

Jones Environmental Laboratory

Client Name: O'Connor Sutton Cronin & Assoc. Ltd
Reference:
Location: St Pauls
Contact: Cian O'Hora
JE Job No.: 15/14318

Report : CEN 10:1 1 Batch

Solids: V=60g VOC jar, J=250g glass jar, T=plastic tub

J E Sample No.	1	2	3	4	5	6	7	8	9	10	Please see attached notes for all abbreviations and acronyms		
Sample ID	BH1	BH1	BH2	BH2	BH2	BH2	BH3	BH4	BH4	BH4			
Depth	0.00-1.00	1.00-2.00	0.50	1.00	2.00	3.00	0.50	0.00-1.00	1.00-2.00	2.00-3.00			
COC No / misc													
Containers	T	T	T	T	T	T	T	T	T	T			
Sample Date	28/09/2015	28/09/2015	30/09/2015	30/09/2015	30/09/2015	30/09/2015	01/10/2015	03/10/2015	03/10/2015	03/10/2015			
Sample Type	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil			
Batch Number	1	1	1	1	1	1	1	1	1	1	LOD/LOR	Units	Method No.
Date of Receipt	06/10/2015	06/10/2015	06/10/2015	06/10/2015	06/10/2015	06/10/2015	06/10/2015	06/10/2015	06/10/2015	06/10/2015			
Dissolved Antimony #	<0.002	0.003	<0.002	<0.002	<0.002	<0.002	0.002	<0.002	0.002	<0.002	<0.002	mg/l	TM30/PM17
Dissolved Antimony (A10) #	<0.02	0.03	<0.02	<0.02	<0.02	<0.02	0.02	<0.02	0.02	<0.02	<0.02	mg/kg	TM30/PM17
Dissolved Arsenic #	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	mg/l	TM30/PM17
Dissolved Arsenic (A10) #	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	mg/kg	TM30/PM17
Dissolved Barium #	0.015	0.012	<0.003	<0.003	0.011	0.051	<0.003	<0.003	0.005	0.004	<0.003	mg/l	TM30/PM17
Dissolved Barium (A10) #	0.15	0.12	<0.03	<0.03	0.11	0.51	<0.03	<0.03	0.05	0.04	<0.03	mg/kg	TM30/PM17
Dissolved Cadmium #	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	mg/l	TM30/PM17
Dissolved Cadmium (A10) #	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	mg/kg	TM30/PM17
Dissolved Chromium #	<0.0015	<0.0015	<0.0015	<0.0015	<0.0015	<0.0015	<0.0015	<0.0015	<0.0015	<0.0015	<0.0015	mg/l	TM30/PM17
Dissolved Chromium (A10) #	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	mg/kg	TM30/PM17
Dissolved Copper #	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	mg/l	TM30/PM17
Dissolved Copper (A10) #	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	mg/kg	TM30/PM17
Dissolved Lead #	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	mg/l	TM30/PM17
Dissolved Lead (A10) #	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	mg/kg	TM30/PM17
Dissolved Molybdenum #	0.035	0.037	0.013	0.021	0.029	0.020	0.006	0.011	0.029	0.028	<0.002	mg/l	TM30/PM17
Dissolved Molybdenum (A10) #	0.35	0.37	0.13	0.21	0.29	0.20	0.06	0.11	0.29	0.28	<0.02	mg/kg	TM30/PM17
Dissolved Nickel #	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	mg/l	TM30/PM17
Dissolved Nickel (A10) #	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	mg/kg	TM30/PM17
Dissolved Selenium #	<0.003	0.027	<0.003	<0.003	<0.003	0.028	<0.003	<0.003	<0.003	<0.003	<0.003	mg/l	TM30/PM17
Dissolved Selenium (A10) #	<0.03	0.27	<0.03	<0.03	<0.03	0.28	<0.03	<0.03	<0.03	<0.03	<0.03	mg/kg	TM30/PM17
Dissolved Zinc #	<0.003	<0.003	0.004	0.004	<0.003	0.004	0.005	0.004	0.005	0.004	<0.003	mg/l	TM30/PM17
Dissolved Zinc (A10) #	<0.03	<0.03	0.04	0.04	<0.03	0.04	0.05	0.04	0.05	0.04	<0.03	mg/kg	TM30/PM17
Mercury Dissolved by CVAF #	<0.00001	<0.00001	0.00028	0.00006	<0.00001	0.00001	0.00029	0.00007	0.00003	0.00002	<0.00001	mg/l	TM61/PM38
Mercury Dissolved by CVAF #	<0.0001	<0.0001	0.0028	0.0006	<0.0001	<0.0001	0.0029	0.0007	0.0003	0.0002	<0.0001	mg/kg	TM61/PM38
Phenol	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	mg/l	TM26/PM0
Phenol	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	mg/kg	TM26/PM0
Fluoride	<0.3	<0.3	0.3	<0.3	<0.3	0.3	0.5	0.5	<0.3	<0.3	<0.3	mg/l	TM27/PM0
Fluoride	<3	<3	3	<3	<3	<3	5	5	<3	<3	<3	mg/kg	TM27/PM0
Chloride	1.1	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	0.4	<0.3	<0.3	<0.3	mg/l	TM27/PM0
Chloride	11	<3	<3	<3	<3	<3	<3	4	<3	<3	<3	mg/kg	TM27/PM0
Sulphate	3.59	16.54	0.28	0.52	4.67	29.70	0.32	0.82	0.50	0.61	<0.05	mg/l	TM27/PM0
Sulphate	35.9	165.5	2.8	5.2	46.7	296.8	3.2	8.2	5.0	6.1	<0.5	mg/kg	TM27/PM0
Mass of raw test portion	0.1051	0.1036	0.1056	0.1003	0.1011	0.1003	0.105	0.1133	0.1007	0.1022		kg	NONE/PM17
Leachant Volume	0.885	0.887	0.885	0.89	0.889	0.889	0.885	0.877	0.889	0.887		l	NONE/PM17
Eluate Volume	0.65	0.75	0.83	0.83	0.85	0.6	0.8	0.75	0.85	0.83		l	NONE/PM17
Dissolved Organic Carbon	3	2	7	4	3	3	7	6	4	4	<2	mg/l	TM60/PM0
Dissolved Organic Carbon	30	20	70	40	30	30	70	60	40	40	<20	mg/kg	TM60/PM0
Total Dissolved Solids #	75	119	71	97	80	149	56	180	107	98	<10	mg/l	TM20/PM0
Total Dissolved Solids #	750	1191	710	970	800	1489	560	1800	1070	980	<100	mg/kg	TM20/PM0

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Murphy Result Report

Mass of sample taken (kg)		0.1051	Dry Matter Content Ratio (%) =		85.9		
Mass of dry sample (kg) =		0.09	Leachant Volume (l)		0.885		
Particle Size <4mm =		>95%	Eluate Volume (l)		0.65		
JEFL Job No		15/14318			Landfill Waste Acceptance Criteria Limits		
Sample No		1					
Client Sample No		BH1					
Depth/Other		0.00-1.00					
Sample Date		28/09/2015					
Batch No		1					
Solid Waste Analysis					Inert	Stable Non-reactive	Hazardous
Total Organic Carbon (%)	0.50						
Sum of BTEX (mg/kg)	<0.025						
Sum of 7 PCBs (mg/kg)	<0.035						
Mineral Oil (mg/kg)	<45						
PAH Sum of 6 (mg/kg)	<0.22						
PAH Sum of 17 (mg/kg)	<0.64						
Eluate Analysis	10:1 concn leached				Limit values for compliance leaching test using BS EN 12457-2 at L/S 10 l/kg		
	A10						
mg/kg	mg/kg						
Arsenic	<0.025				0.5	2	25
Barium	0.15				20	100	300
Cadmium	<0.005				0.04	1	5
Chromium	<0.015				0.5	10	70
Copper	<0.07				2	50	100
Mercury	<0.0001				0.01	0.2	2
Molybdenum	0.35				0.5	10	30
Nickel	<0.02				0.4	10	40
Lead	<0.05				0.5	10	50
Antimony	<0.02				0.06	0.7	5
Selenium	<0.03				0.1	0.5	7
Zinc	<0.03				4	50	200
Chloride	11				800	15000	25000
Fluoride	<3				10	150	500
Sulphate as SO4	35.9				1000	20000	50000
Total Dissolved Solids	750				4000	60000	100000
Phenol	<0.1				1	-	-
Dissolved Organic Carbon	30	500	800	1000			

Mass of sample taken (kg)	0.1036	Dry Matter Content Ratio (%) =	86.9		
Mass of dry sample (kg) =	0.09	Leachant Volume (l)	0.887		
Particle Size <4mm =	>95%	Eluate Volume (l)	0.75		
JEFL Job No	15/14318		Landfill Waste Acceptance Criteria Limits		
Sample No	2				
Client Sample No	BH1		Inert	Stable Non-reactive	Hazardous
Depth/Other	1.00-2.00				
Sample Date	28/09/2015				
Batch No	1				
Solid Waste Analysis					
Total Organic Carbon (%)	1.03		3	5	6
Sum of BTEX (mg/kg)	<0.025		6	-	-
Sum of 7 PCBs (mg/kg)	<0.035		1	-	-
Mineral Oil (mg/kg)	87		500	-	-
PAH Sum of 6 (mg/kg)	<0.22		-	-	-
PAH Sum of 17 (mg/kg)	<0.64		100	-	-
Eluate Analysis	10:1 concn leached		Limit values for compliance leaching test using BS EN 12457-2 at L/S 10 l/kg		
	A10				
	mg/kg		mg/kg		
	Arsenic		<0.025	0.5	2
Barium	0.12		20	100	300
Cadmium	<0.005		0.04	1	5
Chromium	<0.015		0.5	10	70
Copper	<0.07		2	50	100
Mercury	<0.0001		0.01	0.2	2
Molybdenum	0.37		0.5	10	30
Nickel	<0.02		0.4	10	40
Lead	<0.05		0.5	10	50
Antimony	0.03		0.06	0.7	5
Selenium	0.27		0.1	0.5	7
Zinc	<0.03		4	50	200
Chloride	<3		800	15000	25000
Fluoride	<3		10	150	500
Sulphate as SO4	165.5		1000	20000	50000
Total Dissolved Solids	1191		4000	60000	100000
Phenol	<0.1		1	-	-
Dissolved Organic Carbon	20	500	800	1000	

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Murphy Result Report

Mass of sample taken (kg)	0.1056	Dry Matter Content Ratio (%) =	85.4		
Mass of dry sample (kg) =	0.09	Leachant Volume (l)	0.885		
Particle Size <4mm =	>95%	Eluate Volume (l)	0.83		
JEFL Job No	15/14318		Landfill Waste Acceptance Criteria Limits		
Sample No	3				
Client Sample No	BH2		Inert	Stable Non-reactive	Hazardous
Depth/Other	0.50				
Sample Date	30/09/2015				
Batch No	1				
Solid Waste Analysis					
Total Organic Carbon (%)	1.20	3			
Sum of BTEX (mg/kg)	<0.025	6	-	-	
Sum of 7 PCBs (mg/kg)	<0.035	1	-	-	
Mineral Oil (mg/kg)	<45	500	-	-	
PAH Sum of 6 (mg/kg)	<0.22	-	-	-	
PAH Sum of 17 (mg/kg)	<0.64	100	-	-	
Eluate Analysis	10:1 concn leached	Limit values for compliance leaching test using BS EN 12457-2 at L/S 10 l/kg			
	A10				
	mg/kg				
	mg/kg				
Arsenic	<0.025	0.5	2	25	
Barium	<0.03	20	100	300	
Cadmium	<0.005	0.04	1	5	
Chromium	<0.015	0.5	10	70	
Copper	<0.07	2	50	100	
Mercury	0.0028	0.01	0.2	2	
Molybdenum	0.13	0.5	10	30	
Nickel	<0.02	0.4	10	40	
Lead	<0.05	0.5	10	50	
Antimony	<0.02	0.06	0.7	5	
Selenium	<0.03	0.1	0.5	7	
Zinc	0.04	4	50	200	
Chloride	<3	800	15000	25000	
Fluoride	3	10	150	500	
Sulphate as SO4	2.8	1000	20000	50000	
Total Dissolved Solids	710	4000	60000	100000	
Phenol	<0.1	1	-	-	
Dissolved Organic Carbon	70	500	800	1000	

