APPENDIX A1
FORCEMAIN DRAWINGS

GENERAL NOTES

GENERAL:

1. ALL WORKS SHALL BE CONSTRUCTED IN ACCORDANCE WITH CITY OF HAMILTON CONSTRUCTION AND MATERIAL SPECIFICATION, AND ONTARIO PROVINCIAL STANDARD DRAWINGS AND SPECIFICATIONS UNLESS OTHERWISE NOTED.
2. THESE NOTES ARE TO BE READ IN CONJUNCTION WITH GENERAL AND SUPPLEMENTARY CONDITIONS AND SPECIFICATIONS.
3. REQUIRED SHOP DRAWINGS SHALL BE BASED ON FIELD MEASUREMENT AND LAYOUT VERIFICATION BY THE CONTRACTOR.
4. THE CONTRACTOR SHALL REVIEW ALL DRAWINGS AND SPECIFICATIONS TO DETERMINE THE TOTAL SCOPE OF WORK AND ALL REQUIRED COORDINATES.
5. THE CONTRACTOR IS RESPONSIBLE FOR A THOROUGH SITE EXAMINATION TO BE SATISFIED AS TO THE ACTUAL SITE CONDITIONS PRIOR TO SUBMISSION OF HIS PRICE FOR THE WORK.
6. CONTRACTOR TO ENSURE THAT SUPPLIERS ARE ON-SITE DURING CONSTRUCTION TO ENSURE THAT THEIR PRODUCTS ARE PROPERLY INSTALLED ACCORDING TO MANUFACTURER RECOMMENDATIONS.
7. CONTRACTOR MUST COMPLY WITH CONFINED SPACE ENTRY REQUIREMENTS UNDER THE OCCUPATIONAL HEALTH AND SAFETY ACT (OHSA) AND ITS REGULATIONS WHEN REQUIRED.
8. CONTRACTOR TO SUBMIT A CONSTRUCTION SITE SETUP PLAN TO THE ENGINEER AND OWNER SHOWING PROPOSED LAY DOWN AREAS, SITE TRAILERS, SITE ACCESS GATES, MUD MATS AND TEMPORARY ACCESS ROADS. THE PLAN MUST BE SUBMITTED FOR APPROVAL PRIOR TO MOBILIZATION OF CONTRACTOR TO THE SITE.
9. THE CONTRACTOR MUST CHECK ALL DIMENSIONS PRIOR TO COMMENCING WORK AND REPORT ANY DISCREPANCIES TO THE ENGINEER.

UTILITY LOCATES:

1. THE LOCATION OF ALL EXISTING UNDER/ABOVE GROUND UTILITIES AND STRUCTURES SHOWN ON DRAWINGS IS APPROXIMATE ONLY. THE ACCURACY OF THE LOCATION OF SUCH UTILITIES IS NOT GUARANTEED. THE CONTRACTOR SHALL DETERMINE THE LOCATION OF ALL SUCH UTILITIES AND STRUCTURES BY CONSULTING WITH THE APPROPRIATE AUTHORITIES OR UTILITY COMPANIES CONCERNED PRIOR TO CONSTRUCTION AND SHALL BE RESPONSIBLE FOR ADEQUATE PROTECTION OF ALL UTILITIES DURING CONSTRUCTION.
2. CONTRACTOR SHALL VERIFY ALL EXISTING UTILITY LOCATIONS PRIOR TO EXCAVATION AS REQUIRED.
3. THE CONTRACTOR SHALL BE SATISFIED AS TO THE ACTUAL LOCATION AND DEPTH OF ANY UTILITY AND SHALL BE LIABLE FOR ALL, OR ANY DAMAGES TO EXISTING UTILITIES.
4. ANY TEMPORARY RELOCATION AND ADJUSTMENT OF UTILITIES SHALL BE DONE IN CONSULTATION WITH RELEVANT UTILITY COMPANIES, WITH THE OWNER AND ENGINEER BEING COPIED ON ALL COMMUNICATION.
5. THE ENGINEER SHALL BE NOTIFIED OF ANY CONFLICTS WITH EXISTING UTILITIES AND STRUCTURES.
6. EXCAVATION REQUIRED WITHIN PROXIMITY OF UTILITY LINES AND WITHIN DRIP LINE OF TREES DESIGNATED TO REMAIN SHALL BE DONE BY HAND. CONTRACTOR SHALL REPAIR ANY DAMAGE TO EXISTING UTILITY LINES OR STRUCTURES INCURRED DURING CONSTRUCTION OPERATIONS AT NO COST TO THE UTILITY COMPANIES OR THE OWNER.
7. ALL WORK IN PROXIMITY TO ELECTRICAL CONDUCTORS SHALL BE PERFORMED IN ACCORDANCE WITH THE OCCUPATIONAL HEALTH AND SAFETY ACT AND THE ELECTRICAL UTILITY SAFETY RULES BY THE INFRASTRUCTURE HEALTH AND SAFETY ASSOCIATION.

TRAFFIC CONTROL:

1. CONTRACTOR TO MAINTAIN ONE LANE OPEN FOR TRAFFIC AT ALL TIMES DURING THE COURSE OF WORK. PROVIDE FLAG-PERSONS OR TEMPORARY SIGNALS FOR TRAFFIC CONTROL IN ACCORDANCE WITH CITY OF HAMILTON REQUIREMENTS.

RELEVANT REPORTS:

1. REFER TO APPENDICES OF THE CONTRACT DOCUMENTS FOR GEOTECHNICAL REPORT.
2. REFER TO APPENDICES OF THE CONTRACT DOCUMENTS FOR HYDROGEOLOGIC INVESTIGATION REPORT.
3. REFER TO APPENDICES OF THE CONTRACT DOCUMENTS FOR ARBORIST REPORT.

TREE PROTECTION AND MANAGEMENT:

1. REFER TO DRAWINGS TREE PROTECTION PLAN FIGURES 1 TO 8 DATED DEC-16-2016.
2. AT A MINIMUM, THE SUPERVISOR OR CREW LEADER MUST HAVE A MINIMUM QUALIFICATION OF ISA CERTIFIED ARBORIST OR ONTARIO COLLEGE OF TRADES CERTIFIED ARBORIST, WITH MINIMUM OF TWO YEARS OF EXPERIENCE.
3. WHEN REQUIRED, TREE PRUNING SHALL FOLLOW ANSI A300 STANDARDS AND ISA BEST MANAGEMENT PRACTICES FOR TREE PRUNING. ALL CUTS MUST BE MADE USING THE PROPER METHODS, WITH PROPER COLLAR CUTS ON ALL LIMBS THAT ARE TO REMAIN ON THE TREE. FLUSH CUTS, AND TEAR CUTS ARE NOT ALLOWED.
4. WHEN REQUIRED, TREE REMOVALS SHALL INCLUDE FULL TREE REMOVAL INCLUDING STUMPING AND ROOTS, AND DISPOSAL OF ALL WASTE MATERIALS, SITE CLEANUP OF EXCESS DEBRIS, INCLUDING BUT NOT LIMITED TO FOLIAGE, BRUSH, AND SAWDUST. REMOVALS MUST BE DONE IN A SAFE MATTER AND FOLLOW ALL LABOUR LAWS AS OUTLINED IN THE OCCUPATIONAL HEALTH & SAFETY ACT – CONDENSED (ONTARIO GREEN BOOK).
5. ALL WORK SHALL BE CARRIED OUT IN ACCORDANCE TO THE APPLICABLE REGULATIONS INCLUDED IN THE OCCUPATIONAL HEALTH AND SAFETY ACT (R.S.O), 1990, AS AMENDED AND ALL REGULATIONS MADE PURSUANT OF THE ACTS.
6. ALL WORK WILL BE CARRIED OUT IN ACCORDANCE WITH THE LATEST EDITION OF "THE ARBORIST INDUSTRY SAFE WORK PRACTICES" GUIDE.

EROSION AND SEDIMENTATION CONTROL:

1. ALL CONTROL MEASURES SHALL BE INSTALLED AS PER THE DRAWINGS PRIOR TO CONSTRUCTION.
2. CHECK DAMS AND SILTATION CONTROL FENCE SHALL BE INSTALLED AND MAINTAINED AS REQUIRED TO PREVENT SEDIMENT FLOWING ONTO ADJACENT LANDS AND WATERCOURSES.
3. ALL POINTS OF CONSTRUCTION EGRESS OR INGRESS SHALL BE MAINTAINED TO PREVENT TRACKING OR FLOWING OF SEDIMENT ONTO PUBLIC ROADS OR ABUTTING PROPERTIES.
4. EROSION AND SEDIMENTATION CONTROLS WILL BE LEFT IN PLACE UNTIL VEGETATION HAS RE-ESTABLISHED AND ALL PREVIOUSLY EXPOSED AREAS ARE STABLE.
5. ALL EROSION AND SEDIMENTATION CONTROLS SHALL BE CONSTRUCTED AND MAINTAINED IN ACCORDANCE WITH OPSD STANDARD DRAWINGS AND OPSS SPECIFICATIONS OR TO THE SATISFACTION OF THE ENGINEER AND REGULATORY AUTHORITIES, INCLUDING HCA.
6. SILT FENCE DETAILS SHALL BE AS PER CITY OF HAMILTON SITE PLAN GUIDELINES.

SOIL MANAGEMENT PLAN:

1. CONTRACTOR TO PREPARE A SOIL MANAGEMENT PLAN PRIOR TO THE COMMENCEMENT OF CONSTRUCTION TO ENSURE THAT EXCESS SOIL EXCAVATED FROM THE SITE IS BEING DISPOSED OF AT A LOCATION APPROVED BY THE OWNER AND THE ENGINEER. SOIL MANAGEMENT PLAN MUST BE PREPARED IN ACCORDANCE WITH THE MINISTRY OF THE ENVIRONMENT'S DOCUMENT "MANAGEMENT OF EXCESS SOIL – A GUIDE FOR BEST MANAGEMENT PRACTICES" (JANUARY 2014) IN CONJUNCTION WITH THE OPSS 180 REQUIREMENTS.

SURFACE DRAINAGE:

1. CONTRACTOR IS RESPONSIBLE FOR THE SURFACE DRAINAGE PLAN AND TO MAINTAIN POSITIVE FLOW DURING CONTRACT PERIOD.

LAYOUT:

1. THE CONTRACTOR SHALL REVIEW ALL DRAWINGS AND SPECIFICATIONS TO DETERMINE THE TOTAL SCOPE OF WORK AND ALL REQUIRED COORDINATES. ANY ERRORS OR OMISSIONS TO BE BROUGHT TO THE ATTENTION OF THE ENGINEER PRIOR TO COMMENCING WORK.
2. ALL LINE AND GRADE WORK PER DRAWINGS AND SPECIFICATIONS SHALL BE LAID OUT BY A PROFESSIONAL ENGINEER LICENSED IN THE PROVINCE OF ONTARIO OR BY AN ONTARIO LAND SURVEYOR.

ROUGH CARPENTRY:

1. CARPENTRY WORKS TO COMPLY WITH: CANADIAN STANDARDS ASSOCIATION (CSA), CSA B111, WIRE NAILS, SPIKES AND STAPLES; CAN/CSA G164, HOT DIP GALVANIZING OF IRREGULARLY SHAPED ARTICLES; CAN/CSA 0141, SOFTWOOD LUMBER; AND NATIONAL LUMBER GRADES AUTHORITY (NLGA) STANDARD GRADING RULES FOR CANADIAN LUMBER.
2. LUMBER IDENTIFICATION: BY GRADE STAMP OF AN AGENCY CERTIFIED BY CANADIAN LUMBER STANDARDS ACCREDITATION BOARD.
3. DELIVERY, STORAGE AND HANDLING: STORE MATERIALS IN DRY LOCATIONS, LEAVE 150 MM CLEARANCE TO FLOOR OR GROUND. PROTECT FIRE RETARDANT TREATED MATERIALS AGAINST MOISTURE.
4. LUMBER MATERIAL: PRESSURE-TREATED, SOFTWOOD, S4S, MOISTURE CONTENT 19% OR LESS IN ACCORDANCE WITH CAN/CSA 0141 AND NLGA STANDARD GRADING RULES FOR CANADIAN LUMBER. BOARD SIZES TO BE: "STANDARD" OR BETTER GRADE. DIMENSION SIZES TO BE: "STANDARD" LIGHT FRAMING OR BETTER GRADE. POST AND TIMBERS SIZES TO BE: "STANDARD" OR BETTER GRADE.
5. BOLTS: 12.5 MM DIAMETER UNLESS INDICATED OTHERWISE, COMPLETE WITH NUTS AND WASHERS. PROPRIETARY FASTENERS TO BE TOGGLE BOLTS, EXPANSION SHIELDS AND LAG BOLTS, OR SCREWS RECOMMENDED FOR PURPOSE BY MANUFACTURER.
6. PREPARATION AND INSTALLATION: WOOD TO BE PRESSURE TREATED IN FACTORY, PRIOR TO DELIVERY TO SITE. INSTALL TIMBER BULKHEADS AND ASSOCIATED WOOD WORKS AS INDICATED, ALIGN AND PLUMB SURFACES SQUARE, AND SECURE USING GALVANIZED STEEL FASTENERS.
7. FRAME, ANCHOR, AND FASTEN CROSS MEMBERS TO PROVIDE NECESSARY STRENGTH AND RIGIDITY. COUNTERSINK BOLTS WHERE NECESSARY TO PROVIDE CLEARANCE FOR OTHER WORK.

RESTORATION:

1. ANY TEMPORARY RELOCATION AND ADJUSTMENT OF UTILITIES SHALL BE DONE IN CONSULTATION WITH THE RELEVANT UTILITY COMPANIES.
2. THE SURFACE OF THE WORKING AREA SHALL BE FINE GRADED UNLESS DIRECTED OTHERWISE BY THE ENGINEER. ALL WASTE MATERIALS SHALL BE REMOVED AND DISPOSED AT AN APPROVED LOCATION. EXCESS MATERIALS RESULTING FROM FINE GRADING SHALL BE DISPOSED TO A LANDFILL OR SUCH OTHER LOCATION AS APPROVED BY THE ENGINEER.
3. DISTURBED AREAS WITHIN OWNER PROPERTY, MUNICIPAL RIGHT OF WAY, PERMANENT AND TEMPORARY EASEMENTS TO BE RESTORED TO ORIGINAL CONDITION OR BETTER TO SATISFY THE REQUIREMENTS OF CITY OF HAMILTON.
4. ANY AREA OUTSIDE THE LIMIT OF WORK THAT IS DISTURBED SHALL BE RESTORED TO ITS ORIGINAL CONDITION BY THE CONTRACTOR AT NO COST TO THE OWNER.
5. ALL OTHER AREAS DISTURBED BY THE CONTRACTOR'S OPERATIONS SHALL BE RESTORED TO ITS ORIGINAL CONDITION OR BETTER BY THE CONTRACTOR AT NO COST TO THE OWNER.
6. ALL EQUIPMENT AND MATERIALS NOT USED IN THE WORK SHALL BE REMOVED AT THE END OF CONSTRUCTION.
7. ALL EXCESS EXCAVATED MATERIAL, RUBBLE AND BUILDING MATERIALS TO BE DISPOSED OFFSITE, TO A SITE ARRANGED FOR BY THE CONTRACTOR.
8. WHERE NEW PAVING OR EARTHWORK MEETS EXISTING PAVING OR EARTHWORK, SMOOTHLY BLEND LINE AND GRADE OF EXISTING WITH NEW.
9. THE CONTRACTOR SHALL BE RESPONSIBLE FOR DOCUMENTING THE LOCATIONS OF ALL SITE ELEMENTS TO BE RESET IN THEIR SAME HORIZONTAL LOCATION.

KEY DEFINITIONS:

1. REFER TO CONTRACT DOCUMENTS FOR DEFINITIONS.

No.	REVISIONS	DATE	INITLS
2	ISSUED FOR TENDER	26/04/2018	A.A.
1	ISSUED FOR 90% DETAILED DESIGN	AUG 2017	A.A.

DESIGNED BY A.A.
DRAWN BY Z.S.
CHECKED BY R.A.
APPROVED BY J.H.

STAMP

STAMP

VERIFY SCALE
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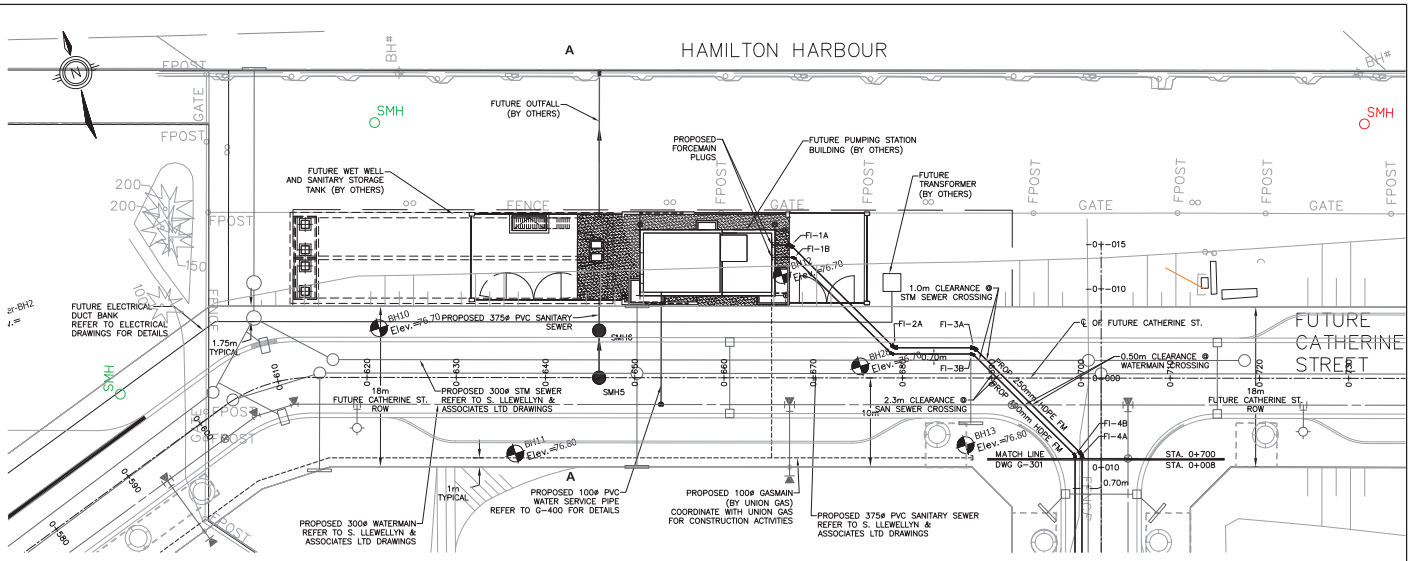
Hamilton
PARSONS

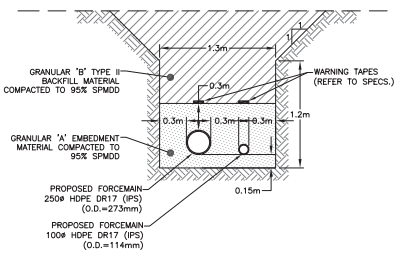
NEW MUNICIPAL WASTEWATER PUMPING STATION ON PIER 8 IN THE CITY OF HAMILTON

GENERAL
GENERAL NOTES

DATE : JULY 2017
SCALE: ---
FILE No.: 475964-G-100
CONTRACT No.:
DRAWING No.:
G-100

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PLOT DATE: Apr 26, 2018-10:18am BY:JDAVIS(SDAC)

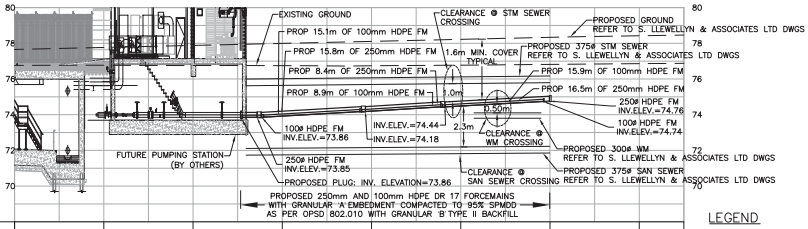




FORCEMAINS TYPICAL TRENCH SECTION (EXCEPT AS INDICATED)

SCALE: 1:20

PROFILE SCALE
H: 1:200
V: 1:100



EX. GROUND ELEVATIONS	76.77	76.76	76.75	76.74	76.77	76.82	76.86
STATIONS	0+650	0+660	0+670	0+680	0+690	0+700	0+710

LEGEND
- EXISTING WATERMAIN
- EXISTING SANITARY SEWER
- EXISTING STORM SEWER
- EXISTING HYDRO/BELL UTILITIES
- EXISTING GASMAIN (BY UNION GAS)

NOTES:
1. REFER TO G-100 FOR GENERAL NOTES.
2. REFER TO G-320 FOR FITTINGS TABLES.

No.	REVISIONS	DATE	INITLS
2	ISSUED FOR TENDER	26/04/2018	A.A.
1	ISSUED FOR 90% DETAILED DESIGN	AUG 2017	A.A.

DESIGNED BY A.A.
DRAWN BY Z.S.
CHECKED BY R.A.
APPROVED BY J.H.

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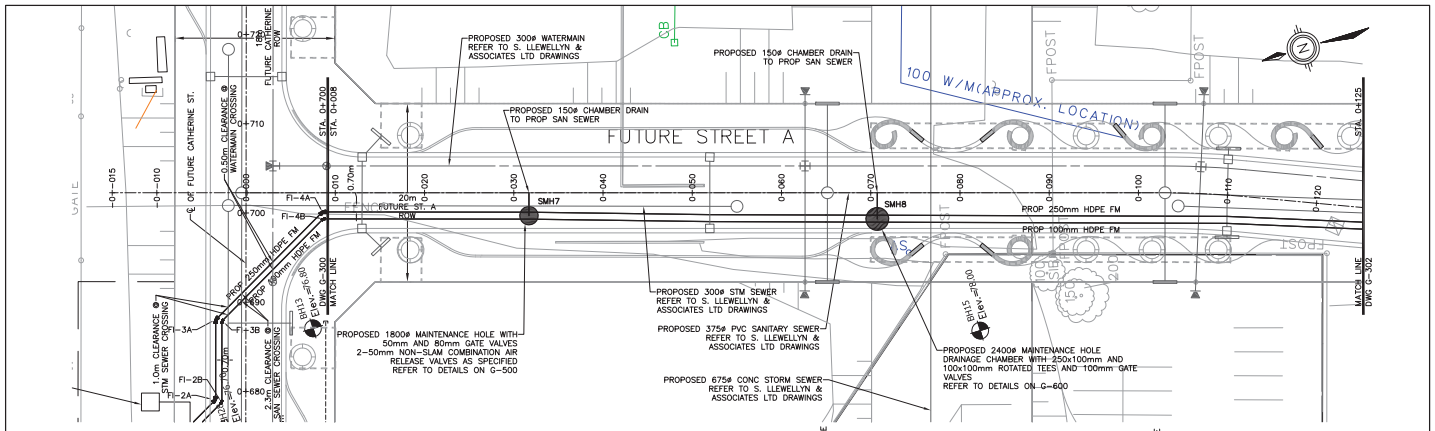
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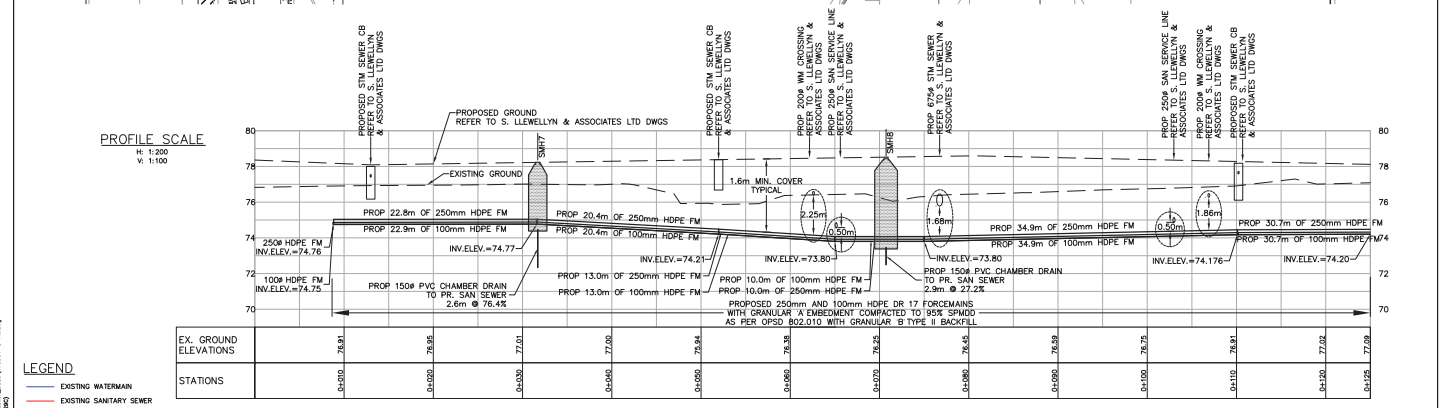
NEW MUNICIPAL WASTEWATER PUMPING STATION ON PIER 8 IN THE CITY OF HAMILTON

CIVIL
FORCEMAINS – PLAN AND PROFILE
CATHERINE STREET 0+650 TO 0+710

DATE : SEPTEMBER 2017
SCALE: 1:200
FILE No.675964-0-C-SERV
CONTRACT No.:
DRAWING No.:
G-300

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PLOT DATE: Apr 25, 2018-4:40pm BY:jyu01328C





LEGEND

- EXISTING WATERMAIN
- EXISTING SANITARY SEWER
- EXISTING STORM SEWER
- EXISTING HYDRO/BELL UTILITIES
- EXISTING GASMAIN (BY UNION GAS)

NOTES:

1. REFER TO G-100 FOR GENERAL NOTES.
2. REFER TO G-300 FOR TRENCH SECTION.
3. REFER TO G-320 FOR FITTINGS TABLES.

No.	REVISIONS	DATE	INITLS
2	ISSUED FOR TENDER	26/04/2018	A.A.
1	ISSUED FOR 90% DETAILED DESIGN	AUG 2017	A.A.

DESIGNED BY A.A.
DRAWN BY Z.S.
CHECKED BY R.A.
APPROVED BY J.H.

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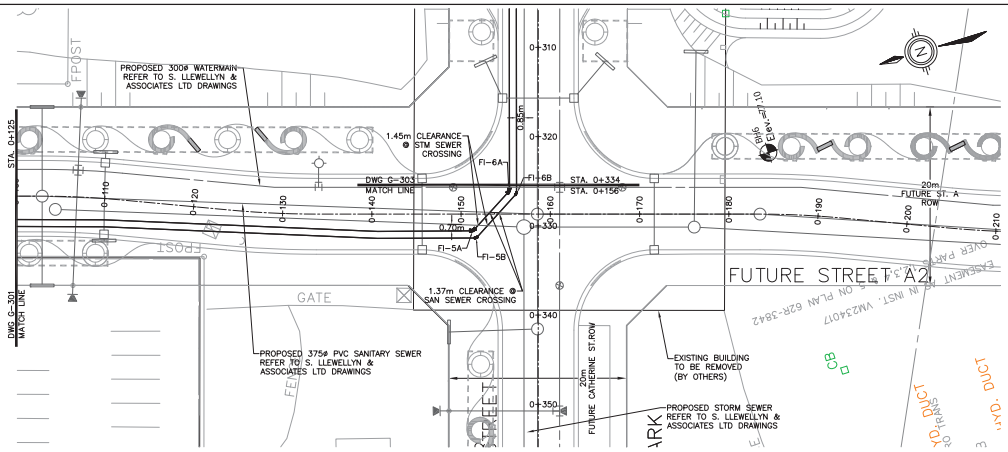
Hamilton
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NEW MUNICIPAL WASTEWATER PUMPING STATION ON PIER 8 IN THE CITY OF HAMILTON

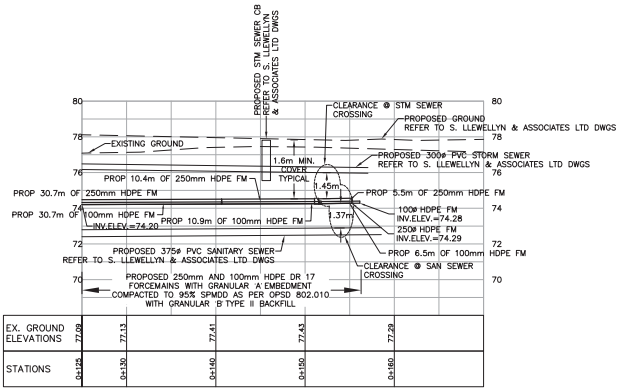
CIVIL
FORCEMAINS – PLAN AND PROFILE
STREET A 0+000 TO 0+125

DATE : SEPTEMBER 2017
SCALE: 1:200
FILE No.675964-0-C-SERV
CONTRACT No.:
DRAWING No.:
G-301

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PLOT DATE: Apr 25, 2018 - 4:00pm BY:ysh01538C



PROFILE SCALE
H: 1:200
V: 1:100



LEGEND

- EXISTING WATERMAIN
- EXISTING SANITARY SEWER
- EXISTING STORM SEWER
- EXISTING HYDRO/BELL UTILITIES
- EXISTING GASMAIN (BY UNION GAS)

NOTES:

1. REFER TO G-100 FOR GENERAL NOTES.
2. REFER TO G-300 FOR TRENCH SECTION.
3. REFER TO G-320 FOR FITTINGS TABLES.

No.	REVISIONS	DATE	INITLS
2	ISSUED FOR TENDER	26/04/2018	A.A.
1	ISSUED FOR 90% DETAILED DESIGN	AUG 2017	A.A.

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APPROVED BY J.H.

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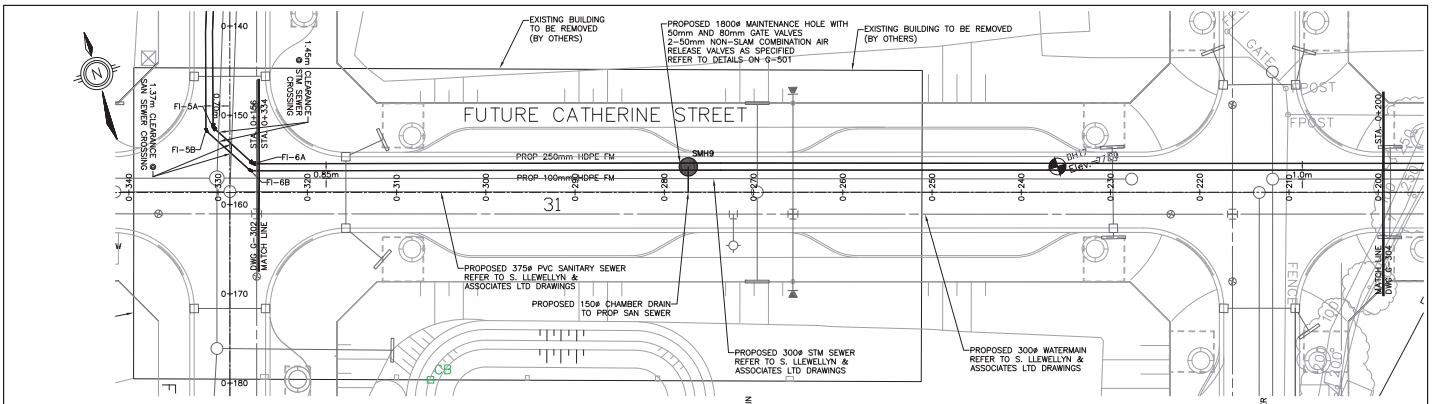
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NEW MUNICIPAL WASTEWATER PUMPING STATION ON PIER 8 IN THE CITY OF HAMILTON

CIVIL
FORCEMAINS – PLAN AND PROFILE
STREET A 0+125 TO 0+160

DATE : SEPTEMBER 2017
SCALE: 1:200
FILE No.675964-0-C-SERV
CONTRACT No.:
DRAWING No.:
G-302

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PLOT DATE: Apr 25, 2018 - 4:03pm BY:jyu(0153RC)



LEGEND

- EXISTING WATERMAIN
- EXISTING SANITARY SEWER
- EXISTING STORM SEWER
- EXISTING HYDRO/BELL UTILITIES
- EXISTING GASMAIN (BY UNION GAS)

NOTES:

1. REFER TO G-100 FOR GENERAL NOTES.
2. REFER TO G-300 FOR TRENCH SECTION.
3. REFER TO G-320 FOR FITTINGS TABLES.

No.	REVISIONS	DATE	INITLS
2	ISSUED FOR TENDER	26/04/2018	A.A.
1	ISSUED FOR 90% DETAILED DESIGN	AUG 2017	A.A.

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DRAWN BY Z.S.
CHECKED BY R.A.
APPROVED BY J.H.

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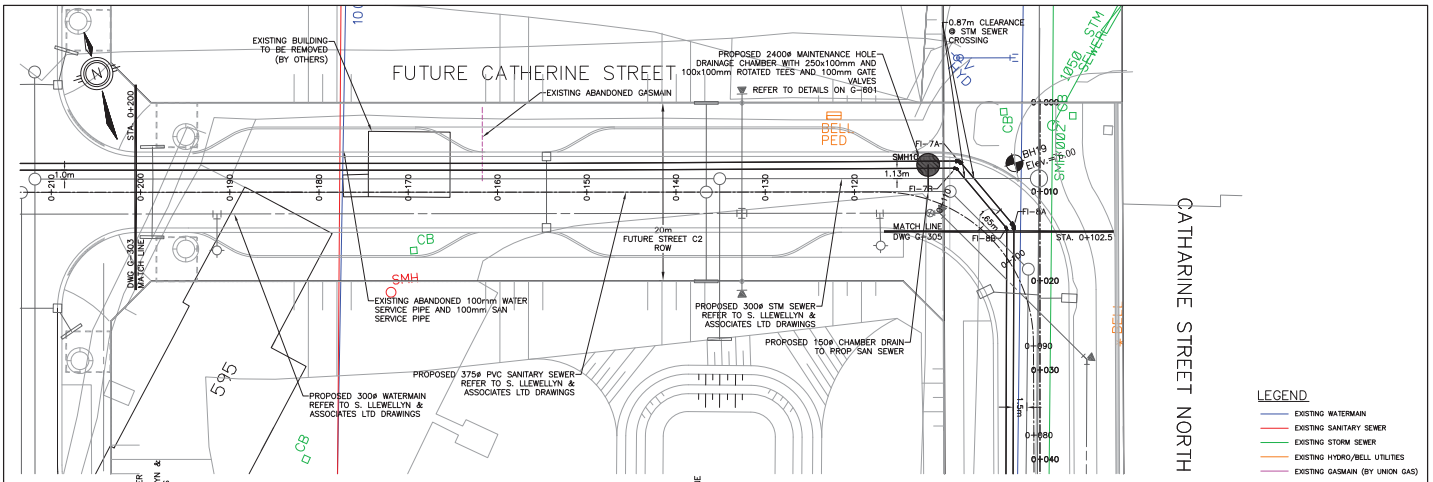
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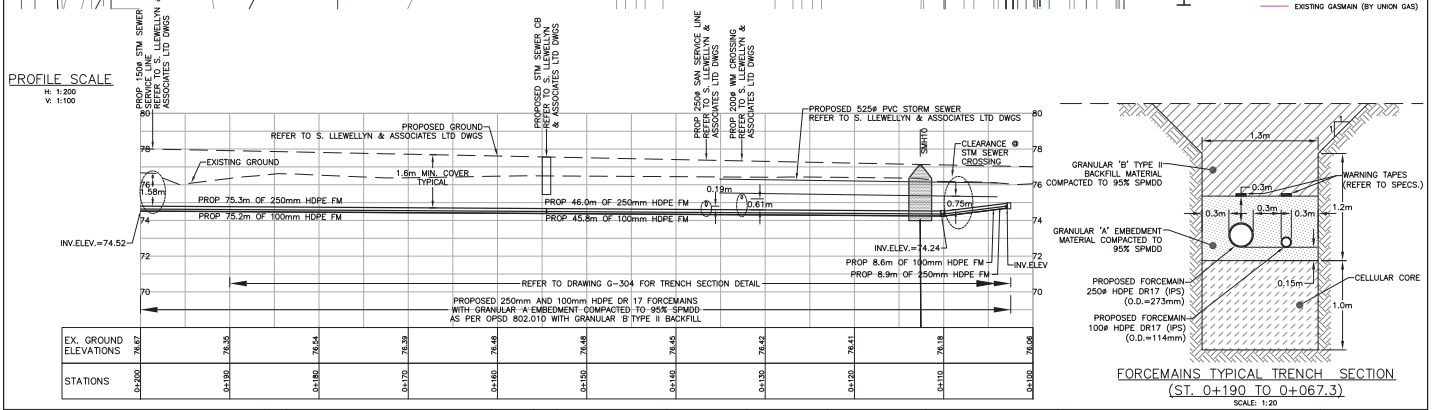
NEW MUNICIPAL WASTEWATER PUMPING STATION ON PIER 8 IN THE CITY OF HAMILTON

CIVIL
FORCEMAINS – PLAN AND PROFILE
CATHERINE STREET 0+330 TO 0+200

DATE : SEPTEMBER 2017
SCALE: 1:200
FILE No.675964-0-C-SERV
CONTRACT No.:
DRAWING No.:
G-303

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PLOT DATE: Apr 25, 2018 - 4:03pm BY:ykh51328





FORCEMAINS TYPICAL TRENCH SECTION
(ST. 0+190 TO 0+067.3)
SCALE: 1:20

NOTES:
1. REFER TO G-100 FOR GENERAL NOTES.
2. REFER TO G-300 FOR TRENCH SECTION.
3. REFER TO G-320 FOR FITTINGS TABLES.

No.	REVISIONS	DATE	INITLS
2	ISSUED FOR TENDER	26/04/2018	A.A.
1	ISSUED FOR 90% DETAILED DESIGN	AUG 2017	A.A.

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DRAWN BY Z.S.
CHECKED BY R.A.
APPROVED BY J.H.

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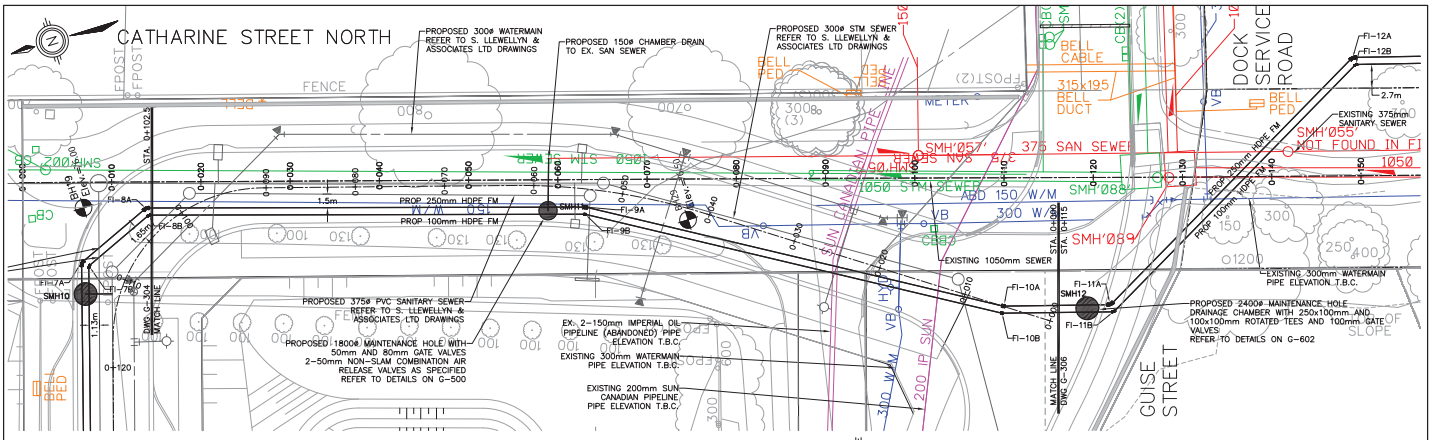
Hamilton
PARSONS

NEW MUNICIPAL WASTEWATER PUMPING STATION ON PIER 8 IN THE CITY OF HAMILTON

CIVIL
FORCEMAINS – PLAN AND PROFILE
CATHERINE STREET 0+200 TO 0+100

DATE : SEPTEMBER 2017
SCALE: 1:200
FILE No.675964-0-C-SERV
CONTRACT No.:
DRAWING No.:
G-304

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PLOT DATE: Apr 25, 2018 - 4:05pm BY:yh015387



NOTES:

1. REFER TO G-100 FOR GENERAL NOTES.
2. REFER TO G-300 & G-304 FOR TRENCH SECTION.
3. REFER TO G-320 FOR FITTINGS TABLES.

No.	REVISIONS	DATE	INITLS
2	ISSUED FOR TENDER	26/04/2018	A.A.
1	ISSUED FOR 90% DETAILED DESIGN	AUG 2017	A.A.

DESIGNED BY A.A.
DRAWN BY Z.S.
CHECKED BY R.A.
APPROVED BY J.H.

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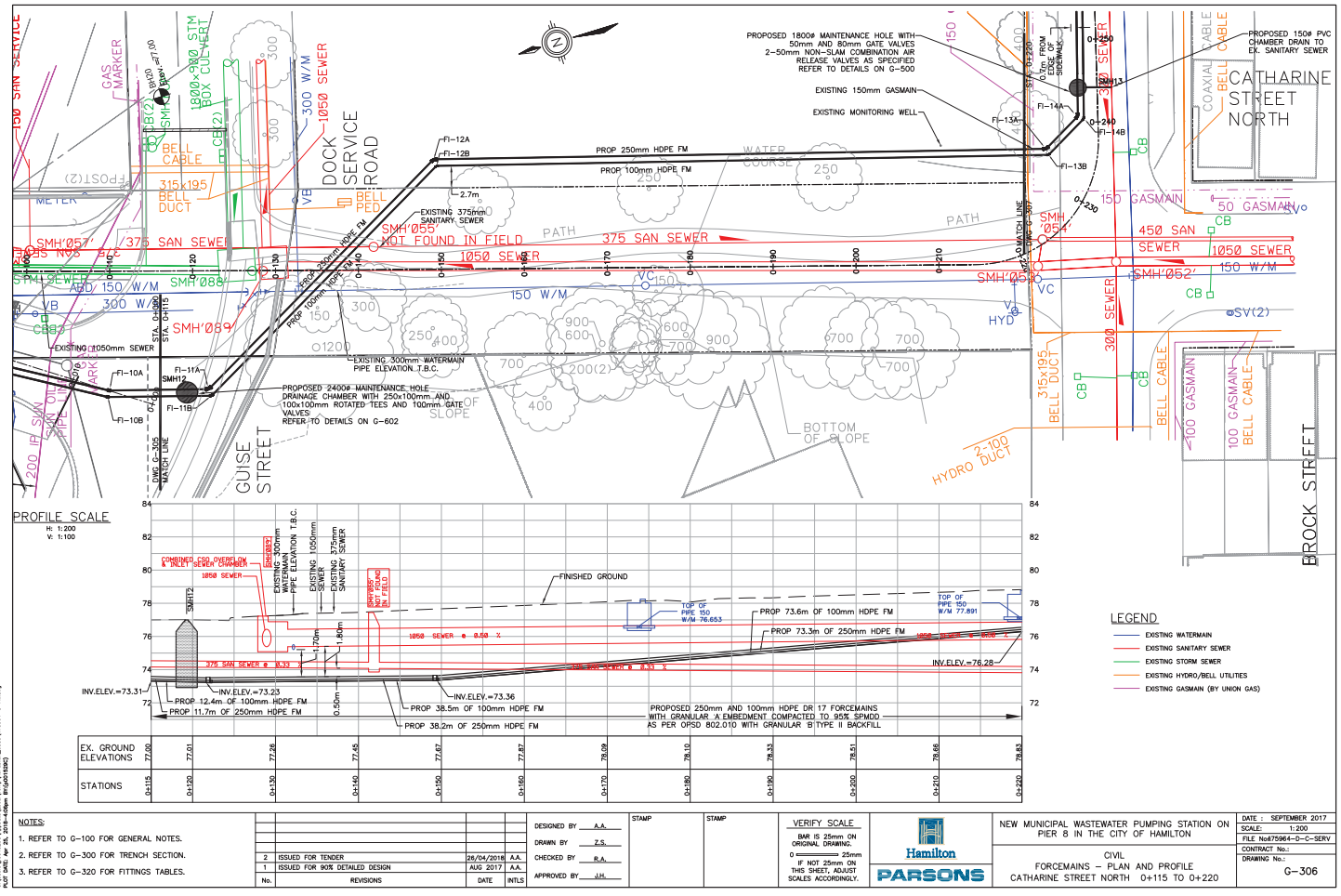
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PARSONS

NEW MUNICIPAL WASTEWATER PUMPING STATION ON PIER 8 IN THE CITY OF HAMILTON

CIVIL
FORCEMAINS – PLAN AND PROFILE
CATHARINE STREET NORTH 0+100 TO 0+000

DATE : SEPTEMBER 2017
SCALE: 1:200
FILE No.675964-0-C-SERV
CONTRACT No.:
DRAWING No.:
G-305

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NOTES:

1. REFER TO G-100 FOR GENERAL NOTES.
2. REFER TO G-300 FOR TRENCH SECTION.
3. REFER TO G-320 FOR FITTINGS TABLES.

No.	REVISIONS	DATE	INITLS
2	ISSUED FOR TENDER	26/04/2018	A.A.
1	ISSUED FOR 90% DETAILED DESIGN	AUG 2017	A.A.

DESIGNED BY A.A.
DRAWN BY Z.S.
CHECKED BY R.A.
APPROVED BY J.H.

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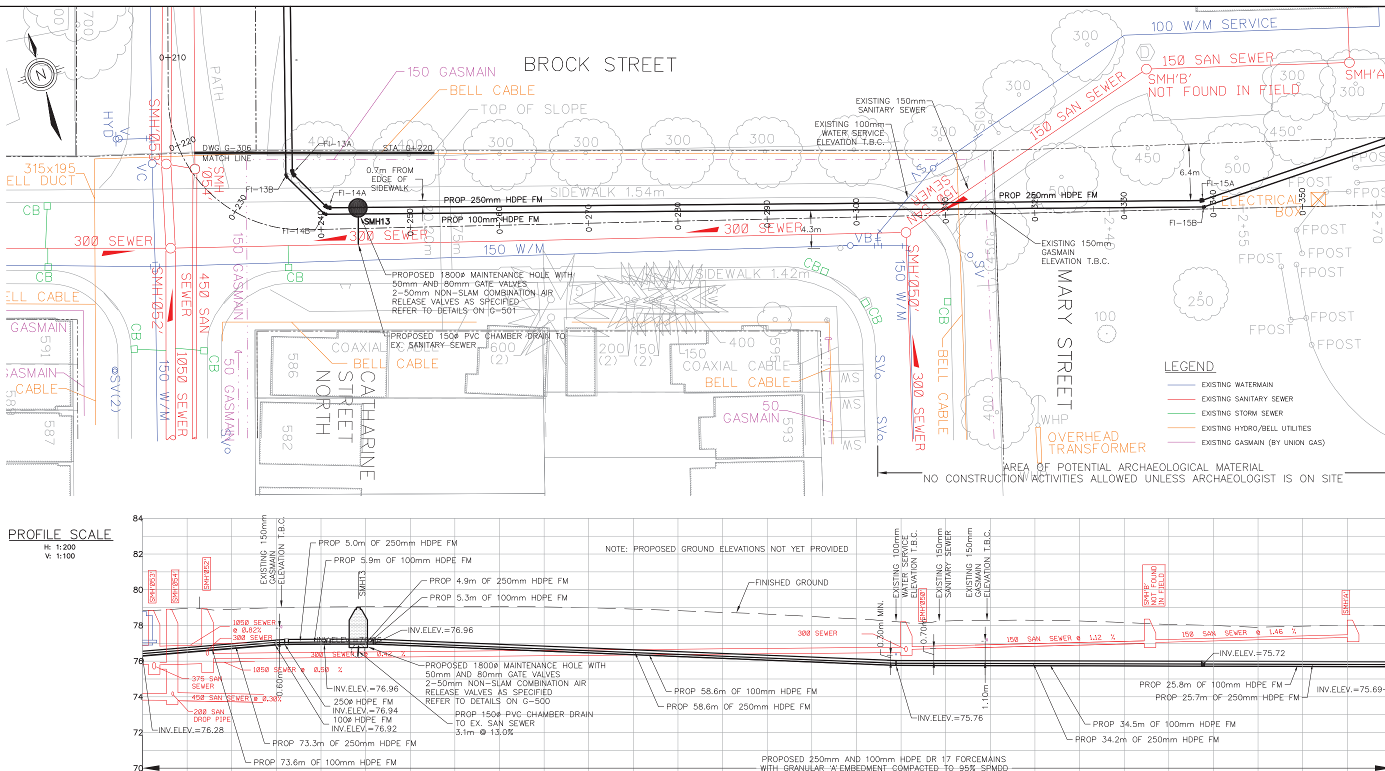
Hamilton
PARSONS

NEW MUNICIPAL WASTEWATER PUMPING STATION ON PIER 8 IN THE CITY OF HAMILTON

CIVIL
FORCEMAINS – PLAN AND PROFILE
CATHARINE STREET NORTH 0+115 TO 0+220

DATE : SEPTEMBER 2017
SCALE: 1:200
FILE No.675964-0-C-SERV
CONTRACT No.:
DRAWING No.:
G-306

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PLOT DATE: Apr 25, 2018 - 4:08pm BY:ykh01538



EX. GROUND ELEVATIONS	78.83	78.90	79.03	79.07	79.06	78.99	78.83	78.63	78.36	78.25	78.29	78.16	78.00	77.96	77.97
STATIONS	0+220	0+230	0+240	0+250	0+260	0+270	0+280	0+290	0+300	0+310	0+320	0+330	0+340	0+350	0+360

NOTES:

1. REFER TO G-100 FOR GENERAL NOTES.
2. REFER TO G-300 FOR TRENCH SECTION.
3. REFER TO G-320 FOR FITTINGS TABLES.

No.	REVISIONS	DATE	INTLS
2	ISSUED FOR TENDER	26/04/2018	A.A.
1	ISSUED FOR 90% DETAILED DESIGN	AUG 2017	A.A.

DESIGNED BY A.A.
DRAWN BY Z.S.
CHECKED BY R.A.
APPROVED BY J.H.

STAMP

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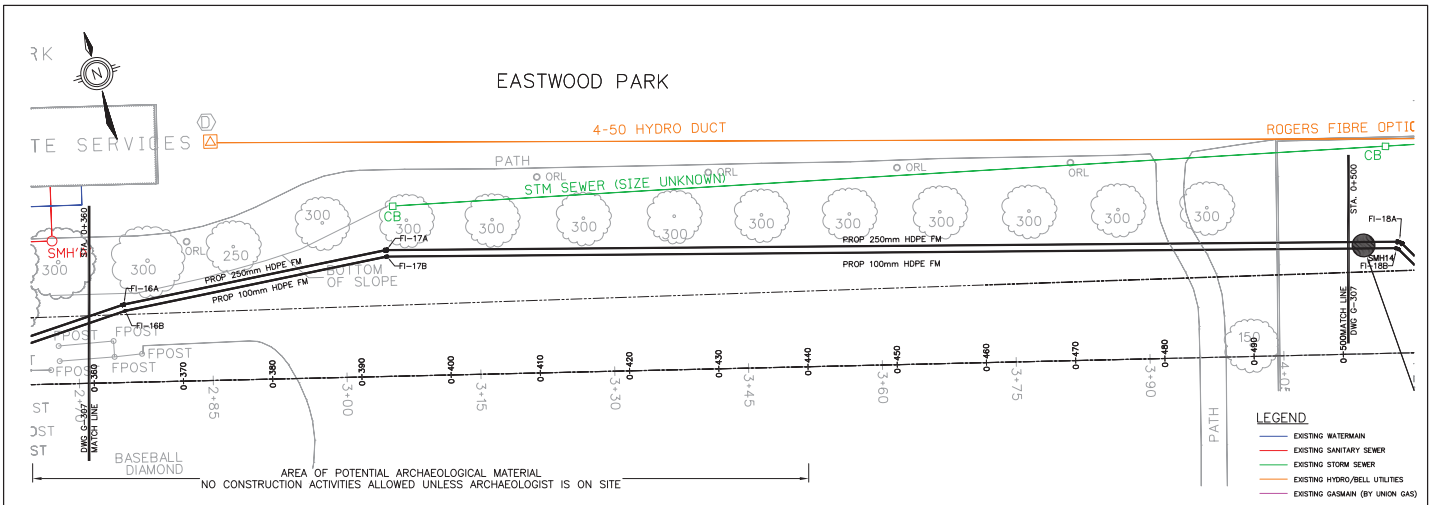
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Hamilton
PARSONS

NEW MUNICIPAL WASTEWATER PUMPING STATION ON PIER 8 IN THE CITY OF HAMILTON

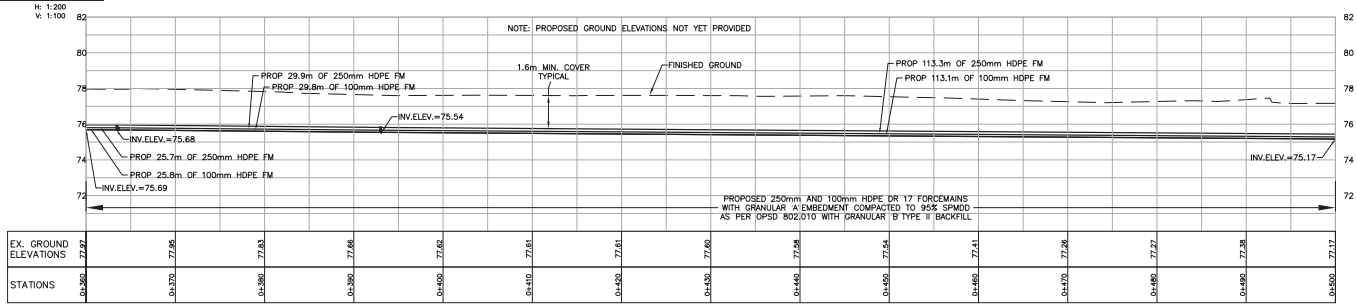
CIVIL
FORCEMAINS – PLAN AND PROFILE
BROCK STREET 0+220 TO 0+360

DATE : SEPTEMBER 2017
SCALE: 1:200
FILE No475964-D-C-SERV
CONTRACT No.:
DRAWING No.: G-307



PROFILE SCALE

H: 1:200
V: 1:100



EX. GROUND ELEVATIONS	77.97	77.95	77.83	77.68	77.62	77.61	77.61	77.60	77.58	77.54	77.41	77.28	77.27	77.38	77.17
STATIONS	0+360	0+370	0+380	0+390	0+400	0+410	0+420	0+430	0+440	0+450	0+460	0+470	0+480	0+490	0+500

NOTES:

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No.	REVISIONS	DATE	INITLS
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DESIGNED BY A.A.
DRAWN BY Z.S.
CHECKED BY R.A.
APPROVED BY J.H.

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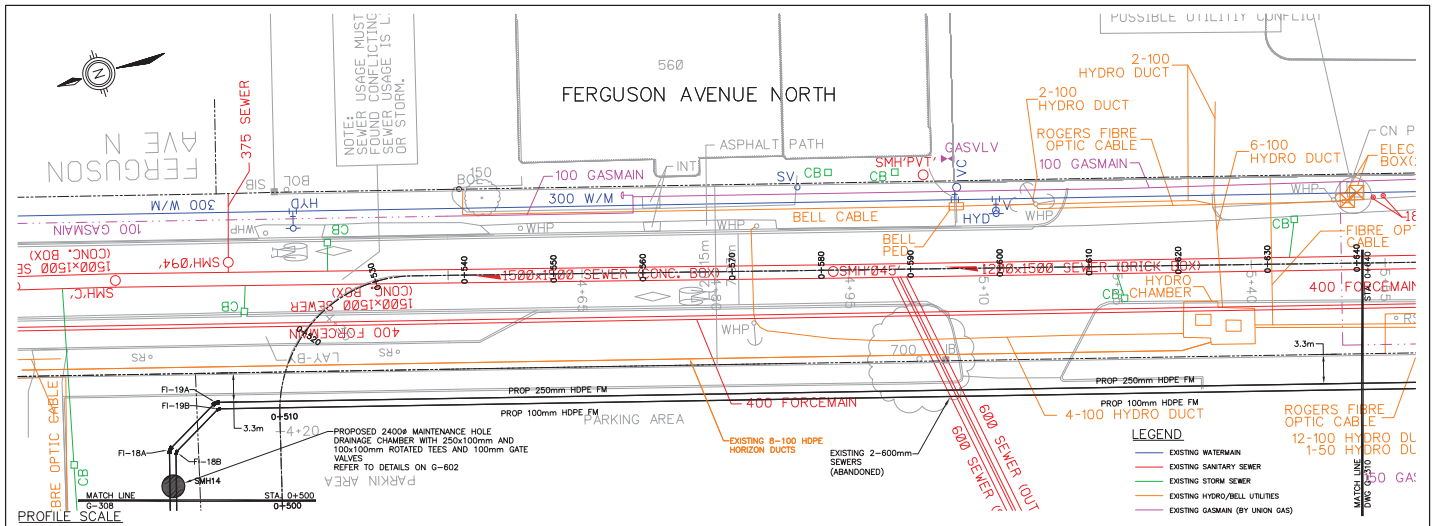
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PARSONS

NEW MUNICIPAL WASTEWATER PUMPING STATION ON PIER 8 IN THE CITY OF HAMILTON

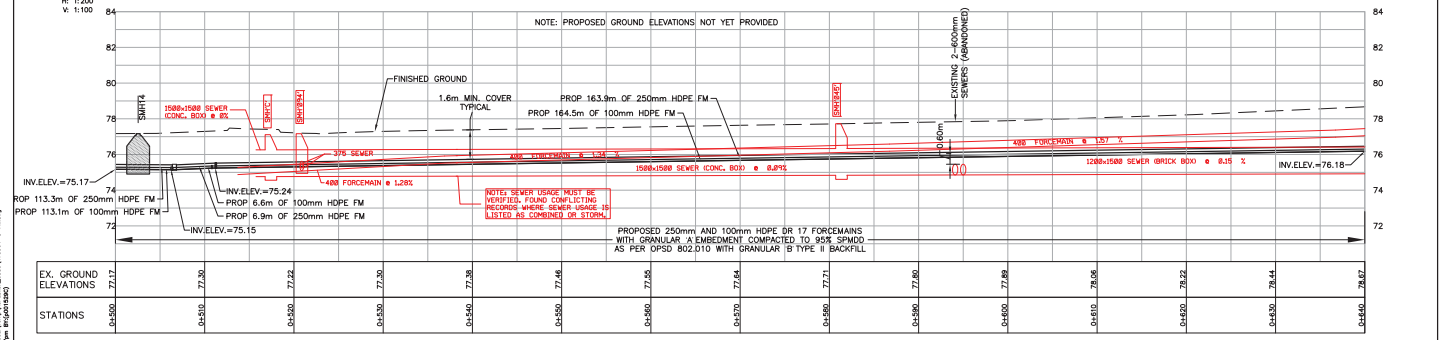
CIVIL
FORCEMAINS – PLAN AND PROFILE
EASTWOOD PARK 0+360 TO 0+500

DATE : SEPTEMBER 2017
SCALE: 1:200
FILE No.675964-0-C-SERV
CONTRACT No.:
DRAWING No.:
G-308

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PLOT DATE: Apr 25, 2018-4:07pm BY:ykh015387



PROFILE SCALE
H: 1:200
V: 1:100



NOTES:
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3. REFER TO G-320 FOR FITTINGS TABLES.

No.	REVISIONS	DATE	INITLS
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DESIGNED BY A.A.
DRAWN BY Z.S.
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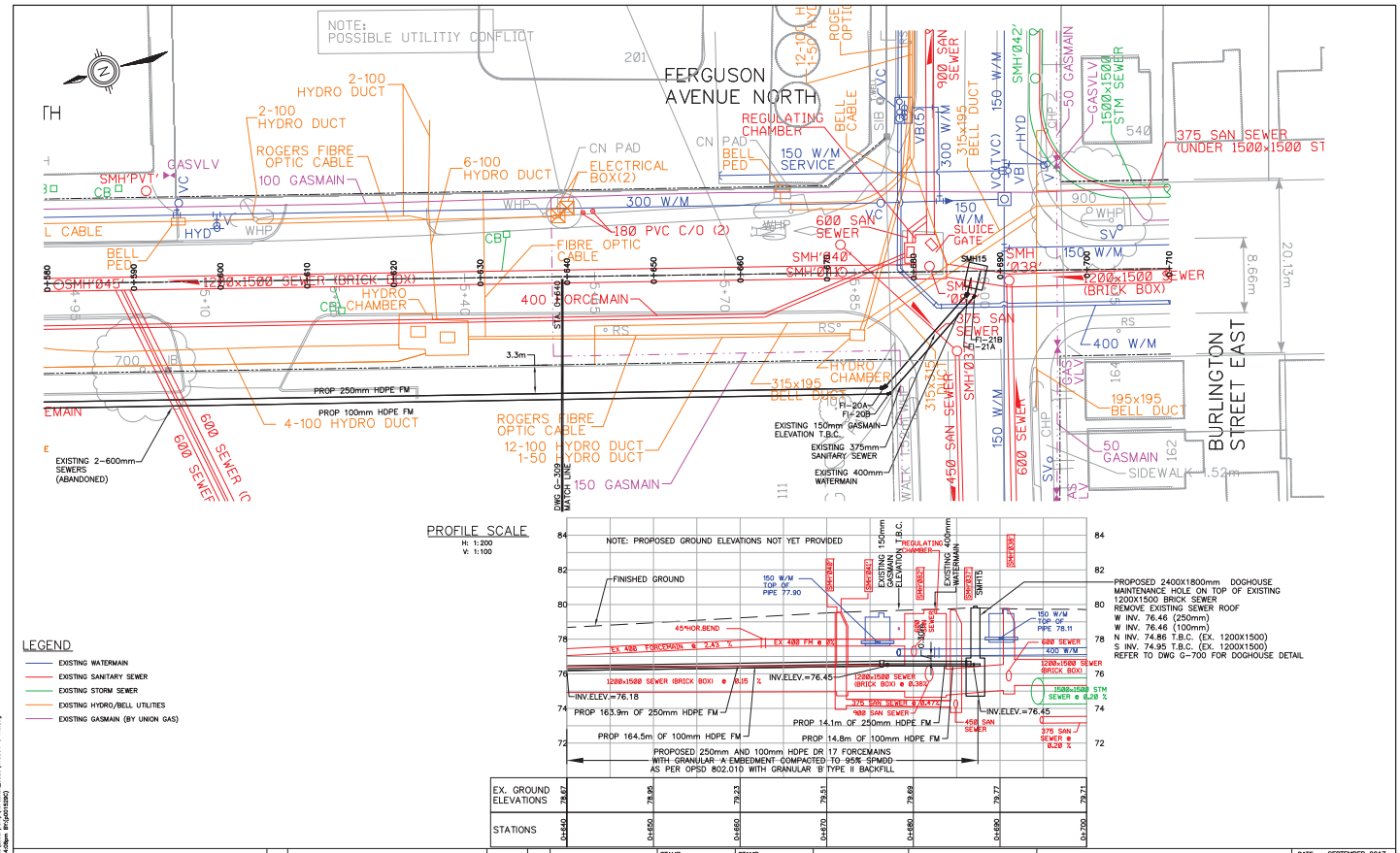
Hamilton
PARSONS

NEW MUNICIPAL WASTEWATER PUMPING STATION ON PIER 8 IN THE CITY OF HAMILTON

CIVIL
FORCEMAINS – PLAN AND PROFILE
FERGUSON AVENUE NORTH 0+500 TO 0+640

DATE : SEPTEMBER 2017
SCALE: 1:200
FILE No.: 475964-C-FM
CONTRACT No.:
DRAWING No.: G-309

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PLOT DATE: Apr 25, 2018-4:07pm BY:jh015387



PROFILE SCALE
H: 1:200
V: 1:100

LEGEND

- EXISTING WATERMAIN
- EXISTING SANITARY SEWER
- EXISTING STORM SEWER
- EXISTING HYDRO/BELL UTILITIES
- EXISTING GASMAIN (BY UNION GAS)

NOTES:

1. REFER TO G-100 FOR GENERAL NOTES.
2. REFER TO G-300 FOR TRENCH SECTION.
3. REFER TO G-320 FOR FITTINGS TABLES.

No.	REVISIONS	DATE	INITLS
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NEW MUNICIPAL WASTEWATER PUMPING STATION ON PIER 8 IN THE CITY OF HAMILTON

CIVIL
FORCEMAINS – PLAN AND PROFILE
FERGUSON AVENUE NORTH 0+640 TO 0+700

DATE : SEPTEMBER 2017
SCALE: 1:200
FILE No.: 475964-C-FM
CONTRACT No.:
DRAWING No.:
G-310

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PLOT DATE: Apr 25, 2018 - 4:08pm BY:ykh015OPC

250mm HDPE FM						
FITTING ID	TYPE	℄ ELEVATION	STATION	℄ OFFSET	NORTHING	EASTING
FI-1A	45.00° BEND	73.99m	Catherine Street 0+667.4	14.9m	4792251.31	592585.10
FI-2A	45.00° BEND	74.32m	Catherine Street 0+679.0	3.4m	4792236.89	592592.77
FI-3A	45.00° BEND	74.58m	Catherine Street 0+688.0	3.4m	4792234.21	592601.35
FI-4A	45.00° BEND	74.90m	Catherine Street 0+700.1	8.6m	4792219.21	592609.35
FI-5A	45.00° BEND	74.39m	Street A 0+151.3	1.9m	4792083.41	592565.51
FI-6A	45.00° BEND	74.42m	Street A 0+155.4	2.6m	4792078.18	592568.57
FI-7A	45.00° BEND	74.39m	Catherine Street 0+110.1	5.2m	4792014.02	592776.73
FI-8A	45.00° BEND	74.82m	Catherine Street 0+102.7	2.9m	4792005.31	592780.45
FI-9A	11.25° BEND	75.13m	Catherine Street 0+054.0	2.0m	4791958.26	592765.72
FI-10A	11.25° BEND	73.51m	Catherine Street 0+005.5	0.0m	4791916.97	592741.05
FI-11A	45.00° BEND	73.37m	FM ALIGNMENT 0+121.9	14.3m	4791905.45	592737.58
FI-12A	45.00° BEND	73.49m	FM ALIGNMENT 0+149.2	13.3m	4791871.26	592755.86
FI-13A	45.00° BEND	77.08m	FM ALIGNMENT 0+236.0	6.3m	4791800.45	592734.84
FI-14A	45.00° BEND	77.09m	FM ALIGNMENT 0+240.8	2.4m	4791795.61	592737.44
FI-15A	22.50° BEND	75.86m	FM ALIGNMENT 0+338.7	1.0m	4791767.40	592831.29
FI-16A	11.25° BEND	75.82m	FM ALIGNMENT 0+363.4	8.7m	4791768.10	592857.18
FI-17A	11.25° BEND	75.68m	FM ALIGNMENT 0+393.0	14.2m	4791765.23	592887.10
FI-18A	45.00° BEND	75.28m	FM ALIGNMENT 0+506.6	12.5m	4791732.51	592995.93
FI-19A	45.00° BEND	75.38m	FM ALIGNMENT 0+511.3	7.2m	4791725.98	592999.44
FI-20A	45.00° BEND	76.59m	FM ALIGNMENT 0+676.4	13.4m	4791568.32	592952.59
FI-21A	22.50° BEND	76.60m	FM ALIGNMENT 0+686.1	2.7m	4791555.95	592959.99

100mm HDPE FM						
FITTING ID	TYPE	℄ ELEVATION	STATION	℄ OFFSET	NORTHING	EASTING
FI-1B	45.00° BEND	73.92m	Catherine Street 0+667.8	13.5m	4792249.86	592585.05
FI-2B	45.00° BEND	74.24m	Catherine Street 0+678.8	2.7m	4792236.29	592592.30
FI-3B	45.00° BEND	74.50m	Catherine Street 0+687.9	2.7m	4792233.59	592600.99
FI-4B	45.00° BEND	74.80m	Catherine Street 0+699.4	8.6m	4792219.36	592608.59
FI-5B	45.00° BEND	74.32m	Street A 0+151.7	2.7m	4792083.30	592564.64
FI-6B	45.00° BEND	74.34m	Street A 0+156.2	2.3m	4792077.51	592568.06
FI-7B	45.00° BEND	74.30m	Catherine Street 0+110.1	4.4m	4792013.36	592776.15
FI-8B	45.00° BEND	74.73m	Catherine Street 0+102.9	2.1m	4792005.25	592779.59
FI-9B	11.25° BEND	75.06m	Catherine Street 0+053.9	2.8m	4791958.57	592764.97
FI-10B	11.25° BEND	73.43m	Catherine Street 0+005.4	0.8m	4791917.36	592740.35
FI-11B	45.00° BEND	73.29m	FM ALIGNMENT 0+122.2	15.1m	4791905.36	592736.72
FI-12B	45.00° BEND	73.42m	FM ALIGNMENT 0+149.5	12.5m	4791871.17	592755.00
FI-13B	45.00° BEND	76.98m	FM ALIGNMENT 0+234.9	5.8m	4791800.37	592734.06
FI-14B	45.00° BEND	77.02m	FM ALIGNMENT 0+240.4	1.7m	4791795.01	592736.94
FI-15B	22.50° BEND	75.78m	FM ALIGNMENT 0+339.0	0.2m	4791766.64	592831.30
FI-16B	11.25° BEND	75.74m	FM ALIGNMENT 0+363.6	8.0m	4791767.38	592857.18
FI-17B	11.25° BEND	75.60m	FM ALIGNMENT 0+393.1	13.4m	4791764.52	592886.96
FI-18B	45.00° BEND	75.21m	FM ALIGNMENT 0+506.3	11.8m	4791731.90	592995.44
FI-19B	45.00° BEND	75.30m	FM ALIGNMENT 0+510.8	6.9m	4791725.90	592998.66
FI-20B	45.00° BEND	76.52m	FM ALIGNMENT 0+677.0	14.0m	4791567.94	592951.75
FI-21B	22.50° BEND	76.52m	FM ALIGNMENT 0+687.0	2.9m	4791555.21	592959.51

NOTES:

1. REFER TO G-100 FOR GENERAL NOTES.
2. REFER TO G-300 FOR TRENCH SECTION.

No.	REVISIONS	DATE	INITLS
2	ISSUED FOR TENDER	26/04/2018	A.A.
1	ISSUED FOR 90% DETAILED DESIGN	AUG 2017	A.A.

DESIGNED BY A.A.
DRAWN BY Z.S.
CHECKED BY R.A.
APPROVED BY J.H.

STAMP

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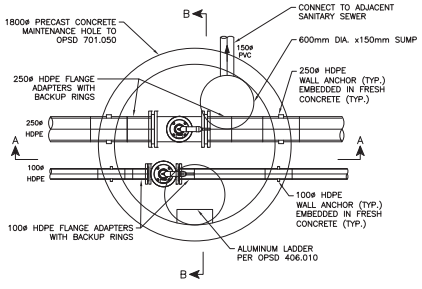
Hamilton
PARSONS

NEW MUNICIPAL WASTEWATER PUMPING STATION ON PIER 8 IN THE CITY OF HAMILTON

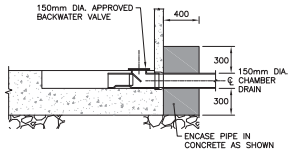
CIVIL
FORCEMAINS – PLAN AND PROFILE
FITTINGS TABLES

DATE : SEPTEMBER 2017
SCALE: ---
FILE No.:475964-D-C-FM
CONTRACT No.:
DRAWING No.:
G-320

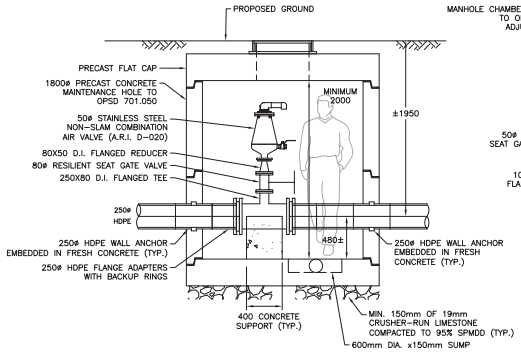
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PLOT DATE: Apr 25, 2018 - 4:08pm BY:ykh0133R



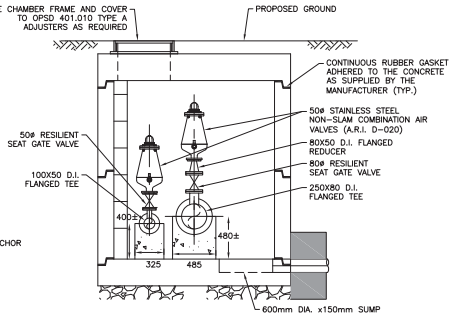
PLAN



BACKWATER VALVE DETAIL



SECTION A–A



SECTION B–B

NOTES:

1. REFER TO G-100 FOR GENERAL NOTES.
2. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.
3. CONTRACTOR SHALL CHECK ALL DIMENSIONS ON THE WORK AND REPORT ANY DISCREPANCY TO THE ENGINEER BEFORE PROCEEDING.
4. PREPARE AND SUBMIT DETAILED SHOP DRAWINGS FOR REVIEW AS SPECIFIED.

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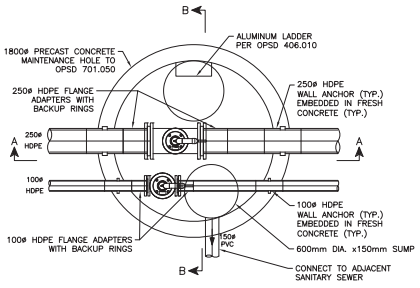
Hamilton
PARSONS

NEW MUNICIPAL WASTEWATER PUMPING STATION ON PIER 8 IN THE CITY OF HAMILTON

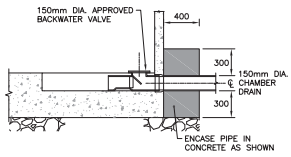
CIVIL
SMH7 & SMH11 DETAIL
COMBINATION AIR VALVE CHAMBER DETAILS

DATE : SEPTEMBER 2017
SCALE: 1:20
FILE No.:475964-C-ENADET
CONTRACT No.:
DRAWING No.:
G-500

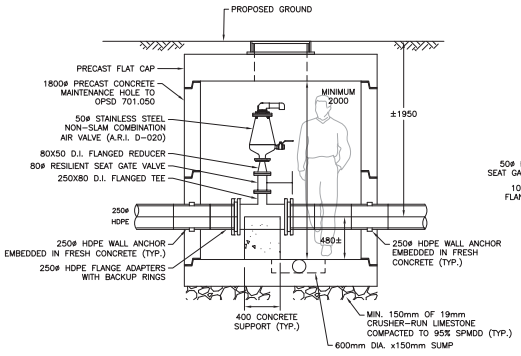
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PLOT DATE: Apr 25, 2018 - 3:48pm BY:ahill1328



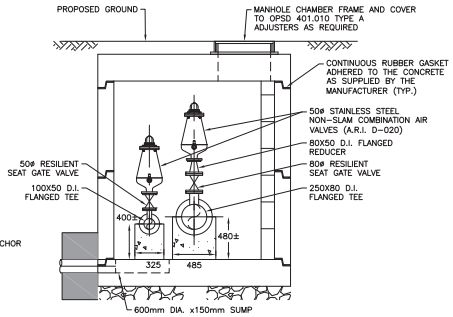
PLAN



BACKWATER VALVE DETAIL



SECTION A–A



SECTION B–B

NOTES:

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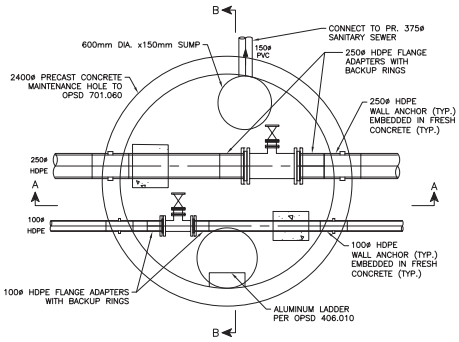
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PARSONS

NEW MUNICIPAL WASTEWATER PUMPING STATION ON PIER 8 IN THE CITY OF HAMILTON

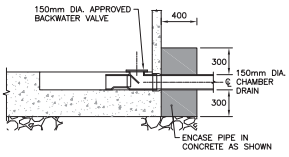
CIVIL
SMH9 & SMH13 DETAIL
COMBINATION AIR VALVE CHAMBER DETAILS

DATE : SEPTEMBER 2017
SCALE: 1:20
FILE No.:475904-C-ENADET
CONTRACT No.:
DRAWING No.:
G-501

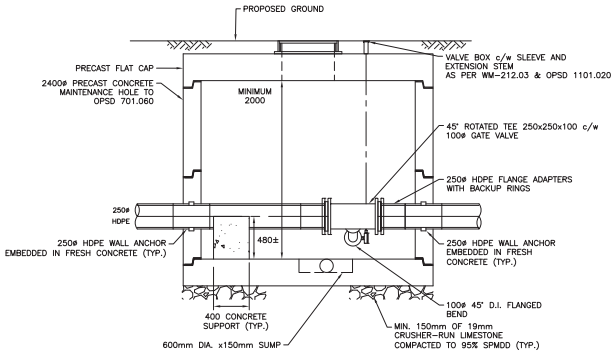
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PLOT DATE: Apr 25, 2018 - 3:48pm BY:ahill3280



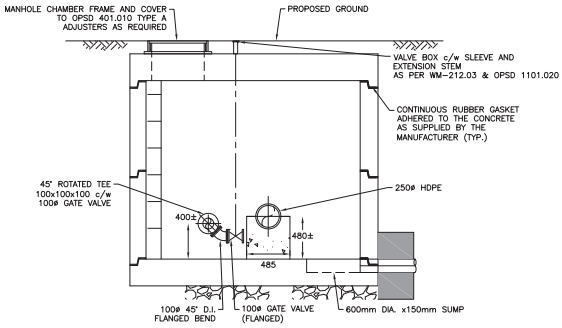
PLAN



BACKWATER VALVE DETAIL



SECTION A–A



SECTION B–B

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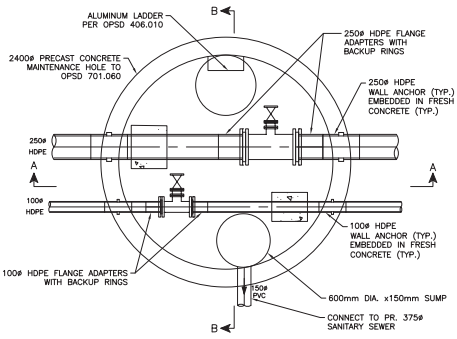
Hamilton
PARSONS

NEW MUNICIPAL WASTEWATER PUMPING STATION ON PIER 8 IN THE CITY OF HAMILTON

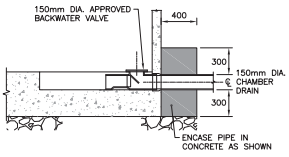
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SMH8 DETAIL
DRAIN VALVE CHAMBER DETAILS

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CONTRACT No.:
DRAWING No.:
G-600

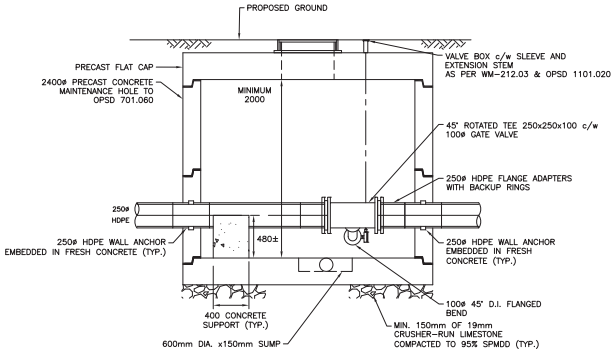
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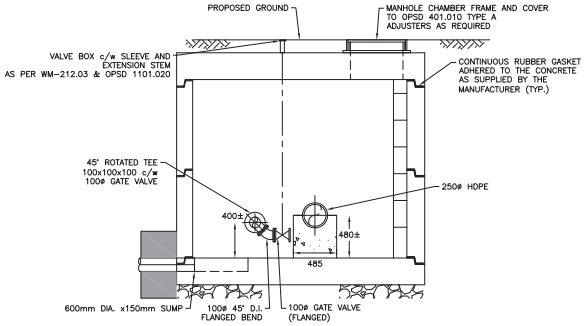
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BACKWATER VALVE DETAIL



SECTION A–A



SECTION B–B

NOTES:

1. REFER TO G-100 FOR GENERAL NOTES.
2. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.
3. CONTRACTOR SHALL CHECK ALL DIMENSIONS ON THE WORK AND REPORT ANY DISCREPANCY TO THE ENGINEER BEFORE PROCEEDING.
4. PREPARE AND SUBMIT DETAILED SHOP DRAWINGS FOR REVIEW AS SPECIFIED.

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1	ISSUED FOR 90% DETAILED DESIGN	AUG 2017	A.A.

DESIGNED BY A.A.
DRAWN BY A.A.
CHECKED BY R.A.
APPROVED BY J.H.

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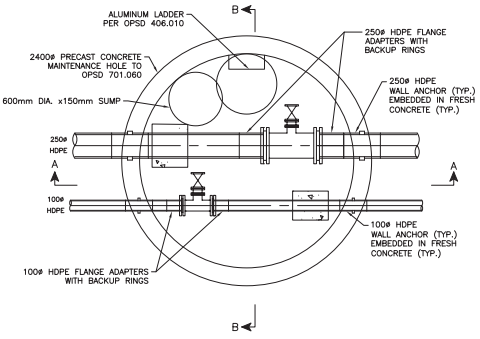
Hamilton
PARSONS

NEW MUNICIPAL WASTEWATER PUMPING STATION ON PIER 8 IN THE CITY OF HAMILTON

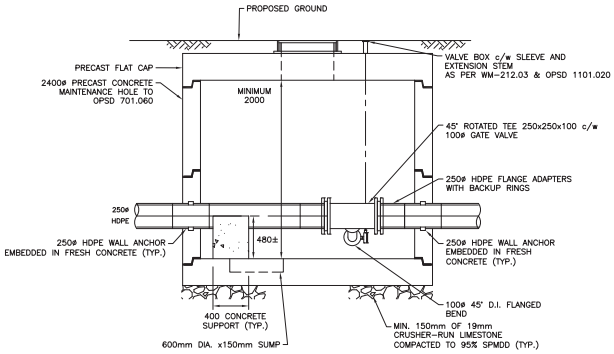
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SMH10 DETAIL
DRAIN VALVE CHAMBER DETAILS

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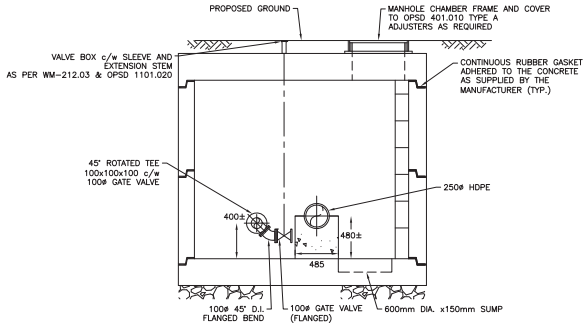
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PLOT DATE: Apr 25, 2018 - 3:56pm BY:ykh013267



PLAN



SECTION A–A



SECTION B–B

NOTES:

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1	ISSUED FOR 90% DETAILED DESIGN	AUG 2017	A.A.

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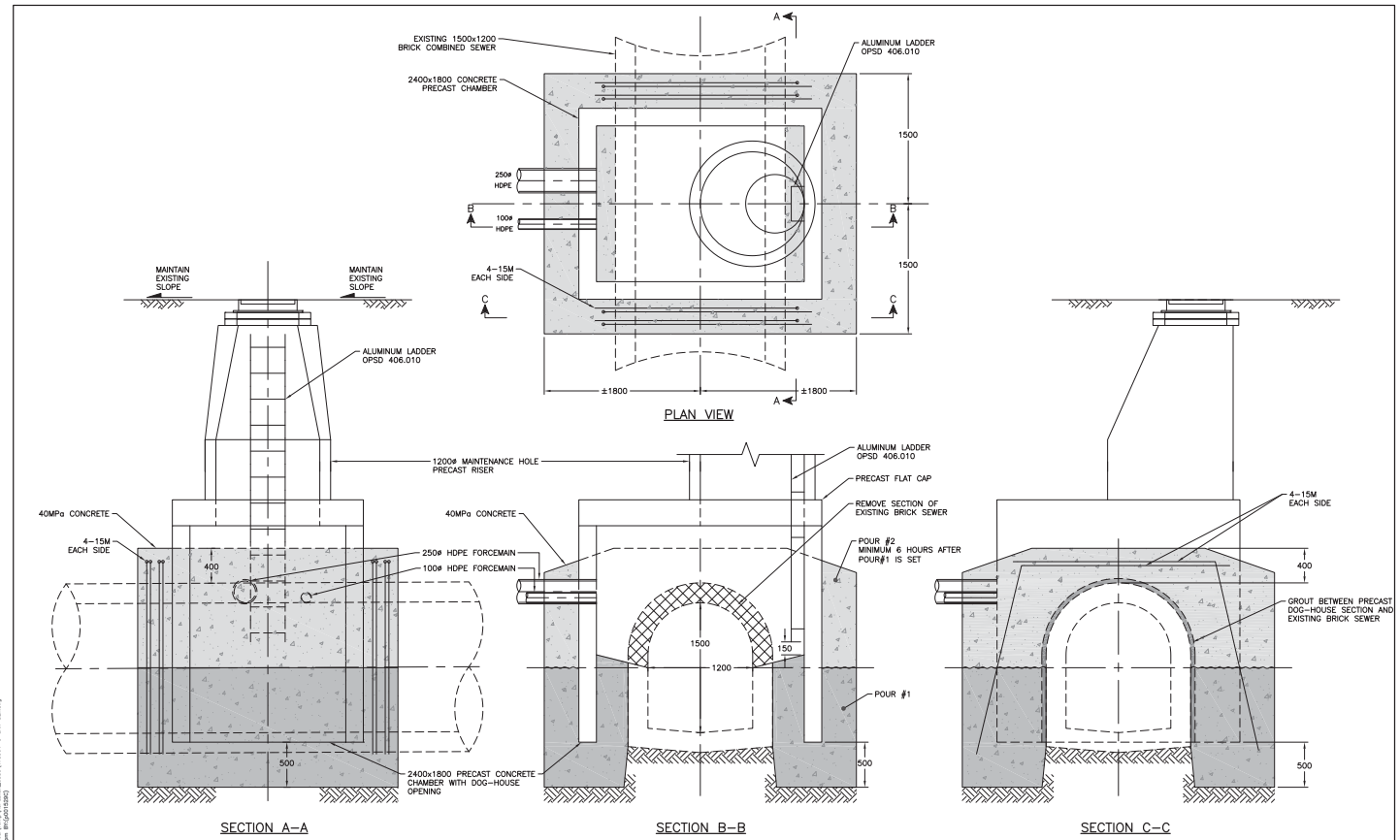
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NEW MUNICIPAL WASTEWATER PUMPING STATION ON PIER 8 IN THE CITY OF HAMILTON

CIVIL
SMH12 & SMH14 DETAIL
DRAIN VALVE CHAMBER DETAILS

DATE : SEPTEMBER 2017
SCALE: 1:20
FILE No.:47599-C-DWG-DET
CONTRACT No.:
DRAWING No.:
G-602

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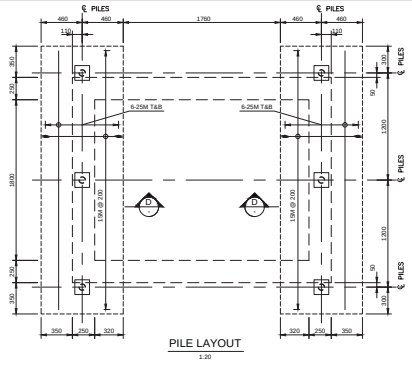
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NEW MUNICIPAL WASTEWATER PUMPING STATION ON PIER 8 IN THE CITY OF HAMILTON

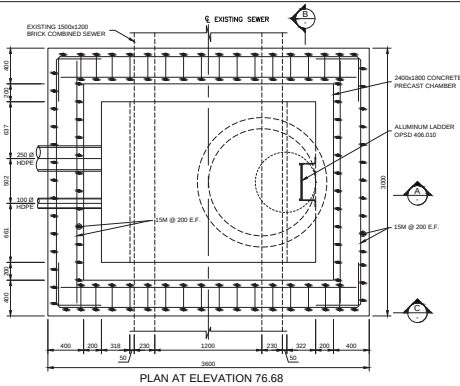
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SMH15 DETAIL
CONNECTION TO EXISTING BRICK SEWER

DATE : SEPTEMBER 2017
SCALE: 1:20
FILE No.:475904-C-FM-DET
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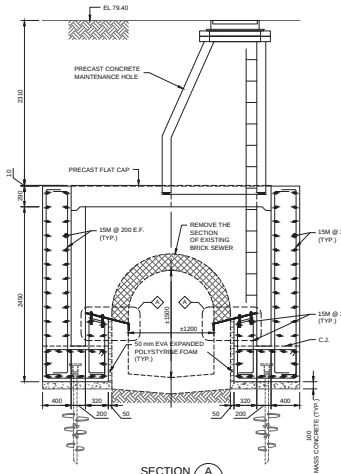
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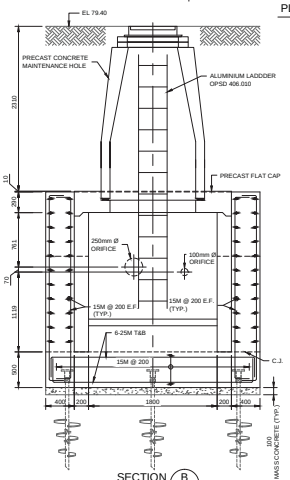
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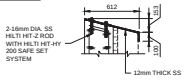
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1:20



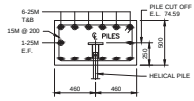
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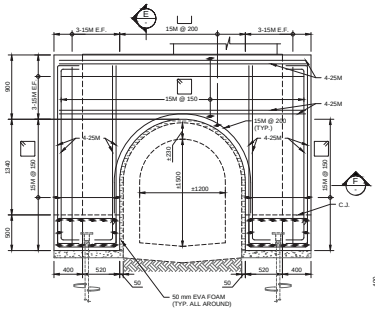
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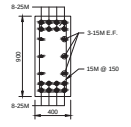
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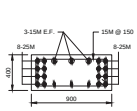
SECTION D
1:20



SECTION C
1:25



SECTION E
1:20



SECTION F
1:20

HELICAL PILE NOTES

1. ALL PILES ARE CHANCE HELICAL PILES OR EQUIVALENT WITH CORROSION PROTECTION SYSTEM AND INSTALLED TO THE MANUFACTURER'S RECOMMENDATIONS.
2. ALL PILES TO BE INSTALLED VERTICALLY.
3. PLIES TO BE INSTALLED TO A MAXIMUM TOLERANCE OF ±75mm IN PLAN.
4. HELICAL PILES TO BE DESIGNED BY THE CONTRACTOR FOR THE LOADS PROVIDED

HELICAL-PILE DESIGN DATA

FACTORED AXIAL LOADS

COMPRESSION SLS = 160 kN/PILE
ULS = 230 kN/PILE

Δmax= 10 mm (SLS)

LOCATION	NO. REQUIRED	LENGTH (min)	BATTER
SMH15	6	15.000*	VERTICAL

* TO BE VARIFIED BY CONTRACTOR

CONCRETE

1. CONCRETE DESIGN AND CONSTRUCTION SHALL CONFORM TO CSA STANDARDS A23.1, A23.2 AND A23.3.
2. CONCRETE CLASS (CSA):
   - FOUNDATION BEAM — CLASS A-3 — 35 MPa
   - PRECAST MANHOLE — CLASS A-3 — 35 MPa
   - CAST-IN-PLACE CONCRETE — CLASS A-3 — 35 MPa
3. REINFORCING STEEL SHALL BE DEFORMED BARS CONFORMING TO CAN/CSA G30.18 GRADE 400, EXCEPT THAT BARS TO BE WELDED SHALL BE GRADE 400W.
4. UNLESS NOTED OTHERWISE, ALL BAR SPLICES SHALL BE CLASS 'B' TENSION LAP SPLICES.
5. CLEAR COVER TO REINFORCING, UNLESS NOTED OTHERWISE, SHALL BE:
   - CAST AGAINST EARTH — 100mm
   - WALLS, BEAMS & SLABS — 50mm
6. SHOP DRAWINGS SHALL BE SUBMITTED FOR REVIEW PRIOR TO FABRICATION OF REINFORCING STEEL. SHOP DRAWINGS SHALL INDICATE ALL MATERIAL GRADES, DIMENSIONS AND DETAILS OF REINFORCING, INCLUDING ALL SPLICE LOCATIONS, CONCRETE COVER AND ANCHOR DETAILS.

CONSTRUCTION NOTE

1. THE DRAWING TO BE READ IN CONJUNCTION WITH G-700 "CIVIL SMH15 DETAIL CONNECTION TO EXISTING BRICK SEWER".
2. CONTRACTOR TO DESIGN PRECAST MAINTENANCE HOLE AND PRECAST CHAMBER.
3. OVER EXCAVATION OF SUBGRADE SHALL BE PLACED WITH MASS CONCRETE OF CLASS 20MPA. IF REQUIRED, MASS CONCRETE WILL BE PLACED WITH IN 4 HOURS OF EXCAVATION.
4. CONSTRUCTION JOINTS AT LOCATIONS OTHER THAN THOSE SHOWN SHALL BE APPROVED BY THE ENGINEER.
5. BACKFILL SHALL NOT BE PLACED UNTIL ALL CONCRETE HAS REACHED AT LEAST 25 MPa STRENGTH.
6. BACKFILL SHALL BE PLACED SIMULTANEOUSLY AROUND THE STRUCTURE KEEPING THE HEIGHT OF THE BACKFILL APPROXIMATELY THE SAME. AT NO TIME SHALL THE DIFFERENCE IN ELEVATION BE GREATER THAN 500mm.
7. WATERSTOPS SHALL BE PROVIDED AT ALL CONSTRUCTION JOINTS. WATERSTOPS SHALL BE HYDROTITE CJ-1020 c/w HYDROTITE LEAKMASTER ADHESIVE OR APPROVED EQUIVALENT.
8. THE CONTRACTOR IS RESPONSIBLE FOR THE STABILITY OF THE EXISTING SEWER DURING ALL STAGES OF EXCAVATION AND CONSTRUCTION.
9. CONTRACTOR SHOULD FOLLOW EXISTING SEWER SHAPE TO THE PRECAST CONCRETE CHAMBER AND CAST-IN PLACE CONCRETE.

STANDARD DRAWING

OPSD 406.010 ALUMINUM LADDER FOR MAINTENANCE HOLES.

LEGEND

- ES DENOTES EACH SIDE
- EF DENOTES EACH FACE
- VEF DENOTES VERTICAL EACH FACE
- T&B DENOTES TOP AND BOTTOM
- C.J. DENOTES CONSTRUCTION JOINT
- L.L. DENOTES LOWER LEVEL
- U.L. DENOTES UPPER LEVEL
- I.F DENOTES INNER FACE
- O.F DENOTES OUTER FACE

It is the responsibility of the contractor to check and verify all dimensions on site and report all errors and/or omissions to the Consultant. Do not scale drawings. Refer to specifications for all requirements not shown on the drawings. Copyright reserved. This drawing is the property of the consultant and is not to be used without consent.

No.	REVISIONS	DATE	INITLS

DESIGNED BY BIA/MFA
DRAWN BY NC
CHECKED BY BIA
APPROVED BY BIA

S. I. ARCHIBALD — 100135715 — PROVINCE OF ONTARIO

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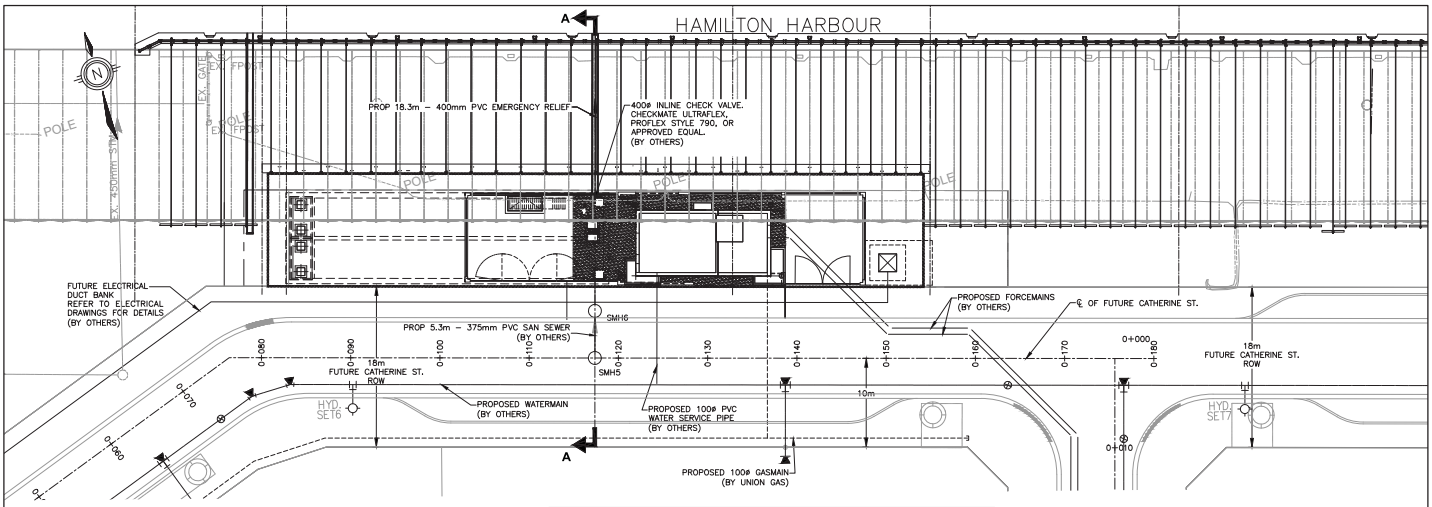
NEW MUNICIPAL WASTEWATER PUMPING STATION ON PIER 8 IN THE CITY OF HAMILTON

SMH15
STRUCTURAL DETAILS

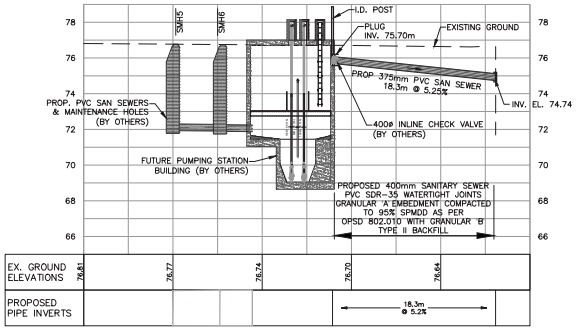
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FILE No.:
CONTRACT No.: C11-01-16
DRAWING No.: S204

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PLOT DATE: Aug 14, 2018-3:11pm By:jlo0929C

APPENDIX A2
EMERGENCY RELIEF DRAWING



PROFILE SCALE
H: 1:200
V: 1:100



SECTION A–A

No.	REVISIONS	DATE	INITLS
1	ISSUED FOR TENDER	JUL. 2018	A.A.

DESIGNED BY A.A.
DRAWN BY Z.S.
CHECKED BY
APPROVED BY J. H.

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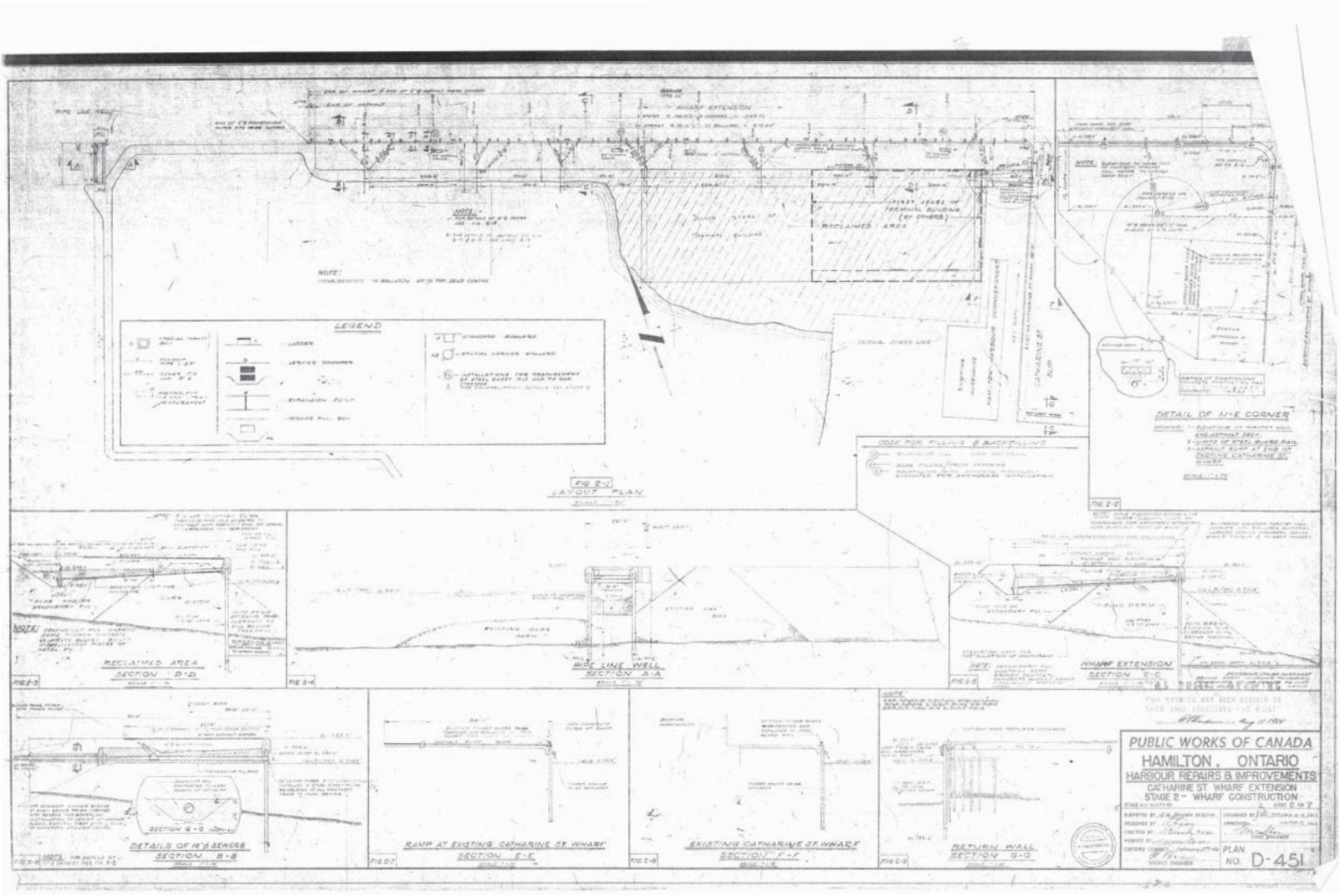
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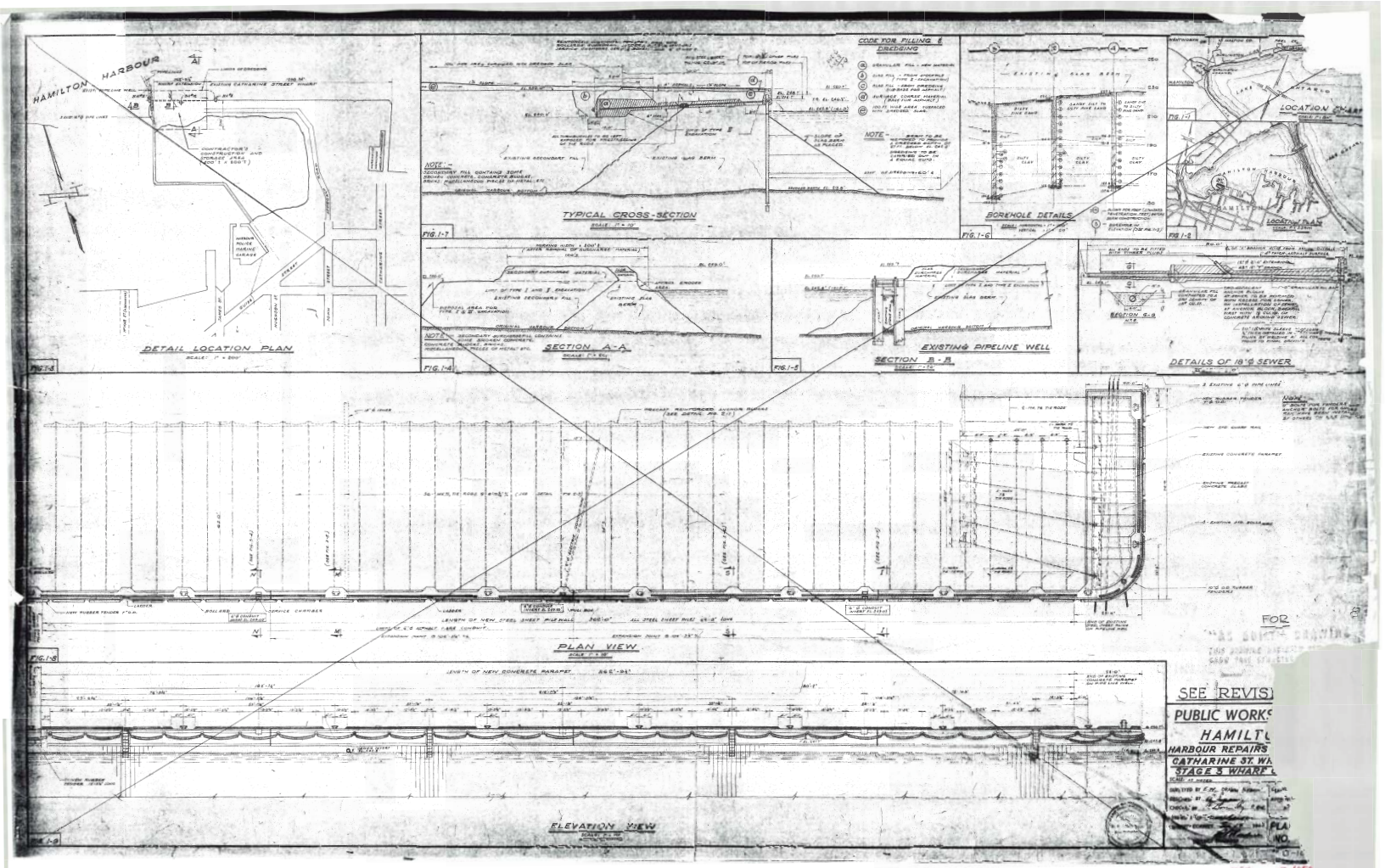
CIVIL
SANITARY SEWERS – PLAN AND PROFILE
SANITARY OUTFALL

DATE : JULY. 2018
SCALE: 1:200
FILE No.675964-D-C-SERV
CONTRACT No.:
DRAWING No.:
G-200A

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PLOT DATE: Jul 16, 2018-4:01pm BY:pb01336C

APPENDIX A3
EXISTING TIE-BACKS DRAWINGS


PIPE LINE WELL
WHARF EXTENSION
RECLAIMED AREA
FIRST STAGE OF TERMINAL BUILDING (BY OTHERS)
CATHARINE ST.
NOTE:
LEGEND
LADDER
SERVICE CHAMBER
EXPANSION JOINT
SERVICE PULL BOX
STANDARD BOLLARD
SPECIAL CORNER BOLLARD
CODE FOR FILLING & BACKFILLING
FIG 2-1
LAYOUT PLAN
DETAIL OF N-E CORNER
FIG 2-2
RECLAIMED AREA
SECTION D-D
FIG 2-3
PIPE LINE WELL
SECTION A-A
FIG 2-4
WHARF EXTENSION
SECTION C-C
FIG 2-5
DETAILS OF 18"ϕ SEWERS
SECTION B-B
FIG 2-6
RAMP AT EXISTING CATHARINE ST. WHARF
SECTION E-E
FIG 2-7
EXISTING CATHARINE ST. WHARF
SECTION F-F
FIG 2-8
RETURN WALL
SECTION G-G
FIG 2-9
PUBLIC WORKS OF CANADA
HAMILTON, ONTARIO
HARBOUR REPAIRS & IMPROVEMENTS
CATHARINE ST. WHARF EXTENSION
STAGE 2 - WHARF CONSTRUCTION
PLAN NO. D-451


HAMILTON HARBOUR
DETAIL LOCATION PLAN
TYPICAL CROSS-SECTION
CODE FOR PILLING & DREDGING
BOREHOLE DETAILS
LOCATION PLAN
SECTION A-A
SECTION B-B
EXISTING PIPELINE WELL
SECTION C-D
DETAILS OF 18"ø SEWER
PLAN VIEW
ELEVATION VIEW
PUBLIC WORKS
HAMILTON
HARBOUR REPAIRS
CATHARINE ST. WHARF
STAGE 3 WHARF

APPENDIX B
GEOTECHNICAL REPORT

Terraprobe

Consulting Geotechnical & Environmental Engineering
Construction Materials Inspection & Testing

GEOTECHNICAL INVESTIGATION
PIER 8 PUMPING STATION
AND FORCEMAIN
HAMILTON, ONTARIO

PREPARED FOR:

City of Hamilton
Waterfront Development Office
77 James Street North, Suite 320
Hamilton, Ontario
L8R 2K3

ATTENTION:

Mr. Jeff Pidsadny
Senior Project Manager

File No. 7-16-0090-01
September 8, 2017
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Distribution:

Copies - City of Hamilton
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EXECUTIVE SUMMARY

This report presents the results of a geotechnical investigation carried out for the design of a new wastewater pumping station, forcemain and other associated works proposed for the Pier 8 area of the Hamilton harbour front.

The results of twenty three boreholes are reported. The predominant subsurface conditions at the site consisted of deep, variable fill deposits overlying strata of generally loose silt, sandy silt and silty fine sand. These loose, fine grained granular deposits were underlain at depth by stiff silty clay. Queenston Formation (bedrock) was confirmed encountered at a depth of 28.5m below the existing ground surface in one of the boreholes. The ground water level encountered in the boreholes was at or slightly above the corresponding water level in the harbour.

A discussion of the geotechnical engineering aspects of the design of the pumping station and other underground plant has been provided.

A deep foundation system consisting of low displacement piles driven to practical refusal in the underlying bedrock is presented as the preferred alternative for supporting the pumping station and holding tank. Comments on excavation, dewatering and shoring have also been provided.

It is expected that the invert elevations of the underground services will be located primarily within the fill deposits. The fill has been in place for many years and large settlements are not expected provided that there is no significant raise in the grades however creep type movements may still be occurring. On this basis, conventional cut and cover construction is considered feasible for the underground services however some measures designed to improve the uniformity of the support for the services, have been recommended. Such measures include the sub-excavation and use of lightweight concrete fill in areas where the fill is particularly loose or where compressible organic soils are encountered.

The results of soil chemistry analyses indicate that most of the excavated fill will probably need to be managed as non-hazardous waste.

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FIGURES

Figure 1 Site Location Plan
Figure 2 Borehole Location Plan
Figure 3 Plan of Pumping Station
Figures 4 & 5 Subsurface Profiles

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Appendix A Borehole Logs
Appendix B Geotechnical Laboratory Results
Appendix C Certificates of Analysis Soil Quality Analyses

1. INTRODUCTION

This report presents the results of a geotechnical investigation carried out for the design of a new wastewater treatment plant, forcemain and other underground services to be constructed in the Pier 8 area of the City of Hamilton. The general area of the site is shown on Figure 1.

The Terms of Reference for the investigation were outlined in a June 20, 2016 email from the Waterfront Development office. A proposal and work plan was outlined in our letter of July 27, 2016. The work is the subject of Purchase Order no. HAMTN-0000082955 issued by the City of Hamilton on August 8, 2016.

The intents of the investigation were to determine the soil and ground water conditions in a series of boreholes and to provide information for the design of the following works:

- A new wastewater pumping station (PS1);
- some 270m of 375mm PVC diameter gravity wastewater main;
- about 1 km of twin 250mm and 100mm diameter HDPE forcemain; and
- 120m of 200mm diameter PCV watermain.

This report was issued in draft format for preliminary design consideration, review and comment on November 11, 2016.

2. BACKGROUND

It is known that the Pier 8 lands and much of the west harbour area was created by filling. Some understanding of how and when the filling took place is beneficial to developing a design approach to developing these lands. The following brief account of the development of the subject lands has been paraphrased from Dillon's report.[1]

The west harbour area is situated north of Guise Street East approximately between James Street North and Ferguson Street as shown on Figure 1. The area was initially developed in the mid-1800s and it is likely that fill was deposited in the south portion of the study area during that period. More aggressive filling took place in the 1960s during which time the northern approximately two thirds of the site was reclaimed and Pier 8 was constructed. These lands were subsequently developed for use primarily as warehousing. Later uses included boat storage and maintenance associated with the marina and yacht club, a ferry terminal, aircraft hangar and trucking terminal and continued use of the land for warehousing and shipyard use. More recently the west side of the harbor has been developed for recreational use.

This background information suggests that the fill was probably placed by progressive end-dumping and forward spreading into the harbor. The results of previous investigations suggest that the fill is somewhat variable in nature and contains brick and other rubble. It is likely that the near surface zone of the fill is in a relatively compact state due to the effects of various land use activities and the deeper fill is likely to be in a less compact.

[1] Dillon Consulting Limited: Phase Two Environmental Site Assessment, Pier 8, Hamilton, Ontario, Draft Report, April 2016

3. PROCEDURE

The fieldwork for this investigation was carried out between August 3 and 17, 2016, October 21 and 27, 2016 and on June 29, 2017, during which time twenty three boreholes were drilled. The boreholes were drilled to provide information on the subsurface soil and ground water conditions at the site of the new pumping station and forcemain as well as other civil works that will be required to develop the west harbour area. Only the boreholes that are relevant to the present undertaking are presented in this report which includes boreholes numbered 6, and 9 to 30. The locations and depths of the boreholes were selected based on a review of existing information, conceptual design information available when the field work was undertaken and in consultation with the Waterfront Development Office.

The existing underground services at the site were located in advance of the drilling by Ontario One Call. In addition, Frontier Utility Locating Services Inc. was retained to confirm that there were no private services conflicting with the borehole locations. The drilling equipment, which consisted of a CME 75 truck mounted drill rig, and a CME-55 High Torque drill rig were supplied and operated by specialist, licenced (O. Reg. 903) drilling contractors. An engineer from our staff arranged for underground service locates, observed the drilling and sampling operations, logged the boreholes and cared for the samples obtained.

