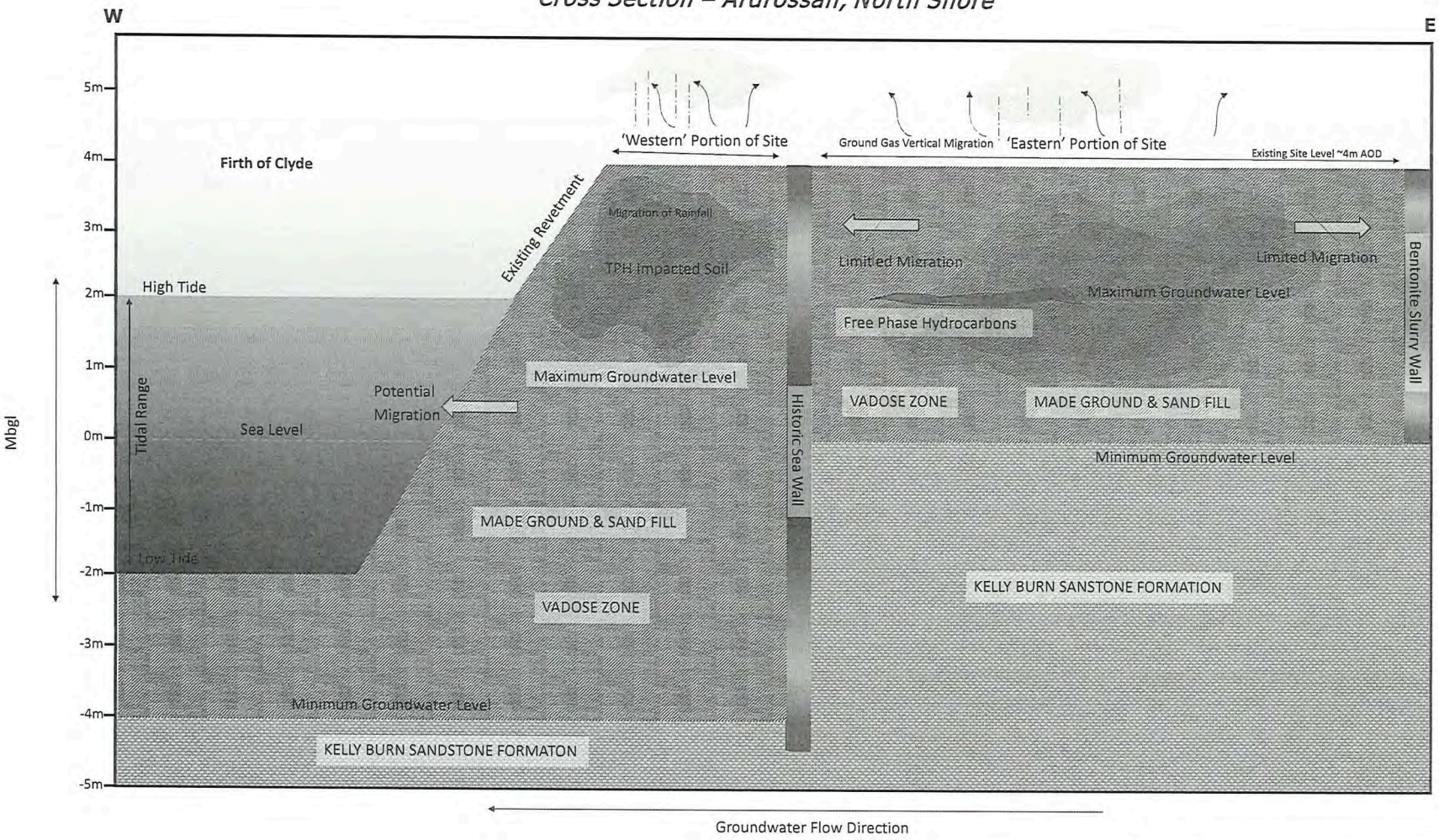
Appendix B Sanctus Figures

Cross Section – Ardrossan, North Shore



Key	Description
	Made Ground & Sandfill
	Kelly Burn Sandstone Formation
	Dissolved Phase TPH
	Groundwater Level

sanctus

Sanctus House, 1 Olympus Park Business Centre,
Quedgeley, Glos, GL2 4DH
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Notes:
DO NOT SCALE Conceptual Site Models are supporting Figures and are for illustrative purposes only

Figure Permissions: N/A

Site Address: Ardrossan North Shore, Ardrossan, North Ayrshire

Rev.	Description	Date
A	First Issue	21/08/23

Project Name: Ardrossan, Northshore

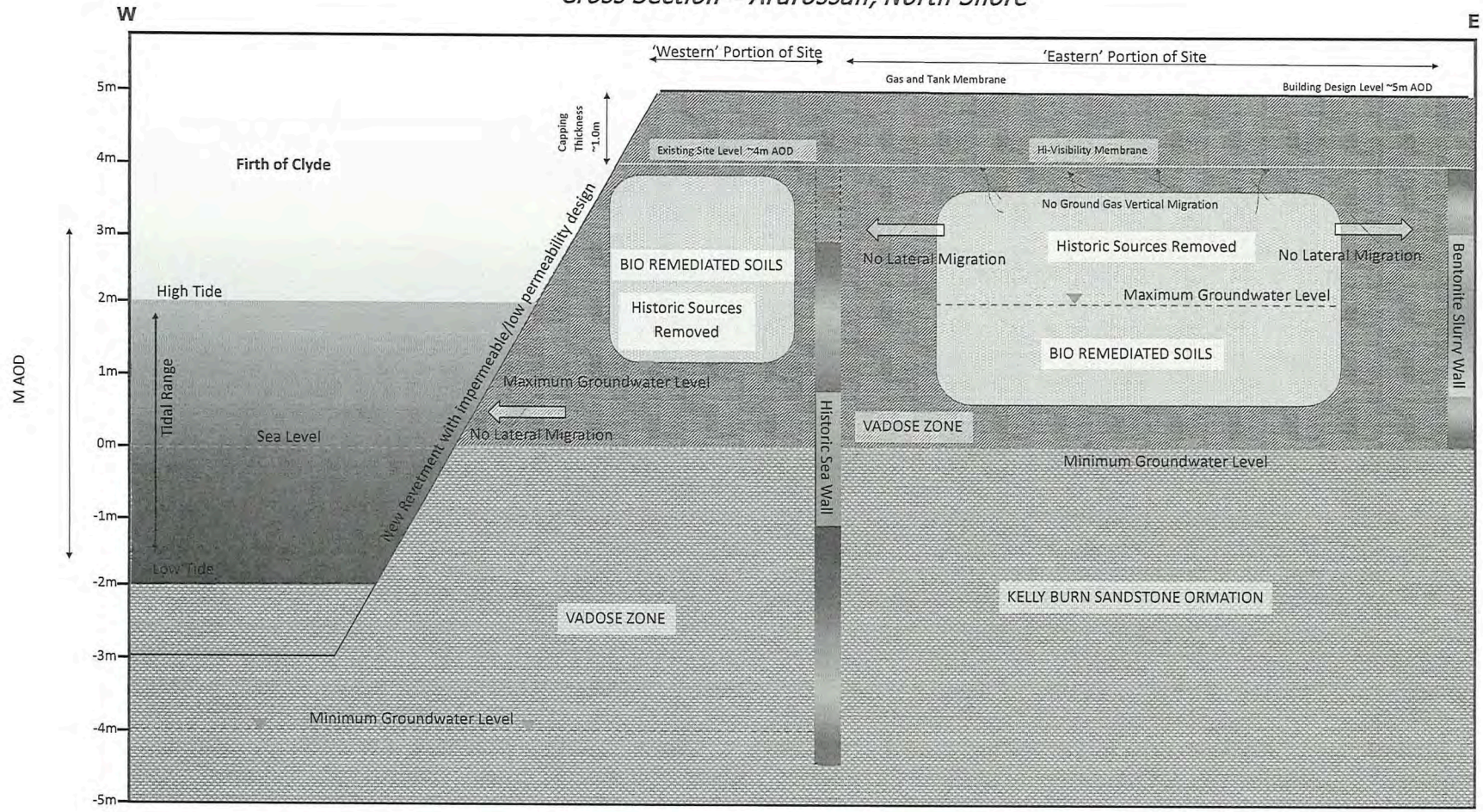
Client: North Ayrshire Council

Figure Title: Pre Existing Conceptual Site Model (Based upon EnviroCentre supplied reports and analysis)

Contract No: S2340	Figure No: 1	Do Not Scale

Drawn [redacted]

Cross Section – Ardrossan, North Shore



Key	Description
	Made Ground & Sandfill
	Bio Remediated Soils
	Kelly Burn Sandstone Formation
	Groundwater Level

sanctus

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Notes:
DO NOT SCALE Conceptual Site Models are supporting Figures and are for illustrative purposes only

Figure Permissions: N/A

Site Address: Ardrossan North Shore, Ardrossan, North Ayrshire

Rev.	Description	Date
A	First Issue	21/08/23

Project Name: Ardrossan, Northshore

Client: North Ayrshire Council

Figure Title: Proposed Conceptual Site Model

Contract No: S2340	Figure No: 2	Do Not Scale
[redacted]		

Appendix C Site Specific Criteria

Table C-1: Sanctus Remedial Criteria

Determinant	Units	Remedial Target Criteria: Remediation (all verification samples)
Petroleum Hydrocarbons**		
Ali C5-6	mg/kg	78
Ali C6-8	mg/kg	230
Ali C8-10	mg/kg	65
AliC10-12	mg/kg	330
Ali C12-16	mg/kg	1000
Ali C16-21	mg/kg	1000
Ali C21-35	mg/kg	1000
Aro C5-7	mg/kg	140
Aro C7-8	mg/kg	290
Aro C8-10*	mg/kg	7.34
Aro C10-12*	mg/kg	48.3
Aro C12-16*	mg/kg	173.47
Aro C16-21*	mg/kg	540
Aro C21-35	mg/kg	<1,000
Aro C5-35*	mg/kg	<1,000
Total Petroleum Hydrocarbons*	mg/kg	Total of all TPH Fractions <1000mg/kg
Speciated PAHs		
Naphthalene*	mg/kg	3.7
Acenaphthylene*	mg/kg	109.9
Acenaphthene	mg/kg	141
Fluorene	mg/kg	400
Phenanthrene	mg/kg	220
Anthracene	mg/kg	<1,000
Fluoranthene	mg/kg	560
Pyrene	mg/kg	<1,000
Benzo(a)anthracene	mg/kg	11
Chrysene	mg/kg	22
Benzo(b)fluoranthene*	mg/kg	20.4
Benzo(k)fluoranthene	mg/kg	93
Benzo(a)pyrene*	mg/kg	25.1
Indeno (1,2,3-c-d)pyrene	mg/kg	36
Dibenz(a,h)anthracene*	mg/kg	48.6
Benzo(g,h,i)perylene	mg/kg	340
Total PAHs	Mg/kg	Total of all PAH Fractions <1000mg/kg
Monoaromatics & Oxygenates		
Benzene	mg/kg	0.170
Toluene	mg/kg	290
Ethylbenzene	mg/kg	110
o-xylene	mg/kg	140
Asbestos		

Determinant	Units	Remedial Target Criteria: Remediation (all verification samples)
Asbestos (Non-Visible)	N/A	<0.01%

Note:
***Denotes values calculated from Sanctus Site Specific Modelling and assumptions detailed within Section 8.0.**
As per Table 13.4

Appendix D Tidal Data

JANUARY 2024 ARDROSSAN

HEIGHTS ABOVE CHART DATUM

Date		High Water				Low Water			
		Morning		Afternoon		Morning		Afternoon	
		Time	m	Time	m	Time	m	Time	m
1	M	03 26	2.8	15 13	3.3	08 48	0.9	21 04	0.7
2	TU	04 08	2.7	15 53	3.2	09 31	1.0	21 50	0.8
3	W	04 53	2.7	16 37	3.0	10 16	1.1	22 39	0.9
4	TH ☾	05 41	2.6	17 26	2.9	11 07	1.2	23 34	1.0
5	F	06 32	2.5	18 20	2.8			12 05	1.3
6	SA	07 33	2.5	19 20	2.7	00 34	1.0	13 09	1.3
7	**SU**	08 40	2.6	20 26	2.7	01 35	1.0	14 15	1.2
8	M	09 41	2.7	21 31	2.8	02 33	1.0	15 14	1.0
9	TU	10 31	2.9	22 30	2.9	03 26	0.9	16 04	0.8
10	W	11 15	3.0	23 23	3.0	04 15	0.8	16 50	0.6
11	TH ●	11 57	3.2			05 01	0.7	17 35	0.4
12	F	00 14	3.0	12 38	3.3	05 48	0.6	18 20	0.3
13	SA	01 06	3.1	13 22	3.4	06 34	0.5	19 06	0.2
14	**SU**	01 55	3.1	14 06	3.5	07 22	0.5	19 54	0.2
15	M	02 43	3.1	14 53	3.5	08 10	0.5	20 43	0.2
16	TU	03 32	3.1	15 40	3.5	08 59	0.5	21 35	0.2
17	W	04 18	3.0	16 29	3.3	09 50	0.6	22 31	0.4
18	TH ☽	05 05	2.9	17 22	3.2	10 44	0.8	23 32	0.5
19	F	05 54	2.8	18 20	3.0	11 46	0.9		
20	SA	06 49	2.7	19 30	2.8	00 38	0.7	12 59	1.0
21	**SU**	08 03	2.6	20 57	2.7	01 46	0.8	14 16	1.0
22	M	09 23	2.7	22 12	2.7	02 50	0.8	15 22	0.9
23	TU	10 26	2.8	23 09	2.8	03 47	0.8	16 17	0.7
24	W	11 13	3.0	23 58	2.9	04 36	0.7	17 02	0.6
25	TH ○	11 55	3.1			05 21	0.7	17 42	0.5
26	F	00 42	2.9	12 33	3.2	06 01	0.6	18 17	0.5
27	SA	01 21	2.9	13 08	3.3	06 37	0.6	18 50	0.5
28	**SU**	01 55	2.8	13 42	3.3	07 10	0.6	19 22	0.5
29	M	02 27	2.8	14 16	3.3	07 43	0.6	19 55	0.5
30	TU	03 01	2.8	14 50	3.3	08 17	0.7	20 29	0.6
31	W	03 36	2.8	15 26	3.2	08 53	0.7	21 05	0.6

Time Zone UT(GMT)

FEBRUARY 2024 ARDROSSAN

HEIGHTS ABOVE CHART DATUM

Date		High Water				Low Water			
		Morning		Afternoon		Morning		Afternoon	
		Time	m	Time	m	Time	m	Time	m
1 TH		04 11	2.8	16 04	3.1	09 31	0.8	21 45	0.7
2 F	☾	04 47	2.7	16 46	3.0	10 14	0.9	22 31	0.8
3 SA		05 28	2.6	17 34	2.8	11 05	1.1	23 26	1.0
4 **SU**		06 17	2.5	18 30	2.6			12 07	1.2
5 M		07 27	2.4	19 41	2.5	00 30	1.1	13 21	1.2
6 TU		08 58	2.5	21 03	2.6	01 45	1.1	14 41	1.0
7 W		10 07	2.7	22 18	2.7	02 59	1.0	15 46	0.8
8 TH		10 58	2.9	23 16	2.9	03 59	0.8	16 36	0.4
9 F	●	11 41	3.1			04 49	0.6	17 21	0.2
10 SA		00 07	3.0	12 26	3.3	05 35	0.4	18 05	0.0
11 **SU**		00 58	3.0	13 10	3.4	06 19	0.3	18 48	-0.1
12 M		01 45	3.1	13 55	3.5	07 04	0.3	19 33	-0.1
13 TU		02 28	3.1	14 39	3.5	07 48	0.2	20 18	-0.0
14 W		03 10	3.1	15 24	3.5	08 34	0.3	21 06	0.1
15 TH		03 49	3.1	16 08	3.4	09 20	0.4	21 56	0.3
16 F	☽	04 28	3.0	16 53	3.1	10 10	0.5	22 54	0.6
17 SA		05 09	2.8	17 41	2.8	11 07	0.7		
18 **SU**		05 56	2.6	18 41	2.5	00 03	0.8	12 26	1.0
19 M		06 54	2.5	20 57	2.4	01 23	1.0	14 00	1.0
20 TU		09 02	2.5	22 14	2.5	02 35	1.0	15 11	0.9
21 W		10 14	2.7	23 05	2.7	03 34	0.9	16 05	0.7
22 TH		11 02	2.9	23 48	2.8	04 24	0.7	16 49	0.5
23 F		11 42	3.1			05 07	0.6	17 26	0.4
24 SA	○	00 27	2.8	12 19	3.1	05 44	0.5	17 58	0.4
25 **SU**		01 02	2.8	12 52	3.2	06 17	0.5	18 27	0.4
26 M		01 33	2.8	13 22	3.2	06 46	0.5	18 54	0.4
27 TU		02 01	2.8	13 52	3.2	07 13	0.5	19 22	0.4
28 W		02 30	2.9	14 24	3.2	07 43	0.5	19 52	0.4
29 TH		03 00	2.9	14 58	3.2	08 15	0.5	20 25	0.4

Time Zone UT(GMT)

MARCH 2024 ARDROSSAN

HEIGHTS ABOVE CHART DATUM

Date			High Water				Low Water			
			Morning		Afternoon		Morning		Afternoon	
			Time	m	Time	m	Time	m	Time	m
1	F		03 30	2.9	15 34	3.1	08 52	0.6	21 04	0.5
2	SA		04 01	2.8	16 13	3.0	09 34	0.7	21 49	0.7
3	**SU**	☾	04 34	2.7	16 57	2.8	10 25	0.9	22 43	0.9
4	M		05 16	2.5	17 52	2.5	11 26	1.0	23 49	1.1
5	TU		06 16	2.3	19 05	2.4			12 44	1.1
6	W		08 11	2.3	20 47	2.4	01 09	1.2	14 17	0.9
7	TH		09 45	2.6	22 12	2.7	02 40	1.1	15 27	0.6
8	F		10 37	2.9	23 06	2.9	03 44	0.8	16 18	0.2
9	SA		11 22	3.1	23 54	3.0	04 33	0.5	17 01	-0.0
10	**SU**	●			12 06	3.3	05 17	0.3	17 43	-0.2
11	M		00 39	3.1	12 52	3.4	05 59	0.2	18 25	-0.2
12	TU		01 23	3.1	13 37	3.5	06 41	0.1	19 07	-0.2
13	W		02 03	3.2	14 21	3.5	07 23	0.1	19 50	-0.1
14	TH		02 40	3.2	15 03	3.5	08 06	0.1	20 35	0.1
15	F		03 17	3.2	15 44	3.3	08 50	0.3	21 23	0.4
16	SA		03 53	3.1	16 26	3.0	09 37	0.5	22 18	0.7
17	**SU**	☽	04 33	2.9	17 13	2.7	10 33	0.7	23 31	1.0
18	M		05 18	2.7	18 10	2.4			12 02	1.0
19	TU		06 15	2.5	20 58	2.3	01 00	1.2	13 42	1.0
20	W		08 35	2.4	22 01	2.5	02 13	1.2	14 50	0.9
21	TH		09 52	2.7	22 45	2.7	03 13	1.0	15 42	0.7
22	F		10 38	2.9	23 23	2.8	04 02	0.8	16 24	0.5
23	SA		11 17	3.0	23 58	2.9	04 43	0.6	16 59	0.4
24	**SU**		11 52	3.1			05 19	0.5	17 30	0.4
25	M	○	00 31	2.9	12 25	3.1	05 49	0.5	17 57	0.5
26	TU		01 02	2.9	12 54	3.1	06 16	0.5	18 22	0.5
27	W		01 31	3.0	13 23	3.1	06 41	0.5	18 48	0.5
28	TH		01 58	3.0	13 56	3.2	07 10	0.5	19 18	0.5
29	F		02 25	3.1	14 31	3.2	07 44	0.5	19 54	0.5
30	SA		02 54	3.1	15 08	3.1	08 22	0.5	20 35	0.6
31	**SU**		03 25	3.0	15 47	3.0	09 07	0.7	21 23	0.8

Time Zone UT(GMT)

APRIL 2024 ARDROSSAN

HEIGHTS ABOVE CHART DATUM

Date			High Water				Low Water			
			Morning		Afternoon		Morning		Afternoon	
			Time	m	Time	m	Time	m	Time	m
1	M		03 57	2.9	16 31	2.8	10 00	0.8	22 19	1.0
2	TU	☾	04 39	2.7	17 28	2.6	11 05	1.0	23 27	1.2
3	W		05 38	2.5	18 46	2.5			12 26	1.0
4	TH		07 35	2.5	20 41	2.5	00 49	1.3	13 55	0.8
5	F		09 16	2.7	21 56	2.7	02 19	1.1	15 02	0.5
6	SA		10 11	3.0	22 46	2.9	03 23	0.8	15 53	0.2
7	**SU**		10 58	3.2	23 31	3.1	04 12	0.5	16 36	-0.1
8	M	●	11 43	3.4			04 55	0.3	17 18	-0.2
9	TU		00 12	3.2	12 29	3.4	05 37	0.2	18 00	-0.1
10	W		00 55	3.2	13 15	3.5	06 18	0.1	18 41	-0.0
11	TH		01 33	3.3	13 59	3.4	06 58	0.1	19 24	0.1
12	F		02 11	3.3	14 41	3.3	07 40	0.2	20 09	0.3
13	SA		02 47	3.3	15 24	3.1	08 23	0.3	20 57	0.6
14	**SU**		03 25	3.2	16 07	2.9	09 11	0.5	21 51	0.9
15	M	☽	04 05	3.0	16 55	2.6	10 09	0.7	23 01	1.1
16	TU		04 50	2.8	17 59	2.3	11 37	0.9		
17	W		05 50	2.6	20 25	2.3	00 25	1.3	13 09	1.0
18	TH		07 33	2.5	21 26	2.5	01 38	1.3	14 14	0.8
19	F		09 12	2.6	22 09	2.6	02 39	1.1	15 06	0.7
20	SA		10 01	2.8	22 46	2.8	03 29	0.9	15 47	0.6
21	**SU**		10 41	3.0	23 21	2.9	04 11	0.7	16 23	0.5
22	M		11 16	3.0	23 54	2.9	04 46	0.6	16 54	0.5
23	TU	○	11 48	3.0			05 18	0.5	17 23	0.5
24	W		00 27	3.0	12 19	3.0	05 45	0.5	17 49	0.5
25	TH		00 57	3.0	12 52	3.1	06 13	0.5	18 18	0.5
26	F		01 25	3.1	13 28	3.1	06 44	0.5	18 53	0.5
27	SA		01 54	3.1	14 08	3.1	07 21	0.5	19 34	0.6
28	**SU**		02 26	3.2	14 48	3.1	08 03	0.5	20 19	0.7
29	M		03 00	3.1	15 31	3.0	08 51	0.6	21 11	0.8
30	TU		03 37	3.0	16 20	2.8	09 48	0.7	22 09	1.0

Time Zone UT(GMT)

MAY 2024 ARDROSSAN

HEIGHTS ABOVE CHART DATUM

Date			High Water				Low Water			
			Morning		Afternoon		Morning		Afternoon	
			Time	m	Time	m	Time	m	Time	m
1	W	☾	04 22	2.8	17 21	2.6	10 56	0.8	23 16	1.1
2	TH		05 27	2.6	18 39	2.5			12 14	0.7
3	F		07 11	2.6	20 16	2.6	00 32	1.2	13 29	0.6
4	SA		08 42	2.8	21 25	2.8	01 50	1.0	14 32	0.3
5	**SU**		09 41	3.0	22 16	2.9	02 54	0.8	15 23	0.1
6	M		10 30	3.2	23 01	3.0	03 46	0.5	16 09	0.0
7	TU		11 17	3.3	23 43	3.1	04 32	0.3	16 53	-0.0
8	W	●			12 04	3.3	05 15	0.2	17 36	0.1
9	TH		00 25	3.2	12 52	3.3	05 57	0.2	18 19	0.2
10	F		01 05	3.3	13 39	3.2	06 38	0.2	19 03	0.4
11	SA		01 43	3.3	14 23	3.1	07 19	0.2	19 49	0.5
12	**SU**		02 22	3.3	15 07	2.9	08 03	0.3	20 38	0.7
13	M		03 00	3.2	15 53	2.7	08 52	0.5	21 30	0.9
14	TU		03 42	3.1	16 45	2.5	09 49	0.7	22 30	1.1
15	W	☽	04 27	2.9	17 50	2.4	10 59	0.8	23 37	1.2
16	TH		05 24	2.7	19 08	2.3			12 17	0.9
17	F		06 38	2.6	20 22	2.4	00 46	1.2	13 22	0.8
18	SA		08 06	2.6	21 15	2.6	01 50	1.1	14 16	0.7
19	**SU**		09 07	2.7	21 58	2.7	02 45	1.0	15 01	0.6
20	M		09 53	2.8	22 38	2.8	03 31	0.8	15 40	0.6
21	TU		10 31	2.9	23 16	2.9	04 10	0.7	16 16	0.6
22	W		11 07	2.9	23 52	3.0	04 45	0.6	16 48	0.6
23	TH	○	11 43	3.0			05 17	0.6	17 21	0.6
24	F		00 26	3.1	12 23	3.0	05 50	0.5	17 56	0.6
25	SA		00 58	3.1	13 06	3.0	06 27	0.5	18 37	0.6
26	**SU**		01 31	3.2	13 49	3.0	07 07	0.5	19 22	0.6
27	M		02 06	3.2	14 34	3.0	07 53	0.5	20 12	0.7
28	TU		02 46	3.2	15 23	2.9	08 44	0.5	21 05	0.8
29	W		03 28	3.1	16 16	2.8	09 42	0.5	22 02	0.9
30	TH	☾	04 18	3.0	17 17	2.7	10 46	0.5	23 03	0.9
31	F		05 23	2.9	18 25	2.7	11 54	0.5		

Time Zone UT(GMT)

JUNE 2024 ARDROSSAN

HEIGHTS ABOVE CHART DATUM

Date			High Water				Low Water			
			Morning		Afternoon		Morning		Afternoon	
			Time	m	Time	m	Time	m	Time	m
1	SA		06 45	2.8	19 38	2.7	00 08	1.0	12 59	0.4
2	**SU**		08 05	2.9	20 45	2.8	01 16	0.9	13 59	0.3
3	M		09 09	3.0	21 41	2.9	02 22	0.8	14 54	0.3
4	TU		10 04	3.1	22 31	3.0	03 20	0.7	15 44	0.2
5	W		10 56	3.2	23 17	3.1	04 11	0.5	16 32	0.3
6	TH	●	11 46	3.2			04 58	0.4	17 17	0.4
7	F		00 00	3.2	12 36	3.1	05 42	0.3	18 03	0.5
8	SA		00 42	3.3	13 24	3.0	06 24	0.3	18 48	0.6
9	**SU**		01 22	3.3	14 11	2.9	07 05	0.4	19 34	0.7
10	M		02 01	3.3	14 56	2.8	07 48	0.4	20 20	0.8
11	TU		02 41	3.3	15 41	2.7	08 34	0.5	21 07	0.9
12	W		03 22	3.2	16 29	2.6	09 23	0.6	21 56	1.0
13	TH		04 05	3.1	17 21	2.6	10 18	0.8	22 47	1.1
14	F	☽	04 53	2.9	18 14	2.5	11 17	0.8	23 43	1.1
15	SA		05 50	2.8	19 08	2.6			12 18	0.9
16	**SU**		06 49	2.7	20 06	2.6	00 43	1.2	13 15	0.9
17	M		07 52	2.7	21 02	2.7	01 45	1.2	14 08	0.9
18	TU		08 51	2.8	21 54	2.8	02 42	1.1	14 55	0.8
19	W		09 44	2.8	22 39	2.9	03 31	1.0	15 38	0.8
20	TH		10 30	2.9	23 21	3.0	04 15	0.8	16 19	0.8
21	F		11 15	3.0	23 58	3.1	04 55	0.7	16 59	0.8
22	SA	○			12 01	3.0	05 35	0.6	17 41	0.7
23	**SU**		00 35	3.2	12 48	3.0	06 15	0.5	18 26	0.7
24	M		01 14	3.3	13 38	3.1	06 59	0.4	19 13	0.7
25	TU		01 54	3.4	14 27	3.1	07 45	0.4	20 03	0.7
26	W		02 36	3.4	15 17	3.0	08 34	0.4	20 53	0.7
27	TH		03 22	3.4	16 09	3.0	09 28	0.4	21 46	0.8
28	F	☾	04 11	3.3	17 01	3.0	10 25	0.4	22 40	0.8
29	SA		05 07	3.2	17 56	2.9	11 26	0.5	23 39	0.9
30	**SU**		06 13	3.1	18 54	2.9			12 28	0.5

Time Zone UT(GMT)

JULY 2024 ARDROSSAN

HEIGHTS ABOVE CHART DATUM

Date		High Water				Low Water			
		Morning		Afternoon		Morning		Afternoon	
		Time	m	Time	m	Time	m	Time	m
1	M	07 26	3.0	19 58	2.8	00 43	1.0	13 30	0.6
2	TU	08 39	3.0	21 05	2.9	01 52	1.0	14 30	0.6
3	W	09 46	3.0	22 06	3.0	02 59	0.9	15 26	0.6
4	TH	10 45	3.0	22 59	3.1	03 58	0.8	16 18	0.7
5	F ●	11 39	3.0	23 45	3.2	04 48	0.6	17 07	0.7
6	SA			12 31	3.0	05 34	0.5	17 53	0.7
7	**SU**	00 28	3.3	13 19	3.0	06 15	0.5	18 37	0.7
8	M	01 08	3.3	14 03	2.9	06 53	0.5	19 18	0.8
9	TU	01 46	3.4	14 42	2.9	07 31	0.5	19 58	0.8
10	W	02 23	3.4	15 20	2.8	08 10	0.6	20 38	0.8
11	TH	03 00	3.3	16 00	2.8	08 51	0.6	21 18	0.9
12	F	03 38	3.2	16 41	2.8	09 34	0.7	22 01	1.0
13	SA ☽	04 18	3.1	17 24	2.8	10 21	0.8	22 47	1.1
14	**SU**	05 03	3.0	18 09	2.7	11 14	0.9	23 38	1.2
15	M	05 54	2.9	18 59	2.7			12 10	1.0
16	TU	06 53	2.8	19 58	2.7	00 38	1.3	13 09	1.1
17	W	07 57	2.7	21 06	2.7	01 46	1.3	14 09	1.1
18	TH	09 03	2.8	22 06	2.9	02 54	1.2	15 05	1.0
19	F	10 04	2.8	22 55	3.0	03 51	1.0	15 56	0.9
20	SA	10 58	2.9	23 37	3.2	04 38	0.8	16 42	0.8
21	**SU** ○	11 49	3.0			05 21	0.6	17 27	0.8
22	M	00 18	3.3	12 39	3.1	06 03	0.4	18 13	0.7
23	TU	01 00	3.4	13 28	3.1	06 45	0.3	18 58	0.6
24	W	01 42	3.5	14 17	3.1	07 29	0.2	19 45	0.6
25	TH	02 26	3.6	15 04	3.1	08 15	0.2	20 33	0.6
26	F	03 10	3.6	15 49	3.1	09 04	0.2	21 21	0.6
27	SA	03 56	3.5	16 33	3.1	09 56	0.4	22 12	0.7
28	**SU** ☾	04 45	3.3	17 19	3.0	10 54	0.5	23 07	0.8
29	M	05 39	3.1	18 07	2.9	11 57	0.7		
30	TU	06 43	2.9	19 04	2.8	00 11	1.0	13 06	0.8
31	W	08 14	2.7	20 30	2.8	01 30	1.1	14 14	0.9