Mass of sample taken (kg)	0.1003	Dry Matter Content Ratio (%) =	89.6		
Mass of dry sample (kg) =	0.09	Leachant Volume (l)	0.89		
Particle Size <4mm =	>95%	Eluate Volume (l)	0.83		
JEFL Job No	15/14318		Landfill Waste Acceptance Criteria Limits		
Sample No	4				
Client Sample No	BH2		Inert	Stable Non-reactive	Hazardous
Depth/Other	1.00				
Sample Date	30/09/2015				
Batch No	1				
Solid Waste Analysis					
Total Organic Carbon (%)	0.44		3	5	6
Sum of BTEX (mg/kg)	<0.025		6	-	-
Sum of 7 PCBs (mg/kg)	<0.035		1	-	-
Mineral Oil (mg/kg)	<45		500	-	-
PAH Sum of 6 (mg/kg)	<0.22		-	-	-
PAH Sum of 17 (mg/kg)	<0.64		100	-	-
Eluate Analysis	10:1 concn leached		Limit values for compliance leaching test using BS EN 12457-2 at L/S 10 l/kg		
	A10				
	mg/kg		mg/kg		
Arsenic	<0.025		0.5	2	25
Barium	<0.03		20	100	300
Cadmium	<0.005		0.04	1	5
Chromium	<0.015		0.5	10	70
Copper	<0.07		2	50	100
Mercury	0.0006		0.01	0.2	2
Molybdenum	0.21		0.5	10	30
Nickel	<0.02		0.4	10	40
Lead	<0.05		0.5	10	50
Antimony	<0.02		0.06	0.7	5
Selenium	<0.03		0.1	0.5	7
Zinc	0.04		4	50	200
Chloride	<3		800	15000	25000
Fluoride	<3		10	150	500
Sulphate as SO4	5.2		1000	20000	50000
Total Dissolved Solids	970		4000	60000	100000
Phenol	<0.1		1	-	-
Dissolved Organic Carbon	40	500	800	1000	

Mass of sample taken (kg)	0.1011	Dry Matter Content Ratio (%) =	88.8		
Mass of dry sample (kg) =	0.09	Leachant Volume (l)	0.889		
Particle Size <4mm =	>95%	Eluate Volume (l)	0.85		
JEFL Job No	15/14318		Landfill Waste Acceptance Criteria Limits		
Sample No	5				
Client Sample No	BH2		Inert	Stable Non-reactive	Hazardous
Depth/Other	2.00				
Sample Date	30/09/2015				
Batch No	1				
Solid Waste Analysis					
Total Organic Carbon (%)	0.53				
Sum of BTEX (mg/kg)	<0.025				
Sum of 7 PCBs (mg/kg)	<0.035				
Mineral Oil (mg/kg)	<45				
PAH Sum of 6 (mg/kg)	<0.22				
PAH Sum of 17 (mg/kg)	<0.64				
Eluate Analysis	10:1 concn leached		Limit values for compliance leaching test using BS EN 12457-2 at L/S 10 l/kg		
	A10				
mg/kg	mg/kg				
Arsenic	<0.025		0.5	2	25
Barium	0.11		20	100	300
Cadmium	<0.005		0.04	1	5
Chromium	<0.015		0.5	10	70
Copper	<0.07		2	50	100
Mercury	<0.0001		0.01	0.2	2
Molybdenum	0.29		0.5	10	30
Nickel	<0.02		0.4	10	40
Lead	<0.05		0.5	10	50
Antimony	<0.02		0.06	0.7	5
Selenium	<0.03		0.1	0.5	7
Zinc	<0.03		4	50	200
Chloride	<3		800	15000	25000
Fluoride	<3		10	150	500
Sulphate as SO4	46.7		1000	20000	50000
Total Dissolved Solids	800		4000	60000	100000
Phenol	<0.1		1	-	-
Dissolved Organic Carbon	30		500	800	1000

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Mass of sample taken (kg)		0.1003	Dry Matter Content Ratio (%) =		89.6		
Mass of dry sample (kg) =		0.09	Leachant Volume (l)		0.889		
Particle Size <4mm =		>95%	Eluate Volume (l)		0.6		
JEFL Job No		15/14318			Landfill Waste Acceptance Criteria Limits		
Sample No		6					
Client Sample No		BH2					
Depth/Other		3.00					
Sample Date		30/09/2015					
Batch No		1					
Solid Waste Analysis					Inert	Stable Non-reactive	Hazardous
Total Organic Carbon (%)	0.53						
Sum of BTEX (mg/kg)	<0.025						
Sum of 7 PCBs (mg/kg)	<0.035						
Mineral Oil (mg/kg)	132						
PAH Sum of 6 (mg/kg)	<0.22						
PAH Sum of 17 (mg/kg)	<0.64						
Eluate Analysis					Limit values for compliance leaching test using BS EN 12457-2 at L/S 10 l/kg		
	10:1 concn leached						
	A10						
	mg/kg				mg/kg		
Arsenic	<0.025				0.5	2	25
Barium	0.51				20	100	300
Cadmium	<0.005				0.04	1	5
Chromium	<0.015				0.5	10	70
Copper	<0.07				2	50	100
Mercury	<0.0001				0.01	0.2	2
Molybdenum	0.20				0.5	10	30
Nickel	<0.02				0.4	10	40
Lead	<0.05				0.5	10	50
Antimony	<0.02				0.06	0.7	5
Selenium	0.28				0.1	0.5	7
Zinc	0.04				4	50	200
Chloride	<3				800	15000	25000
Fluoride	<3				10	150	500
Sulphate as SO4	296.8				1000	20000	50000
Total Dissolved Solids	1489				4000	60000	100000
Phenol	<0.1				1	-	-
Dissolved Organic Carbon	30				500	800	1000

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Murphy Result Report

Mass of sample taken (kg)	0.105	Dry Matter Content Ratio (%) =	85.5		
Mass of dry sample (kg) =	0.09	Leachant Volume (l)	0.885		
Particle Size <4mm =	>95%	Eluate Volume (l)	0.8		
JEFL Job No	15/14318		Landfill Waste Acceptance Criteria Limits		
Sample No	7				
Client Sample No	BH3		Inert	Stable Non-reactive	Hazardous
Depth/Other	0.50				
Sample Date	01/10/2015				
Batch No	1				
Solid Waste Analysis					
Total Organic Carbon (%)	2.27		3	5	6
Sum of BTEX (mg/kg)	<0.025		6	-	-
Sum of 7 PCBs (mg/kg)	<0.035		1	-	-
Mineral Oil (mg/kg)	<45		500	-	-
PAH Sum of 6 (mg/kg)	<0.22		-	-	-
PAH Sum of 17 (mg/kg)	<0.64		100	-	-
Eluate Analysis	10:1 concn leached		Limit values for compliance leaching test using BS EN 12457-2 at L/S 10 l/kg		
	A10				
	mg/kg		mg/kg		
Arsenic	<0.025		0.5	2	25
Barium	<0.03		20	100	300
Cadmium	<0.005		0.04	1	5
Chromium	<0.015		0.5	10	70
Copper	<0.07		2	50	100
Mercury	0.0029		0.01	0.2	2
Molybdenum	0.06		0.5	10	30
Nickel	<0.02		0.4	10	40
Lead	<0.05		0.5	10	50
Antimony	0.02		0.06	0.7	5
Selenium	<0.03		0.1	0.5	7
Zinc	0.05		4	50	200
Chloride	<3		800	15000	25000
Fluoride	5		10	150	500
Sulphate as SO4	3.2		1000	20000	50000
Total Dissolved Solids	560		4000	60000	100000
Phenol	<0.1		1	-	-
Dissolved Organic Carbon	70		500	800	1000

Mass of sample taken (kg)	0.1133	Dry Matter Content Ratio (%) =	79.7		
Mass of dry sample (kg) =	0.09	Leachant Volume (l)	0.877		
Particle Size <4mm =	>95%	Eluate Volume (l)	0.75		
JEFL Job No	15/14318		Landfill Waste Acceptance Criteria Limits		
Sample No	8				
Client Sample No	BH4		Inert	Stable Non-reactive	Hazardous
Depth/Other	0.00-1.00				
Sample Date	03/10/2015				
Batch No	1				
Solid Waste Analysis					
Total Organic Carbon (%)	2.02		3	5	6
Sum of BTEX (mg/kg)	<0.025		6	-	-
Sum of 7 PCBs (mg/kg)	<0.035		1	-	-
Mineral Oil (mg/kg)	<45		500	-	-
PAH Sum of 6 (mg/kg)	<0.22		-	-	-
PAH Sum of 17 (mg/kg)	<0.64		100	-	-
Eluate Analysis	10:1 concn leached		Limit values for compliance leaching test using BS EN 12457-2 at L/S 10 l/kg		
	A10				
	mg/kg		mg/kg		
	Arsenic		<0.025	0.5	2
Barium	<0.03		20	100	300
Cadmium	<0.005		0.04	1	5
Chromium	<0.015		0.5	10	70
Copper	<0.07		2	50	100
Mercury	0.0007		0.01	0.2	2
Molybdenum	0.11		0.5	10	30
Nickel	<0.02		0.4	10	40
Lead	<0.05		0.5	10	50
Antimony	<0.02		0.06	0.7	5
Selenium	<0.03		0.1	0.5	7
Zinc	0.04		4	50	200
Chloride	4		800	15000	25000
Fluoride	5		10	150	500
Sulphate as SO4	8.2		1000	20000	50000
Total Dissolved Solids	1800		4000	60000	100000
Phenol	<0.1		1	-	-
Dissolved Organic Carbon	60	500	800	1000	

Jones Environmental Laboratory

Murphy Result Report

Mass of sample taken (kg)	0.1007	Dry Matter Content Ratio (%) =	88.9		
Mass of dry sample (kg) =	0.09	Leachant Volume (l)	0.889		
Particle Size <4mm =	>95%	Eluate Volume (l)	0.85		
JEFL Job No	15/14318		Landfill Waste Acceptance Criteria Limits		
Sample No	9				
Client Sample No	BH4		Inert	Stable Non-reactive	Hazardous
Depth/Other	1.00-2.00				
Sample Date	03/10/2015				
Batch No	1				
Solid Waste Analysis					
Total Organic Carbon (%)	0.34				
Sum of BTEX (mg/kg)	<0.025				
Sum of 7 PCBs (mg/kg)	<0.035				
Mineral Oil (mg/kg)	<45				
PAH Sum of 6 (mg/kg)	<0.22				
PAH Sum of 17 (mg/kg)	<0.64				
Eluate Analysis	10:1 concn leached		Limit values for compliance leaching test using BS EN 12457-2 at L/S 10 l/kg		
	A10				
	mg/kg		mg/kg		
Arsenic	<0.025		0.5	2	25
Barium	0.05		20	100	300
Cadmium	<0.005		0.04	1	5
Chromium	<0.015		0.5	10	70
Copper	<0.07		2	50	100
Mercury	0.0003		0.01	0.2	2
Molybdenum	0.29		0.5	10	30
Nickel	<0.02		0.4	10	40
Lead	<0.05		0.5	10	50
Antimony	0.02		0.06	0.7	5
Selenium	<0.03		0.1	0.5	7
Zinc	0.05		4	50	200
Chloride	<3		800	15000	25000
Fluoride	<3		10	150	500
Sulphate as SO4	5.0		1000	20000	50000
Total Dissolved Solids	1070		4000	60000	100000
Phenol	<0.1		1	-	-
Dissolved Organic Carbon	40	500	800	1000	

