Appendix N Environmental and Geosciences Assessment for Tongue Creek Option

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Sign-Off

This appendix was prepared by a team consisting of several professionals. The professionals responsible for this appendix are as follows:

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1. Introduction

1.1 General

This report presents the results of a preliminary assessment carried out by AECOM Canada Ltd. (AECOM) for the proposed Tongue Creek flood by-pass. The proposed by-pass channel is located within the Foothills Municipal District in Alberta, as shown on Figure N1-1 in Appendix N1.

The purpose of this desk study was to assess the anticipated environmental, subsurface soil, bedrock, and groundwater conditions along the proposed by-pass channel alignment and to identify major issues that may impact the design and construction of the by-pass channel. It will also provide preliminary recommendations to assist in preparing preliminary design and feasibility of the proposed channel alignment.

The recommendations presented in this report are based on the review of data obtained from the previous investigations near the proposed channel by-pass alignment. A site specific investigation has not been conducted. The subsurface soil/bedrock/groundwater conditions and recommendations provided in this report are preliminary and are subject to review and confirmation during detailed design phase and after completion of site specific investigations.

1.2 Site Description

Tongue Creek originates in the Foothills region between Longview and Turner Valley in southern Alberta and flows in the easterly direction to the Highwood River; north of High River. Approximately 21% of the basin consists of forested areas and the remaining 79% is prairie. The proposed Tongue Creek bypass channel is located west of the Town of High River, with a total length of 3893 metres (m). The preliminary channel design has 4H:1V side slopes with a 60 m wide base. The Tongue Creek by-pass alignment is shown on Figure N1-2 in Appendix N1.

Based on the information provided during preparation of this report, the channel will be constructed in cut and fill sections which will require the construction of the berms. A summary of the available channel information is provided below:

- Channel length approximately 3893 m
- Channel depth generally varies from approximately 4 m to 20 m
- Berm height varies from approximately 1 m to 2 m, depending on the original ground elevation
- Depth of cut varies from approximately 2 m to 20 m
- Channel base width 60 m
- Channel side slopes 4H:1V

The channel will have one drop structure along the proposed alignment.

1.3 Scope of Work

The scope of work for this desktop study is:

- Review available information including publically available ecological databases and reports, geological maps, water well logs, and previous geotechnical reports to assess the anticipated conditions at the proposed by-pass channel location
- Develop preliminary recommendations to support preliminary design and feasibility of the proposed by-pass channel

• Prepare a preliminary report documenting the findings of the review, providing a summary of the anticipated conditions, and providing preliminary recommendations to support preliminary design and feasibility of the proposed by-pass channel

2. Environmental Assessment

2.1 Overview

AECOM conducted an environmental overview desktop review for the proposed Tongue Creek bypass option around High River, Alberta. The purpose was to compile information on existing conditions and to provide recommendations for future works associated with the bypass options. The desktop review consisted of examining a variety of publically available ecological databases and reports. However, this desktop review does not follow the format of an Environmental Impact Assessment (EIA) due to the limited engineering, hydrological, geotechnical, hydrogeological, and geological information available for the scheme and/or site location. Socioeconomic, First Nations, human health, noise, odour, and/or cost benefit analyses are not discussed in this section due to their inclusion in the triple bottom line appendix and limited available information. Instead, this is considered an environmental overview desktop report and is intended as a general guidance document outlining some of the major environmental concerns and regulatory issues associated with the bypass project and area.

The Tongue Creek Project Area (Figure N2-1 in Appendix N1) included the area covered by a 1% (100-year) flood and consists of a 100 m buffer around the scheme and included every quarter section that was intercepted. Within the Tongue Creek Project Area, various sensitive species, protected areas, and historical resource listings were identified. A summary of identified environmental issues, the dataset they were identified from, and impacted species/impacted areas, applicable legislation, and restricted activities are provided in Table 2-1.

Recommendations are supported by AECOM ecologists with a variety of specializations including, but not limited to, soils, terrestrial vegetation, wildlife, fish and fish habitat, wetlands, and environmental permitting. To date, no field investigations have been conducted. As such, there is potential for permitting requirements to change, once field conditions are confirmed and detailed engineering information is provided.

Table 2-1: Summary of Environmental Issues Associated with the Tongue Creek Project Area

Dataset	Environmental Issues	Impacted Species / Impacted Areas	Applicable Legislation	Restricted
Alberta Conservation Information Management System (ACIMS)- Non- Sensitive EOS	Rare species (as determined by ANPC) that are not protected have been identified within the search radius	Rough-stalked Feather moss (<i>Brachythecium</i> <i>rutabulum</i>), low yellow evening-primrose (<i>Oenothera flava</i>)	Alberta Wildlife Act, Species at Risk Act	A rare plant survey will be required prior to construction activities commencing. If rare plants are found, mitigation will be required (i.e. transplanting, taking seeds, etc.).
Key Range Layers	Sensitive raptor and sharp tailed grouse key ranges occur within the Project Area	Sensitive raptors and Sharp-tailed Grouse	Alberta Wildlife Act	Limited work during March 15 th to June 15 th (Sharp-tailed Grouse survey)
Key Wildlife and Biodiversity Zone	Key wildlife zone exists within the Project Area	N/A	Alberta Wildlife Act	All areas identified as Key Wildlife and Biodiversity zones. No construction December 15 th to April 30 th
Listing of Historical Resource	Historical Resource Values of 4 and 5 within the Project Area	HRV 4: contains a historic resource that may require avoidance HRV 5: believed to contain a historic resource	Historical Resources Act	May have restricted activities if historical resources are found
Wetlands	Permanent wetlands existing in Project Area	274.2 ha of marsh and 36.4 ha of open water	Water Act	Impacts to wetlands will need compensation
Wildlife	Migratory birds and important wildlife habitat occur in the area; Species at Risk may occur at the project site	See Table 2-2	Alberta Wildlife Act, Species at Risk Act, Migratory Birds Convention Act	A variety of wildlife surveys will be required prior to construction commencing (breeding bird, amphibian, bat, winter tracking, remote wildlife camera, and/or ungulate). Depending on the species found on site, a variety of mitigation measures may be required.
Fisheries	Important sport fish and Species at Risk may occur in the area	Bull Trout and West Slope Cutthroat Trout	Alberta Wildlife Act, Species at Risk Act	Impacts to the Highwood River will result in possible destruction of fish habitat, important migration routes, and access to spawning habitat. Habitat compensation and mitigation will be required.

2.2 Environmental Concerns

Environmental concerns associated with the proposed Tongue Creek Project Area are described below in the following sections.

2.2.1 First Nations

No First Nations reservations or lands were identified within the Tongue Creek Project Area. However, the Alberta Government requires that all projects on Public Lands undergo a First Nations Consultation assessment request through Alberta Environment and Sustainable Resource Development (AESRD), as required by *Alberta's First Nations Consultation Policy and Guidelines on Land Management and Resource Development* at the start of the project to determine consultation needs and requirements. First Nations consultation would be required for this project due to the regulatory requirements.

2.2.2 Historical Resources

A Statement of Justification for *Historical Resources Act* clearance was conducted for the bypass option D3/E and was used for the Tongue Creek analysis. This is required by Alberta Culture to provide detailed and accurate information about the relationship between project impacts and historic resources (both known and potential) in the area and to determine if a Historical Resources Impact Assessment (HRIA) will be required as the next step. Six

previously recorded Historic Resource sites were recorded within the Tongue Creek project area (Figure N2-2 in Appendix N1).

Additionally, a database search of the *Listing of Historic Resources (Current to March 2014)*, issued by the Government of Alberta (ACCS 2014) was performed and revealed Historic Resource Values (HRVs) of 4 and 5 within the Tongue Creek Project Area. An HRV of 4 means that a site, or sites, have not been fully assessed and require a HRIA, while an HRV of 5 means that there is a high potential for the presence of historical resources sites (archaeological, historic, and/or paleontological) in the area and an HRIA will likely be required. HRIAs are required when an activity will, or will likely, result in the alteration, damage, or destruction of a historic resource. Mitigation must be provided and depending on the value of the resource, projects may be required to change or move to avoid disturbing the historical resource.

Most of the Historical Resources sites found in the project vicinity are located along or near the Highwood River and on its floodplain or by other hydrologic features. Since one end of the proposed bypass will intersect the Highwood River, there is high potential for the presence of undisturbed Historical Resource sites in that area. Much of the rest of the Tongue Creek Project Area has been disturbed by agriculture or road construction. These areas are considered to have low to medium potential depending on sedimentation depth in areas where the plough zone may not have impacted more deeply buried cultural deposits.

Parts of the Tongue Creek Project Area are considered to have high Historical Resources potential and as a result, an HRIA is recommended.

2.2.3 Protected Areas

2.2.3.1 Wildlife Layers

2.2.3.1.1 Key Wildlife and Biodiversity Zones

Key Wildlife and Biodiversity Zones are intended to prevent: (1) loss and fragmentation of habitat, (2) short and longterm all-weather public vehicle access, sensory disturbance during periods of thermal or nutritional stress on wildlife, and (3) the development of barriers to wildlife corridors (e.g. stream crossings). Typically, Key Wildlife and Biodiversity Zones are established along major river valleys. Such landforms have the topographic variation and site productivity conditions that yield high levels of biodiversity and good winter browse conditions with adequate cover (AESRD 2010).

Key Wildlife and Biodiversity Zones were identified west of Highway 2 within the Tongue Creek project area (Figure N2-3 in Appendix N1). As per the recommended wildlife land use guidelines (AESRD 2010), timing restrictions of no construction between December 15th and April 30th would be enforced due to the impacts on wildlife.

2.2.3.2 Key Range Layers

The project area falls within several key range/wildlife layers developed by AESRD. These wildlife feature layers provide industry, government, and the public with the best information available on the range of wildlife sensitivities in the Province (AESRD 2013a). Specific operating procedures apply to industrial activities in these zones in order to reduce impacts to habitat and wildlife populations (AESRD 2013a). Range layers are based on the extent of known, or partially known, ranges of a species within Alberta, and can assist when deciding where to conduct surveys or where mitigation strategies should be applied (AESRD 2013a).

The Tongue Creek Project Area occurs within two Key Range Layers: the Sensitve Raptor Range and the Sharptailed Grouse Range (Figure N2-4 in Appendix N1). The Sharp-tailed Grouse range requires limited work allowance during the March 15th to June 15th lekking (breeding) season.

2.2.3.3 Environmentally Significant Areas

Environmentally Significant Areas (ESAs) represent places in Alberta that are important to the long-term maintenance of biological diversity, soil, water, or other natural processes, at multiple spatial scales (Government of Alberta 2009). They are identified as areas containing rare or unique elements in the province or areas that include elements that may require special management consideration due to their conservation needs. ESAs do not represent government policy and are not necessarily areas that require legal protection, but instead are intended to be an information tool to help inform land use planning and policy at local, regional, and provincial scales.

Although no ESAs were identified within the Tongue Creek Project Area, it is bordered to the south by an area of concern within Grassland 236 (Table 2-1). ESA 236 has a Provincial Significance rating, contains important wildlife habitat, and intact riparian areas. Proposed projects in ESAs may meet greater opposition because of the known high value of these areas with regards to biotic and abiotic resources. The extent of the ESAs are illustrated in Figure N2-4 in Appendix N1.

2.2.3.4 Land Use

The Tongue Creek Project Area is within the Municipal District of Foothills No. 31 and the Intermunicipal Development Plan area. The Town of High River is a rapidly growing municipality and developing in this area creates challenges to ensure cohesion between both current land uses and future land use objectives. Dillon Consulting Limited (2009) provided future growth recommendations to The Town of High River based on: existing land uses and man-made features, protection from natural processes, and ensuring the natural environment and water quality are not negatively impacted. Using maps from Dillon Consulting Limited (2009), the current and future land use within the project area was assessed.

The land impacted within the Tongue Creek Project Area is primarily agricultural, but industrial, residential, and municipal reserve areas are also affected. The Tongue Creek Project Area overlaps the proposed Highway 2A Industrial Area Structure Plan (H2AIASP) to the north of High River. This area has importance as a gateway into and out of the town, and any development in this area is subject to the "Enhanced Design Guidelines" provided in the appendices of H2AIASP (Town of High River and MD of Foothills 2012).

2.2.4 Ecological Factors

2.2.4.1 Vegetation and Rare Plants

The proposed project is in the Foothills Fescue Ecoregion of Alberta's Grassland Natural Region, which is characterized by hummocky and rolling to undulating mainly morainal terrain with significant lacustrine deposits. Native grasslands are Mountain Rough Fescue on moister sites, and western wheatgrass on drier sites. Wet areas are often shrubby. Much of the Project Area has been disturbed by residential development, agriculture, and/or road construction.

A search of the Alberta Conservation Information Management System (ACIMS) Non-Sensitive Element Occurrences, identified Rough-stalked Feather Moss (*Brachythecium rutabulum*), Low Yellow Evening-Primrose (*Oenothera flava*) and Californian Amaranth as potentially impacted rare species within the Tongue Creek Project Area (Figure N2-4 in Appendix N1; Alberta Tourism, Parks and Recreation 2012). It is possible that other rare plant species may exist and as such, rare plant surveys will be required prior to construction. The presence of rare plants can cause delays to construction if the plants have to be relocated or may require modifications to construction methodologies and/or location if the rare plants species are listed as Species at Risk.

2.2.4.2 Soils

The Tongue Creek area is characterized as valley's, with terraces of low relief. Weakly developed Orthic Regosol soils will be found within the fluvial terraces and adjacent side slopes of the Tongue Creek channel, and Orthic Black Chernozems will be associated with the crest of the terraces (Figure N2-5 in Appendix N1). The landscape of the surrounding area is characterized as an undulating landform of low relief, with select locations demonstrating high relief. Moderately fine textured Orthic Black Chernozemic soils are the dominant soil subgroup associated with this landscape. Soils in the project area will not be a limiting factor.

2.2.4.3 Wildlife and Species at Risk

A search of the Fisheries and Wildlife Management Information System (FWMIS) was conducted for the Tongue Creek Project Area. Data of recorded wildlife observations was provided by AESRD. The dataset included bird, mammal, amphibian, and reptilian sightings (AESRD2013b; Figure N2-3in Appendix N1). A 20 kilometre (km) buffer was used to search for Species at Risk. A wider range was used for the Species at Risk search as many wildlife species have large home ranges. Results of these two searches are presented in Table 2-2.

Wildlife species were also included in Table 2-2 based on known range distributions that have the potential to occur within the Tongue Creek Project Area. This was determined by a combination of FWMIS data (provided by AESRD), and from species ranges obtained from the following resources: the Birds of North America online database (Poole 2005), the North American Mammals online database (Smithsonian 2014), the New Stokes Field Guide to Birds Western Region (Stokes and Stokes 2013), the Sibley Field Guide to Birds of Western North America (Sibley 2011), Western Reptiles and Amphibians (Stebbins 2003), Mammals of North America (Reid 2006), and Mammals of Alberta (Pattie and Fisher 1999).

In the Tongue Creek Project Area, seven species are listed by AESRD as "At Risk". The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) lists 12 species as "Special Concern" and five species as "Threatened". The *Species at Risk* Act (SARA) lists five species as "Special Concern" and five species as "Threatened". Piping Plover (*Charadrius melodus*) and Burrowing Owl (*Athene cunicularia*) are listed as "Endangered" by COSEWIC and SARA. All wildlife species identified within the Tongue Creek Project Area, Species at Risk noted within the 20 km buffer, and species with the potential to occur within the Tongue Creek Project Area are listed in Table 2-2. Project delays and/or project related modifications may arise should any Species at Risk occur within the Tongue Creek Project Area. Specific mitigation is required for Species at Risk which include restricted timing windows, disturbance free zones, and the inability to destroy or alter specific habitat features (e.g. dens, nests, hibernacula, etc.). Similarly, migratory birds are, and their nests are, protected under the federal *Migratory Birds Convention Act.* Figure N2-3 in Appendix N1 shows the location of all wildlife species recorded within the Tongue Creek project area.

Table 2-2: Wildlife Species Likely to Occur within the Tongue Creek Project Area

Common Name	Scientific Name	AESRD ¹	COSEWIC ²	SARA ³	Schedule			
	Birds							
American Avocet ⁴	Recurvirostra americana	Secure	Not Listed	Not Listed	N/A			
American Bittern ⁶	Botaurus lentiginosus	Sensitive	Not Listed	Not Listed	N/A			
American Coot ⁴	Fulica americana	Secure	Not At Risk	Not Listed	N/A			
American Dipper ⁴	Cinclus mexicanus	Secure	Not Listed	Not Listed	N/A			
American Kestrel⁵	Falco sparverius	Sensitive	Not Listed	Not Listed	N/A			
American Robin ⁴	Turdus migratorius	Secure	Not Listed	Not Listed	N/A			
American White Pelican ⁵	Pelecanus erythrorhynchos	Sensitive	Not at Risk	Not Listed	N/A			
American Wigeon ⁴	Anas americana	Secure	Not Listed	Not Listed	N/A			
Baird's Sparrow ⁵	Ammodramus bairdii	Sensitive	Special Concern	Not Listed	No Schedule			
Bald Eagle ^{4/5}	Haliaeetus leucocephalus	Sensitive	Not At Risk	Not Listed	N/A			
Baltimore Oriole ⁵	Icterus galbula	Sensitive	Not At Risk	Not Listed	N/A			
Barn Swallow ⁵	Hirundo rustica	Sensitive	Threatened	Not Listed	No Schedule			
Barred Owl ⁶	Strix varia	Sensitive	Not At Risk	Not Listed	N/A			
Black-backed Woodpecker ⁶	Picoides arcticus	Sensitive	Not At Risk	Not Listed	N/A			
Black-billed Magpie ⁴	Pica hudsonia	Secure	Not Listed	Not Listed	N/A			
Black-crowned Night-heron ⁵	Nycticorax nycticorax	Sensitive	Not Listed	Not Listed	N/A			
Black-necked Stilt ⁵	Himantopus mexicanus	Sensitive	Not Listed	Not Listed	N/A			
Black Tern ⁵	Chlidonias niger	Sensitive	Not at Risk	Not Listed	N/A			
Broad-winged Hawk ⁶	Buteo platypterus	Sensitive	Not At Risk	Not Listed	N/A			
Brown Creeper ⁶	Certhia americana	Sensitive	Not At Risk	Not Listed	N/A			
Burrowing Owl ⁵	Athene cunicularia	At Risk	Endangered	Endangered	Schedule 1			
Common Nighthawk ⁶	Chordeiles minor	Sensitive	Threatened	Threatened	Schedule 1			
Common Raven ⁴	Corvus corax	Secure	Not Listed	Not Listed	N/A			
Common Yellowthroat ⁶	Geothlypis trichas	Sensitive	Not Listed	Not Listed	N/A			
Ferruginous Hawk⁵	Buteo regalis	At Risk	Threatened	Threatened	Schedule 1			
Forster's Tern ⁵	Sterna forsteri	Sensitive	Not Listed	Not Listed	N/A			
Gadwall ⁴	Anas strepera	Secure	Not Listed	Not Listed	N/A			
Golden Eagle ⁶	Aquila chrysaetos	Sensitive	Not at Risk	Not Listed	N/A			
Great Blue Heron ⁴	Ardea herodias	Sensitive	Not Listed	Not Listed	N/A			
Great Gray Owl ⁶	Strix nebulosa	Sensitive	Not at Risk	Not Listed	N/A			
Great Horned Owl ⁴	Bubo virginianus	Secure	Not Listed	Not Listed	N/A			
Green-winged Teal ⁵	Anas crecca	Sensitive	Not Listed	Not Listed	N/A			
Harlequin Duck ⁶	Histrionicus histrionicus	Sensitive	Not Listed	Not Listed	N/A			
Horned Grebe⁵	Podiceps auritus	Sensitive	Special Concern	Not Listed	No Schedule			
Horned Lark ⁴	Eremophila alpestris	Secure	Not Listed	Not Listed	N/A			
Killdeer ⁴	Charadrius vociferous	Secure	Not Listed	Not Listed	N/A			
Least Flycatcher ⁶	Empidonax minimus	Sensitive	Not Listed	Not Listed	N/A			

Common Name	Scientific Name	AESRD ¹	COSEWIC ²	SARA ³	Schedule
Lesser Scaup⁵	Aythya affinis	Sensitive	Not Listed	Not Listed	N/A
Loggerhead Shrike ⁵	Lanius ludovicianus excubitorides	Sensitive	Not Listed	Threatened	Schedule 1
Long-billed Curlew ⁵	Numenius americanus	Sensitive	Special Concern	Special Concern	Schedule 1
Mallard ⁴	Anas platyrhynchos	Secure	Not Listed	Not Listed	N/A
Northern Goshawk ⁶	Accipiter gentilis	Sensitive	Not at Risk	Not Listed	N/A
Northern Harrier ⁴	Circus cyaneus	Sensitive	Not At Risk	Not Listed	N/A
Northern Pintail ⁵	Anas acuta	Sensitive	Not Listed	Not Listed	N/A
Northern Pygmy-owl ⁶	Glaucidium gnoma	Sensitive	Not Listed	Not Listed	N/A
Northern Shoveler ⁴	Anas clypeata	Secure	Not Listed	Not Listed	N/A
Olive-sided Flycatcher ⁶	Contopus cooperi	May Be At Risk	Threatened	Threatened	Schedule 1
Osprey ⁵	Pandion haliaetus	Sensitive	Not Listed	Not Listed	N/A
Peregrine Falcon ⁵	Falco peregrinus	At Risk	Special Concern	Special Concern	Schedule 1
Pied-billed Grebe ⁵	Podilymbus podiceps	Sensitive	Not Listed	Not Listed	N/A
Pileated Woodpecker ⁶	Dryocopus pileatus	Sensitive	Not Listed	Not Listed	N/A
Piping Plover ⁵	Charadrius melodus	At Risk	Endangered	Endangered	Schedule 1
Prairie Falcon ⁵	Falco mexicanus	Sensitive	Not at Risk	Not Listed	N/A
Purple Martin ⁶	Progne subis	Sensitive	Not Listed	Not Listed	N/A
Red-tailed Hawk ⁴	Buteo jamaicensis	Secure	Not At Risk	Not Listed	N/A
Rusty Blackbird ⁴	Euphagus carolinus	Sensitive	Special Concern	Special Concern	Schedule 1
Sandhill Crane ⁶	Grus canadensis	Sensitive	Not Listed	Not Listed	N/A
Sharp-tailed Grouse ⁵	Tympanuchus phasianellus	Sensitive	Not Listed	Not Listed	N/A
Short-eared Owl ⁵	Asio flammeus	May Be At Risk	Special Concern	Special Concern	Schedule 1
Sora ⁴	Porzana carolina	Sensitive	Not Listed	Not Listed	N/A
Sprague's Pipit ⁵	Anthus spragueii	Sensitive	Threatened	Threatened	Schedule 1
Swainson's Hawk⁵	Buteo swainsoni	Sensitive	Not Listed	Not Listed	N/A
Trumpeter Swan ⁵	Cygnus buccinator	At Risk	Not at Risk	Not Listed	N/A
Upland Sandpiper ⁶	Bartramia longicauda	Sensitive	Not Listed	Not Listed	N/A
Western Grebe ⁵	Aechmophorus occidentalis	Sensitive	Not Listed	Not Listed	N/A
Western Meadowlark ⁴	Sturnella neglecta	Secure	Not Listed	Not Listed	N/A
Western Tanager ⁶	Piranga ludoviciana	Sensitive	Not Listed	Not Listed	N/A
Western Wood-pewee ⁶	Contopus sordidulus	Sensitive	Not Listed	Not Listed	N/A
White-faced Ibis ⁵	Plegadis chihi	Sensitive	Not Listed	Not Listed	N/A
	Mam	mals			
American Badger ⁶	Taxidea taxus	Sensitive	Special Concern	Not Listed	No Schedule
Bobcat ⁶	Lynx rufus	Sensitive	Not Listed	Not Listed	N/A
Canada Lynx ⁶	Lynx canadensis	Sensitive	Not at Risk	Not Listed	N/A
Deer Mouse ⁴	Peromyscus maniculatus	Secure	Not Listed	Not Listed	N/A
Grizzly Bear ⁵	Ursus arctos	At Risk	Special Concern	Not Listed	No Schedule
Hoary Bat ⁶	Lasiurus cinereus	Sensitive	Not Listed	Not Listed	N/A
		Secure		Not Listed	No Schedule

Common Name	Scientific Name	AESRD ¹	COSEWIC ²	SARA ³	Schedule		
Long-tailed Weasel ⁵	Mustela frenata longicauda	May Be At Risk	Not At Risk	Not Listed	N/A		
Meadow Vole ⁴	Microtus pennsylvanicus	Secure	Not Listed	Not Listed	N/A		
Muskrat ⁴	Ondatra zibethicus	Secure	Not Listed	Not Listed	N/A		
Northern Grasshopper Mouse ⁴	Onychomys leucogaster	Secure	Not Listed	Not Listed	N/A		
Northern Pocket Gopher ⁴	Thomomys talpoides	Secure	Not Listed	Not Listed	N/A		
Prairie Vole ⁴	Microtus ochrogaster	Secure	Not Listed	Not Listed	N/A		
Red Bat ⁶	Lasiurus borealis	Sensitive	Not Listed	Not Listed	N/A		
Silver-haired Bat ⁶	Lasionycteris noctivagans	Sensitive	Not Listed	Not Listed	N/A		
Water Vole ⁶	Microtus richardsoni	Sensitive	Not Listed	Not Listed	N/A		
Wolverine ⁶	Gulo gulo	May Be At Risk	Special Concern	No Status	No Schedule		
	Amph	ibians					
Boreal Chorus Frog ⁴	Pseudacris maculata	Secure	Not Listed	Not Listed	N/A		
Columbia Spotted Frog ⁵	Rana luteiventris	Sensitive	Not at Risk	Not Listed	N/A		
Long-toed Salamander ⁶	Ambystoma macrodactylum	Sensitive	Not at Risk	Not Listed	N/A		
Northern Leopard Frog ⁵	Lithobates pipiens	At Risk	Special Concern	Special Concern	Schedule 1		
Plains Spadefoot ⁶	Spea bombifrons	May Be At Risk	Not at Risk	Not Listed	N/A		
Western Tiger Salamander ⁶	Ambystoma mavortium	Secure	Special Concern	Not Listed	No Schedule		
Western Toad ⁶	Anaxyrus boreas	Sensitive	Special Concern	Special Concern	Schedule 1		
Reptiles							
Plains Garter Snake ⁵	Thamnophis radix	Sensitive	Not Listed	Not Listed	N/A		
Prairie Rattlesnake ⁵	Crotalus viridis	May Be At Risk	Not Listed	Not Listed	N/A		
Red-sided Garter Snake ⁵	Thamnophis sirtalis	Sensitive	Not Listed	Not Listed	N/A		
Wandering Garter Snake ⁵	Thamnophis elegans	Sensitive	Not Listed	Not Listed	N/A		

Notes: 1 = AESRD 2011, 2 = COSEWIC 2013, 3 = Species at Risk Public Registry (Government of Canada 2012), 4 = Documented species within the Northern Diversion Project Location, 5 = Species at Risk recorded within a 20 km buffer of the Northern Diversion Project Location, 6 = Species with the Potential to Occur within the Northern Diversion Project Location.

The project could potentially impact 73 Species at Risk, multiple species sensitive to anthropogenic disturbance, and many migratory bird species. The presence of such species within the Tongue Creek Project Area can have ecological ramifications, which may result in project relocation and/or delays. Mitigation efforts would be required that may include, but are not limited to, abiding to migratory bird and sensitive species restricted timing windows, modifications to construction methodologies and/or schedule, and designing for wildlife passage/use during detailed design.

2.2.4.4 Aquatic Resources

2.2.4.4.1 Fisheries

The Tongue Creek Project Area includes Tongue Creek and the Highwood River. The Highwood River at High River is a Mapped Class C Water Body with dual Restricted Activity Periods (RAPs) of May 1st to July 15th and September 16th to April 15th. According to the AESRD FWMIS database, 16 species of fish have been captured that have the potential to transit between these two water bodies representing sportfish (trout, whitefish, burbot, and pike), minnows, suckers, trout-perch, and sculpins (Table 2-3). Tongue Creek is designated as a Class D except for

the first 2 km upgradient of its confluence with the Highwood River, which takes on the class of the receiving water body (Class C). The RAPs for this area will be concurrent with the Highwood River.

Common Name	Scientific Name	Spawning Season	Provincial Status ¹	COSEWIC ²	SARA ³			
SPORTIFISH	SPORTIFISH							
Brook Trout	Salvelinus fontinalis	Fall	Exotic / Alien	Not Listed	Not Listed			
Brown Trout ^₄	Salmo trutta	Fall	Exotic / Alien	Not Listed	Not Listed			
Burbot ⁴	Lota lota	Winter	Secure	Not Listed	Not Listed			
Bull Trout ⁴	Salvelinus confluentus	Fall	Special Concern	Threatened	Not Listed			
Cutthroat Trout ⁴	Oncorhynchus clarki	Spring	At Risk	Threatened	Threatened			
Mountain Whitefish ⁴	Prosopium williamsoni	Fall	Secure	Not Listed	Not Listed			
Northern Pike⁴	Esox lucius	Spring	Secure	Not Listed	Not Listed			
Rainbow Trout	Oncorhynchus mykiss	Spring-Summer	Secure	Not Listed	Not Listed			
NON-SPORTFISH	·	· · · · · · · · · · · · · · · · · · ·						
Flathead Chub	Platygobio gracilis	Spring	Secure	Not Listed	Not Listed			
Lake Chub	Couesius plumbeus	Spring	Secure	Not Listed	Not Listed			
Pearl Dace ⁴	Margariscus margarita	Spring-Summer	Undetermined	Not Listed	Not Listed			
Longnose Dace⁵	Rhinichthys cataractae	Spring-Summer	Secure	Not Listed	Not Listed			
Longnose Sucker	Catostomus catostomus	Spring	Secure	Not Listed	Not Listed			
White Sucker	Catostomus commersoni	Spring	Secure	Not Listed	Not Listed			
Spottail Shiner ⁵	Notropis hudsonius	Spring	Secure	Not Listed	Not Listed			
Trout-perch	Percopsis omiscomaycus	Spring-Summer	Secure	Not Listed	Not Listed			
Spoonhead Sculpin	Cottus ricei	Spring	May Be at Risk	Not Listed	Not Listed			

Notes1 = AESRD 2011, 2 = COSEWIC 2013, 3 = Species at Risk Public Registry (Government of Canada 2012), 4 = Not documented in Tongue Creek project area, 5 = Not documented in D3 or E project area

Cutthroat Trout and Bull Trout are listed as "Threatened" by COSEWIC, which indicates that the species is facing imminent extirpation or extinction. Cutthroat Trout are also listed under SARA as "Threatened", which means a formal, legal review has been conducted and they are protected under the Act.

Bull Trout are listed provincially as "Special Concern" and "Sensitive" by AESRD (2011). Sensitive species are not at risk of extinction, but may require special attention or protection. Overharvesting and habitat loss have led to the decline in the population. Some stocking has occurred historically.

Cutthroat Trout are listed at "At Risk" by AESRD (2011). Species listed as "At Risk" have undergone a formal detailed status assessment and are legally identified as "Threatened" or "Endangered" in the *Wildlife Act*. The native Cutthroat Trout populations are threatened by stocking of Cutthroat Trout and Rainbow Trout. These two species have hybridized, which is leading to a decline in the Cutthroat Trout population.

Brook Trout and Brown Trout are listed as "Exotic/Alien" by AESRD (2011). "Exotic/Alien" ranked species have been introduced as a result of human activities. Brown Trout are native from Iceland to the White Sea area and Morocco through Algeria to Turkey; Caspian and Aral seas (Nelson and Paetz 1992). Brook Trout are native to northern Manitoba, the Ungava Bay area, Newfoundland and south to the Carolinas and some Mississippi headwaters (Nelson and Paetz 1992). Brook Trout are native through out western Alberta, including the Bow River system.

As Bull Trout and Cutthroat Trout are protected species, project limitations such as timing windows and habitat replacement are anticipated within the Tongue Creek Project Area. The Highwood River is also a very important fishery in southern Alberta and any disruption to migration, spawning, and water quality could have detrimental impacts. In particular, any structures that block upstream migration of fish and impede downstream movement are the primary concern. Both factors could have implications on whether or not the bypass project could go ahead due to the protected nature of Bull and Cutthroat Trout.

The Highwood River and associated tributaries support a predominantly coldwater salmonid fishery with Rainbow Trout, Brook Trout, Bull Trout, Cutthroat Trout, and Mountain Whitefish. The Highwood River Basin provides very successful spawning, rearing, and wintering habitat that supports the fish within the Highwood River and Bow River systems (Golder 1995). Water management and water quality are of great importance for fish, wildlife, and human use of the Highwood River and its tributaries. Severe weather events in recent years have severely affected aquatic, terrestrial, and human environments in the Highwood River Basin. The full extent of the impact of events such as these on fish communities and fish habitat is unknown.

The following potential impacts may occur as a result of the proposed Tongue Creek Project and may warrant further study and will potentially require a request for review from the minister of Fisheries and Oceans and an Application for Authorization:

- An increase in flow in Tongue Creek at or exceeding the flow capacity of the system is likely to result in increased bank erosion, increased sedimentation and damage to riparian vegetation.
- Diverted water and increased flows are likely to cause fish habitat loss, fish mortality, as well as alteration or increased competition caused by the introduction of invasive species and non-native species.
- Water quality concerns caused by increased nutrient loading, sediment loading, and or contaminant flux.
- Water quality concerns caused by the mixing of groundwater seeping from the diversion channel and freshwater from the creek and/or river.
- Fish movement may be impeded or severely impacted forcing fish to go where they would not have naturally gone.
- It is unclear if the flow volumes in Tongue Creek would be capable of flushing fish species from Tongue Creek to the Highwood River, where different quality of habitats exist that would not support certain species or certain life stages. The effects of this transfer of fish warrants further assessment and will potentially require a request for review by the Minister of Fisheries and Oceans and an Application for Authorization.

2.2.4.4.2 Wetlands

A review of existing site information was conducted using the Alberta Canadian Wetland Classification System (CWCS) Merged Wetland Inventory (AESRD 2012). Within the proposed Tongue Creek Project Area, 67 marshes and four open water wetlands have been identified, with marshes covering an area of 274.18 ha and open water bodies covering 36.42 ha (Figure N2-2 in Appendix N1). The majority of all of these wetlands are located in the northern half of the Project Area. As per the *Water Act* (Government of Alberta 2013c), all wetlands that fall within the white zone are protected and any impacts to a wetland as a result of the proposed Project will require compensation. It is important to note that this wetland dataset does not include ephemeral wetlands (Class I to III) and as such, a wetland inventory must be completed.

2.2.4.4.3 Potential Project Impacts

Proposed projects in the basin have the potential to impact areas well beyond the basin. Downstream habitats can be greatly affected by a change in flow rates and as a result, species adapted to this area can be harmed. To address these potential impacts, the river system should be addressed at an ecosystem level, rather than looking at specific habitat areas. The Natural Flow Paradigm is a system that takes into account that the "natural variability of flow in terms of magnitude, duration, frequency and timing is beneficial to the ecosystem" (TWG 2002).

The Highwood and Sheep River Basin is the only unobstructed major tributary to the Bow River and is considered an important spawning and rearing area for both local stocks and the Bow River. Periodic flooding of this area maintains the riparian forests along the Bow River, and certain species, like cottonwood forests, have adapted to these flood events and utilize them for recruitment. Ecosystem function relies on natural variability within the flow regime in all rivers. Therefore, to assess potential impacts of projects to these rivers, an appropriate system to use is the Natural Flow Paradigm (TWG 2002).

The Natural Flow Paradigm aims to conserve the native biodiversity and ecosystem integrity of all rivers by taking into account the pattern of natural flow. Flow components have specific functions within a river system and maintaining the connectivity amongst all components ensures both habitat and species diversity (TWG 2002). Over many years, species have adapted to take advantage of these dynamic systems and a change to flow patterns could impact these species and their habitat areas.

Studies have concluded that in order to set ecosystem objectives, the hydrology, geomorphology, biology, water quality, and connectivity should all be considered, rather than single-flow recommendations, to better succeed in protecting the integrity of aquatic ecosystems (TWG 2002). As any projects in the basin have the potential to impact areas outside of the basin, these components should be incorporated in to any plans to ensure minimal disturbance to downstream ecosystems.

2.2.5 Regulatory Setting

Below is a non-comprehensive list of regulatory agencies, regulations, and acts that will have to be consulted and considered once more detailed project information is known. A summary of other potential environmental legislation that may be required can be found in Alberta Transportation (2013). Information regarding regulatory requirements and timing was obtained directly from the regulatory agencies. Project descriptions and maps were provided to the agencies in order to gain assistance in determining which regulatory approvals would be required and the approximate timelines that each approval would follow. Until detailed project descriptions are provided to each regulatory agency, required regulatory approvals and timelines are not definite and are subject to change based on alterations to the extent or scope of the project. There may be various other minor Federal, Provincial, Municipal approvals or permits required for the project (e.g. burning permits, noise-bylaws). These should be determined and looked at in further detail when the scope of the project is narrowed.

2.2.6 Federal Legislation and Requirements

Works associated with the Tongue Creek Project Area may involve the following federal legislation depending on the final engineering design and reservoir capacity of the dam: *Canadian Environmental Assessment Act* (CEAA) *Fisheries Act, Navigable Waters Protection Act* (NWPA), *Migratory Birds Convention Act* (MBCA), and *Species at Risk Act* (SARA).

2.2.6.1 Canadian Environmental Assessment Act

The Canadian Environmental Assessment Agency (CEAA) establishes a process to assess the environmental effects of projects requiring federal actions or decisions, and requires that the environmental effects of projects be considered early in their planning stages. As per the *Regulations Designating Physical Activities* (SOR/2012-147; Government of Canada 2013a) under the *Canadian Environmental Assessment Act* (S.C. 2012, c. 19, s.52; Government of Canada 2013b), Tongue Creek will be subject to an environmental assessment. The proposed Tongue Creek by-pass channel would involve diverting more than 10,000,000 m³ per year of water from the Highwood River to Tongue Creek and back into the Highwood River during a 1% flood event. This will be subject to the need for an environmental assessment under CEAA, activity 6: "The construction, operation, decommissioning and abandonment of a new structure for the diversion of 10 000 000 m³/yr or more of water from a natural water body into another natural water body". As a provincial Environmental Assessment Cooperation would allow for the assessment and review process to be coordinated and combined. A detailed project description for all diversion options can be sent to CEAA for confirmation once more design information is available.

2.2.6.2 Fisheries Act

The *Fisheries Act* (R.S.C. 1985, c. F-14) applies to all Canadian fisheries waters and Fisheries and Oceans Canada (DFO) has the responsibility to administer and enforce the conservation and protection of fish habitat on private property, as well as on provincial and federal lands (Government of Canada 2013c). Section 36(3) of the *Fisheries Act* prohibits the discharge of deleterious substances into a water body; Section 20(1) requires that any works conducted in and around a water body accommodate fish passage; and Section 35(1) prohibits serious harm to fish, which includes fish and fish habitat that are part of or support commercial, recreational, or Aboriginal fisheries. Serious harm is defined in the *Fisheries Act* as the death of fish, a permanent alteration to fish habitat, and/or the destruction of fish habitat.

DFO has established a self-assessment tool outlining project activities and criteria that do not require DFO review. DFO also provides *Measures to Avoid Harm to Fish and Fish Habitat* which are designed to avoid causing harm and comply with the *Fisheries Act*. If a project does not meet the criteria established by DFO to avoid serious harm to fish and effects cannot be mitigated, a Request for Review must be submitted for consideration by the Minister of Fisheries and Oceans. If activities are determined to cause serious harm to fish, an Application for Authorization will be required that will include a fish and fish habitat report, available design information, a description of effects on fish and fish habitat, a description of measures and standards to avoid or mitigate serious harm to fish and an offsetting plan. The Application for Authorization must also include a letter of credit (from the proponent) to ensure that, if conditions of authorization are not completed, DFO can access funds to implement all remaining elements of the mitigation plan. The amount of the letter of credit should be sufficient to complete the offsetting plan and any required monitoring program.

Design information for the Tongue Creek Project Area has not yet been developed, which prevents specific comment on the potential impacts of a channel. Impacts to fish and fish habitat might include fish passage issues, sedimentation, erosion, habitat loss, habitat alteration, and water quality issues (mixing of ground water and fresh water). Collaboration with DFO officials will be integral in developing the design of the bypass channel, diversion structure, and outfall structures to minimize the risk to fish and fish habitat. The DFO approval process will take approximately one and a half years, depending on whether or not fish habitat destruction will occur.

The Tongue Creek project will result in serious harm to fish and fish habitat, including fish passage and access to spawning habitat. As such, the requirements discussed above will need to be followed, fish and fish habitat studies will need to be completed, and a letter of credit will have to be drafted. The process will take approximately one and a half years.

2.2.6.3 Navigable Waters Protection Act

The Transport Canada Navigable Waters Protection Program supports the regulation of works constructed or placed in, on, over, under, through, or across, navigable waters in Canada in accordance with the *Navigable Waters Protection Act* (NWPA, R.S.C., 1985, c. N-22, Government of Canada 2009). As part of the Federal Government's 2012 Bill C-45, amendments were made to the NWPA including implementation of a schedule listing major waterways for which regulatory approval is required. The project is projected to commence construction after April 2014, when the amendments come into force, therefore, review will not be required by Transport Canada as the Highwood River is not included in the Schedule of the Act. The amendment to the act still allows proponents of works in non-scheduled waters to opt-in and seek approval of their proposed works. It is recommended that the proponent consult with Transport Canada and seek approval on these proposed works as they would significantly impact navigability.

2.2.6.4 Migratory Birds Convention Act

The *Migratory Birds Convention Act* [1994, amended in 2010, c.22] (MBCA) and Migratory Birds Regulation [2005, amended in 2009, c1035] are administered by Environment Canada (Government of Canada 2010). Under the MBCA, CWS has jurisdictional interest with respect to the management of migratory birds and migratory bird populations, protecting nationally significant nesting habitats, and regulating the hunting of migratory game birds such as ducks and geese. Section 6(a) of the General Prohibitions of the Migratory Birds Regulations C.R.C., c. 1035, states that it is an offence to "disturb, destroy or take a nest, egg, or nest shelter" of a migratory bird. Additionally, Section 35(1) stipulates that "no person shall deposit or permit to be deposited oil, oil wastes or any other substance harmful to migratory birds in any waters or any area frequented by migratory birds".

The MBCA and its' associated regulation specify that efforts should be made to preserve and protect habitat necessary for the conservation of migratory birds. This includes nesting and wintering grounds, migratory bird corridors, and encompasses such activities as tree clearing, wetland consolidation, and temporary and permanent disturbances occurring in proximity to migratory bird habitat.

In the southern Parkland and Boreal ecozones of Alberta, Environment Canada advises that habitat destruction activities (e.g. vegetation clearing, flooding, draining, construction, etc.) in upland areas attractive to migratory birds are prohibited between May 1st and August 20th. In wetland areas attractive to migratory birds, the window is between April 15th and August 20th (Paul Gregoire, Environment Canada, personal communication). Migratory birds will be encountered at the project site; therefore, mitigation to avoid construction (e.g. tree clearing and/or potential nest habitat destruction) during migratory bird restricted timing windows will be required.

2.2.6.5 Species at Risk Act

The *Species at Risk Act* [2002, c.29] (SARA) provides protection for Canadian indigenous species, subspecies, and distinct populations and their critical habitats on federal lands, but does not apply to lands held by the Province of Alberta or its private citizens unless "the laws of Alberta do not effectively protect the species or the residences of its individuals" (Government of Canada 2013d). The Minister may issue an order in council to protect federally listed species that occur on provincial or private lands, but this has not occurred.

2.2.7 Provincial Legislation

2.2.7.1 Alberta Environmental Protection and Enhancement Act

The Ministry of Environment and Sustainable Resource Development is responsible for evaluating the impacts that a project may have on the environment and for the administration of Alberta's laws governing Environmental Assessments and Environmental Impact Assessments. The Environmental Assessment Regulation and the Environmental Assessment (Mandatory and Exempted Activities) Regulation provides direction on matters related to the administration of the environmental assessment process. The purpose of Environmental Protection and Enhancement Act (EPEA) (R.S.A. 2000, c. E-12; Government of Alberta 2013e) is to support and promote the protection, enhancement and wise use of the environment.

The proposed Tongue Creek scheme will be subject to an Environmental Impact Assessment (EIA) through the following activities under the *Environmental Assessment (Mandatory and Exempted Activities) Regulations:*

• "The construction, operation or reclamation of a water diversion structure and canals with a capacity greater than 15 cubic metres per second"

As the project is considered a mandatory activity by the EPEA director (personal communication), an Environmental Impact Assessment (EIA) will be subject to and cannot be overridden by any government authority or process. The EIA process will start by submitting a detailed project description to EPEA to determine if an EIA is required. Once that is confirmed, a Terms of Reference (TOR) will be submitted to EPEA and Public Notice will occur (this takes 30 to 45 days). Modifications are made to the TOR depending on the level of public comment (time frame ranging from one month to many months) and an EIA is commenced. The EIA involves field work, analyses, and reporting and generally takes 72 weeks until the TOR is met. The next step is to refer the EIA to the Public Interest Board where the Natural Resources Conservation Board (NRCB) determines if they need more information or if a hearing is required. During the 72 week EIA process, an integrated application can be submitted to all regulatory agencies (EPEA, Water Act, Public Lands, DFO, Transport Canada, CEAA, etc.), but NRCB has to consider a decision before all other approvals are issued. An EIA cannot be submitted until a First Nations Consultation Plan has been approved. From start to finish (meeting the requirements of the TOR), the EIA process takes 2 to 3 years.

When both federal and provincial environmental assessments are required for a project, the two governments act together to minimize overlap and increase efficiency so the assessment will not take any additional time. This process is laid out in the *Canada-Alberta Agreement for Environmental Assessment Cooperation* (Government of Canada 2013e).

2.2.7.2 Natural Resources Conservation Board Act

The NRCB, established in 1991, is an agency independent from the Government of Alberta that reviews proposed non-energy natural resource projects (NRCB 2014). The NRCB, under the *Natural Resources Conservation Board Act*, considers social, environmental, and economic effects when reviewing resource projects before approval is granted to the Proponent (Government of Alberta 2013f). The *Environment Protection and Enhancement Act* sets which projects require EIAs, and of those projects, EPEA determines which will also require a review by the NRCB (NRCB 2007). Reviewable projects include forest industry projects, recreational or tourist projects, metallic or industrial mineral projects, water management projects, and any other type of project prescribed in the regulations (Government of Alberta 2013f). If a water management project requires an EIA under EPEA, it automatically becomes an NRCB reviewed project as described in the *Act*. By definition, a "water management project" means:

- *i)* A project to construct a dam, reservoir or barrier to store water or water containing any other substance for which an environmental impact assessment report has been ordered, or
- *ii)* A project to construct a water diversion structure, or canal capable of conducting water or water containing any other substance for which an environmental impact assessment report has been ordered.

Once an EIA meets its TOR, it is referred to the NRCB to determine if the NRCB requires more information or if a hearing is required. This process can take an additional 1 to 2 years above the EIA timeline of 2 to 3 years.

2.2.7.3 Water Act

All water resources located within the province of Alberta are owned by the Provincial Government. AESRD administers the Alberta *Water Act*, which is the primary legislation governing the use and management of Alberta's water resources, including wetlands. Alberta's *Water Act* (R.S.A. 2000, c. W-3; Government of Alberta 2013c) requires approval and/or attainment of a license before undertaking construction in a surface water body or activities related to a water body which have the potential to impact the aquatic environment. Dams and water diversions require *Water Act* Applications, and diversions also require a *Water Act* Licence. Section 36 of the Act stipulates that an approval is required for all activities that may impact water and the aquatic environment.

The Approved Water Management Plan for the South Saskatchewan River Basin (Alberta Environment 2006) recommends that Alberta Environment no longer accept applications for water allocations in both the Bow, and Oldman Sub-basins until the Minister of Environment specifies, through a Crown Reservation, how water currently unallocated is to be used (Alberta Environment 2006). Water allocated to a Crown Reservation within these sub-basins can only be used for:

- Water conservation objectives.
- Storage of peak flows to mitigate impacts on the aquatic environment and to support existing licenses. (Alberta Environment will assist the Watershed Planning and Advisory Councils in evaluations of the potential for on-stream and off-stream storage).
- Licenses and registrations that may be issued for applications and registrations pending at the date of the Crown Reservation (this does not necessarily imply approval; but the pending applications and registration will be reviewed).
- First Nations Reserves.

The Tongue Creek by-pass channel may be considered an accepted use under one or more of the above depending on the final design.

Also, under Section 16(1) of the *Water Act*, the Director may not issue or amend an approval, preliminary certificate, or licence or approve a transfer of an allocation of water under a licence if the Director is of the opinion an EA or EIA is required. Should an EIA process be required, all *Water Act* Approvals and Licences will occur simultaneously with the EIA approval process. A *Water Act* approval will be required for this project. Depending on the final design of the diversion, it is possible that a licence under the *Water Act* may be required. All timelines listed in Table 2-5 were provided by the *Water Act* Approvals group within AESRD.

2.2.7.4 Alberta's Wetland Policy

AESRD released Alberta's new Wetland Policy in September 2013 (Government of Alberta 2013b). This policy will be phased in in the summer of 2014. Until then, the "Wetlands Management in the Settled Area of Alberta – an Interim Policy" (1993) provides a framework to conserve wetlands within Alberta (Alberta Water Resources Commission 1993). In addition to conserving wetlands, this document also introduces the mitigation of wetland impacts as well as the enhancement, restoration, or creation of ephemeral wetlands. In 2007, the Alberta

Government released the revised edition of the Provincial Wetland Restoration/Compensation Guide, which provides recommendations to achieve the policy's goals, intent, objectives, and mitigation requirements. This will occur in conjunction with the EIA process.

The new wetland policy will apply to all wetlands in the province (no discrimination between wetlands located in the green vs. white zone of Alberta) and will focus on conserving and minimizing wetland losses. Impacted wetlands will need to be evaluated by a Qualified Wetland Aquatic Environment Specialist (QWAES) using a standardized tool to determine Wetland Value. The score determined from the tool will be used in the decision making process in order to avoid, mitigate, or replace wetland losses. Wetland Value will also be used to determine wetland replacement/compensation ratios (Government of Alberta 2013b).

2.2.7.5 Historical Resources Act

The *Historical Resources Act* (R.S.A. 2000, c. H-9) protects historic resources in Alberta, including paleontological, prehistoric, historic, archaeological, and certain cultural or natural objects, sites, or structures (Government of Alberta 2013a). Pursuant to the Act, a Historical Resource Clearance is needed for projects where effects on known and unknown historical resources could occur. The recommendation for this project is that a Historical Resources Impact Assessment be conducted, which will occur concurrently with the EIA process.

2.2.7.6 Public Lands Act

All Public Lands, including the bed and shores of all permanent watercourses and water bodies, are considered Alberta Public Lands unless they are owned by the Government of Canada. As such, approvals under the *Public Lands Act* [R.S.A. 2000, c. P-40] (Government of Alberta 2013d) are required for any activity on Public Lands or the bed or shore of Crown owned rivers, streams, or lakes. Any activity that alters or occupies Public Lands or the bed and shore of a water body requires written approval. As all diversions occur on a water body and on terrestrial Public Lands, multiple Public Lands dispositions will be required. This process would occur concurrently with the EIA application.

2.2.7.7 Wildlife Act

On private land and Alberta's Public Lands, the Alberta Government has the responsibility for all wildlife, including Species at Risk, as established by the *Natural Resources Transfer Act* of 1930. Alberta's *Wildlife Act* (R.S.A. 2000, c. W-10) designated endangered and threatened species, and provincially listed species potentially influenced by the Project (Government of Alberta 2013g). Alberta's *Wildlife Act* protects the residences of wildlife on private and public lands. More specifically, a person must not wilfully molest, disturb or destroy a house, nest or den of certain species. Section 96 of the *Wildlife Regulation* (Government of Alberta 2013h) outlines the wildlife species, areas, and time of year when the Act applies. All endangered wildlife, upland game birds, some migratory birds, snake and bat dens, and beavers (in some instances) are covered under Section 36 of the Act. For most wildlife, disturbing the habitat of these animals is prohibited year-round throughout Alberta. AESRD staff may recommend timing restrictions on activities to minimize disturbance to the nests/dens/hibernaculum of breeding wildlife and birds. The *Wildlife Act* also protects endangered plant species (both vascular and non-vascular) listed in the *Wildlife Regulation*. Project delays and/or project related modifications may arise should any provincially listed Species at Risk occur within the Tongue Creek Project Area. Mitigation measures, set back distances, and restricted timing windows will be required.

2.2.7.8 Summary of Regulatory Requirements

A summary of regulatory requirements applicable to this project is provided in Table 2-4.

Table 2-4: Summary of Regulatory Requirements

Legislation, Policy, or Guidelines	Responsible Authority	Description	Required Action
Federal Legislation			
Canadian Environmental Assessment Act	Canadian Environmental Assessment Agency	To assess the environmental effects of projects requiring federal actions or decisions, and ensure that the environmental effects of projects be considered early in their planning stages.	Submission of a Project Description to determine if an Environmental Assessment under CEAA is required. As the project stands, an EA will likely be required for the Tongue Creek by-pass channel.
Fisheries Act	Fisheries and Oceans Canada	Prohibits any harmful alteration, disruption, or destruction of fish habitat.	<i>Fisheries Act</i> Authorization or Letter of Advice following Fish and Fish Habitat Assessment Report. DFO Authorization will be required.
Navigable Waters Protection Act	Transport Canada	Protects the public right to navigate all navigable waterways within Canada.	Due to the recent changes to NWPA, an application is not required for this water body. However, a voluntary application should be submitted due to the scope of this project.
Migratory Birds Convention Act	Canadian Wildlife Service	Prohibits the killing, capturing, injuring, taking, or disturbing of migratory birds. Prohibits the damaging, destroying, removing, or disturbing of all migratory bird nests	Vegetation clearing restricted from May 1 st to August 20 th . Disturbance of wetlands attractive to migratory birds restricted from April 15 th to August 20 th .
Species at Risk Act	Environment Canada	Prohibits the killing or harming or harassing of listed species, the damage and destruction of their residences, and the destruction of critical habitat.	Activities must acknowledge species-specific Protection and Recovery Plans.
Provincial Legislation			
Environment Protection and Enhancement Act	Alberta Environment and Sustainable Resource Development	Support and promote the protection, enhancement, and wise use of the environment.	Environmental Impact Assessment due to the mandatory activity designation.
Natural Resources Conservation Board Act	Natural Resources Conservation Board	Reviews projects for social, environmental, and economic factors before granting approvals	The Environmental Impact Assessment will be reviewed by the Natural Resources Conservation Board.
Water Act	Alberta Environment and Sustainable Resource Development	The <i>Water Act</i> focuses on managing and protecting <i>Alberta's</i> water, while streamlining administrative processes.	<i>Water Act</i> application for any impacts to a waterbody will be required.
Alberta's Wetland Policy	Alberta Environment and Sustainable Resource Development	Manages the enhancement, restoration, or creation of permanent wetlands.	Wetland conservation and creation according to the wetland policy. Will be required if wetlands are impacted.
Alberta Historical Resources Act	Alberta Culture and Community Spirit (ACCS) and the Royal Tyrrell Museum of Palaeontology	Provides a framework for Historical Resource Impact Assessments (HRIA).	HRIA and clearance letter required

Legislation, Policy, or Guidelines	Responsible Authority	Description	Required Action
Public Lands Act	Alberta Environment and Sustainable Resource Development	Any activity that alters or occupies the bed and shore of a waterbody requires written approval.	Public Lands Disposition will be required for any structures on Crown-owned watercourses and/or land. A Temporary Field Authorization will be required for any temporary access on public land.
Alberta Wildlife Act	Alberta Environment and Sustainable Resource Development	Prohibits the harm of residences of species at risk. Provides restricted timing windows and disturbance setback distances for species at risk.	Consult with AESRD if species at risk are present. Vegetation clearing restricted from March 1 st to August 31 st for sensitive species, year-round for others.

There may be various other minor Federal, Provincial, Municipal approvals or permits required for the project (e.g. burning permits, noise-bylaws, wildlife research permits, etc.). These can be determined once potential projects and locations are known.

2.2.7.8.1 Required Authorizations and Permits

A summary of required authorizations and permits applicable to this project, as well as their timelines is provided in Table 2-5. However, the EIA process allows for the concurrent submission of all applications and approvals as a single process. During the 72 week EIA process, an integrated application can be submitted to all regulatory agencies (EPEA, Water Act, Public Lands, DFO, Transport Canada, CEAA, etc.), but NRCB has to consider a decision before all other approvals are issued. If a water management project requires an EIA under EPEA, it automatically becomes an NRCB approved project. If NRCB does not require more information or a hearing, the EIA process can take 2 to 3 years. If NRCB requires more information or a public hearing, the EIA process can take an additional 1 to 2 years for a total of 3 to 5 years. All timelines were obtained from the respective regulatory agencies.

Regulatory Agency	Approvals	Timeline
Department of Fisheries and	Fisheries Act Authorization	1 year if there is no HADD and 1.5 years if there is HADD (occurs
Oceans		concurrently with EIA process)
Alberta Environment and	Temporary Field Authorization	2 days to 2 weeks
Sustainable Resource	(TFA)	
Development (AESRD)	EPEA Environmental Impact	2 to 3 years
	Assessment Approval	
	First Nations Consultation Request	Less than 2 weeks
	(FNC)	
	Water Act Approval	2 to 3 months (occurs concurrently with EIA process)
	Dispositions	3 months to a year
Alberta Wildlife Act	Wildlife Research and Collection	AECOM has a blanket permit for the entire province so there is no wait time
	Licence	
	Fish Research Licence	1 week
Alberta Culture	Statement of Justification (SoJ)	1 to 2 months (occurs concurrently with EIA process)
	Clearance Letter resulting from a	2 months to a year (occurs concurrently with EIA process)
	Historical Resources Impact	
	Assessment (HRIA)	
Canadian Environmental	Advice to Federal Government	2 to 3 years (if required; occurs concurrently with EIA process and is followed
Assessment Agency	Departments resulting from an	by the NRCB Approval). Depending on the scheme, an Environmental
	Environmental Assessment	Assessment under CEAA will most likely not be required based on the current
		design information
Environment Canada	Species at Risk Act	6 months
Transportation Canada	Navigable Water Protection Act	N/A
	Application	
Natural Resources	NRCB Approval	1 to 2 years (if required)
Conservation Board		

 Table 2-5: Timeline of Required Authorizations and Permits

2.3 Conclusions and Recommendations

The desktop review for the Tongue Creek Project Area identified several environmental concerns:

- The Highwood River at High River is a Mapped Class C Water Body with dual Restricted Activity Periods (RAPs) of May 1st to July 15th and September 16th to April 15th.
- Tongue Creek is designated as a Class D except for the first 2 km upgradient of its confluence with the Highwood River, which takes on the class of the receiving water body (Class C). The RAPs for this area will be concurrent with the Highwood River.
- Bull Trout and Cutthroat Trout have the potential to occur in the area. Cutthroat Trout and Bull Trout are listed as "Threatened" by COSEWIC, which indicates that the species is facing imminent extirpation or extinction. Cutthroat Trout are also listed under SARA as "Threatened", which means a formal, legal review has been conducted and they are protected under the Act.

The Tongue Creek Project Area occurs within Sensitive Raptor and Sharp-tailed Grouse Key Ranges, Key Wildlife and Biodiversity Zones, , and a variety of land use areas. Timing restrictions of no construction between December 15th and April 30th are mandatory for the Key Wildlife and Biodiversity Zone.

A total of 73 wildlife Species at Risk have been identified with the potential to occur within the Northern Diversions Project Area with general status AESRD listings ranging from 'Sensitive' to 'At Risk'. Environment Canada restricts activities that cause habitat destruction (e.g. vegetation clearing, flooding, draining, construction, etc.) in upland areas attractive to migratory birds between May 1st and August 20th and in wetland areas the restriction occurs between April 15th and August 20th.

Within the proposed Tongue Creek Project Area, 67 marshes and four open water wetlands have been identified, with marshes covering an area of 274.2 ha and open water bodies covering 36.4 ha (Figure N2-2 in Appendix N1). The majority of all of these wetlands are located in the northern half of the Project Area.

If the proposed Tongue Creek by-pass scheme is approved, a full suite of field surveys for the Environmental Impact Assessment will be required. The following is a list of recommended environmental surveys and assessments that must be completed for approval prior to the commencement of any construction activities:

- Aquatic surveys
- Wetland assessments
- Vegetation inventories
- Rare plant surveys
- Soil and terrain surveys
- Wildlife and wildlife habitat surveys
- Species at risk surveys
- Fish and fish habitat assessment
- Historical resources impact assessment
- All associated surveys required for an environmental impact assessment (geological, hydrogeological, socioeconomic, air, hydrological, etc.).

Clearing activities associated with the Tongue Creek Project Area have the potential to impact local wildlife populations and vegetation. Clearing will need to adhere to timing restrictions described in Table 2-4. Field surveys, as mentioned above, will be required to determine if sensitive, protected, or rare species occur in this area. An HRIA will also be required for all areas where Historical Resources have high potential to occur along this alignment.

It is important to note that the presence of protected birds, amphibians, mammals and/or plant species may restrict construction activities in the proposed Project area at certain times of year.

Based on current project design, Tongue Creek would be the most environmentally detrimental of all options examined to date due to the destruction of a natural fish bearing water course, unnatural flooding of riparian ecosystems, and mixing of groundwater with fresh water.

3. Review of Existing Information Geosciences

3.1 Review of Existing Information

The following information was reviewed as part of this desk study report:

- Surficial and bedrock geology maps of the High River area from published literature and Alberta Geology Survey
- Review of previous geotechnical investigation reports near the Tongue Creek alignment
- Groundwater conditions from AESRD's Groundwater Information System
- Existing water well testhole logs taken from AESRD's Groundwater Information Centre

The main objective of the review was to gather information on the surficial geology and depth of bedrock along the channel alignment and to assess the anticipated subsurface conditions along the by-pass channel.

3.2 Surficial and Bedrock Geology

The surficial geology and bedrock maps for the High River Area were reviewed to gather information on overburden and bedrock lithologies. The referenced maps and the channel alignment superimposed on the geological maps are shown on Figures N3-1 and N3-2 in Appendix N1. A brief description of the surficial lithology and bedrock anticipated at the site is provided below.

- Pleistocene and Holocene deposits, Undivided:
 - o Glaciolacustrine Deposits fine sediment; (silt and clay; flat to gently undulating surface).
 - Fluvial Deposits coarse sediment; (gravel and sand, minor silt beds).
 - Fluvial Deposits fine sediment; (fine sand, silt and clay, minor gravel beds).
- Pleistocene:
 - Draped moraine till of even thickness, with minor amounts of water sorted material and local bedrock exposures; up to 5 m thick: includes local areas of undifferentiated subglacially molded deposit with streamlined features; flat to undulating surface reflecting topography of underlying bedrock and other deposits.
 - Stagnation moraine till of uneven thickness, local water sorted material of up to 30 m thick, undulating to hummocky topography reflecting variations in till thickness. Undulating topography, generally with relief less than 3 m.

The bedrock geology within the area of the proposed channel alignment is shown on Figure N3-2 in Appendix N1. A brief description to expected bedrock along channel alignment is provided below:

- Willow Creek Formation Grey, green, and pink mudstone with calcareous concretions and friable pale grey, generally fine-grained sandstone, thick bedded and coarse grained in upper part, non marine.
- Porcupine Hills Formation Olive brown mudstone inter-bedded with fine to coarse grained brownish-grey, cross stratified sandstone and siltstone, non marine.

3.3 Regional Groundwater Conditions

Historical groundwater information was collected using an online search of existing water wells within the project area. The search was conducted using AESRD's Water Well Information database. The database contains records of individual water well drilling reports, stratigraphy, and pump test information. Seven well locations which offset approximately 5 m to 800 m from the proposed diversion channel alignment were selected for compilation of groundwater data. The well locations are presented on Figure N1-2 in Appendix N1. A summary of the compiled groundwater data in the vicinity of the diversion channel is provided in Table 3-1.

Measured Da		Loc	ation	Completion Zone Depth	Static Water Level	Approximate Distance from Channel Centre Line	
Well ID	(MM/DD/YYY)	Latitude	Longitude	(mBGS)/Lithology	(mBGS)/Lithology (mBGS)		
128253	05/11/1979	50.590251	-113.945663	24.4 – 44.5 / Bedrock	13.41	200	
166443	06/03/1992	50.575766	-113.957392	29.0 – 44.8 / Bedrock	0.3	800	
241765	10/10/1994	50.575766	-113.957392	22.9 – 32.0 / Bedrock	5.55	600	
244960	10/19/1994	50.597483	-113.945665	13.4 / 16.8 / Bedrock	4.82	5	
264545	09/21/1995	50.597483	-113.945665	6.7 – 7.9 / Gravel	2.41	5	
285090	06/19/1996	50.597483	-113.945665	60.3 – 65.5 / Bedrock	21.03	350	
1555287	11/21/2002	50.590200	-113.946000	5.8 – 13.4 / Sand & Gravel	3.05	100	

Groundwater depths were also obtained from previous testholes drilled near the outlet structure. Table 3-2 provides a summary of testhole information, including date conducted, northing and easting co-ordinates, and depth below ground surface.