The boreholes were advanced using conventional interval augering and sampling techniques. Soil samples were recovered by split barrel sampling in accordance with ASTM Standard D1586 at regular intervals of depth. The bedrock was investigated in one of the boreholes using conventional diamond drilling techniques and NQ sized coring equipment. Soil samples recovered from the boreholes were sealed in clean, single use containers and transferred to Terraprobe's Stoney Creek laboratory for further examination and laboratory testing. Samples for soil quality analyses were stored in dedicated glass containers provided by the analytical laboratory.

Soil cuttings from the boreholes were contained in sealed steel drums which were subsequently removed from the site and managed by a soil management contractor.

The ground water conditions in the open boreholes were observed during and immediately after drilling. In addition, ground water monitoring wells were constructed in selected boreholes. The wells were constructed using nominal 50mm diameter, Schedule 40 well screen and riser pipe. The wells were provided with protective steel casings and flush mount steel covers. As-built details on the wells are shown schematically on the Record of Borehole sheets.

The ground surface elevations at the borehole locations have been inferred from the spot elevations shown on topographical mapping provided by the City of Hamilton.

A program of geotechnical laboratory testing was carried out on the soil samples recovered from the boreholes including moisture content (ASTM D 2216), particle size analysis (ASTM D422), and Atterburg Limits (ASTM D4318). The results of the laboratory testing are presented in Appendix B and are shown on the Records of Borehole sheets in Appendix A.

Selected soil samples were submitted to AGAT Laboratories for soil quality analyses. The analyses included O. Reg. 153-04 metals and inorganics, PAH, PCB, petroleum hydrocarbons, and VOCs. In addition O. Reg. 558 analyses for metals and inorganics, VOCs and benzo(a)pyrene were carried out on composite soil samples. The results of these analyses are summarized in Tables 7.1 to 7.6 following the text of this report. Details on the rationale for the analyses as well as the results of the analyses are discussed in Section 7 of this report. The Certificates of Analyses for the chemical analyses are provided in Appendix C.

4. SUBSURFACE CONDITIONS

4.1 General

The subsurface soil, rock and ground water conditions encountered in the boreholes drilled as part of the present investigation are shown on the Log of Boreholes sheets provided in the accompanying Appendix A. The subsurface conditions were confirmed at the borehole locations only and the conditions will vary between and beyond the boreholes. The boundaries between the various strata shown on the Record of Borehole sheets were based on non-continuous sampling and observations of drilling resistance. These boundaries typically represent a transition between the various stratigraphic units and are not to be interpreted as precise planes of stratigraphic change.

The subsurface conditions encountered at the site generally consisted of fill overlying deposits of loose silt, silty sand and sandy silt. The deeper boreholes encountered a stratum of silty clay beneath the loose silty deposits. Queenston Formation (bedrock) was penetrated in one of the boreholes.

It should be noted that large particle sizes such as construction rubble and other obstructions may be present in the fill stratum that overlies the site although this may not be indicated in the record of borehole logs. The sampling equipment and techniques used were not of sufficient size to capture large particles however the high penetration resistance observed at some locations provides an indication of the likely presence of large sized particles.

Ground water observations were made in the boreholes during and after completion of drilling and ground water monitoring wells were constructed in selected boreholes. The results of ground water level monitoring are reported. Fluctuation in the ground water levels will occur due to seasonal variations and precipitation conditions as well as changes in the lake water level.

The following is a general description of the major stratigraphic units and the ground water conditions encountered in the boreholes. Stratigraphic sections in selected areas of the site are shown on Figures 4 and 5.

4.2 Soil Conditions

4.2.1. Fill

The extent and physical character of the fill encountered in the boreholes was generally consistent with the historical information presented by Dillon and others. The depth of the fill increased toward the present harbor front with the deepest fill encountered at Pier 8.

Pier 8 Area, Boreholes 6, 9 to 19, and 28 to 30

The deepest fill deposits were encountered in boreholes 10 to 15 and 28 where the fill was encountered to depths of about 6 to 12m below the existing ground surface. The fill in the remaining boreholes was encountered to depths of about 4.6 to 7.3m. Boreholes 14, 15 and 16 were terminated in fill at depths of 6 to 10m below the existing ground surface. The fill was variable in nature and ranged from silty sand and sand to clayey silt and silty clay. Rubble consisting of pieces of bricks and mortar, timber, concrete and slag was also encountered.

The N values determined within the upper 2m of the fill in this series of boreholes was in the range of 7 to 35 blows per 0.3m with an average N value of about 15 blows per 0.3m, inferring a generally compact state of packing. The in-situ water content of the near surface fill ranged from about 3 to 21 percent with an average water content of about 14 percent.

The N values in the underlying fill were in the range of 2 to greater than 100 blows per 0.3m. It was considered that the elevated N values reflected the presence of rubble fill and slag. The N values were more typically in the range of about 2 to 23 with an average of about 8 blows per 0.3m. The in-situ water content of the deeper fill deposits ranged from about 11 to 30 percent with an average in-situ water content of 20 percent.

Eastwood Park, Boreholes 20 to 27

Boreholes 20 to 27 were drilled along the alignment of forcemain through Eastwood Park. Fill was encountered in boreholes 20 and 24 to 27. The fill in this series of boreholes was encountered to depths of 2.3 to greater than 5m below the existing ground surface. The fill generally consisted of sandy silt and silty sand with some gravel and pieces of timber, brick, tile, glass and asphalt. The N values in the fill were in the range of 1 to 38 blows per 0.3m with the higher N values generally within the upper 1m of the fill. The in-situ water content of the fill sampled above the ground water level was in the range of about 6 to 42 percent. The fill recovered from below the ground water level has water contents of about 13 to 43 percent.

4.2.2. Organic Silt, Peat

Strata of organic silt and peat were encountered beneath the fill in boreholes 6, 9, 19, 24, 25, and 30. The organic silt in borehole 19 was underlain by peat. A layer of organic silt was also penetrated beneath silty fine sand and sandy silt in borehole 28. The combined thickness of the organic silt and peat ranged from about 0.6 to 7.9m. The N values determined in the organic silt strata ranged from WH (weight of hammer) to 6 blows per 0.3m inferring a very soft to firm consistency. The natural water content of the organic silt ranged from about 28 to 75 percent with an average natural water content of 43 percent. The peat had a natural water content of about 140 percent.

4.2.3. Silt, Sandy Silt and Silty Fine Sand

Strata of silt, sandy silt and silty fine sand were encountered beneath the fill in boreholes 10, 11, 12, 13, 17, 18, 20, 26, 28, and 29 and below the organic silt and peat in boreholes 6, 9, 24 and 25. Boreholes 21, 22 and 23 encountered strata of sandy silt and silty fine sand below near surface fill and topsoil.

The N values determined in these fine grained granular strata were typically in the range of WH to 10 blows per 0.3m inferring a very loose to compact relative density. The corresponding natural water contents ranged from about 14 to 40 percent with an average water content of about 26 percent.

The near surface deposit of sandy silt and silty fine sand penetrated in boreholes 21, 22 and 23, drilled in the Eastwood Park area, was generally more compact with N values of 11 to 44 blows per 0.3m and with an average N value of about 27 blows per 0.3m. The natural water content of the near surface sandy silt and silty fine sand ranged from 5 to 23 percent, generally increasing with depth and proximity to the ground water level.

Grain size distribution curves for samples of the silty fine sand and sandy silt are shown on Figure B1 in Appendix B.

4.2.4. Silty Clay and Clayey Silt

A stratum of silty clay was encountered beneath the silty fine sand and sandy silt in boreholes 6 and 10 and beneath the organic silt in boreholes 28 and 30. The N values determined in the silty clay were in the range of 2 to 23 blows per 0.3m inferring a firm to very stiff consistency. Grain size distribution curves for selected samples of the silty clay recovered from the boreholes are shown on Figure B2 in Appendix B. Corresponding liquid and plastic limits of about 32 and 18 percent respectively were determined on these samples indicating clay of relatively low plasticity as shown on Figure B3.

Strata of clayey silt were penetrated below the strata of silty sand, sandy silt and silt in boreholes 19, 21, 23 and 26. The N values in the clayey silt ranged from 8 to 29 blows per 0.3m indicating a stiff to very stiff consistency. The natural water content of the clayey silt ranged from about 16 to 24 percent.

4.2.5. Queenston Formation

The augering and interval sampling method used to explore the overburden at the site is conventionally accepted investigative practice. However, this method does not define the bedrock surface with precision particularly where the surficial zone of the underlying bedrock

may be weathered. As best could be practically determined, the surface of the bedrock was encountered in borehole 28 at a depth of 28.5m below ground surface or at elevation 48.2m.

The rock formation was continuously cored between elevation 48.1 and 45.1m (i.e. 2 runs of 1.5m each). The total core recovery (TCR) over this interval was 96 and 100 percent, with a corresponding solid core recovery (SCR) of 93 and 100 percent and a rock quality index (RQD) of 34 and 79 percent. These parameters indicate a rock mass classification in the poor to fair range.

Queenston Formation predominantly consists of thinly bedded reddish brown calcareous shale with grey green bands of interbedded argillaceous limestone. The shale is of relatively low strength and the harder limestone layers are of medium strength. Unconfined compressive strengths of 43.6 and 52.5 MPa were determined on two specimens of the intact core recovered from borehole 28. This suggests that the rock formation at this location can be categorized as weak to medium strong.

A summary of other relevant information with respect to this formation is presented in the Ontario Ministry of Transportation and Communication publication RR229 - *Evaluation of Shales for Construction Projects- An Ontario Shale Rating System,* March 1983.

4.3. Ground Water Conditions

Boreholes 21, 22 and 23 drilled in the near surface sandy silt and silty fine sand deposit, were dry during and upon completion. The remainder of the boreholes generally encountered ground water within the fill at depths of about 1 to 3m below the existing ground surface. The following is a summary of ground water levels measured in the monitoring wells.

Summary of Ground Water Level Monitoring

Borehole No.	Screened Interval (m)	Soil Stratum	Elevation of Ground Water Level (m)			
			Sept. 1 2016	Oct. 11 2016	Nov. 7 2016	July 24 2017
6	58.8 – 60.3	silty clay	71.1	74.8	74.3	76.1
10	52.3 – 53.8	silty clay	74.9	75.0	75.4	75.6
11	70.7 – 73.8	fill	75.9	75.9	75.7	76.4
19	66.9 – 69.9	silt	74.9	74.7	74.5	n/a
22	74.0 – 75.5	silty sand	76.8	76.9	76.5	76.0
24	73.0 – 74.5	sandy silt	75.8	75.8	75.9	76.6
27	74.8 – 76.3	fill	76.3	76.5	76.3	77.0
28	67.0 – 70.0	sandy silt	N/A	N/A	74.6	n/a

n/a not accessible

The ground water level measured above may not necessarily represent stabilized conditions. In addition the ground water levels will vary seasonally and with precipitation conditions.

The corresponding water levels in Hamilton harbour during the field work (from Canada Fisheries and Oceans - Station 13150, Burlington) are shown below.

Summary of Lake Ontario Levels (Burlington)				
Date	Sept. 1, 2016	Oct. 11, 2016	Nov. 16, 2016	July 24, 2017
Water level (m) (IGLD 85)	74.76	74.59	74.57	75.68

5. DISCUSSION

The following discussion and recommendations are based on the factual data obtained from this investigation and is intended for use by the owner and the design engineer(s). Comments made regarding the construction aspects are provided only in as much as they may impact on design considerations. Contractors bidding on or undertaking any work at the site should examine the factual results of the investigation, satisfy themselves as to the adequacy of the information for construction and make their own interpretation of the factual data as it affects their proposed construction techniques, schedule, equipment capabilities, costs, sequencing and the like.

This following discussion is provided on the presumption that the design features relevant to the geotechnical analyses will be in accordance with applicable codes, standards and guidelines of practice.

5.1 Pumping Station (PS1)

5.1.1. General

The general arrangement of the pumping station facility is shown on Figure 3. The facility will consist of a control building and valve room, a wet well and an in-ground holding tank. The subsurface conditions encountered in boreholes drilled in the area of the pumping station consisted of deep fill overlying very loose sandy silt and stiff silty clay. Borehole 28 encountered bedrock at a depth of about 28.5m below ground surface or at elevation 48.2m.

As presently proposed the ground floor level in the building will be at elevation 77.1m with a service level floor elevation 3.54m below the ground floor or at about elevation 73.56m. The adjacent wet well will be 2.5m by 4m in plan with an invert elevation at 69.25m or some 7.5m below the existing ground. The holding tank will be a reinforced concrete structure some 30 by 9 m in plan with an underside of bottom slab at about elevation 71.2m or about 5.5m below the existing ground surface.

The results of the boreholes indicate that the structures will be located within the fill. Based on the type and size of structures under consideration and the subsurface conditions at the site consideration has been given to supporting the facility on a reinforced concrete raft slab or on a deep foundation system.

The concept of a reinforced raft slab is to minimize the bearing pressure as well as the potential for differential settlement. Construction would involve excavation to the required depth and placing a leveling course of granular material, a geotextile and reinforcing grid and a well

compacted granular base course. The foundation slab would consist of a structural slab. In this case, some post construction settlement of the foundation slab would be expected however it may be feasible to accommodate these effects by designing flexible connections and incorporating other measures to optimize flexibility. If the serviceability of the plant could be compromised by post construction settlement, then it would be necessary to support the building on a deep foundation system.

Deep foundations would consist of a system of grade beams and piles. A number of pile types could be considered for this project including conventional end bearing driven piles, bored piles, micro piles, and helical piers. The piles would be primarily end bearing developing resistance in the bedrock and in this case low displacement driven piles are considered preferable. The deep foundation alternative will address concerns regarding post construction settlement of the structures and is preferred for this reason. The potential will exist for differential movement of interconnecting infrastructure which should be addressed in the design.

5.1.2. Deep Foundations

The presence of rubble and other obstructions within the fill is a potential concern for deep foundations and for this reason, the use of more robust piles such as driven low displacement steel H piles would be preferred to high displacement piles such as close ended steel tube piles. It is expected that H piles driven to practical refusal will penetrate bedrock which was encountered at elevation 48.2m in borehole 28. The low displacement H piles must be provided with driving points or be reinforced in accordance with OPED 3000.100.

The maximum design capacities for various HP sections are tabulated below.

Section	Area of Steel (mm^2)	Factored Axial Resistance at ULS (kN) fy = 350MPa	Factored Axial Resistance at SLS (kN) fy = 350MPa
HP 310 x 100	14,100	1760	1470
HP 310 x 79	9.980	1250	1040
HP 250 x 85	10,900	1260	1100

The pile sections are to be driven to practical refusal and a dynamic analysis to evaluate the "setting" of the piles shall be carried out using the *Hiley Dynamic Pile Driving Formula,* in accordance with MTO Standard SS103-11. The Hiley Formula generates an unfactored pile capacity which must equal or exceed the corresponding ultimate axial capacities shown below.

Section	Ultimate Capacity (kN) fy = 350MPa
HP310 x 110	4410
HP 310 x 79	3120
HP 250 x 85	3300

Preliminary estimates of the actual pile "set" requirements can be made when the details of the hammer and helmet configuration are known. In this regard, care should be taken in the selection of the pile driving stresses in the piles are limited to a maximum of 90% of the yield strength of the steel.

As indicated above, some difficulties in driving the piles may be encountered due to obstructions within the fill deposits that underlie the site. The risks and costs associated with such obstructions must be clearly addressed in the contract documents.

Grade beam and pile cap units subjected to freezing temperatures must be provided with a minimum soil cover of 1.2 m for adequate frost protection.

5.1.3. Seismic Site Classification

The Ontario Building Code (2012) stipulates the methodology for earthquake design analysis, as set out in Subsection 4.1.8.7. The determination of the type of analysis is predicated on the importance of the structure, the spectral response acceleration and the site classification.

The parameters for determination of Site Classification for Seismic Site Response are set out in Table 4.1.8.4A of the Ontario Building Code (2012). The classification is based on the determination of the average shear wave velocity in the top 30 metres of the site stratigraphy, where shear wave velocity (v_s) measurements have been taken. Alternatively, the classification is estimated on the basis of rational analysis of undrained shear strength (s_u) or penetration resistance (N-values).

Based on the results of the boreholes the site designation for seismic analysis is best represented by **Site Class E**, as shown in Table 4.1.8.4.A of the Ontario Building Code (2012). Tables 4.1.8.4.B and 4.1.8.4.C. of the same code provide the applicable acceleration- and velocity-based site coefficients.

Site Class	Values of Fa as a Function of Site Class and Sa(0.2)				
	$S_a(0.2) \leq 0.25$	$S_a(0.2) = 0.50$	$S_a(0.2) = 0.75$	$S_a(0.2) = 1.00$	$S_a(0.2) \geq 1.25$
E	2.1	1.4	1.1	0.9	0.9

Site Class	Values of Fv as a Function of Site Class and Sa(0.1)				
	$S_a(1.0) \leq 0.1$	$S_a(1.0) = 0.2$	$S_a(1.0) = 0.3$	$S_a(1.0) = 0.4$	$S_a(1.0) \geq 0.5$
E	2.1	2.0	1.9	1.7	1.7

5.1.4. Earth Pressure Design Parameters

The appropriate values for use in the design of structures subject to unbalanced earth pressures at this site are tabulated as follows:

Stratum/Parameter	γ kN/m^3	ϕ (^{o})	K_a	K_o	K_p
Compact Granular Fill Granular 'B' (OPSS.MUNI 1010)	21	32	0.31	0.47	3.26
Existing Earth Fill	20	28	0.36	0.53	2.78
Sandy silt /Silty Sand	19	28	0.36	0.53	2.78

The above earth pressure coefficients pertain to a horizontal grade condition behind a retaining structure. Values of earth pressure parameters for an inclined retained grade condition will vary.

Walls subject to unbalanced earth pressures must be designed to resist a pressure that can be calculated based on the following equation:

$$P = K[\gamma(h - h_w) + \gamma' h_w + q] + \gamma_w h_w$$

where,

P	=	the horizontal pressure at depth, **h** (m)
K	=	the earth pressure coefficient
h_w	=	the depth below the ground water level (m)
γ	=	the bulk unit weight of soil, (kN/m^3)
γ'	=	the submerged unit weight of the exterior soil, (γ - 9.8 kN/m^3)
q	=	the complete surcharge loading (kPa)

A ground water level at elevation 75.0m should be considered for design purposes. In cases where the wall backfill can be drained effectively to eliminate hydrostatic pressures on the wall

that would otherwise act in conjunction with the earth pressure the above equation is simplified to:

$$\boldsymbol{P = K[\gamma h + q]}$$

Consideration must also be given to the possible effects of frost on structures retaining earth. Pressures induced by freezing in frost-susceptible soils exert pressures and are effectively irresistible.

5.2 Underground Services

5.2.1. General

The planned works will include the construction of some 275 lineal m of 375mm diameter sanitary sewer, about 120m of 200mm diameter sanitary sewer and about 1 km of 250 and 100mm diameter forcemain. The watermain and forcemain will be constructed at relatively shallow invert depths, general at about 2 to 3m below the existing ground. The gravity sewer will be deeper with an invert depth of about 4 to 5m below the existing ground surface.

There are risks that are inherent to developing property underlain by fill. The primary concern relates to the potential for ongoing post construction differential settlement. Settlement will occur due to consolidation of the underlying native soils under the weight of the fill and within the fill mass due to the method of deposition. In this case the fill has been in place for some 50+ years and the consolidation of the underlying native soil is expected to be essentially complete under the current loading. It is expected however that even at this stage, secondary consolidation and creep type deformation may be taking place. It is considered that the risk of large settlements to take place is low provided that there is no substantial change in the effective stress within the soil. Such changes in stress could occur due to high foundation loads, surcharge loading (i.e. additional fill placed) or if there is a substantial lowering of the ground water level (an unlikely event).

The construction of underground services will not change the effective stress condition in the ground and on this basis the magnitude of the expected post construction settlement should be tolerable to the services. It is considered however that a grade raise after the construction of the services could cause additional settlement which could potentially affect the performance of the underground plant.

The construction aspects of the underground servicing that should be considered within the context of the design including such aspects as excavation and dewatering are discussed in Section 6 of this report.

5.2.2. Bedding

It is expected that the underground services will be supported in fill for the most part although some sections of the forcemain in the Eastwood Sports Park area will be constructed in competent native silty sand. The nature and condition of the fill was somewhat variable and for this reason, measures intended to improve the uniformity of the support beneath the pipe and to enhance the performance of the underground plant are recommended.

Since there may be rubble within the fill, the excavations for the pipes should extend to at least 0.5m below the invert elevation to provide uniform support immediately beneath the pipes. The foundation bedding material should consist of OPSS Granular "A" uniformly compacted to at least 95 percent of standard Proctor maximum dry density. The pipe must be designed for a Class B bedding condition with Type 3 soil conditions assumed. The underground plant including the pipe joints should be designed to optimize flexibility. It is noted that flexible rather than rigid pipe is proposed for this project.

Highly compressible organic soils were encountered in some sections of the forcemain alignment and additional measures are recommended in these sections. It is recommended that such treatment should consist of over-excavating to a depth of 1m below the invert elevation and restoring the grade using light-weight (cellular) concrete. The light weight concrete should have a unit weight of ≤ 5 kN/m³ and extend at least 300mm on each side of the pipes (it is expected that the forcemain will be constructed in a common trench). The locations where this type of treatment should be provided can best be confirmed during construction however the following sections have been identified based on the results of the boreholes:

Station 0+040 (Catharine Street north) to Station 0+210 (Future Street C2) and

Station 0+360 to 0+540 (Eastwood Park).

Provision should be made in the contract to provide this treatment in other areas that are identified during the course of the construction where such measures are considered prudent.

5.2.3. Backfill

In most instances the soil excavated from the service trenches will consist of fill. In some areas where the servicers are deeper, the underlying silty sand and sandy silt deposits will be encountered. Organic silt and peat may be encountered in other locations. The quality of the fill is somewhat variable. Rubble, asphalt, cinders and the like were observed in the samples of fill recovered from the penetration testing. For this reason re-use of the excavated soil as backfill is generally not recommended and the backfill should consist of OPSS Granular "B".

The soil conditions along the section of forcemain that traverses the Eastwood Sports Park area are slightly improved and selective re-use of the excavated soil may be feasible in this area, subject to field review by the geotechnical engineer during construction.

The trench backfill must be placed in lifts of 300mm thickness or less and uniformly compacted to 95 percent of standard Proctor maximum dry density. The upper 1m of backfill, forming pavement subgrade, should be uniformly compacted to 98 percent of standard Proctor maximum dry density. For optimal performance, the placement water content of the backfill should be within about 2 percent of the corresponding laboratory optimum water content for compaction.

6. DESIGN CONSIDERATIONS FOR CONSTRUCTABILITY

6.1 Excavation

Excavations must be carried out in accordance with the *Occupational Health and Safety Act and Regulations for Construction Projects, November 1993 (Part III - Excavations, Section 222 through 242).* Within this context, *Type 3 Soil* conditions should be assumed for excavations that are less than 5m deep provided that ground water seepage is adequately controlled and surface water is directed away from open excavations. Excavations deeper than 5m are likely to penetrate loose, wet soil deposits and in this case *Type 4 Soil* conditions must be assumed.

Where workmen must enter a trench or excavation deeper than 1.2 m, the soil must be suitably sloped and/or braced in accordance with the regulation requirements. Minimum support system requirements for steeper excavations are stipulated in Sections 235 through 238 and 241 of the Act and Regulations and include provisions for timbering, shoring and moveable trench boxes.

Large size particles (construction rubble, cobbles and boulders) may exist in the fill material. The size and distribution of such obstructions cannot be predicted with boreholes, as the sampler size is insufficient to secure representative samples of particles of this size. Provision must be made in excavation contracts to allocate risks associated with the time spent and equipment utilized to remove or penetrate such obstructions when encountered.

6.2 Dewatering

The ground water levels have been measured between about elevations 74.1 and 76.9m in the monitoring wells constructed at the site. On this basis it is expected that excavation for the pumping station and holding tank as well as some sections of the underground services will extend below the ground water level. Adequate ground water control will be necessary to properly bed the pipes. The excavations for the pumping station will extend several metres below the ground water and adequate ground water control will be necessary to construct these facilities.

The results of a hydrogeological investigation carried out at the site are detailed in Terraprobe Inc. Report No. 7-16-0090-46 entitled “Hydrogeologic Investigation West Harbour Pumping Station and Associated Works”, dated August 9, 2017. Reference should be made to this report for a detailed description of the ground water conditions and information on dewatering. The following is a summary of the conclusions.

i. Excavations for the proposed PS 1 pumping station will be required for the service level, wet well and waste water holding tank. The service level excavation will cover 112 square meters to depths of about 3.5 m. The wet well excavation will cover approximately 12 square meters to a depth of 7.8 m below grade, and the sanitary storage tank will be completed to a depth of 4.8 m with an area of 270 square meters.

ii. Excavations for the twin sanitary forcemain will be required to various depths between 1.5 to 2.6 m below grade. It is anticipated that excavations for the sanitary forcemain will be staged at 100 m lengths or less.

iii. Ground water control will be required to lower ground water levels within open excavations. Ground water levels will be influenced by the close proximity of the site to Burlington Bay. Ground water elevations are anticipated at 76.4 m.

iv. Excavations are anticipated to be completed predominately within fill materials. The hydraulic conductivity of fill materials is anticipated at 1 x 10^{-6} m/s based on hydraulic conductivity testing conducted for monitoring wells screened within fill deposits. The estimated volume of seepage for the PS 1 pumping station is on the order of 110 m^3 per day. Dewatering for the sanitary forcemain was estimated at 75 m^3 per day. It is anticipated that dewatering activities will be posted to the MOECC EASR.

v. The zone of influence associated with the ground water control activities is estimated at approximately 15 m (PS 1 pumping station) to 43 m (sanitary forcemain). There are no water wells or structures found within several hundred meters of the site, hence there are no significant impacts expected.

vi. A program of monitoring during construction is recommended. The monitoring should include frequent inspection of the excavation and discharge water. Detailed records should be maintained regarding excavation progress and pumping rates and volumes.

6.3 Shoring

It is expected that a shoring system will be needed to support the excavations for the pumping station, wet well and holding tank. The shoring system could also be an integral part of the dewatering scheme.

The shoring system must be designed and constructed in accordance with the Occupational Health and Safety Act of Ontario (OHSA). The shape of the soil pressure distribution diagram to be considered for designing the shoring depends on the type and condition of the soil encountered and the amount of movement that can be tolerated. The shoring system can be

restrained, fixed or flexible. Earth pressure computations must also take into account the ground water level. Earth pressure above the ground water level is computed based on the bulk unit weight of the retained soil. Earth pressures below the ground water level will be computed using the submerged (buoyant) unit weight of the soil. A hydrostatic pressure is also applied if the retained soil is not fully drained.

Based on the results of the boreholes drilled at the site and the design information presently available, it is expected that excavations for the wet well and valve house will be primarily in fill. Excavations for the deeper sections of gravity sewer will penetrate fill and in some cases the underlying fine grained granular soil may be penetrated. A ground water level corresponding to the adjacent harbour water level should be considered for design purposes. The recommended unfactored soil parameters that may be considered in the design of the support system are shown below.

Elevation (m)	Stratigraphic Unit	ϕ (degrees)	γ (kN/m³)	γ' (kN/m³)	Earth Pressure Coefficient		
					K_a	K_p	K_o
68.0 - 76.8	Fill	28	20	10.2	0.36	0.53	2.77
55.4 - 68.0	Sandy Silt	28	19	9.2	0.36	0.53	2.77
53.7 - 55.4	Organic Silt	24	15	5.2	0.42	0.59	1.38
49.6- 53.7	Silty Clay	30	20	10.2	0.33	0.50	3.0

The shoring could consist of a system of interlocking steel sheet piling supported with walers and struts. Depending on the design, the sheet piling would extend at least several metres into the sandy silt to silty fine sand deposit beneath the fill which will also be required to control ground water seepage.

6.4 Quality Control

The on-site review of the condition of the foundation soil as the foundations are constructed is an integral part of the geotechnical design function and is required by Section 4.2.2.2 of the Ontario Building Code. The geotechnical engineer should be retained to review the geotechnical aspects of the final design and to verify the conditions encountered during construction.

The pile driving must be monitored by the geotechnical engineer to verify that the design axial resistance has been achieved for each pile.

The design advice in this report is based on an assessment of the subgrade support capabilities as indicated by the boreholes. These conditions may vary across the site depending on the final design grades and therefore, the preparation of the subgrade and the compaction of all fill should be monitored by the geotechnical engineer at the time of construction to confirm material quality, thickness, and to ensure adequate compaction.

The requirements for backfill placement on this project have been stipulated relative to Standard Proctor Maximum Dry Density (SPMDD). In situ determinations of density during fill and asphaltic pavement placement on site are required to demonstrate that the specified placement density is achieved.

Concrete design and construction should be specified in accordance with the requirements of CAN3 - CSA A23.1.

7. SOIL QUALITY

7.1 Methodology

Chemical analyses were carried out on some twenty one (21) soil samples recovered from the boreholes drilled at the site. The intent was to carry out analyses of 2 samples from each borehole however poor recovery, especially within the fill was a constraint on the number of samples selected. The selected soil samples were submitted to AGAT Laboratories. The chemical parameter groups selected for analysis were chosen based on potential Contaminants of Concern as identified by Dillon[2] , and to provide general information regarding to be considered in developing a soil management plan for the construction.

The analyses were conducted for the following parameters groups, as specified in Ministry of Environment and Climate Change (MOECC) *"Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act"*, July 1, 2011.

ORGANIC PARAMETERS

Petroleum Hydrocarbons (PHCs)

Polychlorinated Biphenyls (PCBs)

Polycyclic Aromatic Hydrocarbons (PAHs)

Volatile Organic Compounds I (VOCs)

Volatile Organic Compounds II: Benzene, Toluene, Ethybenzene, Xylene (BTEX)

INORGANIC PARAMETER GROUPS

- Metals (M)
- Metals, Hydride-Forming As, Se and Sb (H-M)
- Other Regulated Parameters (ORPS):
    - boron, hot water soluble (HWS)
    - cyanide
    - electrical conductivity
    - hexavalent chromium
    - mercury
    - pH
    - sodium adsorption ratio (SAR)

[2] Dillon Consulting Limited: Phase Two Environmental Site Assessment, Pier 8, Hamilton, Ontario, Draft Report, April 2016

The certificates of analyses are provided in Appendix C.

The results of the chemical analysis was compared to the Ministry of Environment and Climate Change (MOECC) Standards as found in the *"Soil, Ground Water and Sediment Standards for Use Under Part XV.1 of the Environmental Protection Act"*, April 15, 2011. The Standards which the results were compared to were the following:

Table 1 Full Depth Background Site Condition Standards (Table 1)

Table 3 Full Depth Generic Site Condition Standards in a Non-Potable Ground Water Condition for Industrial, Commercial and Community Land Use (Table 3 ICC)

The Standards were chosen for the following reasons:

Table 1 – The results were compared to the Table 1 Standards in order to determine if the soil material was suitable as clean fill for reuse by any potential receiving site.
Table 3 ICC – The results were compared to the Table 3 ICC Standards in order to determine if the soil material should be considered a waste.

7.2 Results of Analyses

The results of the O. Reg. 153 -04 analyses are presented in Tables 7.1 to 7.5 of this report. The following summarises results of the comparison.

Soil Type	No. of Samples Tested	Samples with Table 1 Exceedances	Samples with Table 3 Exceedances
Fill	8	8	4
Silty sand/silt/sandy silt.	7	1	0
Organic Silt	2	0	0
Silty clay/ clayey silt	4	1	0
Total	21	10	4

The results of the analyses indicated that samples of the fill exceeded the MOECC Table 3 standards for one or more of the following parameters: lead, zinc and PAH. It has also been noted that the recovery of the fill samples was limited and it is possible that fill that exceeds the MOECC Table 3 standards may be more widespread than the results of the analyses suggest. It should also be noted that the aesthetic quality of the fill, in addition to the chemistry will impact on how the excess soil is managed. The fill was observed to be somewhat variable in consistency and contained bricks and other construction rubble as well as slag, cinders and other such material. For this reason it is likely that fill encountered in the excavations will be managed as waste.

The results of the analyses carried out in the native strata including the silt, silty sand, sandy silt, organic silt and silty clay did not indicate Table 3 exceedances. It is considered however that in some instances the relatively high water contents, and/ or the physical character of the soil may also be constraints on managing this material.

Two (2) composite soil samples of the soil recovered from the boreholes were submitted for analysis of O. Reg. 558 Schedule 4 parameters (TCLP analysis) for waste classification purposes. The samples were described as follows:

TCLP1 – Sampled from drummed soil from boreholes 9, 10 and 11 and

TCLP2 – Sampled from drummed soil from boreholes 21 to 27.

The analyses were conducted for the following parameters

- Benzo(a)pyrene
- Metals & Inorganics
- Volatile Organic Compounds (VOCs)

The laboratory Certificates of Analysis are included in Appendix C and summarized in Table 7.6. The results of the analyses indicate that the soil can be managed as solid, non-hazardous waste. The follow additional comments should be considered.

It should be noted that the results of the chemical analysis refer only to the soil samples collected from specific locations, and the soil chemistry may vary between and beyond the sample locations.

Receiving sites accepting soil may have a soil fill management plan with specific aesthetic, engineering property requirements and/or specific requirements for chemical analysis (additional parameters and/or frequency of sampling) that have not been assessed in this sampling.

The above conclusions were based on limited analytical data. The actual quality of the excavated soils will vary and additional sampling and analyses may be warranted during construction, if dissimilar materials are encountered or if aesthetic impact (staining or odours) is observed. Additional sampling and analysis of the soil may also be required by the receiver based on the volume of soil to be received. Qualitative monitoring of the excavated soil should be considered part of the inspection tasks during construction.

Additional information on soil management practices is provided in the Ontario Ministry of the Environment (Central Region) publication entitled 'Management of Excess Soil – A Guide for Best Management Practices', dated January 2014.

8. LIMITATIONS AND USE OF REPORT

8.1 Procedures

This investigation has been carried out using investigation techniques and engineering analysis methods consistent with those ordinarily exercised by Terraprobe and other engineering practitioners, working under similar conditions and subject to the time, financial and physical constraints applicable to this project. The discussions and recommendations that have been presented are based on the factual data obtained from this investigation.

The drilling and sampling was carried out by specialist drilling contractors and was observed and recorded by Terraprobe on a full time basis. The boreholes were made using continuous flight power auger equipment and hollow stem augers. A Terraprobe technician logged the boreholes and examined the samples recovered from the boreholes. The samples obtained were sealed in clean, air-tight containers and transferred to the Terraprobe laboratory, where they were reviewed for consistency of description by a geotechnical engineer. Ground water observations were made in the boreholes as drilling proceeded.

The samples of the strata penetrated were obtained using the Split-Barrel Method technique (ASTM D1586). The samples were taken at intervals. The conventional interval sampling procedure used for this investigation does not recover continuous samples of soil at any borehole location. There is consequently some interpolation of the borehole layering between samples and indications of changes in stratigraphy as shown on the borehole logs are approximate.

It must be recognized that there are special risks whenever engineering or related disciplines are applied to identify subsurface conditions. A comprehensive sampling and testing programme implemented in accordance with the most stringent level of care may fail to detect certain conditions. Terraprobe has assumed for the purposes of providing design parameters and advice, that the conditions that exist between sampling points are similar to those found at the sample locations.

It may not be possible to drill a sufficient number of boreholes, or sample and report them in a way that would provide all the subsurface information and geotechnical advice to completely identify all aspects of the site and works that could affect construction costs, techniques, equipment and scheduling. Contractors bidding on or undertaking work on the project must be directed to draw their own conclusions as to how the subsurface conditions may affect them, based on their own investigations and their own interpretations of the factual investigation

results, and their approach to the construction works, cognizant of the risks implicit in the subsurface investigation activities.

The analytical results contained in this report should not be considered a warranty with respect to the soil quality or the use of the soil for any specific purpose. This report provides the factual results of the chemical analysis only for the specific parameters analysed. The chemical analysis, while completed in general accordance with the requirements of Ontario Regulation 153/04 (as amended), do not constitute a Phase Two ESA under the Regulation. The chemical analyses were not conducted for the purposes of supporting a Record of Site Condition.

8.2 Changes in Site and Scope

The subsurface conditions may potentially be altered with passage of time, natural occurrences, and direct or indirect human intervention at or near the site. Caution should be exercised in the consideration of contractual responsibilities as they relate to control of seepage, disturbance of soils, and frost protection.

The design parameters provided and the engineering advice offered in this report are based on the factual data obtained from this investigation made at the site by Terraprobe and are intended for use by the owner and its retained design consultants in the design phase of the project. If there are changes to the project scope and development features, the interpretations made of the subsurface information, the geotechnical design parameters, advice and comments relating to constructability issues and quality control may not be relevant or complete for the project. Terraprobe should be retained to review the implications of such changes with respect to the contents of this report.

8.3 Use of Report

This report is prepared for the express use of The City of Hamilton and their retained design consultants for use in the design of the pumping station and associated works. The report was not intended for use by others or for other intents. This report is copyright of Terraprobe Inc., and no part of this report may be reproduced by any means, in any form, without the prior written permission of Terraprobe.

We trust that this report is satisfactory for your present requirements. If there is any point requiring further clarification, please contact the undersigned.

Yours Truly

Terraprobe Inc.



J. G. Muckle, P. Eng., Associate

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TABLE 7.1
SUMMARY OF SOIL QUALITY ANALYSIS
Ontario Regulation 153-04 - Metals Inorganics
Pier 8, Hamilton

File No.: 7-16-0090-01

Terraprobe Sample ID			BH6 Sa8	BH9 Sa4	BH10Sa2	BH10Sa13	BH11SA2	BH11Sa7	BH12Sa9	BH13Sa2	BH14Sa6	BH16Sa4	BH17Sa4	BH17Sa6	BH18Sa6	BH19Sa4	BH21Sa6	O.Reg. 153/04	O.Reg. 153/04
Date Sampled			8/5/2016	08/11/2016	08/03/2016	08/03/2016	08/04/2016	08/04/2016	08/09/2016	08/09/2016	08/10/2016	08/11/2016	08/11/2016	08/11/2016	08/11/2016	08/08/2016	08/15/2016	Table 1	Table 3
Soil Description			Si Cl	Fill	Fill	Si Sand	Fill	Sa Silt	Sa Silt	Fill	Fill	Fill	Fill	Sa Silt	Si Sand	Org. Silt	Si Clay		
Parameter	Unit	RDL																R/P/I/I/C/C	I/C/C
Antimony	µg/g	0.8	<0.8	<0.8	2.6	<0.8	<0.8	<0.8	<0.8	1.8	<0.8	<0.8	1.2	<0.8	<0.8	<0.8	<0.8	1.3	50
Arsenic	µg/g	1	4	4	8	3	4	2	2	6	6	7	9	3	2	2	5	18	18
Barium	µg/g	2	42	142	116	37	129	22	29	144	90	126	112	66	22	22	91	220	670
Beryllium	µg/g	0.5	<0.5	1.0	0.7	<0.5	0.8	<0.5	<0.5	0.8	0.8	0.8	0.8	<0.5	<0.5	<0.5	0.6	2.5	10
Boron	µg/g	5	7	24	14	6	14	5	<5	13	18	16	18	7	5	6	9	36	120
Boron (Hot Water Soluble)	µg/g	0.10	0.2	3.78	2.57	0.36	0.63	0.20	0.37	3.03	1.89	1.66	4.42	0.43	0.39	0.11	0.20	na	2
Cadmium	µg/g	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	1.1	<0.5	<0.5	<0.5	<0.5	1.2	1.9
Chromium	µg/g	2	14	28	21	9	25	7	9	19	22	24	22	10	7	9	21	70	160
Chromium VI	µg/g	0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	0.66	10
Cobalt	µg/g	0.5	6.9	10.4	9.6	6.1	10.9	4.5	5.4	8.3	9.6	9.9	9.0	6.0	3.6	6.1	11.5	21.0	100
Copper	µg/g	1	20	28	72	13	22	11	11	57	45	38	83	16	12	16	31	92	300
Cyanide	µg/g	0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	0.051	0.051
Electrical Conductivity	mS/cm	0.005	0.206	0.548	0.443	0.391	0.361	0.181	0.358	0.865	0.568	0.342	0.321	0.206	0.525	0.427	0.187	0.570	1.4
Lead	µg/g	1	7	37	**164**	6	15	5	9	96	75	113	**465**	9	8	8	12	120	120
Mercury	µg/g	0.10	<0.10	<0.10	0.19	<0.10	<0.10	<0.10	<0.10	0.27	0.13	0.47	0.29	<0.10	<0.10	<0.10	<0.10	0.27	20
Molybdenum	µg/g	0.5	<0.5	0.8	0.9	<0.5	<0.5	<0.5	<0.5	0.9	0.9	1	1.7	<0.5	<0.5	<0.5	0.5	2	40
Nickel	µg/g	1	15	21	20	10	22	7	11	19	22	21	23	9	6	11	23	82	340
Selenium	µg/g	0.4	<0.4	<0.4	0.5	<0.4	<0.4	<0.4	<0.4	0.6	<0.4	0.5	0.6	<0.4	<0.4	<0.4	<0.4	1.5	5.5
Silver	µg/g	0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	0.4	<0.2	<0.2	<0.2	<0.2	0.5	50
Sodium Adsorption Ratio	NA	NA	0.598	**2.61**	1.32	1.71	3.520	0.604	1.440	0.379	2.070	3.05	1.29	0.61	5.970	1.89	0.64	2.40	12
Thallium	µg/g	0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	1	3.3
Uranium	µg/g	0.5	0.5	0.8	0.6	<0.5	0.8	<0.5	<0.5	<0.5	0.6	0.7	0.7	<0.5	<0.5	<0.5	0.6	2.5	33
Vanadium	µg/g	1	22	34	27	15	33	13	15	30	29	30	27	16	13	17	27	86	86
Zinc	µg/g	5	39	83	206	33	59	25	37	136	141	163	**3860**	65	39	30	66	290	340
pH, 2:1 CaCl2 Extraction	pH Units	NA	7.71	9.00	9.48	7.64	8.18	7.68	7.58	8.67	9.39	8.49	8.35	7.35	7.53	7.28	7.69	see note 8	see note 8

RDL = Reportable Detection Limit nv - no derived Table 3 standard na - not applicable

Notes:

1. MOECC Soil, Ground Water and Sediment Standards for Use Under Part XV.1 of the Environmental Protection Act; April 15, 2011
2. Table 1 criteria for residential/park/institutional/industrial/commercial/community property use, medium and fine textured soils
3. Table 3 criteria for industrial/commercial/community property use, medium and fine textured soils
4. Table 1 R/P/I/I/C/C exceedances are in bold type with a box border (interpretation by Terraprobe Inc.)
5. Table 3 I/C/C exceedances are in bold white type with a box border and black background (interpretation by Terraprobe Inc.)
6. This table presents a summary of the data presented in the Certificate of Analysis - for convenience purposes only.
7. This table is to be used in conjunction with, not as a replacement for the laboratory C of A, which also includes laboratory QA/QC information.
8. pH should be between 5 and 9 for surface soils and 5 and 11 for subsurface soils

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TABLE 7.1 *continued*

File No.: 7-16-0090-01

SUMMARY OF SOIL QUALITY ANALYSIS
Ontario Regulation 153-04 - Metals Inorganics
Pier 8, Hamilton

Terraprobe Sample ID			BH22Sa6	BH23Sa5	BH24SA6	BH25SA6	BH26SA6	BH27SA6	O.Reg. 153/04	O.Reg. 153/04
Date Sampled			08/15/2016	08/15/2016	08/15/2016	08/15/2016	08/15/2016	08/15/2016	Table 1	Table 3
Soil Description			Si Sand	Cl Silt	Sandy Silt	Organic Silt	Clayey Silt	Fill		
Parameter	Unit	RDL							R/P/I/I/C/C	I/C/C
Antimony	µg/g	0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	1.3	50
Arsenic	µg/g	1	4	4	4	2	4	3	18	18
Barium	µg/g	2	55	82	73	49	56	50	220	670
Beryllium	µg/g	0.5	<0.5	<0.5	0.5	<0.5	<0.5	0.5	2.5	10
Boron	µg/g	5	7	7	8	<5	7	5	36	120
Boron (Hot Water Soluble)	µg/g	0.10	0.20	0.14	0.18	0.92	0.12	0.35	na	2
Cadmium	µg/g	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	1.2	1.9
Chromium	µg/g	2	12	16	17	10	17	14	70	160
Chromium VI	µg/g	0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	0.66	10
Cobalt	µg/g	0.5	6.5	9.6	9.7	5.5	9.7	7.3	21.0	100
Copper	µg/g	1	23	25	25	14	26	20	92	300
Cyanide	µg/g	0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	0.051	0.051
Electrical Conductivity	mS/cm	0.005	0.246	0.166	0.165	0.294	0.149	0.877	0.570	1.4
Lead	µg/g	1	10	10	15	49	13	32	120	120
Mercury	µg/g	0.10	<0.10	<0.10	<0.10	0.24	<0.10	0.26	0.27	20
Molybdenum	µg/g	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	2	40
Nickel	µg/g	1	11	18	18	9	18	13	82	340
Selenium	µg/g	0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	1.5	5.5
Silver	µg/g	0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	0.5	50
Sodium Adsorption Ratio	NA	NA	1.43	0.34	0.49	0.75	0.46	4.19	2.40	12
Thallium	µg/g	0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	1	3.3
Uranium	µg/g	0.5	<0.5	0.6	0.5	<0.5	<0.5	<0.5	2.5	33
Vanadium	µg/g	1	16	21	21	14	22	19	86	86
Zinc	µg/g	5	39	51	53	41	53	53	290	340
pH, 2:1 CaCl2 Extraction	pH Units	NA	7.72	7.73	7.66	7.09	7.78	7.09	see note 8	see note 8

RDL = Reportable Detection Limit nv - no derived standard na - not applicable

Notes:

1. MOECC Soil, Ground Water and Sediment Standards for Use Under Part XV.1 of the Environmental Protection Act; April 15, 2011
2. Table 1 criteria for residential/park/institutional/industrial/commercial/community property use, medium and fine textured soils
3. Table 3 criteria for industrial/commercial/community property use, medium and fine textured soils
4. Table 1 R/P/I/I/C/C exceedances are in bold type with a box border (interpretation by Terraprobe Inc.)
5. Table 3 I/C/C exceedances are in bold white type with a box border and black background (interpretation by Terraprobe Inc.)
6. This table presents a summary of the data presented in the Certificate of Analysis - for convenience purposes only.
7. This table is to be used in conjunction with, not as a replacement for the laboratory C of A, which also includes laboratory QA/QC information.
8. pH should be between 5 and 9 for surface soils and 5 and 11 for subsurface soils

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TABLE 7.2
SUMMARY OF SOIL QUALITY ANALYSIS
O. REG 153/04 - PAH
Pier 8, Hamilton

File No.: 7-16-0090-01

Terraprobe Sample ID			BH6Sa8	BH9Sa4	BH10Sa2	BH10Sa13	BH11Sa2	BH11Sa7	BH12Sa9	BH13Sa2	BH14Sa6	BH16Sa4	BH17Sa4	BH17Sa6	BH18Sa6	BH19Sa4	BH21Sa6	O.Reg. 153/04	O.Reg. 153/04
Date Sampled			8/5/2016	8/1/2016	08/03/2016	08/03/2016	08/04/2016	08/04/2016	08/09/2016	08/09/2016	08/10/2016	08/11/2016	08/11/2016	08/11/2016	08/11/2016	08/08/2016	08/15/2016	Table 1	Table 3
Soil Description			Si Clay	Fill	Fill	Si Sand	Fill	Sa Silt	Sa Silt	Fill	Fill	Fill	Fill	Si Sand	Si Sand	Org. Silt	Si Clay		
Parameter	Unit	RDL																R/P/I/I/C/C	I/C/C
Acenaphthene	µg/g	0.05	<0.05	<0.05	<0.05	0.07	<0.05	<0.05	0.05	0.21	0.05	0.06	0.19	<0.05	<0.05	<0.05	<0.05	0.072	96
Acenaphthylene	µg/g	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.09	0.17
Anthracene	µg/g	0.05	<0.05	<0.05	0.16	0.14	<0.05	<0.05	0.12	0.7	0.14	0.17	0.3	<0.05	<0.05	<0.05	<0.05	0.16	0.74
Benz(a)anthracene	µg/g	0.05	<0.05	0.1	0.3	0.12	<0.05	<0.05	0.24	2.20	0.30	0.45	0.53	<0.05	<0.05	<0.05	<0.05	0.36	0.96
Benzo(a)pyrene	µg/g	0.05	<0.05	<0.05	0.46	0.18	<0.05	<0.05	0.20	1.80	0.21	0.32	0.36	<0.05	<0.05	<0.05	<0.05	0.30	0.3
Benzo(b)fluoranthene	µg/g	0.05	<0.05	<0.05	0.65	0.27	<0.05	<0.05	0.18	1.60	0.32	0.36	0.52	<0.05	<0.05	<0.05	<0.05	0.47	0.96
Benzo(g,h,i)perylene	µg/g	0.05	<0.05	<0.05	0.32	0.12	<0.05	<0.05	0.10	1.20	0.17	0.22	0.27	<0.05	<0.05	<0.05	<0.05	0.68	9.6
Benzo(k)fluoranthene	µg/g	0.05	<0.05	<0.05	0.32	0.13	<0.05	<0.05	0.11	1.10	0.16	0.22	0.20	<0.05	<0.05	<0.05	<0.05	0.48	0.96
Chrysene	µg/g	0.05	<0.05	0.08	0.3	0.13	<0.05	<0.05	0.19	1.70	0.23	0.41	0.45	<0.05	<0.05	<0.05	<0.05	2.80	9.6
Dibenz(a,h)anthracene	µg/g	0.05	<0.05	<0.05	0.05	<0.05	<0.05	<0.05	<0.05	0.19	<0.05	0.06	0.06	<0.05	<0.05	<0.05	<0.05	0.10	0.1
Fluoranthene	µg/g	0.05	<0.05	0.13	0.85	0.56	<0.05	<0.05	0.52	4.20	0.60	1.10	1.20	<0.05	<0.05	<0.05	<0.05	0.6	9.6
Fluorene	µg/g	0.05	<0.05	<0.05	0.08	0.09	<0.05	<0.05	0.09	0.26	0.07	0.18	0.16	<0.05	<0.05	<0.05	<0.05	0.12	69
Indeno(1,2,3-cd)pyrene	µg/g	0.05	<0.05	<0.05	0.28	0.10	<0.05	<0.05	0.09	1.1	0.12	0.2	0.25	<0.05	<0.05	<0.05	<0.05	0.23	0.95
2-and 1-methyl Naphthalene	µg/g	0.05	<0.05	<0.05	0.06	<0.05	<0.05	<0.05	0.05	0.07	0.2	0.1	0.12	<0.05	<0.05	<0.05	<0.05	0.59	85
Naphthalene	µg/g	0.05	<0.05	<0.05	0.05	0.15	<0.05	<0.05	0.09	<0.05	0.06	0.09	0.14	<0.05	<0.05	<0.05	<0.05	0.09	28
Phenanthrene	µg/g	0.05	<0.05	0.06	0.62	0.59	<0.05	<0.05	0.51	2.40	0.52	1.00	1.20	<0.05	<0.05	<0.05	<0.05	0.69	16
Pyrene	µg/g	0.05	<0.05	0.12	0.73	0.41	<0.05	<0.05	0.40	3.20	0.51	0.96	1.00	<0.05	<0.05	<0.05	<0.05	1.0	96

RDL = Reportable Detection Limit

nv - no derived standard

Notes:

1. MOECC Soil, Ground Water and Sediment Standards for Use Under Part XV.1 of the Environmental Protection Act; April 15, 2011
2. Table 1 criteria for residential/park/institutional/industrial/commercial/community property use, medium and fine textured soils
3. Table 3 criteria for industrial/commercial/community property use, medium and fine textured soils
4. Table 1 R/P/I/I/C/C exceedances are in bold type with a box border (interpretation by Terraprobe Inc.)
5. Table 3 I/C/C exceedances are in bold white type with a box border and black background (interpretation by Terraprobe Inc.)
6. This table presents a summary of the data presented in the Certificate of Analysis - for convenience purposes only.
7. This table is to be used in conjunction with, not as a replacement for the laboratory C of A, which also includes laboratory QA/QC information.

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Construction Materials Engineering, Inspection & Testing

File No.: 7-16-0090-01

TABLE 7.2 *continued*
SUMMARY OF SOIL QUALITY ANALYSIS
O. REG 153/04 - PAH
Pier 8, Hamilton

Terraprobe Sample ID			BH22SA6	BH23SA5	BH24SA6	BH25SA6	BH26SA6	BH27SA6	O.Reg. 153/04	O.Reg. 153/04
Date Sampled			08/15/2016	08/15/2016	08/15/2016	08/15/2016	08/15/2016	08/15/2016	Table 1	Table 3
Soil Description			Si Sand	Cl Silt	Sa Silt	Org. Silt	Cl Silt	Fill		
Parameter	Unit	RDL							R/P/I/I/C/C	I/C/C
Acenaphthene	µg/g	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.072	96
Acenaphthylene	µg/g	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.09	0.17
Anthracene	µg/g	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.16	0.74
Benz(a)anthracene	µg/g	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.36	0.96
Benzo(a)pyrene	µg/g	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.30	0.3
Benzo(b)fluoranthene	µg/g	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.47	0.96
Benzo(g,h,i)perylene	µg/g	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.68	9.6
Benzo(k)fluoranthene	µg/g	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.48	0.96
Chrysene	µg/g	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	2.80	9.6
Dibenz(a,h)anthracene	µg/g	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.10	0.1
Fluoranthene	µg/g	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.6	9.6
Fluorene	µg/g	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.12	69
Indeno(1,2,3-cd)pyrene	µg/g	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.23	0.95
2-and 1-methyl Naphthalene	µg/g	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.59	85
Naphthalene	µg/g	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.09	28
Phenanthrene	µg/g	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.69	16
Pyrene	µg/g	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	1.0	96

RDL = Reportable Detection Limit | nv - no derived standard | na - not applicable

Notes:

1. MOECC Soil, Ground Water and Sediment Standards for Use Under Part XV.1 of the Environmental Protection Act; April 15, 2011
2. Table 1 criteria for residential/park/institutional/industrial/commercial/community property use, medium and fine textured soils
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4. Table 1 R/P/I/I/C/C exceedances are in bold type with a box border (interpretation by Terraprobe Inc.)
5. Table 3 I/C/C exceedances are in bold white type with a box border and black background (interpretation by Terraprobe Inc.)
6. This table presents a summary of the data presented in the Certificate of Analysis - for convenience purposes only.
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TABLE 7.3
SUMMARY OF SOIL QUALITY ANALYSIS
O. REG 153/04 - Petroleum Hydrocarbons
Pier 8, Hamilton

File No.: 7-16-0090-01

Terraprobe Sample ID			BH6Sa8	BH9Sa4	BH10Sa2	BH10Sa13	BH11Sa2	BH11Sa7	BH12Sa9	BH13Sa2	BH14Sa6	BH16Sa4	BH17Sa4	BH17Sa6	BH18Sa6	BH19Sa4	BH21Sa6	O.Reg. 153/04	O.Reg. 153/04
Date Sampled			8/1/2016	8/1/2016	08/03/2016	08/03/2016	08/04/2016	08/04/2016	08/09/2016	08/09/2016	08/10/2016	08/11/2016	08/11/2016	08/11/2016	08/11/2016	08/08/2016	08/15/2016	Table 1	Table 3
Soil Description			Si Clay	Fill	Fill	Si Sand	Fill	Sa Silt	Sa Silt	Fill	Fill	Fill	Fill	Si Sand	Si Sand	Org. Silt	Si Clay		
Parameter	Unit	RDL																R/P/I/I/C/C	I/C/C
F1 (C6 to C10)	µg/g	5	<5	<5	<5	<5	<5	<5	<5	<5	5	<5	22	<5	<5	<5	<5	nv	nv
F1 (C6 to C10) minus BTEX	µg/g	5	<5	<5	<5	<5	<5	<5	<5	<5	5	<5	22	<5	<5	<5	<5	25	65
F2 (C10 to C16)	µg/g	10	**16**	<10	<10	<10	<10	<10	<10	11	27	<10	14	<10	<10	<10	<10	10	250
F3 (C16 to C34)	µg/g	50	120	79	220	<50	220	<50	<50	170	140	160	190	<50	<50	<50	<50	240	2500
F4 (C34 to C50)	µg/g	50	<50	<50	71	<50	<50	<50	<50	110	<50	<50	<50	<50	<50	<50	<50	120	6600

RDL = Reportable Detection Limit nv - no derived standard na - not applicable

Terraprobe Sample ID			BH22Sa6	BH23SA5	BH24Sa6	BH25SA6	BH26Sa6	BH27Sa6	O.Reg. 153/04	O.Reg. 153/04
Date Sampled			08/15/2016	08/15/2016	08/15/2016	08/15/2016	08/15/2016	08/15/2016	Table 1	Table 3
Soil Description			Si Sand	Cl Silt	Sa Silt	Org. Silt	Cl Silt	Fill		
Parameter	Unit	RDL							R/P/I/I/C/C	I/C/C
F1 (C6 to C10)	µg/g	5	<5	<5	<5	<5	<5	<5	nv	nv
F1 (C6 to C10) minus BTEX	µg/g	5	<5	<5	<5	<5	<5	<5	25	65
F2 (C10 to C16)	µg/g	10	<10	<10	<10	<10	<10	<10	10	250
F3 (C16 to C34)	µg/g	50	<50	<50	<50	140	<50	<50	240	2500
F4 (C34 to C50)	µg/g	50	<50	<50	<50	72	<50	<50	120	6600

RDL = Reportable Detection Limit nv - no derived standard na - not applicable

Notes:

1. MOECC Soil, Ground Water and Sediment Standards for Use Under Part XV.1 of the Environmental Protection Act; April 15, 2011
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5. Table 3 I/C/C exceedances are in bold white type with a box border and black background (interpretation by Terraprobe Inc.)
6. This table presents a summary of the data presented in the Certificate of Analysis - for convenience purposes only.
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Construction Materials Engineering, Inspection & Testing

File No.: 7-16-0090-01

TABLE 7.4
SUMMARY OF SOIL QUALITY ANALYSIS
O. REG 153/04 PCBs
Pier 8, Hamilton

Terraprobe Sample ID			BH6SA8	BH9SA4	BH10SA2	BH10SA13	BH11SA2	BH11SA7	BH12SA9	BH13SA2	BH14SA6	BH16SA4	BH17SA4	BH17SA6	BH18SA6	BH19SA4	BH21SA6	O.Reg. 153/04 Table 1	O.Reg. 153/04 Table 3
Date Sampled			8/5/2016	8/1/2016	8/3/2016	8/3/2016	8/4/2016	8/4/2016	8/9/2016	8/9/2016	8/10/2016	8/11/2016	8/11/2016	8/11/2016	8/11/2016	8/8/2016	8/15/2016		
Soil Description			Si Clay	Fill	Fill	Si Sand	Fill	Sa Silt	Sa Silt	Fill	Fill	Fill	Fill	Si Sand	Si Sand	Org. Silt	Si Clay		
Parameter	Unit	RDL																R/P/I/I/C/C	I/C/C
Aroclor 1242	µg/g	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	nv	nv
Aroclor 1248	µg/g	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	nv	nv
Aroclor 1254	µg/g	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	nv	nv
Aroclor 1260	µg/g	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	nv	nv
Polychlorinated Biphenyls	µg/g	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.3	1.1

RDL = Reportable Detection Limit nv - no derived standard

Terraprobe Sample ID			BH22SA6	BH23SA5	BH24SA6	BH25SA6	BH26SA6	BH27SA6	O.Reg. 153/04 Table 1	O.Reg. 153/04 Table 3
Date Sampled			8/15/2016	8/15/2016	08/15/2016	8/15/2016	8/15/2016	8/15/2016		
Soil Description			Si Sand	Cl Silt	Si Sand	Org. Silt	Cl Silt	Fill		
Parameter	Unit	RDL							R/P/I/I/C/C	I/C/C
Aroclor 1242	µg/g	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	nv	nv
Aroclor 1248	µg/g	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	nv	nv
Aroclor 1254	µg/g	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	nv	nv
Aroclor 1260	µg/g	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	nv	nv
Polychlorinated Biphenyls	µg/g	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.3	1.1

RDL = Reportable Detection Limit nv - no derived standard na - not applicable

Notes:

1. MOECC Soil, Ground Water and Sediment Standards for Use Under Part XV.1 of the Environmental Protection Act; April 15, 2011
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5. Table 3 I/C/C exceedances are in bold white type with a box border and black background (interpretation by Terraprobe Inc.)
6. This table presents a summary of the data presented in the Certificate of Analysis - for convenience purposes only.
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TABLE 7.5
SUMMARY OF SOIL QUALITY ANALYSIS
O. REG 153/04 - VOCs
Pier 8, Hamilton

File No.: 7-16-0090-01

Terraprobe Sample ID			BH6SA8	BH9SA4	BH10SA2	BH10SA13	BH11SA2	BH11SA7	BH12SA9	BH13SA2	BH14SA6	BH16SA4	BH17SA4	BH17SA6	BH18SA6	BH19SA4	BH21SA6	BH22SA6	O.Reg. 153/04 Table 1	O.Reg. 153/04 Table 3
Date Sampled			8/5/2016	8/11/2016	08/03/2016	08/03/2016	08/04/2016	08/04/2016	08/09/2016	08/09/2016	08/10/2016	08/11/2016	08/11/2016	08/11/2016	08/11/2016	08/08/2016	08/15/2016	08/15/2016		
Soil Description			Si Clay	Fill	Fill	Si Sand	Fill	Sa Silt	Sa Silt	Fill	Fill	Fill	Fill	Si Sand	Si Sand	Org. Silt	Si Clay	Si Sand		
Parameter	Unit	RDL																	R/P/I/I/C/C	I/C/C
Acetone	ug/g	0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.5	28
Benzene	ug/g	0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.02	<0.02	0.04	<0.02	<0.02	<0.02	<0.02	<0.02	0.02	0.4
Bromodichloromethane	ug/g	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.05	18
Bromoform	ug/g	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.05	1.7
Bromomethane	ug/g	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.05	0.05
Carbon Tetrachloride	ug/g	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.05	1.5
Chlorobenzene	ug/g	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.05	2.7
Chloroform	ug/g	0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	0.05	0.18
Cis- 1,2-Dichloroethylene	ug/g	0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.05	13
Dibromochloromethane	ug/g	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.05	8.5
1,3-Dichlorobenzene	ug/g	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.05	12
1,2-Dichlorobenzene	ug/g	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.05	0.84
1,4-Dichlorobenzene	ug/g	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.05	25
Dichlorodifluoromethane	µg/g	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.05	21
1,1-Dichloroethane	ug/g	0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.05	0.05
1,2-Dichloroethane	ug/g	0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	0.05	0.48
1,1-Dichloroethylene	ug/g	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.05	37
1,2-Dichloropropane	ug/g	0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	0.05	9.3
1,3-Dichloropropene	µg/g	0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	0.05	0.68
Ethylbenzene	ug/g	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.05	0.21
Ethylene Dibromide	ug/g	0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	0.05	19
Methyl Ethyl Ketone	ug/g	0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.5	0.05
Methyl Isobutyl Ketone	ug/g	0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.5	88
Methyl tert-butyl Ether	ug/g	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.05	88
Methylene Chloride	ug/g	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.05	210
Styrene	ug/g	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.05	3.2
1,1,2,2-Tetrachloroethane	ug/g	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.05	2
1,1,1,2-Tetrachloroethane	ug/g	0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	0.05	43
Tetrachloroethylene	ug/g	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.05	0.11
Toluene	ug/g	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.09	<0.05	0.09	<0.05	<0.05	<0.05	<0.05	<0.05	0.2	0.094
Trans- 1,2-Dichloroethylene	ug/g	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.05	21
1,1,1-Trichloroethane	ug/g	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.05	78
1,1,2-Trichloroethane	ug/g	0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	0.05	12
Trichloroethylene	ug/g	0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	0.05	0.11
Trichlorofluoromethane	ug/g	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.25	0.61
Vinyl Chloride	ug/g	0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.02	5.8
Xylene Mixture	ug/g	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.1	<0.05	<0.05	<0.05	<0.05	<0.05	0.05	0.25
m & p-Xylene	ug/g	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.1	<0.05	<0.05	<0.05	<0.05	<0.05	na	nv
n-Hexane	µg/g	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	na	nv
o-Xylene	ug/g	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	na	30

RDL = Reportable Detection Limit

nv - no derived standard

na - not applicable

Notes:

1. MOECC Soil, Ground Water and Sediment Standards for Use Under Part XV.1 of the Environmental Protection Act; April 15, 2011
2. Table 1 criteria for residential/park/institutional/industrial/commercial/community property use, medium and fine textured soils
3. Table 3 criteria for industrial/commercial/community property use, medium and fine textured soils
4. Table 1 R/P/I/I/C/C exceedances are in bold type with a box border (interpretation by Terraprobe Inc.)
5. Table 3 I/C/C exceedances are in bold white type with a box border and black background (interpretation by Terraprobe Inc.)
6. This table presents a summary of the data presented in the Certificate of Analysis - for convenience purposes only.
7. This table is to be used in conjunction with, not as a replacement for the laboratory C of A, which also includes laboratory QA/QC information.

Terraprobe
Consulting Geotechnical & Environmental Engineering
Construction Materials Engineering, Inspection & Testing

TABLE 7.5 *continued*
SUMMARY OF SOIL QUALITY ANALYSIS

File No.: 7-16-0090-01

O. REG 153/04 - VOCs
Pier 8, Hamilton

Terraprobe Sample ID			BH22SA6	BH23SA5	BH24SA6	BH25SA6	BH26SA6	BH27SA6	O.Reg. 153/04 Table 1	O.Reg. 153/04 Table 3
Date Sampled			08/15/2016	08/15/2016	08/15/2016	08/15/2016	08/15/2016	08/15/2016		
Soil Description			Si Sand	Cl Silt	Sa Silt	Org Silt	Cl Silt	Fill		
Parameter	Unit	RDL							R/P/I/I/C/C	I/C/C
Acetone	ug/g	0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.5	28
Benzene	ug/g	0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.02	0.4
Bromodichloromethane	ug/g	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.05	18
Bromoform	ug/g	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.05	1.7
Bromomethane	ug/g	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.05	0.05
Carbon Tetrachloride	ug/g	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.05	1.5
Chlorobenzene	ug/g	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.05	2.7
Chloroform	ug/g	0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	0.05	0.18
Cis- 1,2-Dichloroethylene	ug/g	0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.05	13
Dibromochloromethane	ug/g	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.05	8.5
1,3-Dichlorobenzene	ug/g	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.05	12
1,2-Dichlorobenzene	ug/g	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.05	0.84
1,4-Dichlorobenzene	ug/g	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.05	25
Dichlorodifluoromethane	µg/g	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.05	21
1,1-Dichloroethane	ug/g	0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.05	0.05
1,2-Dichloroethane	ug/g	0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	0.05	0.48
1,1-Dichloroethylene	ug/g	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.05	37
1,2-Dichloropropane	ug/g	0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	0.05	9.3
1,3-Dichloropropene	µg/g	0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	0.05	0.68
Ethylbenzene	ug/g	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.05	0.21
Ethylene Dibromide	ug/g	0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	0.05	19
Methyl Ethyl Ketone	ug/g	0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.5	0.05
Methyl Isobutyl Ketone	ug/g	0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.5	88
Methyl tert-butyl Ether	ug/g	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.05	88
Methylene Chloride	ug/g	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.05	210
Styrene	ug/g	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.05	3.2
1,1,2,2-Tetrachloroethane	ug/g	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.05	2
1,1,1,2-Tetrachloroethane	ug/g	0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	0.05	43
Tetrachloroethylene	ug/g	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.05	0.11
Toluene	ug/g	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.2	0.094
Trans- 1,2-Dichloroethylene	ug/g	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.05	21
1,1,1-Trichloroethane	ug/g	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.05	78
1,1,2-Trichloroethane	ug/g	0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	0.05	12
Trichloroethylene	ug/g	0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	0.05	0.11
Trichlorofluoromethane	ug/g	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.25	0.61
Vinyl Chloride	ug/g	0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.02	5.8
Xylene Mixture	ug/g	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.05	0.25
m & p-Xylene	ug/g	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	na	nv
n-Hexane	µg/g	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	na	nv
o-Xylene	ug/g	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	na	30

RDL = Reportable Detection Limit nv - no derived standard na - not applicable

Notes:

1. MOECC Soil, Ground Water and Sediment Standards for Use Under Part XV.1 of the Environmental Protection Act; April 15, 2011
2. Table 1 criteria for residential/park/institutional/industrial/commercial/community property use, medium and fine textured soils
3. Table 3 criteria for industrial/commercial/community property use, medium and fine textured soils
4. Table 1 R/P/I/I/C/C exceedances are in bold type with a box border (interpretation by Terraprobe Inc.)
5. Table 3 I/C/C exceedances are in bold white type with a box border and black background (interpretation by Terraprobe Inc.)
6. This table presents a summary of the data presented in the Certificate of Analysis - for convenience purposes only.
7. This table is to be used in conjunction with, not as a replacement for the laboratory C of A, which also includes laboratory QA/QC information.

TABLE 7.6
SUMMARY OF SOIL QUALITY ANALYSIS
O. REG. 558

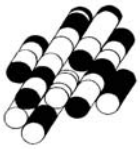
Terraprobe Sample ID			TCLP1	TCLP2	O.Reg. 558
Date Sampled			08/04/2016	08/17/2016	Schedule 4
	Units	RDL			Criteria (mg/L)
Inorganics					
Fluoride Leachate	mg/L	0.05	0.26	0.19	150.0
Cyanide Leachate	mg/L	0.05	<0.05	<0.05	20.0
(Nitrate + Nitrite) as N Leachate	mg/L	0.70	<0.70	<0.70	1000.0
Metals					
Arsenic Leachate	mg/L	0.010	0.021	<0.010	2.5
Barium Leachate	mg/L	0.100	0.981	0.722	100.0
Boron Leachate	mg/L	0.050	0.195	0.092	500.0
Cadmium Leachate	mg/L	0.010	<0.010	<0.010	0.5
Chromium Leachate	mg/L	0.010	0.022	0.018	5.0
Lead Leachate	mg/L	0.010	0.054	0.321	5.0
Mercury Leachate	mg/L	0.01	<0.01	<0.01	0.1
Selenium Leachate	mg/L	0.010	<0.010	<0.010	1.0
Silver Leachate	mg/L	0.010	<0.010	<0.010	5
Uranium Leachate	mg/L	0.050	<0.050	<0.050	10.0
Volatile Organics					
Benzene	mg/L	0.020	<0.020	<0.020	0.5
Carbon Tetrachloride	mg/L	0.020	<0.020	<0.020	0.5
Chlorobenzene	mg/L	0.010	<0.010	<0.010	8.0
Chloroform	mg/L	0.020	<0.020	<0.020	10.0
1,2-Dichlorobenzene	mg/L	0.010	<0.010	<0.010	20.0
1,4-Dichlorobenzene	mg/L	0.010	<0.010	<0.010	0.5
1,2-Dichloroethane	mg/L	0.020	<0.020	<0.020	0.5
1,1 Dichloroethene	mg/L	0.020	<0.020	<0.020	1.4
Dichloromethane	mg/L	0.030	<0.030	<0.030	5.0
Methyl Ethyl Ketone	mg/L	0.090	<0.090	<0.090	200.0
Tetrachloroethene	mg/L	0.050	<0.050	<0.050	3.0
Trichloroethene	mg/L	0.020	<0.020	<0.020	5.0
Vinyl Chloride	mg/L	0.030	<0.030	<0.030	0.2
Benzo(a)pyrene	mg/L	0.001	<0.001	<0.001	0.001

RDL - reportable detection level

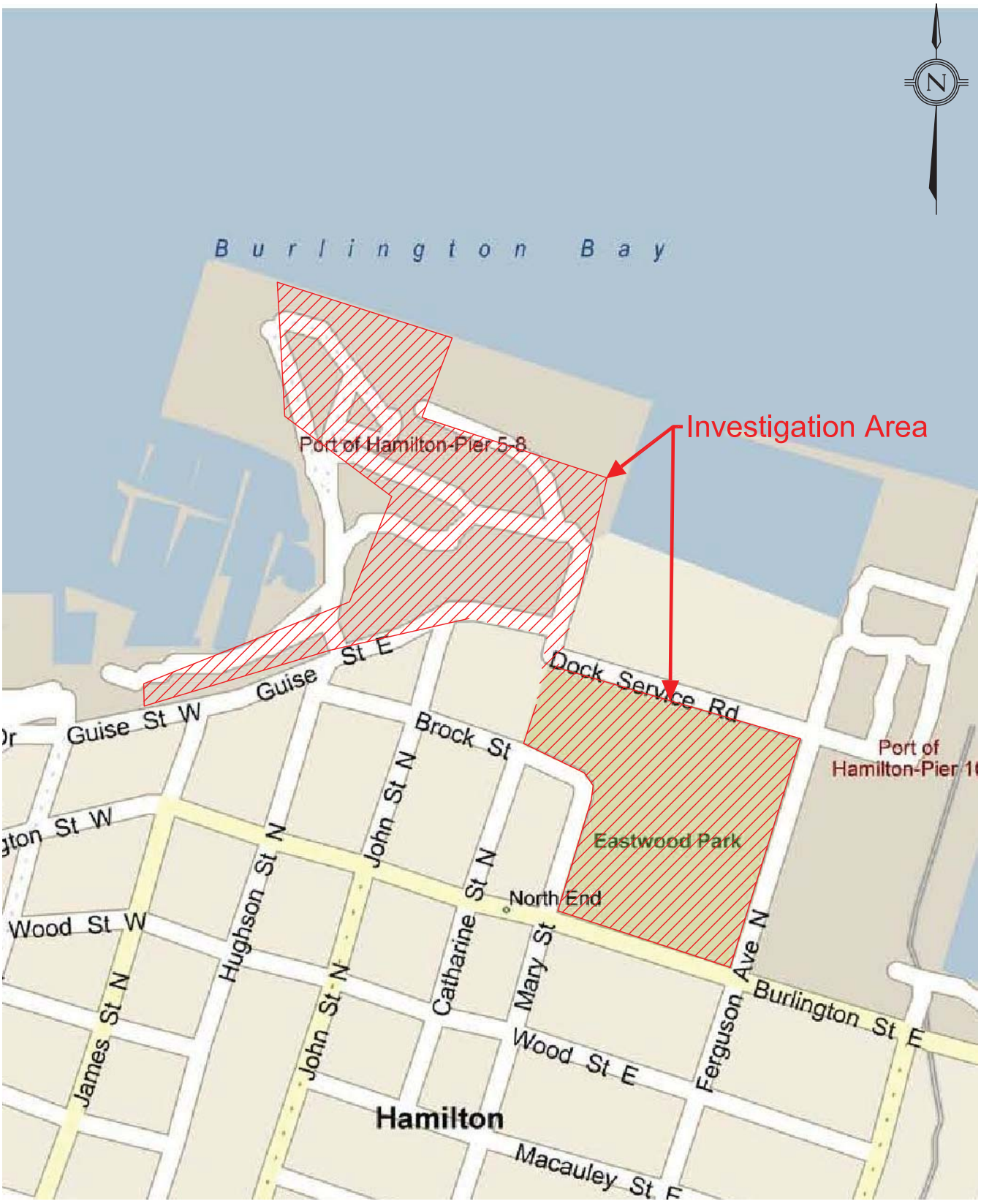
Notes:

1. O.Reg. 558 Schedule 4 Criteria
2. Exceedence of Schedule 4 criteria for 1 or more parameters denotes 'hazardous waste'
3. Schedule 4 exceedences are in bold type and framed; interpretation by Terraprobe Inc.
4. This table represents a summary of the data presented in the Certificate of Analysis, for convenience purposes only.
5. This summary is to be used in conjunction with, not as a replacement for the laboratory C of A.

FIGURES

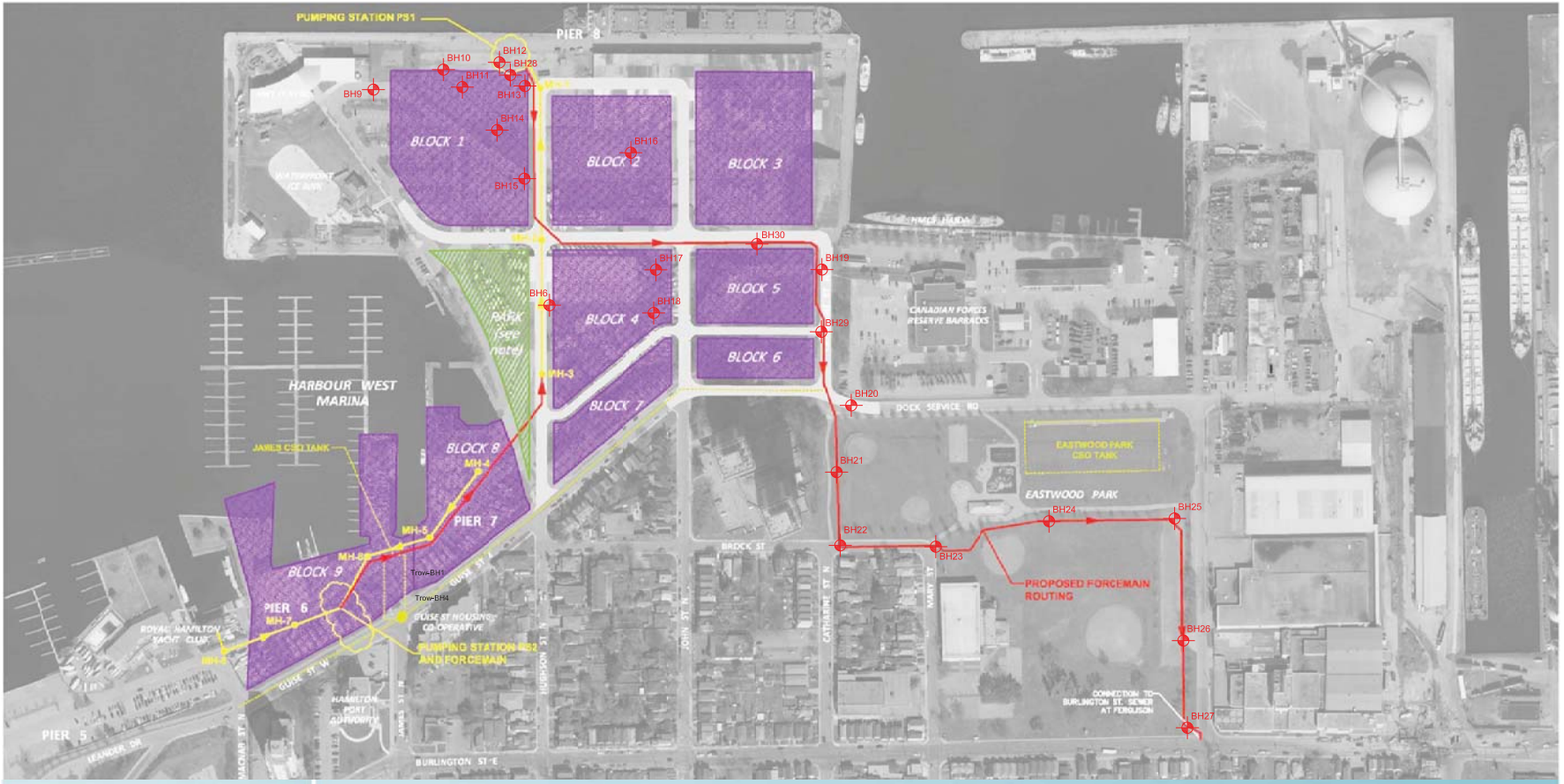


Terraprobe Inc.



Terraprobe
903 Barton Street - Unit 22, Stoney Creek, Ontario, L8E 5R7
Tel: (905) 643-7560, Fax: (905) 643-7559

Title:	FIGURE :
SITE LOCATION PLAN	1
File No. 7-16-0090-01	



LEGEND

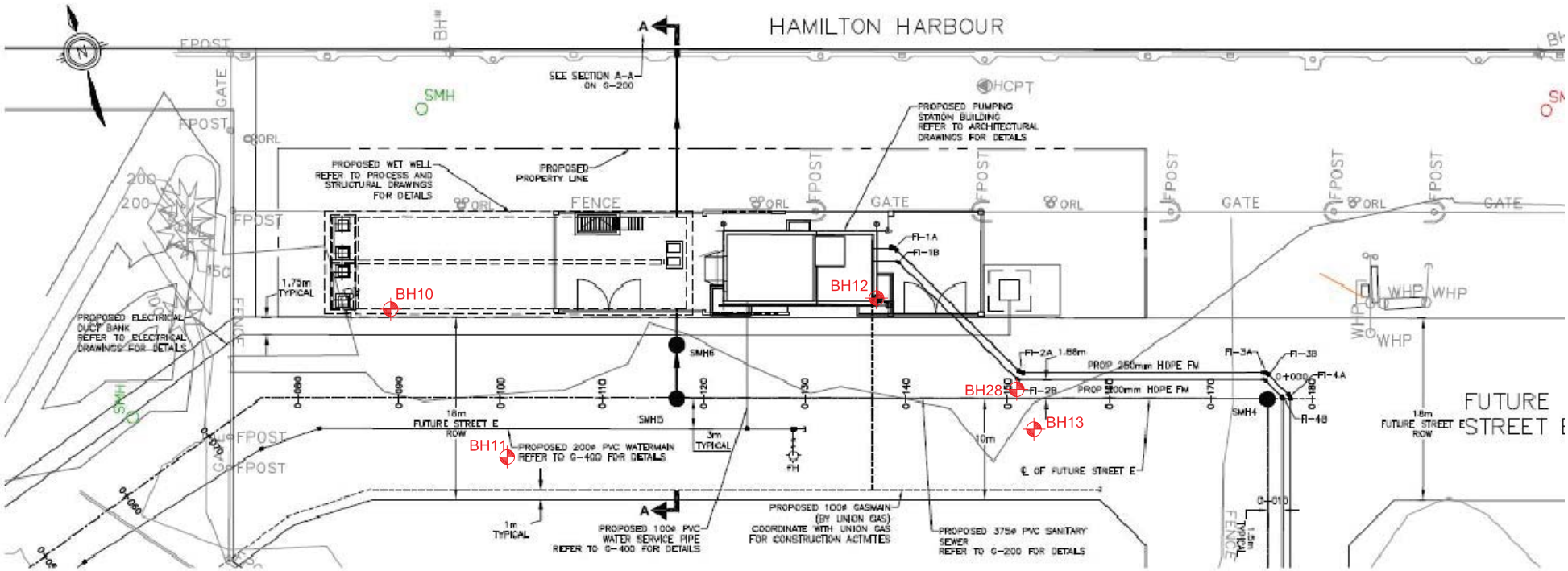
BH1 Borehole Location

Terraprobe
903 Barton Street - Unit 22, Stoney Creek, Ontario, L8E 5R7
Tel: (905) 643-7560, Fax: (905) 643-7559

Title: BOREHOLE LOCATION PLAN

File No. 7-16-0090-01

FIGURE : 2



LEGEND

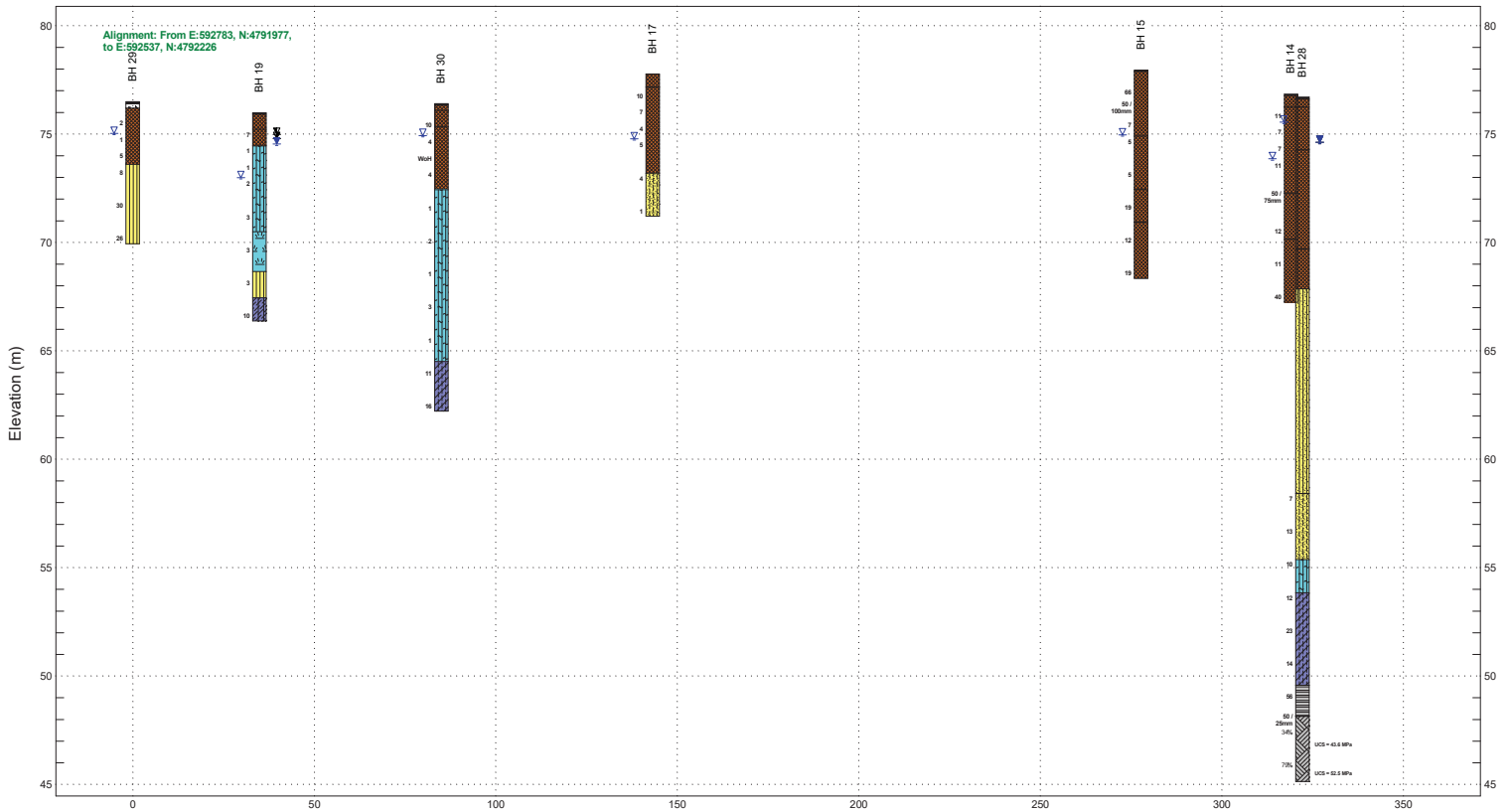
BH1 Borehole Location

Terraprobe
903 Barton Street - Unit 22, Stoney Creek, Ontario, L8E 5R7
Tel: (905) 643-7560, Fax: (905) 643-7559

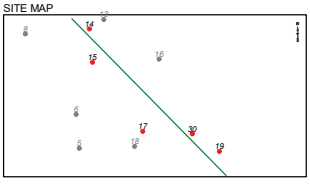
Title: PUMPING STATION LOCATION PLAN

File No. 7-16-0090-01

FIGURE : 3



SITE MAP



LITHOLOGY GRAPHIC LEGEND

- Asphalt
- Fill
- Silty Sand
- Organic Silt
- Peat
- Silt
- Clayey Silt
- Sandy Silt
- Silty Clay
- Bedrock (cored)
- Bedrock
- Concrete

INTERPRETIVE LEGEND

- Unstabilized water level on completion of drilling
- Stabilized water level, most recent
- 30 SPT N-Value

- *FILL*
- *GRAVELS (gravel to gravelly sand)*
- *SILT TO SAND (not till)*
- *COHESIONLESS TILLS*
- *COHESIVE SOILS (clayey silt to clay, incl. tills)*

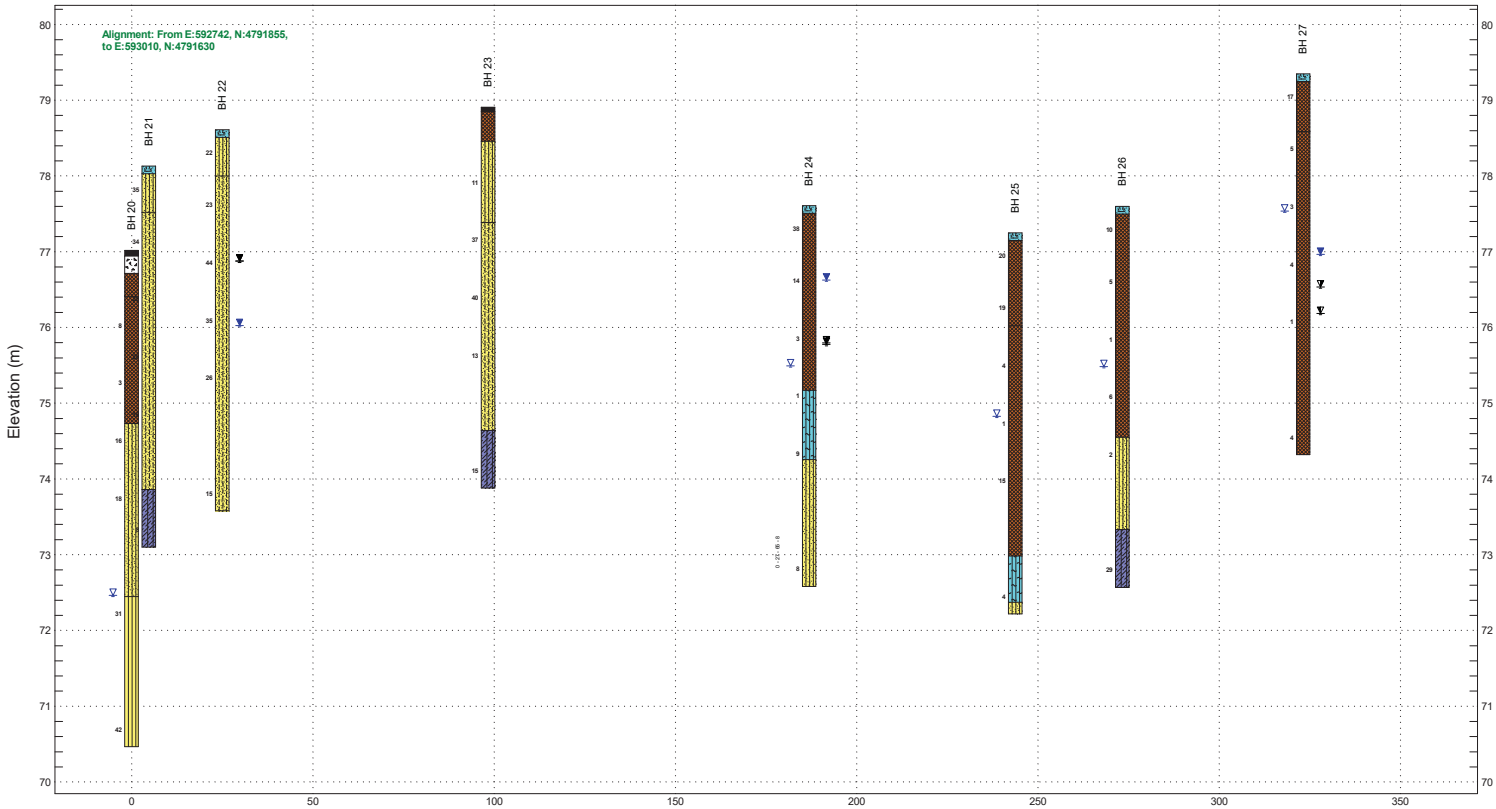
Terraprobe
903 Barton Street, Unit 22
Stoney Creek, Ontario L8E 5P5
(905) 643-7560

Title: **SUBSURFACE PROFILE**

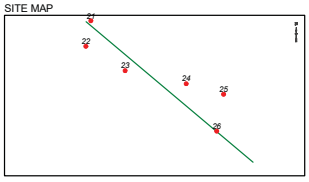
File No.: **7-16-0090-01**

No.: **4**

Report SECTION - TABLOID - ELEV



SITE MAP



LITHOLOGY GRAPHIC LEGEND

- Asphalt
- Concrete
- Fill
- Sandy Silt
- Silt
- Topsoil
- Silty Sand
- Clayey Silt
- Organic Silt

INTERPRETIVE LEGEND

- Unstabilized water level on completion of drilling
- Stabilized water level, most recent
- 30 SPT N-Value

- *FILL*
- *GRAVELS (gravel to gravelly sand)*
- *SILT TO SAND (not till)*
- *COHESIONLESS TILLS*
- *COHESIVE SOILS (clayey silt to clay, incl. tills)*

Terraprobe
903 Barton Street, Unit 22
Stoney Creek, Ontario L8E 5P5
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Title: **SUBSURFACE PROFILE**

File No.: **7-16-0090-01** No.: **5**

Report: ISECTION - TABLOID - ELEV

LOGS OF BOREHOLES

APPENDIX A



Terraprobe Inc.

SAMPLING METHODS

AS	auger sample
CORE	cored sample
DP	direct push
FV	field vane
GS	grab sample
SS	split spoon
ST	shelby tube
WS	wash sample

PENETRATION RESISTANCE

Standard Penetration Test (SPT) resistance ('N' values) is defined as the number of blows by a hammer weighing 63.6 kg (140 lb.) falling freely for a distance of 0.76 m (30 in.) required to advance a standard 50 mm (2 in.) diameter split spoon sampler for a distance of 0.3 m (12 in.).

Dynamic Cone Test (DCT) resistance is defined as the number of blows by a hammer weighing 63.6 kg (140 lb.) falling freely for a distance of 0.76 m (30 in.) required to advance a conical steel point of 50 mm (2 in.) diameter and with 60° sides on 'A' size drill rods for a distance of 0.3 m (12 in.)."

COHESIONLESS SOILS

Compactness	'N' value
very loose	< 4
loose	4 – 10
compact	10 – 30
dense	30 – 50
very dense	> 50

COHESIVE SOILS

Consistency	'N' value	Undrained Shear Strength (kPa)
very soft	< 2	< 12
soft	2 – 4	12 – 25
firm	4 – 8	25 – 50
stiff	8 – 15	50 – 100
very stiff	15 – 30	100 – 200
hard	> 30	> 200

COMPOSITION

Term (e.g)	% by weight
trace silt	< 10
some silt	10 – 20
silty	20 – 35
sand *and* silt	> 35

TESTS AND SYMBOLS

MH	mechanical sieve and hydrometer analysis
w, w_c	water content
w_L, LL	liquid limit
w_P, PL	plastic limit
I_P, PI	plasticity index
k	coefficient of permeability
γ	soil unit weight, bulk
φ'	internal friction angle
c'	effective cohesion
c_u	undrained shear strength

▽	Unstabilized water level
▼	1st water level measurement
▼	2nd water level measurement
▼	Most recent water level measurement
3.0 +	Undrained shear strength from field vane (with sensitivity)
C_c	compression index
c_v	coefficient of consolidation
m_v	coefficient of compressibility
e	void ratio

FIELD MOISTURE DESCRIPTIONS

Damp	refers to a soil sample that does not exhibit any observable pore water from field/hand inspection.
Moist	refers to a soil sample that exhibits evidence of existing pore water (e.g. sample feels cool, cohesive soil is at plastic limit) but does not have visible pore water
Wet	refers to a soil sample that has visible pore water

Terraprobe Inc.

Greater Toronto
11 Indell Lane
Brampton, Ontario L6T 3Y3
(905) 796-2650 Fax: 796-2250

Hamilton – Niagara
903 Barton Street, Unit 22
Stoney Creek, Ontario L8E 5P5
(905) 643-7560 Fax: 643-7559

Central Ontario
220 Bayview Drive, Unit 25
Barrie, Ontario L4N 4Y8
(705) 739-8355 Fax: 739-8369

Northern Ontario
1012 Kelly Lake Rd., Unit 1
Sudbury, Ontario P3E 5P4
(705) 670-0460 Fax: 670-0558

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RECOVERY

TCR Total Core Recovery is the total length of core pieces, irrespective of their individual lengths obtained in a core run, and expressed as a percentage of the length of that core run.

SCR Solid Core Recovery is the total length of sound full-diameter core pieces obtained in a core run, expressed as a percentage of the length of that core run.

RQD Rock Quality Designation pertains to the sum of those pieces of sound core which are 10 cm or greater in length obtained in a core run, expressed as a percentage of the length of that core run.

RQD (%)	0 - 25	25 - 50	50 - 75	75 - 90	90 - 100
QUALITY	**very poor**	**poor**	**fair**	**good**	**excellent**

JOINT CHARACTERISTICS

Orientation

horizontal / flat = 0 - 20°
dipping = 20 - 50°
vertical = 50 - 90°

Joint Aperture

Classification	Aperture
closed	< 0.5 mm
gapped	0.5 to 10 mm
open	> 10 mm

Joint Spacing (ISRM, 1981)

Classification	Spacing (m)
extremely close	< 0.02
very close	0.02 to 0.06
close	0.06 to 0.2
moderately close	0.2 to 0.6
wide	0.6 to 2
very wide	2 to 6
extremely wide	> 6

Joint Filling

Description	Approx φ
tight, hard, non-softening	25 - 35
oxidation, surface staining only	25 - 30
slightly altered, clay-free	25 - 30
sandy particles, clay-free	20 - 25
sandy and silty, minor clay	16 - 24
non-softening clays	6 - 12
swelling clay fillings	n/a

Degree of Weathering (after MTO, RR229 Evaluation of Shales for Construction Projects)

Zone	Degree	Description
Z1	unweathered	shale, regular jointing
Z2	partially weathered	angular blocks of unweathered shale, no matrix, with chemically weathered but intact shale
Z3		soil-like matrix with frequent angular shale fragments < 25mm diameter
Z4a		soil-like matrix with occasional shale fragments < 3mm diameter
Z4b	fully weathered	soil-like matrix only

Strength classification (after Marinos and Hoek, 2001)

Grade	Term	UCS (MPa)	Field Estimate (Description)
R6	extremely strong	> 250	can only be chipped by geological hammer
R5	very strong	100 - 250	requires many blows from geological hammer
R4	strong	50 - 100	requires more than one blow from geological hammer
R3	medium strong	25 - 50	can't be scraped, breaks under one blow from geological hammer
R2	weak	5 - 25	can be peeled / scraped with knife with difficulty
R1	very weak	1 - 5	easily scraped / peeled, crumbles under firm blow of geo. hammer
R0	extremely weak	< 1	indented by thumbnail

LOG OF BOREHOLE 6

Terraprobe

Project No. : 7-16-0090-01 | Client : The City of Hamilton | Originated by : AF

Date started : August 5, 2016 | Project : Pier 8 | Compiled by : GM

Sheet No. : 1 of 1 | Location : Hamilton, Ontario | Checked by : GM

Position : E: 592544, N: 4792074 (UTM 17T) | Elevation Datum : Geodetic (NAD83)

Rig type : D90, truck-mounted | Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Number	Type	SPT 'N' Value
0	77.1	**GROUND SURFACE**				
		FILL, clayey silt, some sand, some shale fragments, pieces of slag, loose to compact, reddish brown		1	SS	6
				2	SS	19
4	72.8					
	4.3	**ORGANIC SILT**, (poor recovery), very soft		3	SS	2
				4	SS	WH
				5	SS	WH
9	68.0					
	9.1	**SANDY SILT to SILTY FINE SAND**, very loose, grey		6	SS	WH
				7	SS	WH
12	64.9					
	12.2	**SILTY CLAY**, trace gravel, firm, grey		8	SS	5
				9	SS	2
					FV	
				10	SS	3
					FV	
				11	SS	6
					FV	
18	58.4			12	SS	3
	18.7					

Penetration Test Values (Blows / 0.3m): Dynamic Cone 10 20 30 40

Undrained Shear Strength (kPa): Unconfined, Pocket Penetrometer, Field Vane, Lab Vane; 40 80 120 160

Moisture / Plasticity: Plastic Limit, Natural Water Content, Liquid Limit; PL MC LL; 10 20 30

Headspace Vapour (ppm)

Instrument Details

Unstabilized Water Level

Lab Data and Comments

GRAIN SIZE DISTRIBUTION (%) (MIT) GR SA SI CL

Elevation Scale (m): 77 76 75 74 73 72 71 70 69 68 67 66 65 64 63 62 61 60 59

Moisture / Plasticity: 40 at 72 m; 43 at 71 m

Undrained Shear Strength: 1.5 at 63 m; 2.0 at 61 m; 1.6 at 60 m

END OF BOREHOLE

Water encountered at 3m depth.
Unstablized water level at 12.8m below ground surface after drilling; borehole was open upon completion of drilling.

50 mm dia. monitoring well installed.

WATER LEVEL READINGS

Date	Water Depth (m)	Elevation (m)
Sep 1, 2016	6.0	71.1
Oct 11, 2016	2.3	74.8
Nov 7, 2016	2.8	74.3

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LOG OF BOREHOLE 9

Terraprobe

Project No. : 7-16-0090-01 | Client : The City of Hamilton | Originated by : AF

Date started : August 1, 1940 | Project : Pier 8 | Compiled by : GM

Sheet No. : 1 of 1 | Location : Hamilton, Ontario | Checked by : GM

Position : E: 592482, N: 4792258 (UTM 17T) | Elevation Datum : Geodetic (NAD83)

Rig type : D90, truck-mounted | Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Number	Type	SPT 'N' Value
0	77.1	**GROUND SURFACE**				
		75mm **ASPHALTIC CONCRETE**				
	76.6	FILL Granular Base				
	0.5	**FILL**, sand, (possibly foundry sand) with brick fragments and clay lumps, compact, black		1	SS	20
1						
				2	SS	35
2						
				3	SS	5
3	74.1					
	3.0	**FILL**, clayey silt, some gravel, some brick fragments, firm to stiff, dark brown		4	SS	9
4						
				5	SS	12
5						
6	71.0					
	6.1	**ORGANIC SILT**, very soft to soft, black		6	SS	6
7						
				7	SS	1
8	68.6					
	8.5	**SILT**, trace sand, loose, dark grey				
9				8	SS	5
	67.5					
	9.6	**END OF BOREHOLE**				

Unstabilized water level measured at 4.0 m below ground surface; borehole was open upon completion of drilling.

Elevation Scale (m): 77, 76, 75, 74, 73, 72, 71, 70, 69, 68

Penetration Test Values (Blows / 0.3m): Dynamic Cone; 10 20 30 40

Undrained Shear Strength (kPa): Unconfined, Pocket Penetrometer, Field Vane, Lab Vane; 40 80 120 160

Moisture / Plasticity: Plastic Limit, Natural Water Content, Liquid Limit; PL, MC, LL; 10 20 30

Headspace Vapour (ppm)

Instrument Details

Unstabilized Water Level

Lab Data and Comments

GRAIN SIZE DISTRIBUTION (%) (MIT)

GR SA SI CL

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LOG OF BOREHOLE 10

Terraprobe

Project No. : 7-16-0090-01 | Client : The City of Hamilton | Originated by : AF

Date started : August 3, 2016 | Project : Pier 8 | Compiled by : GM

Sheet No. : 1 of 1 | Location : Hamilton, Ontario | Checked by : GM

Position : E: 592532, N: 4792261 (UTM 17T) | Elevation Datum : Geodetic (NAD83)

Rig type : CME 75, truck-mounted | Drilling Method : Hollow stem augers

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Number	Type	SPT 'N' Value
0	76.7	**GROUND SURFACE**				
	76.2	50mm **ASPHALTIC CONCRETE**				
	0.5	FILL Granular Base				
1		**FILL**, clayey silt to sandy silt, with pieces of brick, dark brown to reddish brown		1	SS	14
2				2	SS	25
				3	SS	23
3	73.7					
	3.0	FILL TAR, (solid), Black		4	SS	77
	73.1					
4	3.6	**FILL**, sandy silt, with layers of brown and black slag, pieces of concrete and asphalt, loose, brown and black				
5				5	SS	6
6				6	SS	23
7				7	SS	7
8				8	SS	6
9				9	SS	12
10						
11						
12	64.5					
	12.2	**SILTY FINE SAND to SANDY SILT**, very loose, dark brown to dark grey		10	SS	1
13				11	SS	0
14				12	SS	6
15				13	SS	1
16	59.0					
	17.7	**SILTY CLAY**, trace gravel, stiff to very stiff, grey		14	SS	19
17				15	SS	11
18				16	SS	8
19						
20				17	SS	14
21						
22				18	SS	8
23	51.9					
24	24.8					

Elevation Scale (m): 76, 75, 74, 73, 72, 71, 70, 69, 68, 67, 66, 65, 64, 63, 62, 61, 60, 59, 58, 57, 56, 55, 54, 53, 52

Penetration Test Values (Blows / 0.3m): Dynamic Cone; 10 20 30 40

Undrained Shear Strength (kPa): Unconfined, Pocket Penetrometer, Field Vane, Lab Vane; 40 80 120 160

Moisture / Plasticity: Plastic Limit, Natural Water Content, Liquid Limit; PL MC LL; 10 20 30

Headspace Vapour (ppm)

Instrument Details

Unstabilized Water Level

Lab Data and Comments

GRAIN SIZE DISTRIBUTION (%) (MIT)

GR SA SI CL

0 71 24 5

2 10 46 42

END OF BOREHOLE

Unstabilized water level measured at 2.1 m below ground surface; borehole was open upon completion of drilling.

50 mm dia. monitoring well installed.

WATER LEVEL READINGS

Date	Water Depth (m)	Elevation (m)
Sep 1, 2016	1.8	75.0
Oct 11, 2016	1.7	75.0
Nov 7, 2016	1.3	75.4
Jul 24, 2017	1.5	75.2

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LOG OF BOREHOLE 11

Terraprobe

Project No. : 7-16-0090-01 | Client : The City of Hamilton | Originated by : AF

Date started : August 4, 2016 | Project : Pier 8 | Compiled by : GM

Sheet No. : 1 of 1 | Location : Hamilton, Ontario | Checked by : GM

Position : E: 592531, N: 4792239 (UTM 17T) | Elevation Datum : Geodetic (NAD83)

Rig type : CME 75, truck-mounted | Drilling Method : Hollow stem augers

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Number	Type	SPT 'N' Value
	76.8	**GROUND SURFACE**				
		50mm **ASPHALTIC CONCRETE**				
	76.2	FILL Granular Base				
	0.6	**FILL**, silty clay, trace gravel, pieces of bick, very soft to firm, grey		1	SS	7
				2	SS	2
	73.1					
	3.7	**FILL**, clayey silt to sandy silt, with pieces of brick and mortar, loose to compact, dark brown to reddish brown		3	SS	10
				4	SS	5
				5	SS	9
	68.0					
	8.8	**SANDY SILT to SILTY FINE SAND**, loose, dark grey		6	SS	7
				7	SS	7
				8	SS	2
	64.2					
	12.6	**END OF BOREHOLE**				

Penetration Test Values (Blows / 0.3m): Dynamic Cone 10 20 30 40

Undrained Shear Strength (kPa): Unconfined, Pocket Penetrometer, Field Vane, Lab Vane 40 80 120 160

Moisture / Plasticity: Plastic Limit (PL) | Natural Water Content (MC) | Liquid Limit (LL) 10 20 30

Headspace Vapour (ppm)

Instrument Details

Unstabilized Water Level

Lab Data and Comments

GRAIN SIZE DISTRIBUTION (%) (MIT) GR SA SI CL

Unstabilized water level measured at 4.6 m below ground surface; borehole was open upon completion of drilling.

50 mm dia. monitoring well installed.

WATER LEVEL READINGS

Date	Water Depth (m)	Elevation (m)
Sep 1, 2016	0.9	76.0
Oct 11, 2016	1.0	75.9
Nov 7, 2016	1.2	75.7
Jul 24, 2017	0.5	76.3

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LOG OF BOREHOLE 12

Terraprobe

Project No. : 7-16-0090-01 | Client : The City of Hamilton | Originated by : AF

Date started : August 9, 2016 | Project : Pier 8 | Compiled by : GM

Sheet No. : 1 of 1 | Location : Hamilton, Ontario | Checked by : GM

Position : E: 592582, N: 4792247 (UTM 17T) | Elevation Datum : Geodetic (NAD83)

Rig type : D90, truck-mounted | Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Number	Type	SPT 'N' Value	Elevation Scale (m)
	76.7	**GROUND SURFACE**					
0	76.2	75mm **ASPHALTIC CONCRETE**					
	0.5	FILL Granular Base					
1		**FILL**, silty fine sand and gravel, pieces of asphalt, timber and metal, compact, brown / black		1	SS	17	76
2	74.3						75
	2.4	**FILL**, brick fragments, some sand, mortar and rubble, loose to compact		2	SS	20	74
3							73
4				3	SS	7	72
5							71
6				4	SS	20	70
7	69.7						69
	7.0	**FILL**, silty fine sand, with pieces of brick, loose, dark brown to black		5	SS	5	68
8	67.9						67
9	8.8	**SANDY SILT to SILTY FINE SAND**, very loose to loose, dark grey		6	SS	3	66
10							65
11				7	SS	3	64
12							63
13				8	SS	2	62
14							61
15				9	SS	1	60
16							59
17				10	SS	10	58
18							
	58.0			11	SS	9	
	18.7						
				12	SS	6	

Penetration Test Values (Blows / 0.3m)
Dynamic Cone: 10 20 30 40
Undrained Shear Strength (kPa)
Unconfined, Pocket Penetrometer, Field Vane, Lab Vane: 40 80 120 160

Moisture / Plasticity
Plastic Limit (PL) | Natural Water Content (MC) | Liquid Limit (LL)
10 20 30

Headspace Vapour (ppm)

Instrument Details

Unstabilized Water Level

Lab Data and Comments

GRAIN SIZE DISTRIBUTION (%) (MIT)

	GR	SA	SI	CL
11	0	50	44	6
15	0	48	44	8

END OF BOREHOLE

Unstabilized water level measured at 4.6 m below ground surface; borehole was open upon completion of drilling.

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LOG OF BOREHOLE 13

Terraprobe

Project No. : 7-16-0090-01 | Client : The City of Hamilton | Originated by : AF

Date started : August 9, 2016 | Project : Pier 8 | Compiled by : GM

Sheet No. : 1 of 1 | Location : Hamilton, Ontario | Checked by : GM

Position : E: 592588, N: 4792225 (UTM 17T) | Elevation Datum : Geodetic (NAD83)

Rig type : D90, truck-mounted | Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Number	Type	SPT 'N' Value
0	76.8	**GROUND SURFACE**				
		70mm **ASPHALTIC CONCRETE**				
	76.3	FILL Granular Base				
	0.5	**FILL**, sandy silt, with pieces of brick and slag, loose, dark brown		1	SS	9
1						
2				2	SS	5
3	73.1					
	3.7	**FILL**, brick fragments and slag, some sand and gravel, compact		3	SS	30
4						
5						
6				4	SS	16
7	69.5					
	7.3	**FILL**, silty fine sand, with pieces of concrete, very loose, brown		5	SS	4
8	68.3					
	8.5	**SILTY FINE SAND to SANDY SILT**, loose, grey		6	SS	7
9	67.2					
	9.6	**END OF BOREHOLE**				

Elevation Scale (m): 76, 75, 74, 73, 72, 71, 70, 69, 68

Penetration Test Values (Blows / 0.3m): Dynamic Cone 10 20 30 40

Undrained Shear Strength (kPa): Unconfined, Pocket Penetrometer, Field Vane, Lab Vane — 40 80 120 160

Moisture / Plasticity: Plastic Limit (PL) | Natural Water Content (MC) | Liquid Limit (LL) — 10 20 30

Headspace Vapour (ppm)

Instrument Details

Unstabilized Water Level

Lab Data and Comments

GRAIN SIZE DISTRIBUTION (%) (MIT) GR SA SI CL

Unstabilized water level measured at 3.0 m below ground surface; borehole was open upon completion of drilling.

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LOG OF BOREHOLE 14

Terraprobe

Project No. : 7-16-0090-01 | Client : The City of Hamilton | Originated by : AF

Date started : August 10, 2016 | Project : Pier 8 | Compiled by : GM

Sheet No. : 1 of 1 | Location : Hamilton, Ontario | Checked by : GM

Position : E: 592565, N: 4792210 (UTM 17T) | Elevation Datum : Geodetic (NAD83)

Rig type : D90, truck-mounted | Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Number	Type	SPT 'N' Value
	76.9	**GROUND SURFACE**				
		70mm **ASPHALTIC CONCRETE**				
		FILL Granular Base				
	76.3 / 0.6					
		FILL, sandy silt to clayey silt, with pieces of brick and slag, loose		1	SS	11
				2	SS	7
				3	SS	7
				4	SS	11
	72.3 / 4.6					
		FILL, slag and brick fragments, very dense to compact, black and brown		5	SS	50 / 75mm
				6	SS	12
	70.2 / 6.7					
		FILL, silty clay to clayey silt, with pieces of concrete, some sand and gravel, stiff, grey		7	SS	11
				8	SS	40
	67.3 / 9.6					

Elevation Scale (m): 76, 75, 74, 73, 72, 71, 70, 69, 68

Penetration Test Values (Blows / 0.3m): Dynamic Cone 10 20 30 40

Undrained Shear Strength (kPa): Unconfined, Pocket Penetrometer, Field Vane, Lab Vane — 40 80 120 160

Moisture / Plasticity: Plastic Limit (PL) | Natural Water Content (MC) | Liquid Limit (LL) — 10 20 30

Headspace Vapour (ppm)

Instrument Details

Unstabilized Water Level

Lab Data and Comments

GRAIN SIZE DISTRIBUTION (%) (MIT) — GR SA SI CL

END OF BOREHOLE

Unstabilized water level measured at 3.0 m below ground surface; borehole was open upon completion of drilling.

