



# ALLTERRA

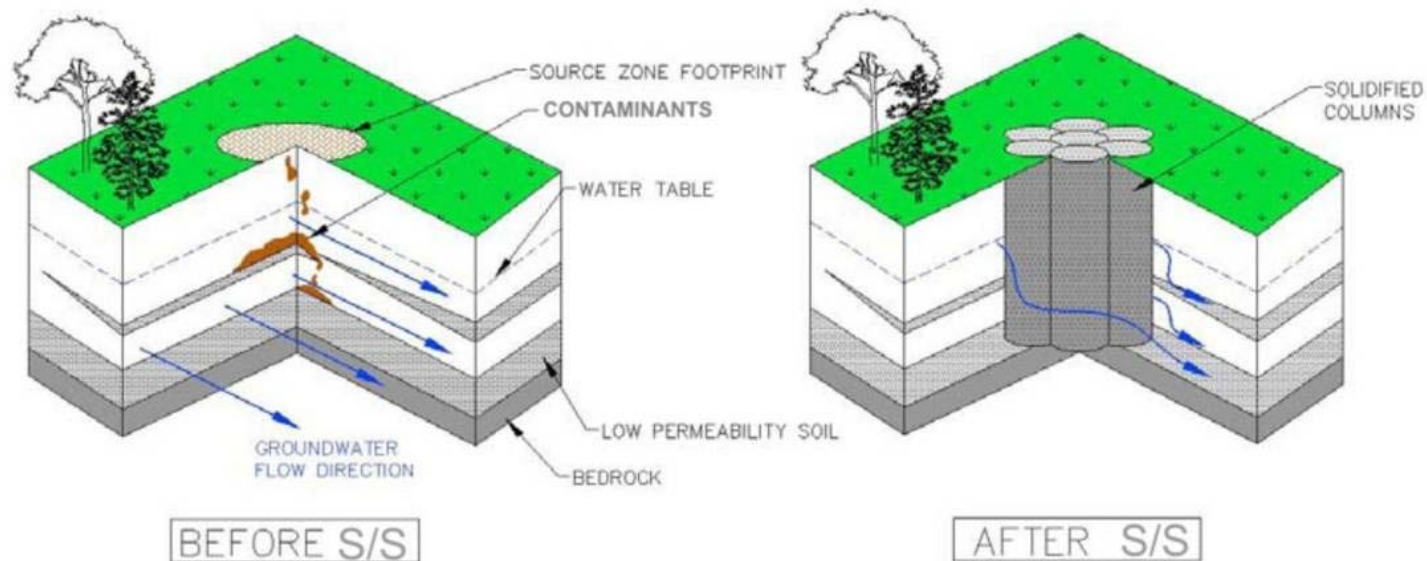


**CONSTRUCTION & ENVIRONMENTAL**

***In-situ Stabilization / Solidification of Contaminated  
Fill at Canadian Naval Base Saves Millions in  
Remediation Costs and Prepares Site for New  
Development***

# Solidification/Stabilization (“S/S”)

- Solidification – bind target in a solid block of low permeability material
- Stabilisation – transform contaminants and reduce leachability.



# REAGENTS

Portland cement, cement kiln dust  
Fly ash - Class F and C (pozzolanic fly ashes)  
Lime - quicklime, hydrated lime, lime kiln dust  
Slag - ground granulated blast furnace slag  
Silicate, (super) phosphate, sulfate  
Proprietary mixtures  
Activated carbon  
Organoclay®  
EnviroBlend®  
Bentonite, ZVI/Bentonite