Table 3-2: Summary of Groundwater Depths Compiled from Testholes Drilled in th	e Area
	5740u

Testhole Drilling	Drilling	Date Drilled	Loc	ation	Groundwater Depth	Approximate Distance from Channel Centre Line (m)	
No.	Method	(MM/DD/YYY)	Northing	Easting	(mBGS)		
01-A1	Auger	06/01/2001	5610750	291680	3.6	1100	
01-A2	Auger	06/01/2001	5610539	291719	3.2	850	
01-A4	Auger	07/04/2001	5609672	290575	1.6	1050	
TH14-01	Auger/ Coring	01/23/2014	5605847.3	291197.2	3.52	0	
TH14-02	Auger/ Coring	01/22/2014	5606036.4	291214.8	3.48	0	
TH14-03	Auger/ Coring	01/15/2014	5606384.8	291591.5	3.15	350	

The available information indicates that aquifers in the region occur within two general types of deposits:

- Sand and gravel deposits inter-bedded in the surficial deposits above the bedrock
- Sandstone, fractured shale or coal seam deposits in near surface bedrock

Regional groundwater flow is generally westward from the mountains towards the Highwood River.

4. Subsurface Conditions

4.1 Subsurface Stratigraphy

The subsurface stratigraphy along the channel alignment is expected to be variable consisting of silt, sand, gravel, clay, clay till and bedrock. Description of the subsurface conditions from boreholes along the first 1000 m of the proposed Tongue Creek alignment is provided on the testhole logs in Appendix N2.

Figures N4-1 and N4-2 show the channel bottom elevation and the existing ground elevation along the proposed channel alignment. It should be noted that the interpreted stratigraphy between testhole locations (Station 0+000 and Station 0+1000) is provided for illustrative purposes only, and the actual stratigraphy may vary from that noted on the figures.

The channel alignment has been divided into two sections for ease of description of the subsurface conditions. These two sections are denoted by station with overall length being taken from the profile of the Tongue Creek channel. The first section is from Station 0+000 to Station 1+000 and the second section runs from Station 1+000 to Station 3+893.

4.1.1 Station 0+000 to Station 1+000

According to the available data, the subsurface stratigraphy near the inlet structure consists of 50 millimetres (mm) to 150 mm thick topsoil, overlying gravel of thicknesses varying from 14.5 to 21 m, followed by bedrock. Bedrock in this region consists of clayshale with interbedded sandstone. Bedrock strength may vary from extremely weak to moderately strong.

Testholes TH14-01 and TH14-02 were drilled close to the inlet structures with existing ground at elevations 1061.5 m and 1061.2 m, respectively. The subsurface stratigraphy near the inlet structure (TH14-01 and TH14-02) consisted of 75 mm thick topsoil, overlying gravel of varying thickness from 14.9 to 21 m, followed by bedrock. In TH14-01 bedrock was encountered at 14.9 metres below ground surface (mBGS) and consisted of clayshale with interbedded sandstone. Bedrock strength varied from extremely weak to moderately strong. The testhole was terminated in clayshale at 45.5 mBGS. The core recovery was 100%, and the Rock-Quality Designation (RQD) varied from 63% to 97%. TH14-02 was a shallow testhole terminating in gravel.

Moving further away from the inlet, the topsoil encountered may have thickness ranging from 100 mm to 400 mm. Topsoil is likely to be underlain by clay which is described as silty with trace of sand, medium plastic, stiff, moist and oxidized. Clay was also encountered underlying clay till.

As the chainage increases, silt and fine grained sand may be encountered underlying the clay. Also the gravel content should decrease as the alignment moves away from the Highwood River.

Clay till may be encountered at 1.5 mBGS to 2.5 mBGS underlying the clay, silt or sand layers. The clay till was described as low plastic and very stiff to very hard. The clay till may be moist, oxidized and might have coal inclusions.

The bedrock should be encountered at depths of 5.0 mBGS to 11.0 mBGS. It consisted of alternating layers of generally weak clayshale, siltstone, and sandstone.

Atterberg Limits were estimated for two bedrock samples. A summary of the Atterberg Limits is provided in Table 4-1.

Testhole	Sample	Soil Unit	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index
TH14-03	8	Clayshale	26.8	18.7	8.1
TH14-03	C4	Clayshale/Siltstone	23.8	19.3	4.5

Table 4-1: Summary of Atterberg Limits Test Results (Station 0+000 to Station 1+000)

Grain size analysis tests (hydrometer and sieve analysis) were conducted on three samples. A summary of the test results is provided in Table 4-2.

Table 4-2: Summary of Grain Size Analysis Test Results (Station 0+000 to Station 1+000)

Testhole	Sample	Soil Unit	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
TH14-03	5	Gravel and Sand	52	31	17	
TH14-04	3	Gravel	60	25	15	
TH14-04	9	Silt	4.7	20.3	59.3	15.7

The unconfined compressive strengths varied from 228 kPa and 38,300 kPa indicating that the bedrock is extremely weak to medium strong. A summary of the test results is provided in Table 4-3.

Table 4-3: Summary of Unconfined Compressive Strength Results (Station 0+000 to 1+000)

Testhole	Sample	Bedrock Unit	Unconfined Compressive Strength (q _u) (kPa)
TH14-01	C1	Clavshale	402
TH14-01	C3	Clayshale	228
TH14-01	C6	Siltstone	38,300

Electrochemical tests were conducted on six samples to determine water soluble sulphate content, water soluble chloride content, pH and resistivity. A summary of the test results, expected degree of corrosion, and the potential for sulphate attack of the subsurface soils on concrete are presented in Table 4-4.

Table 4-4: Summary of Soil Electrochemical Testing Results (Station 0+000 to Station 1+000)

Testhole	Sample	Soil Unit	рН	Sulphate Content (mg/L)	Resistivity (ohm-cm)	Chloride Content (mg/L)	Degree of Corrosiveness	Potential for Sulphate Attack
TH14-01	C1	Clayshale	7.98	64	3420	13	Corrosive	Low
TH14-01	C3	Clayshale	8.37	54	1690	16	Highly Corrosive	Low
TH14-02	3	Gravel	7.61	160	840	28	Extremely Corrosive	Low
TH14-02	11	Gravel	7.79	120	1210	33	Highly Corrosive	Low
TH14-02	18	Gravel	8.47	150	1490	8.7	Highly Corrosive	Low
TH14-02	19	Gravel	8.01	145	1150	32.5	Highly Corrosive	Low

4.1.2 Station 1+000 to Station 3+893

The subsurface stratigraphy was obtained from the water well records along the diversion channel Stations 1+000 to 3+893 consisted of the following soil deposits in descending order:

- *Topsoil* topsoil was encountered at ground surface at the borehole locations. Thickness of topsoil varied from approximately 0 to 0.6 m.
- Silty Clay/ Sandy Clay/ Clay Till clay and/or clay till was encountered at surface or below the topsoil. Based on the well records, the thickness of this soil deposit varied from 2.5 m to 16 m.
- Sand/Gravel sand and gravel was encountered below the clay/clay till. Based on the well records, the thickness of this deposit varied from 6.5 to 11 m.
- *Bedrock* bedrock was encountered below the gravel and sand layer. Based on the well records, the bedrock consisted of interbedded clayshale and sandstone. The bedrock was reported at depths varying from 7 mBGS to 21 mBGS.

The subsurface stratigraphy was also obtained from testholes west of the outlet structure. Testhole 01-A4 (UMA 2001) drilled close to the study area shows 0.9 m of organic topsoil overlying 0.6 m of clayey gravel, overlying 1.8 m of soft to firm silty, sandy clay, overlying 3.5 m of sandy gravel, over siltstone bedrock.

Testholes 01-A1, 01-A2, 01-A3-A, 01-A3-B, 01-A5 and 01-A6 are located 500 to 1000 m north of the outlet structure. Testholes 01-A1, 01-A2 and 01-A5 (UMA 2001) encountered approximately 100 mm of topsoil overlying 4.6 m to 5.0 m of interbedded sand and clay. Claystone bedrock was encountered at 5.0 m depth in testhole 01-A2. The interbedded sand and clay was found to overlie 5.6 m of sandy gravel, in turn overlying siltstone and sandstone bedrock in testhole 01-A1. Clay till was encountered to the base of the testhole in 01-A5.

Testholes 01-A3-A, 01-A3-B and 01-A6 encountered approximately 100 mm of topsoil was encountered overlying silt and clay layers of clay and silt layers, in testholes 01-A3-A and 01-A3-B. In testhole 01-A3-A, silt was found to overlie sand with cobbles which extended to the end of hole at 5.2 mBGS. In testhole 01-A6, a 0.6 m thick boulder layer or occasional rafted bedrock was encountered at the depth of 4.6 mBGS. This was found to overlie clay till with cobbles to 15.2 m depth, which in turn overlies very weak to strong interbedded claystone, siltstone and sandstone bedrock.

4.2 Groundwater Conditions

Standpipe piezometers, consisting of 50 mm diameter slotted PVC pipe were installed in testholes 01-A1, 01-A2 and 01-A4 in 2001 (UMA 2001). The piezometers consisted of a 1.5 m to 3 m long slotted sections installed in a sand, gravel or clay and sand layer. A 1 m bentonite seal was placed at the surface and at the top of the slotted section. Groundwater depths were measured on July 9 and 27, 2001. A summary of piezometer installation details and groundwater conditions are given in Tables 4-5 and 4-6.

Table 4-5: Gr	roundwater M	Monitoring	Results	(July 2	001)
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Piezometer	Lithology	Standpipe Scro	Water Level	
		Тор	Base	(mBGS)
01-A1	Sandy Gravel	4.6	6.1	3.5
01-A2	Clayey Sand with some gravel	3.1	4.6	3.1
01-A4	Silty clay with sand layers and gravel	1.6	4.6	1.7

Table 4-6: Groundwater Monitoring Results

Piezometer	Ground Elevation (masl)	Standpipe Screen Depth (mBGS)	Date	Water Level (mBGS)	Groundwater Elevation (masl)
TH14-01	1061.488	13.3 – 15.0	2014-Feb-24	3.52	1057.97
TH14-02	1061.181	3.7 - 5.2	2014-Feb-22	3.48	1057.70
TH14-03	1059.338	3.6 - 5.3	2014-Feb-22	3.15	1056.19

Groundwater depths may vary seasonally and as a result of precipitation and may be at different depths during construction.

5. Preliminary Geotechnical Considerations

5.1 General

Geotechnical considerations related to the design and construction of the proposed by-pass channel are discussed in this section. Based on the testhole logs present along the proposed alignment of the channel and projected from the testholes drilled along the D3/E alignment, geological maps and water well drilling information, the ground conditions are highly variable. Therefore, based on the soil stratigraphy, the channel alignment has been divided into two sections (Station 0+000 to Station 1+000 and Station 1+000 to Station 3+893). The sections of the channel alignment are summarized below:

- Station 0+000 to Station 1+000: Based on testholes TH14-01 and TH14-04, this section is dominated by coarse grained gravel and sand layers; overlying bedrock, which consisted of alternating layers of clayshale, siltstone, and sandstone. Silt or clay is likely to be encountered near the end of the chainage.
- Station 1+000 to Station 3+893: Based on the water well records, this section of the alignment consists of topsoil underlain by silty clay/sandy clay/clay till which extends up to 16 m depth. Sand and gravel is below the clay and clay till followed by clayshale and sandstone bedrock.

5.2 Geotechnical Concerns

The major geotechnical concerns for the proposed diversion channel alignment are:

- Presence of sand and gravel layers at the surface and extended to depths of 15 m and 21 m: These soils are susceptible to excessive seepage erosion, scouring and piping. Soil erodibility primarily depends on the texture of the soil, especially sand having a grain size between 100 to 200 microns and silt having a grain size between 2 to 100 microns, as well as the water velocity in the channel and permeability of the soil, To protect the channel against seepage, erosion and scouring, channel lining may be required. At locations where heavy erosion is expected, it is recommended to use riprap. Where utilized, riprap should be placed on a medium weight, non-woven geotextile. Non-woven geotextiles typically provide protection against upward migration of fine grained sediments (silt or clay).
- Drop structure: The drop structure should be designed to minimize the potential for failure due to piping, erosion, scouring and uplift pressure forces. Erosion and scour protection such as cut-off walls (or sheet pile walls) on the upstream and downstream sides, as well as at intermediate points along the structure, may be required. Seepage analysis will be required during detailed design to evaluate the need for cut-off walls.
- Bedrock excavation: Bedrock may be intersected within the channel at several locations. The bedrock strength information is not available but the sandstone is expected to be medium strong to strong and the shale is expected to be weak to medium strong. Dozer equipment with a ripper or break hammer may be required to excavate the bedrock.
- Groundwater: The groundwater elevation is expected to fluctuate seasonally and in response to precipitation and may be high during construction. Dewatering of the excavation may be required during construction of the channel.

5.3 Channel Excavation

Construction of the channel will require extensive excavation along the proposed alignment. Based on the available testhole information, the types of subsurface soils that are likely to be encountered within the channel excavation are gravel, clay, sand, silt, and clayshale, siltstone and sandstone bedrock. Exposed channel side slopes will be in the order of 20 m, which may require benching and provision of surface drainage ditches to minimize surface erosion.

Stability of these deep excavation slopes should be investigated during the design phase and side slopes adjusted to obtain long term stability.

Groundwater should be anticipated during excavation operations. The groundwater should be controlled to prevent sloughing of the excavation slopes, and to reduce adverse impacts on the progress of construction. Silt, sand and gravel soils are expected to be encountered during excavation, therefore, lining of the channel base and side slopes may be required in those areas. Conventional excavation equipment should be capable of excavating the overburden soil and clayshale bedrock.

Excavation will encounter a variable thickness of overburden soil and extremely weak rock over medium strong rock. Excavation ease, or rippability, of the rock will be assessed by using seismic velocity, point load strength index or unconfined compressive strength test results along with visual inspection during the detailed design stage.

5.4 Fill Material

Fill materials required for construction of the channel berms to design grade can be obtained from on-site excavations or from approved borrow areas. Locally available low to medium plastic clay soils from excavations can be used as a general engineered fill for building the channel berms. The engineered fill should be placed in 150 mm compacted lifts and compacted to 98% of Standard Proctor Maximum Dry Density (SPMDD) within ±2% of the optimum moisture content (OMC). Fill placement should be undertaken during frost free seasons since the required degree of compaction cannot be achieved during freezing temperatures. If the fills are to be constructed during the winter months, considerable attention to fill quality, moisture content, and placement and compaction practices will be required. Suitable winter earthwork techniques would need to be developed if earthwork construction is planned to occur in winter.

5.5 Dewatering

High groundwater levels could potentially result in various difficulties during construction, including reduced trafficability for heavy equipment, unstable excavation in sand zones, and difficulties with placement and compaction of fill. To facilitate excavations and earthworks, construction should be carried out under relatively dry conditions. Therefore, grading and surface drainage should be undertaken during construction.

In excavations through clay, groundwater yields are expected to be low. In excavations into the sand or gravel, higher rates of seepage will be encountered. In sand and gravel, a network of perimeter drainage ditches would likely provide effective dewatering.

5.6 Subgrade Preparation

All unsuitable soils (soft, loose, organic, frozen) exposed at the channel base should be removed to expose competent soils. The exposed subgrade should be scarified to a minimum depth of 200 mm and compacted to 98% of SPMDD. At the fill sections, engineered fill should be used to raise the subgrade to the design grade and to build the thermal embankment. General engineered fill should comprise low to medium plastic clay/clay till. Locally excavated low to medium plastic clay soil may be used as general engineered fill provided these soils do not contain deleterious material such as organics, roots, debris, etc. The general engineered fill must not contain high plastic clays. The general engineered fill should be placed at acceptable moisture content (within ± 2 % of the OMC) and compacted to 98% of SPMDD.

The fill material must not be placed on frozen subgrade or in freezing conditions. The exposed subgrade should be inspected by a qualified geotechnical engineer prior to construction to confirm that the subgrade is prepared in accordance with recommendations provided in this report.

The subgrade should be proof rolled by two passes of a dual-wheel truck with 80 kN axle load and a minimum gross weight of 24,000 kilograms (kg). The subgrade soils which display rutting or appreciable deflections upon proof rolling should be over-excavated to expose the underlying competent soils and backfilled with general engineered fill compacted to at least 98% of the SPMDD.

5.7 Foundations for Inlet Structure

One inlet location for the channel has been proposed for Tongue Creek alignment. Two testholes TH14-01 and TH14-02 were drilled near the proposed inlet structure. A gravel layer was encountered at the surface and extended to depths of 15 mBGS (EL 1046.5 m) and 21.35 mBGS (EL1049.8 m). Based on the preliminary inlet structure drawings, the base elevation of the inlet will be at 1054.5 m indicating that the foundation for inlet structure will be placed on relatively deep pervious gravel deposits. Such soil conditions can provide a suitable foundation for the structure; however, issues related to controlling seepage through the gravel layer may be encountered. Excessive seepage, piping of the foundation soils, scour, and high uplift pressures may cause instability of the foundation soils at the inlet structure.

In order to control the seepage flow, impermeable cutoff walls that penetrate through the pervious strata and tie into a relatively impermeable stratum below the gravel layer should be provided. The cutoff walls may consist of sheet pile wall, concrete wall, or jet grouting and cement-bentonite slurry wall. Impermeable blankets of impervious material extending upstream from the structure along with vertical cutoffs and drains may also be used as another option to control the seepage rate below the foundation base. Concrete or riprap should also be considered at the upstream and downstream of the structure to reduce scour, erosion and piping.

5.8 Foundations for Drop Structures

One drop structure is provided in Tongue Creek alignment. The drop has an average height of about 3.9 m. The subsoil and groundwater conditions at this location should be investigated during the detailed design stage to provide recommendations for the design and construction of the drop structure.

5.9 Foundations for Outlet Structure

A slope stability analysis and seepage analysis should be carried out during the detailed design stage to confirm the long term factor of safety and determine the seepage rate through foundation soils, uplifts pressures beneath the outlet structure, and possible erosion and scour. Impermeable cutoff walls and/or impermeable blankets of impervious material extending upstream from the structure and drains may be used if the seepage rate is found to be excessive.

One outlet location has been selected for the proposed Tongue Creek channel alignment. Testholes 01-A1, 01-A3-A, 01-A3-B, and 01-A6 were found in the study to be approximately 500 m (or more) north of the outlet structure location. Based on the preliminary structure drawings, the base elevation of the outlet will be at 1050.34 m. If soft soils are encountered below the outlet foundation base, then this soil should be removed and replaced with low to medium plastic clay/clay till compacted to 98% of the SPMDD.

It should be noted that testhole elevations were not available on the testhole logs. The testholes were also drilled about 500 m to 1200 m north of the outlet structure. For the purpose of this desktop evaluation, these testholes were used to assess the subsurface conditions for the area near the outlet structure. A site specific site investigation should be conducted to determine the subsurface conditions along the alignment.

5.10 Cut/Fill Slope Stability

The proposed channel is 60 m wide at the base, and will be constructed mainly in cut sections. The depth of cut will range from 4 to 20 m.

A preliminary slope stability analysis of the side slopes near the inlet and outlet structure was performed to evaluate the long term factors of safety against slope failure. A limit equilibrium method (Morgenstern-Price Method) was used in the analyses. The soil stratigraphy was inferred from testhole information and the typical cross sections of the channel near the outlet structures. The analyses were carried out using cross sections from Figure N5-1 in Appendix N1 and a 4H:1V slope angle. The soil strength parameters used for this preliminary analysis were obtained from published literature and correlations with material index properties. A summary of the soil properties is presented in Table 5-1. The water level was assumed to be at the base of the channel at the respective cross-section and at 1 m above the base within the slope. The results of the stability analysis are presented in Appendix N4 and summarized in Table 5-2.

Table 5-1: Soil Properties Used in Slope Stability Analysis for Inlet and Outlet Structures	
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Structure	Soil Description	Unit weight, γ (kN/m³)	Cohesion, c' (kPa)	Friction Angle, φ (°)	Comments
Outlet	Silt with trace sand and trace clay	19	0	28	Based on Published Literature
Outlet	Compact Sand, medium to fine grained	18	0	30	Based on Published Literature
Outlet	Silty sand with trace gravel, very dense	18	0	32	Based on Published Literature
Outlet	Clay till with some silt and trace gravel, medium plasticity	19	5	28	Based on Published Literature
Outlet	Clay	19	3	25	Based on Published Literature

For the inlet and outlet side slopes stability, two sections were carried out using a maximum slope height of 10 m. The soil stratigraphy was obtained from the nearest testholes TH14-01, TH14-03 and 01-A6 to the proposed section location.

Table 5-2: Summary of Slope Stability Analysis Results

Chainage	Structure	Height (m)	Slope (H:V)	Long Term Factor of Safety
0+000	Outlet	21	4:1	2.015
0+100	Channel	15	4:1	2.164

Further stability analyses, coupled with seepage analyses should be carried out during the detailed design stage. The stability analyses should include sudden drawdown from the highest water level and steady seepage conditions.

5.11 Erosion

Native sand, silt and gravel soils in cut and fill slopes, inlet and outlet structures are susceptible to erosion. Therefore, exposed soils should be protected against erosion. Erosion protection in the form of topsoil and seeding with a native seed mixture and/or erosion control mats should be considered. Permanent turf reinforcement mats (P300 or equivalent), should be used and installed as per manufacturer recommendations to protect the slopes within the site. The use of riprap can also be provided near the inlet, outlet and the outfall structures where heavy scour may be expected. All riprap should be placed on a medium weight non woven geotextile.

5.12 Utility Crossings

Based on the information provided, it is understood that the channel will cross utilities at various locations along the proposed channel alignment. Utility details are provided in Table 5-3. In order for the channel to cross over the utilities without damaging them, some form of protection or mitigation measures will be required. Typical measures may include: installing the utilities at greater depth to provide an adequate soil cover; or realignment of the utilities to avoid intersection with the proposed channel route.

Hydrovaccing should be carried out along the existing utility alignments to identify the depths, locations, and conditions of the utilities to assist in determining suitable protective or mitigation measures. Therefore, details and recommendations regarding utility crossing cannot be provided at this time.

Table 5-3: List of Utilities Within Proposed Diversion Channel Alignments

Utility	Utility Owner	Size	Station
Rural Gas Distribution Pipeline	ATCO Gas	-	2+250 and 3+850
Telephone Trench	Telus	-	2+250 and 3+850
Sour Natural Gas Pipeline	MFC Energy Corporation	168.3 mm	0+600

5.13 Future Geotechnical Work

A detailed geotechnical investigation will be required during detailed design stage to determine the site specific subsurface soil, bedrock and groundwater conditions along the proposed channel alignment. The geotechnical investigation should consist of, but not limited to, the following:

- Drilling testholes along the channel at an approximate 250 m spacing. The testhole depths may vary depending on the final depth of the channel.
- Install standpipe piezometers in the testholes to measure depth to groundwater.
- Conduct hydraulic conductivity tests in the piezometers.
- Perform laboratory testing on soil and bedrock samples for soil classification purposes and determination of engineering properties of soils/bedrock.
- Perform slope stability and seepage analyses using engineering properties obtained from the laboratory testing.
- Prepare a geotechnical evaluation report providing recommendations to support design and construction of channel, drop structures, and other geotechnical elements of the project.

6. Hydrogeological Assessment

The purpose of this hydrogeological assessment was to estimate the amount of groundwater discharge that will enter the Tongue Creek by-pass channel. Preliminary design of the by-pass channel calls for significant excavation into the existing ground. The preliminary geological assessment identified coarse sediment in the area of the by-pass channel. Intersecting these sediments with the channel could lead to a continual groundwater discharge; effectively a new stream will be created. In addition, groundwater chemistry is usually different than freshwater river chemistry. This could affect the chemistry of Tongue Creek where the by-pass channel empties into the creek. A major chemical change in the creek could affect the aquatic biota in that region.

The scope of this report consists of projecting the subsurface geology from the geotechnical investigation of Options D3/E by-pass to the Tongue Creek by-pass, estimation of groundwater conditions, an estimate of the groundwater discharge into the channel and Tongue Creek, and an assessment of any chemical differences between the groundwater and the water in the Tongue Creek.

6.1 Subsurface Conditions

6.1.1 Regional Geology

The regional geology and hydrogeology are described in Sections 3.2 and 3.3, respectively.

6.1.2 Local Geology

The channel alignment has been divided into three sections for ease of description of the subsurface conditions. These three areas are denoted by station with overall length being taken from the profile of the by-pass channel. The first section is from Station 0+000 to Station 1+140, the second section is from Station 1+140 to Station 1+500 and the third section runs from Station 1+500 to Station 3+893

- Station 0+000 to Station 1+140: this section is dominated by coarse grained surficial deposits, such as gravel and sand; overlaying bedrock, which consist of alternating layers of clayshale, siltstone, and sandstone.
- Station 1+140 to Station 1+500: silty clay till overlying a thin gravel bed is the surficial deposits. The bedrock is generally interbedded clayshale and siltstone.
- Station 1+500 to Station 3+893: surficial deposits consisting of clay till, occasionally underlain by silt, underlain by bedrock. The bedrock consisted of interbedded clayshale/claystone.

6.1.3 Local Groundwater Conditions

The groundwater elevations are expected to be similar to those seen in the monitoring wells installed in the geotechnical evaluation of the Option D3/E by-pass channel. In general, from Station 0+000 to Station 1+140 the groundwater is expected to be approximately 3.2 mBGS while from Station 1+140 to the end of the channel the groundwater is expected to be approximately 4 mBGS.

6.2 Hydrogeological Assessment

6.2.1 Groundwater Flow into the Channel

The hydraulic conductivity testing performed on the monitoring wells installed in the geotechnical investigation of the High River by-pass channel can be used to estimate the hydraulic conductivities of the saturated sediments that will

be exposed in the Tongue Creek by-pass channel. The gravels observed in wells along the southern portion of the High River by-pass channel have an approximate hydraulic conductivity of 1.6×10^{-4} metres per second (m/s). The weathered bedrock observed along proposed diversion has hydraulic conductivities on the order of 10^{-7} m/s. The sands observed in the more northern portion have an approximate hydraulic conductivity of 2.1×10^{-5} m/s.

On the basis of the projected geology interpreted for the Tongue Creek by-pass channel, the cross sectional area of the coarse sediments (gravel and sand) was calculated and the appropriate hydraulic conductivity assigned depending on the location of the sediment (i.e., in the south near the Highwood River or on the northerly portion of the channel). This allowed a determination of the amount of groundwater flow into the channel. This was found to be approximately 0.20 cubic metres per second (m³/s).

Flow measurements for Tongue Creek only exist from the 1920's and 1930's. In the summer the average flow in Tongue Creek ranged from 0.12 m³/s to 0.50 m³/s. If the present day flow rate of Tongue Creek is within this historical average, the by-pass channel will increase the flow within the creek by 50 to 100%.

Note although the by-pass channel will lead to a lowering of the groundwater table for an undetermined distance away from the channel, it is not expected to have an impact to users (human or ecological). This is due to no water wells are installed in the shallow sediments that would be affected by the lowered water table and there are no surface water features, other than Tongue Creek, that are groundwater fed in the near vicinity of the proposed bypass channel.

6.2.2 Groundwater Chemistry

Groundwater samples were collected from the monitoring wells installed during the geotechnical investigation along the Option D3/E by-pass alignment. As the main aquifers seen in those wells are expected to be the same seen along the Tongue Creek bypass, the results can be used in this assessment. The geochemical results show that the groundwater is generally sodium bicarbonate type; with the exception of two wells near the Highwood River that are a calcium-sodium bicarbonate type. Table 6-1 presents the average concentrations for sodium, chloride, sulphate, total dissolved solids, alkalinity, and nitrate as nitrogen by lithology in the monitoring wells.

Lithology	Average Na	Average CI	Average SO₄	Average TDS	Average Alkalinity	Average Nitrate-N
Gravel	130	26	154	564	282	1.64
Sand/Silt	255	48	241	917	478	1.48
Weathered Bedrock	217	51	110	693	425	1.36

Table 6-1:	Average Parameter Concentration by Lithology (mg/l	L)
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6.2.3 Groundwater Impact Assessment

The hydrogeological assessment indicates that a permanent groundwater discharge to the by-pass channel will occur creating a creek. This creek will have a flow that is roughly equal or greater than that currently seen in Tongue Creek. This may lead to erosion, scouring or flooding issues downstream of the outfall and unlike during a flood event this increased flow will be permanent.

Table 6.2 presents the surface water chemistry of Tongue Creek for a monitoring station located at 50.62111°N and 113.8747°W. This station is located approximately 5.4 kilometre from the proposed by-pass channel discharge point. The concentrations reported in Table 6-2 are from a sample collected in 1991 (most recent available).

Table 6-2: Surface Water Chemistry – Station AB05BL0350 (mg/L)

Station	Са	Mg	Na	К	HCO ₃	CO ₃	CI	SO₄	TDS	Alkalinity	Nitrate-N
AB05BL0350	82	36	46	6.4	446	85.2	10	65	468	371	0.003

The majority of groundwater discharge into the by-pass channel will come from the gravels. Of the major parameters, the sodium and nitrate concentrations seen in Tongue Creek are the most divergent. Research into sodium effects on freshwater aquatic animals and plants indicates that concentrations need to be over 200 milligrams per litre (mg/L) before toxicity effects are observed to plants. Toxicity effects to aquatic animals at concentrations over 400 mg/L.

The nitrate concentrations are three orders of magnitude higher in the groundwater than in the surface water in Tongue Creek. The likely nitrate sources are fertilizer application on tilled fields and animal waste (stockyards etc.). The nitrate concentration seen in the groundwater is approximately one half the guideline concentration for the protection of aquatic life (the guideline is based on the effects of nitrate on lake trout). As such, direct harmful effects, especially given the dilution of the concentration as it enters the creek, are not likely to occur. Nitrate, however, serves as the primary source of nitrogen for aquatic plants in well oxygenated systems, and as nitrate levels increase, there is an increasing risk of algal blooms and eutrophication in surface waters. Common ecological changes to aquatic systems undergoing nutrient enrichment may include an increase in algal and macrophyte production resulting undesirable blooms, a decrease in water clarity, a loss of cold water fisheries, shortened food chains and changes in species composition (NRC 1978).

As such, the discharge from the by-pass channel may have an impact on the aquatic biota in Tongue creek due to the nutrient enrichment.

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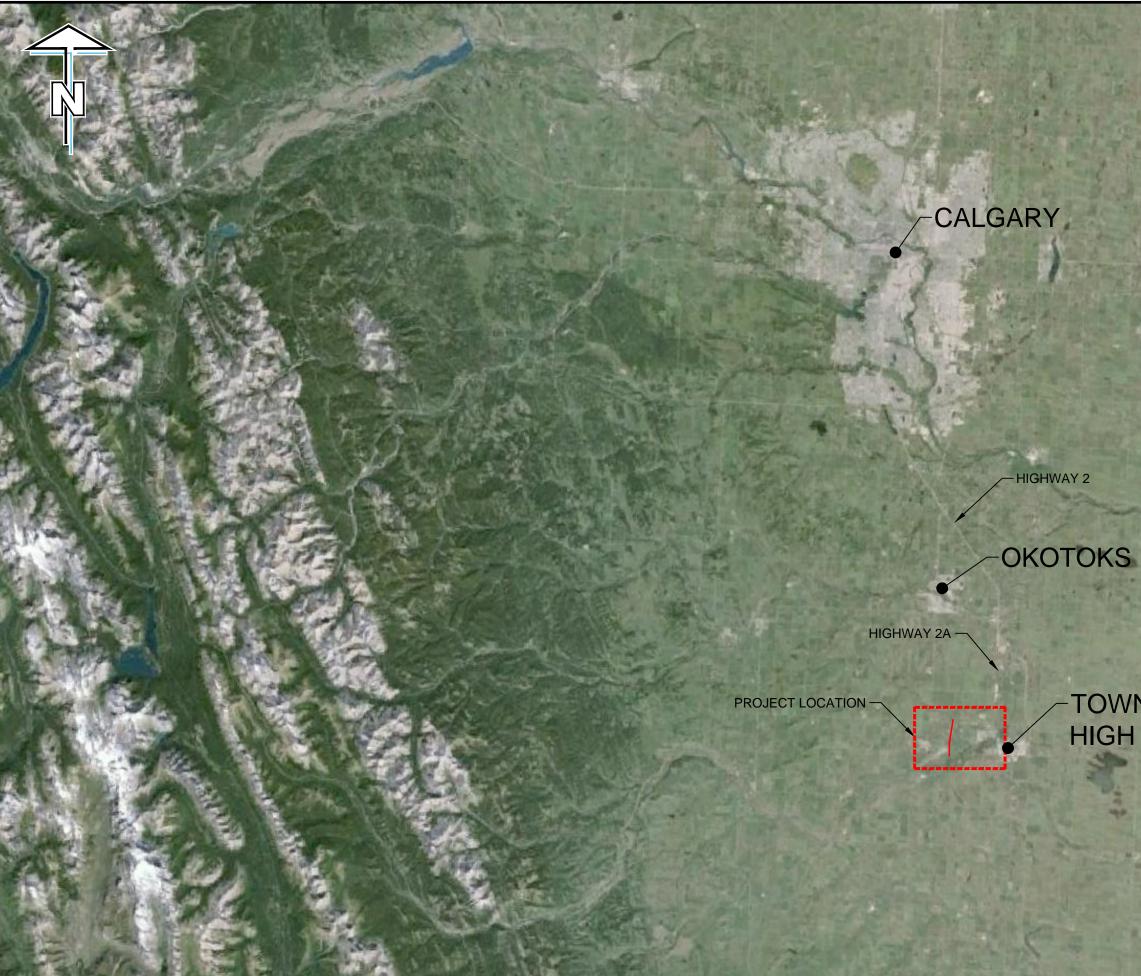
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Appendix N1

Figures







Tongue Creek By-pass Project Location Plan

Southern Alberta Flood Mitigation Feasibility Study Alberta Flood Recovery Task Force Project No.: 60309815

-TOWN OF HIGH RIVER

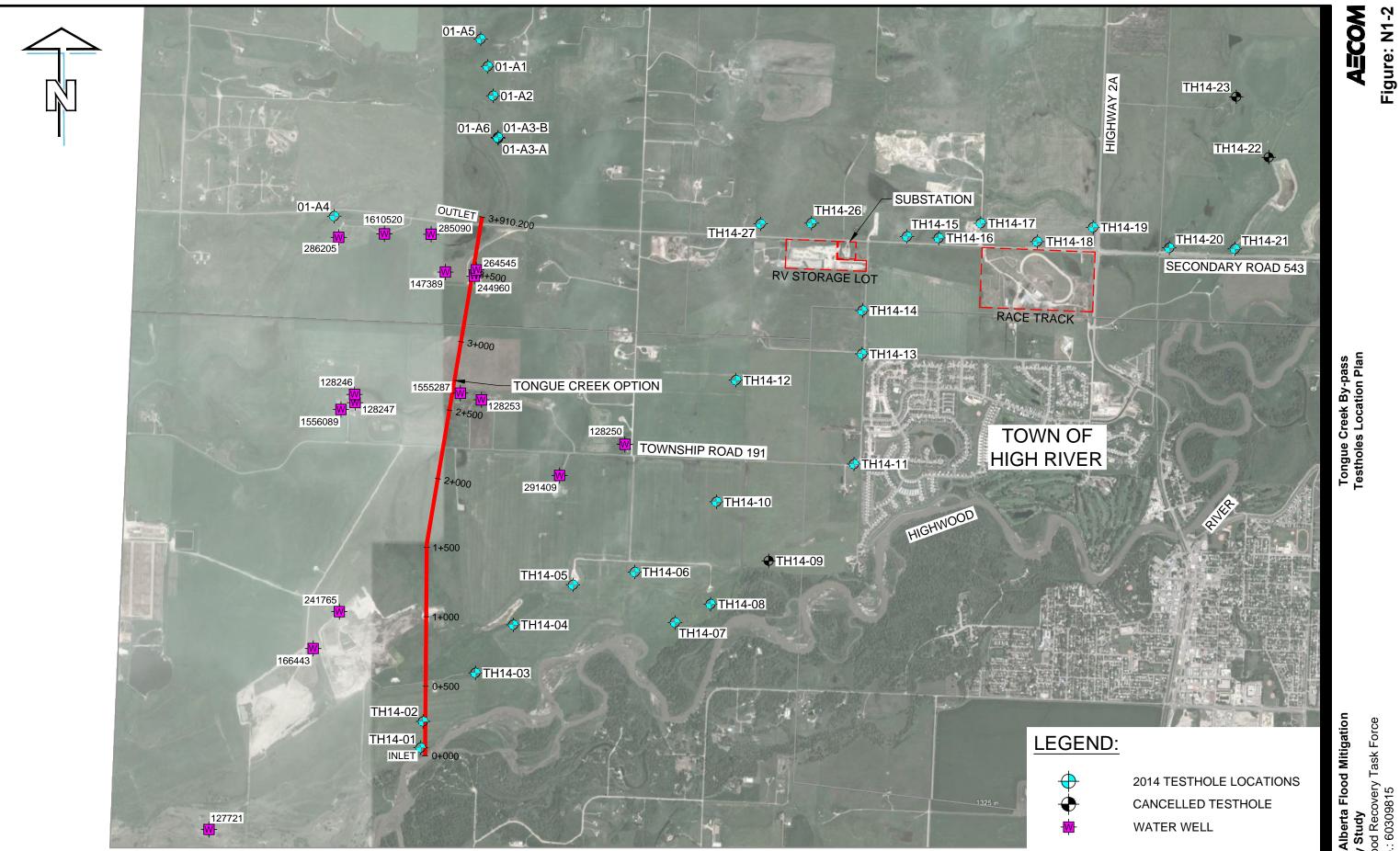
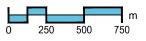


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Alberta Flood Recovery Task Force Project No.: 60309815 Southern . Feasibility

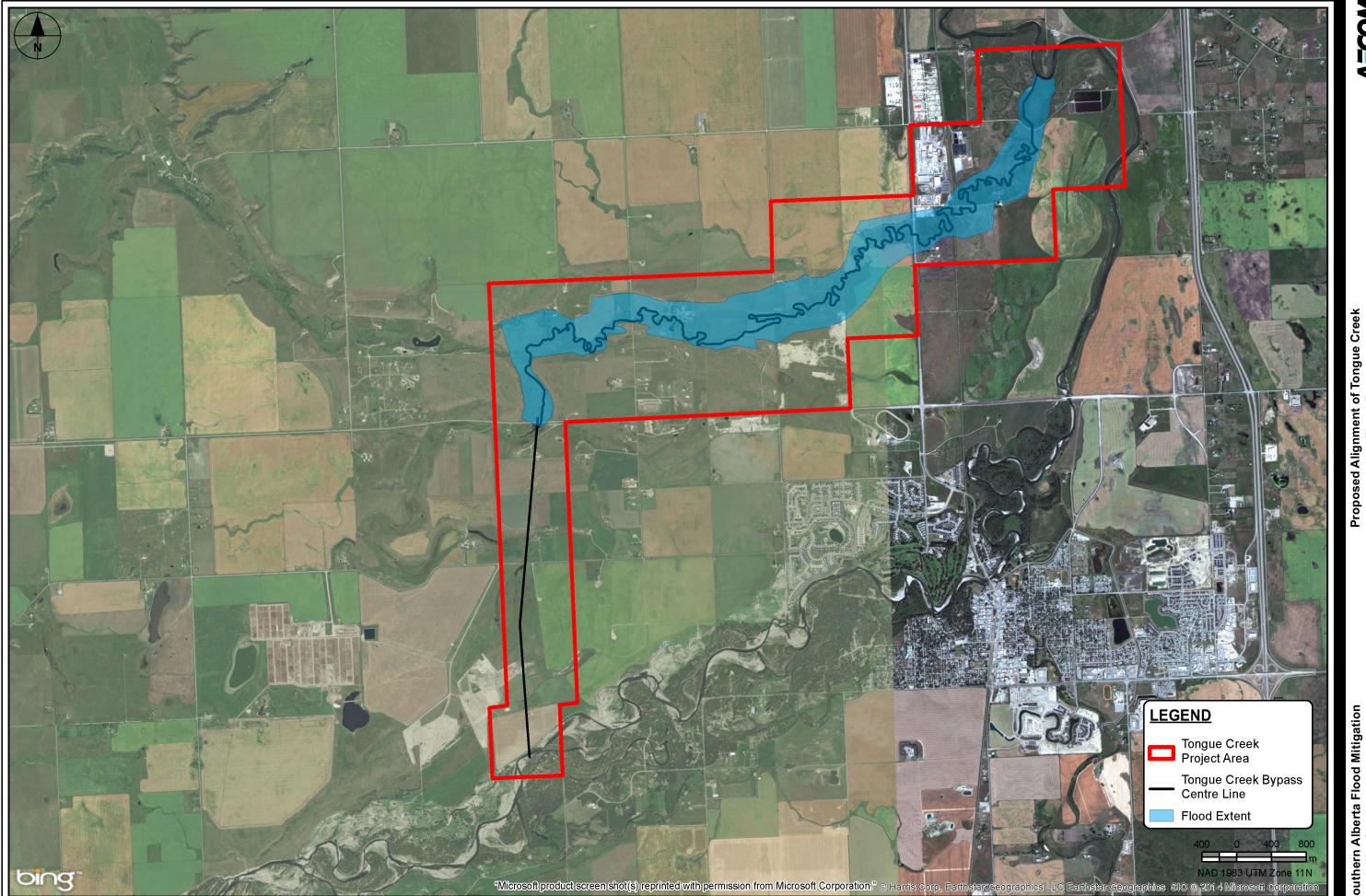
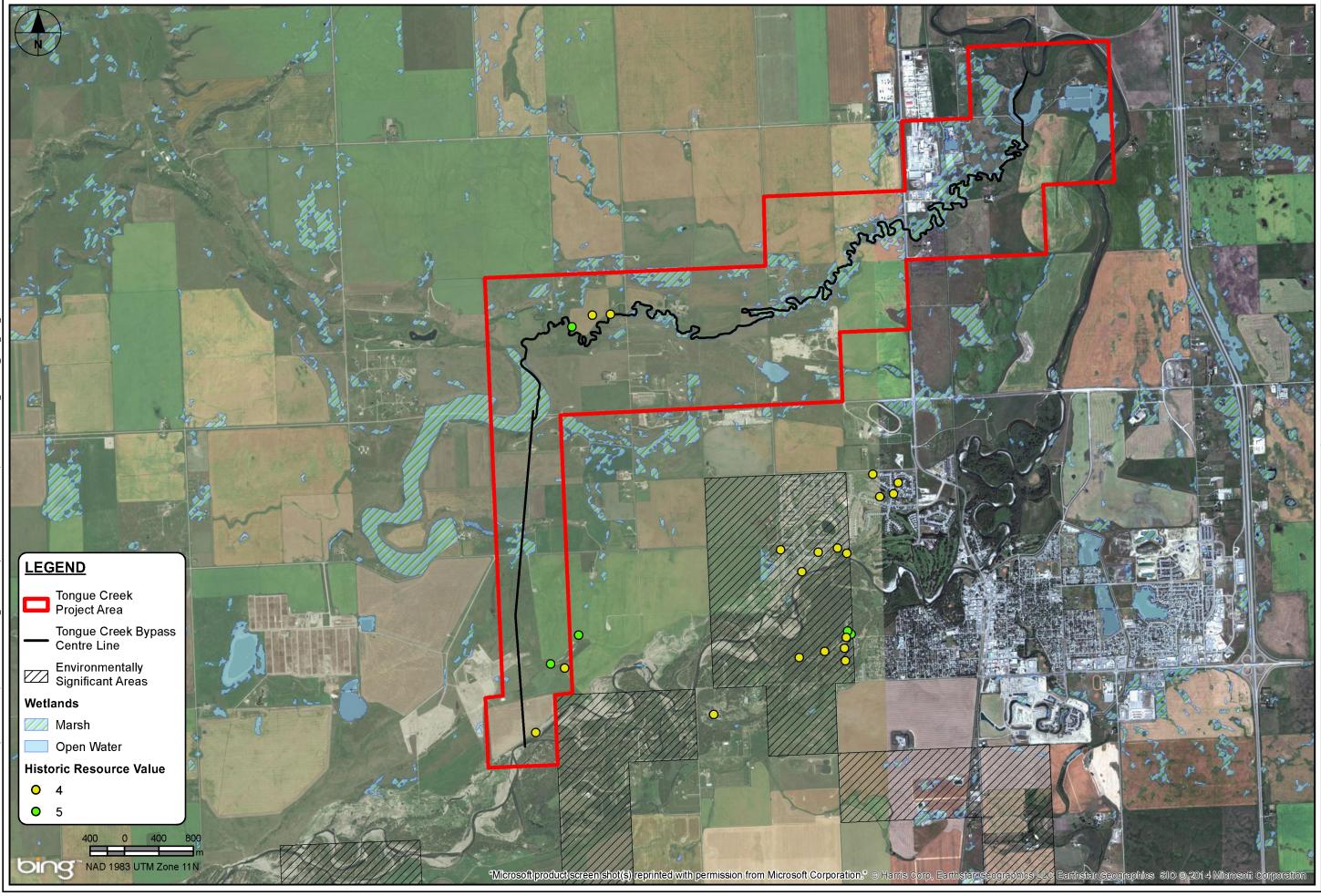


Figure: N2-1 AECOM

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Wetlands, Environmentally Significant Area and Historical Resources in the Proposed Tongue Creek Project Area

	and the second s
SPECIES CODE	SPECIES NAME
AMAV	American Avocet
АМСО	American Coot
AMCR	American Crow
AMDI	American Dipper
AMRO	American Robin
AMWI	American Wigeon
BAEA	Bald Eagle
ввма	Black-billed Magpie
BCCH	Black-capped Chickadee
BCFR	Boreal Chorus Frog
BLJA	Blue Jay
вото	Boreal Toad
BOWA	Bohemian Waxwing
BUFF	Bufflehead
CAGO	Canada Goose
CANV	Canvasback
COGO	
	Common Goldeneye
CORA	Common Raven
DEMO	Deer Mouse
EUST	European Starling
GADW	Gadwall
GBLH	Great Blue Heron
GHOW	Great Horned Owl
GRSQ	Gray Squirrel
GWTE	Green-winged Teal
HOLA	Homed Lark
KILL	Killdeer
MALL	Mallard
MERL	Merlin
MEVO	Meadow Vole
MUSK	Muskrat
NGMO	Northern Grasshopper Mouse
NLFR	Northen Leopard Frog
NOHA	Northern Harrier
NOPI	Northern Pintail
NOSV	Northern Shoveler
NPGO	Northen Pocket Gopher
OSPR	Osprey
PRFA	Prairie Falcon
PRVO	Prairie Vole
RBNU	Red-breasted Nuthatch
REFO	Red Fox
RLHA	Rough-Legged Hawk
RTHA	Red-tailled Hawk
RUBL	Rusty Blackbird
SEOW	Short-eared Owl
SORA	Sora
SPFR	Columbia Spotted Frog
SWHA	Swainson's Hawk
WEME	Western Meadowlark
WILL	Willet
VVILL	vvillet
p:	
LEGEND	
Tongue Creek	Colonial Nesting Bir
Project Area	(Great Blue Heron)
Tongue Creek	Bypass Key Wildlife and
Centre Line	Biodiversity Zones
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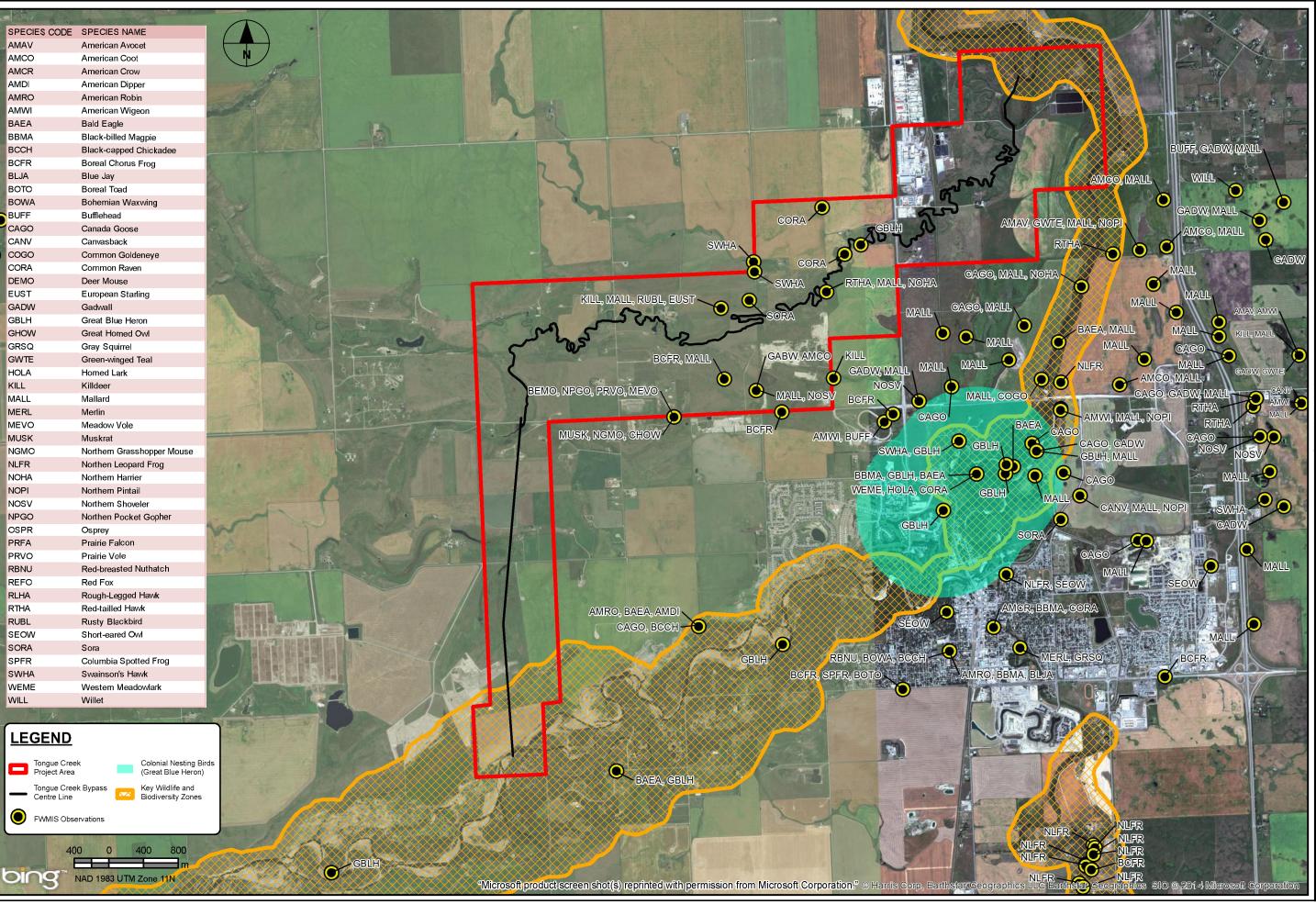
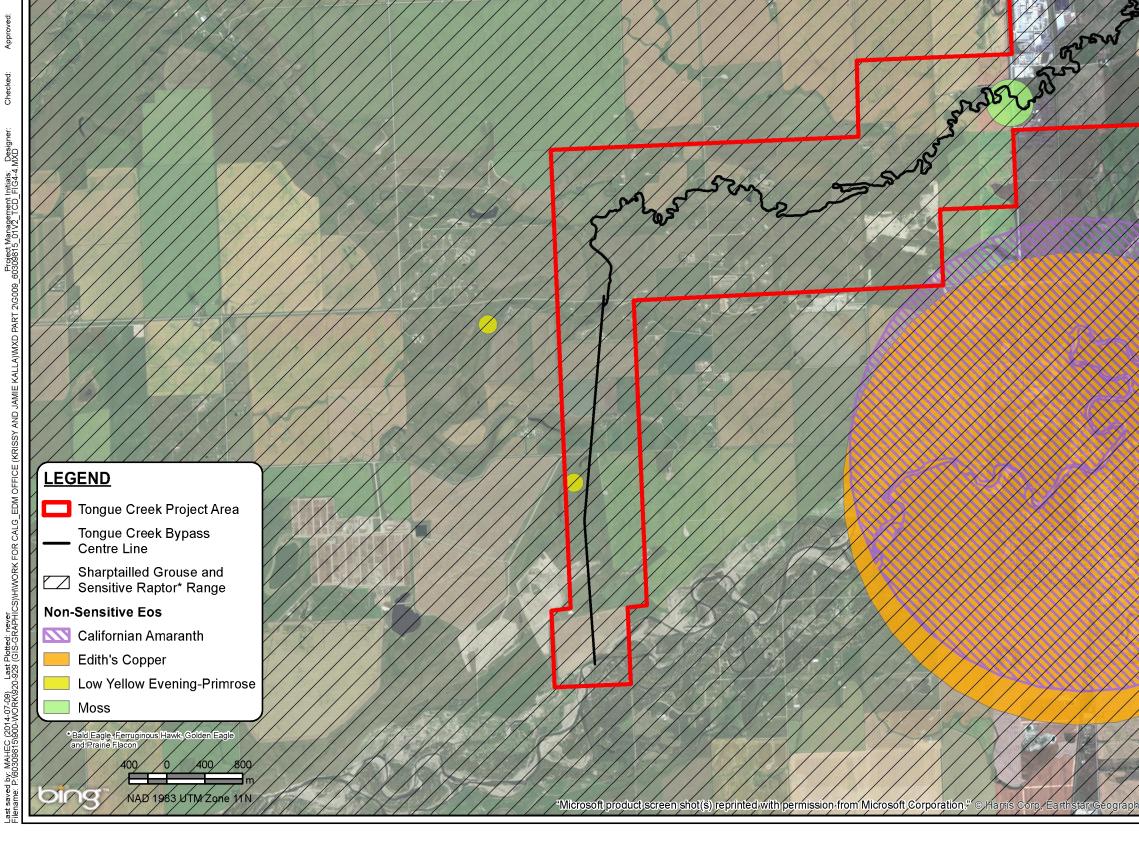


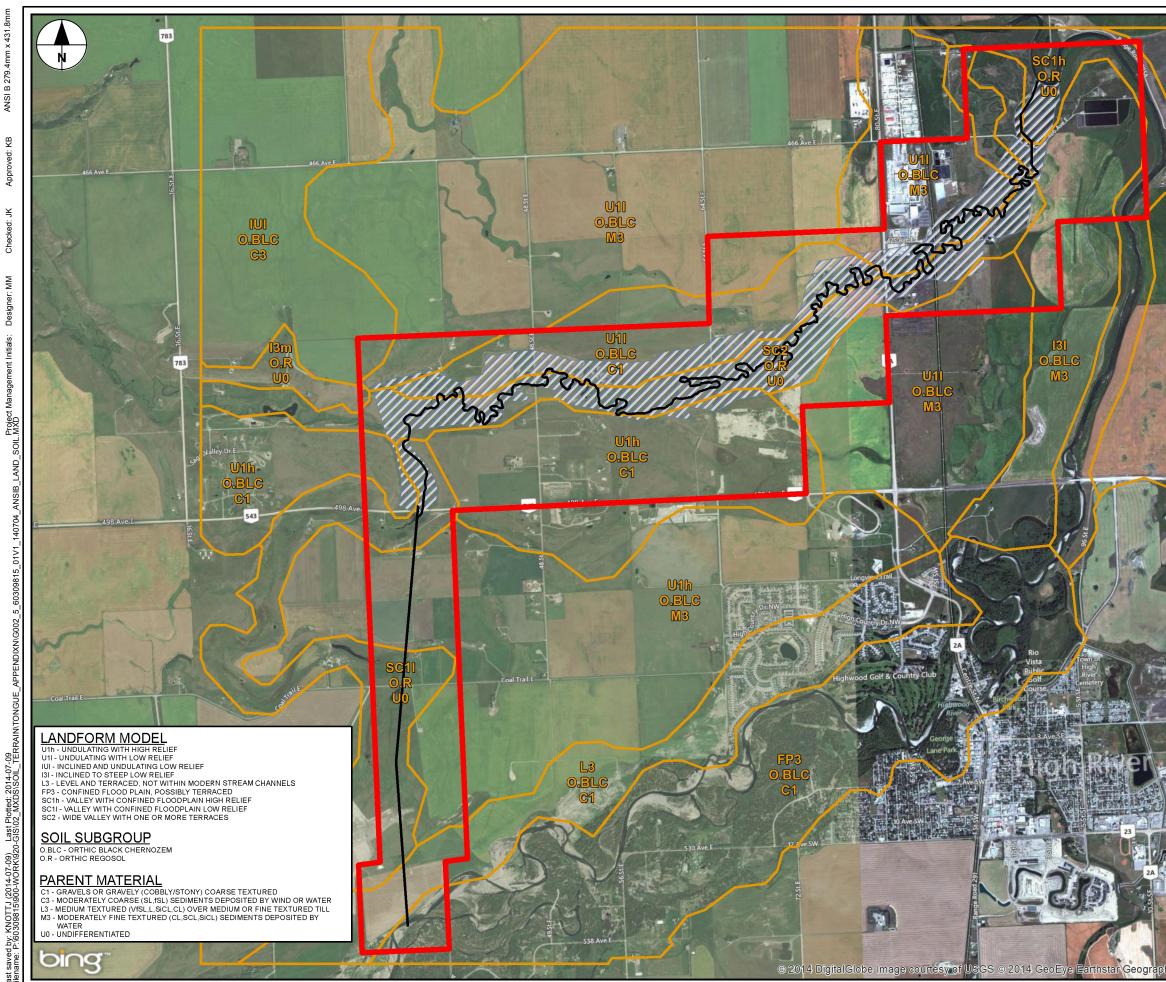
Figure: N2-3

Area Proposed Tongue Creek Project go Key Wildlife I Wildlife O

erta Flood Mitigation d Recovery Task Force 60309815 ົທ g **Feasibility** Alberta Floo Project No...



