1.006	58.260	225	

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
S7	709844.396	730285.814	709844.396	730285.814	Required	
S6	709828.648	730319.498	709828.648	730319.498	Required	
S5.2	709937.655	730442.796	709937.655	730442.796	Required	
S5.1	709879.316	730414.126	709879.316	730414.126	Required	
S5	709801.852	730377.088	709801.852	730377.088	Required	
S4	709786.557	730408.055	709786.557	730408.055	Required	
S3	709774.201	730433.862	709774.201	730433.862	Required	
S2(ATTN)	709758.062	730459.262	709758.062	730459.262	Required	
S1.2.1	709634.418	730444.737	709634.418	730444.737	Required	
S1.2	709656.194	730445.274	709656.194	730445.274	Required	

Manhole Schedules for ROADS

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
S1.1	709737.495	730481.664	709737.495	730481.664	Required	
S1(HB)	709744.458	730485.024	709744.458	730485.024	Required	
S	709743.127	730487.861			No Entry	

PIPELINE SCHEDULES for ROADS

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
P1.000	o	225	S7	65.520	62.500	2.795	Open Manhole	1200
P1.001	o	225	S6	64.440	62.310	1.905	Open Manhole	1200
P2.000	o	300	S5.2	61.100	59.670	1.130	Open Manhole	1200
P2.001	o	300	S5.1	62.000	59.340	2.360	Open Manhole	1200
P1.002	o	300	S5	64.000	58.910	4.790	Open Manhole	1200
P1.003	o	300	S4	63.380	58.730	4.350	Open Manhole	1200
P1.004	o	300	S3	61.800	58.580	2.920	Open Manhole	1200
P1.005	o	750	S2(ATTN)	61.000	58.430	1.820	Open Manhole	1800
P3.000	o	225	S1.2.1	62.250	60.430	1.595	Open Manhole	1200
P3.001	o	225	S1.2	62.250	60.330	1.695	Open Manhole	1200
P3.002	o	225	S1.1	61.250	59.820	1.205	Open Manhole	1200
P1.006	o	225	S1(HB)	61.250	58.280	2.745	Open Manhole	1800

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
P1.000	37.183	195.7	S6	64.440	62.310	1.905	Open Manhole	1200
P1.001	63.519	198.5	S5	64.000	61.990	1.785	Open Manhole	1200
P2.000	65.003	197.0	S5.1	62.000	59.340	2.360	Open Manhole	1200
P2.001	85.863	199.7	S5	64.000	58.910	4.790	Open Manhole	1200
P1.002	34.538	191.9	S4	63.380	58.730	4.350	Open Manhole	1200
P1.003	28.612	190.7	S3	61.800	58.580	2.920	Open Manhole	1200
P1.004	30.094	200.6	S2(ATTN)	61.000	58.430	2.270	Open Manhole	1800
P1.005	29.133	194.2	S1(HB)	61.250	58.280	2.220	Open Manhole	1800
P3.000	21.782	217.8	S1.2	62.250	60.330	1.695	Open Manhole	1200
P3.001	89.074	174.7	S1.1	61.250	59.820	1.205	Open Manhole	1200
P3.002	7.731	193.3	S1(HB)	61.250	59.780	1.245	Open Manhole	1800
P1.006	3.133	156.7	S	61.250	58.260	2.765	Open Manhole	0

Free Flowing Outfall Details for ROADS

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
P1.006	S	61.250	58.260	0.000	0	0

Simulation Criteria for ROADS

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 1 Number of Storage Structures 1 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	2	Cv (Summer)	0.750
Region	Scotland and Ireland	Cv (Winter)	0.840
M5-60 (mm)	17.500	Storm Duration (mins)	30
Ratio R	0.276		

Online Controls for ROADS

Hydro-Brake® Optimum Manhole: S1(HB), DS/PN: P1.006, Volume (m³): 19.9

Unit Reference	MD-SHE-0061-2100-1670-2100
Design Head (m)	1.670
Design Flow (l/s)	2.1
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	61
Invert Level (m)	58.280
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.670	2.1	Kick-Flo®	0.546	1.3
Flush-Flo™	0.270	1.6	Mean Flow over Head Range	-	1.6

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	1.3	0.800	1.5	2.000	2.3	4.000	3.1	7.000	4.1
0.200	1.5	1.000	1.7	2.200	2.4	4.500	3.3	7.500	4.2
0.300	1.6	1.200	1.8	2.400	2.5	5.000	3.5	8.000	4.3
0.400	1.5	1.400	1.9	2.600	2.6	5.500	3.6	8.500	4.5
0.500	1.4	1.600	2.1	3.000	2.7	6.000	3.8	9.000	4.6
0.600	1.3	1.800	2.2	3.500	3.0	6.500	3.9	9.500	4.7

Storage Structures for ROADS

Tank or Pond Manhole: S2(ATTN), DS/PN: P1.005

Invert Level (m) 58.430

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	426.0	1.670	426.0	1.671	0.0

Summary of Critical Results by Maximum Level (Rank 1) for ROADS

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 1 Number of Storage Structures 1 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model		FSR M5-60 (mm) 17.500 Cv (Summer)	0.750
Region	Scotland and Ireland	Ratio R 0.276 Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	OFF
DVD Status	ON
Inertia Status	ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	100
Climate Change (%)	20

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
P1.000	S7	15 Winter	100	+20%					62.677	-0.048
P1.001	S6	15 Winter	100	+20%	100/15 Summer				62.616	0.081
P2.000	S5.2	15 Winter	100	+20%	100/15 Summer				60.789	0.819
P2.001	S5.1	15 Winter	100	+20%	100/15 Summer				60.702	1.062
P1.002	S5	15 Winter	100	+20%	100/15 Summer				60.409	1.199
P1.003	S4	15 Winter	100	+20%	100/15 Summer				59.889	0.859
P1.004	S3	2880 Winter	100	+20%	100/15 Summer				59.818	0.938
P1.005	S2(ATTN)	2880 Winter	100	+20%	100/180 Winter				59.816	0.636
P3.000	S1.2.1	15 Winter	100	+20%	100/15 Summer				61.482	0.827
P3.001	S1.2	15 Winter	100	+20%	100/15 Summer				61.469	0.914
P3.002	S1.1	15 Winter	100	+20%	100/15 Summer				60.158	0.113
P1.006	S1(HB)	2880 Winter	100	+20%	100/15 Summer				59.894	1.389

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
P1.000	S7	0.000	0.61			21.4	OK	
P1.001	S6	0.000	1.13			40.1	SURCHARGED	
P2.000	S5.2	0.000	0.60			45.4	SURCHARGED	
P2.001	S5.1	0.000	0.82			62.4	SURCHARGED	
P1.002	S5	0.000	1.67			123.1	SURCHARGED	
P1.003	S4	0.000	1.87			135.5	SURCHARGED	
P1.004	S3	0.000	0.12			8.6	SURCHARGED	
P1.005	S2(ATTN)	0.000	0.02			12.4	SURCHARGED	
P3.000	S1.2.1	0.000	0.30			9.7	SURCHARGED	
P3.001	S1.2	0.000	1.50			57.4	SURCHARGED	
P3.002	S1.1	0.000	1.92			57.1	SURCHARGED	
P1.006	S1(HB)	0.000	0.07			2.0	SURCHARGED	