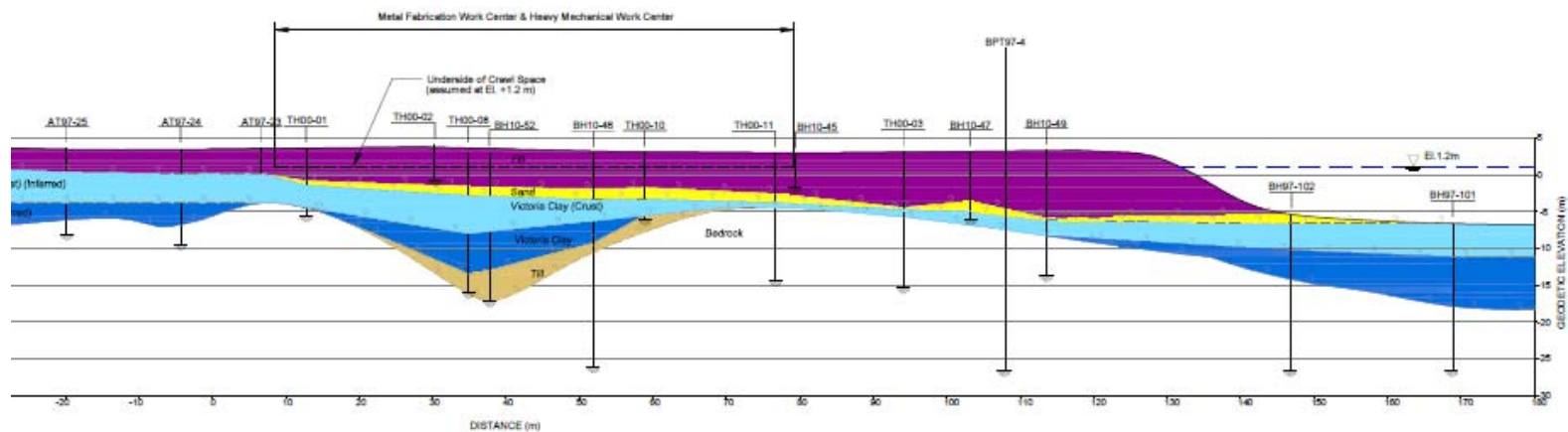




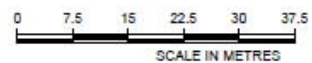
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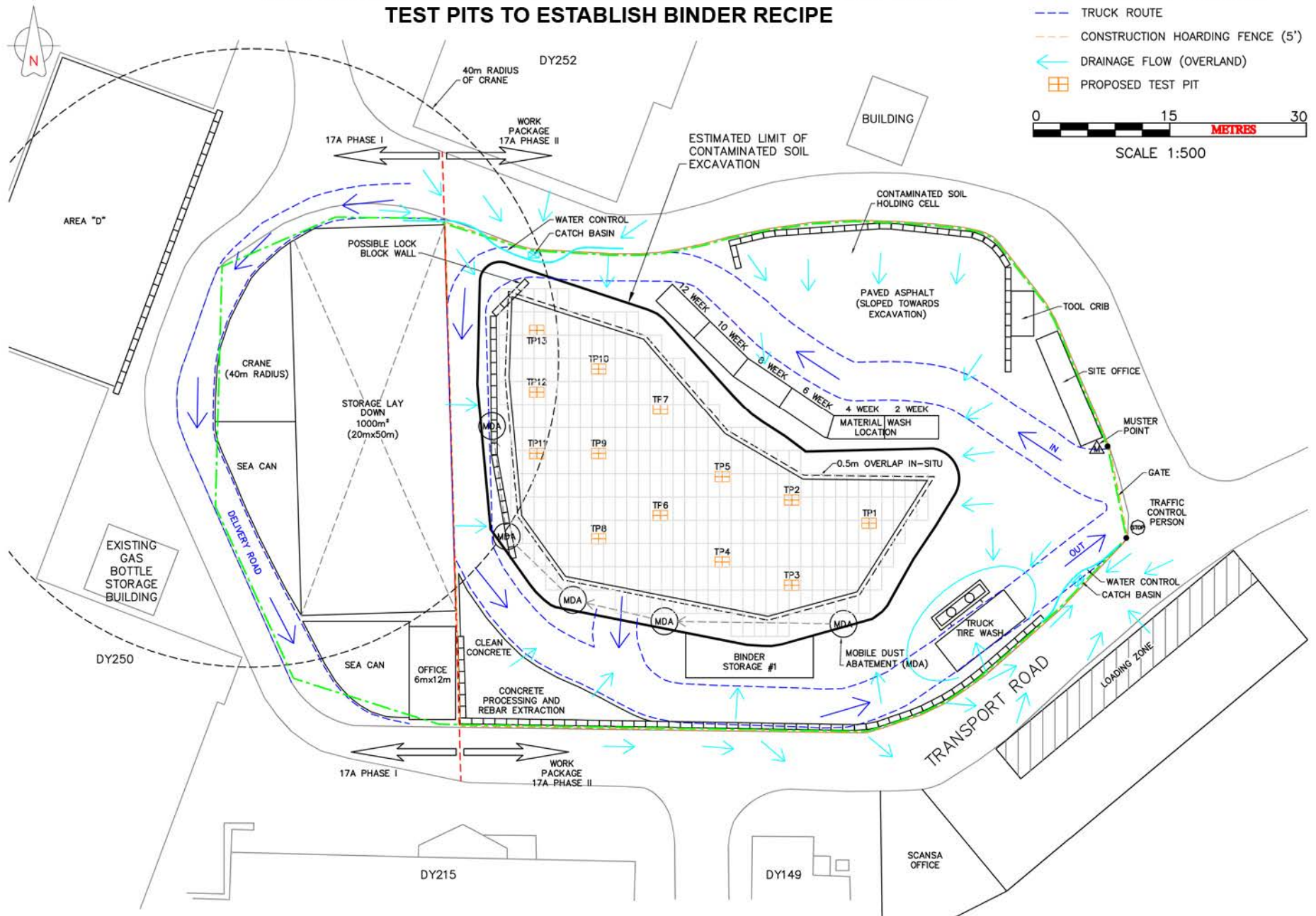
Section A-A'





# POST IN-SITU DRILLING PROGRAM TO IDENTIFY "KIDNEY"

## SOIL CLASSIFICATION THROUGH EX-SITU SOIL SAMPLING FROM TEST PITS TO ESTABLISH BINDER RECIPE



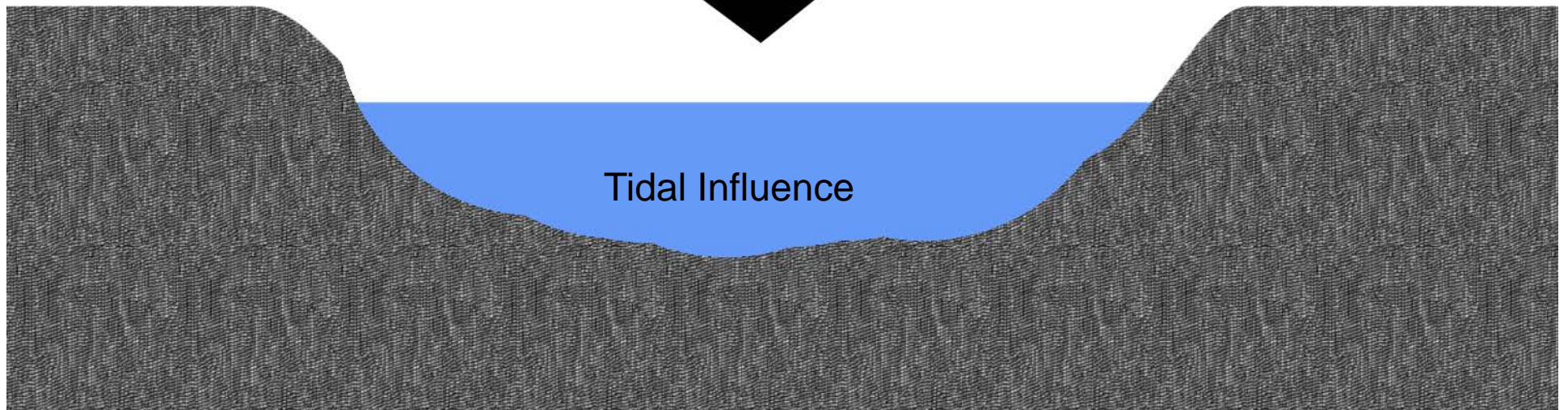
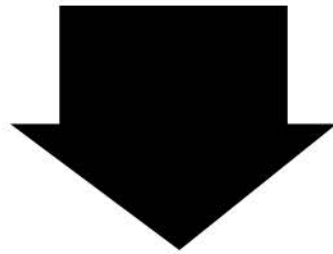
# **INFILLED COVE**