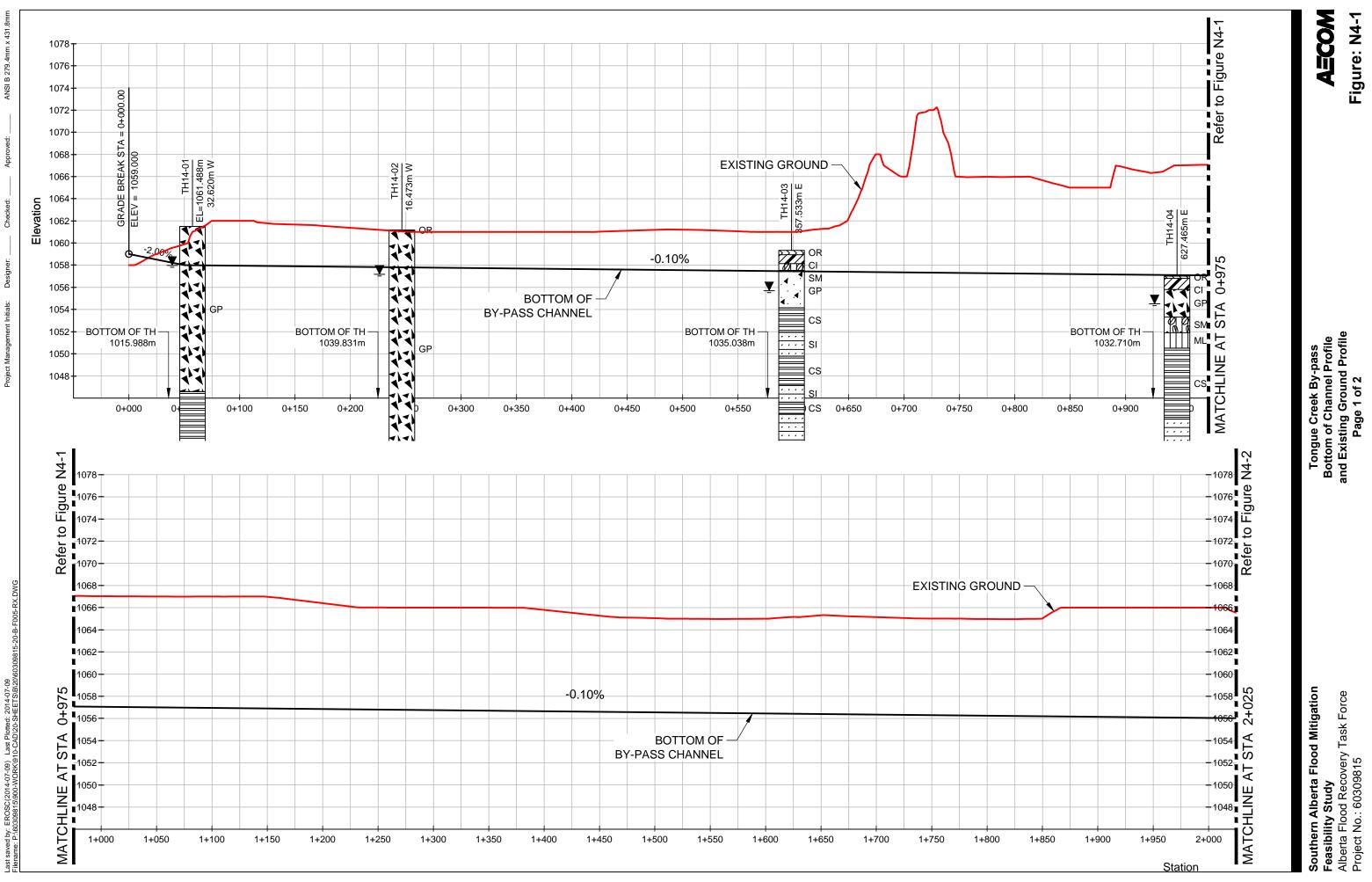




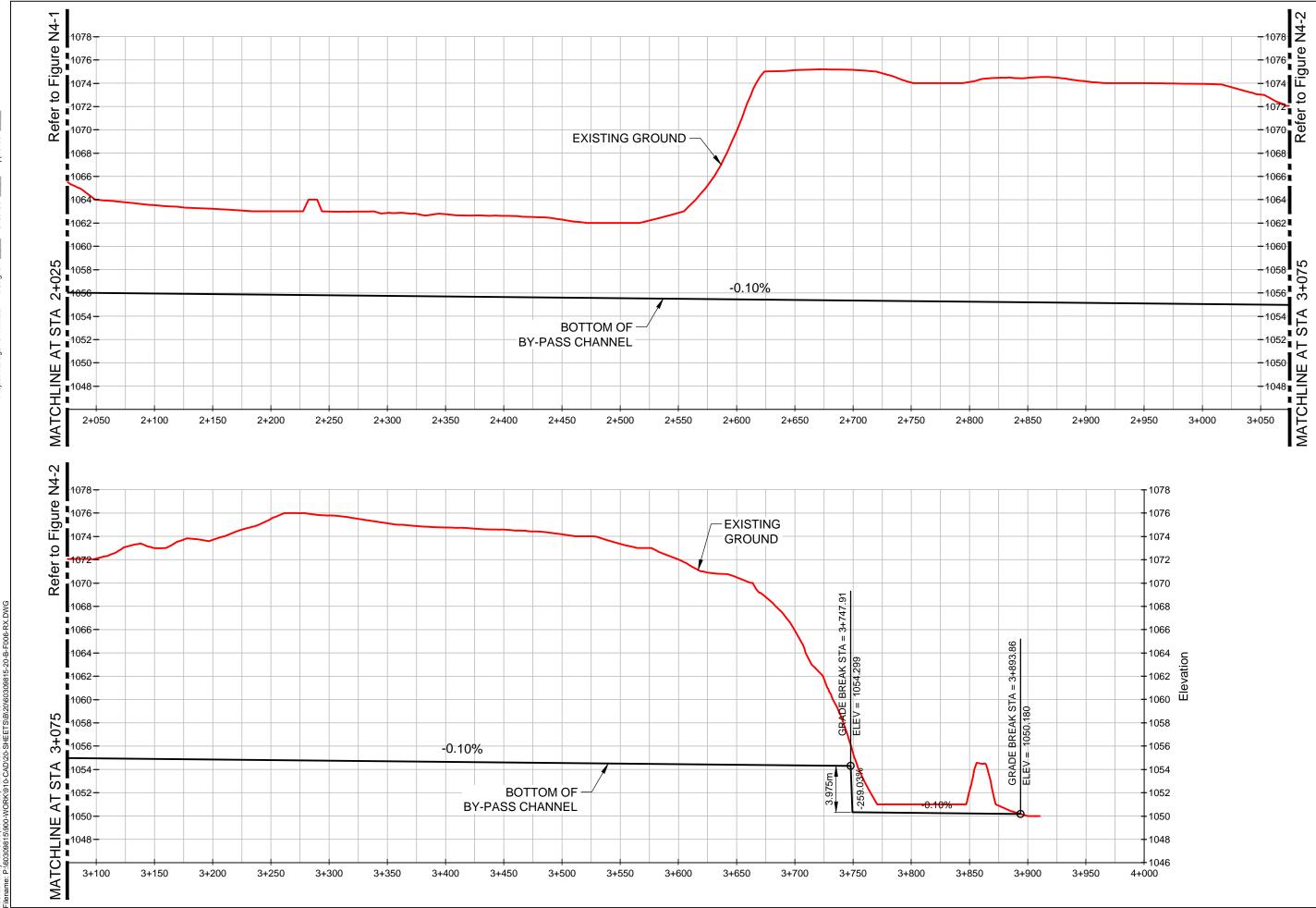
AECOM Figure: N2-5

Assessment of the Tongue Creek Project Area Preliminary Soil Map

Soil Type Delineation 🔲 Tongue Creek Project Area Tongue Creek Bypass Centre Line Flood Extent 350 0 350 700 m 1:35,000 NAD 1983 UTM Zone 11N nics SIO @ 2014 Microsoft Co tion © 2014 Nokia ©/



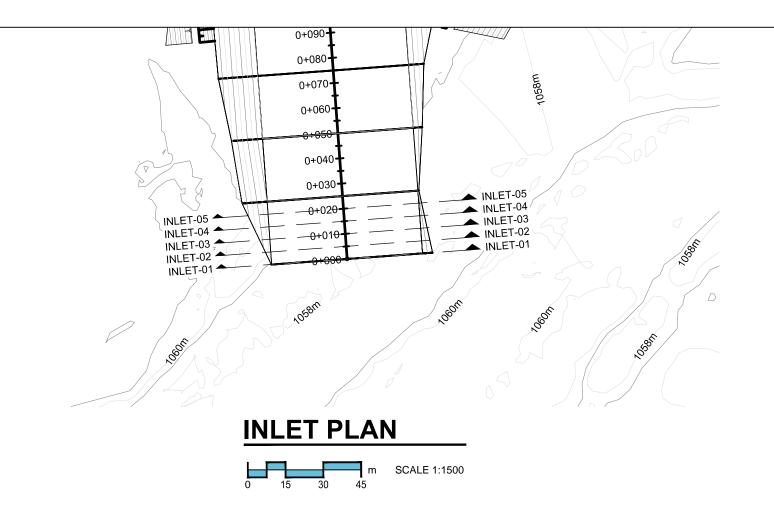
aved by: EROSC(2014-07-09) Last Plotted: 2014-07-09 me: P:\60309815\900-WORK\910-CAD\20-SHEETS\B\20\



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Tongue Creek By-pass Bottom of Channel Profile and Existing Ground Profile Page 2 of 2



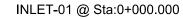
1062

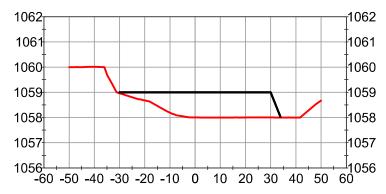
1061

1060

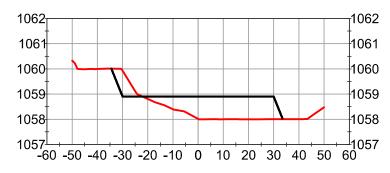
1059

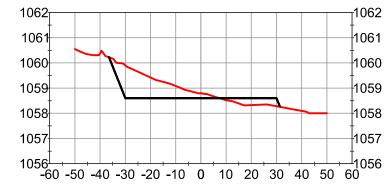
1058





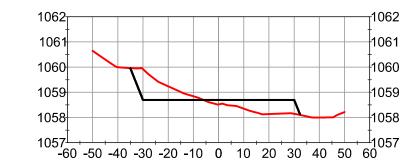
INLET-02 @ Sta:0+005.000







1057¹ -60 -50 -40 -30 -20 -10 0 10 20 30 40 50 60



INLET-04 @ Sta:0+015.000

LEGEND:

- EXISTING GROUND
 - PROPOSED BY-PASS BOTTOM

1058

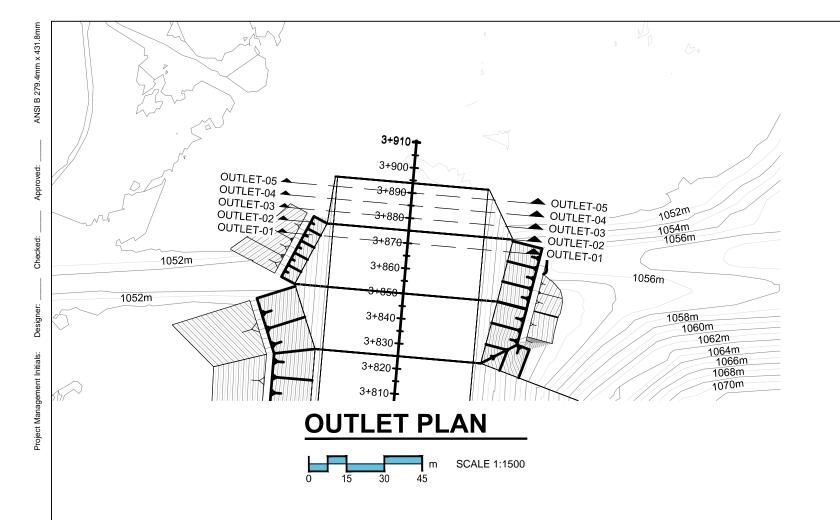
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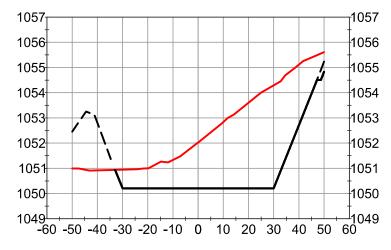
INLET-05 @ Sta:0+020.000

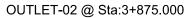
AECOM Figure: N5-1

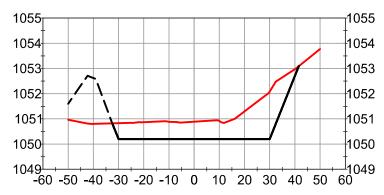
Tongue Creek By-pass Inlet Sections



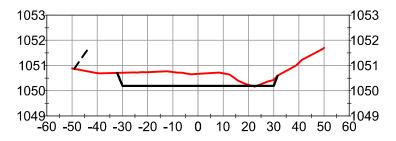
OUTLET-01 @ Sta:3+870.000

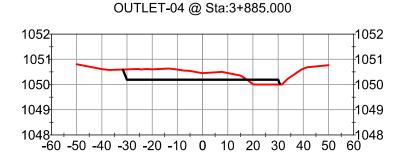




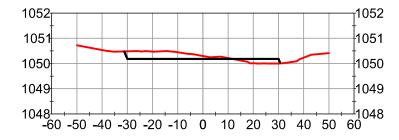














EXISTING GROUND

PROPOSED BY-PASS BOTTOM

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OUTLET-05 @ Sta:3+890.000

Figure: N5-2 AECOM

Tongue Creek By-pass Outlet Sections

Appendix N2

Testhole Logs Modified Unified Classification System for Soils Explanation of Field and Laboratory Test Data Normal Variability of Subsurface Conditions

On DVD in Appendix R

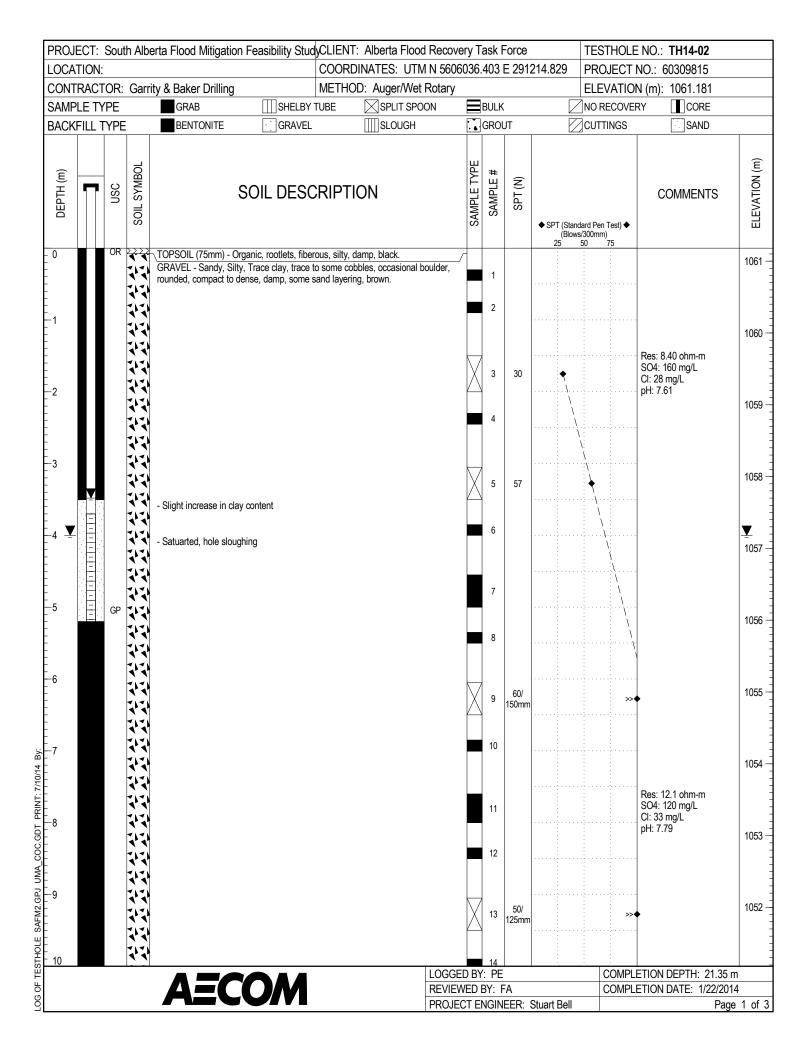
PRO	JECT:	Sout	h Albe	erta Flood Mitigation	Feasibility StudyCLIE	NT: Alberta Flood Rec	overy Tas	sk Fo	orce	TE	ESTHOLE	NO.: TH14-01	
LOC	ATION	:			COC	RDINATES: UTM N 5	605847.29	9 E 2	2911	97.159 PF	ROJECT	NO.: 60309815	
CON	ITRAC	TOR:	Garri	ty & Baker Drilling	MET	HOD: Wet Rotary				El	EVATIO	N (m): 1061.488	
SAM	PLE T	YPE		GRAB	SHELBY TUBE	SPLIT SPOON	BL	JLK			D RECOVER	RY CORE	
BAC	KFILL ⁻	TYPE		BENTONITE	GRAVEL	SLOUGH	G	ROUT	Г	CI	JTTINGS	SAND	
DEPTH (m)	7	USC	SOIL SYMBOL		SOIL DESCR			SAMPLE TYPE	SAMPLE #	PLASTIC M.C. 25 50		COMMENTS	ELEVATION (m)
- 0 			いなななななな	GRAVEL - No Samples rotary.	were collected due to slo	ughing. Hole was carried out	using wet						1061 -
2			*****										1060
3	Ţ		*****										1058 -
		GP	なななない										1057 -
6			いなななな										1056 -
7/10/14 By:			ななななな										1055
COC.GDT PRINT:			くななな										1053 —
LOG OF TESTHOLE SAFM2.GPJ UMA_COC.GDT PRINT: 7/10/14 By:			ななななな										1052 -
± <u>10</u>			-1-1				GED BY:			: :		ETION DEPTH: 45.50 m	
Ч Ч				AEC			IEWED BY:					ETION DEPTH: 45.50 m ETION DATE: 1/23/2014	
000							JECT ENG			Stuart Bell	JOIVIEL		+ 1 of 5

PROJE LOCAT		Soutl	n Alber	ta Flood Mitigation	Feasibility StudyCLIEN	T: Alberta Flood Rec DINATES: UTM N 56						NO.: TH14-01	
CONTR	RACT	OR:	Garrity	y & Baker Drilling	METH	OD: Wet Rotary				E	LEVATIO	N (m): 1061.488	
SAMPL	ETY	РΕ		GRAB	SHELBY TUBE	SPLIT SPOON	BUI	LK		N	O RECOVE	RY CORE	
BACKF	ILL T	YPE		BENTONITE	GRAVEL	SLOUGH	GR	OUT		C	UTTINGS	SAND	
DEPTH (m)		NSC	SOIL SYMBOL		SOIL DESCRIF	PTION		SAMPLE TYPE	SAMPLE #	PLASTIC M.C 25 50		COMMENTS	
10													10
12													1
13		GP											1
4			なななななな										1
15			** ** **	CLAYSHALE - Silty, tra	ce fine sand, moderately we	athered, moderately strong							1
				laminated, some silt/ m	udstone layers, medium plas	tic, damp, dark grey.	-					Res: 34.2 ohm-m SO4: 64 mg/L CI: 13 mg/L pH: 7.98	1
16				 extremely weak 					C1	6.5 ●		Su = 201 kPa Recovery = 100 % RQD = 82 %	1
17		cs											1
18													1
19									C2	91		Recovery = 100 %	1
20									~~			RQD = 87 %	
				AEC			GED BY: F					ETION DEPTH: 45.50 r ETION DATE: 1/23/201	
						DEV	IEWED BY:						

		h Alber	ta Flood Mitigation	Feasibility Stud	-						_		E NO.: TH14-01	
LOCATIO						INATES: UTM		7.29 E 2	29119	97.159			NO.: 60309815	
		Garrity	& Baker Drilling			D: Wet Rotary					_		N (m): 1061.488	
SAMPLE			GRAB	SHELBY	TUBE	SPLIT SPO		BULK			<u> </u>	RECOVE		
BACKFIL	L TYPE	<u> </u>	BENTONITE	GRAVEL		SLOUGH		GROU	Г		Ωcu	TTINGS	SAND	1
DEPTH (m)	nsc	SOIL SYMBOL		SOIL DES	SCRIP	TION		SAMPLE TYPE	SAMPLE #	PLASTIC	M.C. 50		COMMENTS	ELEVATION (m)
-21 -21 -22 -23 -24			highly weathered, Ext	remely weak					С3	10.4			Res: 16.9 ohm-m SO4: 54 mg/L Cl: 16mg/L pH: 8.37 Su = 114 kPa Recovery = 100 % RQD = 68 %	1041 - 1040 - 1039 - 1038 -
-25	CS								C4				Recovery = 86 % RQD = 68 %	1037 - 1036 - 1035 - 1034 -
LOG OF TESTHOLE SAFM.2GPJ UMA_COC.GDT PRINT: 7/10/14 By: 8 8 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1							LOGGED B	Y: PE	C5			COMPL	Recovery = 100 % RQD = 77 % ETION DEPTH: 45.50 m	1033 - 1032 -
5			AEC				REVIEWED					COMPL	ETION DATE: 1/23/2014	
Ŭ							PROJECT I	ENGINE	ER: S	Stuart Be			Page	3 of 5

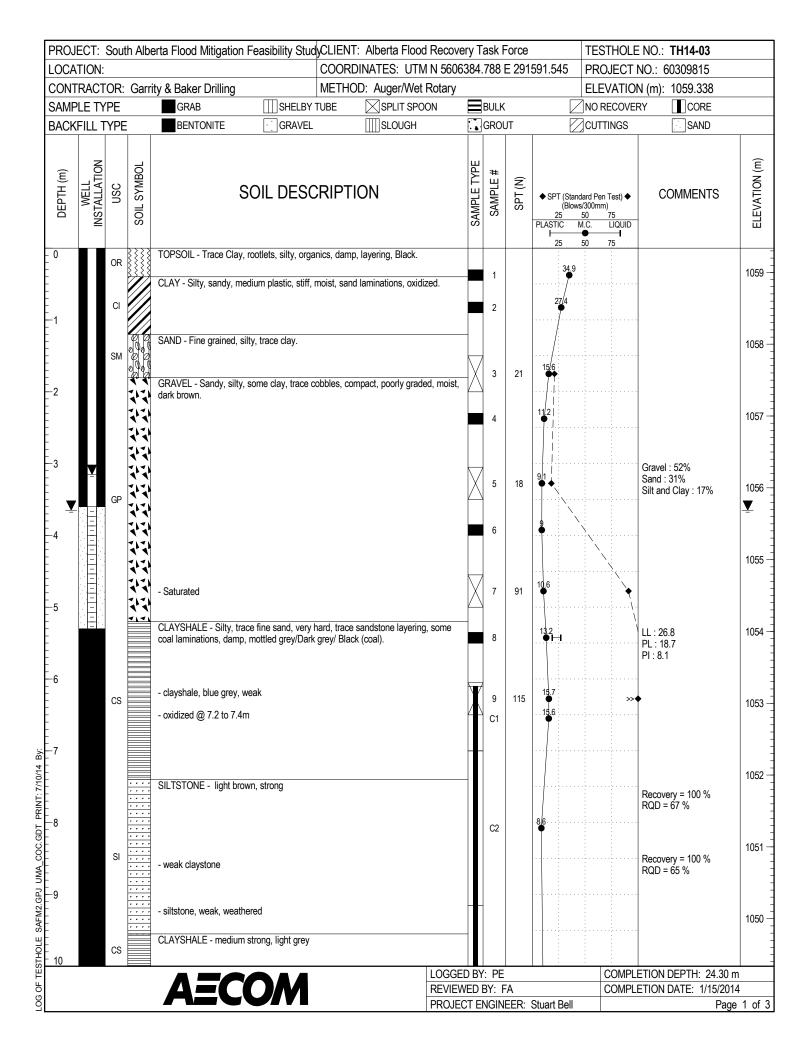
PROJECT: LOCATION:		h Albe	rta Flood Mitigation F		IT: Alberta Flood Reco RDINATES: UTM N 56				-	E NO.: TH14-01 NO.: 60309815	
		Garrif	y & Baker Drilling		OD: Wet Rotary		2011	07.100		N (m): 1061.488	
SAMPLE TY		Curri	GRAB	SHELBY TUBE	SPLIT SPOON	BULK				. ,	
BACKFILL T			BENTONITE	GRAVEL		GRO		-		SAND	
DEPTH (m)	NSC	SOIL SYMBOL		SOIL DESCRI	PTION	SAMPI F TYPF		PLASTIC	M.C. LIQUID	COMMENTS	
30								25	50 75		103
31	00		- some sandstone layerin	g (fine grained)			C6			Recovery = 100 %	10
32	CS		- medium strong							RQD = 63 %	10
33 34			SANDSTONE - fine grain	ed, fresh jointed, very thin	ly bedded, silty, damp, grey						1(
35	SS		, , , , , , , , , , , , , , , , , , ,				C7			Recovery = 100 % RQD = 97 %	10
36			CLAYSHALE - Silty, trace thinly bedded, slightly pra	e fine sand, moderately we ictured, grey, damp.	eathered, moderately weak,	very					10
37											10
38	CS						C8			Recovery = 100 % RQD = 94 %	10
39						_					10
40				N		GED BY: PE				LETION DEPTH: 45.50	
			AEC			EWED BY: F		Ohuert D. P.	COMPI	LETION DATE: 1/23/20	14 e 4 c

LOCATION:									
LOCATION.		COORDINATES: L	JTM N 5605847.29	E 29'	1197.15	9 PR	OJECT	NO.: 60309815	
CONTRACTOR: Garrity & Baker Dr	illing	METHOD: Wet Rot	ary			EL	EVATIO	N (m): 1061.488	
SAMPLE TYPE GRAB	SHELBY 1	TUBE SPLIT S	SPOON BU	LK		NO	RECOVE	RY CORE	
BACKFILL TYPE BENTON	TE GRAVEL	SLOUG	H 🚺 GF	OUT		CU	TTINGS	SAND	
DEPTH (m) USC SOIL SYMBOL	SOIL DES	SCRIPTION		SAMPLE TYPE SAMPLE #		TIC M.C. ● 25 50	LIQUID 75	COMMENTS	ELEVATION (m)
40 -41				С	:9			Recovery = 100 % RQD = 85 %	1021 -
-42 CS									1019 -
-44				C1	10			Recovery = 100 % RQD = 95 %	1018 -
- Water level at	HOLE at 45.5 mBGS 3.5 mBGS at completion								1017 -
- Backfilled with - Water level 3. - Decommission	pipe installed to 15.0 m bentonite chips 52 mBGS in standpipe on F ned on April 22nd at client's	ieb 24, 2014 request							1015 -
									1014 -
									1013 -
<u>50</u>			LOGGED BY:			: :		ETION DEPTH: 45.50 m	<u> </u>
	COM		REVIEWED BY					ETION DEPTH: 45.50 If ETION DATE: 1/23/2014	
			PROJECT ENG		R: Stuart	Bell			5 of 5



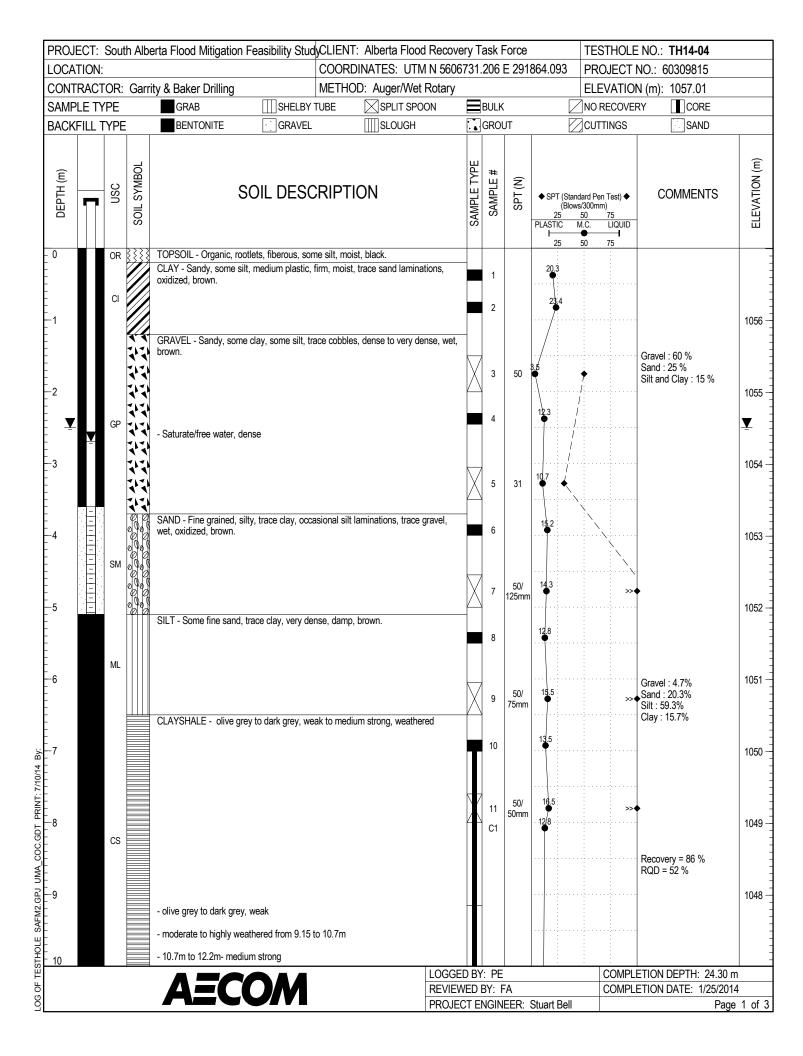
CONT	RACT	OR:	Garrity	/ & Baker Drilling		METH	IOD: Auger/Wet F					ELEVATIO	N (m): 1061.181	
SAMPI	LE TY	PE		GRAB	∭S	HELBY TUBE		N 📃	BULK	K		NO RECOVE	RY CORE	
BACK	FILL T	YPE		BENTONITE	G	RAVEL	SLOUGH		GRO	UT	Z	CUTTINGS	SAND	
DEPTH (m)		NSC	SOIL SYMBOL	S	oil d	ESCRIP	FION	SAMPLE TYPE	SAMPLE #	SPT (N)	◆ SPT (Stan (Blow 25	dard Pen Test) ♦ s/300mm) 50 75	COMMENTS	
10			~ ~ ~ ~											10
-11		•							15					10
12		•	さなななな					X	17	50/ 100mm		»•	•	10
13		•	なななな										Res: 14.9 ohm-m SO4: 150 mg/L CI: 8.7 mg/L	10
14		•	なななななななな						18				pH: 8.47	1(
15		GP .	ななななななな										Res: 11.5 ohm-m SO4: 145 mg/L CI: 32.5 mg/L pH: 8.01	10
16		•						Å	19	50/ 100mm		~		10
17		-												10
18		•	さててていていてい											10
19		•							20					1(
20								LOGGED BY					ETION DEPTH: 21.35	

PROJE	ECT:	Sout	h Albe	erta Flood Mitigation F	easibility StudyC	LIENT: A	Alberta Flood Re	covery T	ask F	Force		TESTHOLE	NO.: TH14-02				
LOCAT	FION	:					ATES: UTM N 5					PROJECT NO.: 60309815					
CONT	RAC	TOR:	Garri	ty & Baker Drilling			Auger/Wet Rota	-					N (m): 1061.181				
SAMPL	LE T	ΥPE		GRAB	SHELBY TU		SPLIT SPOON	•	BULK			NO RECOVER					
BACKF	FILL T	TYPE		BENTONITE	GRAVEL		SLOUGH		GROI	JT		CUTTINGS	SAND				
DEPTH (m)		NSC	SOIL SYMBOL	S	OIL DESCR	RIPTIO	N	SAMPLE TYPE	SAMPLE #	SPT (N)	◆ SPT (Standar (Biows/3 25 5(rd Pen Test) ✦ 300mm) 0 75	COMMENTS	ELEVATION (m)			
- 20			Y Y								25 50			1041 -			
-21		GP	くなななな	END OF TESTHOLE at 2 - Water and slough @ 4	21.35 mBGS mBGS upon complet	ion			21					1040 -			
-22				 50 mm stand pipe insta Water level 3.48 mBGS Decommissioned on Appendix 	lled to 5.2 m									1039 -			
-23														1038 -			
-24														1037 -			
25 														1036 -			
-26														1035 -			
PRINT: 7/10/14 By:														1034 -			
28 														1033 -			
LOG OF TESTHOLE SAFM2.GPJ UMA_COC.GDT PRINT: 7/10/14 By: 06 66 67 10 10 10 10 10 10 10 10 10 10 10 10 10														1032 -			
L LE								GGED B					ETION DEPTH: 21.35 m				
jo g				AEC				VIEWED			0	COMPLI	ETION DATE: 1/22/2014				
2							PR	JIFCLE	NGIN	EER:	Stuart Bell		Page	3 of 3			



CONTRACTOR: Garty & Baker Diffing [METHOD: AugerWet Kolary ELEVENTION (m): 109:333 SAMPLE TYPE GRAVE [Sould UT use Server Server] [Code BACKFILL TYPE GRAVEL [Sould UT use Server] [Code BACKFILL TYPE BROWL [Sould UT use Server] [Code BACKFILL TYPE BROWL [Sould UT use Server] [Code BACKFILL TYPE BROWL [Sould UT use Server] [Code Intermediation for a singet weathered [Sould UT use Server] [Sould UT use Server] [Code 10		TION:	ΩÞ.	Garrit	v & Baker Drilling		RDINATES: UTM N HOD: Auger/Wet Rot		.788	E 291			NO.: 60309815		
SACKFUL TYPE BENTONITE GRAVEL SOIL DESCRIPTION Continue Continue COMMENTS Image: Solid of Solid S				Garni				-	BUIK	:					
Image: Second															
11 CS - sitistone, medium strong, slightly weathered C3 C3 C3 Recovery = 100 % 12 - medium strong to weak, dark blue grey day shele, weathered. - medium strong to weak, dark blue grey day shele, weathered. - medium strong, tightly weathered. - medium strong, tightly weathered. 12 - sitistone, fine grained - claystone, fine grained - claystone, fine grained - claystone, highly weathered 13 S1 - sandstone, fine grained - claystone, highly weathered - claystone, highly weathered 14 - sandstone, fine grained - claystone, highly weathered - claystone, highly weathered 15 - sandstone, fine grained - claystone, highly weathered - claystone, highly weathered 18 - claystone, highly weathered - claystone, highly weathered - claystone, highly weathered	DEPTH (m)	WELL INSTALLATION	nsc	SOIL SYMBOL	SC	DIL DESCRIP	TION	SAMPLE TYPE	SAMPLE #	SPT (N)	(Blows/3 25 50 PLASTIC M.0	00mm)) 75 C. LIQUID			
12 SILTSTONE - fresh joints, olive to dark grey IL: 23.8 13 SI CLAYSHALE - medium strong, dark grey IL: 23.8 14 CS CLAYSHALE - medium strong, dark grey ICA 15 SILTSTONE - medium strong, fractured, dark grey ICA Recovery = 100 % 16 Image: CS SILTSTONE - medium strong, fractured, dark grey Image: CS Image: CS 18 Image: CS Image: CS Image: CS Image: CS Image: CS 18 Image: CS Image: CS Image: CS Image: CS Image: CS 19 Image: CS Image: CS Image: CS Image: CS Image: CS 18 Image: CS Image: CS Image: CS Image: CS Image: CS 19 Image: CS Image: CS Image: CS Image: CS Image: CS 18 Image: CS Image: CS Image: CS Image: CS Image: CS 19 Image: CS Image: CS Image: CS Image: CS Image: CS Image: CS 19 Image: CS Image: CS Image: CS Image: CS Image: CS Image: CS			CS		- siltstone, medium strong,	slightly weathered			C3		10,6		Recovery = 100 % RQD = 58 %	10	
14 CS CLAYSHALE - medium strong, dark grey - siltstone @ 14.0-14.6m 15 - siltstone @ 14.0-14.6m - siltstone @ 14.0-14.6m 16 - sandstone, fine grained - claystone/clayshale, weak, olive grey 17 - claystone/clayshale, weak, olive grey - claystone, highly weathered 19 - claystone, highly weathered - claystone, highly weathered			SI	· · · · · · · · · · · · · · · · · · ·			e, weathered.		-				PL : 19.3	10	
16 16 17 18 18 19 10<	14		CS	· · · · ·		ong, dark grey			C4		58 H		Recovery = 100 % RQD = 77 %	10	
15 - claystone/clayshale, weak, olive grey 17 - claystone/clayshale, weak, olive grey 18 - claystone, highly weathered 19 - claystone, highly weathere	15					ong, fractured, dark grey	,		-					1(
SI Image: simple state in the state i				· · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · · ·	-	k, olive grey			C5				Recovery = 100 % RQD = 83 %	10	
19 - claystone, highly weathered	18		SI	· · · · · · · · · · · · · · · · · · ·										10	
	19				- claystone, highly weather	ed								10	
20 C6 Recovery = 100 %	20								C6				Recovery = 100 %		
LOGGED BY: PE COMPLETION DEPTH: 24.30 REVIEWED BY: FA COMPLETION DATE: 1/15/2 PROJECT ENGINEER: Stuart Bell Page															

PROJ	IECT: Sou	ith Alber	ta Flood Mitigation								TESTHOLE	E NO.: TH14-03	
	TION:					IATES: UTM N 56		.788	E 291	591.545	PROJECT	NO.: 60309815	
		Garrit	y & Baker Drilling			Auger/Wet Rotary						N (m): 1059.338	
	PLE TYPE		GRAB			SPLIT SPOON		BULK			NO RECOVE		
BACK	FILL TYPI	Ξ	BENTONITE	GRAVEL		SLOUGH		GRO	JT		CUTTINGS	SAND	
DEPTH (m)	WELL INSTALLATION USC	SOIL SYMBOL	S	OIL DESCR	riptio	N	SAMPLE TYPE	SAMPLE #	SPT (N)	(Blow 25	dard Pen Test) ♦ s/300mm) 50 75 M.C. LIQUID ● 150 75	COMMENTS	ELEVATION (m)
- 20 21 22 23	SI		- weak, dark grey, claysł - fresh joints CLAYSHALE - weak	nale				C7				RQD = 78 % Recovery = 100 % RQD = 87 %	1039 - 1038 - 1037 -
	CS		END OF HOLE at 21.35	mBGS				-					1036 - 1035 -
- 25			 hole backfilled with ber 50 mm MW installed to Water level 3.15 mBGS Decommissioned on A 	5.2 m S in standpipe on Feb	0 24, 2014								1034 -
: 7/10/14 By:													1033 - 1032 -
LOG OF TESTHOLE SAFM2.GPJ UMA_COC.GDT PRINT: 7/10/14 By:													1031 -
SITHOLE SAFM2.G				_		1.00							1030 -
Е Н							GED B' EWED					ETION DEPTH: 24.30 n ETION DATE: 1/15/201	
000			AEC							Stuart Bell			+- 3 of 3
						11.00						, age	



					LIENT: Alberta Flood OORDINATES: UTM						DLE NO.: TH14-04 CT NO.: 60309815	
CONTRAC	TOR:	Garrity	& Baker Drilling	М	ETHOD: Auger/Wet I	Rotary				ELEVAT	FION (m): 1057.01	
SAMPLE T	YPE		GRAB				BU			NO RECO		
BACKFILL	TYPE		BENTONITE	GRAVEL	SLOUGH		GR	OUT	E		S SAND	
DEPTH (m)	USC	SOIL SYMBOL	SC	DIL DESCR	IPTION	SAMPLE TYPE	CAMPLE #	SPT (N)	♦ SPT (Sta (Blo 25 PLASTIC 25	ndard Pen Test) ws/300mm) <u>50 75</u> M.C. LIQU 50 75		
10												
-11	CS						с	2	11.4		Recovery = 100 % RQD = 55 %	10
12			clayshale, highly weathe	red			_			· · · · · · · · · · · · · · · · · · ·		10
13		· · · · · · · · · · · · · · · · · · ·	SILTSTONE weak claystone									10
14		· · · ·	fresh joints				С	3	6.7		Recovery = 98 % RQD = 61 %	11
15		· · · · · · · · · · · · · · · · · · ·	Olive grey, weak siltston	e		_	_					1
16	SI	· · · · · · · · · · · · · · · · · · ·	weak, olive grey, claysh weak, fresh joints, siltsto		y, siltstone							1
17							С	4			Recovery = 100 % RQD = 69 %	10
18			medium strong siltstone,	slighly weathered		-					••••	11
19	CS	· · · ·	CLAYSHALE- weathered,	weak, clayshale/cla	ystone							1(
20	SI	· · · · · ·	SILTSTONE - weak to me	dium strong siltston	9		c	5			Recovery = 98 % RQD = 77 %	
20		····				LOGGED B			· · ·	CON	IPLETION DEPTH: 24.30	m
			AECO			REVIEWED				00	IPLETION DATE: 1/25/20	1/

CO		:					INATES: UTM N		4 00	~ - ~					
						COOKE	NINATES. UTIVIN	560673	1.20	6 E 2	918	364.093 PF	ROJECT I	NO.: 60309815	
	NIRAC	TOR:	Garri	ty & Baker Drilling		METHO	D: Auger/Wet Ro	tary				EL	EVATION	N (m): 1057.01	
SA	MPLE T	YPE		GRAB	SHELBY T	UBE	SPLIT SPOON	E	BUI	K			D RECOVER	RY CORE	
BA	CKFILL -	TYPE		BENTONITE	GRAVEL		SLOUGH		GR	OUT		CL	JTTINGS	SAND	
DEPTH (m)		USC	SOIL SYMBOL	Ş	SOIL DESC	ripti	ON	SAMDI E TVDE	SAMPIF#	SBT (N)		◆ SPT (Standard F (Blows/300 25 50 PLASTIC M.C. 25 50	Pen Test) ♦ Imm) 75 LIQUID 75	COMMENTS	ELEVATION (m)
_ 20		SI	· · · · ·												-
-21		CS		CLAYSHALE - weather SILTSTONE	ed, weak, clayshale/	claystone,	, olive grey								
22		SI	· · · · · · · · · · · · · · · · · · ·	CLAYSHALE - weak, o	live grey										1035 —
		CS							CI	6				Recovery = 100 % RQD = 84 %	
- 23		SI		SILTSTONE - medium	strong, siltstone										
-24			· · · · · · · · · ·	END OF TESTHOLE a - Water level 2.5 mBGS	at testhole completi	ion									1033
-25				 50 mm stand pipe inta Water level 2.69 mBG Decommissioned on A 	alled to 2.3 mBGS	eb 24. 201	4								1032
-26															1031 — - - - - - -
RINT: 7/10/14 By:															1030
MA_COC.GDT_PF															1029
LOG OF TESTHOLE SAFM2.GPJ UMA_COC.GDT PRINT: 7/10/14 By; 0 66 67 68 67 68 71 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1															
0HLS - 30							,								-
빌								ogged e Eviewed						ETION DEPTH: 24.30 m ETION DATE: 1/25/2014	
000				AEC							R: 5	Stuart Bell			3 of 3



	MAJOR DIVISIO	N	LOG SYMBOLS	USC		TYPIC	AL DESCRIPT	ION	LAB	ORATORY CL CRITE	ASSIFICATION RIA		
		CLEAN GRAVELS		GW	WELL	GRADED	GRAVELS, LIT FINES	ITLE OR NO	C u	$=\frac{D_{60}}{D_{10}} > 4 C_{c} =$	$\frac{(D_{30})^2}{D_{10} \times D_{60}} = 1 \text{ to } 3$		
ကု	GRAVELS (MORE THAN HALF COARSE GRAINS	(LITTLE OR NO FINES)		GP) GRAVELS A S, LITTLE OR		-	NOT MEETING ABOVE REQUIREMENTS			
	LARGER THAN 4.75 mm)	GRAVELS		GM	SIL		.S, GRAVEL-S 1IXTURES	SAND-SILT		NTENT OF S EXCEEDS	ATTERBERG LIMITS BELOW 'A' LINE W _P LESS THAN 4		
GRAINED		WITH FINES		GC	CLAY		LS, GRAVEL- 1IXTURES	SAND-CLAY		12%	ATTERBERG LIMITS ABOVE 'A' LINE W _p MORE THAN 7		
		CLEAN SANDS		SW	WELL		ANDS, GRAVI OR NO FINE		S, C _u	$\frac{D_{60}}{D_{10}} > 6 C_{c} = 0$	$\frac{(D_{30})^2}{D_{10} \times D_{60}} = 1 \text{ to } 3$		
OARSE	SANDS (MORE THAN HALF	(LITTLE OR NO FINES)		SP	POOF	RLY GRADE	D SANDS, LIT FINES	ITLE OR NO		NOT MEETIN REQUIRE			
8	COARSE GRAINS SMALLER THAN 4.75 mm)	SANDS		SM	SIL	TY SANDS,	SAND-SILT M	IIXTURES		NTENT OF	ATTERBERG LIMITS BELOW 'A' LINE W _p LESS THAN 4		
		WITH FINES		SC	CLAY	YEY SANDS	, SAND-CLAY	FINES	S EXCEEDS 12%	ATTERBERG LIMITS ABOVE 'A' LINE W _P MORE THAN 7			
	SILTS (BELOW 'A' LINE	W _L < 50		ML		K FLOUR, S	S AND VERY SILTY SANDS LASTICITY		S, CLAS	SSIFICATION I PLASTICITY (SEE BE			
LS I	NEGLIGIBLE ORGANIC CONTENT)	W _L > 50		ΜΗ			SILTS, MICAC INE SANDY O		ILS				
D SOIL		$W_L < 30$		CL			YS OF LOW Y, OR SILTY CLAYS						
GRAINED	CLAYS (ABOVE 'A' LINE NEGLIGIBLE ORGANIC CONTENT)	$30 < W_L < 50$		CI	INORG	INORGANIC CLAYS OF MEDIUM PLASTICITY, SILTY CLAYS				CONTENT HAS	URE OF THE FINE NOT BEEN S DESIGNATED		
		W _L > 50		СН	INORG	ANIC CLAYS	S OF HIGH PL CLAYS	AT E.G. SF	BY THE LE IS A MIXTUR SILT OR	E OF SAND WITH			
FINE	ORGANIC	$W_L < 50$		OL	ORGAN		ND ORGANIC	rs					
	SILTS & CLAYS (BELOW 'A' LINE)	W _L > 50		ОН	ORGANIC CLAYS OF HIGH PLASTICITY								
	HIGHLY ORGANIC	CSOILS		Pt	PEAT	AND OTHE	r highly or	GANIC SOIL		NG COLOUR	OR ODOUR, AND JS TEXTURE		
	BEDROCK	(BR			SI	EE REPORT	DESCRIPTIC	DN			
	2				·			SOIL COI	MPONENTS				
	20 20		\times			FRAC	TION		SIZE (mm)	PERCENTAG OF MINOR (RANGES OF GE BY WEIGHT COMPONENTS		
						GRAVEL	COARSE	PASSING 75	RETAINED 19	PERCENT	IDENTIFIER		
DEX							FINE	19	4.75	50 - 35	AND		
PLASTICITY INDEX						SAND	COARSE	4.75	2.00	35 – 20	Y		
ASTIC			MH		-		MEDIUM FINE	2.00 0.425	0.425				
Ē		- / - -				SILT (nor		0.120	0.000	20 – 10	SOME		
	a a	$\left\{ + + + + + + + + + + + + + + + + + + +$			or 0.080 CLAY (plastic)					10 - 1	TRACE		
		ML.			\vdash		ED OR SUB-ROU		MATERIALS	ANGULAR			
	0 10 20 30	40 50 60 LIQUID LIMIT	70 80	90 100		COBBL	ED OR SUB-ROU ES 75 mm TO 200 ULDERS >200 mn) mm	ROC	ANGULAR ROCK FRAGMEN CKS > 0.75 m3 IN \			
NOTE							_						
1. E	BOUNDARY CLASSIFICATION							-	-	IED SOIL			
	ARE GIVEN GROUP SYMBOLS WITH CLAY BINDER BETWEEN		LL GRADED GRA			_2012	Cl	_ASSIFI	CATION	SYSTEM	/		



1. Explanation of Field and Laboratory Test Data

The field and laboratory test results, as shown on the logs, are briefly described below.

1.1 Natural Moisture Content and Atterberg Limits

The relationship between the natural moisture content and depth is significant in determining the subsurface moisture conditions. The Atterberg Limits for a sample should be compared to the natural moisture content and should be on the Plasticity Chart in order to determine their classification.

1.2 Soil Profile and Description

Each soil stratum is classified and described noting any special conditions. The Modified Unified Soils Classification System (MUSCS) is used. The soil profile refers to the existing ground level. When available, the existing ground elevation is shown. The soil symbols used are shown in detail on the soil classification chart.

1.3 Tests on Soil Samples

Laboratory and field tests on the logs are identified by the following:

- N (Standard Penetration Test (SPT) Blow Count) The SPT is conducted in the field to assess the in situ consistency of cohesive soils and the relative density of non-cohesive soils. The N value recorded is the number of blows from a 63.5 kg hammer dropped 760 mm which is required to drive a 51 mm split spoon sampler 300 mm into the soil.
- SO₄ (Water Soluble Sulphate Content) Conducted primarily to determine requirements for the use of sulphate resistant cement. Further details on the water soluble sulphate content are given in Section 1.6.
- γ_{D} (Dry Unit Weight) kN/m³ and γ_{T} (Total Unit Weight) kN/m³.
- **Q**_U (Unconfined Compressive Strength) kPa May be used in determining allowable bearing capacity of the soil.
- **C**_U (Undrained Shear Strength) kPa This value is determined by an unconfined compression test and may also be used in determining the allowable bearing capacity of the soil.
- **C**_{PEN} (Pocket Penetrometer Reading) kPa Estimate of the undrained shear strength as determined by a pocket penetrometer.

The following tests may also be performed on selected soil samples and the results are given on the borehole logs: Grain Size Analysis; Standard or Modified Proctor Compaction Test; California Bearing Ratio; Unconfined Compression Test; Permeability Test; Consolidation Test; Triaxial Test



	Table 1.1 Cohesive Soils	
N	Consistency	C _U (kPa) (approx.)
0 - 1	Very Soft	<10
1 - 4	Soft	10 - 25
4 - 8	Firm	25 - 50
8 - 15	Stiff	50 - 100
15 - 30	Very Stiff	100 - 200
30 - 60	Hard	200 - 300
>60	Very Hard	>300

1.4 Soil Density and Consistency

The SPT test described above may be used to estimate the consistency of cohesive soils and the density of cohesionless soils. These approximate relationships are summarized in the following tables:

	le 1.2 Iless Soils
N	Density
0 - 5	Very Loose
5 - 10	Loose
10 - 30	Compact
30 - 50	Dense
>50	Very Dense

1.5 Sample Condition and Type

The depth, type, and condition of samples are indicated on the borehole logs by the following symbols:

Grab Sample

 \square

 \square

- Shelby Tube
- A-Casing
- No Recovery
- SPT Sample
- Core Sample



1.6 Water Soluble Sulphate Concentration

The following table from CSA Standard A23.1-94 indicates the requirements for concrete subjected to sulphate attack based upon the percentage of water soluble sulphate as presented on the borehole logs. CSA Standard A23.1-94 should be read in conjunction with the table.

	Req	uirements for Co	Table 1.3 oncrete Subjecte	d to Sulphate At	tack	
Class of Exposure	Degree of Exposure	Water-Soluble Sulphate (SO₄) in Soil Sample %	Sulphate (SO₄) in Groundwater Samples mg/L	Minimum Specified 28 d Compressive Strength MPa†	Maximum Water/ Cementing Materials Ratio †	Portland Cement to be Used‡
S-1	Very severe	over 2.0	over 10,000	35	0.40	50
S-2	Severe	0.20 - 2.0	1,500 - 10,000	32	0.45	50
S-3	Moderate	0.10 - 0.20	150 - 1,500	30	0.50	20§,40, or 50

- * For sea water exposure see Clause 15.4
- † See Clause 15.1.4
- ‡ See Clause 15.1.5
- § Type 20 cement with moderate sulphate resistance (see Clause 3.1.2)

1.7 Groundwater Table

The groundwater table is indicated by the equilibrium level of standing water in a standpipe installed in a borehole. This level is generally taken at least 24 hours after installation of the standpipe. The groundwater level is subject to seasonal variations and its highest level usually occurs in spring. The symbol on the borehole logs indicating the groundwater level is an inverted solid triangle ($\underline{\bullet}$).



AECOM Canada Ltd. General Statement; Normal Variability Of Subsurface Conditions

The scope of the investigation presented herein is limited to an investigation of the subsurface conditions as to suitability of the site for the proposed project. This report has been prepared to aid in the general evaluation of the site and to assist the design engineer in the conceptual design for the area. The description of the project presented in this report represents the understanding by the geotechnical engineer of the significant aspects of the project relevant to the design and construction of the subdivision, infrastructure and similar. In the event of any changes in the basic design or location of the structures, as outlined in this report or plan, AECOM should be given the opportunity to review the changes and to modify or reaffirm in writing the conclusions and recommendations of this report.

The analysis and recommendations represented in this report are based on the data obtained from the test holes drilled at the locations indicated on the site plans and from other information discussed herein. This report is based on the assumption that the subsurface conditions everywhere on the site are not significantly different from those encountered at the test locations. However, variations in soil conditions may exist between the test holes and, also, general groundwater levels and condition may fluctuate from time to time. The nature and extent of the variations may not become evident until construction. If subsurface conditions, different from those encountered in the test holes are observed or encountered during construction or appear to be present beneath or beyond the excavation, AECOM should be advised at once so that the conditions can be observed and reviewed and the recommendations reconsidered where necessary.

Since it is possible for conditions to vary from those identified at the test locations and from those assumed in the analysis and preparation of recommendations, a contingency fund should be included in the construction budget to allow for the possibility of variations which may result in modifications of the design and construction procedures.

APPENDIX A

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Soil Logs

SYMBOLS AND TERMS USED ON TEST HOLE LOGS

1. VISUAL TEXTURAL CLASSIFICATION OF MINERAL SOILS

CLASSIFICATION

Boulders

Cobbles

Gravel

Sand

Silt

Clay

APPARENT PARTICLE SIZE

Greater than 200 mm 75 mm to 200 mm 5 mm to 75 mm Not visible to 5 mm Non-Plastic particles, not visible to the naked eye Plastic particles, not visible to the naked eye

2. TERMS DESCRIBING CONSISTENCY (COHESIVE SOILS ONLY)

DESCRIPTIVE TERM

APPROXIMATE UNDRAINED SHEAR STRENGTH

Very Soft Soft Firm Stiff Very Stiff Hard Very Hard

Less than 10 kPa 10 - 25 kPa 25 - 50 kPa 50 - 100 kPa 100 - 200 kPa 200 - 300 kPa Greater than 300 kPa

Modified from National Building Code

3. TERMS DESCRIBING DENSITY (COHESIONLESS SOILS ONLY)

DESCRIPTIVE TERM	STANDARD PENETRA (Number of Blows pe	
Very Loose Loose Compact Dense Very Dense	0 - 4 4 - 10 10 - 30 30 - 50 Over 50	Modified from National Building Code
LEGEND FOR TEST HOLE LOGS		

SYMBOL FOR SAMPLE TYPE

	Shelby Tube		A-Casing
\square	SPT		Grab
\boxtimes	No Recovery		Core
	MC - Moisture Content (% by weight) as	deten	mined by sample.



Cu

4.

Water Level Shear Strength determined by pocket penetrometer

Shear Strength determined by pocket vane.

- Undrained Shear Strength determined by unconfined compression test.

MODIFIED UNIFIED CLASSIFICATION SYSTEM FOR SOILS

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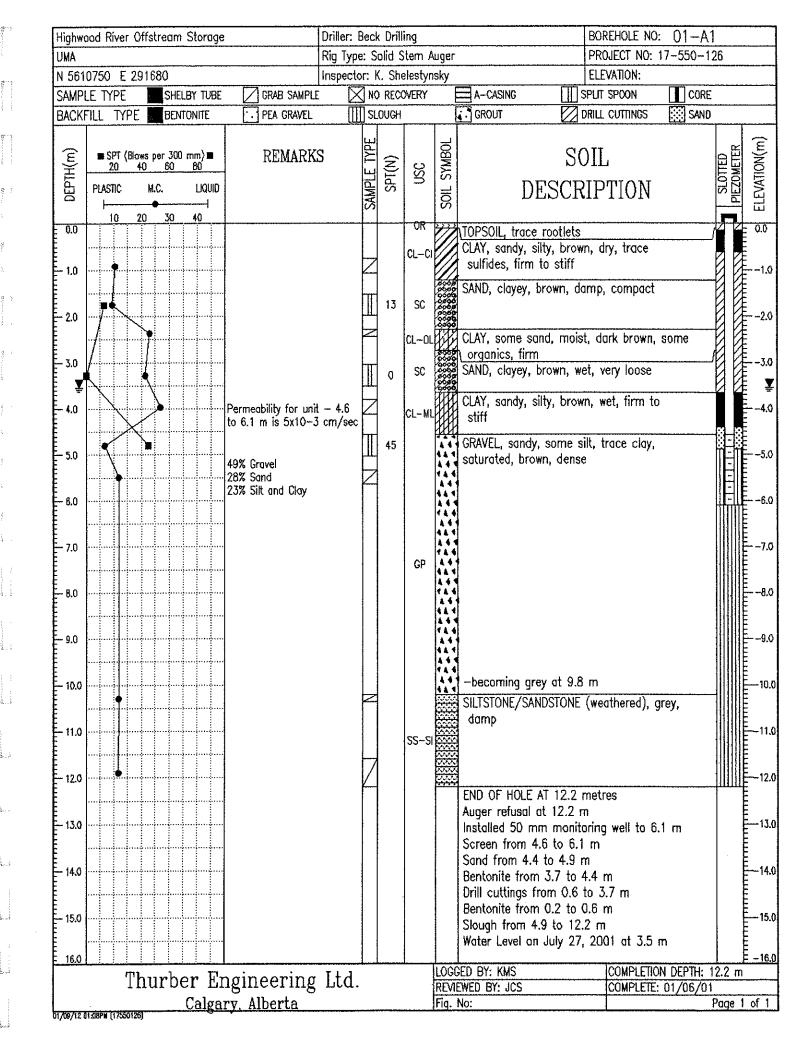
West-11

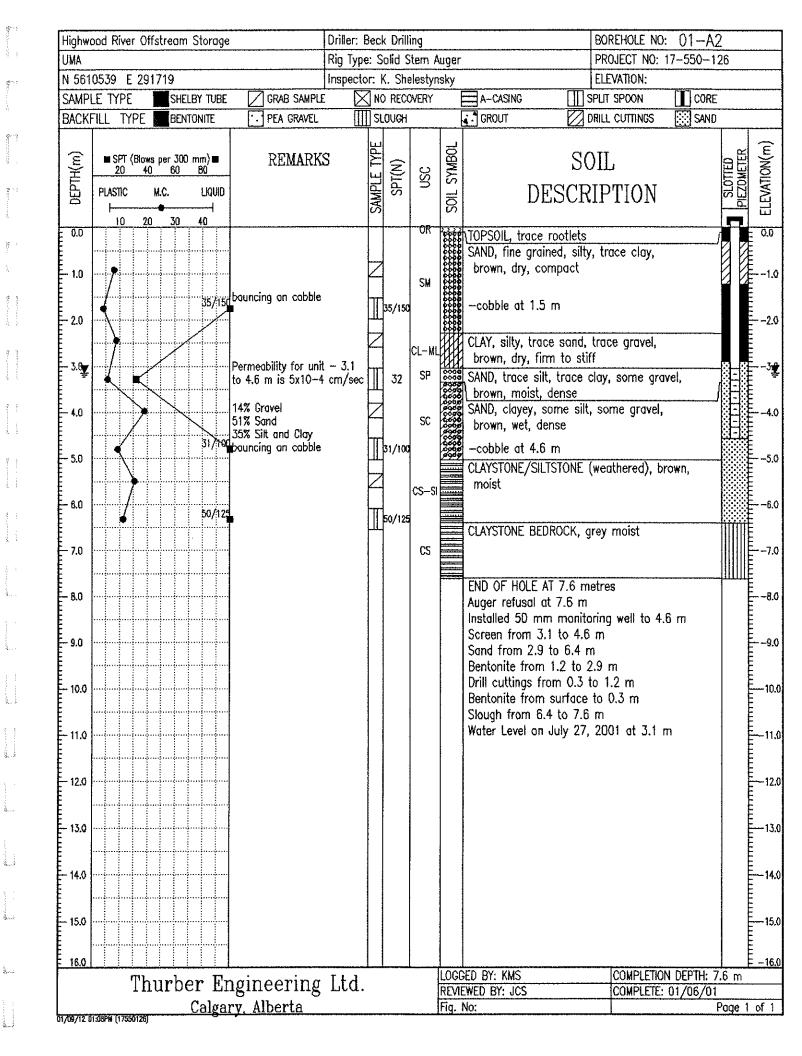
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	MAJOR [DIVISION	GROUP SYMBOL	THURBER LOG SYMBOL	ΤΥΡΙΟ	AL DESCRIPTION	LABORATORY CLASSIFICATION CRITERIA
	¥.,,	CLEAN GRAVELS	G₩	4 V 4 4 V 4 4 V 4 4 V 4	WELL GRADED GRAVELS LITTLE OR NO FINES	, GRAVEL - SAND MIXTURES,	$C_{u} = \frac{D_{M}}{D_{11}} > 4; C_{e} = \frac{(D_{y_{i}})^{2}}{D_{11} \times D_{14}} = 1 \text{ to } 3$
(unis	ELS ALF COAR GER THAN	(LITTLE OR NO FINES)	GP	4 T 4 4 T 4 4 T 4 4 T 4	POORLY GRADED GRAVI MIXTURES, LITTLE OR NO	ELS, GRAVĖL-SAND D FINES	NEL KOT MEETING ALL GRADATION REQUIREMENTS FOR GW
COARSE-GRAINED SOILS (MORE THAN HALF BY WEIGHT LARGER THAN 75µm)	GRAVELS MORE THALF COARSE GRAINS LATIGER THAN 4.75 mm	GRAVELS WITH FINES	GM		SILTY GRAVELS, GRAVE MIXTURES	L·SAND-SILT	The second se
INED SO BHT LARGE	MOF	(APPRECIABLE AMOUNT OF FINES)	GC		CLAYEY GRAVELS, GRA MIXTURES	VEL-SAND-CLAY	AUCYETATIERBERG LIMITS Lases JADVE 'A' LINE Lases JADVE 'A' LINE Lases La
RSE-GRA LF 8Y WEK	R. R	CLEAN SANDS	sw		WELL GRADED SANDS, (LITTLE OR NO FINES		$\begin{array}{c} \mathbf{C} = \mathbf{D}_{11} \mathbf{MORE} \mathbf{IRAR} \mathbf{I} \mathbf{I} $
COA	IDS ALF COAR LLER THAN	(LITTLE OR NO FINES)	SP	0000 0000 0000	POORLY GRADED SAND LITTLE OR NO FINES	S, GRAVELLY SANDS,	A REQUIREMENTS FOR SW
3HOM)	SANDS SANDS MORE THUN IALE COARSE GRAINS SMALLER THUN 4.75 man	SAND WITH FINES	SM		SILTY SANDS, SAND-SIL	T MIXTURES	E 2 2 2 2 - bordertine
	ž	AMOUNT OF FINES)	sc		CLAYEY SANDS, SAND-	CLAY MIXTURES	BE BE ATTERBERG LIMITS cases BE BE BE A ABOVE "A" LINE requiring use COURT in low MORE THAN 7 of dual symbols
-	TS SIGLE ANIC ANIC FENT	w _L < 50%	ML.		INORGANIC SILTS AND SILTY OR CLAYEY FINE WITH SLIGHT PLASTICIT	VERY FINE SANDS, ROCK FLOUR, SANDS OR CLAYEY SILTS Y	CLASSIFICATION IS BASED UPON
(WASL NAVE BY WELD SOLLS FINAN 75/m)	SILTS BELOW -A-LINE NEGLIGEILE CONTENIC CONTENIC	wL> 50%	мн		INORGANIC SILTS, MICA FINE SANDY OR SILTY S	CEOUS OR DIATOMACEOUS,	PLASTICITY CHART (mea beider)
SULLS	15 BANIC	w _L < 30%	CL		INORGANIC CLAYS OF I SANDY, OR SILTY CLAY	OW PLASTICITY, GRAVELLY, S, LEAN CLAYS	
GRAINED Y WEIGHT	CLAYS ABOVE - Y-LINE NEGLIGISLE OFIGANIC CONTENT	30% <wl<50%< td=""><td>Ci</td><td></td><td>INORGANIC CLAYS OF I GRAVELLY CLAYS, SAM</td><td>HEDIUM PLASTICITY, IDY CLAYS, SILTY CLAYS</td><td></td></wl<50%<>	Ci		INORGANIC CLAYS OF I GRAVELLY CLAYS, SAM	HEDIUM PLASTICITY, IDY CLAYS, SILTY CLAYS	
FINE-	REAR	wL> 50%	сн		INORGANIC CLAYS OF	HIGH PLASTICITY, FAT CLAYS	
MORE TH	ORGANIC SILTS & CLAYS ELOW-X'LINE	wL< 50%	OL		ORGANIC SILTS AND O LOW AND MEDIUM PLA	RGANIC SILTY CLAYS OF STICITY	
	OHG SILT BELOW	wL> 50%	он		ORGANIC CLAYS OF HI ORGANIC SILTS	GH PLASTICITY,	
	HIGHLY OF	IGANIC SOILS	Pt		PEAT AND OTHER HIGH		STRONG COLOR OF ODOR, AND OFTEN FIBROUS TEXTURE
		SPECIAL	SYMBOL	.S		50 PLASTICITY CHART FOR	
		BEDROCK (UNDIFFERENTIATED)			OVERBURDEN (UNDIFFERENTIATED)	40 - SOIL FRACTION WITH PARTI SMALLER THAN 425 µm	
		SANDSTONE			SILTSTONE	X HON 20 CL 5 NULLIDILS 10 CL 5 ML	OL OH
		CLAYSTONE (CLAYSHALE OR MUDSTONE)				0 10 20 30	40 \$0 60 70 80 90 LIMIT (%) (wL)
		LIMESTONE					URBER
		CONGLOMERATE				UNIFIED CLASSI	DIFIED IFICATION SYSTEM
			L	ل		(MODIFIED	BY PFRA, 1985)





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	FILL TYPE BENTONITE						GROUT	DRILL CUTTINGS	SAND		
DEPTH(m)	■ SPT (Blows per 300 mm) ■ 20 40 60 80 PLASTIC M.C. LIQUI 10 20 30 40	REMARKS	SAMPLE TYPE	SPT(N)	nsc	SOIL SYMBOL		SOIL SCRIPTION		DATA	FI FVATION(m)
0.0					OR		<u>TOPSOIL, trace roo</u> SILT, gravelly, san	dy, trace clay,	/		0.
- 1.0			4		ML		dry, brown, comp	oact			
- 2.0			Z				SAND, trace grave damp, brown, co	l, some silt, trace o mpact	lay,		" "
- 3.0					SW-SM						
- 4.0						60000000000000000000000000000000000000	-cobbles from 4.	0 to 5.2 m			-
- 5.0						6000 6000 6000	END OF HOLE AT				,
- 6.0							Auger refusal at 5 Slough to 4.4 m Backfilled with ber	ntonite chips			
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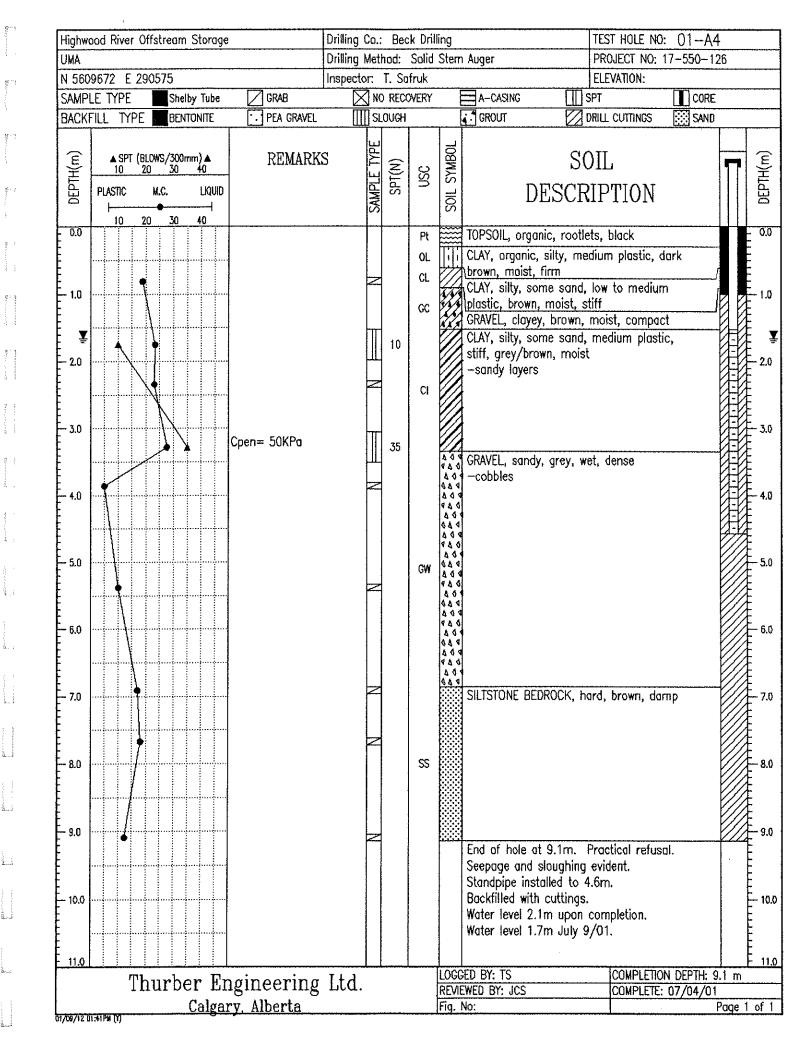
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	FILL TYF		ITONITE			SLOUG			GROUT	DRILL CUTTINGS	SAND
DEPTH(m)	PLASTIC	Blows per 300 40 60 M.C.	liquid 1	REMARKS		SPT(N)	nsc	SOIL SYMBOL		SOIL CRIPTION	INSTRUMENTATION DATA
0.0	10	20 30	40				OR	7	TOPSOIL, trace root		
- 1.0		•		05% 0			CL		CLAY, trace silt, san damp, brown, firm SILT, gravelly, sandy	to stiff , trace clay,	
- 2.0				25% Gravel 25% Sand 50% Silt and Clay —auger grinding cobbles	Ż	4	1716		damp, brown, comp cobbles at 2.0 m END OF HOLE AT 2.1		
- 3.0				adder demond conner					Auger refusal at 2.1 Slough to 1.5 m Backfilled with bento	m	
- 4.0									Dry upon completion		
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DEPTH(m)	PL	AST		(8 2		rs/: .c.	300r 30	mm) 4	0 	ID	REMARI	KS	SAMPLE TYPE	SPT(N)	DSU	SOIL SYMBOL	DE	S0 SCRI	IL IPTION		INSTRUMENTATION DATA	DEDTH(m)
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DEPTH(m)	▲ SPT (BI 10 2	LOWS/300n 0 30	nm)▲ 49	REMARK	S	SAMPLE TYPE SPT(N)	usc	SYMBOL		SOIL		INSTRUMENTATION DATA DFPTH(m)
DEP	PLASTIC 10 2	M.C.	Liquid { 40			SAMP	~	SOIL	DESC	RIPTION		INSTRU I DFP
11.0		<u>u</u>		Run #2 11.28-1 79% REC, 40% RG	3.72m)D		SI SA		SANDSTONE, slightly brown	weathered to fre	sh, R5	- 11
- 12.0				Packer test 12.2- No flow with 2psi	-13.7m				CLAYSTONE, highly to RO-R1, grey -becoming slightly v siltstone			- 12
- 13.0							CS					1:
14.0		× · · · · ·		Run #3 13.72-1 100% REC, 83% F Packer test 13.7- No flow with 3-7	RQD -15.2m		SA		—thin black layer at SANDSTONE, fresh, F			
- 15.0				Packer test 15.2- No flow with 4psi	-16.8m				CLAYSTONE, moderal grey -slightly weathered	tely weathered, R	0-R1,	
17.0				Run #4 16.46—1 100% REC, 54% F Packer test 16.8- No flow with 5psi	RQD		CS		-siltstone bands -thin black layer at	17.4m		
- 18.0				Packer Test 18.3 No flow with 6psi	-19.8m		si-sa		SILTSTONE and SANE grey	OSTONE, fresh, R	1-R5,	
- 19.0	•			Run #5 19.51-2	2.56m				CLAYSTONE, slightly	weathered, RO-R	(1, grey	
20.0	•••••••••••••••••••••••••••••••••••••••			83% REC, 46% R(Packer Test 19.8 No flow with 7psi	QD 21.3m		CS		Cont'd CLAYSTONE, slightly	weathered, R0-F	₹1, grey	
- 21.0							SA		-thin black layer at SANDSTONE, fresh, l CLAYSTONE, slightly	R5, grey		
22.0				<u> </u>			CS		<u> </u>			
	T	hurb		ngineering ry. Alberta	Ltd.			REV	GED BY: TS IEWED BY: JCS No:		ON DEPTH: 2 E: 07/06/01	5.6 m Page 2 of