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LOG OF BOREHOLE 15

Terraprobe

Project No. : 7-16-0090-01 | Client : The City of Hamilton | Originated by : AF

Date started : August 10, 2016 | Project : Pier 8 | Compiled by : GM

Sheet No. : 1 of 1 | Location : Hamilton, Ontario | Checked by : GM

Position : E: 592570, N: 4792157 (UTM 17T) | Elevation Datum : Geodetic (NAD83)

Rig type : D90, truck-mounted | Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Number	Type	SPT 'N' Value
0	78.0	**GROUND SURFACE**				
		60mm **ASPHALTIC CONCRETE**				
		FILL, sandy silt, trace to some gravel, with pieces of asphlat and brick, dense, dark brown to black		1	SS	66
1				2	SS	50 / 100mm
2				3	SS	7
3	75.0 / 3.0	**FILL**, silty clay, trace topsoil, some gravel, firm, dark brown		4	SS	5
4				5	SS	5
5	72.5 / 5.5	**FILL**, brick fragments, trace clay, rubble, compact, dark brown		6	SS	19
6						
7	71.0 / 7.0	**FILL**, silty silt, some gravel, with pieces of brick and asphalt, compact, dark brown		7	SS	12
8						
9	68.4 / 9.6	**END OF BOREHOLE**		8	SS	19

Elevation Scale (m): 77, 76, 75, 74, 73, 72, 71, 70, 69

Penetration Test Values (Blows / 0.3m): Dynamic Cone 10 20 30 40

Undrained Shear Strength (kPa): Unconfined, Pocket Penetrometer, Field Vane, Lab Vane 40 80 120 160

Moisture / Plasticity: Plastic Limit (PL) | Natural Water Content (MC) | Liquid Limit (LL) 10 20 30

Headspace Vapour (ppm)

Instrument Details

Unstabilized Water Level

Lab Data and Comments

GRAIN SIZE DISTRIBUTION (%) (MIT) GR SA SI CL

Unstabilized water level measured at 3.0 m below ground surface; borehole was open upon completion of drilling.

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LOG OF BOREHOLE 16

Project No. : 7-16-0090-01 | Client : The City of Hamilton | Originated by : AF

Date started : August 11, 2016 | Project : Pier 8 | Compiled by : GM

Sheet No. : 1 of 1 | Location : Hamilton, Ontario | Checked by : GM

Position : E: 592676, N: 4792162 (UTM 17T) | Elevation Datum : Geodetic (NAD83)

Rig type : D90, truck-mounted | Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Number	Type	SPT 'N' Value
0	76.0	**GROUND SURFACE**				
		100mm **ASPHALTIC CONCRETE**				
		FILL, silty sand and gravel, trace cinders, pieces of concrete, wood, loose to compact, dark brown		1	SS	17
1						
				2	SS	23
2						
				3	SS	5
3	73.0					
	3.0	**FILL**, clayey silt, some gravel, with pieces of brick and asphalt, loose to compact, dark brown		4	SS	5
4						
				5	SS	32
5	70.7					
	5.3	**FILL**, slag with brick fragments				
6	69.6			6	SS	50 / 125mm
	6.4	**END OF BOREHOLE**				

Elevation Scale (m): 75, 74, 73, 72, 71, 70

Penetration Test Values (Blows / 0.3m): Dynamic Cone; 10 20 30 40

Undrained Shear Strength (kPa): Unconfined, Pocket Penetrometer, Field Vane, Lab Vane; 40 80 120 160

Moisture / Plasticity: Plastic Limit, Natural Water Content, Liquid Limit; PL MC LL; 10 20 30

Headspace Vapour (ppm)

Instrument Details

Unstabilized Water Level

Lab Data and Comments

GRAIN SIZE DISTRIBUTION (%) (MIT): GR SA SI CL

Unstabilized water level measured at 1.2 m below ground surface; borehole was open upon completion of drilling.

file: 7-16-0090-01 pier 8 hamilton.gpj

LOG OF BOREHOLE 17

Terraprobe

Project No. : 7-16-0090-01 | Client : The City of Hamilton | Originated by : AF

Date started : August 11, 2016 | Project : Pier 8 | Compiled by : GM

Sheet No. : 1 of 1 | Location : Hamilton, Ontario | Checked by : GM

Position : E: 592650, N: 4792047 (UTM 17T) | Elevation Datum : Geodetic (NAD83)

Rig type : D90, truck-mounted | Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Sample Number	Sample Type	SPT 'N' Value
0	77.8	**GROUND SURFACE**				
	77.2 / 0.6	FILL Granular Base				
1		**FILL**, sandy silt, trace clay, with pieces of brick, asphalt and timber, very loose to compact, dark brown to black		1	SS	10
				2	SS	7
2				3	SS	4
3				4	SS	5
4	73.2 / 4.6					
		SILTY FINE SAND to SANDY SILT, very loose, dark grey		5	SS	4
5						
6				6	SS	1
	71.2 / 6.6	**END OF BOREHOLE**				

Penetration Test Values (Blows / 0.3m): Dynamic Cone (10, 20, 30, 40)

Undrained Shear Strength (kPa): Unconfined, Pocket Penetrometer, Field Vane, Lab Vane (40, 80, 120, 160)

Elevation Scale (m): 77, 76, 75, 74, 73, 72

Moisture / Plasticity: Plastic Limit (PL), Natural Water Content (MC), Liquid Limit (LL) (10, 20, 30)

Headspace Vapour (ppm)

Instrument Details

Unstabilized Water Level

Lab Data and Comments

GRAIN SIZE DISTRIBUTION (%) (MIT) GR SA SI CL

Unstabilized water level measured at 3.0 m below ground surface; borehole was open upon completion of drilling.

file: 7-16-0090-01 pier 8 hamilton.gpj

LOG OF BOREHOLE 18

Terraprobe

Project No. : 7-16-0090-01 | Client : The City of Hamilton | Originated by : AF

Date started : August 11, 2016 | Project : Pier 8 | Compiled by : GM

Sheet No. : 1 of 1 | Location : Hamilton, Ontario | Checked by : GM

Position : E: 592637, N: 4792023 (UTM 17T) | Elevation Datum : Geodetic (NAD83)

Rig type : D90, truck-mounted | Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Number	Type	SPT 'N' Value
	77.4	**GROUND SURFACE**				
		FILL Granular Base				
	76.8 / 0.6	**FILL**, silty sand to sandy silt, trace clay, with pieces of asphalt, gravel and timber, loose to compact, dark brown		1	SS	19
				2	SS	8
	75.3 / 2.1	**FILL**, clayey silt, some gravel, with pieces of asphalt, soft, dark brown		3	SS	3
				4	SS	4
	72.8 / 4.6	**SILTY FINE SAND to SANDY SILT**, loose to compact, dark grey		5	SS	9
				6	SS	18
	70.8 / 6.6	**END OF BOREHOLE**				

Elevation Scale (m): 77, 76, 75, 74, 73, 72, 71

Penetration Test Values (Blows / 0.3m) — Dynamic Cone: 10, 20, 30, 40

Undrained Shear Strength (kPa) — Unconfined, Pocket Penetrometer, Field Vane, Lab Vane: 40, 80, 120, 160

Moisture / Plasticity — Plastic Limit, Natural Water Content, Liquid Limit: PL, MC, LL; 10, 20, 30

Headspace Vapour (ppm)

Instrument Details

Unstabilized Water Level

Lab Data and Comments

GRAIN SIZE DISTRIBUTION (%) (MIT) — GR SA SI CL

Unstabilized water level measured at 3.7 m below ground surface; borehole was open upon completion of drilling.

file: 7-16-0090-01 pier 8 hamilton.gpj

LOG OF BOREHOLE 19

Terraprobe

Project No. : 7-16-0090-01 | Client : The City of Hamilton | Originated by : AF

Date started : August 8, 2016 | Project : Pier 8 | Compiled by : GM

Sheet No. : 1 of 1 | Location : Hamilton, Ontario | Checked by : GM

Position : E: 592772, N: 4792015 (UTM 17T) | Elevation Datum : Geodetic (NAD83)

Rig type : CME 75, truck-mounted | Drilling Method : Hollow stem augers

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Number	Type	SPT 'N' Value
0	76.0	**GROUND SURFACE**				
		60mm **ASPHALTIC CONCRETE**				
	75.3	FILL Granular Base				
1	0.7	**FILL**, sandy silt, occasional gravel, loose, brown		1	SS	7
	74.5					
2	1.5	**ORGANIC SILT**, (possibly fill), soft, black / brown		2	SS	1
				3	SS	1
3				4	SS	2
4						
5				5	SS	3
	70.5					
6	5.5	**PEAT**, soft, black		6	SS	3
7	68.7					
	7.3	**SILT**, very loose, brown		7	SS	3
8	67.5					
	8.5	**CLAYEY SILT**, with silt sayers, stiff, grey		8	SS	10
9	66.4					
	9.6	**END OF BOREHOLE**				

Elevation Scale (m): 75, 74, 73, 72, 71, 70, 69, 68, 67

Penetration Test Values (Blows / 0.3m): Dynamic Cone 10 20 30 40

Undrained Shear Strength (kPa): Unconfined, Pocket Penetrometer, Field Vane, Lab Vane — 40 80 120 160

Moisture / Plasticity: Plastic Limit (PL) | Natural Water Content (MC) | Liquid Limit (LL) — 10 20 30

Headspace Vapour (ppm): 48, 49, 143

Instrument Details

Unstabilized Water Level

Lab Data and Comments

GRAIN SIZE DISTRIBUTION (%) (MIT) GR SA SI CL

Unstabilized water level measured at 3.0 m below ground surface; borehole was open upon completion of drilling.

50 mm dia. monitoring well installed.

WATER LEVEL READINGS

Date	Water Depth (m)	Elevation (m)
Sep 1, 2016	1.1	74.9
Oct 11, 2016	1.3	74.7
Nov 7, 2016	1.5	74.5

file: 7-16-0090-01 pier 8 hamilton.gpj

LOG OF BOREHOLE 20

Terraprobe

Project No. : 7-16-0090-01 | Client : The City of Hamilton | Originated by : AF

Date started : October 27, 2016 | Project : Pier 8 | Compiled by : GM

Sheet No. : 1 of 1 | Location : Hamilton, Ontario | Checked by : GM

Position : E: 592774, N: 4791893 (UTM 17T) | Elevation Datum : Geodetic (NAD83)

Rig type : CME 75, truck-mounted | Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Number	Type	SPT 'N' Value
	77.0	**GROUND SURFACE**				
0	76.7	75mm **ASPHALTIC CONCRETE**				
	0.3	**FILL**, Granular				
	76.4					
	0.6	**FILL**, construction debris, some sand, some clay, pieces of brick and asphalt, very loose to loose, brownish black		1	SS	8
1						
				2	SS	3
2	74.7					
	2.3	**SANDY SILT**, compact, grey		3	SS	16
3				4	SS	18
4	72.4					
	4.6	**SILT**, trace sand, with clay layers, dense, grey		5	SS	31
5						
6				6	SS	42
	70.4					
	6.6	**END OF BOREHOLE**				

Elevation Scale (m): 77, 76, 75, 74, 73, 72, 71

Penetration Test Values (Blows / 0.3m): Dynamic Cone 10 20 30 40

Undrained Shear Strength (kPa): Unconfined, Pocket Penetrometer, Field Vane, Lab Vane; 40 80 120 160

Moisture / Plasticity: Plastic Limit, Natural Water Content, Liquid Limit; PL MC LL; 10 20 30

Headspace Vapour (ppm)

Instrument Details

Unstabilized Water Level

Lab Data and Comments

GRAIN SIZE DISTRIBUTION (%) (MIT): GR SA SI CL

Unstabilized water level measured at 4.6 m below ground surface; borehole was open upon completion of drilling.

file: 7-16-0090-01 pier 8 hamilton.gpj

LOG OF BOREHOLE 21

Terraprobe

Project No. : 7-16-0090-01 | Client : The City of Hamilton | Originated by : AF

Date started : August 15, 2016 | Project : Pier 8 | Compiled by : GM

Sheet No. : 1 of 1 | Location : Hamilton, Ontario | Checked by : GM

Position : E: 592750, N: 4791857 (UTM 17T) | Elevation Datum : Geodetic (NAD83)

Rig type : D90, truck-mounted | Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Number	Type	SPT 'N' Value
0	78.1	**GROUND SURFACE**				
		100mm **TOPSOIL**				
		SANDY SILT, dense, brown		1	SS	35
	77.5 / 0.6	**SILTY FINE SAND**, compact, brown		2	SS	34
1						
				3	SS	29
2						
				4	SS	20
3						
				5	SS	18
4	73.8 / 4.3	**CLAYEY SILT**, stiff, brown				
				6	SS	8
5	73.1 / 5.0	**END OF BOREHOLE**				

Elevation Scale (m): 78, 77, 76, 75, 74

Penetration Test Values (Blows / 0.3m): Dynamic Cone 10 20 30 40

Undrained Shear Strength (kPa): ○ Unconfined ● Pocket Penetrometer + Field Vane ■ Lab Vane — 40 80 120 160

Moisture / Plasticity: Plastic Limit (PL) | Natural Water Content (MC) | Liquid Limit (LL) — 10 20 30

Headspace Vapour (ppm) | Instrument Details | Unstabilized Water Level | Lab Data and Comments | GRAIN SIZE DISTRIBUTION (%) (MIT) GR SA SI CL

Borehole was dry and open upon completion of drilling.

file: 7-16-0090-01 pier 8 hamilton.gpj

LOG OF BOREHOLE 22

Terraprobe

Project No. : 7-16-0090-01 | Client : The City of Hamilton | Originated by : AF

Date started : August 15, 2016 | Project : Pier 8 | Compiled by : GM

Sheet No. : 1 of 1 | Location : Hamilton, Ontario | Checked by : GM

Position : E: 592742, N: 4791816 (UTM 17T) | Elevation Datum : Geodetic (NAD83)

Rig type : D90, truck-mounted | Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Sample Number	Sample Type	SPT 'N' Value
0	78.6	**GROUND SURFACE**				
		100mm **TOPSOIL**				
		SANDY SILT, compact, brown		1	SS	22
	78.0 / 0.6	**SILTY FINE SAND**, with silt layers, compact to dense, grey		2	SS	23
1						
				3	SS	44
2						
				4	SS	35
3						
				5	SS	26
4						
				6	SS	15
5	73.6 / 5.0	**END OF BOREHOLE**				

Elevation Scale (m): 78, 77, 76, 75, 74

Penetration Test Values (Blows / 0.3m): Dynamic Cone 10 20 30 40

Undrained Shear Strength (kPa): Unconfined, Pocket Penetrometer, Field Vane, Lab Vane — 40 80 120 160

Moisture / Plasticity: Plastic Limit (PL) | Natural Water Content (MC) | Liquid Limit (LL) — 10 20 30

Headspace Vapour (ppm)

Instrument Details

Unstabilized Water Level

Lab Data and Comments

GRAIN SIZE DISTRIBUTION (%) (MIT) — GR SA SI CL

Borehole was dry and open upon completion of drilling.

WATER LEVEL READINGS

Date	Water Depth (m)	Elevation (m)
Sep 1, 2016	1.8	76.9
Oct 11, 2016	1.8	76.9
Nov 7, 2016	2.1	76.5
Jul 24, 2017	2.6	76.0

file: 7-16-0090-01 pier 8 hamilton.gpj

LOG OF BOREHOLE 23

Project No. : 7-16-0090-01 | Client : The City of Hamilton | Originated by : AF

Date started : August 15, 2016 | Project : Pier 8 | Compiled by : GM

Sheet No. : 1 of 1 | Location : Hamilton, Ontario | Checked by : GM

Position : E: 592805, N: 4791777 (UTM 17T) | Elevation Datum : Geodetic (NAD83)

Rig type : D90, truck-mounted | Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Sample Number	Sample Type	SPT 'N' Value
0	78.9	**GROUND SURFACE**				
		60mm **ASPHALTIC CONCRETE**				
	78.4	FILL Granular Base				
	0.5	**SANDY SILT**, compact, brown		1	SS	11
1						
	77.4					
	1.5	**SILTY FINE SAND**, with silt seams and layers, compact to dense, brown		2	SS	37
2				3	SS	40
3				4	SS	13
4	74.6					
	4.3	**CLAYEY SILT**, very stiff, grey		5	SS	15
5	73.9					
	5.0	**END OF BOREHOLE**				

Elevation Scale (m): 78, 77, 76, 75, 74

Penetration Test Values (Blows / 0.3m): Dynamic Cone 10 20 30 40

Undrained Shear Strength (kPa): Unconfined, Pocket Penetrometer, Field Vane, Lab Vane — 40 80 120 160

Moisture / Plasticity: Plastic Limit (PL) | Natural Water Content (MC) | Liquid Limit (LL) — 10 20 30

Headspace Vapour (ppm)

Instrument Details

Unstabilized Water Level

Lab Data and Comments

GRAIN SIZE DISTRIBUTION (%) (MIT) — GR SA SI CL

Borehole was dry and open upon completion of drilling.

file: 7-16-0090-01 pier 8 hamilton.gpj

LOG OF BOREHOLE 24

Terraprobe

Project No. : 7-16-0090-01 | Client : The City of Hamilton | Originated by : AF

Date started : August 15, 2016 | Project : Pier 8 | Compiled by : GM

Sheet No. : 1 of 1 | Location : Hamilton, Ontario | Checked by : GM

Position : E: 592903, N: 4791756 (UTM 17T) | Elevation Datum : Geodetic (NAD83)

Rig type : D90, truck-mounted | Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Sample Number	Sample Type	SPT 'N' Value
0	77.6	**GROUND SURFACE**				
		100mm **TOPSOIL**				
		FILL, silty sand, with pieces of asphalt, some fine gravel, very loose to dense		1	SS	38
1				2	SS	14
				3	SS	3
2	75.2					
	2.4	**ORGANIC SILT**, trace sand, very soft, black		4	SS	1
3	74.2			5	SS	9
	3.4	**SANDY SILT to SILTY SAND**, loose, grey				
4						
				6	SS	8
5	72.6					
	5.0					

Elevation Scale (m): 77, 76, 75, 74, 73

Penetration Test Values (Blows / 0.3m): Dynamic Cone; 10 20 30 40

Undrained Shear Strength (kPa): Unconfined, Pocket Penetrometer, Field Vane, Lab Vane; 40 80 120 160

Moisture / Plasticity: Plastic Limit, Natural Water Content, Liquid Limit; PL MC LL; 10 20 30

Headspace Vapour (ppm)

Instrument Details

Unstabilized Water Level

Lab Data and Comments

GRAIN SIZE DISTRIBUTION (%) (MIT)

GR SA SI CL

0 27 65 8

END OF BOREHOLE

Unstabilized water level measured at 2.1 m below ground surface; borehole was open upon completion of drilling.

50 mm dia. monitoring well installed.

WATER LEVEL READINGS

Date	Water Depth (m)	Elevation (m)
Sep 1, 2016	1.9	75.8
Oct 11, 2016	1.8	75.8
Nov 7, 2016	1.7	75.9
Jul 24, 2017	1.0	76.6

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LOG OF BOREHOLE 25

Terraprobe

Project No. : 7-16-0090-01 | Client : The City of Hamilton | Originated by : AF

Date started : August 15, 2016 | Project : Pier 8 | Compiled by : GM

Sheet No. : 1 of 1 | Location : Hamilton, Ontario | Checked by : GM

Position : E: 592963, N: 4791739 (UTM 17T) | Elevation Datum : Geodetic (NAD83)

Rig type : D90, truck-mounted | Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Number	Type	SPT 'N' Value
0	77.3	**GROUND SURFACE**				
		100mm **TOPSOIL**		1	SS	20
		FILL, silty sand, with pieces of asphalt, glass fragments, compact				
1	76.1			2	SS	19
	1.2	**FILL**, silty sand to sandy silt, with pieces of gravel, timber, organics (plant matter), very loose, dark brown / black		3	SS	4
2						
				4	SS	1
3				5	SS	15
	73.0					
4	4.3	**ORGANIC SILT**, soft, black		6	SS	4
	72.4					
5	72.3	**SANDY SILT**, loose, grey				
	5.0	**END OF BOREHOLE**				

Elevation Scale (m): 77, 76, 75, 74, 73

Penetration Test Values (Blows / 0.3m): Dynamic Cone 10 20 30 40

Undrained Shear Strength (kPa): Unconfined, Pocket Penetrometer, Field Vane, Lab Vane; 40 80 120 160

Moisture / Plasticity: Plastic Limit (PL) 10, Natural Water Content (MC) 20, Liquid Limit (LL) 30

64

Headspace Vapour (ppm)

Instrument Details

Unstabilized Water Level

Lab Data and Comments

GRAIN SIZE DISTRIBUTION (%) (MIT) GR SA SI CL

Unstabilized water level measured at 2.4 m below ground surface; borehole was open upon completion of drilling.

file: 7-16-0090-01 pier 8 hamilton.gpj

LOG OF BOREHOLE 26

Terraprobe

Project No. : 7-16-0090-01 | Client : The City of Hamilton | Originated by : AF

Date started : August 15, 2016 | Project : Pier 8 | Compiled by : GM

Sheet No. : 1 of 1 | Location : Hamilton, Ontario | Checked by : GM

Position : E: 592952, N: 4791680 (UTM 17T) | Elevation Datum : Geodetic (NAD83)

Rig type : D90, truck-mounted | Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Number	Type	SPT 'N' Value
0	77.6	**GROUND SURFACE**				
		100mm **TOPSOIL**		1	SS	10
		FILL, silty sand, with metal and glass fragments, pieces of timber, very loose to loose		2	SS	5
1				3	SS	1
2				4	SS	6
3	74.6 3.0	**SANDY SILT**, very loose, brown		5	SS	2
4	73.3 4.3	**CLAYEY SILT**, very stiff, grey		6	SS	29
5	72.6 5.0	**END OF BOREHOLE**				

Elevation Scale (m): 77, 76, 75, 74, 73

Penetration Test Values (Blows / 0.3m): Dynamic Cone 10 20 30 40

Undrained Shear Strength (kPa): Unconfined, Pocket Penetrometer, Field Vane, Lab Vane; 40 80 120 160

Moisture / Plasticity: Plastic Limit (PL) | Natural Water Content (MC) | Liquid Limit (LL); 10 20 30

Headspace Vapour (ppm)

Instrument Details

Unstabilized Water Level

Lab Data and Comments

GRAIN SIZE DISTRIBUTION (%) (MIT) GR SA SI CL

Unstabilized water level measured at 2.1 m below ground surface; borehole was open upon completion of drilling.

file: 7-16-0090-01 pier 8 hamilton.gpj

LOG OF BOREHOLE 27

Terraprobe

Project No. : 7-16-0090-01 | Client : The City of Hamilton | Originated by : AF

Date started : August 15, 2016 | Project : Pier 8 | Compiled by : GM

Sheet No. : 1 of 1 | Location : Hamilton, Ontario | Checked by : GM

Position : E: 592934, N: 4791581 (UTM 17T) | Elevation Datum : Geodetic (NAD83)

Rig type : D90, truck-mounted | Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Sample Number	Sample Type	SPT 'N' Value
0	79.4	**GROUND SURFACE**				
		100mm **TOPSOIL**				
		FILL, silty sand, trace topsoil, compact, brown		1	SS	17
	78.6					
	0.8					
1		**FILL**, sandy silt to clayey silt, with glass fragments, tile, brick, very loose, black		2	SS	5
				3	SS	3
2						
				4	SS	4
3						
				5	SS	1
4						
				6	SS	4
5	74.4					
	5.0					

Elevation Scale (m): 79, 78, 77, 76, 75

Penetration Test Values (Blows / 0.3m): Dynamic Cone 10 20 30 40

Undrained Shear Strength (kPa): Unconfined, Pocket Penetrometer, Field Vane, Lab Vane — 40 80 120 160

Moisture / Plasticity: Plastic Limit (PL) | Natural Water Content (MC) | Liquid Limit (LL) — 10 20 30

Headspace Vapour (ppm)

Instrument Details

Unstabilized Water Level

Lab Data and Comments

GRAIN SIZE DISTRIBUTION (%) (MIT) — GR SA SI CL

END OF BOREHOLE

Unstabilized water level measured at 1.8 m below ground surface; borehole was open upon completion of drilling.

WATER LEVEL READINGS

Date	Water Depth (m)	Elevation (m)
Sep 1, 2016	3.2	76.2
Oct 11, 2016	2.8	76.5
Nov 7, 2016	3.1	76.3
Jul 24, 2017	2.4	77.0

file: 7-16-0090-01 pier 8 hamilton.gpj

LOG OF BOREHOLE 28

Terraprobe

Project No. : 7-16-0090-01 | Client : The City of Hamilton | Originated by : AF

Date started : October 24, 2016 | Project : Pier 8 | Compiled by : GM

Sheet No. : 1 of 1 | Location : Hamilton, Ontario | Checked by : GM

Position : E: 592590, N: 4792239 (UTM 17T) | Elevation Datum : Geodetic (NAD83)

Rig type : CME 75, truck-mounted | Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Number	Type	SPT 'N' Value
0	76.7	**GROUND SURFACE**				
	76.2 / 0.5	75mm **ASPHALTIC CONCRETE**				
		FILL Granular Base				
	74.3 / 2.4	**FILL**, silty fine sand and gravel, pieces of asphalt, timber and metal, compact, brown / black				
		FILL, brick fragments, some sand, mortar and rubble, loose to compact				
	69.7 / 7.0	**FILL**, silty fine sand, with pieces of brick, loose, dark brown to black				
	67.9 / 8.8	**SANDY SILT to SILTY FINE SAND**, very loose to loose, dark grey				
		...(See BH12 for upper 18m)				
	58.4 / 18.3	**SILTY FINE SAND**, loose, grey		1	SS	7
				2	SS	13
	55.4 / 21.3	**ORGANIC SILT**, stiff, grey		3	SS	10
	53.8 / 22.9	**SILTY CLAY**, trace gravel, stiff to very stiff, grey		4	SS	12
				5	SS	23
				6	SS	14
	49.6 / 27.1	**SHALEY TILL**, with grey silt layers, hard, reddish brown		7	SS	56
	48.2 / 28.5	**WEATHERED SHALE**, reddish brown (QUEENSTON FORMATION)		8	SS	50 / 25mm
	48.1 / 28.6	**QUEENSTON FORMATION** (See rock core log for details)			RUN	
					RUN	
	45.1 / 31.6	**END OF BOREHOLE** Refusal on inferred bedrock				

Elevation Scale (m): 76, 75, 74, 73, 72, 71, 70, 69, 68, 67, 66, 65, 64, 63, 62, 61, 60, 59, 58, 57, 56, 55, 54, 53, 52, 51, 50, 49, 48, 47, 46

Penetration Test Values (Blows / 0.3m): Dynamic Cone; 10 20 30 40

Undrained Shear Strength (kPa): Unconfined, Pocket Penetrometer, Field Vane, Lab Vane; 40 80 120 160

Moisture / Plasticity: Plastic Limit, Natural Water Content, Liquid Limit; PL MC LL; 10 20 30

Headspace Vapour (ppm)

Instrument Details

Unstabilized Water Level

Lab Data and Comments

GRAIN SIZE DISTRIBUTION (%) (MIT): GR SA SI CL

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WATER LEVEL READINGS

Date	Water Depth (m)	Elevation (m)
Nov 7, 2016	2.2	74.6

Unstabilized water level measured at 1.2 m below ground surface; borehole caved to 23.5 m below ground surface upon completion of drilling.

50 mm dia. monitoring well installed.

file: 7-16-0090-01 pier 8 hamilton.gpj

ROCK CORE LOG 28

Project No. : 7-16-0090-01 | Client : The City of Hamilton | Originated by : AF

Date started : October 24, 2016 | Project : Pier 8 | Compiled by : GM

Sheet No. : 1 of 1 | Location : Hamilton, Ontario | Checked by : GM

Position : E: 592590, N: 4792239 (UTM 17T) | Elevation Datum : Geodetic (NAD83)

Rig type : CME 75, truck-mounted | Drilling Method : Solid stem augers

Depth (m)	Graphic Log	GENERAL DESCRIPTION	Run / Elev Depth (m)	Recovery	Elevation (m)	Shale Weathering Zones (Z1 Z2 Z3 Z4)	UCS (MPa) 5 25 50 100 250 / Estimated Strength (R1 R2 R3 R4 R5 R6)	Natural Fractures: Frequency	Natural Fractures: Spacing	Laboratory Testing	Comments	Elevation (m)
		Rock coring started at 28.6m below grade	48.1									
		QUEENSTON FORMATION **Shale**, reddish brown, thickly bedded to medium bedded, weak to medium strong, Limestone (20%), grey green interbeds, bedding normally 25 to 75mm with isolated beds of up to 100mm, weak to medium strength	28.6 R1 46.7	TCR = **96**% SCR = **93**% RQD = **34**%	48 47			5 8 0 3 3	close	**29.9m to 30.0m:** UCS = 43.6 MPa		48 47
29 30			30.0 R2 45.1	TCR = **100**% SCR = **100**% RQD = **79**%	46			3 0 0 0	mod. close	**31.2m to 31.3m:** UCS = 52.5 MPa	**30.2-30.3m:** *Sub-vertical Fracture*	46
31			**31.6m**									
		END OF COREHOLE										

Run 2@Depth 30.0m/Elev. 46.7↓



Run 1@Depth 28.5m/Elev. 48.1↑

file: 7-16-0090-01 pier 8 hamilton.gpj

LOG OF BOREHOLE 29

Terraprobe

Project No. : 7-16-0090-01 | Client : The City of Hamilton | Originated by : AF

Date started : June 29, 2017 | Project : Pier 8 | Compiled by : GM

Sheet No. : 1 of 1 | Location : Hamilton, Ontario | Checked by : GM

Position : E: 592774, N: 4791968 (UTM 17T) | Elevation Datum : Geodetic (NAD83)

Rig type : CME 75, truck-mounted | Drilling Method : Hollow stem augers

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Number	Type	SPT 'N' Value
0	76.5	**GROUND SURFACE**				
	76.2	100mm **ASPHALTIC CONCRETE**				
	0.3	100mm Concrete				
		FILL, construction debris, pieces of brick, asphalt, slag, ceramics, very loose, brownish black		1	SS	2
				2	SS	1
				3	SS	5
	73.6					
	2.9	**SILT to SANDY SILT**, trace clay, compact to dense, brown to grey		4	SS	8
				5	SS	30
				6	SS	26
	69.9					
	6.6	**END OF BOREHOLE**				

Unstabilized water level measured at 1.5 m below ground surface; borehole was open upon completion of drilling.

Elevation Scale (m): 76, 75, 74, 73, 72, 71, 70

Penetration Test Values (Blows / 0.3m): Dynamic Cone 10 20 30 40

Undrained Shear Strength (kPa): Unconfined, Pocket Penetrometer, Field Vane, Lab Vane — 40 80 120 160

Moisture / Plasticity: Plastic Limit (PL) | Natural Water Content (MC) | Liquid Limit (LL) — 10 20 30

Headspace Vapour (ppm)

Instrument Details

Unstabilized Water Level

Lab Data and Comments

GRAIN SIZE DISTRIBUTION (%) (MIT) — GR SA SI CL

file: 7-16-0090-01 pier 8 hamilton.gpj

LOG OF BOREHOLE 30

Terraprobe

Project No. : 7-16-0090-01 | Client : The City of Hamilton | Originated by : AF

Date started : June 29, 2017 | Project : Pier 8 | Compiled by : GM

Sheet No. : 1 of 1 | Location : Hamilton, Ontario | Checked by : GM

Position : E: 592729, N: 4792043 (UTM 17T) | Elevation Datum : Geodetic (NAD83)

Rig type : CME 75, truck-mounted | Drilling Method : Hollow stem augers

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Number	Type	SPT 'N' Value
0	76.4	**GROUND SURFACE**				
	76.1 / 0.3	60mm **ASPHALTIC CONCRETE**				
		FILL, Granular Base				
1	75.3 / 1.1	**FILL**, sandy silt, with traces of coal, compact, black		1	SS	10
		FILL, sandy silt to silty sand, with pieces of timber, very loose, brownish grey		2	SS	4
2				3	SS	WoH
3				4	SS	4
4	72.4 / 4.0	**ORGANIC SILT**, soft, brown to grey		5	SS	1
5				6	SS	2
6				7	SS	1
7				8	SS	3
8				9	SS	1
9				10	SS	11
10				11	SS	16
11						
12	64.5 / 11.9	**SILTY CLAY**, stiff to very stiff, grey to brown				
13						
14	62.2 / 14.2	**END OF BOREHOLE**				

Elevation Scale (m): 76, 75, 74, 73, 72, 71, 70, 69, 68, 67, 66, 65, 64, 63

Penetration Test Values (Blows / 0.3m): Dynamic Cone 10 20 30 40

Undrained Shear Strength (kPa): Unconfined, Pocket Penetrometer, Field Vane, Lab Vane — 40 80 120 160

Moisture / Plasticity: Plastic Limit (PL) | Natural Water Content (MC) | Liquid Limit (LL) — 10 20 30

Headspace Vapour (ppm): 75, 47

Instrument Details

Unstabilized Water Level

Lab Data and Comments

GRAIN SIZE DISTRIBUTION (%) (MIT): GR SA SI CL

Unstabilized water level measured at 1.5 m below ground surface; borehole was open upon completion of drilling.

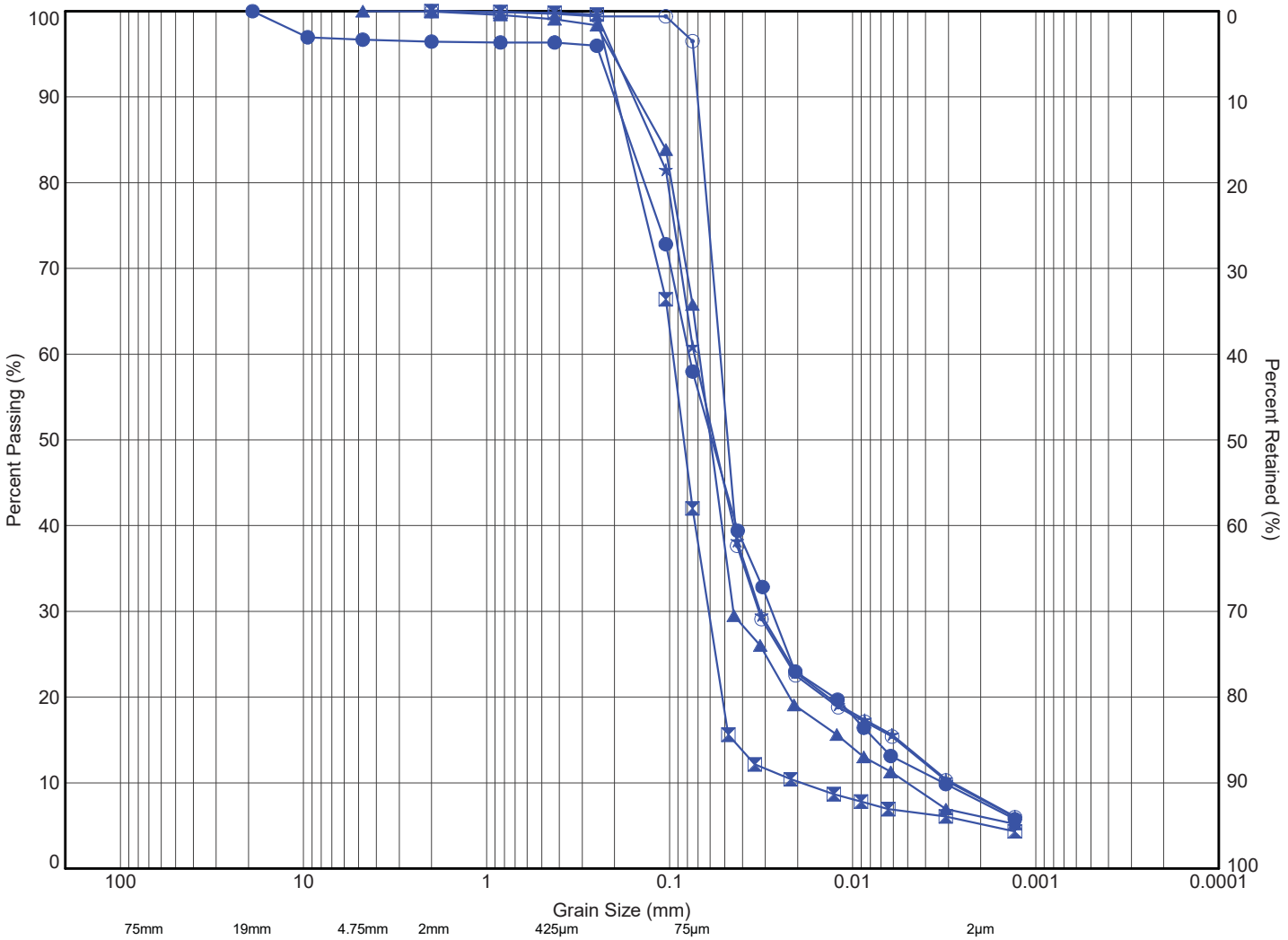
file: 7-16-0090-01 pier 8 hamilton.gpj

GEOTECHNICAL LABORATORY RESULTS

APPENDIX B



Terraprobe Inc.



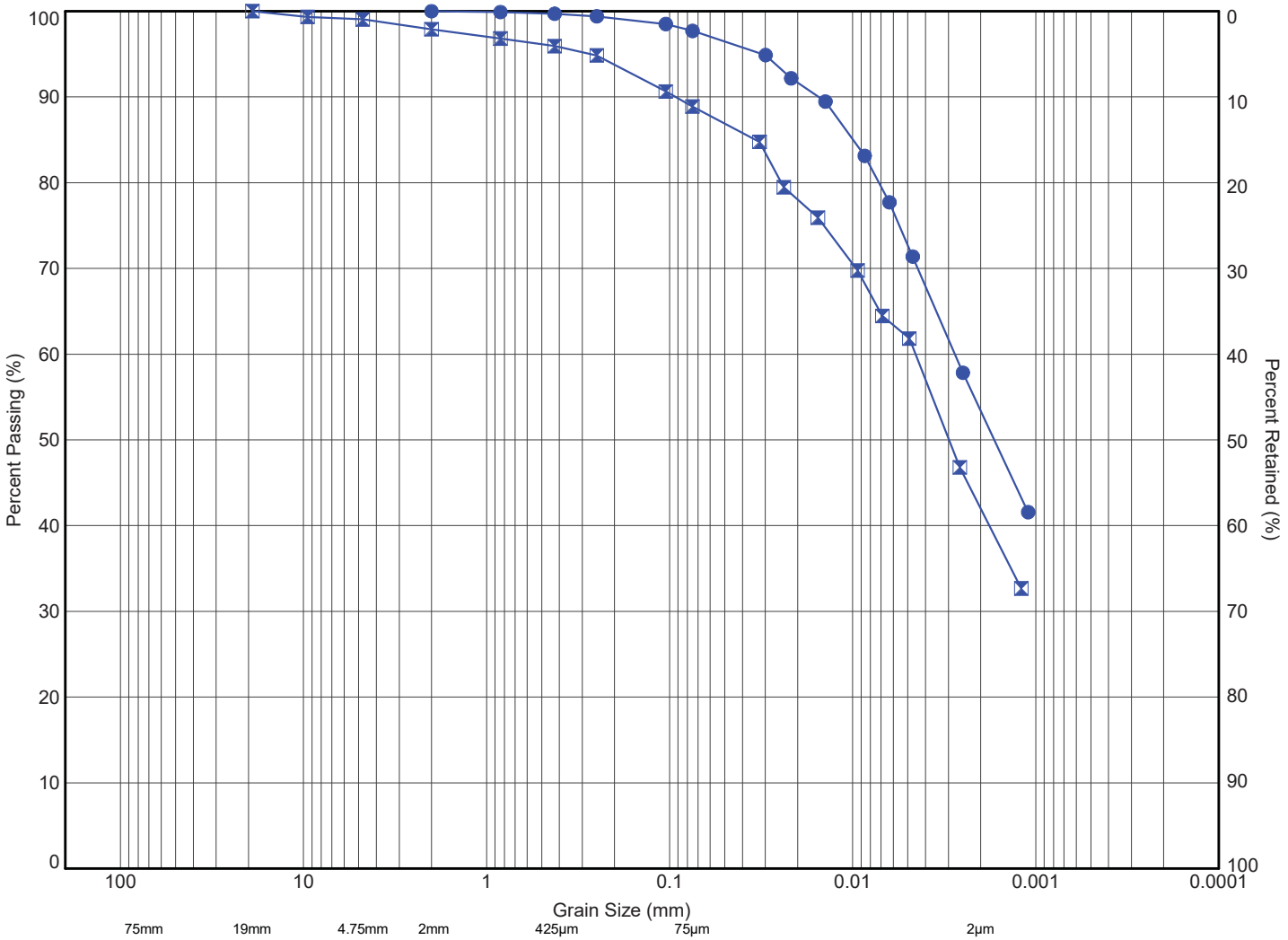
	Hole ID	Sample	Depth (m)	Elev. (m)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)	*(Fines, %)*
●	**5**	SS6	9.4	67.9	3	39	50	8	
⊠	**10**	SS12	15.5	61.3	0	58	37	5	
▲	**12**	SS7	10.9	65.8	0	34	60	6	
★	**12**	SS10	15.5	61.2	0	39	53	8	
⊙	**24**	SS6	4.8	72.8	0	4	88	8	

Sandy Silt & Silty Sand

Terraprobe
11 Indell Lane, Brampton Ontario L6T 3Y3
(905) 796-2650

Title: **GRAIN SIZE DISTRIBUTION** **FIGURE B1**

File No.: **7-16-0090-01**



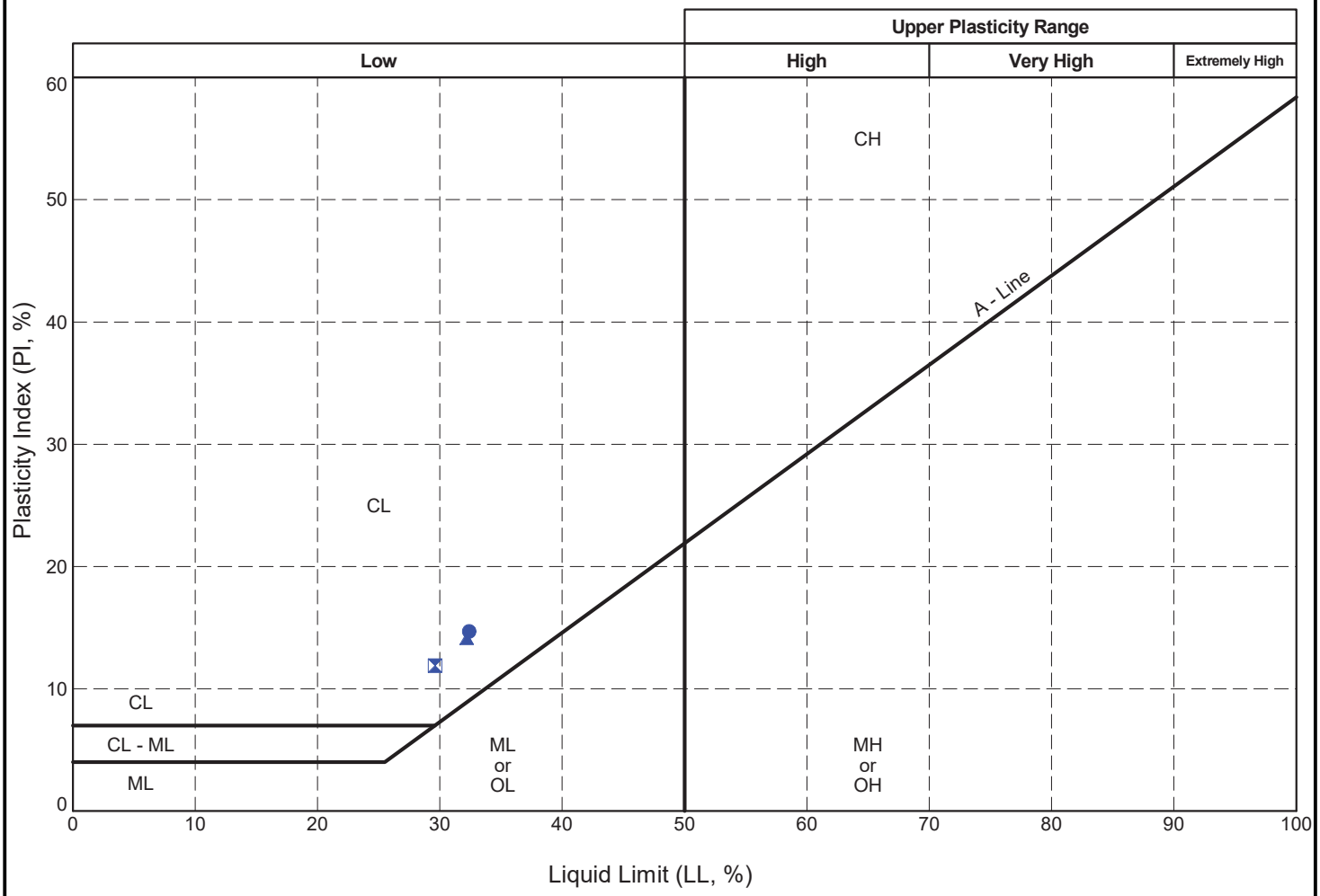
	Hole ID	Sample	Depth (m)	Elev. (m)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)	*(Fines, %)*
●	**5**	SS9	13.9	63.4	0	3	44	53	
⊠	**10**	SS15	20.0	56.7	1	10	47	42	

Silty Clay

Terraprobe
11 Indell Lane, Brampton Ontario L6T 3Y3
(905) 796-2650

Title: **GRAIN SIZE DISTRIBUTION** **FIGURE B2**

File No.: **7-16-0090-01**



	Borehole	Sample	Depth (m)	Elev. (m)	LL (%)	PL (%)	PI (%)
●	5	SS9	13.9	63.4	32	18	14
⊠	10	SS15	20.0	56.7	30	18	12
▲	10	SS18	24.6	52.1	32	18	14

Terraprobe
903 Barton Street, Unit 22, Stoney Creek ON L8E 5P5
(905) 643-7560

Title: **ATTERBERG LIMITS CHART** **FIGURE B3**

File No.: **7-16-0090-01**

CERTIFICATES OF ANALYSES AND QUALITY ASSURANCE REPORT - SOIL

APPENDIX C

Terraprobe Inc.

AGAT Laboratories

5835 COOPERS AVENUE
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FAX (905)712-5122
http://www.agatlabs.com

CLIENT NAME: TERRAPROBE INC
903 Barton Street
Stoney Creek, ON L8E5P5
(905) 643-7560

ATTENTION TO: Garry Muckle

PROJECT: 7-16-0090-01

AGAT WORK ORDER: 16H123484

SOIL ANALYSIS REVIEWED BY: Parvathi Malemath, Data Reviewer

TRACE ORGANICS REVIEWED BY: Oksana Gushyla, Trace Organics Lab Supervisor

DATE REPORTED: Aug 11, 2016

PAGES (INCLUDING COVER): 14

VERSION*: 1

Should you require any information regarding this analysis please contact your client services representative at (905) 712-5100

*NOTES

All samples will be disposed of within 30 days following analysis. Please contact the lab if you require additional sample storage time.

Member of: Association of Professional Engineers, Geologists and Geophysicists of Alberta (APEGGA)
Western Enviro-Agricultural Laboratory Association (WEALA)
Environmental Services Association of Alberta (ESAA)

AGAT Laboratories is accredited to ISO/IEC 17025 by the Canadian Association for Laboratory Accreditation Inc. (CALA) and/or Standards Council of Canada (SCC) for specific tests listed on the scope of accreditation. AGAT Laboratories (Mississauga) is also accredited by the Canadian Association for Laboratory Accreditation Inc. (CALA) for specific drinking water tests. Accreditations are location and parameter specific. A complete listing of parameters for each location is available from www.cala.ca and/or www.scc.ca. The tests in this report may not necessarily be included in the scope of accreditation.

Results relate only to the items tested and to all the items tested
All reportable information as specified by ISO 17025:2005 is available from AGAT Laboratories upon request

AGAT Laboratories

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http://www.agatlabs.com

Certificate of Analysis

AGAT WORK ORDER: 16H123484

PROJECT: 7-16-0090-01

CLIENT NAME: TERRAPROBE INC

ATTENTION TO: Garry Muckle

SAMPLING SITE:

SAMPLED BY:

O. Reg. 153(511) - Metals & Inorganics (Soil)

DATE RECEIVED: 2016-08-05

DATE REPORTED: 2016-08-11

		SAMPLE DESCRIPTION:		BH10/SA2	BH10/SA13	BH11/SA2	BH11/SA7	BH5/SA5
		SAMPLE TYPE:		Soil	Soil	Soil	Soil	Soil
		DATE SAMPLED:		8/3/2016	8/3/2016	8/4/2016	8/4/2016	8/4/2016
Parameter	Unit	G / S	RDL	7754339	7754358	7754371	7754378	7754386
Antimony	µg/g		0.8	2.6	<0.8	<0.8	<0.8	<0.8
Arsenic	µg/g		1	8	3	4	2	3
Barium	µg/g		2	116	37	129	22	53
Beryllium	µg/g		0.5	0.7	<0.5	0.8	<0.5	<0.5
Boron	µg/g		5	14	6	14	5	<5
Boron (Hot Water Soluble)	µg/g		0.10	2.57	0.36	0.63	0.20	0.25
Cadmium	µg/g		0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Chromium	µg/g		2	21	9	25	7	7
Chromium VI	µg/g		0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Cobalt	µg/g		0.5	9.6	6.1	10.9	4.5	4.1
Copper	µg/g		1	72	13	22	11	8
Cyanide	µg/g		0.040	<0.040	<0.040	<0.040	<0.040	<0.040
Electrical Conductivity	mS/cm		0.005	0.443	0.391	0.361	0.181	0.234
Lead	µg/g		1	164	6	15	5	3
Mercury	µg/g		0.10	0.19	<0.10	<0.10	<0.10	<0.10
Molybdenum	µg/g		0.5	0.9	<0.5	<0.5	<0.5	<0.5
Nickel	µg/g		1	20	10	22	7	5
Selenium	µg/g		0.4	0.5	<0.4	<0.4	<0.4	<0.4
Silver	µg/g		0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Sodium Adsorption Ratio	NA		NA	1.32	1.71	3.52	0.604	0.490
Thallium	µg/g		0.4	<0.4	<0.4	<0.4	<0.4	<0.4
Uranium	µg/g		0.5	0.6	<0.5	0.8	<0.5	<0.5
Vanadium	µg/g		1	27	15	33	13	12
Zinc	µg/g		5	206	33	59	25	29
pH, 2:1 CaCl2 Extraction	pH Units		NA	9.48	7.64	8.18	7.68	7.43

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

7754339-7754386 EC & SAR were determined on the DI water extract obtained from the 2:1 leaching procedure (2 parts DI water:1 part soil). pH was determined on the 0.01M CaCl2 extract prepared at 2:1 ratio.

Certified By:



Results relate only to the items tested and to all the items tested

AGAT Laboratories

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Certificate of Analysis

AGAT WORK ORDER: 16H123484

PROJECT: 7-16-0090-01

CLIENT NAME: TERRAPROBE INC

ATTENTION TO: Garry Muckle

SAMPLING SITE:

SAMPLED BY:

O. Reg. 153(511) - PAHs (Soil)

DATE RECEIVED: 2016-08-05

DATE REPORTED: 2016-08-11

		SAMPLE DESCRIPTION:		BH10/SA2	BH10/SA13	BH11/SA2	BH11/SA7	BH5/SA5
		SAMPLE TYPE:		Soil	Soil	Soil	Soil	Soil
		DATE SAMPLED:		8/3/2016	8/3/2016	8/4/2016	8/4/2016	8/4/2016
Parameter	**Unit**	**G / S**	**RDL**	**7754339**	**7754358**	**7754371**	**7754378**	**7754386**
Acenaphthene	µg/g		0.05	<0.05	0.07	<0.05	<0.05	<0.05
Acenaphthylene	µg/g		0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Anthracene	µg/g		0.05	0.16	0.14	<0.05	<0.05	<0.05
Benz(a)anthracene	µg/g		0.05	0.30	0.12	<0.05	<0.05	<0.05
Benzo(a)pyrene	µg/g		0.05	0.46	0.18	<0.05	<0.05	<0.05
Benzo(b)fluoranthene	µg/g		0.05	0.65	0.27	<0.05	<0.05	<0.05
Benzo(g,h,i)perylene	µg/g		0.05	0.32	0.12	<0.05	<0.05	<0.05
Benzo(k)fluoranthene	µg/g		0.05	0.32	0.13	<0.05	<0.05	<0.05
Chrysene	µg/g		0.05	0.30	0.13	<0.05	<0.05	<0.05
Dibenz(a,h)anthracene	µg/g		0.05	0.05	<0.05	<0.05	<0.05	<0.05
Fluoranthene	µg/g		0.05	0.85	0.56	<0.05	<0.05	<0.05
Fluorene	µg/g		0.05	0.08	0.09	<0.05	<0.05	<0.05
Indeno(1,2,3-cd)pyrene	µg/g		0.05	0.28	0.10	<0.05	<0.05	<0.05
Moisture Content	%		0.1	11.3	18.6	13.4	20.9	22.8
Naphthalene	µg/g		0.05	0.05	0.15	<0.05	<0.05	<0.05
Phenanthrene	µg/g		0.05	0.62	0.59	<0.05	<0.05	<0.05
Pyrene	µg/g		0.05	0.73	0.41	<0.05	<0.05	<0.05
2-and 1-methyl Naphthalene	µg/g		0.05	0.06	<0.05	<0.05	<0.05	<0.05
Surrogate	**Unit**	**Acceptable Limits**						
Chrysene-d12	%	50-140		64	83	58	66	74

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

7754339-7754386 Results are based on the dry weight of the soil.
Note: The result for Benzo(b)Fluoranthene is the total of the Benzo(b)&(j)Fluoranthene isomers because the isomers co-elute on the GC column.

Certified By:

Results relate only to the items tested and to all the items tested

AGAT Laboratories

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Certificate of Analysis

AGAT WORK ORDER: 16H123484

PROJECT: 7-16-0090-01

CLIENT NAME: TERRAPROBE INC

ATTENTION TO: Garry Muckle

SAMPLING SITE:

SAMPLED BY:

O. Reg. 153(511) - PCBs (Soil)

DATE RECEIVED: 2016-08-05

DATE REPORTED: 2016-08-11

		SAMPLE DESCRIPTION:		BH10/SA2	BH10/SA13	BH11/SA2	BH11/SA7	BH5/SA5
		SAMPLE TYPE:		Soil	Soil	Soil	Soil	Soil
		DATE SAMPLED:		8/3/2016	8/3/2016	8/4/2016	8/4/2016	8/4/2016
Parameter	**Unit**	**G / S**	**RDL**	**7754339**	**7754358**	**7754371**	**7754378**	**7754386**
Aroclor 1242	µg/g		0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1248	µg/g		0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1254	µg/g		0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1260	µg/g		0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Polychlorinated Biphenyls	µg/g		0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Surrogate	**Unit**	**Acceptable Limits**						
Decachlorobiphenyl	%	60-140		96	60	84	96	84

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

7754339-7754386 Results are based on the dry weight of soil extracted.

Certified By:

Results relate only to the items tested and to all the items tested

AGAT Laboratories

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AGAT WORK ORDER: 16H123484

PROJECT: 7-16-0090-01

CLIENT NAME: TERRAPROBE INC

ATTENTION TO: Garry Muckle

SAMPLING SITE:

SAMPLED BY:

O. Reg. 153(511) - PHCs F1 - F4 (with PAHs) (Soil)

DATE RECEIVED: 2016-08-05

DATE REPORTED: 2016-08-11

		SAMPLE DESCRIPTION:		BH10/SA2	BH10/SA13	BH11/SA2	BH11/SA7	BH5/SA5
		SAMPLE TYPE:		Soil	Soil	Soil	Soil	Soil
		DATE SAMPLED:		8/3/2016	8/3/2016	8/4/2016	8/4/2016	8/4/2016
Parameter	**Unit**	**G / S**	**RDL**	**7754339**	**7754358**	**7754371**	**7754378**	**7754386**
F1 (C6 to C10)	µg/g		5	<5	<5	<5	<5	<5
F1 (C6 to C10) minus BTEX	µg/g		5	<5	<5	<5	<5	<5
F2 (C10 to C16)	µg/g		10	<10	<10	<10	<10	<10
F2 (C10 to C16) minus Naphthalene	µg/g		10	<10	<10	<10	<10	<10
F3 (C16 to C34)	µg/g		50	220	<50	220	<50	<50
F3 (C16 to C34) minus PAHs	µg/g		50	220	<50	220	<50	<50
F4 (C34 to C50)	µg/g		50	71	<50	<50	<50	<50
Gravimetric Heavy Hydrocarbons	µg/g		50	NA	NA	NA	NA	NA
Moisture Content	%		0.1	11.3	19.3	13.4	20.9	22.8
Surrogate	**Unit**	**Acceptable Limits**						
Terphenyl	%	60-140		110	108	105	103	100

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

7754339-7754386 Results are based on sample dry weight.
The C6-C10 fraction is calculated using toluene response factor.
The C10 - C16, C16 - C34, and C34 - C50 fractions are calculated using the average response factor for n-C10, n-C16, and n-C34.
Gravimetric Heavy Hydrocarbons are not included in the Total C16-C50 and are only determined if the chromatogram of the C34 - C50 hydrocarbons indicates that hydrocarbons >C50 are present.
The chromatogram has returned to baseline by the retention time of nC50.
Total C6 - C50 results are corrected for BTEX and PAH contributions.
This method complies with the Reference Method for the CWS PHC and is validated for use in the laboratory.
nC6 and nC10 response factors are within 30% of Toluene response factor.
nC10, nC16 and nC34 response factors are within 10% of their average.
C50 response factor is within 70% of nC10 + nC16 + nC34 average.
Linearity is within 15%.
Extraction and holding times were met for this sample.

Certified By:

Results relate only to the items tested and to all the items tested

AGAT Laboratories

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Certificate of Analysis

AGAT WORK ORDER: 16H123484

PROJECT: 7-16-0090-01

CLIENT NAME: TERRAPROBE INC

ATTENTION TO: Garry Muckle

SAMPLING SITE:

SAMPLED BY:

O. Reg. 153(511) - VOCs (Soil)

DATE RECEIVED: 2016-08-05

DATE REPORTED: 2016-08-11

		SAMPLE DESCRIPTION:		BH10/SA2	BH10/SA13	BH11/SA2	BH11/SA7	BH5/SA5
		SAMPLE TYPE:		Soil	Soil	Soil	Soil	Soil
		DATE SAMPLED:		8/3/2016	8/3/2016	8/4/2016	8/4/2016	8/4/2016
Parameter	Unit	G / S	RDL	7754339	7754358	7754371	7754378	7754386
Acetone	ug/g		0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Benzene	ug/g		0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Bromodichloromethane	ug/g		0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Bromoform	ug/g		0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Bromomethane	ug/g		0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Carbon Tetrachloride	ug/g		0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Chlorobenzene	ug/g		0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Chloroform	ug/g		0.04	<0.04	<0.04	<0.04	<0.04	<0.04
Cis- 1,2-Dichloroethylene	ug/g		0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Dibromochloromethane	ug/g		0.05	<0.05	<0.05	<0.05	<0.05	<0.05
1,3-Dichlorobenzene	ug/g		0.05	<0.05	<0.05	<0.05	<0.05	<0.05
1,2-Dichlorobenzene	ug/g		0.05	<0.05	<0.05	<0.05	<0.05	<0.05
1,4-Dichlorobenzene	ug/g		0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Dichlorodifluoromethane	µg/g		0.05	<0.05	<0.05	<0.05	<0.05	<0.05
1,1-Dichloroethane	ug/g		0.02	<0.02	<0.02	<0.02	<0.02	<0.02
1,2-Dichloroethane	ug/g		0.03	<0.03	<0.03	<0.03	<0.03	<0.03
1,1-Dichloroethylene	ug/g		0.05	<0.05	<0.05	<0.05	<0.05	<0.05
1,2-Dichloropropane	ug/g		0.03	<0.03	<0.03	<0.03	<0.03	<0.03
1,3-Dichloropropene	µg/g		0.04	<0.04	<0.04	<0.04	<0.04	<0.04
Ethylbenzene	ug/g		0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Ethylene Dibromide	ug/g		0.04	<0.04	<0.04	<0.04	<0.04	<0.04
Methyl Ethyl Ketone	ug/g		0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Methyl Isobutyl Ketone	ug/g		0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Methyl tert-butyl Ether	ug/g		0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Methylene Chloride	ug/g		0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Styrene	ug/g		0.05	<0.05	<0.05	<0.05	<0.05	<0.05
1,1,2,2-Tetrachloroethane	ug/g		0.05	<0.05	<0.05	<0.05	<0.05	<0.05
1,1,1,2-Tetrachloroethane	ug/g		0.04	<0.04	<0.04	<0.04	<0.04	<0.04
Tetrachloroethylene	ug/g		0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Toluene	ug/g		0.05	<0.05	<0.05	<0.05	<0.05	<0.05

Certified By:

Results relate only to the items tested and to all the items tested

AGAT Laboratories

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Certificate of Analysis

AGAT WORK ORDER: 16H123484

PROJECT: 7-16-0090-01

CLIENT NAME: TERRAPROBE INC

ATTENTION TO: Garry Muckle

SAMPLING SITE:

SAMPLED BY:

O. Reg. 153(511) - VOCs (Soil)

DATE RECEIVED: 2016-08-05

DATE REPORTED: 2016-08-11

		SAMPLE DESCRIPTION:		BH10/SA2	BH10/SA13	BH11/SA2	BH11/SA7	BH5/SA5
		SAMPLE TYPE:		Soil	Soil	Soil	Soil	Soil
		DATE SAMPLED:		8/3/2016	8/3/2016	8/4/2016	8/4/2016	8/4/2016
Parameter	**Unit**	**G / S**	**RDL**	**7754339**	**7754358**	**7754371**	**7754378**	**7754386**
Trans- 1,2-Dichloroethylene	ug/g		0.05	<0.05	<0.05	<0.05	<0.05	<0.05
1,1,1-Trichloroethane	ug/g		0.05	<0.05	<0.05	<0.05	<0.05	<0.05
1,1,2-Trichloroethane	ug/g		0.04	<0.04	<0.04	<0.04	<0.04	<0.04
Trichloroethylene	ug/g		0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Trichlorofluoromethane	ug/g		0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Vinyl Chloride	ug/g		0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Xylene Mixture	ug/g		0.05	<0.05	<0.05	<0.05	<0.05	<0.05
m & p-Xylene	ug/g		0.05	<0.05	<0.05	<0.05	<0.05	<0.05
n-Hexane	µg/g		0.05	<0.05	<0.05	<0.05	<0.05	<0.05
o-Xylene	ug/g		0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Surrogate	**Unit**	**Acceptable Limits**						
4-Bromofluorobenzene	% Recovery	50-140		91	84	87	93	89
Toluene-d8	% Recovery	50-140		100	100	108	104	99

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

7754339-7754386 The sample was analysed using the high level technique. The sample was extracted using methanol, a small amount of the methanol extract was diluted in water and the purge & trap GC/MS analysis was performed. Results are based on the dry weight of the soil.

Certified By:

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Quality Assurance

CLIENT NAME: TERRAPROBE INC

AGAT WORK ORDER: 16H123484

PROJECT: 7-16-0090-01

ATTENTION TO: Garry Muckle

SAMPLING SITE:

SAMPLED BY:

Soil Analysis

RPT Date: Aug 11, 2016			DUPLICATE				REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
O. Reg. 153(511) - Metals & Inorganics (Soil)															
Antimony	7754339	7754339	2.6	2.3	NA	< 0.8	110%	70%	130%	101%	80%	120%	92%	70%	130%
Arsenic	7754339	7754339	8	8	0.0%	< 1	111%	70%	130%	104%	80%	120%	98%	70%	130%
Barium	7754339	7754339	116	111	4.4%	< 2	97%	70%	130%	94%	80%	120%	86%	70%	130%
Beryllium	7754339	7754339	0.7	0.7	NA	< 0.5	117%	70%	130%	116%	80%	120%	95%	70%	130%
Boron	7754339	7754339	14	14	NA	< 5	76%	70%	130%	107%	80%	120%	88%	70%	130%
Boron (Hot Water Soluble)	7754339	7754339	2.57	2.68	4.2%	< 0.10	96%	60%	140%	94%	70%	130%	99%	60%	140%
Cadmium	7754339	7754339	<0.5	<0.5	NA	< 0.5	98%	70%	130%	103%	80%	120%	90%	70%	130%
Chromium	7754339	7754339	21	19	10.0%	< 2	85%	70%	130%	101%	80%	120%	89%	70%	130%
Chromium VI	7752762		<0.2	<0.2	NA	< 0.2	99%	70%	130%	92%	80%	120%	94%	70%	130%
Cobalt	7754339	7754339	9.6	8.8	8.7%	< 0.5	93%	70%	130%	100%	80%	120%	90%	70%	130%
Copper	7754339	7754339	72	65	10.2%	< 1	94%	70%	130%	106%	80%	120%	87%	70%	130%
Cyanide	7754464		<0.040	<0.040	NA	< 0.040	107%	70%	130%	100%	80%	120%	104%	70%	130%
Electrical Conductivity	7754339	7754339	0.443	0.443	0.0%	< 0.005	99%	90%	110%	NA			NA		
Lead	7754339	7754339	164	165	0.6%	< 1	104%	70%	130%	106%	80%	120%	89%	70%	130%
Mercury	7754339	7754339	0.19	0.19	NA	< 0.10	120%	70%	130%	93%	80%	120%	86%	70%	130%
Molybdenum	7754339	7754339	0.9	0.8	NA	< 0.5	102%	70%	130%	107%	80%	120%	102%	70%	130%
Nickel	7754339	7754339	20	19	5.1%	< 1	93%	70%	130%	97%	80%	120%	88%	70%	130%
Selenium	7754339	7754339	0.5	<0.4	NA	< 0.4	107%	70%	130%	102%	80%	120%	94%	70%	130%
Silver	7754339	7754339	<0.2	<0.2	NA	< 0.2	100%	70%	130%	108%	80%	120%	94%	70%	130%
Sodium Adsorption Ratio	7754339	7754339	1.32	1.32	0.0%	NA	NA			NA			NA		
Thallium	7754339	7754339	<0.4	<0.4	NA	< 0.4	99%	70%	130%	98%	80%	120%	90%	70%	130%
Uranium	7754339	7754339	0.6	0.6	NA	< 0.5	96%	70%	130%	95%	80%	120%	87%	70%	130%
Vanadium	7754339	7754339	27	25	7.7%	< 1	90%	70%	130%	94%	80%	120%	87%	70%	130%
Zinc	7754339	7754339	206	204	1.0%	< 5	102%	70%	130%	110%	80%	120%	94%	70%	130%
pH, 2:1 CaCl2 Extraction	7754464		7.86	7.85	0.1%	NA	101%	80%	120%	NA			NA		

Comments: NA signifies Not Applicable.
Duplicate Qualifier: As the measured result approaches the RL (Reporting Limit), the uncertainty associated with the value increases dramatically, thus duplicate acceptance limits apply only where the average of the two duplicates is greater than five times the RL.

Certified By:



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Quality Assurance

CLIENT NAME: TERRAPROBE INC

AGAT WORK ORDER: 16H123484

PROJECT: 7-16-0090-01

ATTENTION TO: Garry Muckle

SAMPLING SITE:

SAMPLED BY:

Trace Organics Analysis

RPT Date: Aug 11, 2016

PARAMETER	Batch	Sample Id	DUPLICATE			Method Blank	REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
			Dup #1	Dup #2	RPD		Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
O. Reg. 153(511) - VOCs (Soil)															
Acetone	7754683		< 0.50	< 0.50	NA	< 0.50	70%	50%	140%	91%	50%	140%	89%	50%	140%
Benzene	7754683		< 0.02	< 0.02	NA	< 0.02	81%	50%	140%	99%	60%	130%	105%	50%	140%
Bromodichloromethane	7754683		< 0.05	< 0.05	NA	< 0.05	88%	50%	140%	82%	60%	130%	68%	50%	140%
Bromoform	7754683		< 0.05	< 0.05	NA	< 0.05	67%	50%	140%	75%	60%	130%	83%	50%	140%
Bromomethane	7754683		< 0.05	< 0.05	NA	< 0.05	83%	50%	140%	103%	50%	140%	97%	50%	140%
Carbon Tetrachloride	7754683		< 0.05	< 0.05	NA	< 0.05	79%	50%	140%	84%	60%	130%	81%	50%	140%
Chlorobenzene	7754683		< 0.05	< 0.05	NA	< 0.05	72%	50%	140%	82%	60%	130%	90%	50%	140%
Chloroform	7754683		< 0.04	< 0.04	NA	< 0.04	98%	50%	140%	92%	60%	130%	99%	50%	140%
Cis- 1,2-Dichloroethylene	7754683		< 0.02	< 0.02	NA	< 0.02	79%	50%	140%	98%	60%	130%	106%	50%	140%
Dibromochloromethane	7754683		< 0.05	< 0.05	NA	< 0.05	83%	50%	140%	93%	60%	130%	111%	50%	140%
1,3-Dichlorobenzene	7754683		< 0.05	< 0.05	NA	< 0.05	92%	50%	140%	97%	60%	130%	81%	50%	140%
1,2-Dichlorobenzene	7754683		< 0.05	< 0.05	NA	< 0.05	98%	50%	140%	86%	60%	130%	84%	50%	140%
1,4-Dichlorobenzene	7754683		< 0.05	< 0.05	NA	< 0.05	99%	50%	140%	76%	60%	130%	81%	50%	140%
Dichlorodifluoromethane	7754683		< 0.05	< 0.05	NA	< 0.05	100%	50%	140%	102%	50%	140%	91%	50%	140%
1,1-Dichloroethane	7754683		< 0.02	< 0.02	NA	< 0.02	88%	50%	140%	107%	60%	130%	108%	50%	140%
1,2-Dichloroethane	7754683		< 0.03	< 0.03	NA	< 0.03	81%	50%	140%	89%	60%	130%	93%	50%	140%
1,1-Dichloroethylene	7754683		< 0.05	< 0.05	NA	< 0.05	104%	50%	140%	113%	60%	130%	103%	50%	140%
1,2-Dichloropropane	7754683		< 0.03	< 0.03	NA	< 0.03	102%	50%	140%	81%	60%	130%	87%	50%	140%
1,3-Dichloropropene	7754683		< 0.04	< 0.04	NA	< 0.04	81%	50%	140%	97%	60%	130%	93%	50%	140%
Ethylbenzene	7754683		< 0.05	< 0.05	NA	< 0.05	93%	50%	140%	92%	60%	130%	85%	50%	140%
Ethylene Dibromide	7754683		< 0.04	< 0.04	NA	< 0.04	103%	50%	140%	81%	60%	130%	83%	50%	140%
Methyl Ethyl Ketone	7754683		< 0.50	< 0.50	NA	< 0.50	100%	50%	140%	89%	50%	140%	101%	50%	140%
Methyl Isobutyl Ketone	7754683		< 0.50	< 0.50	NA	< 0.50	100%	50%	140%	96%	50%	140%	86%	50%	140%
Methyl tert-butyl Ether	7754683		< 0.05	< 0.05	NA	< 0.05	82%	50%	140%	105%	60%	130%	106%	50%	140%
Methylene Chloride	7754683		< 0.05	< 0.05	NA	< 0.05	83%	50%	140%	111%	60%	130%	110%	50%	140%
Styrene	7754683		< 0.05	< 0.05	NA	< 0.05	68%	50%	140%	86%	60%	130%	84%	50%	140%
1,1,2,2-Tetrachloroethane	7754683		< 0.05	< 0.05	NA	< 0.05	103%	50%	140%	93%	60%	130%	87%	50%	140%
1,1,1,2-Tetrachloroethane	7754683		< 0.04	< 0.04	NA	< 0.04	103%	50%	140%	82%	60%	130%	99%	50%	140%
Tetrachloroethylene	7754683		< 0.05	< 0.05	NA	< 0.05	66%	50%	140%	77%	60%	130%	97%	50%	140%
Toluene	7754683		< 0.05	< 0.05	NA	< 0.05	83%	50%	140%	81%	60%	130%	93%	50%	140%
Trans- 1,2-Dichloroethylene	7754683		< 0.05	< 0.05	NA	< 0.05	101%	50%	140%	101%	60%	130%	98%	50%	140%
1,1,1-Trichloroethane	7754683		< 0.05	< 0.05	NA	< 0.05	102%	50%	140%	86%	60%	130%	92%	50%	140%
1,1,2-Trichloroethane	7754683		< 0.04	< 0.04	NA	< 0.04	109%	50%	140%	83%	60%	130%	79%	50%	140%
Trichloroethylene	7754683		< 0.03	< 0.03	NA	< 0.03	78%	50%	140%	94%	60%	130%	104%	50%	140%
Trichlorofluoromethane	7754683		< 0.05	< 0.05	NA	< 0.05	104%	50%	140%	96%	50%	140%	107%	50%	140%
Vinyl Chloride	7754683		< 0.02	< 0.02	NA	< 0.02	104%	50%	140%	98%	50%	140%	98%	50%	140%
m & p-Xylene	7754683		< 0.05	< 0.05	NA	< 0.05	90%	50%	140%	83%	60%	130%	88%	50%	140%
n-Hexane	7754683		< 0.05	< 0.05	NA	< 0.05	76%	50%	140%	93%	60%	130%	88%	50%	140%
o-Xylene	7754683		< 0.05	< 0.05	NA	< 0.05	85%	50%	140%	85%	60%	130%	86%	50%	140%

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Quality Assurance

CLIENT NAME: TERRAPROBE INC

AGAT WORK ORDER: 16H123484

PROJECT: 7-16-0090-01

ATTENTION TO: Garry Muckle

SAMPLING SITE:

SAMPLED BY:

Trace Organics Analysis (Continued)

RPT Date: Aug 11, 2016			DUPLICATE				REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
O. Reg. 153(511) - PHCs F1 - F4 (with PAHs) (Soil)															
F1 (C6 to C10)	7751550		< 5	< 5	NA	< 5	80%	60%	130%	93%	85%	115%	89%	70%	130%
F2 (C10 to C16)	7754512		< 10	< 10	NA	< 10	99%	60%	130%	91%	80%	120%	88%	70%	130%
F3 (C16 to C34)	7754512		< 50	< 50	NA	< 50	115%	60%	130%	102%	80%	120%	101%	70%	130%
F4 (C34 to C50)	7754512		< 50	< 50	NA	< 50	111%	60%	130%	111%	80%	120%	113%	70%	130%
O. Reg. 153(511) - PAHs (Soil)															
Acenaphthene	7752607		< 0.05	< 0.05	NA	< 0.05	94%	50%	140%	84%	50%	140%	82%	50%	140%
Acenaphthylene	7752607		< 0.05	< 0.05	NA	< 0.05	96%	50%	140%	87%	50%	140%	85%	50%	140%
Anthracene	7752607		< 0.05	< 0.05	NA	< 0.05	104%	50%	140%	92%	50%	140%	91%	50%	140%
Benz(a)anthracene	7752607		< 0.05	< 0.05	NA	< 0.05	68%	50%	140%	59%	50%	140%	72%	50%	140%
Benzo(a)pyrene	7752607		< 0.05	< 0.05	NA	< 0.05	131%	50%	140%	103%	50%	140%	104%	50%	140%
Benzo(b)fluoranthene	7752607		< 0.05	< 0.05	NA	< 0.05	104%	50%	140%	87%	50%	140%	100%	50%	140%
Benzo(g,h,i)perylene	7752607		< 0.05	< 0.05	NA	< 0.05	118%	50%	140%	108%	50%	140%	97%	50%	140%
Benzo(k)fluoranthene	7752607		< 0.05	< 0.05	NA	< 0.05	135%	50%	140%	130%	50%	140%	131%	50%	140%
Chrysene	7752607		< 0.05	< 0.05	NA	< 0.05	99%	50%	140%	72%	50%	140%	78%	50%	140%
Dibenz(a,h)anthracene	7752607		< 0.05	< 0.05	NA	< 0.05	92%	50%	140%	97%	50%	140%	93%	50%	140%
Fluoranthene	7752607		< 0.05	< 0.05	NA	< 0.05	99%	50%	140%	82%	50%	140%	87%	50%	140%
Fluorene	7752607		< 0.05	< 0.05	NA	< 0.05	99%	50%	140%	92%	50%	140%	90%	50%	140%
Indeno(1,2,3-cd)pyrene	7752607		< 0.05	< 0.05	NA	< 0.05	94%	50%	140%	94%	50%	140%	89%	50%	140%
Naphthalene	7752607		< 0.05	< 0.05	NA	< 0.05	94%	50%	140%	92%	50%	140%	87%	50%	140%
Phenanthrene	7752607		< 0.05	< 0.05	NA	< 0.05	90%	50%	140%	80%	50%	140%	81%	50%	140%
Pyrene	7752607		< 0.05	< 0.05	NA	< 0.05	96%	50%	140%	81%	50%	140%	87%	50%	140%
2-and 1-methyl Naphthalene	7752607		< 0.05	< 0.05	NA	< 0.05	109%	50%	140%	80%	50%	140%	77%	50%	140%
O. Reg. 153(511) - PCBs (Soil)															
Aroclor 1242	7755410		< 0.1	< 0.1	NA	< 0.1	NA	60%	140%	NA	60%	140%	NA	60%	140%
Aroclor 1248	7755410		< 0.1	< 0.1	NA	< 0.1	NA	60%	140%	NA	60%	140%	NA	60%	140%
Aroclor 1254	7755410		< 0.1	< 0.1	NA	< 0.1	NA	60%	140%	NA	60%	140%	NA	60%	140%
Aroclor 1260	7755410		< 0.1	< 0.1	NA	< 0.1	NA	60%	140%	NA	60%	140%	NA	60%	140%
Polychlorinated Biphenyls	7755410		< 0.1	< 0.1	NA	< 0.1	107%	60%	140%	94%	60%	140%	112%	60%	140%

Comments: When the average of the sample and duplicate results is less than 5x the RDL, the Relative Percent Difference (RPD) will be indicated as Not Applicable (NA).

Certified By:

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Method Summary

CLIENT NAME: TERRAPROBE INC

AGAT WORK ORDER: 16H123484

PROJECT: 7-16-0090-01

ATTENTION TO: Garry Muckle

SAMPLING SITE:

SAMPLED BY:

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Soil Analysis			
Antimony	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Arsenic	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Barium	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Beryllium	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Boron	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Boron (Hot Water Soluble)	MET-93-6104	EPA SW 846 6010C; MSA, Part 3, Ch.21	ICP/OES
Cadmium	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Chromium	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Chromium VI	INOR-93-6029	SM 3500 B; MSA Part 3, Ch. 25	SPECTROPHOTOMETER
Cobalt	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Copper	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Cyanide	INOR-93-6052	MOE CN-3015 & E 3009 A;SM 4500 CN	TECHNICON AUTO ANALYZER
Electrical Conductivity	INOR-93-6036	McKeague 4.12, SM 2510 B	EC METER
Lead	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Mercury	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Molybdenum	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Nickel	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Selenium	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Silver	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Sodium Adsorption Ratio	INOR-93-6007	McKeague 4.12 & 3.26 & EPA SW-846 6010B	ICP/OES
Thallium	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Uranium	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Vanadium	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Zinc	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
pH, 2:1 CaCl2 Extraction	INOR-93-6031	MSA part 3 & SM 4500-H+ B	PH METER

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Method Summary

CLIENT NAME: TERRAPROBE INC

AGAT WORK ORDER: 16H123484

PROJECT: 7-16-0090-01

ATTENTION TO: Garry Muckle

SAMPLING SITE:

SAMPLED BY:

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Trace Organics Analysis			
Acenaphthene	ORG-91-5106	EPA SW846 3541 & 8270	GC/MS
Acenaphthylene	ORG-91-5106	EPA SW846 3541 & 8270	GC/MS
Anthracene	ORG-91-5106	EPA SW846 3541 & 8270	GC/MS
Benz(a)anthracene	ORG-91-5106	EPA SW846 3541 & 8270	GC/MS
Benzo(a)pyrene	ORG-91-5106	EPA SW846 3541 & 8270	GC/MS
Benzo(b)fluoranthene	ORG-91-5106	EPA SW846 3541 & 8270	GC/MS
Benzo(g,h,i)perylene	ORG-91-5106	EPA SW846 3541 & 8270	GC/MS
Benzo(k)fluoranthene	ORG-91-5106	EPA SW846 3541 & 8270	GC/MS
Chrysene	ORG-91-5106	EPA SW846 3541 & 8270	GC/MS
Chrysene-d12	ORG-91-5106	EPA SW846 3541 & 8270	GC/MS
Dibenz(a,h)anthracene	ORG-91-5106	EPA SW846 3541 & 8270	GC/MS
Fluoranthene	ORG-91-5106	EPA SW846 3541 & 8270	GC/MS
Fluorene	ORG-91-5106	EPA SW846 3541 & 8270	GC/MS
Indeno(1,2,3-cd)pyrene	ORG-91-5106	EPA SW846 3541 & 8270	GC/MS
Moisture Content	ORG-91-5106	EPA SW-846 3541 & 8270	BALANCE
Naphthalene	ORG-91-5106	EPA SW846 3541 & 8270	GC/MS
Phenanthrene	ORG-91-5106	EPA SW846 3541 & 8270	GC/MS
Pyrene	ORG-91-5106	EPA SW846 3541 & 8270	GC/MS
2-and 1-methyl Naphthalene	ORG-91-5106	EPA SW846 3541 & 8270	GC/MS
Aroclor 1242	ORG-91-5113	EPA SW-846 3541 & 8082	GC/ECD
Aroclor 1248	ORG-91-5113	EPA SW-846 3541 & 8082	GC/ECD
Aroclor 1254	ORG-91-5113	EPA SW-846 3541 & 8082	GC/ECD
Aroclor 1260	ORG-91-5113	EPA SW-846 3541 & 8082	GC/ECD
Decachlorobiphenyl	ORG-91-5113	EPA SW-846 3541 & 8082	GC/ECD
Polychlorinated Biphenyls	ORG-91-5113	EPA SW-846 3541 & 8082	GC/ECD
F1 (C6 to C10)	VOL-91-5009	CCME Tier 1 Method	GC / FID
F1 (C6 to C10) minus BTEX	VOL-91-5009	CCME Tier 1 Method	GC / FID
F2 (C10 to C16)	VOL-91-5009	CCME Tier 1 Method	GC / FID
F2 (C10 to C16) minus Naphthalene	VOL-91-5009	CCME Tier 1 Method	GC / FID
F3 (C16 to C34)	VOL-91-5009	CCME Tier 1 Method	GC / FID
F3 (C16 to C34) minus PAHs	VOL-91-5009	CCME Tier 1 Method	GC / FID
F4 (C34 to C50)	VOL-91-5009	CCME Tier 1 Method	GC / FID
Gravimetric Heavy Hydrocarbons	VOL-91-5009	CCME Tier 1 Method	GRAVIMETRIC ANALYSIS
Moisture Content	VOL-91-5009	CCME Tier 1 Method	BALANCE
Terphenyl	VOL-91-5009		GC/FID
Acetone	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Benzene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Bromodichloromethane	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
4-Bromofluorobenzene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Bromoform	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Bromomethane	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Carbon Tetrachloride	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Chlorobenzene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Chloroform	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Cis- 1,2-Dichloroethylene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Dibromochloromethane	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
1,3-Dichlorobenzene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
1,2-Dichlorobenzene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
1,4-Dichlorobenzene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS

Results relate only to the items tested and to all the items tested

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Method Summary

CLIENT NAME: TERRAPROBE INC

AGAT WORK ORDER: 16H123484

PROJECT: 7-16-0090-01

ATTENTION TO: Garry Muckle

SAMPLING SITE:

SAMPLED BY:

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Dichlorodifluoromethane	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
1,1-Dichloroethane	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
1,2-Dichloroethane	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
1,1-Dichloroethylene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
1,2-Dichloropropane	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
1,3-Dichloropropene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Ethylbenzene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Ethylene Dibromide	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Methyl Ethyl Ketone	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Methyl Isobutyl Ketone	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Methyl tert-butyl Ether	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Methylene Chloride	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Styrene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
1,1,2,2-Tetrachloroethane	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
1,1,1,2-Tetrachloroethane	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Tetrachloroethylene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Toluene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Toluene-d8	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Trans- 1,2-Dichloroethylene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
1,1,1-Trichloroethane	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
1,1,2-Trichloroethane	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Trichloroethylene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Trichlorofluoromethane	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Vinyl Chloride	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Xylene Mixture	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
m & p-Xylene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
n-Hexane	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
o-Xylene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS

Results relate only to the items tested and to all the items tested

AGAT Laboratories

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Chain of Custody Record

If this is a Drinking Water sample, please use Drinking Water Chain of Custody Form (potable water intended for human consumption)

Laboratory Use Only
Work Order #: 16H123454
Cooler Quantity:
Arrival Temperatures: 5.4 | 5.8 | 6.1
Custody Seal Intact: ☐Yes ☐No ☐N/A
Notes: Sm cooler

Report Inform
Company: Terraprobe Inc.
Contact: Garry Muckle
Address: 903 Barton Street, Unit 22, Stoney Creek, Ontario L8E 5P5
Phone: Ph: (905) 643-7560 Fax: (905) 643-7559
Email: gmuckle@terraprobe.ca
Reports to be sent to:
1. Email:
2. Email: afelice@terraprobe.ca

Regulatory Requirements: ☐ No Regulatory Requirement
(Please check all applicable boxes)

☒ Regulation 153/04 — Table 1 (Indicate One) ☐ Ind/Com ☐ Res/Park ☐ Agriculture
Soil Texture (Check One) ☐ Coarse ☐ Fine
☐ Sewer Use ☐ Sanitary ☐ Storm — Region ____ (Indicate One)
☐ Regulation 558 ☐ CCME ☐ Prov. Water Quality Objectives (PWQO) ☐ Other ____ (Indicate One)

Is this submission for a Record of Site Condition? ☐ Yes ☒ No
Report Guideline on Certificate of Analysis ☐ Yes ☒ No

Turnaround Time (TAT) Required:
Regular TAT ☒ 5 to 7 Business Days
Rush TAT (Rush Surcharges Apply)
☐ 3 Business Days ☐ 2 Business Days ☐ 1 Business Day
OR Date Required (Rush Surcharges May Apply): ____
Please provide prior notification for rush TAT
**TAT is exclusive of weekends and statutory holidays*

Project Information:
Project: 7-16-0090-01
Site Location:
Sampled By:
AGAT Quote #: PO:
Please note: If quotation number is not provided, client will be billed full price for analysis.

Invoice Information: Bill To Same: Yes ☒ No ☐
Company:
Contact:
Address:
Email:

Sample Matrix Legend
B Biota
GW Ground Water
O Oil
P Paint
S Soil
SD Sediment
SW Surface Water

Sample Identification	Date Sampled	Time Sampled	# of Containers	Sample Matrix	Comments/ Special Instructions	Field Filtered - Metals, Hg, CrVI (Please Circle) Y / N	Metals and Inorganics	Metal Scan	Hydride Forming Metals	Client Custom Metals	ORPs: ☐B-HWS ☐Cl ☐CN ☐C* ☐EC ☐FOC ☐NO_3/NO_2 ☐Total N ☐Hg ☐pH ☐SAR (Check Applicable)	Nutrients: ☐TP ☐NH_3 ☐TKN ☐NO_3 ☐NO_2 ☐NO_3/NO_2	Volatiles: ☒VOC ☒BTEX ☐THM	CCME Fractions 1 to 4	ABNs	PAHs	Chlorophenols	PCBs	Organochlorine Pesticides	TCLP Metals/Inorganics	Sewer Use
BH10/SA2	Aug 3/16	9:14a	4	Soil	3 part Encore		X						X	X		X		X			
BH10/SA13	Aug 3/16	12:24p	4	Soil			X						X	X		X		X			
BH11/SA2	Aug 4/16	10:04a	4	Soil			X						X	X		X		X			
BH11/SA7	Aug 4/16	11:15a	4	Soil			X						X	X		X		X			
BH15/SA5	Aug 4/16	3:34p	4	Soil			X						X	X		X		X			
					ENCORE ARRIVAL TEMP: -7.0 -7.6 -7.8																

Samples Relinquished By (Print Name and Sign):	Date	Time	Samples Received By (Print Name and Sign):	Date	Time
Amber Marie Hoodless	Aug 4/16	15:00	Daniella Jaic	8/5/16	10:05am
Daniella Jaic	8/5/16	3:40pm			
Samples Relinquished By (Print Name and Sign):	Date	Time	Samples Received By (Print Name and Sign):	Date	Time
		5:10			3:46

Page 1 of 1
N°: T 027739

Document ID: DW-28-[illegible]-0011

Pink Copy - Client | Yellow Copy - AGAT | White Copy- AGAT

Date Issued: Feb 18, 2016

AGAT Laboratories

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CLIENT NAME: TERRAPROBE INC
903 Barton Street
Stoney Creek, ON L8E5P5
(905) 643-7560

ATTENTION TO: Garry Muckle

PROJECT: 7-16-0090-01

AGAT WORK ORDER: 16H124901

SOIL ANALYSIS REVIEWED BY: Amanjot Bhela, Inorganic Coordinator

TRACE ORGANICS REVIEWED BY: Oksana Gushyla, Trace Organics Lab Supervisor

DATE REPORTED: Aug 16, 2016

PAGES (INCLUDING COVER): 14

VERSION*: 1

Should you require any information regarding this analysis please contact your client services representative at (905) 712-5100

*NOTES

All samples will be disposed of within 30 days following analysis. Please contact the lab if you require additional sample storage time.

Member of: Association of Professional Engineers, Geologists and Geophysicists of Alberta (APEGGA)
Western Enviro-Agricultural Laboratory Association (WEALA)
Environmental Services Association of Alberta (ESAA)

AGAT Laboratories is accredited to ISO/IEC 17025 by the Canadian Association for Laboratory Accreditation Inc. (CALA) and/or Standards Council of Canada (SCC) for specific tests listed on the scope of accreditation. AGAT Laboratories (Mississauga) is also accredited by the Canadian Association for Laboratory Accreditation Inc. (CALA) for specific drinking water tests. Accreditations are location and parameter specific. A complete listing of parameters for each location is available from www.cala.ca and/or www.scc.ca. The tests in this report may not necessarily be included in the scope of accreditation.

Results relate only to the items tested and to all the items tested
All reportable information as specified by ISO 17025:2005 is available from AGAT Laboratories upon request

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Certificate of Analysis

AGAT WORK ORDER: 16H124901
PROJECT: 7-16-0090-01

CLIENT NAME: TERRAPROBE INC
SAMPLING SITE:

ATTENTION TO: Garry Muckle
SAMPLED BY:

O. Reg. 153(511) - Metals & Inorganics (Soil)

DATE RECEIVED: 2016-08-10

DATE REPORTED: 2016-08-16

				SAMPLE DESCRIPTION:	BH6/SA8	BH19/SA4	BH1/SA4	BH1/SA6	BH12/SA9	BH13/SA2
				SAMPLE TYPE:	Soil	Soil	Soil	Soil	Soil	Soil
				DATE SAMPLED:	8/5/2016	8/8/2016	8/8/2016	8/8/2016	8/9/2016	8/9/2016
Parameter	Unit	G / S	RDL		7761982	7762042	7762049	7762056	7762078	7762079
Antimony	µg/g		0.8		<0.8	<0.8	<0.8	<0.8	<0.8	1.8
Arsenic	µg/g		1		4	2	3	4	2	6
Barium	µg/g		2		42	22	18	67	29	144
Beryllium	µg/g		0.5		<0.5	<0.5	<0.5	<0.5	<0.5	0.8
Boron	µg/g		5		7	6	5	8	<5	13
Boron (Hot Water Soluble)	µg/g		0.10		0.20	0.11	0.35	0.34	0.37	3.03
Cadmium	µg/g		0.5		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Chromium	µg/g		2		14	9	7	15	9	19
Chromium VI	µg/g		0.2		<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Cobalt	µg/g		0.5		6.9	6.1	4.6	9.3	5.4	8.3
Copper	µg/g		1		20	16	29	20	11	57
Cyanide	µg/g		0.040		<0.040	<0.040	<0.040	<0.040	<0.040	<0.040
Electrical Conductivity	mS/cm		0.005		0.206	0.427	0.439	0.192	0.358	0.865
Lead	µg/g		1		7	8	14	8	9	96
Mercury	µg/g		0.10		<0.10	<0.10	0.12	<0.10	<0.10	0.27
Molybdenum	µg/g		0.5		<0.5	<0.5	<0.5	<0.5	<0.5	0.9
Nickel	µg/g		1		15	11	8	16	11	19
Selenium	µg/g		0.4		<0.4	<0.4	<0.4	<0.4	<0.4	0.6
Silver	µg/g		0.2		<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Sodium Adsorption Ratio	NA		NA		0.598	1.89	6.94	0.904	1.44	0.379
Thallium	µg/g		0.4		<0.4	<0.4	<0.4	<0.4	<0.4	<0.4
Uranium	µg/g		0.5		0.5	<0.5	<0.5	0.5	<0.5	<0.5
Vanadium	µg/g		1		22	17	15	20	15	30
Zinc	µg/g		5		39	30	40	43	37	136
pH, 2:1 CaCl2 Extraction	pH Units		NA		7.71	7.28	7.71	8.06	7.58	8.67

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

7761982-7762078 EC & SAR were determined on the DI water extract obtained from the 2:1 leaching procedure (2 parts DI water:1 part soil). pH was determined on the 0.01M CaCl2 extract prepared at 2:1 ratio.

7762079 EC & SAR were determined on the DI water extract obtained from the 2:1 leaching procedure (2 parts DI water:1 part soil). pH was determined on the 0.01M CaCl2 extract prepared at 2:1 ratio. Please note that Antimony value was confirmed by re-analysis.

Certified By: Amanjot Bhela

Results relate only to the items tested and to all the items tested

AGAT Laboratories

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Certificate of Analysis

AGAT WORK ORDER: 16H124901
PROJECT: 7-16-0090-01

CLIENT NAME: TERRAPROBE INC
SAMPLING SITE:

ATTENTION TO: Garry Muckle
SAMPLED BY:

O. Reg. 153(511) - PAHs (Soil)

DATE RECEIVED: 2016-08-10

DATE REPORTED: 2016-08-16

		SAMPLE DESCRIPTION:		BH6/SA8	BH19/SA4	BH1/SA4	BH1/SA6	BH12/SA9	BH13/SA2
		SAMPLE TYPE:		Soil	Soil	Soil	Soil	Soil	Soil
		DATE SAMPLED:		8/5/2016	8/8/2016	8/8/2016	8/8/2016	8/9/2016	8/9/2016
Parameter	Unit	G / S	RDL	7761982	7762042	7762049	7762056	7762078	7762079
Acenaphthene	µg/g		0.05	<0.05	<0.05	<0.05	<0.05	0.05	0.21
Acenaphthylene	µg/g		0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Anthracene	µg/g		0.05	<0.05	<0.05	<0.05	0.05	0.12	0.70
Benz(a)anthracene	µg/g		0.05	<0.05	<0.05	<0.05	0.10	0.24	2.2
Benzo(a)pyrene	µg/g		0.05	<0.05	<0.05	<0.05	0.06	0.20	1.8
Benzo(b)fluoranthene	µg/g		0.05	<0.05	<0.05	0.06	0.09	0.18	1.6
Benzo(g,h,i)perylene	µg/g		0.05	<0.05	<0.05	<0.05	<0.05	0.10	1.2
Benzo(k)fluoranthene	µg/g		0.05	<0.05	<0.05	<0.05	<0.05	0.11	1.1
Chrysene	µg/g		0.05	<0.05	<0.05	<0.05	0.10	0.19	1.7
Dibenz(a,h)anthracene	µg/g		0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.19
Fluoranthene	µg/g		0.05	<0.05	<0.05	<0.05	0.20	0.52	4.2
Fluorene	µg/g		0.05	<0.05	<0.05	<0.05	<0.05	0.09	0.26
Indeno(1,2,3-cd)pyrene	µg/g		0.05	<0.05	<0.05	<0.05	<0.05	0.09	1.1
Moisture Content	%		0.1	16.2	23.3	19.7	14.7	21.4	16.2
Naphthalene	µg/g		0.05	<0.05	<0.05	<0.05	<0.05	0.09	<0.05
Phenanthrene	µg/g		0.05	<0.05	<0.05	<0.05	0.24	0.51	2.4
Pyrene	µg/g		0.05	<0.05	<0.05	<0.05	0.17	0.40	3.2
2-and 1-methyl Naphthalene	µg/g		0.05	<0.05	<0.05	<0.05	<0.05	0.05	0.07
Surrogate	Unit	Acceptable Limits							
Chrysene-d12	%	50-140		126	113	121	110	107	108

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

7761982-7762079 Results are based on the dry weight of the soil.
Note: The result for Benzo(b)Fluoranthene is the total of the Benzo(b)&(j)Fluoranthene isomers because the isomers co-elute on the GC column.

Certified By:

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AGAT Laboratories

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Certificate of Analysis

AGAT WORK ORDER: 16H124901
PROJECT: 7-16-0090-01

CLIENT NAME: TERRAPROBE INC
SAMPLING SITE:

ATTENTION TO: Garry Muckle
SAMPLED BY:

O. Reg. 153(511) - PCBs (Soil)

DATE RECEIVED: 2016-08-10

DATE REPORTED: 2016-08-16

		SAMPLE DESCRIPTION:		BH6/SA8	BH19/SA4	BH1/SA4	BH1/SA6	BH12/SA9	BH13/SA2
		SAMPLE TYPE:		Soil	Soil	Soil	Soil	Soil	Soil
		DATE SAMPLED:		8/5/2016	8/8/2016	8/8/2016	8/8/2016	8/9/2016	8/9/2016
Parameter	Unit	G / S	RDL	7761982	7762042	7762049	7762056	7762078	7762079
Aroclor 1242	µg/g		0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1248	µg/g		0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1254	µg/g		0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1260	µg/g		0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Polychlorinated Biphenyls	µg/g		0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Surrogate	Unit	Acceptable Limits							
Decachlorobiphenyl	%	60-140		84	88	120	116	112	72

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard
7761982-7762079 Results are based on the dry weight of soil extracted.

Certified By:

Results relate only to the items tested and to all the items tested

AGAT Laboratories

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Certificate of Analysis

AGAT WORK ORDER: 16H124901
PROJECT: 7-16-0090-01

CLIENT NAME: TERRAPROBE INC
SAMPLING SITE:

ATTENTION TO: Garry Muckle
SAMPLED BY:

O. Reg. 153(511) - PHCs F1 - F4 (with PAHs) (Soil)

DATE RECEIVED: 2016-08-10

DATE REPORTED: 2016-08-16

				SAMPLE DESCRIPTION:	BH6/SA8	BH19/SA4	BH1/SA4	BH1/SA6	BH12/SA9	BH13/SA2
				SAMPLE TYPE:	Soil	Soil	Soil	Soil	Soil	Soil
				DATE SAMPLED:	8/5/2016	8/8/2016	8/8/2016	8/8/2016	8/9/2016	8/9/2016
Parameter	Unit	G / S	RDL		7761982	7762042	7762049	7762056	7762078	7762079
F1 (C6 to C10)	µg/g		5		<5	<5	<5	<5	<5	<5
F1 (C6 to C10) minus BTEX	µg/g		5		<5	<5	<5	<5	<5	<5
F2 (C10 to C16)	µg/g		10		16	<10	<10	<10	<10	11
F2 (C10 to C16) minus Naphthalene	µg/g		10		16	<10	<10	<10	<10	11
F3 (C16 to C34)	µg/g		50		120	<50	<50	<50	<50	170
F3 (C16 to C34) minus PAHs	µg/g		50		120	<50	<50	<50	<50	150
F4 (C34 to C50)	µg/g		50		<50	<50	<50	<50	<50	110
Gravimetric Heavy Hydrocarbons	µg/g		50		NA	NA	NA	NA	NA	NA
Moisture Content	%		0.1		16.2	23.3	19.7	14.7	21.4	16.2
Surrogate	Unit	Acceptable Limits								
Terphenyl	%	60-140			76	93	77	64	60	76

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

7761982-7762079 Results are based on sample dry weight.
The C6-C10 fraction is calculated using toluene response factor.
The C10 - C16, C16 - C34, and C34 - C50 fractions are calculated using the average response factor for n-C10, n-C16, and n-C34.
Gravimetric Heavy Hydrocarbons are not included in the Total C16-C50 and are only determined if the chromatogram of the C34 - C50 hydrocarbons indicates that hydrocarbons >C50 are present.
The chromatogram has returned to baseline by the retention time of nC50.
Total C6 - C50 results are corrected for BTEX and PAH contributions.
This method complies with the Reference Method for the CWS PHC and is validated for use in the laboratory.
nC6 and nC10 response factors are within 30% of Toluene response factor.
nC10, nC16 and nC34 response factors are within 10% of their average.
C50 response factor is within 70% of nC10 + nC16 + nC34 average.
Linearity is within 15%.
Extraction and holding times were met for this sample.

Certified By:

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Certificate of Analysis

AGAT WORK ORDER: 16H124901
PROJECT: 7-16-0090-01

CLIENT NAME: TERRAPROBE INC
SAMPLING SITE:

ATTENTION TO: Garry Muckle
SAMPLED BY:

O. Reg. 153(511) - VOCs (Soil)

DATE RECEIVED: 2016-08-10

DATE REPORTED: 2016-08-16

		SAMPLE DESCRIPTION:		BH6/SA8	BH19/SA4	BH1/SA4	BH1/SA6	BH12/SA9	BH13/SA2
		SAMPLE TYPE:		Soil	Soil	Soil	Soil	Soil	Soil
		DATE SAMPLED:		8/5/2016	8/8/2016	8/8/2016	8/8/2016	8/9/2016	8/9/2016
Parameter	Unit	G / S	RDL	7761982	7762042	7762049	7762056	7762078	7762079
Acetone	ug/g		0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Benzene	ug/g		0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Bromodichloromethane	ug/g		0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Bromoform	ug/g		0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Bromomethane	ug/g		0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Carbon Tetrachloride	ug/g		0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Chlorobenzene	ug/g		0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Chloroform	ug/g		0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04
Cis- 1,2-Dichloroethylene	ug/g		0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Dibromochloromethane	ug/g		0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
1,3-Dichlorobenzene	ug/g		0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
1,2-Dichlorobenzene	ug/g		0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
1,4-Dichlorobenzene	ug/g		0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Dichlorodifluoromethane	µg/g		0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
1,1-Dichloroethane	ug/g		0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
1,2-Dichloroethane	ug/g		0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
1,1-Dichloroethylene	ug/g		0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
1,2-Dichloropropane	ug/g		0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
1,3-Dichloropropene	µg/g		0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04
Ethylbenzene	ug/g		0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Ethylene Dibromide	ug/g		0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04
Methyl Ethyl Ketone	ug/g		0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Methyl Isobutyl Ketone	ug/g		0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Methyl tert-butyl Ether	ug/g		0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Methylene Chloride	ug/g		0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Styrene	ug/g		0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
1,1,2,2-Tetrachloroethane	ug/g		0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
1,1,1,2-Tetrachloroethane	ug/g		0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04
Tetrachloroethylene	ug/g		0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Toluene	ug/g		0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05

Certified By:

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Certificate of Analysis

AGAT WORK ORDER: 16H124901
PROJECT: 7-16-0090-01

CLIENT NAME: TERRAPROBE INC
SAMPLING SITE:

ATTENTION TO: Garry Muckle
SAMPLED BY:

O. Reg. 153(511) - VOCs (Soil)

DATE RECEIVED: 2016-08-10

DATE REPORTED: 2016-08-16

				SAMPLE DESCRIPTION:	BH6/SA8	BH19/SA4	BH1/SA4	BH1/SA6	BH12/SA9	BH13/SA2
				SAMPLE TYPE:	Soil	Soil	Soil	Soil	Soil	Soil
				DATE SAMPLED:	8/5/2016	8/8/2016	8/8/2016	8/8/2016	8/9/2016	8/9/2016
Parameter	Unit	G / S	RDL		7761982	7762042	7762049	7762056	7762078	7762079
Trans- 1,2-Dichloroethylene	ug/g		0.05		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
1,1,1-Trichloroethane	ug/g		0.05		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
1,1,2-Trichloroethane	ug/g		0.04		<0.04	<0.04	<0.04	<0.04	<0.04	<0.04
Trichloroethylene	ug/g		0.03		<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Trichlorofluoromethane	ug/g		0.05		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Vinyl Chloride	ug/g		0.02		<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Xylene Mixture	ug/g		0.05		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
m & p-Xylene	ug/g		0.05		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
n-Hexane	µg/g		0.05		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
o-Xylene	ug/g		0.05		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Surrogate	Unit	Acceptable Limits								
4-Bromofluorobenzene	% Recovery	50-140			92	90	88	94	91	89
Toluene-d8	% Recovery	50-140			96	96	98	96	99	95

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

7761982-7762079 The sample was analysed using the high level technique. The sample was extracted using methanol, a small amount of the methanol extract was diluted in water and the purge & trap GC/MS analysis was performed. Results are based on the dry weight of the soil.

Certified By:

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Quality Assurance

CLIENT NAME: TERRAPROBE INC
PROJECT: 7-16-0090-01
SAMPLING SITE:

AGAT WORK ORDER: 16H124901
ATTENTION TO: Garry Muckle
SAMPLED BY:

Soil Analysis

RPT Date: Aug 16, 2016			DUPLICATE				REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
O. Reg. 153(511) - Metals & Inorganics (Soil)															
Antimony	7762049	7762049	<0.8	<0.8	NA	< 0.8	99%	70%	130%	94%	80%	120%	100%	70%	130%
Arsenic	7762049	7762049	3	3	NA	< 1	98%	70%	130%	93%	80%	120%	93%	70%	130%
Barium	7762049	7762049	18	17	5.7%	< 2	95%	70%	130%	98%	80%	120%	98%	70%	130%
Beryllium	7762049	7762049	<0.5	<0.5	NA	< 0.5	81%	70%	130%	93%	80%	120%	87%	70%	130%
Boron	7762049	7762049	5	<5	NA	< 5	70%	70%	130%	102%	80%	120%	91%	70%	130%
Boron (Hot Water Soluble)	7762049	7762049	0.35	0.37	NA	< 0.10	76%	60%	140%	98%	70%	130%	98%	60%	140%
Cadmium	7762049	7762049	<0.5	<0.5	NA	< 0.5	104%	70%	130%	96%	80%	120%	101%	70%	130%
Chromium	7762049	7762049	7	8	NA	< 2	94%	70%	130%	107%	80%	120%	92%	70%	130%
Chromium VI	7762942		<0.2	<0.2	NA	< 0.2	92%	70%	130%	97%	80%	120%	98%	70%	130%
Cobalt	7762049	7762049	4.6	4.9	6.3%	< 0.5	93%	70%	130%	101%	80%	120%	95%	70%	130%
Copper	7762049	7762049	29	27	7.1%	< 1	112%	70%	130%	101%	80%	120%	91%	70%	130%
Cyanide	7761982	7761982	<0.040	<0.040	NA	< 0.040	103%	70%	130%	103%	80%	120%	98%	70%	130%
Electrical Conductivity	7762049	7762049	0.439	0.439	0.0%	< 0.005	99%	90%	110%	NA			NA		
Lead	7762049	7762049	14	17	19.4%	< 1	99%	70%	130%	83%	80%	120%	79%	70%	130%
Mercury	7762049	7762049	0.12	<0.10	NA	< 0.10	98%	70%	130%	88%	80%	120%	89%	70%	130%
Molybdenum	7762049	7762049	<0.5	<0.5	NA	< 0.5	100%	70%	130%	100%	80%	120%	103%	70%	130%
Nickel	7762049	7762049	8	9	11.8%	< 1	94%	70%	130%	105%	80%	120%	94%	70%	130%
Selenium	7762049	7762049	<0.4	0.4	NA	< 0.4	117%	70%	130%	99%	80%	120%	107%	70%	130%
Silver	7762049	7762049	<0.2	<0.2	NA	< 0.2	112%	70%	130%	103%	80%	120%	111%	70%	130%
Sodium Adsorption Ratio	7762049	7762049	6.94	7.38	6.1%	NA	NA			NA			NA		
Thallium	7762049	7762049	<0.4	<0.4	NA	< 0.4	89%	70%	130%	106%	80%	120%	104%	70%	130%
Uranium	7762049	7762049	<0.5	<0.5	NA	< 0.5	80%	70%	130%	81%	80%	120%	82%	70%	130%
Vanadium	7762049	7762049	15	15	0.0%	< 1	97%	70%	130%	110%	80%	120%	101%	70%	130%
Zinc	7762049	7762049	40	39	2.5%	< 5	92%	70%	130%	95%	80%	120%	98%	70%	130%
pH, 2:1 CaCl2 Extraction	7762042	7762042	7.28	7.30	0.3%	NA	101%	80%	120%	NA			NA		

Comments: NA signifies Not Applicable.
Duplicate Qualifier: As the measured result approaches the RL, the uncertainty associated with the value increases dramatically, thus duplicate acceptance limits apply only where the average of the two duplicates is greater than five times the RL.

Certified By: Amanjot Bhela

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Quality Assurance

CLIENT NAME: TERRAPROBE INC
PROJECT: 7-16-0090-01
SAMPLING SITE:

AGAT WORK ORDER: 16H124901
ATTENTION TO: Garry Muckle
SAMPLED BY:

Trace Organics Analysis

RPT Date: Aug 16, 2016			DUPLICATE				REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
O. Reg. 153(511) - VOCs (Soil)															
Acetone	7754512		< 0.50	< 0.50	NA	< 0.50	106%	50%	140%	101%	50%	140%	101%	50%	140%
Benzene	7754512		< 0.02	< 0.02	NA	< 0.02	104%	50%	140%	104%	60%	130%	94%	50%	140%
Bromodichloromethane	7754512		< 0.05	< 0.05	NA	< 0.05	81%	50%	140%	101%	60%	130%	103%	50%	140%
Bromoform	7754512		< 0.05	< 0.05	NA	< 0.05	83%	50%	140%	92%	60%	130%	87%	50%	140%
Bromomethane	7754512		< 0.05	< 0.05	NA	< 0.05	106%	50%	140%	101%	50%	140%	101%	50%	140%
Carbon Tetrachloride	7754512		< 0.05	< 0.05	NA	< 0.05	77%	50%	140%	100%	60%	130%	80%	50%	140%
Chlorobenzene	7754512		< 0.05	< 0.05	NA	< 0.05	78%	50%	140%	80%	60%	130%	79%	50%	140%
Chloroform	7754512		< 0.04	< 0.04	NA	< 0.04	90%	50%	140%	103%	60%	130%	86%	50%	140%
Cis- 1,2-Dichloroethylene	7754512		< 0.02	< 0.02	NA	< 0.02	111%	50%	140%	109%	60%	130%	92%	50%	140%
Dibromochloromethane	7754512		< 0.05	< 0.05	NA	< 0.05	99%	50%	140%	88%	60%	130%	106%	50%	140%
1,3-Dichlorobenzene	7754512		< 0.05	< 0.05	NA	< 0.05	94%	50%	140%	83%	60%	130%	99%	50%	140%
1,2-Dichlorobenzene	7754512		< 0.05	< 0.05	NA	< 0.05	104%	50%	140%	83%	60%	130%	84%	50%	140%
1,4-Dichlorobenzene	7754512		< 0.05	< 0.05	NA	< 0.05	117%	50%	140%	89%	60%	130%	91%	50%	140%
Dichlorodifluoromethane	7754512		< 0.05	< 0.05	NA	< 0.05	90%	50%	140%	106%	50%	140%	101%	50%	140%
1,1-Dichloroethane	7754512		< 0.02	< 0.02	NA	< 0.02	107%	50%	140%	107%	60%	130%	92%	50%	140%
1,2-Dichloroethane	7754512		< 0.03	< 0.03	NA	< 0.03	98%	50%	140%	91%	60%	130%	97%	50%	140%
1,1-Dichloroethylene	7754512		< 0.05	< 0.05	NA	< 0.05	100%	50%	140%	111%	60%	130%	101%	50%	140%
1,2-Dichloropropane	7754512		< 0.03	< 0.03	NA	< 0.03	98%	50%	140%	105%	60%	130%	86%	50%	140%
1,3-Dichloropropene	7754512		< 0.04	< 0.04	NA	< 0.04	100%	50%	140%	95%	60%	130%	97%	50%	140%
Ethylbenzene	7754512		< 0.05	< 0.05	NA	< 0.05	101%	50%	140%	96%	60%	130%	80%	50%	140%
Ethylene Dibromide	7754512		< 0.04	< 0.04	NA	< 0.04	83%	50%	140%	96%	60%	130%	85%	50%	140%
Methyl Ethyl Ketone	7754512		< 0.50	< 0.50	NA	< 0.50	103%	50%	140%	99%	50%	140%	89%	50%	140%
Methyl Isobutyl Ketone	7754512		< 0.50	< 0.50	NA	< 0.50	92%	50%	140%	82%	50%	140%	102%	50%	140%
Methyl tert-butyl Ether	7754512		< 0.05	< 0.05	NA	< 0.05	97%	50%	140%	101%	60%	130%	95%	50%	140%
Methylene Chloride	7754512		< 0.05	< 0.05	NA	< 0.05	103%	50%	140%	95%	60%	130%	99%	50%	140%
Styrene	7754512		< 0.05	< 0.05	NA	< 0.05	81%	50%	140%	87%	60%	130%	85%	50%	140%
1,1,2,2-Tetrachloroethane	7754512		< 0.05	< 0.05	NA	< 0.05	82%	50%	140%	91%	60%	130%	92%	50%	140%
1,1,1,2-Tetrachloroethane	7754512		< 0.04	< 0.04	NA	< 0.04	86%	50%	140%	108%	60%	130%	91%	50%	140%
Tetrachloroethylene	7754512		< 0.05	< 0.05	NA	< 0.05	77%	50%	140%	81%	60%	130%	87%	50%	140%
Toluene	7754512		< 0.05	< 0.05	NA	< 0.05	83%	50%	140%	110%	60%	130%	81%	50%	140%
Trans- 1,2-Dichloroethylene	7754512		< 0.05	< 0.05	NA	< 0.05	94%	50%	140%	93%	60%	130%	94%	50%	140%
1,1,1-Trichloroethane	7754512		< 0.05	< 0.05	NA	< 0.05	84%	50%	140%	90%	60%	130%	83%	50%	140%
1,1,2-Trichloroethane	7754512		< 0.04	< 0.04	NA	< 0.04	88%	50%	140%	102%	60%	130%	78%	50%	140%
Trichloroethylene	7754512		< 0.03	< 0.03	NA	< 0.03	99%	50%	140%	104%	60%	130%	99%	50%	140%
Trichlorofluoromethane	7754512		< 0.05	< 0.05	NA	< 0.05	97%	50%	140%	94%	50%	140%	103%	50%	140%
Vinyl Chloride	7754512		< 0.02	< 0.02	NA	< 0.02	111%	50%	140%	111%	50%	140%	95%	50%	140%
m & p-Xylene	7754512		< 0.05	< 0.05	NA	< 0.05	80%	50%	140%	86%	60%	130%	81%	50%	140%
n-Hexane	7754512		< 0.05	< 0.05	NA	< 0.05	81%	50%	140%	99%	60%	130%	87%	50%	140%
o-Xylene	7754512		< 0.05	< 0.05	NA	< 0.05	88%	50%	140%	94%	60%	130%	82%	50%	140%

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Quality Assurance

CLIENT NAME: TERRAPROBE INC

AGAT WORK ORDER: 16H124901

PROJECT: 7-16-0090-01

ATTENTION TO: Garry Muckle

SAMPLING SITE:

SAMPLED BY:

Trace Organics Analysis (Continued)

RPT Date: Aug 16, 2016			DUPLICATE				REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
O. Reg. 153(511) - PHCs F1 - F4 (with PAHs) (Soil)															
F1 (C6 to C10)	7756576		< 5	< 5	NA	< 5	76%	60%	130%	89%	85%	115%	87%	70%	130%
F2 (C10 to C16)	7752081		<10	<10	NA	< 10	100%	60%	130%	86%	80%	120%	71%	70%	130%
F3 (C16 to C34)	7752081		<50	<50	NA	< 50	103%	60%	130%	85%	80%	120%	70%	70%	130%
F4 (C34 to C50)	7752081		< 50	< 50	NA	< 50	88%	60%	130%	99%	80%	120%	100%	70%	130%
O. Reg. 153(511) - PAHs (Soil)															
Acenaphthene	7762049	7762049	< 0.05	< 0.05	NA	< 0.05	109%	50%	140%	111%	50%	140%	106%	50%	140%
Acenaphthylene	7762049	7762049	< 0.05	< 0.05	NA	< 0.05	110%	50%	140%	116%	50%	140%	112%	50%	140%
Anthracene	7762049	7762049	< 0.05	< 0.05	NA	< 0.05	108%	50%	140%	122%	50%	140%	124%	50%	140%
Benz(a)anthracene	7762049	7762049	< 0.05	< 0.05	NA	< 0.05	98%	50%	140%	137%	50%	140%	117%	50%	140%
Benzo(a)pyrene	7762049	7762049	< 0.05	< 0.05	NA	< 0.05	123%	50%	140%	130%	50%	140%	125%	50%	140%
Benzo(b)fluoranthene	7762049	7762049	0.06	0.06	NA	< 0.05	93%	50%	140%	128%	50%	140%	129%	50%	140%
Benzo(g,h,i)perylene	7762049	7762049	< 0.05	< 0.05	NA	< 0.05	116%	50%	140%	138%	50%	140%	139%	50%	140%
Benzo(k)fluoranthene	7762049	7762049	< 0.05	< 0.05	NA	< 0.05	118%	50%	140%	109%	50%	140%	93%	50%	140%
Chrysene	7762049	7762049	< 0.05	< 0.05	NA	< 0.05	107%	50%	140%	126%	50%	140%	133%	50%	140%
Dibenz(a,h)anthracene	7762049	7762049	< 0.05	< 0.05	NA	< 0.05	81%	50%	140%	137%	50%	140%	128%	50%	140%
Fluoranthene	7762049	7762049	< 0.05	< 0.05	NA	< 0.05	106%	50%	140%	125%	50%	140%	139%	50%	140%
Fluorene	7762049	7762049	< 0.05	< 0.05	NA	< 0.05	107%	50%	140%	115%	50%	140%	110%	50%	140%
Indeno(1,2,3-cd)pyrene	7762049	7762049	< 0.05	< 0.05	NA	< 0.05	90%	50%	140%	132%	50%	140%	134%	50%	140%
Naphthalene	7762049	7762049	< 0.05	< 0.05	NA	< 0.05	112%	50%	140%	111%	50%	140%	104%	50%	140%
Phenanthrene	7762049	7762049	< 0.05	< 0.05	NA	< 0.05	103%	50%	140%	118%	50%	140%	117%	50%	140%
Pyrene	7762049	7762049	< 0.05	< 0.05	NA	< 0.05	107%	50%	140%	128%	50%	140%	137%	50%	140%
2-and 1-methyl Naphthalene	7762049	7762049	< 0.05	< 0.05	NA	< 0.05	126%	50%	140%	103%	50%	140%	98%	50%	140%
O. Reg. 153(511) - PCBs (Soil)															
Aroclor 1242	7761982	7761982	< 0.1	< 0.1	NA	< 0.1	NA	60%	140%	NA	60%	140%	NA	60%	140%
Aroclor 1248	7761982	7761982	< 0.1	< 0.1	NA	< 0.1	NA	60%	140%	NA	60%	140%	NA	60%	140%
Aroclor 1254	7761982	7761982	< 0.1	< 0.1	NA	< 0.1	NA	60%	140%	NA	60%	140%	NA	60%	140%
Aroclor 1260	7761982	7761982	< 0.1	< 0.1	NA	< 0.1	NA	60%	140%	NA	60%	140%	NA	60%	140%
Polychlorinated Biphenyls	7761982	7761982	< 0.1	< 0.1	NA	115	NA	60%	140%	110%	60%	140%	114%	60%	140%

Comments: When the average of the sample and duplicate results is less than 5x the RDL, the Relative Percent Difference (RPD) will be indicated as Not Applicable (NA).