**BLASTING BEDROCK**

**SCRAP METAL**

**SHIPYARD WASTE**

**WELDING SLAG**





























# **ENVIRONMENTAL**

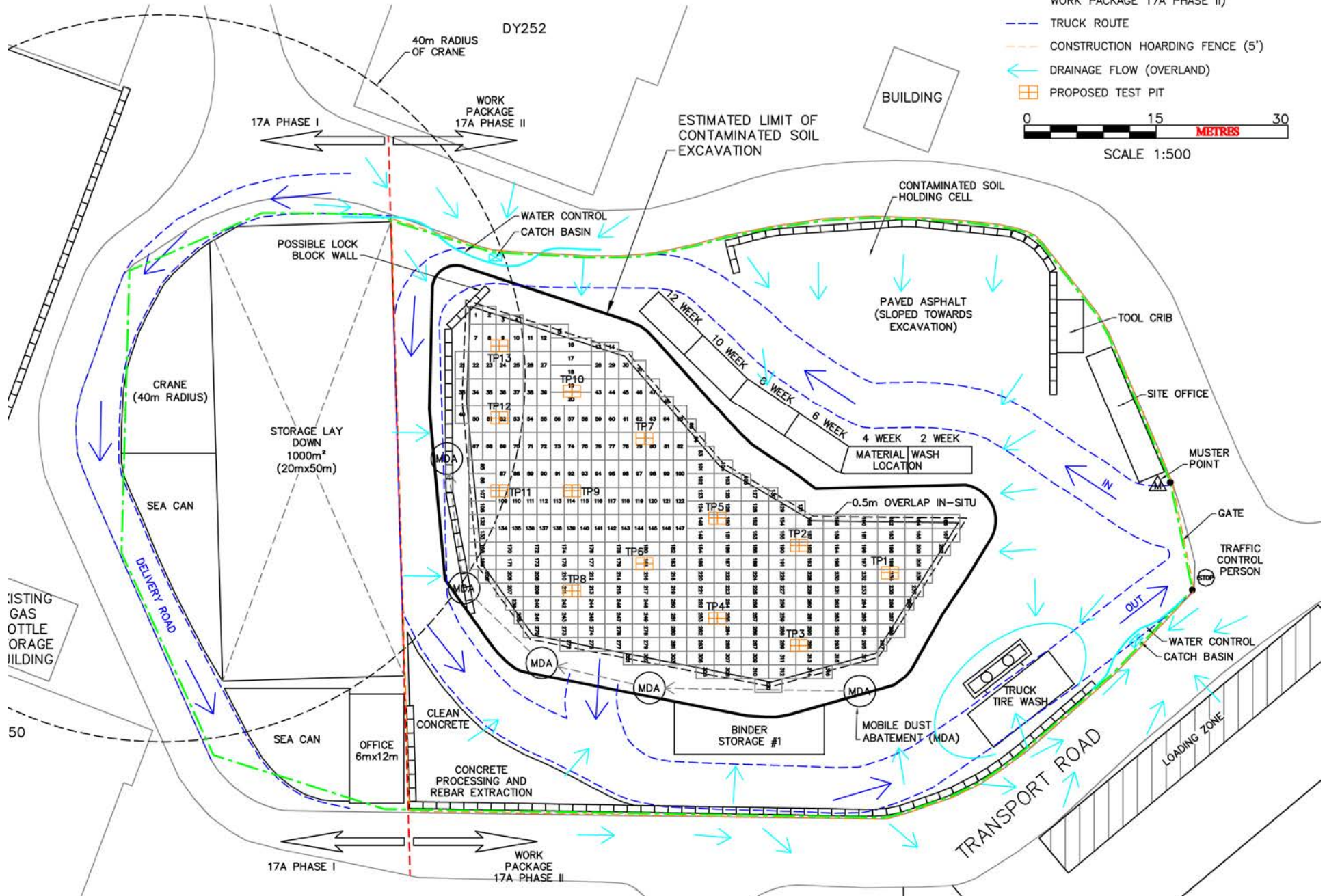
**LEACHABLE METALS  
HYDRO CARBONS  
PCBS**