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Highwo UMA	ood River	Offstream	ı Storage							isen Ltd. //Coring			01-A5		
	0947 E	291629			Inspecto					<u>, 7</u>		ATION:			
	LE TYPE		lby Tube	GRAB	Σ	N	D RECO	WERY		A-CASING	SPT		CORE		
BACKE	FILL TYP	PE B en	πονιτε	PEA GRAVEL	Ú]] SI	OUGH			GROUT		UTTINGS	💮 SAND		
DEPTH(m)	▲ SPT 10 PLASTIC ⊢	(BLOWS/300 20 30 M.C. 20 30	mm)▲ 40 LIQUID 1 40	REMARK	S	SAMPLE TYPE	SPT(N)	JSN	SOIL SYMBOL		SOIL ESCRIPT			INSTRUMENTATION DATA	
22.0	Ĩ									CLAYSTONE, sli	ghtly weathere	d, R0-R1	, grey		E
- 23.0				Run #6 22.56-2 100% REC, 58% I	25.60m RQD			CS SA		-fresh, RO-R4 SANDSTONE, fra CLAYSTONE, sliv	esh, R5, grey	d to free	h		<u>nevergenere</u>
- 24.0	•							CS		R1-R2, grey	gnay would be		11,		
- 25.0															
- 26.0										END OF HOLE , Backfilled with Bentonite seal	cuttings.				
- 27.0															
28.0															
- 29.0															
- 30.0				•											
- 31.0															
- 32.0															
- 33.0) <u>5</u>	Ē
		Thurb	er E	ngineering	g Ltd	•				GED BY: TS IEWED BY: JCS)N DEPTH: 2 : 07/06/01		n
	0151PM (Y)			ry, Alberta	-					No:				Paqe	3

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Highwood River Offstream Storage UMA				Drilling C Drilling N					PRO	TEST HOLE NO: 01-A6 PROJECT NO: 17-550-126						
239	E	2917	53									i	/ATION:			
E TY	ΈE		Shel	by Tu	be	GRAB	\boxtimes	NO REC	OVERY	5	A-CASING					
LL	TYP	E .	BEN	TONIT	E	PEA GRAVEL		SLOUGH			GROUT	DRILL	CUTTINGS			
A	.spt 10	(BLOW) 20 M.	c.	LX	aud H	REMARK	S	SAMPLE TYPE SPT(N)	nsc	SOIL SYMBOL	J				INSTRUMENTATION DATA	
	<u>to</u>	20		40		Wet Rotary to 4.5	57m		+		See TH 01-	A3 for 0-4.5m	stratigrap			0
																- 1
																- :
																- ;
						Run #1 4.57-5	.18m		C4		SANDSTONE	, rofted, fresh,	R5, grey			-
						Set casing to 4. Run #1 Run #2 5.49-6	9m after 10m		00		CLAY TILL, s low plastic, moist	silty, some sand very stiff to ha	, trace gr rd, brown,	avel,		-
	•					Run #3 6.10-7 60% REC, 27% F Cpen> 215KPa	'.62m ?QD									
						Run #4 7.62-5).75m		CI		-madium -	alastic condition	al cobbles	1		
						62% (REC, 0% R Cpen> 215KPa	D					Juano, UCUAIUI				
						 Run #5 9.75~	1.89m									
1	1					-			<u> </u>		GED BY: TS		COMPLET	ION DEPTH:	25.0 m	
		Th	nrh	her	۰Æ	ngineerin	a Itd				AEWED BY: JC	c		E: 07/05/0		
	E TY LL PLAS		TYPE		TYPE Shelby Tu ASPT (BLOWS/300mm) A 10 20 30 40 PLASTIC M.C. LK 10 20 30 40 IO IO IO IO IO IO IO IO IO IO IO IO IO IO IO IO IO IO IO IO	TYPE Shelby Tube	TYPE Shelby Tube □ GRAB LL TYPE BENTONITE □ PEA GRAVEL ASPT (BLOWS/300mm) A REMARK 10 20 30 40 PLASINC M.C. LKOUD REMARK 10 20 30 40 Wet Rotary to 4.5 10 10 10 10 10 10 20 30 40 Wet Rotary to 4.5 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 11 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 <	239 E 291753 Inspector TYPE Shelby Tube □ GRAB LL TYPE BENTONITE [] PEA GRAVEL ▲ SPT (BLOWS/300mm) ▲ 10 20 30 40 REMARKS PLASIC M.C. LIQUID ▲ O 20 30 40 Wet Rotary to 4.57m Begin coring at 4.57m Run #1 4.57-5.18m S0% REC, 25% ROD Set casing to 4.9m after Run #1 Run #2 5.49-6.10m So% REC, 25% RQD So% REC, 27% RQD Set casing to 4.9m after Run #1 Run #3 6.10-7.62m So% REC, 27% RQD Cpen> 215KPa Run #4 7.62-9.75m 62% REC, 0% RQD Cpen> 215KPa Run #5 9.75-11.89m 46% REC, 14% RQD	239 E 291753 Inspector: T. Sc TYPE Shelby Tube □ CRAB NO REC L TYPE BENTONITE [] PEA GRAVEL []] SLOUCH ASPT (BLOWS/300mm) A REMARKS Image: Constraint of the second secon	239 E 291753 Inspector: T. Safruk TYPE Shelby Tube GRAB NO RECOVERY LI TYPE BENTONTE PEA GRAVEL IIII SLOUGH ASPT (BLOWS/300mm) A 10 20 X0 40 REMARKS IIII SLOUGH 10 20 30 40 Wet Rotary to 4.57m IIII SLOUGH 10 20 30 40 Wet Rotary to 4.57m IIII SPECIAL STREED ST	239 E 291753 Inspector: T. Safruk TYPE Shelby Tube GRAB M O RECOVERY L TYPE BENTONITE PEA GRAVEL III SLOUGH ASPT (BLOWS/300mm) A 10 20 30 40 REMARKS III SLOUGH PLASIC M.C. LQUD III SLOUGH In 20 30 40 Wet Rotary to 4.57m III SLOUGH In 20 30 40 Wet Rotary to 4.57m III SLOUGH In 20 30 40 Wet Rotary to 4.57m III SLOUGH In 20 30 40 Wet Rotary to 4.57m III SLOUGH In 20 30 40 Wet Rotary to 4.57m III SLOUGH In 20 30 40 Wet Rotary to 4.57m III SLOUGH In 20 30 40 Wet Rotary to 4.57m III SLOUGH In 20 30 40 Wet Rotary to 4.57m III SLOUGH In 20 30 40 Wet Rotary to 4.57m III SLOUGH In 20 30 40 Wet Rotary to 4.57m III SLOUGH In 20 30 40 Wet Rotary to 4.57m III SLOUGH In 20 50 75m SK SK III SLOUGH In 20 50 75m SK III SLOUGH III SLOUGH In 20 50 75m SK III SLOUGH I	TYPE Shelby Tube □ GRAB ○ NO RECOVERY □ A-CASING L1 TYPE BENTONITE □ PEA GRAVEL □ SLOUGH 4 0 GROUT A SPT (BLONS/300mm) A REMARKS □ GE GE	239 E 291753 Inspector: T. Sofruk ELF TYPE Shelby Tube 0248 No RECOVERY A-CASING III SPI LI TYPE BENTONITE	239 E 291753 Insergetor: T. Sufruk. ELEVATION: ETYPE Shelby Tube 26V8 NO RECOVERY A=CASING III SPT LI TYPE BREINTINE : PEA GRAVEL III SLOUCH II	209 E 291753 Insertor: T. Safruk ELEVATION: ETYPE Stady Take Stady NO RECOVERY A-CASING III SPT III CORE A 307 (RDMC/300m) A ELEVATION: ELEVATION: III SEDUCH IIII SEDUCH III SEDUCH III SEDUCH </td <td>239 E 291753 Inspector: T. Sdruk ELEVATION: TYPE Snay Time PRAB X NO RECORDER: ACASING III SPT III CORE 11 TYPE DDATCAITE PEA CASINE IIII SLOUGH \$2 GROUT DBRL CUTINGS III SOUGH 4501000070000014 REEMARKS IIII SLOUGH \$2 GROUT DBRL CUTINGS IIII SLOUGH 4501000070000014 REEMARKS IIIII SLOUGH \$2 GROUT DBRL CUTINGS IIII SLOUGH 4501000070000014 REEMARKS IIIII SLOUGH \$2 GROUT DESCRIPTION IIII SLOUGH 45010000070000014 REEMARKS IIIII SLOUGH \$2 GROUT DESCRIPTION IIII SLOUGH 45010000070000014 REEMARKS IIII SLOUGH IIII SLOUGH</td>	239 E 291753 Inspector: T. Sdruk ELEVATION: TYPE Snay Time PRAB X NO RECORDER: ACASING III SPT III CORE 11 TYPE DDATCAITE PEA CASINE IIII SLOUGH \$2 GROUT DBRL CUTINGS III SOUGH 4501000070000014 REEMARKS IIII SLOUGH \$2 GROUT DBRL CUTINGS IIII SLOUGH 4501000070000014 REEMARKS IIIII SLOUGH \$2 GROUT DBRL CUTINGS IIII SLOUGH 4501000070000014 REEMARKS IIIII SLOUGH \$2 GROUT DESCRIPTION IIII SLOUGH 45010000070000014 REEMARKS IIIII SLOUGH \$2 GROUT DESCRIPTION IIII SLOUGH 45010000070000014 REEMARKS IIII SLOUGH IIII SLOUGH

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	od River	Offstream	n Storage		Drilling (Drilling N					TEST HOLE NO: 01 PROJECT NO: 17-55						
UMA N 5610)239 E 2	91753		·····	Inspecto				7 - or in 19	ELEVATION:						
	E TYPE		lby Tube	GRAB		NO REC			A-CASING	SPT	CORE					
	ILL TYP		NTONITE	PEA GRAVEL	Ī] SLOVGI	1		GROUT	DRILL CUTTINGS	SAND					
DEPTH(m)	(E) ▲ SPT (BLOWS/300mm)▲ R]			REMARK	S	SAMPLE TYPE SPT(N)	nsc	SOIL SYMBOL		OIL RIPTION	INSTRUMENTATION DATA	DFPTH(m)				
	10	20 30	40								≧	- 10				
10.0				Cpen> 215KPa					Cont'd CLAY TILL, silty, some medium plastic, very moist			11.0				
- 12.0	•			Run #6 11.89 65% REC, 0% RC Cpen> 215KPa	13.11m D		СІ		-grey							
- 13.0				Run #7 13.11- 42% REC, 37% F Cpen> 215KPa												
- 14.0	••••••		4	Run #8 14.63-	16.15m		-					- 1 1				
- 15.0				90% REC, 67% F	RQD				CLAYSTONE, complete	ly weathered, RO, gre	y J					
- 16.0				Run #9 16.15- 90% REC, 75% F			CS		-thin black layer at -highly weathered	16.3m						
17.0	1			Packer Test 16. No flow with 5p			SI		<u>SILTSTONE, slightly w</u> CLAYSTONE, slightly t R0-R4, grey	eathered, R4—R5, gre o highly weathered,	×					
18.0							CS					بببيبيار				
- - 19.0 - -				Run #10 19.20 100% REC, 41%					-thin black layer at	18.75m						
- <u>20.0</u>	•			!								E				
	1	Thur		ngineerin ary, Alberta	g Ltd	•		RE	GGED BY: TS //Ewed by: JCS / No:	COMPLETION DE COMPLETE: 07/						

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lighwo	00	nd F	live	r 0	ffst	rea	m S	Stor	ge							nsen Ltd.		EST HOLE NO:			
JMA N 561	٥'	230		20	17	5 T					Unilling Inspecto				otary	/Coring		PROJECT NO: 1	1-000-12		
SAMPI							ielby	/ Tut)e	GRAB	· · · · · · · · · · · · · · · · · · ·		0 RECC		ĺ	A-CASING			CORE		
BACK					200			INITE		PEA GRAVEL		_	LOUGH			GROUT	المرادليسا المراجع	ILL CUTTINGS	SAND		
DEPTH(m)		PLAS	. SPT 10	(Bl 2		5/30 30	XOmn t	n)▲ 49 LKQI 		REMARK	S.	SAMPLE TYPE	SPI(N)	nsc	SOIL SYMBOL		S0])ESCRI			INSTRUMENTATION DATA	nedth(m)
20.0					<u>u</u>			<u>+</u> U		Packer Test 19.8 No flow with 7psi						Cont'd CLAYSTONE, ≲ R0R4, grey	slightly to hig	ghly weathered	J,		- 2
- 21.0			•											CS		—siltstone ba weathered, f	R1-R4, grey	to completely	/		2
- 22.0														SA		SANDSTONE,		-			2
- 23.0			•							Run #11 22.25- 100% REC, 78%				CS		CLATSTONE, r RO, brown —grey, slighti —thin black l	y weathered	npletely weath m	टास्व,		2
- 23.0														SI CS		SILTSTONE, fr CLAYSTONE, s	resh, R1, gre slightly weath	y nered, RO, gre	у		
- 24.0														SA CS		SANDSTONE,		rey hered, RO, gre	V.		
- 25.0				· · · · · · · · · · · · · · · · · · ·										SA CS		SANDSTONE,	slightly weatl completely w AT 25m.	hered to frest eathered, RO,	n, R5	-	
- 26.0	••••															Bentonite sec	al at surface	-		, ,	
- 27.0																					
- 28.0						•••••••••••••••••••••••••••••••••••••••			·······												بيتليبين
- 29.0			•••••••••••••••••••••••••••••••••••••••	*****					·····												
30.0				•••••												ED BY: TS		COMPLETION	DEDITI- 0	50~	
			i	<u>l'</u> ł	lu	r				ngineering	Ltd.				REVI	EWED BY: JCS		COMPLETE:	07/05/01		
			(AUG1				. (<u>Cal</u>	gai	ry, Alberta					Fig.				1	age	3 of

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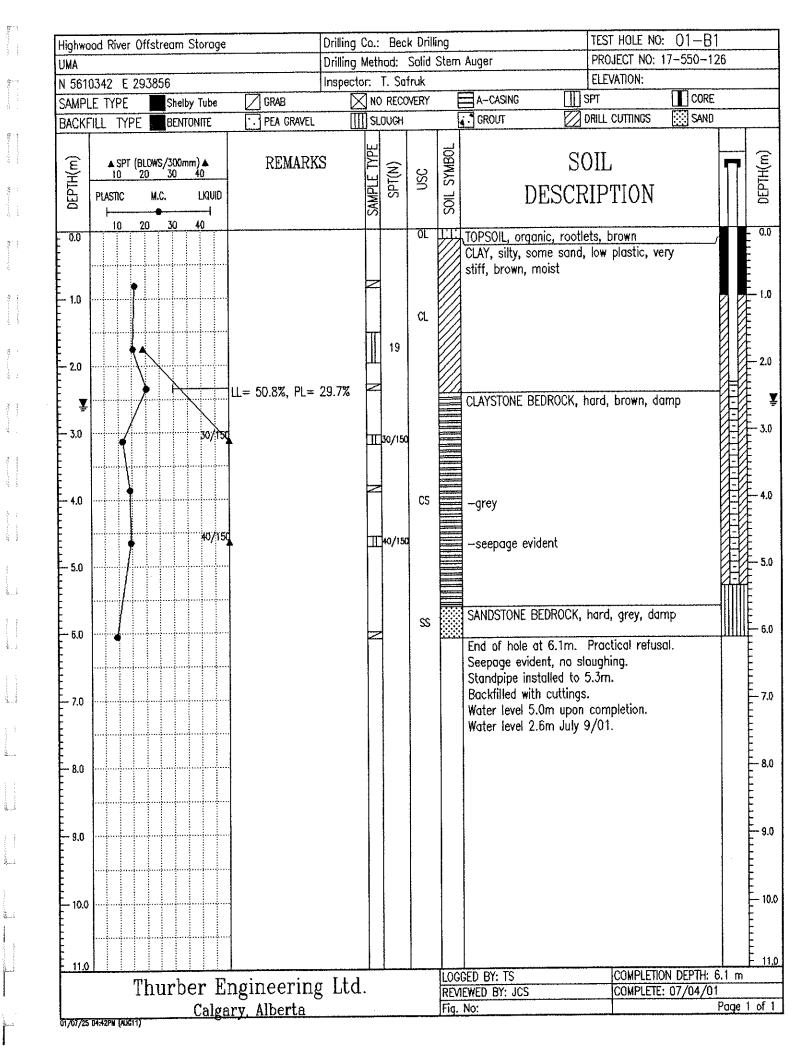
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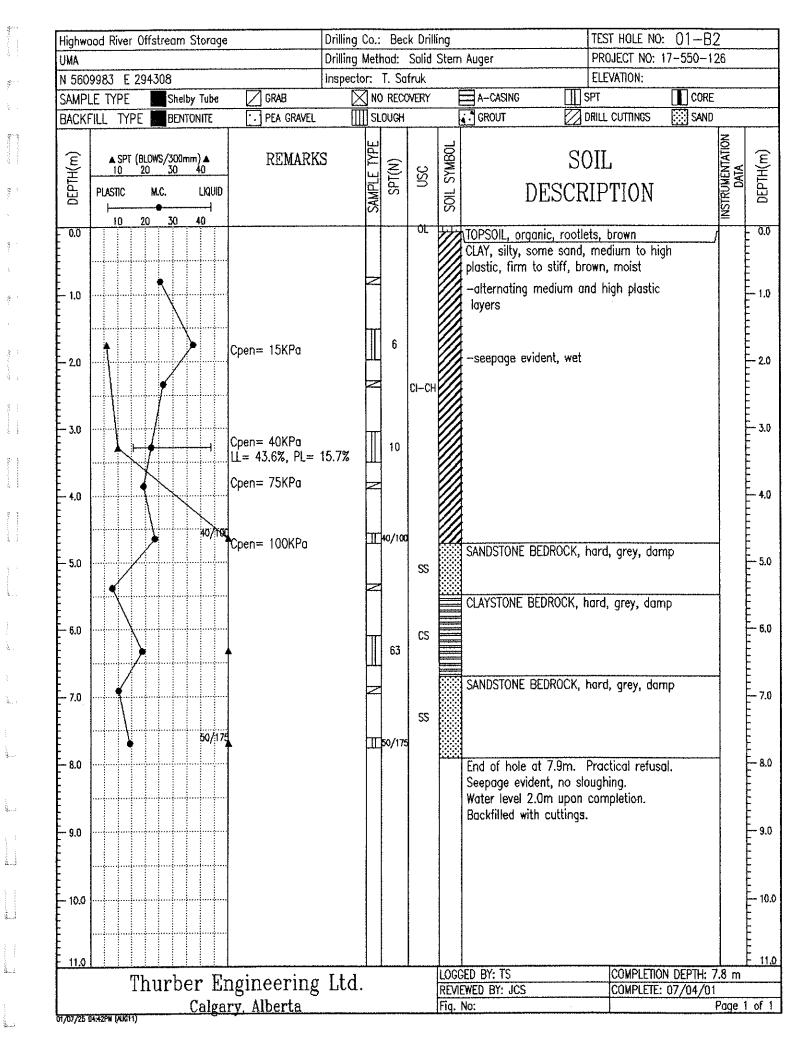
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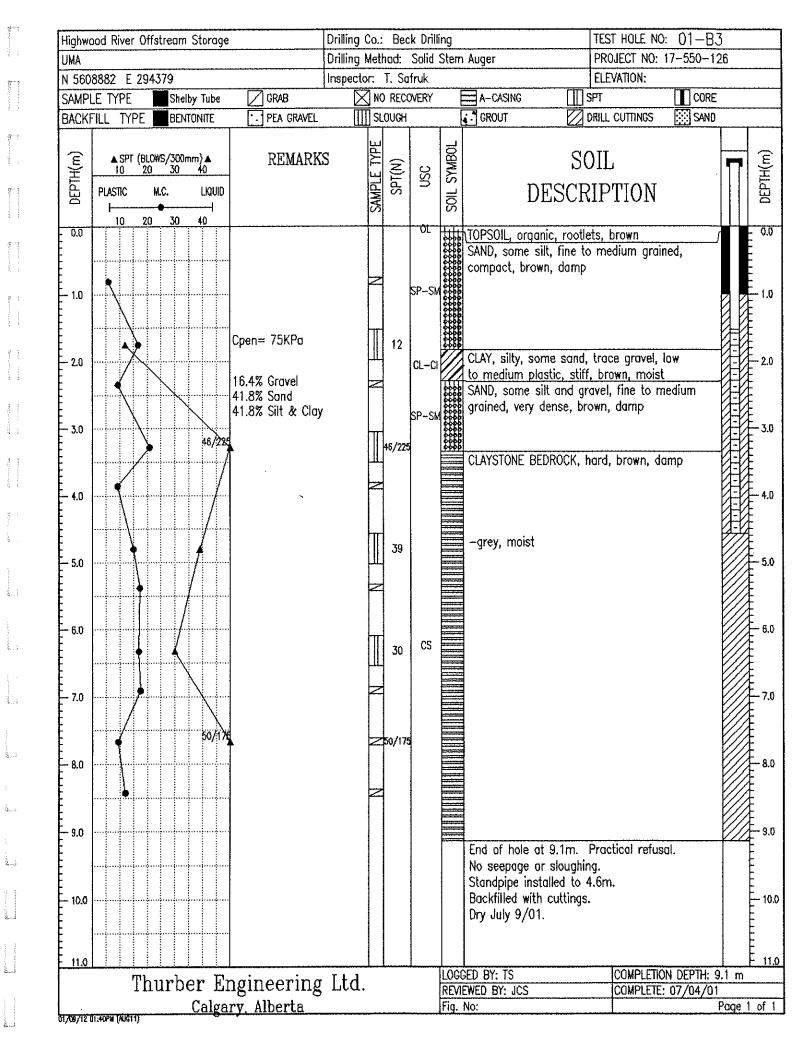
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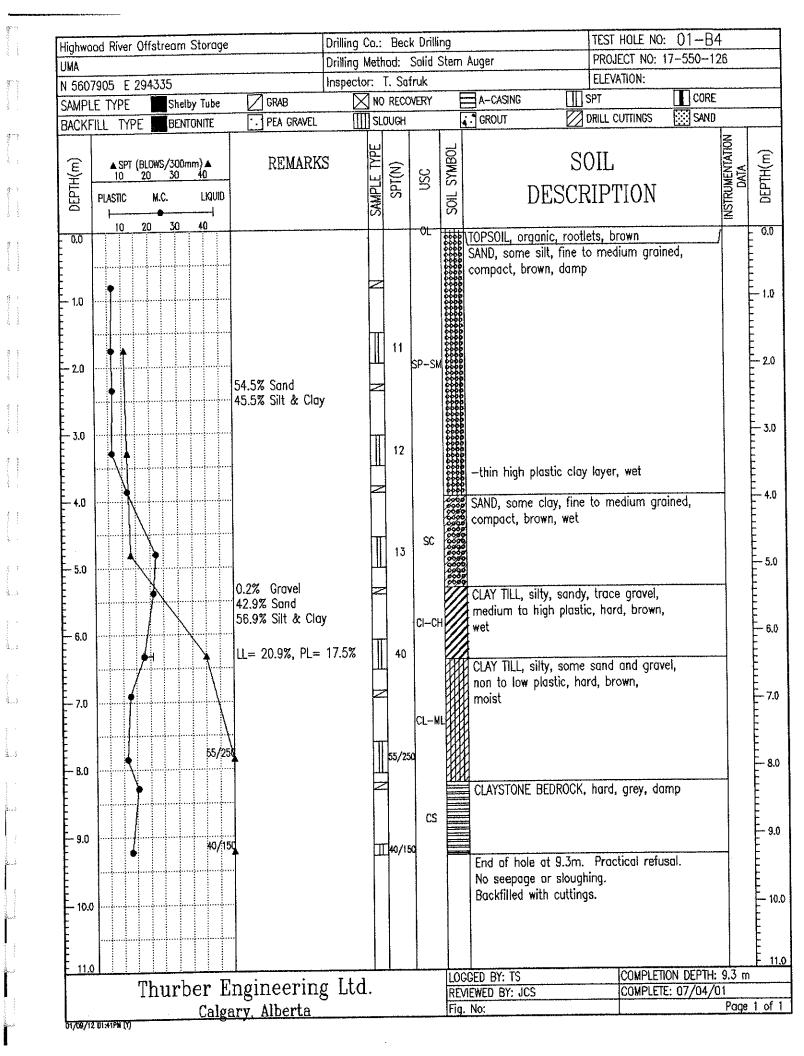
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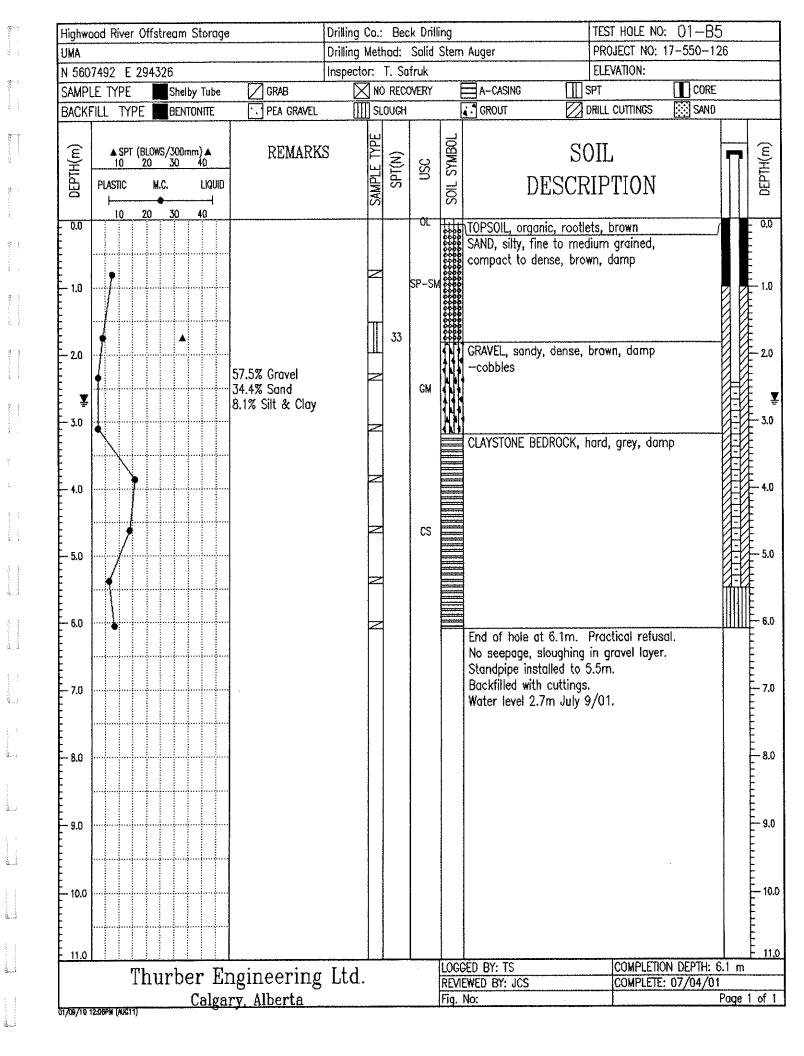
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Water Well Drilling Report GiC Well ID GoA Well Tag No Solution Solut

n Alberta	The driller supplies the data co accuracy. The information on t	ontained in this report. his report will be retair	The Provinc	ce disclaims re lic database.	esponsibility fo	or its	Drilling Company Well ID Date Report Received 1979/12/27			
Well Identification and L	ocation							Measurement in Metric		
Owner Name O'HANLON, HARRY	<i>Address</i> P.O. BOX 158 HIGH	RIVER	Town			Province	Coun	try Postal Code		
Location 1/4 or LSD SW	SECTWPRGE1001929	W of MER 4	Lot	Block	Plan		nal Description			
	of m from m from	GPS Coordina Latitude <u>50</u> How Location Map	0.590251		es (NAD 83, tude <u>-113.9</u>		Elevation How Elevation Estimated			
Drilling Information										
Method of Drilling Cable Tool		Type of Work New Well	k							
Proposed Well Use Domestic										
Formation Log	Μ	easurement in N	/letric	Yield Tes	st Summai	ry		Measurement in Metri		
Depth from Water ground level (m)	Lithology Description			Recomme Test D	anded Pump ate Wa		0.00 L/min Rate (L/min)	Static Water Level (m)		
3.96	Gray Till			1979/05	5/11	11.3	37	13.41		
11.28	Brown Till			Well Con				Measurement in Metri		
16.46	Gray Till					Finished Wel	I Depth Start D			
25.30	Gray Shale			45.72 m			1979/0	5/04 1979/05/11		
27.74 Yes	Light Gray Water Bearing San	dstone		Borehole						
29.87	Gray Shale			Dian	neter (cm)		From (m)	To (m)		
30.78	Light Gray Sandstone			Surface (0.00 Casing (if a	nnlicabla)	0.00	45.72 ing/Liner		
38.40	Gray Shale			Steel	asing (ii a	ррпсаые)	Steel	ing/Liner		
39.01	Dark Gray Sandstone			S	ize OD :	14.12 cr	<u>n</u> S	Size OD : 11.43 cm		
40.84	Gray Shale			Wall Thi		0.478 cr	_	ickness : 0.000 cm		
45.72	Light Gray Sandstone			Bo	ttom at :	14.63 m		Top at : 0.00 m		
				Perforatio	ons			ottom at : 45.72 m		
				From (m 24.38) To (m 44.50		cm) Length			
				Placed	Seal Drive	orch n 0.00 m	to <u>14.63</u>	<u>m</u>		
					Тур	e		At (m)		
				Screen T		0.00 cr	n			
					rom (m)		To (m)	Slot Size (cm)		
					chment Fittings		Bottom	Fittings		
				Pack	<u> </u>			<u> </u>		
				Type Amount			Grain S	Nize		
				Amoun						
Contractor Certification										

Name of Journeyman responsible for drilling/construction of well UNKNOWN NA DRILLER

Certification No 1

Copy of Well report provided to owner Date approval holder signed

Company Name

DEL'S DRILLING

Government Water Well Drilling Report View in Imperial Export to Excel GIC Well ID 128253

DT AID	erta 🗖			ontained in this report. T his report will be retain			esponsibility fo	or its	GoA Well Tag N Drilling Compan Date Report Re	y Well ID	1979/12/27
Well Iden	tification and L	_ocation								Mea	surement in Metric
Owner Nar O'HANLON		Address P.O. BOX	158 HIGH	RIVER	Town			Province	Coun	try	Postal Code
Location	1/4 or LSD SW	SEC TWP 10 019	RGE 29	W of MER 4	Lot	Block	Plan		nal Description		
Measured	from Boundary	of		GPS Coordinat Latitude 50.		0			Elevation	1000 00	
		m from				Longi	tude -113.9	40003	How Elevation		m
		m from		How Location (Map	Jolaineu				Estimated	Optained	
Additiona	I Information									Mea	surement in Metric
Distance I	From Top of Ca	sing to Ground Level		cm							
Is Artesia	an Flow				ls	Flow Con	trol Installed				
	Rate	L/min					Describe				
Recomme	ended Pump Ra			0.00 L/min	Pump	Installed			Depth	m	
Recomme	ended Pump Inta	ake Depth (From TOC)		0.00 m	Туре			Make	Depth	H.P.	
									Model (Outpu	it Rating)	
Did you	Encounter Salir	ne Water (>4000 ppm T	DS)	Depth		m	Well Disin	fected Upon	Completion		
			Gas			m	Geo		g Taken		
								Submitted to) ESRD		
						Sample Co	ollected for F	Potability	S	ubmitted to	ESRD <u>Yes</u>
Addition	nal Comments o	n Well									(Excel)
Yield Tes	t						Tał	ken From C	Ground Level	Mea	surement in Metric
Test Date		Start Time	Sta	tic Water Level				Dept	h to water level		
1979/05/1		12:00 AM	olu	13.41 m		Draw	down (m)		lapsed Time Minutes:Sec	Re	ecovery (m)
Method o	of Water Remov	ral									
	Туре	Bailer			_						
	Removal Rate	11.37 L/min									
Depth Wi	ithdrawn From	0.00 m									

If water removal period was < 2 hours, explain why

Water Diverted for Drilling		
5		
Water Source	Amount Taken	Diversion Date & Time
	1	
	L	

Contractor Certification	
Name of Journeyman responsible for drilling/construction of we UNKNOWN NA DRILLER	ell

Certification No 1

Copy of Well report provided to owner Date approval holder signed

Company Name

DEL'S DRILLING

Water Well Drilling Report

View in Imperial Export to Excel

166443

GIC Well ID GoA Well Tag No. Drilling Company Well ID

ΙΑΊΝΟΙΙ	a 🗖	The	e driller supplies th uracy. The inform	ne data conta ation on this	ained in this report. T report will be retaine	The Provin ed in a put	ce disclaims respor blic database.	nsibility for its		rilling Compa	ny Well ID	1992/06/18
Well Identificati	on and Lo	cation									M	easurement in Metr
Owner Name TUMBLE WEED S LTD	SPRINGS I	FARM	Address HIGH RIVEF	र		Town	1	Pi	rovince	Cou	ntry	Postal Code
	or LSD	SEC 04	<i>TWP</i> 019	RGE 29	W of MER 4	Lot	Block F	Plan	Additional	I Description		
Measured from B	oundary of						cimal Degrees (N		_			
		n from			Latitude <u>50.</u> How Location (-113.95739	_	Elevation How Elevation		
	n	n from			Not Verified	JDIallieu				Not Obtained		1
Drilling Informat	tion			•					<u> </u>			
Method of Drillin				1	Type of Work							
Rotary	-				New Well							
Proposed Well L												
Domestic & Stock	(Mod	asurement in Me	otrio	Yield Test Si	ummon/			N.A.	easurement in Met
Formation Log				IVIES	asurement in ivie	etric			-	18.18 L/min	IVI	easurement in wet
Depth from ground level (m)	Water Bearing	Litholo	gy Description				Recommende Test Date			ate (L/min)	Stati	c Water Level (m)
2.74		Sandy	Clay & Rocks				1992/06/03		22.73			0.30
7.32			, & Rocks				Well Comple				M	easurement in Met
10.67		Sandy	Rocks				Total Depth D		ed Well D	epth Start		End Date
12.80		Clay	& Rocks				56.39 m			1992/	06/02	1992/06/03
16.15		Sandy	Clay & Rocks				Borehole					
19.81		Clay	& Rocks				Diamete		F	From (m)		To (m) 56.39
29.26		Shale	2				0.0 Surface Casil		able)	0.00 Well Ca	sing/Line	
31.09		Sand	stone				Steel	ng (n appno	<i>ubic)</i>	Plastic	onig/ 2000	
32.00		Shale	2					DD: 1			Size OD :	
36.88		Sand	stone				Wall Thickne		.478 cm	Wall T	hickness :	
39.32		Shale	2				Bottom	at: 2	0.42 m	-	Top at : Sottom at :	
43.59		Sand	stone				Perforations			L	ouomat.	35.47 11
56.39		Shale	e & Sandstone L	_edges					Diameter (
							From (m) 28.96	To (m) 48.77	Slot Width(cm 0.318	Slo 1) Length		Hole or Slot Interval(cm) 25.40
							Perforated by Annular Seal					
							Placed from		0 m to	15.24	m	
							Amoun	t				
							Other Seals					
								Туре			At	t (m)
							Screen Type Size (DD :	0.00 cm			
								(m)		To (m)		Slot Size (cm)
							Attachm	ent				
							Top Fittir	ngs		Bottor	n Fittings	
							Pack					
										Grain	Size	
							Amount	0.00				
Contractor Cert												
Name of Journey UNKNOWN NA D		nsible fo	r drilling/constru	uction of w	vell		Cer 1	tification No				

Company Name NIEMANS DRILLING (1980) LTD.

Water Well Drilling Report

The driller supplies the data contained in this report. The Province disclaims responsibility for its

View in Imperial Export to Excel 166443

GoA Well Tag No. Drilling Company Well ID

GIC Well ID

accuracy. The information	n on this report will be retained in a public database.	Date Report Received 1992/06/18
Well Identification and Location		Measurement in Metric
Owner Name Address TUMBLE WEED SPRINGS FARM HIGH RIVER LTD	Town	Province Country Postal Code
Location1/4 or LSDSECTWPR(SE0401929		
Measured from Boundary of m from m from	GPS Coordinates in Decimal Degrees (NAD 83) Latitude 50.575766 Longitude -113.95 How Location Obtained Not Verified	
Additional Information		Measurement in Metric
Distance From Top of Casing to Ground Level Is Artesian Flow RateL/min	cm Is Flow Control Installed Describe	
Recommended Pump Rate Recommended Pump Intake Depth (From TOC)	18.18 L/min Pump Installed	Depth m Make H.P.
		Model (Output Rating)
Did you Encounter Saline Water (>4000 ppm TDS) Gas	Depth m Geop	ected Upon Completion physical Log Taken Submitted to ESRD
Additional Comments on Well	Sample Collected for P	otability Submitted to ESRD
Yield Test	Tak	en From Ground Level Measurement in Metric
Test Date Start Time	Static Water Level	Depth to water level
1992/06/03 12:00 AM	0.30 m Drawdown (m)	Elapsed Time Recovery (m) Minutes:Sec
Method of Water Removal Type Air Removal Rate 22.73 L/min Depth Withdrawn From 55.47 m If water removal period was < 2 hours, explain why		
Water Diverted for Drilling		
Water Source	Amount Taken L	Diversion Date & Time

Contractor Certification	

Name of Journeyman responsible for drilling/construction of well UNKNOWN NA DRILLER

Company Name NIEMANS DRILLING (1980) LTD. Certification No

1

Water Well Drilling Report

 View in Imperial
 Export to Excel

 GIC Well ID
 241765

 GoA Well Tag No.
 Deliver to Care

				tained in this report. The Provir s report will be retained in a pu		nsibility for it		Drilling Company Date Report Rec		1994/10/17
Well Identificati	on and Lo	cation					-			asurement in Metric
<i>Owner Name</i> MCGROGAN, ST	EVE	Address 612 6 S	T SE, HIGH R	Towi	ז		Province	Count		Postal Code
Location 1/4 SE	or LSD	SEC TWP 04 019	<i>RGE</i> 29	W of MER Lot 4	Block F	Plan	Additiona	al Description		
Measured from B	r	n from n from		GPS Coordinates in De Latitude 50.575766 How Location Obtained Not Verified	Longitude	NAD 83) ∂113.957		Elevation How Elevation Not Obtained	Obtained	<u>m</u>
Drilling Information	tion									
Drilling Informa Method of Drillin Rotary Proposed Well L	ıg			Type of Work New Well						
Domestic										
Formation Log			Ме	asurement in Metric	Yield Test S	Summary			Me	asurement in Metric
Depth from ground level (m)	Water Bearing	Lithology Descript	tion		Recommende Test Date			45.46 L/min ate (L/min)	Static	Water Level (m)
1.52		Sandy Clay			1994/10/10)	63.65			5.55
12.80		Clay & Rocks			Well Comple	etion			Me	asurement in Metric
20.73		Sandy Clay			Total Depth D	Drilled Fin	ished Well L			End Date
27.13		Thin Shale & Sar	ndstone Ledge	S	37.49 m			1994/09)/28	1994/09/29
32.61		Shale			Borehole					
33.22		Sandstone			Diamete 0.0		_	From (m) 0.00	_	To (m) 37.49
37.49		Shale & Sandsto	one Ledges		Surface Casi		licable)	Well Cas	ina/Liner	57.15
					From Attachm	To (m) 32.00 Saw Driven m 18 nt Type OD : (m) hent	0.478 cm 20.73 m Diameter Slot Width(cr 0.318 3.29 m to 0.00 cm	or Slot m) Length(c 20.73 m 20.73 m To (m) Bottom	mAt	0.544 cm 18.90 m 37.49 m Hole or Slot Interval(cm) 15.24 (m) Slot Size (cm)
Contractor Cert		nsible for drilling/co	nstruction of	vell	Ce	rtification N	Vo			
UNKNOWN NA D					1					

Company Name

Water Well Drilling Report

View in ImperialExport to ExcelGIC Well ID241765GoA Well Tag No.241765

Alberta 🗖		the data contained in this repo mation on this report will be re			or its	GIC Well ID GoA Well Tag No. Drilling Company Date Report Rece	Well ID
Nell Identification and L	ocation						Measurement in M
Owner Name	Address		Town		Province	Country	
ICGROGAN, STEVE		E, HIGH RIVER					
ocation 1/4 or LSD SE	SEC TWP 04 019	RGE W of MER 29 4	Lot	Block Plan	Additio	nal Description	
leasured from Boundary o	f			al Degrees (NAD 83)			
	m from			Longitude -113.9	57392	Elevation	
	m from		ion Obtained			How Elevation O	btained
		Not Verified	1		I	Not Obtained	
dditional Information							Measurement in M
Distance From Top of Cas		cm					
Is Artesian Flow			Is Fl	low Control Installed			
Rate	L/min			Describe			
Recommended Pump Rate		45.46 L/m	nin Pump Ins	stalled		Depth	m
Recommended Pump Intal	ke Depth (From TOC)	33.53 m	Туре		Make		H.P.
						Model (Output	Rating)
Did you Encounter Saline	e Water (>4000 ppm T	DS) Dep	th	m Well Disin	fected Upor	Completion	
	(Gas Dep	th r	m Geo	physical Lo	g Taken	
					Submitted to		
			Sa	mple Collected for F	Potability	Sut	omitted to ESRD
Additional Comments or	n Well		04				
RILLER REPORT AIR TE	ESTED 50 GPM.						
eld Test				Tal	en From (Ground Level	Measurement in N
	Start Time	Statia Matar Laval		Tu Tu		th to water level	
Fest Date 994/10/10	Start Time 12:00 AM	Static Water Level 5.55 m		Drawdown (m)		Elapsed Time Minutes:Sec	Recovery (m)
Method of Water Remova				3.18		1:00	5.13
Type P				3.26 3.31		2:00 3:00	5.08
	63.65 L/min			3.37		4:00	5.00
				3.40		5:00	4.96
Depth Withdrawn From	35.05 11			3.43		6:00	4.90
f water removal period wa	s < 2 hours explain wh	1V		3.50		7:00 8:00	4.84
		.,		3.52		9:00	4.72
				3.56		10:00	4.68
				3.61		12:00	4.60
				3.63		14:00	4.55
				3.67		16:00	4.50
				3.79 3.96		20:00 25:00	4.40
				4.03		30:00	4.34
				4.13		35:00	4.31
				4.26		40:00	4.28
				4.41		50:00	4.20
				4.55		60:00	4.12
				4.76		75:00	4.04
				4.96		90:00	3.92
				5.12		105:00	3.81
				5.27		120:00 150:00	3.72 3.56
				5.55		180:00	3.50
				5.95		210:00	3.28
				6.09		240:00	3.17
ater Diverted for Drillir	ıg						
Vater Source		Amount Taken	L		Diversio	on Date & Time	
ontractor Certification							
ame of Journeyman respo	onsible for drilling/consi	ruction of well		Certification	n No		
NKNOWN NA DRILLER				1			
Company Name				Copy of We	ell report pro	ovided to owner [Date approval holder sign
IEMANS DRILLING (1980) LTD.						

Government

Nell Identifica	tion and L				s report will be retained in a p			L	ate Report Re		1995/01/05
	ation and L				τ			Dura da era	0		leasurement in Met
D <i>wner Name</i> THIESSEN, LA	RRY		lress . BOX 5	325 HIGH	RIVER	'n		Province	Cou	ntry	Postal Code T1V 1M5
	/4 or LSD W		<i>WP</i> 19	RGE 29	W of MER Lot 4	Block	Plan	Additiona	l Description		
easured from	Boundary o	f			GPS Coordinates in D	•	•	-005	Elever (iere		
_		m from	_		Latitude 50.597483		le <u>-113.945</u>		Elevation		
_		m from			How Location Obtained Not Verified	u			How Elevation Not Obtained	TOplaine	a
				•	Not Venned			I			
rilling Inform	nation										
ethod of Dril otary	ling				Type of Work New Well						
roposed Wel omestic	l Use										
ormation Lo	g			Me	asurement in Metric	Yield Test	Summary			Μ	leasurement in Met
epth from	Water	Lithology Des	scription			Recommend	led Pump F	Rate	18.18 L/min		
ound level (n			puol			Test Date		r Removal R	ate (L/min)	Stat	ic Water Level (m)
0.30		Topsoil				1994/10/1	9	25.00			4.82
2.74		Brown Silty C	Clay & Sa	and		1994/10/1	9	18.18			4.82
6.71		Gravel				Well Comp	letion			Μ	leasurement in Me
7.32		Clay & Rock	s			,	Drilled Fin	nished Well E	Depth Start I		End Date
13.11		Gray Shale				48.77 m			1994/	10/18	1994/10/19
14.02		Gray Sandst	one			Borehole					
14.63		Gray Shale					ter (cm)	_	From (m) 0.00		To (m) 48.77
15.85	Yes	Gray Water E	Bearing S	Sandstone		Surface Cas		olicable)		sing/Line	
18.59		Gray Shale				Plastic			Plastic	-	
19.20		Gray Sandst	one					15.24 cm		Size OD :	
22.25		Gray Shale				Wall Thick		0.940 cm	Wall Ti	hickness :	
24.08	Yes	Gray Water E	Bearing S	Sandstone		Botto	m at :	7.92 m		Top at :	
26.52		Gray Shale				Perforation	s		E	ottom at :	48.77 m
27.13		Gray Sandst	one					Diameter	or		
35.05		Gray Shale				F (m)	T. ()	Slot	Slo		Hole or Slot
40.84	Yes	Gray Water E	Bearing S	Sandstone		From (m) 13.41	To (m) 16.76	Width(cn 0.318	n) Length	(Cfff)	Interval(cm) 17.78
48.77		Gray Shale				21.34	27.43	0.000			0.00
						35.05 Perforated b	42.67 y Saw	0.000			0.00
						Annular Sea					
									7.92	m	
						Amou Other Seals	int				
						ourier Seals	Туре			Δ	ıt (m)
							1,100				()
						Screen Typ	e				
								0.00 cm			
							n (m)		To (m)		Slot Size (cm)
							ment				
						Top Fit	tings		Botton	n Hittings	
						Pack					
						Туре			Grain	Size	
						Amount					
ontractor Ce	ertification										
		nsible for drillin	ig/const	ruction of	vell		ertification l	No			
NKNOWN NA	URIFER					1					

PETER NIEMANS WATER WELL DRILLING

Water Well Drilling Report

The driller supplies the data contained in this report. The Province disclaims responsibility for its

View in Imperial Export to Excel

244960

GIC Well ID

GoA Well Tag No.

					tained in this report. s report will be retain			esponsibility fo	r its	Drilling Compan Date Report Re		1995/01/05
Well Ident	tification and L	_ocation									Me	easurement in Met
Owner Nar THIESSEN			ddress O. BOX 5	325 HIGH	RIVER	Town			Province	Coun	try	Postal Code T1V 1M5
Location	1/4 or LSD NW		<i>TWP</i> 019	RGE 29	W of MER 4	Lot	Block	Plan	Additio	nal Description		
Measured		of m from m from			GPS Coordina Latitude 50. How Location Not Verified	597483		es (NAD 83) tude <u>-113.9</u> 4		Elevation How Elevation Not Obtained		
	From Top of Cas In Flow Rate				cm	ls I	Flow Con	trol Installed Describe				
Recomme	ended Pump Rat	te			18.18 L/min	Pump I	nstalled				m	
Recomme	nded Pump Inta	ake Depth (Fro	m TOC)		42.67 m		-			,	H.P.	
Did you	Encounter Salin	ne Water (>400	0 ppm TL	DS)	Depth		m	Well Disini	fected Upon	Completion		
				Gas			m			g Taken		
									Submitted to			
						S	ample Co	ollected for P	otability	S	Submitted	to ESRD
Additior	nal Comments o	n Well					-					
DRILLER	REPORTS DIS	TANCE FROM	TOP OF	CASING -	TO GROUND LEV	'EL: 15".						

Contractor Certification

Government

of Alberta

Name of Journeyman responsible for drilling/construction of well UNKNOWN NA DRILLER

Company Name PETER NIEMANS WATER WELL DRILLING Certification No

1

Well Identification and Location

Water Well Drilling Report

View in Imperial Export to Excel

244960

The driller supplies the data contained in this report. The Province disclaims responsibility for its accuracy. The information on this report will be retained in a public database.

GoA Well Tag No.

GIC Well ID

	Drilling Company Well Date Report Received	
		Measurement in Metric
vince	Country	Postal Code T1V 1M5

NW 10 019 29 4 Itessured from Boundary of m from GPS Coordinates in Decimal Degrees (NAD 83) Latitude 50.597483 Elevation m m from How Location Obtained Not Verified Latitude 50.597483 Longitude -113.945665 Elevation m Memory Depth for Mater Removal 1994/10/19 Not Verified Not Verified Not Obtained Not Obtained Method of Water Removal Type Air Removal Rate Static Water Level 25.00 L/min Depth Withdrawn From Static Water Level 4.82 m Drawdown (m) Elapsed Time Recovery (m) Recovery (m) If water removal period was < 2 hours, explain why If water removal Level Measurement in Depth to water level Measurement in Depth to water level	THIESSEN			P.O. BOX								T1V 1M5
Interest between on the control balanced in the contend control balanced in the control balanced in the contr	Location						Lot	Block	Plan	Addit	ional Description	
Intern How Location Obtained Not Verified How Elevation Obtained Not Obtained Test Date Start Time Static Water Level Measurement in Depth to water Kevel 1994/10/19 12:00 AM 4.82 m Drawdown (m) Elapsed Time Recovery (m) Wethod of Water Removal Type Air Removal Rate 25:00 Limin 0.00 m Drawdown (m) Elapsed Time Recovery (m) Measurement in Depth Withdrawn From 10:00 m It water removal period was <2 hours, explain why	Measured f	from Boundary	of									
m trom How Location Obtained Not Verified How Elevation Obtained Not Obtained ield Test Take From Ground Level Depth to water kevel Measurement in Depth to water kevel 1984/10/19 12:00 AM 4.82 m Drawdown (m) Elapsed Time Minutes:Sec Recovery (m) Wethod of Water Removal Type Ar Removal Rate 25:00 Umin 0.00 m Drawdown (m) Elapsed Time Nethod of Water Removal Recovery (m) 11 Take From Ground Level Used Water Removal Measurement in Depth Withdrawn From 0.00 m Measurement in Depth withdrawn From 0.00 m Measurement in Depth or water kevel 12:00 AM Static Water Level 4.82 m Measurement in Depth or water kevel Measurement in Depth or water kevel 13:00 Interst Tace Date Static Water Level 4.82 m Measurement in Depth or water kevel Measurement in Depth withdrawn from 33:53 m 14:water removal Rate 18:18 Limin 8.33 5:00 10:00 10:62 6:10 10:00 7:72 8:99 9:900 7:72 8:53 6:00 8:31 8:53 6:00 8:31 8:53 6:00 7:72 8:86 8:00 7:72 8:86 8:00 7:72 8:99 9:900 7:37 9:12 10:00 7:37 9:12 10:00 7:37 9:12 10:00 7:37 9:12 10:00 7:37 9:12 10:00 6:50 9:965 10:200 6:50 9:965 10:200			m from					Longiti	ude -113.94	45665		
Indext Control Level Not Obtained Test Date Start Time Static Water Level Depth to water level Measurement in Depth to water level Method of Water Removal Type Air Drawdown (m) Elapsed Time Recovery (m) Method of Water Removal 25.00 L/min Down Down Minutes:Sec Measurement in Depth vitindrawn From 0.00 m If water removal period was < 2 hours, explain why						How Locat	ion Obtained				How Elevation Ol	otained
Test Date 1994/10/19 Start Time 12:00 AM Static Water Level 4.82 m Depth to water level Wethod of Water Removal Type Air Depth Withdrawn From Depth Wit						Not Verified	d				Not Obtained	
Control of the state function of the state water level displaying in the state water removal period was < 2 hours, explain why Drawdown (m) Elapsed Time in the state in the state water level in the state water removal period was < 2 hours, explain why Water removal period was < 2 hours, explain why	vield Test								Tak			Measurement in M
1934/10/19 12:00 AM 4.82 m Drawdown (m) Elapsed Time Minutes:Sec Recovery (m) Wethod of Water Removal Type Air Removal Rate 25:00 L/min 0.00 m 0.00 m 0.00 m If water removal period was < 2 hours, explain why	Test Date		Start Tim	DA.	Stat	ic Water Level				Dej		
$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$					· · · · ·			Drawd	down (m)			Recovery (m)
Removal Rate 25.00 Lmin Depth Withdrawn From 0.00 m 0.00 m If water removal period was < 2 hours, explain why	Method of											
Depth Withdrawn From 0.00 m If water removal period was < 2 hours, explain why												
If water removal period was < 2 hours, explain why Taken From Ground Level Depth to water level Measurement in Depth to water level Test Date Start Time Static Water Level Drawdown (m) Elapsed Time Recovery (m) 1994/10/19 12:00 AM 4.82 m Drawdown (m) Elapsed Time Recovery (m) Method of Water Removal Type Pump 7.21 2:00 9.53 Removal Rate 18.18 L/min 7.72 3:00 9.09 Both Withdrawn From 33.53 m 8.53 6:00 7.722 1f water removal period was < 2 hours, explain why	F	Removal Rate		2 <u>5.00 L/mi</u> n								
If water removal period was < 2 hours, explain why Taken From Ground Level Depth to water level Measurement in Depth to water level Test Date Start Time Static Water Level Drawdown (m) Elapsed Time Recovery (m) 1994/10/19 12:00 AM 4.82 m Drawdown (m) Elapsed Time Recovery (m) Method of Water Removal Type Pump 7.21 2:00 9.53 Removal Rate 18.18 L/min 7.72 3:00 9.09 Both Withdrawn From 33.53 m 8.53 6:00 7.722 1f water removal period was < 2 hours, explain why	Depth Wit	thdrawn From		0.00 m_								
Taken From Ground Level Measurement in Test Date Start Time Static Water Level Depth to water level Depth to water level 1994/10/19 12:00 AM 4.82 m Drawdown (m) Elapsed Time Recovery (m) Method of Water Removal Type Pump 6.10 1:00 10.01 Type Pump 7.21 2:00 9.53 Removal Rate 18.18 L/min 8.04 4:00 8.71 Depth Withdrawn From 33.53 m 8.53 6:00 7.72 8.04 4:00 8.71 7:00 7.72 8.53 6:00 7.37 9.12 10:00 7.24 9.12 10:00 7.24 9.27 12:00 7.05 9.40 14:00 6.88 9.95 16:00 6.51 9.65 20:00 6.50 9.83 25:00 6.51 9.65 20:00 5.58 10.27 60:00 5.33 9.65 20:00 5.56 10.20 50:00												
Taken From Ground Level Measurement in Test Date Start Time Static Water Level Depth to water level Depth to water level 1994/10/19 12:00 AM 4.82 m Drawdown (m) Elapsed Time Recovery (m) Method of Water Removal Type Pump 6.10 1:00 10.01 Type Pump 7.21 2:00 9.53 Removal Rate 18.18 L/min 8.04 4:00 8.71 Depth Withdrawn From 33.53 m 8.53 6:00 7.72 8.04 4:00 8.71 7:00 7.72 8.53 6:00 7.37 9.12 10:00 7.24 9.12 10:00 7.24 9.27 12:00 7.05 9.40 14:00 6.88 9.95 16:00 6.51 9.65 20:00 6.50 9.83 25:00 6.51 9.65 20:00 5.58 10.27 60:00 5.33 9.65 20:00 5.56 10.20 50:00	lf water rei	moval period w	/as < 2 hour	s, explain w	hy							
Start Time 1994/10/19 Static Water Level 4.82 m Depth to water level Recovery (m) Method of Water Removal Type Pump Removal Rate 18.18 L/min 33.53 m Frawdown (m) Elapsed Time Minutes:Sec Recovery (m) 7.72 3:00 9.09 8.64 4:00 8.71 7.72 3:00 9.09 8.53 6:00 7.98 8.53 6:00 7.98 8.66 8:00 7.52 8.86 8:00 7.52 9.12 10:00 7.24 9.27 12:00 7.05 9.40 14:00 6.88 9.950 16:00 6.73 9.43 25:00 6.50 9.43 30:00 6.51 10.03 35:00 6.51 10.03 35:00 5.33 10.20 50:00 5.68 10.21 10:00 5.33 10.03 35:00 6.51 10.03 35:00 6.51 <t< td=""><td></td><td>-</td><td></td><td>· ·</td><td>-</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></t<>		-		· ·	-							
Start Time 1994/10/19 Static Water Level 4.82 m Depth to water level Recovery (m) Method of Water Removal Type Pump Removal Rate 18.18 L/min 33.53 m Frawdown (m) Elapsed Time Minutes:Sec Recovery (m) 7.72 3:00 9.09 8.64 4:00 8.71 7.72 3:00 9.09 8.53 6:00 7.98 8.53 6:00 7.98 8.66 8:00 7.52 8.86 8:00 7.52 9.12 10:00 7.24 9.27 12:00 7.05 9.40 14:00 6.88 9.950 16:00 6.73 9.43 25:00 6.50 9.43 30:00 6.51 10.03 35:00 6.51 10.03 35:00 5.33 10.20 50:00 5.68 10.21 10:00 5.33 10.03 35:00 6.51 10.03 35:00 6.51 <t< td=""><td>ad Test</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>Tak</td><td>on From</td><td>Cround Level</td><td>Moosurement in M</td></t<>	ad Test								Tak	on From	Cround Level	Moosurement in M
Date Static Water Level 1994/10/19 12:00 AM 4.82 m Method of Water Removal Type Pump Removal Rate 18.18 L/min Removal Rate 18.18 L/min Depth Withdrawn From 33.53 m 33.53 m 8.33 5:00 8.71 8.77.2 3:00 9.09 8.04 4:00 8.71 Bernoval Rate 18.18 L/min 8.33 5:00 8.31 8.53 6:00 7.72 8.00 7.72 8.71 7:00 7.72 8.61 6:00 7.72 8.86 8:00 7.72 8.71 7:00 7.72 9.12 10:00 7.24 9.27 12:00 7.05 9.40 14:00 6.88 9.50 6:00 6.73 9.96 30:00 6.15 10.03 35:00 6.15 10.03 35:00 6.15 10.03 35:00 6.15 10.03 35:00 6.51 10.03 35:00 6.51									lan			Measurement in w
Notified Learning Minutes:Sec Learning Method of Water Removal 18.18 L/min 6.10 1:00 10.62 Removal Rate 18.18 L/min 7.21 2:00 9.53 Depth Withdrawn From 33.53 m 7.72 3:00 9.09 If water removal period was < 2 hours, explain why	Test Date				Stat			Drawc	lown (m)	,		Pecoverv (m)
Method of Water Removal 4.82 $0:00$ 10.62 Type Pump 7.21 $2:00$ 9.53 Removal Rate 18.18 L/min 7.72 $3:00$ 9.09 Both Withdrawn From 33.53 m 7.72 $3:00$ 8.71 If water removal period was < 2 hours, explain why	1994/10/18	9	12:00 AIV	i		4.82 m		Diana				
Type Pump 7.21 $2:00$ 9.53 Removal Rate 18.18 L/min 7.72 $3:00$ 9.09 Depth Withdrawn From 33.53 m 8.33 $5:00$ 8.31 If water removal period was < 2 hours, explain why											0:00	
Removal Rate 18.18 L/min Depth Withdrawn From 33.53 m If water removal period was < 2 hours, explain why	Methoa oi											
Retmoval Rate 18.18 Dmin Depth Withdrawn From 33.53 m If water removal period was < 2 hours, explain why		Туре	Pump									
Bepth Withdrawn From 33.53 m If water removal period was < 2 hours, explain why	F	Removal Rate	,	18 18 L/min								
Bits Bits <th< td=""><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></th<>												
8.71 7:00 7.72 8.86 8:00 7.52 8.99 9:00 7.37 9.12 10:00 7.24 9.27 12:00 7.05 9.40 14:00 6.88 9.50 16:00 6.73 9.65 20:00 6.50 9.83 25:00 6.31 9.96 30:00 6.15 10.02 50:00 5.68 10.27 60:00 5.49 10.27 60:00 5.49 10.27 60:00 5.49 10.36 75:00 5.33 10.44 90:00 5.21 10.50 105:00 5.11 10.56 120:00 5.03	Deptri vvn	hdrawn From		33.53 111								
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$,	21									
$\begin{array}{ c c c c c c c c c c c c c c c c c c c$	If water rei	moval period w	/as < 2 hour	s, explain w	hy							
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$\begin{array}{c ccccccccccccccccccccccccccccccccccc$												
$\begin{array}{ c c c c c }\hline 9.40 & 14:00 & 6.88 \\ \hline 9.50 & 16:00 & 6.73 \\ \hline 9.65 & 20:00 & 6.50 \\ \hline 9.83 & 25:00 & 6.31 \\ \hline 9.96 & 30:00 & 6.15 \\ \hline 10.03 & 35:00 & 6.01 \\ \hline 10.10 & 40:00 & 5.87 \\ \hline 10.20 & 50:00 & 5.68 \\ \hline 10.27 & 60:00 & 5.49 \\ \hline 10.36 & 75:00 & 5.33 \\ \hline 10.44 & 90:00 & 5.21 \\ \hline 10.50 & 105:00 & 5.11 \\ \hline 10.56 & 120:00 & 5.03 \\ \hline \end{array}$												
9.50 16:00 6.73 9.65 20:00 6.50 9.83 25:00 6.31 9.96 30:00 6.15 10.03 35:00 6.01 10.10 40:00 5.87 10.20 50:00 5.68 10.27 60:00 5.49 10.36 75:00 5.33 10.44 90:00 5.21 10.50 105:00 5.11 10.56 120:00 5.03												
9.6520:006.509.8325:006.319.9630:006.1510.0335:006.0110.1040:005.8710.2050:005.6810.2760:005.4910.3675:005.3310.4490:005.2110.50105:005.1110.56120:005.03												
$\begin{array}{ c c c c c c c c c c c c c c c c c c c$												
9.9630:006.1510.0335:006.0110.1040:005.8710.2050:005.6810.2760:005.4910.3675:005.3310.4490:005.2110.50105:005.1110.56120:005.03												
$\begin{array}{ c c c c c c c c c c c c c c c c c c c$												
10.10 40:00 5.87 10.20 50:00 5.68 10.27 60:00 5.49 10.36 75:00 5.33 10.44 90:00 5.21 10.50 105:00 5.11 10.56 120:00 5.03							r					
10.2050:005.6810.2760:005.4910.3675:005.3310.4490:005.2110.50105:005.1110.56120:005.03												
10.2760:005.4910.3675:005.3310.4490:005.2110.50105:005.1110.56120:005.03												
10.3675:005.3310.4490:005.2110.50105:005.1110.56120:005.03							-			_		
10.4490:005.2110.50105:005.1110.56120:005.03							-					
10.50 105:00 5.11 10.56 120:00 5.03							r					
10.56 120:00 5.03							r					
							-					
Vater Diverted for Drilling							L	1	0.50		120.00	5.05
vater Diverted for Drilling		arted for Drill	lina									
	valer Div	ented for Drin	ing									