Certified By:

AGAT Laboratories is accredited to ISO/IEC 17025 by the Canadian Association for Laboratory Accreditation Inc. (CALA) and/or Standards Council of Canada (SCC) for specific tests listed on the scope of accreditation. AGAT Laboratories (Mississauga) is also accredited by the Canadian Association for Laboratory Accreditation Inc. (CALA) for specific drinking water tests. Accreditations are location and parameter specific. A complete listing of parameters for each location is available from www.cala.ca and/or www.scc.ca. The tests in this report may not necessarily be included in the scope of accreditation.

Results relate only to the items tested and to all the items tested

AGAT Laboratories

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
http://www.agatlabs.com

Method Summary

CLIENT NAME: TERRAPROBE INC

AGAT WORK ORDER: 16H124901

PROJECT: 7-16-0090-01

ATTENTION TO: Garry Muckle

SAMPLING SITE:

SAMPLED BY:

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Soil Analysis			
Antimony	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Arsenic	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Barium	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Beryllium	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Boron	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Boron (Hot Water Soluble)	MET-93-6104	EPA SW 846 6010C; MSA, Part 3, Ch.21	ICP/OES
Cadmium	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Chromium	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Chromium VI	INOR-93-6029	SM 3500 B; MSA Part 3, Ch. 25	SPECTROPHOTOMETER
Cobalt	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Copper	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Cyanide	INOR-93-6052	MOE CN-3015 & E 3009 A;SM 4500 CN	TECHNICON AUTO ANALYZER
Electrical Conductivity	INOR-93-6036	McKeague 4.12, SM 2510 B	EC METER
Lead	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Mercury	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Molybdenum	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Nickel	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Selenium	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Silver	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Sodium Adsorption Ratio	INOR-93-6007	McKeague 4.12 & 3.26 & EPA SW-846 6010B	ICP/OES
Thallium	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Uranium	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Vanadium	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Zinc	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
pH, 2:1 CaCl2 Extraction	INOR-93-6031	MSA part 3 & SM 4500-H+ B	PH METER

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Method Summary

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PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Trace Organics Analysis			
Acenaphthene	ORG-91-5106	EPA SW846 3541 & 8270	GC/MS
Acenaphthylene	ORG-91-5106	EPA SW846 3541 & 8270	GC/MS
Anthracene	ORG-91-5106	EPA SW846 3541 & 8270	GC/MS
Benz(a)anthracene	ORG-91-5106	EPA SW846 3541 & 8270	GC/MS
Benzo(a)pyrene	ORG-91-5106	EPA SW846 3541 & 8270	GC/MS
Benzo(b)fluoranthene	ORG-91-5106	EPA SW846 3541 & 8270	GC/MS
Benzo(g,h,i)perylene	ORG-91-5106	EPA SW846 3541 & 8270	GC/MS
Benzo(k)fluoranthene	ORG-91-5106	EPA SW846 3541 & 8270	GC/MS
Chrysene	ORG-91-5106	EPA SW846 3541 & 8270	GC/MS
Chrysene-d12	ORG-91-5106	EPA SW846 3541 & 8270	GC/MS
Dibenz(a,h)anthracene	ORG-91-5106	EPA SW846 3541 & 8270	GC/MS
Fluoranthene	ORG-91-5106	EPA SW846 3541 & 8270	GC/MS
Fluorene	ORG-91-5106	EPA SW846 3541 & 8270	GC/MS
Indeno(1,2,3-cd)pyrene	ORG-91-5106	EPA SW846 3541 & 8270	GC/MS
Moisture Content	ORG-91-5106	EPA SW-846 3541 & 8270	BALANCE
Naphthalene	ORG-91-5106	EPA SW846 3541 & 8270	GC/MS
Phenanthrene	ORG-91-5106	EPA SW846 3541 & 8270	GC/MS
Pyrene	ORG-91-5106	EPA SW846 3541 & 8270	GC/MS
2-and 1-methyl Naphthalene	ORG-91-5106	EPA SW846 3541 & 8270	GC/MS
Aroclor 1242	ORG-91-5113	EPA SW-846 3541 & 8082	GC/ECD
Aroclor 1248	ORG-91-5113	EPA SW-846 3541 & 8082	GC/ECD
Aroclor 1254	ORG-91-5113	EPA SW-846 3541 & 8082	GC/ECD
Aroclor 1260	ORG-91-5113	EPA SW-846 3541 & 8082	GC/ECD
Decachlorobiphenyl	ORG-91-5113	EPA SW-846 3541 & 8082	GC/ECD
Polychlorinated Biphenyls	ORG-91-5113	EPA SW-846 3541 & 8082	GC/ECD
F1 (C6 to C10)	VOL-91-5009	CCME Tier 1 Method	GC / FID
F1 (C6 to C10) minus BTEX	VOL-91-5009	CCME Tier 1 Method	GC / FID
F2 (C10 to C16)	VOL-91-5009	CCME Tier 1 Method	GC / FID
F2 (C10 to C16) minus Naphthalene	VOL-91-5009	CCME Tier 1 Method	GC / FID
F3 (C16 to C34)	VOL-91-5009	CCME Tier 1 Method	GC / FID
F3 (C16 to C34) minus PAHs	VOL-91-5009	CCME Tier 1 Method	GC / FID
F4 (C34 to C50)	VOL-91-5009	CCME Tier 1 Method	GC / FID
Gravimetric Heavy Hydrocarbons	VOL-91-5009	CCME Tier 1 Method	GRAVIMETRIC ANALYSIS
Moisture Content	VOL-91-5009	CCME Tier 1 Method	BALANCE
Terphenyl	VOL-91-5009		GC/FID
Acetone	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Benzene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Bromodichloromethane	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
4-Bromofluorobenzene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Bromoform	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Bromomethane	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Carbon Tetrachloride	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Chlorobenzene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Chloroform	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Cis- 1,2-Dichloroethylene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Dibromochloromethane	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
1,3-Dichlorobenzene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
1,2-Dichlorobenzene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
1,4-Dichlorobenzene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS

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Method Summary

CLIENT NAME: TERRAPROBE INC

AGAT WORK ORDER: 16H124901

PROJECT: 7-16-0090-01

ATTENTION TO: Garry Muckle

SAMPLING SITE:

SAMPLED BY:

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Dichlorodifluoromethane	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
1,1-Dichloroethane	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
1,2-Dichloroethane	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
1,1-Dichloroethylene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
1,2-Dichloropropane	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
1,3-Dichloropropene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Ethylbenzene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Ethylene Dibromide	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Methyl Ethyl Ketone	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Methyl Isobutyl Ketone	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Methyl tert-butyl Ether	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Methylene Chloride	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Styrene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
1,1,2,2-Tetrachloroethane	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
1,1,1,2-Tetrachloroethane	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Tetrachloroethylene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Toluene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Toluene-d8	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Trans- 1,2-Dichloroethylene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
1,1,1-Trichloroethane	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
1,1,2-Trichloroethane	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Trichloroethylene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Trichlorofluoromethane	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Vinyl Chloride	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Xylene Mixture	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
m & p-Xylene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
n-Hexane	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
o-Xylene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS

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AGAT Laboratories (EN-CORE)

5835 Coopers Avenue
Mississauga, Ontario L4Z 1Y2
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webearth.agatlabs.com

Chain of Custody Record

If this is a Drinking Water sample, please use Drinking Water Chain of Custody Form (potable water intended for human consumption)

Laboratory Use Only
Work Order #: 16H124901
Cooler Quantity: LG cooler
Arrival Temperatures: 7.5 | 7.9 | 7.5 / 6.7 | 6.9 | 6.5
Custody Seal Intact: ☐Yes ☐No ☐N/A
Notes: on ice

Report Information:
Company:
Contact:
Address:
Phone:
Reports to be sent to:
1. Email:
2. Email: afelice@terraprobe

Terraprobe Inc. 903 Barton Street, Unit 22 Stoney Creek, Ontario L8E 5P5
Ph: (905) 643-7560 **Fax:** (905) 643-7559
Email: gmuckle@terraprobe.ca
Contact: Garry Muckle

Regulatory Requirements:
☐ No Regulatory Requirement
(Please check all applicable boxes)

☒ Regulation 153/04
Table 1 (Indicate One)
☐ Ind/Com
☐ Res/Park
☐ Agriculture
Soil Texture (Check One)
☐ Coarse
☐ Fine

☐ Sewer Use
☐ Sanitary
☐ Storm
Region _____ (Indicate One)

☐ Regulation 558
☐ CCME
☐ Prov. Water Quality Objectives (PWQO)
☐ Other _____ (Indicate One)

Is this submission for a **Record of Site Condition?** ☐ Yes ☒ No

Report Guideline on *Certificate of Analysis* ☐ Yes ☒ No

Turnaround Time (TAT) Required:
Regular TAT ☒ 5 to 7 Business Days
Rush TAT (Rush Surcharges Apply)
☐ 3 Business Days ☐ 2 Business Days ☐ 1 Business Day
OR Date Required (Rush Surcharges May Apply): _____
Please provide prior notification for rush TAT
**TAT is exclusive of weekends and statutory holidays*

Project Information:
Project: 7-16-0090-01
Site Location:
Sampled By:
AGAT Quote #: _____ PO: _____
Please note: If quotation number is not provided, client will be billed full price for analysis.

Invoice Information:
Bill To Same: Yes ☒ No ☐
Company:
Contact:
Address:
Email:

Sample Matrix Legend
B Biota
GW Ground Water
O Oil
P Paint
S Soil
SD Sediment
SW Surface Water

Sample Identification	Date Sampled	Time Sampled	# of Containers	Sample Matrix	Comments/ Special Instructions	Field Filtered - Metals, Hg, CrVI (Please Circle) Y / N	Metals and Inorganics	Metal Scan	Hydride Forming Metals	Client Custom Metals	ORPs: ☐B-HWS ☐Cl⁻ ☐CN ☐Cr^{6+} ☐EC ☐FOC ☐NO_2/NO_3 ☐Total N ☐Hg ☐pH ☐SAR	Nutrients: ☐TP ☐NH_3 ☐TKN ☐NO_3 ☐NO_2 ☐NO_3/NO_2	Volatiles: ☒VOC ☐BTEX ☐THM	CCME Fractions 1 to 4	ABNs	PAHs	Chlorophenols	PCBs	Organochlorine Pesticides	TCLP Metals/Inorganics	Sewer Use
BH6 | SA8	Aug5/16	3:31p	4	soil			X						X	X		X		X			
BH19 | SA4	Aug8/16	1:45p	4	soil			X						X	X		X		X			
BH1 | SA4	Aug8/16	11:20a	4	soil			X						X	X		X		X			
BH1 | SA6	Aug8/16	11:38a	4	soil	ENCORES		X						X	X		X		X			
BH2 | SA9	Aug9/16	11:04a	4	soil	ARRIVAL		X						X	X		X		X			
~~BH13~~ BH13 | SA2	Aug9/16	1:51	4	soil	TEMP		X						X	X		X		X			
					-7.1 -7.9																
					-8.0																

Samples Relinquished By (Print Name and Sign):	Date	Time	Samples Received By (Print Name and Sign):	Date	Time
Amber Brooks Amber Brooks	Aug10/16	12:05	Daniella Jalc	8/10/16	12:05pm
Daniella Jalc	8/10/16	3:10pm		12/08/10	9:78
	2016/08/10	4:01		16/8/10	4:05

Page 1 of 1
N°: T 027740

Document ID: Div 78-1511.011

Pink Copy - Client | Yellow Copy - AGAT | White Copy- AGAT

Date Issued: Feb 18, 2016

AGAT Laboratories

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CANADA L4Z 1Y2
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FAX (905)712-5122
http://www.agatlabs.com

CLIENT NAME: TERRAPROBE INC
903 Barton Street
Stoney Creek, ON L8E5P5
(905) 643-7560

ATTENTION TO: Garry Muckle

PROJECT: 7-16-0090-01

AGAT WORK ORDER: 16H125870

SOIL ANALYSIS REVIEWED BY: Mike Muneswar, BSc (Chem), Senior Inorganic Analyst

TRACE ORGANICS REVIEWED BY: Gyulhan Yalamova, Report Reviewer

DATE REPORTED: Aug 18, 2016

PAGES (INCLUDING COVER): 15

VERSION*: 1

Should you require any information regarding this analysis please contact your client services representative at (905) 712-5100

*NOTES

All samples will be disposed of within 30 days following analysis. Please contact the lab if you require additional sample storage time.

Member of: Association of Professional Engineers, Geologists and Geophysicists of Alberta (APEGGA)
Western Enviro-Agricultural Laboratory Association (WEALA)
Environmental Services Association of Alberta (ESAA)

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All reportable information as specified by ISO 17025:2005 is available from AGAT Laboratories upon request

AGAT Laboratories

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Certificate of Analysis

AGAT WORK ORDER: 16H125870
PROJECT: 7-16-0090-01

CLIENT NAME: TERRAPROBE INC
SAMPLING SITE:

ATTENTION TO: Garry Muckle
SAMPLED BY:

O. Reg. 153(511) - Metals & Inorganics (Soil)

DATE RECEIVED: 2016-08-12

DATE REPORTED: 2016-08-18

		SAMPLE DESCRIPTION:		BH9/SA4	BH16/SA4		BH17/SA4		BH17/SA6	BH18/SA6	BH14/SA6
		SAMPLE TYPE:		Soil	Soil		Soil		Soil	Soil	Soil
		DATE SAMPLED:		8/11/2016	8/11/2016		8/11/2016		8/11/2016	8/11/2016	8/10/2016
Parameter	Unit	G / S	RDL	7768441	7768449	RDL	7768461	RDL	7768475	7768602	7768607
Antimony	µg/g		0.8	<0.8	<0.8	0.8	1.2	0.8	<0.8	<0.8	<0.8
Arsenic	µg/g		1	4	7	1	9	1	3	2	6
Barium	µg/g		2	142	126	2	112	2	66	22	90
Beryllium	µg/g		0.5	1.0	0.8	0.5	0.8	0.5	<0.5	<0.5	0.8
Boron	µg/g		5	24	16	5	18	5	7	5	18
Boron (Hot Water Soluble)	µg/g		0.10	3.78	1.66	0.10	4.42	0.10	0.43	0.39	1.89
Cadmium	µg/g		0.5	<0.5	<0.5	0.5	1.1	0.5	<0.5	<0.5	<0.5
Chromium	µg/g		2	28	24	2	22	2	10	7	22
Chromium VI	µg/g		0.2	<0.2	<0.2	0.2	<0.2	0.2	<0.2	<0.2	<0.2
Cobalt	µg/g		0.5	10.4	9.9	0.5	9.0	0.5	6.0	3.6	9.6
Copper	µg/g		1	28	38	1	83	1	16	12	45
Cyanide	µg/g		0.040	<0.040	<0.040	0.040	<0.040	0.040	<0.040	<0.040	<0.040
Electrical Conductivity	mS/cm		0.005	0.548	0.342	0.005	0.321	0.005	0.206	0.525	0.568
Lead	µg/g		1	37	113	1	465	1	9	8	75
Mercury	µg/g		0.10	<0.10	0.47	0.10	0.29	0.10	<0.10	<0.10	0.13
Molybdenum	µg/g		0.5	0.8	1.0	0.5	1.7	0.5	<0.5	<0.5	0.9
Nickel	µg/g		1	21	21	1	23	1	9	6	22
Selenium	µg/g		0.4	<0.4	0.5	0.4	0.6	0.4	<0.4	<0.4	<0.4
Silver	µg/g		0.2	<0.2	<0.2	0.2	0.4	0.2	<0.2	<0.2	<0.2
Sodium Adsorption Ratio	NA		NA	2.61	3.05	NA	1.29	NA	0.610	5.97	2.07
Thallium	µg/g		0.4	<0.4	<0.4	0.4	<0.4	0.4	<0.4	<0.4	<0.4
Uranium	µg/g		0.5	0.8	0.7	0.5	0.7	0.5	<0.5	<0.5	0.6
Vanadium	µg/g		1	34	30	1	27	1	16	13	29
Zinc	µg/g		5	83	163	50	3860	5	65	39	141
pH, 2:1 CaCl2 Extraction	pH Units		NA	9.00	8.49	NA	8.35	NA	7.35	7.53	9.39

Certified By:

Results relate only to the items tested and to all the items tested

AGAT Laboratories

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Certificate of Analysis

AGAT WORK ORDER: 16H125870
PROJECT: 7-16-0090-01

CLIENT NAME: TERRAPROBE INC
ATTENTION TO: Garry Muckle
SAMPLING SITE:
SAMPLED BY:

O. Reg. 153(511) - Metals & Inorganics (Soil)

DATE RECEIVED: 2016-08-12
DATE REPORTED: 2016-08-18

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

7768441-7768449 EC & SAR were determined on the DI water extract obtained from the 2:1 leaching procedure (2 parts DI water:1 part soil). pH was determined on the 0.01M CaCl2 extract prepared at 2:1 ratio.

7768461 EC & SAR were determined on the DI water extract obtained from the 2:1 leaching procedure (2 parts DI water:1 part soil). pH was determined on the 0.01M CaCl2 extract prepared at 2:1 ratio. Elevated RDL for Zinc indicate the degree of dilution prior to analysis in order to keep analyte within the calibration range of the instrument and to reduce matrix interferences.

7768475-7768607 EC & SAR were determined on the DI water extract obtained from the 2:1 leaching procedure (2 parts DI water:1 part soil). pH was determined on the 0.01M CaCl2 extract prepared at 2:1 ratio.

Certified By:

Results relate only to the items tested and to all the items tested

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AGAT WORK ORDER: 16H125870
PROJECT: 7-16-0090-01

CLIENT NAME: TERRAPROBE INC
SAMPLING SITE:

ATTENTION TO: Garry Muckle
SAMPLED BY:

O. Reg. 153(511) - PAHs (Soil)

DATE RECEIVED: 2016-08-12

DATE REPORTED: 2016-08-18

				SAMPLE DESCRIPTION:	BH9/SA4	BH16/SA4	BH17/SA4	BH17/SA6	BH18/SA6	BH14/SA6
				SAMPLE TYPE:	Soil	Soil	Soil	Soil	Soil	Soil
				DATE SAMPLED:	8/11/2016	8/11/2016	8/11/2016	8/11/2016	8/11/2016	8/10/2016
Parameter	Unit	G / S	RDL		7768441	7768449	7768461	7768475	7768602	7768607
Acenaphthene	µg/g		0.05		<0.05	0.06	0.19	<0.05	<0.05	0.05
Acenaphthylene	µg/g		0.05		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Anthracene	µg/g		0.05		<0.05	0.17	0.30	<0.05	<0.05	0.14
Benz(a)anthracene	µg/g		0.05		0.10	0.45	0.53	<0.05	<0.05	0.30
Benzo(a)pyrene	µg/g		0.05		<0.05	0.32	0.36	<0.05	<0.05	0.21
Benzo(b)fluoranthene	µg/g		0.05		<0.05	0.36	0.52	<0.05	<0.05	0.32
Benzo(g,h,i)perylene	µg/g		0.05		<0.05	0.22	0.27	<0.05	<0.05	0.17
Benzo(k)fluoranthene	µg/g		0.05		<0.05	0.22	0.20	<0.05	<0.05	0.16
Chrysene	µg/g		0.05		0.08	0.41	0.45	<0.05	<0.05	0.23
Dibenz(a,h)anthracene	µg/g		0.05		<0.05	0.06	0.06	<0.05	<0.05	<0.05
Fluoranthene	µg/g		0.05		0.13	1.1	1.2	<0.05	<0.05	0.60
Fluorene	µg/g		0.05		<0.05	0.18	0.16	<0.05	<0.05	0.07
Indeno(1,2,3-cd)pyrene	µg/g		0.05		<0.05	0.20	0.25	<0.05	<0.05	0.12
Moisture Content	%		0.1		23.3	16.4	18.5	33.5	17.9	19.7
Naphthalene	µg/g		0.05		<0.05	0.09	0.14	<0.05	<0.05	0.06
Phenanthrene	µg/g		0.05		0.06	1.0	1.2	<0.05	<0.05	0.52
Pyrene	µg/g		0.05		0.12	0.96	1.0	<0.05	<0.05	0.51
2-and 1-methyl Naphthalene	µg/g		0.05		<0.05	0.10	0.12	<0.05	<0.05	0.20
Surrogate	Unit	Acceptable Limits								
Chrysene-d12	%	50-140			103	101	88	97	92	83

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

7768441-7768607 Results are based on the dry weight of the soil.
Note: The result for Benzo(b)Fluoranthene is the total of the Benzo(b)&(j)Fluoranthene isomers because the isomers co-elute on the GC column.

Certified By:



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AGAT WORK ORDER: 16H125870
PROJECT: 7-16-0090-01

CLIENT NAME: TERRAPROBE INC
SAMPLING SITE:

ATTENTION TO: Garry Muckle
SAMPLED BY:

O. Reg. 153(511) - PCBs (Soil)

DATE RECEIVED: 2016-08-12

DATE REPORTED: 2016-08-18

		SAMPLE DESCRIPTION:		BH9/SA4	BH16/SA4	BH17/SA4	BH17/SA6	BH18/SA6	BH14/SA6
		SAMPLE TYPE:		Soil	Soil	Soil	Soil	Soil	Soil
		DATE SAMPLED:		8/11/2016	8/11/2016	8/11/2016	8/11/2016	8/11/2016	8/10/2016
Parameter	Unit	G / S	RDL	7768441	7768449	7768461	7768475	7768602	7768607
Aroclor 1242	µg/g		0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1248	µg/g		0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1254	µg/g		0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1260	µg/g		0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Polychlorinated Biphenyls	µg/g		0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Surrogate	Unit	Acceptable Limits							
Decachlorobiphenyl	%	60-140		104	68	60	64	92	64

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard
7768441-7768607 Results are based on the dry weight of soil extracted.

Certified By:

Results relate only to the items tested and to all the items tested

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AGAT WORK ORDER: 16H125870
PROJECT: 7-16-0090-01

CLIENT NAME: TERRAPROBE INC
SAMPLING SITE:

ATTENTION TO: Garry Muckle
SAMPLED BY:

O. Reg. 153(511) - PHCs F1 - F4 (with PAHs) (Soil)

DATE RECEIVED: 2016-08-12

DATE REPORTED: 2016-08-18

				SAMPLE DESCRIPTION:	BH9/SA4	BH16/SA4	BH17/SA4	BH17/SA6	BH18/SA6	BH14/SA6
				SAMPLE TYPE:	Soil	Soil	Soil	Soil	Soil	Soil
				DATE SAMPLED:	8/11/2016	8/11/2016	8/11/2016	8/11/2016	8/11/2016	8/10/2016
Parameter	Unit	G / S	RDL		7768441	7768449	7768461	7768475	7768602	7768607
F1 (C6 to C10)	µg/g		5		<5	<5	22	<5	<5	5
F1 (C6 to C10) minus BTEX	µg/g		5		<5	<5	22	<5	<5	5
F2 (C10 to C16)	µg/g		10		<10	<10	14	<10	<10	27
F2 (C10 to C16) minus Naphthalene	µg/g		10		<10	<10	14	<10	<10	27
F3 (C16 to C34)	µg/g		50		79	160	190	<50	<50	140
F3 (C16 to C34) minus PAHs	µg/g		50		79	160	180	<50	<50	140
F4 (C34 to C50)	µg/g		50		<50	<50	<50	<50	<50	<50
Gravimetric Heavy Hydrocarbons	µg/g		50		NA	NA	NA	NA	NA	NA
Moisture Content	%		0.1		23.3	16.4	18.5	33.5	17.9	19.7
Surrogate	Unit	Acceptable Limits								
Terphenyl	%	60-140			86	63	94	118	129	110

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

7768441-7768607 Results are based on sample dry weight.
The C6-C10 fraction is calculated using toluene response factor.
The C10 - C16, C16 - C34, and C34 - C50 fractions are calculated using the average response factor for n-C10, n-C16, and n-C34.
Gravimetric Heavy Hydrocarbons are not included in the Total C16-C50 and are only determined if the chromatogram of the C34 - C50 hydrocarbons indicates that hydrocarbons >C50 are present.
The chromatogram has returned to baseline by the retention time of nC50.
Total C6 - C50 results are corrected for BTEX and PAH contributions.
This method complies with the Reference Method for the CWS PHC and is validated for use in the laboratory.
nC6 and nC10 response factors are within 30% of Toluene response factor.
nC10, nC16 and nC34 response factors are within 10% of their average.
C50 response factor is within 70% of nC10 + nC16 + nC34 average.
Linearity is within 15%.
Extraction and holding times were met for this sample.

Certified By:

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Certificate of Analysis

AGAT WORK ORDER: 16H125870
PROJECT: 7-16-0090-01

CLIENT NAME: TERRAPROBE INC
SAMPLING SITE:

ATTENTION TO: Garry Muckle
SAMPLED BY:

O. Reg. 153(511) - VOCs (Soil)

DATE RECEIVED: 2016-08-12

DATE REPORTED: 2016-08-18

		SAMPLE DESCRIPTION:		BH9/SA4	BH16/SA4	BH17/SA4	BH17/SA6	BH18/SA6	BH14/SA6
		SAMPLE TYPE:		Soil	Soil	Soil	Soil	Soil	Soil
		DATE SAMPLED:		8/11/2016	8/11/2016	8/11/2016	8/11/2016	8/11/2016	8/10/2016
Parameter	Unit	G / S	RDL	7768441	7768449	7768461	7768475	7768602	7768607
Acetone	ug/g		0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Benzene	ug/g		0.02	<0.02	<0.02	0.04	<0.02	<0.02	0.02
Bromodichloromethane	ug/g		0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Bromoform	ug/g		0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Bromomethane	ug/g		0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Carbon Tetrachloride	ug/g		0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Chlorobenzene	ug/g		0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Chloroform	ug/g		0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04
Cis- 1,2-Dichloroethylene	ug/g		0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Dibromochloromethane	ug/g		0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
1,3-Dichlorobenzene	ug/g		0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
1,2-Dichlorobenzene	ug/g		0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
1,4-Dichlorobenzene	ug/g		0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Dichlorodifluoromethane	µg/g		0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
1,1-Dichloroethane	ug/g		0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
1,2-Dichloroethane	ug/g		0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
1,1-Dichloroethylene	ug/g		0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
1,2-Dichloropropane	ug/g		0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
1,3-Dichloropropene	µg/g		0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04
Ethylbenzene	ug/g		0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Ethylene Dibromide	ug/g		0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04
Methyl Ethyl Ketone	ug/g		0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Methyl Isobutyl Ketone	ug/g		0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Methyl tert-butyl Ether	ug/g		0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Methylene Chloride	ug/g		0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Styrene	ug/g		0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
1,1,2,2-Tetrachloroethane	ug/g		0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
1,1,1,2-Tetrachloroethane	ug/g		0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04
Tetrachloroethylene	ug/g		0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Toluene	ug/g		0.05	<0.05	<0.05	0.09	<0.05	<0.05	0.09

Certified By:

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Certificate of Analysis

AGAT WORK ORDER: 16H125870
PROJECT: 7-16-0090-01

CLIENT NAME: TERRAPROBE INC
SAMPLING SITE:

ATTENTION TO: Garry Muckle
SAMPLED BY:

O. Reg. 153(511) - VOCs (Soil)

DATE RECEIVED: 2016-08-12

DATE REPORTED: 2016-08-18

				SAMPLE DESCRIPTION:	BH9/SA4	BH16/SA4	BH17/SA4	BH17/SA6	BH18/SA6	BH14/SA6
				SAMPLE TYPE:	Soil	Soil	Soil	Soil	Soil	Soil
				DATE SAMPLED:	8/11/2016	8/11/2016	8/11/2016	8/11/2016	8/11/2016	8/10/2016
Parameter	Unit	G / S	RDL		7768441	7768449	7768461	7768475	7768602	7768607
Trans- 1,2-Dichloroethylene	ug/g		0.05		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
1,1,1-Trichloroethane	ug/g		0.05		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
1,1,2-Trichloroethane	ug/g		0.04		<0.04	<0.04	<0.04	<0.04	<0.04	<0.04
Trichloroethylene	ug/g		0.03		<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Trichlorofluoromethane	ug/g		0.05		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Vinyl Chloride	ug/g		0.02		<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Xylene Mixture	ug/g		0.05		<0.05	<0.05	0.10	<0.05	<0.05	<0.05
m & p-Xylene	ug/g		0.05		<0.05	<0.05	0.10	<0.05	<0.05	<0.05
n-Hexane	µg/g		0.05		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
o-Xylene	ug/g		0.05		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Surrogate	Unit	Acceptable Limits								
4-Bromofluorobenzene	% Recovery	50-140			97	97	112	102	98	102
Toluene-d8	% Recovery	50-140			98	98	96	99	99	92

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

7768441-7768607 The sample was analysed using the high level technique. The sample was extracted using methanol, a small amount of the methanol extract was diluted in water and the purge & trap GC/MS analysis was performed. Results are based on the dry weight of the soil.

Certified By:



Results relate only to the items tested and to all the items tested

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Quality Assurance

CLIENT NAME: TERRAPROBE INC
PROJECT: 7-16-0090-01
SAMPLING SITE:

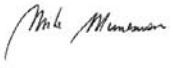
AGAT WORK ORDER: 16H125870
ATTENTION TO: Garry Muckle
SAMPLED BY:

Soil Analysis

RPT Date: Aug 18, 2016			DUPLICATE				REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
O. Reg. 153(511) - Metals & Inorganics (Soil)															
Antimony	7768475	7768475	< 0.8	<0.8	NA	< 0.8	120%	70%	130%	108%	80%	120%	104%	70%	130%
Arsenic	7768475	7768475	3	2	NA	< 1	119%	70%	130%	102%	80%	120%	101%	70%	130%
Barium	7768475	7768475	66	64	3.1%	< 2	109%	70%	130%	102%	80%	120%	96%	70%	130%
Beryllium	7768475	7768475	< 0.5	<0.5	NA	< 0.5	127%	70%	130%	120%	80%	120%	105%	70%	130%
Boron	7768475	7768475	7	6	NA	< 5	97%	70%	130%	120%	80%	120%	111%	70%	130%
Boron (Hot Water Soluble)	7768475	7768475	0.43	0.45	NA	< 0.10	94%	60%	140%	95%	70%	130%	97%	60%	140%
Cadmium	7768475	7768475	< 0.5	<0.5	NA	< 0.5	99%	70%	130%	106%	80%	120%	98%	70%	130%
Chromium	7768475	7768475	10	10	0.0%	< 2	100%	70%	130%	108%	80%	120%	104%	70%	130%
Chromium VI	7763862		<0.2	<0.2	NA	< 0.2	94%	70%	130%	97%	80%	120%	87%	70%	130%
Cobalt	7768475	7768475	6.0	5.7	5.1%	< 0.5	114%	70%	130%	110%	80%	120%	105%	70%	130%
Copper	7768475	7768475	16	16	0.0%	< 1	104%	70%	130%	114%	80%	120%	102%	70%	130%
Cyanide	7775363		<0.040	<0.040	NA	< 0.040	109%	70%	130%	100%	80%	120%	106%	70%	130%
Electrical Conductivity	7768475	7768475	0.206	0.209	1.4%	< 0.005	100%	90%	110%	NA			NA		
Lead	7768475	7768475	9	8	11.8%	< 1	116%	70%	130%	107%	80%	120%	97%	70%	130%
Mercury	7768475	7768475	< 0.10	<0.10	NA	< 0.10	125%	70%	130%	101%	80%	120%	95%	70%	130%
Molybdenum	7768475	7768475	< 0.5	<0.5	NA	< 0.5	113%	70%	130%	109%	80%	120%	110%	70%	130%
Nickel	7768475	7768475	9	9	0.0%	< 1	112%	70%	130%	113%	80%	120%	102%	70%	130%
Selenium	7768475	7768475	< 0.4	<0.4	NA	< 0.4	112%	70%	130%	109%	80%	120%	103%	70%	130%
Silver	7768475	7768475	< 0.2	<0.2	NA	< 0.2	101%	70%	130%	108%	80%	120%	100%	70%	130%
Sodium Adsorption Ratio	7768475	7768475	0.610	0.604	1.0%	NA	NA			NA			NA		
Thallium	7768475	7768475	< 0.4	<0.4	NA	< 0.4	122%	70%	130%	103%	80%	120%	96%	70%	130%
Uranium	7768475	7768475	< 0.5	<0.5	NA	< 0.5	109%	70%	130%	104%	80%	120%	98%	70%	130%
Vanadium	7768475	7768475	16	15	6.5%	< 1	117%	70%	130%	107%	80%	120%	103%	70%	130%
Zinc	7768475	7768475	65	57	13.1%	< 5	112%	70%	130%	117%	80%	120%	112%	70%	130%
pH, 2:1 CaCl2 Extraction	7764929		7.42	7.41	0.1%	NA	100%	80%	120%	NA			NA		

Comments: NA signifies Not Applicable.
Duplicate Qualifier: As the measured result approaches the RL, the uncertainty associated with the value increases dramatically, thus duplicate acceptance limits apply only where the average of the two duplicates is greater than five times the RL.

Certified By:



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TEL (905)712-5100
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http://www.agatlabs.com

Quality Assurance

CLIENT NAME: TERRAPROBE INC
AGAT WORK ORDER: 16H125870
PROJECT: 7-16-0090-01
ATTENTION TO: Garry Muckle
SAMPLING SITE:
SAMPLED BY:

Trace Organics Analysis

RPT Date: Aug 18, 2016			DUPLICATE				REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
O. Reg. 153(511) - VOCs (Soil)															
Acetone	7773456		< 0.50	< 0.50	NA	< 0.50	100%	50%	140%	91%	50%	140%	91%	50%	140%
Benzene	7773456		< 0.02	< 0.02	NA	< 0.02	108%	50%	140%	110%	60%	130%	113%	50%	140%
Bromodichloromethane	7773456		< 0.05	< 0.05	NA	< 0.05	87%	50%	140%	89%	60%	130%	81%	50%	140%
Bromoform	7773456		< 0.05	< 0.05	NA	< 0.05	72%	50%	140%	83%	60%	130%	82%	50%	140%
Bromomethane	7773456		< 0.05	< 0.05	NA	< 0.05	97%	50%	140%	101%	50%	140%	101%	50%	140%
Carbon Tetrachloride	7773456		< 0.05	< 0.05	NA	< 0.05	106%	50%	140%	103%	60%	130%	85%	50%	140%
Chlorobenzene	7773456		< 0.05	< 0.05	NA	< 0.05	100%	50%	140%	93%	60%	130%	92%	50%	140%
Chloroform	7773456		< 0.04	< 0.04	NA	< 0.04	110%	50%	140%	116%	60%	130%	109%	50%	140%
Cis- 1,2-Dichloroethylene	7773456		< 0.02	< 0.02	NA	< 0.02	113%	50%	140%	112%	60%	130%	104%	50%	140%
Dibromochloromethane	7773456		< 0.05	< 0.05	NA	< 0.05	90%	50%	140%	84%	60%	130%	104%	50%	140%
1,3-Dichlorobenzene	7773456		< 0.05	< 0.05	NA	< 0.05	84%	50%	140%	78%	60%	130%	86%	50%	140%
1,2-Dichlorobenzene	7773456		< 0.05	< 0.05	NA	< 0.05	84%	50%	140%	100%	60%	130%	86%	50%	140%
1,4-Dichlorobenzene	7773456		< 0.05	< 0.05	NA	< 0.05	86%	50%	140%	82%	60%	130%	83%	50%	140%
Dichlorodifluoromethane	7773456		< 0.05	< 0.05	NA	< 0.05	100%	50%	140%	80%	50%	140%	100%	50%	140%
1,1-Dichloroethane	7773456		< 0.02	< 0.02	NA	< 0.02	86%	50%	140%	110%	60%	130%	92%	50%	140%
1,2-Dichloroethane	7773456		< 0.03	< 0.03	NA	< 0.03	108%	50%	140%	107%	60%	130%	113%	50%	140%
1,1-Dichloroethylene	7773456		< 0.05	< 0.05	NA	< 0.05	113%	50%	140%	91%	60%	130%	101%	50%	140%
1,2-Dichloropropane	7773456		< 0.03	< 0.03	NA	< 0.03	109%	50%	140%	109%	60%	130%	104%	50%	140%
1,3-Dichloropropene	7773456		< 0.04	< 0.04	NA	< 0.04	95%	50%	140%	92%	60%	130%	97%	50%	140%
Ethylbenzene	7773456		< 0.05	< 0.05	NA	< 0.05	93%	50%	140%	89%	60%	130%	86%	50%	140%
Ethylene Dibromide	7773456		< 0.04	< 0.04	NA	< 0.04	86%	50%	140%	80%	60%	130%	96%	50%	140%
Methyl Ethyl Ketone	7773456		< 0.50	< 0.50	NA	< 0.50	109%	50%	140%	105%	50%	140%	94%	50%	140%
Methyl Isobutyl Ketone	7773456		< 0.50	< 0.50	NA	< 0.50	96%	50%	140%	87%	50%	140%	92%	50%	140%
Methyl tert-butyl Ether	7773456		< 0.05	< 0.05	NA	< 0.05	110%	50%	140%	95%	60%	130%	107%	50%	140%
Methylene Chloride	7773456		< 0.05	< 0.05	NA	< 0.05	115%	50%	140%	109%	60%	130%	110%	50%	140%
Styrene	7773456		< 0.05	< 0.05	NA	< 0.05	85%	50%	140%	91%	60%	130%	85%	50%	140%
1,1,2,2-Tetrachloroethane	7773456		< 0.05	< 0.05	NA	< 0.05	95%	50%	140%	97%	60%	130%	99%	50%	140%
1,1,1,2-Tetrachloroethane	7773456		< 0.04	< 0.04	NA	< 0.04	88%	50%	140%	85%	60%	130%	86%	50%	140%
Tetrachloroethylene	7773456		< 0.05	< 0.05	NA	< 0.05	104%	50%	140%	97%	60%	130%	98%	50%	140%
Toluene	7773456		< 0.05	< 0.05	NA	< 0.05	102%	50%	140%	94%	60%	130%	94%	50%	140%
Trans- 1,2-Dichloroethylene	7773456		< 0.05	< 0.05	NA	< 0.05	93%	50%	140%	92%	60%	130%	108%	50%	140%
1,1,1-Trichloroethane	7773456		< 0.05	< 0.05	NA	< 0.05	117%	50%	140%	110%	60%	130%	103%	50%	140%
1,1,2-Trichloroethane	7773456		< 0.04	< 0.04	NA	< 0.04	94%	50%	140%	95%	60%	130%	85%	50%	140%
Trichloroethylene	7773456		< 0.03	< 0.03	NA	< 0.03	108%	50%	140%	103%	60%	130%	105%	50%	140%
Trichlorofluoromethane	7773456		< 0.05	< 0.05	NA	< 0.05	105%	50%	140%	104%	50%	140%	104%	50%	140%
Vinyl Chloride	7773456		< 0.02	< 0.02	NA	< 0.02	98%	50%	140%	99%	50%	140%	99%	50%	140%
m & p-Xylene	7773456		< 0.05	< 0.05	NA	< 0.05	100%	50%	140%	90%	60%	130%	89%	50%	140%
n-Hexane	7773456		< 0.05	< 0.05	NA	< 0.05	84%	50%	140%	101%	60%	130%	103%	50%	140%
o-Xylene	7773456		< 0.05	< 0.05	NA	< 0.05	100%	50%	140%	90%	60%	130%	91%	50%	140%

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Quality Assurance

CLIENT NAME: TERRAPROBE INC
PROJECT: 7-16-0090-01
SAMPLING SITE:

AGAT WORK ORDER: 16H125870
ATTENTION TO: Garry Muckle
SAMPLED BY:

Trace Organics Analysis (Continued)

RPT Date: Aug 18, 2016			DUPLICATE				REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
O. Reg. 153(511) - PHCs F1 - F4 (with PAHs) (Soil)															
F1 (C6 to C10)	7764568		< 5	< 5	NA	< 5	98%	60%	130%	110%	85%	115%	111%	70%	130%
F2 (C10 to C16)	7762149		< 10	< 10	NA	< 10	107%	60%	130%	91%	80%	120%	99%	70%	130%
F3 (C16 to C34)	7762149		< 50	< 50	NA	< 50	104%	60%	130%	94%	80%	120%	96%	70%	130%
F4 (C34 to C50)	7762149		< 50	< 50	NA	< 50	104%	60%	130%	101%	80%	120%	88%	70%	130%
O. Reg. 153(511) - PAHs (Soil)															
Acenaphthene	7765500		< 0.05	< 0.05	NA	< 0.05	104%	50%	140%	124%	50%	140%	64%	50%	140%
Acenaphthylene	7765500		< 0.05	< 0.05	NA	< 0.05	107%	50%	140%	124%	50%	140%	64%	50%	140%
Anthracene	7765500		< 0.05	< 0.05	NA	< 0.05	110%	50%	140%	125%	50%	140%	58%	50%	140%
Benz(a)anthracene	7765500		< 0.05	< 0.05	NA	< 0.05	121%	50%	140%	139%	50%	140%	66%	50%	140%
Benzo(a)pyrene	7765500		< 0.05	< 0.05	NA	< 0.05	131%	50%	140%	133%	50%	140%	94%	50%	140%
Benzo(b)fluoranthene	7765500		< 0.05	< 0.05	NA	< 0.05	116%	50%	140%	77%	50%	140%	56%	50%	140%
Benzo(g,h,i)perylene	7765500		< 0.05	< 0.05	NA	< 0.05	138%	50%	140%	138%	50%	140%	123%	50%	140%
Benzo(k)fluoranthene	7765500		< 0.05	< 0.05	NA	< 0.05	90%	50%	140%	128%	50%	140%	138%	50%	140%
Chrysene	7765500		< 0.05	< 0.05	NA	< 0.05	110%	50%	140%	139%	50%	140%	61%	50%	140%
Dibenz(a,h)anthracene	7765500		< 0.05	< 0.05	NA	< 0.05	129%	50%	140%	119%	50%	140%	93%	50%	140%
Fluoranthene	7765500		< 0.05	< 0.05	NA	< 0.05	107%	50%	140%	125%	50%	140%	76%	50%	140%
Fluorene	7765500		< 0.05	< 0.05	NA	< 0.05	104%	50%	140%	121%	50%	140%	69%	50%	140%
Indeno(1,2,3-cd)pyrene	7765500		< 0.05	< 0.05	NA	< 0.05	134%	50%	140%	126%	50%	140%	96%	50%	140%
Naphthalene	7765500		< 0.05	< 0.05	NA	< 0.05	115%	50%	140%	130%	50%	140%	74%	50%	140%
Phenanthrene	7765500		< 0.05	< 0.05	NA	< 0.05	102%	50%	140%	119%	50%	140%	58%	50%	140%
Pyrene	7765500		< 0.05	< 0.05	NA	< 0.05	108%	50%	140%	129%	50%	140%	70%	50%	140%
2-and 1-methyl Naphthalene	7765500		< 0.05	< 0.05	NA	< 0.05	130%	50%	140%	118%	50%	140%	57%	50%	140%
O. Reg. 153(511) - PCBs (Soil)															
Aroclor 1242	7768607	7768607	< 0.1	< 0.1	NA	< 0.1	NA	60%	140%	NA	60%	140%	NA	60%	140%
Aroclor 1248	7768607	7768607	< 0.1	< 0.1	NA	< 0.1	NA	60%	140%	NA	60%	140%	NA	60%	140%
Aroclor 1254	7768607	7768607	< 0.1	< 0.1	NA	< 0.1	NA	60%	140%	NA	60%	140%	NA	60%	140%
Aroclor 1260	7768607	7768607	< 0.1	< 0.1	NA	< 0.1	NA	60%	140%	NA	60%	140%	NA	60%	140%
Polychlorinated Biphenyls	7768607	7768607	< 0.1	< 0.1	NA	< 0.1	113%	60%	140%	105%	60%	140%	114%	60%	140%

Comments: When the average of the sample and duplicate results is less than 5x the RDL, the Relative Percent Difference (RPD) will be indicated as Not Applicable (NA).

Certified By:

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Method Summary

CLIENT NAME: TERRAPROBE INC

AGAT WORK ORDER: 16H125870

PROJECT: 7-16-0090-01

ATTENTION TO: Garry Muckle

SAMPLING SITE:

SAMPLED BY:

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Soil Analysis			
Antimony	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Arsenic	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Barium	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Beryllium	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Boron	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Boron (Hot Water Soluble)	MET-93-6104	EPA SW 846 6010C; MSA, Part 3, Ch.21	ICP/OES
Cadmium	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Chromium	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Chromium VI	INOR-93-6029	SM 3500 B; MSA Part 3, Ch. 25	SPECTROPHOTOMETER
Cobalt	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Copper	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Cyanide	INOR-93-6052	MOE CN-3015 & E 3009 A;SM 4500 CN	TECHNICON AUTO ANALYZER
Electrical Conductivity	INOR-93-6036	McKeague 4.12, SM 2510 B	EC METER
Lead	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Mercury	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Molybdenum	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Nickel	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Selenium	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Silver	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Sodium Adsorption Ratio	INOR-93-6007	McKeague 4.12 & 3.26 & EPA SW-846 6010B	ICP/OES
Thallium	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Uranium	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Vanadium	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Zinc	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
pH, 2:1 CaCl2 Extraction	INOR-93-6031	MSA part 3 & SM 4500-H+ B	PH METER

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Method Summary

CLIENT NAME: TERRAPROBE INC

AGAT WORK ORDER: 16H125870

PROJECT: 7-16-0090-01

ATTENTION TO: Garry Muckle

SAMPLING SITE:

SAMPLED BY:

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Trace Organics Analysis			
Acenaphthene	ORG-91-5106	EPA SW846 3541 & 8270	GC/MS
Acenaphthylene	ORG-91-5106	EPA SW846 3541 & 8270	GC/MS
Anthracene	ORG-91-5106	EPA SW846 3541 & 8270	GC/MS
Benz(a)anthracene	ORG-91-5106	EPA SW846 3541 & 8270	GC/MS
Benzo(a)pyrene	ORG-91-5106	EPA SW846 3541 & 8270	GC/MS
Benzo(b)fluoranthene	ORG-91-5106	EPA SW846 3541 & 8270	GC/MS
Benzo(g,h,i)perylene	ORG-91-5106	EPA SW846 3541 & 8270	GC/MS
Benzo(k)fluoranthene	ORG-91-5106	EPA SW846 3541 & 8270	GC/MS
Chrysene	ORG-91-5106	EPA SW846 3541 & 8270	GC/MS
Chrysene-d12	ORG-91-5106	EPA SW846 3541 & 8270	GC/MS
Dibenz(a,h)anthracene	ORG-91-5106	EPA SW846 3541 & 8270	GC/MS
Fluoranthene	ORG-91-5106	EPA SW846 3541 & 8270	GC/MS
Fluorene	ORG-91-5106	EPA SW846 3541 & 8270	GC/MS
Indeno(1,2,3-cd)pyrene	ORG-91-5106	EPA SW846 3541 & 8270	GC/MS
Moisture Content	ORG-91-5106	EPA SW-846 3541 & 8270	BALANCE
Naphthalene	ORG-91-5106	EPA SW846 3541 & 8270	GC/MS
Phenanthrene	ORG-91-5106	EPA SW846 3541 & 8270	GC/MS
Pyrene	ORG-91-5106	EPA SW846 3541 & 8270	GC/MS
2-and 1-methyl Naphthalene	ORG-91-5106	EPA SW846 3541 & 8270	GC/MS
Aroclor 1242	ORG-91-5113	EPA SW-846 3541 & 8082	GC/ECD
Aroclor 1248	ORG-91-5113	EPA SW-846 3541 & 8082	GC/ECD
Aroclor 1254	ORG-91-5113	EPA SW-846 3541 & 8082	GC/ECD
Aroclor 1260	ORG-91-5113	EPA SW-846 3541 & 8082	GC/ECD
Decachlorobiphenyl	ORG-91-5113	EPA SW-846 3541 & 8082	GC/ECD
Polychlorinated Biphenyls	ORG-91-5113	EPA SW-846 3541 & 8082	GC/ECD
F1 (C6 to C10)	VOL-91-5009	CCME Tier 1 Method	GC / FID
F1 (C6 to C10) minus BTEX	VOL-91-5009	CCME Tier 1 Method	GC / FID
F2 (C10 to C16)	VOL-91-5009	CCME Tier 1 Method	GC / FID
F2 (C10 to C16) minus Naphthalene	VOL-91-5009	CCME Tier 1 Method	GC / FID
F3 (C16 to C34)	VOL-91-5009	CCME Tier 1 Method	GC / FID
F3 (C16 to C34) minus PAHs	VOL-91-5009	CCME Tier 1 Method	GC / FID
F4 (C34 to C50)	VOL-91-5009	CCME Tier 1 Method	GC / FID
Gravimetric Heavy Hydrocarbons	VOL-91-5009	CCME Tier 1 Method	GRAVIMETRIC ANALYSIS
Moisture Content	VOL-91-5009	CCME Tier 1 Method	BALANCE
Terphenyl	VOL-91-5009		GC/FID
Acetone	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Benzene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Bromodichloromethane	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
4-Bromofluorobenzene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Bromoform	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Bromomethane	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Carbon Tetrachloride	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Chlorobenzene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Chloroform	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Cis- 1,2-Dichloroethylene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Dibromochloromethane	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
1,3-Dichlorobenzene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
1,2-Dichlorobenzene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
1,4-Dichlorobenzene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS

Results relate only to the items tested and to all the items tested

AGAT Laboratories

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MISSISSAUGA, ONTARIO
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Method Summary

CLIENT NAME: TERRAPROBE INC

AGAT WORK ORDER: 16H125870

PROJECT: 7-16-0090-01

ATTENTION TO: Garry Muckle

SAMPLING SITE:

SAMPLED BY:

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Dichlorodifluoromethane	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
1,1-Dichloroethane	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
1,2-Dichloroethane	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
1,1-Dichloroethylene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
1,2-Dichloropropane	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
1,3-Dichloropropene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Ethylbenzene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Ethylene Dibromide	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Methyl Ethyl Ketone	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Methyl Isobutyl Ketone	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Methyl tert-butyl Ether	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Methylene Chloride	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Styrene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
1,1,2,2-Tetrachloroethane	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
1,1,1,2-Tetrachloroethane	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Tetrachloroethylene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Toluene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Toluene-d8	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Trans- 1,2-Dichloroethylene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
1,1,1-Trichloroethane	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
1,1,2-Trichloroethane	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Trichloroethylene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Trichlorofluoromethane	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Vinyl Chloride	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Xylene Mixture	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
m & p-Xylene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
n-Hexane	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
o-Xylene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS

Results relate only to the items tested and to all the items tested

1 LG Cooler
ENCORE - 1 Small Cooler

AGAT Laboratories

5835 Coopers Avenue
Mississauga, Ontario L4Z 1Y2
Ph: 905.712.5100 Fax: 905.712.5122
webearth.agatlabs.com

Chain of Custody Record

If this is a Drinking Water sample, please use Drinking Water Chain of Custody Form (potable water intended for human consumption)

Report Information

Company: **Terraprobe Inc.** 903 Barton Street, Unit 22
Contact: Stoney Creek, Ontario L8E 5P5
Address: **Ph:** (905) 643-7560 **Fax:** (905) 643-7559
Email: gmuckle@terraprobe.ca
Contact: Garry Muckle

Phone:

Reports to be sent to:

1. Email:
2. Email: dfelice@terraprobe.ca

Regulatory Requirements:

☐ No Regulatory Requirement

(Please check all applicable boxes)

☒ Regulation 153/04 Table 1 *Indicate One*
☐ Ind/Com
☐ Res/Park
☐ Agriculture

Soil Texture *(Check One)*
☐ Coarse
☐ Fine

☐ Sewer Use
☐ Sanitary
☐ Storm

Region *Indicate One*

☐ Regulation 558
☐ CCME
☐ Prov. Water Quality Objectives (PWQO)
☐ Other *Indicate One*

Is this submission for a **Record of Site Condition?** ☐ Yes ☒ No

Report Guideline on *Certificate of Analysis* ☐ Yes ☒ No

Laboratory Use Only

Work Order #: 16H125870

Cooler Quantity: LG cooler

Arrival Temperatures: 7.2 16.9 16.6
6.2 15.9 15.6

Custody Seal Intact: ☐ Yes ☐ No ☐ N/A

Notes: ON ICE.

Turnaround Time (TAT) Required:

Regular TAT ☒ 5 to 7 Business Days

Rush TAT (Rush Surcharges Apply)

☐ 3 Business Days ☐ 2 Business Days ☐ 1 Business Day

OR Date Required (Rush Surcharges May Apply):

Please provide prior notification for rush TAT
**TAT is exclusive of weekends and statutory holidays*

Project Information:

Project: 7-16-0090-01
Site Location:
Sampled By:
AGAT Quote #: PO:

Please note: If quotation number is not provided, client will be billed full price for analysis.

Invoice Information:

Bill To Same: Yes ☒ No ☐

Company:
Contact:
Address:
Email:

Sample Matrix Legend

B	Biota
GW	Ground Water
O	Oil
P	Paint
S	Soil
SD	Sediment
SW	Surface Water

Sample Identification	Date Sampled	Time Sampled	# of Containers	Sample Matrix	Comments/ Special Instructions	Metals and Inorganics	Metal Scan	Hydride Forming Metals	Client Custom Metals	ORPs: ☐ B-HWS ☐ CN ☐ Cr ☐ Cr6+ ☐ EC ☐ F- ☐ NO3/NO2 ☐ Total N ☐ Hg ☐ pH ☐ SAR	Nutrients: ☐ TP ☐ NH3 ☐ TKN ☐ NO2 ☐ NO3/NO2	Volatiles: ☒ VOC ☐ BTEX ☐ THM	CCME Fractions 1 to 4	ABNs	PAHs	Chlorophenols	PCBs	Organochlorine Pesticides	TCLP Metals/Inorganics	Sewer Use
BH9/SA4	Aug 11/16	8:19a	4	Soil		X						X	X	X	X	X				
BH 16/SA4	"	12:54p	"	"		X						X	X	X	X	X				
BH 17/SA4	"	11:17p	"	"		X						X	X	X	X	X				
BH 17/SA6	"	11:31p	"	"		X						X	X	X	X	X				
BH 18/SA6	"	10:30p	"	"		X						X	X	X	X	X				
BH 14/SA6	Aug 10/16	9:08p	4	Soil	ENCORE - 12 Arrival	X						X	X	X	X	X				
					TIME SENSATIVE ENCORES. EXTRACTION TODAY															

Samples Relinquished By (Print Name and Sign)	Date	Time	Samples Received By (Print Name and Sign)	Date	Time
Amber Brooks Amber Brooks	Aug 12/16	12:25	Daniella Jaic [illegible]	8/12/16	12:25pm
Daniella Jaic [illegible]	8/12/16	2:15pm	[illegible]	2016/08/12	2:15

Page 1 of 1

№: T016540

Pink Copy - Client | Yellow Copy - AGAT | White Copy - AGAT

Date Issued: Jan 8, 2015

AGAT Laboratories

5835 COOPERS AVENUE
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TEL (905)712-5100
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http://www.agatlabs.com

CLIENT NAME: TERRAPROBE INC
903 Barton Street
Stoney Creek, ON L8E5P5
(905) 643-7560

ATTENTION TO: Garry Muckle

PROJECT: 7-16-0090-01

AGAT WORK ORDER: 16H126806

SOIL ANALYSIS REVIEWED BY: Amanjot Bhela, Inorganic Coordinator

TRACE ORGANICS REVIEWED BY: Gyulhan Yalamova, Report Reviewer

DATE REPORTED: Aug 22, 2016

PAGES (INCLUDING COVER): 19

VERSION*: 1

Should you require any information regarding this analysis please contact your client services representative at (905) 712-5100

*NOTES

All samples will be disposed of within 30 days following analysis. Please contact the lab if you require additional sample storage time.

Member of: Association of Professional Engineers, Geologists and Geophysicists of Alberta (APEGGA)
Western Enviro-Agricultural Laboratory Association (WEALA)
Environmental Services Association of Alberta (ESAA)

AGAT Laboratories is accredited to ISO/IEC 17025 by the Canadian Association for Laboratory Accreditation Inc. (CALA) and/or Standards Council of Canada (SCC) for specific tests listed on the scope of accreditation. AGAT Laboratories (Mississauga) is also accredited by the Canadian Association for Laboratory Accreditation Inc. (CALA) for specific drinking water tests. Accreditations are location and parameter specific. A complete listing of parameters for each location is available from www.cala.ca and/or www.scc.ca. The tests in this report may not necessarily be included in the scope of accreditation.

Results relate only to the items tested and to all the items tested
All reportable information as specified by ISO 17025:2005 is available from AGAT Laboratories upon request

AGAT Laboratories

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Certificate of Analysis

AGAT WORK ORDER: 16H126806
PROJECT: 7-16-0090-01

CLIENT NAME: TERRAPROBE INC
SAMPLING SITE:

ATTENTION TO: Garry Muckle
SAMPLED BY:

O. Reg. 153(511) - Metals & Inorganics (Soil)

DATE RECEIVED: 2016-08-16

DATE REPORTED: 2016-08-22

		SAMPLE DESCRIPTION:		BH8SA5	BH8SA8	BH2SA10	BH21SA6	BH22SA6	BH23SA5	BH24SA6	BH25SA6
		SAMPLE TYPE:		Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
		DATE SAMPLED:		8/12/2016	8/12/2016	8/12/2016	8/15/2016	8/15/2016	8/15/2016	8/15/2016	8/15/2016
Parameter	Unit	G / S	RDL	7775057	7775058	7775061	7775321	7775338	7775345	7775346	7775360
Antimony	µg/g		0.8	1.3	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8
Arsenic	µg/g		1	9	3	3	5	4	4	4	2
Barium	µg/g		2	110	50	34	91	55	82	73	49
Beryllium	µg/g		0.5	0.7	<0.5	<0.5	0.6	<0.5	<0.5	0.5	<0.5
Boron	µg/g		5	16	7	6	9	7	7	8	<5
Boron (Hot Water Soluble)	µg/g		0.10	1.65	0.60	0.51	0.20	0.20	0.14	0.18	0.92
Cadmium	µg/g		0.5	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Chromium	µg/g		2	22	16	12	21	12	16	17	10
Chromium VI	µg/g		0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Cobalt	µg/g		0.5	6.8	7.7	7.0	11.5	6.5	9.6	9.7	5.5
Copper	µg/g		1	73	21	27	31	23	25	25	14
Cyanide	µg/g		0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040
Electrical Conductivity	mS/cm		0.005	0.763	0.411	1.37	0.187	0.246	0.166	0.165	0.294
Lead	µg/g		1	145	12	18	12	10	10	15	49
Mercury	µg/g		0.10	0.20	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.24
Molybdenum	µg/g		0.5	1.8	<0.5	<0.5	0.5	<0.5	<0.5	<0.5	<0.5
Nickel	µg/g		1	17	13	12	23	11	18	18	9
Selenium	µg/g		0.4	0.6	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4
Silver	µg/g		0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Sodium Adsorption Ratio	NA		NA	2.50	0.894	9.00	0.644	1.43	0.342	0.488	0.751
Thallium	µg/g		0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4
Uranium	µg/g		0.5	0.6	<0.5	<0.5	0.6	<0.5	0.6	0.5	<0.5
Vanadium	µg/g		1	24	20	19	27	16	21	21	14
Zinc	µg/g		5	141	55	49	66	39	51	53	41
pH, 2:1 CaCl2 Extraction	pH Units		NA	9.55	7.65	7.43	7.69	7.72	7.73	7.66	7.09

Certified By: Amanjot Bhela

Results relate only to the items tested and to all the items tested

AGAT Laboratories

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Certificate of Analysis

AGAT WORK ORDER: 16H126806
PROJECT: 7-16-0090-01

CLIENT NAME: TERRAPROBE INC
SAMPLING SITE:

ATTENTION TO: Garry Muckle
SAMPLED BY:

O. Reg. 153(511) - Metals & Inorganics (Soil)

DATE RECEIVED: 2016-08-16

DATE REPORTED: 2016-08-22

				SAMPLE DESCRIPTION:	BH26SA6	BH27SA6
				SAMPLE TYPE:	Soil	Soil
				DATE SAMPLED:	8/15/2016	8/15/2016
Parameter	Unit	G / S	RDL		7775362	7775368
Antimony	µg/g		0.8		<0.8	<0.8
Arsenic	µg/g		1		4	3
Barium	µg/g		2		56	50
Beryllium	µg/g		0.5		<0.5	0.5
Boron	µg/g		5		7	5
Boron (Hot Water Soluble)	µg/g		0.10		0.12	0.35
Cadmium	µg/g		0.5		<0.5	<0.5
Chromium	µg/g		2		17	14
Chromium VI	µg/g		0.2		<0.2	<0.2
Cobalt	µg/g		0.5		9.7	7.3
Copper	µg/g		1		26	20
Cyanide	µg/g		0.040		<0.040	<0.040
Electrical Conductivity	mS/cm		0.005		0.149	0.877
Lead	µg/g		1		13	32
Mercury	µg/g		0.10		<0.10	0.26
Molybdenum	µg/g		0.5		<0.5	<0.5
Nickel	µg/g		1		18	13
Selenium	µg/g		0.4		<0.4	<0.4
Silver	µg/g		0.2		<0.2	<0.2
Sodium Adsorption Ratio	NA		NA		0.458	4.19
Thallium	µg/g		0.4		<0.4	<0.4
Uranium	µg/g		0.5		<0.5	<0.5
Vanadium	µg/g		1		22	19
Zinc	µg/g		5		53	53
pH, 2:1 CaCl2 Extraction	pH Units		NA		7.78	7.09

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

7775057 EC & SAR were determined on the DI water extract obtained from the 2:1 leaching procedure (2 parts DI water:1 part soil). pH was determined on the 0.01M CaCl2 extract prepared at 2:1 ratio. Please note that Lead value was confirmed by re-analysis.

7775058-7775368 EC & SAR were determined on the DI water extract obtained from the 2:1 leaching procedure (2 parts DI water:1 part soil). pH was determined on the 0.01M CaCl2 extract prepared at 2:1 ratio.

Certified By: Amanjot Bhela

Results relate only to the items tested and to all the items tested

AGAT Laboratories

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http://www.agatlabs.com

Certificate of Analysis

AGAT WORK ORDER: 16H126806
PROJECT: 7-16-0090-01

CLIENT NAME: TERRAPROBE INC
SAMPLING SITE:

ATTENTION TO: Garry Muckle
SAMPLED BY:

O. Reg. 153(511) - PAHs (Soil)

DATE RECEIVED: 2016-08-16

DATE REPORTED: 2016-08-22

		SAMPLE DESCRIPTION:		BH8SA5	BH8SA8	BH2SA10	BH21SA6	BH22SA6	BH23SA5	BH24SA6	BH25SA6
		SAMPLE TYPE:		Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
		DATE SAMPLED:		8/12/2016	8/12/2016	8/12/2016	8/15/2016	8/15/2016	8/15/2016	8/15/2016	8/15/2016
Parameter	Unit	G / S	RDL	7775057	7775058	7775061	7775321	7775338	7775345	7775346	7775360
Acenaphthene	µg/g		0.05	6.6	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Acenaphthylene	µg/g		0.05	0.37	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Anthracene	µg/g		0.05	11	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Benz(a)anthracene	µg/g		0.05	17	0.09	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Benzo(a)pyrene	µg/g		0.05	9.4	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Benzo(b)fluoranthene	µg/g		0.05	15	0.06	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Benzo(g,h,i)perylene	µg/g		0.05	6.0	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Benzo(k)fluoranthene	µg/g		0.05	3.8	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Chrysene	µg/g		0.05	12	0.06	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Dibenz(a,h)anthracene	µg/g		0.05	1.4	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Fluoranthene	µg/g		0.05	47	0.16	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Fluorene	µg/g		0.05	8.1	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Indeno(1,2,3-cd)pyrene	µg/g		0.05	5.2	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Moisture Content	%		0.1	18.5	26.8	22.1	16.5	16.2	13.1	15.5	33.3
Naphthalene	µg/g		0.05	4.6	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Phenanthrene	µg/g		0.05	56	0.15	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Pyrene	µg/g		0.05	39	0.14	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
2-and 1-methyl Naphthalene	µg/g		0.05	4.4	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Surrogate	Unit	Acceptable Limits									
Chrysene-d12	%	50-140		98	119	104	93	114	95	97	102

Certified By:

Results relate only to the items tested and to all the items tested

AGAT Laboratories

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FAX (905)712-5122
http://www.agatlabs.com

Certificate of Analysis

AGAT WORK ORDER: 16H126806
PROJECT: 7-16-0090-01

CLIENT NAME: TERRAPROBE INC
SAMPLING SITE:

ATTENTION TO: Garry Muckle
SAMPLED BY:

O. Reg. 153(511) - PAHs (Soil)

DATE RECEIVED: 2016-08-16

DATE REPORTED: 2016-08-22

		SAMPLE DESCRIPTION:		BH26SA6	BH27SA6
		SAMPLE TYPE:		Soil	Soil
		DATE SAMPLED:		8/15/2016	8/15/2016
Parameter	Unit	G / S	RDL	7775362	7775368
Acenaphthene	µg/g		0.05	<0.05	<0.05
Acenaphthylene	µg/g		0.05	<0.05	<0.05
Anthracene	µg/g		0.05	<0.05	<0.05
Benz(a)anthracene	µg/g		0.05	<0.05	<0.05
Benzo(a)pyrene	µg/g		0.05	<0.05	<0.05
Benzo(b)fluoranthene	µg/g		0.05	<0.05	<0.05
Benzo(g,h,i)perylene	µg/g		0.05	<0.05	<0.05
Benzo(k)fluoranthene	µg/g		0.05	<0.05	<0.05
Chrysene	µg/g		0.05	<0.05	<0.05
Dibenz(a,h)anthracene	µg/g		0.05	<0.05	<0.05
Fluoranthene	µg/g		0.05	<0.05	<0.05
Fluorene	µg/g		0.05	<0.05	<0.05
Indeno(1,2,3-cd)pyrene	µg/g		0.05	<0.05	<0.05
Moisture Content	%		0.1	13.9	25.9
Naphthalene	µg/g		0.05	<0.05	<0.05
Phenanthrene	µg/g		0.05	<0.05	<0.05
Pyrene	µg/g		0.05	<0.05	<0.05
2-and 1-methyl Naphthalene	µg/g		0.05	<0.05	<0.05
Surrogate	Unit	Acceptable Limits			
Chrysene-d12	%	50-140		102	107

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

7775057-7775368 Results are based on the dry weight of the soil.
Note: The result for Benzo(b)Fluoranthene is the total of the Benzo(b)&(j)Fluoranthene isomers because the isomers co-elute on the GC column.

Certified By:



Results relate only to the items tested and to all the items tested

AGAT Laboratories

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
http://www.agatlabs.com

Certificate of Analysis

AGAT WORK ORDER: 16H126806
PROJECT: 7-16-0090-01

CLIENT NAME: TERRAPROBE INC
SAMPLING SITE:

ATTENTION TO: Garry Muckle
SAMPLED BY:

O. Reg. 153(511) - PCBs (Soil)

DATE RECEIVED: 2016-08-16

DATE REPORTED: 2016-08-22

		SAMPLE DESCRIPTION:		BH8SA5	BH8SA8	BH2SA10	BH21SA6	BH22SA6	BH23SA5	BH24SA6	BH25SA6
		SAMPLE TYPE:		Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
		DATE SAMPLED:		8/12/2016	8/12/2016	8/12/2016	8/15/2016	8/15/2016	8/15/2016	8/15/2016	8/15/2016
Parameter	Unit	G / S	RDL	7775057	7775058	7775061	7775321	7775338	7775345	7775346	7775360
Aroclor 1242	µg/g		0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1248	µg/g		0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1254	µg/g		0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1260	µg/g		0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Polychlorinated Biphenyls	µg/g		0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Surrogate	Unit	Acceptable Limits									
Decachlorobiphenyl	%	60-140		112	88	124	108	120	120	116	104

		SAMPLE DESCRIPTION:		BH26SA6	BH27SA6
		SAMPLE TYPE:		Soil	Soil
		DATE SAMPLED:		8/15/2016	8/15/2016
Parameter	Unit	G / S	RDL	7775362	7775368
Aroclor 1242	µg/g		0.1	<0.1	<0.1
Aroclor 1248	µg/g		0.1	<0.1	<0.1
Aroclor 1254	µg/g		0.1	<0.1	<0.1
Aroclor 1260	µg/g		0.1	<0.1	<0.1
Polychlorinated Biphenyls	µg/g		0.1	<0.1	<0.1
Surrogate	Unit	Acceptable Limits			
Decachlorobiphenyl	%	60-140		120	64

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard
7775057-7775368 Results are based on the dry weight of soil extracted.

Certified By:

Results relate only to the items tested and to all the items tested

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AGAT WORK ORDER: 16H126806
PROJECT: 7-16-0090-01

CLIENT NAME: TERRAPROBE INC
SAMPLING SITE:

ATTENTION TO: Garry Muckle
SAMPLED BY:

O. Reg. 153(511) - PHCs F1 - F4 (with PAHs) (Soil)

DATE RECEIVED: 2016-08-16

DATE REPORTED: 2016-08-22

		SAMPLE DESCRIPTION:		BH8SA5	BH8SA8	BH2SA10	BH21SA6	BH22SA6	BH23SA5	BH24SA6	BH25SA6
		SAMPLE TYPE:		Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
		DATE SAMPLED:		8/12/2016	8/12/2016	8/12/2016	8/15/2016	8/15/2016	8/15/2016	8/15/2016	8/15/2016
Parameter	Unit	G / S	RDL	7775057	7775058	7775061	7775321	7775338	7775345	7775346	7775360
F1 (C6 to C10)	µg/g		5	<5	<5	<5	<5	<5	<5	<5	<5
F1 (C6 to C10) minus BTEX	µg/g		5	<5	<5	<5	<5	<5	<5	<5	<5
F2 (C10 to C16)	µg/g		10	81	<10	<10	<10	<10	<10	<10	<10
F2 (C10 to C16) minus Naphthalene	µg/g		10	76	<10	<10	<10	<10	<10	<10	<10
F3 (C16 to C34)	µg/g		50	1100	<50	<50	<50	<50	<50	<50	140
F3 (C16 to C34) minus PAHs	µg/g		50	900	<50	<50	<50	<50	<50	<50	140
F4 (C34 to C50)	µg/g		50	690	<50	<50	<50	<50	<50	<50	72
Gravimetric Heavy Hydrocarbons	µg/g		50	NA	NA	NA	NA	NA	NA	NA	NA
Moisture Content	%		0.1	18.5	26.8	22.1	16.5	16.2	13.1	15.5	33.3
Surrogate	Unit	Acceptable Limits									
Terphenyl	%	60-140		98	102	96	84	92	73	100	89

		SAMPLE DESCRIPTION:		BH26SA6	BH27SA6
		SAMPLE TYPE:		Soil	Soil
		DATE SAMPLED:		8/15/2016	8/15/2016
Parameter	Unit	G / S	RDL	7775362	7775368
F1 (C6 to C10)	µg/g		5	<5	<5
F1 (C6 to C10) minus BTEX	µg/g		5	<5	<5
F2 (C10 to C16)	µg/g		10	<10	<10
F2 (C10 to C16) minus Naphthalene	µg/g		10	<10	<10
F3 (C16 to C34)	µg/g		50	<50	<50
F3 (C16 to C34) minus PAHs	µg/g		50	<50	<50
F4 (C34 to C50)	µg/g		50	<50	<50
Gravimetric Heavy Hydrocarbons	µg/g		50	NA	NA
Moisture Content	%		0.1	13.9	25.9
Surrogate	Unit	Acceptable Limits			
Terphenyl	%	60-140		94	112

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PROJECT: 7-16-0090-01

CLIENT NAME: TERRAPROBE INC
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SAMPLING SITE:
SAMPLED BY:

O. Reg. 153(511) - PHCs F1 - F4 (with PAHs) (Soil)

DATE RECEIVED: 2016-08-16
DATE REPORTED: 2016-08-22

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

7775057-7775368 Results are based on sample dry weight.
The C6-C10 fraction is calculated using toluene response factor.
The C10 - C16, C16 - C34, and C34 - C50 fractions are calculated using the average response factor for n-C10, n-C16, and n-C34.
Gravimetric Heavy Hydrocarbons are not included in the Total C16-C50 and are only determined if the chromatogram of the C34 - C50 hydrocarbons indicates that hydrocarbons >C50 are present.
The chromatogram has returned to baseline by the retention time of nC50.
Total C6 - C50 results are corrected for BTEX and PAH contributions.
This method complies with the Reference Method for the CWS PHC and is validated for use in the laboratory.
nC6 and nC10 response factors are within 30% of Toluene response factor.
nC10, nC16 and nC34 response factors are within 10% of their average.
C50 response factor is within 70% of nC10 + nC16 + nC34 average.
Linearity is within 15%.
Extraction and holding times were met for this sample.

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AGAT WORK ORDER: 16H126806
PROJECT: 7-16-0090-01

CLIENT NAME: TERRAPROBE INC
SAMPLING SITE:

ATTENTION TO: Garry Muckle
SAMPLED BY:

O. Reg. 153(511) - VOCs (Soil)

DATE RECEIVED: 2016-08-16

DATE REPORTED: 2016-08-22

		SAMPLE DESCRIPTION:		BH8SA5	BH8SA8	BH2SA10	BH21SA6	BH22SA6	BH23SA5	BH24SA6	BH25SA6
		SAMPLE TYPE:		Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
		DATE SAMPLED:		8/12/2016	8/12/2016	8/12/2016	8/15/2016	8/15/2016	8/15/2016	8/15/2016	8/15/2016
Parameter	Unit	G / S	RDL	7775057	7775058	7775061	7775321	7775338	7775345	7775346	7775360
Acetone	ug/g		0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Benzene	ug/g		0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Bromodichloromethane	ug/g		0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Bromoform	ug/g		0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Bromomethane	ug/g		0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Carbon Tetrachloride	ug/g		0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Chlorobenzene	ug/g		0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Chloroform	ug/g		0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04
Cis- 1,2-Dichloroethylene	ug/g		0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Dibromochloromethane	ug/g		0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
1,3-Dichlorobenzene	ug/g		0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
1,2-Dichlorobenzene	ug/g		0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
1,4-Dichlorobenzene	ug/g		0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Dichlorodifluoromethane	µg/g		0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
1,1-Dichloroethane	ug/g		0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
1,2-Dichloroethane	ug/g		0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
1,1-Dichloroethylene	ug/g		0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
1,2-Dichloropropane	ug/g		0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
1,3-Dichloropropene	µg/g		0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04
Ethylbenzene	ug/g		0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Ethylene Dibromide	ug/g		0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04
Methyl Ethyl Ketone	ug/g		0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Methyl Isobutyl Ketone	ug/g		0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Methyl tert-butyl Ether	ug/g		0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Methylene Chloride	ug/g		0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Styrene	ug/g		0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
1,1,2,2-Tetrachloroethane	ug/g		0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
1,1,1,2-Tetrachloroethane	ug/g		0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04
Tetrachloroethylene	ug/g		0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Toluene	ug/g		0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05

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PROJECT: 7-16-0090-01

CLIENT NAME: TERRAPROBE INC
SAMPLING SITE:

ATTENTION TO: Garry Muckle
SAMPLED BY:

O. Reg. 153(511) - VOCs (Soil)

DATE RECEIVED: 2016-08-16

DATE REPORTED: 2016-08-22

		SAMPLE DESCRIPTION:		BH8SA5	BH8SA8	BH2SA10	BH21SA6	BH22SA6	BH23SA5	BH24SA6	BH25SA6
		SAMPLE TYPE:		Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
		DATE SAMPLED:		8/12/2016	8/12/2016	8/12/2016	8/15/2016	8/15/2016	8/15/2016	8/15/2016	8/15/2016
Parameter	Unit	G / S	RDL	7775057	7775058	7775061	7775321	7775338	7775345	7775346	7775360
Trans- 1,2-Dichloroethylene	ug/g		0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
1,1,1-Trichloroethane	ug/g		0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
1,1,2-Trichloroethane	ug/g		0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04
Trichloroethylene	ug/g		0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Trichlorofluoromethane	ug/g		0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Vinyl Chloride	ug/g		0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Xylene Mixture	ug/g		0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
m & p-Xylene	ug/g		0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
n-Hexane	µg/g		0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
o-Xylene	ug/g		0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Surrogate	Unit	Acceptable Limits									
4-Bromofluorobenzene	% Recovery	50-140		96	97	103	101	98	95	103	97
Toluene-d8	% Recovery	50-140		92	92	94	95	96	95	96	96

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AGAT WORK ORDER: 16H126806
PROJECT: 7-16-0090-01

CLIENT NAME: TERRAPROBE INC
SAMPLING SITE:

ATTENTION TO: Garry Muckle
SAMPLED BY:

O. Reg. 153(511) - VOCs (Soil)

DATE RECEIVED: 2016-08-16

DATE REPORTED: 2016-08-22

		SAMPLE DESCRIPTION:		BH26SA6	BH27SA6
		SAMPLE TYPE:		Soil	Soil
		DATE SAMPLED:		8/15/2016	8/15/2016
Parameter	Unit	G / S	RDL	7775362	7775368
Acetone	ug/g		0.50	<0.50	<0.50
Benzene	ug/g		0.02	<0.02	<0.02
Bromodichloromethane	ug/g		0.05	<0.05	<0.05
Bromoform	ug/g		0.05	<0.05	<0.05
Bromomethane	ug/g		0.05	<0.05	<0.05
Carbon Tetrachloride	ug/g		0.05	<0.05	<0.05
Chlorobenzene	ug/g		0.05	<0.05	<0.05
Chloroform	ug/g		0.04	<0.04	<0.04
Cis- 1,2-Dichloroethylene	ug/g		0.02	<0.02	<0.02
Dibromochloromethane	ug/g		0.05	<0.05	<0.05
1,3-Dichlorobenzene	ug/g		0.05	<0.05	<0.05
1,2-Dichlorobenzene	ug/g		0.05	<0.05	<0.05
1,4-Dichlorobenzene	ug/g		0.05	<0.05	<0.05
Dichlorodifluoromethane	µg/g		0.05	<0.05	<0.05
1,1-Dichloroethane	ug/g		0.02	<0.02	<0.02
1,2-Dichloroethane	ug/g		0.03	<0.03	<0.03
1,1-Dichloroethylene	ug/g		0.05	<0.05	<0.05
1,2-Dichloropropane	ug/g		0.03	<0.03	<0.03
1,3-Dichloropropene	µg/g		0.04	<0.04	<0.04
Ethylbenzene	ug/g		0.05	<0.05	<0.05
Ethylene Dibromide	ug/g		0.04	<0.04	<0.04
Methyl Ethyl Ketone	ug/g		0.50	<0.50	<0.50
Methyl Isobutyl Ketone	ug/g		0.50	<0.50	<0.50
Methyl tert-butyl Ether	ug/g		0.05	<0.05	<0.05
Methylene Chloride	ug/g		0.05	<0.05	<0.05
Styrene	ug/g		0.05	<0.05	<0.05
1,1,2,2-Tetrachloroethane	ug/g		0.05	<0.05	<0.05
1,1,1,2-Tetrachloroethane	ug/g		0.04	<0.04	<0.04
Tetrachloroethylene	ug/g		0.05	<0.05	<0.05
Toluene	ug/g		0.05	<0.05	<0.05

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AGAT WORK ORDER: 16H126806
PROJECT: 7-16-0090-01

CLIENT NAME: TERRAPROBE INC
SAMPLING SITE:

ATTENTION TO: Garry Muckle
SAMPLED BY:

O. Reg. 153(511) - VOCs (Soil)

DATE RECEIVED: 2016-08-16

DATE REPORTED: 2016-08-22

				SAMPLE DESCRIPTION:	BH26SA6	BH27SA6
				SAMPLE TYPE:	Soil	Soil
				DATE SAMPLED:	8/15/2016	8/15/2016
Parameter	Unit	G / S	RDL		7775362	7775368
Trans- 1,2-Dichloroethylene	ug/g		0.05		<0.05	<0.05
1,1,1-Trichloroethane	ug/g		0.05		<0.05	<0.05
1,1,2-Trichloroethane	ug/g		0.04		<0.04	<0.04
Trichloroethylene	ug/g		0.03		<0.03	<0.03
Trichlorofluoromethane	ug/g		0.05		<0.05	<0.05
Vinyl Chloride	ug/g		0.02		<0.02	<0.02
Xylene Mixture	ug/g		0.05		<0.05	<0.05
m & p-Xylene	ug/g		0.05		<0.05	<0.05
n-Hexane	µg/g		0.05		<0.05	<0.05
o-Xylene	ug/g		0.05		<0.05	<0.05
Surrogate	Unit	Acceptable Limits				
4-Bromofluorobenzene	% Recovery	50-140			101	100
Toluene-d8	% Recovery	50-140			94	94

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

7775057-7775368 The sample was analysed using the high level technique. The sample was extracted using methanol, a small amount of the methanol extract was diluted in water and the purge & trap GC/MS analysis was performed. Results are based on the dry weight of the soil.

Certified By:



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Quality Assurance

CLIENT NAME: TERRAPROBE INC
PROJECT: 7-16-0090-01
SAMPLING SITE:

AGAT WORK ORDER: 16H126806
ATTENTION TO: Garry Muckle
SAMPLED BY:

Soil Analysis

RPT Date: Aug 22, 2016			DUPLICATE				REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
O. Reg. 153(511) - Metals & Inorganics (Soil)															
Antimony	7775338	7775338	<0.8	<0.8	NA	< 0.8	110%	70%	130%	104%	80%	120%	108%	70%	130%
Arsenic	7775338	7775338	4	4	NA	< 1	110%	70%	130%	106%	80%	120%	107%	70%	130%
Barium	7775338	7775338	55	57	3.6%	< 2	100%	70%	130%	97%	80%	120%	101%	70%	130%
Beryllium	7775338	7775338	<0.5	<0.5	NA	< 0.5	103%	70%	130%	108%	80%	120%	113%	70%	130%
Boron	7775338	7775338	7	7	NA	< 5	77%	70%	130%	108%	80%	120%	110%	70%	130%
Boron (Hot Water Soluble)	7775338	7775338	0.20	0.20	NA	< 0.10	96%	60%	140%	98%	70%	130%	99%	60%	140%
Cadmium	7775338	7775338	<0.5	<0.5	NA	< 0.5	105%	70%	130%	102%	80%	120%	98%	70%	130%
Chromium	7775338	7775338	12	13	8.0%	< 2	90%	70%	130%	102%	80%	120%	108%	70%	130%
Chromium VI	7775057	7775057	<0.2	<0.2	NA	< 0.2	95%	70%	130%	98%	80%	120%	96%	70%	130%
Cobalt	7775338	7775338	6.5	6.9	6.0%	< 0.5	94%	70%	130%	99%	80%	120%	99%	70%	130%
Copper	7775338	7775338	23	22	4.4%	< 1	95%	70%	130%	102%	80%	120%	102%	70%	130%
Cyanide	7775057	7775057	<0.040	<0.040	NA	< 0.040	106%	70%	130%	106%	80%	120%	99%	70%	130%
Electrical Conductivity	7775338	7775338	0.246	0.246	0.0%	< 0.005	100%	90%	110%	NA			NA		
Lead	7775338	7775338	10	10	0.0%	< 1	100%	70%	130%	99%	80%	120%	105%	70%	130%
Mercury	7775338	7775338	<0.10	<0.10	NA	< 0.10	122%	70%	130%	104%	80%	120%	99%	70%	130%
Molybdenum	7775338	7775338	<0.5	0.6	NA	< 0.5	100%	70%	130%	105%	80%	120%	108%	70%	130%
Nickel	7775338	7775338	11	11	0.0%	< 1	98%	70%	130%	102%	80%	120%	97%	70%	130%
Selenium	7775338	7775338	<0.4	<0.4	NA	< 0.4	99%	70%	130%	98%	80%	120%	101%	70%	130%
Silver	7775338	7775338	<0.2	<0.2	NA	< 0.2	96%	70%	130%	107%	80%	120%	97%	70%	130%
Sodium Adsorption Ratio	7775338	7775338	1.43	1.42	0.7%	NA	NA			NA			NA		
Thallium	7775338	7775338	<0.4	<0.4	NA	< 0.4	91%	70%	130%	100%	80%	120%	102%	70%	130%
Uranium	7775338	7775338	<0.5	<0.5	NA	< 0.5	93%	70%	130%	101%	80%	120%	108%	70%	130%
Vanadium	7775338	7775338	16	17	6.1%	< 1	91%	70%	130%	91%	80%	120%	99%	70%	130%
Zinc	7775338	7775338	39	41	5.0%	< 5	101%	70%	130%	105%	80%	120%	102%	70%	130%
pH, 2:1 CaCl2 Extraction	7775338	7775338	7.72	7.69	0.4%	NA	100%	80%	120%	NA			NA		

Comments: NA signifies Not Applicable.
Duplicate Qualifier: As the measured result approaches the RL, the uncertainty associated with the value increases dramatically, thus duplicate acceptance limits apply only where the average of the two duplicates is greater than five times the RL.

Certified By: Amanjot Bhela

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Quality Assurance

CLIENT NAME: TERRAPROBE INC
AGAT WORK ORDER: 16H126806
PROJECT: 7-16-0090-01
ATTENTION TO: Garry Muckle
SAMPLING SITE:
SAMPLED BY:

Trace Organics Analysis

RPT Date: Aug 22, 2016			DUPLICATE				REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
O. Reg. 153(511) - VOCs (Soil)															
Acetone	7775739		< 0.50	< 0.50	NA	< 0.50	96%	50%	140%	101%	50%	140%	101%	50%	140%
Benzene	7775739		< 0.02	< 0.02	NA	< 0.02	91%	50%	140%	101%	60%	130%	104%	50%	140%
Bromodichloromethane	7775739		< 0.05	< 0.05	NA	< 0.05	98%	50%	140%	80%	60%	130%	81%	50%	140%
Bromoform	7775739		< 0.05	< 0.05	NA	< 0.05	81%	50%	140%	83%	60%	130%	80%	50%	140%
Bromomethane	7775739		< 0.05	< 0.05	NA	< 0.05	101%	50%	140%	108%	50%	140%	109%	50%	140%
Carbon Tetrachloride	7775739		< 0.05	< 0.05	NA	< 0.05	104%	50%	140%	84%	60%	130%	81%	50%	140%
Chlorobenzene	7775739		< 0.05	< 0.05	NA	< 0.05	82%	50%	140%	82%	60%	130%	85%	50%	140%
Chloroform	7775739		< 0.04	< 0.04	NA	< 0.04	85%	50%	140%	96%	60%	130%	93%	50%	140%
Cis- 1,2-Dichloroethylene	7775739		< 0.02	< 0.02	NA	< 0.02	90%	50%	140%	104%	60%	130%	102%	50%	140%
Dibromochloromethane	7775739		< 0.05	< 0.05	NA	< 0.05	108%	50%	140%	85%	60%	130%	86%	50%	140%
1,3-Dichlorobenzene	7775739		< 0.05	< 0.05	NA	< 0.05	104%	50%	140%	113%	60%	130%	80%	50%	140%
1,2-Dichlorobenzene	7775739		< 0.05	< 0.05	NA	< 0.05	83%	50%	140%	93%	60%	130%	80%	50%	140%
1,4-Dichlorobenzene	7775739		< 0.05	< 0.05	NA	< 0.05	109%	50%	140%	93%	60%	130%	84%	50%	140%
Dichlorodifluoromethane	7775739		< 0.05	< 0.05	NA	< 0.05	95%	50%	140%	95%	50%	140%	92%	50%	140%
1,1-Dichloroethane	7775739		< 0.02	< 0.02	NA	< 0.02	102%	50%	140%	80%	60%	130%	92%	50%	140%
1,2-Dichloroethane	7775739		< 0.03	< 0.03	NA	< 0.03	90%	50%	140%	108%	60%	130%	100%	50%	140%
1,1-Dichloroethylene	7775739		< 0.05	< 0.05	NA	< 0.05	85%	50%	140%	110%	60%	130%	103%	50%	140%
1,2-Dichloropropane	7775739		< 0.03	< 0.03	NA	< 0.03	106%	50%	140%	91%	60%	130%	86%	50%	140%
1,3-Dichloropropene	7775739		< 0.04	< 0.04	NA	< 0.04	90%	50%	140%	101%	60%	130%	109%	50%	140%
Ethylbenzene	7775739		< 0.05	< 0.05	NA	< 0.05	104%	50%	140%	115%	60%	130%	90%	50%	140%
Ethylene Dibromide	7775739		< 0.04	< 0.04	NA	< 0.04	81%	50%	140%	95%	60%	130%	94%	50%	140%
Methyl Ethyl Ketone	7775739		< 0.50	< 0.50	NA	< 0.50	95%	50%	140%	95%	50%	140%	102%	50%	140%
Methyl Isobutyl Ketone	7775739		< 0.50	< 0.50	NA	< 0.50	100%	50%	140%	80%	50%	140%	93%	50%	140%
Methyl tert-butyl Ether	7775739		< 0.05	< 0.05	NA	< 0.05	83%	50%	140%	106%	60%	130%	115%	50%	140%
Methylene Chloride	7775739		< 0.05	< 0.05	NA	< 0.05	98%	50%	140%	116%	60%	130%	108%	50%	140%
Styrene	7775739		< 0.05	< 0.05	NA	< 0.05	84%	50%	140%	84%	60%	130%	82%	50%	140%
1,1,2,2-Tetrachloroethane	7775739		< 0.05	< 0.05	NA	< 0.05	92%	50%	140%	89%	60%	130%	80%	50%	140%
1,1,1,2-Tetrachloroethane	7775739		< 0.04	< 0.04	NA	< 0.04	98%	50%	140%	87%	60%	130%	88%	50%	140%
Tetrachloroethylene	7775739		< 0.05	< 0.05	NA	< 0.05	80%	50%	140%	86%	60%	130%	88%	50%	140%
Toluene	7775739		< 0.05	< 0.05	NA	< 0.05	85%	50%	140%	83%	60%	130%	89%	50%	140%
Trans- 1,2-Dichloroethylene	7775739		< 0.05	< 0.05	NA	< 0.05	80%	50%	140%	102%	60%	130%	101%	50%	140%
1,1,1-Trichloroethane	7775739		< 0.05	< 0.05	NA	< 0.05	109%	50%	140%	92%	60%	130%	102%	50%	140%
1,1,2-Trichloroethane	7775739		< 0.04	< 0.04	NA	< 0.04	87%	50%	140%	90%	60%	130%	88%	50%	140%
Trichloroethylene	7775739		< 0.03	< 0.03	NA	< 0.03	89%	50%	140%	100%	60%	130%	104%	50%	140%
Trichlorofluoromethane	7775739		< 0.05	< 0.05	NA	< 0.05	100%	50%	140%	102%	50%	140%	101%	50%	140%
Vinyl Chloride	7775739		< 0.02	< 0.02	NA	< 0.02	97%	50%	140%	98%	50%	140%	106%	50%	140%
m & p-Xylene	7775739		< 0.05	< 0.05	NA	< 0.05	99%	50%	140%	107%	60%	130%	86%	50%	140%
n-Hexane	7775739		< 0.05	< 0.05	NA	< 0.05	79%	50%	140%	85%	60%	130%	97%	50%	140%
o-Xylene	7775739		< 0.05	< 0.05	NA	< 0.05	84%	50%	140%	84%	60%	130%	86%	50%	140%

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Quality Assurance

CLIENT NAME: TERRAPROBE INC

AGAT WORK ORDER: 16H126806

PROJECT: 7-16-0090-01

ATTENTION TO: Garry Muckle

SAMPLING SITE:

SAMPLED BY:

Trace Organics Analysis (Continued)

RPT Date: Aug 22, 2016			DUPLICATE				REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
O. Reg. 153(511) - PHCs F1 - F4 (with PAHs) (Soil)															
F1 (C6 to C10)	7768014		< 5	< 5	NA	< 5	81%	60%	130%	90%	85%	115%	88%	70%	130%
F2 (C10 to C16)	7779874		< 10	< 10	NA	< 10	103%	60%	130%	89%	80%	120%	70%	70%	130%
F3 (C16 to C34)	7779874		< 50	< 50	NA	< 50	106%	60%	130%	88%	80%	120%	83%	70%	130%
F4 (C34 to C50)	7779874		< 50	< 50	NA	< 50	94%	60%	130%	92%	80%	120%	99%	70%	130%
O. Reg. 153(511) - PAHs (Soil)															
Acenaphthene	7775346	7775346	< 0.05	< 0.05	NA	< 0.05	104%	50%	140%	124%	50%	140%	64%	50%	140%
Acenaphthylene	7775346	7775346	< 0.05	< 0.05	NA	< 0.05	107%	50%	140%	124%	50%	140%	64%	50%	140%
Anthracene	7775346	7775346	< 0.05	< 0.05	NA	< 0.05	110%	50%	140%	125%	50%	140%	58%	50%	140%
Benz(a)anthracene	7775346	7775346	< 0.05	< 0.05	NA	< 0.05	121%	50%	140%	139%	50%	140%	66%	50%	140%
Benzo(a)pyrene	7775346	7775346	< 0.05	< 0.05	NA	< 0.05	131%	50%	140%	133%	50%	140%	94%	50%	140%
Benzo(b)fluoranthene	7775346	7775346	< 0.05	< 0.05	NA	< 0.05	116%	50%	140%	77%	50%	140%	56%	50%	140%
Benzo(g,h,i)perylene	7775346	7775346	< 0.05	< 0.05	NA	< 0.05	138%	50%	140%	138%	50%	140%	123%	50%	140%
Benzo(k)fluoranthene	7775346	7775346	< 0.05	< 0.05	NA	< 0.05	90%	50%	140%	128%	50%	140%	138%	50%	140%
Chrysene	7775346	7775346	< 0.05	< 0.05	NA	< 0.05	110%	50%	140%	139%	50%	140%	61%	50%	140%
Dibenz(a,h)anthracene	7775346	7775346	< 0.05	< 0.05	NA	< 0.05	129%	50%	140%	119%	50%	140%	93%	50%	140%
Fluoranthene	7775346	7775346	< 0.05	< 0.05	NA	< 0.05	107%	50%	140%	125%	50%	140%	76%	50%	140%
Fluorene	7775346	7775346	< 0.05	< 0.05	NA	< 0.05	104%	50%	140%	121%	50%	140%	69%	50%	140%
Indeno(1,2,3-cd)pyrene	7775346	7775346	< 0.05	< 0.05	NA	< 0.05	134%	50%	140%	126%	50%	140%	96%	50%	140%
Naphthalene	7775346	7775346	< 0.05	< 0.05	NA	< 0.05	115%	50%	140%	130%	50%	140%	74%	50%	140%
Phenanthrene	7775346	7775346	< 0.05	< 0.05	NA	< 0.05	102%	50%	140%	119%	50%	140%	58%	50%	140%
Pyrene	7775346	7775346	< 0.05	< 0.05	NA	< 0.05	108%	50%	140%	129%	50%	140%	70%	50%	140%
2-and 1-methyl Naphthalene	7775346	7775346	< 0.05	< 0.05	NA	< 0.05	130%	50%	140%	118%	50%	140%	57%	50%	140%
O. Reg. 153(511) - PCBs (Soil)															
Aroclor 1242	7762942		< 0.1	< 0.1	NA	< 0.1	NA	60%	140%	NA	60%	140%	NA	60%	140%
Aroclor 1248	7762942		< 0.1	< 0.1	NA	< 0.1	NA	60%	140%	NA	60%	140%	NA	60%	140%
Aroclor 1254	7762942		< 0.1	< 0.1	NA	< 0.1	NA	60%	140%	NA	60%	140%	NA	60%	140%
Aroclor 1260	7762942		< 0.1	< 0.1	NA	< 0.1	NA	60%	140%	NA	60%	140%	NA	60%	140%
Polychlorinated Biphenyls	7762942		< 0.1	< 0.1	NA	< 0.1	86%	60%	140%	105%	60%	140%	95%	60%	140%

Comments: When the average of the sample and duplicate results is less than 5x the RDL, the Relative Percent Difference (RPD) will be indicated as Not Applicable (NA).

Certified By:

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Method Summary

CLIENT NAME: TERRAPROBE INC

AGAT WORK ORDER: 16H126806

PROJECT: 7-16-0090-01

ATTENTION TO: Garry Muckle

SAMPLING SITE:

SAMPLED BY:

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Soil Analysis			
Antimony	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Arsenic	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Barium	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Beryllium	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Boron	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Boron (Hot Water Soluble)	MET-93-6104	EPA SW 846 6010C; MSA, Part 3, Ch.21	ICP/OES
Cadmium	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Chromium	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Chromium VI	INOR-93-6029	SM 3500 B; MSA Part 3, Ch. 25	SPECTROPHOTOMETER
Cobalt	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Copper	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Cyanide	INOR-93-6052	MOE CN-3015 & E 3009 A;SM 4500 CN	TECHNICON AUTO ANALYZER
Electrical Conductivity	INOR-93-6036	McKeague 4.12, SM 2510 B	EC METER
Lead	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Mercury	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Molybdenum	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Nickel	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Selenium	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Silver	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Sodium Adsorption Ratio	INOR-93-6007	McKeague 4.12 & 3.26 & EPA SW-846 6010B	ICP/OES
Thallium	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Uranium	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Vanadium	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Zinc	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
pH, 2:1 CaCl2 Extraction	INOR-93-6031	MSA part 3 & SM 4500-H+ B	PH METER

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Method Summary

CLIENT NAME: TERRAPROBE INC

AGAT WORK ORDER: 16H126806

PROJECT: 7-16-0090-01

ATTENTION TO: Garry Muckle

SAMPLING SITE:

SAMPLED BY:

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Trace Organics Analysis			
Acenaphthene	ORG-91-5106	EPA SW846 3541 & 8270	GC/MS
Acenaphthylene	ORG-91-5106	EPA SW846 3541 & 8270	GC/MS
Anthracene	ORG-91-5106	EPA SW846 3541 & 8270	GC/MS
Benz(a)anthracene	ORG-91-5106	EPA SW846 3541 & 8270	GC/MS
Benzo(a)pyrene	ORG-91-5106	EPA SW846 3541 & 8270	GC/MS
Benzo(b)fluoranthene	ORG-91-5106	EPA SW846 3541 & 8270	GC/MS
Benzo(g,h,i)perylene	ORG-91-5106	EPA SW846 3541 & 8270	GC/MS
Benzo(k)fluoranthene	ORG-91-5106	EPA SW846 3541 & 8270	GC/MS
Chrysene	ORG-91-5106	EPA SW846 3541 & 8270	GC/MS
Chrysene-d12	ORG-91-5106	EPA SW846 3541 & 8270	GC/MS
Dibenz(a,h)anthracene	ORG-91-5106	EPA SW846 3541 & 8270	GC/MS
Fluoranthene	ORG-91-5106	EPA SW846 3541 & 8270	GC/MS
Fluorene	ORG-91-5106	EPA SW846 3541 & 8270	GC/MS
Indeno(1,2,3-cd)pyrene	ORG-91-5106	EPA SW846 3541 & 8270	GC/MS
Moisture Content	ORG-91-5106	EPA SW-846 3541 & 8270	BALANCE
Naphthalene	ORG-91-5106	EPA SW846 3541 & 8270	GC/MS
Phenanthrene	ORG-91-5106	EPA SW846 3541 & 8270	GC/MS
Pyrene	ORG-91-5106	EPA SW846 3541 & 8270	GC/MS
2-and 1-methyl Naphthalene	ORG-91-5106	EPA SW846 3541 & 8270	GC/MS
Aroclor 1242	ORG-91-5113	EPA SW-846 3541 & 8082	GC/ECD
Aroclor 1248	ORG-91-5113	EPA SW-846 3541 & 8082	GC/ECD
Aroclor 1254	ORG-91-5113	EPA SW-846 3541 & 8082	GC/ECD
Aroclor 1260	ORG-91-5113	EPA SW-846 3541 & 8082	GC/ECD
Decachlorobiphenyl	ORG-91-5113	EPA SW-846 3541 & 8082	GC/ECD
Polychlorinated Biphenyls	ORG-91-5113	EPA SW-846 3541 & 8082	GC/ECD
F1 (C6 to C10)	VOL-91-5009	CCME Tier 1 Method	GC / FID
F1 (C6 to C10) minus BTEX	VOL-91-5009	CCME Tier 1 Method	GC / FID
F2 (C10 to C16)	VOL-91-5009	CCME Tier 1 Method	GC / FID
F2 (C10 to C16) minus Naphthalene	VOL-91-5009	CCME Tier 1 Method	GC / FID
F3 (C16 to C34)	VOL-91-5009	CCME Tier 1 Method	GC / FID
F3 (C16 to C34) minus PAHs	VOL-91-5009	CCME Tier 1 Method	GC / FID
F4 (C34 to C50)	VOL-91-5009	CCME Tier 1 Method	GC / FID
Gravimetric Heavy Hydrocarbons	VOL-91-5009	CCME Tier 1 Method	GRAVIMETRIC ANALYSIS
Moisture Content	VOL-91-5009	CCME Tier 1 Method	BALANCE
Terphenyl	VOL-91-5009		GC/FID
Acetone	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Benzene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Bromodichloromethane	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
4-Bromofluorobenzene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Bromoform	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Bromomethane	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Carbon Tetrachloride	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Chlorobenzene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Chloroform	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Cis- 1,2-Dichloroethylene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Dibromochloromethane	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
1,3-Dichlorobenzene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
1,2-Dichlorobenzene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
1,4-Dichlorobenzene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS

Results relate only to the items tested and to all the items tested

AGAT Laboratories

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http://www.agatlabs.com

Method Summary

CLIENT NAME: TERRAPROBE INC

AGAT WORK ORDER: 16H126806

PROJECT: 7-16-0090-01

ATTENTION TO: Garry Muckle

SAMPLING SITE:

SAMPLED BY:

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Dichlorodifluoromethane	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
1,1-Dichloroethane	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
1,2-Dichloroethane	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
1,1-Dichloroethylene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
1,2-Dichloropropane	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
1,3-Dichloropropene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Ethylbenzene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Ethylene Dibromide	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Methyl Ethyl Ketone	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Methyl Isobutyl Ketone	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Methyl tert-butyl Ether	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Methylene Chloride	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Styrene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
1,1,2,2-Tetrachloroethane	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
1,1,1,2-Tetrachloroethane	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Tetrachloroethylene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Toluene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Toluene-d8	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Trans- 1,2-Dichloroethylene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
1,1,1-Trichloroethane	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
1,1,2-Trichloroethane	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Trichloroethylene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Trichlorofluoromethane	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Vinyl Chloride	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Xylene Mixture	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
m & p-Xylene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
n-Hexane	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
o-Xylene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS

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1 LS AND 1 SW

AGAT Laboratories

ENCORE

5835 Coopers Avenue
Mississauga, Ontario L4Z 1Y2
Ph: 905.712.5100 Fax: 905.712.5122
webearth.agatlabs.com

Chain of Custody Record

If this is a Drinking Water sample, please use Drinking Water Chain of Custody Form (potable water intended for human consumption)

Laboratory Use Only
Work Order #: 16H126806
Cooler Quantity: LG Cooler
Arrival Temperatures: 5.4 | 5.9 | 5.1 | 5.4 | 6.7 | 4.1
Custody Seal Intact: ☐Yes ☐No ☐N/A
Notes: ON ICE

Report Information:
Company: Terraprobe Inc.
Contact: Garry Muckle
Address: 903 Barton Street, Unit #22, Stoney Creek, ON, L8E 5P5
Phone: (905) 643-7560 Fax: (905) 643-7559
Reports to be sent to:
1. Email: gmuckle@terraprobe.ca
2. Email: afelice@terraprobe.ca

Regulatory Requirements: ☐ No Regulatory Requirement
(Please check all applicable boxes)
☒ Regulation 153/04 — Table ___ (Indicate One)
☐ Ind/Com ☐ Res/Park ☐ Agriculture
Soil Texture (Check One): ☐ Coarse ☐ Fine
☐ Sewer Use ☐ Sanitary ☐ Storm
Region ___ (Indicate One)
☐ Regulation 558 ☐ CCME ☐ Prov. Water Quality Objectives (PWQO) ☐ Other ___ (Indicate One)

Turnaround Time (TAT) Required:
Regular TAT ☒ 5 to 7 Business Days
Rush TAT (Rush Surcharges Apply)
☐ 3 Business Days ☐ 2 Business Days ☐ 1 Business Day
OR Date Required (Rush Surcharges May Apply): ___
Please provide prior notification for rush TAT
**TAT is exclusive of weekends and statutory holidays*

Project Information: 7-16-0090-01
Project:
Site Location:
Sampled By:
AGAT Quote #: PO:
Please note: If quotation number is not provided, client will be billed full price for analysis.

Is this submission for a **Record of Site Condition?** ☐ Yes ☒ No

Report Guideline on Certificate of Analysis ☐ Yes ☒ No

Invoice Information: Bill To Same: Yes ☒ No ☐
Company:
Contact:
Address:
Email:

Sample Matrix Legend

B	Biota
GW	Ground Water
O	Oil
P	Paint
S	Soil
SD	Sediment
SW	Surface Water

Sample Identification	Date Sampled	Time Sampled	# of Containers	Sample Matrix	Comments/ Special Instructions	Metals and Inorganics	Metal Scan	Hydride Forming Metals	Client Custom Metals	ORPs: ☐B-HWS ☐Cl ☐CN ☐Cr⁶⁺ ☐EC ☐FOC ☐NO_3/NO_2 ☐Total N ☐Hg ☐pH ☐SAR	Nutrients: ☐TP ☐NH_3 ☐TKN ☐NO_3 ☐NO_2 ☐NO_3/NO_2	Volatiles: ☐VOC ☐BTEX ☐THM	CCME Fractions 1 to 4	ABNs	PAHs	Chlorophenols	PCBs	Organochlorine Pesticides	TCLP Metals/Inorganics	Sewer Use	
BH8 SA5	Aug 12/16	8:55 am	4	soil	3 jars + 1 encore	X						X	X		X	X					
BH8 SA8	Aug 12/16	9:28 am	4	soil		X						X	X		X	X					
BH2 SA10	Aug 12/16	12:30 pm	4	soil		X						X	X		X	X					
BH4 SA6	Aug 15/16	9:00 am	4	soil		X						X	X		X	X					
BH22 SA6	Aug 15/16	9:43 am	4	soil		X						X	X		X	X					
BH23 SA5	Aug 15/16	10:48 am	4	soil		X						X	X		X	X					
BH24 SA6	Aug 15/16	11:25 am	4	soil		X						X	X		X	X					
BH25 SA6	Aug 15/16	12:24 pm	4	soil		X						X	X		X	X					
BH26 SA6	Aug 15/16	1:14 pm	4	soil		X						X	X		X	X					
BH27 SA6	Aug 15/16	2:14 pm	4	soil		X						X	X		X	X					

ENCORE ARRIVAL TEMP
-7.1 -7.2
-7.0

Samples Relinquished By (Print Name and Sign)	Date	Time	Samples Received By (Print Name and Sign)	Date	Time
Anthony Felice	Aug 16/16	10:22 am	Daniella Jaic	8/16/16	10:22 am
Daniella Jaic	8/16/16	2:15 pm		2016/08/16	2:15

Page 1 of 1
N°: T 022947

Pink Copy - Client | Yellow Copy - AGAT | White Copy - AGAT

AGAT Laboratories

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CLIENT NAME: TERRAPROBE INC
903 Barton Street
Stoney Creek, ON L8E5P5
(905) 643-7560

ATTENTION TO: Garry Muckle

PROJECT: 7-16-0090-41

AGAT WORK ORDER: 16H123545

SOIL ANALYSIS REVIEWED BY: Amanjot Bhela, Inorganic Coordinator

TRACE ORGANICS REVIEWED BY: Gyulhan Yalamova, Report Reviewer

DATE REPORTED: Aug 18, 2016

PAGES (INCLUDING COVER): 8

VERSION*: 1

Should you require any information regarding this analysis please contact your client services representative at (905) 712-5100

*NOTES

All samples will be disposed of within 30 days following analysis. Please contact the lab if you require additional sample storage time.

Member of: Association of Professional Engineers, Geologists and Geophysicists of Alberta (APEGGA)
Western Enviro-Agricultural Laboratory Association (WEALA)
Environmental Services Association of Alberta (ESAA)

AGAT Laboratories is accredited to ISO/IEC 17025 by the Canadian Association for Laboratory Accreditation Inc. (CALA) and/or Standards Council of Canada (SCC) for specific tests listed on the scope of accreditation. AGAT Laboratories (Mississauga) is also accredited by the Canadian Association for Laboratory Accreditation Inc. (CALA) for specific drinking water tests. Accreditations are location and parameter specific. A complete listing of parameters for each location is available from www.cala.ca and/or www.scc.ca. The tests in this report may not necessarily be included in the scope of accreditation.

Results relate only to the items tested and to all the items tested
All reportable information as specified by ISO 17025:2005 is available from AGAT Laboratories upon request

AGAT Laboratories

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Certificate of Analysis

AGAT WORK ORDER: 16H123545
PROJECT: 7-16-0090-41

CLIENT NAME: TERRAPROBE INC
SAMPLING SITE:

ATTENTION TO: Garry Muckle
SAMPLED BY:

O. Reg. 558 Metals and Inorganics

DATE RECEIVED: 2016-08-05

DATE REPORTED: 2016-08-18

				SAMPLE DESCRIPTION:	TCLP 1
				SAMPLE TYPE:	Soil
				DATE SAMPLED:	8/4/2016
Parameter	Unit	G / S	RDL	7754542	
Arsenic Leachate	mg/L		0.010	0.021	
Barium Leachate	mg/L		0.100	0.981	
Boron Leachate	mg/L		0.050	0.195	
Cadmium Leachate	mg/L		0.010	<0.010	
Chromium Leachate	mg/L		0.010	0.022	
Cyanide Leachate	mg/L		0.05	<0.05	
Fluoride Leachate	mg/L		0.05	0.26	
Lead Leachate	mg/L		0.010	0.054	
Mercury Leachate	mg/L		0.01	<0.01	
(Nitrate + Nitrite) as N Leachate	mg/L		0.70	<0.70	
Selenium Leachate	mg/L		0.010	<0.010	
Silver Leachate	mg/L		0.010	<0.010	
Uranium Leachate	mg/L		0.050	<0.050	

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

Certified By: Amanjot Bhela

Results relate only to the items tested and to all the items tested

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Certificate of Analysis

AGAT WORK ORDER: 16H123545
PROJECT: 7-16-0090-41

CLIENT NAME: TERRAPROBE INC
SAMPLING SITE:

ATTENTION TO: Garry Muckle
SAMPLED BY:

O. Reg. 558 - Benzo(a) pyrene

DATE RECEIVED: 2016-08-05

DATE REPORTED: 2016-08-18

			SAMPLE DESCRIPTION:	TCLP 1
			SAMPLE TYPE:	Soil
			DATE SAMPLED:	8/4/2016
Parameter	Unit	G / S	RDL	7754542
Benzo(a)pyrene	mg/L		0.001	<0.001

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard
7754542 The sample was leached according to Regulation 558 protocol. Analysis was performed on the leachate.