# **GEOTECHNICAL**

**SOFT SOIL**

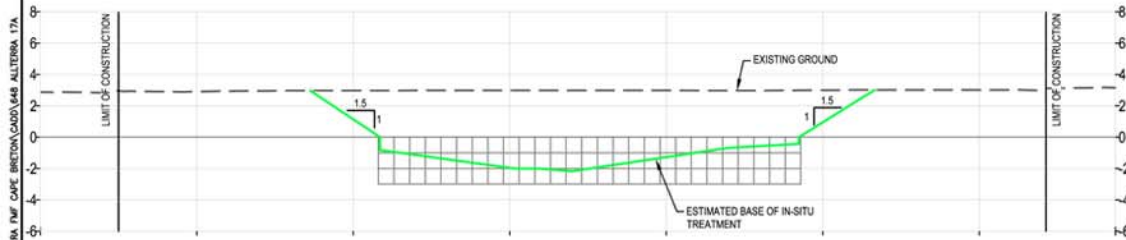


# MASS STABILIZATION PLAN

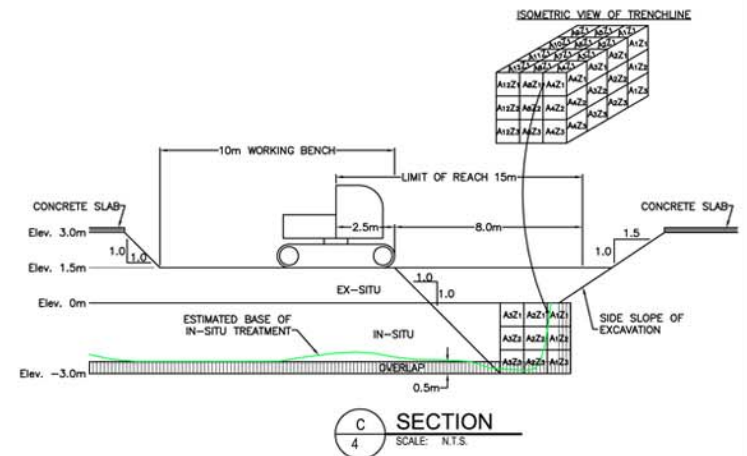




PATH: C:\USERS\GLDWORK\DROPBOX (ACTIVE EARTH)\ENVIRO PROJECTS\648 - ALLTERRA FMF CAPE BRITON\CA00\648 ALLTERRA 17A



**B** SECTION  
4 SCALE: 1:300H 1:300V



REFERENCE: STANTEC CONSULTING LTD. DWG H-E78-9603/17A-6002