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Contractor Certification Name of Journeyman responsible for drilling/construction of well UNKNOWN NA DRILLER Company Name

PETER NIEMANS WATER WELL DRILLING

Certification No 1

Government Water Well Drilling Report View in Imperial Export to Excel

f Albert	a	The drille accuracy	r supplies t . The inforn	he data con nation on th	ntained in this report. T his report will be retained	he Provi ed in a pu	nce disclaims resp blic database.	onsibility for i	ts Dr	A Well Tag No Illing Company Ite Report Rec	Well ID	1995/11/10
Well Identificati	on and Lo								Da	пе кероп кес		asurement in Me
<i>Owner Name</i> ANL RANCH		Ad	ddress 6 38 AVE	SW, CAI	LGARY	Tow	n		Province	Countr CANAI	У	Postal Code T2T 2H7
Location 1/4 NW	or LSD		<i>TWP</i> 19	RGE 29	W of MER 4	Lot	Block	Plan	Additional	Description		
Measured from B	n	n from n from				597483		(NAD 83) le <u>-113.94</u> 5	H	levation low Elevation (ot Obtained		<u>m</u>
Drilling Informa Method of Drillir Rotary Proposed Well L Domestic	ng				<i>Type of Work</i> New Well							
Formation Log				Me	easurement in Me	etric	Yield Test	Summary			Mea	asurement in Me
Depth from ground level (m)	Water Bearing	Lithology D	escription				Recommend Test Date		Rate r Removal Rat	10.91 L/min te (L/min)	Static	Water Level (m)
1.83		Sandy Clay	/				1995/09/2	1	72.74			2.41
5.18		Clay & Bo	ulders				1995/09/2	1	40.91			2.41
5.79		Clay & Sa	nd				Well Comp	letion			Mea	asurement in Me
7.01		Fine Grain	ed Gravel					Drilled Fir	ished Well De	epth Start Da		End Date
8.84		Clay & Ro	cks				40.23 m			1995/09	/20	1995/09/21
9.45		Clay					Borehole					
19.81		Gray Shale	•					ter (cm) .00	F	rom (m) 0.00	_	To (m) 40.23
20.12		Gray Sand	stone				Surface Cas		licable)	Well Casi	na/Liner	40.23
32.92		Gray Shale	•				Plastic	•••••		Plastic	.	
34.14		Gray Sand	stone						15.24 cm		ze OD :	
35.97		Gray Shale	1				Wall Thicki			Wall Thio	_	
38.10		Gray Sand	stone				Botto	m at :	9.75 m		Top at :	
40.23		Gray Shale	:				Perforation	•		BOT	tom at :	40.23 m
							From (m) 6.71 32.31	To (m) 7.92 38.10	Diameter o Slot Width(cm) 0.318 0.000	Slot		Hole or Slot Interval(cm) 17.78 0.00
							Placed fro	al Bentoni	te Chips/Table 3.05 m_to		nAt ((m)

Contractor Certification Name of Journeyman responsible for drilling/construction of well UNKNOWN NA DRILLER

Company Name PETER NIEMANS WATER WELL DRILLING Certification No 1

0.0<u>0 cm</u>

To (m)

Bottom Fittings

Grain Size

Screen Type

Pack Туре

Amount

Size OD :

From (m)

Attachment Top Fittings

Copy of Well report provided to owner Date approval holder signed

Slot Size (cm)

Water Well Drilling Report View in Imperial GIC Well ID 264545

Alberta	1116	driller supplies uracy. The info	the data co rmation on t	ntained in this report his report will be reta	t. The Provinc iined in a publ	e disclaims relic database.	esponsibility fo	r its	GoA Well Tag No. Drilling Company Date Report Rece	Well ID)
Vell Identification an	d Location									Measurement	in M
Owner Name		Address 716 38 AV			Town			Province	Country CANAD		
ocation 1/4 or LSI		TWP	RGE	W of MER	Lot	Block	Plan	Additic	nal Description	1212	
NW	10	19	29	4 GPS Coordin	atao in Dao	imal Dagra	aa (NAD 92)				
Aeasured from Bounda				Latitude 5			· · · · · · · · · · · · · · · · · · ·		Flevation	m	
	m from						110.0		How Elevation O		
	m from			How Location	n Obtained					btained	
				Not Verified					Not Obtained		
dditional Informatio	n									Measurement	in M
Distance From Top of	Casing to Gro	ound Level		85.00 cm							
Is Artesian Flow	-	-			1	s Flow Con	trol Installed				
Rate		L/min									
Recommended Pump				40.91 L/mir	Pum						
Recommended Pump		(From TOC)			Type			Make	Depth	H.P.	
(coommended i ump	intario Doptin	(110111100)		10.25 11	. Type			mane	Model (Output	Rating)	
			50.01								
Did you Encounter S	aiine Water (Completion		
			Gas	Depth		m	Geo	physical Lo	g Taken		
								Submitted t	o ESRD		
Test Date	Start Tin	ne	Stai	tic Water Level				Dep	op of Casing th to water level	Measurement	
1995/09/21	1:00 PM			2.41 m		Draw	/down (m)		Elapsed Time Minutes:Sec	Recovery (m))
Method of Water Ren	noval										
Тур	e Air										
Removal Rat		72 74 1/min	1								
Depth Withdrawn Froi											
Deput Williamit for		0.00 111									
lf water removal period	l was < 2 hou	ırs, explain w	νhy								
BLEW WITH AIR FOR REPORTED.	2.5 HRS. NO	RECOVER	Y MEASU	REMENTS							
ield Test							Tak	en From T	op of Casing	Measurement	in N
Toot Data	Stort Tir	20	Sto	tic Water Level				Dep	th to water level		
Test Date 1995/09/21	Start Tin 4:00 PM		Sla	2.41 m		Draw	/down (m)		Elapsed Time	Recovery (m))
				£.71 III					Minutes:Sec	,	
							2.43		0:00	2.61	
Method of Water Ren	noval						2.50		1:00	2.50	
	e Pump						5.52		2:00	2.46	
Removal Rat	e	40.91 L/min					5.53		3:00	2.45	
Depth Withdrawn Froi							5.54		4:00		
Deput williawit Froi		23.01 111							5:00	2.44	
function none ! !			day i				2.55		6:00	2.42	
f water removal period	i was < 2 nou	irs, explain w	тıу				2.56		10:00	2.43	
							2.57		20:00		
							2.58		35:00		
							2.59		50:00		
							2.60		75:00		
							2.61		120:00		
											_
ater Diverted for D	rilling										
Vater Source			An	nount Taken				Diversio	on Date & Time		

Water Source

Government

L

Diversion Date & Time

Contractor Certification Name of Journeyman responsible for drilling/construction of well UNKNOWN NA DRILLER 1 Company Name PETER NIEMANS WATER WELL DRILLING

Certification No

Water Well Drilling Report

View in ImperialExport to ExcelGIC Well ID285090GoA Well Tag No.285090

		•	· ·	ublic database.		Date Report F	
Vell Identific	ation and		-			0	Measurement in Met
Owner Name HOLBROOK, (GARY	Address 716 38 AVE SW, CA	-GARY	'n	Province	Cou	untry Postal Code T2T 2H7
	1/4 or LSD IW	SEC TWP RGE 10 019 29	W of MER Lot 4			onal Description	
Measured fron	n Boundar	y of	GPS Coordinates in De	e (· · · · · · · · · · · · · · · · · · ·	Elovation	m
_		m from	Latitude <u>50.597483</u> How Location Obtained		-113.945665	How Elevation	m Obtained
_		m from	Not Verified			Not Obtained	
							4
Drilling Inform	nation						
Vethod of Dri Rotary	lling		Type of Work New Well				
P roposed We Domestic	ll Use						
Formation Lo	g	Me	easurement in Metric	Yield Test S	ummary		Measurement in Met
Depth from ground level (r	Water			Recommende Test Date	ed Pump Rate Water Remova		Static Water Level (m)
3.35		Brown Sandy Clay & Rocks		1996/06/19			21.03
3.96		Sand		1996/06/19			21.03
15.85		Brown Sandy Clay & Rocks		Well Comple			Measurement in Met
17.07		Soft Shale			orilled Finished We	ll Depth Start	Date End Date
57.91		Gray Shale & Sandstone		121.92 m		1	5/06/13 1996/06/17
64.62	Yes	,	•	Borehole			
66.45	10.	Gray Shale		Diamete	. ,	From (m)	To (m)
68.88		Gray Sandstone		0.0		0.00	121.92
71.63		Gray Shale		Plastic	ng (if applicable)	Plastic	asing/Liner
76.50	_	Gray Sandstone		Size	OD: 15.24 c	m	Size OD : 11.43 cm
78.94	_	Gray Shale		Wall Thickne	ess: 0.940 c	m Wall T	Thickness : 0.602 cm
81.38		Gray Sandstone		Bottom	n at : 17.98 m		Top at : 10.67 m
86.26	_	Gray Shale		Deufenetiene			Bottom at : 114.30 m
88.39		Gray Sandstone		Perforations	Diamet	er or	
91.14		Gray Shale			Slo	t Slo	
99.06	Yes	Gray Water Bearing Sandstone		From (m) 60.35	To (m) Width 65.53 0.3		h(cm) Interval(cm) 17.78
100.58		Gray Shale		96.01	102.11 0.00		0.00
101.80		Gray Sandstone		Perforated by	Saw		
103.02		Gray Shale		Annular Seal	Driven & Bentoni	te.	
104.55		Gray Sandstone			n 15.24 m		8 m
109.12		Gray Shale		Amour	nt		
110.03		Gray Sandstone		Other Seals		~	
121.92		Shale & Sandstone Ledges			Туре		At (m)
				Screen Type			
					OD: 0.00 c		
				From	(m)	To (m)	Slot Size (cm)
				Attachm	ent		
					ngs		om Fittings
				Pack			
				Туре		Grain	Size
				Amount			
Contractor C	ertificatio	n					
		sponsible for drilling/construction of	well	Ce	rtification No		
JNKNOWN N				1			
Company Nar PETER NIEMA		ER WELL DRILLING		Co	by of Well report pro	ovided to owner	Date approval holder signed

Water Well Drilling Report

The driller supplies the data contained in this report. The Province disclaims responsibility for its

View in Imperial Export to Excel

285090

Submitted to ESRD

GoA Well Tag No.

GIC Well ID

Submitted to ESRD

Sample Collected for Potability

					s report will be retain				/ 113	Date Report Receive	
Well Ident	ification and L	ocation									Measurement in Metric
Owner Nan HOLBROO			Address 716 38 AV	E SW, CAL	GARY	Town			Province	Country	Postal Code T2T 2H7
Location	1/4 or LSD NW	SEC 10	<i>TWP</i> 019	<i>RGE</i> 29	W of MER 4	Lot	Block	Plan		nal Description	
Measured f	from Boundary c	of m from).597483	0	es (NAD 83) itude -113.9		Elevation	m
		m from			How Location	Obtained				How Elevation Obta	ained
				<u> </u>	Not Verified					Not Obtained	
Additional	Information										Measurement in Metric
	From Top of Cas	sing to Grc	ound Level		cm						
Is Artesia	n Flow					1	s Flow Cor	ntrol Installed			
Is Artesia	n Flow Rate		L/min			I.	s Flow Cor	trol Installed Describe			
		e	L/min		9.09 L/min		s Flow Cor			Depth	
Recomme	Rate				9.09 L/min 109.73 m	Pump				,	
Recomme	Rate Inded Pump Rate					Pump	o Installed			,	H.P.
Recomme Recomme	Rate Inded Pump Rate	ake Depth	(From TOC)			Pump	o Installed	Describe	Make	·	H.P.

Additional Comments on Well

Government

of Alberta

DRILLER REPORTS DISTANCE FROM TOP OF CASING TO GROUND LEVEL: .50 M.

Contractor Certification

Name of Journeyman responsible for drilling/construction of well UNKNOWN NA DRILLER

Company Name PETER NIEMANS WATER WELL DRILLING Certification No 1

Copy of Well report provided to owner Date approval holder signed

Government of Alberta The driller supplies the data contained in this report. The Province disclaims responsibility for its accuracy. The information on this report will be retained in a public database.

Water Well Drilling Report

View in Imperial Export to Excel GIC Well ID

GoA Well Tag No.

285090

Drilling Company Well ID 1996/09/30 Date Report Received

ron naonan	cation and L	_ocation								Measurement in M
Dwner Name IOLBROOK,			Address 716 38 AV	/E SW, CAI	LGARY	Town		Province	Country	Postal Coo T2T 2H7
	1/4 or LSD	SEC	TWP	RGE	W of MER	Lot	Block Plan	Additio	onal Description	
	NW	10	019	29	4		(10.00)			
leasured fro	om Boundary o	of					mal Degrees (NAD 83)			
-		m from			Latitude 5		Longitude -113.9	45665	Elevation	
		m from			How Location	n Obtained			How Elevation Ob	tained
					Not Verified				Not Obtained	
iold Toot							Tak		Ground Level	Measurement in M
ield Test							Tar		th to water level	Measurement in M
Test Date		Start Tin		Stat	ic Water Level		Drawdown (m)		Elapsed Time	Recovery (m)
1996/06/19		12:00 AN	VI		21.03 m				Minutes:Sec	Recovery (III)
vietnod of v	Nater Remov									
	Туре					_				
	emoval Rate			1						
Depth Withd	drawn From		0.00 m							
f water remo	oval period wa	as < 2 hou	rs, explain w	/hy						
				-						
ield Test							Tak		Ground Level	Measurement in M
Test Date		Start Tin	ne	Stat	ic Water Level				th to water level	
1996/06/19		12:00 AM			21.03 m		Drawdown (m)		Elapsed Time Minutes:Sec	Recovery (m)
							21.05		0:00	57.15
Wethod of V	Nater Remov	al					22.21		1:00	55.34
	Туре	Pump					23.13		2:00	53.90
Re	_		9.09 L/mir	1		_	23.87	_	3:00	53.07
	emoval Rate			1		_	23.87 24.36		3:00 4:00	53.07 52.48
	_			1			23.87 24.36 24.86		3:00 4:00 5:00	53.07 52.48 52.00
Depth Withd	emoval Rate drawn From	1	09.73 m			_	23.87 24.36 24.86 52.32		3:00 4:00 5:00 6:00	53.07 52.48 52.00 51.53
Depth Withd	emoval Rate	1	09.73 m				23.87 24.36 24.86 52.32 25.76		3:00 4:00 5:00 6:00 7:00	53.07 52.48 52.00 51.53 51.10
Depth Withd	emoval Rate drawn From	1	09.73 m				23.87 24.36 24.86 52.32 25.76 26.16		3:00 4:00 5:00 6:00 7:00 8:00	53.07 52.48 52.00 51.53 51.10 50.70
Depth Withd	emoval Rate drawn From	1	09.73 m				23.87 24.36 24.86 52.32 25.76 26.16 26.51		3:00 4:00 5:00 6:00 7:00 8:00 9:00	53.07 52.48 52.00 51.53 51.10 50.70 50.33
Depth Withd	emoval Rate drawn From	1	09.73 m				23.87 24.36 24.86 52.32 25.76 26.16		3:00 4:00 5:00 6:00 7:00 8:00	53.07 52.48 52.00 51.53 51.10 50.70
Depth Withd	emoval Rate drawn From	1	09.73 m				23.87 24.36 24.86 52.32 25.76 26.16 26.51 26.83 27.52 28.15		3:00 4:00 5:00 6:00 7:00 8:00 9:00 10:00 12:00 14:00	53.07 52.48 52.00 51.53 51.10 50.70 50.33 49.97
Depth Withd	emoval Rate drawn From	1	09.73 m				23.87 24.36 24.86 52.32 25.76 26.16 26.51 26.83 27.52 28.15 29.12		3:00 4:00 5:00 6:00 7:00 8:00 9:00 10:00 12:00 14:00 16:00	53.07 52.48 52.00 51.53 51.10 50.70 50.33 49.97 49.27 48.61 47.98
Depth Withd	emoval Rate drawn From	1	09.73 m				23.87 24.36 24.86 52.32 25.76 26.16 26.51 26.83 27.52 28.15 29.12 31.00		3:00 4:00 5:00 6:00 7:00 8:00 9:00 10:00 12:00 14:00 16:00 20:00	53.07 52.48 52.00 51.53 51.10 50.70 50.33 49.97 49.27 48.61 47.98 46.75
Depth Withd	emoval Rate drawn From	1	09.73 m				23.87 24.36 24.86 52.32 25.76 26.16 26.51 26.83 27.52 28.15 29.12 31.00 32.95		3:00 4:00 5:00 6:00 7:00 8:00 9:00 10:00 12:00 14:00 16:00 20:00 25:00	53.07 52.48 52.00 51.53 51.10 50.70 50.33 49.97 49.27 48.61 47.98 46.75 45.27
Depth Withd	emoval Rate drawn From	1	09.73 m				23.87 24.36 24.86 52.32 25.76 26.16 26.51 26.83 27.52 28.15 29.12 31.00 32.95 34.81		3:00 4:00 5:00 6:00 7:00 8:00 9:00 10:00 12:00 14:00 16:00 20:00 20:00 30:00	53.07 52.48 52.00 51.53 51.10 50.70 50.33 49.97 49.27 48.61 47.98 46.75 45.27 44.06
Depth Withd	emoval Rate drawn From	1	09.73 m				23.87 24.36 24.86 52.32 25.76 26.16 26.51 26.83 27.52 28.15 29.12 31.00 32.95 34.81 36.60		3:00 4:00 5:00 6:00 7:00 8:00 9:00 10:00 12:00 14:00 16:00 20:00 25:00 30:00 35:00	53.07 52.48 52.00 51.53 51.10 50.70 50.33 49.97 49.27 48.61 47.98 46.75 45.27 44.06 43.12
Depth Withd	emoval Rate drawn From	1	09.73 m				23.87 24.36 24.86 52.32 25.76 26.16 26.51 26.83 27.52 28.15 29.12 31.00 32.95 34.81 36.60 38.35		3:00 4:00 5:00 6:00 7:00 8:00 9:00 10:00 12:00 14:00 16:00 20:00 25:00 30:00 35:00 40:00	53.07 52.48 52.00 51.53 51.10 50.70 50.33 49.97 49.27 48.61 47.98 46.75 45.27 44.06 43.12 42.26
Depth Withd	emoval Rate drawn From	1	09.73 m				23.87 24.36 24.86 52.32 25.76 26.16 26.51 26.83 27.52 28.15 29.12 31.00 32.95 34.81 36.60 38.35 41.32		3:00 4:00 5:00 6:00 7:00 8:00 9:00 10:00 12:00 14:00 16:00 20:00 25:00 30:00 35:00 40:00 50:00	53.07 52.48 52.00 51.53 51.10 50.70 50.33 49.97 49.27 48.61 47.98 46.75 45.27 44.06 43.12 42.26 40.55
Depth Withd	emoval Rate drawn From	1	09.73 m				23.87 24.36 24.86 52.32 25.76 26.16 26.51 26.83 27.52 28.15 29.12 31.00 32.95 34.81 36.60 38.35 41.32 43.97		3:00 4:00 5:00 6:00 7:00 8:00 9:00 10:00 12:00 14:00 16:00 20:00 25:00 30:00 35:00 40:00 50:00 60:00	53.07 52.48 52.00 51.53 51.10 50.70 50.33 49.97 49.27 48.61 47.98 46.75 45.27 44.06 43.12 42.26 40.55 38.89
Depth Withd	emoval Rate drawn From	1	09.73 m				23.87 24.36 24.86 52.32 25.76 26.16 26.51 26.83 27.52 28.15 29.12 31.00 32.95 34.81 36.60 38.35 41.32 43.97 47.05		3:00 4:00 5:00 6:00 7:00 8:00 9:00 10:00 12:00 14:00 16:00 20:00 25:00 30:00 35:00 40:00 50:00 60:00 75:00	53.07 52.48 52.00 51.53 51.10 50.70 50.33 49.97 49.27 48.61 47.98 46.75 45.27 44.06 43.12 42.26 40.55 38.89 36.21
Depth Withd	emoval Rate drawn From	1	09.73 m				23.87 24.36 24.86 52.32 25.76 26.16 26.51 26.83 27.52 28.15 29.12 31.00 32.95 34.81 36.60 38.35 41.32 43.97 47.05		3:00 4:00 5:00 6:00 7:00 8:00 9:00 10:00 12:00 14:00 16:00 20:00 25:00 30:00 35:00 40:00 50:00 60:00 75:00 90:00	53.07 52.48 52.00 51.53 51.10 50.70 50.33 49.97 49.27 48.61 47.98 46.75 45.27 44.06 43.12 42.26 40.55 38.89 36.21 33.94
Depth Withd	emoval Rate drawn From	1	09.73 m				23.87 24.36 24.86 52.32 25.76 26.16 26.51 26.83 27.52 28.15 29.12 31.00 32.95 34.81 36.60 38.35 41.32 43.97 47.05 49.52 51.70		3:00 4:00 5:00 6:00 7:00 8:00 9:00 10:00 12:00 14:00 16:00 20:00 25:00 30:00 35:00 40:00 50:00 60:00 75:00 90:00 105:00	53.07 52.48 52.00 51.53 51.10 50.70 50.33 49.97 49.27 48.61 47.98 46.75 45.27 44.06 43.12 42.26 40.55 38.89 36.21 33.94 32.10
Depth Withd	emoval Rate drawn From	1	09.73 m				23.87 24.36 24.86 52.32 25.76 26.16 26.51 26.83 27.52 28.15 29.12 31.00 32.95 34.81 36.60 38.35 41.32 43.97 47.05 49.52 51.70 52.55		3:00 4:00 5:00 6:00 7:00 8:00 9:00 10:00 12:00 14:00 14:00 20:00 25:00 30:00 35:00 40:00 50:00 60:00 75:00 90:00 105:00 120:00	53.07 52.48 52.00 51.53 51.10 50.70 50.33 49.97 49.27 48.61 47.98 46.75 45.27 44.06 43.12 42.26 40.55 38.89 36.21 33.94
Depth Withd	emoval Rate drawn From	1	09.73 m				23.87 24.36 24.86 52.32 25.76 26.16 26.51 26.83 27.52 28.15 29.12 31.00 32.95 34.81 36.60 38.35 41.32 43.97 47.05 49.52 51.70 52.55 56.00		3:00 4:00 5:00 6:00 7:00 8:00 9:00 10:00 12:00 14:00 16:00 20:00 25:00 30:00 35:00 40:00 50:00 60:00 75:00 90:00 105:00 120:00 150:00	53.07 52.48 52.00 51.53 51.10 50.70 50.33 49.97 49.27 48.61 47.98 46.75 45.27 44.06 43.12 42.26 40.55 38.89 36.21 33.94 32.10
Depth Withd	emoval Rate drawn From	1	09.73 m				23.87 24.36 24.86 52.32 25.76 26.16 26.51 26.83 27.52 28.15 29.12 31.00 32.95 34.81 36.60 38.35 41.32 43.97 47.05 49.52 51.70 52.55		3:00 4:00 5:00 6:00 7:00 8:00 9:00 10:00 12:00 14:00 14:00 20:00 25:00 30:00 35:00 40:00 50:00 60:00 75:00 90:00 105:00 120:00	53.07 52.48 52.00 51.53 51.10 50.70 50.33 49.97 49.27 48.61 47.98 46.75 45.27 44.06 43.12 42.26 40.55 38.89 36.21 33.94 32.10
Depth Withd	emoval Rate	<u>1</u> as < 2 hou	09.73 m				23.87 24.36 24.86 52.32 25.76 26.16 26.51 26.83 27.52 28.15 29.12 31.00 32.95 34.81 36.60 38.35 41.32 43.97 47.05 49.52 51.70 52.55 56.00		3:00 4:00 5:00 6:00 7:00 8:00 9:00 10:00 12:00 14:00 16:00 20:00 25:00 30:00 35:00 40:00 50:00 60:00 75:00 90:00 105:00 120:00 150:00	53.07 52.48 52.00 51.53 51.10 50.70 50.33 49.97 49.27 48.61 47.98 46.75 45.27 44.06 43.12 42.26 40.55 38.89 36.21 33.94 32.10
Depth Withd	emoval Rate drawn From oval period wa	<u>1</u> as < 2 hou	09.73 m	'hy	ount Taken		23.87 24.36 24.86 52.32 25.76 26.16 26.51 26.83 27.52 28.15 29.12 31.00 32.95 34.81 36.60 38.35 41.32 43.97 47.05 49.52 51.70 52.55 56.00		3:00 4:00 5:00 6:00 7:00 8:00 9:00 10:00 12:00 14:00 16:00 20:00 25:00 30:00 35:00 40:00 50:00 60:00 75:00 90:00 105:00 120:00 150:00	53.07 52.48 52.00 51.53 51.10 50.70 50.33 49.97 49.27 48.61 47.98 46.75 45.27 44.06 43.12 42.26 40.55 38.89 36.21 33.94 32.10

Contractor Certification Name of Journeyman responsible for drilling/construction of well UNKNOWN NA DRILLER Certification No 1 Company Name Copy of Well report provided to owner Date approval holder signed PETER NIEMANS WATER WELL DRILLING

Government Water Well Drilling Report View in Imperial Export to Excel 291409

)	t Albert	a 🗖	The acc	e driller supplies uracy. The info	the data cor mation on th	ntained in this repo is report will be ret	ort. The Provir tained in a pu	nce disclaims re blic database.	sponsibilit	y for its	GoA Well Ta Drilling Com Date Report	pany Well ID) 1999/01/27
Γ	Well Identificati	on and Lo	cation										easurement in Metric
	Owner Name WESTERN FEED			Address P.O. BOX	5279 HIGH	RIVER	Tow	1		Province	Co	ountry	Postal Code T1V 1M4
	Location 1/4 NE	or LSD	SEC 03	<i>TWP</i> 019	<i>RGE</i> 29	W of MER 4	Lot	Block	Plan		nal Descriptio	n	
	Measured from B	r	n from n from				50.582999		1 A A A A A A A A A A A A A A A A A A A	83) 3.934272		tion Obtained ed	
	Drilling Information Method of Drillin Rotary Proposed Well U Domestic	ng				Type of Wo New Well	ork						
	Formation Log				Me	easurement in	Metric	Yield Tes	t Summ	nary		М	easurement in Metric
	Depth from ground level (m)	Water Bearing	Litholo	gy Descriptio	n			Recomme Test Da		<i>mp Rate</i> Water Removal			ic Water Level (m)
	6.40		Brown Brown S Gray S Gray W Gray S	Clay				1998/10	/24	39.5	55		5.70
	9.14		Brown	Sandy Clay 8	k Rocks			Well Corr	pletion			М	easurement in Metric
	10.06		Gray S	Shale					h Drilled	Finished Wel		rt Date	End Date
	15.54		Gray V	Vet Sandston	е			30.48 m			199	8/10/21	1998/10/21
	25.91		Gray S	Shale & Sand	stone Ledg	es		Borehole					
	30.48		Brown Brown S Gray S Gray W	Shale					neter (cm 0.00	ו)	From (m) 0.00		To (m) 30.48
								Perforation	tom at : ons ons To (17. by beal Be from ount ls T rpe ze OD : om (m) chment _ 	Diamete Slot Slot (m) Width(37 0.31 Saw ntonite Chips/T <u>1.52 m</u> ype 0.00 cr	er or S cm) Leng 8 iablets to 9. <u>n</u> To (m) Bott		6.10 m 30.48 m Hole or Slot Interval(cm) 17.78
	Contractor Cert	ification											

Name of Journeyman responsible for drilling/construction of well UNKNOWN NA DRILLER

Company Name PETER NIEMANS WATER WELL DRILLING Certification No 1

Copy of Well report provided to owner Date approval holder signed

Water Well Drilling Report

The driller supplies the data contained in this report. The Province disclaims responsibility for its accuracy. The information on this report will be retained in a public database.

GIC Well ID GoA Well Tag No. Drilling Company Well ID

View in Imperial Export to Excel

291409

1999/01/27

Well Identification a										
won ruentineation a	and Location	I								Measurement in Metr
Owner Name WESTERN FEEDLO	TS LTD	Address P.O. BOX 5	279 HIGH RIVER		Town			Province	Country	Postal Code T1V 1M4
Location 1/4 or L NE	.SD SEC 03	<i>TWP</i> 019	29 4	MER		Block	Plan		nal Description	
Measured from Bound	dary of m from m from		Latit		.582999	0	es (NAD 83) itude <u>-113.9</u>	I	Elevation How Elevation Ob Not Obtained	
Additional Informat	ion									Measurement in Metr
Distance From Top o Is Artesian Flow Rate				cm	Is	Flow Con	trol Installed Describe		Depth	
Recommended Pum	np Rate		40.9	91 L/min	Pump	Installed			Depth	m
Recommended Pum	nn Intake Dentl	h (From TOC)	27.4	13 m	Type	-		Make		H.P.
	p mano Dopa	((110)) 100)			iypo				Model (Output R	Pating)
Dia you Encounter	Sallile Waler		Gas				Geo		Completion Taken SESRD	
Additional Comme		ROM TOP OF (CASING TO GROU	JND LEVE		Sample Co	ollected for F	Potability	Subr	mitted to ESRD
DRILER REPORTS		ROM TOP OF (CASING TO GROU	JND LEVE		Sample Co				
DRILER REPORTS Yield Test	DISTANCE FF			-		Sample Co		ken From G	Subr	mitted to ESRD
DRILER REPORTS		ime	Static Water	-				ken From G Depti	Ground Level	
DRILER REPORTS Yield Test Test Date 1998/10/24	DISTANCE FF Start T 12:00 F	ime	Static Water	Level		Draw	Tał /down (m) 5.70	ken From G Depti	Fround Level h to water level lapsed Time	Measurement in Metr Recovery (m) 7.84
DRILER REPORTS Yield Test Test Date 1998/10/24 Method of Water Re	DISTANCE FR Start Tr 12:00 A	ime	Static Water	Level		Draw	Tał /down (m) 5.70 6.02	ken From G Depti	Fround Level h to water level lapsed Time Minutes:Sec 0:00 1:00	Measurement in Metr Recovery (m) 7.84 7.30
DRILER REPORTS Yield Test Test Date 1998/10/24 Method of Water Re	DISTANCE FF Start Tr 12:00 F emoval ype Pump	ime M	Static Water	Level		Draw	Tał /down (m) 5.70 6.02 6.13	ken From G Depti	Fround Level h to water level lapsed Time Minutes:Sec 0:00 1:00 2:00	Measurement in Metr Recovery (m) 7.84 7.30 7.27
DRILER REPORTS Yield Test Test Date 1998/10/24 Method of Water Re	DISTANCE FF Start Tr 12:00 F emoval ype Pump	ime	Static Water	Level		Draw	Tał /down (m) 5.70 6.02 6.13 6.20	ken From G Depti	Fround Level h to water level lapsed Time Vinutes:Sec 0:00 1:00 2:00 4:00	Measurement in Metr Recovery (m) 7.84 7.30 7.27 7.23
DRILER REPORTS Yield Test Test Date 1998/10/24 Method of Water Re Ty Removal R	DISTANCE FF Start Tr 12:00 F emoval gype Pump Rate	ime M 39.55 L/min	Static Water	Level		Draw	Tał /down (m) 5.70 6.02 6.13 6.20 6.26	ken From G Depti	Fround Level h to water level lapsed Time Vinutes:Sec 0:00 1:00 2:00 4:00 6:00	Measurement in Metr Recovery (m) 7.84 7.30 7.27 7.23 7.20
DRILER REPORTS Yield Test Test Date 1998/10/24 Method of Water Re	DISTANCE FF Start Tr 12:00 F emoval gype Pump Rate	ime M 39.55 L/min	Static Water	Level		Draw	Tal /down (m) 5.70 6.02 6.13 6.20 6.20 6.26 6.30	ken From G Depti	Bround Level h to water level lapsed Time Minutes:Sec 0:00 1:00 2:00 4:00 6:00 8:00	Measurement in Metr Recovery (m) 7.84 7.30 7.27 7.23 7.20 7.16
DRILER REPORTS Yield Test Test Date 1998/10/24 Method of Water Re Ty Removal R	DISTANCE FF Start Tr 12:00 F emoval gype Pump Rate rom	39.55 L/min 27.43 m	Static Water 5.7	Level		Draw	Tał /down (m) 5.70 6.02 6.13 6.20 6.26	ken From G Depti	Fround Level h to water level lapsed Time Vinutes:Sec 0:00 1:00 2:00 4:00 6:00	Measurement in Metr Recovery (m) 7.84 7.30 7.27 7.23 7.20
DRILER REPORTS Yield Test Test Date 1998/10/24 Method of Water Re Ty Removal R Depth Withdrawn Fr	DISTANCE FF Start Tr 12:00 F emoval gype Pump Rate rom	39.55 L/min 27.43 m	Static Water 5.7	Level		Draw	Tal /down (m) 5.70 6.02 6.13 6.20 6.26 6.30 6.33	ken From G Depti	Stround Level h to water level lapsed Time Minutes:Sec 0:00 1:00 2:00 4:00 6:00 8:00 10:00	Measurement in Metr Recovery (m) 7.84 7.30 7.27 7.23 7.20 7.16 7.13
DRILER REPORTS Yield Test Test Date 1998/10/24 Method of Water Re Ty Removal R Depth Withdrawn Fr	DISTANCE FF Start Tr 12:00 F emoval gype Pump Rate rom	39.55 L/min 27.43 m	Static Water 5.7	Level		Draw	Tal /down (m) 5.70 6.02 6.13 6.20 6.26 6.30 6.33 6.40 6.48 6.48 6.60	ken From G Depti	Fround Level h to water level lapsed Time Vinutes:Sec 0:00 1:00 2:00 4:00 6:00 8:00 10:00 14:00 20:00 30:00	Measurement in Metr Recovery (m) 7.84 7.30 7.27 7.23 7.20 7.16 7.13 7.07 7.03
DRILER REPORTS Yield Test Test Date 1998/10/24 Method of Water Re Ty Removal R Depth Withdrawn Fr	DISTANCE FF Start Tr 12:00 F emoval gype Pump Rate rom	39.55 L/min 27.43 m	Static Water 5.7	Level		Draw	Tal /down (m) 5.70 6.02 6.13 6.20 6.26 6.30 6.33 6.40 6.48 6.60 6.75	ken From G Depti	Fround Level h to water level lapsed Time Vinutes:Sec 0:00 1:00 2:00 4:00 6:00 8:00 10:00 14:00 20:00 30:00 40:00	Recovery (m) 7.84 7.30 7.27 7.23 7.20 7.16 7.13 7.10 7.03 6.99
DRILER REPORTS Yield Test Test Date 1998/10/24 Method of Water Re Ty Removal R Depth Withdrawn Fr	DISTANCE FF Start Tr 12:00 F emoval gype Pump Rate rom	39.55 L/min 27.43 m	Static Water 5.7	Level		Draw	Tal /down (m) 5.70 6.02 6.13 6.20 6.26 6.30 6.33 6.40 6.48 6.60 6.75 7.07	ken From G Depti	Bround Level h to water level lapsed Time Winutes:Sec 0:00 1:00 2:00 4:00 6:00 8:00 10:00 14:00 30:00 40:00 60:00	Recovery (m) 7.84 7.30 7.27 7.23 7.20 7.16 7.13 7.00 7.03 6.99 6.93
DRILER REPORTS Yield Test Test Date 1998/10/24 Method of Water Re Ty Removal R Depth Withdrawn Fr	DISTANCE FF Start Tr 12:00 F emoval gype Pump Rate rom	39.55 L/min 27.43 m	Static Water 5.7	Level		Draw	Tak /down (m) 5.70 6.02 6.13 6.20 6.26 6.30 6.33 6.40 6.48 6.60 6.75 7.07 7.46	ken From G Depti	Ground Level h to water level lapsed Time Minutes:Sec 0:00 1:00 2:00 4:00 6:00 8:00 10:00 14:00 20:00 30:00 40:00 60:00 90:00	Recovery (m) 7.84 7.30 7.27 7.23 7.20 7.16 7.13 7.10 7.03 6.99 6.93 6.84
DRILER REPORTS Yield Test Test Date 1998/10/24 Method of Water Re Ty Removal R Depth Withdrawn Fr	DISTANCE FF Start Tr 12:00 F emoval gype Pump Rate rom	39.55 L/min 27.43 m	Static Water 5.7	Level		Draw	Tal /down (m) 5.70 6.02 6.13 6.20 6.26 6.30 6.33 6.40 6.48 6.60 6.75 7.07	ken From G Depti	Bround Level h to water level lapsed Time Winutes:Sec 0:00 1:00 2:00 4:00 6:00 8:00 10:00 14:00 30:00 40:00 60:00	Recovery (m) 7.84 7.30 7.27 7.23 7.20 7.16 7.13 7.00 7.03 6.99 6.93
DRILER REPORTS Yield Test Test Date 1998/10/24 Method of Water Re Ty Removal R Depth Withdrawn Fr	DISTANCE FF	39.55 L/min 27.43 m	Static Water 5.7	Level		Draw	Tak /down (m) 5.70 6.02 6.13 6.20 6.26 6.30 6.33 6.40 6.48 6.60 6.75 7.07 7.46	ken From G Depti	Ground Level h to water level lapsed Time Minutes:Sec 0:00 1:00 2:00 4:00 6:00 8:00 10:00 14:00 20:00 30:00 40:00 60:00 90:00	Recovery (m) 7.84 7.30 7.27 7.23 7.20 7.16 7.13 7.10 7.03 6.99 6.93 6.84

Contractor Certification		
Name of Journeyman responsible for drilling/construction of well UNKNOWN NA DRILLER	Certification No 1	
Company Name PETER NIEMANS WATER WELL DRILLING	Copy of Well report provided to owner	Date approval holder signed

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Government

of Alberta 🗖

Government of Alberta

Water Well Drilling Report

The driller supplies the data contained in this report. The Province disclaims responsibility for its

GIC Well ID GoA Well Tag No.

View in Imperial Export to Excel

1555287

Drilling Company Well ID

accuracy. The information on this report will be retained in a public databas Date Report Received Well Identification and Location Measurement in Metric Address Postal Code Province Country Owner Name Town MARKERT, GAVIN P.O. BOX 5301 HIGH RIVER AB CA TIV IM5 SEC TWP Additional Description 1/4 or LSD RGF W of MER Block Plan Location Lot SW 10 019 29 4 GPS Coordinates in Decimal Degrees (NAD 83) Measured from Boundary of Elevation Latitude 50.590200 Longitude -113.946000 m m from How Elevation Obtained How Location Obtained m from Not Verified Not Obtained **Drilling Information** Type of Work Method of Drilling Rotarv New Well **Proposed Well Use** Domestic Formation Log Measurement in Metric Yield Test Summary Measurement in Metric Recommended Pump Rate 45.46 L/min Water Depth from Lithology Description Water Removal Rate (L/min) Static Water Level (m) ground level (m) Bearing Test Date 0.61 Topsoil 2002/11/21 84.10 3.05 2.44 Clay & Rocks Well Completion Measurement in Metric Total Depth Drilled Finished Well Depth Start Date End Date 3.05 Sand 15.24 m 2002/11/21 2002/11/21 Fine Grained Sand & Gravel 7.01 Borehole 25.60 Gray Shale Diameter (cm) From (m) To (m) 29.87 Gray Shale & Sandstone Ledges 15.24 0.00 15.24 38.10 Gray Sandstone Surface Casing (if applicable) Well Casing/Liner 60.96 Gray Shale & Sandstone Ledges Steel Plastic Size OD : Size OD : 16.83 cm 12.70 cm 0.478 cm 0.630 cm Wall Thickness : Wall Thickness : 5.49 m Bottom at : Top at : 4.57 m Bottom at : 15.24 m Perforations Diameter or Slot Hole or Slot Slot From (m) To (m) Width(cm) Length(cm) Interval(cm) 5.79 13.41 0.318 15.24 Perforated by Saw Annular Seal Driven & Bentonite Placed from 0.00 m to m Amount Other Seals At (m) Type Screen Type Size OD : cm From (m) To (m) Slot Size (cm) Attachment Bottom Fittings Top Fittings Pack Type Unknown Grain Size Unknown Amount

Contractor Certification

Name of Journeyman responsible for drilling/construction of well CHAD NIEMANS

Company Name NIEMANS DRILLING (1980) LTD. 46340A Copy of Well report provided to owner Date approval holder signed

Certification No

Water Well Drilling Report

Town

The driller supplies the data contained in this report. The Province disclaims responsibility for its accuracy. The information on this report will be retained in a public database.

GIC Well ID GoA Well Tag No. Drilling Company Well ID Date Report Received

Country

View in Imperial Export to Excel

Measurement in Metric

TIV IM5

Postal Code

1555287

	HIGH RI	VER		AB	CA	A	TIV IM5
W of MER 4	Lot	Block	Plan	Additi	onal Descriptio	n	
GPS Coordina	tes in Decim	al Degre	es (NAD 83)				
Latitude 50	.590200	Long	itude -113.946	5000	Elevation		m
How Location	Obtained				How Elevat	ion Obtained	
Not Verified					Not Obtaine	ed	
						Meas	surement in Metric
60.96 cm							
	ls F	low Con	trol Installed				
			Describe				
45.46 L/min	Pump In	nstalled			Depth	m	
10.67 m	Туре			Make		H.P.	
					Model (Ou		
Depth		m	Well Disinfe	cted Upo	n Completion		
Depth		m	Geopl	hysical Lo	g Taken		
				ubmitted			
	Sa	ample C	ollected for Po	tability		Submitted to I	ESRD
			Take		Ground Leve		urement in Metric
Water Level				Dep	oth to water leve	el	
		Draw	down (m)		Flanced Time	Ro	covery (m)

Province

			laken	From Ground Level	Measurement in Metri
Test Date	Start Time	Static Water Level		Depth to water level	
2002/11/21	12:00 AM	3.05 m	Drawdown (m)	Elapsed Time Minutes:Sec	Recovery (m)
Method of Water R	lemevel		3.05	0:00	
			3.11	1:00	3.10
7	Type Pump		3.11	2:00	3.09
Removal I	Rate 84.10 L/m	nin	3.11	3:00	3.08
		<u> </u>	3.11	4:00	3.07
Depth Withdrawn F	rom 13.72 m	_	3.12	5:00	3.05
			3.13	6:00	
If water removal per	riod was < 2 hours, explain	why	3.13	7:00	
			3.13	8:00	
			3.13	9:00	
			3.13	10:00	
			3.13	12:00	
			3.13	14:00	
			3.13	16:00	
			3.13	20:00	
			3.13	25:00	
			3.13	30:00	
			3.13	35:00	
			3.13	40:00	
			3.13	50:00	
			3.13	60:00	
			3.13	75:00	
			3.13	90:00	
			3.13	105:00	
			3.13	120:00	

Contractor Certification

Government

of Alberta

Owner Name

Location

MARKERT, GAVIN

Well Identification and Location

1/4 or LSD

Distance From Top of Casing to Ground Level

Recommended Pump Intake Depth (From TOC)

Did you Encounter Saline Water (>4000 ppm TDS)

SW

Measured from Boundary of

Additional Information

Rate

Recommended Pump Rate

Is Artesian Flow

Address

TWP

019

L/min

SEC

10

m from m from P.O. BOX 5301

RGE

29

Gas

Name of Journeyman responsible for drilling/construction of well CHAD NIEMANS Company Name

NIEMANS DRILLING (1980) LTD.

Certification No

46340A

Copy of Well report provided to owner Date approval holder signed

Printed on 6/19/2014 3:56:24 PM

Appendix N3

Laboratory Test Results

On DVD in Appendix R

Your Project #: AB GOVERNMENT-SAFM-60309815.04 Site Location: HIGH RIVER Your C.O.C. #: A004266, A004267

Attention:RICHARD DAGG

AECOM 200 - 6807 RAILWAY STREET SE CALGARY, AB CANADA T2H2V6

> Report Date: 2014/02/23 Report #: R1521089 Version: 1

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B411666

Received: 2014/02/13, 15:30

Sample Matrix: Soil # Samples Received: 15

		Date	Date		
Analyses	Quantity	Extracted	Analyzed	Laboratory Method	Analytical Method
Chloride (Soluble)	15	2014/02/20	2014/02/21	AB SOP-00020	SM 4500 CI-G
Resistivity	4	N/A	2014/02/20		
Resistivity	11	N/A	2014/02/21		
Conductivity @25C (Soluble)	4	2014/02/20	2014/02/20	AB SOP-00004	SSMA 15.3
Conductivity @25C (Soluble)	11	2014/02/21	2014/02/21	AB SOP-00004	SSMA 15.3
pH @25C (Soluble)	4	2014/02/20	2014/02/20	AB SOP-00006	SSMA 16.2
pH @25C (Soluble)	11	2014/02/20	2014/02/21	AB SOP-00006	SSMA 16.2
Ca,Mg,Na,K,SO4 (Soluble)	4	2014/02/20	2014/02/21	AB SOP-00042	EPA 200.7
Ca,Mg,Na,K,SO4 (Soluble)	11	2014/02/21	2014/02/21	AB SOP-00042	EPA 200.7
Soluble Paste	4	2014/02/20	2014/02/20	AB SOP-00033	SSMA 15.2
Soluble Paste	11	2014/02/20	2014/02/21	AB SOP-00033	SSMA 15.2

* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager. Wendy Sears, Project manager Email: WSears@maxxam.ca Phone# (403) 291-3077

Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.





AECOM

Client Project #: AB GOVERNMENT-SAFM-60309815.04 Site Location: HIGH RIVER

RESULTS OF CHEMICAL ANALYSES OF SOIL

Maxxam ID			IR9	655	IR9	656	IR9	657	IR9	658			Τ
Sampling Date			2014/	02/13	2014/	/02/13	2014/	/02/13	2014/	/02/13			7
COC Number			A004	4266	A004	4266	A004	4266	A004	4266			
		Units	-	TH14-01 15.2M		ГН14-01 21.2M	-	TH14-02 1.5M		TH14-02 7.6M	RDL	QC Batc	h
Calculated Parame	ters												Ē
Resistivity @ 25° C		ohm-m	34	1.2	16	5.9	8.	40	12	2.1	0.05	738315	1
Soluble Parameter	S	1	1		1		•		1		11		
Soluble Chloride (C)	mg/L	1	.3	1	16	2	.8	3	3	5.0	739064	5
Soluble Conductivit	у	dS/m	0.	29	0.	59	1	.2	0.	83	0.020	739005	9
Soluble pH		рН	7.	98	8.	.37	7.	61	7.79 N/A 7389		738971	7	
Saturation %		%	4	-1	3	30	3	1	2	.7	N/A	738915	6
Soluble Sulphate (S	04)	mg/L	6	4	5	54	10	31 27 160 120		20	5.0	739016	4
N/A = Not Applicab	le	IRO	659	IBO	659	IPO	660	IRO	661	IRO	662		
	-	_				-		-		_			
mpling Date			′02/13 4266		/02/13 4266		/02/13 4266		'02/13 4266		/02/13 4266		
	Units	SAFM 1	4200 TH14-02 15.4M	SAFM 1 #19 @	4200 TH14-02 15.4M -Dup	SAFM 1	4200 FH14-07 3.85M	SAFM 1	4200 H14-07 9.2M	SAFM 1		RDL	QC Bat
alculated Parameters													
esistivity @ 25° C	ohm-m	11	L.5	N	/A	10).4	12	2.7	14	1.9	0.05	73831
luble Parameters	•			•		•							
luble Chloride (Cl)	mg/L	3	2	3	3	2	20	9	.5	8	.7	5.0	73901
luble Conductivity	dS/m	0.	87	0.	88	0.	96	0.	79	0.	67	0.020	73892
luble pH	рН	7.	99	8.	04	7.	86	8.	14	8.	47	N/A	73891
turation %	%	2	.5	2	25	4	13	4	7	5	1	N/A	73889
													() () () () () () () () () ()

RDL = Reportable Detection Limit

Lab-Dup = Laboratory Initiated Duplicate

150

mg/L

140

170

140

150

5.0

7389668

N/A = Not Applicable

Soluble Sulphate (SO4)



AECOM

Client Project #: AB GOVERNMENT-SAFM-60309815.04 Site Location: HIGH RIVER

RESULTS OF CHEMICAL ANALYSES OF SOIL

Maxxam ID		IR9746	IR9746	IR9747	IR9748	IR9749		
Sampling Date		2014/02/13	2014/02/13	2014/02/13	2014/02/13	2014/02/13		
COC Number		A004267	A004267	A004267	A004267	A004267		
	Units	SAFM TH14-25 #3 @ 1.5M	SAFM TH14-25 #3 @ 1.5M Lab-Dup	SAFM TH14-25 #6 @ 3.85M	SAFM TH14-25 #10 @ 6.85M	SAFM TH14-25 #24 @ 17.4M	RDL	QC Batch
Calculated Parameters		-		-			-	<u>.</u>
Resistivity @ 25° C	ohm-m	4.10	N/A	10.6	6.70	6.50	0.05	7383151
Soluble Parameters		•	•	•	•	•		
Soluble Chloride (Cl)	mg/L	50	45	62	14	30	5.0	7390645
Soluble Conductivity	dS/m	2.5	2.3	0.94	1.5	1.5	0.020	7390059
Soluble pH	рН	7.70	7.73	7.92	7.66	8.13	N/A	7389717
Saturation %	%	51	51	57	40	33	N/A	7389156
Soluble Sulphate (SO4)	mg/L	880	790	140	500	430	5.0	7390164
DDI Dementekie Detection					1			

RDL = Reportable Detection Limit

Lab-Dup = Laboratory Initiated Duplicate

N/A = Not Applicable

Maxxam ID		IR9750	IR9751	IR9752		
Sampling Date		2014/02/13	2014/02/13	2014/02/13		
COC Number		A004267	A004267	A004267		
	Units	SAFM TH14-25 C1@ 18.3M	SAFM TH14-24 #8 @ 5.35M	SAFM TH14-24 #16 @ 11.35M	RDL	QC Batch
Calculated Parameters						
Resistivity @ 25° C	ohm-m	4.40	9.10	10.9	0.05	7383151
Soluble Parameters						
Soluble Chloride (Cl)	mg/L	31	54	18	5.0	7390645
Soluble Conductivity	dS/m	2.2	1.1	0.92	0.020	7390059
Soluble pH	рН	8.12	8.04	8.08	N/A	7389717
Saturation %	%	38	29	26	N/A	7389156
Soluble Sulphate (SO4)	mg/L	860	540	350	5.0	7390164
RDL = Reportable Detection L N/A = Not Applicable	imit					



AECOM Client Project #: AB GOVERNMENT-SAFM-60309815.04 Site Location: HIGH RIVER

GENERAL COMMENTS

Each temperature is the	average of up to t
Package 1	18.3°C
Results relate only to th	e items tested.



Maxxam Job #: B411666 Report Date: 2014/02/23

AECOM Client Project #: AB GOVERNMENT-SAFM-60309815.04 Site Location: HIGH RIVER

QUALITY ASSURANCE REPORT

QA/QC				Date				
Batch	Init	QC Type	Parameter	Analyzed	Value	Recovery	Units	QC Limits
7388980	LZ0	QC Standard	Saturation %	2014/02/20		100	%	75 - 125
7388980	LZ0	RPD [IR9659-01]	Saturation %	2014/02/20	1.1		%	12
7389156	IK0	QC Standard	Saturation %	2014/02/21		99	%	75 - 125
7389156	IK0	RPD [IR9746-01]	Saturation %	2014/02/21	0.8		%	12
7389158	BL7	QC Standard	Soluble pH	2014/02/20		100	%	98 - 102
7389158	BL7	Spiked Blank	Soluble pH	2014/02/20		100	%	97 - 103
7389158	BL7	RPD [IR9659-01]	Soluble pH	2014/02/20	0.6		%	5
7389221	BL7	QC Standard	Soluble Conductivity	2014/02/20		103	%	75 - 125
7389221	BL7	Spiked Blank	Soluble Conductivity	2014/02/20		99	%	90 - 110
7389221	BL7	Method Blank	Soluble Conductivity	2014/02/20	<0.020		dS/m	
7389221	BL7	RPD [IR9659-01]	Soluble Conductivity	2014/02/20	1.1		%	35
7389668	STI	QC Standard	Soluble Sulphate (SO4)	2014/02/21		106	%	75 - 125
7389668	STI	Method Blank	Soluble Sulphate (SO4)	2014/02/21	<5.0		mg/L	
7389668	STI	RPD [IR9659-01]	Soluble Sulphate (SO4)	2014/02/21	8.8		%	35
7389717	MN0	QC Standard	Soluble pH	2014/02/21		99	%	98 - 102
7389717	MN0	Spiked Blank	Soluble pH	2014/02/21		99	%	97 - 103
7389717	MN0	RPD [IR9746-01]	Soluble pH	2014/02/21	0.4		%	5
7390059	BL7	QC Standard	Soluble Conductivity	2014/02/21		103	%	75 - 125
7390059	BL7	Spiked Blank	Soluble Conductivity	2014/02/21		102	%	90 - 110
7390059	BL7	Method Blank	Soluble Conductivity	2014/02/21	<0.020		dS/m	
7390059	BL7	RPD [IR9746-01]	Soluble Conductivity	2014/02/21	7.0		%	35
7390164	JBA	QC Standard	Soluble Sulphate (SO4)	2014/02/21		106	%	75 - 125
7390164	JBA	Method Blank	Soluble Sulphate (SO4)	2014/02/21	<5.0		mg/L	
7390164	JBA	RPD [IR9746-01]	Soluble Sulphate (SO4)	2014/02/21	10.8		%	35
7390195	ZI	Matrix Spike [IR9659-01]	Soluble Chloride (Cl)	2014/02/21		99	%	75 - 125
7390195	ZI	QC Standard	Soluble Chloride (Cl)	2014/02/21		86	%	75 - 125
7390195	ZI	Spiked Blank	Soluble Chloride (Cl)	2014/02/21		97	%	75 - 125
7390195	ZI	Method Blank	Soluble Chloride (Cl)	2014/02/21	<5.0		mg/L	
7390195	ZI	RPD [IR9659-01]	Soluble Chloride (Cl)	2014/02/21	2.4		%	35
7390645	ZI	Matrix Spike [IR9746-01]	Soluble Chloride (Cl)	2014/02/21		105	%	75 - 125
7390645	ZI	QC Standard	Soluble Chloride (Cl)	2014/02/21		102	%	75 - 125
7390645	ZI	Spiked Blank	Soluble Chloride (Cl)	2014/02/21	_	102	%	75 - 125
7390645	ZI	Method Blank	Soluble Chloride (Cl)	2014/02/21	<5.0		mg/L	_
7390645	ZI	RPD [IR9746-01]	Soluble Chloride (Cl)	2014/02/21	8.9		%	35

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.

QC Standard: A sample of known concentration prepared by an external agency under stringent conditions. Used as an independent check of method accuracy.

Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.



AECOM Client Project #: AB GOVERNMENT-SAFM-60309815.04 Site Location: HIGH RIVER

VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).

Cong Am

Peng Liang, Analyst II

Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

CLIENT:	Government	of Alberta						
PROJECT:	SAFM - High	River						
JOB No.:	60309815.04	ļ						
DATE :	February 10,	2014			Т	ECHNICAN :	CK/GU	
HOLE No.	14-03	14-16	14-16	14-20	14-15	14-15	14-19	14-19
DEPTH	14.3m	8.0m	17.5m	8.2m	8.0m	23.0m	8.2m	14.3m
SAMPLE No.	C3	C1	C4	C1	C1	C6	C1	C3
TARE No.								
WT. SAMPLE WET + TARE	317.4	452.7	524.6	494.0	584.0	597.2	519.0	788.2
WT. SAMPLE DRY + TARE	301.8	405.2	463.2	451.6	504.5	528.5	474.3	745.4
WT. TARE	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5
WATER CONTENT W%	5.4%	12.1%	13.7%	9.7%	16.2%	13.3%	9.7%	5.8%
HOLE No.	14-21	14-08	14-07	14-01	14-01	14-25		
DEPTH	13.0m	10.2m	9.2m	15.2m	21.2m	18.3m		
SAMPLE No.	C2	C2	C1	C1	C3	C1		
TARE No.								
WT. SAMPLE WET + TARE	676.1	439.2	540.9	716.7	678.3	670.4		
WT. SAMPLE DRY + TARE	625.0	388.3	475.2	673.6	648.3	607.6		
WT. TARE	13.5	13.0	13.3	13.3	13.3	13.3		
WATER CONTENT W%	8.4%	13.6%	14.2%	6.5%	4.7%	10.6%		
HOLE No.								
DEPTH								
SAMPLE No.								
TARE No.								
WT. SAMPLE WET + TARE								
WT. SAMPLE DRY + TARE								
WT. TARE								
WATER CONTENT W%								
HOLE No.								
DEPTH								
SAMPLE No.								
TARE No.								
WT. SAMPLE WET + TARE								
WT. SAMPLE DRY + TARE								
WT. TARE								
WATER CONTENT W%								



CLIENT:	Government	of Alberta								
PROJECT:	SAFM - High	River								
JOB No.:	60309815.04	4								
DATE :	February 10	February 10, 2014 TECHNICAN : CK/GU								
HOLE No.	14-03	14-16	14-16	14-20	14-15	14-15	14-19	14-19		
DEPTH	14.3m	8.0m	17.5m	8.2m	8.0m	23.0m	8.2m	14.3m		
SAMPLE No.	C3	C1	C4	C1	C1	C6	C1	C3		
TARE No.										
WT. SAMPLE WET + TARE	317.4	452.7	524.6	494.0	584.0	597.2	519.0	788.2		
WT. SAMPLE DRY + TARE	301.8	405.2	463.2	451.6	504.5	528.5	474.3	745.4		
WT. TARE	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5		
WATER CONTENT W%	5.4%	12.1%	13.7%	9.7%	16.2%	13.3%	9.7%	5.8%		
HOLE No.	14-21									
DEPTH	13.0m									
SAMPLE No.	C2									
TARE No.										
WT. SAMPLE WET + TARE	676.1									
WT. SAMPLE DRY + TARE	625.0									
WT. TARE	13.5									
WATER CONTENT W%	8.4%									
HOLE No.										
DEPTH										
SAMPLE No.										
TARE No.										
WT. SAMPLE WET + TARE										
WT. SAMPLE DRY + TARE										
WT. TARE										
WATER CONTENT W%										
HOLE No.										
DEPTH										
SAMPLE No.										
TARE No.										
WT. SAMPLE WET + TARE										
WT. SAMPLE DRY + TARE										
WT. TARE										
WATER CONTENT W%										



CLIENT:	Government	of Alberta						
PROJECT:	SAFM - High	River						
JOB No.:	60309815.04	Ļ						
DATE :	February 10,	2014			T	ECHNICAN :	CK/GU	
HOLE No.	14-03	14-16	14-16	14-20	14-15	14-15	14-19	14-19
DEPTH	14.3m	8.0m	17.5m	8.2m	8.0m	23.0m	8.2m	14.3m
SAMPLE No.	C3	C1	C4	C1	C1	C6	C1	C3
TARE No.								
WT. SAMPLE WET + TARE	317.4	452.7	524.6	494.0	584.0	597.2	519.0	788.2
WT. SAMPLE DRY + TARE	301.8	405.2	463.2	451.6	504.5	528.5	474.3	745.4
WT. TARE	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5
WATER CONTENT W%	5.4%	12.1%	13.7%	9.7%	16.2%	13.3%	9.7%	5.8%
HOLE No.	14-21	14-08	14-07	14-01	14-01	14-25		
DEPTH	13.0m	10.2m	9.2m	15.2m	21.2m	18.3m		
SAMPLE No.	C2	C2	C1	C1	C3	C1		
TARE No.								
WT. SAMPLE WET + TARE	676.1	439.2	540.9	716.7	678.3	670.4		
WT. SAMPLE DRY + TARE	625.0	388.3	475.2	673.6	648.3	607.6		
WT. TARE	13.5	13.0	13.3	13.3	13.3	13.3		
WATER CONTENT W%	8.4%	13.6%	14.2%	6.5%	4.7%	10.6%		
HOLE No.	14-26		14-13		14-27		14-10	
DEPTH	7.5m	8.7m	6.8m	8.3m	6.6m	8.7m	7.2m	8.8m
SAMPLE No.	C1	C1	C1	C1	C1	C1	C1	C1
TARE No.								
WT. SAMPLE WET + TARE	596.9	404.5	380.6	417.2	651.1	368.5	509.1	566.0
WT. SAMPLE DRY + TARE	514.0	362.7	353.7	389.7	575.6	321.1	477.8	535.3
WT. TARE	15.8	15.8	15.8	15.8	15.8	15.8	15.8	15.8
WATER CONTENT W%	16.6%	12.0%	8.0%	7.4%	13.5%	15.5%	6.8%	5.9%
HOLE No.	TH14-11							
DEPTH	9.3m	11.4m						
SAMPLE No.	C2	C2						
TARE No.								
WT. SAMPLE WET + TARE	511.0	403.0						
WT. SAMPLE DRY + TARE	475.1	362.2						
WT. TARE	15.8	15.8						
WATER CONTENT W%	7.8%	11.8%						



CLIENT:	Government	of Alberta						
PROJECT:	SAFM - High	River						
JOB No.:	60309815.04	ļ						
DATE :	February 26,	2014			TI	ECHNICAN :	CK/GU	
HOLE No.	14-10			14-13			TH-26	
DEPTH	6.2m	6.6	7.8m	6.5m	7.7m	9m	7.8m	8m
SAMPLE No.	R1	R1	R1	R1	R1	R1	R1	R1
TARE No.								
WT. SAMPLE WET + TARE	507.1	474.7	350.0	386.3	413.4	642.8	360.7	344.6
WT. SAMPLE DRY + TARE	454.7	407.9	325.2	355.4	351.4	611.3	335.0	320.2
WT. TARE	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5
WATER CONTENT W%	11.9%	16.9%	8.0%	9.0%	18.3%	5.3%	8.0%	8.0%
HOLE No.	TH14-26	14-27			14-11			
DEPTH	9m	7.5m	8.4m	9m	9.1m	9.6m	9.8	
SAMPLE No.	R1	R1	R1	R1	R2	R2	R2	
TARE No.								
WT. SAMPLE WET + TARE	481.3	361.7	311.9	462.1	468.7	518.7	686.0	
WT. SAMPLE DRY + TARE	433.2	319.1	270.0	414.3	457.9	477.8	631.7	
WT. TARE	13.5	13.0	13.3	13.3	13.3	13.3	13.3	
WATER CONTENT W%	11.5%	13.9%	16.3%	11.9%	2.4%	8.8%	8.8%	
HOLE No.	TH14-01				TH14-03			
DEPTH	18.6m	21.2m	22.8m	23.0m	6.2m	8.8m	9.6m	12.0m
SAMPLE No.	R2	R2	R3	R3	R1	R1	R2	R2
TARE No.								
WT. SAMPLE WET + TARE	517.6	307.9	465.0	573.6	290.2	529.6	539.1	726.8
WT. SAMPLE DRY + TARE	475.5	283.2	420.4	523.5	252.9	488.6	474.2	679.7
WT. TARE	13.4	13.4	13.4	13.4	13.4	13.4	13.4	13.4
WATER CONTENT W%	9.1%	9.2%	11.0%	9.8%	15.6%	8.6%	14.1%	7.1%
HOLE No.	TH14-03	TH14-04					TH14-05	
DEPTH	15.0m	8.2m	8.9m	9.6m	11.8m	15.0m	12.3m	14.9m
SAMPLE No.	R3	R1	R1	R2	R2	R3	R1	R1
TARE No.								
WT. SAMPLE WET + TARE	1106.6	403.8	666.1	570.6	451.8	357.8	627.4	423.0
WT. SAMPLE DRY + TARE	1046.8	347.8	612.8	490.0	427.4	336.1	598.5	397.5
WT. TARE	13.4	13.4	13.4	13.4	13.4	13.4	13.4	13.4
WATER CONTENT W%	5.8%	16.7%	8.9%	16.9%	5.9%	6.7%	4.9%	6.6%