Time Zone UT(GMT)

HEIGHTS ABOVE CHART DATUM

Date			High Water				Low Water			
			Morning		Afternoon		Morning		Afternoon	
			Time	m	Time	m	Time	m	Time	m
1	TH		09 47	2.8	21 55	2.9	02 49	1.1	15 16	0.9
2	F		10 49	2.9	22 52	3.0	03 52	0.9	16 11	0.9
3	SA		11 40	2.9	23 38	3.2	04 43	0.7	16 59	0.8
4	**SU**	●			12 28	3.0	05 26	0.6	17 42	0.7
5	M		00 19	3.3	13 09	2.9	06 03	0.5	18 21	0.7
6	TU		00 56	3.3	13 46	2.9	06 36	0.5	18 56	0.7
7	W		01 29	3.4	14 18	2.9	07 08	0.5	19 29	0.7
8	TH		02 01	3.4	14 49	2.9	07 40	0.6	20 03	0.7
9	F		02 34	3.4	15 22	2.9	08 13	0.6	20 38	0.8
10	SA		03 08	3.3	15 56	2.9	08 48	0.7	21 15	0.8
11	**SU**		03 44	3.2	16 32	2.9	09 26	0.8	21 56	0.9
12	M	☽	04 24	3.1	17 13	2.8	10 10	0.9	22 43	1.1
13	TU		05 10	2.9	17 59	2.7	11 03	1.1	23 41	1.3
14	W		06 07	2.7	18 58	2.6			12 08	1.2
15	TH		07 16	2.6	20 16	2.6	00 54	1.3	13 23	1.3
16	F		08 35	2.6	21 38	2.7	02 22	1.2	14 39	1.2
17	SA		09 52	2.7	22 33	3.0	03 32	1.0	15 39	1.0
18	**SU**		10 51	2.9	23 17	3.2	04 21	0.6	16 27	0.8
19	M	○	11 40	3.0	23 59	3.3	05 03	0.4	17 11	0.6
20	TU				12 27	3.1	05 44	0.1	17 54	0.5
21	W		00 42	3.5	13 13	3.1	06 24	0.0	18 37	0.4
22	TH		01 26	3.6	13 57	3.1	07 06	-0.0	19 21	0.4
23	F		02 11	3.6	14 39	3.2	07 49	0.0	20 06	0.4
24	SA		02 54	3.6	15 19	3.2	08 35	0.2	20 52	0.4
25	**SU**		03 37	3.5	15 59	3.1	09 24	0.4	21 41	0.6
26	M	☾	04 20	3.3	16 41	3.0	10 20	0.6	22 35	0.8
27	TU		05 07	3.0	17 26	2.9	11 29	0.9	23 46	1.0
28	W		06 05	2.7	18 20	2.7			12 51	1.1
29	TH		08 25	2.4	19 59	2.6	01 22	1.1	14 05	1.1
30	F		09 54	2.6	21 48	2.8	02 43	1.0	15 07	1.0
31	SA		10 46	2.8	22 40	3.0	03 43	0.8	15 59	0.9

Time Zone UT(GMT)

SEPTEMBER 2024 — ARDROSSAN

HEIGHTS ABOVE CHART DATUM

Date			High Water				Low Water			
			Morning		Afternoon		Morning		Afternoon	
			Time	m	Time	m	Time	m	Time	m
1	**SU**		11 29	2.9	23 23	3.2	04 30	0.6	16 44	0.7
2	M				12 09	2.9	05 09	0.5	17 24	0.6
3	TU	●	00 00	3.3	12 45	2.9	05 43	0.5	17 59	0.6
4	W		00 35	3.3	13 16	2.9	06 12	0.5	18 29	0.6
5	TH		01 06	3.3	13 44	2.9	06 39	0.5	18 57	0.7
6	F		01 35	3.3	14 12	3.0	07 06	0.5	19 26	0.7
7	SA		02 05	3.3	14 42	3.0	07 35	0.6	19 58	0.7
8	**SU**		02 38	3.3	15 13	3.0	08 06	0.6	20 34	0.7
9	M		03 14	3.2	15 46	3.0	08 42	0.7	21 15	0.9
10	TU		03 51	3.1	16 22	2.8	09 24	0.9	22 02	1.0
11	W	☽	04 34	2.9	17 05	2.7	10 16	1.1	23 01	1.2
12	TH		05 30	2.6	18 06	2.6	11 23	1.3		
13	F		06 44	2.5	19 33	2.5	00 17	1.3	12 47	1.4
14	SA		08 18	2.5	21 10	2.7	01 58	1.2	14 18	1.3
15	**SU**		09 46	2.7	22 09	3.0	03 10	0.8	15 21	1.0
16	M		10 39	2.9	22 54	3.2	03 58	0.5	16 07	0.7
17	TU		11 23	3.1	23 37	3.4	04 39	0.2	16 50	0.5
18	W	○			12 06	3.2	05 19	0.0	17 31	0.4
19	TH		00 21	3.5	12 48	3.2	05 59	-0.1	18 13	0.3
20	F		01 06	3.6	13 29	3.3	06 39	-0.0	18 55	0.3
21	SA		01 50	3.6	14 10	3.3	07 22	0.1	19 38	0.3
22	**SU**		02 33	3.6	14 48	3.3	08 06	0.3	20 24	0.4
23	M		03 15	3.4	15 27	3.2	08 54	0.5	21 12	0.6
24	TU	☾	03 59	3.2	16 08	3.1	09 49	0.8	22 08	0.9
25	W		04 46	2.9	16 54	2.9	11 05	1.2	23 33	1.1
26	TH		05 45	2.5	17 51	2.7			12 36	1.3
27	F		08 37	2.4	19 43	2.6	01 13	1.1	13 48	1.3
28	SA		09 42	2.6	21 25	2.8	02 25	1.0	14 48	1.1
29	**SU**		10 27	2.8	22 15	3.1	03 21	0.8	15 38	0.9
30	M		11 04	3.0	22 56	3.2	04 05	0.6	16 21	0.8

Time Zone UT(GMT)

HEIGHTS ABOVE CHART DATUM

Date			High Water				Low Water			
			Morning		Afternoon		Morning		Afternoon	
			Time	m	Time	m	Time	m	Time	m
1	TU		11 39	3.0	23 32	3.3	04 42	0.5	16 59	0.7
2	W	●			12 10	3.1	05 14	0.5	17 31	0.6
3	TH		00 04	3.3	12 39	3.1	05 42	0.6	17 59	0.7
4	F		00 35	3.3	13 08	3.1	06 07	0.6	18 25	0.7
5	SA		01 05	3.3	13 37	3.1	06 33	0.6	18 53	0.7
6	**SU**		01 37	3.3	14 05	3.2	07 01	0.7	19 25	0.7
7	M		02 11	3.3	14 36	3.2	07 34	0.7	20 03	0.8
8	TU		02 48	3.2	15 08	3.1	08 12	0.8	20 45	0.9
9	W		03 27	3.1	15 44	3.0	08 57	1.0	21 36	1.1
10	TH	☽	04 10	2.9	16 26	2.8	09 51	1.2	22 38	1.2
11	F		05 04	2.7	17 26	2.7	10 58	1.4	23 56	1.2
12	SA		06 22	2.6	18 57	2.6			12 22	1.5
13	**SU**		08 05	2.6	20 35	2.8	01 30	1.1	13 51	1.3
14	M		09 26	2.8	21 38	3.1	02 38	0.8	14 54	1.1
15	TU		10 16	3.0	22 26	3.3	03 28	0.4	15 43	0.8
16	W		10 58	3.2	23 11	3.5	04 11	0.2	16 26	0.5
17	TH	○	11 39	3.3	23 56	3.6	04 52	0.0	17 08	0.4
18	F				12 20	3.3	05 33	0.0	17 50	0.3
19	SA		00 43	3.6	13 01	3.4	06 15	0.1	18 32	0.3
20	**SU**		01 29	3.6	13 41	3.4	06 58	0.3	19 15	0.4
21	M		02 15	3.5	14 20	3.4	07 43	0.5	20 00	0.5
22	TU		02 58	3.3	15 01	3.4	08 31	0.8	20 50	0.7
23	W		03 43	3.1	15 43	3.2	09 27	1.1	21 49	0.9
24	TH	☾	04 33	2.8	16 31	3.0	10 40	1.3	23 15	1.1
25	F		05 44	2.5	17 31	2.8			12 05	1.5
26	SA		08 06	2.5	19 06	2.7	00 45	1.1	13 16	1.4
27	**SU**		09 08	2.7	20 44	2.9	01 53	1.0	14 16	1.3
28	M		09 51	2.8	21 37	3.1	02 46	0.9	15 08	1.0
29	TU		10 28	3.0	22 20	3.2	03 31	0.7	15 51	0.9
30	W		11 01	3.1	22 56	3.2	04 08	0.7	16 29	0.8
31	TH		11 33	3.2	23 29	3.3	04 41	0.7	17 01	0.7

Time Zone UT(GMT)

NOVEMBER 2024 — ARDROSSAN

HEIGHTS ABOVE CHART DATUM

Date			High Water				Low Water			
			Morning		Afternoon		Morning		Afternoon	
			Time	m	Time	m	Time	m	Time	m
1	F	●			12 04	3.2	05 10	0.7	17 30	0.7
2	SA		00 01	3.3	12 36	3.3	05 38	0.7	17 58	0.8
3	**SU**		00 34	3.3	13 06	3.3	06 05	0.8	18 28	0.8
4	M		01 10	3.3	13 37	3.3	06 37	0.8	19 03	0.8
5	TU		01 48	3.3	14 09	3.3	07 13	0.8	19 43	0.8
6	W		02 28	3.2	14 43	3.3	07 55	0.9	20 28	0.9
7	TH		03 09	3.1	15 22	3.2	08 43	1.1	21 21	1.0
8	F		03 55	2.9	16 06	3.0	09 39	1.2	22 24	1.0
9	SA	☽	04 52	2.8	17 04	2.9	10 43	1.4	23 38	1.0
10	**SU**		06 05	2.7	18 26	2.8	11 58	1.4		
11	M		07 35	2.7	19 55	2.9	00 55	0.9	13 15	1.3
12	TU		08 50	2.9	21 03	3.1	02 01	0.7	14 21	1.1
13	W		09 44	3.0	21 56	3.3	02 55	0.4	15 15	0.8
14	TH		10 30	3.2	22 46	3.4	03 43	0.3	16 03	0.6
15	F	○	11 12	3.3	23 35	3.5	04 27	0.2	16 47	0.4
16	SA		11 54	3.4			05 11	0.2	17 30	0.4
17	**SU**		00 24	3.5	12 36	3.4	05 55	0.3	18 14	0.3
18	M		01 13	3.4	13 18	3.5	06 40	0.4	18 58	0.4
19	TU		02 00	3.3	13 59	3.5	07 27	0.6	19 44	0.5
20	W		02 47	3.1	14 41	3.4	08 16	0.8	20 34	0.6
21	TH		03 34	2.9	15 26	3.3	09 09	1.0	21 30	0.8
22	F		04 27	2.7	16 13	3.1	10 08	1.2	22 38	1.0
23	SA	☾	05 32	2.5	17 10	2.9	11 16	1.3	23 54	1.0
24	**SU**		06 51	2.5	18 20	2.8			12 27	1.4
25	M		08 03	2.5	19 36	2.8	01 03	1.0	13 32	1.3
26	TU		08 56	2.7	20 42	2.9	02 00	0.9	14 27	1.1
27	W		09 40	2.8	21 32	3.0	02 48	0.8	15 15	1.0
28	TH		10 21	3.0	22 15	3.0	03 29	0.8	15 56	0.9
29	F		10 59	3.1	22 54	3.0	04 06	0.7	16 33	0.8
30	SA		11 34	3.2	23 31	3.1	04 41	0.7	17 06	0.8

Time Zone UT(GMT)

DECEMBER 2024 ARDROSSAN

HEIGHTS ABOVE CHART DATUM

Date		High Water				Low Water			
		Morning		Afternoon		Morning		Afternoon	
		Time	m	Time	m	Time	m	Time	m
1	SU ●			12 09	3.2	05 13	0.8	17 39	0.7
2	M	00 08	3.1	12 42	3.3	05 46	0.8	18 13	0.7
3	TU	00 49	3.1	13 15	3.3	06 21	0.8	18 51	0.7
4	W	01 32	3.1	13 50	3.3	07 02	0.8	19 32	0.7
5	TH	02 15	3.1	14 28	3.3	07 46	0.9	20 19	0.7
6	F	02 59	3.0	15 09	3.3	08 35	0.9	21 11	0.7
7	SA	03 47	2.9	15 55	3.2	09 28	1.0	22 09	0.7
8	SU ☽	04 41	2.8	16 51	3.1	10 25	1.1	23 12	0.7
9	M	05 41	2.8	17 58	3.0	11 28	1.1		
10	TU	06 51	2.7	19 14	3.0	00 18	0.7	12 36	1.1
11	W	08 03	2.8	20 27	3.0	01 23	0.6	13 44	1.0
12	TH	09 07	2.9	21 30	3.1	02 23	0.5	14 47	0.9
13	F	10 01	3.0	22 27	3.2	03 17	0.4	15 42	0.7
14	SA	10 50	3.1	23 20	3.2	04 08	0.4	16 32	0.5
15	SU ○	11 36	3.3			04 56	0.4	17 19	0.4
16	M	00 12	3.2	12 21	3.3	05 43	0.5	18 04	0.4
17	TU	01 05	3.2	13 04	3.4	06 29	0.6	18 48	0.4
18	W	01 53	3.1	13 46	3.4	07 15	0.7	19 32	0.5
19	TH	02 39	3.0	14 28	3.4	08 00	0.8	20 17	0.5
20	F	03 26	2.8	15 10	3.3	08 46	0.9	21 04	0.7
21	SA	04 11	2.7	15 54	3.2	09 34	1.0	21 55	0.8
22	SU ☾	04 59	2.6	16 41	3.1	10 24	1.1	22 51	0.9
23	M	05 50	2.6	17 32	2.9	11 20	1.2	23 51	1.0
24	TU	06 43	2.6	18 26	2.8			12 23	1.3
25	W	07 41	2.6	19 25	2.7	00 54	1.0	13 29	1.2
26	TH	08 42	2.7	20 28	2.7	01 53	1.0	14 31	1.2
27	F	09 38	2.8	21 28	2.8	02 46	1.0	15 23	1.1
28	SA	10 27	2.9	22 21	2.8	03 34	0.9	16 08	0.9
29	SU	11 09	3.1	23 07	2.9	04 16	0.9	16 48	0.8
30	M ●	11 48	3.2	23 51	3.0	04 55	0.8	17 26	0.7
31	TU			12 24	3.2	05 33	0.8	18 03	0.6

Time Zone UT(GMT)

ARDROSSAN

British Summer Time: 01:00 31 March 2024 – 01:00 27 October 2024

Appendix E DQRA Worksheets

Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

This worksheet has been produced in combination with the document 'Remedial Targets Methodology: Hydrogeological risk assessment for land contamination (Environment Agency 2006).

Users of this worksheet should always refer to the User Manual to the Remedial Targets Methodology and to relevant guidance on UK legislation and policy, in order to understand how this procedure should be applied in an appropriate context.

The calculation of equations in this worksheet has been independently checked by Entec (UK) Ltd on behalf of the Environment Agency.

IMPORTANT: To enable MS Excel worksheet, click Tools, Add -Ins, Analysis Tool Pak and Analysis Tool Pak-VBA (to calculate error functions

Details to be completed for each assessment

Site Name:	**Ardrossan**			
Site Address:	**North Ayrshire**			
Completed by:	**TLevick**			
Date:	**6.9.23**		**Version:**	**V1.1**
Contaminant	**Acenaphthylene**			
Target Concentration (C_T)	**0.001**	**mg/l**	**Origin of C_T:**	**Marine EQS**

This worksheet can be used to determine remedial targets for soils (Worksheets Level 1 Soil, Level 2 and Level 3 Soil) or to determine remedial targets for groundwater (Level 3 Groundwater). For Level 3, parameter values must be entered separately dependent on whether the assessment is for soil or groundwater. For soil, remedial targets are calculated as either mg/kg (for comparision with soil measurements) or mg/l (for comparison with leaching tests or pore water concentrations).
Site details entered on this page are automatically copied to Level 1, 2 and 3 Worksheets.
Worksheet options are identified by brown background and employ a pull-down menus. Data entry are identified as blue background.
Data origin / justification should be noted in cells coloured yellow and fully documented in subsequent reports.
Data carried forward from an earlier worksheet are identified by a light green background
It is recommended that a copy of the original worksheet is saved (all data fields in the original copy are blank).

The spreadsheet also includes a porosity calculation worksheet, a soil impact calculation worksheet and a worksheet that performs some simple hydrogeological calculations.

Remedial Targets Worksheet , Release 3.2

Level 1 - Soil

Environment Agency

Select the method of calculating the soil water Partition Co-efficient by using the pull down menu below

Calculate for non-polar organic chemicals

Contaminant		Acenaphthylene		
Target concentration	C_T	0.001	mg/l	

Input Parameters	Variable	Value	Unit	Source of parameter value
Standard entry				
Water filled soil porosity	θ_W	3.30E-01	fraction	CLEA Sandy Loam
Air filled soil porosity	θa	2.00E-01	fraction	CLEA Sandy Loam
Bulk density of soil zone material	ρ	1.21E+00	g/cm^3	CLEA Sandy Loam
Henry's Law constant	H	4.66E-03	dimensionless	*RAIS database (Risk Assessment Information Syste*
Entry if specify partition coefficient (option)				
Soil water partition coefficient	Kd		l/kg	
Entry for non-polar organic chemicals (option)				
Fraction of organic carbon (in soil)	foc	3.70E-02	fraction	Site Specific Data (historic)
Organic carbon partition coefficient	Koc	5.03E+03	l/kg	*RAIS database (Risk Assessment Information System, http://rais.ornl.gov/tools/)*
Entry for ionic organic chemicals (option)				
Sorption coefficient for neutral species	$K_{oc,n}$		l/kg	
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg	
pH value	pH		pH units	
Acid dissociation constant	pKa			
Fraction of organic carbon (in soil)	foc		fraction	
Soil water partition coefficient used in Level Assessment	**Kd**	**1.86E+02**	**l/kg**	*Calculated value*

This sheet calculates the Level 1 remedial target for soils(mg/kg) based on a selected target concentration and theoretical calculation of soil water partitioning. Three options are included for determining the partition coefficient.

The measured soil concentration as mg/kg should be compared with the Level 1 remedial target to determine the need for further action.

Level 1 Remedial Target

Level 1 Remedial Target	**1.86E-01**	**mg/kg**	**(for comparison with soil analyses)**
	or		
	0.001	**mg/l**	**(for comparison with leachate test results)**

Site being assessed:	Ardrossan
Completed by:	[redacted]
Date:	6.9.23
Version:	V1.1

Remedial Targets Worksheet , Release 3.2

Environment Agency

Level 2 - Soil

Contaminant		**Acenaphthylene**		from Level 1	This sheet calculates the Level 2 remedial target for soils (mg/kg) or for pore water (mg/l).
Target concentration	C_T	**0.001**	**mg/l**	from Level 1	

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 2 remedial target to determine the need for further action. Equations presented in 'Hydrogeological risk assessment for land contamiantion' (Environment Agency 2006)

Input Parameters	**Variable**	**Value**	**Unit**	**Source of parameter value**	
Standard entry					
Infiltration	Inf	6.65E-04	m/d	**Rainfall (FEH) - Evaporation (CEH) 25% of long term**	
Area of contaminant source	A	3.30E+03	m^2	**Estimated Area of Plume (Acenapthylene)**	Not used in calculation
Entry for groundwater flow below site					
Length of contaminant source in direction of groundwater flow	L	2.00E+01	m	**Estimated Plume Length**	
Saturated aquifer thickness	da	1.00E+01	m	**Saturated Aquifer Depth to Sandstone 5+5m**	
Hydraulic Conductivity of aquifer in which dilution occurs	K	5.70E+00	m/d	**Site Data (historic)**	
Hydraulic gradient of water table	i	1.07E-02	fraction	**Site Data**	
Width of contaminant source perpendicular to groundwater flow	w	1.65E+02	m	**Site Data**	Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l	**Assumed to be 0**	
Define mixing zone depth by specifying or calculating depth (using pull down list)		**Calculate**			
Enter mixing zone thickness	Mz		m		
Calculated mixing zone thickness	Mz	2.33E+00	m		

Calculated Parameters

Dilution Factor	**DF**	**1.17E+01**		
Level 2 Remedial Target		**1.17E-02**	**mg/l**	**For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentr**
		or		
		2.18E+00	**mg/kg**	**For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water**

Additional option

Calculation of impact on receptor

Concentration of contaminant in contaminated discharge (entering receptor)	Cc	0.00E+00	mg/l	
Calculated concentration within receptor (dilution only)		0.00E+00	mg/l	0

Site being assessed:	Ardrossan
Completed by:	[redacted]
Date:	6.9.23
Version:	V1.1

Remedial Targets Worksheet , Release 3.2

Environment Agency

Level 3 - Soil

See Note

Input Parameters	Variable	Value	Unit	Source
Contaminant		Acenaphthylene		from Level 1
Target Concentration	C_T	0.001	mg/l	from Level 1
Dilution Factor	DF	1.17E+01		from Level 2

Select analytical solution (click on brown cell below, then on pull-down menu)

Ogata Banks — Equations in HRA publication

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants: Apply degradation rate to dissolved pollutants only

	Variable	Value	Unit	Source of parameter value
Enter source concentration		Determine remedial target based on assumed concentration		
Half life for degradation of contaminant in water	$t_{1/2}$	1.20E+02	days	*Howard et al. 1991, Environmental Degradatio*
Calculated decay rate	λ	5.78E-03	$days^{-1}$	calculated
Width of plume in aquifer at source	Sz	1.65E+02	m	from Level 2
Plume thickness in aquifer at source	Sy	2.33E+00	m	from Level 2
Bulk density of aquifer materials	ρ	1.21E+00	g/cm^3	*Updated technical background to the CLEA model (SR3) table 4.4*
Effective porosity of aquifer	n	3.30E-01	fraction	*Updated technical background to the CLEA m*
Hydraulic gradient	i	1.17E-02	fraction	from Level 2 (adjusted)
Hydraulic conductivity of saturated aquifer	K	5.70E+00	m/d	from Level 2
Distance to compliance point	x	1.25E+02	m	*Seawall to Firth of Clyde*
Distance (lateral) to compliance point perpendicular to flow direction	z		m	
Distance (depth) to compliance point perpendicular to flow direction	y		m	
Time since pollutant entered groundwater	t	1.00E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	7.29E-01	l/kg	*see options*
Longitudinal dispersivity	ax	12.500	m	*see options*
Transverse dispersivity	az	1.250	m	*see options*
Vertical dispersivity	ay	0.125	m	*see options*

Parameter values should be checked against Level 1 and 2

Calculated Parameters	Variable		
Groundwater flow velocity	v	2.02E-01	m/d
Retardation factor	Rf	2.68E+02	fraction
Decay rate used	λ	2.15E-05	d^{-1}
Hydraulic gradient used in aquifer flow down-gradient	i	1.17E-02	fraction
Rate of contaminant flow due to retardation	u	7.54E-04	m/d
Ratio of Compliance Point to Source Concentration	C_{cp}/C_s	1.98E-02	fraction
Attenuation factor (C_s/C_{cp})	**AF**	**5.04E+01**	**fraction**

Enter method of defining partition co-efficient (using pull down list)

Calculate for non-polar organic chemicals

Entry if specify partition coefficient (option)

Soil water partition coefficient — Kd — l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon in aquifer	foc	1.45E-02	fraction
Organic carbon partition coefficient	Koc	5.03E+03	l/kg

Entry for ionic organic chemicals (option)

Sorption coefficient for related species	$K_{sc,n}$		l/kg
Sorption coefficient for ionised species	$K_{sc,i}$		l/kg
pH value	pH		
Acid dissociation constant	pKa		
Fraction of organic carbon in aquifer	foc		fraction
Soil water partition coefficient	Kd	7.29E-01	l/kg

Define dispersivity (click brown cell and use pull down list)

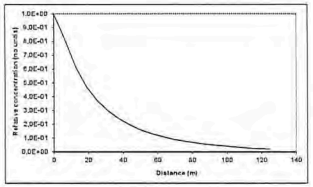
Dispersivities 10%, 1%, 0.1% of pathway length

		Enter value	Calc value	Xu & Eckstein	
Longitudinal dispersivity	ax		1.25E+01		m
Transverse dispersivity	az		1.25E+00		m
Vertical dispersivity	ay		1.25E-01		m

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report $ax = 0.83(\log_{10}x)^{2.414}$; az = ax/10, ay = ax/100 are assumed

Note
This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best described by an electron limited degradation such as oxidation by O_2, NO_3, SO_4 etc than an alternative solution should be used



Note: 'Relative concentration' is the ratio of calculated concentration at a given position compared to the source concentration. The calculations assume plume disperses from the top of the aquifer. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Calculated (relative) concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Relative concentration (No units)
0	1.0E+00
6.3	8.16E-01
12.5	6.15E-01
18.8	4.73E-01
25.0	3.71E-01
31.3	2.97E-01
37.5	2.40E-01
43.8	1.95E-01
50.0	1.61E-01
56.3	1.33E-01
62.5	1.10E-01
68.8	9.18E-02
75.0	7.67E-02
81.3	6.44E-02
87.5	5.41E-02
93.8	4.56E-02
100.0	3.85E-02
106.3	3.25E-02
112.5	2.75E-02
118.8	2.34E-02
125.0	1.98E-02

This sheet calculates the Level 3 remedial target for soils(mg/kg) or for pore water (mg/l), based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks.By setting a long travel time (e.g. 9E99) it will give the steady state solution, which should always be used when calculating remedial targets.

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.9E+99.

Slip being assessed: Andrews Land
Completed by: [redacted]
Date: 6.9.23
Version: V1.1

Remedial Targets

Level 3 Remedial Target		**5.90E-01**	**mg/l**	For comparison with measured pore water concentration.
Ogata Banks		or		This assumes Level 1 Remedial Target is based on Target Concentration.
		1.10E+02	**mg/kg**	For comparison with measured soil concentration. This
Distance to compliance point		**125**	**m**	assumes Level 1 Remedial Target calculated from soil-water
Ratio of Compliance Point to Source Concentration	C_{cp}/C_s	**1.98E-02**	**fraction**	partitioning equation. Ogata Banks

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target.
The recommended value for time when calculating the remedial target is 9.9E+99

Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

This worksheet has been produced in combination with the document 'Remedial Targets Methodology: Hydrogeological risk assessment for land contamination (Environment Agency 2006).

Users of this worksheet should always refer to the User Manual to the Remedial Targets Methodology and to relevant guidance on UK legislation and policy, in order to understand how this procedure should be applied in an appropriate context.

The calculation of equations in this worksheet has been independently checked by Entec (UK) Ltd on behalf of the Environment Agency.

IMPORTANT: To enable MS Excel worksheet, click Tools, Add -Ins, Analysis Tool Pak and Analysis Tool Pak-VBA (to calculate error functions

Details to be completed for each assessment				
Site Name:	**Ardrossan**			
Site Address:	**North Ayrshire**			
Completed by:	[redacted]			
Date:	06.09.23		**Version:**	**V1.1**
Contaminant	**Aro C8-10**			
Target Concentration (C_T)	**0.001**	**mg/l**	**Origin of C_T:**	**Marine EQS**

This worksheet can be used to determine remedial targets for soils (Worksheets Level 1 Soil, Level 2 and Level 3 Soil) or to determine remedial targets for groundwater (Level 3 Groundwater). For Level 3, parameter values must be entered separately dependent on whether the assessment is for soil or groundwater. For soil, remedial targets are calculated as either mg/kg (for comparision with soil measurements) or mg/l (for comparison with leaching tests or pore water concentrations).
Site details entered on this page are automatically copied to Level 1, 2 and 3 Worksheets.
Worksheet options are identified by brown background and employ a pull-down menus. Data entry are identified as blue background.
Data origin / justification should be noted in cells coloured yellow and fully documented in subsequent reports.
Data carried forward from an earlier worksheet are identified by a light green background
It is recommended that a copy of the original worksheet is saved (all data fields in the original copy are blank).

The spreadsheet also includes a porosity calculation worksheet, a soil impact calculation worksheet and a worksheet that performs some simple hydrogeological calculations.

Remedial Targets Worksheet , Release 3.2

Level 1 - Soil

Environment Agency

Select the method of calculating the soil water Partition Co-efficient by using the pull down menu below

Calculate for non-polar organic chemicals

Contaminant		Aro C8-10		
Target concentration	C_T	0.001	mg/l	

Input Parameters	Variable	Value	Unit	Source of parameter value
Standard entry				
Water filled soil porosity	θ_W	3.30E-01	fraction	CLEA Sandy Loam
Air filled soil porosity	θa	2.00E-01	fraction	CLEA Sandy Loam
Bulk density of soil zone material	ρ	1.21E+00	g/cm^3	CLEA Sandy Loam
Henry's Law constant	H	4.80E-01	dimensionless	*Total Petroleum Hydrocarbon Criteria Working Group*
Entry if specify partition coefficient (option)				
Soil water partition coefficient	Kd		l/kg	
Entry for non-polar organic chemicals (option)				
Fraction of organic carbon (in soil)	foc	3.70E-02	fraction	Site Specific Data (historic)
Organic carbon partition coefficient	Koc	1.49E+02	l/kg	*USEPA Value used*
Entry for ionic organic chemicals (option)				
Sorption coefficient for neutral species	$K_{oc,n}$		l/kg	
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg	
pH value	pH		pH units	
Acid dissociation constant	pKa			
Fraction of organic carbon (in soil)	foc		fraction	
Soil water partition coefficient used in Level Assessment	**Kd**	**5.49E+00**	**l/kg**	*Calculated value*

This sheet calculates the Level 1 remedial target for soils(mg/kg) based on a selected target concentration and theoretical calculation of soil water partitioning. Three options are included for determining the partition coefficient.