Mass of sample taken (kg)	0.1022	Dry Matter Content Ratio (%) =	87.7		
Mass of dry sample (kg) =	0.09	Leachant Volume (l)	0.887		
Particle Size <4mm =	>95%	Eluate Volume (l)	0.83		
JEFL Job No	15/14318		Landfill Waste Acceptance Criteria Limits		
Sample No	10				
Client Sample No	BH4		Inert	Stable Non-reactive	Hazardous
Depth/Other	2.00-3.00				
Sample Date	03/10/2015				
Batch No	1				
Solid Waste Analysis					
Total Organic Carbon (%)	0.38		3	5	6
Sum of BTEX (mg/kg)	<0.025		6	-	-
Sum of 7 PCBs (mg/kg)	<0.035		1	-	-
Mineral Oil (mg/kg)	<45		500	-	-
PAH Sum of 6 (mg/kg)	<0.22		-	-	-
PAH Sum of 17 (mg/kg)	<0.64		100	-	-
Eluate Analysis	10:1 conc'n leached		Limit values for compliance leaching test using BS EN 12457-2 at L/S 10 l/kg		
	A10				
	mg/kg		mg/kg		
	Arsenic		<0.025	0.5	2
Barium	0.04		20	100	300
Cadmium	<0.005		0.04	1	5
Chromium	<0.015		0.5	10	70
Copper	<0.07		2	50	100
Mercury	0.0002		0.01	0.2	2
Molybdenum	0.28		0.5	10	30
Nickel	<0.02		0.4	10	40
Lead	<0.05		0.5	10	50
Antimony	<0.02		0.06	0.7	5
Selenium	<0.03		0.1	0.5	7
Zinc	0.04		4	50	200
Chloride	<3		800	15000	25000
Fluoride	<3		10	150	500
Sulphate as SO4	6.1		1000	20000	50000
Total Dissolved Solids	980		4000	60000	100000
Phenol	<0.1		1	-	-
Dissolved Organic Carbon	40	500	800	1000	

Jones Environmental Laboratory

Murphy Result Report

Mass of sample taken (kg)	0.1008	Dry Matter Content Ratio (%) =	89.0		
Mass of dry sample (kg) =	0.09	Leachant Volume (l)	0.889		
Particle Size <4mm =	>95%	Eluate Volume (l)	0.63		
JEFL Job No	15/14318		Landfill Waste Acceptance Criteria Limits		
Sample No	11				
Client Sample No	BH4		Inert	Stable Non-reactive	Hazardous
Depth/Other	3.00-4.00				
Sample Date	03/10/2015				
Batch No	1				
Solid Waste Analysis					
Total Organic Carbon (%)	0.65				
Sum of BTEX (mg/kg)	<0.025				
Sum of 7 PCBs (mg/kg)	<0.035				
Mineral Oil (mg/kg)	<45				
PAH Sum of 6 (mg/kg)	<0.22				
PAH Sum of 17 (mg/kg)	<0.64				
Eluate Analysis	10:1 concn leached		Limit values for compliance leaching test using BS EN 12457-2 at L/S 10 l/kg		
	A10				
mg/kg	mg/kg				
Arsenic	<0.025		0.5	2	25
Barium	0.17		20	100	300
Cadmium	<0.005		0.04	1	5
Chromium	<0.015		0.5	10	70
Copper	<0.07		2	50	100
Mercury	<0.0001		0.01	0.2	2
Molybdenum	0.43		0.5	10	30
Nickel	<0.02		0.4	10	40
Lead	<0.05		0.5	10	50
Antimony	<0.02		0.06	0.7	5
Selenium	<0.03		0.1	0.5	7
Zinc	0.03		4	50	200
Chloride	<3		800	15000	25000
Fluoride	3		10	150	500
Sulphate as SO4	33.8		1000	20000	50000
Total Dissolved Solids	940		4000	60000	100000
Phenol	<0.1		1	-	-
Dissolved Organic Carbon	30		500	800	1000

Matrix : Solid

Client Name: O'Connor Sutton Cronin & Assoc. Ltd Reference:	Matrix : Solid
--	-----------------------

Reference:
Location: St Pauls

Location:	St Pauls
Contact:	Cian O'Hora

[illegible]

Please note that only samples that are deviating are mentioned in this report. If no samples are listed it is because none were deviating.

Only analyses which are accredited are recorded as deviating if set criteria are not met.

NOTES TO ACCOMPANY ALL SCHEDULES AND REPORTS

JE Job No.: 15/14318

SOILS

Please note we are only MCERTS accredited (UK soils only) for sand, loam and clay and any other matrix is outside our scope of accreditation.

Where an MCERTS report has been requested, you will be notified within 48 hours of any samples that have been identified as being outside our MCERTS scope. As validation has been performed on clay, sand and loam, only samples that are predominantly these matrices, or combinations of them will be within our MCERTS scope. If samples are not one of a combination of the above matrices they will not be marked as MCERTS accredited.

It is assumed that you have taken representative samples on site and require analysis on a representative subsample. Stones will generally be included unless we are requested to remove them.

All samples will be discarded one month after the date of reporting, unless we are instructed to the contrary.

If you have not already done so, please send us a purchase order if this is required by your company.

Where appropriate please make sure that our detection limits are suitable for your needs, if they are not, please notify us immediately.

All analysis is reported on a dry weight basis unless stated otherwise. Results are not surrogate corrected. Samples are dried at 35°C ±5°C unless otherwise stated. Moisture content for CEN Leachate tests are dried at 105°C ±5°C.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

Where a CEN 10:1 ZERO Headspace VOC test has been carried out, a 10:1 ratio of water to wet (as received) soil has been used.

% Asbestos in Asbestos Containing Materials (ACMs) is determined by reference to HSG 264 The Survey Guide - Appendix 2 : ACMs in buildings listed in order of ease of fibre release.

Negative Neutralization Potential (NP) values are obtained when the volume of NaOH (0.1N) titrated (pH 8.3) is greater than the volume of HCl (1N) to reduce the pH of the sample to 2.0 - 2.5. Any negative NP values are corrected to 0.

WATERS

Please note we are not a UK Drinking Water Inspectorate (DWI) Approved Laboratory.

ISO17025 (UKAS) accreditation applies to surface water and groundwater and one other matrix which is analysis specific, any other liquids are outside our scope of accreditation.

As surface waters require different sample preparation to groundwaters the laboratory must be informed of the water type when submitting samples.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

DEVIATING SAMPLES

Samples must be received in a condition appropriate to the requested analyses. All samples should be submitted to the laboratory in suitable containers with sufficient ice packs to sustain an appropriate temperature for the requested analysis. If this is not the case you will be informed and any test results that may be compromised highlighted on your deviating samples report.

SURROGATES

Surrogate compounds are added during the preparation process to monitor recovery of analytes. However low recovery in soils is often due to peat, clay or other organic rich matrices. For waters this can be due to oxidants, surfactants, organic rich sediments or remediation fluids. Acceptable limits for most organic methods are 70 - 130% and for VOCs are 50 - 150%. When surrogate recoveries are outside the performance criteria but the associated AQC passes this is assumed to be due to matrix effect. Results are not surrogate corrected.

DILUTIONS

A dilution suffix indicates a dilution has been performed and the reported result takes this into account. No further calculation is required.

NOTE

Data is only reported if the laboratory is confident that the data is a true reflection of the samples analysed. Data is only reported as accredited when all the requirements of our Quality System have been met. In certain circumstances where all the requirements of the Quality System have not been met, for instance if the associated AQC has failed, the reason is fully investigated and documented. The sample data is then evaluated alongside the other quality control checks performed during analysis to determine its suitability. Following this evaluation, provided the sample results have not been effected, the data is reported but accreditation is removed. It is a UKAS requirement for data not reported as accredited to be considered indicative only, but this does not mean the data is not valid.

Where possible, and if requested, samples will be re-extracted and a revised report issued with accredited results. Please do not hesitate to contact the laboratory if further details are required of the circumstances which have led to the removal of accreditation.

Please include all sections of this report if it is reproduced

ABBREVIATIONS and ACRONYMS USED

#	ISO17025 (UKAS) accredited - UK.
B	Indicates analyte found in associated method blank.
DR	Dilution required.
M	MCERTS accredited.
NA	Not applicable
NAD	No Asbestos Detected.
ND	None Detected (usually refers to VOC and/SVOC TICs).
NDP	No Determination Possible
SS	Calibrated against a single substance
SV	Surrogate recovery outside performance criteria. This may be due to a matrix effect.
W	Results expressed on as received basis.
+	AQC failure, accreditation has been removed from this result, if appropriate, see 'Note' on previous page.
++	Result outside calibration range, results should be considered as indicative only and are not accredited.
*	Analysis subcontracted to a Jones Environmental approved laboratory.
AD	Samples are dried at 35°C ±5°C
CO	Suspected carry over
LOD/LOR	Limit of Detection (Limit of Reporting) in line with ISO 17025 and MCERTS
ME	Matrix Effect
NFD	No Fibres Detected
BS	AQC Sample
LB	Blank Sample
N	Client Sample
TB	Trip Blank Sample
OC	Outside Calibration Range

JE Job No: 15/14318

Test Method No.	Description	Prep Method No. (if appropriate)	Description	ISO 17025 (UKAS)	MCERTS (UK soils only)	Analysis done on As Received (AR) or Dried (AD)	Reported on dry weight basis
PM4	Gravimetric measurement of Natural Moisture Content and % Moisture Content at either 35°C or 105°C. Calculation based on ISO 11465 and BS1377.	PM0	No preparation is required.				
TM4	Modified USEPA 8270 method for the solvent extraction and determination of 16 PAHs by GC-MS.	PM8	End over end extraction of solid samples for organic analysis. The solvent mix varies depending on analysis required.			AR	Yes
TM4	Modified USEPA 8270 method for the solvent extraction and determination of 16 PAHs by GC-MS.	PM8	End over end extraction of solid samples for organic analysis. The solvent mix varies depending on analysis required.	Yes		AR	Yes
TM5	Modified USEPA 8015B method for the determination of solvent Extractable Petroleum Hydrocarbons (EPH) with carbon banding within the range C8-C40 GC-FID.	PM16	Fractionation into aliphatic and aromatic fractions using a Rapid Trace SPE.			AR	Yes
TM5	Modified USEPA 8015B method for the determination of solvent Extractable Petroleum Hydrocarbons (EPH) with carbon banding within the range C8-C40 GC-FID.	PM16	Fractionation into aliphatic and aromatic fractions using a Rapid Trace SPE.	Yes		AR	Yes
TM5/TM36	TM005: Modified USEPA 8015B. Determination of solvent Extractable Petroleum Hydrocarbons (EPH) including column fractionation in the carbon range of C10-35 into aliphatic and aromatic fractions by GC-FID. TM036: Modified USEPA 8015B. Determination of Gasoline Range Organics (GRO) in the carbon chain range of C5-10 by headspace GC-FID.	PM12/PM16	CWG GC-FID			AR	Yes
TM17	Modified US EPA method 8270. Determination of specific Polychlorinated Biphenyl congeners by GC-MS.	PM8	End over end extraction of solid samples for organic analysis. The solvent mix varies depending on analysis required.	Yes		AR	Yes
TM20	Modified USEPA 8163. Gravimetric determination of Total Dissolved Solids/Total Solids	PM0	No preparation is required.	Yes		AR	Yes
TM21	Modified USEPA 415.1. Determination of Total Organic Carbon or Total Carbon by combustion in an Eltra TOC furnace/analyser in the presence of oxygen. The CO ₂ generated is quantified using infra-red detection.	PM24	Dried and ground solid samples are washed with hydrochloric acid, then rinsed with deionised water to remove the mineral carbon before TOC analysis.	Yes		AD	Yes
TM26	Determination of phenols by Reversed Phased High Performance Liquid Chromatography and Electro-Chemical Detection.	PM0	No preparation is required.			AR	Yes