CLIENT:	Government	of Alberta						
PROJECT:	SAFM - High	River						
JOB No.:	60309815.04							
DATE :	March 3, 201	4			Т	ECHNICAN :	CK/GU	
HOLE No.	TH14-05			TH14-08				
DEPTH	15.2m	16.6m	17.8m	6.1m	8.1m	9.2m	10.1m	14.3m
SAMPLE No.	R2	R2	R2	R1	R1	R2	R2	R3
TARE No.								
WT. SAMPLE WET + TARE	741.5	272.8	1054.3	452.0	328.0	664.5	903.4	166.2
WT. SAMPLE DRY + TARE	707.6	239.9	1002.5	421.7	306.7	620.3	798.8	147.6
WT. TARE	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5
WATER CONTENT W%	4.9%	14.5%	5.2%	7.4%	7.3%	7.3%	13.3%	13.9%
HOLE No.	TH14-15					TH14-16		
DEPTH	9.4m	10.7m	12.2m	12.9m	14.3m	7.1m	8.0m	12.4m
SAMPLE No.	R2	R2	R2	R3	R3	R1	R1	R3
TARE No.								
WT. SAMPLE WET + TARE	599.4	516.7	831.7	437.6	904.1	481.5	795.3	581.4
WT. SAMPLE DRY + TARE	552.2	470.9	812.1	386.3	824.3	453.7	706.1	542.0
WT. TARE	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5
WATER CONTENT W%	8.8%	10.0%	2.5%	13.8%	9.8%	6.3%	12.9%	7.5%
HOLE No.	TH14-16		TH14-17					TH14-19
DEPTH	13.6m	15.2m	6.3m	8.6m	12.2m	13.6m	15.3m	6.3m
SAMPLE No.	R3	R3	R1	R1	R3	R3	R4	R1
TARE No.								
WT. SAMPLE WET + TARE	657.2	696.1	669.4	739.0	753.3	637.1	470.7	517.0
WT. SAMPLE DRY + TARE	592.4	622.6	605.8	696.3	706.0	564.5	451.0	455.0
WT. TARE	13.4	13.4	13.4	13.4	13.4	13.4	13.4	13.4
WATER CONTENT W%	11.2%	12.1%	10.7%	6.3%	6.8%	13.2%	4.5%	14.0%
HOLE No.	TH14-19				TH14-20			
DEPTH	10.1m	11.1m	12.4m	14.7m	7.1m	9.4m	11.9m	12.6m
SAMPLE No.	R2	R2	R3	R3	R1	R2	R2	R3
TARE No.								
WT. SAMPLE WET + TARE	858.7	226.9	718.8	792.5	883.0	399.4	469.6	1021.5
WT. SAMPLE DRY + TARE	794.2	214.5	628.7	742.1	864.7	355.2	419.4	982.4
WT. TARE	13.4	13.4	13.4	13.4	13.4	13.4	13.4	13.4
WATER CONTENT W%	8.3%	6.2%	14.6%	6.9%	2.1%	12.9%	12.4%	4.0%



CLIENT:	Government	of Alberta						
PROJECT:	SAFM - High	River						
JOB No.:	60309815.04	ļ						
DATE :	March 3, 201	4			Ţ	ECHNICAN :	CK/GU	
HOLE No.	TH14-20	TH14-21					TH14-06	
DEPTH	14.8m	9.6m	12.4m	13.4m	13.6m	15.0m	6.8m	7.7m
SAMPLE No.	R3	R1&R2	R1&R2	R1&R2	R3	R3	R1	R1
TARE No.								
WT. SAMPLE WET + TARE	730.1	710.2	527.0	895.6	449.1	609.7	593.7	477.1
WT. SAMPLE DRY + TARE	655.1	701.7	495.0	834.4	402.1	587.0	525.2	435.2
WT. TARE	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5
WATER CONTENT W%	11.7%	1.2%	6.6%	7.5%	12.1%	4.0%	13.4%	9.9%
HOLE No.	TH14-06			TH14-07				
DEPTH	8.5m	9.5m	12.0m	9.3m	10.1m	12.2m	13.2m	15.0m
SAMPLE No.	R1	R2	R2	R1	R1	R1	R2	R2
TARE No.								
WT. SAMPLE WET + TARE	981.9	517.8	335.3	465.2	599.4	393.4	427.5	427.5
WT. SAMPLE DRY + TARE	928.6	476.2	294.4	414.2	560.0	350.8	383.3	388.8
WT. TARE	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5
WATER CONTENT W%	5.8%	9.0%	14.6%	12.7%	7.2%	12.6%	12.0%	10.3%
HOLE No.	TH14-12					TH14-14		
DEPTH	8.5m	6.8m	10.4m	11.1m	14.0m	7.3m	7.8m	9.0m
SAMPLE No.	R1	R1	R2	R2	R3	R1	R1	R1
TARE No.								
WT. SAMPLE WET + TARE	496.0	475.0	349.9	554.1	579.3	514.9	418.6	729.3
WT. SAMPLE DRY + TARE	428.0	443.6	331.8	501.8	542.6	468.1	357.3	691.4
WT. TARE	13.4	13.4	13.4	13.4	13.4	13.4	13.4	13.4
WATER CONTENT W%	16.4%	7.3%	5.7%	10.7%	6.9%	10.3%	17.8%	5.6%
HOLE No.	TH14-14		TH14-18					TH14-25
DEPTH	10.0m	11.5m	9.4m	12.3m	14.7m	16.1m	17.0m	18.4m
SAMPLE No.	R2	R2	R1	R2	R2	R3	R3	R1
TARE No.								
WT. SAMPLE WET + TARE	634.0	467.9	562.6	426.4	458.0	572.5	641.3	591.9
WT. SAMPLE DRY + TARE	560.3	432.8	489.6	395.8	410.1	543.9	596.6	547.4
WT. TARE	13.4	13.4	13.4	13.4	13.4	13.4	13.4	13.4
WATER CONTENT W%	13.5%	8.4%	15.3%	8.0%	12.1%	5.4%	7.7%	8.3%



CLIENT:	Government of Alberta										
PROJECT:	SAFM - High	River									
JOB No.:	60309815.04										
DATE :	March 3, 201	March 3, 2014 TECHNICAN : CK/GU									
HOLE No.	TH14-25	TH14-25									
DEPTH	21.0m	22.0m	23.5m	25.6m							
SAMPLE No.	R1	R2	R2	R3							
TARE No.											
WT. SAMPLE WET + TARE	482.8	479.6	705.5	490.8							
WT. SAMPLE DRY + TARE	445.3	448.4	661.5	418.7							
WT. TARE	13.5	13.5	13.5	13.5							
WATER CONTENT W%	8.7%	7.2%	6.8%	17.8%							
HOLE No.											
DEPTH											
SAMPLE No.											
TARE No.											
WT. SAMPLE WET + TARE											
WT. SAMPLE DRY + TARE											
WT. TARE											
WATER CONTENT W%											
HOLE No.											
DEPTH											
SAMPLE No.											
TARE No.											
WT. SAMPLE WET + TARE											
WT. SAMPLE DRY + TARE											
WT. TARE											
WATER CONTENT W%											
HOLE No.											
DEPTH											
SAMPLE No.											
TARE No.											
WT. SAMPLE WET + TARE											
WT. SAMPLE DRY + TARE											
WT. TARE											
WATER CONTENT W%											

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CLIENT:	Government	of Alberta						
PROJECT:	SAFM - High	River						
JOB No.:	60309815.04	ļ						
DATE :	February 26,	2014			Т	ECHNICAN :	CK/GU	
HOLE No.	14-10			14-13			TH-26	
DEPTH	6.2m	6.6	7.8m	6.5m	7.7m	9m	7.8m	8m
SAMPLE No.	R1	R1	R1	R1	R1	R1	R1	R1
TARE No.								
WT. SAMPLE WET + TARE	507.1	474.7	350.0	386.3	413.4	642.8	360.7	344.6
WT. SAMPLE DRY + TARE	454.7	407.9	325.2	355.4	351.4	611.3	335.0	320.2
WT. TARE	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5
WATER CONTENT W%	11.9%	16.9%	8.0%	9.0%	18.3%	5.3%	8.0%	8.0%
HOLE No.	TH14-26	14-27			14-11			
DEPTH	9m	7.5m	8.4m	9m	9.1m	9.6m	9.8	
SAMPLE No.	R1	R1	R1	R1	R2	R2	R2	
TARE No.								
WT. SAMPLE WET + TARE	481.3	361.7	311.9	462.1	468.7	518.7	686.0	
WT. SAMPLE DRY + TARE	433.2	319.1	270.0	414.3	457.9	477.8	631.7	
WT. TARE	13.5	13.0	13.3	13.3	13.3	13.3	13.3	
WATER CONTENT W%	11.5%	13.9%	16.3%	11.9%	2.4%	8.8%	8.8%	
HOLE No.								
DEPTH								
SAMPLE No.								
TARE No.								
WT. SAMPLE WET + TARE								
WT. SAMPLE DRY + TARE								
WT. TARE								
WATER CONTENT W%								
HOLE No.								
DEPTH								
SAMPLE No.								
TARE No.								
WT. SAMPLE WET + TARE								
WT. SAMPLE DRY + TARE								
WT. TARE								
WATER CONTENT W%								



CLIENT:	Government	of Alberta						
PROJECT:	SAFM - High	River						
JOB No.:	60309815.04	-						
DATE :	January 30, 2	2014			Т	ECHNICAN :	CK/GU	
HOLE No.	TH14-02							
DEPTH								
SAMPLE No.	1	2	3	4	5	6	7	8
TARE No.								
WT. SAMPLE WET + TARE	633.4	584.5	389.7	580.2	512.9	607.7	442.3	553.5
WT. SAMPLE DRY + TARE	507.6	543.6	370.8	544.2	487.2	579.2	424.2	524.5
WT. TARE	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5
WATER CONTENT W%	25.5%	7.7%	5.3%	6.8%	5.4%	5.0%	4.4%	5.7%
HOLE No.	TH14-02							
DEPTH								
SAMPLE No.	9	10	11	12	13	14	15	16
TARE No.								
WT. SAMPLE WET + TARE	606.1	768.1	794.0	749.6	784.0	735.1	658.6	732.9
WT. SAMPLE DRY + TARE	573.2	716.3	739.7	707.5	732.5	691.6	606.6	673.4
WT. TARE	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5
WATER CONTENT W%	5.9%	7.4%	7.5%	6.1%	7.2%	6.4%	8.8%	9.0%
HOLE No.	TH14-02					TH14-03		
DEPTH								
SAMPLE No.	17	18	19	20	21	1	2	3
TARE No.								
WT. SAMPLE WET + TARE	725.5	656.5	494.5	626.8	798.6	389.3	470.7	408.8
WT. SAMPLE DRY + TARE	676.4	515.4	469.1	583.2	731.1	292.0	372.4	355.5
WT. TARE	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5
WATER CONTENT W%	7.4%	28.1%	5.6%	7.7%	9.4%	34.9%	27.4%	15.6%
HOLE No.	TH14-03						TH14-04	
DEPTH								
SAMPLE No.	4	5	6	7	8	9	1	2
TARE No.								
WT. SAMPLE WET + TARE	645.4	757.2	578.0	192.8	794.1	421.8	517.9	469.3
WT. SAMPLE DRY + TARE	581.6	695.3	531.6	175.6	702.9	366.5	432.8	382.9
WT. TARE	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5
WATER CONTENT W%	11.2%	9.1%	9.0%	10.6%	13.2%	15.7%	20.3%	23.4%



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HOLE No.	TH04-04							
DEPTH								
SAMPLE No.	3	4	5	6	7	8	9	10
TARE No.								
WT. SAMPLE WET + TARE	370.3	576.5	563.2	454.9	197.7	481.1	228.6	550.2
WT. SAMPLE DRY + TARE	358.4	514.7	510.2	396.7	174.7	428.2	199.7	486.2
WT. TARE	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5
WATER CONTENT W%	3.5%	12.3%	10.7%	15.2%	14.3%	12.8%	15.5%	13.5%
HOLE No.	TH14-04	TH14-05						
DEPTH								
SAMPLE No.	11	1	2	3	4	5	6	7
TARE No.								
WT. SAMPLE WET + TARE	310.0	538.6	522.7	314.8	627.0	380.5	615.8	504.0
WT. SAMPLE DRY + TARE	268.1	490.3	475.6	282.5	523.8	323.6	533.0	433.2
WT. TARE	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5
WATER CONTENT W%	16.5%	10.1%	10.2%	12.0%	20.2%	18.3%	15.9%	16.9%
HOLE No.	TH14-05							
DEPTH								
SAMPLE No.	8	9	10	11	12	13	14	15
TARE No.								
WT. SAMPLE WET + TARE	712.7	461.5	509.8	580.8	526.2	660.6	546.7	558.0
WT. SAMPLE DRY + TARE	612.5	383.5	432.7	498.7	432.6	589.1	407.8	469.4
WT. TARE	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5
WATER CONTENT W%	16.7%	21.1%	18.4%	16.9%	22.3%	12.4%	35.2%	19.4%
HOLE No.	TH14-05		TH14-06					
DEPTH								
SAMPLE No.	16	17	1	2	3	4	5	6
TARE No.								
WT. SAMPLE WET + TARE	586.9	274.4	639.4	538.9	595.2	657.6	591.5	585.9
WT. SAMPLE DRY + TARE	524.0	241.2	548.3	472.3	508.3	565.4	498.6	507.2
WT. TARE	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5
WATER CONTENT W%	12.3%	14.6%	17.0%	14.5%	17.6%	16.7%	19.2%	15.9%



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HOLE No.	TH14-06					TH14-07		
DEPTH								
SAMPLE No.	7	8	9	10	11	1	2	3
TARE No.								
WT. SAMPLE WET + TARE	534.6	632.6	507.9	537.6	78.1	680.9	647.9	257.4
WT. SAMPLE DRY + TARE	472.8	560.6	444.7	487.4	73.9	506.0	465.3	236.1
WT. TARE	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5
WATER CONTENT W%	13.5%	13.2%	14.7%	10.6%	7.0%	35.5%	40.4%	9.6%
HOLE No.	TH14-07							
DEPTH								
SAMPLE No.	4	5	6	7	8	9	10	11
TARE No.								
WT. SAMPLE WET + TARE	741.7	656.7	421.0	804.1	780.8	417.0	580.3	580.7
WT. SAMPLE DRY + TARE	645.8	588.0	362.1	711.3	692.1	383.2	528.3	477.0
WT. TARE	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5
WATER CONTENT W%	15.2%	12.0%	16.9%	13.3%	13.1%	9.1%	10.1%	22.4%
HOLE No.	TH14-07	TH14-08						
DEPTH								
SAMPLE No.	12	1	2	3	4	5	6	7
TARE No.								
WT. SAMPLE WET + TARE	589.1	607.7	599.9	480.0	659.3	523.0	726.1	549.1
WT. SAMPLE DRY + TARE	487.5	498.8	503.0	453.7	614.4	477.7	643.5	497.2
WT. TARE	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5
WATER CONTENT W%	21.4%	22.4%	19.8%	6.0%	7.5%	9.8%	13.1%	10.7%
HOLE No.	TH14-08		TH14-14					
DEPTH								
SAMPLE No.	8	9	1	2	3	4	5	6
TARE No.								
WT. SAMPLE WET + TARE	401.9	615.3	637.7	569.8	630.7	612.6	591.6	605.1
WT. SAMPLE DRY + TARE	366.2	572.9	545.6	469.1	545.5	522.0	515.2	530.9
WT. TARE	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5
WATER CONTENT W%	10.1%	7.6%	17.3%	22.1%	16.0%	17.8%	15.2%	14.3%



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HOLE No.	TH14-14			TH14-15							
DEPTH											
SAMPLE No.	7	9	10	1	2	3	4	5			
TARE No.											
WT. SAMPLE WET + TARE	447.2	492.8	553.0	489.4	622.5	269.3	458.9	505.9			
WT. SAMPLE DRY + TARE	390.4	412.0	463.6	425.0	589.4	254.0	393.9	447.2			
WT. TARE	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5			
WATER CONTENT W%	15.1%	20.3%	19.9%	15.7%	5.7%	6.4%	17.1%	13.5%			
HOLE No.	TH14-15				TH14-16						
DEPTH											
SAMPLE No.	6	7	8	9	1	2	3	4			
TARE No.											
WT. SAMPLE WET + TARE	521.1	202.5	507.0	189.1	721.0	576.6	1618.9	700.7			
WT. SAMPLE DRY + TARE	455.0	181.1	458.8	164.4	692.0	525.5	1519.4	614.5			
WT. TARE	13.5	13.5	13.5	13.5	13.5	13.5	252.3	13.5			
WATER CONTENT W%	15.0%	12.8%	10.8%	16.4%	4.3%	10.0%	7.9%	14.3%			
HOLE No.	TH14-16					TH14-17					
DEPTH											
SAMPLE No.	5	6	7	8	9	1	2	3			
TARE No.											
WT. SAMPLE WET + TARE	539.4	517.1	572.0	600.5	135.2	670.0	678.7	548.4			
WT. SAMPLE DRY + TARE	477.1	457.1	505.0	559.7	127.7	618.6	625.1	477.9			
WT. TARE	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5			
WATER CONTENT W%	13.4%	13.5%	13.6%	7.5%	6.6%	8.5%	8.8%	15.2%			
HOLE No.	TH14-17						TH14-18				
DEPTH											
SAMPLE No.	4	5	6	7	8	9	1	2			
TARE No.											
WT. SAMPLE WET + TARE	616.8	640.7	534.6	447.1	701.1	205.4	642.9	641.0			
WT. SAMPLE DRY + TARE	520.5	560.6	454.1	398.3	581.5	189.0	618.3	610.4			
WT. TARE	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5			
WATER CONTENT W%	19.0%	14.6%	18.3%	12.7%	21.1%	9.3%	4.1%	5.1%			



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HOLE No.	TH14-18										
DEPTH											
SAMPLE No.	3	4	5	6	7	8	9	10			
TARE No.											
WT. SAMPLE WET + TARE	403.3	572.2	364.9	588.5	585.7	476.3	595.5	582.2			
WT. SAMPLE DRY + TARE	355.1	542.6	326.4	546.5	518.0	427.3	521.5	506.0			
WT. TARE	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5			
WATER CONTENT W%	14.1%	5.6%	12.3%	7.9%	13.4%	11.8%	14.6%	15.5%			
HOLE No.	TH14-18			TH14-19							
DEPTH											
SAMPLE No.	11	12	13	1	2	3	4	5			
TARE No.											
WT. SAMPLE WET + TARE	571.5	628.9	427.4	388.1	673.1	502.5	663.2	515.6			
WT. SAMPLE DRY + TARE	500.1	560.9	367.2	288.7	543.8	414.1	537.6	445.4			
WT. TARE	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5			
WATER CONTENT W%	14.7%	12.4%	17.0%	36.1%	24.4%	22.1%	24.0%	16.3%			
HOLE No.	TH14-19				TH14-20						
DEPTH											
SAMPLE No.	6	7	8	9	1	2	3	4			
TARE No.											
WT. SAMPLE WET + TARE	549.7	475.2	539.3	319.1	421.9	435.0	382.4	544.3			
WT. SAMPLE DRY + TARE	477.9	420.9	474.7	275.9	333.2	336.9	308.4	446.1			
WT. TARE	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5			
WATER CONTENT W%	15.5%	13.3%	14.0%	16.5%	27.7%	30.3%	25.1%	22.7%			
HOLE No.	TH14-20					TH14-21					
DEPTH											
SAMPLE No.	5	6	7	8	9	1	2	3			
TARE No.											
WT. SAMPLE WET + TARE	538.7	625.1	339.0	411.7	280.0	549.0	377.1	376.7			
WT. SAMPLE DRY + TARE	491.7	531.1	303.1	359.9	248.1	447.1	303.7	296.0			
WT. TARE	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5			
WATER CONTENT W%	9.8%	18.2%	12.4%	15.0%	13.6%	23.5%	25.3%	28.6%			



CLIENT:	Government	Government of Alberta								
PROJECT:	SAFM - High	River								
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DATE :	January 30, 2	2014			Ţ	ECHNICAN :	CK/GU			
HOLE No.	TH14-21									
DEPTH										
SAMPLE No.	4	5	6	7	8	9	10	11		
TARE No.										
WT. SAMPLE WET + TARE	438.1	561.6	660.7	464.1	523.6	400.3	371.5	285.0		
WT. SAMPLE DRY + TARE	342.3	459.3	551.9	387.5	461.0	335.9	314.2	249.7		
WT. TARE	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5		
WATER CONTENT W%	29.1%	22.9%	20.2%	20.5%	14.0%	20.0%	19.1%	14.9%		
HOLE No.	TH14-21									
DEPTH										
SAMPLE No.	12	13								
TARE No.										
WT. SAMPLE WET + TARE	443.6	268.1								
WT. SAMPLE DRY + TARE	369.9	235.6								
WT. TARE	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5		
WATER CONTENT W%	20.7%	14.6%								
HOLE No.										
DEPTH										
SAMPLE No.										
TARE No.										
WT. SAMPLE WET + TARE										
WT. SAMPLE DRY + TARE										
WT. TARE	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5		
WATER CONTENT W%										
HOLE No.										
DEPTH										
SAMPLE No.										
TARE No.										
WT. SAMPLE WET + TARE										
WT. SAMPLE DRY + TARE										
WT. TARE	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5		
WATER CONTENT W%										



CLIENT:	Government	Government of Alberta									
PROJECT:	SAFM - High	River									
JOB No.:	60309815.04	ļ									
DATE :	February 18,	2014			Т	ECHNICAN :	CK/GU				
HOLE No.	TH14-10										
DEPTH											
SAMPLE No.	1	2	3	4	5	6	7	8			
TARE No.											
WT. SAMPLE WET + TARE	459.7	615.5	514.2	501.2	564.5	642.8	549.2	604.4			
WT. SAMPLE DRY + TARE	405.9	538.8	441.0	423.7	488.5	568.9	483.5	522.8			
WT. TARE	13.4	13.4	13.4	13.4	13.4	13.4	13.4	13.4			
WATER CONTENT W%	13.7%	14.6%	17.1%	18.9%	16.0%	13.3%	14.0%	16.0%			
HOLE No.	TH14-10			TH14-11							
DEPTH											
SAMPLE No.	9	10	11	1	2	3	4	5			
TARE No.											
WT. SAMPLE WET + TARE	561.4	594.7	322.3	426.5	418.4	323.0	558.0	449.0			
WT. SAMPLE DRY + TARE	514.5	556.8	298.2	401.5	393.0	299.3	516.9	410.3			
WT. TARE	13.4	13.4	13.4	13.4	13.4	13.4	13.4	13.4			
WATER CONTENT W%	9.4%	7.0%	8.5%	6.4%	6.7%	8.3%	8.2%	9.8%			
HOLE No.	TH14-11						TH14-13				
DEPTH											
SAMPLE No.	6	7	8	9	10	11	1	2			
TARE No.											
WT. SAMPLE WET + TARE	641.3	473.3	538.4	408.4	599.3	472.2	576.0	555.4			
WT. SAMPLE DRY + TARE	582.0	389.7	449.0	357.5	536.5	421.8	509.4	492.1			
WT. TARE	13.4	13.4	13.4	13.4	13.4	13.4	13.4	13.4			
WATER CONTENT W%	10.4%	22.2%	20.5%	14.8%	12.0%	12.3%	13.4%	13.2%			
HOLE No.	TH14-13										
DEPTH											
SAMPLE No.	3	4	5	6	7	8	9				
TARE No.											
WT. SAMPLE WET + TARE	471.9	626.1	444.6	544.2	613.6	480.1	443.8				
WT. SAMPLE DRY + TARE	385.7	536.0	380.0	469.4	521.5	420.4	388.5				
WT. TARE	13.4	13.4	13.4	13.4	13.4	13.4	13.4				
WATER CONTENT W%	23.2%	17.2%	17.6%	16.4%	18.1%	14.7%	14.7%				



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HOLE No.	TH14-26							
DEPTH								
SAMPLE No.	1	2	3	4	5	6	7	8
TARE No.								
WT. SAMPLE WET + TARE	521.7	645.0	504.9	545.5	562.5	587.5	335.8	635.9
WT. SAMPLE DRY + TARE	499.9	626.6	487.0	520.5	492.9	482.8	299.2	517.7
WT. TARE	13.4	13.4	13.4	13.4	13.4	13.4	13.4	13.4
WATER CONTENT W%	4.5%	3.0%	3.8%	4.9%	14.5%	22.3%	12.8%	23.4%
HOLE No.	TH14-26			TH14-27				
DEPTH								
SAMPLE No.	9	10	11	1	2	3	4	5
TARE No.								
WT. SAMPLE WET + TARE	567.9	560.9	342.5	510.8	573.5	366.3	482.2	562.3
WT. SAMPLE DRY + TARE	487.6	494.7	304.1	485.1	547.0	322.3	423.7	510.1
WT. TARE	13.4	13.4	13.4	13.4	13.4	13.4	13.4	13.4
WATER CONTENT W%	16.9%	13.8%	13.2%	5.4%	5.0%	14.2%	14.3%	10.5%
HOLE No.	TH14-27							
DEPTH								
SAMPLE No.	6	7	8	9	10	11		
TARE No.								
WT. SAMPLE WET + TARE	509.4	483.1	577.6	521.8	510.8	469.8		
WT. SAMPLE DRY + TARE	434.0	413.5	501.4	464.6	466.9	409.5		
WT. TARE	13.4	13.4	13.4	13.4	13.4	13.4		
WATER CONTENT W%	17.9%	17.4%	15.6%	12.7%	9.7%	15.2%		
HOLE No.								
DEPTH								
SAMPLE No.								
TARE No.								
WT. SAMPLE WET + TARE								
WT. SAMPLE DRY + TARE								
WT. TARE								
WATER CONTENT W%								



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HOLE No.	TH14-02										
DEPTH											
SAMPLE No.	1	2	3	4	5	6	7	8			
TARE No.											
WT. SAMPLE WET + TARE	633.4	584.5	389.7	580.2	512.9	607.7	442.3	553.5			
WT. SAMPLE DRY + TARE	507.6	543.6	370.8	544.2	487.2	579.2	424.2	524.5			
WT. TARE	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5			
WATER CONTENT W%	25.5%	7.7%	5.3%	6.8%	5.4%	5.0%	4.4%	5.7%			
HOLE No.	TH14-02										
DEPTH											
SAMPLE No.	9	10	11	12	13	14	15	16			
TARE No.											
WT. SAMPLE WET + TARE	606.1	768.1	794.0	749.6	784.0	735.1	658.6	732.9			
WT. SAMPLE DRY + TARE	573.2	716.3	739.7	707.5	732.5	691.6	606.6	673.4			
WT. TARE	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5			
WATER CONTENT W%	5.9%	7.4%	7.5%	6.1%	7.2%	6.4%	8.8%	9.0%			
HOLE No.	TH14-02					TH14-03					
DEPTH											
SAMPLE No.	17	18	19	20	21	1	2	3			
TARE No.											
WT. SAMPLE WET + TARE	725.5	656.5	494.5	626.8	798.6	389.3	470.7	408.8			
WT. SAMPLE DRY + TARE	676.4	515.4	469.1	583.2	731.1	292.0	372.4	355.5			
WT. TARE	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5			
WATER CONTENT W%	7.4%	28.1%	5.6%	7.7%	9.4%	34.9%	27.4%	15.6%			
HOLE No.	TH14-03						TH14-04				
DEPTH											
SAMPLE No.	4	5	6	7	8	9	1	2			
TARE No.											
WT. SAMPLE WET + TARE	645.4	757.2	578.0	192.8	794.1	421.8	517.9	469.3			
WT. SAMPLE DRY + TARE	581.6	695.3	531.6	175.6	702.9	366.5	432.8	382.9			
WT. TARE	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5			
WATER CONTENT W%	11.2%	9.1%	9.0%	10.6%	13.2%	15.7%	20.3%	23.4%			



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HOLE No.	TH04-04							
DEPTH								
SAMPLE No.	3	4	5	6	7	8	9	10
TARE No.								
WT. SAMPLE WET + TARE	370.3	576.5	563.2	454.9	197.7	481.1	228.6	550.2
WT. SAMPLE DRY + TARE	358.4	514.7	510.2	396.7	174.7	428.2	199.7	486.2
WT. TARE	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5
WATER CONTENT W%	3.5%	12.3%	10.7%	15.2%	14.3%	12.8%	15.5%	13.5%
HOLE No.	TH14-04	TH14-05						
DEPTH								
SAMPLE No.	11	1	2	3	4	5	6	7
TARE No.								
WT. SAMPLE WET + TARE	310.0	538.6	522.7	314.8	627.0	380.5	615.8	504.0
WT. SAMPLE DRY + TARE	268.1	490.3	475.6	282.5	523.8	323.6	533.0	433.2
WT. TARE	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5
WATER CONTENT W%	16.5%	10.1%	10.2%	12.0%	20.2%	18.3%	15.9%	16.9%
HOLE No.	TH14-05							
DEPTH								
SAMPLE No.	8	9	10	11	12	13	14	15
TARE No.								
WT. SAMPLE WET + TARE	712.7	461.5	509.8	580.8	526.2	660.6	546.7	558.0
WT. SAMPLE DRY + TARE	612.5	383.5	432.7	498.7	432.6	589.1	407.8	469.4
WT. TARE	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5
WATER CONTENT W%	16.7%	21.1%	18.4%	16.9%	22.3%	12.4%	35.2%	19.4%
HOLE No.	TH14-05		TH14-06					
DEPTH								
SAMPLE No.	16	17	1	2	3	4	5	6
TARE No.								
WT. SAMPLE WET + TARE	586.9	274.4	639.4	538.9	595.2	657.6	591.5	585.9
WT. SAMPLE DRY + TARE	524.0	241.2	548.3	472.3	508.3	565.4	498.6	507.2
WT. TARE	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5
WATER CONTENT W%	12.3%	14.6%	17.0%	14.5%	17.6%	16.7%	19.2%	15.9%



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HOLE No.	TH14-06					TH14-07		
DEPTH								
SAMPLE No.	7	8	9	10	11	1	2	3
TARE No.								
WT. SAMPLE WET + TARE	534.6	632.6	507.9	537.6	78.1	680.9	647.9	257.4
WT. SAMPLE DRY + TARE	472.8	560.6	444.7	487.4	73.9	506.0	465.3	236.1
WT. TARE	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5
WATER CONTENT W%	13.5%	13.2%	14.7%	10.6%	7.0%	35.5%	40.4%	9.6%
HOLE No.	TH14-07							
DEPTH								
SAMPLE No.	4	5	6	7	8	9	10	11
TARE No.								
WT. SAMPLE WET + TARE	741.7	656.7	421.0	804.1	780.8	417.0	580.3	580.7
WT. SAMPLE DRY + TARE	645.8	588.0	362.1	711.3	692.1	383.2	528.3	477.0
WT. TARE	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5
WATER CONTENT W%	15.2%	12.0%	16.9%	13.3%	13.1%	9.1%	10.1%	22.4%
HOLE No.	TH14-07	TH14-08						
DEPTH								
SAMPLE No.	12	1	2	3	4	5	6	7
TARE No.								
WT. SAMPLE WET + TARE	589.1	607.7	599.9	480.0	659.3	523.0	726.1	549.1
WT. SAMPLE DRY + TARE	487.5	498.8	503.0	453.7	614.4	477.7	643.5	497.2
WT. TARE	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5
WATER CONTENT W%	21.4%	22.4%	19.8%	6.0%	7.5%	9.8%	13.1%	10.7%
HOLE No.	TH14-08		TH14-14					
DEPTH								
SAMPLE No.	8	9	1	2	3	4	5	6
TARE No.								
WT. SAMPLE WET + TARE	401.9	615.3	637.7	569.8	630.7	612.6	591.6	605.1
WT. SAMPLE DRY + TARE	366.2	572.9	545.6	469.1	545.5	522.0	515.2	530.9
WT. TARE	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5
WATER CONTENT W%	10.1%	7.6%	17.3%	22.1%	16.0%	17.8%	15.2%	14.3%



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HOLE No.	TH14-14			TH14-15							
DEPTH											
SAMPLE No.	7	9	10	1	2	3	4	5			
TARE No.											
WT. SAMPLE WET + TARE	447.2	492.8	553.0	489.4	622.5	269.3	458.9	505.9			
WT. SAMPLE DRY + TARE	390.4	412.0	463.6	425.0	589.4	254.0	393.9	447.2			
WT. TARE	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5			
WATER CONTENT W%	15.1%	20.3%	19.9%	15.7%	5.7%	6.4%	17.1%	13.5%			
HOLE No.	TH14-15				TH14-16						
DEPTH											
SAMPLE No.	6	7	8	9	1	2	3	4			
TARE No.											
WT. SAMPLE WET + TARE	521.1	202.5	507.0	189.1	721.0	576.6	1618.9	700.7			
WT. SAMPLE DRY + TARE	455.0	181.1	458.8	164.4	692.0	525.5	1519.4	614.5			
WT. TARE	13.5	13.5	13.5	13.5	13.5	13.5	252.3	13.5			
WATER CONTENT W%	15.0%	12.8%	10.8%	16.4%	4.3%	10.0%	7.9%	14.3%			
HOLE No.	TH14-16					TH14-17					
DEPTH											
SAMPLE No.	5	6	7	8	9	1	2	3			
TARE No.											
WT. SAMPLE WET + TARE	539.4	517.1	572.0	600.5	135.2	670.0	678.7	548.4			
WT. SAMPLE DRY + TARE	477.1	457.1	505.0	559.7	127.7	618.6	625.1	477.9			
WT. TARE	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5			
WATER CONTENT W%	13.4%	13.5%	13.6%	7.5%	6.6%	8.5%	8.8%	15.2%			
HOLE No.	TH14-17						TH14-18				
DEPTH											
SAMPLE No.	4	5	6	7	8	9	1	2			
TARE No.											
WT. SAMPLE WET + TARE	616.8	640.7	534.6	447.1	701.1	205.4	642.9	641.0			
WT. SAMPLE DRY + TARE	520.5	560.6	454.1	398.3	581.5	189.0	618.3	610.4			
WT. TARE	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5			
WATER CONTENT W%	19.0%	14.6%	18.3%	12.7%	21.1%	9.3%	4.1%	5.1%			



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HOLE No.	TH14-18							
DEPTH								
SAMPLE No.	3	4	5	6	7	8	9	10
TARE No.								
WT. SAMPLE WET + TARE	403.3	572.2	364.9	588.5	585.7	476.3	595.5	582.2
WT. SAMPLE DRY + TARE	355.1	542.6	326.4	546.5	518.0	427.3	521.5	506.0
WT. TARE	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5
WATER CONTENT W%	14.1%	5.6%	12.3%	7.9%	13.4%	11.8%	14.6%	15.5%
HOLE No.	TH14-18			TH14-19				
DEPTH								
SAMPLE No.	11	12	13	1	2	3	4	5
TARE No.								
WT. SAMPLE WET + TARE	571.5	628.9	427.4	388.1	673.1	502.5	663.2	515.6
WT. SAMPLE DRY + TARE	500.1	560.9	367.2	288.7	543.8	414.1	537.6	445.4
WT. TARE	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5
WATER CONTENT W%	14.7%	12.4%	17.0%	36.1%	24.4%	22.1%	24.0%	16.3%
HOLE No.	TH14-19				TH14-20			
DEPTH								
SAMPLE No.	6	7	8	9	1	2	3	4
TARE No.								
WT. SAMPLE WET + TARE	549.7	475.2	539.3	319.1	421.9	435.0	382.4	544.3
WT. SAMPLE DRY + TARE	477.9	420.9	474.7	275.9	333.2	336.9	308.4	446.1
WT. TARE	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5
WATER CONTENT W%	15.5%	13.3%	14.0%	16.5%	27.7%	30.3%	25.1%	22.7%
HOLE No.	TH14-20					TH14-21		
DEPTH								
SAMPLE No.	5	6	7	8	9	1	2	3
TARE No.								
WT. SAMPLE WET + TARE	538.7	625.1	339.0	411.7	280.0	549.0	377.1	376.7
WT. SAMPLE DRY + TARE	491.7	531.1	303.1	359.9	248.1	447.1	303.7	296.0
WT. TARE	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5
WATER CONTENT W%	9.8%	18.2%	12.4%	15.0%	13.6%	23.5%	25.3%	28.6%



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HOLE No.	TH14-21							
DEPTH								
SAMPLE No.	4	5	6	7	8	9	10	11
TARE No.								
WT. SAMPLE WET + TARE	438.1	561.6	660.7	464.1	523.6	400.3	371.5	285.0
WT. SAMPLE DRY + TARE	342.3	459.3	551.9	387.5	461.0	335.9	314.2	249.7
WT. TARE	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5
WATER CONTENT W%	29.1%	22.9%	20.2%	20.5%	14.0%	20.0%	19.1%	14.9%
HOLE No.	TH14-21		TH14-12					
DEPTH								
SAMPLE No.	12	13	1	2	3	4	5	6
TARE No.								
WT. SAMPLE WET + TARE	443.6	268.1	480.0	471.2	361.8	637.8	445.1	664.0
WT. SAMPLE DRY + TARE	369.9	235.6	452.5	435.9	335.0	521.9	361.0	538.4
WT. TARE	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5
WATER CONTENT W%	20.7%	14.6%	6.3%	8.4%	8.3%	22.8%	24.2%	23.9%
HOLE No.	TH14-12					TH14-24		
DEPTH								
SAMPLE No.	7	8	9	10	11	1	2	3
TARE No.								
WT. SAMPLE WET + TARE	539.2	378.7	288.1	581.5	198.3	375.0	508.3	296.6
WT. SAMPLE DRY + TARE	444.2	314.2	257.6	489.6	171.5	356.8	464.7	282.6
WT. TARE	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5
WATER CONTENT W%	22.1%	21.4%	12.5%	19.3%	17.0%	5.3%	9.7%	5.2%
HOLE No.	TH14-24							
DEPTH								
SAMPLE No.	4	5	6	7	8	9	10	11
TARE No.								
WT. SAMPLE WET + TARE	535.3	366.5	515.7	568.1	535.4	433.9	479.9	356.4
WT. SAMPLE DRY + TARE	478.7	317.9	458.0	509.6	468.3	385.9	402.0	302.5
WT. TARE	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5
WATER CONTENT W%	12.2%	16.0%	13.0%	11.8%	14.8%	12.9%	20.1%	18.7%



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HOLE No.	TH14-24											
DEPTH												
SAMPLE No.	12	13	14	15	16	18	19	20				
TARE No.												
WT. SAMPLE WET + TARE	560.7	556.0	564.5	254.1	560.2	520.0	449.1	550.2				
WT. SAMPLE DRY + TARE	447.0	448.0	459.3	217.4	457.4	444.8	378.2	454.7				
WT. TARE	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5				
WATER CONTENT W%	26.2%	24.9%	23.6%	18.0%	23.2%	17.4%	19.4%	21.6%				
HOLE No.	TH14-25											
DEPTH												
SAMPLE No.	1	2	3	4	5	6	7	8				
TARE No.												
WT. SAMPLE WET + TARE	371.1	509.0	358.8	417.2	326.8	537.6	611.7	609.1				
WT. SAMPLE DRY + TARE	331.5	460.3	297.6	333.6	263.5	439.8	518.5	484.0				
WT. TARE	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5				
WATER CONTENT W%	12.5%	10.9%	21.5%	26.1%	25.3%	22.9%	18.5%	26.6%				
HOLE No.	TH14-25											
DEPTH												
SAMPLE No.	9	10	11	12	13	14	15	16				
TARE No.												
WT. SAMPLE WET + TARE	520.3	565.8	432.2	528.5	394.8	563.8	498.8	553.0				
WT. SAMPLE DRY + TARE	423.7	471.7	363.2	446.8	351.4	498.5	451.4	483.7				
WT. TARE	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5				
WATER CONTENT W%	23.5%	20.5%	19.7%	18.9%	12.8%	13.5%	10.8%	14.7%				
HOLE No.	TH14-25											
DEPTH												
SAMPLE No.	17	18	19	20	21	22	23	24				
TARE No.												
WT. SAMPLE WET + TARE	485.0	528.5	356.0	493.1	425.9	635.5	362.5	601.2				
WT. SAMPLE DRY + TARE	429.4	474.9	317.9	432.9	381.7	574.6	322.5	518.5				
WT. TARE	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5				
WATER CONTENT W%	13.4%	11.6%	12.5%	14.4%	12.0%	10.9%	12.9%	16.4%				



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HOLE No.	TH14-25							
DEPTH								
SAMPLE No.	25							
TARE No.								
WT. SAMPLE WET + TARE	251.0							
WT. SAMPLE DRY + TARE	225.8							
WT. TARE	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5
WATER CONTENT W%	11.9%							
HOLE No.								
DEPTH								
SAMPLE No.								
TARE No.								
WT. SAMPLE WET + TARE								
WT. SAMPLE DRY + TARE								
WT. TARE	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5
WATER CONTENT W%								
HOLE No.								
DEPTH								
SAMPLE No.								
TARE No.								
WT. SAMPLE WET + TARE								
WT. SAMPLE DRY + TARE								
WT. TARE	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5
WATER CONTENT W%								
HOLE No.								
DEPTH								
SAMPLE No.								
TARE No.								
WT. SAMPLE WET + TARE								
WT. SAMPLE DRY + TARE								
WT. TARE	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5
WATER CONTENT W%								



CLIENT:	Government	Government of Alberta									
PROJECT:	SAFM - High	River									
JOB No.:	60309815.04										
DATE :	January 30, 2	2014			Т	ECHNICAN :	CK/GU				
HOLE No.	TH14-02										
DEPTH											
SAMPLE No.	1	2	3	4	5	6	7	8			
TARE No.											
WT. SAMPLE WET + TARE	633.4	584.5	389.7	580.2	512.9	607.7	442.3	553.5			
WT. SAMPLE DRY + TARE	507.6	543.6	370.8	544.2	487.2	579.2	424.2	524.5			
WT. TARE	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5			
WATER CONTENT W%	25.5%	7.7%	5.3%	6.8%	5.4%	5.0%	4.4%	5.7%			
HOLE No.	TH14-02										
DEPTH											
SAMPLE No.	9	10	11	12	13	14	15	16			
TARE No.											
WT. SAMPLE WET + TARE	606.1	768.1	794.0	749.6	784.0	735.1	658.6	732.9			
WT. SAMPLE DRY + TARE	573.2	716.3	739.7	707.5	732.5	691.6	606.6	673.4			
WT. TARE	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5			
WATER CONTENT W%	5.9%	7.4%	7.5%	6.1%	7.2%	6.4%	8.8%	9.0%			
HOLE No.	TH14-02					TH14-03					
DEPTH											
SAMPLE No.	17	18	19	20	21	1	2	3			
TARE No.											
WT. SAMPLE WET + TARE	725.5	656.5	494.5	626.8	798.6	389.3	470.7	408.8			
WT. SAMPLE DRY + TARE	676.4	515.4	469.1	583.2	731.1	292.0	372.4	355.5			
WT. TARE	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5			
WATER CONTENT W%	7.4%	28.1%	5.6%	7.7%	9.4%	34.9%	27.4%	15.6%			
HOLE No.	TH14-03						TH14-04				
DEPTH											
SAMPLE No.	4	5	6	7	8	9	1	2			
TARE No.											
WT. SAMPLE WET + TARE	645.4	757.2	578.0	192.8	794.1	421.8	517.9	469.3			
WT. SAMPLE DRY + TARE	581.6	695.3	531.6	175.6	702.9	366.5	432.8	382.9			
WT. TARE	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5			
WATER CONTENT W%	11.2%	9.1%	9.0%	10.6%	13.2%	15.7%	20.3%	23.4%			



CLIENT:	Government	of Alberta						
PROJECT:	SAFM - High	River						
JOB No.:	60309815.04	ļ						
DATE :	January 30, 2	2014			Т	ECHNICAN :	CK/GU	
HOLE No.	TH04-04							
DEPTH								
SAMPLE No.	3	4	5	6	7	8	9	10
TARE No.								
WT. SAMPLE WET + TARE	370.3	576.5	563.2	454.9	197.7	481.1	228.6	550.2
WT. SAMPLE DRY + TARE	358.4	514.7	510.2	396.7	174.7	428.2	199.7	486.2
WT. TARE	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5
WATER CONTENT W%	3.5%	12.3%	10.7%	15.2%	14.3%	12.8%	15.5%	13.5%
HOLE No.	TH14-04	TH14-05						
DEPTH								
SAMPLE No.	11	1	2	3	4	5	6	7
TARE No.								
WT. SAMPLE WET + TARE	310.0	538.6	522.7	314.8	627.0	380.5	615.8	504.0
WT. SAMPLE DRY + TARE	268.1	490.3	475.6	282.5	523.8	323.6	533.0	433.2
WT. TARE	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5
WATER CONTENT W%	16.5%	10.1%	10.2%	12.0%	20.2%	18.3%	15.9%	16.9%
HOLE No.	TH14-05							
DEPTH								
SAMPLE No.	8	9	10	11	12	13	14	15
TARE No.								
WT. SAMPLE WET + TARE	712.7	461.5	509.8	580.8	526.2	660.6	546.7	558.0
WT. SAMPLE DRY + TARE	612.5	383.5	432.7	498.7	432.6	589.1	407.8	469.4
WT. TARE	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5
WATER CONTENT W%	16.7%	21.1%	18.4%	16.9%	22.3%	12.4%	35.2%	19.4%
HOLE No.	TH14-05		TH14-06					
DEPTH								
SAMPLE No.	16	17	1	2	3	4	5	6
TARE No.								
WT. SAMPLE WET + TARE	586.9	274.4	639.4	538.9	595.2	657.6	591.5	585.9
WT. SAMPLE DRY + TARE	524.0	241.2	548.3	472.3	508.3	565.4	498.6	507.2
WT. TARE	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5
WATER CONTENT W%	12.3%	14.6%	17.0%	14.5%	17.6%	16.7%	19.2%	15.9%



CLIENT:	Government	of Alberta						
PROJECT:	SAFM - High	River						
JOB No.:	60309815.04	ļ						
DATE :	January 30, 2	2014			Т	ECHNICAN :	CK/GU	
HOLE No.	TH14-06					TH14-07		
DEPTH								
SAMPLE No.	7	8	9	10	11	1	2	3
TARE No.								
WT. SAMPLE WET + TARE	534.6	632.6	507.9	537.6	78.1	680.9	647.9	257.4
WT. SAMPLE DRY + TARE	472.8	560.6	444.7	487.4	73.9	506.0	465.3	236.1
WT. TARE	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5
WATER CONTENT W%	13.5%	13.2%	14.7%	10.6%	7.0%	35.5%	40.4%	9.6%
HOLE No.	TH14-07							
DEPTH								
SAMPLE No.	4	5	6	7	8	9	10	11
TARE No.								
WT. SAMPLE WET + TARE	741.7	656.7	421.0	804.1	780.8	417.0	580.3	580.7
WT. SAMPLE DRY + TARE	645.8	588.0	362.1	711.3	692.1	383.2	528.3	477.0
WT. TARE	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5
WATER CONTENT W%	15.2%	12.0%	16.9%	13.3%	13.1%	9.1%	10.1%	22.4%
HOLE No.	TH14-07	TH14-08						
DEPTH								
SAMPLE No.	12	1	2	3	4	5	6	7
TARE No.								
WT. SAMPLE WET + TARE	589.1	607.7	599.9	480.0	659.3	523.0	726.1	549.1
WT. SAMPLE DRY + TARE	487.5	498.8	503.0	453.7	614.4	477.7	643.5	497.2
WT. TARE	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5
WATER CONTENT W%	21.4%	22.4%	19.8%	6.0%	7.5%	9.8%	13.1%	10.7%
HOLE No.	TH14-08		TH14-14					
DEPTH								
SAMPLE No.	8	9	1	2	3	4	5	6
TARE No.								
WT. SAMPLE WET + TARE	401.9	615.3	637.7	569.8	630.7	612.6	591.6	605.1
WT. SAMPLE DRY + TARE	366.2	572.9	545.6	469.1	545.5	522.0	515.2	530.9
WT. TARE	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5
WATER CONTENT W%	10.1%	7.6%	17.3%	22.1%	16.0%	17.8%	15.2%	14.3%



CLIENT:	Government	Government of Alberta									
PROJECT:	SAFM - High	River									
JOB No.:	60309815.04	ļ									
DATE :	January 30, 2	2014			Т	ECHNICAN :	CK/GU				
HOLE No.	TH14-14			TH14-15							
DEPTH											
SAMPLE No.	7	9	10	1	2	3	4	5			
TARE No.											
WT. SAMPLE WET + TARE	447.2	492.8	553.0	489.4	622.5	269.3	458.9	505.9			
WT. SAMPLE DRY + TARE	390.4	412.0	463.6	425.0	589.4	254.0	393.9	447.2			
WT. TARE	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5			
WATER CONTENT W%	15.1%	20.3%	19.9%	15.7%	5.7%	6.4%	17.1%	13.5%			
HOLE No.	TH14-15				TH14-16						
DEPTH											
SAMPLE No.	6	7	8	9	1	2	3	4			
TARE No.											
WT. SAMPLE WET + TARE	521.1	202.5	507.0	189.1	721.0	576.6	1618.9	700.7			
WT. SAMPLE DRY + TARE	455.0	181.1	458.8	164.4	692.0	525.5	1519.4	614.5			
WT. TARE	13.5	13.5	13.5	13.5	13.5	13.5	252.3	13.5			
WATER CONTENT W%	15.0%	12.8%	10.8%	16.4%	4.3%	10.0%	7.9%	14.3%			
HOLE No.	TH14-16					TH14-17					
DEPTH											
SAMPLE No.	5	6	7	8	9	1	2	3			
TARE No.											
WT. SAMPLE WET + TARE	539.4	517.1	572.0	600.5	135.2	670.0	678.7	548.4			
WT. SAMPLE DRY + TARE	477.1	457.1	505.0	559.7	127.7	618.6	625.1	477.9			
WT. TARE	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5			
WATER CONTENT W%	13.4%	13.5%	13.6%	7.5%	6.6%	8.5%	8.8%	15.2%			
HOLE No.	TH14-17						TH14-18				
DEPTH											
SAMPLE No.	4	5	6	7	8	9	1	2			
TARE No.											
WT. SAMPLE WET + TARE	616.8	640.7	534.6	447.1	701.1	205.4	642.9	641.0			
WT. SAMPLE DRY + TARE	520.5	560.6	454.1	398.3	581.5	189.0	618.3	610.4			
WT. TARE	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5			
WATER CONTENT W%	19.0%	14.6%	18.3%	12.7%	21.1%	9.3%	4.1%	5.1%			



CLIENT:	Government	of Alberta						
PROJECT:	SAFM - High	River						
JOB No.:	60309815.04							
DATE :	January 30, 2	2014			Т	ECHNICAN :	CK/GU	
HOLE No.	TH14-18							
DEPTH								
SAMPLE No.	3	4	5	6	7	8	9	10
TARE No.								
WT. SAMPLE WET + TARE	403.3	572.2	364.9	588.5	585.7	476.3	595.5	582.2
WT. SAMPLE DRY + TARE	355.1	542.6	326.4	546.5	518.0	427.3	521.5	506.0
WT. TARE	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5
WATER CONTENT W%	14.1%	5.6%	12.3%	7.9%	13.4%	11.8%	14.6%	15.5%
HOLE No.	TH14-18			TH14-19				
DEPTH								
SAMPLE No.	11	12	13	1	2	3	4	5
TARE No.								
WT. SAMPLE WET + TARE	571.5	628.9	427.4	388.1	673.1	502.5	663.2	515.6
WT. SAMPLE DRY + TARE	500.1	560.9	367.2	288.7	543.8	414.1	537.6	445.4
WT. TARE	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5
WATER CONTENT W%	14.7%	12.4%	17.0%	36.1%	24.4%	22.1%	24.0%	16.3%
HOLE No.	TH14-19				TH14-20			
DEPTH								
SAMPLE No.	6	7	8	9	1	2	3	4
TARE No.								
WT. SAMPLE WET + TARE	549.7	475.2	539.3	319.1	421.9	435.0	382.4	544.3
WT. SAMPLE DRY + TARE	477.9	420.9	474.7	275.9	333.2	336.9	308.4	446.1
WT. TARE	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5
WATER CONTENT W%	15.5%	13.3%	14.0%	16.5%	27.7%	30.3%	25.1%	22.7%
HOLE No.	TH14-20					TH14-21		
DEPTH								
SAMPLE No.	5	6	7	8	9	1	2	3
TARE No.								
WT. SAMPLE WET + TARE	538.7	625.1	339.0	411.7	280.0	549.0	377.1	376.7
WT. SAMPLE DRY + TARE	491.7	531.1	303.1	359.9	248.1	447.1	303.7	296.0
WT. TARE	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5
WATER CONTENT W%	9.8%	18.2%	12.4%	15.0%	13.6%	23.5%	25.3%	28.6%



CLIENT:	Government	of Alberta						
PROJECT:	SAFM - High	River						
JOB No.:	60309815.04	Ļ						
DATE :	February 4, 2	2014			Т	ECHNICAN :	CK/GU	
HOLE No.	TH14-21							
DEPTH								
SAMPLE No.	4	5	6	7	8	9	10	11
TARE No.								
WT. SAMPLE WET + TARE	438.1	561.6	660.7	464.1	523.6	400.3	371.5	285.0
WT. SAMPLE DRY + TARE	342.3	459.3	551.9	387.5	461.0	335.9	314.2	249.7
WT. TARE	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5
WATER CONTENT W%	29.1%	22.9%	20.2%	20.5%	14.0%	20.0%	19.1%	14.9%
HOLE No.	TH14-21		TH14-12					
DEPTH								
SAMPLE No.	12	13	1	2	3	4	5	6
TARE No.								
WT. SAMPLE WET + TARE	443.6	268.1	480.0	471.2	361.8	637.8	445.1	664.0
WT. SAMPLE DRY + TARE	369.9	235.6	452.5	435.9	335.0	521.9	361.0	538.4
WT. TARE	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5
WATER CONTENT W%	20.7%	14.6%	6.3%	8.4%	8.3%	22.8%	24.2%	23.9%
HOLE No.	TH14-12					TH14-24		
DEPTH								
SAMPLE No.	7	8	9	10	11	1	2	3
TARE No.								
WT. SAMPLE WET + TARE	539.2	378.7	288.1	581.5	198.3	375.0	508.3	296.6
WT. SAMPLE DRY + TARE	444.2	314.2	257.6	489.6	171.5	356.8	464.7	282.6
WT. TARE	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5
WATER CONTENT W%	22.1%	21.4%	12.5%	19.3%	17.0%	5.3%	9.7%	5.2%
HOLE No.	TH14-24							
DEPTH								
SAMPLE No.	4	5	6	7	8	9	10	11
TARE No.								
WT. SAMPLE WET + TARE	535.3	366.5	515.7	568.1	535.4	433.9	479.9	356.4
WT. SAMPLE DRY + TARE	478.7	317.9	458.0	509.6	468.3	385.9	402.0	302.5
WT. TARE	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5
WATER CONTENT W%	12.2%	16.0%	13.0%	11.8%	14.8%	12.9%	20.1%	18.7%



CLIENT:	Government	of Alberta						
PROJECT:	SAFM - High	River						
JOB No.:	60309815.04	-						
DATE :	February 4, 2	2014			Т	ECHNICAN :	CK/GU	
HOLE No.	TH14-24							
DEPTH								
SAMPLE No.	12	13	14	15	16	18	19	20
TARE No.								
WT. SAMPLE WET + TARE	560.7	556.0	564.5	254.1	560.2	520.0	449.1	550.2
WT. SAMPLE DRY + TARE	447.0	448.0	459.3	217.4	457.4	444.8	378.2	454.7
WT. TARE	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5
WATER CONTENT W%	26.2%	24.9%	23.6%	18.0%	23.2%	17.4%	19.4%	21.6%
HOLE No.	TH14-25							
DEPTH								
SAMPLE No.	1	2	3	4	5	6	7	8
TARE No.								
WT. SAMPLE WET + TARE	371.1	509.0	358.8	417.2	326.8	537.6	611.7	609.1
WT. SAMPLE DRY + TARE	331.5	460.3	297.6	333.6	263.5	439.8	518.5	484.0
WT. TARE	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5
WATER CONTENT W%	12.5%	10.9%	21.5%	26.1%	25.3%	22.9%	18.5%	26.6%
HOLE No.	TH14-25							
DEPTH								
SAMPLE No.	9	10	11	12	13	14	15	16
TARE No.								
WT. SAMPLE WET + TARE	520.3	565.8	432.2	528.5	394.8	563.8	498.8	553.0
WT. SAMPLE DRY + TARE	423.7	471.7	363.2	446.8	351.4	498.5	451.4	483.7
WT. TARE	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5
WATER CONTENT W%	23.5%	20.5%	19.7%	18.9%	12.8%	13.5%	10.8%	14.7%
HOLE No.	TH14-25							
DEPTH								
SAMPLE No.	17	18	19	20	21	22	23	24
TARE No.								
WT. SAMPLE WET + TARE	485.0	528.5	356.0	493.1	425.9	635.5	362.5	601.2
WT. SAMPLE DRY + TARE	429.4	474.9	317.9	432.9	381.7	574.6	322.5	518.5
WT. TARE	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5
WATER CONTENT W%	13.4%	11.6%	12.5%	14.4%	12.0%	10.9%	12.9%	16.4%



CLIENT:	Government	of Alberta						_
PROJECT:	SAFM - High	River						
JOB No.:	60309815.04							
DATE :	February 4, 2	014			Т	ECHNICAN :	CK/GU	
HOLE No.	TH14-25							
DEPTH								
SAMPLE No.	25							
TARE No.								
WT. SAMPLE WET + TARE	251.0							
WT. SAMPLE DRY + TARE	225.8							
WT. TARE	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5
WATER CONTENT W%	11.9%							
HOLE No.								
DEPTH								
SAMPLE No.								
TARE No.								
WT. SAMPLE WET + TARE								
WT. SAMPLE DRY + TARE								
WT. TARE	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5
WATER CONTENT W%								
HOLE No.								
DEPTH								
SAMPLE No.								
TARE No.								
WT. SAMPLE WET + TARE								
WT. SAMPLE DRY + TARE								
WT. TARE	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5
WATER CONTENT W%								
HOLE No.								
DEPTH								
SAMPLE No.								
TARE No.								
WT. SAMPLE WET + TARE								
WT. SAMPLE DRY + TARE								
WT. TARE	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5
WATER CONTENT W%								



SIEVE ANALYSIS

CLIENT :	Govern	ment of Albert	a						
PROJECT :	SAFM								
JOB No. :	603098	15.04							
LOCATION :					SAMPLE:		5		
TESTHOLE :	14-03				DEPTH :		3.3m		
DATE :	Februar	ry 3, 2014			TECHNICIAN	l:	GU		
TOTAL DRY W		SIEVE	SIZE OF (OPENING	WEIGHT	PERCENT	PERCENT	SPECIFI	CATION
OF SAMPL	.E	NO. (μm)	APPROX.	mm	RETAINED	RETAINED	FINER THAN	LOWER	UPPER
Before Washing		150000	INCHES 6	150.0	(g)		100%		
Wet + Tare		75000	3	75.0			100%		
Dry+Tare	949.9	50000	2	50.0			100%		
Tare	265.2	40000	1 1/2	40.0			100%		
Wt. Dry	684.7	25000	1	25.0	17.9	3%			
Moisture Content		20000	3/4	20.0	74.9	11%			
Wet + Tare		16000	5/8	16.0	154.5	23%	77%		
Dry+Tare		12500	1/2	12.5	217.3	32%	68%		
Tare		10000	3/8	10.0	247.4	36%	64%		
MC (%)		5000	0.185	5.0	354.9	52%	48%		
	Passing								
After Washing		2000	0.0937	2.0	418.7	61%			
Wt. Dry+Tare	841.7	1250	0.0469	1.25	438.6	64%			
Tare	265.2	630	0.0234	0.630	464.8	68%			
Wt. Dry	576.5	315	0.0116	0.315	496.5	73%			
Tare No.		160	0.0059	0.160	531.8	78%			
		80 PAN	0.0029	0.080	570.6 574.8	83%	17%		
Classification:	G	M or GC	Description an	d Remarks:	014.0				
Cc Cu		#N/A #N/A							
				SIEVE	SIZE (mm)				
1000		100		10		.	0.1	-	0.01
100%									
90%			+++						
80%									
70%	++-			\rightarrow \parallel \mid \mid					
X60% +++++									
<u></u> ^{50%}				—— N					
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30%									
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0%			Gravel			Sand			
	Cobbles		Coarse	Fine	Coarse M	/Jedium	Fine	Silt or	Clay
		•	· · ·	•					

GAFM 0309815.04 TH14-03 Tebruary 4, 2014			SAMPLE: DEPTH :		8		
H14-03					8		
					8		
					5.4m		
			TECHNIC	IAN :	CK		
		LIQUID L					
		1					
		24					
e)(g)		45.10					
		38.01					
		11.70					
		26.3					
						1	1
ERAGE VALUES				PLAS			
		Trial No.			1		T
			Number				
				(q)	31.65		
				57			
CL							
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			C	н			
		CI					
				МН			
CII-MI	•	ML					
10 20	30	40 5 LIQUI	50 6 D LIMIT	0 70	80	90	100
<i>,</i>	e)(g) //ERAGE VALUES 26.8 18.7 8.1 PLE DESCRIPTION CL	e)(g) /ERAGE VALUES 26.8 18.7 8.1 PLE DESCRIPTION CL	e)(g) 38.01 11.70 26.3 7.1 26.9% /ERAGE VALUES 26.8 18.7 Container N 8.1 Wt. Sample Wt. Sample Wt. Tare (g) Wt. Dry Soil Wt. Water (g) Wt. Water (g) Water Cont	a)(g) 38.01 11.70 26.3 7.1 26.9% //ERAGE VALUES Trial No. 26.8 Trial No. 18.7 Container Number Vt. Sample (wet+tare) Wt. Sample (dry+tare)(VLE DESCRIPTION Wt. Sample (dry+tare)(Vt. Tare (g) Wt. Ury Soil (g) Wt. Water (g) Water Content (%) CL Cl CL Cl CL Cl CL K. Dry Soil (g) Wt. Water (g) Water Content (%) CL Cl CL ML	38.01 11.70 26.3 7.1 26.9% PLAS 26.8 Trial No. 18.7 Container Number 8.1 Wt. Sample (wet+tare)(g) PLE DESCRIPTION Wt. Sample (dry+tare)(g) Wt. Tare (g) Wt. Tare (g) Wt. Vater (g) Water Content (%) CL CH Cl CH Cl ML	a)(g) 38.01 11.70 26.3 7.1 26.9% 26.8 7.1 18.7 Container Number 8.1 Wt. Sample (wet+tare)(g) 21 29.20 Wt. Sample (dry+tare)(g) 29.20 Wt. Tare (g) 16.09 Wt. Tare (g) 13.1 Wt. Water (g) 2.5 Water Content (%) 18.7%	b)(g) 38.01 11.70 26.3 7.1 1 26.9% PLASTIC LIMIT Z6.8 Trial No. 1 18.7 Container Number 8.1 Wt. Sample (wet+tare)(g) 31.65 PLE DESCRIPTION Wt. Sample (dry+tare)(g) 29.20 Wt. Tare (g) 16.09 Wt. Tare (g) 13.1 Wt. Water (g) 2.5 Water Content (%) 18.7%

FORM: SAFM TH14-03#8 Att.xlsx DATE: 2/5/2014



CLIENT :	Government of All	oerta								
PROJECT :	SAFM									
JOB No. :	60309815.04									
LOCATION :					SAMPLE:		C3			
BOREHOLE:	TH14-03				DEPTH :		14.3m			
DATE :	February 10, 2014	ļ.			TECHNIC	IAN :	СК			
				LIQUID L	IMIT					
Trial No.				1						
Number of Blows				19						
Container Number										
Wt. Sample (wet+ta	are)(g)			50.78						
Wt. Sample (dry+ta	re)(g)			43.07						
Wt. Tare (g)				11.73						
Wt. Dry Soil (g)				31.3						
Wt. Water (g)				7.7						
Water Content (%)				24.6%						
	AVERAGE VALUES					PLA	STIC LIMIT			
Liquid Limit	23	3.8	-	Trial No.			1			
Plastic Limit	19	9.3	(Container N	lumber				T	
Plasticity Index	4	.5	,	Wt. Sample	(wet+tare)	(g)	34.1	7		
SA	MPLE DESCRIPTIC	DN	,	Wt. Sample	(dry+tare)(g)	31.2	5		
			,	Wt. Tare (g)			16.1	0		
Classification:	CL	-ML	,	Wt. Dry Soil	(g)		15.2	2		
			۱.	Wt. Water (g	g)		2.9			
			N N	Water Cont	ent (%)		19.39	%		
60 -										_
50										
50										
40					С	u				
N N										
≧ 30 –										
AS.				CI						
		CL	/			МН				
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	CL-	ML	N	L						
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0	10 20	30	4	0 5 LIQUII	0 6 D LIMIT	0 70) 80)	90	100