The measured soil concentration as mg/kg should be compared with the Level 1 remedial target to determine the need for further action.

Level 1 Remedial Target

Level 1 Remedial Target	**5.85E-03**	**mg/kg**	**(for comparison with soil analyses)**
	or		
	0.001	**mg/l**	**(for comparison with leachate test results)**

Site being assessed: [redacted]
Completed by:
Date:
Version:

Remedial Targets Worksheet , Release 3.2

Level 2 - Soil

Environment Agency

Contaminant		Aro C8-10		from Level 1
Target concentration	C_T	0.001	mg/l	from Level 1

This sheet calculates the Level 2 remedial target for soils (mg/kg) or for pore water (mg/l).

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 2 remedial target to determine the need for further action. Equations presented in 'Hydrogeological risk assessment for land contamiantion' (Environment Agency 2006)

Input Parameters	**Variable**	**Value**	**Unit**	**Source of parameter value**	
Standard entry					
Infiltration	Inf	6.65E-04	m/d	Rainfall (FEH) - Evaporation (CEH) 25% of long term	
Area of contaminant source	A	2.50E+01	m^2	Source Area Estimated from Site Data	Not used in calculation
Entry for groundwater flow below site					
Length of contaminant source in direction of groundwater flow	L	2.00E+01	m	Source Area Estimated from Site Data (20m)	
Saturated aquifer thickness	da	1.00E+01	m	Saturated Aquifer Depth to Sandstone 5+5m	
Hydraulic Conductivity of aquifer in which dilution occurs	K	5.70E+00	m/d	Site Data (historic)	
Hydraulic gradient of water table	i	1.07E-02	fraction	Site Data	
Width of contaminant source perpendicular to groundwater flow	w	2.00E+01	m	Site Data	Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l	Assumed to be 0	
Define mixing zone depth by specifying or calculating depth (using pull down list)		Calculate			
Enter mixing zone thickness	Mz		m		
Calculated mixing zone thickness	Mz	2.33E+00	m		

Calculated Parameters

Dilution Factor	DF	1.17E+01		
Level 2 Remedial Target		1.17E-02	mg/l	For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concent
		or		
		6.84E-02	mg/kg	For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water

Additional option

Calculation of impact on receptor

Concentration of contaminant in contaminated discharge (entering receptor)	Cc	0.00E+00	mg/l	
Calculated concentration within receptor (dilution only)		0.00E+00	mg/l	0

Site being assessed:	Ardrossan
Completed by:	[redacted]
Date:	[redacted]
Version:	V1.1

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note

Environment Agency

Input Parameters

	Variable	Value	Unit	Source
Contaminant		Aro C8-10		from Level 1
Target Concentration	C_T	0.001	mg/l	from Level 1
Dilution Factor	DF	1.17E+01		from Level 2

Select analytical solution (click on brown cell below, then on pull-down menu)

Ogata Banks — Equations in HRA publication

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants: Apply degradation rate to dissolved pollutants only

	Variable	Value	Unit	Source of parameter value
Enter source concentration		Determine remedial target based on assumed concentration		
Half life for degradation of contaminant in water	$t_{1/2}$	1.25E+02	days	*Ethylbenzene (C8) / Xylene (C8). 125 days. E*
Calculated decay rate	λ	5.55E-03	$days^{-1}$	calculated
Width of plume in aquifer at source	Sz	2.00E+01	m	from Level 2
Plume thickness in aquifer at source	Sy	2.23E+00	m	from Level 2
Bulk density of aquifer materials	ρ	1.21E+00	g/cm^3	*Updated technical background to the CLEA model (SR3) table 4.4*
Effective porosity of aquifer	n	3.30E-01	fraction	*Updated technical background to the CLEA m*
Hydraulic gradient	i	1.17E-02	fraction	from Level 2 (adjusted)
Hydraulic conductivity of saturated aquifer	K	5.70E+00	m/d	from Level 2
Distance to compliance point	x	1.25E+02	m	*Seawall to Firth of Clyde Site average*
Distance (lateral) to compliance point perpendicular to flow direction	z		m	
Distance (depth) to compliance point perpendicular to flow direction	y		m	
Time since pollutant entered groundwater	t	1.00E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	2.11E+00	l/kg	*see options*
Longitudinal dispersivity	ax	12.500	m	*see options*
Transverse dispersivity	az	1.250	m	*see options*
Vertical dispersivity	ay	0.125	m	*see options*

Parameter values should be checked against Level 1 and 2

Calculated Parameters

	Variable		
Groundwater flow velocity	v	2.02E-01	m/d
Retardation factor	Rf	8.75E+00	fraction
Decay rate used	λ	5.34E-04	d^{-1}
Hydraulic gradient used in aquifer flow down-gradient	i	1.17E-02	fraction
Rate of contaminant flow due to retardation	μ	2.31E-02	m/d
Ratio of Compliance Point to Source Concentration	C_{TP}/C_S	9.31E-03	fraction
Attenuation factor (C_S/C_{TP})	AF	1.07E+02	fraction

Remedial Targets

Level 3 Remedial Target		1.26E+00	mg/l	For comparison with measured pore water concentration.
Ogata Banks		or		This assumes Level 1 Remedial Target is based on Target Concentration.
		7.34E+00	mg/kg	For comparison with measured soil concentration. This
Distance to compliance point		125	m	assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
Ratio of Compliance Point to Source Concentration	C_{TP}/C_S	9.31E-03	fraction	Ogata Banks

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target.
The recommended value for time when calculating the remedial target is 9.9E+99

Enter method of defining partition co-efficient (using pull down list)

Calculate for non-polar organic chemicals

Entry if specify partition coefficient (option)

Soil water partition coefficient — Kd — l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon in aquifer	foc	1.45E-02	fraction
Organic carbon partition coefficient	Koc	1.46E+02	l/kg

Entry for ionic organic chemicals (option)

Sorption coefficient for related species	$K_{ae,n}$		l/kg
Sorption coefficient for ionised species	$K_{ae,i}$		l/kg
pH value	pH		
Acid dissociation constant	pKa		
Fraction of organic carbon in aquifer	foc		fraction
Soil water partition coefficient	Kd	2.11E+00	l/kg

Define dispersivity (click brown cell and use pull down list)

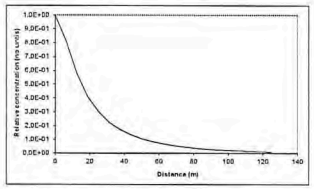
Dispersivities 10%, 1%, 0.1% of pathway length

		Enter value	Calc value	Xu & Eckstein	
Longitudinal dispersivity	ax		1.25E+01		m
Transverse dispersivity	az		1.25E+00		m
Vertical dispersivity	ay		1.25E-01		m

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report $ax = 0.83(\log_{10}x)^{2.414}$; az = ax/10, ay = ax/100 are assumed

Note
This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best desribed by an electron limited degradation such as oxidation by O_2, NO_3, SO_4 etc than an alternative solution should be used



Note 'Relative concentration' is the ratio of calculated concentation at a given position compared to the source concentration. The calculations assume plume disperses from the top of the aquifer. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

This sheet calculates the Level 3 remedial target for soils(mg/kg) or for pore water (mg/l), based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks.By setting a long travel time (e.g. 9E99) it will give the steady state solution, which should always be used when calculating remedial targets.

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.9E+99.

Site being assessed: Ardrossan
Completed by: [redacted]
Date: 08/09/23
Version: V1.1

Calculated (relative) concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Relative concentration (No units)
0	1.0E+00
6.3	8.10E-01
12.5	5.75E-01
18.8	4.10E-01
25.0	3.00E-01
31.3	2.25E-01
37.5	1.72E-01
43.8	1.33E-01
50.0	1.05E-01
56.3	8.31E-02
62.5	6.65E-02
68.8	5.35E-02
75.0	4.34E-02
81.3	3.53E-02
87.5	2.89E-02
93.8	2.38E-02
100.0	1.96E-02
106.3	1.62E-02
112.5	1.34E-02
118.8	1.12E-02
125.0	9.31E-03

Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

This worksheet has been produced in combination with the document 'Remedial Targets Methodology: Hydrogeological risk assessment for land contamination (Environment Agency 2006).

Users of this worksheet should always refer to the User Manual to the Remedial Targets Methodology and to relevant guidance on UK legislation and policy, in order to understand how this procedure should be applied in an appropriate context.

IMPORTANT: To enable MS Excel worksheet, click Tools, Add -Ins, Analysis Tool Pak and Analysis Tool Pak-VBA (to calculate error functions).

Details to be completed for each assessment				
Site Name:	Ardrossan			
Site Address:	North Ayrshire			
Completed by:	[redacted]			
Date:	06-Sep-23		Version:	1.1
Contaminant	Aro C10-12			
Target Concentration (C_T)	0.001	mg/l	Origin of C_T:	Marine EQS

This worksheet can be used to determine remedial targets for soils (Worksheets Level 1 Soil, Level 2 and Level 3 Soil) or to determine remedial targets for groundwater (Level 3 Groundwater). For Level 3, parameter values must be entered separately dependent on whether the assessment is for soil or groundwater. For soil, remedial targets are calculated as either mg/kg (for comparision with soil measurements) or mg/l (for comparison with leaching tests or pore water concentrations).
Site details entered on this page are automatically copied to Level 1, 2 and 3 Worksheets.
Worksheet options are identified by brown background and employ a pull-down menus. Data entry are identified as blue background.
Data origin / justification should be noted in cells coloured yellow and fully documented in subsequent reports.
Data carried forward from an earlier worksheet are identified by a light green background
It is recommended that a copy of the original worksheet is saved (all data fields in the original copy are blank).

The spreadsheet also includes a porosity calculation worksheet, a soil impact calculation worksheet and a worksheet that performs some simple hydrogeological calculations.

Remedial Targets Worksheet , Release 3.2

Level 1 - Soil

Environment Agency

Select the method of calculating the soil water Partition Co-efficient by using the pull down menu below

Calculate for non-polar organic chemicals

Contaminant		Aro C10-12		
Target concentration	C_T	0.001	mg/l	
Input Parameters	**Variable**	**Value**	**Unit**	**Source of parameter value**
Standard entry				
Water filled soil porosity	θ_W	3.30E-01	fraction	CLEA Sandy Loam
Air filled soil porosity	θa	2.00E-01	fraction	CLEA Sandy Loam
Bulk density of soil zone material	ρ	1.21E+00	g/cm^3	CLEA Sandy Loam
Henry's Law constant	H	1.40E-01	dimensionless	*Total Petroleum Hydrocarbon Criteria Working Grou*
Entry if specify partition coefficient (option)				
Soil water partition coefficient	Kd		l/kg	
Entry for non-polar organic chemicals (option)				
Fraction of organic carbon (in soil)	foc	3.70E-02	fraction	Site Specific Data (historic)
Organic carbon partition coefficient	Koc	2.51E+03	l/kg	*Total Petroleum Hydrocarbon Criteria Working Group Series (TPHCWG), 1999. Human Health Risk-Based Evaluation of Petroleum Release Sites: Implei*
Entry for ionic organic chemicals (option)				
Sorption coefficient for neutral species	$K_{oc,n}$		l/kg	
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg	
pH value	pH		pH units	
Acid dissociation constant	pKa			
Fraction of organic carbon (in soil)	foc		fraction	
Soil water partition coefficient used in Level Assessment	**Kd**	**9.29E+01**	**l/kg**	*Calculated value*

This sheet calculates the Level 1 remedial target for soils(mg/kg) based on a selected target concentration and theoretical calculation of soil water partitioning. Three options are included for determining the partition coefficient.

The measured soil concentration as mg/kg should be compared with the Level 1 remedial target to determine the need for further action.

Level 1 Remedial Target

Level 1 Remedial Target	9.32E-02	mg/kg	**(for comparison with soil analyses)**
	or		
	0.001	mg/l	**(for comparison with leachate test results)**

Site being assessed:	Ardrossan
Completed by:	[redacted]
Date:	06-Sep-23
Version:	1.1

Remedial Targets Worksheet , Release 3.2

Level 2 - Soil

Environment Agency

Contaminant		Aro C10-12		from Level 1
Target concentration	C_T	0.001	mg/l	from Level 1

This sheet calculates the Level 2 remedial target for soils (mg/kg) or for pore water (mg/l).

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 2 remedial target to determine the need for further action. Equations presented in 'Hydrogeological risk assessment for land contamiantion' (Environment Agency 2006)

Input Parameters	Variable	Value	Unit	Source of parameter value	
Standard entry					
Infiltration	Inf	6.65E-04	m/d	Rainfall (FEH) - Evaporation (CEH) 25% of long term	
Area of contaminant source	A	2.50E+01	m^2	Estimated Area of Plume	Not used in calculation
Entry for groundwater flow below site					
Length of contaminant source in direction of groundwater flow	L	2.00E+01	m	Estimated Plume Length - assumed 25m2 hotspot	
Saturated aquifer thickness	da	1.00E+01	m	Saturated Aquifer Depth to Sandstone 5+5m	
Hydraulic Conductivity of aquifer in which dilution occurs	K	5.70E+00	m/d	Site Data (historic)	
Hydraulic gradient of water table	i	1.07E-02	fraction	Site Data	
Width of contaminant source perpendicular to groundwater flow	w	2.00E+01	m	Estimated Plume Width - assumed 25m2 hotspot	Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l	Assumed to be 0	
Define mixing zone depth by specifying or calculating depth (using pull down list)		Calculate			
Enter mixing zone thickness	Mz		m		
Calculated mixing zone thickness	Mz	2.33E+00	m		

Calculated Parameters

Dilution Factor	DF	1.17E+01		
Level 2 Remedial Target		1.17E-02	mg/l	For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentra
		or		
		1.09E+00	mg/kg	For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water

Additional option

Calculation of impact on receptor

Concentration of contaminant in contaminated discharge (entering receptor)	Cc	0.00E+00	mg/l	
Calculated concentration within receptor (dilution only)		0.00E+00	mg/l	0

Site being assessed:	[redacted]
Completed by:	[redacted]
Date:	06-Sep-23
Version:	1.1

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note

Environment Agency

Input Parameters	Variable	Value	Unit	Source
Contaminant		Aro C10-12		from Level 1
Target Concentration	C_T	0.001	mg/l	from Level 1
Dilution Factor	DF	1.17E+01		from Level 2

Select analytical solution (click on brown cell below, then on pull-down menu)

Ogata Banks — Equations in HRA publication

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants: Apply degradation rate to dissolved pollutants only

	Variable	Value	Unit	Source of parameter value
Enter source concentration		Determine remedial target based on assumed concentration		
Half life for degradation of contaminant in water	$t_{1/2}$	2.00E+02	days	*Naphthalene - Howard et al, 1991*
Calculated decay rate	λ	3.47E-03	$days^{-1}$	calculated
Width of plume in aquifer at source	Sz	2.00E+01	m	from Level 2
Plume thickness in aquifer at source	Sy	2.33E+00	m	from Level 2
Bulk density of aquifer materials	ρ	1.21E+00	g/cm^3	*Updated technical background to the CLEA model (SR3) table 4.4*
Effective porosity of aquifer	n	3.30E-01	fraction	*Updated technical background to the CLEA n*
Hydraulic gradient	i	1.17E-02	fraction	from Level 2 (adjusted)
Hydraulic conductivity of saturated aquifer	K	5.70E+00	m/d	from Level 2
Distance to compliance point	x	1.25E+02	m	*Seawall to Firth of Clyde*
Distance (lateral) to compliance point perpendicular to flow direction	z		m	
Distance (depth) to compliance point perpendicular to flow direction	y		m	
Time since pollutant entered groundwater	t	1.00E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	3.64E+01	l/kg	*see options*
Longitudinal dispersivity	ax	12.500	m	*see options*
Transverse dispersivity	az	1.250	m	*see options*
Vertical dispersivity	ay	0.125	m	*see options*

Parameter values should be checked against Level 1 and 2

Calculated Parameters	Variable		
Groundwater flow velocity	v	2.02E-01	m/d
Retardation factor	Rf	1.35E+02	fraction
Decay rate used	λ	2.58E-05	d^{-1}
Hydraulic gradient used in aquifer flow down-gradient	i	1.17E-02	fraction
Rate of contaminant flow due to retardation	u	1.50E-03	m/d
Ratio of Compliance Point to Source Concentration	C_{cp}/C_s	2.26E-02	fraction
Attenuation factor (C_s/C_{cp})	AF	4.43E+01	fraction

Enter method of defining partition co-efficient (using pull down list)

Calculate for non-polar organic chemicals

Entry if specify partition coefficient (option)

Soil water partition coefficient — Kd — l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon in aquifer	foc	1.45E-02	fraction
Organic carbon partition coefficient	Koc	2.51E+03	l/kg

Entry for ionic organic chemicals (option)

Sorption coefficient for related species	$K_{oc\,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc\,i}$		l/kg
pH value	pH		
Acid dissociation constant	pKa		
Fraction of organic carbon in aquifer	foc		fraction
Soil water partition coefficient	Kd	3.64E+01	l/kg

Define dispersivity (click brown cell and use pull down list)

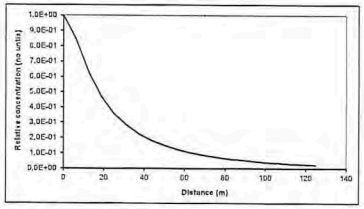
Dispersivities 10%, 1%, 0.1% of pathway length

		Enter value	Calc value	Xu & Eckstein	
Longitudinal dispersivity	ax		1.25E+01		m
Transverse dispersivity	az		1.25E+00		m
Vertical dispersivity	ay		1.25E-01		m

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report $ax = 0.83(\log_{10}x)^{2.414}$; az = ax/10, ay = ax/100 are assumed

Note
This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best desribed by an electron limited degradation such as oxidation by O_2, NO_3, SO_4 etc than an alternative solution should be used



Note: 'Relative concentration' is the ratio of calculated concentation at a given position compared to the source concentration. The calculations assume plume disperses from the top of the aquifer. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

This sheet calculates the Level 3 remedial target for soils(mg/kg) or for pore water (mg/l), based on the distance to the receptor or compliance located down hydraulic gradient of the source.Three solution methods are included, the preferred option is Ogata Banks.By setting a long travel time (e.g. 9E99) it will give the steady state solution, which should always be used when calculating remedial targets.

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.9E+99.

Calculated (relative) concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Relative concentration (No units)
0	1.0E+00
6.3	8.47E-01
12.5	6.28E-01
18.8	4.59E-01
25.0	3.59E-01
31.3	2.81E-01
37.5	2.24E-01
43.8	1.82E-01
50.0	1.49E-01
56.3	1.24E-01
62.5	1.03E-01
68.8	8.71E-02
75.0	7.38E-02
81.3	6.28E-02
87.5	5.38E-02
93.8	4.62E-02
100.0	3.98E-02
106.3	3.44E-02
112.5	2.98E-02
118.8	2.59E-02
125.0	2.26E-02

Site being assessed:	Ardrishaig			
Completed by:	[redacted]			
Date:	########			
Version:	1.1			

Remedial Targets

Level 3 Remedial Target	5.18E-01	mg/l	For comparison with measured pore water concentration.
Ogata Banks	or		This assumes Level 1 Remedial Target is based on Target Concentration.
	4.83E+01	mg/kg	For comparison with measured soil concentration. This
Distance to compliance point	125	m	assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
Ratio of Compliance Point to Source Concentration C_{cp}/C_s	2.26E-02	fraction	Ogata Banks

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target.
The recommended value for time when calculating the remedial target is 9.9E+99

Remedial Targets Worksheet , Release 3.2

Calculation of contaminant concentration in groundwater from a soil source

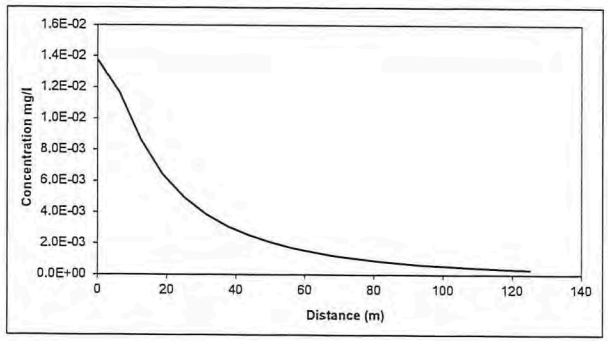
Only input required is Soil Contaminant Concentration

	Input Parameters			
	Soil contaminant concentration	C_0	1.50E+01	mg/kg
Level 1 Parameters				
	Water filled soil porosity	θ_w	3.30E-01	fraction
	Air filled soil porosity	θa	2.00E-01	fraction
	Bulk density	ρ	1.21E+00	g/cm^3
	Henry's Law constant	H	1.40E-01	dimensionless
	Soil water partition coefficient used in Level Assessment	Kd	9.29E+01	l/kg
	Factor (partitioning between soil and water)		9.32E+01	dimensionless
Level 2 Parameters	**Dilution Factor**	DF	1.17E+01	
Level 3 Parameters	**Attenuation factor (C_0/C_{ED})**	AF	4.43E+01	

Predicted concentrations at compliance point

Level 1	C	1.61E-01	mg/l	No dilution or attenuation
Level 2	C	1.38E-02	mg/l	Dilution taken into account
Level 3	C	3.11E-04	mg/l	Dilution and attenuation taken into account

Predicted concentrations between source and compliance point - Level 3



Distance m	Concentration mg/l
0.00	1.38E-02
6.25	1.16E-02
12.50	8.64E-03
18.75	6.44E-03
25.00	4.93E-03
31.25	3.87E-03
37.50	3.09E-03
43.75	2.50E-03
50.00	2.05E-03
56.25	1.70E-03
62.50	1.42E-03
68.75	1.20E-03
75.00	1.02E-03
81.25	8.64E-04
87.50	7.39E-04
93.75	6.35E-04
100.00	5.47E-04
106.25	4.73E-04
112.50	4.10E-04
118.75	3.57E-04
125.00	3.11E-04

Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

This worksheet has been produced in combination with the document 'Remedial Targets Methodology: Hydrogeological risk assessment for land contamination (Environment Agency 2006).

Users of this worksheet should always refer to the User Manual to the Remedial Targets Methodology and to relevant guidance on UK legislation and policy, in order to understand how this procedure should be applied in an appropriate context.

The calculation of equations in this worksheet has been independently checked by Entec (UK) Ltd on behalf of the Environment Agency.

IMPORTANT: To enable MS Excel worksheet, click Tools, Add -Ins, Analysis Tool Pak and Analysis Tool Pak-VBA (to calculate error functions

Details to be completed for each assessment				
Site Name:	**Ardrossan**			
Site Address:	**North Ayrshire**			
Completed by:	[redacted]			
Date:	**07-Sep-23**		**Version:**	**V1.4**
Contaminant	**Benzo(a)pyrene**			
Target Concentration (C_T)	**0.001**	**mg/l**	**Origin of C_T:**	**Marine EQS**

This worksheet can be used to determine remedial targets for soils (Worksheets Level 1 Soil, Level 2 and Level 3 Soil) or to determine remedial targets for groundwater (Level 3 Groundwater). For Level 3, parameter values must be entered separately dependent on whether the assessment is for soil or groundwater. For soil, remedial targets are calculated as either mg/kg (for comparision with soil measurements) or mg/l (for comparison with leaching tests or pore water concentrations).
Site details entered on this page are automatically copied to Level 1, 2 and 3 Worksheets.
Worksheet options are identified by brown background and employ a pull-down menus. Data entry are identified as blue background.
Data origin / justification should be noted in cells coloured yellow and fully documented in subsequent reports.
Data carried forward from an earlier worksheet are identified by a light green background
It is recommended that a copy of the original worksheet is saved (all data fields in the original copy are blank).

The spreadsheet also includes a porosity calculation worksheet, a soil impact calculation worksheet and a worksheet that performs some simple hydrogeological calculations.

Remedial Targets Worksheet , Release 3.2

Level 1 - Soil

Environment Agency

Select the method of calculating the soil water Partition Co-efficient by using the pull down menu below

Calculate for non-polar organic chemicals

Contaminant		Benzo(a)pyrene		
Target concentration	C_T	0.001	mg/l	

Input Parameters	Variable	Value	Unit	Source of parameter value
Standard entry				
Water filled soil porosity	θ_W	3.30E-01	fraction	CLEA Sandy Loam
Air filled soil porosity	θa	2.00E-01	fraction	CLEA Sandy Loam
Bulk density of soil zone material	ρ	1.21E+00	g/cm^3	CLEA Sandy Loam
Henry's Law constant	H	1.76E-06	dimensionless	*Environment Agency 2008. Compilation of data for pr*
Entry if specify partition coefficient (option)				
Soil water partition coefficient	Kd		l/kg	
Entry for non-polar organic chemicals (option)				
Fraction of organic carbon (in soil)	foc	1.19E-02	fraction	Site Specific Data (historic)
Organic carbon partition coefficient	Koc	1.29E+05	l/kg	*Environment Agency 2008. Compilation of data for priority organic pollutants for derivation of Soil Guideline Values*
Entry for ionic organic chemicals (option)				
Sorption coefficient for neutral species	$K_{oc,n}$		l/kg	
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg	
pH value	pH		pH units	
Acid dissociation constant	pKa			
Fraction of organic carbon (in soil)	foc		fraction	
Soil water partition coefficient used in Level Assessment	**Kd**	**1.54E+03**	**l/kg**	*Calculated value*

This sheet calculates the Level 1 remedial target for soils(mg/kg) based on a selected target concentration and theoretical calculation of soil water partitioning. Three options are included for determining the partition coefficient.

The measured soil concentration as mg/kg should be compared with the Level 1 remedial target to determine the need for further action.

Level 1 Remedial Target

Level 1 Remedial Target	**1.54E+00**	**mg/kg**	**(for comparison with soil analyses)**
	or		
	0.001	**mg/l**	**(for comparison with leachate test results)**

Site being assessed:	Ardrossan
Completed by:	[redacted]
Date:	07-Sep-23
Version:	V1.4

Remedial Targets Worksheet , Release 3.2

Level 2 - Soil

Environment Agency

Contaminant		Benzo(a)pyrene		from Level 1
Target concentration	C_T	0.001	mg/l	from Level 1

This sheet calculates the Level 2 remedial target for soils (mg/kg) or for pore water (mg/l).

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 2 remedial target to determine the need for further action. Equations presented in 'Hydrogeological risk assessment for land contamiantion' (Environment Agency 2006)

Input Parameters	**Variable**	**Value**	**Unit**	**Source of parameter value**	
Standard entry					
Infiltration	Inf	1.70E-03	m/d	Rainfall (FEH) - Evaporation (CEH) 25% of long term	
Area of contaminant source	A	3.30E+03	m^2	Estimated Area of Plume	Not used in calculation
Entry for groundwater flow below site					
Length of contaminant source in direction of groundwater flow	L	2.00E+01	m	Estimated Plume Length - assumed 3300m2 hotspot	
Saturated aquifer thickness	da	1.00E+01	m	Saturated Aquifer Depth to Sandstone 5+5m	
Hydraulic Conductivity of aquifer in which dilution occurs	K	2.70E+00	m/d	Site Data (historic)	
Hydraulic gradient of water table	i	1.07E-02	fraction	Site Data	
Width of contaminant source perpendicular to groundwater flow	w	1.65E+02	m	Estimated Plume Width - assumed 3300m2 hotspot	Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l	Assumed to be 0	
Define mixing zone depth by specifying or calculating depth (using pull down list)		Calculate			
Enter mixing zone thickness	Mz		m		
Calculated mixing zone thickness	Mz	3.23E+00	m		

Calculated Parameters

Dilution Factor	**DF**	**3.74E+00**		
Level 2 Remedial Target		**3.74E-03**	**mg/l**	**For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concent**
		or		
		5.76E+00	**mg/kg**	**For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water**

Additional option

Calculation of impact on receptor

Concentration of contaminant in contaminated discharge (entering receptor)	Cc	0.00E+00	mg/l	
Calculated concentration within receptor (dilution only)		0.00E+00	mg/l	0

Site being assessed:	Ardrossan
Completed by:	[redacted]
Date:	07-Sep-23
Version:	V1.4

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note

Input Parameters	Variable	Value	Unit	Source
Contaminant		Benzo(a)pyrene		from Level 1
Target Concentration	C_T	0.001	mg/l	from Level 1
Dilution Factor	DF	3.74E+00		from Level 2

Select analytical solution (click on brown cell below, then on pull-down menu)

Ogata Banks — **Equations in HRA publication**

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants: **Apply degradation rate to dissolved pollutants only**

	Variable	Value	Unit	Source of parameter value
Enter source concentration		**Determine remedial target based on assumed concentration**		
Half life for degradation of contaminant in water	$t_{1/2}$	1.06E+03	days	*Howard et al. 1991. Environmental Degradatio*
Calculated decay rate	λ	6.55E-04	$days^{-1}$	calculated
Width of plume in aquifer at source	Sz	1.65E+02	m	from Level 2
Plume thickness in aquifer at source	Sy	3.23E+00	m	from Level 2
Bulk density of aquifer materials	ρ	1.21E+00	g/cm^3	*Updated technical background to the CLEA model (SR3) table 4.4*
Effective porosity of aquifer	n	3.30E-01	fraction	*Updated technical background to the CLEA m*
Hydraulic gradient	i	1.46E-02	fraction	from Level 2 (adjusted)
Hydraulic conductivity of saturated aquifer	K	2.70E+00	m/d	from Level 2
Distance to compliance point	x	1.25E+02	m	*Seawall to Firth of Clyde*
Distance (lateral) to compliance point perpendicular to flow direction	z		m	
Distance (depth) to compliance point perpendicular to flow direction	y		m	
Time since pollutant entered groundwater	t	1.00E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	1.54E+03	l/kg	*see options*
Longitudinal dispersivity	ax	12.500	m	*see options*
Transverse dispersivity	az	1.250	m	*see options*
Vertical dispersivity	ay	0.125	m	*see options*

Parameter values should be checked against Level 1 and 2

Calculated Parameters	Variable	Value	Unit
Groundwater flow velocity	v	1.19E-01	m/d
Retardation factor	Rf	5.64E+03	fraction
Decay rate used	λ	1.16E-07	d^{-1}
Hydraulic gradient used in aquifer flow down-gradient	i	1.46E-02	fraction
Rate of contaminant flow due to retardation	u	2.12E-05	m/d
Ratio of Compliance Point to Source Concentration	C_{ED}/C_0	2.29E-01	fraction
Attenuation factor (C_0/C_{ED})	AF	**4.36E+00**	**fraction**

Remedial Targets

		Value	Unit	
Level 3 Remedial Target Ogata Banks		**1.63E-02**	**mg/l**	For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentration.
		or		
		2.51E+01	**mg/kg**	For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
Distance to compliance point		**125**	**m**	
Ratio of Compliance Point to Source Concentration	C_{ED}/C_0	**2.29E-01**	**fraction**	Ogata Banks

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target.
The recommended value for time when calculating the remedial target is 9.9E+99

Enter method of defining partition co-efficient (using pull down list)

Calculate for non-polar organic chemicals

	Variable	Value	Unit
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.19E-02	fraction
Organic carbon partition coefficient	Koc	1.29E+05	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
Acid dissociation constant	pKa		
Fraction of organic carbon in aquifer	foc		fraction
Soil water partition coefficient	Kd	1.54E+03	l/kg

Define dispersivity (click brown cell and use pull down list)

Dispersivities 10%, 1%, 0.1% of pathway length

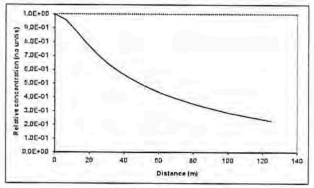
		Enter value	Calc value	Xu & Eckstein	
Longitudinal dispersivity	**ax**		1.25E+01		m
Transverse dispersivity	**az**		1.25E+00		m
Vertical dispersivity	**ay**		1.25E-01		m

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report $ax = 0.83(\log_{10}x)^{2.414}$, az = ax/10, ay = ax/100 are assumed

Note
This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best desribed by an electron limited degradation such as oxidation by O_2, NO_3, SO_4 etc than an alternative solution should be used

Environment Agency



Note: 'Relative concentration' is the ratio of calculated concentation at a given position compared to the source concentration. The calculations assume plume disperses from the top of the aquifer. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

This sheet calculates the Level 3 remedial target for soils(mg/kg) or for pore water (mg/l), based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks.By setting a long travel time (e.g. 9E99) it will give the steady state solution, which should always be used when calculating remedial targets.