PLAN NO: LRD6002/22-
67
REC:06/09/2022

JE Job No: 15/14318

Test Method No.	Description	Prep Method No. (if appropriate)	Description	ISO 17025 (UKAS)	MCERTS (UK soils only)	Analysis done on As Received (AR) or Dried (AD)	Reported on dry weight basis
TM27	Modified US EPA method 9056. Determination of water soluble anions using Dionex (Ion-Chromatography).	PM0	No preparation is required.			AR	Yes
TM30	Determination of Trace Metal elements by ICP-OES (Inductively Coupled Plasma - Optical Emission Spectrometry). Modified US EPA Method 200.7	PM15	Acid digestion of dried and ground solid samples using Aqua Regia refluxed at 112.5 °C. Samples containing asbestos are not dried and ground.			AD	Yes
TM30	Determination of Trace Metal elements by ICP-OES (Inductively Coupled Plasma - Optical Emission Spectrometry). Modified US EPA Method 200.7	PM15	Acid digestion of dried and ground solid samples using Aqua Regia refluxed at 112.5 °C. Samples containing asbestos are not dried and ground.	Yes		AD	Yes
TM30	Determination of Trace Metal elements by ICP-OES (Inductively Coupled Plasma - Optical Emission Spectrometry). Modified US EPA Method 200.7	PM17	Modified method EN12457-2 As received solid samples are leached with water in a 10:1 water to soil ratio for 24 hours, the moisture content of the sample is included in the ratio.	Yes		AR	Yes
TM31	Modified USEPA 8015B. Determination of Methyltertbutylether, Benzene, Toluene, Ethylbenzene and Xylene by headspace GC-FID.	PM12	Modified US EPA method 5021. Preparation of solid and liquid samples for GC headspace analysis.			AR	Yes
TM31	Modified USEPA 8015B. Determination of Methyltertbutylether, Benzene, Toluene, Ethylbenzene and Xylene by headspace GC-FID.	PM12	Modified US EPA method 5021. Preparation of solid and liquid samples for GC headspace analysis.	Yes		AR	Yes
TM36	Modified US EPA method 8015B. Determination of Gasoline Range Organics (GRO) in the carbon chain range of C4-12 by headspace GC-FID.	PM12	Modified US EPA method 5021. Preparation of solid and liquid samples for GC headspace analysis.			AR	Yes
TM36	Modified US EPA method 8015B. Determination of Gasoline Range Organics (GRO) in the carbon chain range of C4-12 by headspace GC-FID.	PM12	Modified US EPA method 5021. Preparation of solid and liquid samples for GC headspace analysis.	Yes		AR	Yes
TM38	Soluble Ion analysis using the Thermo Aquakem Photometric Automatic Analyser. Modified US EPA methods 325.2, 375.4, 365.2, 353.1, 354.1	PM20	Extraction of dried and ground samples with deionised water in a 2:1 water to solid ratio for anions. Extraction of as received samples with deionised water in a 2:1 water to solid ratio for ammoniacal nitrogen. Samples are extracted using an orbital shaker.	Yes		AD	Yes
TM38	Soluble Ion analysis using the Thermo Aquakem Photometric Automatic Analyser. Modified US EPA methods 325.2, 375.4, 365.2, 353.1, 354.1	PM20	Extraction of dried and ground samples with deionised water in a 2:1 water to solid ratio for anions. Extraction of as received samples with deionised water in a 2:1 water to solid ratio for ammoniacal nitrogen. Samples are extracted using an orbital shaker.	Yes		AR	Yes

JE Job No: 15/14318

Test Method No.	Description	Prep Method No. (if appropriate)	Description	ISO 17025 (UKAS)	MCERTS (UK soils only)	Analysis done on As Received (AR) or Dried (AD)	Reported on dry weight basis
TM60	Modified USEPA 9060. Determination of TOC by calculation from Total Carbon and Inorganic Carbon using a TOC analyser, the carbon in the sample is converted to CO ₂ and then passed through a non-dispersive infrared gas analyser (NDIR).	PM0	No preparation is required.			AR	Yes
TM61	Modified US EPA methods 245.7 and 200.7. Determination of Mercury by Cold Vapour Atomic Fluorescence.	PM38	Samples are brominated to reduce all mercury compounds to Mercury (II) which is analysed using method TM061.	Yes		AR	Yes
TM73	Modified US EPA methods 150.1 and 9045D. Determination of pH by Metrohm automated probe analyser.	PM11	Extraction of as received solid samples using one part solid to 2.5 parts deionised water.	Yes		AR	No
NONE	No Method Code	NONE	No Method Code			AR	Yes
NONE	No Method Code	PM17	Modified method EN12457-2 As received solid samples are leached with water in a 10:1 water to soil ratio for 24 hours, the moisture content of the sample is included in the ratio.				
NONE	No Method Code	PM17	Modified method EN12457-2 As received solid samples are leached with water in a 10:1 water to soil ratio for 24 hours, the moisture content of the sample is included in the ratio.			AR	
NONE	No Method Code	PM4	Gravimetric measurement of Natural Moisture Content and % Moisture Content at either 35°C or 105°C. Calculation based on ISO 11465 and BS1377.			AR	

 PLAN NO: LRD6002/22-
 57
 REC: 06/09/2022

Appendix - Methods used for WAC (2003/33/EC)

Leachate tests	
10l/kg; 4mm	I.S. EN 12457-2:2002 Specified particle size; water added to L/S ratio; capped; agitated for 24 ± 0.5 hours; eluate settled and filtered over 0.45 µm membrane filter.
Eluate analysis	
As	I.S. EN 12506 : EN ISO 11885 (ICP-OES)
Ba	I.S. EN 12506 : EN ISO 11885 (ICP-OES)
Cd	I.S. EN 12506 : EN ISO 11885 (ICP-OES)
Cr total	I.S. EN 12506 : EN ISO 11885 (ICP-OES)
Cu	I.S. EN 12506 : EN ISO 11885 (ICP-OES)
Hg	I.S. EN 13370 rec. EN 1483 (CVAAS)
Mo	I.S. EN 12506 : EN ISO 11885 (ICP-OES)
Ni	I.S. EN 12506 : EN ISO 11885 (ICP-OES)
Pb	I.S. EN 12506 : EN ISO 11885 (ICP-OES)
Sb	I.S. EN 12506 : EN ISO 11885 (ICP-OES)
Se	I.S. EN 12506 : EN ISO 11885 (ICP-OES)
Zn	I.S. EN 12506 : EN ISO 11885 (ICP-OES)
Chloride	I.S. EN 12506 rec. EN ISO 10304-part 1 (liquid chromatography of ions)
Fluoride	I.S. EN 12506 rec. EN ISO 10304-part 1 (liquid chromatography of ions)
Sulphate	I.S. EN 12506 rec. EN ISO 10304-part 1 (liquid chromatography of ions)
Phenol index	I.S. EN 13370 rec. ISO 6439 (4-Aminoantipyrine spectrometric methods after distillation)* (BY HPLC - Jones Env)
DOC	I.S. EN 1484
TDS	I.S. EN 15216
Compositional analysis	
TOC	I.S. EN 13137 Method B: carbonates removed with acid; TOC by combustion.
BTEX	GC-FID
PCB7**	I.S. EN 15308 analysis by GC-ECD.
Mineral oil	I.S. EN 14039 C10 to C40 analysis by GC-FID.
PAH17***	I.S. EN 15527 PAH17 analysis by GC-MS
Metals	I.S. EN 13657 - Aqua regia digestion: EN ISO 11885 (ICP-OES)
Other	
Dry matter	I.S. EN 14346 sample is dried to a constant mass in an oven at 105 ± 3 °C; Method B Water content by direct Karl-Fischer-titration and either volumetric or coulometric detection.
LOI	I.S. EN 15169 Difference in mass after heating in a furnace up to 550 ± 25 °C.
ANC	CEN/TS 15364 Determined by amounts of acid or base needed to cover the pH range
Notes: *If not suitable due to LOD, precision, etc., any other suitable method can be used, e.g. AFS, ICP-MS **PCB-28, PCB-52, PCB-101, PCB-118, PCB-138, PCB-153 and PCB-180 ***Naphthalene, Acenaphthylene, Acenaphthene, Anthracene, Benzo(a)anthracene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Benzo(g,h,i)perylene, Benzo(a)pyrene, Chrysene, Coronene, Dibenzo(a,h)anthracene, Fluorene, Fluoranthene, Indeno(1,2,3-c,d)pyrene, Phenanthrene and Pyrene.	

PLAN NO: LRD6002/22-
63 REC:06/09/2022

Appendix 4: Groundwater Monitoring

GROUNDWATER MONITORING

PLAN NO: LRD6002/22-
63 REC:06/09/2022

St Pauls Raheny

BOREHOLE	DATE	GROUNDWATER		Comments
		m BGL	m OD	
BH1	19/10/2015	1.08	23.772	
BH2	19/10/2015	1.79	20.699	
BH3	19/10/2015	2.17	19.773	
BH6	19/10/2015	Dry	-	
BH9	19/10/2015	2.40	19.021	



Appendix J Surface Water Sampling Laboratory Reports

Customer

Muriel Ennis

Enviroguide Consulting

Unit 3D, Block 71c

The Plaza

Parkwest

Dublin 8

PLAN NO: LRD6002/22-
83 REC:06/09/2022

Certificate Of Analysis

Job Number: 19-53505

Issue Number: 1

Report Date: 5 April 2019

Site: Not Applicable

PO Number: Not Supplied

Date Samples Received: 07/03/2019

Please find attached the results for the samples received at our laboratory on 07/03/2019.

Should you have any queries regarding the report or require any further services, we would be happy to discuss your requirements. For additional information about the company please log-on to our website at the above address.

Thank you for choosing City Analysts Limited. We look forward to assisting you again.

Authorised By:



Shane Reynolds
Laboratory Manager

Authorised Date: 5 April 2019

Notes:

Results relate only to the items tested.

Information on methods of analysis and performance characteristics is available on request.

Any opinions or interpretations indicated are outside the scope of our INAB accreditation.

This test report shall not be reproduced except in full or with written approval of City Analysts Limited.

Certificate Of Analysis

Customer

Muriel Ennis
Enviroguide Consulting
Unit 3D, Block 71c
The Plaza
Parkwest
Dublin 8

Report Reference: 19-53505

Report Version: 1

Site: Not Applicable

Sample Description: SW1

Date of Sampling: 07/03/2019

Sample Type: Surface

Date Sample Received: 07/03/2019

Lab Reference Number: 431227

Site / Method Ref.	Analysis Start Date	Parameter	Result	Units	PV Value (Drinking Water Only)
D/D3000#	08/03/2019	Ammonia as N	0.256	mg/l	-
D/D1003#	07/03/2019	CBOD5	3	mg/l O2	-
D/D3001#	13/03/2019	Cadmium	< 0.2	ug/l	-
D/D3006	07/03/2019	Chlorine, Free	< 0.010	mg/l	-
D/D3000#	08/03/2019	Chloride	42.744	mg/l	-
D/D3001#	13/03/2019	Chromium	1.2	ug/l	-
*U	-	Chromium VI	< 0.020	mg/l	-
*U	-	Chromium III	< 0.020	mg/l	-
D/D1009#	08/03/2019	COD	9	mg/l O2	-
D/D3011#	07/03/2019	Conductivity @ 20°C	600.0	uS/cm @20°C	-
D/D3001#	13/03/2019	Copper	3.1	ug/l	-
D/D3015#	08/03/2019	Fluoride	0.3	mg/l	-
D/D3001#	13/03/2019	Hardness as CaCO3	341.135	mg/l	-
D/D3001#	13/03/2019	Lead	2.2	ug/l	-
D/D3001#	13/03/2019	Nickel	1.6	ug/l	-
EW188#*	-	Arsenic - Total	0.9	ug/L	-
DEAFULT*U	-	Total Cyanide Low	< 10.0000	ug/L	-
D/D3000#	08/03/2019	Orthophosphate as P	0.115	mg/l	-

= INAB Accredited, U = UKAS Accredited, * = Subcontracted

Note:

PV Value is the parametric value, taken from European Communities, (Drinking Water) Regulations, 2014. S.I. No. 122 of 2014 and relates only to drinking water samples.

For queries on results, please contact us within two weeks of the report date to ensure that we can accommodate your query as samples cannot be stored indefinitely.

NAC & ATC - No abnormal change and acceptable to customers.

TVC - Total viable count

Site D = Analysed at City Analysts Dublin. Site S = Analysed at City Analysts Shannon

Certificate Of Analysis

Customer

Muriel Ennis
Enviroguide Consulting
Unit 3D, Block 71c
The Plaza
Parkwest
Dublin 8

Report Reference: 19-53505

Report Version: 1

PLAN NO: LRD6002/22-
93 REC: 06/09/2022

Site: Not Applicable

Sample Description: SW1

Date of Sampling: 07/03/2019

Sample Type: Surface

Date Sample Received: 07/03/2019

Lab Reference Number: 431227

Site / Method Ref.	Analysis Start Date	Parameter	Result	Units	PV Value (Drinking Water Only)
D/D1041#	07/03/2019	PH	7.84	pH Unit	-
D/D1049#	08/03/2019	Total Suspended Solids	< 2	mg/l	-
D/D3001#	13/03/2019	Zinc	10.2	ug/l	-

= INAB Accredited, U = UKAS Accredited, * = Subcontracted

Note:

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For queries on results, please contact us within two weeks of the report date to ensure that we can accommodate your query as samples cannot be stored indefinitely.