Certified By:

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Certificate of Analysis

AGAT WORK ORDER: 16H123545
PROJECT: 7-16-0090-41

CLIENT NAME: TERRAPROBE INC
SAMPLING SITE:

ATTENTION TO: Garry Muckle
SAMPLED BY:

O. Reg. 558 - VOCs

DATE RECEIVED: 2016-08-05

DATE REPORTED: 2016-08-18

				SAMPLE DESCRIPTION:	TCLP 1
				SAMPLE TYPE:	Soil
				DATE SAMPLED:	8/4/2016
Parameter	Unit	G / S	RDL	7754542	
Benzene	mg/L		0.020	<0.020	
Carbon Tetrachloride	mg/L		0.020	<0.020	
Chlorobenzene	mg/L		0.010	<0.010	
Chloroform	mg/L		0.020	<0.020	
1,4-Dichlorobenzene	mg/L		0.010	<0.010	
1,2-Dichlorobenzene	mg/L		0.010	<0.010	
1,2-Dichloroethane	mg/L		0.020	<0.020	
1,1 Dichloroethene	mg/L		0.020	<0.020	
Dichloromethane	mg/L		0.030	<0.030	
Methyl Ethyl Ketone	mg/L		0.090	<0.090	
Tetrachloroethene	mg/L		0.050	<0.050	
Trichloroethene	mg/L		0.020	<0.020	
Vinyl Chloride	mg/L		0.030	<0.030	
Surrogate	Unit	Acceptable Limits			
Toluene-d8	% Recovery	60-130		107	

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard
7754542 Sample was prepared using Regulation 558 protocol and a zero headspace extractor.

Certified By:

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Quality Assurance

CLIENT NAME: TERRAPROBE INC

AGAT WORK ORDER: 16H123545

PROJECT: 7-16-0090-41

ATTENTION TO: Garry Muckle

SAMPLING SITE:

SAMPLED BY:

Soil Analysis

RPT Date: Aug 18, 2016			DUPLICATE				REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
O. Reg. 558 Metals and Inorganics															
Arsenic Leachate	7754528		<0.010	<0.010	NA	< 0.010	102%	90%	110%	106%	80%	120%	109%	70%	130%
Barium Leachate	7754528		0.476	0.474	NA	< 0.100	99%	90%	110%	104%	80%	120%	98%	70%	130%
Boron Leachate	7754528		<0.050	<0.050	NA	< 0.050	98%	90%	110%	97%	80%	120%	98%	70%	130%
Cadmium Leachate	7754528		<0.010	<0.010	NA	< 0.010	99%	90%	110%	101%	80%	120%	103%	70%	130%
Chromium Leachate	7754528		0.019	0.018	NA	< 0.010	100%	90%	110%	119%	80%	120%	109%	70%	130%
Cyanide Leachate	7754528		<0.05	<0.05	NA	< 0.05	107%	90%	110%	100%	90%	110%	105%	70%	130%
Fluoride Leachate	7754528		0.26	0.26	0.0%	< 0.05	96%	90%	110%	100%	90%	110%	94%	70%	130%
Lead Leachate	7754528		0.021	0.021	NA	< 0.010	101%	90%	110%	99%	80%	120%	100%	70%	130%
Mercury Leachate	7754528		<0.01	<0.01	NA	< 0.01	107%	90%	110%	92%	80%	120%	89%	70%	130%
(Nitrate + Nitrite) as N Leachate	7754528		<0.70	<0.70	NA	< 0.70	97%	80%	120%	102%	80%	120%	96%	70%	130%
Selenium Leachate	7754528		<0.010	<0.010	NA	< 0.010	104%	90%	110%	103%	80%	120%	108%	70%	130%
Silver Leachate	7754528		<0.010	<0.010	NA	< 0.010	102%	90%	110%	109%	80%	120%	111%	70%	130%
Uranium Leachate	7754528		<0.050	<0.050	NA	< 0.050	104%	90%	110%	94%	80%	120%	94%	70%	130%

Comments: NA signifies Not Applicable.
Duplicate Qualifier: As the measured result approaches the RL, the uncertainty associated with the value increases dramatically, thus duplicate acceptance limits apply only where the average of the two duplicates is greater than five times the RL.

Certified By: Amanjot Bhela

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Quality Assurance

CLIENT NAME: TERRAPROBE INC

AGAT WORK ORDER: 16H123545

PROJECT: 7-16-0090-41

ATTENTION TO: Garry Muckle

SAMPLING SITE:

SAMPLED BY:

Trace Organics Analysis

RPT Date: Aug 18, 2016			DUPLICATE				REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
O. Reg. 558 - VOCs															
Benzene	7754528		< 0.020	< 0.020	NA	< 0.020	81%	70%	130%	85%	70%	130%	NA	60%	140%
Carbon Tetrachloride	7754528		< 0.020	< 0.020	NA	< 0.020	71%	70%	130%	94%	70%	130%	NA	60%	140%
Chlorobenzene	7754528		< 0.010	< 0.010	NA	< 0.010	88%	70%	130%	104%	70%	130%	NA	60%	140%
Chloroform	7754528		< 0.020	< 0.020	NA	< 0.020	83%	70%	130%	94%	70%	130%	NA	60%	140%
1,4-Dichlorobenzene	7754528		< 0.010	< 0.010	NA	< 0.010	92%	70%	130%	95%	70%	130%	NA	60%	140%
1,2-Dichlorobenzene	7754528		< 0.010	< 0.010	NA	< 0.010	88%	70%	130%	85%	70%	130%	NA	60%	140%
1,2-Dichloroethane	7754528		< 0.020	< 0.020	NA	< 0.020	86%	70%	130%	85%	70%	130%	NA	60%	140%
1,1 Dichloroethene	7754528		< 0.020	< 0.020	NA	< 0.020	109%	70%	130%	100%	70%	130%	NA	60%	140%
Dichloromethane	7754528		< 0.030	< 0.030	NA	< 0.030	95%	70%	130%	123%	70%	130%	NA	60%	140%
Methyl Ethyl Ketone	7754528		< 0.090	< 0.090	NA	< 0.090	85%	70%	130%	96%	70%	130%	NA	60%	140%
Tetrachloroethene	7754528		< 0.050	< 0.050	NA	< 0.050	82%	70%	130%	108%	70%	130%	NA	60%	140%
Trichloroethene	7754528		< 0.020	< 0.020	NA	< 0.020	80%	70%	130%	103%	70%	130%	NA	60%	140%
Vinyl Chloride	7754528		< 0.030	< 0.030	NA	< 0.030	124%	60%	140%	83%	60%	140%	NA	60%	140%
O. Reg. 558 - Benzo(a) pyrene															
Benzo(a)pyrene	7768590		< 0.001	< 0.001	NA	< 0.001	130%	70%	130%	70%	70%	130%	NA	70%	130%

Comments: When the average of the sample and duplicate results is less than 5x the RDL, the Relative Percent Difference (RPD) will be indicated as Not Applicable (NA).

Certified By:

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AGAT Laboratories

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FAX (905)712-5122
http://www.agatlabs.com

Method Summary

CLIENT NAME: TERRAPROBE INC

AGAT WORK ORDER: 16H123545

PROJECT: 7-16-0090-41

ATTENTION TO: Garry Muckle

SAMPLING SITE:

SAMPLED BY:

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Soil Analysis			
Arsenic Leachate	MET-93-6103	EPA SW-846 1311 & 3010A & 6020A	ICP-MS
Barium Leachate	MET-93-6103	EPA SW-846 1311 & 3010A & 6020A	ICP-MS
Boron Leachate	MET-93-6103	EPA SW-846 1311 & 3010A & 6020A	ICP-MS
Cadmium Leachate	MET-93-6103	EPA SW-846 1311 & 3010A & 6020A	ICP-MS
Chromium Leachate	MET-93-6103	EPA SW-846 1311 & 3010A & 6020A	ICP-MS
Cyanide Leachate	INOR-93-6052	EPA SW-846-1311 & MOE 3015 & SM 4500 CN- I	TECHNICON AUTO ANALYZER
Fluoride Leachate	INOR-93-6018	EPA SW-846-1311 & SM4500-F- C	ION SELECTIVE ELECTRODE
Lead Leachate	MET-93-6103	EPA SW-846 1311 & 3010A & 6020A	ICP-MS
Mercury Leachate	MET-93-6103	EPA SW-846 1311 & 3010A & 6020A	ICP-MS
(Nitrate + Nitrite) as N Leachate	INOR-93-6053	EPA SW 846-1311 & SM 4500 - NO3- I	LACHAT FIA
Selenium Leachate	MET-93-6103	EPA SW-846 1311 & 3010A & 6020A	ICP-MS
Silver Leachate	MET-93-6103	EPA SW-846 1311 & 3010A & 6020A	ICP-MS
Uranium Leachate	MET-93-6103	EPA SW-846 1311 & 3010A & 6020A	ICP-MS
Trace Organics Analysis			
Benzo(a)pyrene	ORG-91-5114	EPA SW846 3540 & 8270	GC/MS
Benzene	VOL-91-5001	EPA SW-846 5230B & 8260	(P&T)GC/MS
Carbon Tetrachloride	VOL-91-5001	EPA SW-846 5230B & 8260	(P&T)GC/MS
Chlorobenzene	VOL-91-5001	EPA SW-846 5230B & 8260	(P&T)GC/MS
Chloroform	VOL-91-5001	EPA SW-846 5230B & 8260	(P&T)GC/MS
1,4-Dichlorobenzene	VOL-91-5001	EPA SW-846 5230B & 8260	(P&T)GC/MS
1,2-Dichlorobenzene	VOL-91-5001	EPA SW-846 5230B & 8260	(P&T)GC/MS
1,2-Dichloroethane	VOL-91-5001	EPA SW-846 5230B & 8260	(P&T)GC/MS
1,1 Dichloroethene	VOL-91-5001	EPA SW-846 5230B & 8260	(P&T)GC/MS
Dichloromethane	VOL-91-5001	EPA SW-846 5230B & 8260	(P&T)GC/MS
Methyl Ethyl Ketone	VOL-91-5001	EPA SW-846 5230B & 8260	(P&T)GC/MS
Tetrachloroethene	VOL-91-5001	EPA SW-846 5230B & 8260	(P&T)GC/MS
Toluene-d8	VOL-91-5001	EPA SW-846 5230B & 8260	(P&T)GC/MS
Trichloroethene	VOL-91-5001	EPA SW-846 5230B & 8260	(P&T)GC/MS
Vinyl Chloride	VOL-91-5001	EPA SW-846 5230B & 8260	(P&T)GC/MS

Results relate only to the items tested and to all the items tested

AGAT Laboratories

5835 Coopers Avenue
Mississauga, Ontario L4Z 1Y2
Ph: 905.712.5100 Fax: 905.712.5122
webearth.agatlabs.com

Chain of Custody Record

If this is a Drinking Water sample, please use Drinking Water Chain of Custody Form (potable water intended for human consumption)

Laboratory Use Only

Work Order #: 16H12345

Cooler Quantity:

Arrival Temperatures: 8.6 | 8.4 | 8.0
8.6 | 7.1 | 7.6

Custody Seal Intact: ☐Yes ☐No ☐N/A

Notes: Sm cooler

Report Information:

Company: Terraprobe Inc.
Contact: 903 Barton Street, Unit 22
Address: Stoney Creek, Ontario L8E 5P5
Ph: (905) 643-7560 Fax: (905) 643-7559
Email: gmuckle@terraprobe.ca
Contact: Garry Muckle
Phone:

Reports to be sent to:

1. Email:
2. Email: ofelice@terraprobe.ca

Regulatory Requirements:

☐ No Regulatory Requirement

(Please check all applicable boxes)

☐ Regulation 153/04
Table _____ *Indicate One*
☐ Ind/Com
☐ Res/Park
☐ Agriculture

Soil Texture *(Check One)*
☐ Coarse
☐ Fine

☐ Sewer Use
☐ Sanitary
☐ Storm

Region _____ *Indicate One*

☒ Regulation 558
☐ CCME
☐ Prov. Water Quality Objectives (PWQO)
☐ Other _____ *Indicate One*

Is this submission for a **Record of Site Condition?** ☐ Yes ☒ No

Report Guideline on *Certificate of Analysis* ☐ Yes ☒ No

Turnaround Time (TAT) Required:

Regular TAT ☒ 5 to 7 Business Days

Rush TAT (Rush Surcharges Apply)

☐ 3 Business Days ☐ 2 Business Days ☐ 1 Business Day

OR Date Required (Rush Surcharges May Apply):

Please provide prior notification for rush TAT
**TAT is exclusive of weekends and statutory holidays*

Project Information:

Project: 7-16-0090-41
Site Location:
Sampled By:
AGAT Quote #: PO:

Please note: If quotation number is not provided, client will be billed full price for analysis.

Invoice Information:

Bill To Same: Yes ☒ No ☐

Company:
Contact:
Address:
Email:

Sample Matrix Legend

B	Biota
GW	Ground Water
O	Oil
P	Paint
S	Soil
SD	Sediment
SW	Surface Water

Sample Identification	Date Sampled	Time Sampled	# of Containers	Sample Matrix	Comments/ Special Instructions	Field Filtered - Metals, Hg, CrVI (Please Circle) Y/N	Metals and Inorganics	Metal Scan	Hydride Forming Metals	Client Custom Metals	ORPs: ☐B-HWS ☐Cl ☐CN ☐Cr^{6+} ☐EC ☐FOC ☐NO_3/NO_2 ☐Total N ☐Hg ☐pH ☐SAR	Nutrients: ☐TP ☐NH_3 ☐TKN ☐NO_3 ☐NO_2 ☐NO_3/NO_2	Volatiles: ☒VOC ☐BTEX ☐THM	CCME Fractions 1 to 4	ABNs	PAHs	Chlorophenols	PCBs	Organochlorine Pesticides	TCLP Metals/Inorganics	Sewer Use
TCLP1	Aug 4/16	3:24	2	soil			X						X							X	

(Check Applicable)

Samples Relinquished By (Print Name and Sign):	Date	Time	Samples Received By (Print Name and Sign):	Date	Time
Amber Brooks Amber Brooks	Aug 4/16	16:00	Daniella Jaic DJaic	8/5/16	10:05
Daniella Jaic DJaic	8/5/16	3:40pm		2016 08 05	3:40
	2016 08 05	5:15			

Page 1 of 1

N°: T 027758

Document ID: 0h 78-151 1217

Pink Copy - Client | Yellow Copy - AGAT | White Copy- AGAT

Date Issued: Feb 18, 2016

AGAT Laboratories

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
http://www.agatlabs.com

CLIENT NAME: TERRAPROBE INC
903 Barton Street
Stoney Creek, ON L8E5P5
(905) 643-7560

ATTENTION TO: Garry Muckle

PROJECT: 7-16-0090-01

AGAT WORK ORDER: 16H127914

SOIL ANALYSIS REVIEWED BY: Parvathi Malemath, Data Reviewer

TRACE ORGANICS REVIEWED BY: Gyulhan Yalamova, Report Reviewer

DATE REPORTED: Aug 22, 2016

PAGES (INCLUDING COVER): 8

VERSION*: 1

Should you require any information regarding this analysis please contact your client services representative at (905) 712-5100

*NOTES

All samples will be disposed of within 30 days following analysis. Please contact the lab if you require additional sample storage time.

Member of: Association of Professional Engineers, Geologists and Geophysicists of Alberta (APEGGA)
Western Enviro-Agricultural Laboratory Association (WEALA)
Environmental Services Association of Alberta (ESAA)

AGAT Laboratories is accredited to ISO/IEC 17025 by the Canadian Association for Laboratory Accreditation Inc. (CALA) and/or Standards Council of Canada (SCC) for specific tests listed on the scope of accreditation. AGAT Laboratories (Mississauga) is also accredited by the Canadian Association for Laboratory Accreditation Inc. (CALA) for specific drinking water tests. Accreditations are location and parameter specific. A complete listing of parameters for each location is available from www.cala.ca and/or www.scc.ca. The tests in this report may not necessarily be included in the scope of accreditation.

Results relate only to the items tested and to all the items tested
All reportable information as specified by ISO 17025:2005 is available from AGAT Laboratories upon request

AGAT Laboratories

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
http://www.agatlabs.com

Certificate of Analysis

AGAT WORK ORDER: 16H127914
PROJECT: 7-16-0090-01

CLIENT NAME: TERRAPROBE INC
SAMPLING SITE:

ATTENTION TO: Garry Muckle
SAMPLED BY:

O. Reg. 558 Metals and Inorganics

DATE RECEIVED: 2016-08-18

DATE REPORTED: 2016-08-22

		SAMPLE DESCRIPTION:		TCLP 2
		SAMPLE TYPE:		Soil
		DATE SAMPLED:		8/17/2016
Parameter	Unit	G / S	RDL	7783847
Arsenic Leachate	mg/L		0.010	<0.010
Barium Leachate	mg/L		0.100	0.722
Boron Leachate	mg/L		0.050	0.092
Cadmium Leachate	mg/L		0.010	<0.010
Chromium Leachate	mg/L		0.010	0.018
Cyanide Leachate	mg/L		0.05	<0.05
Fluoride Leachate	mg/L		0.05	0.19
Lead Leachate	mg/L		0.010	0.321
Mercury Leachate	mg/L		0.01	<0.01
(Nitrate + Nitrite) as N Leachate	mg/L		0.70	<0.70
Selenium Leachate	mg/L		0.010	<0.010
Silver Leachate	mg/L		0.010	<0.010
Uranium Leachate	mg/L		0.050	<0.050

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

Certified By:



Results relate only to the items tested and to all the items tested

AGAT Laboratories

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Certificate of Analysis

AGAT WORK ORDER: 16H127914
PROJECT: 7-16-0090-01

CLIENT NAME: TERRAPROBE INC
SAMPLING SITE:

ATTENTION TO: Garry Muckle
SAMPLED BY:

O. Reg. 558 - Benzo(a) pyrene

DATE RECEIVED: 2016-08-18

DATE REPORTED: 2016-08-22

			SAMPLE DESCRIPTION:	TCLP 2
			SAMPLE TYPE:	Soil
			DATE SAMPLED:	8/17/2016
Parameter	Unit	G / S	RDL	7783847
Benzo(a)pyrene	mg/L		0.001	<0.001

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard
7783847 The sample was leached according to Regulation 558 protocol. Analysis was performed on the leachate.

Certified By:

Results relate only to the items tested and to all the items tested

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http://www.agatlabs.com

Certificate of Analysis

AGAT WORK ORDER: 16H127914
PROJECT: 7-16-0090-01

CLIENT NAME: TERRAPROBE INC
SAMPLING SITE:

ATTENTION TO: Garry Muckle
SAMPLED BY:

O. Reg. 558 - VOCs

DATE RECEIVED: 2016-08-18

DATE REPORTED: 2016-08-22

		SAMPLE DESCRIPTION:		TCLP 2
		SAMPLE TYPE:		Soil
		DATE SAMPLED:		8/17/2016
Parameter	Unit	G / S	RDL	7783847
Benzene	mg/L		0.020	<0.020
Carbon Tetrachloride	mg/L		0.020	<0.020
Chlorobenzene	mg/L		0.010	<0.010
Chloroform	mg/L		0.020	<0.020
1,4-Dichlorobenzene	mg/L		0.010	<0.010
1,2-Dichlorobenzene	mg/L		0.010	<0.010
1,2-Dichloroethane	mg/L		0.020	<0.020
1,1 Dichloroethene	mg/L		0.020	<0.020
Dichloromethane	mg/L		0.030	<0.030
Methyl Ethyl Ketone	mg/L		0.090	<0.090
Tetrachloroethene	mg/L		0.050	<0.050
Trichloroethene	mg/L		0.020	<0.020
Vinyl Chloride	mg/L		0.030	<0.030
Surrogate	Unit	Acceptable Limits		
Toluene-d8	% Recovery	60-130		109

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard
7783847 Sample was prepared using Regulation 558 protocol and a zero headspace extractor.

Certified By:

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AGAT Laboratories

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CANADA L4Z 1Y2
TEL (905)712-5100
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http://www.agatlabs.com

Quality Assurance

CLIENT NAME: TERRAPROBE INC

AGAT WORK ORDER: 16H127914

PROJECT: 7-16-0090-01

ATTENTION TO: Garry Muckle

SAMPLING SITE:

SAMPLED BY:

Soil Analysis

RPT Date: Aug 22, 2016			DUPLICATE				REFERENCE MATERIAL				METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
O. Reg. 558 Metals and Inorganics															
Arsenic Leachate	7778628		<0.010	<0.010	NA	< 0.010	105%	90%	110%	114%	80%	120%	107%	70%	130%
Barium Leachate	7778628		0.676	0.731	7.8%	< 0.100	105%	90%	110%	109%	80%	120%	111%	70%	130%
Boron Leachate	7778628		0.065	0.063	NA	< 0.050	102%	90%	110%	106%	80%	120%	104%	70%	130%
Cadmium Leachate	7778628		<0.010	<0.010	NA	< 0.010	107%	90%	110%	110%	80%	120%	104%	70%	130%
Chromium Leachate	7778628		0.013	0.013	NA	< 0.010	103%	90%	110%	116%	80%	120%	106%	70%	130%
Cyanide Leachate	7778628		<0.05	<0.05	NA	< 0.05	106%	90%	110%	106%	90%	110%	108%	70%	130%
Fluoride Leachate	7778628		0.28	0.28	0.0%	< 0.05	100%	90%	110%	101%	90%	110%	97%	70%	130%
Lead Leachate	7778628		<0.010	<0.010	NA	< 0.010	106%	90%	110%	96%	80%	120%	93%	70%	130%
Mercury Leachate	7778628		<0.01	<0.01	NA	< 0.01	104%	90%	110%	100%	80%	120%	94%	70%	130%
(Nitrate + Nitrite) as N Leachate	7778628		<0.70	<0.70	NA	< 0.70	95%	80%	120%	90%	80%	120%	97%	70%	130%
Selenium Leachate	7778628		<0.010	<0.010	NA	< 0.010	109%	90%	110%	113%	80%	120%	111%	70%	130%
Silver Leachate	7778628		<0.010	<0.010	NA	< 0.010	109%	90%	110%	117%	80%	120%	113%	70%	130%
Uranium Leachate	7778628		<0.050	<0.050	NA	< 0.050	108%	90%	110%	106%	80%	120%	99%	70%	130%

Comments: NA signifies Not Applicable.
Duplicate Qualifier: As the measured result approaches the RL (Reporting Limit), the uncertainty associated with the value increases dramatically, thus duplicate acceptance limits apply only where the average of the two duplicates is greater than five times the RL.

Certified By:



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Results relate only to the items tested and to all the items tested

AGAT Laboratories

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
http://www.agatlabs.com

Quality Assurance

CLIENT NAME: TERRAPROBE INC

AGAT WORK ORDER: 16H127914

PROJECT: 7-16-0090-01

ATTENTION TO: Garry Muckle

SAMPLING SITE:

SAMPLED BY:

Trace Organics Analysis

RPT Date: Aug 22, 2016			DUPLICATE				REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
O. Reg. 558 - VOCs															
Benzene	7777930		< 0.020	< 0.020	NA	< 0.020	86%	70%	130%	98%	70%	130%	NA	60%	140%
Carbon Tetrachloride	7777930		< 0.020	< 0.020	NA	< 0.020	70%	70%	130%	87%	70%	130%	NA	60%	140%
Chlorobenzene	7777930		< 0.010	< 0.010	NA	< 0.010	94%	70%	130%	114%	70%	130%	NA	60%	140%
Chloroform	7777930		< 0.020	< 0.020	NA	< 0.020	87%	70%	130%	95%	70%	130%	NA	60%	140%
1,4-Dichlorobenzene	7777930		< 0.010	< 0.010	NA	< 0.010	91%	70%	130%	115%	70%	130%	NA	60%	140%
1,2-Dichlorobenzene	7777930		< 0.010	< 0.010	NA	< 0.010	88%	70%	130%	104%	70%	130%	NA	60%	140%
1,2-Dichloroethane	7777930		< 0.020	< 0.020	NA	< 0.020	87%	70%	130%	83%	70%	130%	NA	60%	140%
1,1 Dichloroethene	7777930		< 0.020	< 0.020	NA	< 0.020	83%	70%	130%	91%	70%	130%	NA	60%	140%
Dichloromethane	7777930		< 0.030	< 0.030	NA	< 0.030	115%	70%	130%	115%	70%	130%	NA	60%	140%
Methyl Ethyl Ketone	7777930		< 0.090	< 0.090	NA	< 0.090	111%	70%	130%	77%	70%	130%	NA	60%	140%
Tetrachloroethene	7777930		< 0.050	< 0.050	NA	< 0.050	97%	70%	130%	114%	70%	130%	NA	60%	140%
Trichloroethene	7777930		< 0.020	< 0.020	NA	< 0.020	99%	70%	130%	99%	70%	130%	NA	60%	140%
Vinyl Chloride	7777930		< 0.030	< 0.030	NA	< 0.030	96%	60%	140%	93%	60%	140%	NA	60%	140%
O. Reg. 558 - Benzo(a) pyrene															
Benzo(a)pyrene	7778628		< 0.001	< 0.001	NA	< 0.001	119%	70%	130%	100%	70%	130%	101%	70%	130%

Comments: When the average of the sample and duplicate results is less than 5x the RDL, the Relative Percent Difference (RPD) will be indicated as Not Applicable (NA).

Certified By:



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AGAT Laboratories

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
http://www.agatlabs.com

Method Summary

CLIENT NAME: TERRAPROBE INC

AGAT WORK ORDER: 16H127914

PROJECT: 7-16-0090-01

ATTENTION TO: Garry Muckle

SAMPLING SITE:

SAMPLED BY:

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Soil Analysis			
Arsenic Leachate	MET-93-6103	EPA SW-846 1311 & 3010A & 6020A	ICP-MS
Barium Leachate	MET-93-6103	EPA SW-846 1311 & 3010A & 6020A	ICP-MS
Boron Leachate	MET-93-6103	EPA SW-846 1311 & 3010A & 6020A	ICP-MS
Cadmium Leachate	MET-93-6103	EPA SW-846 1311 & 3010A & 6020A	ICP-MS
Chromium Leachate	MET-93-6103	EPA SW-846 1311 & 3010A & 6020A	ICP-MS
Cyanide Leachate	INOR-93-6052	EPA SW-846-1311 & MOE 3015 & SM 4500 CN- I	TECHNICON AUTO ANALYZER
Fluoride Leachate	INOR-93-6018	EPA SW-846-1311 & SM4500-F- C	ION SELECTIVE ELECTRODE
Lead Leachate	MET-93-6103	EPA SW-846 1311 & 3010A & 6020A	ICP-MS
Mercury Leachate	MET-93-6103	EPA SW-846 1311 & 3010A & 6020A	ICP-MS
(Nitrate + Nitrite) as N Leachate	INOR-93-6053	EPA SW 846-1311 & SM 4500 - NO3- I	LACHAT FIA
Selenium Leachate	MET-93-6103	EPA SW-846 1311 & 3010A & 6020A	ICP-MS
Silver Leachate	MET-93-6103	EPA SW-846 1311 & 3010A & 6020A	ICP-MS
Uranium Leachate	MET-93-6103	EPA SW-846 1311 & 3010A & 6020A	ICP-MS
Trace Organics Analysis			
Benzo(a)pyrene	ORG-91-5114	EPA SW846 3540 & 8270	GC/MS
Benzene	VOL-91-5001	EPA SW-846 5230B & 8260	(P&T)GC/MS
Carbon Tetrachloride	VOL-91-5001	EPA SW-846 5230B & 8260	(P&T)GC/MS
Chlorobenzene	VOL-91-5001	EPA SW-846 5230B & 8260	(P&T)GC/MS
Chloroform	VOL-91-5001	EPA SW-846 5230B & 8260	(P&T)GC/MS
1,4-Dichlorobenzene	VOL-91-5001	EPA SW-846 5230B & 8260	(P&T)GC/MS
1,2-Dichlorobenzene	VOL-91-5001	EPA SW-846 5230B & 8260	(P&T)GC/MS
1,2-Dichloroethane	VOL-91-5001	EPA SW-846 5230B & 8260	(P&T)GC/MS
1,1 Dichloroethene	VOL-91-5001	EPA SW-846 5230B & 8260	(P&T)GC/MS
Dichloromethane	VOL-91-5001	EPA SW-846 5230B & 8260	(P&T)GC/MS
Methyl Ethyl Ketone	VOL-91-5001	EPA SW-846 5230B & 8260	(P&T)GC/MS
Tetrachloroethene	VOL-91-5001	EPA SW-846 5230B & 8260	(P&T)GC/MS
Toluene-d8	VOL-91-5001	EPA SW-846 5230B & 8260	(P&T)GC/MS
Trichloroethene	VOL-91-5001	EPA SW-846 5230B & 8260	(P&T)GC/MS
Vinyl Chloride	VOL-91-5001	EPA SW-846 5230B & 8260	(P&T)GC/MS

Results relate only to the items tested and to all the items tested

AGAT Laboratories (En Core)

5835 Coopers Avenue
Mississauga, Ontario L4Z 1Y2
Ph: 905.712.5100 Fax: 905.712.5122
webearth.agatlabs.com

Chain of Custody Record

If this is a Drinking Water sample, please use Drinking Water Chain of Custody Form (potable water intended for human consumption)

Laboratory Use Only

Work Order #: 16H127914

Cooler Quantity: sm cooler

Arrival Temperatures: 6.0 | 5.8 | 5.7 | 5.0 | 4.8 | 4.

Custody Seal Intact: ☐ Yes ☐ No ☐ N/A

Notes: on ice

Report Information:

Company: Terraprobe Inc

Contact: Garry Muehle

Address: 903 Barton Street, Unit #22, Stoney Creek, ON, L8E 5P5

Phone: (905) 643-7560 Fax: (905) 643-7559

Reports to be sent to:

1. Email: gmuehle@terraprobe.ca
2. Email: afelice@terraprobe.ca

Regulatory Requirements:

☐ No Regulatory Requirement

(Please check all applicable boxes)

☒ Regulation 153/04
Table 1 *Indicate One*
☐ Ind/Com
☐ Res/Park
☐ Agriculture

Soil Texture *(Check One)*
☐ Coarse
☐ Fine

☐ Sewer Use
☐ Sanitary
☐ Storm

Region _____ *Indicate One*

☐ Regulation 558
☐ CCME
☐ Prov. Water Quality Objectives (PWQO)
☐ Other _____ *Indicate One*

Is this submission for a **Record of Site Condition?** ☐ Yes ☒ No

Report Guideline on *Certificate of Analysis* ☐ Yes ☒ No

Turnaround Time (TAT) Required:

Regular TAT ☐ 5 to 7 Business Days

Rush TAT (Rush Surcharges Apply)

☐ 3 Business Days ☒ 2 Business Days ☐ 1 Business Day

OR Date Required (Rush Surcharges May Apply): _____

Please provide prior notification for rush TAT
**TAT is exclusive of weekends and statutory holidays*

Project Information:

Project: 7-16-0040-01

Site Location:

Sampled By:

AGAT Quote #: _____ PO: _____

Please note: If quotation number is not provided, client will be billed full price for analysis.

Invoice Information:

Bill To Same: Yes ☒ No ☐

Company:

Contact:

Address:

Email:

Sample Matrix Legend

B	Biota
GW	Ground Water
O	Oil
P	Paint
S	Soil
SD	Sediment
SW	Surface Water

Sample Identification	Date Sampled	Time Sampled	# of Containers	Sample Matrix	Comments/ Special Instructions	Metals and Inorganics	Metal Scan	Hydride Forming Metals	Client Custom Metals	ORPs: ☐ B-HWS ☐ Cl ☐ CN ☐ EC ☐ FOC ☐ NO_2/NO_3 ☐ Cr^{6+} ☐ pH ☐ SAR ☐ Total ☐ Hg	Nutrients: ☐ TP ☐ NH_4 ☐ TKN ☐ NO_2 ☐ NO_2/NO_3 ☐ NO_3	Volatiles: ☒ VOC ☐ BTEX ☐ THM	CCME Fractions 1 to 4	ABNs	PAHs	Chlorophenols	PCBs	Organochlorine Pesticides	TCLP Metals/Inorganics	Sewer Use	BAP
TCLP 2	Aug 17/16	8:53am	2	soil	2 jars							X							X	X

Samples Relinquished By (Print Name and Sign)	Date	Time	Samples Received By (Print Name and Sign)	Date	Time
Anthony Felice	Aug 18/16	12:45pm	Daniella Jare	8/18/16	12:50pm
Daniella Jare	8/18/16			2016/08/18	6:30

Page 1 of 1

N°: T 022908

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APPENDIX C
HYDROGEOLOGICAL REPORT

Terraprobe
Consulting Geotechnical & Environmental Engineering
Construction Materials Engineering, Inspection & Testing

January 7, 2019

File No. 7-16-0090-46
Stoney Creek Office

City of Hamilton
Waterfront Development Office
77 James Street North, Suite 320
Hamilton, Ontario L8R 2K3

Attention: Mr. Jeff Pisadny, Senior Project Manager

RE: HYDROGEOLOGIC INVESTIGATION
WEST HARBOUR PUMPING STATION AND ASSOCIATED WORKS
HAMILTON, ONTARIO

Dear Sir:

Terraprobe was retained by the City of Hamilton to complete a hydrogeologic assessment for the proposed construction of a new sewage pumping station (PS1) and associated sanitary forcemain in the west harbour area (Pier 8) of the City of Hamilton. The project area is located north of Guise Street East bound by Hughson Street North to the west, Catherine Street North to the east and the Hamilton Harbour Pier 8 to the north. The proposed sanitary forcemain extends from the proposed pumping station across Eastwood Park to the Burlington Street sewer at Ferguson Street as indicated on the attached Figure 1. An additional forcemain, sanitary sewer and pumping station (PS2) are proposed within the subject area but are outside of the scope of the current investigation.

1.0 INTRODUCTION

The proposed pumping station (PS1) is proposed to have a footing area of approximately 111.2 m^2 (15.1 m by 7.4 m) with the underside of foundation slab at a depth of approximately 4.3 m below grade (elevations of approximately 72.8 m above sea level). The proposed permanent sump pit within the pumping station is proposed at a depth of approximately 5.2 m below grade (elevation of 71.9 m) covering an area of 2.7 m^2 (1.8 m by 1.5 m).

Associated wet well and sanitary storage tank features are proposed at the PS1 site. The PS1 wet well covers approximately 47.5 m^2 (10.8 m by 4.4 m) with an invert depth of approximately 7.6 m below grade. The pump pit within the wet well footprint (47.5 m^2 area) is proposed to cover an area of approximately 25.5 m^2 (5.8 m by 4.4 m) with an invert depth of approximately 10.0 m below grade (elevation of 67.2 m). The PS1 sanitary storage tank has a proposed footing area of approximately 354.2 m^2 square meters (32.8 m by 10.8 m). The proposed depth of the sanitary storage tank is variable with a 338.0 m^2 (31.3 m by 10.8 m) protion of the sanitary storage tank at a proposed at a depth of 5.5 m below grade (elevation of 71.6 m) and an area of approximately 16.2 m^2 (1.5 m by 10.8 m) proposed at a depth of 6.5 m below grade (elevation of 70.6 m) for the proposed sluice gate connecting the sanitary storage tank with the wet well.

A twin 100 mm and 250 mm diameter HDPE sanitary forcemain is proposed. The current alignment for the sanitary forcemain covers a distance of approximately 395 m in length. Details of the proposed structure are included in the attached enclosures (Appendix D).

The hydrogeologic investigation was completed to determine the dewatering requirements for the construction of the pumping station and sanitary forcemain. Field investigations were conducted using monitoring wells installed at the site as part of the geotechnical investigation completed for the site by Terraprobe.

2.0 SITE GEOLOGY AND HYDROGEOLOGY

Site soil conditions were investigated as part of the *Geotechnical Investigation for the West Harbour Pumping Station and Associated Works*, completed by Terraprobe dated November 11, 2016. This investigation consisted of the completion of 27 boreholes to various depths. Based on the results of the geotechnical investigation soil encountered consisted of fill overlying organic silt and peat, silt sandy silt and silty fine sand to silty clay overlaying shale bedrock of the Queenston Formation. Borehole logs are provided in the attached enclosures (Appendix A) and borehole locations are shown on the attached Figure 2.

2.1 Fill Deposits

Fill deposits ranged in depths across the subject area. Fill deposits to the north of Guise Street were encountered to depths of 3 to 4 m below the ground surface. Fill consisted of silty sand to sandy silt with pieces of brick, concrete and timber. Toward the shoreline of the Hamilton Harbour fill deposits were encountered to depths of approximately 9 to 12 m below the existing ground surface and consisted of silty

sand and sand to clayey silt and silty clay. Layers of rubble fill consisting of bricks, mortar, timber, concrete and slag were encountered. Boreholes completed within Eastwood Park fully penetrated fill deposits to depths of 1.5 to 4.3 m below grade. Fill within Eastwood Park generally consisted of sandy silt and silty sand with some gravel and pieces of timber, brick, tile, glass and asphalt. Fill was encountered to the depth of investigation for Boreholes 14, 15, 16 and 27. Blow counts (N-values) recorded within fill deposits ranged from 1 to 38 blows per 300 mm of penetration indicating a compact to very loose relative density.

2.2 Organic Silt, Peat

An organic silt layer was encountered underlying fill deposits within Boreholes 5, 6, 8, 9, 19, 24 and 25 and organic silt was observed underlying sandy silt in BH28. Deposits of organic silt were generally located irregularly across the northern and eastern portions of the study area. Peat was encountered underlying fill deposits in BH19. The thickness of organic silt and peat varied between 0.8 to 5.2 m in depth. Blow counts recorded within organic silt deposits ranged from 0 to 6 blows indicating a very soft relative density.

2.3 Silt to Silty Fine Sand

A layer of loose brown to grey silt to silty fine sand was encountered underlying fill and organic silt deposits generally across the subject area. The thickness of silt to silty sand ranged from approximately 1.2 to 5.5 m in depth. Silt to silty sand was encountered to the depth of investigation for Boreholes 1, 3, 8, 11, 12, 13, 17, 18, 20, 22, 24, and 25. Blow counts recorded within silt to silty fine sand deposits ranged from 1 to 36 blows indicating a very soft to compact relative density.

2.4 Silty Clay

Silty clay deposits were generally encountered underlying deposits of silty sand across the study area. Silty clay was generally grey in colour and firm to stiff in consistency. Within BH28 (completed into bedrock) silty clay was found to be overlying shale bedrock of the Queenston Formation encountered at a depth of approximately 28.5 m (elevation of 48.2 m). Blow counts recorded within silty clay deposits ranged from 29 to 56 blows indicating a stiff to very stiff relative density.

2.5 Ground Water Conditions

As part of the geotechnical investigation completed by Terraprobe monitoring wells were established

along the proposed forcemain alignment and in the area of the proposed PS1 location. In total ten monitoring well locations, consisting of 50 mm diameter PVC installations, were established at various depths ranging from 4.5 to 24.5 m and screened within the various geological formations encountered within the study area. A summary of monitoring well locations is provided in the table below:

Summary of Monitoring Well Locations

Monitoring Well Location	Easting	Northing	Ground Surface Elevation (m)	Depth (m)
BH 1	592231	4791861	78.1	6.5 (71.6)
BH 5	592549	4792020	77.3	18.5 (58.8)
BH 6	592544	4792074	77.1	18.5 (58.6)
BH 10	592532	4792261	76.7	24.5 (52.7)
BH 11	592531	4792239	76.8	6.5 (70.3)
BH 19	592772	4792015	76.0	9.5 (66.5)
BH 22	592742	4791816	78.6	4.5 (74.1)
BH 24	592903	4791756	77.6	4.5 (73.1)
BH 27	592934	4791581	79.4	4.5 (74.9)
BH 28	592590	4792239	76.7	12.5 (64.2)

Ground water levels were taken at various dates from the completed monitoring well installations. In-situ hydraulic conductivity testing was completed in July 2017 for the installed monitoring wells at the subject site. The test involved the removal of water from the well (i.e. bail test). The recovery of the ground water level with time was then observed. Water level data obtained from the in-situ testing was interpreted using the Hvorslev method for a point piezometer. Methodology of the analysis of in-situ hydraulic conductivity is provided in the attached enclosures (Appendix B). A summary of measured ground water elevations and rates of hydraulic conductivity are summarized in the table below:

Summary of Ground Water Elevations

Well Location	Screened Interval (m)	Soil Stratum	Ground Water Elevation (m)				Hydraulic Conductivity (m/s)
			1-Sep-16	11-Oct-16	7-Nov-16	24-Jul-17	
BH 1	72.0 - 73.5	Silt	75.5	76.0	76.1	76.4	1.7×10^{-6}
BH 5	59.0 – 60.5	Silty Clay	69.1	74.5	74.1	75.9	3.6×10^{-8}
BH 6	58.8 – 60.3	Silty Clay	71.1	74.8	74.3	76.1	3.0×10^{-9}
BH 10	52.3 – 53.8	Silty Clay	74.9	75.0	75.4	75.6	1.7×10^{-9}
BH 11	70.7 – 73.8	Fill	75.9	75.9	75.7	76.4	1.0×10^{-6}
BH 19	66.9 – 69.9	Silt	74.9	74.7	74.5	N/A	Not Completed
BH 22	74.0 – 75.5	Silty Sand	76.8	76.9	76.5	76.0	8.8×10^{-7}
BH 24	73.0 – 74.5	Sandy Silt	75.8	75.8	75.9	76.6	1.1×10^{-7}
BH 27	74.8 – 76.3	Fill	76.3	76.5	76.3	77.0	4.9×10^{-6}
BH 28	67.0 – 70.0	Sandy Silt	N/A	N/A	74.6	N/A	Not Accessible

Based on the observed recovery within completed monitoring wells the following hydraulic conductivities were considered for the various soil types encountered at the subject site:

Summary of Hydraulic Conductivity

Soil Type	Hydraulic Conductivity (m/s)
Silty Clay	3.6×10^{-8}
Silt	1.7×10^{-6}
Silty Sand	8.9×10^{-7}
Fill	1.0×10^{-6}

Due to the high variability in soil conditions at the site it is anticipated that the rates of ground water flow at the site will be highly variable depending on the presence and types of fill located along the sanitary forcemain alignment and in the vicinity of the PS1 pumping station.

3.0 LOCAL WATER RESOURCES

The site is located within the Hamilton Harbour lands located to the south of Burlington Bay. A description of the fill placement at the subject site was described in the *Phase Two Environmental Site Assessment, Pier 8, Hamilton ON* completed by Dilion Consulting dated April 2016 as follows:

The west harbour area under investigation in this report is situated north of Guise Street East approximately between James Street North and Ferguson Street. Much of the land was reclaimed by filling. The area was initially developed in the mid-1800s and it is likely that fill was deposited in the south portion of the study area. More aggressive filling took place during the 1960s during which time

the northern two thirds of the site was reclaimed and Pier 8 was constructed. These lands were subsequently developed for use primarily as warehousing. Later uses included boat storage and maintenance associated with the marina and yacht club, a ferry terminal, aircraft hangar and trucking terminal and continual use of the land for warehousing and shipyard use. More recently the west side of the harbour has been developed for recreational use.

The site currently consists primarily of vacant lands, with previous warehousing being demolished to allow for the redevelopment of the Pier 8 lands. The subject site and vicinity are currently serviced with municipal water and sewer servicing.

A review of the Ministry of the Environment Conservation and Parks (MECP) well records in the vicinity of the site was conducted. Records were located for a large number of monitoring wells located to the north of Guise Street associated with the redevelopment of these lands. Private wells are not anticipated within the vicinity of the subject site.

The Burlington Bay is situated to the north and west of the subject site. It is anticipated that the surface water level within Burlington Bay will influence shallow ground water levels at the site. Ground water flows are expected to be directed to the north and west of the site toward Burlington Bay.

4.0 REQUIREMENTS FOR GROUND WATER CONTROL

Due to the varying soil conditions and the depth of construction the dewatering requirements for both the PS1 pumping station and sanitary forcemains were considered separately.

Dewatering requirements for PS1, the wet well and the sanitary storage tank were analyzed following a Darcy's Law approach. The hydraulic gradient was considered at the conservative value of 1 to account for potential upwelling of ground water through fill deposits and potential variations in hydraulic conductivity from within fill deposits at the site.

Dewatering requirements for the forcemain were estimated following the approach for trench dewatering as by Powers (2007). This approach assumed staging for the sanitary forcemain would consist of 30 m lengths and is detailed in Section 4.2 below. Detailed calculations are provided in the attacghed Appendix C.

4.1 Pumping Station (PS1) Dewatering Requirements

Construction for the PS1 pumping station is to consist of three parts requiring open excavations below the

ground water level. The parts consist of the service level for the pumping station, the wet well and the sanitary storage tank. A further discussion for the assessment of dewatering required for the excavations for these three features is provided below.

4.1.1 Pumping Station Service Level

Excavations for the service level section and the permanent sump pit of the PS1 pumping station will be required. The footing depth for the service level is approximately 4.3 m below grade (elevation of 72.8 m) with a dewatering target approximately 1.0 m below the base of excavations (elevation of 71.8 m). The proposed sump pit is proposed at a depth of approximately 5.2 m below grade (elevation of 71.9 m) with a dewatering target of 70.9 m. The area of the PS1 service level is approximately 111.2 m^2 (15.1 m by 7.4 m). Water levels in the vicinity of the proposed location of the PS1 pumping station were observed at 76.4 m during monitoring completed in July 2017. The anticipated drawdown in shallow ground water for the PS1 service level is anticipated at 4.6 m, and the drawdown for the sump pit is anticipated at 5.5 m.

Excavations for the PS1 service level are expected to be completed within fill deposits with an expected hydraulic conductivity of 1 x 10^{-6} m/s (based on hydraulic conductivity completed at BH 11 within fill deposits). Based on the above parameters it is estimated that ground water dewatering for excavations required for the PS1 service level will be approximately 27,900 L/day. Precipitation falling within the 111.2 m^2 excavation, accounting for the 25 mm rainfall event, is expected to result in a volume of 3,000 L/day of discharge for a total dewatering volume for the service level of PS1 estimated at 30,900 L/day.

4.1.2 Wet Well

Excavations for footings for the wet well and pump pit within the wet well are proposed approximately 7.6 m below grade (elevation of 69.5 m) and 10.0 m below grade (elevation 67.2 m) respectively. The dewatering target for excavations is approximately 1.0 m below the base of excavations at an elevation of 68.5 m for the wet well feature and an elevation of 66.2 m below the pump pit within the wet well. The area of the PS1 wet well is approximately 47.5 m^2 (10.8 m by 4.4 m) and the area of the pump pit is approximately 25.5 m^2 (5.8 m by 4.4 m). Water levels in the vicinity of the proposed location of the wet well were observed at 76.4 m during monitoring completed in July 2017. The anticipated drawdown in shallow ground water is anticipated at 7.9 m for the wet well and 10.2 m for the pump pit within the wet well.

Excavations for the wet well are expected to be completed within fill deposits with an expected hydraulic conductivity of 1 x 10^{-6} m/s (based on hydraulic conductivity completed at BH 11 within fill deposits). Based on the above parameters it is estimated that dewatering for excavations required for the wet well will be approximately 38,600 L/day. Precipitation falling within the 47.5 m^2 excavation, accounting for the 25 mm rainfall event, is expected to result in a volume of 1,200 L/day of discharge for a total dewatering volume for the wet well estimated at 39,800 L/day.

4.1.3 Sanitary Storage Tank

Excavations will be completed for the PS1 pumping station sanitary storage tank to depths approximately 5.5 m below grade (elevation of 71.6 m), with a portion of the sanitary storage tank is proposed at a depth of 6.5 m below grade. The dewatering target for excavations completed for the sanitary storage tank is approximately 1.0 m below the base of excavations at elevation of 70.6 m and 69.6 m. The area of the PS1 sanitary storage tank is approximately 354.2 m^2 (32.8 m by 10.8 m) with a 16.2 m^2 area proposed at a depth of 1.0 m below the remainder of the sanitary storage tank which covers an area of approximately 338 m^2. Water levels in the vicinity of the proposed location of the PS1 sanitary storage tank were observed at 76.4 m during monitoring completed in July 2017. The anticipated drawdown in shallow ground water is anticipated at 5.8 m and 6.8 m.

Excavations for the PS1 sanitary storage tank are expected to be completed within fill deposits with an expected hydraulic conductivity of 1 x 10^{-6} m/s (based on hydraulic conductivity completed at BH 11 within fill deposits). Based on the above parameters it is estimated that dewatering for excavations required for the PS1 sanitary storage tank will be approximately 81,000 L/day. Precipitation falling within the 354.2 m^2 excavation accounting for the 25 mm rainfall event is expected to result in a volume of 9,000 L/day of discharge for a total dewatering volume for the sanitary storage tank estimated at 90,000 L/day.

The total estimated dewatering requirements for the pumping station PS1 (including the pumping station, wet well and sanitary storage tank) is estimated at 160,700 L/day.

4.2 Sanitary Forcemain Dewatering Requirements

Dewatering requirements for the installation of the twin sanitary forcemain were assessed. Dewatering was based on the anticipated staging of 30 m length open excavations approximately 1.3 m in width. Soil conditions were found to be highly variable across the proposed alignment of the sanitary forcemain. As such, hydraulic conductivity for the forcemain installation was based on the highest observed conductivity

(1×10^{-6} m/s) within fill deposits at BH11 (located to the north of the site in the vicinity of the proposed PS1 pumping station). The invert depth of the sanitary forcemain is variable along the proposed alignment between depths of 2.6 m to 1.5 m (elevations of 73.9 m to 76.5 m).

The greatest dewatering is anticipated for northern sections of the forcemain (connecting with the PS1 pumping station). Water levels within this area were encountered at 76.4 m with forcemain invert elevations at 73.9 m and a dewatering target of 72.9 m. The expected drawdown for shallow ground water is anticipated at approximately 3.6 m. The resulting dewatering for 30 m of open excavation is estimated at 28,200 L/day. Precipitation falling within the 30 m excavation accounting for the 25 mm rainfall event is expected to result in a volume of 2,700 L/day of discharge for a total dewatering volume for the twin sanitary forcemains is estimated at 30,900 L/day.

Based on the rates of dewatering anticipated for the west harbour pumping station and associated works it is anticipated that dewatering will be completed at rates requiring a posting to the Environmental Activity and Sector Registry (EASR). Posting to EASR is required for construction dewatering projects with required takings exceeding 50,000 L/day, but less than 400,000 L/day. The cumulative anticipated rate of water taking for the PS1 pumping station and the twin sanitary forcemains is anticipated at 191,600 L/day.

The proposed dewatering method may consist of one or more of the following:

- Installation of vacuum well points;
- Installation of educator well points; or,
- Installation of filtered sump pits at the base of open excavations.

It is anticipated that a shoring system will be incorporated for the PS1 pumping station excavations. For the purposes of the above dewatering estimate it was assumed that permeable shoring would be used which would allow for lateral ground water flow (horizontal flow) to open excavations. In the event that an impervious caisson wall is utilized dewatering volumes are expected to be lower than the above estimates. The radius of influence of dewatering work for the PS1 pumping station is anticipated at approximately 19.3 m and a maximum of 10.7 m for the sanitary forcemain. Detailed dewatering calculations are provided in the attached Appendix C.

5.0 IMPACT ASSESSMENT

The following impact assessment is based on the current design information for the west harbour pumping station and associated works provided in this report, and the results of the subsurface

investigation. The purpose of the impact assessment is to determine the potential ground water flow which may be in encountered during construction, along with potential impact to surrounding features.

5.1 Geotechnical Impacts of Dewatering

The lowering of ground water levels has the potential to induce ground settlement within the radius of influence. The results of the geotechnical investigation indicate that the overlying soil materials generally consist of compact fill deposits. Minor consolidation or settlement of these materials may be caused by construction dewatering. Consolidation is anticipated to be minor based on the limited radius of influence and limited duration of dewatering required.

It is noted that the settlement can also occur in the event of loss of ground through the pumping of fines or suspended materials through the dewatering system. The dewatering system must be properly designed to ensure that there is no pumping of fines or suspended material.

It is noted that there are no existing structures or residences within the zone of influence. Existing buildings within the west harbour lands (Pier 8) have been demolished and the subject site consists primarily of vacant lands. Any minor consolidation of surface fill deposits is not expected to have impacts to the vicinity of active dewatering works.

5.2 Dewatering Impacts on Local Ground Water Resource

There are no existing ground water supply wells or significant ground water related features found within a 500 m radius of the site. The expected radius of influence of the ground water control is approximately 15 to 43 m. Therefore, impacts to local ground water resources, arising from the ground water control activities are not expected.

5.3 Dewatering Impacts on Surface Water

It is noted that the site is situated south of Burlington Bay which is expected to influence shallow groud water levels at the subject site. Surface water elevations within Burlington Bay were measure at 76.4 m during site investigations. Construction dewatering activities relating to the west harbour pumping station and associated works are not expected to impact surface water within Burlington Bay.

5.6 Discharge of Water

It is proposed to direct construction dewatering discharge from the ground water control activities to the sanitary sewer. Due to the nature of fill deposits and heavy industrial uses within the Burlington Bay area

it is anticipated that discharge to the sanitary sewer will be required. Since dewatering activities are required for municipal servicing it is anticipated that the discharge to the sanitary sewer will be exempt from the City of Hamilton sewer discharge by-laws. Discharge to surface water or to infiltration via overland flow is not expected for the associated dewatering activities.

Ground water quality was sampled from BH11 on October 4, 2017 and water quality exceedances above the City of Hamilton sanitary and combined sewer use bylaw standards were observed for total PAH, pH and total suspended solids (TSS) for the collected unfiltered ground water quality sample. Results of water quality sampling were reported in the letter report titled *"Results of Sewer Use Discharge Sampling, West Harbour Pumping Station and Associated Owrks, Hamilton Ontario"*, completed by Terraprobe dated October 11, 2017 (project number 7-16-0090-46) provided in the attached enclosures (Appendix E).

6.0 MONITORING CONTINGENCY PLAN

The results of the study and impact analysis suggest there will be no significant impacts created by the ground water control activities. Nonetheless, it is important to maintain records to ensure that any unforeseen impacts are properly identified and appropriate contingency measures can be implemented.

Record keeping should be conducted over the duration of the ground water control activities. Records should include the following:

- Daily records of the current location, depth and extent of all excavations on the site;
- Daily records of water taking including time and rate of pumping;
- Inspection of discharge from the ground water control system on an hourly basis for evidence of visible suspended solids or silt; and,
- Daily inspection of excavation activities for the potential presence of deleterious materials which may result in impact to water quality.

In the event that significant fines are noted in the ground water discharge then the pumping should be stopped immediately and proper control measures should be implemented to prevent the movement of fines.

As there are no existing water wells or building within several hundred meters of the site, a program for

monitoring of water wells and ground settlement is not required.

7.0 SUMMARY

Based on the results of the study, the following summary and conclusions are made:

i. Excavations for the proposed PS1 pumping station will be required for the service level, wet well and sanitary storage tank. The service level excavation will cover 111 m^2 to depths of about 4.3 m (depth of 5.2 m below grade for the sump pit). The wet well excavation will cover approximately 12 m^2 to a depth of 7.6 m below grade (depth of 10.0 m below grade for the pump pit), and the sanitary storage tank will be completed to a depth of 5.5 m to 6.5 m with an area of 354 m^2.

ii. Excavations for the twin sanitary forcemain will be required to various depths between 1.5 to 2.6 m below grade. It is anticipated that excavations for the sanitary forcemain will be staged at 30 m lengths or less.

iii. Ground water control will be required to lower ground water levels within open excavations. Ground water levels will be influenced by the close proximity of the site to Burlington Bay. Ground water elevations are anticipated at 76.4 m.

iv. Excavations are anticipated to be completed predominately within fill materials. The hydraulic conductivity of fill materials is anticipated at 1 x 10^{-6} m/s based on hydraulic conductivity testing conducted for monitoring wells screened within fill deposits. The estimated volume of seepage including precipitation falling within open excavations for the PS1 pumping station (including the service level, wet well and sanitary storage tank) is on the order of 160.7 m^3 per day. Dewatering for the sanitary forcemain was estimated at 30.9 m^3 per day. It is anticipated that dewatering activities will be posted to the Ministry of the Environment Conservation and Parks Environmental Activity and Sector Registry.

v. The zone of influence associated with the ground water control activities is estimated at approximately 19.3 m (PS1 pumping station) to 10.7 m (sanitary forcemain). There are no water wells or structures found within several hundred meters of the site, hence there are no significant impacts expected.

vi. A program of monitoring during construction is recommended. The monitoring should include frequent inspection of the excavation and discharge water. Detailed records should be maintained

regarding excavation progress and pumping rates and volumes.

We trust this information is sufficient for your present purposes. Should you have any questions concerning the above, please do not hesitate to contact the undersigned.

Yours truly,
Terraprobe Inc.



Paul L. Raepple, P.Geo.
Hydrogeologist

R. Baker Wohayeb, M.A.Sc., P.Eng., QP_{RA}
Principal

Stoney Creek Office

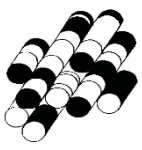
Enclosures

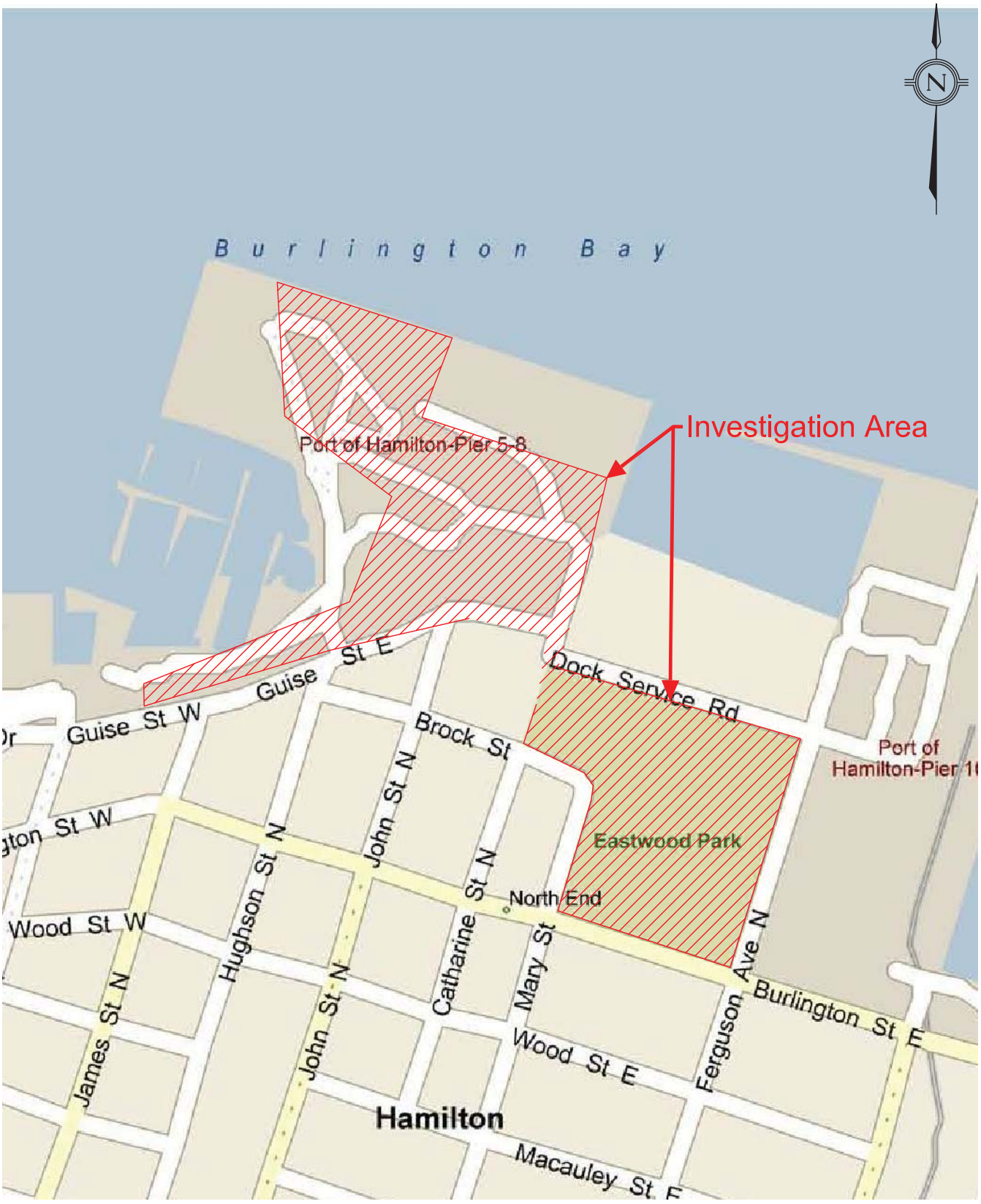
Figure 1 – Site Location Plan
Figure 2 – Borehole Location Plan

Appendix A – Borehole Logs
Appendix B – Results of In-Situ Hydraulic Conductivity Testing
Appendix C - Dewatering Analysis
Appendix D – Engineering Drawings, West Harbour Pumping Station and Associated Works
Appendix E – Results of Ground Water Quality Sampling

FIGURES

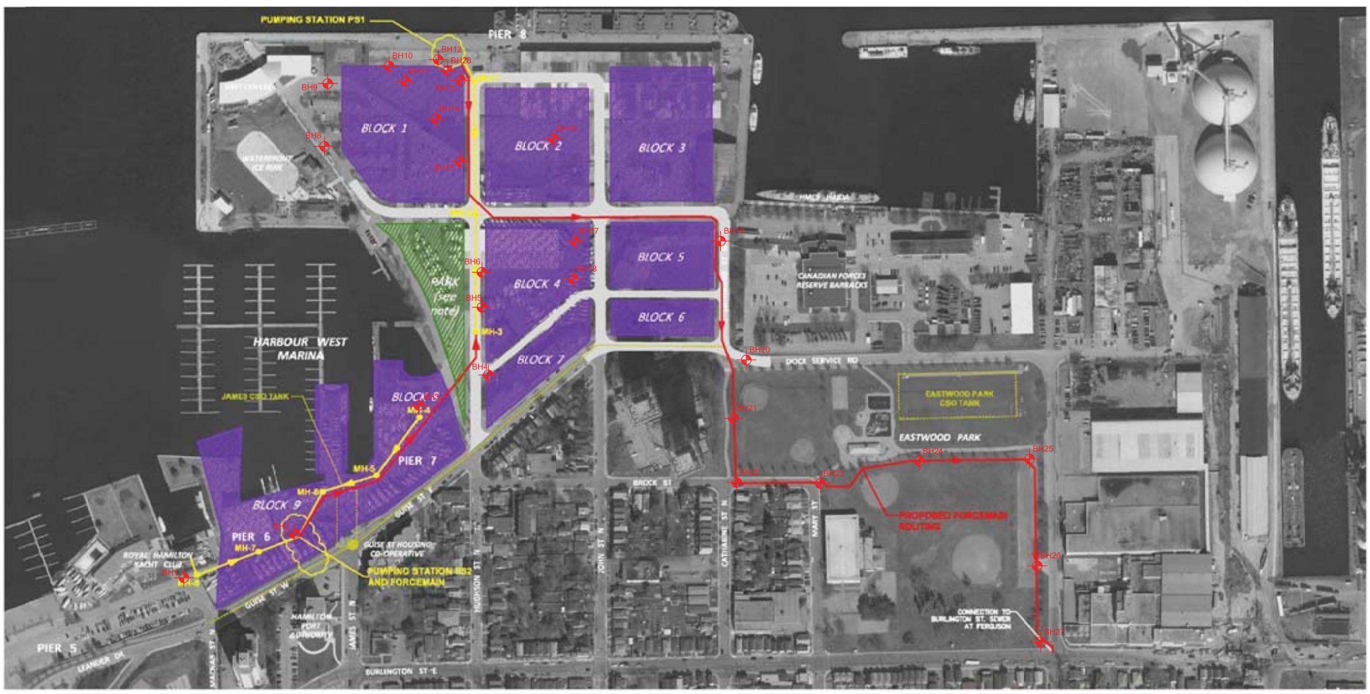
Terraprobe Inc.





Terraprobe
903 Barton Street - Unit 22, Stoney Creek, Ontario, L8E 5R7
Tel: (905) 643-7560, Fax: (905) 643-7559

Title:	FIGURE :
SITE LOCATION PLAN	1
File No. 7-16-0090-01	



CITY OF HAMILTON
WEST HARBOUR PUMPING STATION AND FORCEMAIN

CONCEPTUAL PUMPING STATION, SANITARY SEWER, AND FORCEMAIN FIGURE

Hamilton | Hamilton Waterfront Trust

EXISTING SANITARY SEWER
PROPOSED SANITARY FORCEMAIN ROUTING
PROPOSED SANITARY SEWER
BLOCK AREAS

File Location:
g:\cad\141396 waterfront development engineering\10 water_waste\2016-01-18 sanitary forcemain routing\plan with blocks figure.dwg
January, 20, 2016 9:32 PM

MAP/DRAWING INFORMATION
Mapping from City of Hamilton

SCALE 1:3,000
0 30 60 120m

DILLON CONSULTING

PROJECT: 14 1396
STATUS: DRAFT
DATE: JANUARY 2016

LEGEND

BH1 Borehole Location

Terraprobe
903 Barton Street - Unit 22, Stoney Creek, Ontario, L8E 5R7
Tel: (905) 643-7560, Fax: (905) 643-7559

Title: BOREHOLE LOCATION PLAN

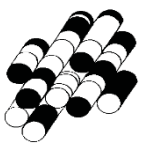
File No. 7-16-0090-01

FIGURE : 2

Borehole Logs

APPENDIX A

Terraprobe Inc.



LOG OF BOREHOLE 1

Terraprobe

Project No. : 7-16-0090-01 | Client : The City of Hamilton | Originated by : AF

Date started : August 8, 2016 | Project : Pier 8 | Compiled by : GM

Sheet No. : 1 of 1 | Location : Hamilton, Ontario | Checked by : GM

Position : E: 592231, N: 4791861 (UTM 17T) | Elevation Datum : Geodetic (NAD83)

Rig type : CME 75, truck-mounted | Drilling Method : Hollow stem augers

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Number	Type	SPT 'N' Value
0	78.1	**GROUND SURFACE**				
		60mm **ASPHALTIC CONCRETE**				
		FILL Granular Base				
	77.6					
	0.5	**FILL**, silty sand to sandy silt, pieces of wood, asphalt, glass fragments, very loose to loose, dark brown to brown		1	SS	4
1						
				2	SS	3
2						
				3	SS	4
3						
				4	SS	7
4						
	73.5					
	4.6	**SILT**, trace sand, trace clay, compact, grey		5	SS	10
5						
				6	SS	10
6						
	71.5					
	6.6					

Elevation Scale (m): 78, 77, 76, 75, 74, 73, 72

Penetration Test Values (Blows / 0.3m): Dynamic Cone; 10 20 30 40

Undrained Shear Strength (kPa): Unconfined, Pocket Penetrometer, Field Vane, Lab Vane; 40 80 120 160

Moisture / Plasticity: Plastic Limit, Natural Water Content, Liquid Limit; PL MC LL; 10 20 30

Headspace Vapour (ppm)

Instrument Details

Unstabilized Water Level

Lab Data and Comments

GRAIN SIZE DISTRIBUTION (%) (MIT): GR SA SI CL

END OF BOREHOLE

Unstabilized water level measured at 3.0 m below ground surface; borehole was open upon completion of drilling.

50 mm dia. monitoring well installed.

WATER LEVEL READINGS

Date	Water Depth (m)	Elevation (m)
Sep 1, 2016	2.6	75.6
Oct 11, 2016	2.2	76.0
Nov 7, 2016	2.0	76.1

file: 7-16-0090-01 pier 8 hamilton.gpj

LOG OF BOREHOLE 2

Terraprobe

Project No. : 7-16-0090-01 | Client : The City of Hamilton | Originated by : AF

Date started : August 12, 2016 | Project : Pier 8 | Compiled by : GM

Sheet No. : 1 of 1 | Location : Hamilton, Ontario | Checked by : GM

Position : E: 592339, N: 4791867 (UTM 17T) | Elevation Datum : Geodetic (NAD83)

Rig type : D90, truck-mounted | Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Number	Type	SPT 'N' Value	Elevation Scale (m)
	76.7	**GROUND SURFACE**					
0	75.8 0.9	FILL Granular Base					
1	0.9	**FILL**, sandy silt, some topsoil, very loose to loose, dark brown to brown		1	SS	5	76
2				2	SS	2	75
3	74.0 2.7			3	SS	6	74
		SANDY SILT to SILTY FINE SAND, very loose to loose, brown to grey		4	SS	20	73
4							
5				5	SS	6	72
6				6	SS	4	71
7	69.4 7.3						70
		SILTY CLAY, trace gravel, stiff, brown to grey		7	SS	13	69
8							68
9				8	SS	10	67
10							
11				9	SS	9	66
12	64.5 12.2						65
	64.1 12.6	**SILTY FINE SAND**, with clay layers, compact, grey		10	SS	10	

END OF BOREHOLE

Unstabilized water level measured at 6.1 m below ground surface; borehole was open upon completion of drilling.

Penetration Test Values (Blows / 0.3m): Dynamic Cone 10 20 30 40

Undrained Shear Strength (kPa): Unconfined, Pocket Penetrometer, Field Vane, Lab Vane 40 80 120 160

Moisture / Plasticity: Plastic Limit (PL) | Natural Water Content (MC) | Liquid Limit (LL) 10 20 30

Headspace Vapour (ppm)

Instrument Details

Unstabilized Water Level

Lab Data and Comments

GRAIN SIZE DISTRIBUTION (%) (MIT) GR SA SI CL

file: 7-16-0090-01 pier 8 hamilton.gpj

LOG OF BOREHOLE 3

Terraprobe

Project No. : 7-16-0090-01 | Client : The City of Hamilton | Originated by : AF

Date started : August 17, 2016 | Project : Pier 8 | Compiled by : GM

Sheet No. : 1 of 1 | Location : Hamilton, Ontario | Checked by : GM

Position : E: 592463, N: 4791951 (UTM 17T) | Elevation Datum : Geodetic (NAD83)

Rig type : D90, truck-mounted | Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Number	Type	SPT 'N' Value
0	76.5	**GROUND SURFACE**				
		60mm **ASPHALTIC CONCRETE**				
	76.0	FILL Granular Base				
	0.5	**FILL**, cinders with timber, some sand, very loose		1	SS	1
1						
				2	SS	59
2						
				3	SS	8
3						
				4	SS	3
4	72.2					
	4.3	**SILTY FINE SAND to SANDY SILT**, compact to dense, dark grey		5	SS	14
5						
6				6	SS	36
	69.9					
	6.6	**END OF BOREHOLE**				

Elevation Scale (m): 76, 75, 74, 73, 72, 71, 70

Penetration Test Values (Blows / 0.3m): Dynamic Cone 10 20 30 40

Undrained Shear Strength (kPa): Unconfined, Pocket Penetrometer, Field Vane, Lab Vane; 40 80 120 160

Moisture / Plasticity: Plastic Limit (PL) | Natural Water Content (MC) | Liquid Limit (LL); 10 20 30

Headspace Vapour (ppm)

Instrument Details

Unstabilized Water Level

Lab Data and Comments

GRAIN SIZE DISTRIBUTION (%) (MIT) GR SA SI CL

Unstabilized water level measured at 3.0 m below ground surface; borehole was open upon completion of drilling.

file: 7-16-0090-01 pier 8 hamilton.gpj

LOG OF BOREHOLE 4

Terraprobe

Project No. : 7-16-0090-01 | Client : The City of Hamilton | Originated by : AF

Date started : August 17, 2016 | Project : Pier 8 | Compiled by : GM

Sheet No. : 1 of 1 | Location : Hamilton, Ontario | Checked by : GM

Position : E: 592526, N: 4791951 (UTM 17T) | Elevation Datum : Geodetic (NAD83)

Rig type : D90, truck-mounted | Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Sample Number	Sample Type	SPT 'N' Value
0	77.2	**GROUND SURFACE**				
		FILL Granular Base				
	76.6 / 0.6					
1		**FILL**, silty sand, some gravel, with pieces of concrete and brick, compact		1	SS	27
				2	SS	13
2	74.9 / 2.3					
		FILL, silty sand, some gravel, with pieces of concrete and brick, compact		3	SS	8
				4	SS	10
3						
4	73.1 / 4.1					
		SILTY CLAY, with silt seams and layers, stiff, grey		5	SS	8
5						
6				6	SS	9
	70.6 / 6.6					

Elevation Scale (m): 77, 76, 75, 74, 73, 72, 71

Penetration Test Values (Blows / 0.3m): Dynamic Cone 10 20 30 40

Undrained Shear Strength (kPa): Unconfined, Pocket Penetrometer, Field Vane, Lab Vane — 40 80 120 160

Moisture / Plasticity: Plastic Limit (PL) | Natural Water Content (MC) | Liquid Limit (LL) — 10 20 30

Headspace Vapour (ppm)

Instrument Details

Unstabilized Water Level

Lab Data and Comments

GRAIN SIZE DISTRIBUTION (%) (MIT) — GR SA SI CL

END OF BOREHOLE

Unstabilized water level measured at 2.1 m below ground surface; borehole was open upon completion of drilling.

file: 7-16-0090-01 pier 8 hamilton.gpj

LOG OF BOREHOLE 5

Project No. : 7-16-0090-01 | Client : The City of Hamilton | Originated by : AF

Date started : August 4, 2016 | Project : Pier 8 | Compiled by : GM

Sheet No. : 1 of 1 | Location : Hamilton, Ontario | Checked by : GM

Position : E: 592549, N: 4792020 (UTM 17T) | Elevation Datum : Geodetic (NAD83)

Rig type : D90, truck-mounted | Drilling Method : Solid stem augers

Depth (m)	Elev Depth (m)	Description	Number	Type	SPT 'N' Value
0	77.3	**GROUND SURFACE**			
	76.7	FILL Granular Base			
	0.6	**FILL**, clayey silt to sandy silt, with glass fragments and pieces of asphalt, gravel, loose, brown	1	SS	8
2			2	SS	11
	73.0				
4	4.3	**ORGANIC SILT**, shell fragments, very soft, dark grey	3	SS	0
5			4	SS	0
6			5	SS	3
8			6	SS	0
9			7	SS	3
11	65.4				
12	11.9	**SILTY CLAY**, soft	8	SS	2
13			9	SS	2
14				FV	
15			10	SS	3
16					
17			11	SS	3
18				FV	
	58.6		12	SS	4
	18.7				

Penetration Test Values (Blows / 0.3m): Dynamic Cone 10 20 30 40

Undrained Shear Strength (kPa): Unconfined, Pocket Penetrometer, Field Vane, Lab Vane 40 80 120 160

Moisture / Plasticity: Plastic Limit, Natural Water Content, Liquid Limit; PL MC LL; 10 20 30

Elevation Scale (m): 77 76 75 74 73 72 71 70 69 68 67 66 65 64 63 62 61 60 59

Headspace Vapour (ppm): 57 40 1.7 1.6

Instrument Details

Unstabilized Water Level

Lab Data and Comments

GRAIN SIZE DISTRIBUTION (%) (MIT)

GR SA SI CL

4 45 43 8

0 3 44 53

END OF BOREHOLE

Water encountered at 2m depth.
Unstablized water level at 12.2m below ground surface after drilling; borehole was open upon completion of drilling.

50 mm dia. monitoring well installed.

WATER LEVEL READINGS

Date	Water Depth (m)	Elevation (m)
Sep 1, 2016	8.2	69.2
Oct 11, 2016	2.9	74.5
Nov 7, 2016	3.2	74.1

file: 7-16-0090-01 pier 8 hamilton.gpj

LOG OF BOREHOLE 6

Terraprobe

Project No. : 7-16-0090-01 | Client : The City of Hamilton | Originated by : AF

Date started : August 5, 2016 | Project : Pier 8 | Compiled by : GM

Sheet No. : 1 of 1 | Location : Hamilton, Ontario | Checked by : GM

Position : E: 592544, N: 4792074 (UTM 17T) | Elevation Datum : Geodetic (NAD83)

Rig type : D90, truck-mounted | Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Number	Type	SPT 'N' Value
0	77.1	**GROUND SURFACE**				
		FILL, clayey silt, some sand, some shale fragments, pieces of slag, loose to compact, reddish brown		1	SS	6
				2	SS	19
4	72.8					
	4.3	**ORGANIC SILT**, (poor recovery), very soft		3	SS	2
				4	SS	0
				5	SS	0
9	68.0					
	9.1	**SANDY SILT to SILTY FINE SAND**, very loose, grey		6	SS	0
				7	SS	0
12	64.9					
	12.2	**SILTY CLAY**, trace gravel, firm, grey		8	SS	5
				9	SS	2
					FV	
				10	SS	3
					FV	
				11	SS	6
					FV	
18	58.4			12	SS	3
	18.7					

Elevation Scale (m): 77, 76, 75, 74, 73, 72, 71, 70, 69, 68, 67, 66, 65, 64, 63, 62, 61, 60, 59

Penetration Test Values (Blows / 0.3m): Dynamic Cone 10 20 30 40

Undrained Shear Strength (kPa): Unconfined, Pocket Penetrometer, Field Vane, Lab Vane; 40 80 120 160

Field Vane readings: 1.5, 2.0, 1.6

Moisture / Plasticity: Plastic Limit, Natural Water Content, Liquid Limit; PL MC LL; 10 20 30

Moisture values: 40, 43

Headspace Vapour (ppm)

Instrument Details

Unstabilized Water Level

Lab Data and Comments

GRAIN SIZE DISTRIBUTION (%) (MIT)

GR SA SI CL

END OF BOREHOLE

Water encountered at 3m depth.
Unstablized water level at 12.8m below ground surface after drilling; borehole was open upon completion of drilling.

50 mm dia. monitoring well installed.

WATER LEVEL READINGS

Date	Water Depth (m)	Elevation (m)
Sep 1, 2016	6.0	71.1
Oct 11, 2016	2.3	74.8
Nov 7, 2016	2.8	74.3

file: 7-16-0090-01 pier 8 hamilton.gpj

LOG OF BOREHOLE 8

Terraprobe

Project No. : 7-16-0090-01 | Client : The City of Hamilton | Originated by : AF

Date started : August 12, 2016 | Project : Pier 8 | Compiled by : GM

Sheet No. : 1 of 1 | Location : Hamilton, Ontario | Checked by : GM

Position : E: 592463, N: 4792202 (UTM 17T) | Elevation Datum : Geodetic (NAD83)

Rig type : D90, truck-mounted | Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Number	Type	SPT 'N' Value
0	77.8	**GROUND SURFACE**				
		75mm **ASPHALTIC CONCRETE**				
	77.3	FILL Granular Base				
	0.5	**FILL**, silty sand and gravel, some clay, pieces of slag, glass fragments and cinders, compact, dark brown / black		1	SS	21
1						
				2	SS	35
2						
				3	SS	9
3	74.8					
	3.0	**FILL**, clayey silt to sandy silt, trace cinders, pieces of brick fragments, very loose to compact, dark brown		4	SS	9
4						
				5	SS	36
5						
				6	SS	3
6						
	70.5					
	7.3	**ORGANIC SILT**, soft, black		7	SS	4
7						
	69.0					
	8.8	**SILT**, trace sand, loose, dark grey		8	SS	6
8	68.2					
	9.6	**END OF BOREHOLE**				
9						

Elevation Scale (m): 77, 76, 75, 74, 73, 72, 71, 70, 69

Penetration Test Values (Blows / 0.3m): Dynamic Cone 10 20 30 40

Undrained Shear Strength (kPa): Unconfined, Pocket Penetrometer, Field Vane, Lab Vane — 40 80 120 160

Moisture / Plasticity: Plastic Limit (PL) | Natural Water Content (MC) | Liquid Limit (LL) — 10 20 30

43

Headspace Vapour (ppm)

Instrument Details

Unstabilized Water Level

Lab Data and Comments

GRAIN SIZE DISTRIBUTION (%) (MIT)

GR SA SI CL

Unstabilized water level measured at 5.5 m below ground surface; borehole was open upon completion of drilling.

file: 7-16-0090-01 pier 8 hamilton.gpj

LOG OF BOREHOLE 9

Terraprobe

Project No. : 7-16-0090-01 | Client : The City of Hamilton | Originated by : AF

Date started : August 1, 1940 | Project : Pier 8 | Compiled by : GM

Sheet No. : 1 of 1 | Location : Hamilton, Ontario | Checked by : GM

Position : E: 592482, N: 4792258 (UTM 17T) | Elevation Datum : Geodetic (NAD83)

Rig type : D90, truck-mounted | Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Number	Type	SPT 'N' Value
0	77.1	**GROUND SURFACE**				
		75mm **ASPHALTIC CONCRETE**				
	76.6	FILL Granular Base				
	0.5	**FILL**, sand, (possibly foundry sand) with brick fragments and clay lumps, compact, black		1	SS	20
1						
				2	SS	35
2						
				3	SS	5
3	74.1					
	3.0	**FILL**, clayey silt, some gravel, some brick fragments, firm to stiff, dark brown		4	SS	9
4						
				5	SS	12
5						
6	71.0					
	6.1	**ORGANIC SILT**, very soft to soft, black		6	SS	6
7						
				7	SS	1
8	68.6					
	8.5	**SILT**, trace sand, loose, dark grey				
9				8	SS	5
	67.5					
	9.6	**END OF BOREHOLE**				

Unstabilized water level measured at 4.0 m below ground surface; borehole was open upon completion of drilling.

Elevation Scale (m): 77, 76, 75, 74, 73, 72, 71, 70, 69, 68

Penetration Test Values (Blows / 0.3m): Dynamic Cone 10 20 30 40

Undrained Shear Strength (kPa): Unconfined, Pocket Penetrometer, Field Vane, Lab Vane 40 80 120 160

Moisture / Plasticity: Plastic Limit (PL) | Natural Water Content (MC) | Liquid Limit (LL) 10 20 30

Headspace Vapour (ppm)

Instrument Details

Unstabilized Water Level

Lab Data and Comments

GRAIN SIZE DISTRIBUTION (%) (MIT) GR SA SI CL

file: 7-16-0090-01 pier 8 hamilton.gpj

LOG OF BOREHOLE 10

Terraprobe

Project No. : 7-16-0090-01 | Client : The City of Hamilton | Originated by : AF

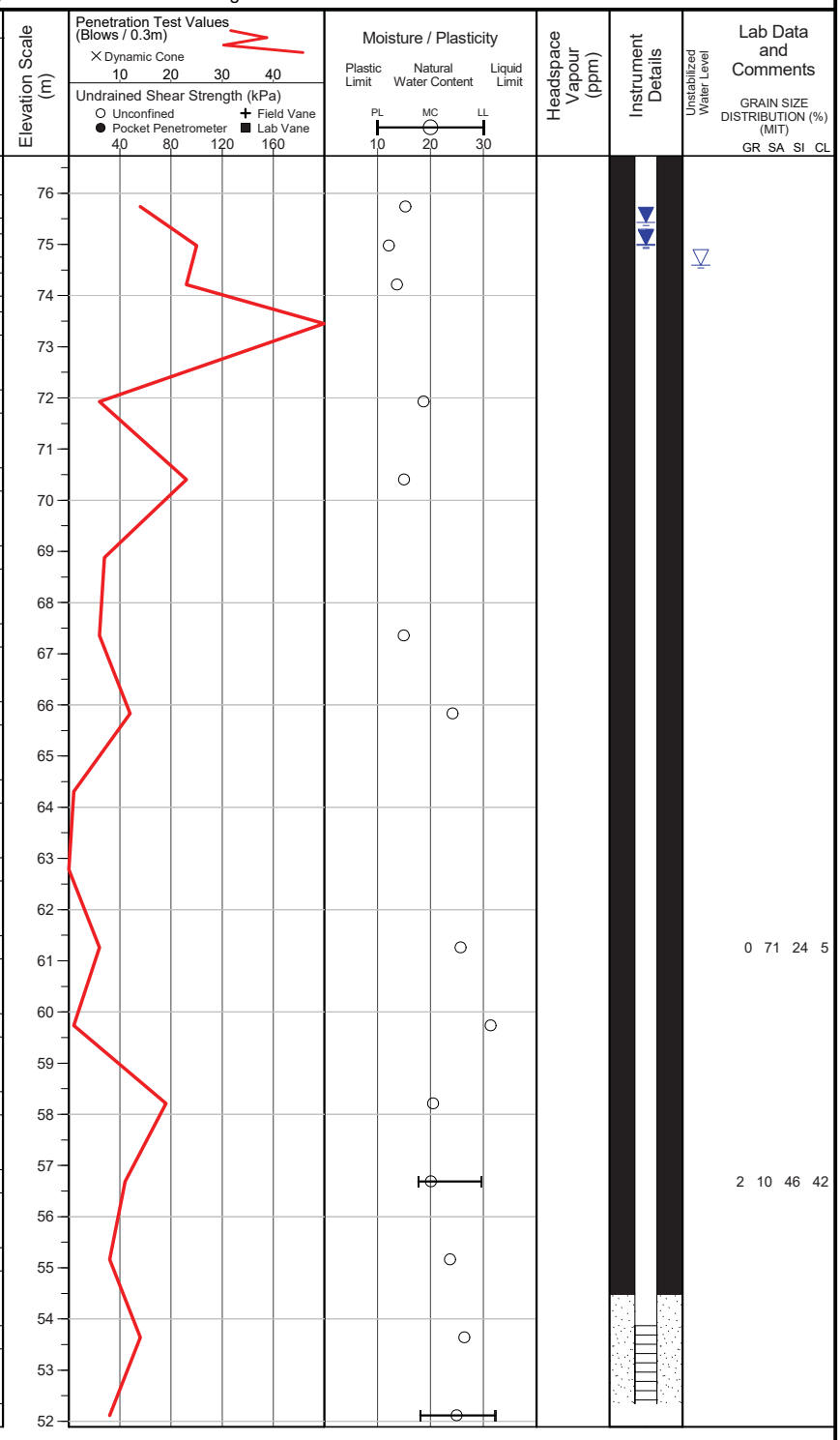
Date started : August 3, 2016 | Project : Pier 8 | Compiled by : GM

Sheet No. : 1 of 1 | Location : Hamilton, Ontario | Checked by : GM

Position : E: 592532, N: 4792261 (UTM 17T) | Elevation Datum : Geodetic (NAD83)

Rig type : CME 75, truck-mounted | Drilling Method : Hollow stem augers

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Number	Type	SPT 'N' Value
	76.7	**GROUND SURFACE**				
0	76.2	50mm **ASPHALTIC CONCRETE**				
	0.5	FILL Granular Base		1	SS	14
1		**FILL**, clayey silt to sandy silt, with pieces of brick, dark brown to reddish brown		2	SS	25
2				3	SS	23
3	73.7					
	3.0	FILL TAR, (solid), Black		4	SS	77
	73.1					
4	3.6	**FILL**, sandy silt, with layers of brown and black slag, pieces of concrete and asphalt, loose, brown and black				
5				5	SS	6
6				6	SS	23
7				7	SS	7
8				8	SS	6
9				9	SS	12
10						
11						
12	64.5					
	12.2	**SILTY FINE SAND to SANDY SILT**, very loose, dark brown to dark grey		10	SS	1
13				11	SS	0
14				12	SS	6
15				13	SS	1
16	59.0					
	17.7	**SILTY CLAY**, trace gravel, stiff to very stiff, grey		14	SS	19
17				15	SS	11
18				16	SS	8
19						
20				17	SS	14
21						
22				18	SS	8
23	51.9					
24	24.8					



END OF BOREHOLE

Unstabilized water level measured at 2.1 m below ground surface; borehole was open upon completion of drilling.

50 mm dia. monitoring well installed.

WATER LEVEL READINGS

Date	Water Depth (m)	Elevation (m)
Sep 1, 2016	1.8	75.0
Oct 11, 2016	1.7	75.0
Nov 7, 2016	1.3	75.4

file: 7-16-0090-01 pier 8 hamilton.gpj

LOG OF BOREHOLE 11

Terraprobe

Project No. : 7-16-0090-01 | Client : The City of Hamilton | Originated by : AF

Date started : August 4, 2016 | Project : Pier 8 | Compiled by : GM

Sheet No. : 1 of 1 | Location : Hamilton, Ontario | Checked by : GM

Position : E: 592531, N: 4792239 (UTM 17T) | Elevation Datum : Geodetic (NAD83)

Rig type : CME 75, truck-mounted | Drilling Method : Hollow stem augers

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Sample Number	Sample Type	SPT 'N' Value
	76.8	**GROUND SURFACE**				
		50mm **ASPHALTIC CONCRETE**				
	76.2	FILL Granular Base				
	0.6	**FILL**, silty clay, trace gravel, pieces of bick, very soft to firm, grey		1	SS	7
				2	SS	2
	73.1					
	3.7	**FILL**, clayey silt to sandy silt, with pieces of brick and mortar, loose to compact, dark brown to reddish brown		3	SS	10
				4	SS	5
				5	SS	9
	68.0					
	8.8	**SANDY SILT to SILTY FINE SAND**, loose, dark grey		6	SS	7
				7	SS	7
				8	SS	2
	64.2					
	12.6	**END OF BOREHOLE**				

Penetration Test Values (Blows / 0.3m): Dynamic Cone 10 20 30 40

Undrained Shear Strength (kPa): Unconfined, Pocket Penetrometer, Field Vane, Lab Vane 40 80 120 160

Moisture / Plasticity: Plastic Limit (PL) | Natural Water Content (MC) | Liquid Limit (LL) 10 20 30

Headspace Vapour (ppm)

Instrument Details

Unstabilized Water Level

Lab Data and Comments

GRAIN SIZE DISTRIBUTION (%) (MIT) GR SA SI CL

Unstabilized water level measured at 4.6 m below ground surface; borehole was open upon completion of drilling.

50 mm dia. monitoring well installed.

WATER LEVEL READINGS

Date	Water Depth (m)	Elevation (m)
Sep 1, 2016	0.9	76.0
Oct 11, 2016	1.0	75.9
Nov 7, 2016	1.2	75.7

file: 7-16-0090-01 pier 8 hamilton.gpj

LOG OF BOREHOLE 12

Terraprobe

Project No. : 7-16-0090-01 | Client : The City of Hamilton | Originated by : AF

Date started : August 9, 2016 | Project : Pier 8 | Compiled by : GM

Sheet No. : 1 of 1 | Location : Hamilton, Ontario | Checked by : GM

Position : E: 592582, N: 4792247 (UTM 17T) | Elevation Datum : Geodetic (NAD83)

Rig type : D90, truck-mounted | Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Number	Type	SPT 'N' Value	Elevation Scale (m)
	76.7	**GROUND SURFACE**					
0	76.2	75mm **ASPHALTIC CONCRETE**					
	0.5	FILL Granular Base					
1		**FILL**, silty fine sand and gravel, pieces of asphalt, timber and metal, compact, brown / black		1	SS	17	76
2	74.3						75
	2.4	**FILL**, brick fragments, some sand, mortar and rubble, loose to compact		2	SS	20	74
3							73
4				3	SS	7	72
5							71
6				4	SS	20	70
7	69.7						69
	7.0	**FILL**, silty fine sand, with pieces of brick, loose, dark brown to black		5	SS	5	68
8	67.9						67
9	8.8	**SANDY SILT to SILTY FINE SAND**, very loose to loose, dark grey		6	SS	3	66
10							65
11				7	SS	3	64
12							63
13				8	SS	2	62
14							61
15				9	SS	1	60
16							59
17				10	SS	10	58
18							
	58.0			11	SS	9	
	18.7						
				12	SS	6	

Penetration Test Values (Blows / 0.3m)
Dynamic Cone: 10 20 30 40
Undrained Shear Strength (kPa)
Unconfined, Pocket Penetrometer, Field Vane, Lab Vane: 40 80 120 160

Moisture / Plasticity
Plastic Limit | Natural Water Content | Liquid Limit
PL MC LL
10 20 30

Headspace Vapour (ppm)

Instrument Details

Unstabilized Water Level

Lab Data and Comments

GRAIN SIZE DISTRIBUTION (%) (MIT)

	GR	SA	SI	CL
11	0	50	44	6
15	0	48	44	8

END OF BOREHOLE

Unstabilized water level measured at 4.6 m below ground surface; borehole was open upon completion of drilling.

file: 7-16-0090-01 pier 8 hamilton.gpj

LOG OF BOREHOLE 13

Terraprobe

Project No. : 7-16-0090-01 | Client : The City of Hamilton | Originated by : AF

Date started : August 9, 2016 | Project : Pier 8 | Compiled by : GM

Sheet No. : 1 of 1 | Location : Hamilton, Ontario | Checked by : GM

Position : E: 592588, N: 4792225 (UTM 17T) | Elevation Datum : Geodetic (NAD83)

Rig type : D90, truck-mounted | Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Number	Type	SPT 'N' Value
0	76.8	**GROUND SURFACE**				
		70mm **ASPHALTIC CONCRETE**				
	76.3	FILL Granular Base				
	0.5	**FILL**, sandy silt, with pieces of brick and slag, loose, dark brown		1	SS	9
1						
2				2	SS	5
3	73.1					
	3.7	**FILL**, brick fragments and slag, some sand and gravel, compact		3	SS	30
4						
5						
6				4	SS	16
7	69.5					
	7.3	**FILL**, silty fine sand, with pieces of concrete, very loose, brown		5	SS	4
8	68.3					
	8.5	**SILTY FINE SAND to SANDY SILT**, loose, grey		6	SS	7
9	67.2					
	9.6	**END OF BOREHOLE**				

Elevation Scale (m): 76, 75, 74, 73, 72, 71, 70, 69, 68

Penetration Test Values (Blows / 0.3m): Dynamic Cone 10 20 30 40

Undrained Shear Strength (kPa): Unconfined, Pocket Penetrometer, Field Vane, Lab Vane — 40 80 120 160

Moisture / Plasticity: Plastic Limit (PL) | Natural Water Content (MC) | Liquid Limit (LL) — 10 20 30

Headspace Vapour (ppm)

Instrument Details

Unstabilized Water Level

Lab Data and Comments

GRAIN SIZE DISTRIBUTION (%) (MIT) GR SA SI CL

Unstabilized water level measured at 3.0 m below ground surface; borehole was open upon completion of drilling.

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LOG OF BOREHOLE 14

Terraprobe

Project No. : 7-16-0090-01 | Client : The City of Hamilton | Originated by : AF

Date started : August 10, 2016 | Project : Pier 8 | Compiled by : GM

Sheet No. : 1 of 1 | Location : Hamilton, Ontario | Checked by : GM

Position : E: 592565, N: 4792210 (UTM 17T) | Elevation Datum : Geodetic (NAD83)

Rig type : D90, truck-mounted | Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Number	Type	SPT 'N' Value
	76.9	**GROUND SURFACE**				
		70mm **ASPHALTIC CONCRETE**				
		FILL Granular Base				
	76.3 / 0.6					
		FILL, sandy silt to clayey silt, with pieces of brick and slag, loose		1	SS	11
				2	SS	7
				3	SS	7
				4	SS	11
	72.3 / 4.6					
		FILL, slag and brick fragments, very dense to compact, black and brown		5	SS	50 / 75mm
				6	SS	12
	70.2 / 6.7					
		FILL, silty clay to clayey silt, with pieces of concrete, some sand and gravel, stiff, grey		7	SS	11
				8	SS	40
	67.3 / 9.6					

Elevation Scale (m): 76, 75, 74, 73, 72, 71, 70, 69, 68

Penetration Test Values (Blows / 0.3m): Dynamic Cone 10 20 30 40

Undrained Shear Strength (kPa): Unconfined, Pocket Penetrometer, Field Vane, Lab Vane — 40 80 120 160

Moisture / Plasticity: Plastic Limit (PL) | Natural Water Content (MC) | Liquid Limit (LL) — 10 20 30

Headspace Vapour (ppm)

Instrument Details

Unstabilized Water Level

Lab Data and Comments

GRAIN SIZE DISTRIBUTION (%) (MIT) — GR SA SI CL

END OF BOREHOLE

Unstabilized water level measured at 3.0 m below ground surface; borehole was open upon completion of drilling.

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LOG OF BOREHOLE 15

Terraprobe

Project No. : 7-16-0090-01 | Client : The City of Hamilton | Originated by : AF

Date started : August 10, 2016 | Project : Pier 8 | Compiled by : GM

Sheet No. : 1 of 1 | Location : Hamilton, Ontario | Checked by : GM

Position : E: 592570, N: 4792157 (UTM 17T) | Elevation Datum : Geodetic (NAD83)

Rig type : D90, truck-mounted | Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Number	Type	SPT 'N' Value
0	78.0	**GROUND SURFACE**				
		60mm **ASPHALTIC CONCRETE**				
		FILL, sandy silt, trace to some gravel, with pieces of asphlat and brick, dense, dark brown to black		1	SS	66
1				2	SS	50 / 100mm
2				3	SS	7
3	75.0 / 3.0	**FILL**, silty clay, trace topsoil, some gravel, firm, dark brown		4	SS	5
4				5	SS	5
5	72.5 / 5.5	**FILL**, brick fragments, trace clay, rubble, compact, dark brown		6	SS	19
6						
7	71.0 / 7.0	**FILL**, silty silt, some gravel, with pieces of brick and asphalt, compact, dark brown		7	SS	12
8						
9	68.4 / 9.6	**END OF BOREHOLE**		8	SS	19

Elevation Scale (m): 77, 76, 75, 74, 73, 72, 71, 70, 69

Penetration Test Values (Blows / 0.3m): Dynamic Cone 10 20 30 40

Undrained Shear Strength (kPa): Unconfined, Pocket Penetrometer, Field Vane, Lab Vane 40 80 120 160

Moisture / Plasticity: Plastic Limit (PL) | Natural Water Content (MC) | Liquid Limit (LL) 10 20 30

Headspace Vapour (ppm)

Instrument Details

Unstabilized Water Level

Lab Data and Comments

GRAIN SIZE DISTRIBUTION (%) (MIT) GR SA SI CL

Unstabilized water level measured at 3.0 m below ground surface; borehole was open upon completion of drilling.

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LOG OF BOREHOLE 16

Project No. : 7-16-0090-01 | Client : The City of Hamilton | Originated by : AF

Date started : August 11, 2016 | Project : Pier 8 | Compiled by : GM

Sheet No. : 1 of 1 | Location : Hamilton, Ontario | Checked by : GM

Position : E: 592676, N: 4792162 (UTM 17T) | Elevation Datum : Geodetic (NAD83)

Rig type : D90, truck-mounted | Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Number	Type	SPT 'N' Value
0	76.0	**GROUND SURFACE**				
		100mm **ASPHALTIC CONCRETE**				
		FILL, silty sand and gravel, trace cinders, pieces of concrete, wood, loose to compact, dark brown		1	SS	17
1						
				2	SS	23
2						
				3	SS	5
3	73.0					
	3.0	**FILL**, clayey silt, some gravel, with pieces of brick and asphalt, loose to compact, dark brown		4	SS	5
4						
				5	SS	32
5	70.7					
	5.3	**FILL**, slag with brick fragments				
6	69.6			6	SS	50 / 125mm
	6.4	**END OF BOREHOLE**				

Elevation Scale (m): 75, 74, 73, 72, 71, 70

Penetration Test Values (Blows / 0.3m): Dynamic Cone; 10 20 30 40

Undrained Shear Strength (kPa): Unconfined, Pocket Penetrometer, Field Vane, Lab Vane; 40 80 120 160

Moisture / Plasticity: Plastic Limit, Natural Water Content, Liquid Limit; PL MC LL; 10 20 30

Headspace Vapour (ppm)

Instrument Details

Unstabilized Water Level

Lab Data and Comments

GRAIN SIZE DISTRIBUTION (%) (MIT): GR SA SI CL

Unstabilized water level measured at 1.2 m below ground surface; borehole was open upon completion of drilling.

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LOG OF BOREHOLE 17

Terraprobe

Project No. : 7-16-0090-01 | Client : The City of Hamilton | Originated by : AF

Date started : August 11, 2016 | Project : Pier 8 | Compiled by : GM

Sheet No. : 1 of 1 | Location : Hamilton, Ontario | Checked by : GM

Position : E: 592650, N: 4792047 (UTM 17T) | Elevation Datum : Geodetic (NAD83)

Rig type : D90, truck-mounted | Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Sample Number	Sample Type	SPT 'N' Value
0	77.8	**GROUND SURFACE**				
	77.2 / 0.6	FILL Granular Base				
1		**FILL**, sandy silt, trace clay, with pieces of brick, asphalt and timber, very loose to compact, dark brown to black		1	SS	10
				2	SS	7
2				3	SS	4
3				4	SS	5
4	73.2 / 4.6					
		SILTY FINE SAND to SANDY SILT, very loose, dark grey		5	SS	4
5						
6				6	SS	1
	71.2 / 6.6	**END OF BOREHOLE**				

Penetration Test Values (Blows / 0.3m): Dynamic Cone (10, 20, 30, 40)

Undrained Shear Strength (kPa): Unconfined, Pocket Penetrometer, Field Vane, Lab Vane (40, 80, 120, 160)

Elevation Scale (m): 77, 76, 75, 74, 73, 72

Moisture / Plasticity: Plastic Limit (PL), Natural Water Content (MC), Liquid Limit (LL) (10, 20, 30)

Headspace Vapour (ppm)

Instrument Details

Unstabilized Water Level

Lab Data and Comments

GRAIN SIZE DISTRIBUTION (%) (MIT) GR SA SI CL

Unstabilized water level measured at 3.0 m below ground surface; borehole was open upon completion of drilling.

file: 7-16-0090-01 pier 8 hamilton.gpj

LOG OF BOREHOLE 18

Terraprobe

Project No. : 7-16-0090-01 | Client : The City of Hamilton | Originated by : AF

Date started : August 11, 2016 | Project : Pier 8 | Compiled by : GM

Sheet No. : 1 of 1 | Location : Hamilton, Ontario | Checked by : GM

Position : E: 592637, N: 4792023 (UTM 17T) | Elevation Datum : Geodetic (NAD83)

Rig type : D90, truck-mounted | Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Number	Type	SPT 'N' Value
	77.4	**GROUND SURFACE**				
		FILL Granular Base				
	76.8 / 0.6	**FILL**, silty sand to sandy silt, trace clay, with pieces of asphalt, gravel and timber, loose to compact, dark brown		1	SS	19
				2	SS	8
	75.3 / 2.1	**FILL**, clayey silt, some gravel, with pieces of asphalt, soft, dark brown		3	SS	3
				4	SS	4
	72.8 / 4.6	**SILTY FINE SAND to SANDY SILT**, loose to compact, dark grey		5	SS	9
				6	SS	18
	70.8 / 6.6	**END OF BOREHOLE**				

Elevation Scale (m): 77, 76, 75, 74, 73, 72, 71

Penetration Test Values (Blows / 0.3m) — Dynamic Cone: 10, 20, 30, 40

Undrained Shear Strength (kPa) — Unconfined, Pocket Penetrometer, Field Vane, Lab Vane: 40, 80, 120, 160

Moisture / Plasticity — Plastic Limit, Natural Water Content, Liquid Limit: PL, MC, LL; 10, 20, 30

Headspace Vapour (ppm)

Instrument Details

Unstabilized Water Level

Lab Data and Comments

GRAIN SIZE DISTRIBUTION (%) (MIT) — GR SA SI CL

Unstabilized water level measured at 3.7 m below ground surface; borehole was open upon completion of drilling.

file: 7-16-0090-01 pier 8 hamilton.gpj

LOG OF BOREHOLE 19

Terraprobe

Project No. : 7-16-0090-01 | Client : The City of Hamilton | Originated by : AF

Date started : August 8, 2016 | Project : Pier 8 | Compiled by : GM

Sheet No. : 1 of 1 | Location : Hamilton, Ontario | Checked by : GM

Position : E: 592772, N: 4792015 (UTM 17T) | Elevation Datum : Geodetic (NAD83)

Rig type : CME 75, truck-mounted | Drilling Method : Hollow stem augers

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Number	Type	SPT 'N' Value
0	76.0	**GROUND SURFACE**				
		60mm **ASPHALTIC CONCRETE**				
	75.3	FILL Granular Base				
1	0.7	**FILL**, sandy silt, occasional gravel, loose, brown		1	SS	7
	74.5					
2	1.5	**ORGANIC SILT**, (possibly fill), soft, black / brown		2	SS	1
				3	SS	1
3				4	SS	2
4						
5				5	SS	3
	70.5					
6	5.5	**PEAT**, soft, black		6	SS	3
7	68.7					
	7.3	**SILT**, very loose, brown		7	SS	3
8	67.5					
	8.5	**CLAYEY SILT**, with silt sayers, stiff, grey		8	SS	10
9	66.4					
	9.6	**END OF BOREHOLE**				

Elevation Scale (m): 75, 74, 73, 72, 71, 70, 69, 68, 67

Penetration Test Values (Blows / 0.3m): Dynamic Cone 10 20 30 40

Undrained Shear Strength (kPa): Unconfined, Pocket Penetrometer, Field Vane, Lab Vane — 40 80 120 160

Moisture / Plasticity: Plastic Limit (PL) | Natural Water Content (MC) | Liquid Limit (LL) — 10 20 30

Headspace Vapour (ppm): 48, 49, 143

Instrument Details

Unstabilized Water Level

Lab Data and Comments

GRAIN SIZE DISTRIBUTION (%) (MIT) GR SA SI CL

Unstabilized water level measured at 3.0 m below ground surface; borehole was open upon completion of drilling.

50 mm dia. monitoring well installed.

WATER LEVEL READINGS

Date	Water Depth (m)	Elevation (m)
Sep 1, 2016	1.1	74.9
Oct 11, 2016	1.3	74.7
Nov 7, 2016	1.5	74.5

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LOG OF BOREHOLE 20

Terraprobe

Project No. : 7-16-0090-01 | Client : The City of Hamilton | Originated by : AF

Date started : October 27, 2016 | Project : Pier 8 | Compiled by : GM

Sheet No. : 1 of 1 | Location : Hamilton, Ontario | Checked by : GM

Position : E: 592774, N: 4791893 (UTM 17T) | Elevation Datum : Geodetic (NAD83)

Rig type : CME 75, truck-mounted | Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Number	Type	SPT 'N' Value	Elevation Scale (m)
	77.0	**GROUND SURFACE**					
0	76.7	75mm **ASPHALTIC CONCRETE**					77
	0.3	**FILL**, Granular					
	76.4						
	0.6	**FILL**, Granular, trace clay, trace construction debris, very loose to loose, brownish black		1	SS	8	
1							76
				2	SS	3	
2	74.7						75
	2.3	**SANDY SILT**, compact, grey		3	SS	16	
3							74
				4	SS	18	
4							73
	72.4						
	4.6	**SILT**, trace sand, with clay layers, dense, grey		5	SS	31	
5							72
6				6	SS	42	71
	70.4						
	6.6	**END OF BOREHOLE**					

Penetration Test Values (Blows / 0.3m): Dynamic Cone 10 20 30 40

Undrained Shear Strength (kPa): Unconfined, Pocket Penetrometer, Field Vane, Lab Vane; 40 80 120 160

Moisture / Plasticity: Plastic Limit, Natural Water Content, Liquid Limit; PL MC LL; 10 20 30

Headspace Vapour (ppm)

Instrument Details

Unstabilized Water Level

Lab Data and Comments

GRAIN SIZE DISTRIBUTION (%) (MIT): GR SA SI CL

Unstabilized water level measured at 4.6 m below ground surface; borehole was open upon completion of drilling.

file: 7-16-0090-01 pier 8 hamilton.gpj

LOG OF BOREHOLE 21

Terraprobe

Project No. : 7-16-0090-01 | Client : The City of Hamilton | Originated by : AF

Date started : August 15, 2016 | Project : Pier 8 | Compiled by : GM

Sheet No. : 1 of 1 | Location : Hamilton, Ontario | Checked by : GM

Position : E: 592750, N: 4791857 (UTM 17T) | Elevation Datum : Geodetic (NAD83)

Rig type : D90, truck-mounted | Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Number	Type	SPT 'N' Value
0	78.1	**GROUND SURFACE**				
		100mm **TOPSOIL**				
		SANDY SILT, dense, brown		1	SS	35
	77.5 / 0.6	**SILTY FINE SAND**, compact, brown		2	SS	34
1						
				3	SS	29
2						
				4	SS	20
3						
				5	SS	18
4	73.8 / 4.3	**CLAYEY SILT**, stiff, brown				
				6	SS	8
5	73.1 / 5.0	**END OF BOREHOLE**				

Elevation Scale (m): 78, 77, 76, 75, 74

Penetration Test Values (Blows / 0.3m): Dynamic Cone 10 20 30 40

Undrained Shear Strength (kPa): ○ Unconfined ● Pocket Penetrometer + Field Vane ■ Lab Vane — 40 80 120 160

Moisture / Plasticity: Plastic Limit (PL) | Natural Water Content (MC) | Liquid Limit (LL) — 10 20 30

Headspace Vapour (ppm) | Instrument Details | Unstabilized Water Level | Lab Data and Comments | GRAIN SIZE DISTRIBUTION (%) (MIT) GR SA SI CL

Borehole was dry and open upon completion of drilling.

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LOG OF BOREHOLE 22

Terraprobe

Project No. : 7-16-0090-01 | Client : The City of Hamilton | Originated by : AF

Date started : August 15, 2016 | Project : Pier 8 | Compiled by : GM

Sheet No. : 1 of 1 | Location : Hamilton, Ontario | Checked by : GM

Position : E: 592742, N: 4791816 (UTM 17T) | Elevation Datum : Geodetic (NAD83)

Rig type : D90, truck-mounted | Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Sample Number	Sample Type	SPT 'N' Value
0	78.6	**GROUND SURFACE**				
		100mm **TOPSOIL**				
		SANDY SILT, compact, brown		1	SS	22
	78.0 / 0.6	**SILTY FINE SAND**, with silt layers, compact to dense, grey		2	SS	23
1						
				3	SS	44
2						
				4	SS	35
3						
				5	SS	26
4						
				6	SS	15
5	73.6 / 5.0	**END OF BOREHOLE**				

Elevation Scale (m): 78, 77, 76, 75, 74

Penetration Test Values (Blows / 0.3m): Dynamic Cone 10 20 30 40

Undrained Shear Strength (kPa): Unconfined, Pocket Penetrometer, Field Vane, Lab Vane — 40 80 120 160

Moisture / Plasticity: Plastic Limit (PL) | Natural Water Content (MC) | Liquid Limit (LL) — 10 20 30

Headspace Vapour (ppm)

Instrument Details

Unstabilized Water Level

Lab Data and Comments

GRAIN SIZE DISTRIBUTION (%) (MIT) — GR SA SI CL

Borehole was dry and open upon completion of drilling.

WATER LEVEL READINGS

Date	Water Depth (m)	Elevation (m)
Sep 1, 2016	1.8	76.9
Oct 11, 2016	1.8	76.9
Nov 7, 2016	2.1	76.5

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LOG OF BOREHOLE 23

Project No. : 7-16-0090-01 | Client : The City of Hamilton | Originated by : AF

Date started : August 15, 2016 | Project : Pier 8 | Compiled by : GM

Sheet No. : 1 of 1 | Location : Hamilton, Ontario | Checked by : GM

Position : E: 592805, N: 4791777 (UTM 17T) | Elevation Datum : Geodetic (NAD83)

Rig type : D90, truck-mounted | Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Sample Number	Sample Type	SPT 'N' Value
0	78.9	**GROUND SURFACE**				
		60mm **ASPHALTIC CONCRETE**				
	78.4	FILL Granular Base				
	0.5	**SANDY SILT**, compact, brown		1	SS	11
1						
	77.4					
	1.5	**SILTY FINE SAND**, with silt seams and layers, compact to dense, brown		2	SS	37
2				3	SS	40
3				4	SS	13
4	74.6					
	4.3	**CLAYEY SILT**, very stiff, grey		5	SS	15
5	73.9					
	5.0	**END OF BOREHOLE**				

Elevation Scale (m): 78, 77, 76, 75, 74

Penetration Test Values (Blows / 0.3m): Dynamic Cone 10 20 30 40

Undrained Shear Strength (kPa): Unconfined, Pocket Penetrometer, Field Vane, Lab Vane — 40 80 120 160

Moisture / Plasticity: Plastic Limit (PL) | Natural Water Content (MC) | Liquid Limit (LL) — 10 20 30

Headspace Vapour (ppm)

Instrument Details

Unstabilized Water Level

Lab Data and Comments

GRAIN SIZE DISTRIBUTION (%) (MIT) — GR SA SI CL

Borehole was dry and open upon completion of drilling.

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LOG OF BOREHOLE 24

Terraprobe

Project No. : 7-16-0090-01 | Client : The City of Hamilton | Originated by : AF

Date started : August 15, 2016 | Project : Pier 8 | Compiled by : GM

Sheet No. : 1 of 1 | Location : Hamilton, Ontario | Checked by : GM

Position : E: 592903, N: 4791756 (UTM 17T) | Elevation Datum : Geodetic (NAD83)

Rig type : D90, truck-mounted | Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Sample Number	Sample Type	SPT 'N' Value
0	77.6	**GROUND SURFACE**				
		100mm **TOPSOIL**				
		FILL, silty sand, with pieces of asphalt, some fine gravel, very loose to dense		1	SS	38
1				2	SS	14
				3	SS	3
2	75.2					
	2.4	**ORGANIC SILT**, trace sand, very soft, black		4	SS	1
3	74.2			5	SS	9
	3.4	**SANDY SILT to SILTY SAND**, loose, grey				
4						
				6	SS	8
5	72.6					
	5.0	**END OF BOREHOLE**				

Elevation Scale (m): 77, 76, 75, 74, 73

Penetration Test Values (Blows / 0.3m): Dynamic Cone — 10, 20, 30, 40

Undrained Shear Strength (kPa): Unconfined, Pocket Penetrometer, Field Vane, Lab Vane — 40, 80, 120, 160

Moisture / Plasticity: Plastic Limit (PL), Natural Water Content (MC), Liquid Limit (LL) — 10, 20, 30

Headspace Vapour (ppm)

Instrument Details

Unstabilized Water Level

Lab Data and Comments

GRAIN SIZE DISTRIBUTION (%) (MIT)

GR SA SI CL

0 27 65 8

Unstabilized water level measured at 2.1 m below ground surface; borehole was open upon completion of drilling.

50 mm dia. monitoring well installed.