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.9E+99.

Site being assessed	Ardrossan
Completed by	[redacted]
Date	########
Version	V1.4

Calculated (relative) concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Relative concentration (No units)
0	1.0E+00
6.3	9.59E-01
12.5	8.74E-01
18.8	7.84E-01
25.0	7.06E-01
31.3	6.40E-01
37.5	5.84E-01
43.8	5.35E-01
50.0	4.94E-01
56.3	4.57E-01
62.5	4.24E-01
68.8	3.96E-01
75.0	3.70E-01
81.3	3.46E-01
87.5	3.25E-01
93.8	3.05E-01
100.0	2.88E-01
106.3	2.71E-01
112.5	2.56E-01
118.8	2.42E-01
125.0	2.29E-01

Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

This worksheet has been produced in combination with the document 'Remedial Targets Methodology: Hydrogeological risk assessment for land contamination (Environment Agency 2006).

Users of this worksheet should always refer to the User Manual to the Remedial Targets Methodology and to relevant guidance on UK legislation and policy, in order to understand how this procedure should be applied in an appropriate context.

The calculation of equations in this worksheet has been independently checked by Entec (UK) Ltd on behalf of the Environment Agency.

IMPORTANT: To enable MS Excel worksheet, click Tools, Add -Ins, Analysis Tool Pak and Analysis Tool Pak-VBA (to calculate error functions

Details to be completed for each assessment

Site Name:	**Ardrossan**			
Site Address:	**North Ayrshire**			
Completed by:	[redacted]			
Date:	**06-Sep-23**		**Version:**	**V1.4**
Contaminant	**Benzo(b)fluoranthene**			
Target Concentration (C_T)	**0.001**	**mg/l**	**Origin of C_T:**	**Marine EQS**

This worksheet can be used to determine remedial targets for soils (Worksheets Level 1 Soil, Level 2 and Level 3 Soil) or to determine remedial targets for groundwater (Level 3 Groundwater). For Level 3, parameter values must be entered separately dependent on whether the assessment is for soil or groundwater. For soil, remedial targets are calculated as either mg/kg (for comparision with soil measurements) or mg/l (for comparison with leaching tests or pore water concentrations).
Site details entered on this page are automatically copied to Level 1, 2 and 3 Worksheets.
Worksheet options are identified by brown background and employ a pull-down menus. Data entry are identified as blue background.
Data origin / justification should be noted in cells coloured yellow and fully documented in subsequent reports.
Data carried forward from an earlier worksheet are identified by a light green background
It is recommended that a copy of the original worksheet is saved (all data fields in the original copy are blank).

The spreadsheet also includes a porosity calculation worksheet, a soil impact calculation worksheet and a worksheet that performs some simple hydrogeological calculations.

Remedial Targets Worksheet , Release 3.2

Level 1 - Soil

Environment Agency

Select the method of calculating the soil water Partition Co-efficient by using the pull down menu below

Calculate for non-polar organic chemicals

Contaminant		Benzo(b)fluoranthene		
Target concentration	C_T	0.001	mg/l	

Input Parameters	Variable	Value	Unit	Source of parameter value
Standard entry				
Water filled soil porosity	θ_W	3.30E-01	fraction	CLEA Sandy Loam
Air filled soil porosity	θa	2.00E-01	fraction	CLEA Sandy Loam
Bulk density of soil zone material	ρ	1.21E+00	g/cm^3	CLEA Sandy Loam
Henry's Law constant	H	2.05E-06	dimensionless	*Environment Agency 2008. Compilation of data for pr*
Entry if specify partition coefficient (option)				
Soil water partition coefficient	Kd		l/kg	
Entry for non-polar organic chemicals (option)				
Fraction of organic carbon (in soil)	foc	1.19E-02	fraction	Site Specific Data (historic)
Organic carbon partition coefficient	Koc	1.05E+05	l/kg	*Environment Agency 2008. Compilation of data for priority organic pollutants for derivation of Soil Guideline Values*
Entry for ionic organic chemicals (option)				
Sorption coefficient for neutral species	$K_{oc,n}$		l/kg	
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg	
pH value	pH		pH units	
Acid dissociation constant	pKa			
Fraction of organic carbon (in soil)	foc		fraction	
Soil water partition coefficient used in Level Assessment	**Kd**	**1.25E+03**	**l/kg**	*Calculated value*

This sheet calculates the Level 1 remedial target for soils(mg/kg) based on a selected target concentration and theoretical calculation of soil water partitioning. Three options are included for determining the partition coefficient.

The measured soil concentration as mg/kg should be compared with the Level 1 remedial target to determine the need for further action.

Level 1 Remedial Target

Level 1 Remedial Target	**1.25E+00**	**mg/kg**	**(for comparison with soil analyses)**
	or		
	0.001	**mg/l**	**(for comparison with leachate test results)**

Site being assessed:	Ardrossan
Completed by:	[redacted]
Date:	06-Sep-23
Version:	V1.4

Remedial Targets Worksheet , Release 3.2

Environment Agency

Level 2 - Soil

Contaminant		Benzo(b)fluoranthene		from Level 1
Target concentration	C_T	0.001	mg/l	from Level 1

This sheet calculates the Level 2 remedial target for soils (mg/kg) or for pore water (mg/l).

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 2 remedial target to determine the need for further action. Equations presented in 'Hydrogeological risk assessment for land contamiantion' (Environment Agency 2006)

Input Parameters	Variable	Value	Unit	Source of parameter value	
Standard entry					
Infiltration	Inf	1.70E-03	m/d	Rainfall (FEH) - Evaporation (CEH) 25% of long term	
Area of contaminant source	A	3.30E+03	m^2	Estimated Area of Plume	Not used in calculation
Entry for groundwater flow below site					
Length of contaminant source in direction of groundwater flow	L	2.00E+01	m	Estimated Plume Length - assumed 3300m2 hotspot	
Saturated aquifer thickness	da	1.00E+01	m	Saturated Aquifer Depth to Sandstone 5+5m	
Hydraulic Conductivity of aquifer in which dilution occurs	K	2.70E+00	m/d	Site Data (historic)	
Hydraulic gradient of water table	i	1.07E-02	fraction	Site Data	
Width of contaminant source perpendicular to groundwater flow	w	1.65E+02	m	Estimated Plume Width - assumed 3300m2 hotspot	Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l	Assumed to be 0	
Define mixing zone depth by specifying or calculating depth (using pull down list)		Calculate			
Enter mixing zone thickness	Mz		m		
Calculated mixing zone thickness	Mz	3.23E+00	m		

Calculated Parameters

Dilution Factor	DF	3.74E+00		
Level 2 Remedial Target		3.74E-03	mg/l	For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentr
		or		
		4.68E+00	mg/kg	For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water

Additional option

Calculation of impact on receptor

Concentration of contaminant in contaminated discharge (entering receptor)	Cc	0.00E+00	mg/l	
Calculated concentration within receptor (dilution only)		0.00E+00	mg/l	0

Site being assessed:	Ardrossan
Completed by:	[redacted]
Date:	06-Sep-23
Version:	V1.4

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note

Environment Agency

Input Parameters	Variable	Value	Unit	Source
Contaminant		Benzo(b)fluoranthene		from Level 1
Target Concentration	C_T	0.001	mg/l	from Level 1
Dilution Factor	DF	3.74E+00		from Level 2

Select analytical solution (click on brown cell below, then on pull-down menu)

Ogata Banks — Equations in HRA publication

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants: Apply degradation rate to dissolved pollutants only

	Variable	Value	Unit	Source of parameter value
Enter source concentration		Determine remedial target based on assumed concentration		
Half life for degradation of contaminant in water	$t_{1/2}$	1.08E+03	days	*Howard et al. 1991, Environmental Degradatio*
Calculated decay rate	λ	6.55E-04	$days^{-1}$	calculated
Width of plume in aquifer at source	Sz	1.65E+02	m	from Level 2
Plume thickness in aquifer at source	Sy	3.23E+00	m	from Level 2
Bulk density of aquifer materials	ρ	1.21E+00	g/cm^3	*Updated technical background to the CLEA model (SR3) table 4.4*
Effective porosity of aquifer	n	3.30E-01	fraction	*Updated technical background to the CLEA mo*
Hydraulic gradient	i	1.46E-02	fraction	from Level 2 (adjusted)
Hydraulic conductivity of saturated aquifer	K	2.70E+00	m/d	from Level 2
Distance to compliance point	x	1.25E+02	m	*Seawall to Firth of Clyde*
Distance (lateral) to compliance point perpendicular to flow direction	z		m	
Distance (depth) to compliance point perpendicular to flow direction	y		m	
Time since pollutant entered groundwater	t	1.00E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	1.25E+03	l/kg	*see options*
Longitudinal dispersivity	ax	12.500	m	*see options*
Transverse dispersivity	az	1.250	m	*see options*
Vertical dispersivity	ay	0.125	m	*see options*

Parameter values should be checked against Level 1 and 2

Calculated Parameters	Variable		
Groundwater flow velocity	v	1.10E-01	m/d
Retardation factor	Rf	4.59E+03	fraction
Decay rate used	λ	1.43E-07	d^{-1}
Hydraulic gradient used in aquifer flow down-gradient	i	1.46E-02	fraction
Rate of contaminant flow due to retardation	u	2.60E-05	m/d
Ratio of Compliance Point to Source Concentration	C_{cp}/C_s	2.29E-01	fraction
Attenuation factor (C_s/C_{cp})	AF	4.36E+00	fraction

Enter method of defining partition co-efficient (using pull down list)

Calculate for non-polar organic chemicals

Entry if specify partition coefficient (option)

Soil water partition coefficient — Kd — l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon in aquifer	foc	1.19E-02	fraction
Organic carbon partition coefficient	Koc	1.05E+05	l/kg

Entry for ionic organic chemicals (option)

Sorption coefficient for related species	$K_{sc,n}$		l/kg
Sorption coefficient for ionised species	$K_{sc,i}$		l/kg
pH value	pH		
Acid dissociation constant	pKa		
Fraction of organic carbon in aquifer	foc		fraction
Soil water partition coefficient	Kd	1.25E+03	l/kg

Define dispersivity (click brown cell and use pull down list)

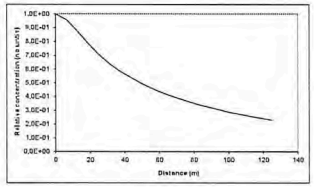
Dispersivities 10%, 1%, 0.1% of pathway length

		Enter value	Calc value	Xu & Eckstein	
Longitudinal dispersivity	ax		1.25E+01		m
Transverse dispersivity	az		1.25E+00		m
Vertical dispersivity	ay		1.25E-01		m

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report $ax = 0.83(\log_{10}x)^{2.414}$; az = ax/10, ay = ax/100 are assumed

Note
This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best desribed by an electron limited degradation such as oxidation by O_2, NO_3, SO_4 etc than an alternative solution should be used



Note: 'Relative concentration' is the ratio of calculated concentation at a given position compared to the source concentration. The calculations assume plume disperses from the top of the aquifer. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Calculated (relative) concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Relative concentration (No units)
0	1.0E+00
6.3	9.59E-01
12.5	8.74E-01
18.8	7.84E-01
25.0	7.06E-01
31.3	6.40E-01
37.5	5.84E-01
43.8	5.35E-01
50.0	4.94E-01
56.3	4.57E-01
62.5	4.24E-01
68.8	3.96E-01
75.0	3.70E-01
81.3	3.46E-01
87.5	3.25E-01
93.8	3.05E-01
100.0	2.88E-01
106.3	2.71E-01
112.5	2.56E-01
118.8	2.42E-01
125.0	2.29E-01

This sheet calculates the Level 3 remedial target for soils(mg/kg) or for pore water (mg/l), based on the distance to the receptor or compliance located down hydraulic gradient of the source.Three solution methods are included, the preferred option is Ogata Banks.By setting a long travel time (e.g. 9E99) it will give the steady state solution, which should always be used when calculating remedial targets.

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.9E+99.

Site being assessed: Anonymous
Completed by: [redacted]
Date: [redacted]
Version: v1.4

Remedial Targets

Level 3 Remedial Target		**1.03E-02**	**mg/l**	For comparison with measured pore water concentration.
Ogata Banks		or		This assumes Level 1 Remedial Target is based on Target Concentration.
		2.84E+01	**mg/kg**	For comparison with measured soil concentration. This
Distance to compliance point		**125**	**m**	assumes Level 1 Remedial Target calculated from soil-water
				partitioning equation.
Ratio of Compliance Point to Source Concentration	C_{cp}/C_s	**2.29E-01**	**fraction**	Ogata Banks

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target.
The recommended value for time when calculating the remedial target is 9.9E+99

Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

This worksheet has been produced in combination with the document 'Remedial Targets Methodology: Hydrogeological risk assessment for land contamination (Environment Agency 2006).

Users of this worksheet should always refer to the User Manual to the Remedial Targets Methodology and to relevant guidance on UK legislation and policy, in order to understand how this procedure should be applied in an appropriate context.

The calculation of equations in this worksheet has been independently checked by Entec (UK) Ltd on behalf of the Environment Agency.

IMPORTANT: To enable MS Excel worksheet, click Tools, Add -Ins, Analysis Tool Pak and Analysis Tool Pak-VBA (to calculate error functions

Details to be completed for each assessment				
Site Name:	Ardrossan			
Site Address:	North Ayrshire			
Completed by:	[redacted]			
Date:	06-Sep-23		Version:	V1.1
Contaminant	C12-16 Aro			
Target Concentration (C_T)	0.001	mg/l	Origin of C_T:	Marine EQS

This worksheet can be used to determine remedial targets for soils (Worksheets Level 1 Soil, Level 2 and Level 3 Soil) or to determine remedial targets for groundwater (Level 3 Groundwater). For Level 3, parameter values must be entered separately dependent on whether the assessment is for soil or groundwater. For soil, remedial targets are calculated as either mg/kg (for comparision with soil measurements) or mg/l (for comparison with leaching tests or pore water concentrations).
Site details entered on this page are automatically copied to Level 1, 2 and 3 Worksheets.
Worksheet options are identified by brown background and employ a pull-down menus. Data entry are identified as blue background.
Data origin / justification should be noted in cells coloured yellow and fully documented in subsequent reports.
Data carried forward from an earlier worksheet are identified by a light green background
It is recommended that a copy of the original worksheet is saved (all data fields in the original copy are blank).

The spreadsheet also includes a porosity calculation worksheet, a soil impact calculation worksheet and a worksheet that performs some simple hydrogeological calculations.

Remedial Targets Worksheet , Release 3.2

Level 1 - Soil

Environment Agency

Select the method of calculating the soil water Partition Co-efficient by using the pull down menu below

Calculate for non-polar organic chemicals

Contaminant		C12-16 Aro		
Target concentration	C_T	0.001	mg/l	

Input Parameters	Variable	Value	Unit	Source of parameter value
Standard entry				
Water filled soil porosity	θ_W	3.30E-01	fraction	CLEA Sandy Loam
Air filled soil porosity	θa	2.00E-01	fraction	CLEA Sandy Loam
Bulk density of soil zone material	ρ	1.21E+00	g/cm^3	CLEA Sandy Loam
Henry's Law constant	H	5.30E-02	dimensionless	*Total Petroleum Hydrocarbon Criteria Working Group*
Entry if specify partition coefficient (option)				
Soil water partition coefficient	Kd		l/kg	
Entry for non-polar organic chemicals (option)				
Fraction of organic carbon (in soil)	foc	3.70E-02	fraction	Site Specific Data (historic)
Organic carbon partition coefficient	Koc	5.01E+03	l/kg	*Total Petroleum Hydrocarbon Criteria Working Group Series (TPHCWG), 1999. Human Health Risk-Based Evaluation of Petroleum Release Sites: Impl*
Entry for ionic organic chemicals (option)				
Sorption coefficient for neutral species	$K_{oc,n}$		l/kg	
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg	
pH value	pH		pH units	
Acid dissociation constant	pKa			
Fraction of organic carbon (in soil)	foc		fraction	
Soil water partition coefficient used in Level Assessment	Kd	1.85E+02	l/kg	*Calculated value*

This sheet calculates the Level 1 remedial target for soils(mg/kg) based on a selected target concentration and theoretical calculation of soil water partitioning. Three options are included for determining the partition coefficient.

The measured soil concentration as mg/kg should be compared with the Level 1 remedial target to determine the need for further action.

Level 1 Remedial Target

Level 1 Remedial Target	**1.86E-01**	**mg/kg**	**(for comparison with soil analyses)**
	or		
	0.001	**mg/l**	**(for comparison with leachate test results)**

Site being assessed:	Ardrossan
Completed by:	[redacted]
Date:	06-Sep-23
Version:	V1.1

Remedial Targets Worksheet , Release 3.2

Environment Agency

Level 2 - Soil

Contaminant		C12-16 Aro		from Level 1
Target concentration	C_T	0.001	mg/l	from Level 1

This sheet calculates the Level 2 remedial target for soils (mg/kg) or for pore water (mg/l).

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 2 remedial target to determine the need for further action. Equations presented in 'Hydrogeological risk assessment for land contamiantion' (Environment Agency 2006)

Input Parameters	Variable	Value	Unit	Source of parameter value	
Standard entry					
Infiltration	Inf	6.65E-04	m/d	Rainfall (FEH) - Evaporation (CEH) 25% of long term	
Area of contaminant source	A	3.30E+03	m^2	Estimated Area of Plume (Acena)	Not used in calculation
Entry for groundwater flow below site					
Length of contaminant source in direction of groundwater flow	L	2.00E+01	m	Estimated Plume Length	
Saturated aquifer thickness	da	1.00E+01	m	Saturated Aquifer Depth to Sandstone 5+5m	
Hydraulic Conductivity of aquifer in which dilution occurs	K	5.70E+00	m/d	Site Data (historic)	
Hydraulic gradient of water table	i	1.07E-02	fraction	Site Data	
Width of contaminant source perpendicular to groundwater flow	w	2.00E+01	m	Site Data (20)	Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l	Assumed to be 0	
Define mixing zone depth by specifying or calculating depth (using pull down list)		Calculate			
Enter mixing zone thickness	Mz		m		
Calculated mixing zone thickness	Mz	2.33E+00	m		

Calculated Parameters

Dilution Factor	**DF**	**1.17E+01**		
Level 2 Remedial Target		**1.17E-02**	**mg/l**	**For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentr**
		or		
		2.17E+00	**mg/kg**	**For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water**

Additional option

Calculation of impact on receptor

Concentration of contaminant in contaminated discharge (entering receptor)	Cc	0.00E+00	mg/l	
Calculated concentration within receptor (dilution only)		0.00E+00	mg/l	0

Site being assessed:	Ardrossan
Completed by:	[redacted]
Date:	06-Sep-23
Version:	V1.1

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note

Environment Agency

Input Parameters

	Variable	Value	Unit	Source
Contaminant		C12-16 Aro		from Level 1
Target Concentration	C_T	0.001	mg/l	from Level 1
Dilution Factor	DF	1.17E+01		from Level 2

Select analytical solution (click on brown cell below, then on pull-down menu)

Ogata Banks — Equations in HRA publication

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants: Apply degradation rate to dissolved pollutants only

	Variable	Value	Unit	Source of parameter value
Enter source concentration		Determine remedial target based on assumed concentration		
Half life for degradation of contaminant in water	$t_{1/2}$	1.50E+03	days	Total Petroleum Hydrocarbon Criteria Working
Calculated decay rate	λ	4.62E-04	$days^{-1}$	calculated
Width of plume in aquifer at source	Sz	2.00E+01	m	from Level 2
Plume thickness in aquifer at source	Sy	2.33E+00	m	from Level 2
Bulk density of aquifer materials	ρ	1.21E+00	g/cm^3	Updated technical background to the CLEA model (SR3) table 4.4
Effective porosity of aquifer	n	3.30E-01	fraction	Updated technical background to the CLEA mo
Hydraulic gradient	i	1.17E-02	fraction	from Level 2 (adjusted)
Hydraulic conductivity of saturated aquifer	K	5.70E+00	m/d	from Level 2
Distance to compliance point	x	1.25E+02	m	Seawall to Firth of Clyde
Distance (lateral) to compliance point perpendicular to flow direction	z		m	
Distance (depth) to compliance point perpendicular to flow direction	y		m	
Time since pollutant entered groundwater	t	1.00E+99	days	time variant options only
Parameters values determined from options				
Partition coefficient	Kd	7.27E+01	l/kg	see options
Longitudinal dispersivity	ax	12.500	m	see options
Transverse dispersivity	az	1.250	m	see options
Vertical dispersivity	ay	0.125	m	see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters

	Variable		
Groundwater flow velocity	v	2.02E-01	m/d
Retardation factor	Rf	2.67E+02	fraction
Decay rate used	λ	1.73E-06	d^{-1}
Hydraulic gradient used in aquifer flow down-gradient	i	1.17E-02	fraction
Rate of contaminant flow due to retardation	u	7.56E-04	m/d
Ratio of Compliance Point to Source Concentration	C_{cp}/C_s	1.05E-01	fraction
Attenuation factor (C_s/C_{cp})	AF	**9.53E+00**	**fraction**

Remedial Targets

Level 3 Remedial Target	**1.11E-01**	**mg/l**	For comparison with measured pore water concentration.
Ogata Banks	or		This assumes Level 1 Remedial Target is based on Target Concentration.
	2.07E+01	**mg/kg**	For comparison with measured soil concentration. This
Distance to compliance point	**125**	**m**	assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
Ratio of Compliance Point to Source Concentration	**C_{cp}/C_s** **1.05E-01**	**fraction**	Ogata Banks

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target.
The recommended value for time when calculating the remedial target is 9.9E+99

Enter method of defining partition co-efficient (using pull down list)

Calculate for non-polar organic chemicals

Entry if specify partition coefficient (option)

Soil water partition coefficient — Kd — l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon in aquifer	foc	1.45E-02	fraction
Organic carbon partition coefficient	Koc	5.01E+03	l/kg

Entry for ionic organic chemicals (option)

Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
Acid dissociation constant	pKa		
Fraction of organic carbon in aquifer	foc		fraction
Soil water partition coefficient	Kd	7.27E+01	l/kg

Define dispersivity (click brown cell and use pull down list)

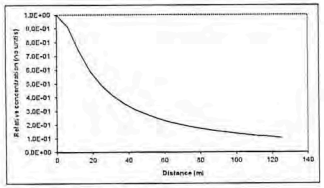
Dispersivities 10%, 1%, 0.1% of pathway length

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax		1.25E+01	m
Transverse dispersivity	az		1.25E+00	m
Vertical dispersivity	ay		1.25E-01	m

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = $0.83(\log_{10}x)^{2.414}$; az = ax/10, ay = ax/100 are assumed

Note
This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best desribed by an electron limited degradation such as oxidation by O_2, NO_3, SO_4 etc than an alternative solution should be used



Note: 'Relative concentration' is the ratio of calculated concentration at a given position compared to the source concentration, The calculations assume plume disperses from the top of the aquifer. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

This sheet calculates the Level 3 remedial target for soils(mg/kg) or for pore water (mg/l), based on the distance to the receptor or compliance located down hydraulic gradient of the source.Three solution methods are included, the preferred option is Ogata Banks.By setting a long travel time (e.g. 9E99) it will give the steady state solution, which should always be used when calculating remedial targets.

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.9E+99.

Site being assessed: Anthrolash
Completed by: [redacted]
Date: 08/09/2023
Version: V1.1

Calculated (relative) concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Relative concentration
	(No units)
0	1.0E+00
6.3	9.1 4E-01
12.5	7.32E-01
18.8	5.90E-01
25.0	4.88E-01
31.3	4.13E-01
37.5	3.56E-01
43.8	3.11E-01
50.0	2.76E-01
56.3	2.47E-01
62.5	2.23E-01
68.8	2.03E-01
75.0	1.85E-01
81.3	1.71E-01
87.5	1.58E-01
93.8	1.46E-01
100.0	1.36E-01
106.3	1.27E-01
112.5	1.19E-01
118.8	1.12E-01
125.0	1.05E-01

Environment Agency

Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

This worksheet has been produced in combination with the document 'Remedial Targets Methodology: Hydrogeological risk assessment for land contamination (Environment Agency 2006).

Users of this worksheet should always refer to the User Manual to the Remedial Targets Methodology and to relevant guidance on UK legislation and policy, in order to understand how this procedure should be applied in an appropriate context.

IMPORTANT: To enable MS Excel worksheet, click Tools, Add -Ins, Analysis Tool Pak and Analysis Tool Pak-VBA (to calculate error functions)

Details to be completed for each assessment				
Site Name:	Ardrossan			
Site Address:	North Ayrshire			
Completed by:	[redacted]			
Date:	06-Sep-23		Version:	V1.2
Contaminant	C12-16 Aro			
Target Concentration (C_T)	0.001	mg/l	Origin of C_T:	Marine EQS / LoD in solids

This worksheet can be used to determine remedial targets for soils (Worksheets Level 1 Soil, Level 2 and Level 3 Soil) or to determine remedial targets for groundwater (Level 3 Groundwater). For Level 3, parameter values must be entered separately dependent on whether the assessment is for soil or groundwater. For soil, remedial targets are calculated as either mg/kg (for comparision with soil measurements) or mg/l (for comparison with leaching tests or pore water concentrations).
Site details entered on this page are automatically copied to Level 1, 2 and 3 Worksheets.
Worksheet options are identified by brown background and employ a pull-down menus. Data entry are identified as blue background.
Data origin / justification should be noted in cells coloured yellow and fully documented in subsequent reports.
Data carried forward from an earlier worksheet are identified by a light green background
It is recommended that a copy of the original worksheet is saved (all data fields in the original copy are blank).

The spreadsheet also includes a porosity calculation worksheet, a soil impact calculation worksheet and a worksheet that performs some simple hydrogeological calculations.

Remedial Targets Worksheet , Release 3.2

Level 1 - Soil

Environment Agency

Select the method of calculating the soil water Partition Co-efficient by using the pull down menu below

Calculate for non-polar organic chemicals

Contaminant		C12-16 Aro		
Target concentration	C_T	0.001	mg/l	

Input Parameters	**Variable**	**Value**	**Unit**	**Source of parameter value**
Standard entry				
Water filled soil porosity	θ_W	3.30E-01	fraction	CLEA Sandy Loam
Air filled soil porosity	θa	2.00E-01	fraction	CLEA Sandy Loam
Bulk density of soil zone material	ρ	1.21E+00	g/cm^3	CLEA Sandy Loam
Henry's Law constant	H	1.04E-03	dimensionless	*USEPA; ECHA Support Doc for the Identification of A*
Entry if specify partition coefficient (option)				
Soil water partition coefficient	Kd		l/kg	
Entry for non-polar organic chemicals (option)				
Fraction of organic carbon (in soil)	foc	3.70E-02	fraction	Site Specific Data (historic)
Organic carbon partition coefficient	Koc	4.21E+04	l/kg	*USEPA; ECHA Support Doc for the Identification of Anthracene, 2008; Chemical Fate Half-Lives for Toxics Release Inventory (TRI) Chemicals, Syracuse*
Entry for ionic organic chemicals (option)				
Sorption coefficient for neutral species	$K_{oc,n}$		l/kg	
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg	
pH value	pH		pH units	
Acid dissociation constant	pKa			
Fraction of organic carbon (in soil)	foc		fraction	
Soil water partition coefficient used in Level Assessment	**Kd**	**1.56E+03**	**l/kg**	*Calculated value*

This sheet calculates the Level 1 remedial target for soils(mg/kg) based on a selected target concentration and theoretical calculation of soil water partitioning. Three options are included for determining the partition coefficient.

The measured soil concentration as mg/kg should be compared with the Level 1 remedial target to determine the need for further action.