NAC & ATC - No abnormal change and acceptable to customers.

TVC - Total viable count

Site D = Analysed at City Analysts Dublin. Site S = Analysed at City Analysts Shannon

Certificate Of Analysis

Customer

Muriel Ennis
Enviroguide Consulting
Unit 3D, Block 71c
The Plaza
Parkwest
Dublin 8

Report Reference: 19-53505

Report Version: 1

Site: Not Applicable

Sample Description: SW2

Date of Sampling: 07/03/2019

Sample Type: Surface

Date Sample Received: 07/03/2019

Lab Reference Number: 431228

Site / Method Ref.	Analysis Start Date	Parameter	Result	Units	PV Value (Drinking Water Only)
D/D3000#	08/03/2019	Ammonia as N	0.163	mg/l	-
D/D1003#	07/03/2019	CBOD5	2	mg/l O2	-
D/D3001#	13/03/2019	Cadmium	< 0.2	ug/l	-
D/D3006	07/03/2019	Chlorine, Free	< 0.010	mg/l	-
D/D3000#	08/03/2019	Chloride	48.961	mg/l	-
D/D3001#	13/03/2019	Chromium	1.1	ug/l	-
*U	-	Chromium VI	< 0.020	mg/l	-
*U	-	Chromium III	< 0.020	mg/l	-
D/D1009#	12/03/2019	COD	10	mg/l O2	-
D/D3011#	07/03/2019	Conductivity @ 20°C	620.0	uS/cm @20°C	-
D/D3001#	13/03/2019	Copper	5.6	ug/l	-
D/D3015#	08/03/2019	Fluoride	0.3	mg/l	-
D/D3001#	13/03/2019	Hardness as CaCO3	349.416	mg/l	-
D/D3001#	13/03/2019	Lead	2.1	ug/l	-
D/D3001#	13/03/2019	Nickel	1.1	ug/l	-
EW188#*	-	Arsenic - Total	1.0	ug/L	-
DEAFULT*U	-	Total Cyanide Low	< 10.0000	ug/L	-
D/D3000#	08/03/2019	Orthophosphate as P	0.048	mg/l	-

= INAB Accredited, U = UKAS Accredited, * = Subcontracted

Note:

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TVC - Total viable count

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Certificate Of Analysis

Customer

Muriel Ennis
Enviroguide Consulting
Unit 3D, Block 71c
The Plaza
Parkwest
Dublin 8

Report Reference: 19-53505

Report Version: 1

PLAN NO: LRD6002/22-
63 REC:06/09/2022

Site: Not Applicable

Sample Description: SW2

Date of Sampling: 07/03/2019

Sample Type: Surface

Date Sample Received: 07/03/2019

Lab Reference Number: 431228

Site / Method Ref.	Analysis Start Date	Parameter	Result	Units	PV Value (Drinking Water Only)
D/D1041#	07/03/2019	PH	7.95	pH Unit	-
D/D1049#	08/03/2019	Total Suspended Solids	< 2	mg/l	-
D/D3001#	13/03/2019	Zinc	11.6	ug/l	-

= INAB Accredited, U = UKAS Accredited, * = Subcontracted

Note:

PV Value is the parametric value, taken from European Communities, (Drinking Water) Regulations, 2014. S.I. No. 122 of 2014 and relates only to drinking water samples.

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Customer

Muriel Ennis
Enviroguide Consulting
Unit 3D, Block 71c
The Plaza
Parkwest
Dublin 8

Certificate Of Analysis

Job Number: 19-54627
Issue Number: 1
Report Date: 29 April 2019

Site: Not Applicable
PO Number: Not Supplied
Date Samples Received: 04/04/2019

Please find attached the results for the samples received at our laboratory on 04/04/2019.

Should you have any queries regarding the report or require any further services, we would be happy to discuss your requirements. For additional information about the company please log-on to our website at the above address.

Thank you for choosing City Analysts Limited. We look forward to assisting you again.

Authorised By:



Shane Reynolds
Laboratory Manager

Authorised Date: 29 April 2019

Notes:

Results relate only to the items tested.
Information on methods of analysis and performance characteristics is available on request.
Any opinions or interpretations indicated are outside the scope of our INAB accreditation.
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Enviroguide Consulting
Unit 3D, Block 71c
The Plaza
Parkwest
Dublin 8

Report Reference: 19-54627

Report Version: 1

PLAN NO: LRD6002/22-
83 REC:06/09/2022

Site: Not Applicable

Sample Description: SW1

Date of Sampling: 04/04/2019

Sample Type: Surface

Date Sample Received: 04/04/2019

Lab Reference Number: 434422

Site / Method Ref.	Analysis Start Date	Parameter	Result	Units	PV Value (Drinking Water Only)
D/D3000#	05/04/2019	Ammonia as N	0.288	mg/l	-
D/D1003#	04/04/2019	CBOD5	< 2	mg/l O2	-
D/D3001#	17/04/2019	Cadmium	< 0.2	ug/l	-
D/D3006	05/04/2019	Chlorine, Free	< 0.010	mg/l	-
D/D3000#	05/04/2019	Chloride	34.099	mg/l	-
D/D3001#	17/04/2019	Chromium	< 0.9	ug/l	-
*U	-	Chromium VI	< 0.020	mg/l	-
*U	-	Chromium III	< 0.020	mg/l	-
D/D1009#	05/04/2019	COD	8	mg/l O2	-
D/D3011#	04/04/2019	Conductivity @ 20°C	495.0	uS/cm @20°C	-
D/D3001#	17/04/2019	Copper	7.2	ug/l	-
D/D3015#	05/04/2019	Fluoride	0.4	mg/l	-
D/D3001#	17/04/2019	Hardness as CaCO3	230.386	mg/l	-
D/D3001#	17/04/2019	Lead	4.4	ug/l	-
D/D3001#	17/04/2019	Nickel	1.3	ug/l	-
EW188#*	-	Arsenic - Total	< 1.0	ug/L	-
DEAFULT*U	-	Total Cyanide Low	< 0.7000	ug/L	-
D/D3000#	05/04/2019	Orthophosphate as P	0.146	mg/l	-

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Note:

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Unit 3D, Block 71c
The Plaza
Parkwest
Dublin 8

Report Reference: 19-54627

Report Version: 1

Site: Not Applicable

Sample Description: SW1

Date of Sampling: 04/04/2019

Sample Type: Surface

Date Sample Received: 04/04/2019

Lab Reference Number: 434422

Site / Method Ref.	Analysis Start Date	Parameter	Result	Units	PV Value (Drinking Water Only)
D/D1041#	04/04/2019	PH	7.91	pH Unit	-
D/D1049#	05/04/2019	Total Suspended Solids	< 2	mg/l	-
D/D3001#	17/04/2019	Zinc	15.2	ug/l	-

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Note:

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Dublin 8

Report Reference: 19-54627

Report Version: 1

PLAN NO: LRD6002/22-
33 REC: 06/09/2022

Site: Not Applicable

Sample Description: SW2

Date of Sampling: 04/04/2019

Sample Type: Surface

Date Sample Received: 04/04/2019

Lab Reference Number: 434423

Site / Method Ref.	Analysis Start Date	Parameter	Result	Units	PV Value (Drinking Water Only)
D/D3000#	05/04/2019	Ammonia as N	0.144	mg/l	-
D/D1003#	04/04/2019	CBOD5	< 2	mg/l O2	-
D/D3001#	17/04/2019	Cadmium	< 0.2	ug/l	-
D/D3006	05/04/2019	Chlorine, Free	< 0.010	mg/l	-
D/D3000#	05/04/2019	Chloride	35.624	mg/l	-
D/D3001#	17/04/2019	Chromium	< 0.9	ug/l	-
*U	-	Chromium VI	< 0.020	mg/l	-
*U	-	Chromium III	< 0.020	mg/l	-
D/D1009#	05/04/2019	COD	10	mg/l O2	-
D/D3011#	04/04/2019	Conductivity @ 20°C	506.0	uS/cm @20°C	-
D/D3001#	17/04/2019	Copper	3.4	ug/l	-
D/D3015#	05/04/2019	Fluoride	0.4	mg/l	-
D/D3001#	17/04/2019	Hardness as CaCO3	230.136	mg/l	-
D/D3001#	17/04/2019	Lead	4.6	ug/l	-
D/D3001#	17/04/2019	Nickel	1.8	ug/l	-
EW188#*	-	Arsenic - Total	1.1	ug/L	-
DEAFULT*U	-	Total Cyanide Low	< 0.7000	ug/L	-
D/D3000#	05/04/2019	Orthophosphate as P	0.075	mg/l	-

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Unit 3D, Block 71c
The Plaza
Parkwest
Dublin 8

Report Reference: 19-54627

Report Version: 1

Site: Not Applicable

Sample Description: SW2

Date of Sampling: 04/04/2019

Sample Type: Surface

Date Sample Received: 04/04/2019

Lab Reference Number: 434423

Site / Method Ref.	Analysis Start Date	Parameter	Result	Units	PV Value (Drinking Water Only)
D/D1041#	04/04/2019	PH	8.14	pH Unit	-
D/D1049#	05/04/2019	Total Suspended Solids	< 2	mg/l	-
D/D3001#	17/04/2019	Zinc	11.5	ug/l	-

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Customer

Muriel Ennis
Enviroguide Consulting
Unit 3D, Block 71c
The Plaza
Parkwest
Dublin 8

Certificate Of Analysis

Job Number: 19-56085
Issue Number: 1
Report Date: 11 June 2019

Site: Not Applicable
PO Number: Not Supplied
Date Samples Received: 14/05/2019

Please find attached the results for the samples received at our laboratory on 14/05/2019.

Should you have any queries regarding the report or require any further services, we would be happy to discuss your requirements. For additional information about the company please log-on to our website at the above address.

Thank you for choosing City Analysts Limited. We look forward to assisting you again.

Authorised By:



Shane Reynolds
Laboratory Manager

Authorised Date: 11 June 2019

Notes:

Results relate only to the items tested.
Information on methods of analysis and performance characteristics is available on request.
Any opinions or interpretations indicated are outside the scope of our INAB accreditation.
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Enviroguide Consulting
Unit 3D, Block 71c
The Plaza
Parkwest
Dublin 8

Report Reference: 19-56085

Report Version: 1

Site: Not Applicable

Sample Description: SW1

Date of Sampling: 14/05/2019

Sample Type: Surface

Date Sample Received: 14/05/2019

Lab Reference Number: 438617

Site / Method Ref.	Analysis Start Date	Parameter	Result	Units	PV Value (Drinking Water Only)
D/D3000#	15/05/2019	Ammonia as N	1.270	mg/l	-
D/D1003#	15/05/2019	CBOD5	2	mg/l O2	-
D/D3001#	16/05/2019	Cadmium	0.3	ug/l	-
D/D3006	14/05/2019	Chlorine, Free	0.020	mg/l	-
D/D3000#	15/05/2019	Chloride	36.478	mg/l	-
D/D3001#	16/05/2019	Chromium	1.1	ug/l	-
*U	-	Chromium VI	< 0.020	mg/l	-
*U	-	Chromium III	< 0.020	mg/l	-
D/D1009#	14/05/2019	COD	11	mg/l O2	-
D/D3011#	14/05/2019	Conductivity @ 20°C	526.0	uS/cm @20°C	-
D/D3001#	16/05/2019	Copper	3.8	ug/l	-
D/D3015#	17/05/2019	Fluoride	0.4	mg/l	-
D/D3001#	16/05/2019	Hardness as CaCO3	249.329	mg/l	-
D/D3001#	16/05/2019	Lead	2.2	ug/l	-
D/D3001#	16/05/2019	Nickel	1.6	ug/l	-
DEAFULT*U	-	Total Cyanide Low	< 9.0000	ug/L	-
EW188#*	-	Arsenic - Total	< 1.0	ug/L	-
D/D3000#	15/05/2019	Orthophosphate as P	0.096	mg/l	-