WATER LEVEL READINGS

Date	Water Depth (m)	Elevation (m)
Sep 1, 2016	1.9	75.8
Oct 11, 2016	1.8	75.8
Nov 7, 2016	1.7	75.9

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LOG OF BOREHOLE 25

Terraprobe

Project No. : 7-16-0090-01 | Client : The City of Hamilton | Originated by : AF

Date started : August 15, 2016 | Project : Pier 8 | Compiled by : GM

Sheet No. : 1 of 1 | Location : Hamilton, Ontario | Checked by : GM

Position : E: 592963, N: 4791739 (UTM 17T) | Elevation Datum : Geodetic (NAD83)

Rig type : D90, truck-mounted | Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Number	Type	SPT 'N' Value
0	77.3	**GROUND SURFACE**				
		100mm **TOPSOIL**		1	SS	20
		FILL, silty sand, with pieces of asphalt, glass fragments, compact				
1	76.1			2	SS	19
	1.2	**FILL**, silty sand to sandy silt, with pieces of gravel, timber, organics (plant matter), very loose, dark brown / black		3	SS	4
2						
				4	SS	1
3				5	SS	15
	73.0					
4	4.3	**ORGANIC SILT**, soft, black		6	SS	4
	72.4					
5	72.3	**SANDY SILT**, loose, grey				
	5.0	**END OF BOREHOLE**				

Elevation Scale (m): 77, 76, 75, 74, 73

Penetration Test Values (Blows / 0.3m): Dynamic Cone 10 20 30 40

Undrained Shear Strength (kPa): Unconfined, Pocket Penetrometer, Field Vane, Lab Vane; 40 80 120 160

Moisture / Plasticity: Plastic Limit (PL) 10, Natural Water Content (MC) 20, Liquid Limit (LL) 30

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Headspace Vapour (ppm)

Instrument Details

Unstabilized Water Level

Lab Data and Comments

GRAIN SIZE DISTRIBUTION (%) (MIT) GR SA SI CL

Unstabilized water level measured at 2.4 m below ground surface; borehole was open upon completion of drilling.

file: 7-16-0090-01 pier 8 hamilton.gpj

LOG OF BOREHOLE 26

Terraprobe

Project No. : 7-16-0090-01 | Client : The City of Hamilton | Originated by : AF

Date started : August 15, 2016 | Project : Pier 8 | Compiled by : GM

Sheet No. : 1 of 1 | Location : Hamilton, Ontario | Checked by : GM

Position : E: 592952, N: 4791680 (UTM 17T) | Elevation Datum : Geodetic (NAD83)

Rig type : D90, truck-mounted | Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Number	Type	SPT 'N' Value
0	77.6	**GROUND SURFACE**				
		100mm **TOPSOIL**		1	SS	10
		FILL, silty sand, with metal and glass fragments, pieces of timber, very loose to loose		2	SS	5
1				3	SS	1
2				4	SS	6
3	74.6 3.0	**SANDY SILT**, very loose, brown		5	SS	2
4	73.3 4.3	**CLAYEY SILT**, very stiff, grey		6	SS	29
5	72.6 5.0	**END OF BOREHOLE**				

Elevation Scale (m): 77, 76, 75, 74, 73

Penetration Test Values (Blows / 0.3m): Dynamic Cone 10 20 30 40

Undrained Shear Strength (kPa): Unconfined, Pocket Penetrometer, Field Vane, Lab Vane; 40 80 120 160

Moisture / Plasticity: Plastic Limit (PL) | Natural Water Content (MC) | Liquid Limit (LL); 10 20 30

Headspace Vapour (ppm)

Instrument Details

Unstabilized Water Level

Lab Data and Comments

GRAIN SIZE DISTRIBUTION (%) (MIT) GR SA SI CL

Unstabilized water level measured at 2.1 m below ground surface; borehole was open upon completion of drilling.

file: 7-16-0090-01 pier 8 hamilton.gpj

LOG OF BOREHOLE 27

Terraprobe

Project No. : 7-16-0090-01 | Client : The City of Hamilton | Originated by : AF

Date started : August 15, 2016 | Project : Pier 8 | Compiled by : GM

Sheet No. : 1 of 1 | Location : Hamilton, Ontario | Checked by : GM

Position : E: 592934, N: 4791581 (UTM 17T) | Elevation Datum : Geodetic (NAD83)

Rig type : D90, truck-mounted | Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Sample Number	Sample Type	SPT 'N' Value
0	79.4	**GROUND SURFACE**				
		100mm **TOPSOIL**				
		FILL, silty sand, trace topsoil, compact, brown		1	SS	17
	78.6					
	0.8					
1		**FILL**, sandy silt to clayey silt, with glass fragments, tile, brick, very loose, black		2	SS	5
				3	SS	3
2						
				4	SS	4
3				5	SS	1
4						
				6	SS	4
5	74.4					
	5.0					

Elevation Scale (m): 79, 78, 77, 76, 75

Penetration Test Values (Blows / 0.3m): Dynamic Cone 10 20 30 40

Undrained Shear Strength (kPa): Unconfined, Pocket Penetrometer, Field Vane, Lab Vane — 40 80 120 160

Moisture / Plasticity: Plastic Limit (PL) | Natural Water Content (MC) | Liquid Limit (LL) — 10 20 30

Headspace Vapour (ppm)

Instrument Details

Unstabilized Water Level

Lab Data and Comments

GRAIN SIZE DISTRIBUTION (%) (MIT) — GR SA SI CL

END OF BOREHOLE

Unstabilized water level measured at 1.8 m below ground surface; borehole was open upon completion of drilling.

WATER LEVEL READINGS

Date	Water Depth (m)	Elevation (m)
Sep 1, 2016	3.2	76.2
Oct 11, 2016	2.8	76.5
Nov 7, 2016	3.1	76.3

file: 7-16-0090-01 pier 8 hamilton.gpj

LOG OF BOREHOLE 28

Terraprobe

Project No. : 7-16-0090-01 | Client : The City of Hamilton | Originated by : AF

Date started : October 24, 2016 | Project : Pier 8 | Compiled by : GM

Sheet No. : 1 of 1 | Location : Hamilton, Ontario | Checked by : GM

Position : E: 592590, N: 4792239 (UTM 17T) | Elevation Datum : Geodetic (NAD83)

Rig type : CME 75, truck-mounted | Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Number	Type	SPT 'N' Value
0	76.7	**GROUND SURFACE**				
	76.2 / 0.5	75mm **ASPHALTIC CONCRETE**				
		FILL Granular Base				
	74.3 / 2.4	**FILL**, silty fine sand and gravel, pieces of asphalt, timber and metal, compact, brown / black				
		FILL, brick fragments, some sand, mortar and rubble, loose to compact				
	69.7 / 7.0	**FILL**, silty fine sand, with pieces of brick, loose, dark brown to black				
	67.9 / 8.8	**SANDY SILT to SILTY FINE SAND**, very loose to loose, dark grey				
		...(See BH12 for upper 18m)				
	58.4 / 18.3	**SILTY FINE SAND**, loose, grey		1	SS	7
				2	SS	13
	55.4 / 21.3	**ORGANIC SILT**, stiff, grey		3	SS	10
	53.8 / 22.9	**SILTY CLAY**, trace gravel, stiff to very stiff, grey		4	SS	12
				5	SS	23
				6	SS	14
	49.6 / 27.1	**SHALEY TILL**, with grey silt layers, hard, reddish brown		7	SS	56
	48.2 / 28.5	**WEATHERED SHALE**, reddish brown (QUEENSTON FORMATION)		8	SS	50 / 25mm
	48.1 / 28.6	**QUEENSTON FORMATION** (See rock core log for details)			RUN	
					RUN	
	45.1 / 31.6	**END OF BOREHOLE** Refusal on inferred bedrock				

Elevation Scale (m): 76, 75, 74, 73, 72, 71, 70, 69, 68, 67, 66, 65, 64, 63, 62, 61, 60, 59, 58, 57, 56, 55, 54, 53, 52, 51, 50, 49, 48, 47, 46

Penetration Test Values (Blows / 0.3m): Dynamic Cone; 10 20 30 40

Undrained Shear Strength (kPa): Unconfined, Pocket Penetrometer, Field Vane, Lab Vane; 40 80 120 160

Moisture / Plasticity: Plastic Limit, Natural Water Content, Liquid Limit; PL MC LL; 10 20 30

Headspace Vapour (ppm)

Instrument Details

Unstabilized Water Level

Lab Data and Comments

GRAIN SIZE DISTRIBUTION (%) (MIT): GR SA SI CL

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WATER LEVEL READINGS

Date	Water Depth (m)	Elevation (m)
Nov 7, 2016	2.2	74.6

Unstabilized water level measured at 1.2 m below ground surface; borehole caved to 23.5 m below ground surface upon completion of drilling.

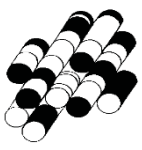
50 mm dia. monitoring well installed.

file: 7-16-0090-01 pier 8 hamilton.gpj

Results of In-Situ Hydraulic Conductivity Testing

APPENDIX B

Terraprobe Inc.



Appendix B: Results of Field Testing
Borehole 1
West Horbour Pumping Station
Hamilton ON

* To = t when (H-h)/(H-Ho) = 0.37

well depth	5.90	m
r (casing radius)	0.025	m
L (length of screen)	1.5	m
R (filter pack [borehole] radius)	0.102	m
To (time lag*)	340	sec
H (initial water level before slug)	1.68	m
Ho (water level at t=0)	3.4	m
h (recorded water level at time t)	See Column B	

Hydraulic Conductivity
1.65E-06 m/sec

Date	Water Level (mbmp)	(H-h)/(H-Ho)	Elapsed Time (s)
2017-07-18	3.24	0.91	15
2017-07-18	3.18	0.87	30
2017-07-18	3.12	0.84	45
2017-07-18	3.06	0.80	60
2017-07-18	2.99	0.76	75
2017-07-18	2.93	0.73	90
2017-07-18	2.88	0.70	105
2017-07-18	2.83	0.67	120
2017-07-18	2.73	0.61	150
2017-07-18	2.65	0.56	180
2017-07-18	2.57	0.52	210
2017-07-18	2.50	0.48	240
2017-07-18	2.43	0.44	270
2017-07-18	2.38	0.41	300
2017-07-18	2.27	0.34	360
2017-07-18	2.18	0.29	420
2017-07-18	2.10	0.24	480
2017-07-18	2.04	0.21	540
2017-07-18	1.99	0.18	600
2017-07-18	1.91	0.13	720
2017-07-18	1.85	0.10	840
2017-07-18	1.80	0.07	960
2017-07-18	1.77	0.05	1080
2017-07-18	1.75	0.04	1200
2017-07-18	1.73	0.03	1320
2017-07-18	1.71	0.02	1440
2017-07-18	1.70	0.01	1560
2017-07-18	1.70	0.01	1680
2017-07-18	1.70	0.01	1800
2017-07-18	1.69	0.01	2100
2017-07-18	1.68	0.00	2400

Appendix B: Results of Field Testing
Borehole 5
West Horbour Pumping Station
Hamilton ON

* To = t when (H-h)/(H-Ho) = 0.37

well depth	1.37	m
r (casing radius)	0.025	m
L (length of screen)	1.5	m
R (filter pack [borehole] radius)	0.102	m
To (time lag*)	15373	sec
H (initial water level before slug)	1.37	m
Ho (water level at t=0)	3.72	m
h (recorded water level at time t)	See Column B	

Hydraulic Conductivity

3.64E-08 m/sec

Date/time	Water Level (masl)	(H-h)/(H-Ho)	Elapsed Time (s)
2017-07-24	3.72	1.00	15
2017-07-24	3.70	0.99	30
2017-07-24	3.69	0.99	45
2017-07-24	3.66	0.97	60
2017-07-24	3.65	0.97	75
2017-07-24	3.64	0.97	90
2017-07-24	3.63	0.96	105
2017-07-24	3.62	0.96	120
2017-07-24	3.61	0.95	150
2017-07-24	3.59	0.94	180
2017-07-24	3.57	0.94	210
2017-07-24	3.55	0.93	240
2017-07-24	3.54	0.92	270
2017-07-24	3.53	0.92	300
2017-07-24	3.52	0.91	360
2017-07-24	3.51	0.91	420
2017-07-24	3.50	0.91	480
2017-07-24	3.49	0.90	540
2017-07-24	3.49	0.90	600
2017-07-24	3.48	0.90	720
2017-07-24	3.48	0.90	840
2017-07-24	3.48	0.90	960
2017-07-24	3.48	0.90	1080
2017-07-24	3.48	0.90	1200
2017-07-24	3.48	0.90	1500
2017-07-24	3.48	0.90	1800
2017-07-24	3.47	0.89	2100
2017-07-24	3.47	0.89	2400
2017-07-24	3.47	0.89	2700
2017-07-24	3.47	0.89	3000
2017-07-24	3.47	0.89	3300
2017-07-24	3.47	0.89	3600
2017-07-24	3.46	0.89	4200
2017-07-24	3.46	0.89	4800

Appendix B: Results of Field Testing
Borehole 6
West Horbour Pumping Station
Hamilton ON

* To = t when (H-h)/(H-Ho) = 0.37

well depth	8.22	m
r (casing radius)	0.025	m
L (length of screen)	1.5	m
R (filter pack [borehole] radius)	0.102	m
To (time lag*)	189530	sec
H (initial water level before slug)	1	m
Ho (water level at t=0)	4.17	m
h (recorded water level at time t)	See Column B	

Hydraulic Conductivity

2.95E-09 m/sec

Date/time	Water Level (masl)	(H-h)/(H-Ho)	Elapsed Time (s)
2017-07-21	4.16	1.00	15
2017-07-21	4.16	1.00	30
2017-07-21	4.16	1.00	45
2017-07-21	4.16	1.00	60
2017-07-21	4.16	1.00	75
2017-07-21	4.16	1.00	90
2017-07-21	4.16	1.00	105
2017-07-21	4.16	1.00	120
2017-07-21	4.16	1.00	150
2017-07-21	4.16	1.00	180
2017-07-21	4.15	0.99	210
2017-07-21	4.15	0.99	240
2017-07-21	4.15	0.99	270
2017-07-21	4.15	0.99	300
2017-07-21	4.15	0.99	360
2017-07-21	4.15	0.99	420
2017-07-21	4.15	0.99	480
2017-07-21	4.15	0.99	540
2017-07-21	4.15	0.99	600
2017-07-21	4.15	0.99	720
2017-07-21	4.15	0.99	840
2017-07-21	4.15	0.99	960
2017-07-21	4.14	0.99	1080
2017-07-21	4.14	0.99	1200
2017-07-21	4.14	0.99	1320
2017-07-21	4.14	0.99	1440
2017-07-21	4.14	0.99	1560
2017-07-21	4.14	0.99	1680
2017-07-21	4.14	0.99	1800
2017-07-21	4.13	0.99	2100
2017-07-21	4.13	0.99	2400
2017-07-21	4.13	0.99	2700
2017-07-21	4.13	0.99	3000
2017-07-21	4.12	0.98	3300
2017-07-21	4.12	0.98	3600
2017-07-21	4.12	0.98	4200
2017-07-21	4.11	0.98	4800
2017-07-21	4.11	0.98	5400

Appendix B: Results of Field Testing
Borehole 10
West Horbour Pumping Station
Hamilton ON

* To = t when (H-h)/(H-Ho) = 0.37

well depth	24.25	m
r (casing radius)	0.025	m
L (length of screen)	1.5	m
R (filter pack [borehole] radius)	0.102	m
To (time lag*)	331856	sec
H (initial water level before slug)	1.1	m
Ho (water level at t=0)	4.95	m
h (recorded water level at time t)	See Column B	

Hydraulic Conductivity

1.69E-09 m/sec

Date/time	Water Level (masl)	(H-h)/(H-Ho)	Elapsed Time (s)
2017-07-19	4.95	1.00	15
2017-07-19	4.95	1.00	30
2017-07-19	4.95	1.00	45
2017-07-19	4.95	1.00	60
2017-07-19	4.94	1.00	75
2017-07-19	4.94	1.00	90
2017-07-19	4.94	1.00	105
2017-07-19	4.94	1.00	120
2017-07-19	4.94	1.00	150
2017-07-19	4.94	1.00	180
2017-07-19	4.94	1.00	210
2017-07-19	4.94	1.00	240
2017-07-19	4.94	1.00	270
2017-07-19	4.94	1.00	300
2017-07-19	4.94	1.00	360
2017-07-19	4.94	1.00	420
2017-07-19	4.94	1.00	480
2017-07-19	4.94	1.00	540
2017-07-19	4.94	1.00	600
2017-07-19	4.94	1.00	720
2017-07-19	4.93	0.99	840
2017-07-19	4.93	0.99	960
2017-07-19	4.93	0.99	1080
2017-07-19	4.93	0.99	1200
2017-07-19	4.93	0.99	1500
2017-07-19	4.93	0.99	1800
2017-07-19	4.93	0.99	2100
2017-07-19	4.93	0.99	2400
2017-07-19	4.93	0.99	2700
2017-07-19	4.92	0.99	3000
2017-07-19	4.92	0.99	3300
2017-07-19	4.92	0.99	3600
2017-07-19	4.92	0.99	3900
2017-07-19	4.92	0.99	4200
2017-07-19	4.91	0.99	4800
2017-07-19	4.91	0.99	5400

Appendix B: Results of Field Testing
Borehole 11
West Horbour Pumping Station
Hamilton ON

* To = t when (H-h)/(H-Ho) = 0.37

well depth	6.02	m
r (casing radius)	0.025	m
L (length of screen)	3	m
R (filter pack [borehole] radius)	0.102	m
To (time lag*)	350	sec
H (initial water level before slug)	0.43	m
Ho (water level at t=0)	2.16	m
h (recorded water level at time t)	See Column B	

Hydraulic Conductivity

1.01E-06 m/sec

Date/time	Water Level (masl)	(H-h)/(H-Ho)	Elapsed Time (s)
2017-07-19	2.04	0.93	15
2017-07-19	1.93	0.87	30
2017-07-19	1.86	0.83	45
2017-07-19	1.78	0.78	75
2017-07-19	1.70	0.73	90
2017-07-19	1.65	0.71	105
2017-07-19	1.53	0.64	120
2017-07-19	1.43	0.58	150
2017-07-19	1.35	0.53	180
2017-07-19	1.28	0.49	210
2017-07-19	1.22	0.46	240
2017-07-19	1.16	0.42	270
2017-07-19	1.12	0.40	300
2017-07-19	1.04	0.35	360
2017-07-19	0.98	0.32	420
2017-07-19	0.93	0.29	480
2017-07-19	0.89	0.27	540
2017-07-19	0.86	0.25	600
2017-07-19	0.80	0.21	720
2017-07-19	0.76	0.19	840
2017-07-19	0.74	0.18	960
2017-07-19	0.71	0.16	1080
2017-07-19	0.68	0.14	1200
2017-07-19	0.67	0.14	1320
2017-07-19	0.65	0.13	1440
2017-07-19	0.64	0.12	1560
2017-07-19	0.61	0.10	1680
2017-07-19	0.60	0.10	1800
2017-07-19	0.59	0.09	2100
2017-07-19	0.57	0.08	2400
2017-07-19	0.56	0.08	2700
2017-07-19	0.54	0.06	3000
2017-07-19	0.52	0.05	3600
2017-07-19	0.51	0.05	4200
2017-07-19	0.50	0.04	4800
2017-07-19	0.48	0.03	5400
2017-07-19	0.47	0.02	6000

Appendix B: Results of Field Testing
Borehole 22
West Horbour Pumping Station
Hamilton ON

* To = t when (H-h)/(H-Ho) = 0.37

well depth	3.78	m
r (casing radius)	0.025	m
L (length of screen)	1.5	m
R (filter pack [borehole] radius)	0.102	m
To (time lag*)	640	sec
H (initial water level before slug)	2.58	m
Ho (water level at t=0)	3.47	m
h (recorded water level at time t)	See Column B	

Hydraulic Conductivity

8.75E-07 m/sec

Date/time	Water Level (masl)	(H-h)/(H-Ho)	Elapsed Time (s)
2017-07-19	3.44	0.97	15
2017-07-19	3.40	0.92	30
2017-07-19	3.33	0.84	45
2017-07-19	3.31	0.82	60
2017-07-19	3.25	0.75	75
2017-07-19	3.23	0.73	90
2017-07-19	3.22	0.72	105
2017-07-19	3.21	0.71	120
2017-07-19	3.17	0.66	150
2017-07-19	3.15	0.64	180
2017-07-19	3.13	0.62	210
2017-07-19	3.11	0.60	240
2017-07-19	3.08	0.56	270
2017-07-19	3.06	0.54	300
2017-07-19	3.03	0.51	360
2017-07-19	3.00	0.47	420
2017-07-19	2.97	0.44	480
2017-07-19	2.95	0.42	540
2017-07-19	2.93	0.39	600
2017-07-19	2.90	0.36	720
2017-07-19	2.86	0.31	840
2017-07-19	2.81	0.26	960
2017-07-19	2.72	0.16	1080
2017-07-19	2.65	0.08	1200
2017-07-19	2.61	0.03	1320
2017-07-19	2.60	0.02	1440
2017-07-19	2.59	0.01	1560
2017-07-19	2.58	0.00	1680
2017-07-19	2.58	0.00	1800
2017-07-19	2.58	0.00	2100

Appendix B: Results of Field Testing
Borehole 24
West Horbour Pumping Station
Hamilton ON

* To = t when (H-h)/(H-Ho) = 0.37

well depth	4.34	m
r (casing radius)	0.025	m
L (length of screen)	1.5	m
R (filter pack [borehole] radius)	0.102	m
To (time lag*)	5100	sec
H (initial water level before slug)	1.04	m
Ho (water level at t=0)	3.77	m
h (recorded water level at time t)	See Column B	

Hydraulic Conductivity
1.10E-07 m/sec

Date/time	Water Level (masl)	(H-h)/(H-Ho)	Elapsed Time (s)
2017-07-18	3.74	0.99	15
2017-07-18	3.74	0.99	30
2017-07-18	3.73	0.99	45
2017-07-18	3.73	0.99	60
2017-07-18	3.72	0.98	75
2017-07-18	3.71	0.98	90
2017-07-18	3.70	0.97	105
2017-07-18	3.69	0.97	120
2017-07-18	3.68	0.97	150
2017-07-18	3.67	0.96	180
2017-07-18	3.65	0.96	210
2017-07-18	3.63	0.95	240
2017-07-18	3.62	0.95	270
2017-07-18	3.61	0.94	300
2017-07-18	3.59	0.93	360
2017-07-18	3.56	0.92	420
2017-07-18	3.53	0.91	480
2017-07-18	3.51	0.90	540
2017-07-18	3.48	0.89	600
2017-07-18	3.43	0.88	720
2017-07-18	3.37	0.85	840
2017-07-18	3.32	0.84	960
2017-07-18	3.27	0.82	1080
2017-07-18	3.22	0.80	1200
2017-07-18	3.18	0.78	1320
2017-07-18	3.11	0.76	1440
2017-07-18	3.07	0.74	1560
2017-07-18	3.02	0.73	1680
2017-07-18	2.98	0.71	1800
2017-07-18	2.85	0.66	2100
2017-07-18	2.76	0.63	2400
2017-07-18	2.65	0.59	2700
2017-07-18	2.56	0.56	3000
2017-07-18	2.47	0.52	3300
2017-07-18	2.40	0.50	3600
2017-07-18	2.31	0.47	3900
2017-07-18	2.24	0.44	4200
2017-07-18	2.17	0.41	4500
2017-07-18	2.10	0.39	4800
2017-07-18	2.00	0.35	5400
2017-07-18	1.90	0.32	6000
2017-07-18	1.80	0.28	6600
2017-07-18	1.72	0.25	7200
2017-07-18	1.65	0.22	7800
2017-07-18	1.58	0.20	8400
2017-07-18	1.48	0.16	9600

Appendix B: Results of Field Testing
Borehole 27
West Horbour Pumping Station
Hamilton ON

* To = t when (H-h)/(H-Ho) = 0.37

well depth	4.33	m
r (casing radius)	0.025	m
L (length of screen)	1.5	m
R (filter pack [borehole] radius)	0.102	m
To (time lag*)	115	sec
H (initial water level before slug)	2.41	m
Ho (water level at t=0)	2.55	m
h (recorded water level at time t)	See Column B	

Hydraulic Conductivity

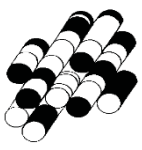
4.87E-06 m/sec

Date/time	Water Level (masl)	(H-h)/(H-Ho)	Elapsed Time (s)
2017-07-18	2.53	0.86	15
2017-07-18	2.52	0.79	30
2017-07-18	2.50	0.64	45
2017-07-18	2.49	0.57	60
2017-07-18	2.48	0.50	75
2017-07-18	2.47	0.43	90
2017-07-18	2.47	0.43	105
2017-07-18	2.46	0.36	120
2017-07-18	2.45	0.29	150
2017-07-18	2.45	0.29	180
2017-07-18	2.44	0.21	210
2017-07-18	2.44	0.21	240
2017-07-18	2.43	0.14	270
2017-07-18	2.43	0.14	300
2017-07-18	2.42	0.07	360
2017-07-18	2.42	0.07	420
2017-07-18	2.42	0.07	480
2017-07-18	2.42	0.07	540
2017-07-18	2.42	0.07	600
2017-07-18	2.41	0.00	720
2017-07-18	2.41	0.00	840
2017-07-18	2.41	0.00	960

Dewatering Analysis

APPENDIX C

Terraprobe Inc.



West Harbour Pumping Station, Pier 8, Hamilton ON

Job No. **7-16-0090-46**

Short-term - PS 1 Service Level Excavation Dewatering

	Excavation Area (m2)	Dewatering Target (mbgl)	Excavation Perimeter (m)	Water Level (mbgl)	Excavation Depth (m below water table)	Vertical Area Below Water Table (m2)	K (m/s)	Soil Stratum
Service Level	111.2	4.64	44.94	0.7	3.94	177	1E-06	Fill
Sump Pit	2.7	5.54	6.6	0.7	4.84	32	1E-06	Fill

Darcy - flow into excavation $Q = kiA$

		Q (m^3/s)	A (m^2)	i	k (m/s)	Q (m^3/hr)	Q (L/hr)	Q (gal/min)	**Q (L/day)**
Horizontal	Service Level	1.77E-04	177	1	1E-06	0.6374	637	2.81	**15,298**
	Sump Pit	3.19E-05	32	1	1E-06	0.1150	115	0.51	**2,760**

		Q (m^3/s)	A (m^2)	i	k (m/s)	Q (m^3/hr)	Q (L/hr)	Q (gal/min)	**Q (L/day)**
Vertical	Service Level	1.11E-04	111	1	1E-06	0.4003	400	1.76	**9,608**
	Sump Pit	2.70E-06	3	1	1E-06	0.0097	10	0.04	**233**

	Rainfall Event (mm)	A (m^2)	**Q (L/day)**
Rainfall	25	111	**3,000**

Total ground water (Less Rainfall) Q (L/day)
27,900

Total Dewatering Q (L/day)
30,900

Radius of Influence - Sichardt's equation

$$R = 3000\sqrt{k}$$

R (m)	drawdown (m)	K (m/s)
11.8	3.94	1.00E-06

West Harbour Pumping Station, Pier 8, Hamilton ON

Job No. **7-16-0090-46**

Short-term - PS 1 Wet Well Excavation Dewatering

	Excavation Area (m2)	Dewatering Target (mbgl)	Excavation Perimeter (m)	Water Level (mbgl)	Excavation Depth (m below water table)	Vertical Area Below Water Table (m2)	K (m/s)	Soil Stratum
Wet Well	47.5	6.93	30.4	0.5	6.43	195	1E-06	Fill
Pump Pit	25.5	9.25	20.4	0.5	8.75	179	1E-06	Fill

Darcy - flow into excavation $Q = kiA$

		Q (m^3/s)	A (m^2)	i	k (m/s)	Q (m^3/hr)	Q (L/hr)	Q (gal/min)	**Q (L/day)**
Horizontal	Wet Well	1.95E-04	195	1	1E-06	0.7037	704	3.10	**16,889**
	Pump Pit	1.79E-04	179	1	1E-06	0.6426	643	2.83	**15,422**

		Q (m^3/s)	A (m^2)	i	k (m/s)	Q (m^3/s)	Q (L/hr)	Q (gal/min)	**Q (L/day)**
Vertical	Wet Well	4.75E-05	48	1	1E-06	0.1710	171	0.75	**4,104**
	Pump Pit	2.55E-05	26	1	1E-06	0.0918	92	0.40	**2,203**

	Rainfall Event (mm)	A (m^2)	**Q (L/day)**
Rainfall	25	48	**1,200**

Total ground water (Less Rainfall)
Q (L/day)
38,600

Total Dewatering
Q (L/day)
39,800

Radius of Influence - Sichardt's equation

$$R = 3000\sqrt{k}$$

R (m)	drawdown (m)	K (m/s)
19.3	6.43	1.00E-06

West Harbour Pumping Station, Pier 8, Hamilton ON

Job No. **7-16-0090-46**

Short-term - PS 1 Sanitary Storage Tank Excavation Dewatering

	Excavation Area (m^2)	Dewatering Target (mbgl)	Excavation Perimeter (m)	Water Level (mbgl)	Excavation Depth (m below water table)	Vertical Area Below Water Table (m^2)	K (m/s)	Soil Stratum
Sanitary Storage	338	5.83	84.2	0.7	5.13	432	1E-06	Fill
Sluice Gate	16.2	6.83	24.6	0.7	6.13	151	1E-06	Fill

Darcy - flow into excavation $Q = kiA$

		Q (m^3/s)	A (m^2)	i	k (m/s)	Q (m^3/hr)	Q (L/hr)	Q (gal/min)	**Q (L/day)**
Horizontal	Sanitary Storage	4.32E-04	432	1	1E-06	1.5550	1555	6.85	**37,320**
	Sluice Gate	1.51E-04	151	1	1E-06	0.5429	543	2.39	**13,029**

		Q (m^3/s)	A (m^2)	i	k (m/s)	Q (m^3/hr)	Q (L/hr)	Q (gal/min)	**Q (L/day)**
Vertical	Sanitary Storage	3.38E-04	338	1	1E-06	1.2168	1217	5.36	**29,203**
	Sluice Gate	1.62E-05	16	1	1E-06	0.0583	58	0.26	**1,400**

	Rainfall Event (mm)	A (m^2)	**Q (L/day)**
Rainfall	25	354	**9,000**

Total ground water (Less Rainfall)
Q (L/day)
81,000

Total Dewatering
Q (L/day)
90,000

Radius of Influence - Sichardt's equation

$$R = 3000\sqrt{k}$$

R (m)	drawdown (m)	K (m/s)
15.4	5.13	1.00E-06

West Harbour Pumping Station, Pier 8, Hamilton ON

Job No. **7-16-0090-46**

Short-term - Twin Sanitary Forcemain Excavation Dewatering

$R_0 = 3000*dH*K^{0.5}$ (Sichart and Dryieleis, dH and R_0 in feet, K in m/sec)

$r_s = (a+b)/3.14$ applies when a/b is large

$r_s = ((a*b)/3.14)^{0.5}$ both equations apply when a/b <1.5 and $R_0 >> r_s$

$$Q = \frac{3.14*K*(H^2-h_w^2)}{\ln(R_0/r_s)}$$ (unconfined aquirfer)

$$Q = \frac{\mathbf{2}*3.14*K*(H^2-h_w^2)}{\ln(R_0/r_s)}$$ (confined aquifer)

Site Area 1

K =	1.00E-06	m/s	
H =	8.5	m	from static water table to the assumed aquifer bottom
h_w =	5.0	m	from the dewatering target to the assumed aquifer bottom
dH =	3.6	m	dewatering thickness
R_{0} =	10.65	m	
$r_s + R_{0}$ =	21	m	
a =	30	m	
b =	4	m	
r_s =	11	m	assumed for a small rectangular area at the end of the dewatering trench

Q =	**18,752**	**L/day**	
Q =	**28,129**	**L/day**	safety factor of 1.5 applied

Q_{RAIN} =	**2,700**	**L/day**	removal of storm water from a 25 mm storm event in 24 hours

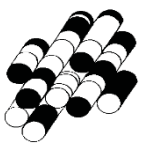
Reference: J. Patrick Powers… [et al.] (2007), "Construction Dewatering and Groundwater Control: New Methods and Applications, 3rd ed." Wiley, Hoboken, NJ.

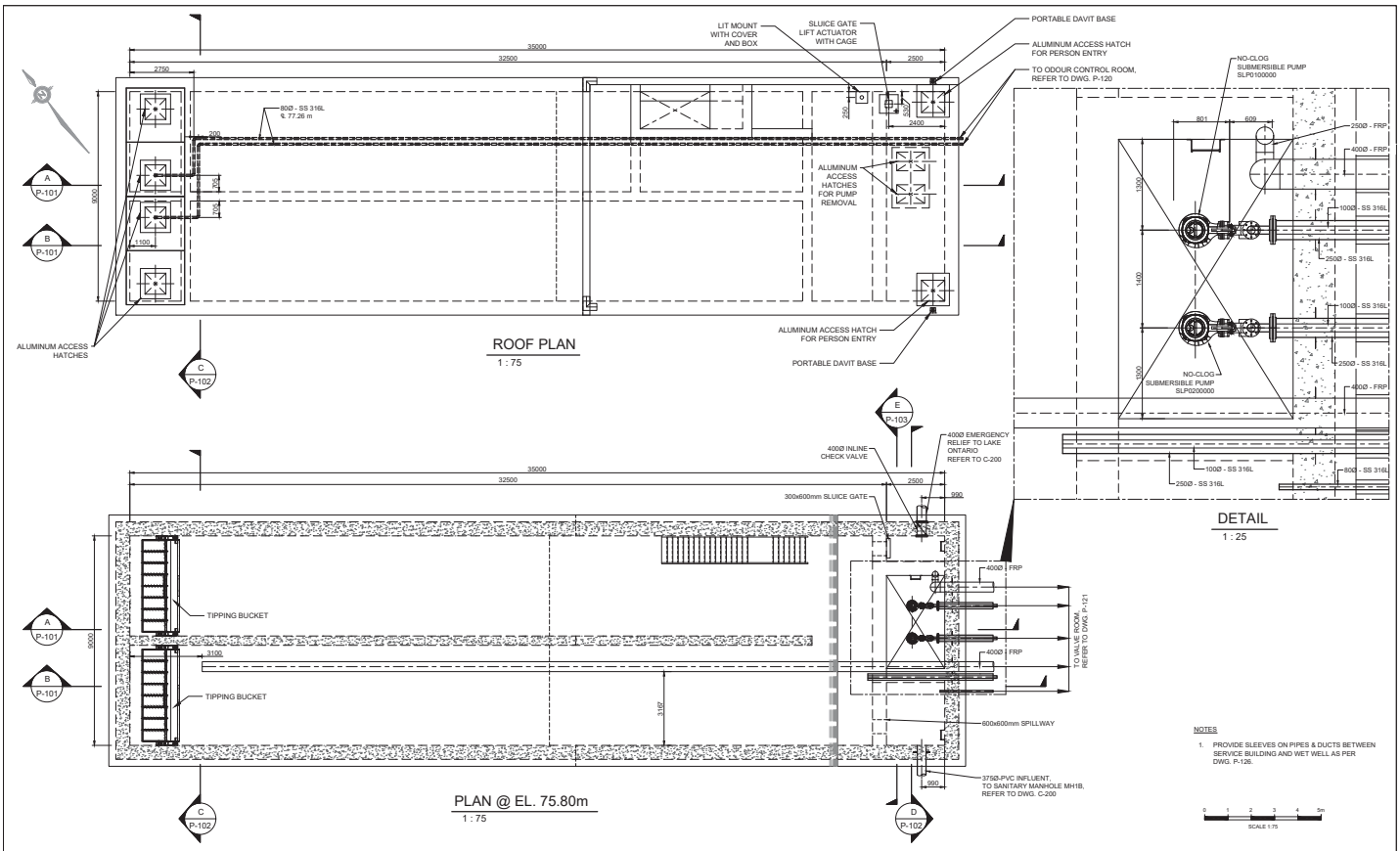
Ground Surface	77.1	masl
Highest Water Level	76.4	masl
Base of Excavation	73.9	masl
Drawdown Target	72.9	masl
Aquifer Bottom	67.9	masl
Rain Fall	25.0	mm
Factor of Safety	1.5	

Engineering Drawings
West Harbour Pumping Station

APPENDIX D

Terraprobe Inc.





No.	REVISIONS	DATE	INTLS
1	ISSUED FOR TENDER	AUG 2018	A.A.

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CHECKED BY J. HIMANEN
APPROVED BY J. HIMANEN

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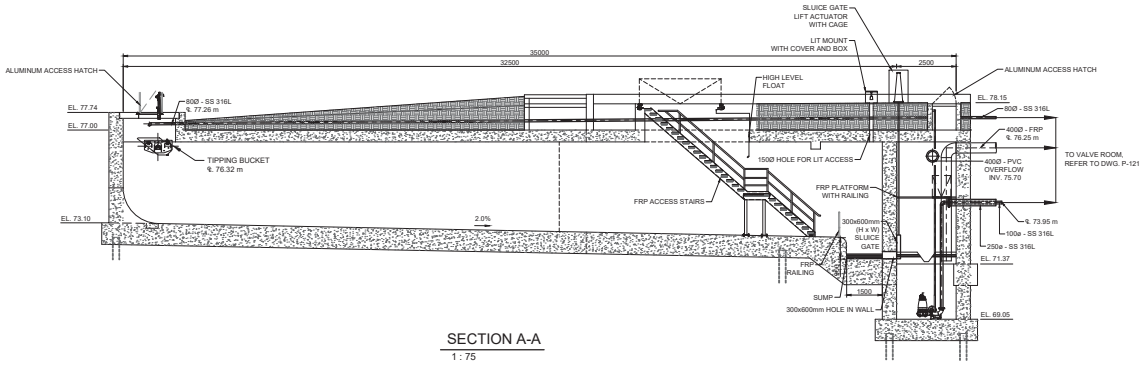
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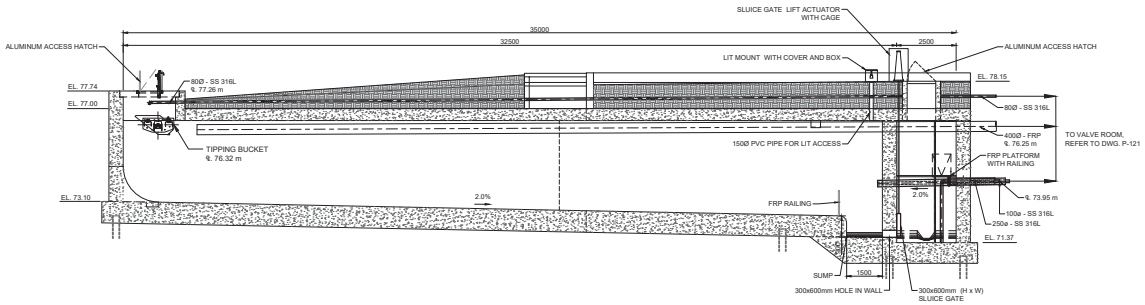
PROCESS
PIER 8 WASTEWATER PUMPING STATION
WET WELL & SANITARY STORAGE TANK PLANS

DATE : AUGUST 2018
SCALE: AS SHOWN
FILE No.:
CONTRACT No.:
DRAWING No.: P-100



SECTION A-A

1 : 75



SECTION B-B

1 : 75

0 1 2 3 4 5m

SCALE 1:75

1	ISSUED FOR TENDER	AUG 2018	A.A.	DESIGNED BY B. DRAPER	STAMP: PROFESSIONAL ENGINEER J. A. HIMANEN PROVINCE OF ONTARIO
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PROCESS

PIER 8 WASTEWATER PUMPING STATION

WET WELL & SANITARY STORAGE TANK SECTIONS A-A & B-B

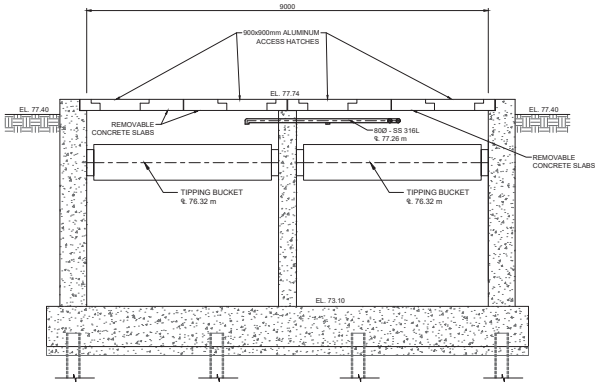
DATE : AUGUST 2018

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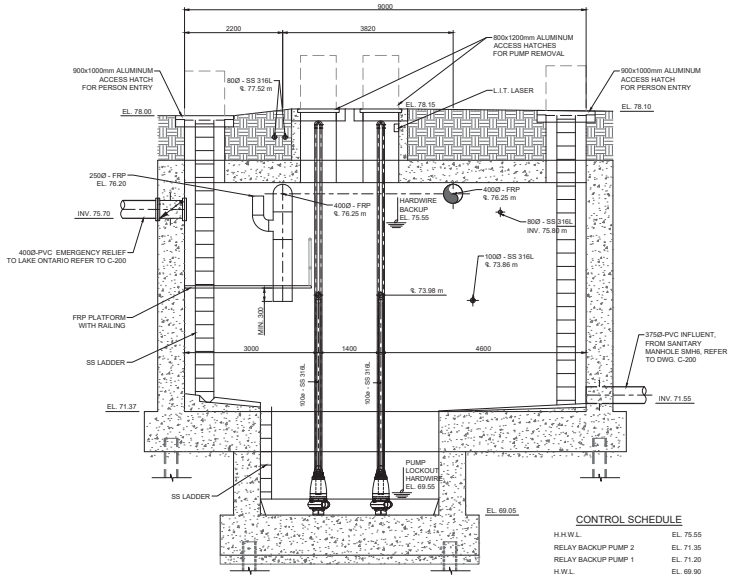
CONTRACT No.:

DRAWING No.: P-101



SECTION C-C

1 : 40



SECTION D-D

1 : 40

CONTROL SCHEDULE

H.H.W.L.	EL. 75.55
RELAY BACKUP PUMP 2	EL. 71.35
RELAY BACKUP PUMP 1	EL. 71.20
H.W.L.	EL. 69.90
L.W.L.	EL. 69.75
RELAY BACKUP ALL PUMPS STOP	EL. 69.60

0 1 2 3 4m

SCALE 1:40

No.	REVISIONS	DATE	INITLS
1	ISSUED FOR TENDER	AUG 2018	A.A.

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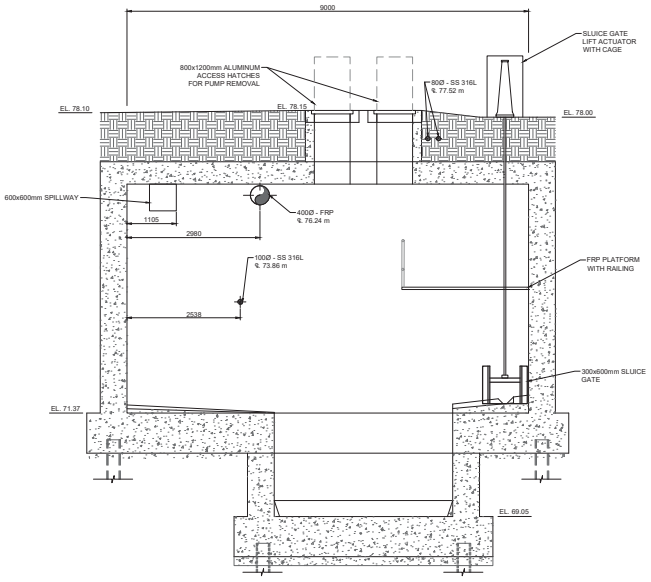
NEW MUNICIPAL WASTEWATER PUMPING STATION ON PIER 8 IN THE CITY OF HAMILTON

PROCESS

PIER 8 WASTEWATER PUMPING STATION

WET WELL & SANITARY STORAGE TANK SECTIONS C-C & D-D

DATE : AUGUST 2018
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DRAWING No.: P-102



SECTION E-E

1 : 40

0 1 2 3 4m

SCALE 1:40

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PROFESSIONAL ENGINEER
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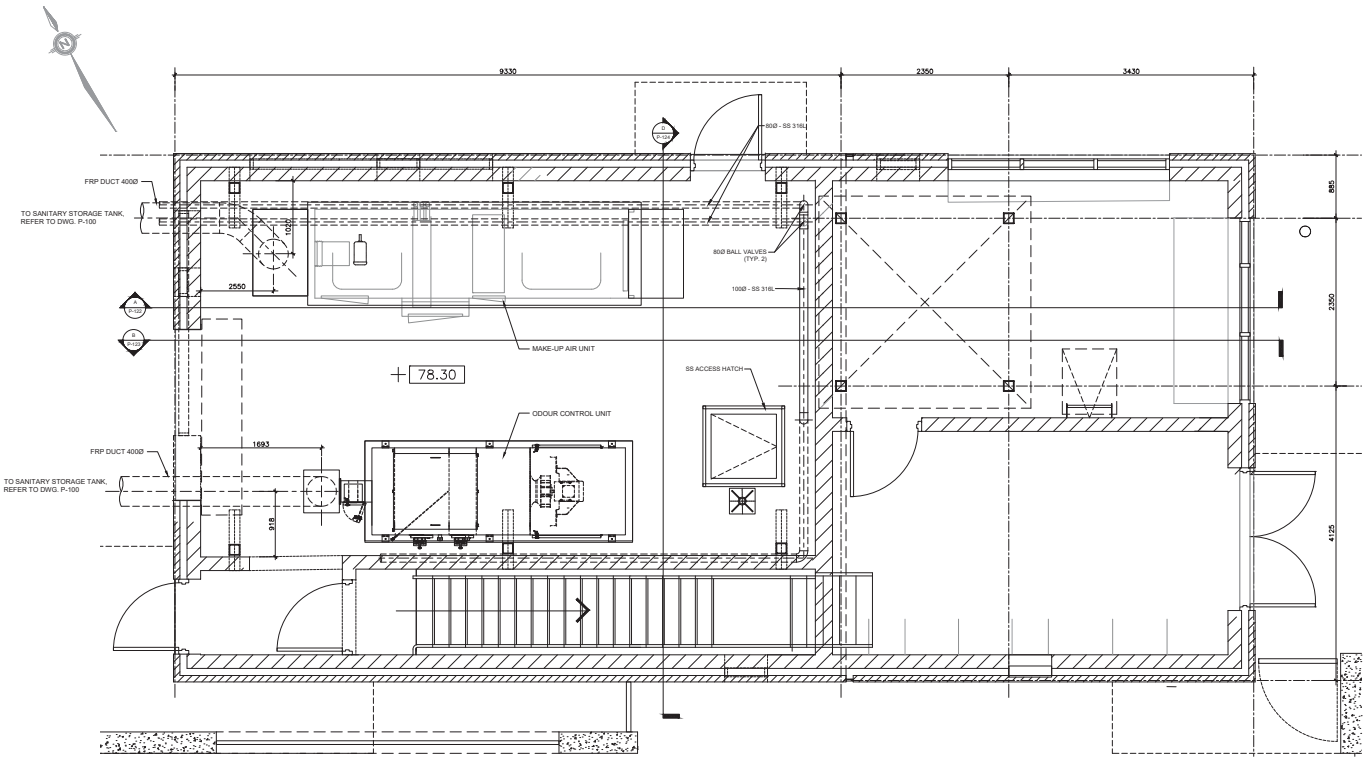
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PROCESS
PIER 8 WASTEWATER PUMPING STATION
WET WELL SECTION E-E

DATE : AUGUST 2018
SCALE: AS SHOWN
FILE No.:
CONTRACT No.:
DRAWING No.:
P-103



GROUND FLOOR PLAN

1 : 25

0 1 2m

SCALE 1:25

NOTES

1. PROVIDE SLEEVES ON PIPES & DUCTS BETWEEN SERVICE BUILDING AND WET WELL AS PER DWG. P-126.

No.	REVISIONS	DATE	INITLS
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PROFESSIONAL ENGINEER
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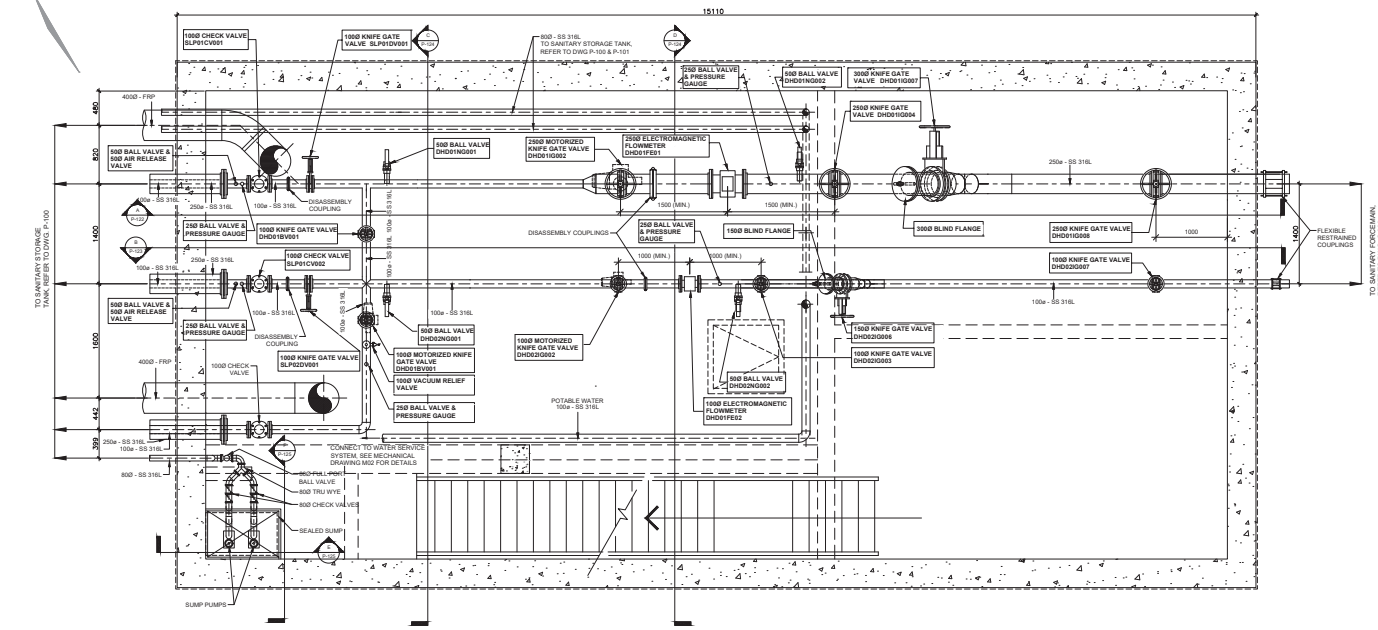
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PROCESS
PIER 8 WASTEWATER PUMPING STATION
ODOR CONTROL ROOM - GROUND FLOOR PLAN

DATE : AUGUST 2018
SCALE: 1 : 25
FILE No.:
CONTRACT No.:
DRAWING No.: P-120



VALVE ROOM PLAN

1 : 25

0 1 2m

SCALE 1:25

NOTES

1. PROVIDE SLEEVES ON PIPES & DUCTS BETWEEN SERVICE BUILDING AND WET WELL AS PER DWG. P-126.
2. AIR VALVES TO BE PIPED TO NEAREST FLOOR DRAIN

No.	REVISIONS	DATE	INTLS
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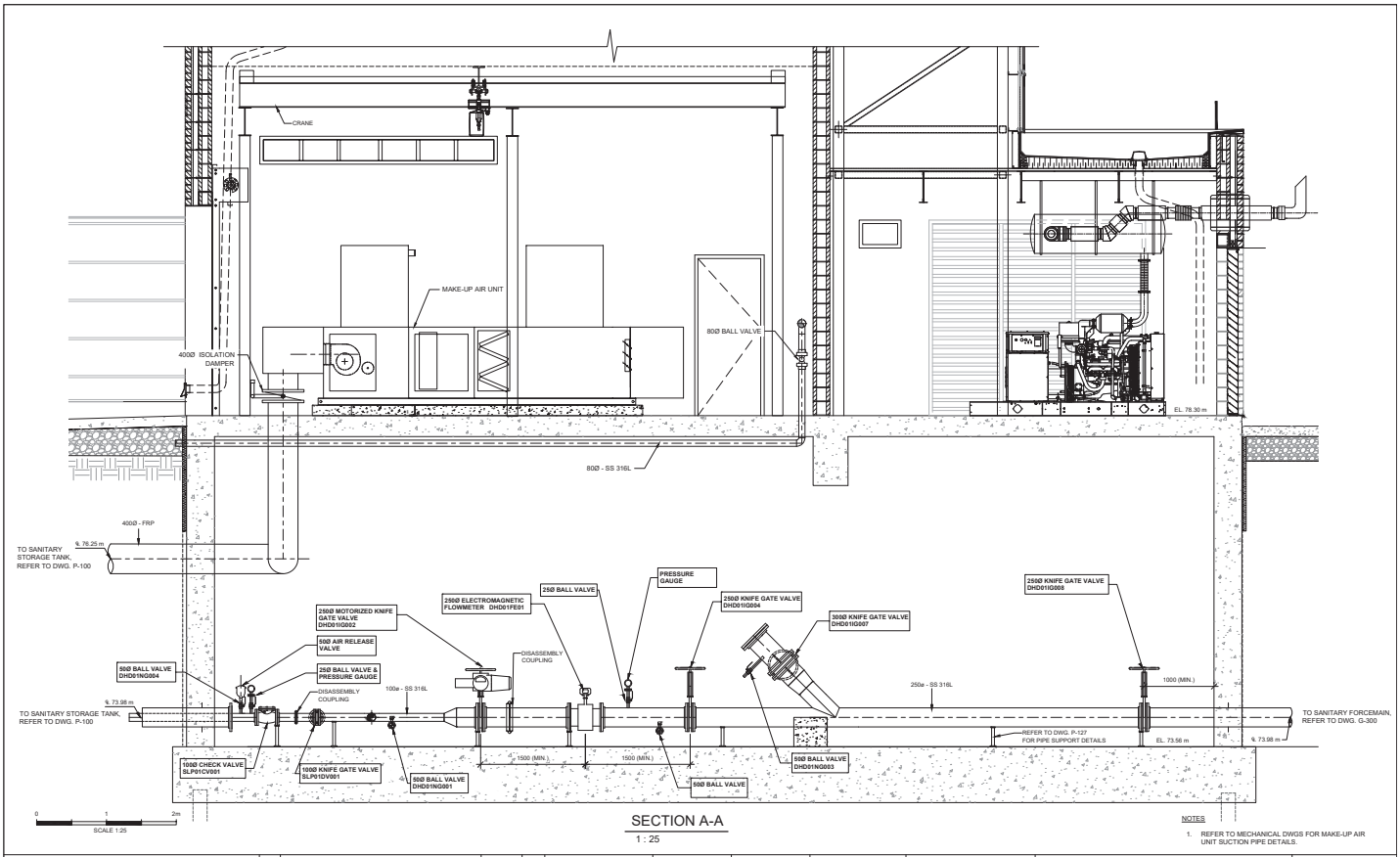
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NEW MUNICIPAL WASTEWATER PUMPING STATION ON PIER 8 IN THE CITY OF HAMILTON

PROCESS
PIER 8 WASTEWATER PUMPING STATION
VALVE ROOM PLAN

DATE : AUGUST 2018
SCALE: 1 : 25
FILE No.:
CONTRACT No.:
DRAWING No.: P-121



SECTION A-A

1 : 25

NOTES

1. REFER TO MECHANICAL DWGS FOR MAKE-UP AIR UNIT SUCTION PIPE DETAILS.

No.	REVISIONS	DATE	INITLS
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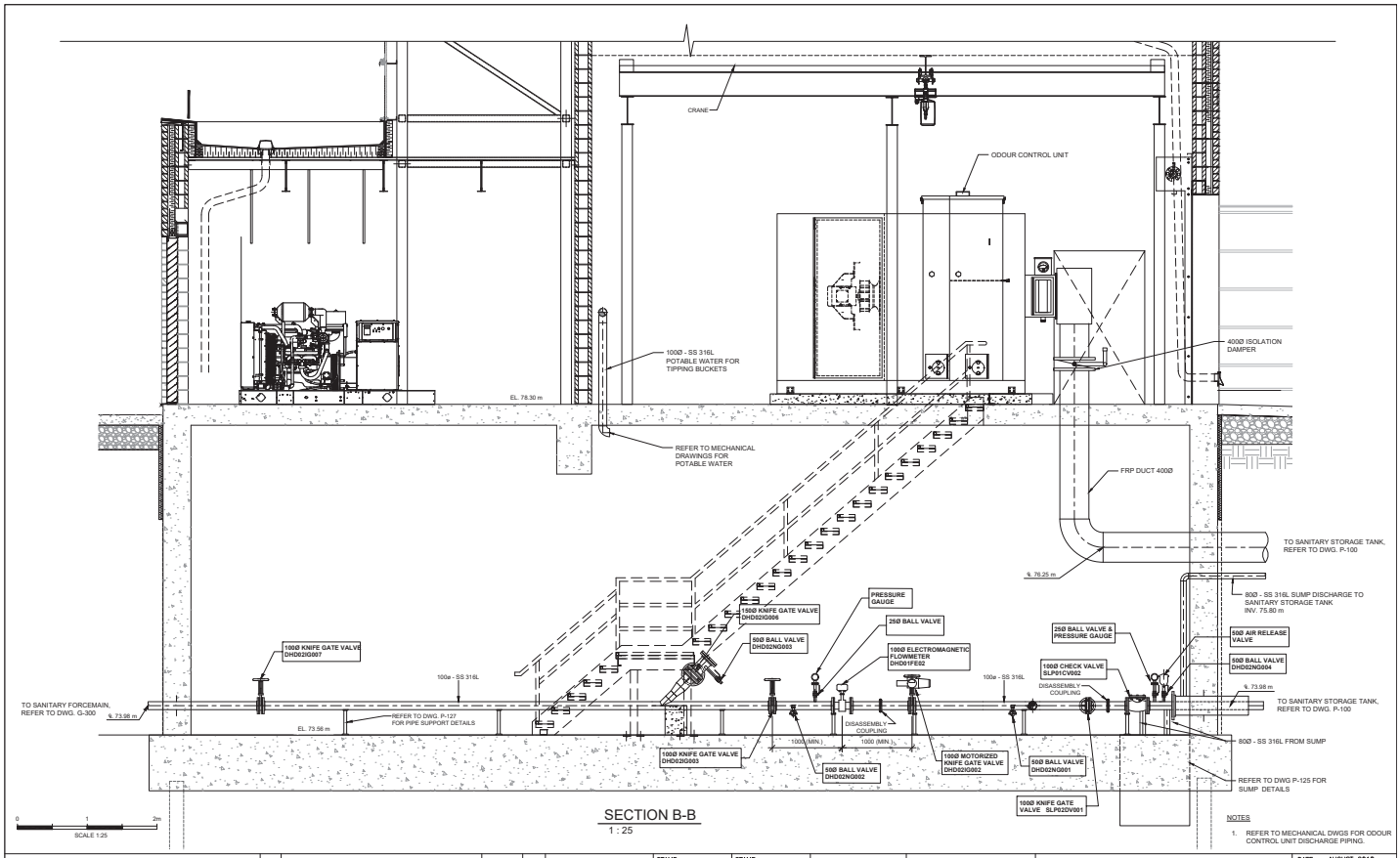
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NEW MUNICIPAL WASTEWATER PUMPING STATION ON PIER 8 IN THE CITY OF HAMILTON

PROCESS
PIER 8 WASTEWATER PUMPING STATION
SECTION A-A

DATE : AUGUST 2018
SCALE: 1 : 25
FILE No.:
CONTRACT No.:
DRAWING No.:
P-122



SECTION B-B
1 : 25

NOTES

1. REFER TO MECHANICAL DWGS FOR ODOUR CONTROL UNIT DISCHARGE PIPING.

No.	REVISIONS	DATE	INTLS
1	ISSUED FOR TENDER	AUG 2018	A.A.

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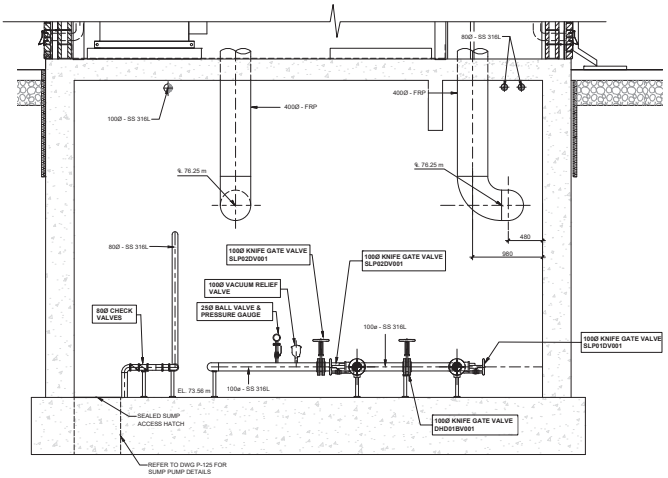
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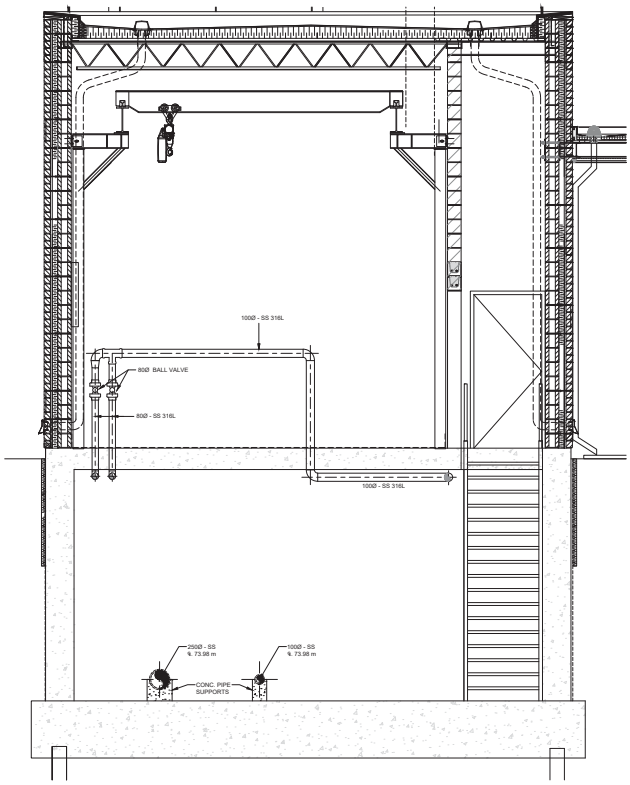
PROCESS
NEW PIER 8 WASTEWATER PUMPING STATION
SECTION B-B

DATE : AUGUST 2018
SCALE: 1 : 25
FILE No.:
CONTRACT No.:
DRAWING No.: P-123



SECTION C-C

1 : 25



SECTION D-D

1 : 25

0 1 2m

SCALE 1:25

No.	REVISIONS	DATE	INTLS
1	ISSUED FOR TENDER	AUG 2018	A.A.

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PROFESSIONAL ENGINEER
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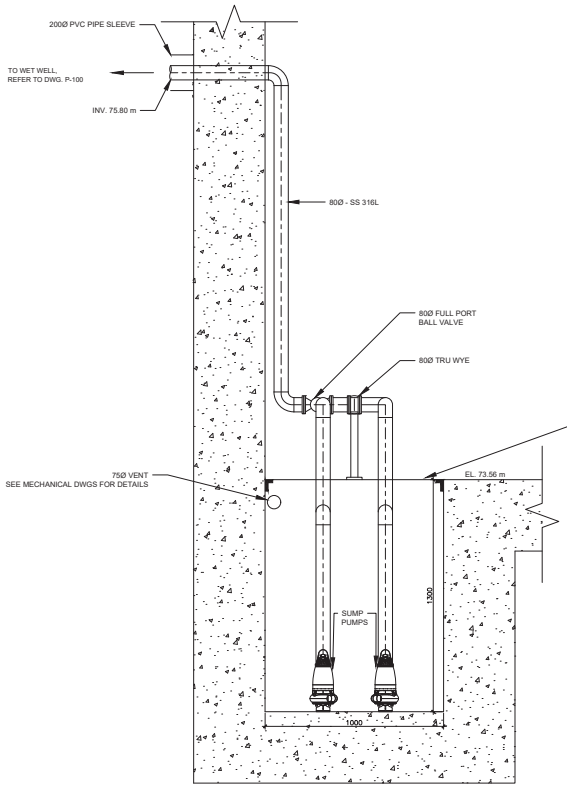
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PARSONS

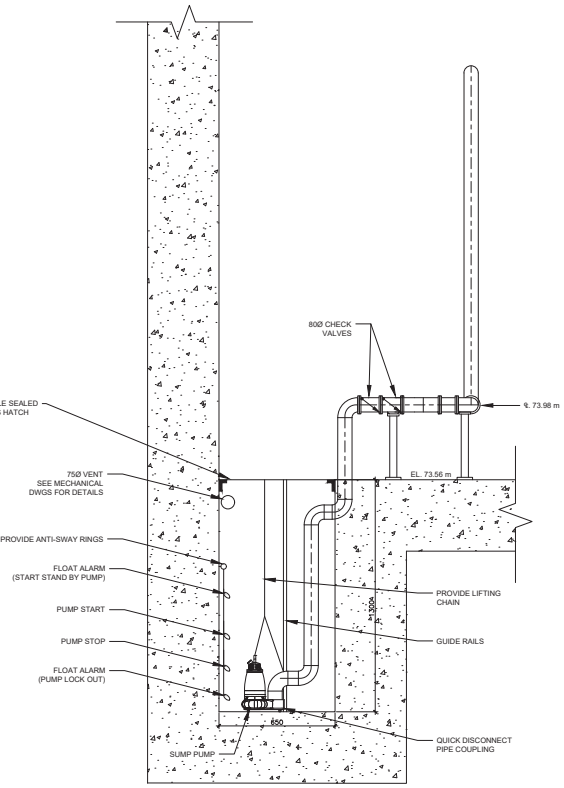
NEW MUNICIPAL WASTEWATER PUMPING STATION ON PIER 8 IN THE CITY OF HAMILTON

PROCESS
PIER 8 WASTEWATER PUMPING STATION
SECTION C-C & D-D

DATE : AUGUST 2018
SCALE: 1 : 25
FILE No.:
CONTRACT No.:
DRAWING No.:
P-124



SECTION E-E
1 : 10



SECTION F-F
1 : 10

NOTES

1. PROVIDE SLEEVES ON PIPES BETWEEN SERVICE BUILDING AND WET WELL AS PER DWG. P-126.

No.	REVISIONS	DATE	INTLS
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PARSONS

NEW MUNICIPAL WASTEWATER PUMPING STATION ON PIER 8 IN THE CITY OF HAMILTON

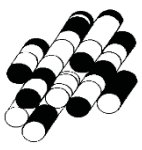
PROCESS
PIER 8 WASTEWATER PUMPING STATION
SUMP PUMP SECTIONS

DATE : AUGUST 2018
SCALE: 1 : 10
FILE No.:
CONTRACT No.:
DRAWING No.:
P-125

APPENDIX D

Results of Sewer Use Discharging Ground Water Quality Sampling

Terraprobe Inc.



Terraprobe
Consulting Geotechnical & Environmental Engineering
Construction Materials Inspection & Testing

October 19, 2017

File No. 7-17-0055-21
Stoney Creek Office

City of Hamilton
Waterfront Development Office
77 James Street North, Suite 320
Hamilton, Ontario L8R 2K3

Attention: Mr. Jeff Pisadny, Senior Project Manager, B.Sc.

RE: RESULTS OF SEWER USE DISCHARGE SAMPLING WEST HARBOUR PUMPING STATION AND ASSOCIATED WORKS HAMILTON, ONTARIO

Dear Sir:

This letter presents the results of ground water quality sampling completed for the above stated project. It is currently proposed to construct a sewage pumping station (PS1) and associated sanitary forcemain in the west harbour area (Pier 8) of the City of Hamilton. The project area is located north of Guise Street East bound by Hughson Street North to the west, Catherine Street North to the east and the Hamilton Harbour to the north. The site location is provided on the attached Figure 1. The proposed sanitary forcemain extends from the proposed pumping station to the Burlington St. sanitary sewer at Ferguson St.

Ground water sampling was completed in the vicinity of the proposed pumping station PS1 at monitoring well location MW11 as shown on the attached borehole location plan (Figure 2). The following summarizes the observed ground water conditions at MW11:

Summary of Observed Ground Water Conditions (MW11)

Monitoring Location	Ground Elevation (masl)	Depth (masl)	Water Level (masl)				
			1-Sep-16	11-Oct-16	7-Nov-16	19-Jul-17	4-Oct-17
MW11	76.8	70.9	76.0	75.9	75.7	76.4	76.1

Monitoring well location MW11 was completed to a depth of approximately 6.0 m below grade within fill deposits consisting of loose silty clay with construction debris to sandy silt with construction debris. The borehole log for MW11 is provided in the attached enclosures.

Ground water was purged and sampled on October 4, 2017. Standing water was purged from the monitoring well prior to sampling for the parameters of the City of Hamilton combined sewer use by-law. Two samples were obtained from MW11. One sample consisted of raw untreated ground water and a second sample was obtained using a standard 20 micron filter to remove suspended soils from ground water sampled. The filtered sample was obtained to represent water quality following basic filtration for suspended sediment from discharge water.

Water samples were collected using laboratory supplied analysis bottles appropriate for the requested analysis (i.e. sample preservative). All collected samples were stored on ice and transported to AGAT Laboratories in Mississauga for analysis. The results of water quality analysis are provided in the attached laboratory certificates of analysis.

In summary water quality exceedances above the City of Hamilton sanitary sewer and combined sewer use by-laws were observed for total PAH, pH and total suspended solids for the unfiltered sample. Exceedances of pH were noted for the filtered water quality sample.

It is anticipated that through the implementation of sedimentation control measures (i.e. filtration) that the water quality guidelines of the Hamilton sanitary sewer and combined sewer use by-law can be achieved for discharge water.

We trust this information is sufficient for your present purposes. Should you have any questions concerning the above, please do not hesitate to contact the undersigned.

Yours truly,

Terraprobe Inc.

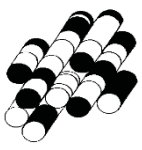


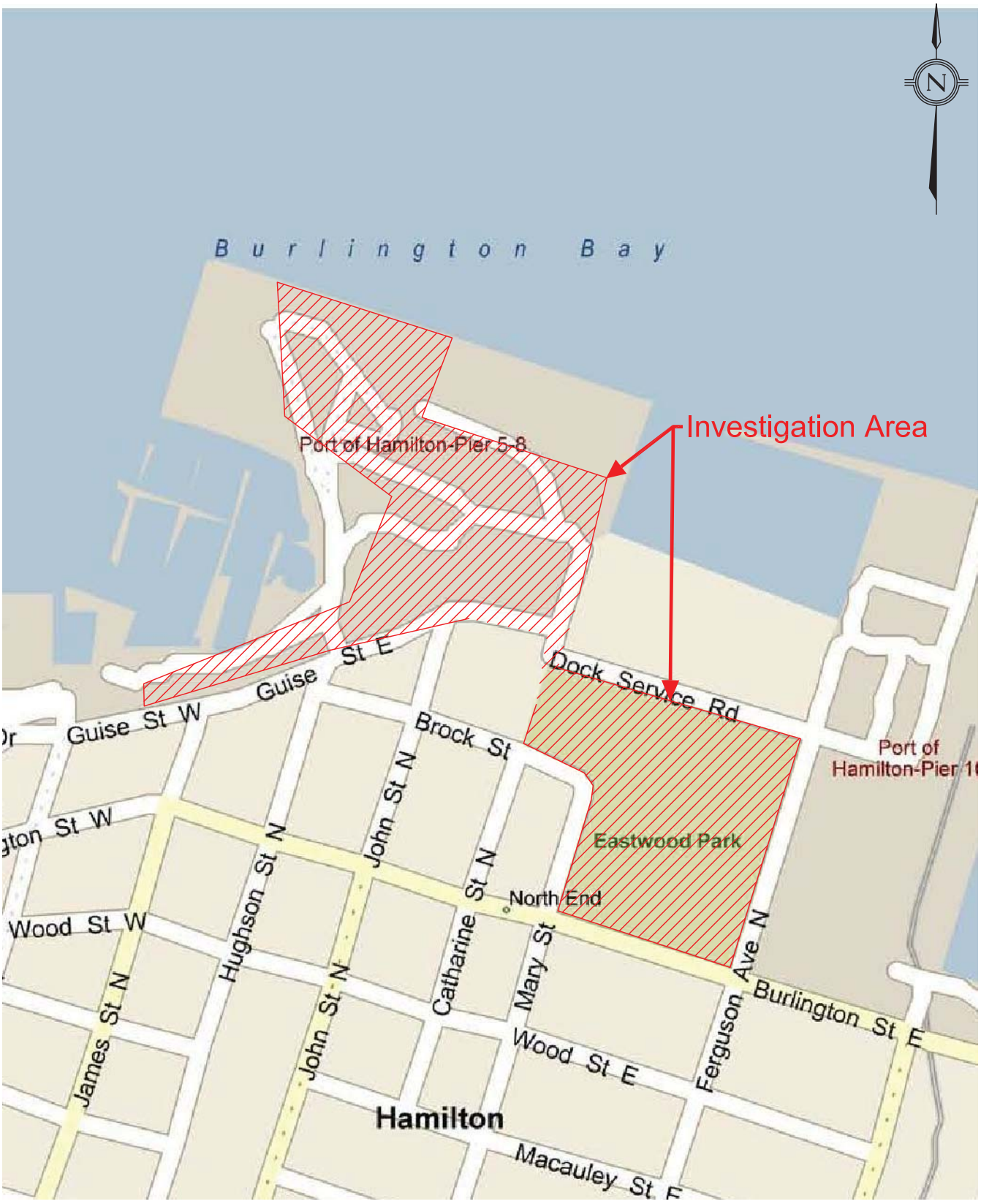
Paul L. Raepple, P.Geo.

Stoney Creek Office

ENCLOSURES

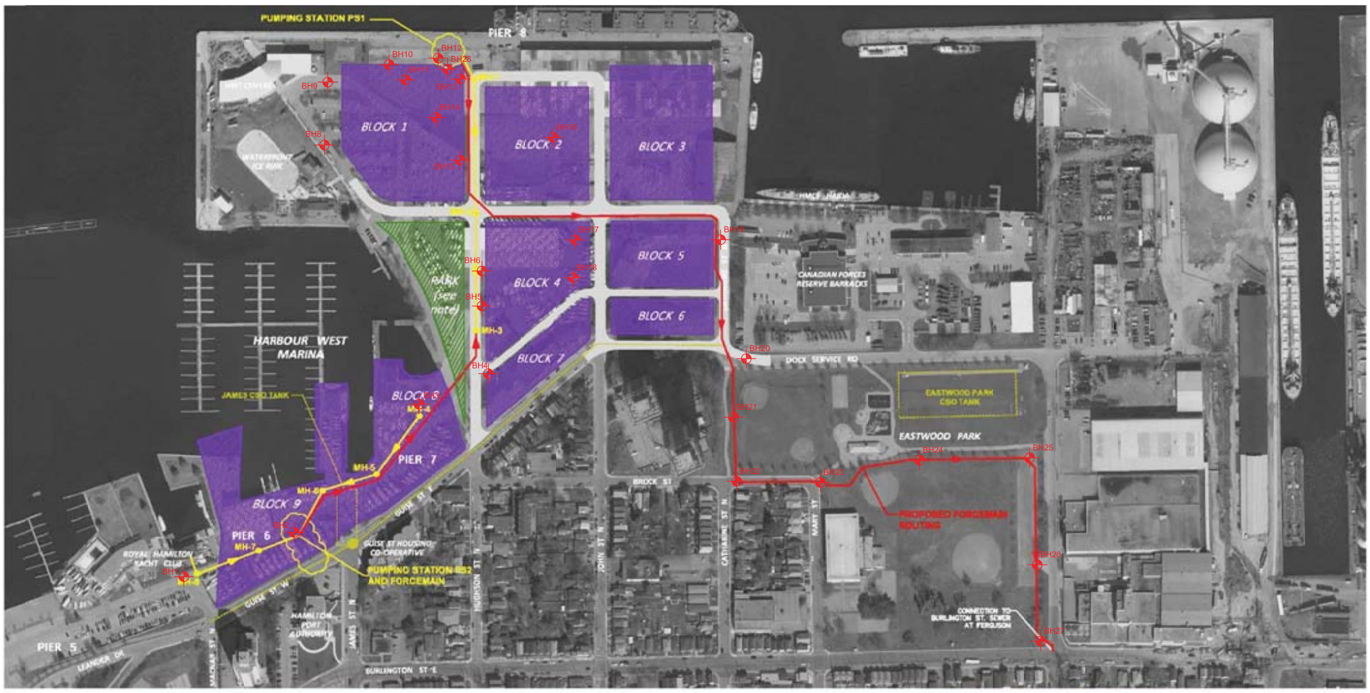
Terraprobe Inc.





Terraprobe
903 Barton Street - Unit 22, Stoney Creek, Ontario, L8E 5R7
Tel: (905) 643-7560, Fax: (905) 643-7559

Title:	FIGURE :
SITE LOCATION PLAN	1
File No. 7-16-0090-01	



CITY OF HAMILTON
WEST HARBOUR PUMPING STATION AND FORCEMAIN

CONCEPTUAL PUMPING STATION, SANITARY SEWER, AND FORCEMAIN FIGURE

Hamilton | Hamilton Waterfront Trust

EXISTING SANITARY SEWER
PROPOSED SANITARY FORCEMAIN ROUTING
BLOCK AREAS
PROPOSED SANITARY SEWER

File Location:
g:\cad\141396 waterfront development engineering\10 water_waste\2016-01-18 sanitary forcemain routing\plan with blocks figure.dwg
January, 20, 2016 9:32 PM

MAP/DRAWING INFORMATION
Mapping from City of Hamilton

SCALE 1:3,000
0 30 60 120m

DILLON CONSULTING

PROJECT: 14 1396
STATUS: DRAFT
DATE: JANUARY 2016

LEGEND
BH1 Borehole Location

Terraprobe
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Tel: (905) 643-7560, Fax: (905) 643-7559

Title: BOREHOLE LOCATION PLAN
File No. 7-16-0090-01
FIGURE : 2

LOG OF BOREHOLE 11

Terraprobe

Project No. : 7-16-0090-01 | Client : The City of Hamilton | Originated by : AF

Date started : August 4, 2016 | Project : Pier 8 | Compiled by : GM

Sheet No. : 1 of 1 | Location : Hamilton, Ontario | Checked by : GM

Position : E: 592531, N: 4792239 (UTM 17T) | Elevation Datum : Geodetic (NAD83)

Rig type : CME 75, truck-mounted | Drilling Method : Hollow stem augers

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Sample Number	Sample Type	SPT 'N' Value
	76.8	**GROUND SURFACE**				
		50mm **ASPHALTIC CONCRETE**				
	76.2	FILL Granular Base				
	0.6	**FILL**, silty clay, trace gravel, pieces of bick, very soft to firm, grey		1	SS	7
				2	SS	2
	73.1					
	3.7	**FILL**, clayey silt to sandy silt, with pieces of brick and mortar, loose to compact, dark brown to reddish brown		3	SS	10
				4	SS	5
				5	SS	9
	68.0					
	8.8	**SANDY SILT to SILTY FINE SAND**, loose, dark grey		6	SS	7
				7	SS	7
				8	SS	2
	64.2					
	12.6	**END OF BOREHOLE**				

Penetration Test Values (Blows / 0.3m): Dynamic Cone 10 20 30 40

Undrained Shear Strength (kPa): Unconfined, Pocket Penetrometer, Field Vane, Lab Vane 40 80 120 160

Moisture / Plasticity: Plastic Limit (PL) | Natural Water Content (MC) | Liquid Limit (LL) 10 20 30

Headspace Vapour (ppm)

Instrument Details

Unstabilized Water Level

Lab Data and Comments

GRAIN SIZE DISTRIBUTION (%) (MIT) GR SA SI CL

Unstabilized water level measured at 4.6 m below ground surface; borehole was open upon completion of drilling.

50 mm dia. monitoring well installed.

WATER LEVEL READINGS

Date	Water Depth (m)	Elevation (m)
Sep 1, 2016	0.9	76.0
Oct 11, 2016	1.0	75.9
Nov 7, 2016	1.2	75.7

file: 7-16-0090-01 pier 8 hamilton.gpj

AGAT Laboratories

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MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
http://www.agatlabs.com

CLIENT NAME: TERRAPROBE INC
903 Barton Street
Stoney Creek, ON L8E5P5
(905) 643-7560

ATTENTION TO: Paul Raepple

PROJECT: 7-16-0090-46

AGAT WORK ORDER: 17H267979

MICROBIOLOGY ANALYSIS REVIEWED BY: Inesa Alizarchyk, Inorganic Lab Supervisor

TRACE ORGANICS REVIEWED BY: Neli Popnikolova, Senior Chemist

WATER ANALYSIS REVIEWED BY: Nivine Basily, Inorganics Report Writer

DATE REPORTED: Oct 16, 2017

PAGES (INCLUDING COVER): 13

VERSION*: 1

Should you require any information regarding this analysis please contact your client services representative at (905) 712-5100

*NOTES

All samples will be disposed of within 30 days following analysis. Please contact the lab if you require additional sample storage time.

Member of: Association of Professional Engineers and Geoscientists of Alberta (APEGA)
Western Enviro-Agricultural Laboratory Association (WEALA)
Environmental Services Association of Alberta (ESAA)

AGAT Laboratories is accredited to ISO/IEC 17025 by the Canadian Association for Laboratory Accreditation Inc. (CALA) and/or Standards Council of Canada (SCC) for specific tests listed on the scope of accreditation. AGAT Laboratories (Mississauga) is also accredited by the Canadian Association for Laboratory Accreditation Inc. (CALA) for specific drinking water tests. Accreditations are location and parameter specific. A complete listing of parameters for each location is available from www.cala.ca and/or www.scc.ca. The tests in this report may not necessarily be included in the scope of accreditation.

Results relate only to the items tested and to all the items tested
All reportable information as specified by ISO 17025:2005 is available from AGAT Laboratories upon request

AGAT Laboratories

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Certificate of Analysis

AGAT WORK ORDER: 17H267979

PROJECT: 7-16-0090-46

CLIENT NAME: TERRAPROBE INC

ATTENTION TO: Paul Raepple

SAMPLING SITE:

SAMPLED BY:

Microbiological Analysis (water)

DATE RECEIVED: 2017-10-04

DATE REPORTED: 2017-10-07

				SAMPLE DESCRIPTION:	MW11-F	MW11-UF
				SAMPLE TYPE:	Water	Water
				DATE SAMPLED:	2017-10-04	2017-10-04
Parameter	Unit	G / S	RDL	8787574	8788168	
Escherichia coli	CFU/100mL	0	2	ND	ND	

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: Refers to SDWA - Microbiology
Guideline values are for general reference only. The guidelines provided may or may not be relevant for the intended use. Refer directly to the applicable standard for regulatory interpretation.

8787574-8788168 RDL >1 indicates dilutions of the sample.
ND - Not Detected.

Certified By:



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Certificate of Analysis

AGAT WORK ORDER: 17H267979
PROJECT: 7-16-0090-46

CLIENT NAME: TERRAPROBE INC
SAMPLING SITE:

ATTENTION TO: Paul Raepple
SAMPLED BY:

Hamilton Sanitary Sewer and Combined Sewer Use - Organics

DATE RECEIVED: 2017-10-04

DATE REPORTED: 2017-10-12

		SAMPLE DESCRIPTION:		MW11-F	MW11-UF
		SAMPLE TYPE:		Water	Water
		DATE SAMPLED:		2017-10-04	2017-10-04
Parameter	Unit	G / S	RDL	8787574	8788168
Oil and Grease (animal/vegetable) in water	mg/L	150	0.5	5.1	4.5
Oil and Grease (mineral) in water	mg/L	15	0.5	<0.5	<0.5
Di-n-butyl phthalate	mg/L	0.08	0.0005	0.0010	0.0019
Bis(2-Ethylhexyl)phthalate	mg/L	0.012	0.0005	<0.0005	0.0011
Total PAHs	mg/L	0.005	0.0003	0.0045	0.0097
3,3'-Dichlorobenzidine	mg/L	0.002	0.0005	<0.0005	<0.0005
Pentachlorophenol	mg/L	0.005	0.0005	0.0008	<0.0005
Hexachlorobenzene	mg/L		0.0001	<0.0001	<0.0001
Aldrin + Dieldrin	mg/L	0.0002	0.0002	<0.0002	<0.0002
Chlordane (Total)	mg/L	0.1	0.007	<0.007	<0.007
DDT (o,p' + p,p')	mg/L	0.0001	0.0001	<0.0001	<0.0001
PCBs	mg/L	0.001	0.0002	<0.0002	<0.0002
Mirex	mg/L	0.1	0.0005	<0.0005	<0.0005
Hexachlorocyclohexane	mg/L	0.1	0.0001	<0.0001	<0.0001
Benzene	mg/L	0.01	0.0004	0.0021	0.0028
Chloroform	mg/L	0.04	0.0004	<0.0004	<0.0004
Methylene Chloride	mg/L	2	0.0006	<0.0006	<0.0006
cis- 1,2-Dichloroethylene	mg/L	4	0.0004	<0.0004	<0.0004
trans-1,3-Dichloropropylene	mg/L	0.14	0.0006	<0.0006	<0.0006
Trichloroethylene	mg/L	0.4	0.0004	<0.0004	<0.0004
1,1,2,2-Tetrachloroethane	mg/L	1.4	0.0002	<0.0002	<0.0002
Toluene	mg/L	0.016	0.0004	0.0007	0.0008
Ethylbenzene	mg/L	0.16	0.0002	<0.0002	<0.0002
Tetrachloroethylene	mg/L	1	0.0002	<0.0002	<0.0002
1,2-Dichlorobenzene	mg/L	0.05	0.0002	<0.0002	<0.0002
1,4-Dichlorobenzene	mg/L	0.08	0.0002	<0.0002	<0.0002
Total Xylenes	mg/L	1.4	0.0002	0.0003	0.0003

Certified By: N Popnikolof

Results relate only to the items tested and to all the items tested

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Certificate of Analysis

AGAT WORK ORDER: 17H267979
PROJECT: 7-16-0090-46

CLIENT NAME: TERRAPROBE INC
ATTENTION TO: Paul Raepple
SAMPLING SITE:
SAMPLED BY:

Hamilton Sanitary Sewer and Combined Sewer Use - Organics

DATE RECEIVED: 2017-10-04
DATE REPORTED: 2017-10-12

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: Refers to Hamilton San.2015
Guideline values are for general reference only. The guidelines provided may or may not be relevant for the intended use. Refer directly to the applicable standard for regulatory interpretation.

8787574-8788168 Dilution factor=2
The sample was diluted because it was foamy. The reporting detection limit has been corrected for the dilution factor used.

Certified By: N Popnikolof

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AGAT WORK ORDER: 17H267979
PROJECT: 7-16-0090-46

CLIENT NAME: TERRAPROBE INC
SAMPLING SITE:

ATTENTION TO: Paul Raepple
SAMPLED BY:

Hamilton Sanitary Sewer and Combined Sewer Use By-law

DATE RECEIVED: 2017-10-04

DATE REPORTED: 2017-10-15

				SAMPLE DESCRIPTION:		MW11-UF
				SAMPLE TYPE:		Water
				DATE SAMPLED:		2017-10-04
Parameter	Unit	G / S	RDL	8787574	RDL	8788168
pH	pH Units	5.5-9.5	NA	10.6	NA	10.6
CBOD (5)	mg/L	300	5	<5	5	<5
Total Suspended Solids	mg/L	350	10	132	10	422
Phenols	mg/L	1	0.002	0.009	0.002	0.010
Total Cyanide	mg/L	2	0.002	0.010	0.002	0.016
Total Kjeldahl Nitrogen	mg/L	100	0.10	8.79	0.10	9.22
Total Phosphorus	mg/L	10	0.05	0.17	0.10	0.73
Chloride	mg/L	1500	1.0	483	1.0	451
Fluoride	mg/L	10	0.5	<0.5	0.5	<0.5
Sulphate	mg/L	1500	1.0	125	1.0	118
Total Aluminum	mg/L	50	0.040	3.44	0.040	8.14
Total Antimony	mg/L	5	0.020	<0.020	0.020	<0.020
Total Arsenic	mg/L	1	0.015	0.018	0.015	0.022
Total Bismuth	mg/L	5	0.020	<0.020	0.020	<0.020
Total Cadmium	mg/L	0.7	0.020	<0.020	0.020	<0.020
Total Chromium	mg/L	5	0.030	<0.030	0.030	<0.030
Total Cobalt	mg/L	5	0.020	<0.020	0.020	<0.020
Total Copper	mg/L	2	0.030	<0.030	0.030	0.043
Total Iron	mg/L	50	0.050	2.72	0.050	8.35
Total Lead	mg/L	2	0.020	<0.020	0.020	0.023
Total Manganese	mg/L	5	0.020	0.094	0.020	0.295
Total Mercury	mg/L	0.01	0.0002	<0.0002	0.0002	<0.0002
Total Molybdenum	mg/L	1	0.020	0.039	0.020	0.036
Total Nickel	mg/L	2	0.030	<0.030	0.030	<0.030
Total Selenium	mg/L	1	0.020	<0.020	0.020	<0.020
Total Silver	mg/L	5	0.020	<0.020	0.020	<0.020
Total Tin	mg/L	5	0.020	<0.020	0.020	<0.020
Total Titanium	mg/L	5	0.020	0.070	0.020	0.186
Total Vanadium	mg/L	5	0.020	<0.020	0.020	<0.020
Total Zinc	mg/L	3	0.020	0.026	0.020	0.067

Certified By: Divine Basily

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Certificate of Analysis

AGAT WORK ORDER: 17H267979
PROJECT: 7-16-0090-46

CLIENT NAME: TERRAPROBE INC
ATTENTION TO: Paul Raepple
SAMPLING SITE:
SAMPLED BY:

Hamilton Sanitary Sewer and Combined Sewer Use By-law

DATE RECEIVED: 2017-10-04
DATE REPORTED: 2017-10-15

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: Refers to Hamilton San.2015
Guideline values are for general reference only. The guidelines provided may or may not be relevant for the intended use. Refer directly to the applicable standard for regulatory interpretation.
8787574-8788168 Elevated RDLs indicate the degree of sample dilutions prior to the analysis to keep analytes within the calibration range, reduce matrix interference and/or to avoid contaminating the instrument.

Certified By: Divine Basily

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Guideline Violation

AGAT WORK ORDER: 17H267979

PROJECT: 7-16-0090-46

CLIENT NAME: TERRAPROBE INC

ATTENTION TO: Paul Raepple

SAMPLEID	SAMPLE TITLE	GUIDELINE	ANALYSIS PACKAGE	PARAMETER	UNIT	GUIDEVALUE	RESULT
8787574	MW11-F	Hamilton San.2015	Hamilton Sanitary Sewer and Combined Sewer Use By-law	pH	pH Units	5.5-9.5	10.6
8788168	MW11-UF	Hamilton San.2015	Hamilton Sanitary Sewer and Combined Sewer Use - Organics	Total PAHs	mg/L	0.005	0.0097
8788168	MW11-UF	Hamilton San.2015	Hamilton Sanitary Sewer and Combined Sewer Use By-law	Total Suspended Solids	mg/L	350	422
8788168	MW11-UF	Hamilton San.2015	Hamilton Sanitary Sewer and Combined Sewer Use By-law	pH	pH Units	5.5-9.5	10.6

Results relate only to the items tested and to all the items tested

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Quality Assurance

CLIENT NAME: TERRAPROBE INC

AGAT WORK ORDER: 17H267979

PROJECT: 7-16-0090-46

ATTENTION TO: Paul Raepple

SAMPLING SITE:

SAMPLED BY:

Microbiology Analysis

RPT Date:			DUPLICATE			Method Blank	REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD		Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
Microbiological Analysis (water)															
Escherichia coli	8786875		ND	ND	NA	< 1									

Comments: ND – Not detected; NA - % RPD Not Applicable

Certified By:

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Quality Assurance

CLIENT NAME: TERRAPROBE INC

AGAT WORK ORDER: 17H267979

PROJECT: 7-16-0090-46

ATTENTION TO: Paul Raepple

SAMPLING SITE:

SAMPLED BY:

Trace Organics Analysis

RPT Date:			DUPLICATE			Method Blank	REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD		Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
Hamilton Sanitary Sewer and Combined Sewer Use - Organics															
Oil and Grease (animal/vegetable) in water		TW	< 0.5	< 0.5	NA	< 0.5	NA	70%	130%	108%	70%	130%	103%	70%	130%
Oil and Grease (mineral) in water		TW	< 0.5	< 0.5	NA	< 0.5	NA	70%	130%	84%	70%	130%	83%	70%	130%
Di-n-butyl phthalate		TW	< 0.0005	< 0.0005	NA	< 0.0005	110%	60%	130%	122%	60%	130%	89%	60%	130%
Bis(2-Ethylhexyl)phthalate		TW	< 0.0005	< 0.0005	NA	< 0.0005	101%	60%	130%	92%	60%	130%	69%	60%	130%
Total PAHs		TW	< 0.0003	< 0.0003	NA	< 0.0003	96%	60%	130%	93%	60%	130%	87%	60%	130%
3,3'-Dichlorobenzidine		TW	< 0.0005	< 0.0005	NA	< 0.0005	94%	60%	130%	91%	60%	130%	73%	60%	130%
Pentachlorophenol		TW	< 0.0005	< 0.0005	NA	< 0.0005	79%	60%	130%	121%	60%	130%	69%	60%	130%
Hexachlorobenzene		TW	< 0.0001	< 0.0001	NA	< 0.0001	95%	60%	130%	85%	60%	130%	104%	60%	130%
Aldrin + Dieldrin		TW	< 0.0002	< 0.0002	NA	< 0.0002	105%	60%	130%	100%	60%	130%	107%	60%	130%
Chlordane (Total)		TW	< 0.007	< 0.007	NA	< 0.007	104%	60%	130%	102%	60%	130%	114%	60%	130%
DDT (o,p' + p,p')		TW	< 0.0001	< 0.0001	NA	< 0.0001	100%	60%	130%	103%	60%	130%	113%	60%	130%
PCBs		TW	< 0.0002	< 0.0002	NA	< 0.0002	95%	60%	130%	80%	60%	130%	NA	60%	130%
Mirex		TW	< 0.0005	< 0.0005	NA	< 0.0005	113%	60%	130%	73%	60%	130%	95%	60%	130%
Hexachlorocyclohexane		TW	< 0.0001	< 0.0001	NA	< 0.0001	106%	60%	130%	81%	60%	130%	93%	60%	130%
Benzene	8793027		< 0.0002	< 0.0002	NA	< 0.0002	95%	60%	130%	75%	60%	130%	84%	60%	130%
Chloroform	8793027		< 0.0002	< 0.0002	NA	< 0.0002	90%	60%	130%	78%	60%	130%	99%	60%	130%
Methylene Chloride	8793027		< 0.0003	< 0.0003	NA	< 0.0003	99%	60%	130%	98%	60%	130%	89%	60%	130%
cis- 1,2-Dichloroethylene	8793027		< 0.0002	< 0.0002	NA	< 0.0002	78%	60%	130%	74%	60%	130%	84%	60%	130%
trans-1,3-Dichloropropylene	8793027		< 0.0003	< 0.0003	NA	< 0.0003	101%	60%	130%	110%	60%	130%	109%	60%	130%
Trichloroethylene	8793027		< 0.0002	< 0.0002	NA	< 0.0002	107%	60%	130%	100%	60%	130%	100%	60%	130%
1,1,2,2-Tetrachloroethane	8793027		< 0.0001	< 0.0001	NA	< 0.0001	91%	60%	130%	89%	60%	130%	74%	60%	130%
Toluene	8793027		< 0.0002	< 0.0002	NA	< 0.0002	73%	60%	130%	95%	60%	130%	92%	60%	130%
Ethylbenzene	8793027		< 0.0001	< 0.0001	NA	< 0.0001	75%	60%	130%	125%	60%	130%	86%	60%	130%
Tetrachloroethylene	8793027		< 0.0001	< 0.0001	NA	< 0.0001	71%	60%	130%	76%	60%	130%	97%	60%	130%
1,2-Dichlorobenzene	8793027		< 0.0001	< 0.0001	NA	< 0.0001	87%	60%	130%	97%	60%	130%	99%	60%	130%
1,4-Dichlorobenzene	8793027		< 0.0001	< 0.0001	NA	< 0.0001	120%	60%	130%	100%	60%	130%	103%	60%	130%

Comments: Tap water analysis has been performed as QC sample testing for duplicate and matrix spike due to insufficient sample volume.
When the average of the sample and duplicate results is less than 5x the RDL, the Relative Percent Difference (RPD) will be indicated as Not Applicable (NA).

Certified By: N Popowich

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http://www.agatlabs.com

Quality Assurance

CLIENT NAME: TERRAPROBE INC
AGAT WORK ORDER: 17H267979

PROJECT: 7-16-0090-46
ATTENTION TO: Paul Raepple

SAMPLING SITE:
SAMPLED BY:

Water Analysis

RPT Date:			DUPLICATE				REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
Hamilton Sanitary Sewer and Combined Sewer Use By-law															
pH	8792160		8.05	8.12	0.9%	NA	99%	90%	110%						
CBOD (5)	8791983		9	9	NA	< 5	101%	75%	125%						
Total Suspended Solids	8788802		1820	1660	9.2%	< 10	100%	80%	120%						
Phenols	8787574	8787574	0.009	0.010	NA	< 0.002	102%	90%	110%	101%	90%	110%	101%	80%	120%
Total Cyanide	8790010		<0.002	<0.002	NA	< 0.002	91%	80%	120%	101%	90%	110%	94%	70%	130%
Total Kjeldahl Nitrogen	8790009		0.27	0.34	NA	< 0.10	102%	80%	120%	101%	80%	120%	101%	70%	130%
Total Phosphorus	8799951		<0.05	<0.05	NA	< 0.05	96%	90%	110%	103%	90%	110%	103%	80%	120%
Chloride	8798845		110	108	1.8%	< 0.10	98%	90%	110%	105%	90%	110%	108%	80%	120%
Fluoride	8798845		<0.25	<0.25	NA	< 0.05	106%	90%	110%	97%	90%	110%	100%	80%	120%
Sulphate	8798845		114	112	1.8%	< 0.10	96%	90%	110%	100%	90%	110%	105%	80%	120%
Total Aluminum	8794294		0.286	0.271	5.4%	< 0.040	96%	90%	110%	99%	80%	120%	88%	70%	130%
Total Antimony	8794294		<0.020	<0.020	NA	< 0.020	99%	90%	110%	103%	80%	120%	98%	70%	130%
Total Arsenic	8794294		<0.015	<0.015	NA	< 0.015	101%	90%	110%	106%	80%	120%	99%	70%	130%
Total Bismuth	8794294		<0.020	<0.020	NA	< 0.020	108%	90%	110%	93%	80%	120%	86%	70%	130%
Total Cadmium	8794294		<0.020	<0.020	NA	< 0.020	100%	90%	110%	106%	80%	120%	102%	70%	130%
Total Chromium	8794294		<0.030	<0.030	NA	< 0.030	103%	90%	110%	101%	80%	120%	87%	70%	130%
Total Cobalt	8794294		<0.020	<0.020	NA	< 0.020	90%	90%	110%	98%	80%	120%	88%	70%	130%
Total Copper	8794294		<0.030	<0.030	NA	< 0.030	94%	90%	110%	100%	80%	120%	90%	70%	130%
Total Iron	8794294		1.17	1.09	7.1%	< 0.050	91%	90%	110%	117%	80%	120%	89%	70%	130%
Total Lead	8794294		<0.020	<0.020	NA	< 0.020	92%	90%	110%	94%	80%	120%	88%	70%	130%
Total Manganese	8794294		0.033	0.034	NA	< 0.020	91%	90%	110%	97%	80%	120%	85%	70%	130%
Total Mercury	8787574	8787574	<0.0002	<0.0002	NA	< 0.0002	102%	90%	110%	104%	90%	110%	102%	80%	120%
Total Molybdenum	8794294		0.025	0.025	NA	< 0.020	97%	90%	110%	104%	80%	120%	98%	70%	130%
Total Nickel	8794294		<0.030	<0.030	NA	< 0.030	101%	90%	110%	108%	80%	120%	98%	70%	130%
Total Selenium	8794294		<0.020	<0.020	NA	< 0.020	100%	90%	110%	103%	80%	120%	97%	70%	130%
Total Silver	8794294		<0.020	<0.020	NA	< 0.020	102%	90%	110%	120%	80%	120%	113%	70%	130%
Total Tin	8794294		<0.020	<0.020	NA	< 0.020	103%	90%	110%	111%	80%	120%	101%	70%	130%
Total Titanium	8794294		<0.020	<0.020	NA	< 0.020	98%	90%	110%	102%	80%	120%	97%	70%	130%
Total Vanadium	8794294		<0.020	<0.020	NA	< 0.020	102%	90%	110%	109%	80%	120%	100%	70%	130%
Total Zinc	8794294		0.100	0.101	1.0%	< 0.020	93%	90%	110%	96%	80%	120%	94%	70%	130%

Comments: NA signifies Not Applicable.
Duplicate Qualifier: As the measured result approaches the RL, the uncertainty associated with the value increases dramatically, thus duplicate acceptance limits apply only where the average of the two duplicates is greater than five times the RL.

Certified By: Divine Basily

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http://www.agatlabs.com

Method Summary

CLIENT NAME: TERRAPROBE INC

AGAT WORK ORDER: 17H267979

PROJECT: 7-16-0090-46

ATTENTION TO: Paul Raepple

SAMPLING SITE:

SAMPLED BY:

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Microbiology Analysis			
Escherichia coli	MIC-93-7010	EPA 1604	Membrane Filtration
Trace Organics Analysis			
Oil and Grease (animal/vegetable) in water	VOL-91-5011	EPA SW-846 1664A & SM 5520	BALANCE
Oil and Grease (mineral) in water	VOL-91-5011	EPA SW-846 1664A & SM 5520	BALANCE
Di-n-butyl phthalate	ORG-91-5114	EPA SW-846 3510C & 8270D	GC/MS
Bis(2-Ethylhexyl)phthalate	ORG-91-5114	EPA SW-846 3510C & 8270D	GC/MS
Total PAHs	ORG-91-5105	EPA SW-846 3510C & 8270D	GC/MS
3,3'-Dichlorobenzidine	ORG-91-5114	EPA SW-846 3510C & 8270D	GC/MS
Pentachlorophenol	ORG-91-5114	EPA SW-846 3510C & 8270D	GC/MS
Hexachlorobenzene	ORG-91-5112	EPA SW846 3510C & 8081B	GC/ECD
Aldrin + Dieldrin	ORG-91-5112	EPA SW-846 3510C & 8081B	GC/ECD
Chlordane (Total)	ORG-91-5112	EPA SW-846 3510C & 8081B	GC/ECD
DDT (o,p' + p,p')	ORG-91-5112	EPA SW-846 3510C & 8081B	GC/ECD
PCBs	ORG-91-5112	EPA SW-846 3510C & 8082A	GC/ECD
Mirex	ORG-91-5112	EPA SW-846 3510C & 8081B	GC/ECD
Hexachlorocyclohexane	ORG-91-5112	EPA SW-846 3510C & 8081B	GC/ECD
Benzene	VOL-91-5001	EPA SW-846 5030B & 8260B	(P&T)GC/MS
Chloroform	VOL-91-5001	EPA SW-846 5030B & 8260B	(P&T)GC/MS
Methylene Chloride	VOL-91-5001	EPA SW-846 5030B & 8260B	(P&T)GC/MS
cis- 1,2-Dichloroethylene	VOL-91-5001	EPA SW-846 5030B & 8260B	(P&T)GC/MS
trans-1,3-Dichloropropylene	VOL-91-5001	EPA SW-846 5030B & 8260B	(P&T)GC/MS
Trichloroethylene	VOL-91-5001	EPA SW-846 5030B & 8260B	(P&T)GC/MS
1,1,2,2-Tetrachloroethane	VOL-91-5001	EPA SW-846 5030B & 8260B	(P&T)GC/MS
Toluene	VOL-91-5001	EPA SW-846 5030B & 8260B	(P&T)GC/MS
Ethylbenzene	VOL-91-5001	EPA SW-846 5030B & 8260B	(P&T)GC/MS
Tetrachloroethylene	VOL-91-5001	EPA SW-846 5030B & 8260B	(P&T)GC/MS
1,2-Dichlorobenzene	VOL-91-5001	EPA SW-846 5030B & 8260B	(P&T)GC/MS
1,4-Dichlorobenzene	VOL-91-5001	EPA SW-846 5030B & 8260B	(P&T)GC/MS
Total Xylenes	VOL-91-5001	EPA SW-846 5030B & 8260B	(P&T)GC/MS

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Method Summary

CLIENT NAME: TERRAPROBE INC

AGAT WORK ORDER: 17H267979

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ATTENTION TO: Paul Raepple

SAMPLING SITE:

SAMPLED BY:

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Water Analysis			
pH	INOR-93-6000	SM 4500-H+ B	PC TITRATE
CBOD (5)	INOR-93-6006	SM 5210 B	DO METER
Total Suspended Solids	INOR-93-6028	SM 2540 D	BALANCE
Phenols	INOR-93-6050	MOE ROPHEN-E3179 & SM 5530 D	TECHNICON AUTO ANALYZER
Total Cyanide	INOR-93-6051	MOE 3015 & SM 4500 CN- A,B,C	TECHNICON AUTO ANALYZER
Total Kjeldahl Nitrogen	INOR-93-6048	QuiKChem 10-107-06-2-I & SM 4500-Norg D	LACHAT FIA
Total Phosphorus	INOR-93-6022	SM 4500-P B&E	SPECTROPHOTOMETER
Chloride	INOR-93-6004	SM 4110 B	ION CHROMATOGRAPH
Fluoride	INOR-93-6004	SM 4110 B	ION CHROMATOGRAPH
Sulphate	INOR-93-6004	SM 4110 B	ION CHROMATOGRAPH
Total Aluminum	MET-93-6103	EPA SW-846 3010A & 6020A	ICP-MS
Total Antimony	MET-93-6103	EPA SW-846 3010A & 6020A	ICP-MS
Total Arsenic	MET-93-6103	EPA SW-846 3010A & 6020A	ICP-MS
Total Bismuth	MET-93-6103	EPA SW-846 3010A & 6020A	ICP-MS
Total Cadmium	MET-93-6103	EPA SW-846 3010A & 6020A	ICP-MS
Total Chromium	MET-93-6103	EPA SW-846 3010A & 6020A	ICP-MS
Total Cobalt	MET-93-6103	EPA SW-846 3010A & 6020A	ICP-MS
Total Copper	MET-93-6103	EPA SW-846 3010A & 6020A	ICP-MS
Total Iron	MET-93-6103	EPA SW-846 3010A & 6020A	ICP-MS
Total Lead	MET-93-6103	EPA SW-846 3010A & 6020A	ICP-MS
Total Manganese	MET-93-6103	EPA SW-846 3010A & 6020A	ICP-MS
Total Mercury	MET-93-6100	EPA SW 846-7470 & 245.1	CVAAS
Total Molybdenum	MET-93-6103	EPA SW-846 3010A & 6020A	ICP-MS
Total Nickel	MET-93-6103	EPA SW-846 3010A & 6020A	ICP-MS
Total Selenium	MET-93-6103	EPA SW-846 3010A & 6020A	ICP-MS
Total Silver	MET-93-6103	EPA SW-846 3010A & 6020A	ICP-MS
Total Tin	MET-93-6103	EPA SW-846 3010A & 6020A	ICP-MS
Total Titanium	MET-93-6103	EPA SW-846 3010A & 6020A	ICP-MS
Total Vanadium	MET-93-6103	EPA SW-846 3010A & 6020A	ICP-MS
Total Zinc	MET-93-6103	EPA SW-846 3010A & 6020A	ICP-MS

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AGAT Laboratories — Short Holding Time

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Mississauga, Ontario L4Z 1Y2
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webearth.agatlabs.com

Chain of Custody Record

If this is a Drinking Water sample, please use Drinking Water Chain of Custody Form (potable water consumed by humans)

Report Information:

Company: Terraprobe Inc.
Contact: Paul Raepple
Address: 903 Barton Street Unit 22
Stoney Creek L8E 5P5
Phone: 905-643-7560 Fax: 905-643-7559
Reports to be sent to:
1. Email: praepple@terraprobe.ca
2. Email:

Project Information:

Project: 7-16-0090-46
Site Location: Pier 8
Sampled By: A.B. / S.G.
AGAT Quote #: PO:
Please note: If quotation number is not provided, client will be billed full price for analysis.

Invoice Information:

Bill To Same: Yes ☑ No ☐
Company:
Contact:
Address:
Email: lrossi@terraprobe.ca

Regulatory Requirements:

(Please check all applicable boxes)

☐ No Regulatory Requirement

☐ Regulation 153/04
Table _____ *Indicate One*
☐ Ind/Com
☐ Res/Park
☐ Agriculture
Soil Texture *(Check One)*
☐ Coarse
☐ Fine

☑ Sewer Use
☑ Sanitary
☑ Storm
Region Hamilton *Indicate One*
☐ MISA

☐ Regulation 558
☐ CCME
☐ Prov. Water Quality Objectives (PWQO)
☐ Other
Indicate One

Is this submission for a Record of Site Condition? ☐ Yes ☑ No

Report Guideline on Certificate of Analysis ☐ Yes ☑ No

Sample Matrix Legend

B	Biota
GW	Ground Water
O	Oil
P	Paint
S	Soil
SD	Sediment
SW	Surface Water

Laboratory Use Only

Work Order #: 17H267979
Cooler Quantity:
Arrival Temperatures: 8.4 | 8.5 | 8.7 / 7.4 | 7.5 | 7.7
Custody Seal Intact: ☐ Yes ☐ No ☐ N/A
Notes: LG cooler

Turnaround Time (TAT) Required:

Regular TAT ☑ 5 to 7 Business Days

Rush TAT (Rush Surcharges Apply)

☐ 3 Business Days ☐ 2 Business Days ☐ Next Business Day

OR Date Required (Rush Surcharges May Apply):

Please provide prior notification for rush TAT
**TAT is exclusive of weekends and statutory holidays*

For 'Same Day' analysis, please contact your AGAT CPM

Sample Identification	Date Sampled	Time Sampled	# of Containers	Sample Matrix	Comments/ Special Instructions	Field Filtered - Metals, Hg, CrVI (Y/N)	Metals and Inorganics (O. Reg 153): ☐ All Metals ☐ 153 Metals (excl. Hydrides) ☐ Hydride Metals ☐ 153 Metals (incl. Hydrides); ORPs: ☐ B-HWS ☐ Cl⁻ ☐ CN⁻ ☐ $CrVI^{6+}$ ☐ EC ☐ FOC ☐ Hg ☐ pH ☐ SAR	Full Metals Scan	Regulation/Custom Metals	Nutrients: ☐ TP ☐ NH_3 ☐ TKN ☐ NO_3 ☐ NO_2 ☐ NO_3+NO_2	Volatiles: ☐ VOC ☐ BTEX ☐ THM	CCME Fractions 1 to 4	ABNs	PAHs	PCBs: ☐ Total ☐ Aroclors	Organochlorine Pesticides	TCLP: ☐ M&I ☐ VOCs ☐ ABNs ☐ B(a)P ☐ PCBs	Sewer Use (City of Hamilton)
MW 11 - F	Oct 4/17	3:30p	16	GW		N												✓
MW 11 - UF	Oct 4/17	4:00p	16	GW		Y												✓

	Date	Time	Received By	Date	Time
Samples Relinquished By: Amber Brooks	Oct 4/17	4:45p	Daniella Jaic	10/4/17	4:48pm
Samples Relinquished By: Daniella Jaic	10/5/17	1:45pm	Samples Received By: 2017/10/05		1:48
Samples Relinquished By: 2017/10/05		3:55	Samples Received By:		

Page 1 of 1

N°: T 048770

Pink Copy - Client | Yellow Copy - AGAT | White Copy- AGAT

DILLON CONSULTING

Appendix E

Risk Management Plan

April 2018

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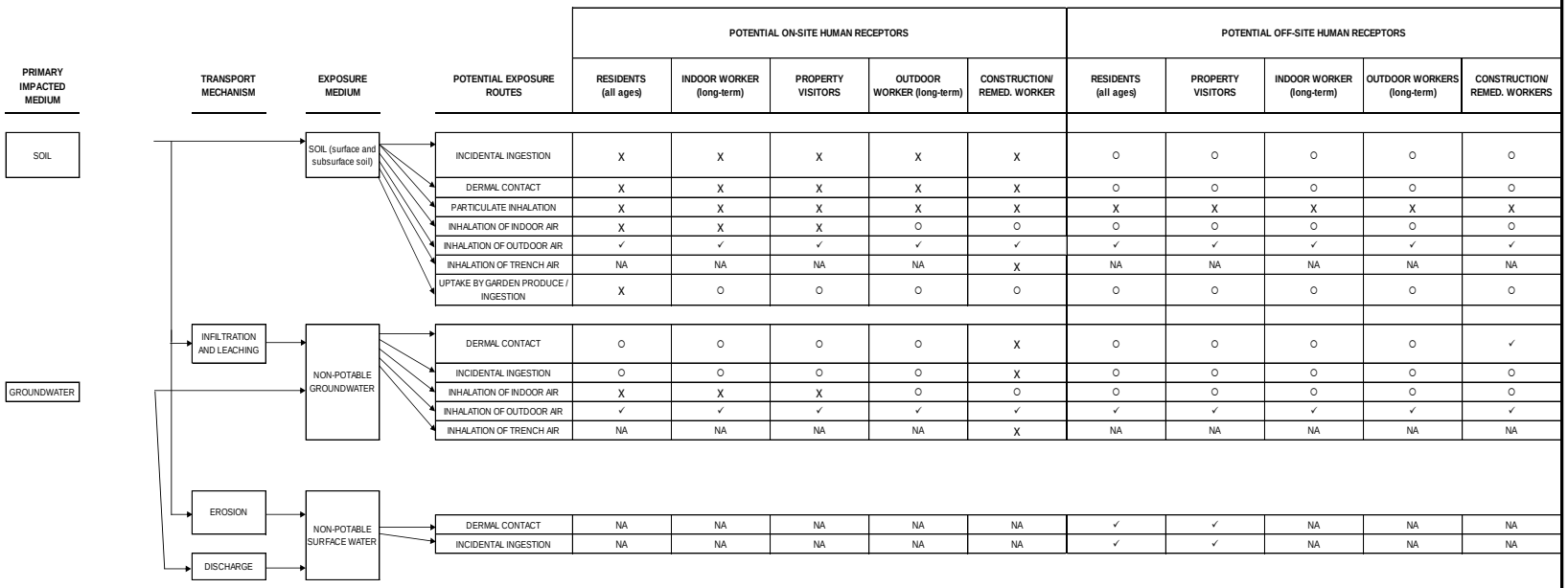
1.0 Risk Management Plan

1.1 Risk Management Plan

The results of the RA indicated that the resident (i.e., toddler and lifetime composite receptor), indoor worker (i.e., commercial worker), outdoor worker (i.e., maintenance worker), subsurface worker (e.g., construction worker engaged in excavation activities), and ecological receptors (i.e., plants and soil organisms, mammals and birds, as well as off-site aquatic receptors) could be exposed to COCs at concentrations that may result in potential adverse risks in the absence of risk management measures (RMMs) via one or more of the following exposure pathways: direct contact with soil, direct contact with groundwater, indoor air inhalation, soil particulate inhalation, and trench air inhalation.