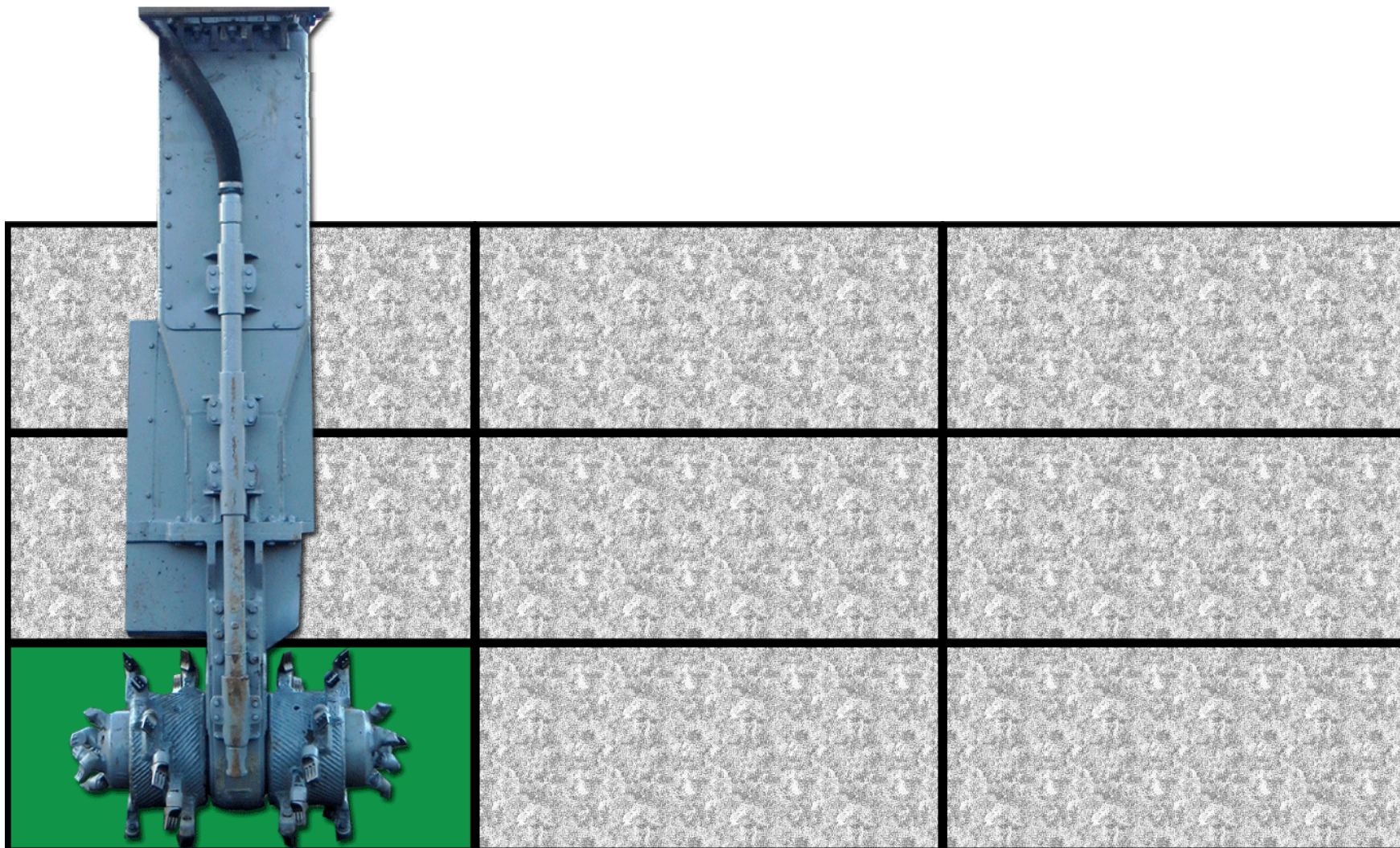




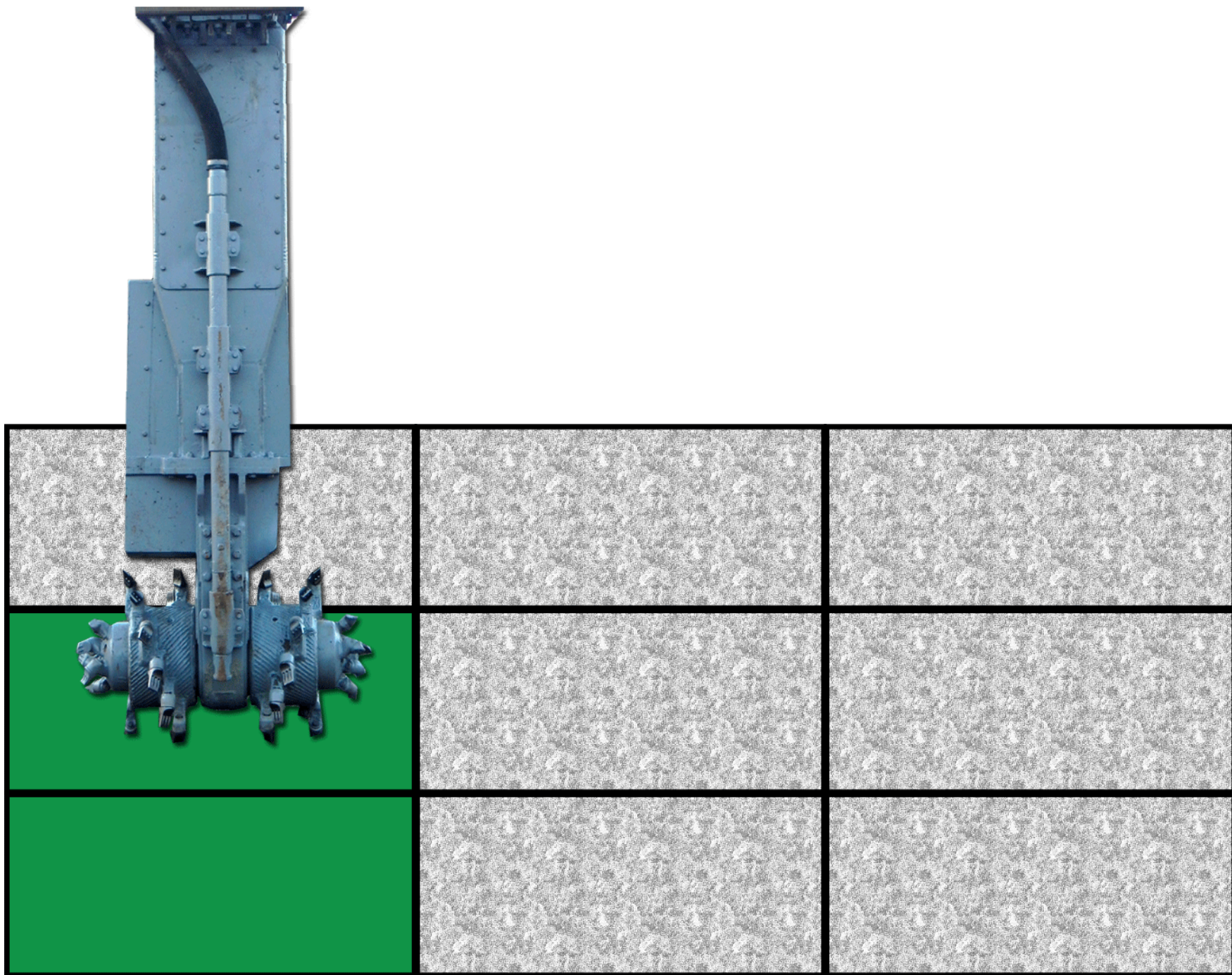




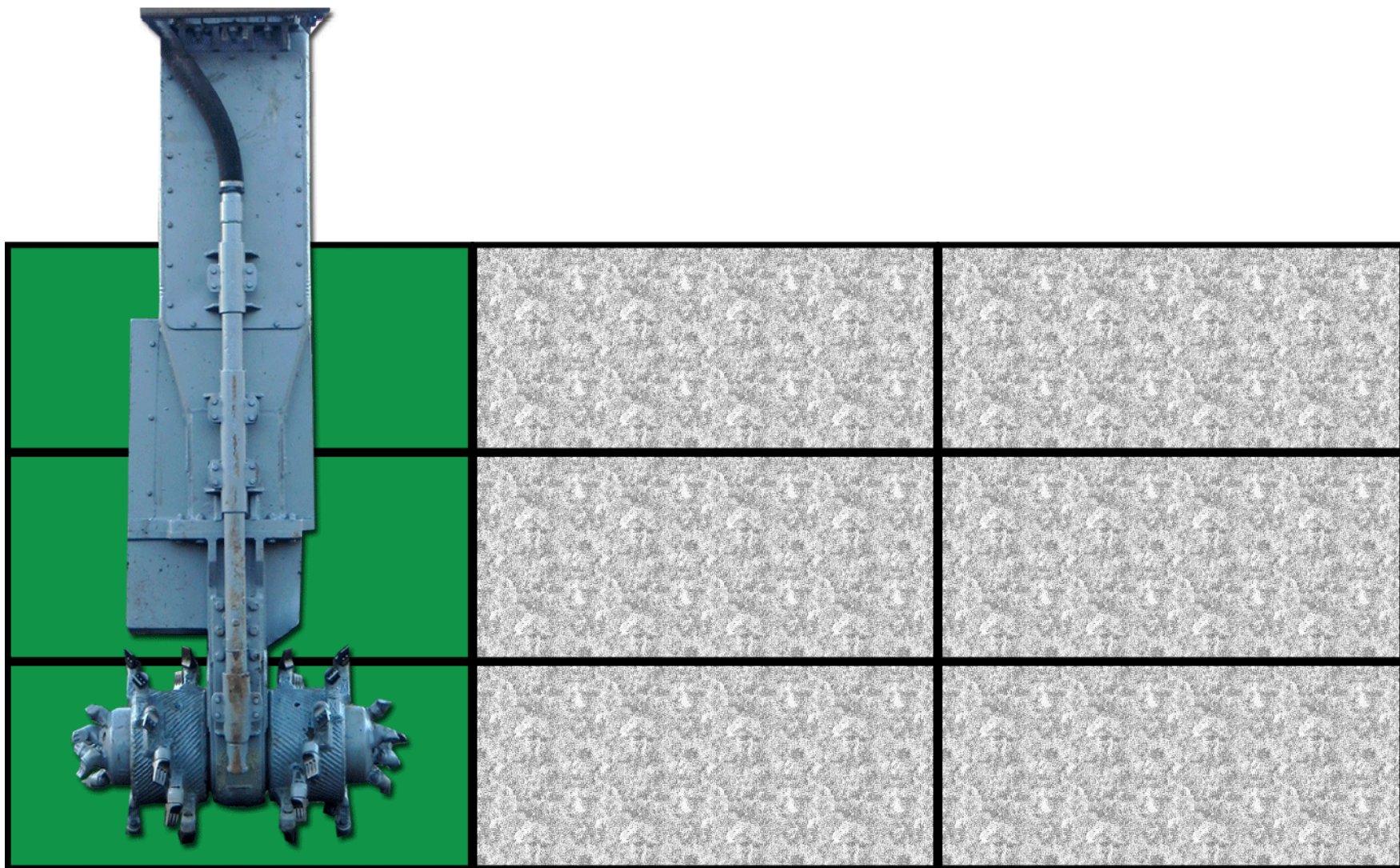


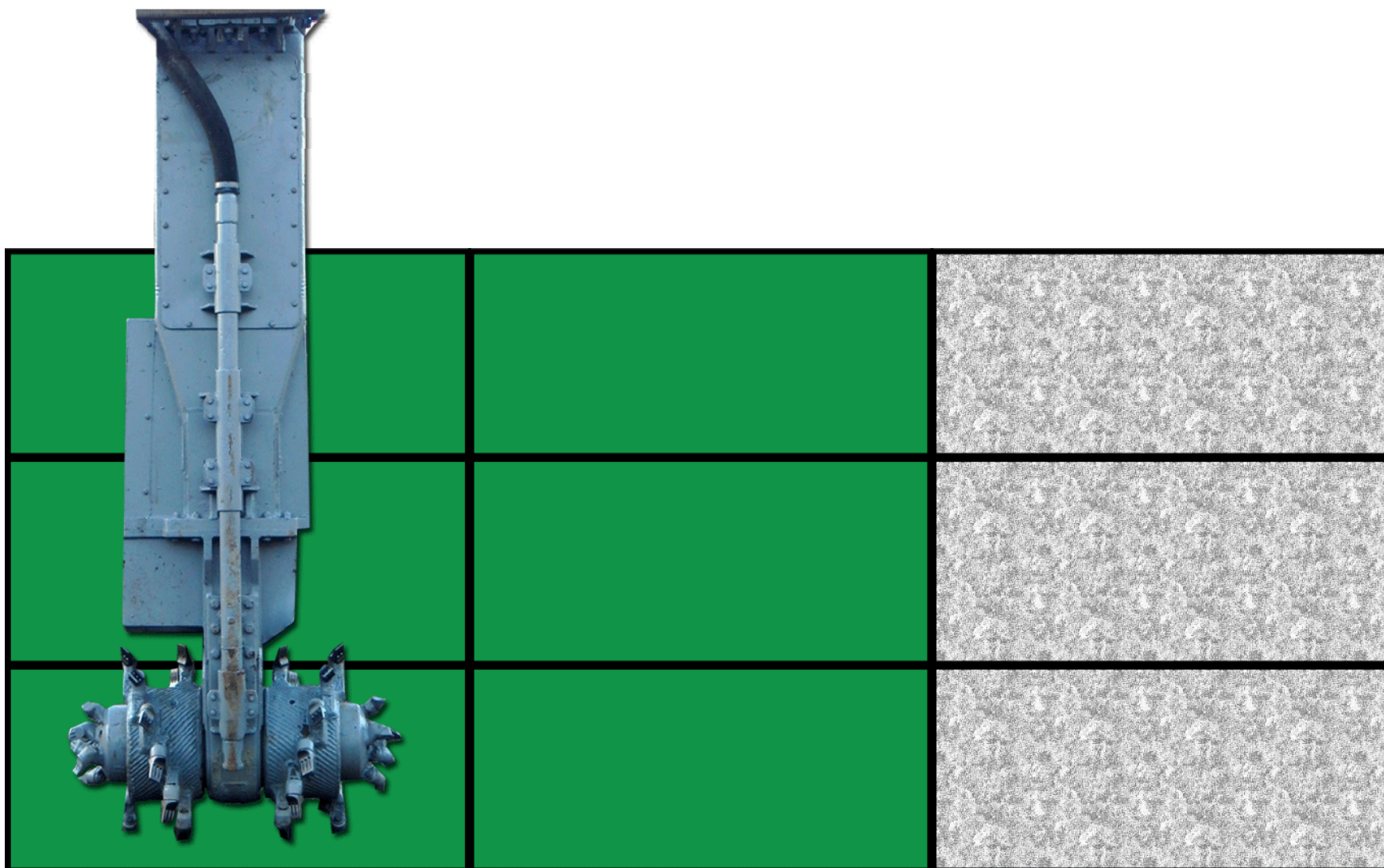




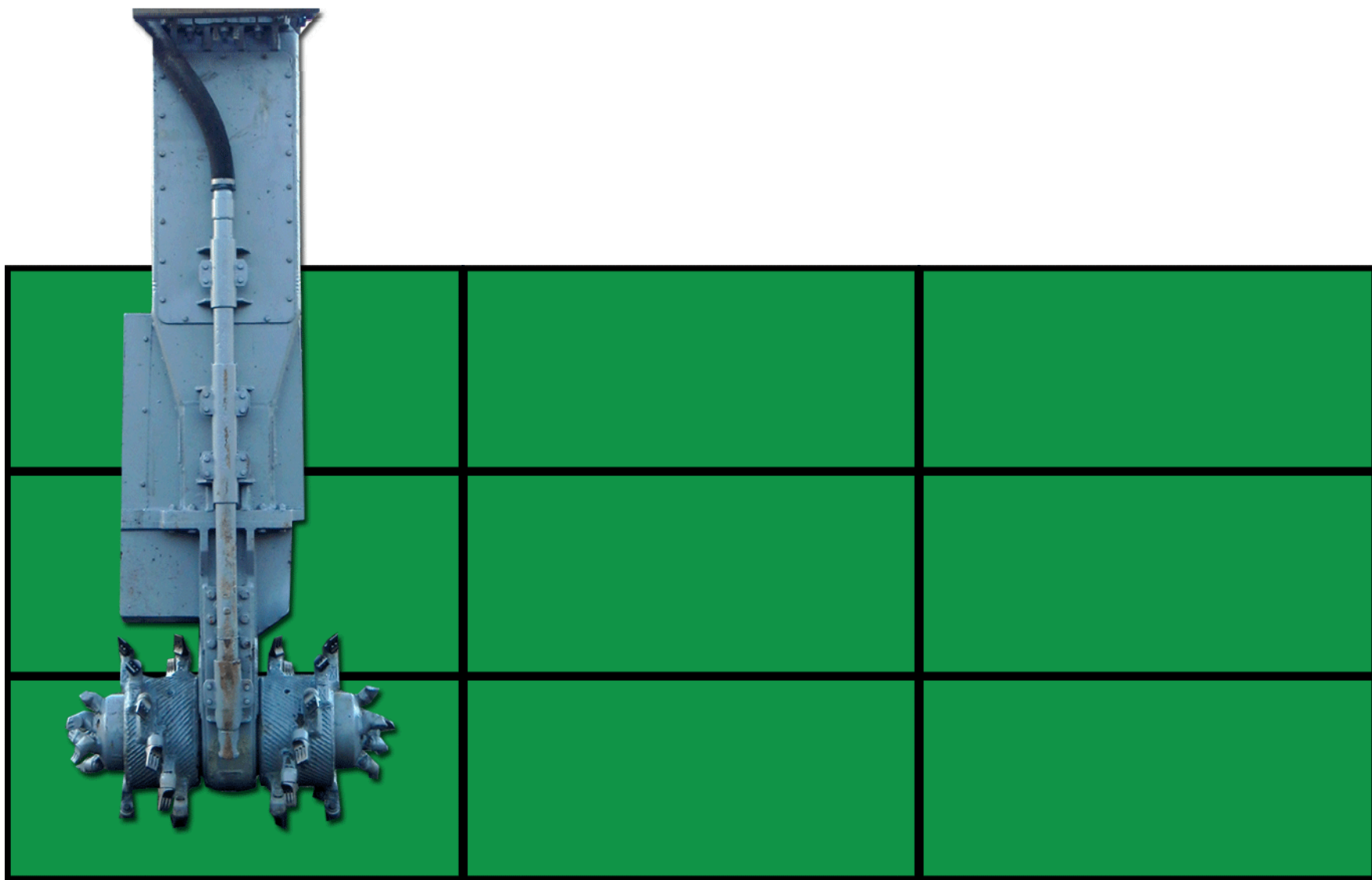






















**RYZUK GEOTECHNICAL**  
ENGINEERING & MATERIALS TESTING

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Victoria, B.C.  
V8Z 1S3  
Tel: 250-475-3131  
Fax: 250-475-3611  
mail@ryzuk.com

**Soilcrete Test Summary Report**

Project No.: 8-6134-25  
Project: In-Situ Soil Mixing - WP17A, CFB Esquimalt  
Client: Allterra Construction  
Contact: Mr. Derek Killburn  
Email / Fax No.: derek@allterraconstruction.ca  
Date: September 5, 2014

Copy to:

Copy to:

Sample Identification	Break Date	Specimen Age (Days)	Average Diameter (mm)	Length (mm)	Load (N)	Area (mm <sup>2</sup> )	Corrected Strength (kPa)
17A-C022-1.0	11-Jul-14	3	100.0	203.0	3820	7854	486
17A-C022-1.0	15-Jul-14	7	99.5	203.0	6304	77	
17A-C022-1.5	11-Jul-14	3	101.5	203.0	3860	80	
17A-C022-1.5	15-Jul-14	7	98.0	203.0	5504	75	
17A-C026-0.5	9-Jul-14	5	101.5	203.0	14304	80	
17A-C026-0.5	16-Jul-14	7	101.0	203.0	24568	80	
17A-C026-1.5	9-Jul-14	5	100.0	203.0	16652	7854	2121
17A-C026-1.5	16-Jul-14	7	101.5	203.0	18704	8091	2310
17A-C026-2.5	9-Jul-14	5	100.0	203.0	10112	7854	1288
17A-C029-1.0	7-Jul-14	3	101.5	203.0	2376	8091	294
17A-C029-1.0	11-Jul-14	7	101.5	203.0	4144	8091	511
17A-C029-1.5	7-Jul-14	3	101.5	203.0	2940	8091	487
17A-C029-1.5	11-Jul-14	7	101.5	203.0	5380	8091	665
17A-C035-0.5	18-Jul-14	4	101.0	203.0	10820	80	
17A-C035-0.5	22-Jul-14	8	100.0	203.0	14388	785	
17A-C035-1.5	18-Jul-14	4	101.0	203.0	10480	80	
17A-C035-1.5	22-Jul-14	8	101.0	203.0	18948	80	
17A-C035-2.5	18-Jul-14	4	101.0	203.0	15632	80	
17A-C035-2.5	22-Jul-14	8	101.0	203.0	18744	8012	2338
17A-C046-0.5	11-Jul-14	3	101.5	203.0	8420	8091	1040
17A-C046-0.5	18-Jul-14	7	101.0	203.0	13412	8012	1673
17A-C046-1.5	11-Jul-14	3	101.5	203.0	18420	8091	2275
17A-C046-1.5	18-Jul-14	7	101.0	203.0	33960	8012	4239
17A-C046-2.5	11-Jul-14	3	101.5	203.0	21296	8091	2632
17A-C046-2.5	18-Jul-14	7	101.0	203.0	25560	8012	3192
17A-C052-0.5	22-Jul-14	5	101.0	203.0	12076	8012	1509
17A-C052-0.5	24-Jul-14	7	101.0	203.0	11996	8012	1498
17A-C052-1.5	22-Jul-14	5	101.0	203.0	14052	8012	1754
17A-C052-1.5	24-Jul-14	7	100.5	203.0	15156	7933	1911
17A-C052-2.5	22-Jul-14	5	100.0	203.0	9080	7854	1155
17A-C052-2.5	24-Jul-14	7	100.0	203.0	9288	7854	1183
17A-C057-0.5	22-Jul-14	6	100.0	203.0	7232	7854	921
17A-C057-0.5	23-Jul-14	7	100.5	203.0	8040	7933	1015
17A-C057-1.5	22-Jul-14	6	100.0	203.0	9040	7854	1152
17A-C057-1.5	23-Jul-14	7	100.0	203.0	9204	7854	1173
17A-C057-2.5	22-Jul-14	6	100.5	203.0	6432	7933	812
17A-C057-2.5	23-Jul-14	7	101.5	203.0	8752	8091	1082
17A-C063-0.5	18-Jul-14	3	101.0	203.0	16440	8012	2051
17A-C063-0.5	22-Jul-14	7	101.5	203.0	27808	8091	3437
17A-C063-1.0	18-Jul-14	3	101.0	203.0	10564	8012	1320
17A-C063-1.0	22-Jul-14	7	101.5	203.0	17832	8091	2205
17A-C063-1.5	18-Jul-14	3	101.0	203.0	9368	8012	1169
17A-C063-1.5	22-Jul-14	7	101.5	203.0	14556	8091	1799
17A-C068-0.5	28-Jul-14	5	100.0	203.0	760	7854	105
17A-C063-1.5	22-Jul-14	7	101.5	203.0	14556	8091	1799
17A-C068-0.5	28-Jul-14	5	100.0	203.0	760	7854	105
17A-C068-0.5	31-Jul-14	8	99.0	203.0	1680	7698	210
17A-C068-0.5	20-Aug-14	28	101.5	203.0	2000	8091	245
17A-C068-2.0	28-Jul-14	5	100.0	203.0	4160	7854	525
17A-C068-2.0	31-Jul-14	8	101.0	205.0	3680	8012	455
17A-C068-2.0	20-Aug-14	28	100.0	203.0	4600	7854	595
17A-C073-0.5	25-Jul-14	3	101.5	203.0	2948	8091	364
17A-C073-0.5	29-Jul-14	7	101.5	203.0	5000	8091	630
17A-C073-0.5	25-Jul-14	3	101.5	203.0	4820	8091	595
17A-C073-0.5	29-Jul-14	7	101.5	203.0	11840	8091	1470
17A-C073-0.5	25-Jul-14	3	101.5	203.0	9536	8091	1180
17A-C073-2.5	25-Jul-14	7	101.5	203.0	15840	8091	1715
17A-C080-0.5	23-Jul-14	5	100.0	203.0	1944	7854	249
17A-C080-0.5	25-Jul-14	7	101.5	203.0	2904	8091	361
17A-C080-0.5	15-Aug-14	28	100.0	203.0	2640	7854	350
17A-C080-1.0	25-Jul-14	7	101.5	203.0	14984	8091	1852
17A-C080-2.0	23-Jul-14	5	101.0	203.0	15200	8012	1897
17A-C080-2.0	25-Jul-14	7	101.5	203.0	18988	8091	2345
17A-C088-0.5	28-Jul-14	3	101.5	203.0	10320	8091	1260
17A-C088-0.5	1-Aug-14	7	100.0	203.0	15960	7854	2030
17A-C088-1.5	28-Jul-14	3	101.5	203.0	11000	8091	1365
17A-C088-1.5	1-Aug-14	7	101.0	203.0	15680	8012	1960



Table 1: Analytical Results for Metals in Soil - WP17A - Solidification &amp; Stabilization Samples

Sample Description	CCME (IL) <sup>1</sup>	CSR (IL) <sup>2</sup>	SRA <sup>3</sup>	17a-C63-0.5- Day3	17a-C63-1.0- Day3	17a-C63-1.5- Day3	17a-C57-0.5- Day3	17a-C57-1.5- Day3	17a-C57-2.5- Day3	17a-c52-0.5- Day3	17a-c52-1.5- Day3	17a-c52-2.5- Day3	17a-c80-0.5- Day3	17a-c80-1.0- Day3	17a-c80-2.0- Day3	17a-C73-0.5- Day3	17a-C73-1.5- Day3	17a-C73-2.5- Day3
Corrected Strength (kPa)																		
Date Sampled (mm/dd/yyyy)				07/15/2014	07/15/2014	07/15/2014	07/16/2014	07/16/2014	07/16/2014	07/17/2014	07/17/2014	07/17/2014	07/17/2014	07/17/2014	07/17/2014	07/22/2014	07/22/2014	07/22/2014
pH 1:2	6 to 8	-	-	11.6	11.4	11.5	11.5	11.5	11.2	11.5	11.7	11.8	10.9	11.5	11.7	11.9	11.8	11.8
<b>Metals</b>																		
Antimony (Sb)	40	40	20	46.4	31.3	43	47.5	39.8	40.4	30.5	67.1	32.8	36.5	37.9	35.4	32.1	32.8	39.8
Arsenic (As)	12	25	15	30.3	26.3	27.7	21.9	25	17.3	13.7	16.6	14.7	19.4	23.2	20.9	16.6	20.4	19.7
Barium (Ba)	2000	1500	400	446	660	496	662	754	761	521	621	538	857	782	832	650	696	664
Beryllium (Be)	8	8	4	0.4	0.4	0.5	0.4	0.4	0.4	0.3	0.4	0.3	0.5	0.5	0.5	0.3	0.3	0.3
Boron (B) (Hot Water Soluble)	-	-	-	1.5	1.3	1.5	1.1	1.1	1.0	1.5	1.4	1.3	2.1	1.5	1.7	1.0	1.0	1.1
Cadmium (Cd) pH < 7.0		2																
pH 7.0 < 7.5		3.5																
pH 7.5 < 8.0		35																
pH >= 8.0		200		7.1	6.4	10.4	7.5	22.9	5.9	2.85	3.2	2.9	6.3	5.9	5.3	2.8	3.4	2.9
Chromium (Cd)	87	60	60	103	274	72	70	61	56	47	43	41	54	61	55	44	59	85
Cobalt (Cr)	300	300	50	17.8	15.4	15.0	14.9	15.6	14.8	11.3	12.0	11.1	12.1	13.2	12.9	12.5	12.9	13.3
Copper (Cu) pH < 5.0		90																
pH 5.0 < 5.5		100																
pH 5.5 < 6.0	91	200	90															
pH >= 6.0		250		1760	93400	1480	1040	1040	926	519	793	1500	1110	1250	950	572	1100	737
Lead (Pb) pH < 5.5		150																
pH 5.5 < 6.0	600	250	100															
pH >= 6.0		2000		1940	1460	1350	1300	1150	734	623	755	627	1350	1240	1200	691	707	867
Mercury (Hg)	50	150	15	4.0	3.2	3.0	1.7	1.9	1.4	1.3	1.6	1.3	5.9	3.3	2.6	1.4	1.7	1.4
Molybdenum (Mo)	40	40	10	14.6	12.4	14	9.0	13	8.1	5.4	6.3	5.5	9.9	10.6	8.5	6.7	7.1	7
Nickel (Ni)	50	500	100	132	206	99.8	79.9	85	64.9	49	51.8	54.1	82.3	93.9	77.5	50.3	60.4	63.6
Selenium (Se)	2.9	10	3	0.5	0.9	0.6	0.7	0.9	0.9	0.4	0.5	0.6	0.6	0.7	0.6	0.4	0.5	0.6
Silver (Ag)	40	40	20	1.0	2.1	1.6	0.6	0.6	0.8	<0.5	0.6	0.9	0.8	1.1	1.1	0.7	0.5	0.5
Thallium (Ti)	1	-	-	0.1	0.1	0.1	0.1	0.2	0.1	0.1	0.1	0.1	0.2	0.1	0.1	0.2	0.1	0.1
Tin (Sn)	300	300	50	319	203	293	284	177	75.1	79.3	57.2	90.9	135	163	144	53.4	67.1	127
Uranium (U)	300	200	-	1.5	1.3	1.5	1.4	1.5	1.1	1.2	1.3	1.2	1.3	1.4	1.3	-	-	-
Vanadium (V)	130	-	200	68.0	55.0	58.0	62.0	58.0	64.0	54.0	55.0	52.0	60.0	56.0	56.0	50.0	53.0	56.0
Zinc (Zn) pH < 6.5		150																
pH 6.5 < 7.0	360	300	150															
pH >= 7.0		600		3730	2860	3290	2150	2420	1620	1210	1310	1120	2090	2520	2250	1230	1450	1280