Level 1 Remedial Target

Level 1 Remedial Target	**1.56E+00**	**mg/kg**	**(for comparison with soil analyses)**
	or		
	0.001	**mg/l**	**(for comparison with leachate test results)**

Site being assessed:	Ardrossan
Completed by:	[redacted]
Date:	06-Sep-23
Version:	V1.2

Remedial Targets Worksheet , Release 3.2

Level 2 - Soil

Contaminant		**C12-16 Aro**	from Level 1	This sheet calculates the Level 2 remedial target for soils (mg/kg) or for pore water (mg/l).
Target concentration	C_T	**0.001** mg/l	from Level 1	

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 2 remedial target to determine the need for further action. Equations presented in 'Hydrogeological risk assessment for land contamiantion' (Environment Agency 2006)

Input Parameters	Variable	Value	Unit	Source of parameter value	
Standard entry					
Infiltration	Inf	6.65E-04	m/d	**Rainfall (FEH) - Evaporation (CEH) 25% of long term**	
Area of contaminant source	A	3.30E+03	m^2	**Estimated Area of Plume (Acena)**	Not used in calculation
Entry for groundwater flow below site					
Length of contaminant source in direction of groundwater flow	L	2.00E+01	m	**Estimated Plume Length**	
Saturated aquifer thickness	da	1.00E+01	m	**Saturated Aquifer Depth to Sandstone 5+5m**	
Hydraulic Conductivity of aquifer in which dilution occurs	K	5.70E+00	m/d	**Site Data (historic)**	
Hydraulic gradient of water table	i	1.07E-02	fraction	**Site Data**	
Width of contaminant source perpendicular to groundwater flow	w	2.00E+01	m	**Site Data (20)**	Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l	**Assumed to be 0**	
Define mixing zone depth by specifying or calculating depth (using pull down list)		Calculate			
Enter mixing zone thickness	Mz		m		
Calculated mixing zone thickness	Mz	2.33E+00	m		

Calculated Parameters

Dilution Factor	DF	**1.17E+01**		
Level 2 Remedial Target		**1.17E-02**	mg/l	**For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentrati**
		or		
		1.82E+01	mg/kg	**For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water**

Additional option

Calculation of impact on receptor

Concentration of contaminant in contaminated discharge (entering receptor)	Cc	0.00E+00	mg/l	
Calculated concentration within receptor (dilution only)		0.00E+00	mg/l	0

Site being assessed:	Ardrossan
Completed by:	[redacted]
Date:	06-Sep-23
Version:	V1.2

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note

Environment Agency

Input Parameters	Variable	Value	Unit	Source
Contaminant		C12-16 Aro		from Level 1
Target Concentration	C_T	0.001	mg/l	from Level 1
Dilution Factor	DF	1.17E+01		from Level 2

Select analytical solution (click on brown cell below, then on pull-down menu)

Ogata Banks — Equations in HRA publication

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants: Apply degradation rate to dissolved pollutants only

	Variable	Value	Unit	Source of parameter value
Enter source concentration		Determine remedial target based on assumed concentration		
Half life for degradation of contaminant in water	$t_{1/2}$	1.50E+03	days	*Total Petroleum Hydrocarbon Criteria Working*
Calculated decay rate	λ	4.62E-04	$days^{-1}$	calculated
Width of plume in aquifer at source	Sz	2.00E+01	m	from Level 2
Plume thickness in aquifer at source	Sy	2.33E+00	m	from Level 2
Bulk density of aquifer materials	ρ	1.21E+00	g/cm^3	*Updated technical background to the CLEA model (SR3) table 4.4*
Effective porosity of aquifer	n	3.30E-01	fraction	*Updated technical background to the CLEA m*
Hydraulic gradient	i	1.17E-02	fraction	from Level 2 (adjusted)
Hydraulic conductivity of saturated aquifer	K	5.70E+00	m/d	from Level 2
Distance to compliance point	x	1.25E+02	m	*Seawall to Firth of Clyde*
Distance (lateral) to compliance point perpendicular to flow direction	z		m	
Distance (depth) to compliance point perpendicular to flow direction	y		m	
Time since pollutant entered groundwater	t	1.00E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	6.10E+02	l/kg	*see options*
Longitudinal dispersivity	ax	12.500	m	*see options*
Transverse dispersivity	az	1.250	m	*see options*
Vertical dispersivity	ay	0.125	m	*see options*

Parameter values should be checked against Level 1 and 2

Calculated Parameters	Variable		
Groundwater flow velocity	v	2.02E-01	m/d
Retardation factor	Rf	2.24E+03	fraction
Decay rate used	λ	2.07E-07	d^{-1}
Hydraulic gradient used in aquifer flow down-gradient	i	1.17E-02	fraction
Rate of contaminant flow due to retardation	u	9.04E-05	m/d
Ratio of Compliance Point to Source Concentration	C_{cp}/C_s	1.05E-01	fraction
Attenuation factor (C_p/C_{cp})	AF	**9.53E+00**	fraction

Enter method of defining partition co-efficient (using pull down list)

Calculate for non-polar organic chemicals

Entry if specify partition coefficient (option)

Soil water partition coefficient — Kd — l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon in aquifer	foc	1.45E-02	fraction
Organic carbon partition coefficient	Koc	4.21E+04	l/kg

Entry for ionic organic chemicals (option)

Sorption coefficient for ionised species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
Acid dissociation constant	pKa		
Fraction of organic carbon in aquifer	foc		fraction
Soil water partition coefficient	Kd	6.10E+02	l/kg

Define dispersivity (click brown cell and use pull down list)

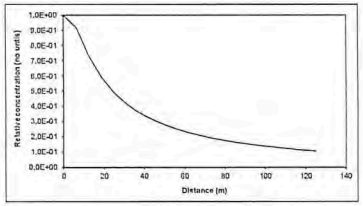
Dispersivities 10%, 1%, 0.1% of pathway length

		Enter value	Calc value	Xu & Eckstein	
Longitudinal dispersivity	ax		1.25E+01		m
Transverse dispersivity	az		1.25E+00		m
Vertical dispersivity	ay		1.25E-01		m

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = $0.83(\log_{10}x)^{2.414}$; az = ax/10, ay = ax/100 are assumed

Note
This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best desribed by an electron limited degradation such as oxidation by O_2, NO_3, SO_4 etc than an alternative solution should be used



Note: 'Relative concentration' is the ratio of calculated concentation at a given position compared to the source concentration. The calculations assume plume disperses from the top of the aquifer, An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Calculated (relative) concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Relative concentration (No units)
0	1.0E+00
6.3	9.14E-01
12.5	7.32E-01
18.8	5.90E-01
25.0	4.88E-01
31.3	4.13E-01
37.5	3.56E-01
43.8	3.11E-01
50.0	2.76E-01
56.3	2.47E-01
62.5	2.23E-01
68.8	2.03E-01
75.0	1.85E-01
81.3	1.71E-01
87.5	1.58E-01
93.8	1.46E-01
100.0	1.36E-01
106.3	1.27E-01
112.5	1.19E-01
118.8	1.12E-01
125.0	1.05E-01

This sheet calculates the Level 3 remedial target for soils(mg/kg) or for pore water (mg/l), based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks,By setting a long travel time (e.g. 9E99) it will give the steady state solution, which should always be used when calculating remedial targets.

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.9E+99.

Site being assessed:	Ardrossan
Completed by:	[redacted]
Date:	06/09/2023
Version:	V1.2

Remedial Targets

Level 3 Remedial Target		**1.11E-01**	**mg/l**	For comparison with measured pore water concentration.
Ogata Banks		or		This assumes Level 1 Remedial Target is based on Target Concentration.
		1.73E+02	mg/kg	For comparison with measured soil concentration. This
Distance to compliance point		**125**	**m**	assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
Ratio of Compliance Point to Source Concentration	C_{cp}/C_s	**1.05E-01**	**fraction**	Ogata Banks

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target.
The recommended value for time when calculating the remedial target is 9.9E+99

Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

This worksheet has been produced in combination with the document 'Remedial Targets Methodology: Hydrogeological risk assessment for land contamination (Environment Agency 2006).

Users of this worksheet should always refer to the User Manual to the Remedial Targets Methodology and to relevant guidance on UK legislation and policy, in order to understand how this procedure should be applied in an appropriate context.

The calculation of equations in this worksheet has been independently checked by Entec (UK) Ltd on behalf of the Environment Agency.

IMPORTANT: To enable MS Excel worksheet, click Tools, Add -Ins, Analysis Tool Pak and Analysis Tool Pak-VBA (to calculate error functions

Details to be completed for each assessment				
Site Name:	**Ardrossan**			
Site Address:	**North Ayrshire**			
Completed by:	[redacted]			
Date:	**07-Sep-23**		**Version:**	**V1.5**
Contaminant	**Dibenz(a,h)anthracene**			
Target Concentration (C_T)	**0.001**	**mg/l**	**Origin of C_T:**	**Marine EQS**

This worksheet can be used to determine remedial targets for soils (Worksheets Level 1 Soil, Level 2 and Level 3 Soil) or to determine remedial targets for groundwater (Level 3 Groundwater). For Level 3, parameter values must be entered separately dependent on whether the assessment is for soil or groundwater. For soil, remedial targets are calculated as either mg/kg (for comparision with soil measurements) or mg/l (for comparison with leaching tests or pore water concentrations).
Site details entered on this page are automatically copied to Level 1, 2 and 3 Worksheets.
Worksheet options are identified by brown background and employ a pull-down menus. Data entry are identified as blue background.
Data origin / justification should be noted in cells coloured yellow and fully documented in subsequent reports.
Data carried forward from an earlier worksheet are identified by a light green background
It is recommended that a copy of the original worksheet is saved (all data fields in the original copy are blank).

The spreadsheet also includes a porosity calculation worksheet, a soil impact calculation worksheet and a worksheet that performs some simple hydrogeological calculations.

Remedial Targets Worksheet , Release 3.2

Level 1 - Soil

Environment Agency

Select the method of calculating the soil water Partition Co-efficient by using the pull down menu below

Calculate for non-polar organic chemicals

Contaminant		Dibenz(a,h)anthracene		
Target concentration	C_T	0.001	mg/l	

Input Parameters	**Variable**	**Value**	**Unit**	**Source of parameter value**
Standard entry				
Water filled soil porosity	θ_W	3.30E-01	fraction	CLEA Sandy Loam
Air filled soil porosity	θa	2.00E-01	fraction	CLEA Sandy Loam
Bulk density of soil zone material	ρ	1.21E+00	g/cm^3	CLEA Sandy Loam
Henry's Law constant	H	5.76E-06	dimensionless	*USEPA*
Entry if specify partition coefficient (option)				
Soil water partition coefficient	Kd		l/kg	
Entry for non-polar organic chemicals (option)				
Fraction of organic carbon (in soil)	foc	1.19E-02	fraction	Site Specific Data (historic)
Organic carbon partition coefficient	Koc	5.65E+05	l/kg	*Means et al, 1980 from USEPA*
Entry for ionic organic chemicals (option)				
Sorption coefficient for neutral species	$K_{oc,n}$		l/kg	
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg	
pH value	pH		pH units	
Acid dissociation constant	pKa			
Fraction of organic carbon (in soil)	foc		fraction	
Soil water partition coefficient used in Level Assessment	**Kd**	**6.75E+03**	**l/kg**	*Calculated value*

This sheet calculates the Level 1 remedial target for soils(mg/kg) based on a selected target concentration and theoretical calculation of soil water partitioning. Three options are included for determining the partition coefficient.

The measured soil concentration as mg/kg should be compared with the Level 1 remedial target to determine the need for further action.

Level 1 Remedial Target

Level 1 Remedial Target	**6.75E+00**	**mg/kg**	**(for comparison with soil analyses)**
	or		
	0.001	**mg/l**	**(for comparison with leachate test results)**

Site being assessed:	Ardrossan
Completed by:	[redacted]
Date:	07-Sep-23
Version:	V1.5

Remedial Targets Worksheet , Release 3.2

Environment Agency

Level 2 - Soil

Contaminant		Dibenz(a,h)anthracene		from Level 1
Target concentration	C_T	0.001	mg/l	from Level 1

This sheet calculates the Level 2 remedial target for soils (mg/kg) or for pore water (mg/l).

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 2 remedial target to determine the need for further action. Equations presented in 'Hydrogeological risk assessment for land contamiantion' (Environment Agency 2006)

Input Parameters	**Variable**	**Value**	**Unit**	**Source of parameter value**	
Standard entry					
Infiltration	Inf	1.70E-03	m/d	Rainfall (FEH) - Evaporation (CEH) 25% of long term	
Area of contaminant source	A	3.30E+03	m^2	Estimated Area of Plume	Not used in calculation
Entry for groundwater flow below site					
Length of contaminant source in direction of groundwater flow	L	4.00E+01	m	Estimated Plume Length	
Saturated aquifer thickness	da	1.00E+01	m	Saturated Aquifer Depth to Sandstone 5+5m	
Hydraulic Conductivity of aquifer in which dilution occurs	K	2.70E+00	m/d	Site Data (historic)	
Hydraulic gradient of water table	i	1.07E-02	fraction	Site Data	
Width of contaminant source perpendicular to groundwater flow	w	1.65E+02	m	Site Data	Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l	Assumed to be 0	
Define mixing zone depth by specifying or calculating depth (using pull down list)		Calculate			
Enter mixing zone thickness	Mz		m		
Calculated mixing zone thickness	Mz	6.33E+00	m		

Calculated Parameters

Dilution Factor	DF	3.69E+00		
Level 2 Remedial Target		3.69E-03	mg/l	For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentr
		or		
		2.49E+01	mg/kg	For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water

Additional option

Calculation of impact on receptor

Concentration of contaminant in contaminated discharge (entering receptor)	Cc	0.00E+00	mg/l	
Calculated concentration within receptor (dilution only)		0.00E+00	mg/l	0

Site being assessed:	Ardrossan
Completed by:	[redacted]
Date:	07-Sep-23
Version:	V1.5

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note

Environment Agency

Input Parameters	Variable	Value	Unit	Source
Contaminant		Dibenz(a,h)anthracene		from Level 1
Target Concentration	C_T	0.001	mg/l	from Level 1
Dilution Factor	DF	3.69E+00		from Level 2

Select analytical solution (click on brown cell below, then on pull-down menu)

Ogata Banks — Equations in HRA publication

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants: Apply degradation rate to dissolved pollutants only

	Variable	Value	Unit	Source of parameter value
Enter source concentration		Determine remedial target based on assumed concentration		
Half life for degradation of contaminant in water	$t_{1/2}$	1.88E+03	days	*Howard et al. 1991. Environmental Degradatio*
Calculated decay rate	λ	3.69E-04	$days^{-1}$	calculated
Width of plume in aquifer at source	Sz	1.85E+02	m	from Level 2
Plume thickness in aquifer at source	Sy	6.33E+00	m	from Level 2
Bulk density of aquifer materials	ρ	1.21E+00	g/cm^3	*Updated technical background to the CLEA model (SR3) table 4.4*
Effective porosity of aquifer	n	3.30E-01	fraction	*Updated technical background to the CLEA m*
Hydraulic gradient	i	1.47E-02	fraction	from Level 2 (adjusted)
Hydraulic conductivity of saturated aquifer	K	2.70E+00	m/d	from Level 2
Distance to compliance point	x	1.25E+02	m	*Seawall to Firth of Clyde*
Distance (lateral) to compliance point perpendicular to flow direction	z		m	
Distance (depth) to compliance point perpendicular to flow direction	y		m	
Time since pollutant entered groundwater	t	1.00E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	6.75E+03	l/kg	*see options*
Longitudinal dispersivity	ax	12.500	m	*see options*
Transverse dispersivity	az	1.250	m	*see options*
Vertical dispersivity	ay	0.125	m	*see options*

Parameter values should be checked against Level 1 and 2

Calculated Parameters	Variable		
Groundwater flow velocity	v	1.20E-01	m/d
Retardation factor	Rf	2.47E+04	fraction
Decay rate used	λ	1.49E-08	d^{-1}
Hydraulic gradient used in aquifer flow down-gradient	i	1.47E-02	fraction
Rate of contaminant flow due to retardation	u	4.85E-06	m/d
Ratio of Compliance Point to Source Concentration	C_{cp}/C_s	5.13E-01	fraction
Attenuation factor (C_s/C_{cp})	AF	1.95E+00	fraction

Enter method of defining partition co-efficient (using pull down list)

Calculate for non-polar organic chemicals

Entry if specify partition coefficient (option)

Soil water partition coefficient — Kd — l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon in aquifer — foc — 1.19E-02 — fraction

Organic carbon partition coefficient — Koc — 5.65E+05 — l/kg

Entry for ionic organic chemicals (option)

Sorption coefficient for related species — $K_{ref\ s}$ — l/kg

Sorption coefficient for ionised species — $K_{ref\ i}$ — l/kg

pH value — pH

Acid dissociation constant — pKa

Fraction of organic carbon in aquifer — foc — fraction

Soil water partition coefficient — Kd — 6.75E+03 — l/kg

Define dispersivity (click brown cell and use pull down list)

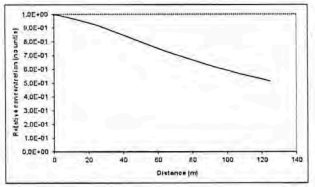
Dispersivities 10%, 1%, 0.1% of pathway length

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax		1.25E+01	m
Transverse dispersivity	az		1.25E+00	m
Vertical dispersivity	ay		1.25E-01	m

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report $ax = 0.83(\log_{10}x)^{2.414}$; az = ax/10, ay = ax/100 are assumed

Note
This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best described by an electron limited degradation such as oxidation by O_2, NO_3, SO_4 etc then an alternative solution should be used



Note: 'Relative concentration' is the ratio of calculated concentation at a given position compared to the source concentration. The calculations assume plume disperses from the top of the aquifer. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

This sheet calculates the Level 3 remedial target for soils(mg/kg) or for pore water (mg/l), based on the distance to the receptor or compliance located down hydraulic gradient of the source.Three solution methods are included, the preferred option is Ogata Banks.By setting a long travel time (e.g. 9E99) it will give the steady state solution, which should always be used when calculating remedial targets.

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.9E+99.

Soil being assessed: Arsenical
Completed by: [redacted]
Date: ##/##/####
Version: V1.5

Calculated (relative) concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Relative concentration
	(No units)
0	1.0E+00
6.3	9.82E-01
12.5	9.63E-01
18.8	9.43E-01
25.0	9.18E-01
31.3	8.90E-01
37.5	8.60E-01
43.8	8.30E-01
50.0	7.99E-01
56.3	7.69E-01
62.5	7.40E-01
68.8	7.12E-01
75.0	6.86E-01
81.3	6.60E-01
87.5	6.36E-01
93.8	6.13E-01
100.0	5.91E-01
106.3	5.70E-01
112.5	5.50E-01
118.8	5.31E-01
125.0	5.13E-01

Remedial Targets

Level 3 Remedial Target	**7.19E-03**	**mg/l**	For comparison with measured pore water concentration.
Ogata Banks	**or**		This assumes Level 1 Remedial Target is based on Target Concentration.
	4.86E+01	**mg/kg**	For comparison with measured soil concentration. This
Distance to compliance point	**125**	**m**	assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
Ratio of Compliance Point to Source Concentration	**C_{cp}/C_s 5.13E-01**	**fraction**	Ogata Banks

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target.
The recommended value for time when calculating the remedial target is 9.9E+99

Environment Agency

Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

This worksheet has been produced in combination with the document 'Remedial Targets Methodology: Hydrogeological risk assessment for land contamination (Environment Agency 2006).

Users of this worksheet should always refer to the User Manual to the Remedial Targets Methodology and to relevant guidance on UK legislation and policy, in order to understand how this procedure should be applied in an appropriate context.

The calculation of equations in this worksheet has been independently checked by Entec (UK) Ltd on behalf of the Environment Agency.

IMPORTANT: To enable MS Excel worksheet, click Tools, Add -Ins, Analysis Tool Pak and Analysis Tool Pak-VBA (to calculate error functions

Details to be completed for each assessment

Site Name:	**Ardrossan**			
Site Address:	**North Ayrshire**			
Completed by:	[redacted]			
Date:	**06.09.23**		**Version:**	**V1.1**
Contaminant	**Napthalene**			
Target Concentration (C_T)	**0.001**	**mg/l**	**Origin of C_T:**	**Marine EQS**

This worksheet can be used to determine remedial targets for soils (Worksheets Level 1 Soil, Level 2 and Level 3 Soil) or to determine remedial targets for groundwater (Level 3 Groundwater). For Level 3, parameter values must be entered separately dependent on whether the assessment is for soil or groundwater. For soil, remedial targets are calculated as either mg/kg (for comparision with soil measurements) or mg/l (for comparison with leaching tests or pore water concentrations).
Site details entered on this page are automatically copied to Level 1, 2 and 3 Worksheets.
Worksheet options are identified by brown background and employ a pull-down menus. Data entry are identified as blue background.
Data origin / justification should be noted in cells coloured yellow and fully documented in subsequent reports.
Data carried forward from an earlier worksheet are identified by a light green background
It is recommended that a copy of the original worksheet is saved (all data fields in the original copy are blank).

The spreadsheet also includes a porosity calculation worksheet, a soil impact calculation worksheet and a worksheet that performs some simple hydrogeological calculations.

Remedial Targets Worksheet , Release 3.2

Level 1 - Soil

Environment Agency

Select the method of calculating the soil water Partition Co-efficient by using the pull down menu below

Calculate for non-polar organic chemicals

Contaminant		Napthalene		
Target concentration	C_T	0.001	mg/l	
Input Parameters	**Variable**	**Value**	**Unit**	**Source of parameter value**
Standard entry				
Water filled soil porosity	θ_W	3.30E-01	fraction	CLEA Sandy Loam
Air filled soil porosity	θa	2.00E-01	fraction	CLEA Sandy Loam
Bulk density of soil zone material	ρ	1.21E+00	g/cm^3	CLEA Sandy Loam
Henry's Law constant	H	6.62E-03	dimensionless	*Environment Agency 2008. Compilation of data for pi*
Entry if specify partition coefficient (option)				
Soil water partition coefficient	Kd		l/kg	
Entry for non-polar organic chemicals (option)				
Fraction of organic carbon (in soil)	foc	3.70E-02	fraction	Site Specific Data (historic)
Organic carbon partition coefficient	Koc	6.46E+02	l/kg	*Environment Agency 2008. Compilation of data for priority organic pollutants for derivation of Soil Guideline Values*
Entry for ionic organic chemicals (option)				
Sorption coefficient for neutral species	$K_{oc,n}$		l/kg	
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg	
pH value	pH		pH units	
Acid dissociation constant	pKa			
Fraction of organic carbon (in soil)	foc		fraction	
Soil water partition coefficient used in Level Assessment	**Kd**	**2.39E+01**	**l/kg**	*Calculated value*

This sheet calculates the Level 1 remedial target for soils(mg/kg) based on a selected target concentration and theoretical calculation of soil water partitioning. Three options are included for determining the partition coefficient.

The measured soil concentration as mg/kg should be compared with the Level 1 remedial target to determine the need for further action.

Level 1 Remedial Target

Level 1 Remedial Target	**2.42E-02**	**mg/kg**	**(for comparison with soil analyses)**
	or		
	0.001	**mg/l**	**(for comparison with leachate test results)**

Site being assessed:	Ardrossan
Completed by:	[redacted]
Date:	06.09.23
Version:	V1.1

Remedial Targets Worksheet , Release 3.2

Level 2 - Soil

Environment Agency

Contaminant		Napthalene	from Level 1	This sheet calculates the Level 2 remedial target for soils (mg/kg) or for pore water (mg/l).
Target concentration	C_T	0.001 mg/l	from Level 1	

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 2 remedial target to determine the need for further action. Equations presented in 'Hydrogeological risk assessment for land contamiantion' (Environment Agency 2006)

Input Parameters	Variable	Value	Unit	Source of parameter value	
Standard entry					
Infiltration	Inf	6.65E-04	m/d	Rainfall (FEH) - Evaporation (CEH) 25% of long term	
Area of contaminant source	A	3.30E+03	m^2	Estimated Area of Plume (acena)	Not used in calculation
Entry for groundwater flow below site					
Length of contaminant source in direction of groundwater flow	L	2.00E+01	m	Estimated Plume Length	
Saturated aquifer thickness	da	1.00E+01	m	Saturated Aquifer Depth to Sandstone 5+5m	
Hydraulic Conductivity of aquifer in which dilution occurs	K	5.70E+00	m/d	Site Data (historic)	
Hydraulic gradient of water table	i	1.07E-02	fraction	Site Data	
Width of contaminant source perpendicular to groundwater flow	w	1.65E+02	m	Site Data	Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l	Assumed to be 0	
Define mixing zone depth by specifying or calculating depth (using pull down list)		Calculate			
Enter mixing zone thickness	Mz		m		
Calculated mixing zone thickness	Mz	2.33E+00	m		

Calculated Parameters

Dilution Factor	**DF**	**1.17E+01**		
Level 2 Remedial Target		**1.17E-02**	**mg/l**	**For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentr**
		or		
		2.83E-01	**mg/kg**	**For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water**

Additional option

Calculation of impact on receptor				
Concentration of contaminant in contaminated discharge (entering receptor)	Cc	0.00E+00	mg/l	
Calculated concentration within receptor (dilution only)		0.00E+00	mg/l	0

Site being assessed:	Ardrossan
Completed by:	[redacted]
Date:	06.09.23
Version:	V1.1

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note

Environment Agency

Input Parameters	Variable	Value	Unit	Source
Contaminant		Napthalene		from Level 1
Target Concentration	C_T	0.001	mg/l	from Level 1
Dilution Factor	DF	1.17E+01		from Level 2

Select analytical solution (click on brown cell below, then on pull-down menu)

Ogata Banks — Equations in HRA publication

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants: Apply degradation rate to dissolved pollutants only

	Variable	Value	Unit	Source of parameter value
Enter source concentration		Determine remedial target based on assumed concentration		
Half life for degradation of contaminant in water	$t_{1/2}$	2.59E+02	days	*Howard et al. 1991. Environmental Degradatio*
Calculated decay rate	λ	2.67E-03	$days^{-1}$	calculated
Width of plume in aquifer at source	Sz	1.65E+02	m	from Level 2
Plume thickness in aquifer at source	Sy	2.33E+00	m	from Level 2
Bulk density of aquifer materials	ρ	1.21E+00	g/cm^3	*Updated technical background to the CLEA model (SR3) table 4.4*
Effective porosity of aquifer	n	3.30E-01	fraction	*Updated technical background to the CLEA m*
Hydraulic gradient	i	1.17E-02	fraction	from Level 2 (adjusted)
Hydraulic conductivity of saturated aquifer	K	5.70E+00	m/d	from Level 2
Distance to compliance point	x	1.25E+02	m	*Seawall to Firth of Clyde*
Distance (lateral) to compliance point perpendicular to flow direction	z		m	
Distance (depth) to compliance point perpendicular to flow direction	y		m	
Time since pollutant entered groundwater	t	1.00E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	9.37E+00	l/kg	*see options*
Longitudinal dispersivity	ax	12.500	m	*see options*
Transverse dispersivity	az	1.250	m	*see options*
Vertical dispersivity	ay	0.125	m	*see options*

Parameter values should be checked against Level 1 and 2

Calculated Parameters	Variable		
Groundwater flow velocity	v	2.02E-01	m/d
Retardation factor	Rf	3.53E+01	fraction
Decay rate used	λ	7.57E-05	d^{-1}
Hydraulic gradient used in aquifer flow down-gradient	i	1.17E-02	fraction
Rate of contaminant flow due to retardation	u	5.72E-03	m/d
Ratio of Compliance Point to Source Concentration	C_{cp}/C_s	7.62E-02	fraction
Attenuation factor (C_s/C_{cp})	AF	1.31E+01	fraction

Enter method of defining partition co-efficient (using pull down list)

Calculate for non-polar organic chemicals

Entry if specify partition coefficient (option)

Soil water partition coefficient — Kd — l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon in aquifer	foc	1.42E-02	fraction
Organic carbon partition coefficient	Koc	6.48E+02	l/kg

Entry for ionic organic chemicals (option)

Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
Acid dissociation constant	pKa		
Fraction of organic carbon in aquifer	foc		fraction
Soil water partition coefficient	Kd	9.37E+00	l/kg

Define dispersivity (click brown cell and use pull down list)

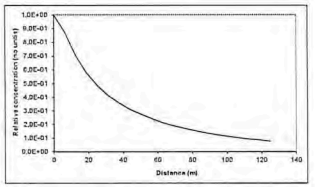
Dispersivities 10%, 1%, 0.1% of pathway length

		Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax		1.25E+01	m
Transverse dispersivity	az		1.25E+00	m
Vertical dispersivity	ay		1.25E-01	m

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report $ax = 0.83(\log_{10}x)^{2.414}$; az = ax/10, ay = ax/100 are assumed

Note
This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best described by an electron limited degradation such as oxidation by O_2, NO_3, SO_4 etc than an alternative solution should be used



Note: 'Relative concentration' is the ratio of calculated concentration at a given position compared to the source concentration. The calculations assume plume disperses from the top of the aquifer. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Calculated (relative) concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Relative concentration
	(No units)
0	1.0E+00
6.3	8.73E-01
12.5	7.04E-01
18.8	5.79E-01
25.0	4.86E-01
31.3	4.15E-01
37.5	3.59E-01
43.8	3.13E-01
50.0	2.75E-01
56.3	2.43E-01
62.5	2.16E-01
68.8	1.93E-01
75.0	1.72E-01
81.3	1.54E-01
87.5	1.39E-01
93.8	1.25E-01
100.0	1.13E-01
106.3	1.02E-01
112.5	9.26E-02
118.8	8.40E-02
125.0	7.62E-02

This sheet calculates the Level 3 remedial target for soils(mg/kg) or for pore water (mg/l), based on the distance to the receptor or compliance located down hydraulic gradient of the source.Three solution methods are included, the preferred option is Ogata Banks.By setting a long travel time (e.g. 9E99) it will give the steady state solution, which should always be used when calculating remedial targets.

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.9E+99.