RMMs that are recommended to be implemented at the Site include both administrative and physical RMMs. Administrative RMMs include: the implementation of site specific Health and Safety Plans (HASP) for subsurface workers (construction/remediation workers), and the implementation of a Soil and Groundwater Management Plan for the handling and disposal of potentially impacted soil and groundwater. Physical RMMs include the implementation of surface barriers (Engineered Barriers) and vapour intrusion mitigation measures below future buildings to manage or block the vapour intrusion exposure pathway (i.e., installation of Sub-Slab Vapour Barrier, Collection, and Venting system, or the presence of vehicle storage garages with separate air handling systems). The RMMs are described within the following subsections. The human health and ecological CSMs with proposed RMMs are presented as **Figure 7-1, Figure 7-2a** and **Figure 7-2b.**

Figure 7- 1 Human Health Conceptual Site Model With Risk Management Measures



PRIMARY IMPACTED MEDIUM	TRANSPORT MECHANISM	EXPOSURE MEDIUM	POTENTIAL EXPOSURE ROUTES	POTENTIAL ON-SITE HUMAN RECEPTORS					POTENTIAL OFF-SITE HUMAN RECEPTORS				
				RESIDENTS (all ages)	INDOOR WORKER (long-term)	PROPERTY VISITORS	OUTDOOR WORKER (long-term)	CONSTRUCTION/ REMED. WORKER	RESIDENTS (all ages)	PROPERTY VISITORS	INDOOR WORKER (long-term)	OUTDOOR WORKERS (long-term)	CONSTRUCTION/ REMED. WORKERS
SOIL		SOIL (surface and subsurface soil)	INCIDENTAL INGESTION	X	X	X	X	X	O	O	O	O	O
			DERMAL CONTACT	X	X	X	X	X	O	O	O	O	O
			PARTICULATE INHALATION	X	X	X	X	X	X	X	X	X	X
			INHALATION OF INDOOR AIR	X	X	X	O	O	O	O	O	O	O
			INHALATION OF OUTDOOR AIR	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
			INHALATION OF TRENCH AIR	NA	NA	NA	NA	X	NA	NA	NA	NA	NA
			UPTAKE BY GARDEN PRODUCE / INGESTION	X	O	O	O	O	O	O	O	O	O
GROUNDWATER	INFILTRATION AND LEACHING	NON-POTABLE GROUNDWATER	DERMAL CONTACT	O	O	O	O	X	O	O	O	O	✓
			INCIDENTAL INGESTION	O	O	O	O	X	O	O	O	O	O
			INHALATION OF INDOOR AIR	X	X	X	O	O	O	O	O	O	O
			INHALATION OF OUTDOOR AIR	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
			INHALATION OF TRENCH AIR	NA	NA	NA	NA	X	NA	NA	NA	NA	NA
	EROSION	NON-POTABLE SURFACE WATER	DERMAL CONTACT	NA	NA	NA	NA	NA	✓	✓	NA	NA	NA
	DISCHARGE		INCIDENTAL INGESTION	NA	NA	NA	NA	NA	✓	✓	NA	NA	NA

Notes:

✔ - Indicates a potentially complete exposure pathway
✓ - Indicates a potentially complete exposure pathway, but minimal
O - Indicates pathway incomplete
x - Indicates blocked pathway
NA - Indicates pathway not applicable

Figure 7- 2a Terrestrial Ecological Conceptual Site Model with Risk Management Measures

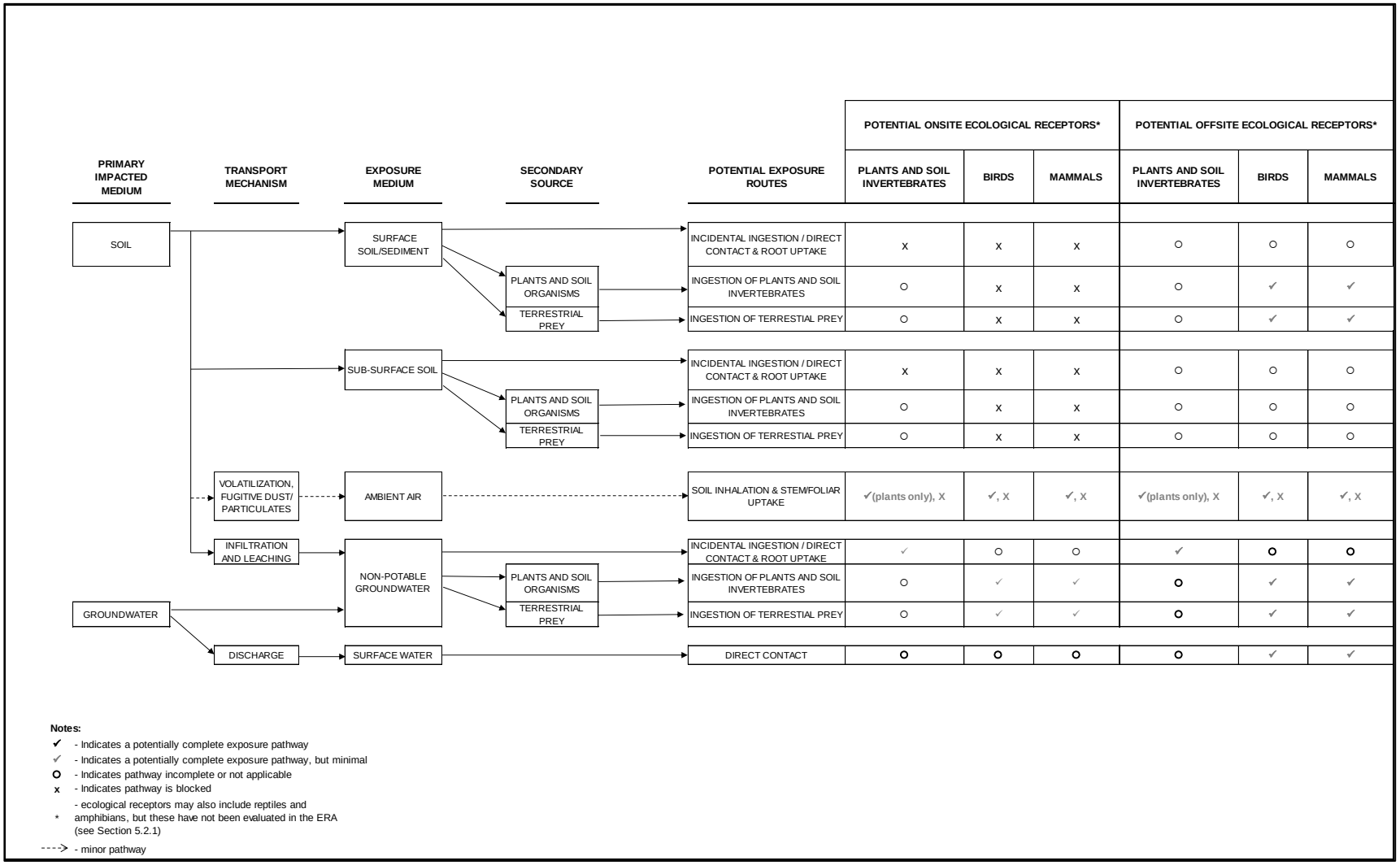
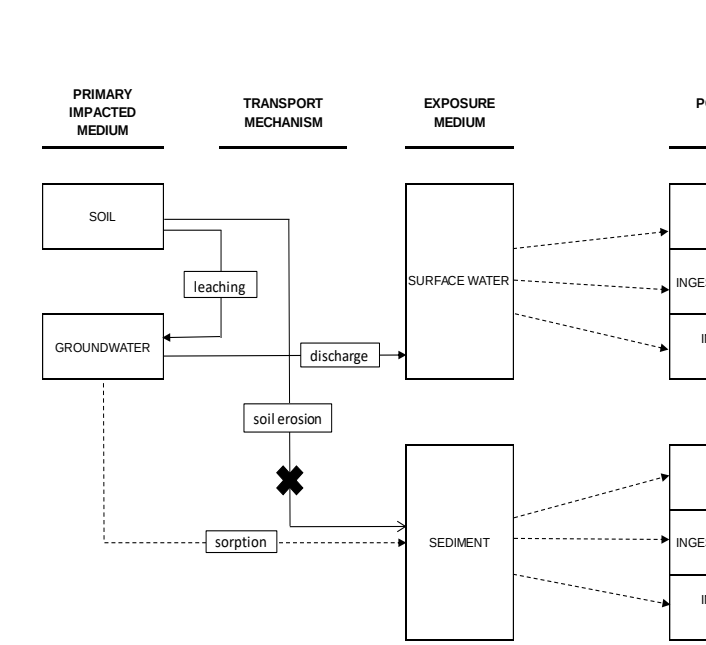


Figure 7-2b: Aquatic Ecological Conceptual Site Model With Risk Management Measures



PRIMARY IMPACTED MEDIUM	TRANSPORT MECHANISM	EXPOSURE MEDIUM	POTENTIAL EXPOSURE ROUTES	POTENTIAL ONSITE ECOLOGICAL RECEPTORS			POTENTIAL OFFSITE ECOLOGICAL RECEPTORS		
				AQUATIC PLANTS	AQUATIC INVERTEBRATES	FISH	AQUATIC PLANTS	AQUATIC INVERTEBRATES	FISH
SOIL	leaching, discharge, soil erosion	SURFACE WATER	DIRECT CONTACT	O	O	O	✓	✓	✓
			INGESTION OF AQUATIC PLANTS	O	O	O	O	✓	✓
			INGESTION OF AQUATIC INVERTEBRATES	O	O	O	O	O	✓
GROUNDWATER	discharge, sorption	SEDIMENT	DIRECT CONTACT	O	O	O	✓	✓	✓
			INGESTION OF AQUATIC PLANTS	O	O	O	O	✓	✓
			INGESTION OF AQUATIC INVERTEBRATES	O	O	O	O	O	✓

Notes:
✓ - Indicates a potentially complete exposure pathway
✓ - Indicates a potentially complete exposure pathway, but minimal
O - Indicates pathway incomplete or not applicable
X - Indicates pathway blocked
----> - minor pathway

1.1.1 Risk Management Performance Objectives

This RMP has been developed for the Site in order to address the potential human and ecological health risks.

The on-site human receptors and exposure pathways identified in the risk assessment that require specific RMMs to mitigate potential health risks include:

- Dermal contact/incidental ingestion of soil by residents (i.e., toddler and lifetime composite receptor), indoor workers, outdoor workers, and subsurface workers;
- Dermal contact/incidental ingestion of groundwater by subsurface workers (in excavation/ trench);
- Ingestion of garden produce by residents (i.e., toddler and lifetime composite receptor);
- Inhalation of soil vapours in indoor air by residents (i.e., toddler and lifetime composite receptors) and indoor workers;
- Inhalation of soil particulates by outdoor workers; and
- Inhalation of excavation/trench air by subsurface workers.

On-site ecological receptors identified in the risk assessment that require specific RMM to mitigate potential health risks based on exposure estimates are:

- Direct contact with soil and groundwater by plants and soil organisms; and
- Direct contact with soil and groundwater by mammals and birds.

The RMMs proposed herein will also serve to mitigate potential risks to off-site aquatic receptors in Lake Ontario via potential erosion of contaminated soil and through monitoring of contaminated groundwater.

The RMP outlines the RMMs required to protect human and ecological receptors. The RMP is intended to provide options for redevelopment of the Site that will achieve an on-site reduction in exposure concentrations to levels at or below risk benchmarks considered acceptable by the Ontario Ministry of the Environment and Climate Change (MOECC). Where identified, soil and groundwater impacts will remain in place at the Site following implementation of RMMs.

1.1.2 Exposure Reduction Objectives

The proposed Engineered Barrier and HASP RMMs are intended to achieve the exposure reductions to the Ontario Regulation 153/04 (O.Reg.153/04) Table 1 Site Condition Standards (SCS) for COCs in soil and groundwater. The vapour intrusion RMM is intended to achieve the exposure reductions in soil

vapour to the MOECC's Health-Based Indoor Air Criteria (HBIAC) for residential land use after applying the attenuation factor of 0.02 for vapour migration across the floor slab of a residential building (MOECC, 2016b). The exposure reductions required for RMMs to achieve the applicable standards in soil, groundwater, and soil vapour are presented in **Tables 7-1** to **7-4**. The RMM exposure reductions are calculated as follows:

Equation 7-1: Calculation of RMM Exposure Reduction Objectives

$$RMM_Concentration_Reduction = \left(\frac{COCmax - COCacc}{COCmax}\right) \times 100\%$$

Where: [COCacc] = Acceptable Concentration µg/g, µg/L, µg/m^3
[COCmax] = Maximum COC Concentration µg/g, µg/L, µg/m^3

Table 1-1: Soil COC Concentration Reduction

Required Risk Management Measure	COC	Maximum COC Concentration (µg/g)	O.Reg.153/04 Table 1 SCS (µg/g)	Reduction in Concentration Required (%)
Engineered Barrier – Soil direct contact and soil particulate inhalation exposure by resident, indoor worker, outdoor worker, and subsurface worker	Antimony	8.5	1.3	85%
	Arsenic	36.4	18	51%
	Cadmium	13.2	1.2	91%
	Cobalt	32.5	21	35%
	Copper	1,140	92	92%
	PHC F2	19,700	10	100%
	PHC F3	13,700	240	98%
	PHC F4	44,100	120	100%
	Benzo(a)anthracene	25.7	0.36	99%
	Benzo(a)pyrene	17.5	0.3	98%
	Benzo(b/j)fluoranthene	24.8	0.47	98%
	Benzo(ghi)perylene	8.3	0.68	92%
	Benzo(k)fluoranthene	8.06	0.48	94%
	Chrysene	25.2	2.8	89%
	Dibenzo(a,h)anthracene	3.16	0.1	97%
	Fluoranthene	48.2	0.56	99%

Required Risk Management Measure	COC	Maximum COC Concentration (µg/g)	O.Reg.153/04 Table 1 SCS (µg/g)	Reduction in Concentration Required (%)
	Indeno(1,2,3-cd)pyrene	9.44	0.23	98%
	Methylnaphthalene, 2-(1-)	440	0.59	100%
	PCBs	3.95	0.3	92%

Table 1-2: Groundwater COC Concentration Reduction

Required Risk Management Measure	COC	Maximum COC Concentration (µg/L)	O.Reg.153/04 Table 1 SCS (µg/L)	Reduction in Concentration Required (%)
Health and Safety Plan – Groundwater direct contact by subsurface worker	PHC F2	12,200	150	99%
	PHC F3	11,400	500	96%
	Fluoranthene	182	0.4	100%
	Methylnaphthalene	3,070	2	100%
	Benzo(a)anthracene	73.5	0.2	100%
	Benzo(a)pyrene	52.2	0.01	100%
	Benzo(b/j)fluoranthene	70.1	0.1	100%
	Benzo(ghi)perylene	25	0.2	99%
	Benzo(k)fluoranthene	29.7	0.1	100%
	Chrysene	64.6	0.1	100%
	Dibenzo(a,h)anthracene	6.82	0.2	97%
	Indeno(1,2,3-cd)pyrene	29.8	0.2	99%

Table 1-3: Soil Vapour COC Concentration Reduction

Required Risk Management Measure	COC	Predicted Indoor Air Concentration[a] ($\mu g/m^3$)	Health-Based Indoor Air Criteria[b] ($\mu g/m^3$)	Reduction in Concentration Required (%)
Vapour Intrusion RMM – Indoor air	Benzene	16* (3.1)	0.5	97% (84%)

Required Risk Management Measure	COC	Predicted Indoor Air Concentration[a] (µg/m^3)	Health-Based Indoor Air Criteria[b] (µg/m^3)	Reduction in Concentration Required (%)
inhalation by resident and indoor worker	Xylenes	332	146	56%
	PHC F1	17,520	2,490	86%
	PHC F2	694	471	32%
	1,2-dichloroethane	1.5* (0.015)	0.04	97% (n/a)
	1,4-dichlorobenzene	2.2 (0.02)	0.28	88% (n/a)
	Hexane	2,040	521	75%
	Trichloroethylene	2.0* (0.26)	0.27	87% (n/a)
	Methylnaphthalene 2-(1-)	3,648** (18.7)	0.77***	100% (96%)
	Vinyl chloride	0.9* (0.07)	0.13	86% (n/a)
	Naphthalene	3.9* (0.16)	0.77	81% (n/a)

Notes:

[a] Predicted indoor air concentration derived from the measured soil vapour concentration and application of the MOECC (2011b) default residential building attenuation factor of 0.02.

[b] MOECC Health-Based Indoor Air Criteria (HBIAC) established in the MGRA Tier 2 Model (MOECC, 2016a) for residential land use scenario.

" * ": Predicted indoor air concentration based on the raised laboratory detection limit. Predicted indoor air concentration based on the maximum detected vapour concentration and the required reduction concentration to the maximum detected concentration are provided in brackets.

" ** ": Sum of theoretical estimated vapour concentration from soil and groundwater. Pro-rated concentration based on observed difference between theoretical and measured concentrations for naphthalene shown in brackets.

" ***": In the absence of HBIAC value for methylnaphthalene, the HBIAC value for naphthalene was used as surrogate.

n/a: Predicted indoor air concentration based on the maximum detected concentration is lower than the HBIAC.

Table 1-4: Soil Vapour COC Concentration Reduction – Subsurface Worker in a Trench

Required Risk Management Measure	COC	Predicted Trench Air Concentration[a] (µg/m^3)	Health-Based Indoor Air Criteria[b] (µg/m^3)	Reduction in Concentration Required (%)
Health and Safety Plan – Trench air inhalation by subsurface worker	Trichloroethylene	8.9* (1.2)	0.87	91% (28%)
	Methylnaphthalene 2-(1-)	16,416** (84.3)	2.65	100% (97%)

Notes:

[a] Predicted trench air concentration derived from the measured soil vapour concentration and application of an attenuation factor of 0.09.

[b] MOECC Health-Based Indoor Air Criteria (HBIAC) established in the MGRA Tier 2 Model (MOECC, 2016a) for commercial/industrial land use scenario. The HBIAC was conservatively used for calculation of exposure reduction.

" * ": Predicted trench air concentration based on the raised laboratory detection limit. Predicted trench air concentration based on the maximum detected vapour concentration and the required reduction concentration to the maximum detected concentration is provided in brackets.

" ** ": Sum of theoretical estimated vapour concentration from soil and groundwater.

" ***": In the absence of HBIAC value for methylnaphthalene, the HBIAC value for naphthalene was used as surrogate.

n/a: Predicted indoor air concentration based on the maximum detected concentration is lower than the HBIAC.

1.1.3 Risk Management Measures

The recommended risk management measures, exposure pathways that they address, and relevant on-site receptors are outlined in **Table 7-5**.

Table 1-5: Proposed Risk Management Measures

Receptors	Exposure Pathways Addressed	Risk Management Measures
Residents, indoor workers, outdoor workers, and subsurface workers, terrestrial and aquatic ecological receptors	Direct contact with soil (human and ecological receptors) and soil particulate inhalation; garden produce ingestion (residents)	Engineered Barrier (Hardscape or Soil Cap)
Residents and indoor workers	On-site vapour intrusion to indoor air	Vapour Intrusion RMM (Vehicle Storage Garage or Sub-Slab Vapour Barrier, Collection, and Venting system) for buildings

Receptors	Exposure Pathways Addressed	Risk Management Measures
Subsurface worker	Direct contact with soil and groundwater, and air inhalation in trench	Health and Safety Plan
Residents, outdoor workers, and subsurface workers	Direct contact with soil and groundwater	Soil and Groundwater Management Plan
Off-site aquatic receptors	Erosion and deposition of sediment Groundwater discharge	Engineered Barrier Groundwater Monitoring

1.1.3.1 Engineered Barriers

The risk assessment identified that various metals, PHCs and PAHs in soil may represent a risk via the direct contact pathway for the resident, indoor worker, and outdoor worker, as well as to terrestrial and aquatic ecological receptors. In addition, cadmium in soil may represent a risk via soil particulate inhalation for the outdoor worker. In addition, in the absence of reliable exposure estimates via consumption of home garden produce, it was conservatively assumed that unacceptable risk may occur to the resident receptors via this pathway. Therefore, Engineered Barriers are required at the Site to mitigate the risk associated with the identified COCs in impacted soils. Engineered Barriers will consist of either a Soil Cap or a Hardscape, as described below. The Engineered Barriers will provide 100% blockage of the soil direct contact and soil particulate inhalation pathways, as well as prevent erosion of potentially impacted materials to Lake Ontario. Unimpacted soil is soil in which no contaminant is present or in which one or more contaminants are present, but at a concentration less than the applicable O.Reg.153/04 Table 1 SCS. Specific information associated with each Engineered Barrier RMM is included in the following sections.

Hardscape Cap

Where redevelopment areas will be covered by hard surfaces, including buildings, parking facilities, and other hardscape areas, the Hardscape Cap shall consist of a minimum thickness of 225 mm, as follows:

- Hot mix asphalt or poured concrete of at least 75 mm thickness underlain by 150 mm or more of Granular 'A' and/or Granular 'B' aggregate or equivalent sub-base material (building slabs or building foundation and floor slabs shall also meet this requirement); and/or
- Other hardscape materials such as pavers or flagstone, underlain by Granular 'A' and/or Granular 'B' aggregate or equivalent sub-base material to provide a total minimum thickness of 225 mm.

Typical cross-sectional views illustrating Hardscape Cap barrier requirements are shown on **Figure E-3** in **Appendix E**. Imported granular fill (base and sub-base materials) for construction of the RMMs shall be

from a commercial sand and gravel pit or quarry licensed by the Ministry of Natural Resources pursuant to the *Aggregate Resources Act, R.S.O. 1990*. If not from a commercial source, then granular materials shall meet the applicable O.Reg.153/04 Table 1 SCS. Soils imported to the Site shall be sampled in accordance with the Requirements of Schedule E of O.Reg.153/04 for soils brought to an RSC property.

Soil Cap

Where Hardscape Cap will not be used in the redevelopment areas (e.g., landscape areas), the following Soil Cap will be required:

- At least 1.0 m of unimpacted (clean) soil on top of the impacted soil. Imported soil (non-granular) fill shall meet the the applicable O.Reg.153/04 Table 1 SCS. **Figure E-3** in **Appendix E** provides generic details associated with the required Soil Cap. Soils imported to the Site shall be sampled in accordance with the Requirements of Schedule E of O.Reg.153/04 for soils brought to an RSC property. Soils excavated from the Site can be reused on-site if it meets Table 1 SCS and sampled in accordance with the Requirements of Schedule E of O.Reg.153/04.

Cap Requirement for Deep-Rooting Trees

Where future plantings of deeper rooting trees are to occur, the following minimum cap requirement will apply:

- At least 1.5 m of unimpacted (clean) soil on top of the impacted soil. The clean soil shall be extended laterally at a thickness of 1.5 m to the expected drip line of the mature tree. Imported soil (non-granular) fill shall meet the the applicable O.Reg.153/04 Table 1 SCS. **Figure E-3** in **Appendix E** provides generic details associated with the required Cap. Soils imported to the Site shall be sampled in accordance with the Requirements of Schedule E of O.Reg.153/04 for soils brought to an RSC property.

General

Given the widespread presence of historical fill across the Site, it is assumed that Engineered Barriers as described herein will be required in all areas. It should be noted that the Engineered Barrier RMMs can be integrated with the surface treatment design specifications for future developments. The RMM designs illustrated in **Figure E-3** in **Appendix E** are provided as examples of the minimum requirements for inclusion in future detailed design specifications for the Site. The detailed designs for redevelopment are not currently available. These example RMMs provide the minimum requirements of the Engineered Barrier RMMs.

Existing (Pre-Development) Conditions

Current conditions at the Site include existing surface coverings with asphalt, concrete, compacted granular materials, or vegetated/landscaped areas. In addition, much of the area has restricted access and is fenced. These existing surface coverings are considered to serve as adequate mitigative measures to serve as interim barrier caps at the Site prior to redevelopment activities.

Once site preparation work begins and these existing surfaces are disturbed, access to the redevelopment area shall be restricted through the use of fencing (e.g., chain link fencing, construction hoarding) until such time as the new engineered barrier system is in place. In addition, dust control measures shall be implemented as required to control fugitive dust/particulate emissions from any disturbed areas.

1.1.3.2 Vapour Intrusion RMM

The risk assessment identified that exposures to one or more of PHC F1, PHC F2, benzene, xylenes, trichloroethylene, hexane, 1,2-dichloroethane, 1,4-dichlorobenzene, vinyl chloride, naphthalene, and methylnaphthalene 2-(1-) in indoor air may have the potential to result in adverse health effects on residents (i.e., toddler and composite receptors) and indoor worker receptors at the Site. Therefore, RMMs will be required in the design of any buildings constructed on the Site with potential vapour intrusion concerns to address the potential migration of soil vapours to indoor air.

The recommended vapour intrusion RMMs include either the inclusion of a vehicle storage garage that includes a ventilation system that is in compliance with the applicable requirements of the Ontario Building Code (O.Reg.350/06), or a Sub-slab Vapour Barrier, Collection and Venting system (or a combination of the two in cases where a vehicle storage garage does not cover the full footprint of the occupied structure). Specific information associated with these RMMs are included in the following sections.

Vehicle Storage Garage

As an option to mitigate the migration of vapours to indoor air, future buildings may include a vehicle storage garage (parking garage), as defined in O.Reg.350/06 (Building Code). As required by Section 6.2.2.3 – *Ventilation of Storage and Repair Garages* of O.Reg.350/06 (Building Code), the parking garage will include a mechanical (intermittent) ventilation system meeting the requirements of this regulation and that will function as a soil vapour RMM for the building. The ventilation system should have an intermittent supply of outdoor air at a rate of not less than 3.9 L/s for each square meter of floor area. Sub-grade portions of buildings will be used only for underground parking, and will be maintained at an air pressure less than adjoining portions of the building that are used for residential or commercial occupancy. According to the MOECC's MGRA model (2016c), this is sufficient to provide a 99.5% (i.e., factor of 200) blockage of the vapour intrusion pathway for non-developmental toxicants and 91.6% (i.e., factor of 12) blockage for trichloroethylene, meeting the reduction requirements of **Table 7-3**. Methylnaphthalene 2-(1-) is the only COC for which the required concentration reduction was greater than 99.5%, however this was based on the application of theoretical soil vapour concentrations known to be overly conservative. As indicated in **Table 7-3**, the required concentration reduction would be much lower using the pro-rated concentration of methylnaphthalene 2-(1-) that would be expected to occur based on the measured naphthalene concentrations (i.e., 195 times lower, as the measured naphthalene concentrations were approximately 195 times lower than the theoretical concentrations). Pro-rating in this manner is considered valid as a means of providing a reasonable approximation of the

expected concentrations of methylnaphthalene 2-(1-) as the properties of these methylnaphthalene isomers relevant to the issue of volatilization and vapour migration do not vary significantly from those of naphthalene (i.e., similar vapour pressures and Henry's law constants). While there is certainly a higher degree of uncertainty with the predicted concentration based on pro-rating, it is noted that the actual concentration would only have to be 25 times lower than the theoretical concentration to meet the concentration reduction requirement (i.e., concentrations much higher than the pro-rated concentration would still be acceptable). Since there can be considered to be a high degree of certainty that the actual concentrations would be at least 25 times lower than the theoretical concentrations, there is a high degree of confidence that the concentration reduction requirement would be achieved. It is further noted that there is additional conservatism in that the naphthalene concentration considered here was actually based on a sample with elevated detection limits, and therefore likely overestimates actual naphthalene concentrations in soil vapour (which would result in a still greater difference between the measured and theoretical concentrations; thus the 195 times pro-rating is likely conservative).

It is noted that the vehicle storage garage option is not limited to the development of an underground storage garage, as it could also be developed at grade or partially below grade, so long as it physically separates occupied commercial or residential spaces from the ground surface, and it includes equivalent ventilation to that specified herein.

Sub-Slab Vapour Barrier, Collection and Venting System

New buildings that are to be constructed on-site that do not include a vehicle storage garage are required to include a Sub-slab Vapour Barrier, Collection and Venting system. A conceptual Sub-slab Vapour Barrier, Collection and Venting system is shown on **Figure E-4** and **Figure E-5** in **Appendix E**. The conceptual designs are provided as examples of the minimum requirements for incorporation to future detailed building design specifications for the Site. The detailed designs for redevelopment are not currently available. These conceptual designs provide the minimum requirements of the Sub-slab Vapour Barrier, Collection and Venting system. Final designs will need to consider geotechnical requirements for building foundations and the structural and mechanical designs of the buildings. Final designs for the vapour mitigation systems shall be completed by a Professional Engineer licensed in Ontario.

The Vapour Barrier shall be a continuous vapour proof geomembrane below the floor slab of the building(s). Joints and seams shall be water/vapour proof and welded in accordance with manufacturer's recommendations. Geomembrane boots for penetrations (e.g., vent stack risers, sewer connections, foundation piles) shall be welded to the continuous geomembrane barrier and sealed around penetrations in accordance with manufacturer's and designer's recommendations. Vapour barrier material shall be a minimum of 1 mm (40 mils) thick and have appropriate chemical resistance to the site's COCs including consideration of COCs in vapours generated in the LNAPL area. Examples of industry standard vapour barriers include generic high density polyethylene (HDPE) or linear low density

polyethylene (LLDPE) with welded joints, and spray on barriers such as Cetco's Liquid Boot® 500; however, a number of geomembrane barriers can provide equal protection and chemical resistance and may be equally suitable for selection by the building's designers. Vapour barriers shall have the following minimum specifications with respect to vapour permeability for the COCs. When tested in accordance with American Society for Testing of Materials (ASTM) D814, "Vapour Transmission of Volatile Liquids," the solvent vapour permeability shall be equal to or less than 10 g/m^{3}hr. When tested in accordance with ASTM D1434, "Determining Gas Permeability Characteristics of Plastic Film and Sheeting," the vapour transmission value for methane permeability shall be equal to or less than 690 mL/m^2-day.

The Vapour Barrier shall be installed and joined or welded in accordance with the manufacturer's recommendations by qualified installers. Following installation, quality assurance (QA) testing shall be conducted on the completed installation to evaluate the integrity of the Vapour Barrier and its seams. The QA tests will be in accordance with manufacturer's recommendations for gas permeability and may include smoke testing or other non-destructive test methods. The QA test results shall be recorded and provided in the as-built documentation for the buildings.

The Vapour Barrier shall be underlain and overlain by protective layers that may consist of a cushioning geotextile or a sand layer protecting the barrier from damage during the construction of the overlying concrete floor slab and from pressures against the underlying venting media. With the Vapour Barrier in place, blocking the soil vapour to indoor air pathway for volatile COCs, the thickness of the concrete floor slab is not significant from an attenuation perspective; however, a minimum thickness of 112.5 mm is the recommended thickness, matching the default floor thickness in the MOECC Approved Model for MGRA (MOECC, 2016c). As the floor slab also serves the purpose of a hardscape cap, it must not be less than 75 mm in thickness (and minimum 225 mm total thickness including sub-base or venting layer). The vapour barrier will provide 100% blockage of the pathway, meeting the reduction requirements detailed in **Table 7-3**.

The secondary Vapour Collection and Venting System, underlying the Vapour Barrier, will consist of a series of perforated pipes placed on 1.2 m centres below the floor slab. Pipe materials shall have appropriate chemical resistance (in the vapour phase) to the Site's COCs including consideration of COCs in vapours generated in the LNAPL area. It is envisioned that 100 mm diameter schedule 40 PVC piping will be the selected material providing adequate chemical resistance and structural stability for the sub-slab vapour collection, but other piping materials may also be appropriate as selected by the building's mechanical designers. Above grade piping and components must meet the requirements of the Ontario Building Code. The collection piping will be placed mid-depth in a 300 mm thick venting media layer. Vertical vent stacks extending above the floor slab and through the building shall be as true (i.e., vertical) as possible and extend a minimum of 0.90 m above the roof. The vent stacks can also be placed along the outer building wall. There shall be a minimum of one vent stack and associated sample port for each residential unit (on the lowest level of residential occupancy), or one vent stack and sample

port for every 1,000 m^2 of commercial units (i.e., depending on whether the lowest level of occupancy is residential or commercial). Vent stacks (running in passive mode) shall be completed above the roof elevation with a wind turbine to enhance the passive venting. Vent stacks shall be located away from any building air intake or openable windows.

The venting media layer consists of a material with suitably high gas permeability rates and structural stability (i.e., must be able to support the floor slab and building loads). Homogenous granular materials such as pea gravel or clear stone with an average diameter of 6.3 mm (1/4") or larger would be suitable. Alternatively, specialty building products designed for sub-slab depressurization and ventilation may also be appropriate depending on final building designs. Precaution in the construction of the venting media layer must be taken to minimize the migration of materials (e.g., fines, concrete) into the venting media that could reduce its gas permeability. Geotextile filter cloth may need to be incorporated into the designs to address this concern. Given the presence of shallow groundwater on the Site (i.e., < 1 m below ground surface in some areas), drains or openings are required at the end of collection pipes to ensure drainage and dewatering of the soil vapour venting layer, if required.

The Vapour Collection and Venting System can be operated as a passive or active system. It is anticipated that Sub-slab Vapour Barriers and Vapour Collection and Venting systems installed at the Site will initially operate as passive systems which are expected to provide adequate blockage of the soil vapour to indoor air pathway and protection to the human (e.g., indoor) receptors.

Should monitoring of the sub-slab vapours indicate the potential for unacceptable indoor air impacts (see **Section 7.1.5.2**), the Vapour Collection and Venting System could be converted to active operation, as a contingent action, through the addition of a blower(s) and the application of a slight vacuum to the sub-slab venting media layer. Selection of blower specifications will be dependent on final sub-slab designs; however, based on guidance published by the United States Environmental Protection Agency (Indoor Air Vapour Intrusion Mitigation Approaches - USEPA, 2008), the reliable demonstration of a differential pressure of 4 to 10 pa [0.0006 to 0.0014 psi] between ambient building pressure and sub-slab pressures throughout the building is sufficient to show a negative pressure gradient has been achieved and the pathway blocked.

1.1.3.3 Site Specific Health and Safety Plan

The risk assessment identified potential risks to human health for the subsurface worker (e.g., construction or utility worker involved in excavation activities) via direct contact with soil and groundwater (including light non-aqueous phase liquid (LNAPL)) and inhalation of excavation/trench air under a scenario in which no RMMs are in place. Potential subsurface worker exposures to impacted soil and groundwater will be addressed via the use of a site specific Health and Safety Plan (HASP), personal protective equipment (PPE), and engineering controls as required by the Ontario *Occupational Health and Safety Act* (OHSA, 1990) and associated regulations. Specifically, O.Reg. 213/91 Construction Projects and O.Reg. 632/05 Confined Spaces include requirements for monitoring of the breathing zone

for hazardous gases, engineering controls such as; purging/ventilation of excavations and confined spaces, excavation dewatering, and project specific PPE such as full length clothing, waterproof boots, gloves and respiratory protection as appropriate to the task. At the time of construction, the landowner or tenant must communicate the known site hazards to the Constructor who is responsible for the development and implementation of a site specific HASP. The HASP shall be prepared by a Competent Person (as defined in OHSA) in consultation with a Qualified Person (as defined in O.Reg. 153/04) and provided to the landowner or tenant prior to any intrusive activities being undertaken at the Site. The HASP shall specifically include (but is not limited to) the following:

- Identification of the required PPE and work procedures to reduce potential dermal contact and incidental ingestion exposures by subsurface workers (with soil and groundwater, and potential LNAPL[1]) to acceptable levels.
- Identification of the required monitoring, PPE and work procedures to reduce inhalation of vapours generated from potentially impacted soil or groundwater/LNAPL by subsurface workers to acceptable levels. This includes identifying monitoring equipment, procedures and record keeping, requirements for additional ventilation of excavations, and PPE as required).
- Work procedures for decontamination and hygiene shall also be identified.

These requirements apply both to activities during redevelopment of the Site and to activities completed after site redevelopment (e.g., trenching for new utilities, etc.). For the latter scenario, these requirements do not apply to activities that are limited to the depth of the Engineered Barrier (i.e., do not involve excavation or trenching into materials below the barrier cap).

1.1.3.4 Soil and Groundwater Management Plan

Independent of the application of Engineered Barrier RMMs as described above, the development of the Site may require the excavation, short term stockpiling, relocation and disposal of impacted soil and placement of compacted engineered fill to permit the installation of various design features including parking lots, building footings, foundations and floors, and landscaped (green) areas. Further, during the redevelopment activities, it is possible that management of groundwater from excavation/trench dewatering may be required at the Site. The management of impacted soil and groundwater shall be governed by the implementation of a Soil and Groundwater Management Plan. A Soil and Groundwater Management Plan shall be developed by a QP_{ESA} for the owner and provided to contractors undertaking subsurface site works. Site works (i.e., excavations, soil handling, and dewatering) shall be overseen and documented by a QP_{ESA} retained by the site owner or tenant. The Soil and Groundwater Management Plan shall include provisions for:

[1] Residual light non-aqueous phase liquid (LNAPL) may be encountered in the vicinity of the former Shed 6 within development blocks 2 and 3, as well as roadways in this area.

- Excavations and on-site handling to reduce the COC exposures and inadvertent relocation of COCs, to include dust control measures (e.g., spraying with potable water) and the minimization of contaminant tracking in equipment tracks and treads (e.g., equipment/tire/tread wash stations).
- Temporary stockpile requirements including measures to control contact with underlying materials (e.g., liners), designation of stockpile areas, site security and access, and storm water runoff control (e.g., silt fences, filter socks for catch-basins and utility covers).
- Characterization of excavated materials to determine if materials exceed the PSSs and require off-site disposal in accordance with R.R.O.Reg.347, or if the material meets the appropriate SCS and is appropriate for on-site reuse based on testing in accordance with Schedule E of O.Reg. 153/04.
- Disposal requirements including that waste soils only be transported by haulers approved for waste transport in Ontario (i.e., holder of Waste Management System Certificate of Approval or registered with Ontario's Environmental Activity Sector Registry) to waste management facilities approved in Ontario through a Waste Disposal Site Certificate of Approval or Environmental Compliance Approval (or appropriately approved in other jurisdictions).
- Excavation dewatering requirements: in the event there is a need for temporary construction dewatering to keep an excavation free of groundwater, dewatering activities shall be conducted under Permit to Take Water approvals from the MOECC (as applicable), as well as an agreement to discharge to the City of Hamilton sanitary sewer and/or an Environmental Compliance Approval (ECA) for Industrial Sewage Works issued by the MOECC. Temporary construction dewatering activities will not involve any discharges to the natural environment, unless an appropriate industrial sewage works Certificate of Approval or ECA is provided for the Site and the applicable discharge monitoring conducted. If excavation dewatering is required in areas where LNAPL may be encountered (vicinity of the former Shed 6 within development blocks 2 and 3, as well as roadways in this area), measures shall be implemented to collect and contain the LNAPL and any groundwater mixed with LNAPL, and this shall be disposed of off-site by a licensed hauler and in accordance with applicable requirements for hazardous liquid waste disposal.
- Record keeping requirements: dates, weather conditions, duration of the works, location and depth of excavation activities and dewatering activities, sample collection details and the implementation of the above required provisions, names and contact information for the Qualified Persons, contractors, receiving and source sites shall be recorded. Also, any complaints received related to the site's activities including soil, storm water, and any groundwater management activities shall be recorded.

1.1.3.5 Off-Site Implications of Proposed RMMs

The implementation of the above noted RMMs and future development of the Site will not negatively impact off-site human health and ecological receptors. The future implementation of RMMs will not materially change the current subsurface and hydrogeological conditions of the Site (e.g., groundwater

gradients or flow direction) such that contaminants are adversely redistributed in groundwater or soil. Furthermore, similar impacts to soil and groundwater are known to exist on the neighbouring properties to the west (i.e., Piers 6 and 7) and likely on the adjacent property to the east considering similar history of construction and fill placement, and historical port activities on these properties. Notwithstanding, as documented in the Phase Two ESA (Dillon, 2016) and supporting documents it is believed that migration of either dissolved impacts or LNAPL impacts on the Site are in a stable or steady state condition.

With respect to the adjacent surface water (Hamilton Harbour/Lake Ontario), implementation of the Engineered Barrier RMM is expected to mitigate the potential discharge of contaminants from the site via potential soil erosion. As noted above, it is believed that migration of either dissolved impacts or LNAPL impacts on the Site are in a stable or steady state condition, and this will be verified through monitoring (see **Section 7.1.5.3**).

1.1.4 Duration of Risk Management Measures

This section describes the required duration of the risk management measures.

1.1.4.1 Duration of Administrative RMMs

Administrative RMMs including site specific Health and Safety Plan and Soil and Groundwater Management Plan are required as long as COCs are present on the Site at concentrations above the applicable SCS, or until such time as they are revoked by the MOECC upon the request of the owner.

1.1.4.2 Duration of Engineered Barriers

Engineered Barriers are required as long as COCs are present in soils on the Site at concentrations above the applicable SCS, or until such time they are revoked by the MOECC upon the request of the owner.

1.1.4.3 Duration of Vapour Intrusion RMM

Vehicle Storage Garage

The Vehicle Storage garage requirement shall be maintained as long as volatile COCs (PHC F1, PHC F2, semi-volatile and volatile organic compounds) are present in soil or groundwater at the Site at concentrations above their applicable SCS, LNAPL is present, or until such time as the requirement for the vapour intrusion RMM is revoked by the MOECC upon the request of the owner.

Sub-Slab Vapour Barrier, Collection and Venting System

The Sub-Slab Vapour Barriers and Vapour Collection and Venting systems requirement shall be maintained as long as volatile COCs (PHC F1, PHC F2, semi-volatile and volatile organic compounds) are present in soil or groundwater at the Site at concentrations above their applicable SCS, LNAPL is present, or until such time as they are revoked by the MOECC upon the request of the owner.

Please note that either or both of these RMMs must be maintained as indicated above, depending on which RMM was selected for the building in question.

1.1.5 Requirements for Monitoring and Maintenance

1.1.5.1 Engineered Barriers

The Site owner shall conduct semi-annual inspections of the Engineered Barrier RMMs. Inspections will take place in the spring and fall of each year and will be recorded on a form that documents, at a minimum, the inspection date, barrier status (checklist), and the inspector's signature. The inspections will check the integrity of the Hardscape or Soil Cap Engineered Barriers. Any deficiencies (e.g. excessive potholes) or breaches (e.g., unwarranted excavations) in the barriers will be recorded and repaired in a manner consistent with the minimum RMM requirements as soon as practical to maintain the exposure pathway blocking and in accordance with the Soil Management Plan.

Monitoring will also be required for re-development and post-development excavation activities to ensure that any RMM barriers breached by planned or emergency excavations are repaired or replaced in a manner consistent with the minimum RMM requirements for Engineered Barriers. Soil excavated from below the barriers shall not be left on surface and shall be disposed of off-site or reused at depth (below reinstated barriers) in accordance with the Soil Management Plan. This work shall be overseen by a QPESA and documented. Record documents will include the reason for excavation, the monitoring date(s), approximate quantities of materials imported or removed/reused, environmental quality of imported materials and final barrier status.

Interim Barriers and Fencing – As noted in **Section 7.1.3.1**, existing surface coverings at the Site are considered to serve as adequate mitigative measures to serve as interim barrier caps prior to redevelopment activities. These surfaces should also be inspected semi-annually as outlined above until such time as the permanent barriers are installed. Similarly, any fencing restricting access to disturbed areas during redevelopment should be inspected on a regular basis (at least semi-annually but more frequently as required depending on the nature of activities at the Site) and any deficiencies corrected forthwith.

1.1.5.2 Vapour Intrusion RMM

Vehicle Storage Garage

The mechanical ventilation system for the vehicle storage garage needs to be semi-annually inspected for components such as air intakes, blowers, and exhaust ducts for blockage. The inspections need to be recorded on a form that documents, at a minimum, the inspection date, the status of mechanical system components (checklist), and the inspector's signature.

Sub-Slab Vapour Barrier, Collection and Venting System

Building/site owner(s) will operate the Sub-Slab Vapour Barrier, Collection and Venting system in accordance with its Operation & Maintenance Manual (to be prepared by the building designer(s) in association with a QP_{ESA}). The Manual will be developed in association with the design and installation of the system and will include as-built records. In general, it is anticipated that the operational monitoring

will include semi-annual inspections of the system to ensure inlet/discharge pipes are in good condition and free of debris, and that building floor slabs remain intact. The inspections will be recorded on a form that documents, at a minimum, the inspection date, system status (checklist), and the inspector's signature. In the event that the system is upgraded to an active collection system, additional monitoring requirements will include verification of blower operation and the collection of vacuum readings on the blower(s) intake(s) and any other monitoring ports.

Confirmatory sub-slab vapour samples will be collected semi-annually from dedicated sub-slab sample ports installed in the sand protection layer on top of the vapour barrier (see **Figure E-6** in **Appendix E**) and analyzed for the chemicals listed as COCs in **Section 7.1.2**. Sub-slab vapour samples shall be collected and analyzed in accordance to the MOECC's "Draft Technical Guidance Soil Vapour Intrusion Assessment" (MOECC, 2013). An ambient outdoor air sample shall also be collected during sampling events to provide data on background conditions. Ambient weather conditions (e.g., barometric pressure, temperature, precipitation, relative humidity) will also be recorded. The first monitoring round shall be conducted after building completion but prior to occupancy. Sub-slab vapour monitoring trigger concentrations are provided in **Table 7-3.** Sub-slab trigger values are the MOECC HBIAC for residential property use divided by a default attenuation factor of 0.02. Should sub-slab vapour concentrations exceed the trigger values, the QP_{ESA} shall notify the District Manager (Director) within 10 days of receiving the analytical results and shall develop a contingency action plan for approval to the Director within 30 days after confirming the exceedance. Confirmatory sampling should be completed within 15 days of the receipt of the analytical results at the locations where the exceedance initially occurred. The contingency action plan may consider the following contingency actions:

- More frequent sampling to assess variability in sub-slab vapours at the locations where the initial exceedance occurred;
- Smoke testing or pressure testing of the geomembrane vapour barrier to evaluate blockage of the pathway;
- Measurement of ambient pressures gradients (sub-slab vs. indoor), to evaluate potential for migration across vapour barrier membrane and concrete floor slab;
- Conversion of the passive venting system to an active collection system;
- Modification of the building's ventilation rates; and/or,
- Completion of an indoor air sampling program.

Sub-slab vapour sampling will be completed semi-annually for three years to assess seasonal trends. After this initial three year period, if stable to declining trends in sub-slab vapour concentrations are confirmed and below the trigger concentrations (**Table 7-3**) application can be made by a QP_{ESA} on behalf of the owner to the MOECC to remove the sub-slab sampling requirement.

1.1.5.3 Groundwater/LNAPL Monitoring

Ongoing groundwater monitoring will be completed to validate that the dissolved phase groundwater and LNAPL plumes are stable, and thus, interpreted to not pose a potentially unacceptable risk to the adjacent aquatic environment in Hamilton Harbour. LNAPL and groundwater monitoring are proposed for the continued assessment of seasonal conditions and the potential for LNAPL migration, as well as dissolved contaminant migration at concentrations exceeding the Groundwater Trigger Concentrations (see below). Five groundwater monitoring locations are proposed at locations down gradient of areas where LNAPL or dissolved COC concentrations in excess of the GW3 component criteria have been observed (see **Figure E-6** in **Appendix E;** this includes three locations to the north of the LNAPL zone, and two locations in the south-western portion of the site). These will consist of new water table monitoring wells proximal to the harbour dockwall. In addition, three LNAPL monitoring locations have been proposed at locations downgradient of the LNAPL zone (former Shed 6 area), in order to confirm that LNAPL is not migrating towards the surface water receiver. These would consist of existing locations MW144, MW145, and MW149.

The LNAPL mass in the LNAPL zone is considered stable (Dillon, 2016); however, fluctuations in LNAPL thicknesses are expected to occur with seasonal fluctuations in the water table. To assess the trends in the LNAPL thickness to demonstrate long-term stability, recovery well RW8, located centrally within the LNAPL zone, is proposed to monitor the free product thickness trends with the LNAPL zone. Following installation of RW8 in March 2017, the maximum recorded thickness of LNAPL at this location was 0.38 m. It is proposed that this will be the trigger level for which contingency actions will be required (i.e., if greater thicknesses than this are observed).

Groundwater/LNAPL monitoring at the identified monitoring wells (or equivalent replacement wells) will be completed quarterly for two years to assess seasonal trends, and semi-annually thereafter. After the initial two year period, if stable to declining trends in COC groundwater concentrations are confirmed, migration of LNAPL has not been observed, and LNAPL is considered to be stable, application can be made by a QP_{ESA} on behalf of the owner to the MOECC to remove the groundwater/LNAPL monitoring requirement. It is noted that if LNAPL is completely removed from the Site in the future, a QP_{ESA} on behalf of the owner can provide supporting documentation confirming this condition to the MOECC and can apply to remove the LNAPL monitoring requirements.

Groundwater monitoring will include: sample collection, analysis of COCs at the five new groundwater monitoring locations, evaluation of LNAPL presence/absence at the three existing locations (MW144, MW145, and MW149), and LNAPL thickness measurements at RW8. The need for contingency actions will be triggered through the monitoring program based on:

- Dissolved PHC F2 concentrations at one or more of the five groundwater monitoring locations proximal to the dockwall in excess of the GW3 component value associated with the Table 3 SCS (i.e., 970 µg/L – see additional discussion below); or

- The presence of LNAPL at any one or more of the three LNAPL monitoring locations (as confirmed through the presence of a measurable thickness of separate phase product); or
- LNAPL thickness greater than 0.38 m at RW8 located within the LNAPL zone.

If any of these conditions is met, the implementation of contingency measures shall consist of the development of a groundwater and/or LNAPL management plan by a QP_{ESA}. This shall be based on the findings of the monitoring program and any additional monitoring that may be required in the opinion of the QP_{ESA}, such that any change in risks to the down gradient surface water receiver is identified, as well as an evaluation of whether remedial measures may be required. If required, appropriate remedial measures will be identified and implemented (e.g., hydraulic control by pumping, LNAPL recovery, or in-situ remediation remedies). The QP_{ESA} shall notify the District Manager (Director) within 10 days of receiving the analytical results or observation of LNAPL in the down-gradient monitoring wells or exceedances of the LNAPL thickness trigger criteria and shall develop a contingency action plan for approval to the Director within 30 days after confirming the exceedance. Confirmatory sampling should be completed within 15 days of the receipt of the analytical results at the locations where the exceedance initially occurred.

The GW3 component value associated with the Table 3 SCS (as opposed to the Table 9 SCS) was selected as a trigger concentration protective of the adjacent aquatic environment of Hamilton Harbour based on the following rationale:

- The hydraulic conductivity of the shallow fill materials underlying the Site where the water table aquifer occurs is significantly lower than that assumed by the MOECC in the development of the generic SCS. The geometric mean hydraulic conductivity of the fill unit based on in-situ testing was determined to be 2.6×10^{-6} m/s (approximately 12 times lower than the value of 3×10^{-5} m/s assumed in the derivation of the generic SCS).
- Hamilton harbour (an embayment of Lake Ontario) affords significantly greater dilution potential than assumed in the derivation of the generic SCS. As discussed in **Section 4.2.2**, the theoretical groundwater flux into the harbour using Darcy's equation is estimated to be approximately 2.0×10^{-5} m^3/s. This is based on an assumed cross-section of dockwall for a length of 250 m (i.e., 150 m along north of LNAPL zone and 100 m along the west/southwest site boundary) and height of 10 m, hydraulic conductivity of 2.6×10^{-6} m/s, and horizontal gradient of 0.003 m/m (i.e., estimated for the areas near the harbour). The estimated groundwater flux is approximately five orders of magnitude lower than the estimated rate of flushing of 2.7 m^3/s in the harbour (calculated based on an estimated harbour volume of 254×10^6 m^3 and rate of flushing of approximately three years). While clearly this level of dilution would not immediately occur at the groundwater-surface water interface, it should be noted that the discharge to the harbour is not a point source discharge, but rather would represent a slow rate of discharge dispersed throughout the area that then rapidly dilutes within the harbour through wave and current action. This discharge would thus be reflective of typical groundwater concentrations at the site as opposed to higher concentrations that occur in localized areas, and it is noted that

typical groundwater contaminant levels at the site either did not exceed the Table 1 SCS, or would only require minimal dilution to be considered acceptable in surface water (i.e., far less dilution than would be expected to actually occur).

- These factors are considered to more than compensate for the additional conservatism applied by the MOECC in the setting of the GW3 component value associated with the Table 9 SCS.

Groundwater monitoring will be conducted under the supervision of a QP_{ESA} in accordance with the requirements of O.Reg. 153/04 and O.Reg. 903. A minimum of one blind field duplicate quality assurance sample will be collected per sampling event. Additionally, one trip blank sample will be prepared and analyzed per event. Groundwater samples will be analyzed by a CALA accredited laboratory.

Only PHC F2 has been identified as a COC in groundwater for which dissolved phase groundwater sampling and analysis has been proposed as this represents the only contaminant observed at concentrations exceeding the GW3 criteria at locations outside of the LNAPL zone, and is considered the most appropriate parameter for monitoring of potential petroleum hydrocarbon related impacts at the Site.

1.1.5.4 Reporting

An annual report will be provided to the MOECC District Office within two months of collection of the last monitoring sample for that reporting year. The report will present the inspection and monitoring results for the Engineered Barrier RMMs and the Sub-slab Vapour Barrier, Collection and Venting system RMMs for the year (including monitoring results and an evaluation of the need for contingency actions), in addition to the results of the groundwater/LNAPL monitoring program.

1.1.6 Financial Assurance

Financial Assurance requirements do not apply as the Site is owned by a municipal authority.

1.1.7 Closure

This Risk Management Plan (RMP) has been prepared as part of the Risk Assessment (RA) submission in support of the filing of a Record of Site Condition (RSC) for Pier 8 in Hamilton, Ontario. The RMP is an integral part of the RA submission and is subject to the same assumptions and limitations as identified in the main RA report.

Respectfully submitted,
DILLON CONSULTING LIMITED

Tom Grimminck, P.Eng.
Environmental Engineer, Associate



Figures

FIGURE E-1: HUMAN HEALTH CONCEPTUAL SITE MODEL WITH RISK MANAGEMENT MEASURES

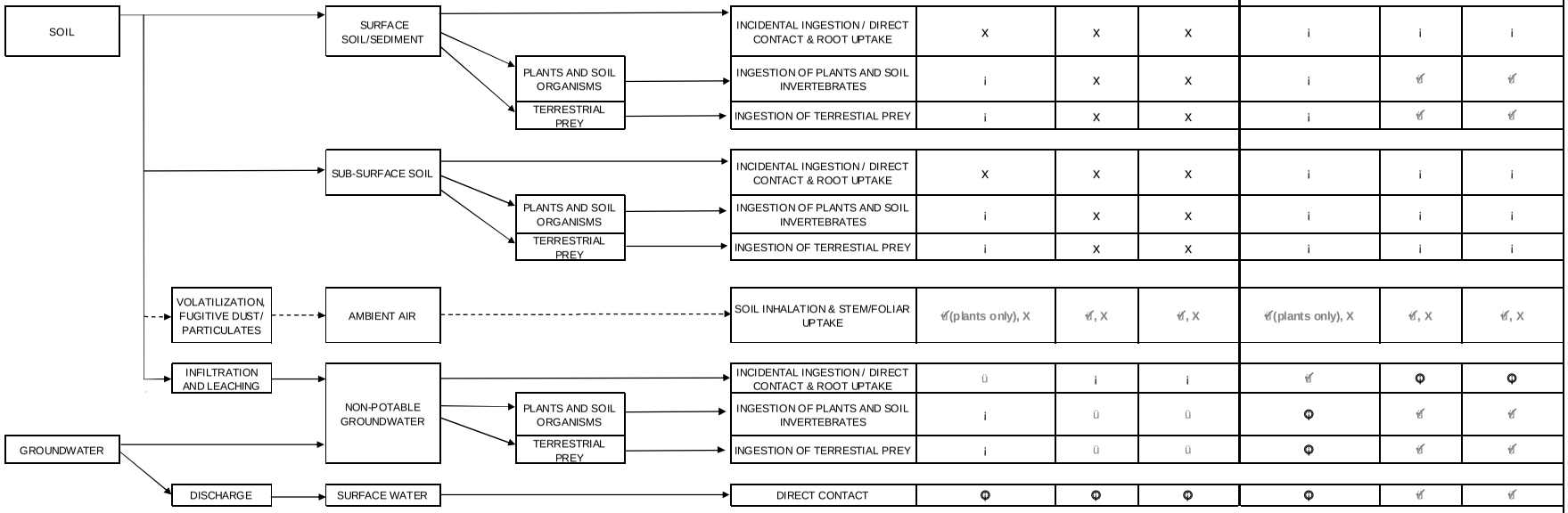


PRIMARY IMPACTED MEDIUM	TRANSPORT MECHANISM	EXPOSURE MEDIUM	POTENTIAL EXPOSURE ROUTES	POTENTIAL ON-SITE HUMAN RECEPTORS					POTENTIAL OFF-SITE HUMAN RECEPTORS				
				RESIDENTS (all ages)	INDOOR WORKER (long-term)	PROPERTY VISITORS	OUTDOOR WORKER (long-term)	CONSTRUCTION/ REMED. WORKER	RESIDENTS (all ages)	PROPERTY VISITORS	INDOOR WORKER (long-term)	OUTDOOR WORKERS (long-term)	CONSTRUCTION/ REMED. WORKERS
SOIL		SOIL (surface and subsurface soil)	INCIDENTAL INGESTION	X	X	X	X	X	i	i	i	i	i
			DERMAL CONTACT	X	X	X	X	X	i	i	i	i	i
			PARTICULATE INHALATION	X	X	X	X	X	X	X	X	X	X
			INHALATION OF INDOOR AIR	X	X	X	i	i	i	i	i	i	i
			INHALATION OF OUTDOOR AIR	ü	ü	ü	ü	ü	ü	ü	ü	ü	ü
			INHALATION OF TRENCH AIR	NA	NA	NA	NA	X	NA	NA	NA	NA	NA
			UPTAKE BY GARDEN PRODUCE / INGESTION	X	i	i	i	i	i	i	i	i	i
GROUNDWATER	INFILTRATION AND LEACHING	NON-POTABLE GROUNDWATER	DERMAL CONTACT	i	i	i	i	X	i	i	i	i	ü
			INCIDENTAL INGESTION	i	i	i	i	X	i	i	i	i	i
			INHALATION OF INDOOR AIR	X	X	X	i	i	i	i	i	i	i
			INHALATION OF OUTDOOR AIR	ü	ü	ü	ü	ü	ü	ü	ü	ü	ü
			INHALATION OF TRENCH AIR	NA	NA	NA	NA	X	NA	NA	NA	NA	NA
	EROSION	NON-POTABLE SURFACE WATER	DERMAL CONTACT	NA	NA	NA	NA	NA	ü	ü	NA	NA	NA
	DISCHARGE		INCIDENTAL INGESTION	NA	NA	NA	NA	NA	ü	ü	NA	NA	NA

Notes:

ü - Indicates a potentially complete exposure pathway
ü - Indicates a potentially complete exposure pathway, but minimal
i - Indicates pathway incomplete
x - Indicates blocked pathway
NA - Indicates pathway not applicable

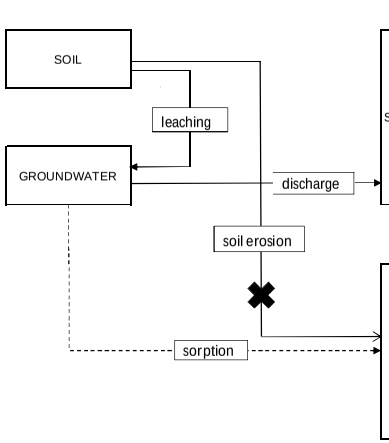
FIGURE E-2a: TERRESTRIAL ECOLOGICAL CONCEPTUAL SITE MODEL WITH RISK MANAGEMENT MEASURES



Notes:

- ✓ - Indicates a potentially complete exposure pathway
- ✓ - Indicates a potentially complete exposure pathway, but minimal
- Ø - Indicates pathway incomplete or not applicable
- x - Indicates pathway is blocked
- * - ecological receptors may also include reptiles and amphibians, but these have not been evaluated in the ERA (see Section 5.2.1)
- ---> - minor pathway

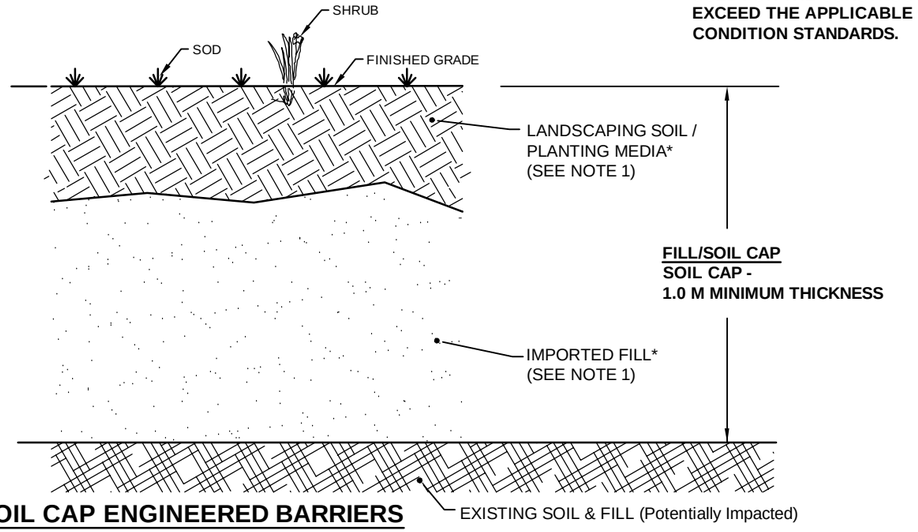
FIGURE E-2b: AQUATIC ECOLOGICAL CONCEPTUAL SITE MODEL WITH RISK MANAGEMENT MEASURES



PRIMARY IMPACTED MEDIUM	TRANSPORT MECHANISM	EXPOSURE MEDIUM	POTENTIAL EXPOSURE ROUTES	POTENTIAL ONSITE ECOLOGICAL RECEPTORS			POTENTIAL OFFSITE ECOLOGICAL RECEPTORS		
				AQUATIC PLANTS	AQUATIC INVERTEBRATES	FISH	AQUATIC PLANTS	AQUATIC INVERTEBRATES	FISH
SOIL	leaching	SURFACE WATER	DIRECT CONTACT	⊘	⊘	⊘	✓	✓	✓
GROUNDWATER	discharge		INGESTION OF AQUATIC PLANTS	⊘	⊘	⊘	⊘	✓	✓
			INGESTION OF AQUATIC INVERTEBRATES	⊘	⊘	⊘	⊘	⊘	✓
SOIL	soil erosion	SEDIMENT	DIRECT CONTACT	⊘	⊘	⊘	✓	✓	✓
GROUNDWATER	sorption		INGESTION OF AQUATIC PLANTS	⊘	⊘	⊘	⊘	✓	✓
			INGESTION OF AQUATIC INVERTEBRATES	⊘	⊘	⊘	⊘	⊘	✓

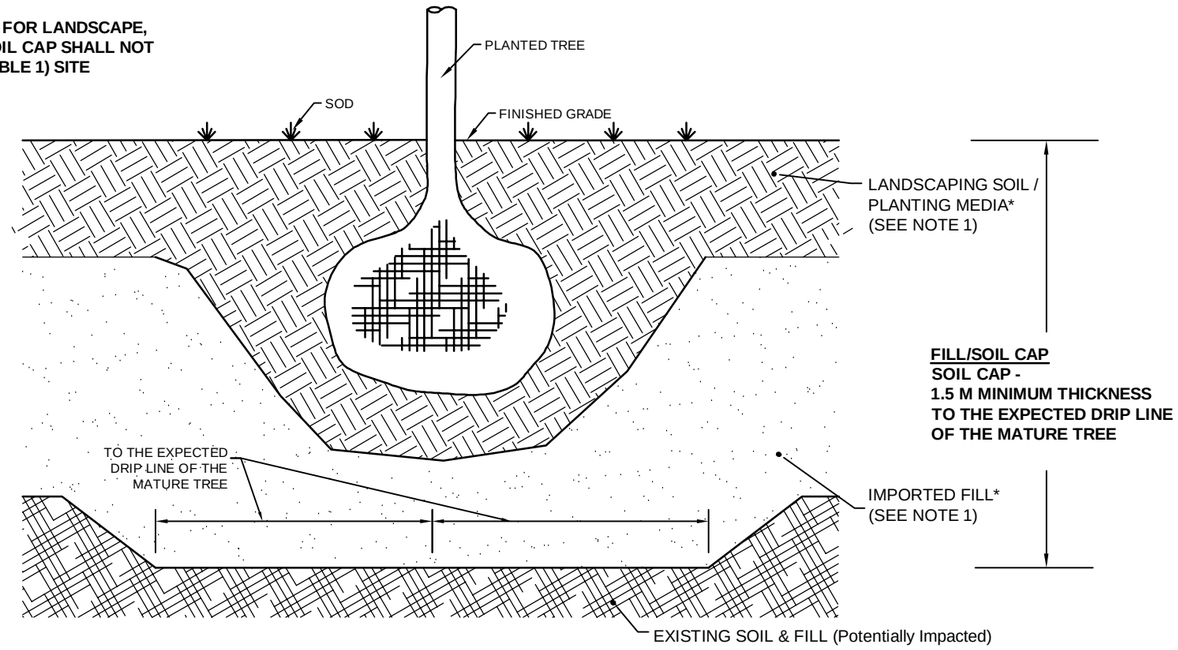
Notes:
- ✓ - Indicates a potentially complete exposure pathway
- ✓ - Indicates a potentially complete exposure pathway, but minimal
- ⊘ - Indicates pathway incomplete or not applicable
- X - Indicates pathway blocked
- ----> - minor pathway

NOTE 1:
SOIL OR FILL INCLUDING PLANTING MEDIA FOR LANDSCAPE, USED FOR THE CONSTRUCTION OF FILL/SOIL CAP SHALL NOT EXCEED THE APPLICABLE MOECC (E.G. TABLE 1) SITE CONDITION STANDARDS.

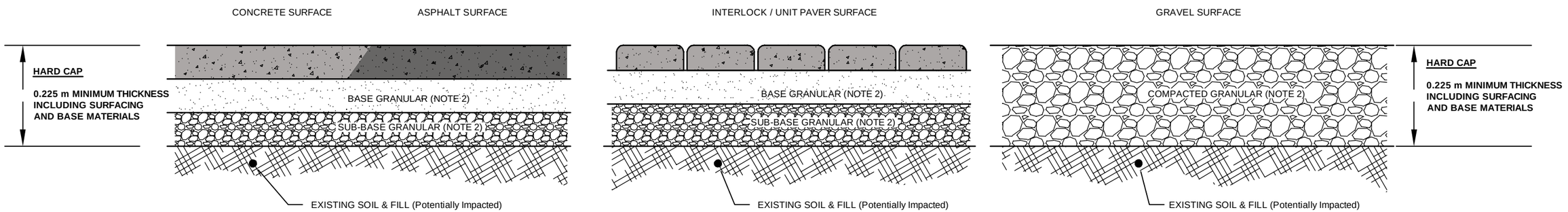


SOIL CAP ENGINEERED BARRIERS
N.T.S.

FILL/SOIL CAP RISK MANAGEMENT MEASURE - GENERAL
N.T.S.



FILL/SOIL CAP RISK MANAGEMENT MEASURE - DEEP ROOTING PLANTS
N.T.S.



HARD CAP RISK MANAGEMENT MEASURE
N.T.S.

NOTE 2:
BASE, SUB-BASE AND GRANULAR FILL MUST BE FROM A COMMERCIAL SAND AND GRAVEL PIT OR QUARRY LICENSED BY THE MNRF PURSUANT TO THE AGGREGATE RESOURCES ACT, OR IF NOT FROM A COMMERCIAL SOURCE, GRANULAR MATERIALS SHALL NOT EXCEED THE APPLICABLE MOECC SITE CONDITION STANDARDS.

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NOTES:

The conceptual designs are provided as examples of the minimum requirements. These are not detailed design drawing, nor construction drawings. These conceptual designs provide the minimum requirements for the Hardscape and Soil Cap Engineered Barriers. Final designs will need to consider site planning, transportation, geotechnical and landscaping requirements for the Site.

NOT FOR CONSTRUCTION

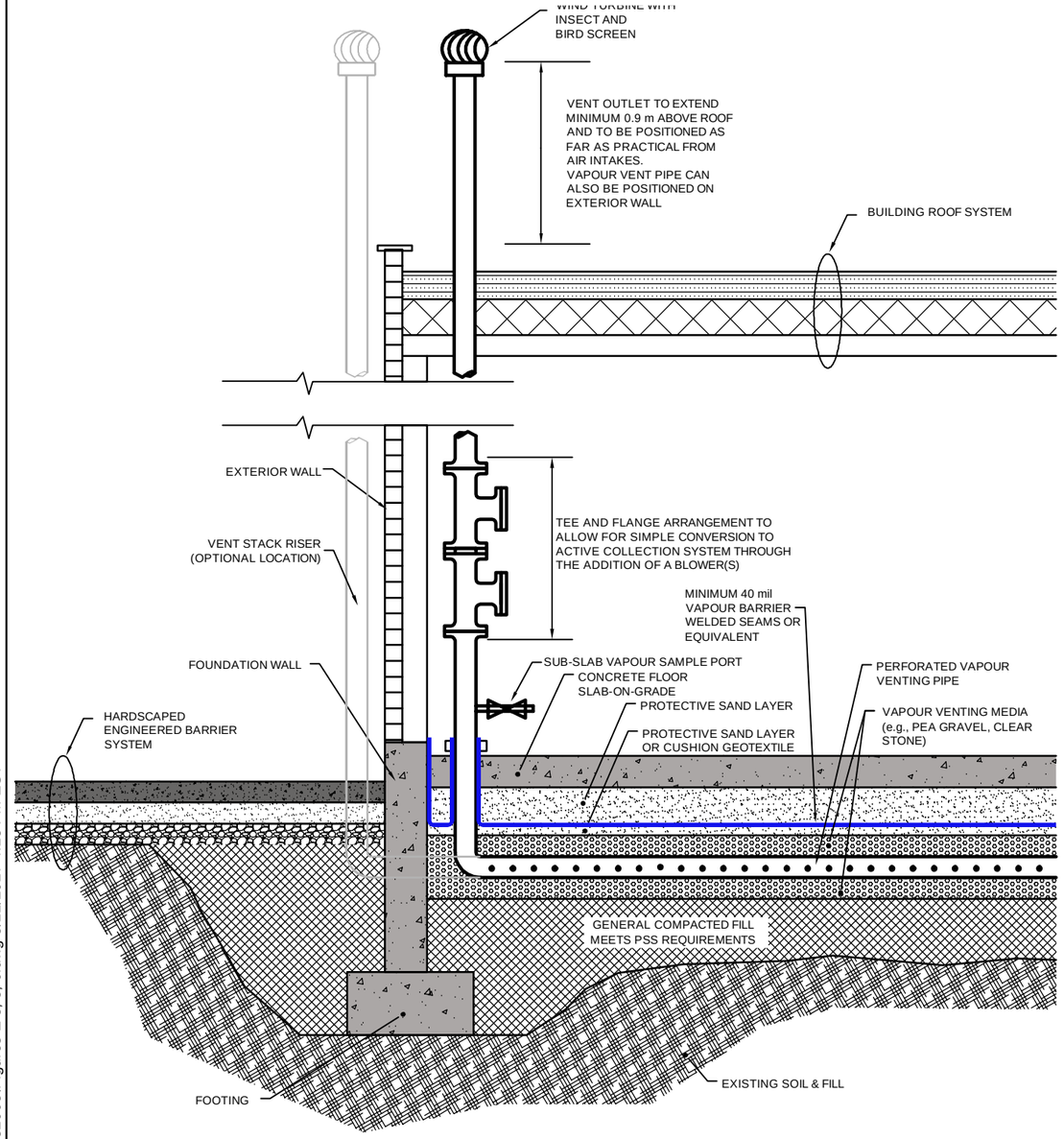
LICENSED PROFESSIONAL ENGINEER — THG — T.H. GRIMMINCK — May 2, 2018 — PROVINCE OF ONTARIO

CONCEPTUAL DESIGN ENGINEERED BARRIERS PIER 8, HAMILTON, ON

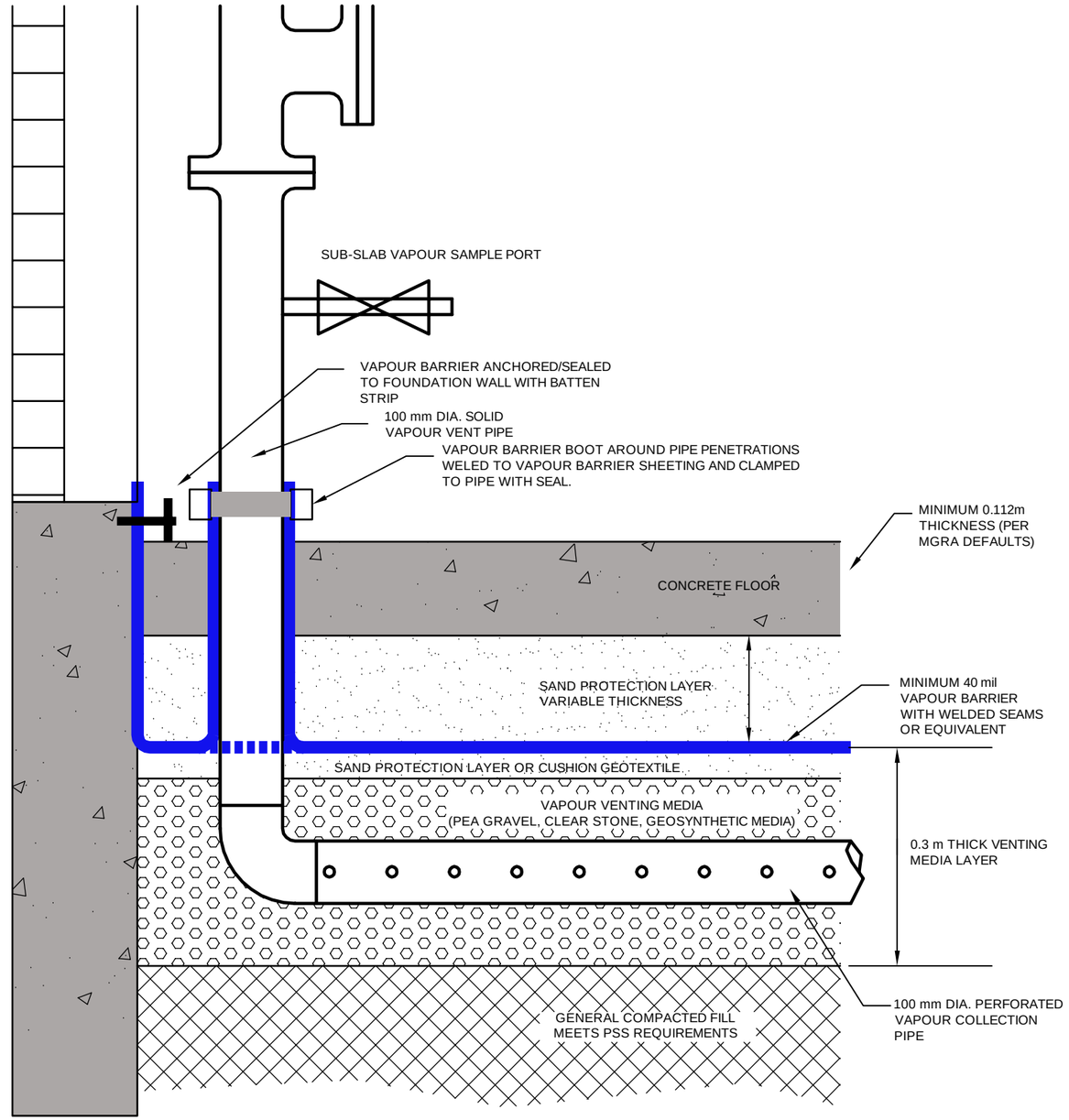
Proj. Manager:	DB	Drawn By:	AZ
Scale:	NTS	Checked By:	THG
Date Issued:	May 2018	Project No:	16-3774
		File Name:	Figure E-3, 4, 5

Figure No. **E-3**

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CONCEPTUAL DESIGN
VAPOUR BARRIER AND VENTING SYSTEM - CROSS-SECTION
N.T.S.



CONCEPTUAL DESIGN
VAPOUR BARRIER AND VENTING SYSTEM - CLOSE-UP
N.T.S.

DILLON CONSULTING

NOTES:

The conceptual designs are provided as examples of the minimum requirements. These are not detailed design drawing, nor construction drawings. These conceptual designs provide the minimum requirements for the Sub-slab Vapour Barrier, Collection and Venting system. Final designs will need to consider geotechnical requirements for building foundations and the structural and mechanical designs of the buildings.

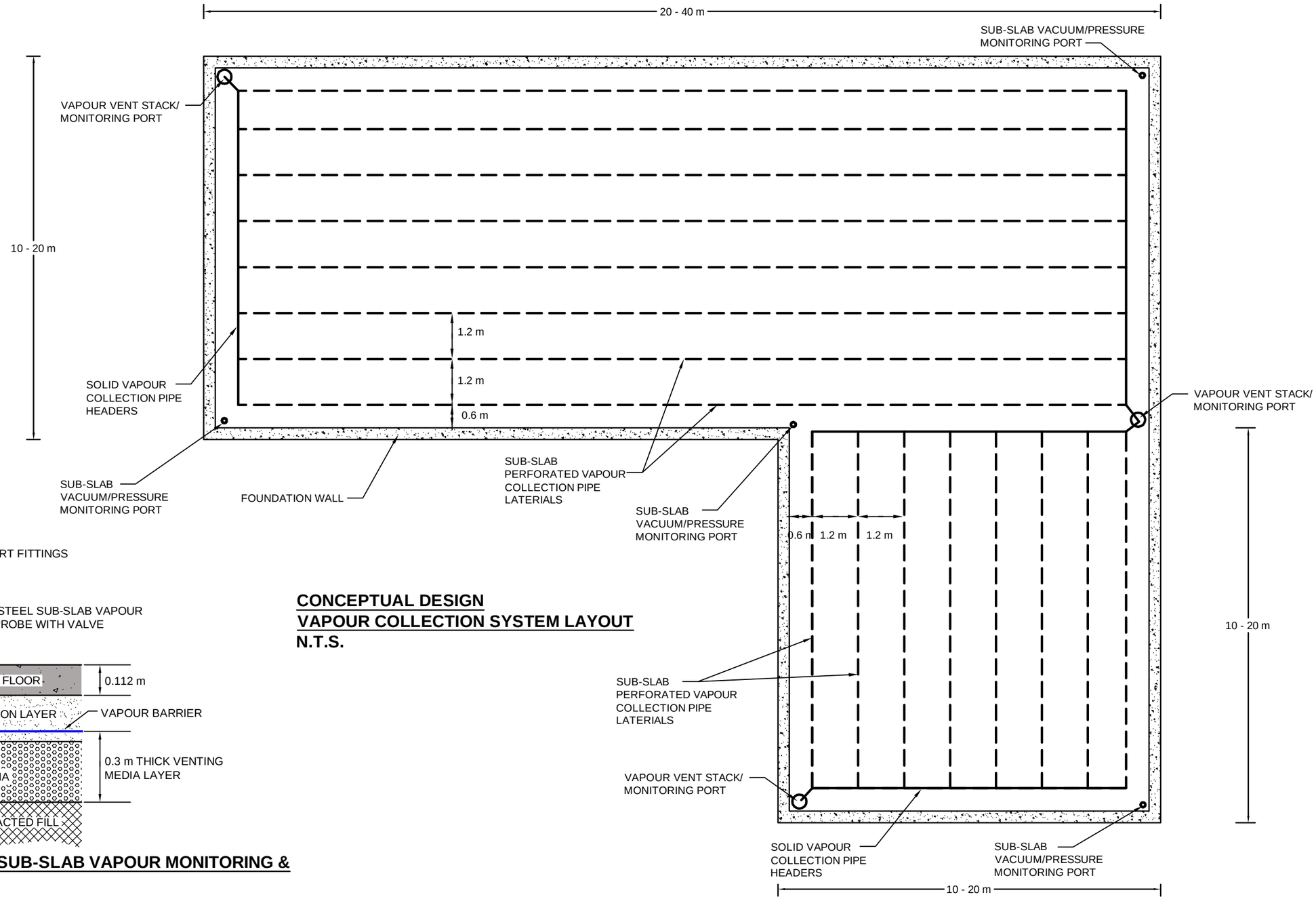
NOT FOR CONSTRUCTION

LICENSED PROFESSIONAL ENGINEER — THG — T.H. GRIMMINCK — Jun. 12 2017 — PROVINCE OF ONTARIO

CONCEPTUAL DESIGN - SUB-SLAB VAPOUR BARRIER, COLLECTION & VENTING SYSTEM - SHEET 1
PIER 8, HAMILTON, ON

Proj. Manager:	DO	Drawn By:	AZ	Figure No.
Scale:	NTS	Checked By:	AA	**E-4**
Date Issued:	May 2017	Project No:	16-3774	
		File Name:	Figure E-3, 4, 5, 6	

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DETAIL A: DEDICATED SUB-SLAB VAPOUR MONITORING & SAMPLING PORT
N.T.S.

CONCEPTUAL DESIGN
VAPOUR COLLECTION SYSTEM LAYOUT
N.T.S.

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DILLON CONSULTING

NOTES:

The conceptual designs are provided as examples of the minimum requirements. These are not detailed design drawing, nor construction drawings. These conceptual designs provide the minimum requirements for the Sub-slab Vapour Barrier, Collection and Venting system. Final designs will need to consider geotechnical requirements for building foundations and the structural and mechanical designs of the buildings.

NOT FOR CONSTRUCTION

LICENSED PROFESSIONAL ENGINEER
THG
T.H. GRIMMINCK
JUN. 12 2017
PROVINCE OF ONTARIO

CONCEPTUAL DESIGN - SUB-SLAB VAPOUR BARRIER, COLLECTION & VENTING SYSTEM - SHEET 2
PIER 8, HAMILTON, ON

Proj. Manager:	DO	Drawn By:	AZ	Figure No.
Scale:	NTS	Checked By:	AA	E-5
Date Issued:	May 2017	Project No:	16-3774	
		File Name:	Figure E-3, 4, 5, 6	

Hamilton

RISK MANAGEMENT PLAN
PIER 8,
HAMILTON, ONTARIO

PROPOSED GROUNDWATER MONITORING LOCATIONS AND PROPOSED LNAPL MONITORING LOCATION
FIGURE E-6

- Recovery Well
- New Groundwater Monitoring Location (F2)
- NAPL Monitoring Location
- Test Pit
- Borehole
- Monitoring Well
- Excavation Wall Sample
- Existing Aboveground Fuel Storage Tank
- Existing Underground Fuel Storage Tank
- Former Aboveground Fuel Storage Tank
- Former Underground Fuel Storage Tank
- Historical Test Location
- Estimated Area of Free Product/Sheen
- Internal Fence
- Sun Canada & Imperial Oil Pipeline
- Sanitary Sewer
- Forcemain
- Storm Sewer
- Watermain
- Building
- Former Building
- Study Area
- Property Boundary
- Water Body

1:1,500

0 10 20 40 60 m

MAP DRAWING INFORMATION:
DATA PROVIDED BY MNR

MAP CREATED BY: GM
MAP CHECKED BY: DB
MAP PROJECTION: NAD 1983 UTM Zone 17N

DILLON CONSULTING

PROJECT: 152428
STATUS: FINAL
DATE: 6/6/2017

FILE LOCATION: I:\GIS\141137 - Hamilton Waterfront Trust\mxd\Phase Two\Figure E-7 Proposed Groundwater Monitoring Locationa nd Proposed LNAPL Monitoring Location.mxd

APPENDIX F
PROCESS CONTROL NARRATIVE

Hamilton

WASTEWATER PUMPING STATION HC062

(Pier 8)

PROCESS CONTROL NARRATIVE

Version 0.4

(Narrative format: SCADA Standards Version 4.4)

Prepared by:

NLS Engineering

July 2018

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Revision History

Version	Date	City Approval	Description Of Revisions
0.1	November 2016		Issued for PDR
0.2	August 2017		Issued for 95% review
0.3	June 2018		Issued for 100% review
0.4	July 2018		Issued for Tender
0.5	December 2018		Re-Issued for Tender – added Station Phasing details

Definitions Glossary

Term	Definition
ADSL	Asymmetric Digital Subscriber Line (ADSL) is a method of communication that allows data transmission over telephone lines.
AI	Analog Input (AI). Incoming signals (inputs) that are modulating in nature (i.e. 4-20mA or 0-5VDC).
AO	Analog Output (AO). Outgoing setpoint signals (outputs) that are modulating in nature (i.e. 4-20mA or 0-5VDC).
ATS	Automatic Transfer Switch (ATS). A device which automatically transfers normal power to emergency power in the event of disruption in normal or quality of normal power feed.
DI	Digital Input (DI). Incoming signals (inputs) that are on/off in nature.
DO	Digital Output (DO). Outgoing command signals (outputs) that are on/off in nature.
HMI	Human Machine Interface (HMI) is the user interface in a process control system. It provides a graphics-based visualization of an industrial control and monitoring system. An HMI typically resides in an office-based Windows computer that communicates with programmable logic controllers throughout the plant.
HVAC	Heating, Ventilation, and Air Conditioning (HVAC).
I/O	Input/output (I/O).
ISR	Intrinsically Safe Relay (ISR). This is a relay that provides an 'intrinsically safe' barrier between circuits. Typically used when interfacing signals that are sourced from hazardous environments.
MCC	Motor Control Centre (MCC).
NAC	Network Access Closet (NAC). A cabinet that houses the WAN equipment.
OIT	Operator Interface Terminal (OIT) aka panel computer. This is a local display which allows operations staff to view process and alarming as well as enter setpoints and control equipment without using a SCADA workstation. Typically, it is mounted on the control panel enclosure doors at remote stations or on vendor panels.
P&ID	Process and Instrumentation Diagram (P&ID) – A diagram illustrating all the process equipment, interconnecting piping and instrumentation, including the connections to the process control system.
PAC	Process Automation Controller (PAC) – A microprocessor-controlled device to which all of the process and instrumentation I/O is connected, and which contains the process control logic.
PCN	Process Control Narrative (PCN).
PLC	Programmable Logic Controller (PLC). This is a programmable field controller.
PRV	Pressure Reducing Valve (PRV). A valve that will automatically open when a pre-set pressure is reached then close automatically when the pressure is relieved.
SCADA	Supervisory Control and Data Acquisition (SCADA) refers to an industrial control system; a computer system monitoring and controlling a process.

Term	Definition
SCADA TAG	The term 'SCADA Tag' or 'code' refers to the 18-character code that is defined within this standard. The code is used to define the physical location of the equipment within the City's water and wastewater system.
SLP	Sewage Lift Pump (SLP).
SNMP	Simple Network Management Protocol (SNMP). Internet-standard protocol for managing devices on IP networks.
UPS	Uninterruptible Power Supply (UPS). A power supply device which provides emergency power to the supplied device from battery power during a power failure/quality event.
VAC	Voltage Alternating Current (VAC). A unit of voltage.
VDC	Voltage Direct Current (VDC). A unit of voltage.
VFD	Variable Frequency Drive (VFD). This is a motor starter unit which utilizes a solid state (electronic) starter control which allows dynamic/adjustable motor speed control.
WAN	Wide Area Network (WAN) is a geographically dispersed telecommunications network. The term distinguishes a broader telecommunication structure from a local area network (LAN).
WAO	Work Area Outlet (WAO). A set of Ethernet jacks to connect to the SCADA system.
WTP	Water Treatment Plant (WTP).
WWTP	Wastewater Treatment Plant (WWTP).

1 FACILITY DESCRIPTION

1.1 FACILITY OVERVIEW

The Pier 8 wastewater pumping station is located in the park block at the Northwest corner of Street A and Street E on Pier 8 in Hamilton. The station itself is a single-story building with an adjacent subsurface single cell wet well with dual force mains.

The following table lists important information about the site:

Table 1: HC062 Station Details

Station	Detail
Civic Address	123 Wastewater Street, Hamilton, Ontario A1B 2C3
Site Phone Number	(905) 123 – 4567
Hydro Account Number	#
Hydro Meter Number	#

1.1.1 Main Process

The station collects wastewater from the Pier 8 sewer system in a 10 m^3 wet well and automatically pumps it via a 100mm HDPE forcemain to SMH13 at Ferguson Avenue North and Burlington Street East where the sewer system carries the wastewater to the Woodward WWTP. The station is equipped with a 250 mm forcemain for future upgrades which runs parallel to the 100 mm forcemain and can be opened independently with a manual knife gate valve. Future flows to the station have been forecast to increase in three (3) phases. Phase 1 will have a rated capacity of 6.5 L/s. When flows are forecast to exceed the Phase 1 rated capacity the pumps will be replaced in Phase 2 with pumps at a rated capacity of 90 L/s each c/w VFD drives. The pump VFD drives will be adjusted so that the pumps operate at a capacity of 40 L/s and the piping within the station will be modified to 250 mm diameter and connected to the previously mentioned 250 mm forcemain. At this point the 100 mm diameter forcemain used in Phase 1 will be taken out of service. As flows increase beyond 40 L/s Phase 3 will be implemented, the pump VFD drives will adjusted to operate at full speed i.e. 90L/s and the Phase 1 100 mm. forcemain will be brought back into service.

There are two (2) submersible sewage lift pumps (duty, standby). Each sewage lift pump currently has a rated capacity of 6.5 L/s. Each sewage lift pump is controlled by a Soft Starter. There is provision for upgrading the pumps to VFD control as stated above. Refer to “Automatic Duty Rotation Modes” in Section 5.4 for detailed sewage lift pump duty arrangements.

The pump layout from the station can be found in Figure 1-1: HC062 Sewage Lift Pump Layout, below.

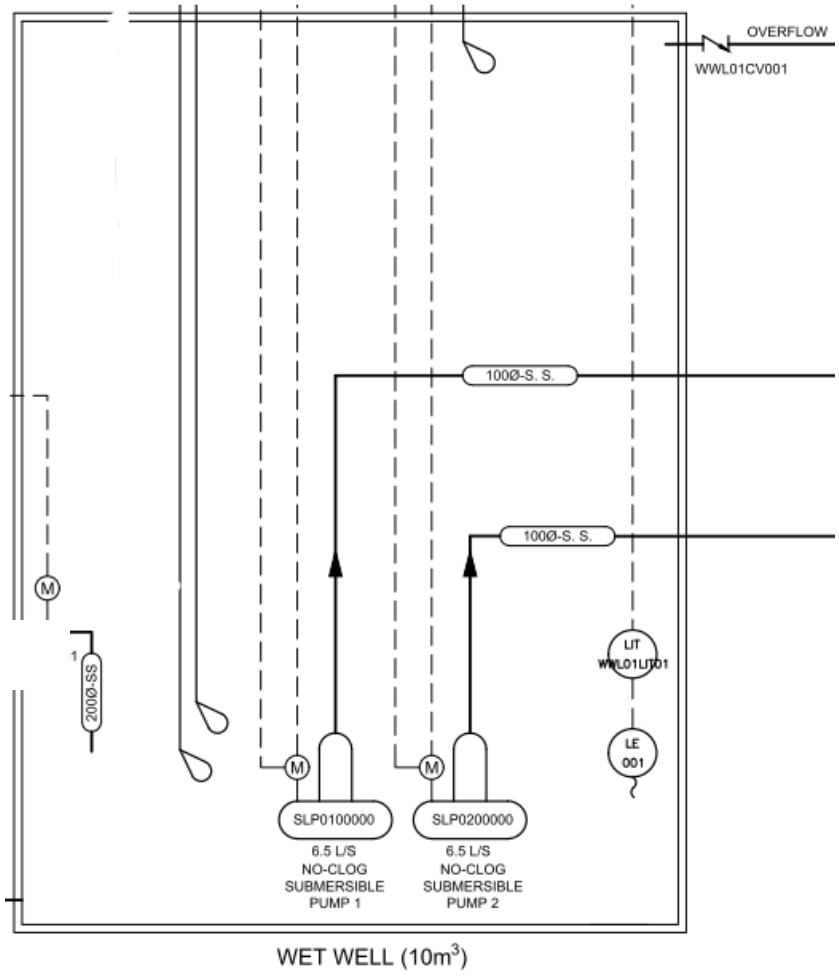


Figure 1-1: HC062 Sewage Lift Pump Layout

1.1.2 Key Instrumentation

Key process instrumentation at this station includes three (3) level float switches and a level transmitter in the single wet well cell. The three (3) level float switches in the wet well have the following functionality: Wet Well Emergency Relief, High (Backup Start) Level, Low (Backup Stop) Level.

There are three (3) flow meters, one on each of the two (2) Discharge Force mains at this station and one on the incoming Service Water line.

Also, there is one (1) level transmitter in the single sanitary storage tank. The Level Transmitter is used for monitoring only.

1.1.3 Wet well Emergency Relief

In the event of a failure of the pumps to operate, or sewage inflows are greater than the pump capacity ratings, there is a possibility that the station will reach the emergency relief. The following table describes the emergency relief details:

Table 2: HC062 Overflow Summary

Overflow Type	Elevation	Destination	Civil Drawing
PVC Pipe	75.7	Hamilton Harbour	C-200

1.1.4 Backup Power

There is an on-site standby Natural Gas Generator.

Refer to Section 8 - Electrical Equipment and Standby Power for detailed power information at this station.

1.2 SCADA SYSTEM OVERVIEW

The station is monitored and can be controlled via the SCADA HMI from the Woodward WTP/WWTP, Dundas WWTP or other locations based on security access.

There is one (1) main PAC control panel (HC062CP001) which contains an Allen-Bradley ControlLogix PAC.

The PAC controls all the SCADA controlled equipment at this station.

The controller details are shown in the following table:

Table 3: HC062 Communications

SCADA Tag	Equipment Description
HC062PAC0100000	HC062 Wastewater Pumping Station PAC

See Appendix F – Message Table for detailed information on communication between the main PAC and vendor PLCs/PACs.

Local control at the station is available using hardwired selector switches and pushbuttons on the MCC.

The plant SCADA HMI application stores additional data points, graphics, trends, alarms, and reports associated with this facility.

Table 4: HC062 Network Equipment Summary

SCADA Tag	Equipment Description
HC062WAN0100000	WAN Panel
HC062NWA0100000	Network Work Area Outlet in PAC Panel HC062CP001
HC062NWA0200000	Network Work Area Outlet in MCC

Refer to DWG. 475964- C13-06-16-HC062 I-301 the SCADA system network diagram, for further information.

1.3 FACILITY DRAWINGS

The following drawings should be viewed in conjunction with this narrative:

Electrical 475964-C13-06-16-HC062 101, General 475964-C13-06-16-HC062 G001, Instrumentation & Control 475964-C13-06-16-HC062 I001-I003 and Process 475964-C13-06-16-HC062 P100-P102.

Refer to Appendix C for P&ID drawings.

2 EQUIPMENT & INSTRUMENTATION

2.1 MECHANICAL EQUIPMENT

The facility includes the following major mechanical equipment connected to the SCADA system.

Table 5: HC062 SCADA Mechanical Equipment Summary

SCADA Tag	Equipment Description
HC062SLP0100000	Sewage Lift Pump No.1
HC062SLP0200000	Sewage Lift Pump No.2
HC062DHD01IG001	Discharge Header No.1 Pressure Relief Valve
HC062DHD02IG001	Discharge Header No.2 Pressure Relief Valve
HC062WWL01IG001	Wet Well Transfer Modulating Sluice Gate
HC062OCS0100000	Odour Control Unit
HC062GEN0100000	Diesel Generator
HC062ATS0100000	Automatic Transfer Switch
HC062STK01IG001	Storage Tank Isolation Valve

The facility includes the following major mechanical equipment that is not connected to the SCADA system.

Table 6: HC062 Mechanical Equipment Summary

SCADA Tag	Equipment Description
HC062SLP01DV001	Sewage Lift Pump No.1 Discharge Valve
HC062SLP02DV001	Sewage Lift Pump No.2 Discharge Valve
HC062DHD01IG008	Discharge Header No.1 Isolation Gate
HC062DHD01IG007	Discharge Header No.2 Isolation Gate

Table 7: HC062 Pump Capacity Summary

Pump	Nominal Rate Capacity	Comments
Sewage Lift Pump No.1	6.5 L/s (85.8 GPM)	Constant Speed *{Installed Capacity}*
Sewage Lift Pump No.2	6.5 L/s (85.8 GPM)	Constant Speed *{Installed Capacity}*
Sewage Lift Pump No.1	***90 L/s (1,188 GPM)***	***Variable Speed {Ultimate Capacity}***
Sewage Lift Pump No.2	***90 L/s (1,188 GPM)***	***Variable Speed {Ultimate Capacity}***

Table 8: HC062 Wet well Capacity Summary

Wet well	Nominal Capacity	Comments
HC062WWL0100000	10 m^3	wet well Capacity
HC062STK0100000	800 m^3	Sanitary Storage Tank Capacity

2.2 INSTRUMENTATION

The following process related instruments are located in this station:

Table 9: HC062 Instrumentation Summary

SCADA Tag	Instrument Description	Analog / Discrete	Span
HC062WWL01LIT01	Wet Well Level Transmitter	Analog	0-7.2 m
HC062WWL01LSH02	Wet Well Emergency Relief Float Switch	Discrete	N/A
HC062WWL01LSH01	Wet Well High Level Float Switch - Sewage Lift Pumps On	Discrete	N/A
HC062WWL01LSL01	Wet Well Low Level Float Switch - Sewage Lift Pumps Off	Discrete	N/A
HC062STK01LIT01	Sanitary Storage Tank Level Transmitter	Analog	0-4.9 m
HC062STK01LSH01	Sanitary Storage Tank High Level Alarm Float Switch	Discrete	N/A
HC062DHD01FIT01	Discharge Header No.1 Flow Meter	Analog	0-125 L/s
HC062DHD02FIT01	Discharge Header No.2 Flow Meter	Analog	0-125 L/s
HC026STN01FIT01	Station Service Water Flow Meter	Analog	0-50 L/s

2.3 I/O LISTING

Refer to the I/O listings in Appendices A and B. Appendix A provides an I/O listing grouped by device and can be cross-referenced to the facility loop diagrams. Appendix A also includes a comprehensive list of all the Networked I/O that communicates with the PAC from other communication protocols (e.g. Modbus or Device Net).

Appendix B provides an I/O listing grouped by PAC I/O card assignments and can be cross-referenced to the facility I/O drawings.

3 COMPLIANCE WITH HAMILTON SCADA STANDARDS

All work was completed in accordance with the Hamilton SCADA standards V. 4.4 as of November 1st, 2013 with the exception of the following deviations:

Table 10: HC062 Standards Deviation

Deviation	Description
N/A	No deviations from standard

4 CONTROL MODES

The station is normally unattended and is continuously monitored via the SCADA HMI at the Woodward Avenue WWTP. Three (3) control modes are available for “normal” operation of the station equipment: local, SCADA Manual, and SCADA Auto.

The following table defines each of the three (3) control modes as generally applied to the City’s SCADA system.

Table 11: HC062 Standard Control Modes

Local Control Modes	Description
LOCAL	The selection of local control mode is typically made in the field at or near the device, MCC, or PAC control panel by means of a physical hand-off-auto or local-remote selector switch. Switching a device's selector switch out of remote mode will place the device in local mode. With the selector switch for the device in hand/local position, the device can be controlled through the use of pushbuttons or other local switches in the field. Putting a device in local mode will bypass all software interlocks and may bypass some hardwired interlocks that apply to other modes of operation. In addition, devices in local mode will not be operated by hardwired backup circuits. Note that when a device is returned from local to remote mode, the SCADA manual control mode or SCADA auto control mode will be selected based on which mode the device was in before it was placed in the local control mode.
Remote Control Modes	**Description**
SCADA MANUAL	Under the SCADA manual mode of control, the starting and stopping of a device is controlled over the SCADA network by an operator via commands that are input into a SCADA HMI computer, or panel computer. The SCADA manual control mode can be selected by an operator on a SCADA HMI computer or panel computer, provided the device's hand-off-auto or local-remote switch is in auto/remote position. Devices operating in SCADA manual mode will not be operated automatically by the PAC. Putting a device in SCADA manual mode will typically not bypass software interlocks and will not bypass any hardwired interlocks. Devices that are being operated in SCADA manual mode will typically still be operated by hardwired backup circuits. Following a power failure, a device in SCADA manual mode may require operator intervention to be returned to the correct state of operation. In general, switching a device from SCADA auto to SCADA manual will provide a bumpless transfer of device operation.
SCADA AUTO	Under the SCADA auto mode of control, the starting and stopping of a device is controlled automatically by a PAC. The SCADA auto control mode can be selected by an operator on a SCADA HMI computer or panel computer, provided the device's hand-off-auto or local-remote switch is in auto/remote position. The PAC will operate the device based on PAC logic that has been programmed into the PAC. Putting a device in SCADA auto mode will not bypass software interlocks and will not bypass any hardwired interlocks. Devices that are being operated in SCADA auto mode will still be operated by hardwired backup circuits. Following a power failure, a device in SCADA auto mode will typically be returned to the correct state of operation by the PAC without operator intervention. Switching a device from local or SCADA manual mode to SCADA auto mode may cause the device to operate immediately if required by the PAC automatic logic.

5 STATION CONTROL

5.1 GENERAL DESCRIPTION

5.1.1 Main Process

The two (2) sewage lift pumps are operated automatically, based on wet well levels and associated start and stop level setpoints programmed in the PAC logic.

Sewage lift pump duty is rotated automatically at the end of each cycle by the PAC, or manually by an Operator via the SCADA HMI.

The two (2) discharge header valves and one (1) transfer modulating knife valve are operated automatically, based on the wet weather mode selection and associated open and close condition programmed in the PAC logic.

The Wet Weather mode will be activated manually by an operator via SCADA HMI.

5.2 SUMMARY OF RELATED DEVICES

There are no additional related devices within the station.

Table 12: HC062 Related Devices Summary

SCADA Tag	Equipment Description
N/A	

5.3 SEWAGE LIFT PUMP LOGIC

The following subsections describe the operation of the SCADA – connected major equipment.

Refer to "Appendix G – Program Variables & Internal Software Parameters" for setpoint information.

5.3.1 Starting the Pump

In HAND/LOCAL position (Local Mode):

- Sewage Lift pump (constant speed/soft start) is started by pressing the start button on the MCC. The Sewage Lift pump ramps up to full speed unless prevented by an interlock or fault. ***{Initial Operation at installed capacity}***

In OFF position (Local Mode):

- Equipment in the OFF position cannot be started.

In AUTO/REMOTE position (SCADA Manual Mode):

- Sewage Lift pump (constant speed/soft start) is started by clicking on the start button on the SCADA HMI. The Sewage Lift pump ramps up to full speed unless prevented by an interlock or fault. ***{Initial Operation at installed capacity}***
- speed setpoint is adjusted on the SCADA HMI screen by entering a speed setpoint on the Sewage Lift pump popup. ***{Future Operation at Ultimate Capacity}***

In AUTO/REMOTE position (SCADA Auto Mode):

- Sewage Lift pump (constant speed/soft start) is started automatically based on setpoints programmed in the PAC. The Sewage Lift pump ramps up to full speed unless prevented by an interlock or fault. ***{Initial Operation at installed capacity}***

5.3.2 Pump Running

In HAND/LOCAL position (Local Mode):

- Sewage Lift Pump (constant speed/soft start) runs at full speed. An interlock or fault will automatically shut down the Sewage Lift pump. ***{Initial Operation at installed capacity}***

In AUTO/REMOTE position (SCADA Manual Mode):

- Sewage Lift Pump (constant speed/soft start) runs at full speed. If the Sewage Lift pump is interlocked or faulted, the pump will automatically shut down. ***{Initial Operation at installed capacity}***

In AUTO/REMOTE position (SCADA Auto Mode):

- Sewage Lift Pump (constant speed/soft start) runs at full speed. If the Sewage Lift pump is interlocked or faulted, the Sewage Lift pump will automatically shut down. ***{Initial Operation at installed capacity}***

5.3.3 Stopping the Pump

In HAND/LOCAL position (Local Mode):

- Sewage Lift Pump (constant speed/soft start) is stopped by pressing the STOP button on the MCC. The Sewage Lift pump will be ramped to a stop by the soft starter. ***{Initial Operation at installed capacity}***

In AUTO/REMOTE position (SCADA Manual Mode):

- Sewage Lift Pump (constant speed/soft start) is stopped by clicking on the STOP button on the SCADA HMI Sewage Lift pump popup. The Sewage Lift pump will be ramped to a stop by the soft starter. ***{Initial Operation at installed capacity}***

In AUTO/REMOTE position (SCADA Auto Mode):

- Sewage Lift Pump (constant speed/soft start) is stopped automatically based on setpoints programmed in the PAC. The Sewage Lift pump will be ramped to a stop by the soft starter. ***{Initial Operation at installed capacity}***

5.4 PROCESS CONTROL LOGIC

5.4.1 Control Modes

The local control mode is attained when the selector switch located on the MCC or by the equipment in the station is switched to the LOCAL or HAND position. In local mode, the equipment is controlled directly by switches or pushbuttons. In the local mode, all software interlocks are bypassed.

The equipment is transferred to remote mode when the selector switch is toggled to the REMOTE or AUTO position. In remote mode, the equipment can be controlled in either SCADA manual or SCADA auto modes of control.

The following table summarizes the control modes for the equipment:

Table 13: HC062 Mechanical Equipment Modes of Operation

SCADA Tag	Equipment Description	Local	SCADA Manual	SCADA Auto	Hardwired Backup Control
HC062SLP0100000	Sewage Lift Pump No.1	☑	☑	☑	☑
HC062SLP0200000	Sewage Lift Pump No.2	☑	☑	☑	☑
HC062SLP01DV001	Sewage Discharge Header Valve 1	☑	☑	☑	☒
HC062SLP02DV001	Sewage Discharge Header Valve 2	☑	☑	☑	☒
HC062STK01IG001	Storage Tank Isolation Valve	☑	☑	☑	☒
HC062WWL01IG001	Wet Well Modulating Sluice Gate	☑	☑	☑	☒

5.4.2 Hardwired Interlocks

Hardwired interlocks are used for equipment and personnel safety or backup control. These will stop the equipment and prevent it from restarting, under the specified control modes. All hardwired interlocks are also programmed into the controller. The following hardwired interlocks are installed:

Table 14: HC062 Hardwired Interlocks by Device

Device	Interlock	Action / Consequences	Interlock Active In			
			Local	SCADA Manual	SCADA Auto	Latching
HC062SLP0100000 HC062SLP0200000	SLP General Fault	SLP motor stops. The interlock is unlatched when the general fault is reset.	☑	☑	☑	☑
	SLP Emergency Stop	E-Stop safety relay is tripped. SLP motor stops. The interlock is unlatched when the E-stop pushbutton is reset (disengaged). Note: The Emergency Stop pushbuttons are not physically interlocked with the SLP. The physical interlock to the SLP is achieved via the E-Stop Safety Relay (see below)	☑	☑	☑	☑
	SLP Soft Starter Fault	SLP motor stops. The interlock is unlatched when the soft starter is reset, or power cycled.	☑	☑	☑	☑

Device	Interlock	Action / Consequences	Interlock Active In			
			Local	SCADA Manual	SCADA Auto	Latching
	SLP Over-Temperature miniCAS II	SLP motor stops. The interlock is unlatched when the miniCAS pump monitor is reset or power cycled. Note: there is a switch on the MCC that allows this interlock to be bypassed.	☑	☑	☑	☑
	SLP Seal Leak Alarm miniCAS II	Annunciates an alarm on the HMI but does not stop the SLP. The alarm is unlatched when the miniCAS pump monitor is reset or power cycled.	☒	☒	☒	☑
	SLP E-Stop Safety Relay	SLP motor stops. The interlock is unlatched when the safety relay is reset. Note: the safety relay CANNOT be reset until BOTH Emergency Stop pushbuttons have first been returned to the normal (disengaged) position.	☑	☑	☑	☑

5.4.3 Backup Control System

The hardwired backup control system circuitry utilizes low and high level LIT relays along with low and high level float switches to back up the PAC control in the event of a failure of the PAC, or a failure of the PAC to operate the sewage lift pumps as required. The LIT and float backup modes help prevent a station overflow. The PAC will not issue pump start or stop commands while the backup system is active, however, if the PAC has not failed, it will attempt to regain control of the pumps once the backup system has deactivated. The backup system is always enabled unless Operations uses the backup control remote interrupts to disable it, as described below.

When the backup system is activated, all available pumps that are in AUTO will be available to be started. One pump will run at a time. Initially, SLP01 will be called to start. If SLP01 fails, then SLP02 will be called to start. Pumps that are not in AUTO or faulted will not be started by the backup control system.

First Backup Control Mode (LIT) Description of Operation

The LIT relay backup system setpoints are typically set outside of the PAC start and stop setpoints to ensure that the backup circuit does not interfere with normal PAC control of the sewage lift pump(s).

In the event of a failure of the PAC, if the wet well level rises above the LIT backup system high level relay setpoint, the LIT high level relay will close and the LIT backup system will become active. This will start all of the sewage lift pumps in the wet well, as indicated in the Section above. The LIT backup system remains active until released by the

opening of the LIT backup system low level relay, or by manual operation of the LIT Backup Control Remote Interrupt.

Table 15: HC062 Hardwired LIT Relay Backup Setpoints

SCADA Tag	Equipment Description	Unit	Setpoint
HC062WWL01LIT01LAH	Wet Well LIT High Level Relay	m	2.60
HC062WWL01LIT01LAL	Wet Well LIT Low Level Relay	m	1.00

Second Backup Control Mode (Float) Description of Operation

The float backup system floats are physically hung at levels outside of the PAC start and stop setpoints and LIT relay start and stop setpoints to ensure that the float backup system does not interfere with normal PAC control of the sewage lift pump(s), or the LIT relay backup system.

In the event of a failure of the PAC, and the LIT relay backup system, if the wet well level rises and tips the high level float a timer will be energized in the PAC control panel. If the high level float remains tipped for 30 seconds consecutively, the float backup system will activate. This will start all of the sewage lift pumps in the wet well, as described in the first Section above. The float backup system remains active until released by the dropping of the low level float, or by manual operation of the Backup Control Remote Interrupt.

Table 16: HC062 Hardwired Float Backup Setpoints

SCADA Tag	Equipment Description	Unit	Setpoint
HC062WWL01LSH01LAH	Wet Well High Level (SLP Start) Float	m	2.30
HC062WWL01LSL01LAL	Wet Well Low Level (SLP Stop) Float	m	0.50

Backup System Remote Interrupts

The backup system is always enabled unless an Operator disables it locally via a pushbutton mounted on the Backup Control Panel or remotely by activating the remote interrupts through SCADA HMI. There are two (2) remote SCADA interrupts, one (1) interrupt for the LIT Backup Control and one (1) interrupt for the Float Backup Control.

Local Interruption

An Operator can deactivate the LIT or float backup system locally by pressing the 'BACKUP SYSTEM RESET' button on the front of the PAC control panel. This will immediately disable the backup system and shut down any pump that were being operated by the backup system. However, if the wet well level is still above the LIT backup system high level relay setpoint, or the high float is tipped, the backup system will immediately re-activate when the BACKUP SYSTEM RESET button is released.

Remote Interruption

The Process Supervisor can temporarily disable the LIT or float backup system remotely; assuming the PAC has not failed and communications to the station are functional, by clicking on the 'LIT BACKUP SYSTEM REMOTE INTERRUPT' button or the 'FLOAT BACKUP SYSTEM REMOTE INTERRUPT' button on the SCADA HMI screen. This will immediately disable the corresponding backup system and shut down any pump that was being operated by the backup system. Additionally, this will disable the backup system for a period of 24 hours. The backup system will be automatically re-enabled after 24 hours. The Process Supervisor takes full responsibility for this action

when remotely interrupting the backup system. The security level associated with the interrupt command is SUPERVISOR.

5.4.4 Software Interlocks

Software interlocks are used to prevent the operation of equipment based on specific requirements. Software interlocks are active in the following modes of control:

Table 17: HC062 Software Interlocks by Device

Device	Interlock	Action / Consequences	Interlock Active In			
			Local	SCADA Manual	SCADA Auto	Latching
HC062SLP0100000 HC062SLP0200000	Both Discharge Headers Out of Service	The PAC will stop all sewage lift pumps until at least one (1) Discharge Header is placed back In Service or if the Station is placed into Wet Weather Mode	☒	☒	☑	☒
	Level Transmitter General Fault	The PAC will stop the sewage lift pump until the signal is re-established or until the high level float is triggered (activating backup control).	☒	☒	☑	☒
	Sanitary Storage Tank Isolation Valve Failure	The PAC will stop all sewage lift pumps until the condition is cleared or at least one (1) Discharge Header is placed back In Service. Only applicable if the station is in Wet Weather mode.	☒	☒	☑	☒

5.4.5 Program Variables & Internal Software Parameters

Program variables are values within the PAC logic that are adjustable through the SCADA HMI based on security level authorization.

Internal software parameters are values are entered in the PAC programs that are set at the time of commissioning and not adjustable from the SCADA system.

See Appendix G for a detailed table of program variables and internal software parameters.