FORM: SAFM TH14-03#C3 Att.xlsx DATE: 2/11/2014

SIEVE ANALYSIS

CLIENT :	Governi	ment of Albert	а						
PROJECT :	SAFM								
JOB No. :	603098	15.04							
LOCATION :					SAMPLE:		3		
TESTHOLE :	14-04				DEPTH :		1.7m		
DATE :	Februar	y 6, 2014			TECHNICIAN	۷:	СК		
TOTAL DRY W		SIEVE	SIZE OF (OPENING	WEIGHT	PERCENT	PERCENT	SPECIF	CATION
OF SAMPL	_E	NO. (μm)	APPROX.	mm	RETAINED	RETAINED	FINER THAN	LOWER	UPPER
		450000	INCHES	450.0	(g)		4000/	-	-
Before Washing Wet + Tare		150000 75000	6 3	150.0 75.0			100% 100%		
Dry+Tare	3884.3	50000	2	73.0 50.0	335.0	10%			
Tare	433.7	40000	1 1/2	40.0	647.4	19%			
Wt. Dry	3450.6	25000	1	25.0	1366.8	40%			
Moisture Content		20000	3/4	20.0	1527.9	44%			
Wet + Tare		16000	5/8	16.0	1656.2	48%			
Dry+Tare		12500	1/2	12.5	1753.9	51%			
Tare		10000	3/8	10.0	1862.3	54%	46%		
MC (%)		5000	0.185	5.0	2064.3	60%	40%		
	Passing								
After Washing		2000	0.0937	2.0	2226.4	65%			
Wt. Dry+Tare	3395.5	1250	0.0469	1.25	2276.0	66%			
Tare	433.6	630 04 5	0.0234	0.630	2329.7	68%			
Wt. Dry	2961.9	315	0.0116	0.315	2447.2	71%			
Tare No.		160 80	0.0059 0.0029	0.160 0.080	2729.7 2934.3	79% 85%			
		PAN	0.0029	0.060	2934.3	0376	15%		
Classification:	GN	A or GC	Description ar	nd Remarks:					
Cc		#N/A							
Cu		#N/A							
1000		100		SIEVE 2	SIZE (mm)	~	5		0.01
100%									
90%		L	\downarrow		+ $+$ $+$ $-$				
80%									
70%			+++++						
<u> </u>	+ + -	┟───┼┼┼┼┼	+++		+++	╶┼┼┼┼┼┼┼		┼┼┼┼┼┼	
X60% HI 250% 40% %	+		++++		\downarrow				_ _
×						-####			
30%									
20%			++++		+++-			┼┼┼┼┼┼	
								1	
10%									
	Cobbles		Gravel			Sand		Silt or	Clav
	CODDIES	C	Coarse	Fine	Coarse	Vedium	Fine	Sill Of	Jiay

ΑΞϹΟΜ

CLIENT :	Government of Al	berta						
PROJECT :	SAFM							
JOB No. :	60309815.04							
LOCATION :					SAMPLE:		9	
	44.04				DEPTH :			
TESTHOLE:	14-04						6.3	
DATE :	February 7, 2014		0.75.05		TECHNICIAN :		GU	
TOTAL DRY WEIGH		SIEVE NO. (µm)	SIZE OF (APPROX.	JPENING	WEIGHT	PERCENT	PERCENT FINER	REMARKS
TOTAL DRT WEIGH	IT OF SAMPLE	SIEVE NO. (µIII)	INCHES	mm	RETAINED (g)	RETAINED	THAN	REMARKS
Before Washing		150,000	6	150.0		0%	100%	
Wet + Tare		75,000	3	75.0		0%		
Dry+Tare	354.1	50,000	2	50.0		0%		
Tare	100.0	40,000	1 1/2	40.0		0%		
Wt. Dry	254.1	25,000	1	25.0		0%	100%	
Moisture Content		20,000	3/4	20.0		0%		
Wet + Tare		16,000	5/8	16.0		0%		
Dry+Tare		12,500	1/2	12.5		0%		
Tare		10,000	3/8	10.0	4.1	2%	98.4%	
MC (%)		5,000	0.185	5.0	11.9	5%	95.3%	
	Passing							
After Washing		2,000	0.0937	2.0	16.5	6%	93.5%	
Wt. Dry+Tare		1,250	0.0469	1.25	21.3	8%	91.6%	
Tare		630	0.0234	0.63	24.1	9%	90.5%	
Wt. Dry		315	0.0116	0.315	27.9	11%		
Tare No.		160	0.0059	0.160	34.6	14%	86.4%	
		75 PAN	0.00295	0.075	63.5	25%	75.0%	
HYDROMETE	ER DATA	READING	TIME (min)	DIAMETER (mm)	TEMP. (°C)	CORR. READING	PERCENT FINER THAN	REMARKS
Wt Dry+Tare	354.1	40	0.5	0.059	20	36	65.7%	
Wt Tare	100.0	34	1	0.044	20	30	54.6%	
Wt Dry	254.1	29	2	0.032	20	25	45.4%	
Sample Size :	50	24	5	0.021	20	20	36.1%	
Wt Retained 2 mm:	16.5	20	15	0.013	20	16	28.7%	
% Passing 2 mm:	93.5%	18	30	0.009	20	14	25.0%	
Specific Gravity :	2.70	16	60	0.006	20	12	21.3%	
Hydrometer No.:	43-9856	14	120	0.005	20	10	17.6%	
Solution (g/L):	40	13	240	0.003	20	9	15.7%	
		11	1440	0.001	20	7	12.0%	
		10	2880	0.001	20	6	10.2%	

Government of Alberta CLIENT : SAFM PROJECT : 60309815.04 JOB No. : LOCATION : SAMPLE: 9 TESTHOLE: DEPTH : 14-04 6.3 DATE : February 7, 2014 **TECHNICIAN** : GU SIEVE SIZE (mm) 0.001 1000 0.01 100 0.1 10 100% 90% 80% 70% 60% % FINER THAN 50% 40% 30% 20% 10% 0% Sand Gravel Cobbles Silt or Clay Coarse Coarse Fine Medium Fine

CLIENT :	Government of Alberta							
PROJECT :	SAFM							
JOB No. :	60309815.04							
LOCATION :				SAMPLE:		17		
BOREHOLE:	TH14-05			DEPTH :		12.5m		
DATE :	February 6, 2014			TECHNIC	IAN :	СК		
			LIQUID L					
Trial No.			1					
Number of Blows			27					
Container Number								
Wt. Sample (wet+ta	are)(g)		40.96					
Wt. Sample (dry+ta			32.65					
Wt. Tare (g)			11.79					
Wt. Dry Soil (g)			20.9					
Wt. Water (g)			8.3					
Water Content (%)			39.8%					
	AVERAGE VALUES			<u> </u>	PLAS			<u> </u>
Liquid Limit	40.2		Trial No.			1		
Plastic Limit	24.3		Container N	lumber				
Plasticity Index	15.9		Wt. Sample		(a)	30.51		
	MPLE DESCRIPTION		Wt. Sample			27.68		
			Wt. Tare (g)		.97	16.05		
Classification:	CI		Wt. Dry Soil			11.6		
Clacomodition.	01		Wt. Water (2.8		
			Water Cont			24.3%		
				0(/0)		2		
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	CL-ML		ML					
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FORM: SAFM TH14-05 #17 Att.xlsx DATE: 2/7/2014



CLIENT :	Government of A	Iberta								
PROJECT :	SAFM									
JOB No. :	60309815.04									
LOCATION :					SAMPLE:		6			
BOREHOLE:	TH14-05				DEPTH :		3.9m			
DATE :	February 6, 2014	4			TECHNIC	IAN :	СК			
				LIQUID L						
Trial No.				1						
Number of Blows				21						
Container Numbe	r									
Wt. Sample (wet+t	are)(g)			43.21						
Wt. Sample (dry+ta				36.85						
Wt. Tare (g)	,,			12.05						
Wt. Dry Soil (g)				24.8						
Wt. Water (g)				6.4						
Water Content (%)				25.6%	1					
	AVERAGE VALUE	S			<u>I</u>	PI A	STIC LIMIT	I		1
Liquid Limit		25.1		Trial No.			1			
Plastic Limit		16.6		Container N	lumber					
Plasticity Index		8.5		Wt. Sample		(a)	33.3	6		
	MPLE DESCRIPT			Wt. Sample			30.9			
				Wt. Tare (g)		9)	16.4			
Classification:		CL		Wt. Dry Soil			14.			
Classification.		UL		Wt. Water (2.4			
			F	Water Cont			16.6			
					5111 (70)		10.0	/0		
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FORM: SAFM TH14-05 #6 Att.xlsx DATE: 2/7/2014



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CLIENT :	Government of Al	berta						
PROJECT :	SAFM							
JOB No. :	60309815.04							
LOCATION :					SAMPLE:		3	
	44.05							
TESTHOLE:	14-05				DEPTH :		1.7	
DATE :	February 7, 2014				TECHNICIAN :		GU	
TOTAL DRY WEIGH			SIZE OF	OPENING	WEIGHT	PERCENT	PERCENT FINER	REMARKS
	T OF SAMPLE	SIEVE NO. (µm)	APPROX. INCHES	mm	RETAINED (g)	RETAINED	THAN	REMARKS
Before Washing		150,000	6	150.0		0%	100%	
Wet + Tare		75,000	3	75.0		0%		
Dry+Tare	209.7	50,000	2	50.0		0%	100%	
Tare	100.0	40,000	1 1/2	40.0		0%	100%	
Wt. Dry	109.7	25,000	1	25.0		0%	100%	
Moisture Content		20,000	3/4	20.0		0%		
Wet + Tare		16,000	5/8	16.0		0%		
Dry+Tare		12,500	1/2	12.5		0%		
Tare		10,000	3/8	10.0		0%	100.0%	
MC (%)	Passing	5,000	0.185	5.0		0%	100.0%	
After Washing		2,000	0.0937	2.0	0.5	0%	99.5%	
Wt. Dry+Tare		1,250	0.0469	1.25	0.7	1%	99.3%	
Tare		630	0.0234	0.63	0.9	1%	99.1%	
Wt. Dry		315	0.0116	0.315	1.8	2%		
Tare No.		160	0.0059	0.160	4.6	4%	95.8%	
		75 PAN	0.00295	0.075	25.8	24%	76.4%	
HYDROMETER	R DATA	READING	TIME (min)	DIAMETER (mm)	TEMP. (°C)	CORR. READING	PERCENT FINER THAN	REMARKS
Wt Dry+Tare	209.7	40	0.5	0.059	20	36	70.0%	
Wt Tare	100.0	34	1	0.044	20	30	58.1%	
Wt Dry	109.7	29	2	0.032	20	25	48.3%	
Sample Size :	50	26	5	0.021	20	22	42.4%	
Wt Retained 2 mm:	0.5	23	15	0.012	20	19	36.5%	
% Passing 2 mm:	99.5%	21	30	0.009	20	17	32.5%	
Specific Gravity :	2.70	19	60	0.006	20	15	28.6%	
Hydrometer No.:	43-9856	17	120	0.005	20	13	24.6%	
Solution (g/L):	40	15	240	0.003	20	11	20.7%	
		13	1440	0.001	20	9	16.8%	
		12	2880	0.001	20	8	14.8%	

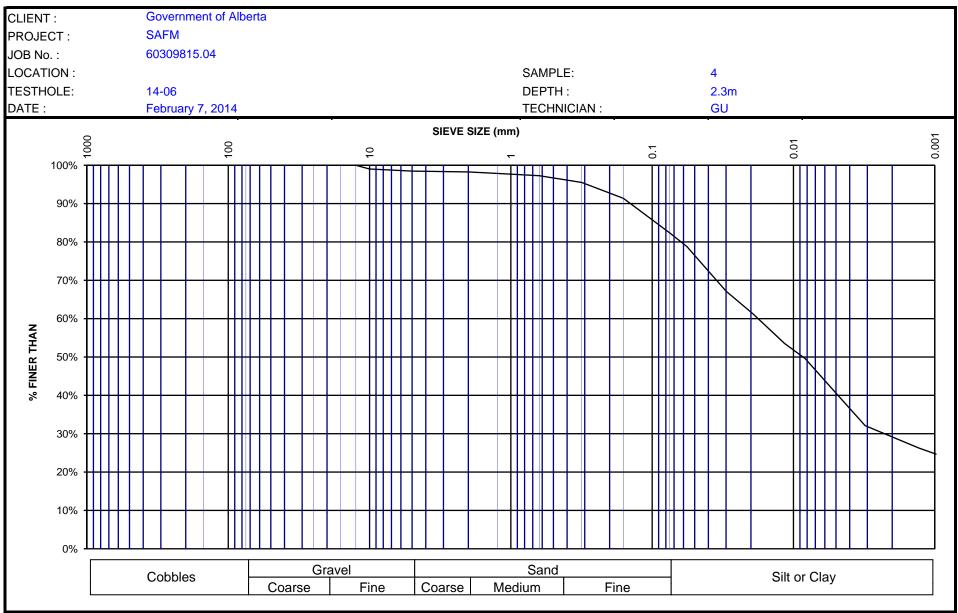
Government of Alberta CLIENT : SAFM PROJECT : 60309815.04 JOB No. : LOCATION : SAMPLE: 3 TESTHOLE: DEPTH : 14-05 1.7 DATE : February 7, 2014 **TECHNICIAN** : GU SIEVE SIZE (mm) 0.001 1000 0.01 100 0.1 10 ~ 100% 90% 80% 70% 60% % FINER THAN 50% 40% 30% Г 20% 10% 0% Sand Gravel Cobbles Silt or Clay Coarse Coarse Fine Medium Fine

CLIENT :	Government of A	Vberta								
PROJECT :	SAFM									
JOB No. :	60309815.04									
LOCATION :					SAMPLE:		4			
BOREHOLE:	TH14-06				DEPTH :		2.3m			
DATE :	February 6, 201	4			TECHNIC	IAN :	СК			
				LIQUID L						
Trial No.				1						
Number of Blows				28						
Container Number	r									
Wt. Sample (wet+t	are)(g)			42.44						
Wt. Sample (dry+ta				36.01						
Wt. Tare (g)				11.71						
Wt. Dry Soil (g)				24.3						
Wt. Water (g)				6.4						
Water Content (%)				26.5%	1					
	AVERAGE VALUE	S			ı	PI A				
Liquid Limit		26.8	ŀ	Trial No.		/ (1			
Plastic Limit		16.3		Container N	lumber		· ·			
Plasticity Index		10.5		Wt. Sample		(a)	31.1	9		
	MPLE DESCRIPT			Wt. Sample			29.0			
				Wt. Tare (g)		9/	16.0			
Classification:		CL		Wt. Dry Soil			13.0			
Classification.		UL		Wt. Water (2.1	,		
			-	Water Cont			16.39	%		
							10.0			
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FORM: SAFM TH14-06 #4 Att.xlsx DATE: 2/7/2014



CLIENT : Government of Alberta SAFM PROJECT : JOB No. : 60309815.04 LOCATION : SAMPLE: 4 TESTHOLE: 14-06 DEPTH : 2.3m DATE : GU February 7, 2014 **TECHNICIAN**: SIZE OF OPENING WEIGHT PERCENT PERCENT FINER TOTAL DRY WEIGHT OF SAMPLE REMARKS SIEVE NO. (µm) APPROX. RETAINED (g) RETAINED THAN mm INCHES Before Washing 150,000 6 150.0 0% 100% Wet + Tare 75,000 3 75.0 0% 100% Dry+Tare 650.7 50,000 2 50.0 0% 100% 0% Tare 100.0 40,000 $1 \frac{1}{2}$ 40.0 100% Wt. Dry 550.7 25,000 1 25.0 0% 100% Moisture Content 20.0 0% 100% 20.000 3/4 Wet + Tare 0% 100% 16,000 5/8 16.0 Dry+Tare 12,500 1/2 12.5 0% 100% 1% 99.0% Tare 10.000 3/8 10.0 5.4 MC (%) 0.185 5.0 8.4 2% 98.5% 5,000 Passing After Washing 0.0937 98.3% 2.000 2.0 9.6 2% Wt. Dry+Tare 1,250 0.0469 1.25 2% 97.9% 11.8 3% Tare 630 0.0234 0.63 15.0 97.3% Wt. Dry 315 0.0116 0.315 24.8 4% 95.5% Tare No. 9% 160 0.0059 0.160 47.5 91.4% 75 0.00295 0.075 97.3 18% 82.3% PAN PERCENT FINER HYDROMETER DATA READING DIAMETER (mm) TEMP. (°C) CORR. READING REMARKS TIME (min) THAN Wt Dry+Tare 650.7 45 0.5 0.057 20 41 78.8% Wt Tare 100.0 42 0.041 20 38 73.0% 1 Wt Dry 550.7 39 2 0.030 20 35 67.1% 36 Sample Size : 50 5 0.019 20 32 61.3% 32 Wt Retained 2 mm: 9.6 15 0.012 20 28 53.5% 30 % Passing 2 mm: 30 20 26 49.6% 98.3% 0.008 27 Specific Gravity : 2.70 60 0.006 20 23 43.8% 43-9856 24 20 20 Hydrometer No.: 120 0.004 37.9% 21 20 Solution (g/L): 40 240 0.003 17 32.1% 18 1440 0.001 20 26.3% 14 17 2880 0.001 20 13 24.3%



SIEVE ANALYSIS

CLIENT : G	overnment of	Albert	а						
PROJECT : SA	AFM								
JOB No. : 60	0309815.04								
LOCATION :					SAMPLE:		4		
TESTHOLE : 14	1-08				DEPTH :		2.3m		
DATE : Fe	ebruary 6, 20	14			TECHNICIAN	l:	СК		
TOTAL DRY WEIG			SIZE OF	OPENING	WEIGHT	PERCENT	PERCENT	SPECIFI	CATION
OF SAMPLE	NO. (μm)	APPROX. INCHES	mm	RETAINED (g)	RETAINED	FINER THAN	LOWER	UPPER
Before Washing		50000	6	150.0			100%		
Wet + Tare		75000	3	75.0			100%		
•		50000	2	50.0			100%		
		40000	1 1/2	40.0			100%		
		25000	1	25.0			100%		
Moisture Content		20000	3/4	20.0	36.8	6%			
Wet + Tare		16000	5/8 1/2	16.0	113.5	19%			
Dry+Tare Tare		12500 10000	1/2 3/8	12.5 10.0	218.2 279.6	36% 46%			
MC (%)		5000	0.185	5.0	383.6	40 % 64%			
	assing	3000	0.105	5.0	303.0	0478	3078		
After Washing		2000	0.0937	2.0	425.7	71%	29%		
-	792.3	1250	0.0469	1.25	435.5	72%			
Tare	231.2	630	0.0234	0.630	447.7	74%	26%		
Wt. Dry	561.1	315	0.0116	0.315	470.9	78%	22%		
Tare No.		160	0.0059	0.160	527.1	88%	13%		
		80	0.0029	0.080	557.0	92%	8%		
Classification:	GP	PAN	Description a	nd Remarks:	560.4				
Cc	3.8		Docomption						
Cu	97								
1000		100		은 SIEVE	SIZE (mm)	-	0.1		0.01
100%									
90%		++++	+++						_
80%									
				\land $ $					
70%									
₹00%		┼┼┼┼┼	┼┼┼┼						
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_{0%} [[]]] []									
	hhlaa		Gravel			Sand		0.14	Class
Co	bbles	С	Coarse	Fine	Coarse M	/ledium	Fine	Silt or	Ciay

CLIENT : G	overnment of Alberta				
PROJECT : S	AFM				
JOB No.: 6	0309815.04				
LOCATION :			SAMPLE:	9	
	H14-08		DEPTH :	6.3m	
	ebruary 4, 2014		TECHNICIAN :	СК	
		LIQUID L			
Trial No.		1			
Number of Blows		22			
Container Number					
Wt. Sample (wet+tare)(g)	46.18			
Wt. Sample (dry+tare)		39.33			
Wt. Tare (g)		11.55			
Wt. Dry Soil (g)		27.8			
Wt. Water (g)		6.9			
Water Content (%)		24.7%			
	ERAGE VALUES		<u> </u>	LASTIC LIMIT	I
Liquid Limit	24.2	Trial No.	I	1	
Plastic Limit	18.6	Container I	Number		
Plasticity Index	5.6		e (wet+tare)(g)	29.96	
			e (dry+tare)(g)	27.20	
0, 101		Wt. Tare (g		12.36	
Classification:	CL-ML	Wt. Dry Soi		14.8	
Classification.		Wt. Water (2.8	
		Water Cont		18.6%	
				10.070	
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	CL-M	ML			
0 +		•			
0 7	10 20 30	40	50 60 D LIMIT	70 80	90 100

FORM: SAFM TH14-08 #9 Att.xlsx DATE: 2/7/2014



CLIENT :	Government of A	Nberta								
PROJECT :	SAFM									
JOB No. :	60309815.04									
LOCATION :					SAMPLE:		C2			
BOREHOLE:	TH14-08				DEPTH :		10.2m			
DATE :	February 12, 20	14			TECHNIC	IAN :	СК			
				LIQUID L	IMIT					
Trial No.				1						
Number of Blows				19						
Container Number										
Wt. Sample (wet+ta	re)(g)			44.18						
Wt. Sample (dry+ta				35.06						
Wt. Tare (g)				12.10						
Wt. Dry Soil (g)				23.0						
Wt. Water (g)				9.1						
Water Content (%)				39.7%						
	VERAGE VALUE	S				PLAS	STIC LIMIT			
Liquid Limit		38.4		Trial No.			1			
Plastic Limit		28.3		Container N	lumber					
Plasticity Index		10.1		Wt. Sample	(wet+tare)	(g)	29.23	3		
SA	PLE DESCRIPT	ION		Wt. Sample			26.23	3		
				Wt. Tare (g)			15.62	2		
Classification:		ML		Wt. Dry Soil	(g)		10.6			
				Wt. Water (g	g)		3.0			
				Water Cont	ent (%)		28.3%	, 0		
60										_
										1
50										
50										
4 0										
40 +					C	н				
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0 +										
0	10 2	0 3	0 4	40 5 LIQUI	06 0 LIMIT	0 70	80	9	90	100

FORM: SAFM TH14-08 C2 Att.xlsx DATE: 2/13/2014

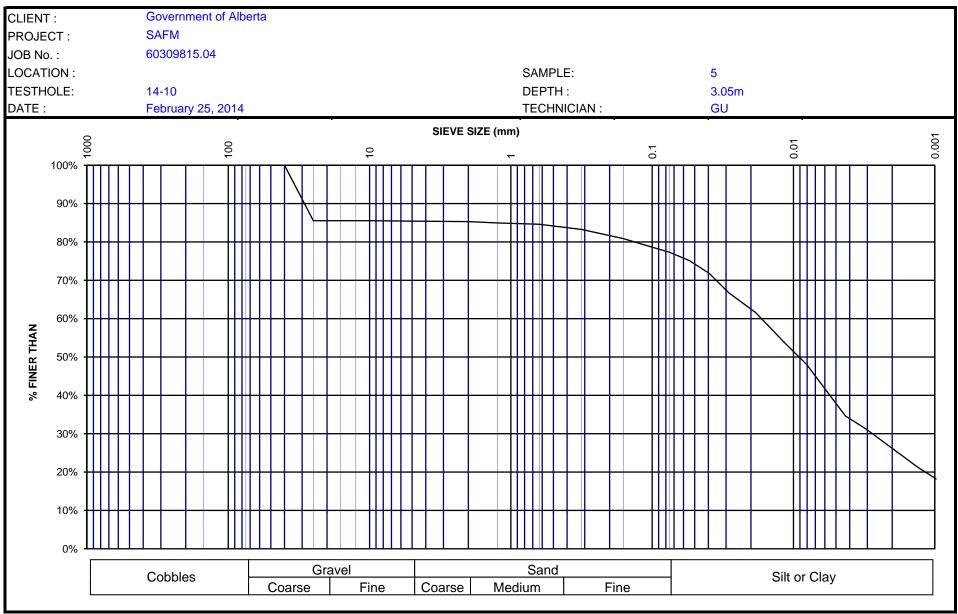


CLIENT :	Government of A	Vberta								
PROJECT :	SAFM									
JOB No. :	60309815.04									
LOCATION :					SAMPLE:		5			
BOREHOLE:	TH14-10				DEPTH :		3.05m			
	February 25, 20	14			TECHNIC	IAN :	GU			
				LIQUID L	MIT					
Trial No.				1						
Number of Blows				24						
Container Number										
Wt. Sample (wet+tai	re)(g)			59.30						
Wt. Sample (dry+tar	e)(g)			50.19						
Wt. Tare (g)				16.45						
Wt. Dry Soil (g)				33.7						
Wt. Water (g)				9.1						
Water Content (%)				27.0%						
A	VERAGE VALUE	S				PLA	STIC LIMIT	-		
Liquid Limit		26.9		Trial No.			1			
Plastic Limit		15.5		Container N	lumber					
Plasticity Index		11.3		Wt. Sample	(wet+tare)	(g)	38.	59		
SAM	IPLE DESCRIPT	ION		Wt. Sample	(dry+tare)(g)	35.0	02		
				Wt. Tare (g)			12.0	06		
Classification:		CL		Wt. Dry Soil	(g)		23	.0		
				Wt. Water (g	1)		3.6	6		
				Water Cont	ent (%)		15.5	5%		
60										
50										
50										
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0	10 2	0 3	0	40 5 LIQUII	0 6 D LIMIT	0 70) 8	60	90	100

FORM: SAFM TH14-10 #5 Att.xlsx DATE: 2/26/2014



CLIENT :: Government of Alberts PROJECT :: SAFM DOR 00:: 60030815.04 LOCATION : 5 TSTHOLE: 14-10 DATE :: February 25, 2014 TOTAL DRY WEIGHT OF SAMPLE SIZE OF OFENING INCREES TECHNICIAN : TOTAL DRY WEIGHT OF SAMPLE SIZE OF OFENING INCREES TECHNICIAN : TOTAL DRY WEIGHT OF SAMPLE SIZE OF OFENING INCREES TECHNICIAN : VIL Dry Tane 285.00 0 150.00 VIL Dry Tane 285.00 1 2 66.0 0.0% 100% VIL Dry Tane 285.00 1 2 5 23.3 14.4% 86% Molesue Ontamin 10.000 3/4 25.00 2.3 14.4% 86% Ontaria 10.000 3/8 100 2.3 14.4% 86% Ortaria 10.000 3/8 0.0 2.3 14.4% 86% Molesue Ontamin 10.000 3/8 0.0 2.41 15% 85.3%									
JOB No.:: 60309815.04 LOCATION :: SAMPLE:: 5 TSTHOLE:: 14-10 DEPTH :: 3.05m DATE:: February 25, 2014 TECHNICIAN : GU TOTAL DRY WEIGHT OF SAMPLE SEVE NO. (un) APPROX. INCHES TECHNICIAN : GU Mathematical Control of the Contro of the Control of the Contro of the Control o	CLIENT :	Government of A	lberta						
LOCATION : SAMPLE: 5 TESTHOLE: 14-10 DTE: February 25, 2014 TCOTAL DRY WEIGHT OF SAMPLE SIEVE NO. (um) SI	PROJECT :	SAFM							
TESTHOLE: 14-10 Pebruary 25, 2014 DEPTH: 3.05m DATE: February 25, 2014 TCOMCIAN: GU TOTAL DRY WEIGHT OF SAMPLE SIEVE N0. (m) NOTE Mark PECRENT [INER RETAINED (g) PECRENT [INER RETAINED (g) REMARKS Belore: Washing 150.000 6 150.0 0% 100% Wet + Tare 265.3 50.000 2 50.0 0% 100% Tare 100.0 40.000 111/2 40.0 0% 100% Woth - Tare 16.00.0 5/8 16.0 23.9 14% 86% Dry-Tare 12.500 1/2 12.5 23.9 14% 86% Dry-Tare 12.600 1/2 12.5 23.9 14% 86% MC (%) Passing 5.000 0.185 5.0 24.1 15% 85.5% MC (%) Passing 5.000 0.185 5.0 24.1 15% 84.6% MC (%) Passing 0.00295	JOB No. :	60309815.04							
TESTHOLE: 14-10 February 25, 2014 DEPTH: 3.05m TCAL DRY WEIGHT OF SAMPLE SIEVE NO. (m) NCHES SIZE OF OPENING INCHES WEIGHT RETAINED (g) PERCENT RETAINED (g) PERCENT RETAINED (g) PERCENT THAN REMARKS Before Washing Wei + Tare 150.000 6 150.00 0 0% 100% Dy+Tare 265.3 50,000 3 75.0 0% 100% 100% Tare 100.0 40,000 11/2 40.0 0% 100% 100% Work - Tare 100.00 40,000 1/2 26.0 0% 100% 100% Work - Tare 10,000 5/8 16.0 23.9 14% 88% Dry+Tare 12,500 1/2 12.5 23.9 14% 88% MC (%) Passing 5,000 0.185 5.0 24.1 15% 85.5% MC (%) Passing 5,000 0.185 5.0 24.9 15% 86.4% MD ry-Tare 12.50 0.0468	LOCATION :					SAMPLE:		5	
DATE: February 25, 2014 TECHNICAN: GU TOTAL DRY WEIGHT OF SAMPLE SIZE OF OPENING WEIGHT APPROX PERCENT RETAINED PERCENT RETAINED PERCENT THAN PERCENT THAN PERCENT RETAINED Before Washing Weit + Tare 75,000 6 150.00 0% 100% 100% Dy+Tare 28.5 50,000 2 650.0 0% 100% Tare 100.0 40,000 11/2 40.0 0% 100% Wt. Dry 166.3 22.000 34 22.0 23.9 14% 88% Moisture Content 16.000 5/8 16.0 23.9 14% 88% More Tare 12.500 1/2 12.5 23.9 14% 88% More Tare 12.500 0.0458 1.50 24.1 15% 85.3% MC (%) Passing 0.0468 1.25 24.9 15% 85.6% MC (%) Passing 0.0023 0.016 31.6 23.9 15% <td>TESTHOLE:</td> <td>14-10</td> <td></td> <td></td> <td></td> <td>DEPTH :</td> <td></td> <td></td> <td></td>	TESTHOLE:	14-10				DEPTH :			
SIZE OF OPENING WEIGHT PERCENT RETAINED (g) PERCENT RETAINED (g) PERCENT THAN REMARKS Before Washing 150.000 6 150.00 0% 100% Wet + Tare 255.3 50.000 2 50.0 0% 100% Dry-Tare 265.3 50.000 1 25.0 0% 100% Wet + Tare 100.0 40.000 1 25.0 0% 100% Moisture Content 20.000 3/4 20.0 23.9 14% 86% Moisture Content 10.000 3/8 10.0 23.9 14% 86% Dry-Tare 12.500 1/2 12.5 23.9 14% 86% MC (%) 5.000 0.125 24.9 15% 85.3% MC (%) Passing 0.0037 2.0 24.3 15% 85.0% Tare 63.0 0.0234 0.63 25.4 15% 84.6% W1. Dry-Tare 1.250 0.0116			4						
TOTAL DRY WEIGHT OF SAMPLE SIEVE NO. (µm) APPROX. INCHES mm RETAINED (g) PERCENT PERCENT PERCENT PIRCE THAN REMARKS Before Washing 150.000 6 150.0 3 75.00 3 75.00 0% 100% Dry-Tare 2663.3 50.000 11/2 40.00 0% 100% Tare 100.0 40.000 11/2 40.00 0% 100% WD. Dry 165.3 20.000 3/4 20.00 23.9 14% 86% Moisture Content 16.000 5/8 16.0 23.9 14% 86% Dry-Tare 12.500 1/2 12.5 23.9 14% 86% MC(%) passing 5.000 0.185 5.0 24.1 15% 85.5% MC (%) Passing 0.0234 0.33 25.4 15% 85.0% Tare 1.250 0.0469 1.25 24.3 15% 85.0% Tare 0.0295		, , , , , , , , , , , , , , , , , , ,		SIZE OF	OPENING		DEDOENT		
Before Washing INCHES Inches <thinches< th=""> <thi< td=""><td>TOTAL DRY WEIGH</td><td>IT OF SAMPLE</td><td>SIEVE NO. (µm)</td><td>APPROX.</td><td></td><td></td><td></td><td></td><td>REMARKS</td></thi<></thinches<>	TOTAL DRY WEIGH	IT OF SAMPLE	SIEVE NO. (µm)	APPROX.					REMARKS
Wet+Tare 75,000 3 75.0 00% 100% Dry+Tare 265.3 50,000 2 50.0 0% 100% Tare 100.0 40,000 11/2 40.0 0.3% 100% With Tare 165.3 25,000 1 25.0 23.9 14% 86% Wet+Tare 16,000 5/8 16.0 23.9 14% 86% Dry+Tare 12,500 1/2 12.5 23.9 14% 86% Tare 10,000 3/8 10.0 23.9 14% 86% MC (%)				INCHES		RETAINED (g)			
Dry-Tare 265.3 50.000 2 50.0 9% 100% Tare 100.0 40,000 1 1/2 40.0 0% 100% W1: Dry 165.3 25.000 1 25.0 23.9 14% 86% Moisture Content 20.000 3/4 20.0 23.9 14% 86% Motesture Content 16,000 5/8 16.0 23.9 14% 86% Dry-Tare 12,500 1/2 12.5 23.9 14% 86% Tare 10,000 3/8 10.0 23.9 14% 85.5% MC (%) Passing 5,000 0.185 5.0 24.1 15% 85.3% W1: Dry-Tare 1,250 0.0469 1.25 24.9 15% 84.6% W1: Dry-Tare 1,250 0.0469 1.25 24.9 15% 83.3% Tare 1,250 0.016 0.315 27.7 17% 83.3% Tare	_								
Tare 100.0 40.000 11/2 40.0 90% 100% Wt. Dry 165.3 25,000 1 25.0 23.9 14% 86% Misture Content 20,000 3/4 20.0 23.9 14% 86% Wet + Tare 16,000 5/8 16.0 23.9 14% 86% Dry+Tare 12,500 1/2 12.5 23.9 14% 86% MC (%) 5,000 0.165 5.0 24.1 15% 85.3% MC (%) 5,000 0.037 2.0 24.3 15% 85.3% Mt Dry+Tare 1,250 0.0469 1.25 24.9 15% 85.0% Tare 1,250 0.0469 1.25 24.9 15% 84.6% Wt. Dry 315 0.0116 0.316 27.7 17% 83.3% Tare 0.00 0.00295 0.075 37.6 20 77.3% W Dry 165.3 49 </td <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td>									
Wt. Dry 165.3 22,000 1 22.00 3/4 20.00 3/4 20.00 23.9 14% 86% Moisture Content 10,000 3/4 20.0 23.9 14% 86% Dry+Tare 12,500 1/2 12.5 23.9 14% 86% Dry+Tare 12,500 1/2 12.5 23.9 14% 86% C(%) 20.00 3/8 10.0 23.9 14% 86% MC(%) 20.00 3/8 10.0 23.9 14% 86% MC(%) 20.00 0.937 2.0 24.3 15% 85.3% MC (bry) 1,250 0.0469 1.25 24.4 15% 85.0% After Washing 2.00 0.0234 0.63 2.57.7 17% 83.3% 80.9% Tare No. 160 0.0059 0.160 31.6 19% 80.9% 75.3% 75 0.00295 0.075 37.6 23.3% 77.3% Wt Dry Tare 265.3 44 2 0.029 20	-								
Moisture Content Wet + Tare 20,000 3/4 20,0 23.9 14% 86% Dy+Tare 16,000 5/8 16.0 23.9 14% 86% Tare 10,000 3/8 10.0 23.9 14% 86% MC (%) 5.00 0.185 5.0 24.1 15% 85.3% MC (%) - 1.250 0.0469 1.25 24.9 15% 85.3% Mt. Dry+Tare 1,250 0.0469 1.25 24.9 15% 85.3% Tare No. 1315 0.0116 0.315 2.7.7 11% 83.3% Tare No. 160 0.0059 0.0160 31.6 19% 80.9% Tare No. 160 0.0059 0.075 37.6 23% 77.3% Mt Dry+Tare 265.3 49 0.5 0.055 20 43 71.8% Wt Dry+Tare 265.3 49 0.5 0.055 20 43 71.8%				1 1/2			0%		
Wet + Tare 16,000 5/8 16.0 23.9 14% 86% Dry-Tare 12,500 1/2 12.5 23.9 14% 86% Tare 10,000 3/8 10.00 23.9 14% 86% MC (%) - - - - - - After Washing 2.000 0.0937 2.0 24.1 15% 85.3% Wt. Dry+Tare 1,250 0.0469 1.25 24.9 15% 85.0% Tare 630 0.0234 0.63 25.4 15% 84.6% Wt. Dry 315 0.0116 0.316 27.7 17% 83.3% Tare No. 160 0.0059 0.160 31.6 19% 80.9% Wt Dry+Tare 265.3 49 0.5 0.055 20 43 71.8% Wt Dry 165.3 44 2 0.029 20 44 66.7% Sample Size : 50		165.3							
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $									
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $			16,000				14%		
MC (%) Passing 5,000 0.185 5.0 24.1 15% 85.4% After Washing Wt. Dry+Tare 2,000 0.0937 2.0 24.3 15% 85.3% Tare 1,250 0.0469 1.25 24.9 15% 85.5% Tare 630 0.0234 0.63 25.4 15% 84.6% Wt. Dry 315 0.0116 0.315 27.7 17% 83.3% Tare No. 160 0.0059 0.160 31.6 19% 80.9% YT 75 0.00295 0.075 37.6 23% 77.3% HYDROMETER DATA READING TIME (min) DIAMETER (mm) TEMP. (°C) CORR. READING THAN REMARKS Wt Dry+Tare 265.3 49 0.5 0.055 20 45 75.2% Wt Dry 165.3 44 2 0.029 20 40 66.7% Sample Size : 50 41 5 0.019 20 <t< td=""><td>Dry+Tare</td><td></td><td>12,500</td><td></td><td>12.5</td><td></td><td>14%</td><td>86%</td><td></td></t<>	Dry+Tare		12,500		12.5		14%	86%	
Passing Image: Non-Stress of the stress of the	Tare		10,000	3/8	10.0	23.9	14%	85.5%	
After Washing Wt. Dry+Tare 2,000 0.0937 2.0 24.3 15% 85.3% Wt. Dry+Tare 1,250 0.0469 1.25 24.9 15% 85.0% Tare 630 0.0234 0.63 25.4 15% 84.6% Wt. Dry 315 0.0116 0.315 27.7 17% 83.3% Tare No. 160 0.0059 0.160 31.6 19% 80.9% 75 0.00295 0.075 37.6 23% 77.3% Wt Dry+Tare 265.3 49 0.5 0.055 20 45 75.2% Wt Tare 100.0 47 1 0.039 20 43 71.8% Sample Size : 50 41 5 0.019 20 37 61.6% Wt Retained 2 mm: 24.3 36 15 0.011 20 32 53.2% % Passing 2 mm: 85.3% 33 30 0.008 20 29 48.1%	MC (%)			0.185	5.0	24.1	15%	85.4%	
Wt. Dry+Tare 1,250 0.0469 1.25 24.9 15% 85.0% Tare 630 0.0234 0.63 25.4 15% 84.6% Wt. Dry 315 0.0160 0.315 27.7 17% 83.3% Tare No. 160 0.0059 0.160 31.6 19% 80.9% 75 0.00295 0.075 37.6 23% 77.3% 77.3% HYDROMETER DATA READING TIME (min) DIAMETER (mm) TEMP. (°C) CORR. READING REMARKS Wt Dry+Tare 265.3 49 0.5 0.055 20 43 71.8% Wt Dry 165.3 44 2 0.029 20 40 66.7% Sample Size : 50 41 5 0.011 20 32 53.2% % Passing 2 mm: 85.3% 33 30 0.008 20 29 48.1% Kydrometer No.: 43.9856 25 120 0.004 20 21 34.6% Solution (g/L) : 40 23 <td< td=""><td></td><td>Passing</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></td<>		Passing							
Tare 630 0.0234 0.63 25.4 15% 84.6% Wt. Dry 315 0.0116 0.315 27.7 17% 83.3% Tare No. 160 0.0059 0.160 31.6 19% 80.9% Tare No. 75 0.00295 0.075 37.6 23% 77.3% Wt Dry+Tare 265.3 49 0.5 0.055 20 45 75.2% Wt Dry+Tare 265.3 49 0.5 0.055 20 45 75.2% Wt Dry 165.3 444 2 0.029 20 40 66.7% Sample Size : 50 41 5 0.011 20 32 53.2% Wt Retained 2 mm: 24.3 36 15 0.011 20 32 53.2% % Passing 2 mm: 85.3% 33 30 0.008 20 29 48.1% Specific Gravity : 2.70 2.9 60 0.006 20 <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td>									
Wt. Dry Tare No. 315 0.0116 0.315 27.7 17% 83.3% HYDROMETER DATA 160 0.0059 0.015 31.6 19% 80.9% 77.3% Wt Dry+Tare 265.3 49 0.5 0.0055 20 CORR. READING PERCENT FINER THAN REMARKS Wt Dry+Tare 265.3 49 0.5 0.055 20 43 71.8% REMARKS Wt Tare 100.0 47 1 0.039 20 43 71.8% REMARKS Sample Size : 50 41 5 0.019 20 43 71.8% REMARKS Vt Retained 2 mm: 24.3 36 15 0.011 20 37 61.6% Specific Gravity : 2.70 29 60 0.006 20 25 41.4% Solution (g/L) : 40 2.3 240 0.003 20 13 21.1%	-								
Tare No. 160 0.0059 0.00295 0.160 31.6 19% 80.9% HYDROMETER DATA READING TIME (min) DIAMETER (mm) TEMP. (°C) CORR. READING PERCENT FINER THAN REMARKS Wt Dry+Tare 265.3 49 0.5 0.055 20 45 75.2% Wt Tare 100.0 47 1 0.039 20 43 71.8% Wt Dry 165.3 44 2 0.029 20 40 66.7% Sample Size : 50 41 5 0.019 20 37 61.6% Wt Retained 2 mm: 24.3 36 15 0.011 20 32 53.2% % Passing 2 mm: 85.3% 33 30 0.008 20 29 48.1% Specific Gravity : 2.70 29 60 0.006 20 25 41.4% Hydrometer No.: 43.9856 25 120 0.004 20 21 34.6% Solution (g/L) : 40 23 240 0.003 20 13<									
TS 0.00295 0.075 37.6 23% 77.3% HYDROMETER DATA READING TIME (min) DIAMETER (mm) TEMP. (°C) CORR. READING PERCENT FINER THAN REMARKS Wt Dry+Tare 265.3 49 0.5 0.055 20 45 75.2% Wt Tare 100.0 47 1 0.039 20 43 71.8% Wt Dry 165.3 44 2 0.029 20 443 71.8% Sample Size : 50 41 5 0.019 20 37 661.6% Wt Retained 2 mm: 24.3 36 15 0.011 20 32 53.2% % Passing 2 mm: 85.3% 33 30 0.008 20 29 48.1% Hydrometer No.: 43-9856 25 120 0.004 20 21 34.6% Solution (g/L) : 40 23 240 0.003 20 13 21.1%									
PAN PAN Image: Constraint of the state	Tare No.								
HYDROMETER DATA READING TIME (min) DIAMETER (mm) TEMP. (°C) CORR. READING PERCENT FINER THAN REMARKS Wt Dry+Tare 265.3 49 0.5 0.055 20 45 75.2% Wt Tare 100.0 47 1 0.039 20 43 71.8% Wt Dry 165.3 44 2 0.029 20 40 66.7% Sample Size : 50 41 5 0.019 20 37 61.6% Wt Retained 2 mm: 24.3 36 15 0.011 20 32 53.2% % Passing 2 mm: 85.3% 33 30 0.008 20 29 48.1% Specific Gravity : 2.70 29 60 0.006 20 25 41.4% Hydrometer No.: 43-9856 25 120 0.004 20 21 34.6% Solution (g/L) : 40 23 240 0.003 20 19 31.2% </td <td></td> <td></td> <td></td> <td>0.00295</td> <td>0.075</td> <td>37.6</td> <td>23%</td> <td>77.3%</td> <td></td>				0.00295	0.075	37.6	23%	77.3%	
HYDROMETER DATA READING TIME (min) DIAMETER (mm) TEMP. (°C) CORR. READING THAN REMARKS Wt Dry+Tare 265.3 49 0.5 0.055 20 45 75.2% Wt Tare 100.0 47 1 0.039 20 43 71.8% Wt Dry 165.3 44 2 0.029 20 40 66.7% Sample Size : 50 41 5 0.019 20 37 61.6% Wt Retained 2 mm: 24.3 36 15 0.011 20 32 53.2% % Passing 2 mm: 85.3% 33 30 0.008 20 29 48.1% Specific Gravity : 2.70 29 60 0.006 20 25 41.4% Hydrometer No.: 43-9856 25 120 0.004 20 21 34.6% Solution (g/L) : 40 23 240 0.003 20 19 31.2%			PAN						
Wt Tare100.04710.039204371.8%Wt Dry165.34420.029204066.7%Sample Size :504150.019203761.6%Wt Retained 2 mm:24.336150.011203253.2%% Passing 2 mm:85.3%33300.008202948.1%Specific Gravity :2.7029600.006202541.4%Hydrometer No.:43-9856251200.004202134.6%Solution (g/L) :40232400.001201321.1%	HYDROMETE	R DATA	READING	TIME (min)	DIAMETER (mm)	TEMP. (°C)	CORR. READING		REMARKS
Wt Dry165.34420.029204066.7%Sample Size :504150.019203761.6%Wt Retained 2 mm:24.336150.011203253.2%% Passing 2 mm:85.3%33300.008202948.1%Specific Gravity :2.7029600.006202541.4%Hydrometer No.:43-9856251200.004202134.6%Solution (g/L) :40232400.001201321.1%	Wt Dry+Tare			0.5			45		
Sample Size :504150.019203761.6%Wt Retained 2 mm:24.336150.011203253.2%% Passing 2 mm:85.3%33300.008202948.1%Specific Gravity :2.7029600.006202541.4%Hydrometer No.:43-9856251200.004202134.6%Solution (g/L) :40232400.001201321.1%	Wt Tare		47	1			43		
Wt Retained 2 mm:24.336150.011203253.2%% Passing 2 mm:85.3%33300.008202948.1%Specific Gravity :2.7029600.006202541.4%Hydrometer No.:43-9856251200.004202134.6%Solution (g/L) :40232400.001201931.2%	Wt Dry	165.3	44	2	0.029	20	40	66.7%	
% Passing 2 mm: 85.3% 33 30 0.008 20 29 48.1% Specific Gravity : 2.70 29 60 0.006 20 25 41.4% Hydrometer No.: 43-9856 25 120 0.004 20 21 34.6% Solution (g/L) : 40 23 240 0.003 20 19 31.2% Image: Marking Control of the second of	Sample Size :	50	41	5	0.019	20	37	61.6%	
Specific Gravity : 2.70 29 60 0.006 20 25 41.4% Hydrometer No.: 43-9856 25 120 0.004 20 21 34.6% Solution (g/L) : 40 23 240 0.003 20 19 31.2% Image: Comparison of the system 17 1440 0.001 20 13 21.1%	Wt Retained 2 mm:	24.3	36		0.011	20	32	53.2%	
Hydrometer No.:43-9856251200.004202134.6%Solution (g/L):40232400.003201931.2%1714400.001201321.1%	% Passing 2 mm:	85.3%	33	30	0.008	20	29	48.1%	
Solution (g/L): 40 23 240 0.003 20 19 31.2% 17 1440 0.001 20 13 21.1%		2.70		60	0.006	20	25	41.4%	
17 1440 0.001 20 13 21.1%	Hydrometer No.:	43-9856	25	120	0.004	20	21	34.6%	
	Solution (g/L):	40	23	240	0.003	20	19	31.2%	
15 2880 0.001 20 11 17.7%									
			15	2880	0.001	20	11	17.7%	



CLIENT :	Government of A	lberta								
PROJECT :	SAFM									
JOB No. :	60309815.04									
LOCATION :					SAMPLE:		C1			
BOREHOLE:	TH14-10				DEPTH :		6.5m			
DATE :	March 3, 2014				TECHNIC	IAN :	СК			
				LIQUID L						
Trial No.				1						
Number of Blows				29						
Container Numbe	r									
Wt. Sample (wet+t	are)(g)			42.59						
Wt. Sample (dry+ta				34.25						
Wt. Tare (g)				12.08						
Wt. Dry Soil (g)				22.2						
Wt. Water (g)				8.3						
Water Content (%)				37.6%						
	AVERAGE VALUE	S				PLA	STIC LIMIT			
Liquid Limit	3	38.3		Trial No.			1			
Plastic Limit	2	25.4		Container N	lumber					
Plasticity Index	1	2.9	,	Wt. Sample	(wet+tare)	(g)	31.9	8		
SA	MPLE DESCRIPTI	ON	,	Wt. Sample	(dry+tare)(g)	28.8	33		
				Wt. Tare (g)			16.4	4		
Classification:		ML		Wt. Dry Soil			12.	4		
				Wt. Water (g			3.2	2		
				Water Cont			25.4	%		
60	T			I		Г Г				
50										
50								/		
ä 40										
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40 40			/							
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FORM: SAFM TH14-10#C1 Att.xlsx DATE: 3/4/2014

PROJECT : JOB No. :	SAFM									
JOB No. :										
	60309815.04									
LOCATION :					SAMPLE:		C3			
BOREHOLE:	TH14-10				DEPTH :		13.1m			
DATE :	March 3, 2014				TECHNIC	IAN ·	СК			
				LIQUID L						
Trial No.				1						
Number of Blows				17						
Container Numbe	r									
Wt. Sample (wet+t				48.82						
Wt. Sample (dry+ta				40.72						
Wt. Tare (g)				11.54						
Wt. Dry Soil (g)				29.2						
Wt. Water (g)				8.1						
Water Content (%)				27.8%					<u> </u>	
	AVERAGE VALUE	S		,	<u>I</u>			<u> </u>		
Liquid Limit		26.5		Trial No.		1 2/ 6	1			
Plastic Limit		23.9	ł	Container N	lumber					
Plasticity Index		2.6		Wt. Sample		(a)	29.17			
	MPLE DESCRIPT			Wt. Sample			26.16			
				Wt. Tare (g)		.37	13.55			
Classification:		ML		Wt. Dry Soil			12.6			
				Wt. Water (g			3.0			
			-	Water Cont			23.9%			
60 -	1		-	T		1 1				
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0 1	10 2	20 3	0 4	40 5 LIQUII	0 6 D LIMIT	0 70	80	90	1(00

FORM: SAFM TH14-10#C3 Att.xlsx DATE: 3/4/2014



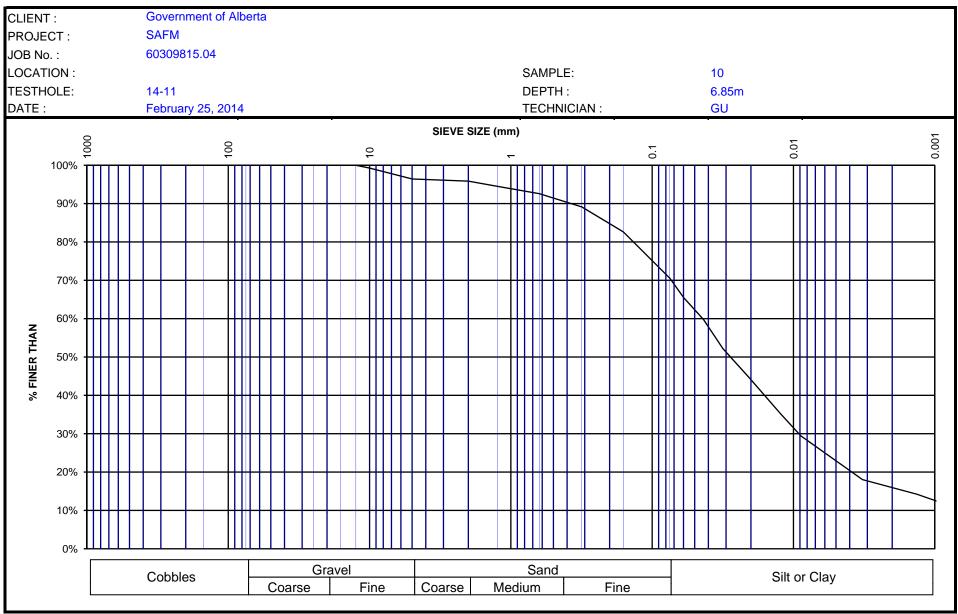
CLIENT :	Government of	Alberta								
PROJECT :	SAFM									
JOB No. :	60309815.04									
LOCATION :					SAMPLE:		10			
BOREHOLE:	TH14-11				DEPTH :		6.85m			
DATE :	February 25, 20	14			TECHNIC	IAN :	GU			
				LIQUID L						
Trial No.				1						
Number of Blows				20						
Container Number										
Wt. Sample (wet+ta	are)(g)			56.01						
Wt. Sample (dry+ta	re)(g)			48.26						
Wt. Tare (g)				13.54						
Wt. Dry Soil (g)				34.7						
Wt. Water (g)				7.8						
Water Content (%)				22.3%						
	AVERAGE VALUE	S				PLA	STIC LIMI	-		
Liquid Limit		21.7		Trial No.			1			
Plastic Limit		12.0		Container N	lumber					
Plasticity Index		9.7		Wt. Sample	(wet+tare)	(g)	36.4	44		
SA	MPLE DESCRIPT	FION		Wt. Sample	(dry+tare)(g)	33.8	33		
				Wt. Tare (g)			12.0	09		
Classification:		CL		Wt. Dry Soil	(g)		21	.7		
				Wt. Water (g)		2.6	6		
				Water Cont	ent (%)		12.0)%		
60										_
50										
50										
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40				1						
S 20				CI						
		CL				МН				
10				1						
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0	10 2	20 3	0	40 5 LIQUII	0 6 D LIMIT	0 7	8 0	60	90	100

FORM: SAFM TH14-11 #10 Att.xlsx DATE: 2/26/2014

SIEVE ANALYSIS

CLIENT :		Go	verni	ment	tof	Alb	ert	a																											
PROJECT	:	SA	FM																																
JOB No. :		603	8098	15.04	4																														
LOCATION	1:															S	٩M	PLE	≣:					2	4										
TESTHOLE	Ε:	14-	11													DI	EP	τн	:					2	2.5m										
DATE :			oruar													TE	ECI	HNI	CIAN	1:				(GU										
TOTAL DI			IT		SIEV							OPE						IG					NT		PEF					SF	PEC		CAT	ION	
OF S.	SAMPL	E.		NC	Ο. (μ	um)				RO> HES			m	m		F		AIN (g)	IED	R	ET.	AIN	NEC		FINE	R TI	HAN		LC	DWI	ER		ι	JPPE	R
Before Was	-					500			(6				0.0				(0)									00%								
Wet + Tare		_				750				3				5.0													00%								
Dry+Tare			70.6			5000				2				0.0													00%								
Tare			61.2 09.4			400(250(1/2 1				0.0													00%								
Wt. Dry Moisture Co	ntent		09.4			2500 2000				1 /4				5.0).0													00% 00%								
Wet + Tare						160				/ 4 /8				5.0 5.0													00%								
Dry+Tare						1250				/2				2.5													00%								
Tare						100				/8				0.0													00%								
MC (%)						50	00		0.1	185			5	.0												1	00%	,							
After Washi	na	Pas	sing			20	00		0.0	937			2	.0										_		1	00%					_			
Wt. Dry+Tar		6	10.4			12				469				.0 25													00%								
Tare	10		61.2				30			234				20 530					3.0				1	%			99%								
Wt. Dry			49.2				15									2	225.3				44				56%										
Tare No.						10	60		0.0	059			0.1	160				З	313.1				61	%			39%	,							
					-		80		0.0	029			0.0	080					345.7				68	%			32%	,							
Classificatio	n.		SI	/ or		PAN	N	D۵	scr	intio	n ar	nd R	۵m	arke	2.			2	249.2																
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	Cu			#N/A	4																														
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CLIENT :	Government of A	lberta						
PROJECT :	SAFM							
JOB No. :	60309815.04							
LOCATION :					SAMPLE:		10	
TESTHOLE:	14-11				DEPTH :		6.85m	
DATE :	February 25, 201	4			TECHNICIAN :		GU	
DATE .	1 cordary 20, 201		SIZE OF	OPENING				
TOTAL DRY WEIGHT	F OF SAMPLE	SIEVE NO. (µm)	APPROX.		WEIGHT RETAINED (g)	PERCENT RETAINED	PERCENT FINER THAN	REMARKS
			INCHES	mm	RETAINED (g)			
Before Washing		150,000	6	150.0		0%	100%	
Wet + Tare		75,000	3	75.0		0%	100%	
Dry+Tare	276.0	50,000	2	50.0		0%	100%	
Tare	100.0	40,000	1 1/2	40.0		0%	100%	
Wt. Dry	176.0	25,000	1	25.0		0%	100%	
Moisture Content		20,000	3/4	20.0		0%	100%	
Wet + Tare		16,000	5/8	16.0		0%	100%	
Dry+Tare		12,500	1/2	12.5		0%	100%	
Tare		10,000	3/8	10.0	1.3	1%	99.3%	
MC (%)		5,000	0.185	5.0	6.3	4%	96.4%	
	Passing							
After Washing		2,000	0.0937	2.0	7.3	4%	95.9%	
Wt. Dry+Tare		1,250	0.0469	1.25	9.7	5%	94.5%	
Tare		630	0.0234	0.63	13.0	7%	92.6%	
Wt. Dry		315	0.0116	0.315	19.1	11%	89.1%	
Tare No.		160	0.0059	0.160	30.6	17%	82.6%	
		75 PAN	0.00295	0.075	51.8	29%	70.5%	
							PERCENT FINER	
HYDROMETER		READING	TIME (min)	DIAMETER (mm)	TEMP. (°C)	CORR. READING	THAN	REMARKS
Wt Dry+Tare	276.0	39	0.5	0.060	20	35	65.5%	
Wt Tare	100.0	36	1	0.043	20	32	59.8%	
Wt Dry	176.0	32	2	0.032	20	28	52.2%	
Sample Size :	50	28	5	0.021	20	24	44.6%	
Wt Retained 2 mm:	7.3	23	15	0.012	20	19	35.1%	
% Passing 2 mm:	95.9%	20	30	0.009		16	29.4%	
Specific Gravity :	2.70	18	60	0.006	20	14	25.6%	
Hydrometer No.:	43-9856	16	120	0.005	20	12	21.8%	
Solution (g/L):	40	14	240	0.003	20	10	18.0%	
		12	1440	0.001	20	8	14.2%	
		11	2880	0.001	20	7	12.3%	



SIEVE ANALYSIS

CLIENT :	Govern	ment of	Alb	erta	a																						٦
PROJECT :	SAFM																										
JOB No. :	603098	15.04																									
LOCATION :											SAI	MPL	E:				2	2									
TESTHOLE :	14-12										DEI	РТН	:				C).75m	า								
DATE :	Februar	y 18, 20)14								TEC	CHN	ICIAN	l :			C	GU									
TOTAL DRY W		SIE				IZE OF	OPE					VEIG				ENT			CENT			SF	PEC	IFIC	CATIO	NC	
OF SAMPI	_E	NO. (J	μm)			ROX. HES		mı	m		RE	TAIN (g)	NED	RE	IA	INEC		-INEF	R THA	N	L	SWI	ER		U	PPER	
Before Washing		1:	5000	00		6		150	0.0			(9/							100	%				1			-
Wet + Tare			7500			3		75											100								
Dry+Tare	557.2		5000			2		50											100								
Tare	233.6		4000			1/2		40											100								
Wt. Dry Moisture Content	323.6		2500 2000			1 3/4		25 20											100 [°] 100°								
Wet + Tare			2000 1600			5/8		20 16											100								
Dry+Tare			1250			//2		12											100								ľ
Tare			1000			8/8		10											100								
MC (%)	Dessian		500	00	0.	185		5.	0				2.7			1	%		99	%							
After Washing	Passing		200	00	0.0)937		2.	0				17.1			5	%		95	%				+			ļ
Wt. Dry+Tare	446.1		125			0469		1.2					26.0				%		92								
Tare	233.6		63	30	0.0)234		0.6	30				45.9			14	%		86	%							
Wt. Dry	212.5			15		0116		0.3					124.2			38			62								
Tare No.				50		0059		0.1					192.6			60			40								
			ع PAN	30 1	0.0	029		0.0	80				212.2 212.4			66	%		34	%							
Classification:		I or SC		1	Descr	iption a	and Re	ema	arks											_							
Cc Cu		#N/A #N/A																									
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CLIENT :	Government of a	Alberta								
PROJECT :	SAFM									
JOB No. :	60309815.04									
LOCATION :					SAMPLE:		5			
BOREHOLE:	TH14-12				DEPTH :		3.05m			
DATE :	February 18, 20	14			TECHNIC	IAN :	СК			
				LIQUID L	MIT					
Trial No.				1						
Number of Blows				29						
Container Number	-									
Wt. Sample (wet+t	are)(g)			38.01						
Wt. Sample (dry+ta	are)(g)			31.84						
Wt. Tare (g)				12.07						
Wt. Dry Soil (g)				19.8						
Wt. Water (g)				6.2						
Water Content (%)				31.2%						
	AVERAGE VALUE	S				PLA	STIC LIMIT			
Liquid Limit		31.7		Trial No.			1			
Plastic Limit		18.1		Container N	lumber					
Plasticity Index		13.6		Wt. Sample	(wet+tare)	(g)	34.2	28		
SA	MPLE DESCRIPT	TION		Wt. Sample	(dry+tare)(g)	31.5	54		
				Wt. Tare (g)			16.4	4		
Classification:	(CI-CL		Wt. Dry Soil	(g)		15.	1		
				Wt. Water (g))		2.7	,		
				Water Cont	ent (%)		18.1	%		
										1
60 -					[[[
50										
50										
40 40 40 40 40 40 40 40 40 40 40 40 40 4					C	н				
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FORM: SAFM TH14-12#5 Att.xlsx DATE: 2/19/2014



CLIENT : Government of Al	berta						
PROJECT : SAFM							
JOB No. : 60309815.04							
LOCATION :			SAMPLE:		9		
BOREHOLE: TH14-12			DEPTH :		6.05m		
DATE : February 18, 2014	4		TECHNIC	IAN :	СК		
		LIQUID LI	MIT				
Trial No.		1					
Number of Blows		19					
Container Number							
Wt. Sample (wet+tare)(g)		38.28					
Wt. Sample (dry+tare)(g)		32.09					
Wt. Tare (g)		11.54					
Wt. Dry Soil (g)		20.6					
Wt. Water (g)		6.2					
Water Content (%)		30.1%					
AVERAGE VALUES				PLAS	TIC LIMIT		
Liquid Limit 2	9.1	Trial No.			1		
Plastic Limit 2	1.0	Container N	lumber				
Plasticity Index 8	3.2	Wt. Sample	(wet+tare)	(g)	33.52		
SAMPLE DESCRIPTION	ON	Wt. Sample	(dry+tare)(g)	30.50		
		Wt. Tare (g)			16.09		
Classification: Cl	CI	Wt. Dry Soil	(g)		14.4		
		Wt. Water (g	1)		3.0		
		Water Conte	ent (%)		21.0%)	
60							
50							
			С	н			
E 30							
40 40 30 20 20							
20		CI					
	CL	1		МН			
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		2.901					

FORM: SAFM TH14-12#9 Att.xlsx DATE: 2/19/2014



	Government of Albe	rta						
PROJECT :	SAFM							
JOB No. :	60309815.04							
LOCATION :				SAMPLE:		4		
BOREHOLE:	TH14-13			DEPTH :		2.5m		
DATE :	February 25, 2014			TECHNICI	AN :	GU		
			LIQUID L	IMIT				
Trial No.			1					
Number of Blows			24					
Container Number								
Wt. Sample (wet+ta	are)(g)		65.16					
Wt. Sample (dry+ta			57.06					
Wt. Tare (g)			16.33					
Wt. Dry Soil (g)			40.7					
Wt. Water (g)			8.1					
Water Content (%)			19.9%					
	AVERAGE VALUES				PLAS			
Liquid Limit	19.8	3	Trial No.			1		
Plastic Limit	14.5		Container N	Number				
Plasticity Index	5.3			e (wet+tare)(a)	27.98		
	VPLE DESCRIPTION			e (dry+tare)(25.93		
		<u> </u>	Wt. Tare (g)		57	11.75		
Classification:	CL-M	AL.	Wt. Dry Soil			14.2		
			Wt. Water (2.1		
			Water Cont			14.5%		
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	CL-MI 10 20		ML	50 60 D LIMIT		80	90	100

FORM: SAFM TH14-13 #4 Att.xlsx DATE: 2/26/2014



CLIENT :	Governm	ent of Albert	а						
PROJECT :	SAFM								
JOB No. :	60309815	5.04							
LOCATION :					SAMPLE:		6		
TESTHOLE :	14-13				DEPTH :		3.85m		
DATE :	February	25, 2014			TECHNICIAN	1:	GU		
TOTAL DRY WE		SIEVE	SIZE OF (OPENING	WEIGHT	PERCENT	PERCENT	SPECIF	CATION
OF SAMPL	E	NO. (μm)	APPROX.	mm	RETAINED	RETAINED	FINER THAN	LOWER	UPPER
		450000	INCHES	450.0	(g)		1000/		
Before Washing Wet + Tare		150000 75000	6	150.0 75.0			100% 100%		
Dry+Tare	710.6	75000 50000	3 2	75.0 50.0			100%		
Tare	252.0	40000	2 1 1/2	40.0			100%		
Wt. Dry	252.0 458.6	40000 25000	1 1/2	40.0 25.0			100%		
Moisture Content	450.0	20000	3/4	20.0	19.9	4%	96%		
Wet + Tare		16000	5/8	16.0	19.9	4%	96%		
Dry+Tare		12500	1/2	12.5	28.9	6%	94%		
Tare		10000	3/8	10.0	31.4	7%	93%		
MC (%)		5000	0.185	5.0	38.8	8%	92%		
	Passing								
After Washing		2000	0.0937	2.0	51.8	11%	89%		
Wt. Dry+Tare	513.8	1250	0.0469	1.25	57.1	12%	88%		
Tare	252.0	630	0.0234	0.630	66.1	14%	86%		
Wt. Dry	261.8	315	0.0116	0.315	92.7	20%	80%		
Tare No.		160	0.0059	0.160	157.0	34%	66%		
		80 PAN	0.0029	0.080	243.9 261.6	53%	47%		
Classification:	SM	or SC	Description ar	nd Remarks:	201.0				
Cc		N/A	·						
Cu	#1	N/A		SIEVE	SIZE (mm)				
1000		100		9	512E (mm)	.	0.1		0.01
100%									
90%	+++				+++-				
80%							++		
70%									
X60% HL 50% HL 40% %									
								++++	
30%									
20%									
10%	+++				+ $+$ $+$ $-$				
0%									
	0.111		Gravel			Sand		0.14	
	Cobbles	C	Coarse	Fine	Coarse N	Medium	Fine	Silt or	Clay