Site being assessed: Ardrossan
Completed by: [redacted]
Date: 08.09.23
Version: V1.1

Remedial Targets

Level 3 Remedial Target		**1.33E-01**	**mg/l**	For comparison with measured pore water concentration.
Ogata Banks		or		This assumes Level 1 Remedial Target is based on Target Concentration.
		3.71E+00	**mg/kg**	For comparison with measured soil concentration, This
Distance to compliance point		**125**	**m**	assumes Level 1 Remedial Target calculated from soil-water partitioning equation,
Ratio of Compliance Point to Source Concentration	C_{cp}/C_s	**7.62E-02**	**fraction**	Ogata Banks

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target.
The recommended value for time when calculating the remedial target is 9.9E+99

Appendix F DQRA Modelling Assumptions

Site-Specific Inputs and Sensitivity Considerations for RTM	Values	Source and Justification
Modelling Type	Reverse Modelling	Use of models to back calculate concentration at the source that would result in exposure or concentrations at the receptor equalling allowable exposure (i.e., EQS). Using models to calculate SSAC, Remediation or Validation Criteria, to address risk to the water environment Prepared to address key uncertainties of the project Prepared in accordance with SEPA WAT-PS-10-01
Hydrogeology		
Aquifer Soil Type	Silty Sandy Loam	*EA (2009) Updated Background to CLEA model (SR3) Table 4.4* Selected after review of site data (exploratory hole logs and PSD analysis). Soil type considered appropriate based on nature of fill either side of historic sea wall combined.
Bulk Density	1.21 c/cm3	As above
Air Filled Soil Porosity	0.20	As above
Water Filled (Effective) Porosity	0.33	As above
Hydraulic Conductivity	5.70 m/day	Site Information – from historic close down report modelling
Hydraulic Gradient	0.0107	Calculated from site specific information. Considered groundwater monitoring data from and distance between, BH07 & BH08
Depth to Groundwater	3.49m	Site Specific Information. Average depths form monitoring data of BH07, BH08, BH09 and BH20.
Groundwater Flow Direction	East to West	Site specific inform ation. Radiant calculation form site transects mainly considering BH08 and BH09. See D3240/011 in Appendix A
Saturated Aquifer Thickness	5.00m	Site specific information. Review of borehole logs for strata and water strikes, monitoring data. Kelly Burn Sandstone not conceptually appropriate for inclusion due to groundwater flow inhibition by sea walls. 5.00m mixing zone considered within Kelly Burn Sandstone for conservatism.
Plume Dimensions (Clustered Zone)	165m width 20m length	Area of Acenaphthylene exceedances in soils
Plume Dimensions (Scattered Zones)	20m width 20m length	Assumed hotspot extents for individual, scattered exceedances in soils
Fraction of Organic Carbon in Soil	0.037	Carried forward from historic modelling in close down report by EnviroCentre
Fraction of Organic Carbon in Soil: Benzo(a)pyrene, Benzo(b)fluoranthene, Dibenzo(a,h)anthracene	0.0011946	Site Specific Data. Calculated using SOM data from site laboratory analysis.
Contaminant Characteristics		
Background Concentration of Contaminant in Groundwater (all)	0.00	Introduce conservatism into model
Target Concentrations C_T	EQS Coastal	Best practice and following SEPA Guidance WAT-SG-53

Compliance Point and Critical Water Environment Receptor	Firth of Clyde at Mean High Tide Water Level / Edge of sea Wall	Best practice Following SEPA Guidance WAT-SG-53 and WAT-PS-10-01
Dilution Assessments	Only at Level 2 and 3 Soil	Not assessed further to introduce conservatism into model
Henrys Law Constants (H unitless)		
Aromatic C8-C10	0.48	*Total Petroleum Hydrocarbon Criteria Working Group Series (TPHCWG), 1999. Human Health Risk-Based Evaluation of Petroleum Release Sites: Implementing the Working Group Approach, Volume 5, Table 1.*
Aromatic C10-C12	0.14	
Aromatic C12-C16	0.053	
Aromatic C16-C21	0.013	
Naphthalene	0.00662	*Environment Agency 2008. Compilation of data for priority organic pollutants for derivation of Soil Guideline Values*
Acenaphthylene	0.00466	*RAIS database (Risk Assessment Information System, http://rais.ornl.gov/tools/)*
Benzo(a)pyrene	0.00000176	*Environment Agency 2008. Compilation of data for priority organic pollutants for derivation of Soil Guideline Values*
Benzo(b)fluoranthene	0.00000205	*Environment Agency 2008. Compilation of data for priority organic pollutants for derivation of Soil Guideline Values*
Dibenzo(a,h)anthracene	0.00000576	*RAIS database (Risk Assessment Information System, http://rais.ornl.gov/tools/)*
Organic Carbon Partition Coefficient KoC (l/kg)		
Aromatic C8-C10	148.5	*USEPA Archive Document, Technical Factsheet on: Ethylbenzene, National Primary Drinking Water Regulations (Ethylbenzene)*
Aromatic C10-C12	2,512	*Total Petroleum Hydrocarbon Criteria Working Group Series (TPHCWG), 1999. Human Health Risk-Based Evaluation of Petroleum Release Sites: Implementing the Working Group Approach, Volume 5, Table 1.*
Aromatic C12-C16	5,012	
Aromatic C16-C21	1,5849	
Naphthalene	646	*Environment Agency 2008. Compilation of data for priority organic pollutants for derivation of Soil Guideline Values*
Acenaphthylene	5,207	*RAIS database (Risk Assessment Information System, http://rais.ornl.gov/tools/)*
Benzo(a)pyrene	128,825	*Environment Agency 2008. Compilation of data for priority organic pollutants for derivation of Soil Guideline Values*
Benzo(b)fluoranthene	104,713	
Dibenzo(a,h)anthracene	565,014	*Means et al, 1980 from USEPA*
Half Life for Degradation in Water (days)		
Aromatic C8-C10	125	*Environment Agency 2008. Compilation of data for priority organic pollutants for derivation of Soil Guideline Values*
Aromatic C10-C12	200	*Environment Agency 2008. Compilation of data for priority organic pollutants for derivation of Soil Guideline Values*
Aromatic C12-C16	1499	*Environment Agency 2008. Compilation of data for priority organic pollutants for derivation of Soil Guideline Values*
Aromatic C16-C21	1982	*Environment Agency 2008. Compilation of data for priority organic pollutants for derivation of Soil Guideline Values*
Naphthalene	226.3	*Howard et al. 1991. Environmental Degradation Rates. Max values.*
Acenaphthylene	120.	*Howard et al. 1991. Environmental Degradation Rates. Max values.*
Benzo(a)pyrene	1058.5	*Howard et al. 1991. Environmental Degradation Rates. Max values.*
Benzo(b)fluoranthene	1219.1	*Howard et al. 1991. Environmental Degradation Rates. Max values.*
Dibenzo(a,h)anthracene	1879.75	*Howard et al. 1991. Environmental Degradation Rates. Max values.*

Appendix G DQRA Sensitivity Analysis

Sensitivity Analysis			
Contaminant	Parameter Change (%)	RTL Change (%)	Comment
Aromatic C8-C10	Infiltration +25%	-27%	Model is moderately sensitive to Infiltration
	0.00083125m/d	5.75mg/kg	
	Infiltration -25%	+36%	
	0.00049875m/d	10mg/kg	
Aromatic C8-C10	KoC +25%	+23.6%	Model is moderately sensitive to KoC
	185.625L/kg	9.07mg/kg	
	KoC -25%	-24.9%	
	109.125L/kg	5.51mg/kg	
Aromatic C8-C10	Hydraulic Gradient +25%	-21.3%	Model is moderately to highly sensitive to Hydraulic Gradient
	0.013375	5.78mg/kg	
	Hydraulic Gradient -25%	+44.4%	
	0.008025	10.6mg/kg	

Appendix H CAR Discharge Permit

SEPA
Scottish Environment Protection Agency
Buidheann Dion Àrainneachd na h-Alba

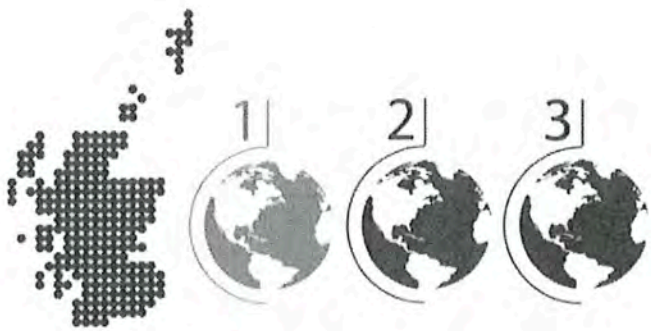
Construction Run-Off Permit

CAR/S/5001029

North Shore, Ardrossan

For information on accessing this document in an alternative format or language please contact SEPA by email at equalities@sepa.org.uk

If you are a user of British Sign Language (BSL) the Contact Scotland BSL service gives you access to an online interpreter enabling you to communicate with us using sign language: http://contactscotland-bsl.org/



Introduction

This introduction is not part of the authorisation.

Authorisations

Who we are: The Scottish Environment Protection Agency (SEPA) is a non-departmental public body of the Scottish Government. Our purpose is to deliver environmental protection and improvement in ways that, as far as possible, also create health and wellbeing benefits and sustainable economic growth.

Why we issue authorisations: We are responsible for preventing or controlling pollution and improving the environment. One of the tools available to us is the authorisation of activities that present environmental risk. Authorisations give permission for these activities to occur and set conditions that the activities must comply with.

When we issue authorisations: We will issue an authorisation following our determination of an application, when satisfied that the authorised person has put in place measures to protect the environment and is capable of carrying out activities in line with the conditions of an authorisation.

Changes to authorisations: We can amend, suspend or revoke an authorisation in response to changes in legislation, the activities undertaken or authorisation holder performance.

Compliance and enforcement: SEPA Officers may undertake monitoring and inspections to assess compliance with authorisation conditions. All authorisations and inspection reports are publicly available. If an authorised person fails to comply with an authorisation, we may take enforcement action in line with our enforcement policy and guidance.

General Information:

Address:	North Shore Moonlight Place Ardrossan KA22 8BL
Description of authorised activities:	The discharge of water run-off from construction works at a construction site to the water environment.
Environmental risks SEPA has regulatory powers to control:	The impact on the water environment due to the discharge of water run-off from a construction site.

Authorisation Number: CAR/S/5001029

SEPA
Scottish Environment Protection Agency
Buidheann Dion Àrainneachd na h-Alba

Notice: Grant of Authorisation

This authorisation has been granted by the Scottish Environment Protection Agency (SEPA) in exercise of its powers under:

The Water Environment (Controlled Activities) (Scotland) Regulations 2011

Authorisation Number:	CAR/S/5001029
Authorised Person:	North Ayrshire Council Cunninghame House Irvine Scotland KA12 8EE
Date of Authorisation:	10 February 2022
Authorised Activities:	The discharge of water run-off from construction works at a construction site to the water environment.
Authorised Place:	The construction site location as further detailed in the schedules of this authorisation.
Conditions applicable to this authorisation:	The conditions contained in the schedules of this authorisation. Terms used in this authorisation are, unless otherwise specified, defined in the Interpretation of Terms schedule.

Authorisation Number: CAR/S/5001029

SEPA
Scottish Environment Protection Agency
Buidheann Dìon Àrainneachd na h-Alba

Contents

Schedule 1: The Authorised Person and Activities

Purpose: This schedule places responsibility on the authorised person to ensure compliance with the conditions of this authorisation and details the activities that can be carried out.

1.1 Duty of Authorised Person

1.1.1 The authorised person must ensure compliance with the conditions of this authorisation.

1.2 Authorised Activities

1.2.1 The authorised activities are:

(a) The discharge of water run-off to the water environment from construction works at the construction site outlined in red on the plan attached at Appendix 1;

necessary for North Shore Development, Ardrossan.

Schedule 2: Impacts on the Water Environment

Purpose: This schedule limits the impact of the authorised activities on the water environment. These descriptive conditions cover the vast majority of impacts that may arise from pollution, and allow SEPA to take action if these impacts occur.

2.1 Environmental Impacts

2.1.1 The authorised activities must not have a significant impact on the water environment as a result of:

(a) Iridescence / sheen due to oil;

(b) Discolouration;

(c) Deposition of solids;

(d) Increased foaming;

(e) Microbiological growth.

Authorisation Number: CAR/S/5001029

Schedule 3: Construction Water Run-Off

Purpose: This schedule limits the scale, location and impact of water run-off from construction works at the construction site. During construction, the development must be drained by a sustainable urban drainage system, or equivalent. The water run-off must be treated to meet the sample discharge limits.

3.1 Discharge Activities

3.1.1 The discharge of water run-off from the construction site must be treated by a sustainable urban drainage system or equivalent.

3.1.2 The discharge of water run-off from the construction site must not be chemically treated.

3.2 Environmental Limits

3.2.1 Any of the discharges specified in Table 1 must not exceed the corresponding limits specified in Table 1.

Table 1 Sustainable Urban Drainage System, or equivalent, Discharge Limits

Discharge	Limit	
	Suspended Solids (mg/l)	pH
Discharge of water run-off to the North Ayrshire Coastal catchment	80	>5 and <9

3.2.2 The discharge of any other substance not specified in Table 1, to the water environment from the sustainable urban drainage system, or equivalent, must not cause environmental harm.

Schedule 4: Environmental Events

Purpose: This schedule requires the cessation, prevention and reporting of any potentially polluting event that may arise from the authorised activities.

4.1 Notification of SEPA

4.1.1 SEPA must be notified via its pollution hotline contact telephone number as soon as reasonably practicable, and in any case within 24 hours of identification of an event, of any of the following:

(a) An event that has caused or could cause adverse impact to the environment or harm to human health;

(b) An event that results, or could result, in an emission to the environment that is not authorised;

(c) An event that has caused a breach of a condition of this authorisation.

4.2 Management of the Event

4.2.1 All measures that are reasonably practicable must be taken to stop an event and to minimise its effect on the environment.

4.3 Reporting of the Event

4.3.1 Within 14 days of an event a report must be submitted to SEPA detailing:

(a) The reason(s) for the event;

(b) The action(s) taken to stop the event and minimise the impacts; and

(c) The action(s) taken to prevent the event from recurring.

Authorisation Number: CAR/S/5001029

Schedule 5: Record Keeping and Data Submission

Purpose: This schedule requires the authorised person to keep records of specific activities carried out and to provide SEPA with specified information at regular intervals.

5.1 Record Keeping

5.1.1 All information recorded, kept or submitted to SEPA in accordance with a condition of this authorisation must be:

(a) True and accurate;

(b) Kept for a minimum of six years; and

(c) Provided to SEPA upon request.

Schedule 6: Interpretation of Terms

For the purposes of this authorisation, and unless the context requires otherwise, the following definitions apply.

Term	Definition
authorisation	The Water Use Licence granted by SEPA under The Water Environment (Controlled Activities) (Scotland) Regulations 2011.
authorised activities	The activities which may be carried on under this authorisation.
authorised person	The holder of this authorisation and person responsible for securing compliance with the conditions of it.
authorised place	The geographic location or locations at which the authorised activities may be carried on.
construction works	The carrying out of any building, civil engineering or engineering construction work, including any preparatory groundworks
environmental harm	(a) Harm to the health of human beings or other living organisms, (b) Harm to the quality of the water environment, including: (i) harm to the quality of the water environment taken as a whole, (ii) other impairment of, or interference with, the quality of aquatic ecosystems or terrestrial ecosystems directly depending on aquatic ecosystems, (c) Offence to the sense of human beings, (d) Damage to property, or (e) Impairment of, or any interference with, amenities or other legitimate uses of the water environment.
event	• Any accident which has caused or could cause environmental harm; or • Any malfunction, breakdown or failure of plant, infrastructure or techniques which has caused or could cause environmental harm; or • Force majeure or action taken to save human life or limb.
SEPA	Scottish Environment Protection Agency.

Authorisation Number: CAR/S/5001029

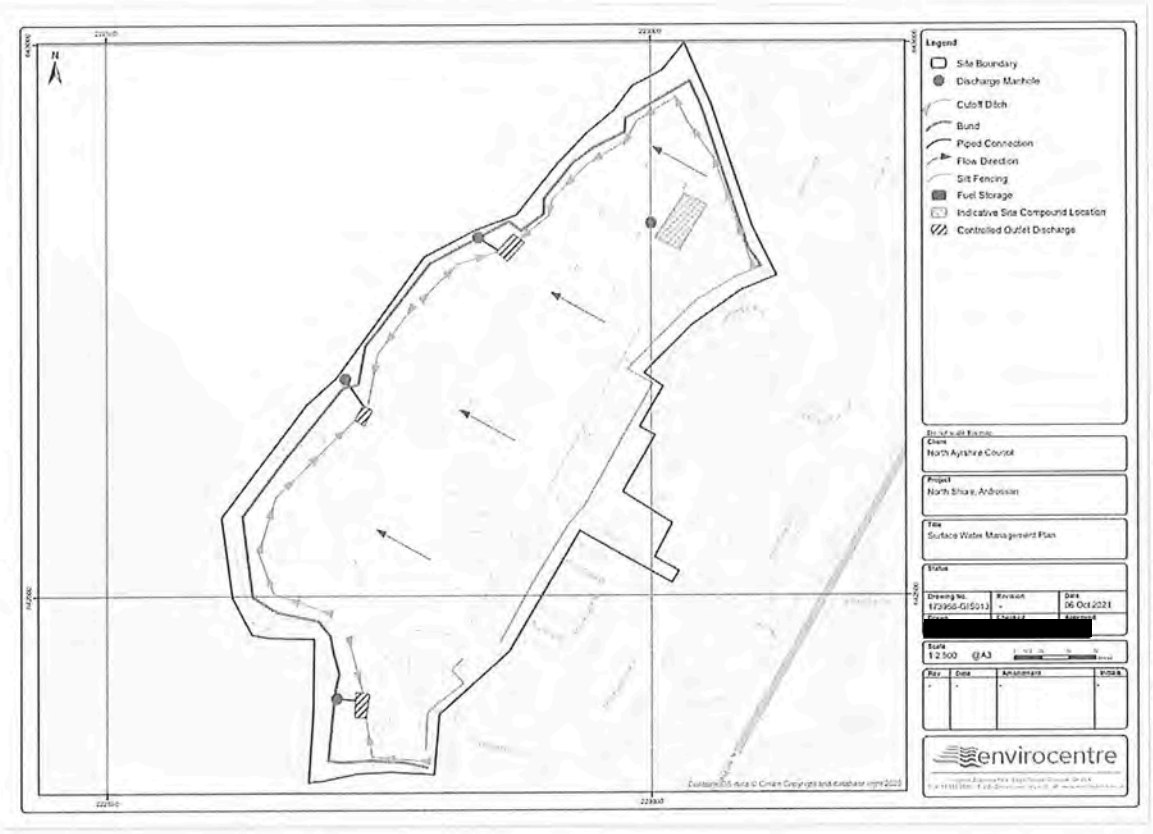
Term	Definition
surface water	Inland water (other than groundwater), transitional water and coastal water.
Surface water drainage system	A system, such as a SUD system, that is used to collect and drain water run-off from one or more premises and transport it to, and discharge it into, the water environment
sustainable urban drainage system	A drainage system which: (a) facilitates attenuation, settlement or treatment of surface water from two or more premises (whether or not together with road water), and (b) includes one or more of the following: inlet structures, outlet structures, swales, constructed wetlands, ponds, filter trenches, attenuation tanks and detention basins (together with any associated pipes and equipment)
water environment	All surface water, groundwater and wetlands.
water run-off	Any water from rainfall or any meltwater from ice or snow flowing over or horizontally through the surface of the ground and any matter picked up by that water.
wetland	An area of ground the ecological, chemical and hydrological characteristics of which are attributed to frequent inundation or saturation by water and which is directly dependent, with regard to its water needs, on a body of groundwater or a body of surface water

Except where specified otherwise, any reference to an enactment or statutory instrument includes a reference to it as amended (whether before or after the date of the authorisation) and to any other enactment, which may after the date of the authorisation replace or amend it.

Authorisation Number: CAR/S/5001029

SEPA
Scottish Environment Protection Agency
Buidheann Dion Àrainneachd na h-Alba

Appendix 1. Plan of Construction Site



Appendix I Environmental Monitoring Plan

Environmental Monitoring Plan Outline.

Environmental morning for the site, commencing following access on September 25th, aims to comprehensively assess and manage key environmental parameters, including dust, asbestos, volatile organic compounds (VOCs), and noise. To establish a reliable baseline, data collection will commence for two weeks after site

access begins (before remediation activities). This initial baseline will serve as a critical reference point against which weekly monitoring results will be compared.

Dust levels will be closely monitored to gauge their impact on the surrounding environment. Asbestos will also be monitored (in addition to the specific Asbestos Controls). Additionally, volatile organic compounds (VOCs) emissions will be scrutinized to assess their potential atmospheric impact, while noise levels will be measured to evaluate their potential disturbances to the local community.

Specific Environmental Monitoring Stations (EMS) will be strategically positioned within the site as outlined in the Site-Specific Working Plan. These EMS locations have been strategically selected to provide a representative sampling of environmental conditions across the site. Each EMS will be equipped with the necessary monitoring equipment to continuously assess key parameters, including dust, asbestos, volatile organic compounds (VOCs). Noise will be monitored remotely using mobile equipment. The EMS will play a crucial role in data collection to establish baseline data. The baseline data from EMS will serve as a reference point for ongoing weekly monitoring,

If successive monitoring results reveal an increasing trend in any of these parameters, a thorough assessment of controls and mitigation measures will be conducted. Regulators will be promptly engaged in discussions to collaboratively identify and implement strategies aimed at minimizing environmental impact, thus ensuring responsible and sustainable site operations.

Table I-1: Environmental Monitoring Schedule

Monitoring Type	Frequency	Baseline (To be Confirmed W/C 25/09/2023)
Dust	Weekly	
Asbestos	Weekly	
VOCs	Weekly	
Noise	Daily	

Appendix J Groundwater – Free Phase Hydrocarbon Validation Procedure

Groundwater Free Phase Hydrocarbon Validation Procedure

All excavations encountering groundwater will be assessed for the presence of free phase hydrocarbon contamination.

Sanctus's excavations will be undertaken under the watching brief of the environmental engineer.

Groundwater will be pumped using a submersible pump unit if not suspected of hydrocarbon free product. This will be treated as per the site-specific working plan and as per section 14.6.

Where Free Phase Hydrocarbons are encountered, a skimmer pump will be used to reduce NAPL thickness until no visible sheen/globules or separation is visible from the surface. It is understood that previous remediation phases have identified visually dark and obvious free phase hydrocarbons. If the water recharges, then continuous dewatering pumps will be active for the duration of that excavation, until no visual NAPL is noted.

Following skimming the engineer will take a representative water sample from the excavation. This will be in a clear bailer or glass vessel when appropriate.

The sample will be allowed to settle for 15 minutes to allow any free phase hydrocarbons to separate and form distinct layers if present. Whereby a photograph will be taken for lines of evidence.

Based upon the works completed to date and from historic site information the following definitions have been generated to define a sheen vs a free phase product:

- A sheen is defined as: light grey to rainbow film with no demonstrable thickness (Photo 01);
- Free Phase Product: highly viscous dark brown to black oils of demonstrable and measurable thickness (Photo 02).

Visual assessment is the primary method where the presence of a sheen, colour differences, and distinct layering in water samples are observed.

Suitable photographs will be taken to demonstrate the presence or lack of free phase hydrocarbon product. If product is still present skimming and pumping will resume.

If the settled sample provides no indication of free phase product, then groundwater samples are to be analysed to validate removal of free phase hydrocarbons from the groundwater for the specific location. The results will be recorded and shown to the clerk of works.

The excavation will be backfilled and reinstated with suitable material in agreement, should soil validations also pass criteria with the independent clerk of works.

Photo 01: (Left): Visible Rainbow Sheen within groundwater.

Photo 02 (Right): Black to Dark Brown heavy fuel free phase product.

- Following visual assessment of the pumped waters, the remaining ground water is to be considered suitably remediated if both of the following conditions are met:1mm or less of measurable free phase thickness of a representative groundwater sample obtained from the remediation excavations. After a 15-minute settlement period, the water sample shall be measured using a ruler on a clear vertical bailer/suitable transparent glass vessel of a maximum internal diameter of 50 mm; and/or
- Less than 10% surface area coverage within the excavation of a visible sheen.

If both free product and a sheen are detected, both metrics will be required to be passed, in order to deem the groundwater remediation suitable. If one or both of the conditions are not met, the above dewatering and monitoring process is repeated until both conditions are met.

Appendix K - Bioremediated Stockpile Technical Note – Reuse and declaration form creation

North Ayrshire Council,
Cunninghame House,
Irvine,
Scotland,
KA12 8EE

16th August 2024,
Our Ref: SL2274.3240.02.JRA

For the attention of [redacted]

Re: S3240 Ardrossan – Technical Note for the reuse of bioremediated treated Stockpiles.

Dear [redacted]

Introduction

Following on from the initial trials for bioremediation soil treatment and sampling of the known impacted material at the Ardrossan site, Sanctus propose to reuse a number of treated material stockpiles. Sectional declarations of suitability for stockpiled material, including a chemical suitability review, current location and a volumes to material the data applies to.

Production and testing of treated soil Stockpiles

Throughout the ongoing remediation works at the Ardrossan site, a number of bioremediated Stockpiles have been formed, prior to their reuse within the site. These stockpiles currently range between 700m^3 and 2,000m^3 in overall volume. After each Stockpile's initial dosing and formation, a series of representative samples are taken, relative to the requirements outlined in the Remediation Specification (Rev E) – at least 1 per 100m^3. Both the Stockpile's and individual radially spread sampling locations shall be recorded relative to the two established treatment areas.

The entire treated Stockpile is tested for banded and Total Petroleum Hydrocarbons (TPHs). The tests are repeated frequently (each round between 1 to 2 weeks after the previous round). The sampling rounds are repeated until 3No. consecutive sampling rounds show a suitable total TPH levels for reuse.

Figure 1 – Example Stockpile location extract with Sampling locations (treated Stockpile 07)

All samples are to be taken from a within the body of the Stockpile, with internal soils initially exposed by an excavator. This is done as a safe sample retrieval option as well as to target an internal representative sample location mid-way from the edge to the centre of the Stockpile, as discussed under BS ISO 18400-104:2018 (Sampling Strategies), subsection 9.

The subsequent sample depths will be between 1-2 m below the Stockpile's surface and a minimum of 4No. characteristic subsamples are taken from an area of approximately $1m^2$ of the newly exposed material. The 4No. sub-locations are chosen in a X-pattern and the combined testing soil material becomes a composite sample, following a systematic stratified random sub-sampling location of a 3-dimensional source.

Material split of treated Stockpile 09 and current testing

Following the sampling rounds which began at the end of April 2024, a significant portion of the treated Stockpile 09 was seen to have 3no.consecutive sampling rounds which passed all of the reuse criteria. 40% of the material (sample locations 01, 14 – 20 as seen in Figure 2 below), grouped together in the south of the stockpile achieved the consecutive rounds. The remaining material was interspersed with material which achieved the majority of the reuse criteria, but not all (failures seen within the Total TPH analytes), in such a fashion that the remaining sample locations which were seen as compliant, could not be easily/accurately separated and reused (samples from location 04, 07, 10, 11 and 12).

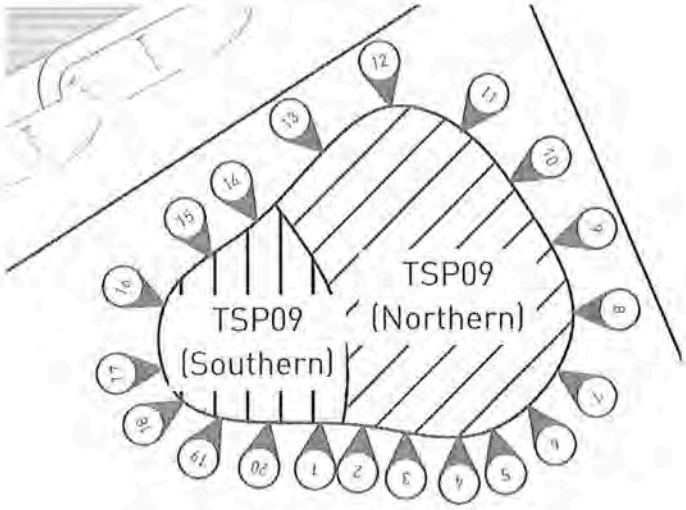


Figure 2 - Sampling locations of treated Stockpile 09

Subsequently, treated Stockpile 09 was split into a northern portion ($1,200m^3$) where treatment and testing will continue and a southern portion ($800m^3$) was deemed as chemically suitable for reuse by Sanctus, so was consequently stockpiled separately and reused.
The test results related to the southern portion of the treated Stockpile 09 (renamed as TSP09 South) are included within the example treated Stockpile declaration form, within Enclosure A.

Proposed Phased reuse of treated Stockpile 09

Sanctus proposes to reuse the material from Stockpile 09 in two phases:

- Phase 1 – TSP09 South. Due to the demonstration of suitability for the southern 800 m^3 of materials (From samples SP09-01 and SP09-14 to SP09-20)
- Phase 2 – TSP09 North. The remaining 1,200m^3 of the original TSP09 stockpile Continued material treatment, sampling and future reuse following validation.

Stockpile reuse and cross party validation

In order to aid a prompt transition for treated soil stockpile reuse and client acceptance, Sanctus proposes a reuse declaration form. An updated example of such a form (for TSP09 South) is included in Enclosure A, from which Sanctus have stated the following information:

- Size and location of the treated Stockpile to be reviewed.
- The number of samples, from which 3No. consecutive rounds (sampled at a rate of 1 sample per 100m^3 as required by the Remediation Specification (Rev E)).
- The names of each sample position deemed chemically suitable for reuse.
- The sample positions will be plotted showing a systematic radial spread for their locations.
- Following the retrieval of the samples for the round, the entire Stockpile is to be mechanically turned to allow future homologous representative samples to be taken.
- A signed declaration by Sanctus on the acceptance for the reuse of the material in question, following a review of the included chemical data.

The reuse of the material is dependent on obtaining 3No. consecutive rounds in which all analytes are reported below the reuse criteria, or showing an insignificant amount of outlying results with a minimum statistical confidence, as discussed below. The declarations shall contain the information pertaining to the 3No. consecutive rounds and will also acknowledge the previous sampling rounds in which the material was not yet suitable for reuse.

Where required, a statistical overview and data trendlines of the screened chemical data will accompany the declaration, when outlier exceedances are encountered. In order for screened data to be deemed as suitable, an upper confidence (U95) of at least 95% will be required for material to be declared as suitable, where exceedance results (total TPH levels for individual samples >1,000 mg/kg) are noted. For data sets seen that include exceedances these results are statistically screened in following the principles of the CL:AIRE Guidance on applying statistics to land contamination decision-making - 2020 (1). As per section 14.14 of contained within the Remediation Specification Rev. E, where required, statistical evidence (in the form of a log-normal histogram and confirmation of the U95% conformance) will be presented in all declaration forms where required. For material showing outlier(s) which skew the data outside of the U95% confidence level, that material is not suitable for use, retests and material segregation will occur as appropriate and weekly testing continued until 3no. suitable concurrent rounds are achieved.