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Note:

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Muriel Ennis
Enviroguide Consulting
Unit 3D, Block 71c
The Plaza
Parkwest
Dublin 8

Report Reference: 19-56085

Report Version: 1

Site: Not Applicable

Sample Description: SW1

Date of Sampling: 14/05/2019

Sample Type: Surface

Date Sample Received: 14/05/2019

Lab Reference Number: 438617

Site / Method Ref.	Analysis Start Date	Parameter	Result	Units	PV Value (Drinking Water Only)
D/D1041#	14/05/2019	PH	7.64	pH Unit	-
D/D1049#	15/05/2019	Total Suspended Solids	2	mg/l	-
D/D3001#	16/05/2019	Zinc	13.1	ug/l	-

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Note:

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Unit 3D, Block 71c
The Plaza
Parkwest
Dublin 8

Report Reference: 19-56085

Report Version: 1

Site: Not Applicable

Sample Description: SW2

Date of Sampling: 14/05/2019

Sample Type: Surface

Date Sample Received: 14/05/2019

Lab Reference Number: 438618

Site / Method Ref.	Analysis Start Date	Parameter	Result	Units	PV Value (Drinking Water Only)
D/D3000#	15/05/2019	Ammonia as N	0.618	mg/l	-
D/D1003#	15/05/2019	CBOD5	< 2	mg/l O2	-
D/D3001#	16/05/2019	Cadmium	0.4	ug/l	-
D/D3006	14/05/2019	Chlorine, Free	< 0.010	mg/l	-
D/D3000#	15/05/2019	Chloride	35.882	mg/l	-
D/D3001#	16/05/2019	Chromium	< 0.9	ug/l	-
*U	-	Chromium VI	< 0.020	mg/l	-
*U	-	Chromium III	< 0.020	mg/l	-
D/D1009#	14/05/2019	COD	10	mg/l O2	-
D/D3011#	14/05/2019	Conductivity @ 20°C	632.0	uS/cm @20°C	-
D/D3001#	16/05/2019	Copper	3.5	ug/l	-
D/D3015#	17/05/2019	Fluoride	0.4	mg/l	-
D/D3001#	16/05/2019	Hardness as CaCO3	247.782	mg/l	-
D/D3001#	16/05/2019	Lead	2.7	ug/l	-
D/D3001#	16/05/2019	Nickel	< 0.5	ug/l	-
EW188#*	-	Arsenic - Total	1.2	ug/L	-
DEAFULT*U	-	Total Cyanide Low	< 9.0000	ug/L	-
D/D3000#	15/05/2019	Orthophosphate as P	0.066	mg/l	-

= INAB Accredited, U = UKAS Accredited, * = Subcontracted

Note:

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TVC - Total viable count

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Certificate Of Analysis

Customer

Muriel Ennis
Enviroguide Consulting
Unit 3D, Block 71c
The Plaza
Parkwest
Dublin 8

Report Reference: 19-56085

Report Version: 1

Site: Not Applicable

Sample Description: SW2

Date of Sampling: 14/05/2019

Sample Type: Surface

Date Sample Received: 14/05/2019

Lab Reference Number: 438618

Site / Method Ref.	Analysis Start Date	Parameter	Result	Units	PV Value (Drinking Water Only)
D/D1041#	14/05/2019	PH	7.65	pH Unit	-
D/D1049#	15/05/2019	Total Suspended Solids	< 2	mg/l	-
D/D3001#	16/05/2019	Zinc	8.5	ug/l	-

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Note:

PV Value is the parametric value, taken from European Communities, (Drinking Water) Regulations, 2014. S.I. No. 122 of 2014 and relates only to drinking water samples.

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TVC - Total viable count

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Customer

Muriel Ennis
Enviroguide Consulting
Unit 3D, Block 71c
The Plaza
Parkwest
Dublin 8

Certificate Of Analysis


Job Number: 19-58097
Issue Number: 1
Report Date: 22 July 2019

Site: Not Applicable
PO Number: Not Supplied
Date Samples Received: 27/06/2019

Please find attached the results for the samples received at our laboratory on 27/06/2019.

Should you have any queries regarding the report or require any further services, we would be happy to discuss your requirements. For additional information about the company please log-on to our website at the above address.

Thank you for choosing City Analysts Limited. We look forward to assisting you again.

Authorised By: 
Shane Reynolds
Laboratory Manager

Authorised Date: 22 July 2019

Notes:

Results relate only to the items tested.
Information on methods of analysis and performance characteristics is available on request.
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Muriel Ennis
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Unit 3D, Block 71c
The Plaza
Parkwest
Dublin 8

Report Reference: 19-58097

Report Version: 1

Site: Not Applicable

Sample Description: SW1

Date of Sampling: 27/06/2019

Sample Type: Surface

Date Sample Received: 27/06/2019

Lab Reference Number: 444595

Site / Method Ref.	Analysis Start Date	Parameter	Result	Units	PV Value (Drinking Water Only)
D/D3000#	02/07/2019	Ammonia as N	0.102	mg/l	-
D/D1003#	27/06/2019	CBOD5	4	mg/l O2	-
D/D3001#	01/07/2019	Cadmium	< 0.2	ug/l	-
D/D3006	28/06/2019	Chlorine, Free	< 0.010	mg/l	-
D/D3000#	02/07/2019	Chloride	32.097	mg/l	-
D/D3001#	01/07/2019	Chromium	< 0.9	ug/l	-
*U	-	Chromium VI	< 0.020	mg/l	-
*U	-	Chromium III	< 0.020	mg/l	-
D/D1009#	28/06/2019	COD	28	mg/l O2	-
D/D3011#	28/06/2019	Conductivity @ 20°C	575.0	uS/cm @20°C	-
D/D3001#	01/07/2019	Copper	< 2.0	ug/l	-
D/D3015#	29/06/2019	Fluoride	0.5	mg/l	-
D/D3001#	01/07/2019	Hardness as CaCO3	291.779	mg/l	-
D/D3001#	04/07/2019	Lead	< 1.7	ug/l	-
D/D3001#	01/07/2019	Nickel	0.8	ug/l	-
EW188#*	-	Arsenic - Total	< 1.0	ug/L	-
DEAFULT*U	-	Total Cyanide Low	< 0.7000	ug/L	-
D/D3000#	02/07/2019	Orthophosphate as P	< 0.025	mg/l	-

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Note:

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Unit 3D, Block 71c
The Plaza
Parkwest
Dublin 8

Report Reference: 19-58097

Report Version: 1

Site: Not Applicable

Sample Description: SW1

Date of Sampling: 27/06/2019

Sample Type: Surface

Date Sample Received: 27/06/2019

Lab Reference Number: 444595

Site / Method Ref.	Analysis Start Date	Parameter	Result	Units	PV Value (Drinking Water Only)
D/D1041#	28/06/2019	PH	8.11	pH Unit	-
D/D1049#	01/07/2019	Total Suspended Solids	2	mg/l	-
D/D3001#	01/07/2019	Zinc	6.6	ug/l	-

= INAB Accredited, U = UKAS Accredited, * = Subcontracted

Note:

PV Value is the parametric value, taken from European Communities, (Drinking Water) Regulations, 2014. S.I. No. 122 of 2014 and relates only to drinking water samples.

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Certificate Of Analysis

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Parkwest
Dublin 8

Report Reference: 19-58097

Report Version: 1

Site: Not Applicable

Sample Description: SW2

Date of Sampling: 27/06/2019

Sample Type: Surface

Date Sample Received: 27/06/2019

Lab Reference Number: 444596

Site / Method Ref.	Analysis Start Date	Parameter	Result	Units	PV Value (Drinking Water Only)
D/D3000#	02/07/2019	Ammonia as N	0.083	mg/l	-
D/D1003#	27/06/2019	CBOD5	< 2	mg/l O2	-
D/D3001#	01/07/2019	Cadmium	0.3	ug/l	-
D/D3006	28/06/2019	Chlorine, Free	< 0.010	mg/l	-
D/D3000#	02/07/2019	Chloride	30.953	mg/l	-
D/D3001#	01/07/2019	Chromium	< 0.9	ug/l	-
*U	-	Chromium VI	< 0.020	mg/l	-
*U	-	Chromium III	< 0.020	mg/l	-
D/D1009#	28/06/2019	COD	26	mg/l O2	-
D/D3011#	28/06/2019	Conductivity @ 20°C	570.0	uS/cm @20°C	-
D/D3001#	01/07/2019	Copper	< 2.0	ug/l	-
D/D3015#	29/06/2019	Fluoride	0.4	mg/l	-
D/D3001#	01/07/2019	Hardness as CaCO3	289.799	mg/l	-
D/D3001#	04/07/2019	Lead	< 1.7	ug/l	-
D/D3001#	01/07/2019	Nickel	1.1	ug/l	-
EW188#*	-	Arsenic - Total	< 1.0	ug/L	-
DEAFULT*U	-	Total Cyanide Low	< 0.7000	ug/L	-
D/D3000#	02/07/2019	Orthophosphate as P	0.068	mg/l	-

= INAB Accredited, U = UKAS Accredited, * = Subcontracted

Note:

PV Value is the parametric value, taken from European Communities, (Drinking Water) Regulations, 2014. S.I. No. 122 of 2014 and relates only to drinking water samples.

For queries on results, please contact us within two weeks of the report date to ensure that we can accommodate your query as samples cannot be stored indefinitely.

NAC & ATC - No abnormal change and acceptable to customers.

TVC - Total viable count

Site D = Analysed at City Analysts Dublin. Site S = Analysed at City Analysts Shannon

Certificate Of Analysis

Customer

Muriel Ennis
Enviroguide Consulting
Unit 3D, Block 71c
The Plaza
Parkwest
Dublin 8

Report Reference: 19-58097

Report Version: 1

Site: Not Applicable

Sample Description: SW2

Date of Sampling: 27/06/2019

Sample Type: Surface

Date Sample Received: 27/06/2019

Lab Reference Number: 444596

Site / Method Ref.	Analysis Start Date	Parameter	Result	Units	PV Value (Drinking Water Only)
D/D1041#	28/06/2019	PH	8.11	pH Unit	-
D/D1049#	01/07/2019	Total Suspended Solids	< 2	mg/l	-
D/D3001#	01/07/2019	Zinc	5.6	ug/l	-

= INAB Accredited, U = UKAS Accredited, * = Subcontracted

Note:

PV Value is the parametric value, taken from European Communities, (Drinking Water) Regulations, 2014. S.I. No. 122 of 2014 and relates only to drinking water samples.