5.4.6 Calculated Variables

The following parameters are calculated within the PAC logic:

Table 18: HC062 Calculated Values

Control Parameter	Calculation Description	Variables
Total Station Instantaneous Flow Rate	Both Flow Transmitters OK (not faulted) and In Service: = (Discharge Header No.1 Flow) + (Discharge Header No.2 Flow) Discharge Header No.1 Flow Transmitter faulted OR Discharge Header No.1 Out of Service: = (Discharge Header No.2 Flow) Discharge Header No.2 Flow Transmitter faulted OR Discharge Header No.2 Out of Service: = (Discharge Header No.1 Flow) Both Flow Transmitters faulted (Minimum of one (1) Discharge Header in Service) AND: 1 Sewage Lift Pump Running: = (nominal discharge flow for a single pump) **x** (run status) **x** 1 2 Sewage Lift Pumps Running: = (nominal discharge flow for a single pump) **x** (run status) **x** 1.6	• Discharge Header No.1 Flow Indication(L/s) • Discharge Header No.1 Flow Transmitter General Fault • Discharge Header No.1 Out of Service (HC062DHD0100000OS_) • Discharge Header No.2 Flow Indication(L/s) • Discharge Header No.2 Flow Transmitter General Fault • Discharge Header No.2 Out of Service (HC062DHD0200000OS_)
Rainfall (mm)	= Pulse Count * 0.2mm	• Rain Gauge Pulse Input
Sanitary Storage Tank Volume Rate	=Tank Area **x** Δ Tank Height	• The Volume Unite is (m^3)

5.4.7 Normal Operating Conditions

During normal station operation, the wet well level signal is used by the PAC to control the sewage lift pumps. The PAC will use the signal to control the starting and stopping of all sewage lift pumps. The PAC program automatically assigns individual sewage lift pump duties (Duty and Standby) based on sewage lift pump availability and runtime. The PAC program also alternates sewage lift pump operation between each duty cycle.

Station flow totals are calculated per forcemain and for total station flow using the individual flow transmitter signals and the calculated station total (Table 5-7 above), respectively.

5.4.8 Multi-cell Wet Well Operation and Normal/Maintenance Modes

This section not applicable for a single cell wet well.

5.4.9 Duty Starting/Stopping Conditions

In the SCADA auto mode, the equipment is controlled by the PAC logic. The PAC operates the equipment as follows:

On Rising Wet Well Level:

- Sewage level rises to the duty 1 start level. Duty 1 sewage lift pump starts.
- Duty 1 sewage lift pump maintains the Duty 1 Speed Setpoint. ***{Future Operation at Ultimate Capacity}***

On Falling Wet Well Level:

- The duty sewage lift pump is running and when the sewage level is at or above duty 1 start level.
- Duty 1 sewage lift pump is maintaining the Duty 1 Speed Setpoint. ***{Future Operation at Ultimate Capacity}***
- Duty 1 sewage lift pump stops at the duty 1 stop level.

Refer to Figure 5-1: HC062 Normal Operating Levels for normal operating levels of the wet well.

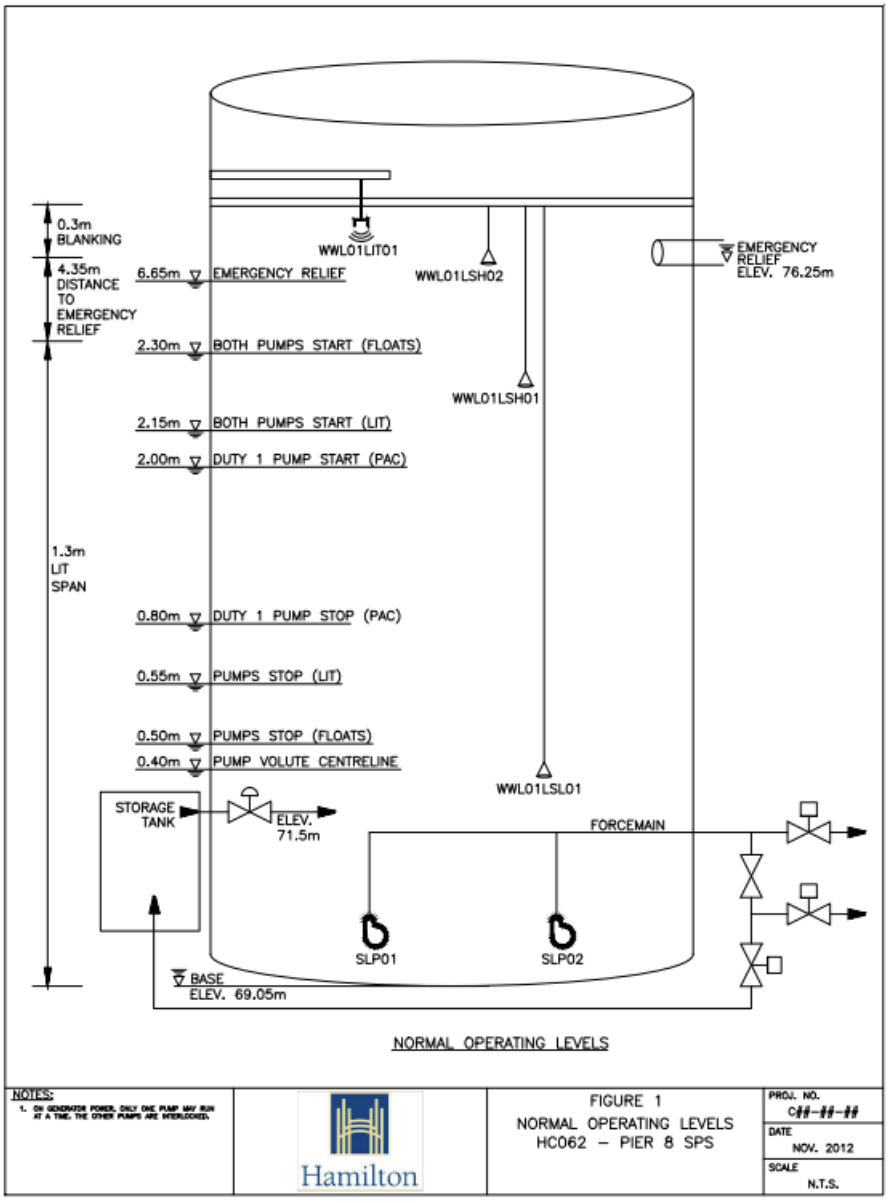


Figure 5-1: HC062 Normal Operating Levels

5.4.10 Operation with One Cell out of Service

N/A – Single Wet Well

5.4.11 Automatic Duty Rotation Modes

When in SCADA auto mode, five (5) automatic duty rotation modes are available.

Table 19: HC062 Duty Rotation Modes

Duty Rotation Mode	Description
1. Cycle End*	Automatic duty rotation will occur after the completion of a pumping cycle, when the sewage lift pumps have stopped. Typically, it is City policy to set all duty stop setpoints at the same level.
2. Cycle End & Runtime*	Automatic duty rotation will occur after the completion of a pumping cycle based on accumulated runtime. The pump with the least amount of runtime will always be placed in the DUTY 1 position.
3. Set Time*	Automatic duty rotation will occur at a preset time each day.
4. Set Time & Runtime*	Automatic duty rotation will occur at a preset time, and the pump with the least amount of running time will always be placed in the duty 1 or lead position.
5. Manual	An operator rotates the sewage lift pump duty assignments via the SCADA HMI.

*For duty rotation modes 1, 2, 3, and 4, automatic duty rotation will always occur if the duty 1 pump is failed. The next available pump will be automatically rotated into the duty 1 position.

An available pump is a pump that is in SCADA auto mode and is not out of service or faulted.

Single Sewage Lift Pump Failure

On failure of the duty 1 sewage lift pump, the pump will be unavailable and removed from the duty rotation. The standby sewage lift pump will be moved to the duty 1 position. The new Duty 1 pump will start as required by the PAC. A sewage lift pump that is faulted will not be included in the duty rotation. The pump will be put back into the duty rotation when the fault is cleared, and the pump is put into SCADA auto mode.

All Sewage Lift Pumps Fail

Immediate action must be taken by Operations staff to prevent flooding of the station (this is beyond the scope of this narrative).

5.5 DISCHARGE HEADERS AND SANITARY STORAGE TANK OPERATION

5.5.1 Discharge Headers - Normal Operating Conditions

Each Discharge Header is equipped with a motorized valve. Operations can select via the SCADA HMI whether either Discharge Header is “In Service” or “Out of Service”. When a Discharge Header is “In Service”, its respective Isolation Valve will be opened and its flowmeter will be included in the Overall Station Flow Total. During Normal Operation, the Sanitary Storage Tank Isolation Valve will be closed.

5.5.2 Sanitary Storage Tank – Wet Weather Mode Operating Conditions

Operations can select via the SCADA HMI whether or not the station is in Wet Weather Mode. When Wet Weather Mode is activated, the Sanitary Storage Tank Isolation Valve is opened. Once confirmed open, any open Discharge Header Isolation Valves are closed, forcing the Sewage/Storm Water into the Sanitary Storage Tank. When Wet Weather Mode is deactivated, the “In Service” Discharge Header Isolation Valves are opened. Once confirmed open, the Sanitary Storage Tank Isolation Valve is closed. Because a discharge flow path is always maintained, Wet

Weather Mode can be switched while the station is in operation. Entering/exiting Wet Weather Mode has no effect on the Normal Operation of the Sewage Lift Pumps.

Storm events will be totalized based on volume accumulated in the Sanitary Storage Tank. The Storm Event volume represents the change in volume of the Sanitary Storage Tank from the time that Wet Weather Mode is activated until it is deactivated, Refer to 5.4.6 for details.

5.5.3 Sanitary Storage Tank – Wetwell Transfer Gate

A 24" modulating sluice gate is installed between the Sanitary Storage Tank and the Wet Well. This gate allows for the return of the stored Storm Water/Sewage back to the Wet Well after the Storage Event. This gate can be controlled via the SCADA HMI in manual only, there is no automatic functionality for this gate.

6 WASTEWATER EVENT MANAGEMENT

This following table describes critical events that present risk to the operation of this station and defines how these events are mitigated through systems and practices built into the SCADA system:

Table 20: HC062 Wastewater Event Management

Hazard and Effect	Risk Level	Critical Risk	Risk Mitigation	Processes & Procedures
SCADA system failure. Potential for wet well overflow and spillage into the environment.	Med	No	The Station is able to function without SCADA. There are two levels of backup control at the station.	Additional operational resources may be required monitor and/or operate the station locally while repairs are being made.
Mechanical Failure of Sewage Lift Pump	Low	No	There are multiple pumps for redundancy.	Issue work order and follow policies and procedures to replace equipment.
Facility Power Failure	High	Yes	Backup generator power available on site.	Electrical or Equipment Failure Emergency procedure.
Sabotage - Damage to Equipment/Property. Possible loss of function.	Low	No	Facility is locked, fenced and has an alarm system.	Call police.

7 FAULT RESPONSE AND ALARMS

7.1 FAULT RESPONSE OPERATION

7.1.1 Facility Power Failure

In the event of a station power failure, all equipment in the facility that is not backed up by UPS power will shut down. The PAC, instruments, backup control system, and network equipment are powered by a UPS. If power does not return or generator power is not available prior to the UPS battery draining to empty, the PAC and communications

equipment will power down, and communications to the station will be lost. Refer to Appendix C for the UPS pop up screen for status information that is available remotely from the UPS.

When power is restored, a device in LOCAL/HAND mode will need to be restarted with the pushbutton. A device that was in SCADA manual mode prior to the power failure will need to be restarted manually via the SCADA HMI. A device that was in SCADA auto mode will operate based on the PAC control setpoints after a preset delay – no operator intervention is required.

There is an ATS located at this station for automatic transfer between hydro power and generator power. If hydro power fails, the generator will be started after a ***(enter time*** **here)** delay. Once the generator is running, the ATS will transfer to generator power after a **(enter time here)** delay. Upon restoration of hydro power for at least **(enter time here)**, the ATS will seamlessly transfer back to hydro power, and the generator will shut off after a **(enter time here)** cool down period. **Values to be updated during commissioning.**

Once hydro or generator power restores power to the station for a continuous period of 60 seconds, in the SCADA auto control mode will restart automatically as required without Operator intervention. Equipment in SCADA manual mode will need to be restarted manually.

See section 8.1 – Electrical Equipment and Standby Power for more information.

7.1.2 SCADA Communication Failure

The HMI sends heartbeat signals to the PAC every 10 seconds. If no heartbeat signal is received for a period of 60 seconds, the PAC will set a communication alarm. In the event of an HMI to PAC communication failure the equipment will continue to operate in its last state and the PAC automatic logic will continue to operate equipment in SCADA auto mode of control.

Operations staff is to treat communication alarms as high priority. There is no way to remotely determine if the loss of communications is due to power failure, communication infrastructure failure, or catastrophic failure of the station. No remote alarming will be possible from the station during a communications failure.

7.1.3 PAC Failure

If the station PAC fails, the PAC will not be able to control the pumps or other station equipment. The station will operate on the hardwired backup control systems to control the sewage lift pumps while the PAC is unavailable. The pumps can also be operated manually at the station.

Upon PAC restart the equipment in SCADA auto mode will restart as required after a 60 second delay.

7.1.4 Wet Well Level Transmitter Failure

If the wet well level transmitter fails, a transmitter fault will be annunciated on the SCADA HMI and any running pumps will be commanded to stop. The station will still be able to operate automatically in backup control mode using the high and low level floats.

7.1.5 Sanitary Storage Tank Level Transmitter Failure

If the sanitary storage tank level transmitter fails, a transmitter fault will be annunciated on the SCADA HMI and no further action will be taken by the PAC. The station will operate as before.

7.1.6 Discharge Header Flow Transmitter Failure

If either Discharge Header flow transmitter fails, a transmitter fault will be annunciated on the SCADA HMI and no further action will be taken by the PAC. The station will operate as before. Operations should isolate the applicable Discharge Header at the earliest opportunity in order to maximize the accuracy of flow readings.

If both Discharge Header flow transmitters fail, a "Both Flowmeters Failed" alarm will be annunciated on the SCADA HMI and the Total Station Flow will be estimated (refer to Section 5.4.6 for further details). The station will continue operate as before, with the exception of the "SLP No Flow" alarms, which will be suppressed.

7.1.7 Discharge Header Isolation Valve Failure

If either Discharge Header isolation valve fails, a fault will be annunciated on the SCADA HMI. If the valve is failed and open, no further action will be taken by the PAC. If the valve is failed and NOT open the PAC will set the Forcemain "Out of Service". The station will operate as before.

If both Discharge Header Isolation Valves fail and are closed, a "Both Discharge Header Valves Failed" alarm will be annunciated on the SCADA HMI and both Discharge Headers will be placed "Out of Service". Operation of the SLPs will not be possible unless one (1) Discharge Header is placed back "In Service" or the station is put into Wet Weather Mode and the Storage Tank Isolation Valve is not failed.

7.1.8 Storage Tank Isolation Valve Failure

If the Storage Tank Isolation Valve fails, a fault will be annunciated on the SCADA HMI. If the valve is failed the station is not in Wet Weather Mode, no further action will be taken by the PAC. If the valve is failed and NOT open while IN Wet Weather Mode, operation of the SLPs will not be possible.

7.1.9 Wetwell Transfer Gate Failure

If the Wetwell Transfer Gate fails, a fault will be annunciated on the SCADA HMI, no further action will be taken by the PAC.

7.1.10 Service Water Flow Transmitter Failure

If the service water flow transmitter fails, a transmitter fault will be annunciated on the SCADA HMI and no further action will be taken by the PAC.

7.1.11 Sewage Lift Pump Failure

If a sewage lift pump is faulted an alarm will be displayed on the SCADA HMI indicating that the pump has failed. The sewage lift pump will not be able to be operated remotely in SCADA manual mode or SCADA auto mode, and in many cases, local mode. If a sewage lift pump failure occurs while the sewage lift pump is in SCADA auto mode, the PAC will repeatedly attempt to stop the sewage lift pump until the sewage lift pump stops. A seal leak alarm will annunciate an alarm on the HMI but will not shut down the pump.

Fault Conditions that will shut down a Sewage Lift Pump

- General Fault
- Over-temperature Fault*
- Facility Power Failure
- Emergency Stop (Safety Relay)
- Soft Starter General Fault
- No Flow Alarm

*There is an Over-temp bypass switch on the MCC that will allow an over-temperature fault to be bypassed. The position of this switch is monitored on the SCADA HMI and is only to be operated by authorized personnel.

7.2 ALARMS

Appendix E contains a Table of alarms associated with this station and generated by the PAC. All alarms are of the Boolean Data Type and are recorded by the Historian as an alarm.

7.2.1 Sewage Lift Pump Virtual Alarm Auto-Acknowledge

The PAC is programmed to auto-acknowledge sewage lift pump virtual alarms. When enabled, the PAC will auto-acknowledge all PAC generated virtual alarms after 60 seconds. Up to nine (9) virtual alarms will be auto-acknowledged within a one (1) hour period. If a tenth virtual alarm is triggered within the one (1) hour period, an alarm will be annunciated on the SCADA HMI and virtual alarms will no longer be auto-acknowledged until the Operator acknowledges this alarm.

Any sewage lift pump no-flow alarms will be suppressed while the pump is not running.

7.2.2 HMI - Red Screen of Death

Very critical processes in some facilities or areas require immediate attention and action. The City of Hamilton uses a 'Red Screen of Death' on the SCADA HMI to annunciate these alarms.

There is no Red Screen of Death for this station.

7.2.3 Pilot Lights

'System OK' Pilot Light

Under normal conditions, the System OK pilot light is lit. The System OK pilot light is turned off by the PAC when there are any active alarms/faults (including equipment virtual alarms, but excluding SCADA system specific alarms) that are monitored by the PAC. The System OK pilot light will relight once all alarms/faults have been cleared.

'SCADA Alarm' Pilot Light

Under normal conditions, the SCADA Alarm pilot light is off. The 'SCADA alarm' pilot light is turned on by the PAC for SCADA specific set of faults, such as an I/O card fault, UPS fault, DC power supply fault, Ethernet switch fault, etc. Operations are to notify the SCADA Group in the event that this pilot light is lit.

7.2.4 Alarm Horn

There is no alarm horn at this station.

7.3 MUNICIPAL DRINKING WATER LICENSE OR OTHER REGULATORY REQUIREMENTS

Refer to Certificate of Approval (Sewage) # x-xxxx-xx-xxx.

7.4 TRENDING OF INPUTS

The SCADA HMI trend screen uses chart group files to populate the trending configurations for each station. The trends are grouped by station.

The following points are captured from the Historian and trended by the SCADA HMI.

Table 21: HC062 Trending Points

SCADA Tag	Description
Analog Trending	
HC062WWL01LIT01LI_	Wet Well Level Indication
HC062STK01LIT01LI_	Sanitary Storage Tank Level Indication
HC062DHD01FIT01FI_	Discharge Header No.1 Flow Indication
HC062DHD02FIT01FI_	Discharge Header No.2 Flow Indication
HC062STN01TIT01TI_	Building Temperature Indication
Digital Trending	
HC062SLP0100000MN_	Sewage Lift Pump No.1 Running Status
HC062SLP0200000MN_	Sewage Lift Pump No.2 Running Status
HC062WWL0100000AUX	Wet Well Backup System Active Status
HC062DHD0100000OS_	Discharge Header No.1 Out of Service Status
HC062DHD0200000OS_	Discharge Header No.2 Out of Service Status
HC062STK0100000WM_	Station in Wet Weather Mode
HC062GEN0100000MN_	Generator Running Status
Calculated Value Trending	
HC062STN01FIT010FI_	Station Discharge Flow Indication
HC062STK01FIT01VL_	Sanitary Storage Tank Volume Rate
Communications Network I/O Trending *(I/O read over Modbus/TCP)*	
HC062SLP01EIT01EI_	Sewage Lift Pump No.1 Motor Voltage Indication
HC062SLP01IIT01II_	Sewage Lift Pump No.1 Motor Current Indication
HC062SLP02EIT01EI_	Sewage Lift Pump No.2 Motor Voltage Indication
HC062SLP02IIT01II_	Sewage Lift Pump No.2 Motor Current Indication
HC062STN01JIR01II_	Station Current Indication
HC062STN01JIR01EI_	Station Voltage Indication
HC062STN01JIR01FRQ	Station Frequency Indication
HC062STN01JIR01JI_	Station Real Power Indication (kW)
HC062STN01JIR01JP_	Station Power Factor Indication
HC062STN01JIR01JR_	Station Reactive Power Indication (kVAR)
HC062STN01JIR01JV_	Station Complex Power Indication (kVA)
HC062GEN0100000II_	Generator Current Indication
HC062GEN0100000EI_	Generator Voltage Indication
HC062GEN0100000FRQ	Generator Frequency Indication

SCADA Tag	Description
HC062GEN0100000EI1	Generator Voltage Indication Phase 'A'
HC062GEN0100000EI2	Generator Voltage Indication Phase 'B'
HC062GEN0100000EI3	Generator Voltage Indication Phase 'C'

7.5 REPORTING

The following points are captured from the Historian and are included in the station daily reports. A Sample Report can be found in Appendix D – Historian Report.

Table 22: HC062 Reporting Variables List

SCADA Tag	Parameter Description	Reporting Variables
HC062SLP0100000MN_	Sewage Lift Pump No.1	• Hourly Runtime (min)
HC062SLP010000RT_		• Daily Runtime Total (hr)
HC062SLP0200000MN_	Sewage Lift Pump No.2	• Hourly Runtime (min)
HC062SLP020000RT_		• Daily Runtime Total (hr)
HC062WWL01LIT01LI_	Wet Well Level Indication	• Hourly Average Level (m) • Total Average, Min. & Max. (m)
HC062STK01LIT01LI_	Storage Tank Level Indication	• Hourly Average Level (m) • Total Average, Min. & Max. (m)
HC062SDHD1FIT01FI_	Discharge Header No.1 Flow	• Hourly Average Flow Rate (l/s) • Total Average, Min. & Max. (l/s)
HC062DHD01FIT01TY_		• Daily Flow Total (m^3)
HC062DHD02FIT01FI_	Discharge Header No.2 Flow	• Hourly Average Flow Rate (l/s) • Total Average, Min. & Max. (l/s)
HC062DHD02FIT01TY_		• Daily Flow Total (m^3)
HC062STN01FIT010FI_	Station Discharge Flow	• Hourly Average Flow Rate (l/s) • Total Average, Min. & Max. (l/s)
HC062STN01FIT010TY_		• Daily Flow Total (m^3)
HC062STK01FIT01VL0	Sanitary Storage Tank Volume	• *Current Event Volume (m^3)
HC062STK01FIT01VL1	Sanitary Storage Tank Volume	• *Previous Event Volume (m^3)

SCADA Tag	Parameter Description	Reporting Variables
HC062WWL0100000AUX	Wet Well Backup System Active	• System Active Total Count (per day)
HC062RGA0100000TY_	Station Rain Gauge	• Daily Total Rainfall (mm)

*Event: The volume should be tracking by each cycle of the wet weather selection and it would be reset when Wet Weather Mode is deselected.

7.6 LOCAL LOGGING

The following analog input point values are stored in an array on the PAC local RAM memory. Data is logged every minute. The data is stored for seven (7) days (10,080 records). Data is stored on a first in, first out basis; older data will be overwritten after seven (7) days.

Table 23: HC062 Local Logging

SCADA Tag	Description	Capture Frequency	Log Time
HC062STN01TIT01TI_	Station Temperature Indication	1 minute	7 days
HC062WWL01LIT01LI_	Wet Well Level Indication	1 minute	7 days
HC062STK01LIT01LI_	Sanitary Storage Tank Level Indication	1 minute	7 days
HC062DHD01FIT01FI_	Discharge Header No.1 Flow Indication	1 minute	7 days
HC062DHD02FIT01FI_	Discharge Header No.2 Flow Indication	1 minute	7 days
HC062STN01FIT010FI_	Station Discharge Flow Indication	1 minute	7 days
HC062STK01FIT01VL_	Sanitary Storage Tank Volume Rate	1 minute	7 days

8 MISCELLANEOUS

8.1 ELECTRICAL EQUIPMENT AND STANDBY POWER

The incoming hydro service for this site is 600V, 3 phase, 4 wires.

Refer to DWG. 475964- C13-05-12-HC062E104, the electrical diagram, for further power information.

An ATS is located at the station, as well as standby Natural Gas generator.

The generator at this station is sized to run both sewage lift pumps at the same time.

The following major electrical equipment in the station is present and monitored by the SCADA system.

Table 24: HC062 Electrical Equipment Summary

SCADA Tag	Equipment Description
HC062CP001UPS01	PAC Panel UPS No.1
HC062STN01JIR01	Station Power Monitor
HC062ATS0100000	Automatic Transfer Switch

SCADA Tag	Equipment Description
HC062GEN0100000	Natural Gas Generator

The following table describes the on-site diesel generator:

Table 25: HC062 Generator Summary

Type	Rating	Fuel		Approximate Run Time at Full Load with Full Fuel Tanks
		No. of Tanks	Total Volume (L)	
On-site NG Generator	100kW	0	n/a	n/a (Natural Gas)

8.2 HVAC

The following HVAC equipment is present at this station:

- There are ten (10) smoke detectors present inside the station that are connected to the SCADA system. These Smoke Detectors are wired back to the PAC to indicate the following smoke/fire alarm detection zones:
    - Electrical Room Fire/Smoke Alarm (HC062STN01SKD01)
    - Odour Control Room Fire/Smoke Alarms (HC062STN01SKD03, 4, 5)
    - Generator Room Heat Detector Alarm (HC062STN01SKD02)
    - Lower Level & Stair Fire/Smoke Alarm (HC062STN01SKD06, 7, 8, 9, 10)
- There is an analog temperature sensor (HC062CP001TIT01) mounted to the front of the PAC Control Panel with a span of -50 – 100 °C connected to the SCADA system for remote monitoring of the temperature inside the station.
- There is one SCADA monitored Make-Up Air Unit (MAU) for heating the station, with a built-in thermostat. The MAU is not controlled by the SCADA System.
- There are three (3) SCADA monitored building exhaust fans at this station (HC062STN01EXF01, 2, 3). The fans are controlled by a thermostat mounted on the wall near each fan. The fans are not controllable via the SCADA System, but are monitored.
- There is a SCADA monitored Odour Control Unit at this station (HC062OCS0100000). The system is controlled by integral timers within the local control panel. The Odour Control Unit is not controllable via the SCADA System.

8.3 HAZARDOUS GASES

There is no monitoring of hazardous gases at this site.

8.4 STATION FLOOD

A station flood float (HC062STN01LSH01) is installed at this station. In the event of a station flood, the alarm will be displayed on the SCADA HMI.

8.5 STATION SECURITY

- There is a station security system that consists of five (5) door contacts to monitor all doors, seven (7) Hatch limit switches to monitor all wet well and storage tank hatches and a key-operated security switch (HC062STN01HSW01) to enable and disable the security system. When a door/hatch is opened, the person entering has 45 seconds to use their key to disarm the security system by turning the security key switch to DISARM. If the security key switch is not turned to DISARM before the time delay elapses, an intrusion alarm will be displayed on the SCADA HMI. A notification that a station door has opened will always be displayed on the SCADA HMI regardless of whether the security system is armed or disarmed. These door contacts and hatch switches are wired back to the PAC to indicate the following intrusion detection zones:
    - Main Entrance/Odour Control Room Intrusion Zone comprised of door contacts (HC062OCS01ESW01, 2, 3)
    - Electrical Room Intrusion Zone comprised of door contacts (HC062GEN01ESW04, 5)
    - Wet Well/Storage Tank Intrusion Zone comprised of hatches limit switches (HC062WWL01ESW01, 2, 3; HC062STK01ESW01, 2, 3, 4, 5, 6)

To rearm the security system when leaving the station, the key switch should be turned to 'ARM' immediately before leaving the station. There will be a 45 second delay before the security system is re-armed to allow for safe exit of the station without tripping the intrusion alarm. Once the security system has been armed, the station has been exited, and all doors are closed and locked, the Process Supervisor is to be called to confirm that they can see the security system armed, the doors closed, and that the intrusion alarm has not been activated.

8.6 PRECIPITATION (RAINFALL) MONITORING

This station has a precipitation gauge that is monitored by the PAC (HC062RGA0100000). The precipitation gauge uses a tipping bucket that is self-emptying. The bucket will tip after 0.2mm of rainfall fills the bucket. When the bucket tips, a pulsed digital input is sent to the PAC for recording. Five (5) pulses equals 1mm of precipitation. Refer to section 05 'Calculated Variables' for the tip count to rainfall conversion. This data is totalized and is included in the daily report.

The precipitation gauge at this station is only capable of monitoring rainfall. The gauge is unable to monitor snowfall.

APPENDIX A – SCADA I/O LISTING BY DEVICE

I/O List

The following table details the I/O at this station arranged by major device type.

HC062 I/O list by Device

I/O TYPE	SCADA TAG	DESCRIPTION
DI	HC062ATS0100000XA_	ATS General Alarm
DI	HC062ATS0100000YN_	ATS in Auto/Remote
DI	HC062ATS01JSW01YX_	ATS in Normal/Hydro Power Position
DI	HC062ATS01JSW02YX_	ATS in Emergency/Generator Power Position
DI	HC062ATS01LNE01YX_	ATS Normal/Hydro Power Available
DI	HC062ATS01LNE02YX_	ATS Emergency/Generator Power Available
DI	HC062CP001DCP01XA_	PAC Panel DC Power Supply Fault
DI	HC062CP001JSW01JA_	PAC Panel Power Failure
DI	HC062CP001UPS01MN_	PAC Panel UPS Online
DI	HC062CP001UPS01XA_	PAC Panel UPS Fault/Low Battery
DI	HC062CP002JSW01XY1	Backup Control Panel PAC Panel Power Feed Fail
DI	HC062CP002JSW02XY1	Backup Control Panel Lighting Panel Power Feed Fail
DI	HC062CP002JSW03XY1	Backup Control Panel PAC and Lighting Power Feed Fail
AI	HC062DHD01FIT01FI_	Wet Well Discharge Header No.1 Flow Indication
DO	HC062DHD01IG001CE_	Discharge Header No. 1 Isolation Valve Close Command
DO	HC062DHD01IG001OP_	Discharge Header No. 1 Isolation Valve Open Command
DI	HC062DHD01IG001YN_	Discharge Header No. 1 Isolation Valve In Remote
DI	HC062DHD01IG001ZH_	Discharge Header No. 1 Isolation Valve Opened
DI	HC062DHD01IG001ZL_	Discharge Header No. 1 Isolation Valve Closed
DI	HC062DHD01LIT01XA_	Wet Well Discharge Header #1 Flow Transmitter General Fault
AI	HC062DHD02FIT01FI_	Wet Well Discharge Header No.2 Flow Indication
DO	HC062DHD02IG002CE_	Discharge Header No. 2 Isolation Valve Close Command
DO	HC062DHD02IG002OP_	Discharge Header No. 2 Isolation Valve Open Command
DI	HC062DHD02IG002YN_	Wet Well Discharge Header No. 2 Isolation Valve In Remote
DI	HC062DHD02IG002ZH_	Wet Well Discharge Header No. 2 Isolation Valve Opened
DI	HC062DHD02IG002ZL_	Wet Well Discharge Header No. 2 Isolation Valve Closed
DI	HC062DHD02LIT01XA_	Wet Well Discharge Header #2 Flow Transmitter General Fault
DI	HC062EFX0300000MN_	Exhaust Fan EF-3 Running Status
DI	HC062EFX0300000XA_	Exhaust Fan EF-3 General Fault
DI	HC062EFX0300000YN_	Exhaust Fan EF-3 In Remote
DI	HC062EXF0100000MN_	Exhaust Fan EF-1 Running Status
DI	HC062EXF0100000XA_	Exhaust Fan EF-1 General Fault
DI	HC062EXF0100000YN_	Exhaust Fan EF-1 In Remote
DI	HC062EXF0200000MN_	Exhaust Fan EF-2 Running Status
DI	HC062EXF0200000XA_	Exhaust Fan EF-2 General Fault

I/O TYPE	SCADA TAG	DESCRIPTION
DI	HC062EXF0200000YN_	Exhaust Fan EF-2 In Remote
DI	HC062GEN0100000MN_	Generator Running Status
DI	HC062GEN0100000XA_	Generator General Alarm
DI	HC062GEN0100000YN_	Generator in Auto/Remote
DI	HC062GEN01HSW01HAS	Generator E-Stop Activated
DI	HC062MAU0100000MN_	Make-Up Air Unit MAU-1 Heater On Status
DI	HC062MAU0100000XA_	Make-Up Air Unit MAU-1 Heater General Fault
DI	HC062MAU01FAN01MN_	Make-Up Air Unit MAU-1 Fan Running Status
DI	HC062MAU01FAN01XA_	Make-Up Air Unit MAU-1 Fan General Fault
DI	HC062NAC01NAS01XA_	WAN Panel Ethernet Switch Alarm - Minor Fault
DI	HC062NAC01NAS01XA2	WAN Panel Ethernet Switch Alarm - Major Fault
DI	HC062OCS01DPR01XA_	Odour Control System Damper General Fault
DI	HC062OCS01DPR01ZH_	Odour Control System Damper Opened Status
DI	HC062OCS01FAN01MN_	Odour Control System Running Status
DI	HC062OCS01FAN01XA_	Odour Control System General Fault
DI	HC062OCS01FAN01XOL	Odour Control System Overload
DO	HC062P001BCS01AB_	Wetwell LIT Backup System Remote Interrupt
DO	HC062P001BCS02AB_	Wetwell Float Backup System Remote Interrupt
DO	HC062PAC0100000XA_	SCADA Alarm Pilot Light
DO	HC062PAC0100000YX_	System OK Pilot Light
DI	HC062RGA0100000YN_	Station Rain Gauge Tipped
DI	HC062SLP0100000HAS	Sewage Lift Pump No. 1 E-Stop Activated
DO	HC062SLP0100000MB_	Sewage Lift Pump No. 1 Stop Command
DO	HC062SLP0100000MH_	Sewage Lift Pump No. 1 Run Command
DI	HC062SLP0100000MN_	Sewage Lift Pump No. 1 Running Status
DI	HC062SLP0100000SRA	Sewage Lift Pump No. 1 E-Stop Safety Relay Status
DI	HC062SLP0100000XA_	Sewage Lift Pump No. 1 General Fault
DI	HC062SLP0100000XLB	Sewage Lift Pump No. 1 Overtemp Fault Bypass Switch Status
DI	HC062SLP0100000XLL	Sewage Lift Pump No. 1 Seal Leak Alarm
DI	HC062SLP0100000XLT	Sewage Lift Pump No. 1 Overtemp Fault
DI	HC062SLP0100000YN_	Sewage Lift Pump No. 1 in Remote
DI	HC062SLP01SSC01XAS	Sewage Lift Pump No. 1 Soft Starter Fault*
AO	HC062SLP01VFD01SC_	Sewage Lift Pump No. 1 Speed Setpoint {Future}
AI	HC062SLP01VFD01SI_	Sewage Lift Pump No. 1 Speed Indication {Future}
DI	HC062SLP01VFD01XAV	Sewage Lift Pump No. 1 VFD Not Ready {Future}
DI	HC062SLP0200000HAS	Sewage Lift Pump No. 2 E-Stop Activated
DO	HC062SLP0200000MB_	Sewage Lift Pump No. 2 Stop Command
DO	HC062SLP0200000MH_	Sewage Lift Pump No. 2 Run Command
DI	HC062SLP0200000MN_	Sewage Lift Pump No. 2 Running Status

I/O TYPE	SCADA TAG	DESCRIPTION
DI	HC062SLP0200000SRA	Sewage Lift Pump No. 2 E-Stop Safety Relay Status
DI	HC062SLP0200000XA_	Sewage Lift Pump No. 2 General Fault
DI	HC062SLP0200000XLB	Sewage Lift Pump No. 2 Overtemp Fault Bypass Switch Status
DI	HC062SLP0200000XLL	Sewage Lift Pump No. 2 Seal Leak Alarm
DI	HC062SLP0200000XLT	Sewage Lift Pump No. 2 Overtemp Fault
DI	HC062SLP0200000YN_	Sewage Lift Pump No. 2 in Remote
DI	HC062SLP02SSC01XAS	Sewage Lift Pump No. 2 Soft Starter Fault*
AO	HC062SLP02VFD01SC_	Sewage Lift Pump No. 2 Speed Setpoint {Future}
AI	HC062SLP02VFD01SI_	Sewage Lift Pump No. 2 Speed Indication {Future}
DI	HC062SLP02VFD01XAV	Sewage Lift Pump No. 2 VFD Not Ready {Future}
DI	HC062STK01ESW01ZSH	Storage Tank Hatch Contact
DI	HC062STK01ESW02ZSH	Storage Tank Hatch Contact
DI	HC062STK01ESW03ZSH	Storage Tank Hatch Contact
DI	HC062STK01ESW04ZSH	Storage Tank Hatch Contact
DI	HC062STK01ESW05ZSH	Storage Tank Stair Access Hatch Contact
DI	HC062STK01ESW06ZSH	Storage Tank LIT Access Hatch Contact
DO	HC062STK01IG001CE_	Storage Tank Isolation Valve Close Command
DO	HC062STK01IG001OP_	Storage Tank Isolation Valve Open Command
DI	HC062STK01IG001YN_	Storage Tank Isolation Valve In Remote
DI	HC062STK01IG001ZH_	Storage Tank Isolation Valve Opened
DI	HC062STK01IG001ZL_	Storage Tank Isolation Valve Closed
AI	HC062STK01LIT01LI_	Storage Tank Level Indication
DI	HC062STK01LIT01XA_	Storage Tank Loss of Echo Alarm/Transmitter Fault
DI	HC062STN01ESW01ZSH	Main Entrance Door Contact
DI	HC062STN01ESW02ZSH	Odour Control Room Overhead Door Contact
DI	HC062STN01ESW03ZSH	Odour Control Room Door Contact
DI	HC062STN01ESW04ZSH	Electrical Room Door Contact
DI	HC062STN01ESW05ZSH	Electrical Room Door Contact
AI	HC062STN01FIT01FI_	Service Water Flow Indication
DI	HC062STN01FIT01XA_	Service Water Flow Transmitter General Fault
DI	HC062STN01HSW01YX_	Station Security Key Switch
DI	HC062STN01JIR01XA_	Power Monitor General Alarm
DI	HC062STN01JIR01XA1	Power Monitor Phase Fault
DI	HC062STN01JSW01XA_	Station Power General Fault
DI	HC062STN01JSW01XA2	Station Phase/Voltage General Fault
DI	HC062STN01LSH01LHH	Station Flood Alarm
DI	HC062STN01SKD01XA_	Electrical Room Smoke/Fire Alarm
DI	HC062STN01SKD02XA_	Generator Room Heat Detector
DI	HC062STN01SKD03XA_	Odour Control Room Smoke/Fire Alarm

I/O TYPE	SCADA TAG	DESCRIPTION
DI	HC062STN01SKD04XA_	Odour Control Room Smoke/Fire Alarm
DI	HC062STN01SKD05XA_	Odour Control Room Smoke/Fire Alarm
DI	HC062STN01SKD06XA_	Lower Level Smoke/Fire Alarm
DI	HC062STN01SKD07XA_	Lower Level Smoke/Fire Alarm
DI	HC062STN01SKD08XA_	Stairwell Smoke/Fire Alarm
DI	HC062STN01SKD09XA_	Lower Level Smoke/Fire Alarm
DI	HC062STN01SKD10XA_	Lower Level Smoke/Fire Alarm
AI	HC062STN01TIT01TI_	Building Temperature Indication
DI	HC062WWL0100000AUX	Wet Well Backup System Active
DI	HC062WWL01ESW01ZSH	Wet Well Hatch Contact
DI	HC062WWL01ESW02ZSH	Wet Well Hatch Contact
DI	HC062WWL01ESW03ZSH	Wet Well Hatch Contact
DI	HC062WWL01IG001YN_	Wet Well Transfer Gate Remote
AO	HC062WWL01IG001ZC_	Wet Well Transfer Gate Position Command
AI	HC062WWL01IG001ZI_	Wet Well Transfer Gate Position Indication
DI	HC062WWL01IG001ZL_	Wet Well Transfer Gate Closed
AI	HC062WWL01LIT01LI_	Wet Well Level Indication
DI	HC062WWL01LIT01XA_	Wet Well Loss of Echo Alarm/Transmitter Fault
DI	HC062WWL01LSH01LAH	Wet Well Backup Start Float
DI	HC062WWL01LSH02LHH	Wet Well Level Emergency Relief
DI	HC062WWL01LSL01LAL	Wet Well Backup Stop Float

*SLP Soft Starters will be replaced with VFDs when the station is upgraded to ultimate capacity. At that time, the Soft Starter Fault alarms will be replaced by the VFD General Fault Alarm.

APPENDIX B – SCADA I/O LISTING BY CARD ASSIGNMENT

I/O List

The following table details the I/O at this station arranged by card layout.

HC062 I/O list by Card

Platform: ControlLogix
Processor: 1756-L73
Power Supply: 1756-PA75

Rack	Slot	Points	Card Type	Card Model
0	0	N/A	CPU	1756-L73
	1	N/A	ETHERNET CARD	1756-EN2TR
	2	N/A	ETHERNET CARD	1756-EN2TR
	3	N/A	COM	MVI56E-MNET
	4			Spare
	5	16	DIGITAL OUTPUT	1756-OW16I
	6			Spare
	7	8	ANALOG OUTPUT	1756-OF8I
	8	16	DIGITAL INPUT	1756-IV16
	9	16	DIGITAL INPUT	1756-IV16
	10	16	DIGITAL INPUT	1756-IV16
	11	8	ANALOG INPUT	1756-IF8I
	12	8	ANALOG INPUT	1756-IF8I
1	13	N/A	ETHERNET CARD	1756-EN2TR
	14			Spare
	15			Spare
	16	16	DIGITAL OUTPUT	1756-OW16I
	17			Spare
	18			Spare
	19	16	DIGITAL INPUT	1756-IV16
	20	16	DIGITAL INPUT	1756-IV16
	21	16	DIGITAL INPUT	1756-IV16
	22	16	DIGITAL INPUT	1756-IV16
	23	16	DIGITAL INPUT	1756-IV16
	24			Spare
	25			Spare

Rack	Slot	Type	Point	SCADA TAG	Description
0	0				Processor
0	1				Ethernet Card
0	2				Ethernet Card
0	3				Comm Module (MVI56-MNET)
0	4				Spare
0	5	DO	0	HC062PAC0100000XA_	SCADA Alarm Pilot Light
			1	HC062PAC0100000YX_	System OK Pilot Light
			2	SPARE	
			3	HC062SLP0100000MH_	Sewage Lift Pump No. 1 Run Command
			4	HC062SLP0100000MB_	Sewage Lift Pump No. 1 Stop Command
			5	SPARE	
			6	HC062P001BCS01AB_	Wetwell LIT Backup System Remote Interrupt
			7	HC062P001BCS02AB_	Wetwell Float Backup System Remote Interrupt
			8	SPARE	
			9	SPARE	
			10	HC062STK01IG001OP_	Storage Tank Isolation Valve Open Command
			11	HC062STK01IG001CE_	Storage Tank Isolation Valve Close Command
			12	SPARE	
			13	SPARE	
			14	SPARE	
			15	SPARE	
0	6				Spare
0	7	AO	0	HC062SLP01VFD01SC_	Sewage Lift Pump No. 1 Speed Setpoint {Future}
			1	SPARE	
			2	HC062WWL01IG001ZC_	Wet Well Transfer Gate Position Command
			3	SPARE	
			4	HC062SLP02VFD01SC_	Sewage Lift Pump No. 2 Speed Setpoint {Future}
			5	SPARE	
			6	SPARE	
			7	SPARE	

Rack	Slot	Type	Point	SCADA TAG	Description
0	8	DI	0	HC062SLP0100000YN_	Sewage Lift Pump No. 1 in Remote
			1	HC062SLP0100000MN_	Sewage Lift Pump No. 1 Running Status
			2	HC062SLP0100000XA_	Sewage Lift Pump No. 1 General Fault
			3	HC062SLP01SSC01XAS	Sewage Lift Pump No. 1 Soft Starter Fault*
			4	HC062SLP0100000XLT	Sewage Lift Pump No. 1 Overtemp Fault
			5	HC062SLP0100000XLB	Sewage Lift Pump No. 1 Overtemp Fault Bypass Switch Status
			6	HC062SLP0100000XLL	Sewage Lift Pump No. 1 Seal Leak Alarm
			7	HC062SLP0100000HAS	Sewage Lift Pump No. 1 E-Stop Activated
			8	HC062SLP0100000SRA	Sewage Lift Pump No. 1 E-Stop Safety Relay Status
			9	HC062SLP01VFD01XAV	Sewage Lift Pump No. 1 VFD Not Ready {Future}
			10	HC062DHD01IG001YN_	Discharge Header No. 1 Isolation Valve In Remote
			11	HC062DHD01IG001ZH_	Discharge Header No. 1 Isolation Valve Opened
			12	HC062DHD01IG001ZL_	Discharge Header No. 1 Isolation Valve Closed
			13	SPARE	
			14	SPARE	
			15	SPARE	
0	9	DI	0	HC062NAC01NAS01XA_	WAN Panel Ethernet Switch Alarm - Minor Fault
			1	HC062NAC01NAS01XA2	WAN Panel Ethernet Switch Alarm - Major Fault
			2	SPARE	
			3	HC062STN01HSW01YX_	Station Security Key Switch
			4	HC062STN01LSH01LHH	Station Flood Alarm
			5	HC062STN01FIT01XA_	Service Water Flow Transmitter General Fault
			6	SPARE	
			7	HC062RGA0100000YN_	Station Rain Gauge Tipped
			8	SPARE	
			9	HC062STN01JIR01XA_	Power Monitor General Alarm

Rack	Slot	Type	Point	SCADA TAG	Description
			10	HC062STN01JIR01XA1	Power Monitor Phase Fault
			11	HC062STN01JSW01XA2	Station Phase/Voltage General Fault
			12	HC062STN01JSW01XA_	Station Power General Fault
			14	HC062CP001JSW01JA_	PAC Panel Power Failure
			14	SPARE	
			15	SPARE	
0	10	DI	0	HC062ATS0100000YN_	ATS in Auto/Remote
			1	HC062ATS01JSW01YX_	ATS in Normal/Hydro Power Position
			2	HC062ATS01JSW02YX_	ATS in Emergency/Generator Power Position
			3	HC062ATS01LNE01YX_	ATS Normal/Hydro Power Available
			4	HC062ATS01LNE02YX_	ATS Emergency/Generator Power Available
			5	HC062ATS0100000XA_	ATS General Alarm
			6	HC062GEN0100000YN_	Generator in Auto/Remote
			7	HC062GEN0100000MN_	Generator Running Status
			8	HC062GEN0100000XA_	Generator General Alarm
			9	HC062GEN01HSW01HAS	Generator E-Stop Activated
			10	HC062CP001UPS01MN_	PAC Panel UPS Online
			11	HC062CP001UPS01XA_	PAC Panel UPS Fault/Low Battery
			12	HC062CP001DCP01XA_	PAC Panel DC Power Supply Fault
			13	SPARE	
			14	HC062WWL0100000AUX	Wet Well Backup System Active
			15	SPARE	
0	11	AI	0	HC062DHD01FIT01FI_	Wet Well Discharge Header No.1 Flow Indication
			1	HC062SLP01VFD01SI_	Sewage Lift Pump No. 1 Speed Indication {Future}
			2	HC062WWL01LIT01LI_	Wet Well Level Indication
			3	HC062STN01TIT01TI_	Building Temperature Indication
			4	SPARE	
			5	SPARE	
			6	SPARE	
			7	SPARE	

Rack	Slot	Type	Point	SCADA TAG	Description
0	12	AI	0	HC062DHD02FIT01FI_	Wet Well Discharge Header No.2 Flow Indication
			1	HC062SLP02VFD01SI_	Sewage Lift Pump No. 2 Speed Indication {Future}
			2	HC062STK01LIT01LI_	Storage Tank Level Indication
			3	HC062STN01FIT01FI_	Service Water Flow Indication
			4	HC062WWL01IG001ZI_	Wet Well Transfer Gate Position Indication
			5	SPARE	
			6	SPARE	
			7	SPARE	
1	13				Ethernet Card
1	14				Spare
1	15				Spare
1	16	DO	0	HC062SLP0200000MH_	Sewage Lift Pump No. 2 Run Command
			1	HC062SLP0200000MB_	Sewage Lift Pump No. 2 Stop Command
			2	SPARE	
			3	SPARE	
			4	SPARE	
			5	SPARE	
			6	SPARE	
			7	SPARE	
			8	SPARE	
			9	SPARE	
			10	HC062DHD01IG001OP_	Discharge Header No. 1 Isolation Valve Open Command
			11	HC062DHD01IG001CE_	Discharge Header No. 1 Isolation Valve Close Command
			12	SPARE	
			13	HC062DHD02IG002OP_	Discharge Header No. 2 Isolation Valve Open Command
			14	HC062DHD02IG002CE_	Discharge Header No. 2 Isolation Valve Close Command
			15	SPARE	
1	17				Spare

Rack	Slot	Type	Point	SCADA TAG	Description
1	18	DI	0	SPARE	
			1	SPARE	
			2	SPARE	
			3	SPARE	
			4	SPARE	
			5	SPARE	
			6	SPARE	
			7	SPARE	
			8	SPARE	
			9	SPARE	
			10	SPARE	
			11	SPARE	
			12	SPARE	
			13	SPARE	
			14	SPARE	
			15	SPARE	
1	19	DI	0	HC062SLP0200000YN_	Sewage Lift Pump No. 2 in Remote
			1	HC062SLP0200000MN_	Sewage Lift Pump No. 2 Running Status
			2	HC062SLP0200000XA_	Sewage Lift Pump No. 2 General Fault
			3	HC062SLP02SSC01XAS	Sewage Lift Pump No. 2 Soft Starter Fault*
			4	HC062SLP0200000XLT	Sewage Lift Pump No. 2 Overtemp Fault
			5	HC062SLP0200000XLB	Sewage Lift Pump No. 2 Overtemp Fault Bypass Switch Status
			6	HC062SLP0200000XLL	Sewage Lift Pump No. 2 Seal Leak Alarm
			7	HC062SLP0200000HAS	Sewage Lift Pump No. 2 E-Stop Activated
			8	HC062SLP0200000SRA	Sewage Lift Pump No. 2 E-Stop Safety Relay Status
			9	HC062SLP02VFD01XAV	Sewage Lift Pump No. 2 VFD Not Ready {Future}
			10	HC062DHD02IG002YN_	Wet Well Discharge Header No. 2 Isolation Valve In Remote
			11	HC062DHD02IG002ZH_	Wet Well Discharge Header No. 2 Isolation Valve Opened

Rack	Slot	Type	Point	SCADA TAG	Description
			12	HC062DHD02IG002ZL_	Wet Well Discharge Header No. 2 Isolation Valve Closed
			13	SPARE	
			14	HC062WWL01IG001YN_	Wet Well Transfer Gate Remote
			15	HC062WWL01IG001ZL_	Wet Well Transfer Gate Closed
1	20	DI	0	HC062WWL01LIT01XA_	Wet Well Loss of Echo Alarm/Transmitter Fault
			1	HC062STK01LIT01XA_	Storage Tank Loss of Echo Alarm/Transmitter Fault
			2	HC062DHD01LIT01XA_	Wet Well Discharge Header #1 Flow Transmitter General Fault
			3	HC062DHD02LIT01XA_	Wet Well Discharge Header #2 Flow Transmitter General Fault
			4	HC062WWL01LSH02LHH	Wet Well Level Emergency Relief
			5	HC062WWL01LSL01LAL	Wet Well Backup Stop Float
			6	HC062WWL01LSH01LAH	Wet Well Backup Start Float
			7	SPARE	
			8	SPARE	
			9	HC062STK01ESW06ZSH	Storage Tank LIT Access Hatch Contact
			10	HC062OCS01DPR01ZH_	Odour Control System Damper Opened Status
			11	HC062OCS01DPR01XA_	Odour Control System Damper General Fault
			12	HC062OCS01FAN01MN_	Odour Control System Running Status
			13	HC062OCS01FAN01XA_	Odour Control System General Fault
			14	HC062OCS01FAN01XOL	Odour Control System Overload
			15	HC062STK01ESW05ZSH	Storage Tank Stair Access Hatch Contact
1	21	DI	0	HC062EXF0100000YN_	Exhaust Fan EF-1 In Remote
			1	HC062EXF0100000MN_	Exhaust Fan EF-1 Running Status
			2	HC062EXF0100000XA_	Exhaust Fan EF-1 General Fault
			3	HC062EXF0200000YN_	Exhaust Fan EF-2 In Remote

Rack	Slot	Type	Point	SCADA TAG	Description
			4	HC062EXF0200000MN_	Exhaust Fan EF-2 Running Status
			5	HC062EXF0200000XA_	Exhaust Fan EF-2 General Fault
			6	HC062EFX0300000YN_	Exhaust Fan EF-3 In Remote
			7	HC062EFX0300000MN_	Exhaust Fan EF-3 Running Status
			8	HC062EFX0300000XA_	Exhaust Fan EF-3 General Fault
			9	SPARE	
			10	HC062MAU01FAN01MN_	Make-Up Air Unit MAU-1 Fan Running Status
			11	HC062MAU01FAN01XA_	Make-Up Air Unit MAU-1 Fan General Fault
			12	HC062MAU0100000MN_	Make-Up Air Unit MAU-1 Heater On Status
			13	HC062MAU0100000XA_	Make-Up Air Unit MAU-1 Heater General Fault
			14	SPARE	
			15	SPARE	
1	22	DI	0	HC062STN01ESW02ZSH	Odour Control Room Overhead Door Contact
			1	HC062STN01ESW05ZSH	Electrical Room Door Contact
			2	HC062WWL01ESW02ZSH	Wet Well Hatch Contact
			3	HC062STK01ESW02ZSH	Storage Tank Hatch Contact
			4	HC062STK01ESW04ZSH	Storage Tank Hatch Contact
			5	HC062STN01SKD05XA_	Odour Control Room Smoke/Fire Alarm
			6	HC062STN01SKD04XA_	Odour Control Room Smoke/Fire Alarm
			7	HC062STN01SKD08XA_	Stairwell Smoke/Fire Alarm
			8	HC062STN01SKD09XA_	Lower Level Smoke/Fire Alarm
			9	HC062STN01SKD10XA_	Lower Level Smoke/Fire Alarm
			10	SPARE	
			11	SPARE	
			12	SPARE	
			13	HC062STK01IG001YN_	Storage Tank Isolation Valve In Remote
			14	HC062STK01IG001ZH_	Storage Tank Isolation Valve Opened

Rack	Slot	Type	Point	SCADA TAG	Description
			15	HC062STK01IG001ZL_	Storage Tank Isolation Valve Closed
1	23	DI	0	HC062STN01ESW01ZSH	Main Entrance Door Contact
			1	HC062STN01ESW03ZSH	Odour Control Room Door Contact
			2	HC062STN01ESW04ZSH	Electrical Room Door Contact
			3	HC062WWL01ESW01ZSH	Wet Well Hatch Contact
			4	HC062WWL01ESW03ZSH	Wet Well Hatch Contact
			5	HC062STK01ESW01ZSH	Storage Tank Hatch Contact
			6	HC062STK01ESW03ZSH	Storage Tank Hatch Contact
			7	HC062STN01SKD01XA_	Electrical Room Smoke/Fire Alarm
			8	HC062STN01SKD02XA_	Generator Room Heat Detector
			9	HC062STN01SKD03XA_	Odour Control Room Smoke/Fire Alarm
			10	HC062STN01SKD06XA_	Lower Level Smoke/Fire Alarm
			11	HC062STN01SKD07XA_	Lower Level Smoke/Fire Alarm
			12	HC062CP002JSW01XY1	Backup Control Panel PAC Panel Power Feed Fail
			13	HC062CP002JSW02XY1	Backup Control Panel Lighting Panel Power Feed Fail
			14	HC062CP002JSW03XY1	Backup Control Panel PAC and Lighting Power Feed Fail
			15	SPARE	
1	24				Spare
1	25				Spare

*SLP Soft Starters will be replaced with VFDs when the station is upgraded to ultimate capacity. At that time, the Soft Starter Fault alarms will be replaced by the VFD General Fault Alarm.

Virtual I/O List

There is some Modbus virtual I/O at this station that is communicated to a third-party Modbus TCP card installed in the PAC. This I/O is transmitted via Ethernet to the third-party Modbus TCP card. The following table details the Modbus I/O at this station. **Details, addressing and availability TBD**

Device	IP Address	Modbus Register	I/O Type	SCADA TAG / PAC Address	Description
SLP01 Motor Soft Starter	192.168.x.x	Xxxxx	AI	HC062SLP01EIT01EI_	Sewage lift Pump No.1 Motor Voltage Indication
		Xxxxx	AI	HC062SLP01IIT01II_	Sewage lift Pump No.1 Motor Current Indication
SLP02 Motor Soft Starter	192.168.x.x	Xxxxx	AI	HC062SLP02EIT01EI_	Sewage lift Pump No.2 Motor Voltage Indication
		Xxxxx	AI	HC062SLP02IIT01II_	Sewage lift Pump No.2 Motor Current Indication
Station Power Monitor	192.168.x.x	Xxxxx	AI	HC062STN01JIR01II_	Station Current Indication
		Xxxxx	AI	HC062STN01JIR01EI_	Station Voltage Indication
		Xxxxx	AI	HC062STN01JIR01FRQ	Station Frequency Indication
		Xxxxx	AI	HC062STN01JIR01JI_	Station Real Power Indication (kW)
		Xxxxx	AI	HC062STN01JIR01JP_	Station Power Factor Indication
		Xxxxx	AI	HC062STN01JIR01JR_	Station Reactive Power Indication (kVAR)
		Xxxxx	AI	HC062STN01JIR01JV_	Station Complex Power Indication (kVA)
Generator	192.168.x.x	Xxxxx	AI	HC062GEN0100000II_	Sewage lift Pump No.3 Motor Voltage Indication
		Xxxxx	AI	HC062GEN0100000EI_	Generator Current Indication
		Xxxxx	AI	HC062GEN0100000FRQ	Generator Voltage Indication
		Xxxxx	AI	HC062GEN0100000EI1	Generator Frequency Indication
		Xxxxx	AI	HC062GEN0100000EI2	Generator Voltage Indication Phase ‘A’
		Xxxxx	AI	HC062GEN0100000EI3	Generator Voltage Indication Phase ‘B’

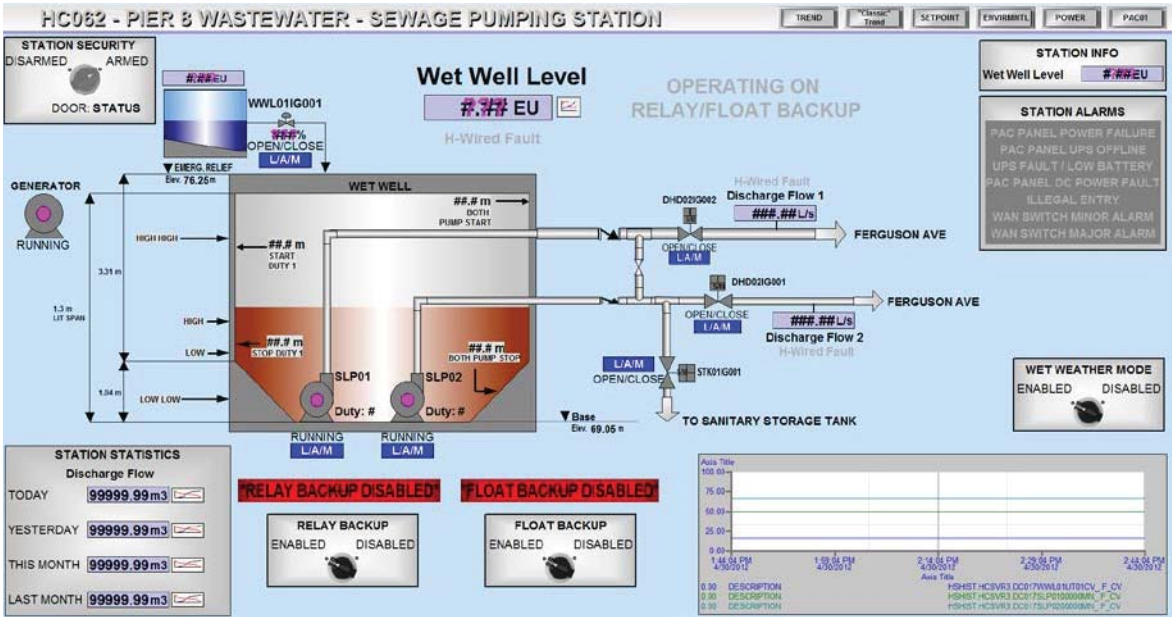
APPENDIX C – SCADA HMI SCREENS AND P&IDS

Provide pictures of all major SCADA HMI screens for this site as well as the Process and Instrumentation Diagrams (P&IDs) in this section to better describe the functioning of the process. SCADA HMI screens should include the Process, environmental and electrical (switching, Power etc.) screens where applicable.

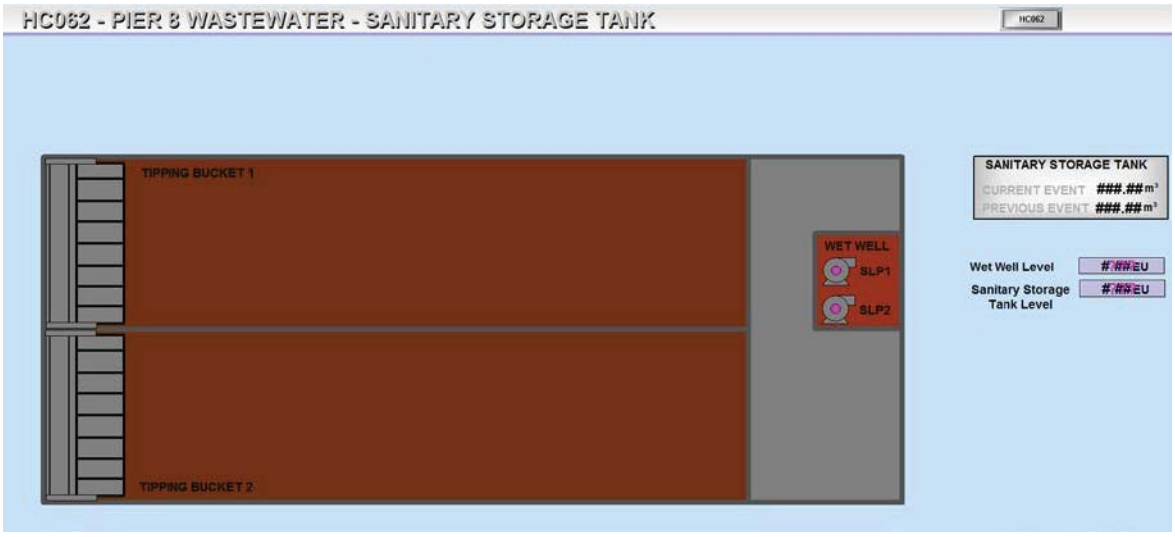
To be Updated.

HMI Screens

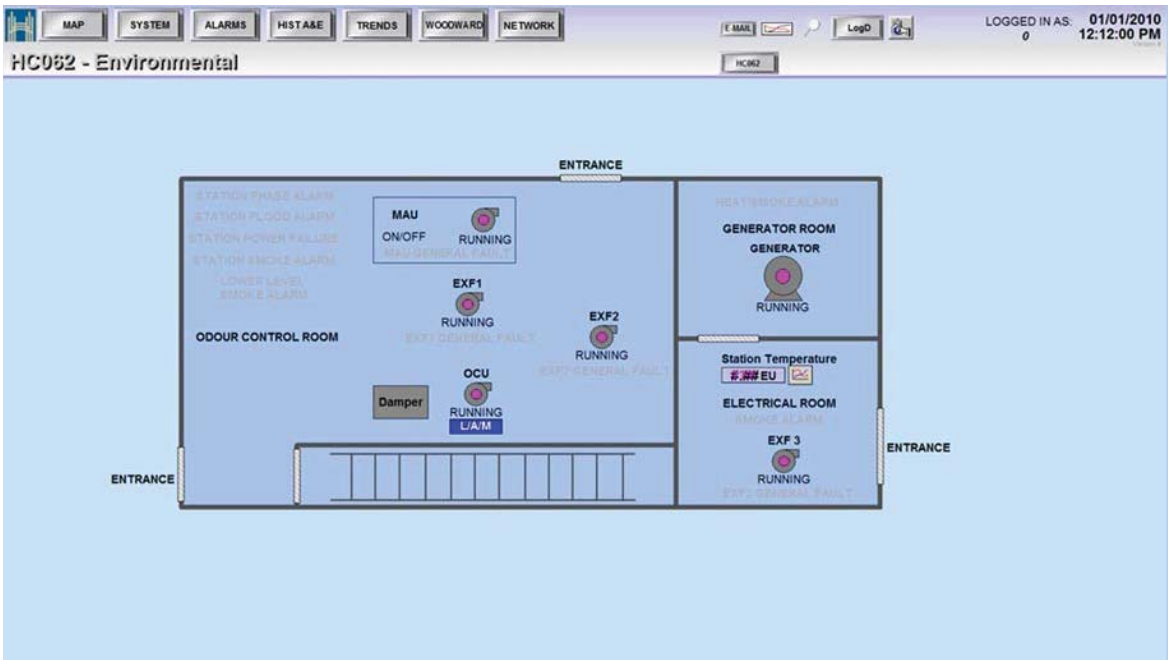
Below are screen captures of the HMI screens at this station. For detailed SCADA HMI screen information, see the HC062 Operations and Maintenance Manual



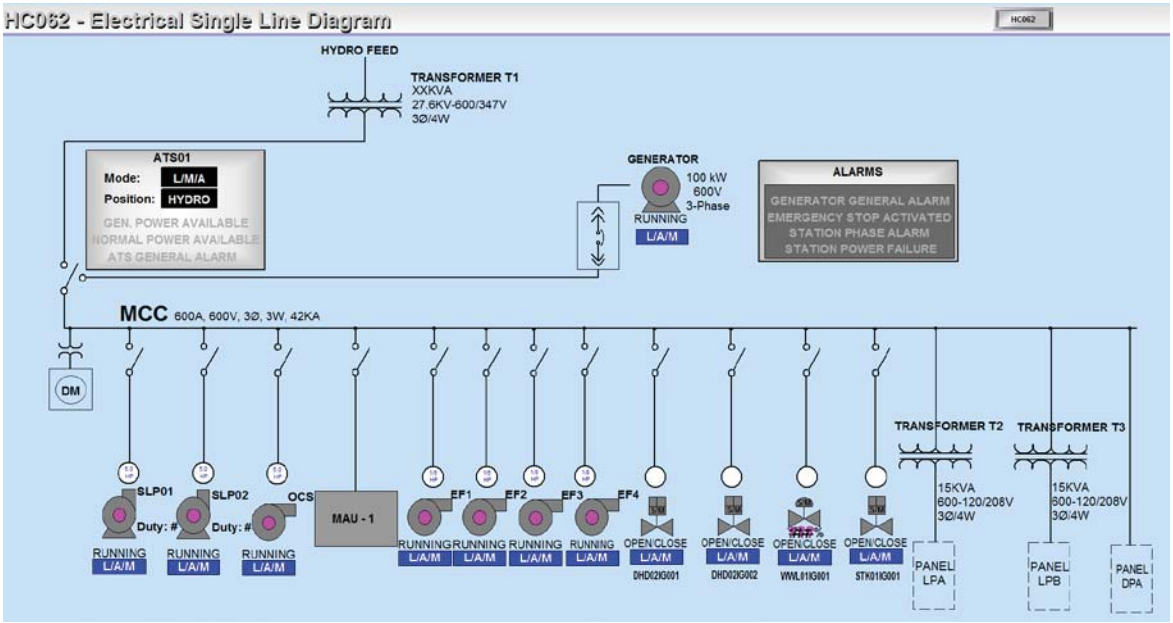
HC062 HMI Screen – Main Overview



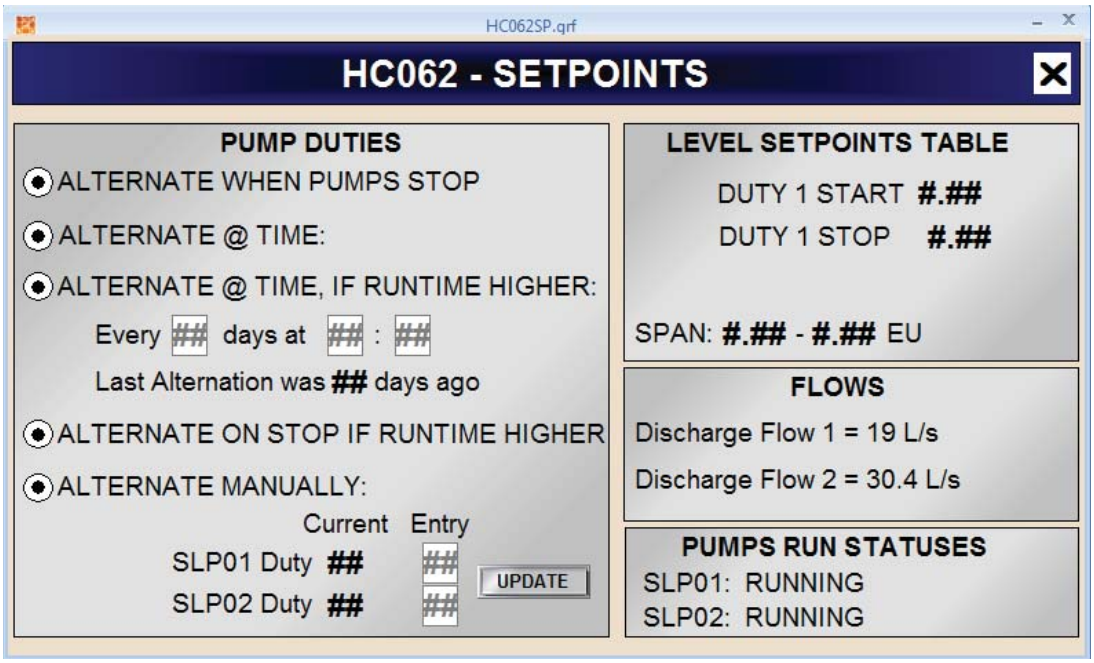
HC062 HMI Screen – Sanitary Storage Tank



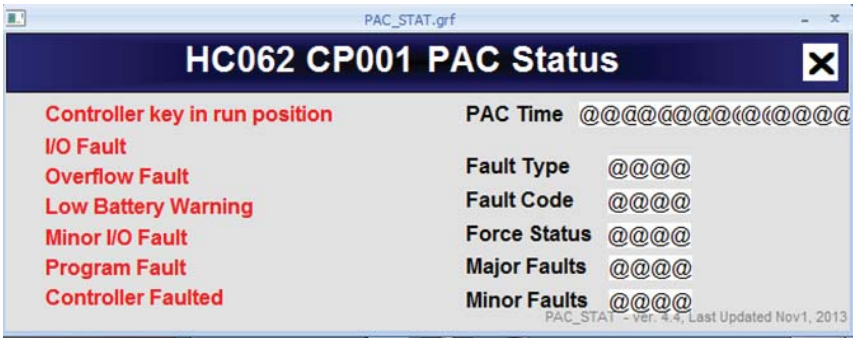
HC062 HMI Screen – Environmental



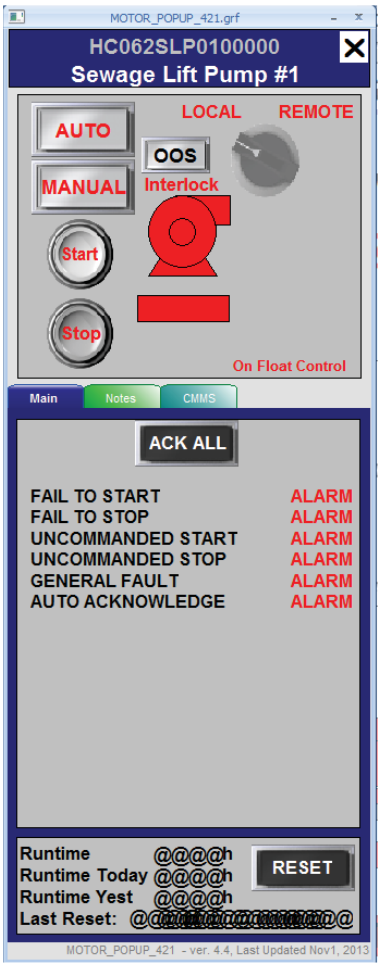
HC062 HMI Screen – Power

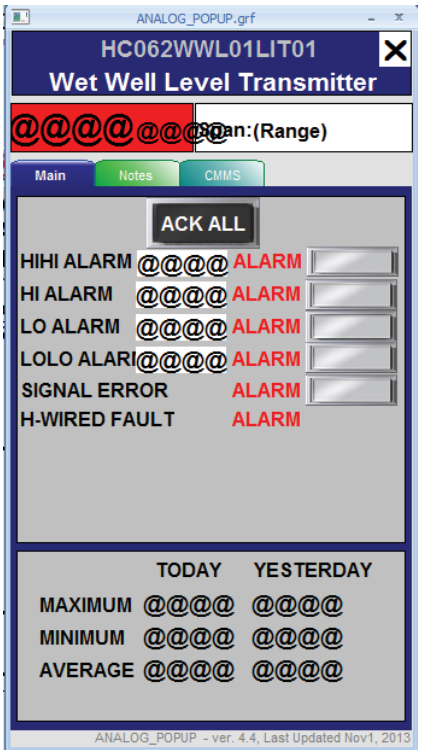


HC062 HMI Screen – Setpoints Popup

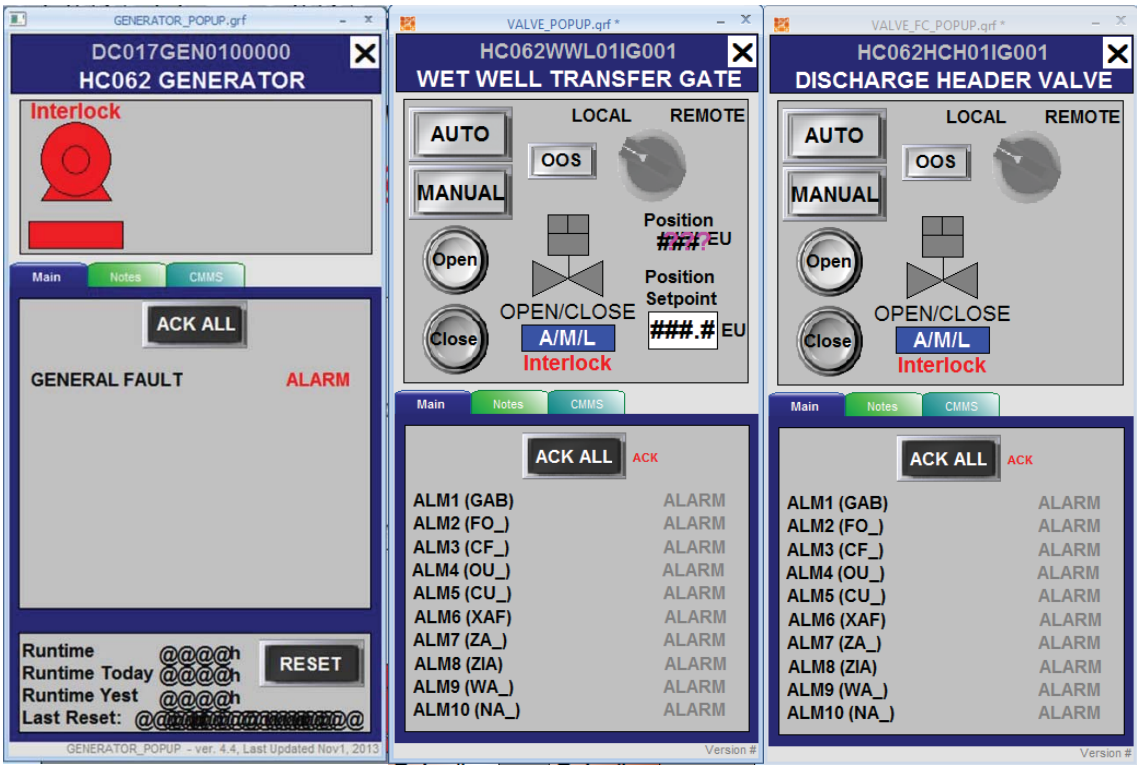


HC062 HMI Screen – PAC Popup

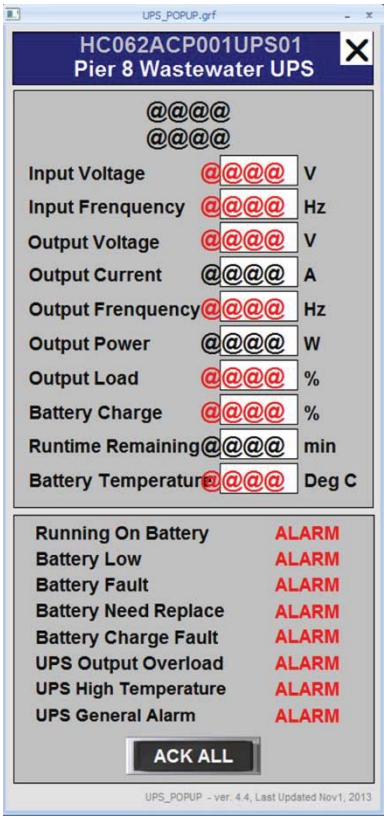




HC062 HMI Screen – Popups



HC062 HMI Screen – Popups



HC062 HMI Screen – SNMP UPS Popups

Piping and Instrumentation Diagram

The following is the P&ID for this station

Attach a PDF of the P&ID in the final PDF version of the narrative.

APPENDIX D – HISTORIAN REPORT

Historian Report

Below is the XLReport for this station.

START Date/Time	SewgWet Well Level (m) WWL01LIT01LI_ AVERAGE	DischHdr 1 Flow (L/s) DHD01FIT01FI_ AVERAGE	DischHdr 2 Flow (L/s) DHD02FIT01FI_ AVERAGE	STNFlow (L/s) STN01FIT01FI_ AVERAGE	SLP01 Run (min/h) SLP010000MN_ AVERAGE	SLP02 Run (min/h) SLP020000MN_ AVERAGE	WWL01 Aux WLL0100000AUX AVERAGE
00:00 (26-Oct-2016)	$.$$	$.$$	$.$$	$.$$	$.$$	$.$$	$.$$
01:00 (26-Oct-2016)	$.$$	$.$$	$.$$	$.$$	$.$$	$.$$	$.$$
02:00 (26-Oct-2016)	$.$$	$.$$	$.$$	$.$$	$.$$	$.$$	$.$$
03:00 (26-Oct-2016)	$.$$	$.$$	$.$$	$.$$	$.$$	$.$$	$.$$
04:00 (26-Oct-2016)	$.$$	$.$$	$.$$	$.$$	$.$$	$.$$	$.$$
05:00 (26-Oct-2016)	$.$$	$.$$	$.$$	$.$$	$.$$	$.$$	$.$$
06:00 (26-Oct-2016)	$.$$	$.$$	$.$$	$.$$	$.$$	$.$$	$.$$
07:00 (26-Oct-2016)	$.$$	$.$$	$.$$	$.$$	$.$$	$.$$	$.$$
08:00 (26-Oct-2016)	$.$$	$.$$	$.$$	$.$$	$.$$	$.$$	$.$$
09:00 (26-Oct-2016)	$.$$	$.$$	$.$$	$.$$	$.$$	$.$$	$.$$
10:00 (26-Oct-2016)	$.$$	$.$$	$.$$	$.$$	$.$$	$.$$	$.$$
11:00 (26-Oct-2016)	$.$$	$.$$	$.$$	$.$$	$.$$	$.$$	$.$$
12:00 (26-Oct-2016)	$.$$	$.$$	$.$$	$.$$	$.$$	$.$$	$.$$
13:00 (26-Oct-2016)	$.$$	$.$$	$.$$	$.$$	$.$$	$.$$	$.$$
14:00 (26-Oct-2016)	$.$$	$.$$	$.$$	$.$$	$.$$	$.$$	$.$$
15:00 (26-Oct-2016)	$.$$	$.$$	$.$$	$.$$	$.$$	$.$$	$.$$
16:00 (26-Oct-2016)	$.$$	$.$$	$.$$	$.$$	$.$$	$.$$	$.$$
17:00 (26-Oct-2016)	$.$$	$.$$	$.$$	$.$$	$.$$	$.$$	$.$$
18:00 (26-Oct-2016)	$.$$	$.$$	$.$$	$.$$	$.$$	$.$$	$.$$
19:00 (26-Oct-2016)	$.$$	$.$$	$.$$	$.$$	$.$$	$.$$	$.$$
20:00 (26-Oct-2016)	$.$$	$.$$	$.$$	$.$$	$.$$	$.$$	$.$$
21:00 (26-Oct-2016)	$.$$	$.$$	$.$$	$.$$	$.$$	$.$$	$.$$
22:00 (26-Oct-2016)	$.$$	$.$$	$.$$	$.$$	$.$$	$.$$	$.$$
23:00 (26-Oct-2016)	$.$$	$.$$	$.$$	$.$$	$.$$	$.$$	$.$$
Average:	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**
Minimum:	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**

Maximum:	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**

	HC062 SLP01 RunTm \HI SLP010000RT_ (h)	DC0099 SLP02 RunTm \HI SLP020000RT_ (h)	HC062 TotalDay Flow \HI STN01FIT01TY_ (m^3)	HC062 Disch Hdr1 Day Flow \HI DHD01FIT01TY_ (m^3)	HC062 Disch Hdr2 Day Flow \HI DHD02FIT01TY_ (m^3)	HC062 TotalDay Rainfall \HI RGA0100000TY_ (mm)
01: (27-Oct-2016)	$.$$	$.$$	$.$$	$.$$	$.$$	$.$$

APPENDIX E – ALARM TABLE

Alarms

All alarms are of the Boolean type and can be acknowledged at the SCADA HMI by any operator, supervisor or administrator security level.

HC062 Alarms

SCADA Tag	Alarm Description	Units	Priority	Sig. Digits	Default	Delay Timer (sec)	MOE (Y/N)
Station / Building							
HC062STN01SKD01XA_	Electrical Room Smoke/Fire	N/A	H	N/A	N/A	10	N
HC062STN01SKD02XA_	Generator Room Heat Detector	N/A	H	N/A	N/A	10	N
HC062STN01SKD03XA_	Odour Control Room Smoke/Fire	N/A	H	N/A	N/A	10	N
HC062STN01SKD04XA_	Odour Control Room Smoke/Fire	N/A	H	N/A	N/A	10	N
HC062STN01SKD05XA_	Odour Control Room Smoke/Fire	N/A	H	N/A	N/A	10	N
HC062STN01SKD06XA_	Lower Level Smoke/Fire	N/A	H	N/A	N/A	10	N
HC062STN01SKD07XA_	Lower Level Smoke/Fire	N/A	H	N/A	N/A	10	N
HC062STN01SKD08XA_	Stairwell Smoke/Fire	N/A	H	N/A	N/A	10	N
HC062STN01SKD09XA_	Lower Level Smoke/Fire	N/A	H	N/A	N/A	10	N
HC062STN01SKD10XA_	Lower Level Smoke/Fire	N/A	H	N/A	N/A	10	N
HC062STN01LSH01LHH	Station Flood	N/A	H	N/A	N/A	0	N
HC062STN01ESW01ZS_	Station Illegal Entry	sec	L	3	0	45	N
HC062CP001TIT01AHH	PAC Panel Temperature HIHI	°C	L	2	40	10	N
HC062CP001TIT01AAH	PAC Panel Temperature HI	°C	L	2	35	10	N
HC062CP001TIT01AAL	PAC Panel Temperature LO	°C	L	2	10	10	N

SCADA Tag	Alarm Description	Units	Priority	Sig. Digits	Default	Delay Timer (sec)	MOE (Y/N)
HC062CP001TIT01ALL	PAC Panel Temperature LOLO	°C	L	2	5	10	N
HC062EXF0100000XA	Exhaust Fan 1 General Fault	N/A	L	N/A	N/A	0	N
HC062EXF0200000XA	Exhaust Fan 2 General Fault	N/A	L	N/A	N/A	0	N
HC062EXF0300000XA	Exhaust Fan 3 General Fault	N/A	L	N/A	N/A	0	N
HC062MAU0100000XA	Makeup Air Unit Heater General Fault	N/A	L	N/A	N/A	0	N
HC062MAU01FAN01XA	Makeup Air Unit Fan/Blower General Fault	N/A	L	N/A	N/A	0	N
Power							
HC062ATS0100000XA_	ATS General Fault	N/A	M	N/A	N/A	0	N
HC062STN01JSW01XA_	Station Power General Fault	N/A	L	N/A	N/A	60	N
HC062GEN0100000XA_	Generator General Fault	N/A	M	N/A	N/A	0	N
HC062GEN0100000HAS	Generator E-Stop Activated	N/A	M	N/A	N/A	0	N
HC062STN01JSW01XA2	Phase/Voltage General Fault	N/A	L	N/A	N/A	0	N
HC062STN01JIR01XA_	Power Monitor General Alarm	N/A	L	N/A	N/A	0	N
HC062STN01JIR01XA1	Power Monitor Phase Fault	N/A	L	N/A	N/A	0	N
WAN Panel							
HC062NAC01NAS01XA_	WAN Panel Ethernet Switch Minor Fault	N/A	L	N/A	N/A	0	N
HC062NAC01NAS01XA2	WAN Panel Ethernet Switch Major Fault	N/A	L	N/A	N/A	0	N

SCADA Tag	Alarm Description	Units	Priority	Sig. Digits	Default	Delay Timer (sec)	MOE (Y/N)
PAC Control Panel							
HC062PAC0100000COM	PAC to HMI Communication Failure	N/A	HH	N/A	N/A	60	N
HC062PAC01DCP01XA_	PAC Panel DC Power Fault	N/A	M	N/A	N/A	0	N
HC062PAC0100000XAM	PAC I/O Fault	N/A	M	N/A	N/A	0	N
HC062CP001JSW01JA_	PAC Panel AC Power Failure	N/A	M	N/A	N/A	10	N
HC062CP001UPS01XA_	UPS General Fault / Low Battery	N/A	L	N/A	N/A	0	N
Sewage Lift Pumps							
HC062SLP0100000SF_	Sewage Lift Pump No.1 Failed to Start	N/A	L	N/A	N/A	30	N
HC062SLP0100000XF_	Sewage Lift Pump No.1 Failed to Stop	N/A	L	N/A	N/A	30	N
HC062SLP0100000SU_	Sewage Lift Pump No.1 Uncommanded Start	N/A	L	N/A	N/A	N/A	N
HC062SLP0100000XU_	Sewage Lift Pump No.1 Uncommanded Stop	N/A	L	N/A	N/A	N/A	N
HC062SLP0100000XA_	Sewage Lift Pump No.1 General Fault	N/A	M	N/A	N/A	N/A	N
HC062SLP0100000XLT	Sewage Lift Pump No.1 Over-Temp	N/A	M	N/A	N/A	N/A	N
HC062SLP0100000XLL	Sewage Lift Pump No.1 Seal Leak Fault	N/A	L	N/A	N/A	N/A	N

SCADA Tag	Alarm Description	Units	Priority	Sig. Digits	Default	Delay Timer (sec)	MOE (Y/N)
HC062SLP0100000XLB	Sewage Lift Pump No.1 Over-Temp Bypass On	N/A	L	N/A	N/A	N/A	N
HC062SLP0100000NF_	Sewage Lift Pump No.1 No Flow	N/A	M	N/A	N/A	30	N
HC062SLP0100000HAS	Sewage Lift Pump No.1 E-Stop Activated	N/A	M	N/A	N/A	N/A	N
HC062SLP01SSC01XAS	Sewage Lift Pump No.1 Soft Starter Fault	N/A	L	N/A	N/A	N/A	N
HC062SLP0100000SRA	Sewage Lift Pump No.1 E-Stop Safety Relay Activated	N/A	M	N/A	N/A	N/A	N
DC099SLP01VFD01SIA	Sewage Lift Pump No.1 VFD Speed Deviation {Future}	N/A	L	N/A	N/A	N/A	N
DC099SLP01VFD01XAV	Sewage Lift Pump No.1 VFD Not Ready {Future}	N/A	L	N/A	N/A	N/A	N
DC099SLP01VFD01XA_	Sewage Lift Pump No.1 VFD General Fault {Future}*	N/A	M	N/A	N/A	N/A	N
HC062SLP01VFD01SHH	Sewage Lift Pump No.1 Speed Speed HIHI {Future}	%	L	2	TBD	15	N
HC062SLP01VFD01SAH	Sewage Lift Pump No.1 Speed Speed HI {Future}	%	L	2	TBD	15	N
HC062SLP01VFD01SAL	Sewage Lift Pump No.1 Speed Speed LO {Future}	%	L	2	TBD	15	N

SCADA Tag	Alarm Description	Units	Priority	Sig. Digits	Default	Delay Timer (sec)	MOE (Y/N)
HC062SLP01VFD01SLL	Sewage Lift Pump No.1 Speed Speed LOLO {Future}	%	L	2	TBD	15	N
HC062SLP0200000SF_	Sewage Lift Pump No.2 Failed to Start	N/A	L	N/A	N/A	30	N
HC062SLP0200000XF_	Sewage Lift Pump No.2 Failed to Stop	N/A	L	N/A	N/A	30	N
HC062SLP0200000SU_	Sewage Lift Pump No.2 Uncommanded Start	N/A	L	N/A	N/A	N/A	N
HC062SLP0200000XU_	Sewage Lift Pump No.2 Uncommanded Stop	N/A	L	N/A	N/A	N/A	N
HC062SLP0200000XA_	Sewage Lift Pump No.2 General Fault	N/A	M	N/A	N/A	N/A	N
HC062SLP0200000XLT	Sewage Lift Pump No.2 Over-Temp	N/A	M	N/A	N/A	N/A	N
HC062SLP0200000XLL	Sewage Lift Pump No.2 Seal Leak Fault	N/A	L	N/A	N/A	N/A	N
HC062SLP0200000XLB	Sewage Lift Pump No.2 Over-Temp Bypass On	N/A	L	N/A	N/A	N/A	N
HC062SLP0200000NF_	Sewage Lift Pump No.2 No Flow	N/A	M	N/A	N/A	30	N
HC062SLP0200000HAS	Sewage Lift Pump No.2 E-Stop Activated	N/A	M	N/A	N/A	N/A	N
HC062SLP02SSC01XAS	Sewage Lift Pump No.2 Soft Starter Fault	N/A	L	N/A	N/A	N/A	N

SCADA Tag	Alarm Description	Units	Priority	Sig. Digits	Default	Delay Timer (sec)	MOE (Y/N)
HC062SLP0200000SRA	Sewage Lift Pump No.2 E-Stop Safety Relay Activated	N/A	M	N/A	N/A	N/A	N
DC099SLP02VFD01SIA	Sewage Lift Pump No.2 VFD Speed Deviation {Future}	N/A	L	N/A	N/A	N/A	N
DC099SLP02VFD01XAV	Sewage Lift Pump No.2 VFD Not Ready {Future}	N/A	L	N/A	N/A	N/A	N
DC099SLP02VFD01XA_	Sewage Lift Pump No.2 VFD General Fault {Future}*	N/A	M	N/A	N/A	N/A	N
HC062SLP02VFD01SHH	Sewage Lift Pump No.2 Speed Speed HIHI {Future}	%	L	2	TBD	15	N
HC062SLP02VFD01SAH	Sewage Lift Pump No.2 Speed Speed HI {Future}	%	L	2	TBD	15	N
HC062SLP02VFD01SAL	Sewage Lift Pump No.2 Speed Speed LO {Future}	%	L	2	TBD	15	N
HC062SLP02VFD01SLL	Sewage Lift Pump No.2 Speed Speed LOLO {Future}	%	L	2	TBD	15	N
Wet Well/Sanitary Storage Tank							
HC062WWL01LIT01LHH	Wet Well Level HIHI	m	L	2	3.2	15	N
HC062WWL01LIT01LAH	Wet Well Level HI	m	L	2	2.9	15	N
HC062WWL01LIT01LAL	Wet Well Level LO	m	L	2	0	15	N

SCADA Tag	Alarm Description	Units	Priority	Sig. Digits	Default	Delay Timer (sec)	MOE (Y/N)
HC062WWL01LIT01LLL	Wet Well Level LOLO	m	L	2	0	15	N
HC062WWL01LIT01XA_	Wet Well Level Transmitter General Fault	N/A	M	N/A	N/A		N
HC062WWL01LIT01ER_	Wet Well Level Transmitter Signal Error	N/A	L	N/A	N/A	10	N
HC062WWL01LSH01LAH	Wet Well Level High (Backup)	N/A	M	N/A	N/A	N/A	N
HC062WWL01LSH02LHH	Wet Well Level Emergency Relief	N/A	L	N/A	N/A	N/A	N
HC062WWL01LSL01LAL	Wet Well Level Low (Backup)	N/A	L	N/A	N/A	N/A	N
HC062WWL0100000AUX	Backup System Active	N/A	L	N/A	N/A	N/A	N
HC062STK01LIT01LHH	Sanitary Storage Tank Level HIHI	m	L	2	3.2	15	N
HC062STK01LIT01LAH	Sanitary Storage Tank Level HI	m	L	2	2.9	15	N
HC062STK01LIT01LAL	Sanitary Storage Tank Level LO	m	L	2	0	15	N
HC062STK01LIT01LLL	Sanitary Storage Tank Level LOLO	m	L	2	0	15	N
HC062STK01LIT01XA_	Sanitary Storage Tank Level Transmitter General Fault	N/A	M	N/A	N/A		N
HC062STK01LIT01ER_	Sanitary Storage Tank Level Transmitter Signal Error	N/A	L	N/A	N/A	10	N
HC062WWL01IG001ZIA	Wetwell Transfer Gate Position Indication Out of Range	N/A	L	N/A	N/A	10	N

SCADA Tag	Alarm Description	Units	Priority	Sig. Digits	Default	Delay Timer (sec)	MOE (Y/N)
HC062WWL01IG001ZA_	Wetwell Transfer Gate Position Alarm	N/A	L	N/A	N/A	300	N
Station Discharge Header No.1							
HC062DHD01FIT01FAHH	Station Discharge Header No.1 Flow Transmitter HIHI	L/s	L	1	tbd	15	N
HC062DHD01FIT01FAH	Station Discharge Header No.1 Flow Transmitter HI	L/s	L	1	tbd	15	N
HC062DHD01FIT01FAL	Station Discharge Header No.1 Flow Transmitter LO	L/s	L	1	tbd	15	N
HC062DHD01FIT01FALL	Station Discharge Header No.1 Flow Transmitter LOLO	L/s	L	1	tbd	15	N
HC062DHD01FIT01XA_	Station Discharge Header No.1 Flow Transmitter General Fault	N/A	L	N/A	N/A	0	N
HC062DHD01FIT01ER_	Station Discharge Header No.1 Flow Transmitter Signal Error	N/A	L	N/A	N/A	10	N
HC062DHD01IG001FO_	Station Discharge Header No. 1 Isolation Valve Failed to Open	N/A	L	N/A	N/A	30	N
HC062DHD01IG001CF_	Station Discharge Header No. 1 Isolation Valve Failed to Close	N/A	L	N/A	N/A	30	N
HC062DHD01IG001OU_	Station Discharge Header No. 1 Isolation Valve Uncommanded Open	N/A	L	N/A	N/A	N/A	N

SCADA Tag	Alarm Description	Units	Priority	Sig. Digits	Default	Delay Timer (sec)	MOE (Y/N)
HC062DHD01IG001CU_	Station Discharge Header No. 1 Isolation Valve Uncommanded Close	N/A	L	N/A	N/A	N/A	N
Station Discharge Header No.2							
HC062DHD01FIT02FAHH	Station Discharge Header No.2 Flow Transmitter HIHI	L/s	L	1	tbd	15	N
HC062DHD01FIT02FAH	Station Discharge Header No.2 Flow Transmitter HI	L/s	L	1	tbd	15	N
HC062DHD01FIT02FAL	Station Discharge Header No.2 Flow Transmitter LO	L/s	L	1	tbd	15	N
HC062DHD01FIT02FALL	Station Discharge Header No.2 Flow Transmitter LOLO	L/s	L	1	tbd	15	N
HC062DHD01FIT02XA_	Station Discharge Header No.2 Flow Transmitter General Fault	N/A	L	N/A	N/A	0	N
HC062DHD01FIT02ER_	Station Discharge Header No.2 Flow Transmitter Signal Error	N/A	L	N/A	N/A	10	N
HC062DHD02IG001FO_	Station Discharge Header No. 2 Isolation Valve Failed to Open	N/A	L	N/A	N/A	30	N
HC062DHD02IG001CF_	Station Discharge Header No. 2 Isolation Valve Failed to Close	N/A	L	N/A	N/A	30	N

SCADA Tag	Alarm Description	Units	Priority	Sig. Digits	Default	Delay Timer (sec)	MOE (Y/N)
HC062DHD02IG001OU_	Station Discharge Header No. 2 Isolation Valve Uncommanded Open	N/A	L	N/A	N/A	N/A	N
HC062DHD02IG001CU_	Station Discharge Header No. 2 Isolation Valve Uncommanded Close	N/A	L	N/A	N/A	N/A	N

*SLP Soft Starters will be replaced with VFDs when the station is upgraded to ultimate capacity. At that time, the Soft Starter Fault alarms will be replaced by the VFD General Fault Alarm.

APPENDIX F – MESSAGE TABLE

Message Table

There is no message table for this station.

APPENDIX G – PROGRAM VARIABLES & INTERNAL SOFTWARE PARAMETERS

Program Variables

These variables are adjustable at the SCADA HMI or panel computer.

HC062 Program Variables

SCADA Tag	Description	Data Type	Units	Sig. Digits	Input Range		Default	Security Level
					MIN	MAX		
HC062CP001JSW01DIS	PAC Panel AC Power Failure Enable/Disable	BOOL	N/A	N/A	ENA	DIS	DIS	ADM
HC062SLP0000000DIS	Low Flow Interlock Enable/Disable	BOOL	N/A	N/A	ENA	DIS	DIS	ADM
HC062DHD0100000OM_	Discharge Header No.1 Out of Service Request	BOOL	N/A	N/A	OOS	OK	OK	ADM
HC062DHD0200000OM_	Discharge Header No.2 Out of Service Request	BOOL	N/A	N/A	OOS	OK	OOS	ADM
HC062SLPDY00000MOD	Duty Rotation Mode Selection	INT	N/A	N/A	1	5	1	CSOP
HC062SLPDY00000P1_	DUTY 1 Selection	INT	N/A	N/A	1	2	1	CSOP
HC062SLPDY00000SC_	DUTY 1 Speed Setpoint {Future}	REAL	%	2	60	100	60	ADM
HC062SLPDY00000P2_	STANDBY Selection	INT	N/A	N/A	1	2	2	CSOP
HC062SLPDY00000DTU	Duty Rotation Table Update	BOOL	N/A	N/A	OFF	ON	OFF	CSOP
HC062SLPDY00000DYH	Duty Rotation Set Time Hours	INT	hr	N/A	0	23	2	ADM
HC062SLPDY00000DYM	Duty Rotation Set Time Minutes	INT	min	N/A	0	59	0	ADM
HC062SLPDY00000NDR	Duty Rotation Days before Rotation	INT	day	N/A	1	365	1	ADM
HC062CP001BCS01DIS	wet well Backup System Remote Interrupt	BOOL	N/A	N/A	OFF	ON	OFF	CSOP
HC062CP001xxxxxxx	Station in Storage Mode	BOOL	N/A	N/A	OFF	ON	OFF	CSOP
HC062CP001xxxxxxx	Sanitary Storage Tank Initiate Flushing Sequence	BOOL	N/A	N/A	OFF	ON	OFF	CSOP

SCADA Tag	Description	Data Type	Units	Sig. Digits	Input Range		Default	Security Level
					MIN	MAX		
HC062xxxxxxxxxxxxx	Sanitary Storage Tank Start Flushing Sequence	REAL	m	3	1	5	2	CSOP
HC062xxxxxxxxxxxxx	Sanitary Storage Tank Number of Flushing Cycles	INT	#	N/A	1	5	2	CSOP
HC062CP001TIT01HHS	PAC Panel Temperature HIHI Alarm Setpoint	REAL	°C	2	-50	100	40	ADM
HC062CP001TIT01HHE	PAC Panel Temperature HIHI Alarm Enable	BOOL	N/A	N/A	OFF	ON	ON	ADM
HC062CP001TIT01HIS	PAC Panel Temperature HI Alarm Setpoint	REAL	°C	2	-50	100	35	SUP
HC062CP001TIT01HAE	PAC Panel Temperature HI Alarm Enable	BOOL	N/A	N/A	OFF	ON	ON	SUP
HC062CP001TIT01LAS	PAC Panel Temperature LO Alarm Setpoint	REAL	°C	2	-50	100	10	SUP
HC062CP001TIT01LAE	PAC Panel Temperature LO Alarm Enable	BOOL	N/A	N/A	OFF	ON	ON	SUP
HC062CP001TIT01LLS	PAC Panel Temperature LOLO Alarm Setpoint	REAL	°C	2	-50	100	5	ADM
HC062CP001TIT01LLE	PAC Panel Temperature LOLO Alarm Enable	BOOL	N/A	N/A	OFF	ON	ON	ADM
HC062WWL01LIT01HHS	Wetwell No. 1 Level HIHI Setpoint	REAL	m	2	0	5	TBD	ADM
HC062WWL01LIT01HHE	Wetwell No. 1 Level HIHI Enable	BOOL	N/A	N/A	OFF	ON	ON	ADM
HC062WWL01LIT01HIS	Wetwell No. 1 Level HI Alarm Setpoint	REAL	m	2	0	5	TBD	SUP
HC062WWL01LIT01HAE	Wetwell No. 1 Level HI Alarm Enable	BOOL	N/A	N/A	OFF	ON	ON	SUP

SCADA Tag	Description	Data Type	Units	Sig. Digits	Input Range		Default	Security Level
					MIN	MAX		
HC062WWL01LIT01LAS	Wetwell No. 1 Level LO Alarm Setpoint	REAL	m	2	0	5	TBD	SUP
HC062WWL01LIT01LAE	Wetwell No. 1 Level LO Alarm Enable	BOOL	N/A	N/A	OFF	ON	ON	SUP
HC062WWL01LIT01LLS	Wetwell No. 1 Level LOLO Alarm Setpoint	REAL	m	2	0	5	TBD	ADM
HC062WWL01LIT01LLE	Wetwell No. 1 Level LOLO Alarm Enable	BOOL	N/A	N/A	OFF	ON	ON	ADM
HC062DHD01FIT01HHS	Station Discharge Header No.1 Flow HIHI Alarm Setpoint	REAL	L/s	1	0	125	TBD	ADM
HC062DHD01FIT01HHE	Station Discharge Header No.1 Flow HIHI Alarm Enable	BOOL	N/A	N/A	OFF	ON	ON	ADM
HC062DHD01FIT01HIS	Station Discharge Header No.1 Flow HI Alarm Setpoint	REAL	L/s	1	0	125	TBD	SUP
HC062DHD01FIT01HAE	Station Discharge Header No.1 Flow HI Alarm Enable	BOOL	N/A	N/A	OFF	ON	ON	SUP
HC062DHD01FIT01LAS	Station Discharge Header No.1 Flow LO Alarm Setpoint	REAL	L/s	1	0	125	TBD	SUP
HC062DHD01FIT01LAE	Station Discharge Header No.1 Flow LO Alarm Enable	BOOL	N/A	N/A	OFF	ON	ON	SUP
HC062DHD01FIT01LLS	Station Discharge Header No.1 Flow LOLO Alarm Setpoint	REAL	L/s	1	0	125	TBD	ADM
HC062DHD01FIT01LLE	Station Discharge Header No.1 Flow LOLO Alarm Enable	BOOL	N/A	N/A	OFF	ON	ON	ADM
HC062DHD01PIT01HHS	Station Discharge Header No.1 Pressure HIHI Alarm Setpoint	REAL	kPa	0	0	1000	TBD	ADM
HC062DHD01PIT01HHE	Station Discharge Header No.1 Pressure HIHI Alarm Enable	BOOL	N/A	N/A	OFF	ON	ON	ADM

SCADA Tag	Description	Data Type	Units	Sig. Digits	Input Range		Default	Security Level
					MIN	MAX		
HC062DHD01PIT01HIS	Station Discharge Header No.1 Pressure HI Alarm Setpoint	REAL	kPa	0	0	1000	TBD	SUP
HC062DHD01PIT01HAE	Station Discharge Header No.1 Pressure HI Alarm Enable	BOOL	N/A	N/A	OFF	ON	ON	SUP
HC062DHD01PIT01LAS	Station Discharge Header No.1 Pressure LO Alarm Setpoint	REAL	kPa	0	0	1000	TBD	SUP
HC062DHD01PIT01LAE	Station Discharge Header No.1 Pressure LO Alarm Enable	BOOL	N/A	N/A	OFF	ON	ON	SUP
HC062DHD01PIT01LLS	Station Discharge Header No.1 Pressure LOLO Alarm Setpoint	REAL	kPa	0	0	1000	TBD	ADM
HC062DHD01PIT01LLE	Station Discharge Header No.1 Pressure LOLO Alarm Enable	BOOL	N/A	N/A	OFF	ON	ON	ADM
HC062DHD02FIT01HHS	Station Discharge Header No.2 Flow HIHI Alarm Setpoint	REAL	L/s	1	0	125	TBD	ADM
HC062DHD02FIT01HHE	Station Discharge Header No.2 Flow HIHI Alarm Enable	BOOL	N/A	N/A	OFF	ON	ON	ADM
HC062DHD02FIT01HIS	Station Discharge Header No.2 Flow HI Alarm Setpoint	REAL	L/s	1	0	125	TBD	SUP
HC062DHD02FIT01HAE	Station Discharge Header No.2 Flow HI Alarm Enable	BOOL	N/A	N/A	OFF	ON	ON	SUP
HC062DHD02FIT01LAS	Station Discharge Header No.2 Flow LO Alarm Setpoint	REAL	L/s	1	0	125	TBD	SUP
HC062DHD02FIT01LAE	Station Discharge Header No.2 Flow LO Alarm Enable	BOOL	N/A	N/A	OFF	ON	ON	SUP
HC062DHD02FIT01LLS	Station Discharge Header No.2 Flow LOLO Alarm Setpoint	REAL	L/s	1	0	125	TBD	ADM

SCADA Tag	Description	Data Type	Units	Sig. Digits	Input Range		Default	Security Level
					MIN	MAX		
HC062DHD02FIT01LLE	Station Discharge Header No.2 Flow LOLO Alarm Enable	BOOL	N/A	N/A	OFF	ON	ON	ADM
HC062DHD02PIT01HHS	Station Discharge Header No.2 Pressure HIHI Alarm Setpoint	REAL	kPa	0	0	1000	TBD	ADM
HC062DHD02PIT01HHE	Station Discharge Header No.2 Pressure HIHI Alarm Enable	BOOL	N/A	N/A	OFF	ON	ON	ADM
HC062DHD02PIT01HIS	Station Discharge Header No.2 Pressure HI Alarm Setpoint	REAL	kPa	0	0	1000	TBD	SUP
HC062DHD02PIT01HAE	Station Discharge Header No.2 Pressure HI Alarm Enable	BOOL	N/A	N/A	OFF	ON	ON	SUP
HC062DHD02PIT01LAS	Station Discharge Header No.2 Pressure LO Alarm Setpoint	REAL	kPa	0	0	1000	TBD	SUP
HC062DHD02PIT01LAE	Station Discharge Header No.2 Pressure LO Alarm Enable	BOOL	N/A	N/A	OFF	ON	ON	SUP
HC062DHD02PIT01LLS	Station Discharge Header No.2 Pressure LOLO Alarm Setpoint	REAL	kPa	0	0	1000	TBD	ADM
HC062DHD02PIT01LLE	Station Discharge Header No.2 Pressure LOLO Alarm Enable	BOOL	N/A	N/A	OFF	ON	ON	ADM
HC062STN01FIT010HHS	Station Discharge Flow HIHI Alarm Setpoint	REAL	L/s	1	0	125	TBD	ADM
HC062STN01FIT010HHE	Station Discharge Flow HIHI Alarm Enable	BOOL	N/A	N/A	OFF	ON	ON	ADM
HC062STN01FIT010HIS	Station Discharge Flow HI Alarm Setpoint	REAL	L/s	1	0	125	TBD	SUP
HC062STN01FIT010HAE	Station Discharge Flow HI Alarm Enable	BOOL	N/A	N/A	OFF	ON	ON	SUP

SCADA Tag	Description	Data Type	Units	Sig. Digits	Input Range		Default	Security Level
					MIN	MAX		
HC062STN01FIT010LAS	Station Discharge Flow LO Alarm Setpoint	REAL	L/s	1	0	125	TBD	SUP
HC062STN01FIT010LAE	Station Discharge Flow LO Alarm Enable	BOOL	N/A	N/A	OFF	ON	ON	SUP
HC062STN01FIT010LLS	Station Discharge Flow LOLO Alarm Setpoint	REAL	L/s	1	0	125	TBD	ADM
HC062STN01FIT010LLE	Station Discharge Flow LOLO Alarm Enable	BOOL	N/A	N/A	OFF	ON	ON	ADM
HC062SLP0100000RRT	SLP01 Runtime Reset	BOOL	N/A	N/A	OFF	ON	OFF	SUP
HC062SLP0200000RRT	SLP02 Runtime Reset	BOOL	N/A	N/A	OFF	ON	OFF	SUP
HC062SLP0300000RRT	SLP03 Runtime Reset	BOOL	N/A	N/A	OFF	ON	OFF	SUP
HC062GEN0100000RRT	GEN01 Runtime Reset	BOOL	N/A	N/A	OFF	ON	OFF	SUP

Internal Software Parameters

These variables are set at the time of commissioning and are not adjustable at the SCADA HMI or panel computer.

HC062 Internal Software Setpoint Parameters

SCADA Tag	Description	Data Type	Units	Sig. Digits	Input Range		Default
					MIN	MAX	
HC062SLPDY00000D1T	DUTY 1 Start Setpoint	REAL	m	N/A	0	2.00	2.00
HC062SLPDY00000D1P	DUTY 1 Stop Setpoint	REAL	m	N/A	0	2.00	0.70
HC062DHD0100000OS_	Discharge Header #1 Out of Service	BOOL	n/a	N/A	OFF (I.S.)	ON (O.S.)	OFF (I.S.)
HC062DHD0200000OS_	Discharge Header #2 Out of Service	BOOL	n/a	N/A	OFF (I.S.)	ON (O.S.)	OFF (I.S.)
HC062STK0100000WM_	Station in Wet Weather Mode	BOOL	n/a	N/A	OFF	ON	OFF

HC062 Internal Software Delay Parameters

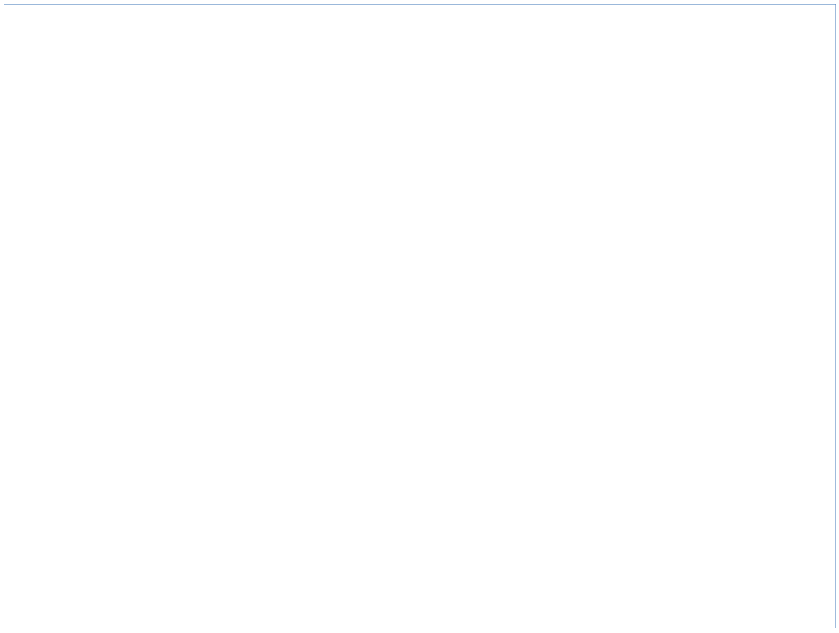
Parameter	Value	Description
Pump Minimum on Timer	30 seconds	Minimum time a pump must run once started before it will accept a pump auto stop command. A manual stop command will override this interlock and will issue a pump stop command immediately. This feature is used to prevent rapid starting/stopping of the pumps.
Pump Minimum Off Timer	30 seconds	Minimum time a pump must remain off after stopping before it will accept a pump auto start command. A manual start command will override this interlock and will issue a pump start command immediately. This feature is used to prevent rapid starting/stopping of the pumps.
Valve Open Timer Delay	N/A	Minimum time required for the open condition of a valve to be true before the auto open command is issued to the valve AOI.
Valve Close Timer Delay	N/A	Minimum time required for the close condition of a valve to be true before the auto close command is issued to the valve AOI.
Valve Minimum Opened Timer	N/A	Minimum time a valve must remain opened after opening before it will accept a valve auto close command.

Parameter	Value	Description
Valve Minimum Closed Timer	N/A	Minimum time a valve must remain closed after closing before it will accept a valve auto open command.
Pump Duty Start Delay Time	10 seconds	Minimum time required for the starting condition of a pump to be true before the auto start command is issued to the pump AOI. For example, if a five (5) second pump on timer delay is used at a wet well the level in the wet well must be above the duty 1 start level setpoint for five (5) seconds before the auto start command is issued.
Pump Stop Delay Time	10 seconds	Minimum time required for the stopping condition of a pump to be true before the auto stop command is issued to the pump AOI.
Non-Concurrent Start Delay	10 seconds	Delay between the starting of pumps to prevent unnecessary current draw.
Backup System Remote Interrupt Time	2 seconds	Timer that remote interrupts are latched on before unlatching.
Disable Backup System Remote Interrupt Time	24 hours	The Backup System Remote Interrupt can be disabled for up to 24 hours before it is re-enabled.
Debounce Timer(s)	5 seconds	Time delay to ensure a proper low pressure, high pressure, low flow, high flow and heat trace alarm signal is transmitted.
Door Contact Vibration Filter	2 seconds	Timer during which the door contact has to be enabled before registering.

APPENDIX H – REFERENCE SITE PHOTOS

Site Reference Photos

These photos show the general layout of the station and where the major equipment is located. To be updated after commissioning.



HC062 - Station Exterior Layout

HC062 - Station Interior Layout No.1

HC062 - Station Interior Layout No.2

HC062 - Electrical Equipment Layout

HC062 - PAC Panel Layout

HC062 - WAN Panel Layout

HC062 - Control Panel Layout

HC062 – Sewage Lift Pump Nameplate

HC062 - Generator

HC062 - Generator Nameplate

APPENDIX I – FLOOR PLAN

Station Floor Plan

The floor plan shows the general layout of the station and where the major equipment is located. ***To be updated after commissioning.***