Sanctus will issue such a form to NAC for a data review prior to reuse of treated material and any such material shall be accurately spatially recorded, as required by the Remediation Specification (Rev E).

Sanctus hope you are happy with such a proposal and an initial suitability agreement for the chemical testing of TSP09 South and the wider strategy for testing and validate bioremediated stockpiles.

Yours Sincerely,

[redacted]

[redacted]

Enclosures

Enclosure A – Treated Stockpile Declaration Form Example – TSP09 South, Rev B

References

1. **Contaminated Land: Applications in Real Environments (CL:AIRE).** *Guidance on applying statistics to land contamination decision-making.* 2020. ISBN: 978-1-905046-35-5.

Treated Stockpile Reuse Validation Form 001 – TSP09 South

Stockpile ID

Stockpile ID: TSP09 South

Material Volume: 800 m^3

Validation Samples Included 8 No.

Tested Location: Treatment Area 01

Stockpile Creation Date: 15/04/2024

Release Date: TBC

Sampling Data (3No. full rounds for validation to release)

Passing Round 1 (Overall Sample Round 3 of 5)	Sample Date: 24/04/2024	Report Number & Date: 24-016293 - 02/05/2024	Lab: Eurofins
Passing Round 2 (Overall Sample Round 4 of 5)	Sample Date: 01/05/2024	Report Number & Date: 24-017477 - 10/05/2024	Lab: Eurofins
Passing Round 3 (Overall Sample Round 5 of 5)	Sample Date: 08/05/2024	Report Number & Date: 24-018602 - 16/05/2024	Lab: Eurofins

Sampling Data

Passing Round 1

Report Number: 24-016293

Report Date: 02/05/2024

Sample ID (Sample Names): TSP09-01B, TSP09-14B, TSP09-15B, TSP09-16B, TSP09-17B, TSP09-18B, TSP09-19B, TSP09-20B

Report ID (Lab): Eurofins

Comments:

Test Results: PASS / ~~FAIL~~

Overall, 3rd round of sampling undertaken from the treated Stockpile. No exceedances seen throughout. Average Total TPH = 196 mg/kg. Sanctus deem this round of sampling as chemically suitable for reuse.

Passing Round 2

Report Number: 24-017477

Report Date: 10/05/2024

Sample ID (Sample Names): TSP09-01C, TSP09-14C, TSP09-15C, TSP09-16C, TSP09-17C, TSP09-18C, TSP09-19C, TSP09-20C

Report ID (Lab): Eurofins

Comments:

Test Results: PASS / ~~FAIL~~

Overall, 4th round of sampling undertaken from the treated Stockpile. No exceedances seen throughout. Average Total TPH = 730 mg/kg. Sanctus deem this round of sampling as chemically suitable for reuse.

Passing Round 3

Report Number: 24-018602

Report Date: 16/05/2024

Sample ID (Sample Names): TSP09-01D, TSP09-14D, TSP09-15D, TSP09-16D, TSP09-17D, TSP09-18D, TSP09-19D, TSP09-20D

Report ID (Lab): Eurofins

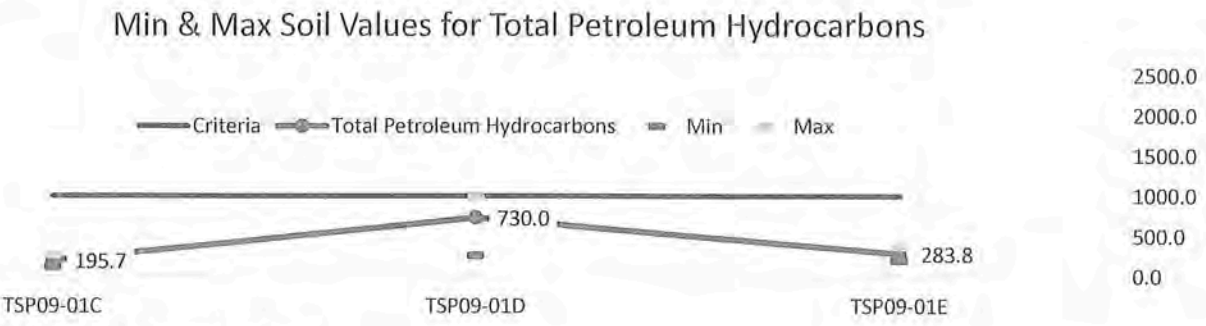
Comments:

Test Results: PASS / ~~FAIL~~

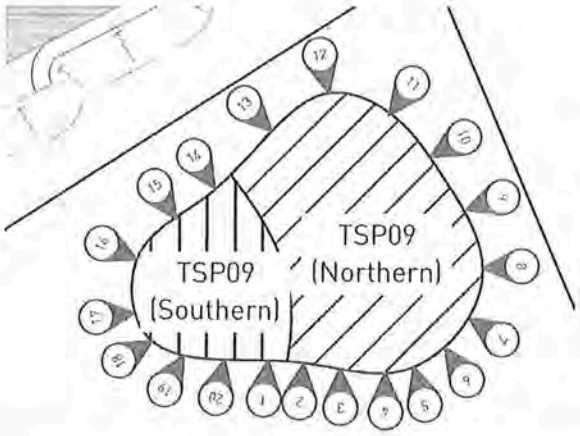
Overall, 5th round of sampling undertaken from the treated Stockpile. No exceedances seen throughout. Average Total TPH = 284 mg/kg. Sanctus deem this round of sampling as chemically suitable for reuse.

Data Review

Data Trend for Total TPH levels:



Treated Stockpile Sample Plan:



Sampling Strategy:

All samples have been taken in compliance with ISO BS 18400, including the following notes:

- Stainless steel/washable sampling devices (trowels, buckets, etc) will be employed for the gathering of the soils samples and cleaned between each sample location so that consecutive samples are not cross-contaminated.
- The sample positions shown above indicate the position relative to the base boundary of the stockpile. All samples are taken from a within the body of the Stockpile, retrieved by an excavator. This is done as a safe sample retrieval option as well as to target an internal representative sample location mid-way from the edge to the centre of the Stockpile, as discussed under BS ISO 18400-104:2018 (Sampling Strategies), subsection 9.
- The subsequent sample depths were between 1-2 m below the Stockpile's surface and a minimum of 4No. characteristic subsamples were taken from an area of approximately $1m^2$ of the newly exposed material. The 4No. or more sub-locations were chosen in a X-pattern and the combined testing soil material is described as a composite sample, following a systematic stratified random sub-sampling location of a 3-dimensional source.
- The mechanically retrieved material is then sub-sampled into the required sampling jars/pots by the Sanctus Engineer as a representative sample from the numbered location.

Sanctus Declaration:

We confirm that:

1. The material that this form relates to, has been sampled representatively, as discussed above and in accordance with the client's requirements (Ardrossan Remediation Specification Rev E).
2. The material has been proven to be suitable for REUSE on site as there are 3 No. consecutive rounds, with a statistical insignificant number of exceedances of the accepted reuse criteria. No exceedances are seen within the first two monitoring rounds and each round's average for the total TPH levels have been significantly below the 1,000 mg/kg threshold level.
3. The laboratory analysis results are representative of the materials investigated.
4. The material released will also be recorded spatially at its reuse location.

NAME: [redacted]
POSITION: [redacted]
DATE: 16/08/2024
SIGNED:

Recoverable Signature

[redacted]

Signed by: 7ee90afd-5b10-4b4f-a839-775383c68d48

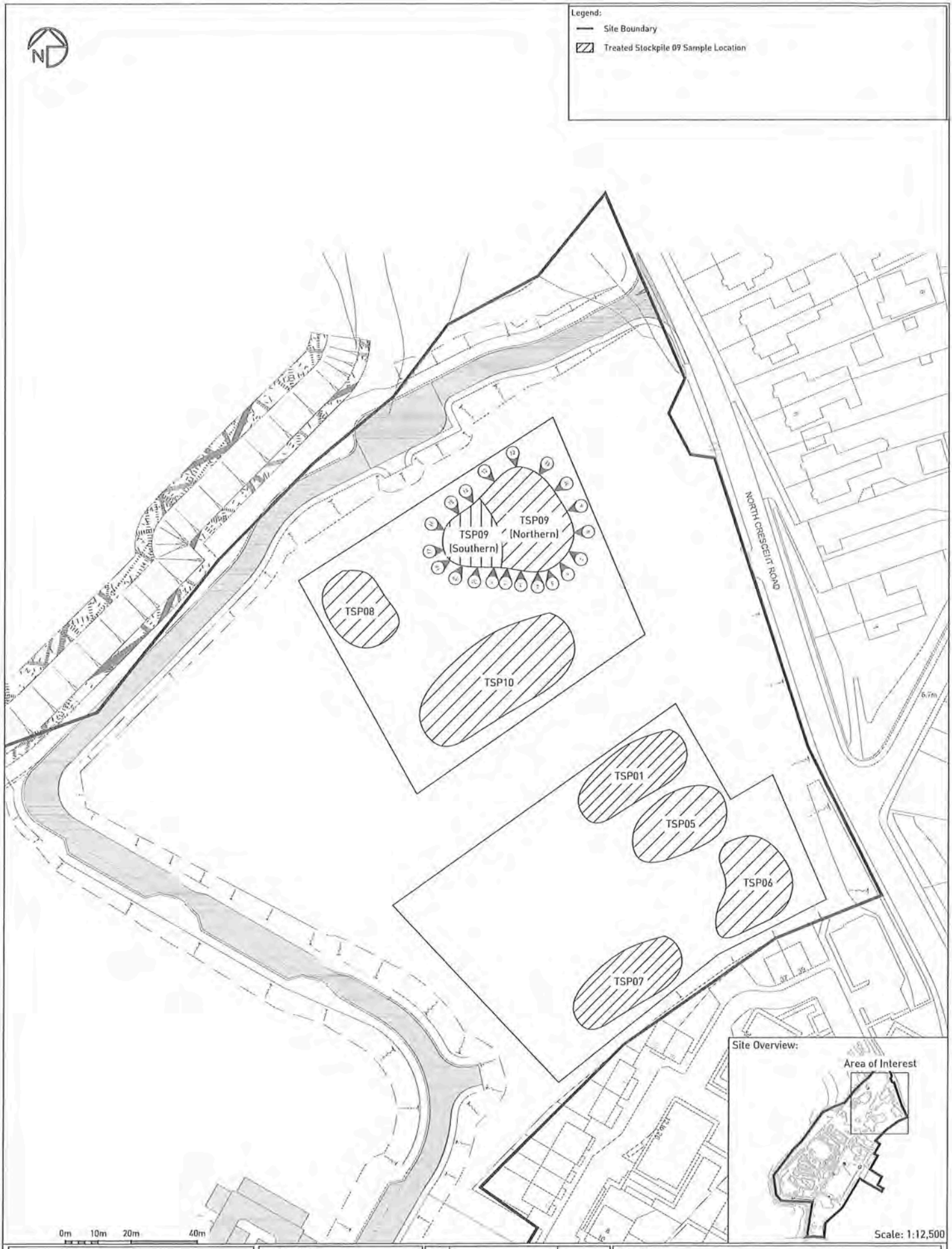
Record of reuse

For Sanctus Use Only:

Approved for reuse:

Beginning of Movement from stockpile:

End of Movement into site:



sanctus
Sanctus House, 1 Olympus Park Business Centre,
Quedgeley, Glos, GL2 4DH
T: 01453 828222
E: info@sanctusltd.co.uk www.sanctusltd.com

Drawing Notes:
Based on client supplied DWG - ARDROSSAN 2D produced by Aird Group 23/03/2020. All locations are approximate. Must be printed in colour.

Site Address:
Raylight Place
Ardrossan
North Ayrshire
Scotland

Rev.	Description	Date
A	First Issue	13/06/2024

APPROVED

Project Name: North Shore, Ardrossan
Client: North Ayrshire Council
Drawing Title: Treated Stockpile 09 Sample Locations

Contract No:	Drawing No:	Scale @ A3:
S3240	D3240/061	1:1000
Drawn By: [redacted]	QC Check By:	Approved By:

Sample ID	Test Reference	Stockpile Reference	Date Sampled	Total Petroleum Hydrocarbons	Aliphatic TPH >C5-C6	Aliphatic TPH >C6-C8	Aliphatic TPH >C8-C10	Aliphatic TPH >C10-C12	Aliphatic TPH >C12-C16	Aliphatic TPH >C16-C21	Aliphatic TPH >C21-C35	Aromatic TPH >C5-C7	Aromatic TPH >C7-C8	Aromatic TPH >C8-C10	Aromatic TPH >C10-C12	Aromatic TPH >C12-C16	Aromatic TPH >C16-C21	Aromatic TPH >C21-C35
Units				mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
LOD				10	0.02	0.02	0.05	1	2	8	8	0.01	0.01	0.05	1	2	10	10
Screening Criteria				1000	76	230	65	830	1000	1000	1000	140	280	7.34	46.9	173.47	540	1000
Max Value				2000	0	0	0	4.8	120	270	550	0	0	0	1.8	24	140	580
TSP09-01B	24-016293	TSP09 South	24/04/2024	280	< 0.020	< 0.020	< 0.050	3.1	39	52	59	< 0.010	< 0.010	< 0.050	< 1.0	15	37	57
TSP09-02B	24-016293	TSP09 North	24/04/2024	< 10	< 0.020	< 0.020	< 0.050	< 1.0	< 2.0	< 8.0	< 8.0	< 0.010	< 0.010	< 0.050	< 1.0	< 2.0	< 10	< 10
TSP09-03B	24-016293	TSP09 North	24/04/2024	100	< 0.020	< 0.020	< 0.050	< 1.0	12	18	15	< 0.010	< 0.010	< 0.050	< 1.0	6.4	18	26
TSP09-04B	24-016293	TSP09 North	24/04/2024	< 10	< 0.020	< 0.020	< 0.050	< 1.0	< 2.0	< 8.0	< 8.0	< 0.010	< 0.010	< 0.050	< 1.0	< 2.0	< 10	< 10
TSP09-05B	24-016293	TSP09 North	24/04/2024	100	< 0.020	< 0.020	< 0.050	1.4	17	24	23	< 0.010	< 0.010	< 0.050	< 1.0	4.4	14	16
TSP09-06B	24-016293	TSP09 North	24/04/2024	< 10	< 0.020	< 0.020	< 0.050	< 1.0	< 2.0	< 8.0	< 8.0	< 0.010	< 0.010	< 0.050	< 1.0	< 2.0	< 10	< 10
TSP09-07B	24-016293	TSP09 North	24/04/2024	160	< 0.020	< 0.020	< 0.050	1.6	17	28	37	< 0.010	< 0.010	< 0.050	< 1.0	8	23	37
TSP09-08B	24-016293	TSP09 North	24/04/2024	240	< 0.020	< 0.020	< 0.050	2	13	38	81	< 0.010	< 0.010	< 0.050	< 1.0	2.5	15	52
TSP09-09B	24-016293	TSP09 North	24/04/2024	200	< 0.020	< 0.020	< 0.050	< 1.0	9.1	28	62	< 0.010	< 0.010	< 0.050	< 1.0	4.6	14	51
TSP09-10B	24-016293	TSP09 North	24/04/2024	200	< 0.020	< 0.020	< 0.050	< 1.0	5.1	26	71	< 0.010	< 0.010	< 0.050	< 1.0	4.3	13	47
TSP09-11B	24-016293	TSP09 North	24/04/2024	48	< 0.020	< 0.020	< 0.050	< 1.0	< 2.0	< 8.0	< 8.0	< 0.010	< 0.010	< 0.050	< 1.0	< 2.0	< 10	30
TSP09-12B	24-016293	TSP09 North	24/04/2024	150	< 0.020	< 0.020	< 0.050	< 1.0	8	17	58	< 0.010	< 0.010	< 0.050	< 1.0	2.1	< 10	36
TSP09-13B	24-016293	TSP09 North	24/04/2024	190	< 0.020	< 0.020	< 0.050	1.1	7.5	25	70	< 0.010	< 0.010	< 0.050	< 1.0	4.2	13	42
TSP09-14B	24-016293	TSP09 South	24/04/2024	150	< 0.020	< 0.020	< 0.050	< 1.0	4.5	18	45	< 0.010	< 0.010	< 0.050	< 1.0	2.9	11	45
TSP09-15B	24-016293	TSP09 South	24/04/2024	220	< 0.020	< 0.020	< 0.050	1	9	26	69	< 0.010	< 0.010	< 0.050	< 1.0	4.1	22	62
TSP09-16B	24-016293	TSP09 South	24/04/2024	200	< 0.020	< 0.020	< 0.050	< 1.0	10	30	79	< 0.010	< 0.010	< 0.050	< 1.0	< 2.0	11	44
TSP09-17B	24-016293	TSP09 South	24/04/2024	230	< 0.020	< 0.020	< 0.050	1.1	8.1	28	73	< 0.010	< 0.010	< 0.050	1.6	3.9	14	66
TSP09-18B	24-016293	TSP09 South	24/04/2024	210	< 0.020	< 0.020	< 0.050	< 1.0	10	28	73	< 0.010	< 0.010	< 0.050	< 1.0	2.6	13	49
TSP09-19B	24-016293	TSP09 South	24/04/2024	140	< 0.020	< 0.020	< 0.050	< 1.0	5.5	19	47	< 0.010	< 0.010	< 0.050	< 1.0	< 2.0	< 10	41
TSP09-20B	24-016293	TSP09 South	24/04/2024	250	< 0.020	< 0.020	< 0.050	1.4	11	29	86	< 0.010	< 0.010	< 0.050	< 1.0	2.6	15	60
TSP09-01C	24-017477	TSP09 South	01/05/2024	200	< 0.020	< 0.020	< 0.050	< 1.0	8	19	52	< 0.010	< 0.010	< 0.050	< 1.0	2	12	50
TSP09-02C	24-017477	TSP09 North	01/05/2024	390	< 0.020	< 0.020	< 0.050	< 1.0	15	40	96	< 0.010	< 0.010	< 0.050	< 1.0	5.5	32	110
TSP09-03C	24-017477	TSP09 North	01/05/2024	160	< 0.020	< 0.020	< 0.050	< 1.0	8.8	18	43	< 0.010	< 0.010	< 0.050	< 1.0	< 2.0	13	44
TSP09-04C	24-017477	TSP09 North	01/05/2024	330	< 0.020	< 0.020	< 0.050	< 1.0	11	30	89	< 0.010	< 0.010	< 0.050	< 1.0	3.2	26	95
TSP09-05C	24-017477	TSP09 North	01/05/2024	160	< 0.020	< 0.020	< 0.050	< 1.0	< 2.0	< 8.0	17	< 0.010	< 0.010	< 0.050	< 1.0	3.2	20	75
TSP09-06C	24-017477	TSP09 North	01/05/2024	270	< 0.020	< 0.020	< 0.050	< 1.0	3.3	15	53	< 0.010	< 0.010	< 0.050	< 1.0	5.5	30	100
TSP09-07C	24-017477	TSP09 North	01/05/2024	770	< 0.020	< 0.020	< 0.050	< 1.0	25	77	220	< 0.010	< 0.010	< 0.050	< 1.0	6.1	52	220
TSP09-08C	24-017477	TSP09 North	01/05/2024	450	< 0.020	< 0.020	< 0.050	< 1.0	17	48	130	< 0.010	< 0.010	< 0.050	< 1.0	4.8	31	120
TSP09-09C	24-017477	TSP09 North	01/05/2024	650	< 0.020	< 0.020	< 0.050	< 1.0	26	68	180	< 0.010	< 0.010	< 0.050	< 1.0	7.5	45	180
TSP09-10C	24-017477	TSP09 North	01/05/2024	900	< 0.020	< 0.020	< 0.050	< 1.0	31	89	250	< 0.010	< 0.010	< 0.050	< 1.0	8.4	62	260
TSP09-11C	24-017477	TSP09 North	01/05/2024	68	< 0.020	< 0.020	< 0.050	< 1.0	< 2.0	< 8.0	< 8.0	< 0.010	< 0.010	< 0.050	< 1.0	< 2.0	< 10	32
TSP09-12C	24-017477	TSP09 North	01/05/2024	510	< 0.020	< 0.020	< 0.050	< 1.0	26	59	140	< 0.010	< 0.010	< 0.050	< 1.0	8.1	40	140
TSP09-13C	24-017477	TSP09 North	01/05/2024	180	< 0.020	< 0.020	< 0.050	< 1.0	8	18	35	< 0.010	< 0.010	< 0.050	< 1.0	< 2.0	16	60
TSP09-14C	24-017477	TSP09 South	01/05/2024	120	< 0.020	< 0.020	< 0.050	< 1.0	6.1	14	25	< 0.010	< 0.010	< 0.050	< 1.0	< 2.0	11	40
TSP09-15C	24-017477	TSP09 South	01/05/2024	260	< 0.020	< 0.020	< 0.050	2.2	17	30	67	< 0.010	< 0.010	< 0.050	< 1.0	3.3	20	72
TSP09-16C	24-017477	TSP09 South	01/05/2024	< 10	< 0.020	< 0.020	< 0.050	< 1.0	< 2.0	< 8.0	< 8.0	< 0.010	< 0.010	< 0.050	< 1.0	< 2.0	< 10	< 10
TSP09-17C	24-017477	TSP09 South	01/05/2024	170	< 0.020	< 0.020	< 0.050	< 1.0	< 2.0	9.1	38	< 0.010	< 0.010	< 0.050	< 1.0	3.9	18	67
TSP09-18C	24-017477	TSP09 South	01/05/2024	210	< 0.020	< 0.020	< 0.050	< 1.0	2.8	18	60	< 0.010	< 0.010	< 0.050	< 1.0	3.7	18	63
TSP09-19C	24-017477	TSP09 South	01/05/2024	180	< 0.020	< 0.020	< 0.050	< 1.0	4.8	16	44	< 0.010	< 0.010	< 0.050	< 1.0	4.2	19	56
TSP09-20C	24-017477	TSP09 South	01/05/2024	230	< 0.020	< 0.020	< 0.050	< 1.0	8.1	26	60	< 0.010	< 0.010	< 0.050	< 1.0	2.6	20	72
TSP09-01D	24-018602	TSP09 South	08/05/2024	980	< 0.020	< 0.020	< 0.050	3.1	41	120	280	< 0.010	< 0.010	< 0.050	1.1	7.5	80	290
TSP09-02D	24-018602	TSP09 North	08/05/2024	1400	< 0.020	< 0.020	< 0.050	1.3	62	160	350	< 0.010	< 0.010	< 0.050	< 1.0	13	120	440
TSP09-03D	24-018602	TSP09 North	08/05/2024	2000	< 0.020	< 0.020	< 0.050	4.2	120	270	550	< 0.010	< 0.010	< 0.050	1.3	13	160	580
TSP09-04D	24-018602	TSP09 North	08/05/2024	490	< 0.020	< 0.020	< 0.050	< 1.0	9.6	31	110	< 0.010	< 0.010	< 0.050	< 1.0	10	43	190
TSP09-05D	24-018602	TSP09 North	08/05/2024	1000	< 0.020	< 0.020	< 0.050	< 1.0	40	110	250	< 0.010	< 0.010	< 0.050	1.8	19	100	330
TSP09-06D	24-018602	TSP09 North	08/05/2024	1300	< 0.020	< 0.020	< 0.050	2	57	160	360	< 0.010	< 0.010	< 0.050	< 1.0	18	120	390
TSP09-07D	24-018602	TSP09 North	08/05/2024	840	< 0.020	< 0.020	< 0.050	< 1.0	37	100	230	< 0.010	< 0.010	< 0.050	< 1.0	12	75	250
TSP09-08D	24-018602	TSP09 North	08/05/2024	1600	< 0.020	< 0.020	< 0.050	4.6	87	210	440	< 0.010	< 0.010	< 0.050	1.5	20	140	480
TSP09-09D	24-018602	TSP09 North	08/05/2024	1700	< 0.020	< 0.020	< 0.050	3.8	90	190	380	< 0.010	< 0.010	< 0.050	1.6	24	160	570
TSP09-10D	24-018602	TSP09 North	08/05/2024	730	< 0.020	< 0.020	< 0.050	3	44	81	160	< 0.010	< 0.010	< 0.050	< 1.0	14	73	260
TSP09-11D	24-018602	TSP09 North	08/05/2024	720	< 0.020	< 0.020	< 0.050	< 1.0	22	66	170	< 0.010	< 0.010	< 0.050	< 1.0	5.7	60	270
TSP09-12D	24-018602	TSP09 North	08/05/2024	940	< 0.020	< 0.020	< 0.050	2.3	45	99	220	< 0.010	< 0.010	< 0.050	< 1.0	17	90	310
TSP09-13D	24-018602	TSP09 North	08/05/2024	1200	< 0.020	< 0.020	< 0.050	2	68	140	310	< 0.010	< 0.010	< 0.050	< 1.0	16	110	360
TSP09-14D	24-018602	TSP09 South	08/05/2024	700	< 0.020	< 0.020	< 0.050	< 1.0	31	75	170	< 0.010	< 0.010	< 0.050	< 1.0	11	66	220
TSP09-15D	24-018602	TSP09 South	08/05/2024	670	< 0.020	< 0.020	< 0.050	1.1	22	68	170	< 0.010	< 0.010	< 0.050	< 1.0	9.1	55	220
TSP09-16D	24-018602	TSP09 South	08/05/2024	790	< 0.020	< 0.020	< 0.050	3.2	45	100	190	< 0.010	< 0.010	< 0.050	< 1.0	5.7	72	250
TSP09-17D	24-018602	TSP09 South	08/05/2024	660	< 0.020	< 0.020	< 0.050	2.7	37	75	170	< 0.010	< 0.010	< 0.050	< 1.0	5.2	49	190
TSP09-18D	24-018602	TSP09 South	08/05/2024	810	< 0.020	< 0.020	< 0.050	2.4	47	100	230	< 0.010	< 0.010	< 0.050	< 1.0	4.9	55	220
TSP09-19D	24-018602	TSP09 South	08/05/2024	260	< 0.020	< 0.020	< 0.050	< 1.0	7.3	24	73	< 0.010	< 0.010	< 0.050	< 1.0	< 2.0	13	76
TSP09-20D	24-018602	TSP09 South	08/05/2024	970	< 0.020	< 0.020	< 0.050	2	56	120	260	< 0.010	< 0.010	< 0.050	< 1.0	9.1	74	280

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Analytical Report Number : 24-016293-2A

Replaces Analytical Report Number: 24-016293, issue no. 1
Report format change.
Report split as per clients request

Project / Site name:	Ardrossan North Shore	**Samples received on:**	25/04/2024
Your job number:	S3240	**Samples instructed on/ Analysis started on:**	25/04/2024
Your order number:	S3240	**Analysis completed by:**	02/05/2024
Report Issue Number:	2A	**Report issued on:**	13/06/2024
Samples Analysed:	8 soil samples		

[redacted]

Signed:

[redacted]

For & on behalf of i2 Analytical Ltd.

Standard Geotechnical, Asbestos and Chemical Testing Laboratory located at: ul. Pionierów 39, 41-711 Ruda Śląska, Poland.

Accredited tests are defined within the report, opinions and interpretations expressed herein are outside the scope of accreditation.

Standard sample disposal times, unless otherwise agreed with the laboratory, are :

soils	- 4 weeks from reporting
leachates	- 2 weeks from reporting
waters	- 2 weeks from reporting
asbestos	- 6 months from reporting

Excel copies of reports are only valid when accompanied by this PDF certificate.

Any assessments of compliance with specifications are based on actual analytical results with no contribution from uncertainty of measurement.
Application of uncertainty of measurement would provide a range within which the true result lies.
An estimate of measurement uncertainty can be provided on request.