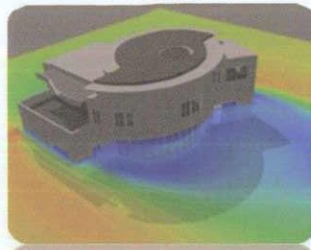
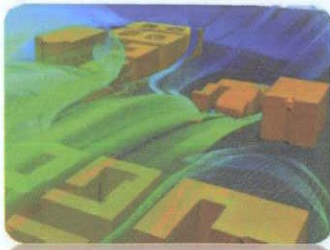
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Appendix K Computational Fluid Dynamics (CFD) Model



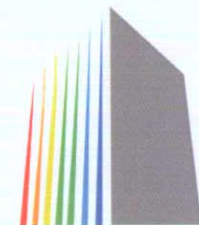
WIND AND MICROCLIMATE MODELLING

Mixed Use Residential Development

at lands to the East of St. Pauls College,
Sybil Hill Road, Dublin 5

Prepared by: B-Fluid Ltd. | Buildings Fluid Dynamics
Consultants

For: Raheny 3 Limited Partnership

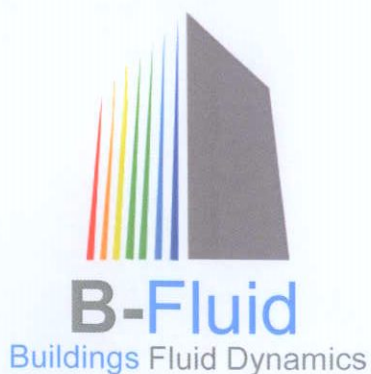


B-Fluid

Buildings Fluid Dynamics

Document Reference		
Project Name	WIND AND MICROCLIMATE MODELLING Mixed Use Residential Development St. Pauls College, Sybil Hill Road, Dublin 5	
Project Ref.	W_2109255	
Site location	Lands to the East of St. Pauls College, Sybil Hill Road, Dublin 5	
CFD Study by	B-Fluid Ltd.	
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B - Fluid | Wind Modelling

Contents

1	EXECUTIVE SUMMARY	1
2	PROJECT DESCRIPTION	7
2.1	INTRODUCTION	8
2.2	DESCRIPTION OF DEVELOPMENT	9
2.3	EXTENTS OF ANALYSED AREA	10
2.4	OBJECTIVE OF THE WIND MICROCLIMATE STUDY	11
2.4.1	National Policies	11
3	STUDY METHODOLOGY	13
3.1	STUDY METHODOLOGY	14
3.2	WIND IMPACT ASSESSMENT ON BUILDINGS	14
3.2.1	PLANETARY BOUNDARY LAYER AND TERRAIN ROUGHNESS	14
3.3	ACCEPTANCE CRITERIA	16
3.3.1	PEDESTRIAN COMFORT AND LAWSON CRITERIA	16
3.4	MITIGATION MEASURES	22
4	CFD MODELLING METHOD	26
4.1	CFD MODELLING METHOD	27
4.1.1	NUMERICAL SOLVER	28
4.2	COMPUTATIONAL MESH	28
4.3	BOUNDARY CONDITIONS	29

5	WIND DESKTOP STUDY	30
5.1	LOCAL WIND CONDITIONS	31
5.1.1	TOPOGRAPHY and BUILT IN ENVIRONMENT	35
5.1.2	OPEN AREA FUNCTIONS	36
6	ANALYSIS OF CFD RESULTS	37
6.1	CFD RESULTS	38
6.2	MICROCLIMATE ASSESSMENT OF PROPOSED DEVELOPMENT	38
6.2.1	Flow Velocity Results - Ground Floor	40
6.2.2	Flow Velocity Results - Courtyard	50
6.2.3	Flow Velocity Results - Balconies	58
6.2.4	Pedestrian Comfort Assessment	66
7	CONCLUSIONS	70
7.1	CONCLUSIONS and COMMENTS ON CFD WIND STUDY	71
8	BIBLIOGRAPHY	73

1. EXECUTIVE SUMMARY

B-Fluid Limited has been commissioned by 'Raheny 3 Limited Partnership' to carry out a Wind and Micro-climate Modelling Study for the proposed Mixed Use Residential Development at lands to the East of St. Pauls College, Sybil Hill Road, Dublin 5. Figure 1.1 shows an isometric view of the proposed development.



Figure 1.1: Proposed Mixed Use Residential Development

Wind microclimate studies identify the possible wind patterns around the existing environment and the proposed development under mean and peak wind conditions typically occurring in Dublin. A wind microclimate assessment is performed through advanced Computational Fluid Dynamics (CFD) which is a numerical method used to simulate wind conditions and its impact on the development and to identify areas of concern in terms of downwash/funneling/downdraft/critical flow accelerations that may likely occur. The Advanced CFD numerical algorithms applied here are solved using high performance computing cluster.

The results of this analysis are utilized by the design team to configure the optimal layout for the proposed Mixed Use Residential Development to achieve accounting for the use of each areas/building (i.e. comfortable and pleasant for potential pedestrian) and not to introduce any critical wind impact on the surrounding areas and on the existing buildings.

This technical report describes the wind microclimate study performed and rationals of the methodology and assumptions that B-Fluid Ltd. has adopted for this analysis.

For the purpose of performing an elaborate wind microclimate study, 18 different wind scenarios and directions have been modeled as shown in Table 1.1 in order to take into account all the relevant wind directions in Dublin. In particular, a total of 18 compass directions on the wind rose are selected. For each direction, the reference wind speed is set to the 5% exceedance wind speed for that direction, i.e. the wind speed that is exceeded for over 5% of the time whenever that wind direction occurs.

This technical report focuses on reporting the 8 worst case and most relevant wind speeds with cardinal directions, which are the speeds and directions showing the most critical wind speeds relevant to the development. The modelled scenarios reported in this study are presented in Figure 1.2.

DUBLIN WIND SCENARIOS AND DIRECTIONS		
Velocity (<i>m/s</i>)	Direction (deg)	Frequency
5.601	225	11.233
4.626	135	6.849
5.847	236.25	6.792
6.049	258.75	6.747
6.034	247.5	6.689
5.888	270	5.662
4.994	315	4.338
5.503	281.25	3.904
4.974	292.5	3.436
5.357	213.75	3.288
4.736	123.75	3.105
4.406	146.25	2.751
5.101	303.75	2.648
5.246	112.5	2.500
4.121	157.5	2.386
4.581	101.25	2.340
4.169	45	2.180
3.558	90	2.135

Table 1.1: Summary of The 18 Wind Scenarios Modelled for Proposed Development

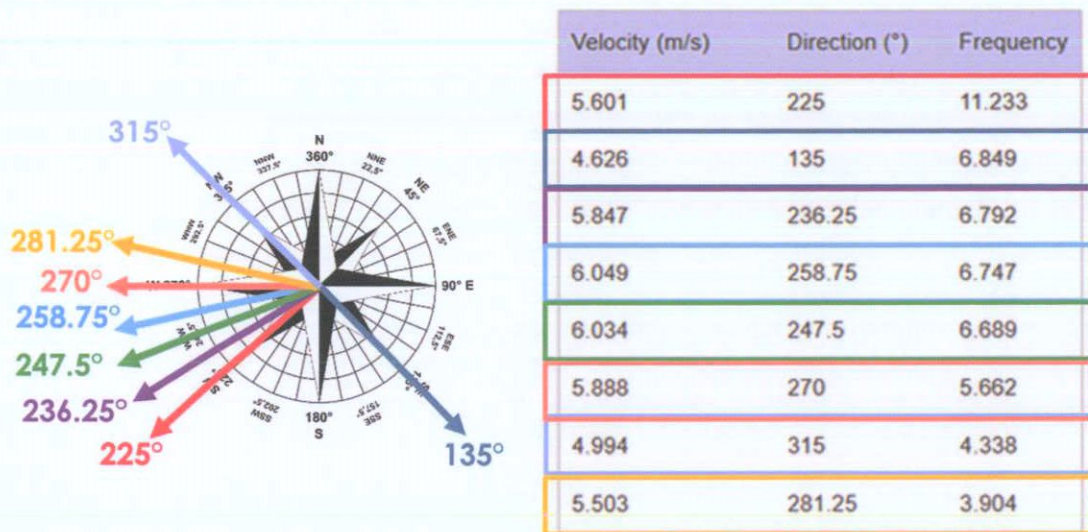


Figure 1.2: Summary of 8 Wind Scenarios Reported

A qualitative and quantitative summary of the wind microclimate modelling study performed for the proposed Mixed Use Residential Development shows that:

- The wind profile around the existing development environment was built using the annual average meteorology data collected at Dublin Airport Weather Station. In particular, the local wind climate was determined from historical meteorological data recorded 10 m above ground level at Dublin Airport.
- The prevailing wind directions for the site are identified as West, South-East and West-South-West, with magnitude of approximately 6m/s.
- The proposed Mixed Use Residential Development has been designed in order to produce a high-quality environment that is attractive and comfortable for pedestrians of all categories. To achieve this objective, throughout the design process, the impact of wind has been considered and analysed, in the areas where critical patterns were found, the appropriate mitigation measures were introduced.
- As a result of the final proposed and mitigated design, wind flow speeds at ground floor are shown to be within tenable conditions. Some higher velocity indicating minor funnelling effects are found between block D and G and the corners of block A, B, C and G. However, these areas can be utilised for the intended use such as short-term sitting, walking and strolling.
- Area between Block A and Block D is suitable for short-term sitting instead of long-term sitting due to flow acceleration between the Blocks.
- Courtyard on Block D is well protected and good shielding is achieved. Therefore, it can be used for all activities including long-term sitting.
- Small areas of Courtyard on Block G are suitable for short term sitting instead of

long-term sitting, however the majority of the area is appropriate for long term sitting.

- Tree planting all around the development has been utilised, with particular attention to the corners of the Blocks has positively mitigated any critical wind effects.
- Regarding the balconies, higher velocities are found for some directions, only on some of the balconies (mostly on the South and West sides of the blocks). However, these velocities are below the threshold values defined by the acceptance criteria and therefore are not critical for safety.
- The proposed development does not impact or give rise to negative or critical wind speed profiles at the nearby adjacent roads, or nearby buildings. Moreover, in terms of distress, no critical conditions were found for “Frail persons or cyclists” and for members of the “General Public” in the surrounding of the development.
- The proposed development does not impact or give rise to negative or critical wind speed profiles at the nearby adjacent roads, or nearby buildings.

2. PROJECT DESCRIPTION

2.1 INTRODUCTION

B-Fluid Limited has been commissioned by 'Raheny 3 Limited Partnership' to carry out a Wind and Micro-climate Modelling Study for the proposed Mixed Use Residential Development at lands to the East of St. Pauls College, Sybil Hill Road, Dublin 5.

Figure 2.1 shows an isometric view of the proposed development with locations of its Blocks.



Figure 2.1: Proposed Mixed Use Residential Development

The following paragraphs detail all the project information used throughout the study, together with results of the assessment carried out.

2.2 DESCRIPTION OF DEVELOPMENT

The proposed development consists of the construction of a residential and nursing home development set out in 7 no. blocks, ranging in height from 4-7 storeys to accommodate 580 no. apartments, residential tenant amenity spaces, a crèche and a 100 bed nursing home. The site will accommodate car parking spaces, bicycle parking spaces, storage, services and plant areas at both basement and podium level. Landscaping will include extensive communal amenity areas, and a significant public open space provision on the east and south of the site. The proposed application includes all site landscaping works, green roofs, substations, boundary treatments, lighting, servicing, signage, surface water attenuation facilities and associated and ancillary works, including site development works and services above and below ground. For a full description of the proposed development please refer to the Statutory Notices.

Figure 2.2 shows the position of the development site in 3D model.



Figure 2.2: The proposed Mixed Use Residential 3D Model South View

2.3 EXTENTS OF ANALYSED AREA

The proposed Mixed Use Residential Development will be situated at lands to the East of St. Pauls College, Sybil Hill Road, Dublin 5. The Existing Environment site is shown in Figure 2.3. The area considered for the existing environment and proposed development are represented in Figure 2.4.

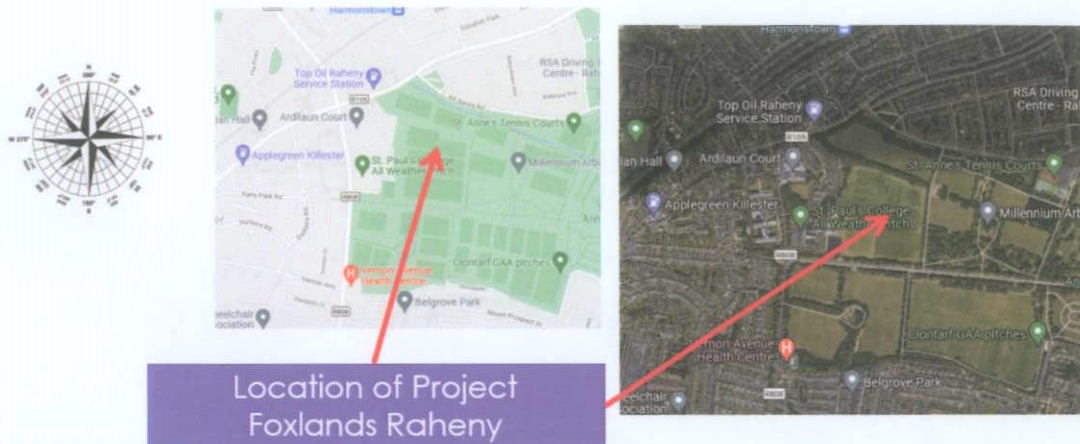


Figure 2.3: The proposed Mixed Use Residential Development Site Location and Existing Environment



Figure 2.4: Extents of Analysed Existing Environment Around the proposed Mixed Use Residential Development

2.4 OBJECTIVE OF THE WIND MICROCLIMATE STUDY

The CFD wind model is adopted to identify areas of concern in terms of critical flows and areas where the pedestrian safety and comfort could be compromised. Pedestrian Wind Comfort and Safety Studies are conducted to predict, assess and, where necessary, mitigate the impact of the development on pedestrian level wind conditions. The objective is to maintain comfortable and safe pedestrian level wind conditions that are appropriate for the season and the intended use of pedestrian areas. Pedestrian areas include sidewalks and street frontages, pathways, building entrance areas, open spaces, amenity areas, outdoor sitting areas, and accessible roof top areas among others.