## Notes:

Associated AGAT Files: 14V864334, 14V865558, 14V865746, 14V867519

All concentrations in mg/kg unless otherwise noted.

\* &lt; means less than the laboratory detection limit indicated.

\* - means not analyzed or no standard or guideline applies.

\* RPDs are not normally calculated where one or more concentrations are less than five times MDL.

(1) Canadian Soil Quality Guidelines (CEQG) for the Protection of Environmental and Human Health, Canadian Council of Ministers of the Environment (CCME), 1999, including updates to 2014. Guidelines for Industrial Land Use, Surficial Soils. The exposure pathway(s) used for determining the guidelines for this site include: general, direct contact, eco soil contact, general incl. gw, protection of gw for aquatic life and management limit (whichever is most stringent).

(2) BC Contaminated Sites Regulation (CSR BC Reg. 375/96 includes amendments up to BC Reg. 97/2011) Generic Numerical Soil Standards (Schedules 4 and 10) and Matrix Numerical Soil Standards (Schedule 5), considering the site specific factors of groundwater flow to surface water used by marine aquatic life, Industrial (IL) Land Use.

(3) BC Contaminated Sites Regulation (CSR BC Reg. 375/96 includes amendments up to BC Reg. 286/2010) Standards Triggering Contaminated Soil Relocation Agreements (Schedule 7) for Soil Relocation to Non-Agricultural Lands (Column II). If soils exceed these standards, a Soil Relocation Agreement is required to dispose of soils off-Site, without authorization.

**BOLD, BLUE SHADING**

Concentration greater than CCME Industrial Land Use (IL) Standard

**BOLD, RED SHADING**

Concentration greater than CSR Industrial Land Use (IL) Standard

**Underline, Grey Shading**

Concentration &gt; CSR SRA Standard.



Table 2: Analytical Results for Leachable Metals in Soil - WP17A - Solidification &amp; Stabilization Samples

Sample ID	Hazardous Waste Standards <sup>(1)</sup>	17a-C63-0.5-Day3	17a-C63-1.0-Day3	17a-C63-1.5-Day3	17a-C57-0.5-Day3	17a-C57-1.5-Day3	17a-C57-2.5-Day3	17a-c52-0.5-Day3	17a-c52-1.5-Day3	17a-c52-2.5-Day3	17a-c80-0.5-Day3	17a-c80-1.0-Day3	17a-c80-2.0-Day3	17a-C73-0.5-Day3	17a-C73-1.5-Day3	17a-C73-2.5-Day3
Corrected Strength (kPa)																
Date Sampled (mm/dd/yyyy)		07/15/2014	07/15/2014	07/15/2014	07/16/2014	07/16/2014	07/16/2014	07/17/2014	07/17/2014	07/17/2014	07/17/2014	07/17/2014	07/17/2014	07/22/2014	07/22/2014	07/22/2014
TCLP Metals (mg/L)																
Antimony (Sb)-Leachable	-	0.02	0.02	0.02	0.07	<0.01	0.03	0.05	0.05	0.03	0.11	0.02	0.02	0.01	0.02	<0.01
Arsenic (As)-Leachable	2.5	<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
Barium (Ba)-Leachable	100.0	0.49	0.43	0.37	0.31	<0.05	0.34	0.36	0.52	0.68	0.17	0.67	0.58	0.71	0.60	1.01
Beryllium (Be)-Leachable	-	<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
Boron (B)-Leachable	500.0	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.70	<0.5	<0.5	<0.5	<0.5	<0.5
Cadmium (Cd)-Leachable	0.5	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Chromium (Cr)-Leachable	5.0	0.02	0.01	<0.01	0.02	<0.01	0.01	0.03	0.01	0.02	<0.01	0.02	0.02	0.02	0.03	0.02
Cobalt (Co)-Leachable	-	<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
Copper (Cu)-Leachable	100.0	0.20	0.14	0.10	0.10	<0.05	0.11	0.22	0.15	0.19	0.10	0.14	0.16	0.07	0.10	0.08
Iron (Fe)-Leachable	-	2.00	4.00	2.00	<1	<1	<1	5.00	<1	2.00	3.00	<1	1.00	<1	1.00	<1
Lead (Pb)-Leachable	5.0	0.16	0.17	0.06	0.04	<0.01	0.02	0.16	0.05	0.10	0.11	0.06	0.05	0.03	0.05	0.30
Mercury (Hg)-Leachable	0.1	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Nickel (Ni)-Leachable	-	<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
Selenium (Se)-Leachable	1.0	<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
Silver (Ag)-Leachable	5.0	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Thallium (Tl)-Leachable	-	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Uranium (U)	10.0	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Vanadium (V)-Leachable	-	<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
Zinc (Zn)-Leachable	500.0	0.10	0.10	<0.1	<0.1	<0.1	<0.1	0.10	<0.1	0.10	0.10	<0.1	<0.1	<0.1	<0.1	<0.1
Zirconium	-	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01

Notes:

Associated AGAT Files: 14V864334, 14V865558, 14V865746, 14V867519

All concentrations in mg/L, except pH.

BOLD, MAGENTA SHADING

Concentration greater than Hazardous Waste (HW) Standards

\* &lt; " less than the laboratory method detection limit (MDL) indicated.

\* - means not analyzed or no standard or guideline applies.


(1) BC Hazardous Waste Regulation, Schedule 4, Table 1



**PROJECTED COST \$22 MILLION**

**ACTUAL COST \$5 MILLION**





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# ALLTERRA

**CONSTRUCTION & ENVIRONMENTAL**