Analytical Report Number: 24-016293-2A
Project / Site name: Ardrossan North Shore
Your Order No: S3240

Lab Sample Number				181358	181371	181372	181373	181374
Sample Reference				TSP09-01B	TSP09-14B	TSP09-15B	TSP09-16B	TSP09-17B
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Date Sampled				24/04/2024	24/04/2024	24/04/2024	24/04/2024	24/04/2024
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
Stone Content	%	0.1	NONE	10.2	< 0.1	< 0.1	< 0.1	< 0.1
Moisture Content	%	0.01	NONE	4.9	11	10	11	9.3
Total mass of sample received	kg	0.1	NONE	0.5	0.5	0.6	0.5	0.6
Petroleum Hydrocarbons								
TPHCWG - Aliphatic >C5 - C6 HS_1D_AL	mg/kg	0.02	NONE	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020
TPHCWG - Aliphatic >C6 - C8 HS_1D_AL	mg/kg	0.02	NONE	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020
TPHCWG - Aliphatic >C8 - C10 HS_1D_AL	mg/kg	0.05	NONE	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
TPHCWG - Aliphatic >C10 - C12 EH_CU_1D_AL	mg/kg	1	MCERTS	3.1	< 1.0	1	< 1.0	1.1
TPHCWG - Aliphatic >C12 - C16 EH_CU_1D_AL	mg/kg	2	MCERTS	39	4.5	9	10	8.1
TPHCWG - Aliphatic >C16 - C21 EH_CU_1D_AL	mg/kg	8	MCERTS	52	18	26	30	28
TPHCWG - Aliphatic >C21 - C35 EH_CU_1D_AL	mg/kg	8	MCERTS	59	45	69	79	73
TPHCWG - Aliphatic >C5 - C35 EH_CU+HS_1D_AL	mg/kg	10	NONE	150	67	100	120	110
TPHCWG - Aromatic >EC5 - EC7 HS_1D_AR	mg/kg	0.01	NONE	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
TPHCWG - Aromatic >EC7 - EC8 HS_1D_AR	mg/kg	0.01	NONE	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
TPHCWG - Aromatic >EC8 - EC10 HS_1D_AR	mg/kg	0.05	NONE	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
TPHCWG - Aromatic >EC10 - EC12 EH_CU_1D_AR	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	1.6
TPHCWG - Aromatic >EC12 - EC16 EH_CU_1D_AR	mg/kg	2	MCERTS	15	2.9	4.1	< 2.0	3.9
TPHCWG - Aromatic >EC16 - EC21 EH_CU_1D_AR	mg/kg	10	MCERTS	37	11	22	11	14
TPHCWG - Aromatic >EC21 - EC35 EH_CU_1D_AR	mg/kg	10	MCERTS	57	45	62	44	66
TPHCWG - Aromatic >EC5 - EC35 EH_CU+HS_1D_AR	mg/kg	10	NONE	110	59	88	55	86
TPH (C10 - C40) EH_CU_1D_TOTAL	mg/kg	10	MCERTS	280	150	220	200	230
VOCs								
MTBE (Methyl Tertiary Butyl Ether)	µg/kg	5	NONE	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Benzene	µg/kg	5	MCERTS	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Toluene	µg/kg	5	MCERTS	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Ethylbenzene	µg/kg	5	MCERTS	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
p & m-Xylene	µg/kg	5	MCERTS	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
o-Xylene	µg/kg	5	MCERTS	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0

U/S = Unsuitable Sample I/S = Insufficient Sample ND = Not detected

Analytical Report Number: 24-016293-2A
Project / Site name: Ardrossan North Shore
Your Order No: S3240

Lab Sample Number				181375	181376	181377
Sample Reference				TSP09-18B	TSP09-19B	TSP09-20B
Sample Number				None Supplied	None Supplied	None Supplied
Depth (m)				None Supplied	None Supplied	None Supplied
Date Sampled				24/04/2024	24/04/2024	24/04/2024
Time Taken				None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**			
Stone Content	%	0.1	NONE	< 0.1	< 0.1	< 0.1
Moisture Content	%	0.01	NONE	11	10	11
Total mass of sample received	kg	0.1	NONE	0.5	0.6	0.2
Petroleum Hydrocarbons						
TPHCWG - Aliphatic >C5 - C6 HS_1D_AL	mg/kg	0.02	NONE	< 0.020	< 0.020	< 0.020
TPHCWG - Aliphatic >C6 - C8 HS_1D_AL	mg/kg	0.02	NONE	< 0.020	< 0.020	< 0.020
TPHCWG - Aliphatic >C8 - C10 HS_1D_AL	mg/kg	0.05	NONE	< 0.050	< 0.050	< 0.050
TPHCWG - Aliphatic >C10 - C12 EH_CU_1D_AL	mg/kg	1	MCERTS	< 1.0	< 1.0	1.4
TPHCWG - Aliphatic >C12 - C16 EH_CU_1D_AL	mg/kg	2	MCERTS	10	5.5	11
TPHCWG - Aliphatic >C16 - C21 EH_CU_1D_AL	mg/kg	8	MCERTS	28	19	29
TPHCWG - Aliphatic >C21 - C35 EH_CU_1D_AL	mg/kg	8	MCERTS	73	47	86
TPHCWG - Aliphatic >C5 - C35 EH_CU+HS_1D_AL	mg/kg	10	NONE	110	71	130
TPHCWG - Aromatic >EC5 - EC7 HS_1D_AR	mg/kg	0.01	NONE	< 0.010	< 0.010	< 0.010
TPHCWG - Aromatic >EC7 - EC8 HS_1D_AR	mg/kg	0.01	NONE	< 0.010	< 0.010	< 0.010
TPHCWG - Aromatic >EC8 - EC10 HS_1D_AR	mg/kg	0.05	NONE	< 0.050	< 0.050	< 0.050
TPHCWG - Aromatic >EC10 - EC12 EH_CU_1D_AR	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0
TPHCWG - Aromatic >EC12 - EC16 EH_CU_1D_AR	mg/kg	2	MCERTS	2.6	< 2.0	2.6
TPHCWG - Aromatic >EC16 - EC21 EH_CU_1D_AR	mg/kg	10	MCERTS	13	< 10	15
TPHCWG - Aromatic >EC21 - EC35 EH_CU_1D_AR	mg/kg	10	MCERTS	49	41	60
TPHCWG - Aromatic >EC5 - EC35 EH_CU+HS_1D_AR	mg/kg	10	NONE	65	41	78
TPH (C10 - C40) EH_CU_1D_TOTAL	mg/kg	10	MCERTS	210	140	250
VOCs						
MTBE (Methyl Tertiary Butyl Ether)	µg/kg	5	NONE	< 5.0	< 5.0	< 5.0
Benzene	µg/kg	5	MCERTS	< 5.0	< 5.0	< 5.0
Toluene	µg/kg	5	MCERTS	< 5.0	< 5.0	< 5.0
Ethylbenzene	µg/kg	5	MCERTS	< 5.0	< 5.0	< 5.0
p & m-Xylene	µg/kg	5	MCERTS	< 5.0	< 5.0	< 5.0
o-Xylene	µg/kg	5	MCERTS	< 5.0	< 5.0	< 5.0

U/S = Unsuitable Sample I/S = Insufficient Sample ND = Not detected

Analytical Report Number : 24-016293-2A
Project / Site name: Ardrossan North Shore

* These descriptions are only intended to act as a cross check if sample identities are questioned. The major constituent of the sample is intended to act with respect to MCERTS validation. The laboratory is accredited for sand, clay and loam (MCERTS) soil types. Data for unaccredited types of solid should be interpreted with care.

Stone content of a sample is calculated as the % weight of the stones not passing a 10 mm sieve. Results are not corrected for stone content.

Lab Sample Number	Sample Reference	Sample Number	Depth (m)	Sample Description *
181358	TSP09-01B	None Supplied	None Supplied	Brown sandy loam with vegetation and stones
181371	TSP09-14B	None Supplied	None Supplied	Brown loam and clay with gravel
181372	TSP09-15B	None Supplied	None Supplied	Brown loam and clay with gravel and vegetation
181373	TSP09-16B	None Supplied	None Supplied	Brown loam and clay with gravel and vegetation
181374	TSP09-17B	None Supplied	None Supplied	Brown loam and clay with gravel and vegetation
181375	TSP09-18B	None Supplied	None Supplied	Brown loam and clay with gravel and vegetation
181376	TSP09-19B	None Supplied	None Supplied	Brown loam and clay with gravel and vegetation
181377	TSP09-20B	None Supplied	None Supplied	Brown loam and clay with gravel and vegetation

Analytical Report Number : 24-016293-2A
Project / Site name: Ardrossan North Shore

Water matrix abbreviations:
Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Waters (PrW) Final Sewage Effluent (FSE) Landfill Leachate (LL)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Moisture Content	Moisture content, determined gravimetrically (up to 30°C)	In-house method	L019B	W	NONE
Stones content of soil	Standard preparation for all samples unless otherwise detailed. Gravimetric determination of stone > 10 mm as % dry weight	In-house method based on British Standard Methods and MCERTS requirements.	L019B	D	NONE
BTEX and/or Volatile organic compounds in soil	Determination of volatile organic compounds in soil by headspace GC-MS	In-house method based on USEPA 8260	L073B	W	MCERTS
Total petroleum hydrocarbons with carbon banding by GC-FID/GC-MS HS in soil	Determination of total petroleum hydrocarbons in soil by GC-FID/GC-MS HS with carbon banding aliphatic and aromatic	In-house method	L076B/L088	D/W	MCERTS
Total petroleum hydrocarbons by GC-FID/GC-MS HS in soil	Determination of total petroleum hydrocarbons in soil by GC-FID/GC-MS HS	In-house method	L076B/L088	D/W	MCERTS

For method numbers ending in 'UK' or 'A' analysis have been carried out in our laboratory in the United Kingdom (Watford).
For method numbers ending in 'F' analysis have been carried out in our laboratory in the United Kingdom (East Kilbride).
For method numbers ending in 'PL' or 'B' analysis have been carried out in our laboratory in Poland.
Soil analytical results are expressed on a dry weight basis. Where analysis is carried out on as-received the results obtained are multiplied by a moisture correction factor that is determined gravimetrically using the moisture content which is carried out at a maximum of 30oC.
Unless otherwise indicated, site information, order number, project number, sampling date, time, sample reference and depth are provided by the client. The instructed on date indicates the date on which this information was provided to the laboratory.

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Analytical Report Number : 24-017477-2A

Replaces Analytical Report Number: 24-017477, issue no. 1
Report format change.
Report split as per clients request

Project / Site name:	Ardrossan North Shore	**Samples received on:**	02/05/2024
Your job number:	S3240	**Samples instructed on/ Analysis started on:**	02/05/2024
Your order number:	S3240	**Analysis completed by:**	10/05/2024
Report Issue Number:	2A	**Report issued on:**	13/06/2024
Samples Analysed:	8 soil samples		

[redacted]

Signed: _____

[redacted]

For & on behalf of i2 Analytical Ltd.

Standard Geotechnical, Asbestos and Chemical Testing Laboratory located at: ul. Pionierów 39, 41-711 Ruda Śląska, Poland.

Accredited tests are defined within the report, opinions and interpretations expressed herein are outside the scope of accreditation.

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soils - 4 weeks from reporting
leachates - 2 weeks from reporting
waters - 2 weeks from reporting
asbestos - 6 months from reporting

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Application of uncertainty of measurement would provide a range within which the true result lies.
An estimate of measurement uncertainty can be provided on request.

Analytical Report Number: 24-017477-2A
Project / Site name: Ardrossan North Shore
Your Order No: S3240

Lab Sample Number				187499	187512	187513	187514	187515
Sample Reference				TSP09-01C	TSP09-14C	TSP09-15C	TSP09-16C	TSP09-17C
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Date Sampled				01/05/2024	01/05/2024	01/05/2024	01/05/2024	01/05/2024
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
Stone Content	%	0.1	NONE	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Moisture Content	%	0.01	NONE	11	11	11	9.8	11
Total mass of sample received	kg	0.1	NONE	0.4	0.3	0.3	0.4	0.4
Petroleum Hydrocarbons								
TPHCWG - Aliphatic >C5 - C6 HS_1D_AL	mg/kg	0.02	NONE	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020
TPHCWG - Aliphatic >C6 - C8 HS_1D_AL	mg/kg	0.02	NONE	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020
TPHCWG - Aliphatic >C8 - C10 HS_1D_AL	mg/kg	0.05	NONE	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
TPHCWG - Aliphatic >C10 - C12 EH_CU_1D_AL	mg/kg	1	MCERTS	< 1.0	< 1.0	2.2	< 1.0	< 1.0
TPHCWG - Aliphatic >C12 - C16 EH_CU_1D_AL	mg/kg	2	MCERTS	8	6.1	17	< 2.0	< 2.0
TPHCWG - Aliphatic >C16 - C21 EH_CU_1D_AL	mg/kg	8	MCERTS	19	14	30	< 8.0	9.1
TPHCWG - Aliphatic >C21 - C35 EH_CU_1D_AL	mg/kg	8	MCERTS	52	25	67	< 8.0	38
TPHCWG - Aliphatic >C5 - C35 EH_CU+HS_1D_AL	mg/kg	10	NONE	79	45	120	< 10	47
TPHCWG - Aromatic >EC5 - EC7 HS_1D_AR	mg/kg	0.01	NONE	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
TPHCWG - Aromatic >EC7 - EC8 HS_1D_AR	mg/kg	0.01	NONE	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
TPHCWG - Aromatic >EC8 - EC10 HS_1D_AR	mg/kg	0.05	NONE	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
TPHCWG - Aromatic >EC10 - EC12 EH_CU_1D_AR	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPHCWG - Aromatic >EC12 - EC16 EH_CU_1D_AR	mg/kg	2	MCERTS	2	< 2.0	3.3	< 2.0	3.9
TPHCWG - Aromatic >EC16 - EC21 EH_CU_1D_AR	mg/kg	10	MCERTS	12	11	20	< 10	18
TPHCWG - Aromatic >EC21 - EC35 EH_CU_1D_AR	mg/kg	10	MCERTS	50	40	72	< 10	67
TPHCWG - Aromatic >EC5 - EC35 EH_CU+HS_1D_AR	mg/kg	10	NONE	64	51	96	< 10	88
TPH (C10 - C40) EH_CU_1D_TOTAL	mg/kg	10	MCERTS	200	120	260	< 10	170
VOCs								
MTBE (Methyl Tertiary Butyl Ether)	µg/kg	5	NONE	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Benzene	µg/kg	5	MCERTS	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Toluene	µg/kg	5	MCERTS	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Ethylbenzene	µg/kg	5	MCERTS	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
p & m-Xylene	µg/kg	5	MCERTS	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
o-Xylene	µg/kg	5	MCERTS	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0

U/S = Unsuitable Sample I/S = Insufficient Sample ND = Not detected

Analytical Report Number: 24-017477-2A
Project / Site name: Ardrossan North Shore
Your Order No: S3240

Lab Sample Number				187516	187517	187518
Sample Reference				TSP09-18C	TSP09-19C	TSP09-20C
Sample Number				None Supplied	None Supplied	None Supplied
Depth (m)				None Supplied	None Supplied	None Supplied
Date Sampled				01/05/2024	01/05/2024	01/05/2024
Time Taken				None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**			
Stone Content	%	0.1	NONE	< 0.1	< 0.1	< 0.1
Moisture Content	%	0.01	NONE	12	11	10
Total mass of sample received	kg	0.1	NONE	0.4	0.3	0.3
Petroleum Hydrocarbons						
TPHCWG - Aliphatic >C5 - C6 HS_1D_AL	mg/kg	0.02	NONE	< 0.020	< 0.020	< 0.020
TPHCWG - Aliphatic >C6 - C8 HS_1D_AL	mg/kg	0.02	NONE	< 0.020	< 0.020	< 0.020
TPHCWG - Aliphatic >C8 - C10 HS_1D_AL	mg/kg	0.05	NONE	< 0.050	< 0.050	< 0.050
TPHCWG - Aliphatic >C10 - C12 EH_CU_1D_AL	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0
TPHCWG - Aliphatic >C12 - C16 EH_CU_1D_AL	mg/kg	2	MCERTS	2.8	4.8	8.1
TPHCWG - Aliphatic >C16 - C21 EH_CU_1D_AL	mg/kg	8	MCERTS	18	16	26
TPHCWG - Aliphatic >C21 - C35 EH_CU_1D_AL	mg/kg	8	MCERTS	60	44	60
TPHCWG - Aliphatic >C5 - C35 EH_CU+HS_1D_AL	mg/kg	10	NONE	80	65	93
TPHCWG - Aromatic >EC5 - EC7 HS_1D_AR	mg/kg	0.01	NONE	< 0.010	< 0.010	< 0.010
TPHCWG - Aromatic >EC7 - EC8 HS_1D_AR	mg/kg	0.01	NONE	< 0.010	< 0.010	< 0.010
TPHCWG - Aromatic >EC8 - EC10 HS_1D_AR	mg/kg	0.05	NONE	< 0.050	< 0.050	< 0.050
TPHCWG - Aromatic >EC10 - EC12 EH_CU_1D_AR	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0
TPHCWG - Aromatic >EC12 - EC16 EH_CU_1D_AR	mg/kg	2	MCERTS	3.7	4.2	2.6
TPHCWG - Aromatic >EC16 - EC21 EH_CU_1D_AR	mg/kg	10	MCERTS	18	19	20
TPHCWG - Aromatic >EC21 - EC35 EH_CU_1D_AR	mg/kg	10	MCERTS	63	56	72
TPHCWG - Aromatic >EC5 - EC35 EH_CU+HS_1D_AR	mg/kg	10	NONE	85	79	94
TPH (C10 - C40) EH_CU_1D_TOTAL	mg/kg	10	MCERTS	210	180	230
VOCs						
MTBE (Methyl Tertiary Butyl Ether)	µg/kg	5	NONE	< 5.0	< 5.0	< 5.0
Benzene	µg/kg	5	MCERTS	< 5.0	< 5.0	< 5.0
Toluene	µg/kg	5	MCERTS	< 5.0	< 5.0	< 5.0
Ethylbenzene	µg/kg	5	MCERTS	< 5.0	< 5.0	< 5.0
p & m-Xylene	µg/kg	5	MCERTS	< 5.0	< 5.0	< 5.0
o-Xylene	µg/kg	5	MCERTS	< 5.0	< 5.0	< 5.0

U/S = Unsuitable Sample I/S = Insufficient Sample ND = Not detected

Analytical Report Number : 24-017477-2A
Project / Site name: Ardrossan North Shore

* These descriptions are only intended to act as a cross check if sample identities are questioned. The major constituent of the sample is intended to act with respect to MCERTS validation. The laboratory is accredited for sand, clay and loam (MCERTS) soil types. Data for unaccredited types of solid should be interpreted with care.

Stone content of a sample is calculated as the % weight of the stones not passing a 10 mm sieve. Results are not corrected for stone content.

Lab Sample Number	Sample Reference	Sample Number	Depth (m)	Sample Description *
187499	TSP09-01C	None Supplied	None Supplied	Brown sand with gravel and vegetation
187512	TSP09-14C	None Supplied	None Supplied	Brown sand with gravel and vegetation
187513	TSP09-15C	None Supplied	None Supplied	Brown sand with gravel and vegetation
187514	TSP09-16C	None Supplied	None Supplied	Brown sand with gravel
187515	TSP09-17C	None Supplied	None Supplied	Brown sand with gravel
187516	TSP09-18C	None Supplied	None Supplied	Brown sand with gravel and vegetation
187517	TSP09-19C	None Supplied	None Supplied	Brown sand with gravel and vegetation
187518	TSP09-20C	None Supplied	None Supplied	Brown sand with gravel and vegetation

Analytical Report Number : 24-017477-2A
Project / Site name: Ardrossan North Shore

Water matrix abbreviations:
Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Waters (PrW) Final Sewage Effluent (FSE) Landfill Leachate (LL)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Moisture Content	Moisture content, determined gravimetrically (up to 30°C)	In-house method	L019B	W	NONE
Stones content of soil	Standard preparation for all samples unless otherwise detailed. Gravimetric determination of stone > 10 mm as % dry weight	In-house method based on British Standard Methods and MCERTS requirements.	L019B	D	NONE
BTEX and/or Volatile organic compounds in soil	Determination of volatile organic compounds in soil by headspace GC-MS	In-house method based on USEPA 8260	L073B	W	MCERTS
Total petroleum hydrocarbons with carbon banding by GC-FID/GC-MS HS in soil	Determination of total petroleum hydrocarbons in soil by GC-FID/GC-MS HS with carbon banding aliphatic and aromatic	In-house method	L076B/L088	D/W	MCERTS
Total petroleum hydrocarbons by GC-FID/GC-MS HS in soil	Determination of total petroleum hydrocarbons in soil by GC-FID/GC-MS HS	In-house method	L076B/L088	D/W	MCERTS

For method numbers ending in 'UK' or 'A' analysis have been carried out in our laboratory in the United Kingdom (Watford).
For method numbers ending in 'F' analysis have been carried out in our laboratory in the United Kingdom (East Kilbride).
For method numbers ending in 'PL' or 'B' analysis have been carried out in our laboratory in Poland.
Soil analytical results are expressed on a dry weight basis. Where analysis is carried out on as-received the results obtained are multiplied by a moisture correction factor that is determined gravimetrically using the moisture content which is carried out at a maximum of 30oC.
Unless otherwise indicated, site information, order number, project number, sampling date, time, sample reference and depth are provided by the client. The instructed on date indicates the date on which this information was provided to the laboratory.

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Analytical Report Number : 24-018602-2A

Replaces Analytical Report Number: 24-018602, issue no. 1
Report format change.
Report split as per clients request

Project / Site name:	Ardrossan North Shore	**Samples received on:**	09/05/2024
Your job number:	S3240	**Samples instructed on/ Analysis started on:**	09/05/2024
Your order number:	S3240	**Analysis completed by:**	16/05/2024
Report Issue Number:	2A	**Report issued on:**	13/06/2024
Samples Analysed:	8 soil samples		

Signed: [redacted]

[redacted]

For & on behalf of i2 Analytical Ltd.

Standard Geotechnical, Asbestos and Chemical Testing Laboratory located at: ul. Pionierów 39, 41-711 Ruda Śląska, Poland.

Accredited tests are defined within the report, opinions and interpretations expressed herein are outside the scope of accreditation.

Standard sample disposal times, unless otherwise agreed with the laboratory, are :

soils - 4 weeks from reporting
leachates - 2 weeks from reporting
waters - 2 weeks from reporting
asbestos - 6 months from reporting

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Any assessments of compliance with specifications are based on actual analytical results with no contribution from uncertainty of measurement.
Application of uncertainty of measurement would provide a range within which the true result lies.
An estimate of measurement uncertainty can be provided on request.

Analytical Report Number: 24-018602-2A
Project / Site name: Ardrossan North Shore
Your Order No: S3240

Lab Sample Number				193699	193712	193713	193714	193715
Sample Reference				TSP09-01D	TSP09-14D	TSP09-15D	TSP09-16D	TSP09-17D
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Date Sampled				08/05/2024	08/05/2024	08/05/2024	08/05/2024	08/05/2024
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
Stone Content	%	0.1	NONE	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Moisture Content	%	0.01	NONE	7.4	8.6	8	8.1	7.4
Total mass of sample received	kg	0.1	NONE	0.3	0.2	0.3	0.2	0.3
Petroleum Hydrocarbons								
TPHCWG - Aliphatic >C5 - C6 HS_1D_AL	mg/kg	0.02	NONE	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020
TPHCWG - Aliphatic >C6 - C8 HS_1D_AL	mg/kg	0.02	NONE	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020
TPHCWG - Aliphatic >C8 - C10 HS_1D_AL	mg/kg	0.05	NONE	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
TPHCWG - Aliphatic >C10 - C12 EH_CU_1D_AL	mg/kg	1	MCERTS	3.1	< 1.0	1.1	3.2	2.7
TPHCWG - Aliphatic >C12 - C16 EH_CU_1D_AL	mg/kg	2	MCERTS	41	31	22	45	37
TPHCWG - Aliphatic >C16 - C21 EH_CU_1D_AL	mg/kg	8	MCERTS	120	75	68	100	75
TPHCWG - Aliphatic >C21 - C35 EH_CU_1D_AL	mg/kg	8	MCERTS	280	170	170	190	170
TPHCWG - Aliphatic >C5 - C35 EH_CU+HS_1D_AL	mg/kg	10	NONE	450	280	260	340	280
TPHCWG - Aromatic >EC5 - EC7 HS_1D_AR	mg/kg	0.01	NONE	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
TPHCWG - Aromatic >EC7 - EC8 HS_1D_AR	mg/kg	0.01	NONE	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
TPHCWG - Aromatic >EC8 - EC10 HS_1D_AR	mg/kg	0.05	NONE	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
TPHCWG - Aromatic >EC10 - EC12 EH_CU_1D_AR	mg/kg	1	MCERTS	1.1	< 1.0	< 1.0	< 1.0	< 1.0
TPHCWG - Aromatic >EC12 - EC16 EH_CU_1D_AR	mg/kg	2	MCERTS	7.5	11	9.1	5.7	5.2
TPHCWG - Aromatic >EC16 - EC21 EH_CU_1D_AR	mg/kg	10	MCERTS	80	66	55	72	49
TPHCWG - Aromatic >EC21 - EC35 EH_CU_1D_AR	mg/kg	10	MCERTS	290	220	220	250	190
TPHCWG - Aromatic >EC5 - EC35 EH_CU+HS_1D_AR	mg/kg	10	NONE	380	300	280	330	240
TPH (C10 - C40) EH_CU_1D_TOTAL	mg/kg	10	MCERTS	980	700	670	790	660
VOCs								
MTBE (Methyl Tertiary Butyl Ether)	µg/kg	5	NONE	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Benzene	µg/kg	5	MCERTS	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Toluene	µg/kg	5	MCERTS	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Ethylbenzene	µg/kg	5	MCERTS	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
p & m-Xylene	µg/kg	5	MCERTS	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
o-Xylene	µg/kg	5	MCERTS	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0

U/S = Unsuitable Sample I/S = Insufficient Sample ND = Not detected

UKAS TESTING 4041

MCERTS

Analytical i2 Environmental Science

Analytical Report Number: 24-018602-2A
Project / Site name: Ardrossan North Shore
Your Order No: S3240

Lab Sample Number				193716	193717	193718
Sample Reference				TSP09-18D	TSP09-19D	TSP09-20D
Sample Number				None Supplied	None Supplied	None Supplied
Depth (m)				None Supplied	None Supplied	None Supplied
Date Sampled				08/05/2024	08/05/2024	08/05/2024
Time Taken				None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**			
Stone Content	%	0.1	NONE	< 0.1	< 0.1	< 0.1
Moisture Content	%	0.01	NONE	9.7	9.3	9.3
Total mass of sample received	kg	0.1	NONE	0.2	0.3	0.3
Petroleum Hydrocarbons						
TPHCWG - Aliphatic >C5 - C6 HS_1D_AL	mg/kg	0.02	NONE	< 0.020	< 0.020	< 0.020
TPHCWG - Aliphatic >C6 - C8 HS_1D_AL	mg/kg	0.02	NONE	< 0.020	< 0.020	< 0.020
TPHCWG - Aliphatic >C8 - C10 HS_1D_AL	mg/kg	0.05	NONE	< 0.050	< 0.050	< 0.050
TPHCWG - Aliphatic >C10 - C12 EH_CU_1D_AL	mg/kg	1	MCERTS	2.4	< 1.0	2
TPHCWG - Aliphatic >C12 - C16 EH_CU_1D_AL	mg/kg	2	MCERTS	47	7.3	56
TPHCWG - Aliphatic >C16 - C21 EH_CU_1D_AL	mg/kg	8	MCERTS	100	24	120
TPHCWG - Aliphatic >C21 - C35 EH_CU_1D_AL	mg/kg	8	MCERTS	230	73	260
TPHCWG - Aliphatic >C5 - C35 EH_CU+HS_1D_AL	mg/kg	10	NONE	380	100	430
TPHCWG - Aromatic >EC5 - EC7 HS_1D_AR	mg/kg	0.01	NONE	< 0.010	< 0.010	< 0.010
TPHCWG - Aromatic >EC7 - EC8 HS_1D_AR	mg/kg	0.01	NONE	< 0.010	< 0.010	< 0.010
TPHCWG - Aromatic >EC8 - EC10 HS_1D_AR	mg/kg	0.05	NONE	< 0.050	< 0.050	< 0.050
TPHCWG - Aromatic >EC10 - EC12 EH_CU_1D_AR	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0
TPHCWG - Aromatic >EC12 - EC16 EH_CU_1D_AR	mg/kg	2	MCERTS	4.9	< 2.0	9.1
TPHCWG - Aromatic >EC16 - EC21 EH_CU_1D_AR	mg/kg	10	MCERTS	55	13	74
TPHCWG - Aromatic >EC21 - EC35 EH_CU_1D_AR	mg/kg	10	MCERTS	220	76	280
TPHCWG - Aromatic >EC5 - EC35 EH_CU+HS_1D_AR	mg/kg	10	NONE	280	88	360
TPH (C10 - C40) EH_CU_1D_TOTAL	mg/kg	10	MCERTS	810	260	970
VOCs						
MTBE (Methyl Tertiary Butyl Ether)	µg/kg	5	NONE	< 5.0	< 5.0	< 5.0
Benzene	µg/kg	5	MCERTS	< 5.0	< 5.0	< 5.0
Toluene	µg/kg	5	MCERTS	< 5.0	< 5.0	< 5.0
Ethylbenzene	µg/kg	5	MCERTS	< 5.0	< 5.0	< 5.0
p & m-Xylene	µg/kg	5	MCERTS	< 5.0	< 5.0	< 5.0
o-Xylene	µg/kg	5	MCERTS	< 5.0	< 5.0	< 5.0

U/S = Unsuitable Sample I/S = Insufficient Sample ND = Not detected

Analytical Report Number : 24-018602-2A
Project / Site name: Ardrossan North Shore

* These descriptions are only intended to act as a cross check if sample identities are questioned. The major constituent of the sample is intended to act with respect to MCERTS validation. The laboratory is accredited for sand, clay and loam (MCERTS) soil types. Data for unaccredited types of solid should be interpreted with care.

Stone content of a sample is calculated as the % weight of the stones not passing a 10 mm sieve. Results are not corrected for stone content.

Lab Sample Number	Sample Reference	Sample Number	Depth (m)	Sample Description *
193699	TSP09-01D	None Supplied	None Supplied	Brown loam with gravel
193712	TSP09-14D	None Supplied	None Supplied	Brown loam with gravel and vegetation
193713	TSP09-15D	None Supplied	None Supplied	Brown loam with gravel and vegetation
193714	TSP09-16D	None Supplied	None Supplied	Brown loam with gravel and vegetation
193715	TSP09-17D	None Supplied	None Supplied	Brown loam with gravel and vegetation
193716	TSP09-18D	None Supplied	None Supplied	Brown loam with gravel and vegetation
193717	TSP09-19D	None Supplied	None Supplied	Brown loam with gravel and vegetation
193718	TSP09-20D	None Supplied	None Supplied	Brown loam with gravel and vegetation

Analytical Report Number : 24-018602-2A
Project / Site name: Ardrossan North Shore

Water matrix abbreviations:
Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Waters (PrW) Final Sewage Effluent (FSE) Landfill Leachate (LL)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Moisture Content	Moisture content, determined gravimetrically (up to 30°C)	In-house method	L019B	W	NONE
Stones content of soil	Standard preparation for all samples unless otherwise detailed. Gravimetric determination of stone > 10 mm as % dry weight	In-house method based on British Standard Methods and MCERTS requirements.	L019B	D	NONE
BTEX and/or Volatile organic compounds in soil	Determination of volatile organic compounds in soil by headspace GC-MS	In-house method based on USEPA 8260	L073B	W	MCERTS
Total petroleum hydrocarbons with carbon banding by GC-FID/GC-MS HS in soil	Determination of total petroleum hydrocarbons in soil by GC-FID/GC-MS HS with carbon banding aliphatic and aromatic	In-house method	L076B/L088	D/W	MCERTS
Total petroleum hydrocarbons by GC-FID/GC-MS HS in soil	Determination of total petroleum hydrocarbons in soil by GC-FID/GC-MS HS	In-house method	L076B/L088	D/W	MCERTS

For method numbers ending in 'UK' or 'A' analysis have been carried out in our laboratory in the United Kingdom (Watford).
For method numbers ending in 'F' analysis have been carried out in our laboratory in the United Kingdom (East Kilbride).
For method numbers ending in 'PL' or 'B' analysis have been carried out in our laboratory in Poland.
Soil analytical results are expressed on a dry weight basis. Where analysis is carried out on as-received the results obtained are multiplied by a moisture correction factor that is determined gravimetrically using the moisture content which is carried out at a maximum of 30oC.
Unless otherwise indicated, site information, order number, project number, sampling date, time, sample reference and depth are provided by the client. The instructed on date indicates the date on which this information was provided to the laboratory.