2.4.1 National Policies

According to the 'Urban Development and Building Heights, Guidelines for Planning Authorities (Government of Ireland, December 2018)' document, specific impact assessment of the micro-climatic effects should be performed for 'buildings taller than prevailing building heights in urban areas'. (In the same guidance, standard buildings height is considered 6-8 storeys. Above this height, buildings are considered 'taller' for Dublin standards.)

Usually, the recommended approach to wind microclimate studies is based on the building height, as presented in Figure 2.5 and prescribed by the Wind Microclimate Guidelines for Developments in the City of London (August 2019).

Building Height	Recommended Approach to Wind Microclimate Studies
Similar or lower than the average height of surrounding buildings Up to 25m	Wind studies are not required, unless sensitive pedestrian activities are intended (e.g. around hospitals, transport hubs, etc.) or the project is located on an exposed location
Up to double the average height of surrounding buildings 25m to 50m	Computational (CFD) Simulations OR Wind Tunnel Testing
Up to 4 times the average height of surrounding buildings 50m to 100m	Computational (CFD) Simulations AND Wind Tunnel Testing
High Rise Above 100m	Early Stage Massing Optimization: Wind Tunnel Testing OR Computational (CFD) Simulations Detailed Design: Wind Tunnel Testing AND Computational (CFD) Simulations to demonstrate the performance of the final building design

Figure 2.5: Recommended Approach to Wind Microclimate Studies based on Building Height, as prescribed by the Wind Microclimate Guidelines for Developments in the City of London (August 2019)

Good wind microclimate conditions are necessary for creating outstanding public spaces. Adverse wind effects can reduce the quality and usability of outdoor areas, and lead to safety concerns in extreme cases.

Computational fluid dynamics (CFD) tools can create high quality output that provide a good understanding of fundamental flow features. The CFD models must include a detailed three-dimensional representation of the proposed development.

Maximum cell sizes near critical locations (e.g. entrances, corners, etc.) must be 0.3m or smaller. Sufficient cells should be also used between buildings with a minimum of 10 across a street canyon. However, the cell size of buildings away from the target can be larger to allow for modelling efficiency. The CFD models should represent all surrounding buildings that are within 400m from the centre of the site. Other taller buildings outside of this zone that could have an influence on wind conditions within the project site should be included for wind directions where they are upwind of the project site. The models must contain at least 3 prism layers below 1.5m height, to capture near-ground effects.

CFD analysis also reports conditions in areas away from the site where cumulative effects of a cluster of tall buildings could lead to adverse wind conditions.

3. STUDY METHODOLOGY

3.1 STUDY METHODOLOGY

The methodology adopted for the wind microclimate analysis of the proposed development is outlined as follows;

The following sections give details on the methodology utilized.

- Perform a wind desktop study of the existing environment.
- Perform computational wind microclimate analysis of the proposed development within the existing environment.

3.2 WIND IMPACT ASSESSMENT ON BUILDINGS

3.2.1 PLANETARY BOUNDARY LAYER AND TERRAIN ROUGHNESS

Due to aerodynamic drag, there is a wind gradient in the wind flow just a few hundred meters above the Earth's surface – “the surface layer of the planetary boundary layer”.

Wind speed increases with increasing height above the ground, starting from zero, due to the no-slip condition. In particular, the wind velocity profile is parabolic. Flow near the surface encounters obstacles that reduce the wind speed, and introduce random vertical and horizontal velocity components. This turbulence causes vertical mixing between the air moving horizontally at one level, and the air at those levels immediately above and below it. For this reason, the velocity profile is given by a fluctuating velocity along a mean velocity value. Figure 3.1 shows the wind velocity profile, as described above.

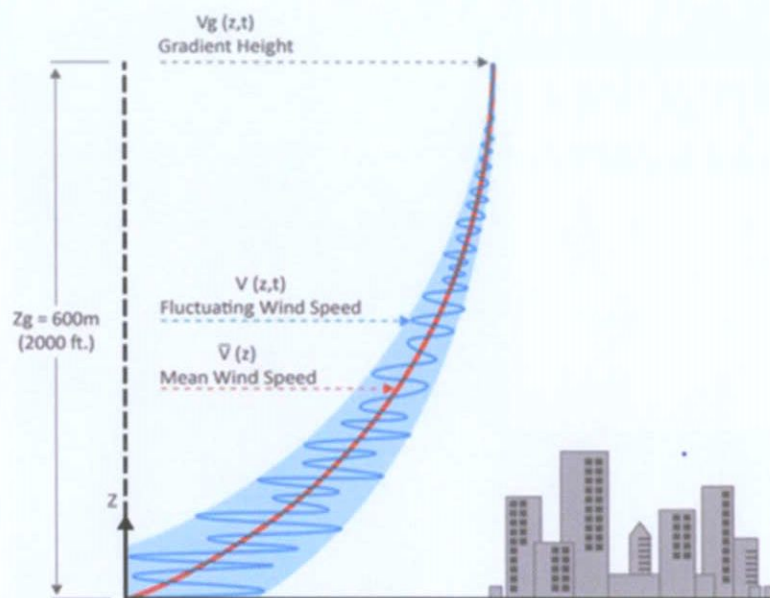


Figure 3.1: Wind Velocity Profile

Two effects influence the shape of the wind speed profile:

- Contours of the terrain: a rising terrain such as an escarpment will produce a fuller profile at the top of the slope compared with the profile of the wind approaching the slope.

- Aerodynamic 'roughness' of the upstream terrain: natural roughness in the form of woods or man-made roughness in the form of buildings. Obstructions near the ground create turbulence and friction, lowering the average wind speed. The higher the obstructions, the greater the turbulence and the lower the windspeed. As a general rule, windspeed increases with height.

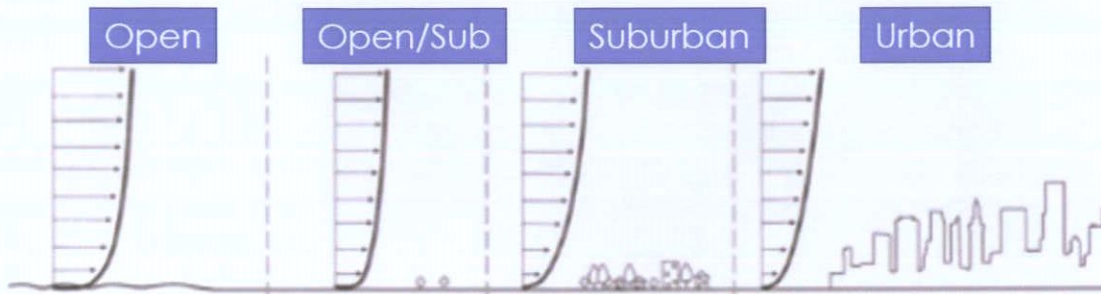


Figure 3.2: Wind Velocity Profile for different terrains

In order to assess the wind conditions in a particular area, it is important to know (Figure 3.3):

- Weather conditions in the area
- Location and orientation of the site
- Buildings distribution in the area
- Flow patterns at the building

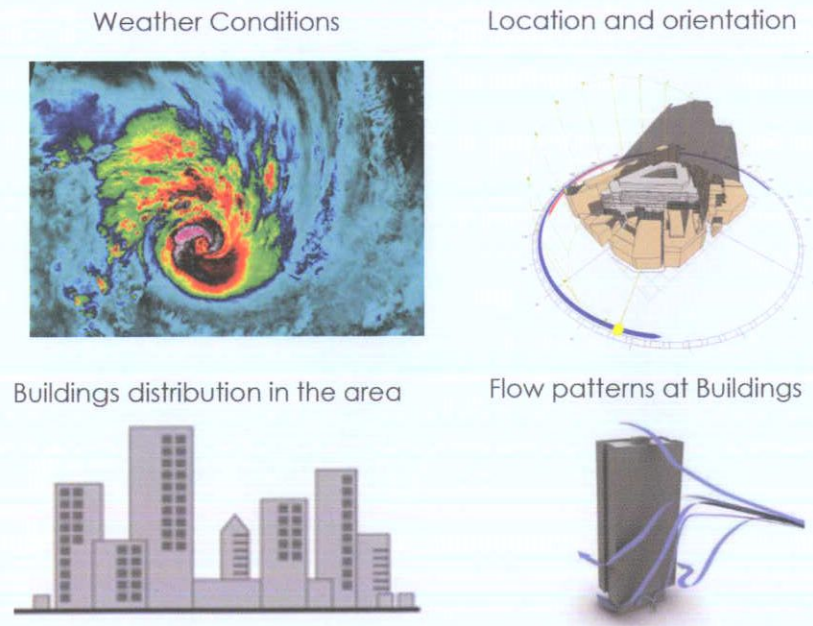


Figure 3.3: Parameters to know for Wind Conditions Assessment

Moreover, it is important to understand key flow features (Figure 3.3):

- Broad Building Face creates "DOWNWASH"
- Low Building Upwind Increases Wind Effects
- Gaps Between Buildings Increases Wind Velocity
- Low Building Upwind Increases Wind Effects

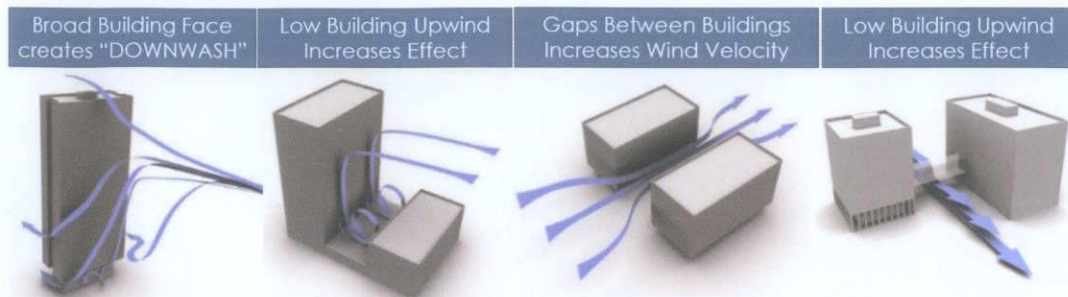


Figure 3.4: Parameters to know for Wind Conditions Assessment

3.3 ACCEPTANCE CRITERIA

3.3.1 PEDESTRIAN COMFORT AND LAWSON CRITERIA

Pedestrian Wind Comfort is measured in function of the frequency of wind speed threshold exceeded based on the pedestrian activity. The assessment of pedestrian level wind conditions requires a standard against which measured or expected wind velocities can be compared.

Only gust winds are considered in the safety criterion. These are usually rare events, but deserve special attention in city planning and building design due to their potential impact on pedestrian safety. Gusts cause the majority of cases of annoyance and distress and are assessed in addition to average wind speeds. Gust speeds should be divided by 1.85 and these "gust equivalent mean" (GEM) speeds are compared to the same criteria as for the mean hourly wind speeds. This avoids the need for different criteria for mean and gust wind speeds.

The following criteria are widely accepted by municipal authorities as well as the international building design and city planning community:

- **DISCOMFORT CRITERIA:** Relates to the activity of the individual.
Onset of discomfort:
 - Depends on the activity in which the individual is engaged and is defined in terms of a mean hourly wind speed (or GEM) which is exceeded for 5% of the time.
- **DISTRESS CRITERIA:** Relates to the physical well-being of the individual.
Onset of distress:
 - 'Frail Person Or Cyclist': equivalent to an hourly mean speed of 15 m/s and a gust speed of 28 m/s (62 mph) to be exceeded less often than once a year. This is intended to identify wind conditions which less able individuals or cyclists may