CLIENT :	Government of A	Alberta								
PROJECT :	SAFM									
JOB No. :	60309815.04									
LOCATION :					SAMPLE:		8			
BOREHOLE:	TH14-13				DEPTH :		5.3m			
DATE :	February 25, 20	14			TECHNIC	IAN :	GU			
				LIQUID L	IMIT					
Trial No.				1						
Number of Blows				26						
Container Number										
Wt. Sample (wet+t	are)(g)			57.39						
Wt. Sample (dry+ta	are)(g)			47.70						
Wt. Tare (g)				16.09						
Wt. Dry Soil (g)				31.6						
Wt. Water (g)				9.7						
Water Content (%)				30.7%						
	AVERAGE VALUE	S				PLAS		•		
Liquid Limit		30.8	-	Trial No.			1			
Plastic Limit		18.6		Container N	lumber					
Plasticity Index					(wet+tare)	(g)	29.78	3		
SA	MPLE DESCRIPT	ION		Wt. Sample			26.92	2		
				Wt. Tare (g)			11.54	L I		
Classification:	C	CI-CL		Wt. Dry Soil			15.4			
				Wt. Water (g			2.9			
				Water Cont			18.6%	6		
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FORM: SAFM TH14-13 #8 Att.xlsx DATE: 2/26/2014



CLIENT :	Government of Alberta				
PROJECT :	SAFM				
JOB No. :	60309815.04				
LOCATION :			SAMPLE:	3	
BOREHOLE:	TH14-14		DEPTH :	1.7m	
DATE :	February 6, 2014		TECHNICIAN :	СК	
		LIQUID L			
Trial No.		1			
Number of Blows		32			
Container Number					
Wt. Sample (wet+ta	are)(g)	47.15			
Wt. Sample (dry+ta		41.18			
Wt. Tare (g)		12.11			
Wt. Dry Soil (g)		29.1			
Wt. Water (g)		6.0			
Water Content (%)		20.5%			
	AVERAGE VALUES		<u> </u>	ASTIC LIMIT	I
Liquid Limit	21.1	Trial No.		1	
Plastic Limit	16.6	Container I	Number		
Plasticity Index	4.5	Wt. Sample	e (wet+tare)(g)	35.84	
	MPLE DESCRIPTION		(dry+tare)(g)	32.96	
		Wt. Tare (g		15.64	
Classification:	CL-ML	Wt. Dry Soi		17.3	
		Wt. Water (2.9	
		Water Cont		16.6%	
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	CL_ML	ML			
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0 + 0	10 20 30	40 t LIQUI	60 60 D LIMIT	70 80	90 100

FORM: SAFM TH14-14 #3 Att.xlsx DATE: 2/7/2014



CLIENT :	Government of	Alberta								
PROJECT :	SAFM									
JOB No. :	60309815.04									
LOCATION :					SAMPLE:		6			
BOREHOLE:	TH14-14				DEPTH :		3.9m			
DATE :	February 6, 201	4			TECHNIC	IAN :	СК			
				LIQUID L	IMIT					
Trial No.				1						
Number of Blows				20						
Container Numbe	r									
Wt. Sample (wet+t	are)(g)			44.66						
Wt. Sample (dry+ta				39.01						
Wt. Tare (g)				12.06						
Wt. Dry Soil (g)				27.0						
Wt. Water (g)				5.7						
Water Content (%)				21.0%	1					
	AVERAGE VALUI	ES			•	PLA	STIC LIMIT			•
Liquid Limit		20.4		Trial No.			1			
Plastic Limit		17.1		Container N	lumber					
Plasticity Index		3.3		Wt. Sample	(wet+tare)	(g)	32.4	10		
	MPLE DESCRIP	TION		Wt. Sample			30.0)6		
				Wt. Tare (g)			16.3	37		
Classification:		ML		Wt. Dry Soil			13.	7		
				Wt. Water (2.3	3		
				Water Cont			17.1	%		
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0	10 2	20 3	30 4	40 5	60 6 D LIMIT	60 7(D 8	0	90	100

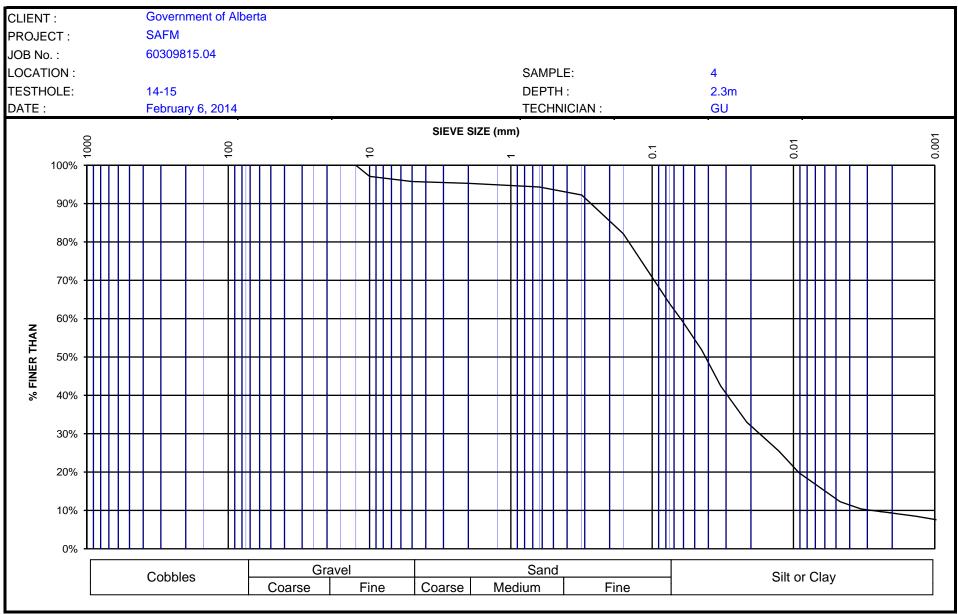
FORM: SAFM TH14-14 #6 Att.xlsx DATE: 2/7/2014



CLIENT :	Government of A	lberta						
PROJECT :	SAFM							
JOB No. :	60309815.04							
LOCATION :					SAMPLE:		6	
TESTHOLE:	14-14				DEPTH :		3.9	
DATE :	February 7, 2014				TECHNICIAN :		GU	
			SIZE OF	OPENING	WEIGHT	PERCENT	PERCENT FINER	
TOTAL DRY WEIGH	T OF SAMPLE	SIEVE NO. (µm)	APPROX. INCHES	mm	RETAINED (g)	RETAINED	THAN	REMARKS
Before Washing		150,000	6	150.0		0%	100%	
Wet + Tare		75,000	3	75.0		0%	100%	
Dry+Tare	618.5	50,000	2	50.0		0%	100%	
Tare	100.0	40,000	1 1/2	40.0		0%	100%	
Wt. Dry	518.5	25,000	1	25.0		0%		
Moisture Content		20,000	3/4	20.0		0%	100%	
Wet + Tare		16,000	5/8	16.0		0%	100%	
Dry+Tare		12,500	1/2	12.5		0%	100%	
Tare		10,000	3/8	10.0		0%	100.0%	
MC (%)	Passing	5,000	0.185	5.0	1.1	0%	99.8%	
After Washing	i doonig	2,000	0.0937	2.0	2.0	0%	99.6%	
Wt. Dry+Tare		1,250	0.0469	1.25	4.1	1%		
Tare		630	0.0234	0.63	7.2	1%		
Wt. Dry		315	0.0116	0.315	15.4	3%		
Tare No.		160	0.0059	0.160	98.1	19%	81.1%	
		75	0.00295	0.075	205.5	40%	60.4%	
		PAN						
HYDROMETE		READING	TIME (min)	DIAMETER (mm)	TEMP. (°C)	CORR. READING	PERCENT FINER THAN	REMARKS
Wt Dry+Tare	618.5	33	0.5	0.063		29	56.2%	
Wt Tare	100.0	31	1	0.045		27	52.3%	
Wt Dry	518.5	29	2	0.032		25	48.3%	
Sample Size :	50	26	5	0.021	20	22	42.4%	
Wt Retained 2 mm:	2	23	15	0.012		19	36.5%	
% Passing 2 mm:	99.6%	21	30	0.009		17	32.5%	
Specific Gravity :	2.70	19	60	0.006		15	28.6%	
Hydrometer No.:	43-9856	16	120	0.005		12	22.7%	
Solution (g/L):	40	14	240	0.003		10	18.7%	
		12	1440	0.001	20	8	14.8%	
		11	2880	0.001	20	7	12.8%	

Government of Alberta CLIENT : SAFM PROJECT : 60309815.04 JOB No. : LOCATION : SAMPLE: 6 TESTHOLE: DEPTH : 14-14 3.9 DATE : February 7, 2014 **TECHNICIAN** : GU SIEVE SIZE (mm) 0.001 1000 0.01 100 0.1 10 ~ 100% 90% 80% 70% 60% % FINER THAN 50% 40% Г 30% 20% 10% 0% Sand Gravel Cobbles Silt or Clay Coarse Coarse Fine Medium Fine

CLIENT :	Government of Al	berta						
PROJECT :	SAFM							
JOB No. :	60309815.04							
LOCATION :					SAMPLE:		4	
TESTHOLE:	14-15				DEPTH :		2.3m	
DATE :							GU	
DATE:	February 6, 2014		SIZE OF (TECHNICIAN :		GU	
TOTAL DRY WEIGH	HT OF SAMPLE	SIEVE NO. (µm)	APPROX. INCHES	mm	WEIGHT RETAINED (g)	PERCENT RETAINED	PERCENT FINER THAN	REMARKS
Before Washing		150,000	6	150.0		0%	100%	
Wet + Tare		75,000	3	75.0		0%		
Dry+Tare	479.3	50,000	2	50.0		0%		
Tare	100.0	40,000	_ 1 1/2	40.0		0%		
Wt. Dry	379.3	25,000	1	25.0		0%	100%	
Moisture Content		20,000	3/4	20.0		0%	100%	
Wet + Tare		16,000	5/8	16.0		0%	100%	
Dry+Tare		12,500	1/2	12.5		0%	100%	
Tare		10,000	3/8	10.0	11.0	3%	97.1%	
MC (%)		5,000	0.185	5.0	16.1	4%	95.8%	
After Washing	Passing	2 000	0.0937	0.0	47.0	F 0/	95.3%	
Mt. Dry+Tare		2,000 1,250	0.0937	2.0 1.25	17.9 19.3	5% 5%		
Tare		630	0.0234	0.63	21.5	5% 6%	94.9%	
Wt. Dry		315	0.0234	0.315	29.5	8%	92.2%	
Tare No.		160	0.0059	0.160	67.8	18%		
		75	0.00295	0.075	137.2	36%		
		PAN						
HYDROMETI	ER DATA	READING	TIME (min)	DIAMETER (mm)	TEMP. (°C)	CORR. READING	PERCENT FINER THAN	REMARKS
Wt Dry+Tare	479.3	36	0.5	0.061	20	32	59.4%	
Wt Tare	100.0	32	1	0.045	20	28	51.9%	
Wt Dry	379.3	27	2	0.033	20	23	42.4%	
Sample Size :	50	22	5	0.021	20	18	33.0%	
Wt Retained 2 mm:	17.9	18	15	0.013	20	14	25.5%	
% Passing 2 mm:	95.3%	15	30	0.009	20	11	19.8%	
Specific Gravity :	2.70	13	60	0.007	20	9	16.0%	
Hydrometer No.:	43-9856	11	120	0.005	20	7	12.3%	
Solution (g/L):	40	10	240	0.003	20	6	10.4%	
		9	1440 2880	0.001 0.001	20 20	5	8.5% 7.5%	



CLIENT :	Alberta Government						
PROJECT :	SAFM						
JOB No. :	60309815.04						
LOCATION :			SAMPLE:	5			
	TH14-15		DEPTH :	3.3	m		
	February 4, 2014		TECHNICIAN				
		LIQUID L					
Trial No.		1					
Number of Blows		17					
Container Number							
Wt. Sample (wet+ta	re)(g)	48.21					
Wt. Sample (dry+tar		42.21					
Wt. Tare (g)		11.72					
Wt. Dry Soil (g)		30.5					
Wt. Water (g)		6.0					
Water Content (%)		19.7%					
	VERAGE VALUES		<u>. </u>	PLASTIC L	IMIT	L	
Liquid Limit	18.8	Trial No.			1		
Plastic Limit	14.1	Container N	lumber				
Plasticity Index	4.7	Wt. Sample	(wet+tare)(g)		30.44		
	PLE DESCRIPTION		(dry+tare)(g)		28.36		
		Wt. Tare (g)			13.61		
Classification:	CL-ML	Wt. Dry Soil			14.8		
		Wt. Water (2.1		
		Water Cont		,	14.1%		
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FORM: SAFM TH14-15#5 Att.xlsx DATE: 2/5/2014

AECOM

CLIENT :	Alberta Governm	ent								
PROJECT :	SAFM									
JOB No. :	60309815.04									
LOCATION :					SAMPLE:		7			
BOREHOLE:	TH14-15				DEPTH :		4.8m			
DATE :	February 4, 2014				TECHNIC	IAN :	СК			
	, , , , , , , , , , , , , , , , , , ,			LIQUID L						
Trial No.				1						
Number of Blows				33						
Container Numbe	r									
Wt. Sample (wet+t	tare)(g)			40.40						
Wt. Sample (dry+ta				33.68						
Wt. Tare (g)	-			12.05						
Wt. Dry Soil (g)				21.6						
Wt. Water (g)				6.7						
Water Content (%))			31.1%						
	AVERAGE VALUES	3				PLA	STIC LIMIT			
Liquid Limit	3	2.1	•	Trial No.			1			
Plastic Limit	1	7.3		Container N	lumber					
Plasticity Index	1	4.8	,	Wt. Sample	(wet+tare)	(g)	31.2	28		
SA	MPLE DESCRIPTI	ON	,	Wt. Sample	(dry+tare)(g)	29.0	8		
				Wt. Tare (g)			16.3	37		
Classification :		CI		Wt. Dry Soil			12.	7		
			,	Wt. Water (g	1)		2.2	2		
			,	Water Cont	ent (%)		17.3	%		
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FORM: SAFM TH14-15#7 Att.xlsx DATE: 2/5/2014



CLIENT :	Government of	Alberta								
PROJECT :	SAFM									
JOB No. :	60309815.04									
LOCATION :					SAMPLE:		C1			
BOREHOLE:	TH14-15				DEPTH :		8.0m			
DATE :	February 11, 20	014			TECHNIC	IAN :	СК			
				LIQUID L	IMIT					
Trial No.				1						
Number of Blows				17						
Container Numbe	r									
Wt. Sample (wet+	tare)(g)			41.52						
Wt. Sample (dry+t				33.49						
Wt. Tare (g)				11.71						
Wt. Dry Soil (g)				21.8						
Wt. Water (g)				8.0						
Water Content (%)			36.9%	1					
	AVERAGE VALU	ES			•	PLA		-		
Liquid Limit		35.2		Trial No.			1			
Plastic Limit		23.0		Container N	lumber					
Plasticity Index		12.1		Wt. Sample	(wet+tare)	(g)	29.8	36		
	MPLE DESCRIP	TION		Wt. Sample			27.3	33		
				Wt. Tare (g)		,	16.3	35		
Classification	:	CI		Wt. Dry Soil			11	0		
				Wt. Water (2.5	5		
				Water Cont			23.0	1%		
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FORM: SAFM TH14-15#C1 Att.xlsx DATE: 2/12/2014

CLIENT :	Government of	Alberta								
PROJECT :	SAFM									
JOB No. :	60309815.04									
LOCATION :					SAMPLE:		C6			
BOREHOLE:	TH14-15				DEPTH :		23.0m			
DATE :	February 12, 20	14			TECHNIC	IAN :	СК			
	, ,,			LIQUID L						
Trial No.				1						
Number of Blows				25						
Container Number	r									
Wt. Sample (wet+t	are)(g)			40.23						
Wt. Sample (dry+ta	are)(g)			31.47						
Wt. Tare (g)				12.05						
Wt. Dry Soil (g)				19.4						
Wt. Water (g)				8.8						
Water Content (%)				45.1%						
	AVERAGE VALUE	S			·	PLA	STIC LIMIT	-		
Liquid Limit		45.1		Trial No.			1			
Plastic Limit		24.7		Container N	lumber					
Plasticity Index		20.4		Wt. Sample	(wet+tare)	(g)	26.4	48		
SA	MPLE DESCRIPT	TION		Wt. Sample	(dry+tare)(g)	23.0	58		
				Wt. Tare (g)			12.3	35		
Classification:		CI		Wt. Dry Soil	(g)		11	.3		
				Wt. Water (g	1)		2.8	3		
				Water Cont	ent (%)		24.7	'%		
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FORM: SAFM TH14-15#C6 Att.xlsx DATE: 2/13/2014

CLIENT :	Govern	ment of Albert	a						
PROJECT :	SAFM								
JOB No. :	603098	15.04							
LOCATION :					SAMPLE:		3		
TESTHOLE :	14-16				DEPTH :		1.8m		
DATE :	Februa	ry 3, 2014			TECHNICIAN	1:	GU		
TOTAL DRY W	EIGHT	SIEVE	SIZE OF (OPENING	WEIGHT	PERCENT	PERCENT	SPECIFI	CATION
OF SAMPI	E	NO. (μm)	APPROX.	mm	RETAINED	RETAINED	FINER THAN	LOWER	UPPER
5 ())())			INCHES		(g)		(
Before Washing		150000	6	150.0			100%		
Wet + Tare	1500 1	75000	3 2	75.0			100%		
Dry+Tare Tare	1520.1 252.3	50000	2 1 1/2	50.0 40.0			100%		
Wt. Dry	252.3 1267.8		1 1/2	40.0 25.0	107.6	8%	100% 92%		
Moisture Content		20000	۱ 3/4	20.0	160.3	13%			
Wet + Tare		16000	5/8	20.0 16.0	214.0	13%			
Dry+Tare		12500	5/8 1/2	12.5	214.0	23%			
Tare		10000	3/8	10.0	338.5	23%			
MC (%)		5000	0.185	5.0	445.7	35%			
me (70)	Passing	0000	0.100	0.0	11011	0070	0070		
After Washing		2000	0.0937	2.0	544.1	43%	57%		
Wt. Dry+Tare	1064.1	1250	0.0469	1.25	576.4	45%			
Tare	252.3		0.0234	0.630	612.6	48%			
Wt. Dry	811.8	315	0.0116	0.315	646.0	51%	49%		
Tare No.		160	0.0059	0.160	710.0	56%	44%		
		80	0.0029	0.080	802.6	63%	37%		
Olassifiastias		PAN M or GC	Description	d D a se a si a	811.1				
Classification: Cc		#N/A	Description ar	id Remarks:					
Cu		#N/A							
1000		100		SIEVE	SIZE (mm)		0.1		0.01
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90%									
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20%									
10%									
	Cobbles		Gravel Coarse	Fine	Coarse M	Sand Medium	Fine	Silt or	Clay
			Judise	FILLE			Fille		

CLIENT :	Govern	ment of Albert	a						
PROJECT :	SAFM								
JOB No. :	603098	15.04							
LOCATION :					SAMPLE:		6		
TESTHOLE :	14-16				DEPTH :		3.9m		
DATE :	Februa	ry 3, 2014			TECHNICIAN	1:	GU		
TOTAL DRY W		SIEVE		OPENING	WEIGHT	PERCENT	PERCENT	SPECIFI	CATION
OF SAMPL	_E	NO. (μm)	APPROX. INCHES	mm	RETAINED (g)	RETAINED	FINER THAN	LOWER	UPPER
Before Washing		150000	6	150.0			100%		
Wet + Tare		75000	3	75.0			100%		
Dry+Tare	707.8		2	50.0			100%		
Tare	264.1	40000	1 1/2	40.0			100%		
Wt. Dry	443.7	25000	1	25.0			100%		
Moisture Content		20000	3/4	20.0			100%		
Wet + Tare		16000	5/8	16.0			100%		
Dry+Tare		12500	1/2	12.5			100%		
Tare		10000	3/8	10.0	3.8	1%			
MC (%)	Passing	5000	0.185	5.0	15.7	4%	96%		
After Washing		2000	0.0937	2.0	28.2	6%	94%		
Wt. Dry+Tare	397.4	1250	0.0469	1.25	33.5	8%	92%		
Tare	264.1	630	0.0234	0.630	41.1	9%	91%		
Wt. Dry	133.3	315	0.0116	0.315	53.4	12%	88%		
Tare No.		160	0.0059	0.160	81.5	18%			
		80	0.0029	0.080	130.6	29%	71%		
Classification:	SILT	PAN F or CLAY	Description ar	nd Remarks:	133.2				
Cc Cu		#N/A #N/A							
1000		100		SIEVE ♀	SIZE (mm)		0.1	:	0.01
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0%									
			Gravel			Sand			
	Cobbles		Coarse	Fine	Coarse M	Vedium	Fine	Silt or	Clay
						I	-		

CLIENT :	Government of	Alberta								
PROJECT :	SAFM									
JOB No. :	60309815.04									
LOCATION :					SAMPLE:		C1			
BOREHOLE:	TH14-16				DEPTH :		8.0m			
DATE :	February 10, 20	14			TECHNIC	IAN :	СК			
				LIQUID L	MIT					
Trial No.				1						
Number of Blows				18						
Container Numbe	er									
Wt. Sample (wet+	tare)(g)			45.21						
Wt. Sample (dry+t	are)(g)			36.78						
Wt. Tare (g)				12.06						
Wt. Dry Soil (g)				24.7						
Wt. Water (g)				8.4						
Water Content (%)			34.1%						
	AVERAGE VALUE	ES				PLAS	STIC LIMIT			
Liquid Limit		32.7		Trial No.			1			
Plastic Limit		23.0		Container N	lumber					
Plasticity Index		9.7		Wt. Sample	(wet+tare)	(g)	31.1	5		
S	AMPLE DESCRIP	ΓΙΟΝ		Wt. Sample	(dry+tare)(g)	28.3	9		
				Wt. Tare (g)			16.3	37		
Classification	:	CI		Wt. Dry Soil	(g)		12.	0		
				Wt. Water (1)		2.8	3		
				Water Cont	ent (%)		23.0	%		
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FORM: SAFM TH14-16#C1 Att.xlsx DATE: 2/11/2014

CLIENT : Gov	ernment of Alberta						
PROJECT : SAF	M						
JOB No. : 603	09815.04						
LOCATION :			SAMPLE:		C4		
	4-16		DEPTH :		17.5m		
	ruary 10, 2014		TECHNICI	AN :	CK		
		LIQUID L			-		
Trial No.		1					
Number of Blows		18					
Container Number							
Wt. Sample (wet+tare)(g	J)	40.72					
Wt. Sample (dry+tare)(g)		30.57					
Wt. Tare (g)		11.54					
Wt. Dry Soil (g)		19.0					
Wt. Water (g)		10.2					
Water Content (%)		53.3%					
	AGE VALUES			PLAS			
Liquid Limit	51.3	Trial No.			1		
Plastic Limit	27.4	Container N	lumber				
Plasticity Index	23.9	Wt. Sample	(wet+tare)(a)	25.72		
	DESCRIPTION	Wt. Sample			22.85		
		Wt. Tare (g)			12.36		
Classification:	CH-CI	Wt. Dry Soil			10.5		
		Wt. Water (g			2.9		
		Water Cont			27.4%		
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10	CL						
	CL-ML	ML					
	10 20 30	40 5 LIQUI	0 60 D LIMIT	D 70	80	90	100

FORM: SAFM TH14-16#C4 Att.xlsx DATE: 2/11/2014



CLIENT :	Govern	ment of	Alb	erta	à																						
PROJECT :	SAFM																										
JOB No. :	603098	15.04																									
LOCATION :											SA	MPL	E:					4									
TESTHOLE :	14-17										DE	РТН	:					2.3m									
DATE :	Februa	ry 6, 201	14								TE	СНИ	ICIAN	1:				СК									
TOTAL DRY W		SIE\				IZE OI	F OPE					VEIG				EN			CEN			S	PE(CIFI	CAT	ION	
OF SAMPL	-E	NO. (j	μm)			PROX. CHES		m	m		R	IIATE (g)		R	ETA	INE	D	FINE	R TH	AN	L	_OV	/ER		ι	JPPE	R
Before Washing			5000			6		150				(9)							10								
Wet + Tare			7500			3		75											100								
Dry+Tare	762.7		5000			2		50											100								
Tare	254.4		4000			1/2		40											100								
Wt. Dry Moisture Content	508.3		2500 2000			1 3/4		25 20											100 100								
Wet + Tare			2000 1600			5/8		20 16											100								
Dry+Tare			1250			1/2		12											100								
Tare			1000			3/8		10											100								
MC (%)	Dessing		500	00	0.	185		5.	0				0.4			C)%		100	0%							
After Washing	Passing		200	00	0.0	0937	+	2.	.0				3.2			1	1%		99	9%							
Wt. Dry+Tare	544.9		125			0469		1.2					4.4				1%			9%							
Tare	254.4		63	30	0.0	0234		0.6	30				7.7			2	2%		98	8%							
Wt. Dry	290.5			15		0116		0.3					31.1				5%			4%							
Tare No.			16			0059		0.1					165.6				3%			7%							
			PAN	30 1	0.0	0029		0.0	80				272.3 290.6			54	4%		46	6%							
Classification:		I or SC			Desci	ription	and R	ema	arks	:																	_
Cc Cu		#N/A #N/A																									
g			_					;	SIE	VE	SIZE	E (mn	n)														~
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	Cobbles			<u> </u>	oarse	Grave		Fine		+	Соа			Acd	Sa lium	and	<u> </u>		ine		\neg		Si	lt or	Clay	/	
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CLIENT :	Government of /	Alberta								
PROJECT :	SAFM									
JOB No. :	60309815.04									
LOCATION :					SAMPLE:		10			
BOREHOLE:	TH14-18				DEPTH :		7.0m			
DATE :	February 6, 201	4			TECHNIC	IAN :	СК			
				LIQUID L	IMIT					
Trial No.				1						
Number of Blows				18						
Container Numbe	r									
Wt. Sample (wet+	tare)(g)			41.64						
Wt. Sample (dry+t				34.61						
Wt. Tare (g)				11.72						
Wt. Dry Soil (g)				22.9						
Wt. Water (g)				7.0						
Water Content (%)			30.7%						
	AVERAGE VALUE	S			<u>.</u>	PLAS			I	
Liquid Limit		29.5	ľ	Trial No.			1			
Plastic Limit		15.3		Container N	lumber					
Plasticity Index		14.2		Wt. Sample	(wet+tare)	(g)	31.57	,		
	MPLE DESCRIPT	ION		Wt. Sample			29.55	5		
				Wt. Tare (g)		•	16.32	2		
Classification	: 0	CL-CI		Wt. Dry Soil			13.2			
				Wt. Water (2.0			
			-	Water Cont			15.3%	, 0		
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	CI	-ML	N	1L						
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FORM: SAFM TH14-18 #10 Att.xlsx DATE: 2/7/2014

CLIENT :	Govern	ment of Albert	a						
PROJECT :	SAFM								
JOB No. :	603098	15.04							
LOCATION :					SAMPLE:		2		
TESTHOLE :	14-18				DEPTH :		0.8m		
DATE :	Februar	ry 6, 2014			TECHNICIAN	۱:	СК		
TOTAL DRY W		SIEVE	SIZE OF	OPENING	WEIGHT	PERCENT	PERCENT	SPECIFI	CATION
OF SAMPL	E	NO. (μm)	APPROX. INCHES	mm	RETAINED (g)	RETAINED	FINER THAN	LOWER	UPPER
Before Washing		150000	6	150.0	(9)		100%		
Wet + Tare		75000	3	75.0			100%		
Dry+Tare	863.6	50000	2	50.0			100%		
Tare	264.1	40000	1 1/2	40.0			100%		
Wt. Dry	599.5	25000	1	25.0			100%		
Moisture Content		20000	3/4	20.0			100%		
Wet + Tare		16000	5/8	16.0	6.0	1%			
Dry+Tare		12500	1/2	12.5	6.0	1%	99%		
Tare		10000	3/8	10.0	6.0	1%	99%		
MC (%)	Passing	5000	0.185	5.0	10.6	2%	98%		
After Washing	r ussing	2000	0.0937	2.0	15.0	3%	97%		
Wt. Dry+Tare	720.4	1250	0.0469	1.25	18.1	3%			
Tare	264.1	630	0.0234	0.630	28.6	5%			
Wt. Dry	456.3	315	0.0116	0.315	131.6	22%			
Tare No.		160	0.0059	0.160	344.5	57%			
		80	0.0029	0.080	448.2	75%			
		PAN			456.3				
Classification:		Ͷ or SC #N/A	Description ar	nd Remarks:					
Cc Cu		#N/A #N/A							
1000		Q			SIZE (mm)		_		5
₽ 100% 	<u> </u>	9		9		.		; ; ; ; ; ; ; ; ; ; ; ; ; ; ; ; ; ; ; ;	0.01
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			Gravel			Sand			
	Cobbles		Coarse	Fine	Coarse M	Vedium	Fine	Silt or	Clay
		1	I	1	I	I			

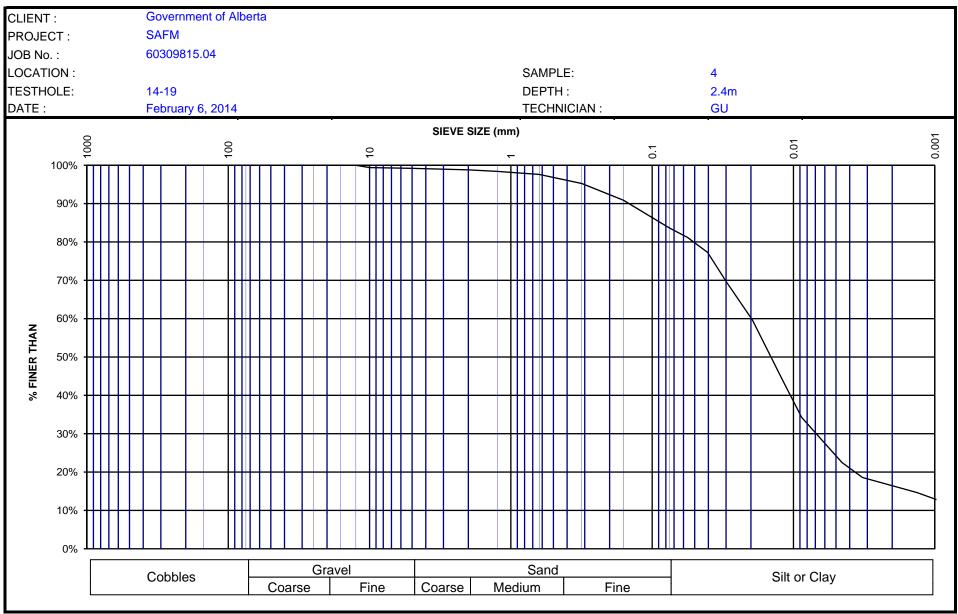
CLIENT :	Governm	ent of Albert	а						
PROJECT :	SAFM								
JOB No. :	60309815	5.04							
LOCATION :					SAMPLE:		4		
TESTHOLE :	14-18				DEPTH :		2.3m		
DATE :	February	6, 2014			TECHNICIAN	1:	СК		
TOTAL DRY W		SIEVE	SIZE OF (OPENING	WEIGHT	PERCENT	PERCENT	SPECIFI	CATION
OF SAMPL	.E	NO. (μm)	APPROX. INCHES	mm	RETAINED	RETAINED	FINER THAN	LOWER	UPPER
Before Washing		150000	1NCHE3 6	150.0	(g)		100%		
Wet + Tare		75000	3	75.0			100%		
Dry+Tare	781.7	50000	2	50.0			100%		
Tare	250.6	40000	1 1/2	40.0			100%		
Wt. Dry	531.1	25000	1	25.0	123.7	23%			
Moisture Content		20000	3/4	20.0	195.9	37%			
Wet + Tare		16000	5/8	16.0	227.1	43%			
Dry+Tare		12500	1/2	12.5	237.1	45%			
Tare		10000	3/8	10.0	257.0	48%	52%		
MC (%)		5000	0.185	5.0	289.5	55%	45%		
	Passing								
After Washing		2000	0.0937	2.0	307.7	58%			
Wt. Dry+Tare	699.8	1250	0.0469	1.25	313.2	59%			
Tare	250.6	630	0.0234	0.630	321.5	61%			
Wt. Dry	449.2	315	0.0116	0.315	345.7	65%			
Tare No.		160	0.0059	0.160	408.7	77%			
		80	0.0029	0.080	442.5	83%	17%		
Classification:	GM	PAN or GC	Description ar	d Remarks	448.6				
Cc	#	N/A	Description a						
Cu	#	N/A		SIEVE	SIZE (mm)				
1000		100		9 2			0.1		0.01
100%									
90%			++++						
80%	+++		$++$ $\wedge+$		+ $+$ $+$ $-$				
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20%								$\left\{ \left \left \right\rangle \right \right\}$	
10%	+++								
0%									
			Gravel			Sand			
	Cobbles	c	oarse	Fine	Coarse M	Nedium	Fine	Silt or	Clay

CLIENT :	Alberta Governme	nt						
PROJECT :	SAFM							
JOB No. :	60309815.04							
LOCATION :				SAMPLE:		3		
BOREHOLE:	TH14-19			DEPTH :		1.8m		
DATE :	February 4, 2014			TECHNICI	AN :	CK		
			LIQUID L					
Trial No.			1					
Number of Blows			27					
Container Numbe	r							
Wt. Sample (wet+	tare)(g)		40.44					
Wt. Sample (dry+t			34.54					
Wt. Tare (g)			11.54					
Wt. Dry Soil (g)			23.0					
Wt. Water (g)			5.9					
Water Content (%)		25.7%					
	AVERAGE VALUES			<u>.</u>	PLAS			
Liquid Limit	25	.8	Trial No.			1		
Plastic Limit	18		Container N	lumber				
Plasticity Index	7.		Wt. Sample	(wet+tare)(g)	28.41		
	MPLE DESCRIPTIO			(dry+tare)(g		25.93		
			Wt. Tare (g)			12.38		
Classification	: С	L	Wt. Dry Soil			13.6		
			Wt. Water (2.5		
			Water Cont			18.3%		
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FORM: SAFM TH14-19#3 Att.xlsx DATE: 2/5/2014



CLIENT :	Government of Al	berta						
PROJECT :	SAFM							
JOB No. :	60309815.04							
LOCATION :					SAMPLE:		4	
TESTHOLE:	14-19				DEPTH :		- 2.4m	
DATE :							GU	
DATE :	February 6, 2014				TECHNICIAN :		GU	
TOTAL DRY WEIGH		SIEVE NO. (µm)	SIZE OF (APPROX.	JPENING	WEIGHT	PERCENT	PERCENT FINER	REMARKS
TOTAL DRT WEIGH	IT OF SAMPLE		INCHES	mm	RETAINED (g)	RETAINED	THAN	REMARKS
Before Washing		150,000	6	150.0		0%	100%	
Wet + Tare		75,000	3	75.0		0%		
Dry+Tare	621.5	50,000	2	50.0		0%		
Tare	100.0	40,000	1 1/2	40.0		0%	100%	
Wt. Dry	521.5	25,000	1	25.0		0%	100%	
Moisture Content		20,000	3/4	20.0		0%		
Wet + Tare		16,000	5/8	16.0		0%		
Dry+Tare		12,500	1/2	12.5		0%		
Tare		10,000	3/8	10.0	3.2	1%		
MC (%)		5,000	0.185	5.0	4.2	1%	99.2%	
	Passing							
After Washing		2,000	0.0937	2.0	6.3	1%		
Wt. Dry+Tare		1,250	0.0469	1.25	8.4	2%		
Tare		630	0.0234	0.63	12.5	2%	97.6%	
Wt. Dry		315	0.0116	0.315	24.8	5%		
Tare No.		160	0.0059	0.160	47.5	9%		
		75 PAN	0.00295	0.075	85.6	16%	83.6%	
HYDROMETE	R DATA	READING	TIME (min)	DIAMETER (mm)	TEMP. (°C)	CORR. READING	PERCENT FINER THAN	REMARKS
Wt Dry+Tare	621.5	46	0.5	0.056	20	42	81.2%	
Wt Tare	100.0	44	1	0.040	20	40	77.3%	
Wt Dry	521.5	40	2	0.030	20	36	69.4%	
Sample Size :	50	35	5	0.020	20	31	59.7%	
Wt Retained 2 mm:	6.3	27	15	0.012	20	23	44.0%	
% Passing 2 mm:	98.8%	22	30	0.009	20	18	34.2%	
Specific Gravity :	2.70	19	60	0.006	20	15	28.4%	
Hydrometer No.:	43-9856	16	120	0.005	20	12	22.5%	
Solution (g/L):	40	14	240	0.003	20	10	18.6%	
		12	1440	0.001	20	8	14.7%	
		11	2880	0.001	20	7	12.7%	



CLIENT :	Alberta Government				
PROJECT :	SAFM				
JOB No. :	60309815.04				
LOCATION :			SAMPLE:	7	
BOREHOLE:	TH14-19		DEPTH :	4.8m	
DATE :	February 4, 2014		TECHNICIAN :	СК	
		LIQUID L			
Trial No.		1			
Number of Blows		23			
Container Numbe	r				
Wt. Sample (wet+t	are)(g)	36.49			
Wt. Sample (dry+ta		30.02			
Wt. Tare (g)		11.80			
Wt. Dry Soil (g)		18.2			
Wt. Water (g)		6.5			
Water Content (%)		35.5%			
	AVERAGE VALUES			PLASTIC LIMIT	
Liquid Limit	35.2	Trial No.		1	
Plastic Limit	17.0	Container N	lumber		
Plasticity Index	18.1		(wet+tare)(g)	31.59	
	MPLE DESCRIPTION		(dry+tare)(g)	29.33	
		Wt. Tare (g)		16.06	
Classification:	CI	Wt. Dry Soil		13.3	
		Wt. Water (2.3	
		Water Cont		17.0%	
60					
50					
4 0					
Q			СН		
<u></u> ≥ 30					
5 5 5					
ST		СІ			
40 40 40 40 40 40 40 40 40 40 40 40 40 4					- <u> </u>
			мн		
10	CL				
	CL-ML	ML			
0	10 20 30	40 5 LIQUI	0 60 D LIMIT	70 80	90 100
0	10 20 30	40 5 LIQUI	0 60 D LIMIT	70 80	90 100

FORM: SAFM TH14-19#7 Att.xlsx DATE: 2/5/2014

AECOM

CLIENT :	Government of A	lberta								
PROJECT :	SAFM									
JOB No. :	60309815.04									
LOCATION :					SAMPLE:		C1			
BOREHOLE:	TH14-19				DEPTH :		8.2m			
DATE :	February 12, 201	4			TECHNIC	IAN :	СК			
				LIQUID L	IMIT					
Trial No.				1						
Number of Blows				21						
Container Number										
Wt. Sample (wet+ta	are)(g)			46.21						
Wt. Sample (dry+ta	re)(g)			38.84						
Wt. Tare (g)				11.74						
Wt. Dry Soil (g)				27.1						
Wt. Water (g)				7.4						
Water Content (%)				27.2%						
	AVERAGE VALUE	S				PLAS	STIC LIMIT			
Liquid Limit	:	26.6		Trial No.			1			
Plastic Limit	:	20.4	1	Container N	lumber					
Plasticity Index		6.3	,	Wt. Sample	(wet+tare)	(g)	30.98	3		
SA	MPLE DESCRIPT	ION	1	Wt. Sample	(dry+tare)(g)	28.50	D		
			,	Wt. Tare (g)			16.32	2		
Classification:	C	L-ML	,	Wt. Dry Soil	(g)		12.2			
			,	Wt. Water (g	g)		2.5			
			1	Water Cont	ent (%)		20.4%	6		
										
60						[]			-	_
										1
50										
50										
40					C					
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	CL	-ML	N	L						
0										
0	10 2	0 3	0 4	10 5 LIQUII	0 6 D LIMIT	0 70	80) (90	100

FORM: SAFM TH14-19#C1 Att.xlsx DATE: 2/13/2014



CLIENT :	Government of A	lberta								
PROJECT :	SAFM									
JOB No. :	60309815.04									
LOCATION :					SAMPLE:		C3			
BOREHOLE:	TH14-19				DEPTH :		14.3m			
DATE :	February 12, 201	4			TECHNIC	IAN :	СК			
				LIQUID L						
Trial No.				1						
Number of Blows				20						
Container Number										
Wt. Sample (wet+ta	are)(g)			45.61						
Wt. Sample (dry+ta				38.20						
Wt. Tare (g)				12.25						
Wt. Dry Soil (g)				26.0						
Wt. Water (g)				7.4						
Water Content (%)				28.6%						
	AVERAGE VALUE	S				PLA	STIC LIMIT			
Liquid Limit	2	27.8	ŀ	Trial No.			1			
Plastic Limit	2	20.8	1	Container N	lumber					
Plasticity Index		7.0	1	Wt. Sample	(wet+tare)	(g)	32.89			
SA	MPLE DESCRIPTI	ON		Wt. Sample			30.03	(
			,	Wt. Tare (g)			16.30			
Classification:	CI	-ML	,	Wt. Dry Soil	(g)		13.7			
			,	Wt. Water (g	g)		2.9			
			,	Water Cont	ent (%)		20.8%	D		
60										
50										
50										
40										
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ASI				CI						
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		CL				МН				
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0	10 20) 3(0 4	40 5 LIQUII	0 6 D LIMIT	0 70) 80	90	100	J

FORM: SAFM TH14-19#C3 Att.xlsx DATE: 2/13/2014



OF SAMPLE NO. (μm) APPROX. INCHES mm RETAINED (g) RETAINED FINER THAN LOWER Before Washing Wet + Tare 150000 6 150.0 100% 100% Dry+Tare 720.2 50000 2 50.0 100% 100% Tare 242.1 40000 1 1/2 40.0 100% 100% Wt. Dry 478.1 25000 1 25.0 33.3 7% 93% Moisture Content 20000 3/4 20.0 44.3 9% 91% Wet + Tare 16000 5/8 16.0 62.9 13% 87% Dry+Tare 12500 1/2 12.5 93.2 19% 81% Tare 10000 3/8 10.0 106.8 22% 78% MC (%) 5000 0.185 5.0 167.4 35% 65% Wt. Dry+Tare 621.4 1250 0.0469 1.25 229.8 48% 52% T	ICATION UPPER	
Solution: SAMPLE: 5 SAMPLE: 5 DEPTH : 3.3m DATE : 14-20 DEPTH : 3.3m DATE : February 3, 2014 TECHNICIAN : GU TOTAL DRY WEIGHT OF SAMPLE SIZE OF OPENING WEIGHT RETAINED (g) PERCENT PERCENT PERCENT INCH SPECIF DEPTH : 3.3m DATE : February 3, 2014 TECHNICIAN : GU TOTAL DRY WEIGHT OF SAMPLE SIZE OF OPENING (g) PERCENT PERCENT PERCENT FINER THAN INCHES DEPTH : 3.3m Before Washing 150000 6 1000% Wet + Tare 720.2 50000 2 50.0 100% MOL (µn) 1/2 40000 11/2 40006 OT AT DRY WEIGHT 20000 33.3 7% 93% MUL Dry 478.1 25000 1 2500 1 2000 378.1 20000 <th colspan<="" td=""><td></td></th>	<td></td>	
TESTHOLE : 14-20 DEPTH : 3.3m DATE : February 3, 2014 TECHNICIAN GU TOTAL DRY WEIGHT OF SAMPLE SIEVE NO. (µm) SIZE OF OPENING APPROX. WEIGHT (g) PERCENT RETAINED (g) PERCENT RETAINED PERCENT NO. (µm) SPECIF LOWER Before Washing Wet + Tare 150000 6 150.0 (g) 100% 100% Dry+Tare 720.2 50000 2 50.0 100% 100% Tare 242.1 40000 1 1/2 40.0 100% 100% Wt. Dry 478.1 25000 1 25.0 33.3 7% 93% Dry+Tare 12500 1/2 12.5 33.3 7% 93% 100% Wet + Tare 16000 5/8 16.0 62.9 13% 87% 10% Dry+Tare 12500 1/2 12.5 93.2 19% 61% 10% MC (%) 5000 0.185 5.0 167.4 35% 65% 16% MC (%) Passing 0.00499 1.25 22.98		
DATE : February 3, 2014 TECHNICIAN : GU TOTAL DRY WEIGHT OF SAMPLE SIEVE NO. (μm) SIZE OF OPENING APPROX. INCHES WEIGHT (g) PERCENT RETAINED (g) PERCENT FINER THAN PERCENT FINER THAN SPECIF LOWER Before Washing Ory+Tare 150000 6 150.0 100% 100% Wet + Tare 720.2 50000 2 50.0 100% 100% Tare 242.1 40000 1 1/2 40.0 100% 100% Wet + Tare 16000 5/8 16.0 62.9 13% 87% Moisture Content 20000 3/4 20.0 44.3 9% 91% Vet + Tare 16000 5/8 16.0 62.9 13% 87% Dry+Tare 12500 1/2 12.5 93.2 19% 81% Gue Area 10000 3/8 10.0 106.8 22% 78% MC (%) 2000 0.0937 2.0 213.4 45% 55% <t< td=""><td></td></t<>		
DATE : February 3, 2014 TECHNICIAN : GU TOTAL DRY WEIGHT OF SAMPLE SIEVE NO. (μm) SIZE OF OPENING APPROX. INCHES WEIGHT (g) PERCENT RETAINED (g) PERCENT FINER THAN PERCENT FINER THAN SPECIF LOWER Before Washing Wet + Tare 150000 6 150.0 (g) 100% 100% Ort + Tare 720.2 50000 2 50.0 100% 100% Tare 242.1 40000 1 1/2 40.0 100% 100% Wet + Tare 25000 1 25.0 33.3 7% 93% Moisture Content 20000 3/4 20.0 44.3 9% 91% Moisture Content 10000 3/8 10.0 106.8 22% 78% MC (%) 9 0.0125 5.0 167.4 35% 65% MC (%) 9 0.0469 1.25 229.8 48% 52% MC (%) 9 0.0469 1.25 229.8 48% 52%		
TOTAL DRY WEIGHT OF SAMPLE SIEVE NO. (µm) SIZE OF OPENING (µm) WEIGHT RETAINED INCHES PERCENT RETAINED (g) PERCENT RETAINED PERCENT FINER THAN SPECIF LOWER Before Washing Wet + Tare 150000 6 150.0 100% 100% Dry+Tare 720.2 50000 2 50.0 100% 100% Vt. Dry 478.1 25000 1 25.0 33.3 7% 93% Moisture Content 20000 3/4 20.0 44.3 9% 91% Wet + Tare 16000 5/8 16.0 62.9 13% 87% Dry+Tare 12500 1/2 12.5 93.2 19% 81% Tare 10000 3/8 10.0 106.8 22% 78% MC (%) 5000 0.185 5.0 167.4 35% 65% MC (%) 2000 0.0937 2.0 213.4 45% 55% MC (%) 939.3 0.016 0.315 303.0 <td< td=""><td></td></td<>		
INCHES (g) LOWER Before Washing Wet + Tare 15000 6 150.0 100% Dry+Tare 720.2 50000 2 50.0 100% Tare 242.1 40000 1 1/2 40.0 100% Wt. Dry 478.1 25000 1 25.0 100% Moisture Content 20000 3/4 20.0 34.3 7% 93% Moisture Content 20000 3/4 20.0 44.3 9% 91% Wet + Tare 16000 5/8 16.0 62.9 13% 87% Dry+Tare 12500 1/2 12.5 93.2 19% 81% Tare 10000 3/8 10.0 106.8 22% 78% MC (%) 5000 0.185 5.0 167.4 35% 65% Wt. Dry+Tare 621.4 1250 0.0469 1.25 229.8 48% 52% Tare 242.1 630	UPPER	
Before Washing 15000 6 150.0 (g) 100% Wet + Tare 75000 3 75.0 100% Dry+Tare 720.2 50000 2 50.0 100% Tare 242.1 40000 1 1/2 40.0 100% Wt. Dry 478.1 25000 3/4 20.0 44.3 9% 91% Wet + Tare 16000 5/8 16.0 62.9 13% 87% Dry+Tare 12500 1/2 12.5 93.2 19% 81% Tare 10000 3/8 10.0 106.8 22% 78% Dry+Tare 12500 1/2 12.5 93.2 19% 81% Tare 10000 3/8 10.0 106.8 22% 78% MC (%) 5000 0.185 5.0 167.4 35% 65% Wt. Dry+Tare 621.4 1250 0.0469 1.25 229.8 48% 52% <td></td>		
Wet + Tare 7500 3 75.0 100% Dry+Tare 720.2 50000 2 50.0 100% Tare 242.1 40000 1 1/2 40.0 100% Wt. Dry 478.1 25000 1 25.0 33.3 7% 93% Moisture Content 20000 3/4 20.0 44.3 9% 91% Wet + Tare 16000 5/8 16.0 62.9 13% 87% Dry+Tare 12500 1/2 12.5 93.2 19% 81% Tare 10000 3/8 10.0 106.8 22% 78% MC (%) 5000 0.185 5.0 167.4 35% 65% Mt. Dry+Tare 621.4 1250 0.0469 1.25 229.8 48% 52% Tare 242.1 630 0.0234 0.630 256.5 54% 46% Wt. Dry 379.3 315 0.0116 0.315		
Dry+Tare 720.2 50000 2 50.0 100% Tare 242.1 40000 11/2 40.0 100% Wt. Dry 478.1 25000 1 25.0 33.3 7% 93% Moisture Content 20000 3/4 20.0 44.3 9% 91% Wet + Tare 16000 5/8 16.0 62.9 13% 87% Dry+Tare 12500 1/2 12.5 93.2 19% 81% Tare 10000 3/8 10.0 106.8 22% 78% MC (%) 5000 0.185 5.0 167.4 35% 65% MC (%) 5000 0.0937 2.0 213.4 45% 55% Wt. Dry+Tare 621.4 1250 0.0469 1.25 229.8 48% 52% Wt. Dry 379.3 315 0.0116 0.315 303.0 63% 37% Tare No. 160 0.0059 0.160 343.3 72% 28% Wt. Dry 379.3 3		
Tare 242.1 40000 1 1/2 40.0 100% Wt. Dry 478.1 25000 1 25.0 33.3 7% 93% Moisture Content 20000 3/4 20.0 44.3 9% 91% Wet + Tare 16000 5/8 16.0 62.9 13% 87% Dry+Tare 12500 1/2 12.5 93.2 19% 81% Tare 10000 3/8 10.0 106.8 22% 78% MC (%) 5000 0.185 5.0 167.4 35% 65% MC (%) 2000 0.0937 2.0 213.4 45% 55% Wt. Dry+Tare 621.4 1250 0.0469 1.25 229.8 48% 52% Tare 242.1 630 0.0234 0.630 256.5 54% 46% Wt. Dry 379.3 315 0.0116 0.315 303.0 63% 37% Tare No. 160 0.0059 0.160 343.3 72% 28% PAN <td></td>		
Wt. Dry 478.1 25000 1 25.0 33.3 7% 93% Moisture Content 20000 3/4 20.0 44.3 9% 91% Wet + Tare 16000 5/8 16.0 62.9 13% 87% Dry+Tare 12500 1/2 12.5 93.2 19% 81% Tare 10000 3/8 10.0 106.8 22% 78% MC (%) 5000 0.185 5.0 167.4 35% 65% Mt Er Washing 2000 0.0937 2.0 213.4 45% 55% Wt. Dry+Tare 621.4 1250 0.0469 1.25 229.8 48% 52% Wt. Dry+Tare 621.4 1250 0.0315 303.0 63% 37% Tare 242.1 630 0.0234 0.630 256.5 54% 46% Wt. Dry 379.3 315 0.0116 0.315 303.0 63% 37% Tare No. 160 0.0059 0.160 343.3 72% 28%		
Moisture Content 20000 3/4 20.0 44.3 9% 91% Wet + Tare 16000 5/8 16.0 62.9 13% 87% Dry+Tare 12500 1/2 12.5 93.2 19% 81% Tare 10000 3/8 10.0 106.8 22% 78% MC (%) 5000 0.185 5.0 167.4 35% 65% Passing 2000 0.0937 2.0 213.4 45% 55% Wt. Dry+Tare 621.4 1250 0.0469 1.25 229.8 48% 52% Tare 242.1 630 0.0234 0.630 256.5 54% 46% Wt. Dry 379.3 315 0.0116 0.315 303.0 63% 37% Tare No. 160 0.0059 0.160 343.3 72% 28% Wt. Dry 379.3 315 0.0160 343.3 72% 28% Tare No. 160 0.0029 0.080 376.2 79% 21% <		
Wet + Tare 16000 5/8 16.0 62.9 13% 87% Dry+Tare 12500 1/2 12.5 93.2 19% 81% Tare 10000 3/8 10.0 106.8 22% 78% MC (%) 5000 0.185 5.0 167.4 35% 65% After Washing 2000 0.0937 2.0 213.4 45% 55% Wt. Dry+Tare 621.4 1250 0.0469 1.25 229.8 48% 52% Wt. Dry 379.3 315 0.0116 0.315 303.0 63% 37% Wt. Dry 379.3 315 0.0116 0.315 303.0 63% 37% Tare No. 160 0.0059 0.160 343.3 72% 28% Wt. Dry 379.3 315 0.0116 343.3 72% 28% Mo 0.0029 0.080 376.2 79% 21% PAN Tare 378.9 Tare Tare Tare Tare Tare Tare Ta		
Dry+Tare 12500 1/2 12.5 93.2 19% 81% Tare 10000 3/8 10.0 106.8 22% 78% MC (%) 5000 0.185 5.0 167.4 35% 65% Passing 2000 0.0937 2.0 213.4 45% 55% Wt. Dry+Tare 621.4 1250 0.0469 1.25 229.8 48% 52% Tare 242.1 630 0.0234 0.630 256.5 54% 46% Wt. Dry 379.3 315 0.0116 0.315 303.0 63% 37% Tare No. 160 0.0029 0.180 376.2 79% 21% Ren No. 80 0.0029 0.080 376.2 79% 21% PAN VL PAN VL 378.9 VL VL 378.9 VL Classification: SM or SC Description arkes: SK VL VL VL VL VL		
Tare 10000 3/8 10.0 106.8 22% 78% MC (%) 5000 0.185 5.0 167.4 35% 65% Passing 2000 0.0937 2.0 213.4 45% 55% Wt. Dry+Tare 621.4 1250 0.0469 1.25 229.8 48% 52% Tare 242.1 630 0.0234 0.630 256.5 54% 46% Wt. Dry 379.3 315 0.0116 0.315 303.0 63% 37% Tare No. 160 0.0029 0.080 376.2 79% 21% MC PAN 0.0029 0.080 376.2 79% 21% Classification: SM or SC Description and Remarks: U U U U U		
MC (%) Passing 5000 0.185 5.0 167.4 35% 65% After Washing 2000 0.0937 2.0 213.4 45% 55% Wt. Dry+Tare 621.4 1250 0.0469 1.25 229.8 48% 52% Tare 242.1 630 0.0234 0.630 256.5 54% 46% Wt. Dry 379.3 315 0.0116 0.315 303.0 63% 37% Tare No. 160 0.0059 0.160 343.3 72% 28% MC (%) PAN 0.0029 0.080 376.2 79% 21% Classification: SM or SC Description and Remarks: 5% 5% 5%		
After Washing 2000 0.0937 2.0 213.4 45% 55% Wt. Dry+Tare 621.4 1250 0.0469 1.25 229.8 48% 52% Tare 242.1 630 0.0234 0.630 256.5 54% 46% Wt. Dry 379.3 315 0.0116 0.315 303.0 63% 37% Tare No. 160 0.0059 0.160 343.3 72% 28% 80 0.0029 0.080 376.2 79% 21% PAN 378.9 378.9 1 1	1	
Wt. Dry+Tare 621.4 1250 0.0469 1.25 229.8 48% 52% Tare 242.1 630 0.0234 0.630 256.5 54% 46% Wt. Dry 379.3 315 0.0116 0.315 303.0 63% 37% Tare No. 160 0.0059 0.160 343.3 72% 28% Mt. Dry 80 0.0029 0.080 376.2 79% 21% PAN V 378.9 V V V V V Classification: SM or SC Description and Remarks: V V V V		
Tare 242.1 630 0.0234 0.630 256.5 54% 46% Wt. Dry 379.3 315 0.0116 0.315 303.0 63% 37% Tare No. 160 0.0059 0.160 343.3 72% 28% 80 0.0029 0.080 376.2 79% 21% PAN PAN 378.9 1 1		
Wt. Dry 379.3 315 0.0116 0.315 303.0 63% 37% Tare No. 160 0.0059 0.160 343.3 72% 28% 80 0.0029 0.080 376.2 79% 21% PAN 7 28% 21% 21%		
Tare No. 160 0.0059 0.160 343.3 72% 28% 80 0.0029 0.080 376.2 79% 21% PAN 378.9 378.9 1 1		
80 PAN 0.0029 PAN 0.080 378.9 376.2 378.9 79% 21% 21% Classification: SM or SC Description and Remarks: Emarks: Emarks:		
PAN 378.9 Classification: SM or SC Description and Remarks:		
Classification: SM or SC Description and Remarks:		
Cc #N/A Cu #N/A		
0000 01 01 01 01 01 01 01 01	0.01	
90%		
N60%		
Gravel Sand		
Cobbles Coarse Fine Coarse Medium Fine Silt or		
	r Clay	

CLIENT : Gov	ernment of A	lberta	а						
PROJECT : SAF	M								
	09815.04								
LOCATION :					SAMPLE:		8		
TESTHOLE : 14-2	20				DEPTH :		5.4m		
DATE : Feb	ruary 3, 2014	ŀ			TECHNICIAN	1:	GU		
TOTAL DRY WEIGH	T SIEVE		SIZE OF (OPENING	WEIGHT	PERCENT	PERCENT	SPECIFI	CATION
OF SAMPLE	NO. (μn	n)	APPROX. INCHES	mm	RETAINED (g)	RETAINED	FINER THAN	LOWER	UPPER
Before Washing	150	0000	6	150.0	(9)		100%		
Wet + Tare	75	5000	3	75.0			100%		
Dry+Tare 60	8.4 50	0000	2	50.0			100%		
Tare 26	1.2 40	0000	1 1/2	40.0			100%		
Wt. Dry 34	7.2 25	5000	1	25.0			100%		
Moisture Content	20	0000	3/4	20.0			100%		
Wet + Tare		000	5/8	16.0			100%		
Dry+Tare		2500	1/2	12.5			100%		
Tare		0000	3/8	10.0	5.2	1%			
MC (%)		5000	0.185	5.0	11.0	3%	97%		
Pass									
After Washing		2000	0.0937	2.0	17.7	5%			
-		250	0.0469	1.25	20.0	6%			
		630 315	0.0234 0.0116	0.630 0.315	23.3	7%			
Wt. Dry 8 Tare No.		315 160	0.0059	0.315	30.5 48.7	9% 14%			
Tare NO.		80	0.0059	0.160	40.7 87.3	14% 25%			
	P	AN	0.0029	0.000	89.7	2370	13%		
Classification:	SILT or CLAY		Description ar	nd Remarks:					
Cc	#N/A		2000.10.000						
Cu	#N/A								
1000	100			은 SIEVE	SIZE (mm)	~	0.1		0.01
100%		Ш							
90%		+++	+++-			╶╫╫╄┾	+		
80%									
								HIIIII	
70%									
4 0%		╂╂╂							
		$\parallel \mid$							
₩40% 									
30%		╂╂╂							
20%									
10%		╂╂╂							
0%									
Cobb			Gravel			Sand		0:14	Clay
	601	С	oarse	Fine	Coarse M	Nedium	Fine	Silt or	Ciay

SAFM					
60309815.04					
		SAMPLE:	6		
TH14-20					
	LIQUID I				
	1				
	26				
re)(g)	44.17				
	38.44				
	12.09				
	26.4				
				+	
			PLASTIC LIMIT		
	Trial No.		1		
		Number			
			29.30		
CL-ML					
	Ι				
		СН			
	CI				
	0,			<u> </u>	
			ин		
CL		ļ"	····		
	MI				
CH-MIL					
10 20 30) 40 LIQUI	50 60 D LIMIT	70 80	90 100	
ı r	TH14-20 February 4, 2014 are)(g) re)(g) AVERAGE VALUES 21.8 16.2 5.7 MPLE DESCRIPTION CL-ML	February 4, 2014 LIQUID L 1 26 are)(g) 44.17 re)(g) 38.44 12.09 26.4 5.7 21.7% AVERAGE VALUES 21.8 21.8 Trial No. 16.2 Container 5.7 Wt. Sample VPLE DESCRIPTION Wt. Sample Wt. Tare (g Wt. Dry Soi Wt. Water (d) Water Con CL-ML Cl Verter (d) Cl Uput Cl Uput Cl	TH14-20 DEPTH :: February 4, 2014 TECHNICIAN : IQUID LIMIT 1 2 ire)(g) 44.17 38.44 12.09 ire)(g) 44.17 38.44 12.09 ice 21.7% ice ice VERAGE VALUES Trial No. Container Number 5.7 Wt. Sample (wet+tare)(g) Wt. Sample (wet+tare)(g) MPLE DESCRIPTION Wt. Sample (intertained intertained interained inter	TH14-20 DEPTH :: 3.9m February 4, 2014 TECHNICIAN : CK LIQUID LIMIT 1 1 26 ire)(g) 44.17 38.44 12.09 26.4 5.7 21.8 Trial No. 1 16.2 Container Number 1 Container Number 13.55 WERAGE VALUES Wt. Sample (ary+tare)(g) 27.11 Wt. Sample (ary+tare)(g) 22.2 Wt. Tare (g) 13.6 Wt. Tare (g) 2.2 Water Content (%) 16.2% CL-ML CL-ML Ch MU Container Number Cl-ML Mt. Tare (g) 13.6 Wt. Water (g) 2.2 Water Content (%) 16.2% CH MH CH MU CL-ML CL-ML MU CH MU CH <td c<="" td=""></td>	

FORM: SAFM TH14-20#6 Att.xlsx DATE: 2/5/2014



CLIENT :	Government of A	lberta								
PROJECT :	SAFM									
JOB No. :	60309815.04									
LOCATION :					SAMPLE:		C1			
BOREHOLE:	TH14-20				DEPTH :		8.2m			
DATE :	February 10, 20 ⁻	14			TECHNIC	IAN :	СК			
	-			LIQUID L	IMIT					
Trial No.				1						
Number of Blows				18						
Container Numbe	r									
Wt. Sample (wet+t	are)(g)			38.47						
Wt. Sample (dry+ta	are)(g)			31.91						
Wt. Tare (g)				11.82						
Wt. Dry Soil (g)				20.1						
Wt. Water (g)				6.6						
Water Content (%)				32.7%						
	AVERAGE VALUE	S				PLA	STIC LIMIT			
Liquid Limit	:	31.4		Trial No.			1			
Plastic Limit	:	21.2		Container N	lumber					
Plasticity Index		10.2		Wt. Sample	(wet+tare)	(g)	29.85	5		
SA	MPLE DESCRIPT	ION		Wt. Sample	(dry+tare)(g)	27.44	1		
				Wt. Tare (g)			16.06	5		
Classification:	C	I-CL		Wt. Dry Soil	(g)		11.4			
				Wt. Water (g	g)		2.4			
				Water Cont	ent (%)		21.2%	6		
60			r	1					1	_
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50										
50										
40 40										
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ASA				CI						
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		CL				МН				
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	CL	ML	N	1L						
0 +										
0	10 2	0 3	0 4	40 5 LIQUI	0 0 LIMIT	0 70) 80	Ş	90	100

FORM: SAFM TH14-20#C1 Att.xlsx DATE: 2/11/2014

CLIENT :	Govern	ment of a	Albe	erta																						
PROJECT :	SAFM																									
JOB No. :	603098	15.04																								
LOCATION :											SA	MPL	E:					10								
TESTHOLE :	14-21										DE	РТН	:					6.9m								
DATE :	Februa	ry 3, 201	4										ICIAN	1:				GU								
TOTAL DRY V		SIEV		Γ	SI	ZE OF	OPE	NIN	IG			VEIG			RC	EN			CENT			SP	ECI	FIC/		N
OF SAMP	LE	NΟ. (μ	ιm)			ROX.		m	m		RI	ETAI		RE	ΞTA	INE	D	FINEF	R THAN	١	10	OWE	R		UPF	PER
		45				HES		4.54				(g)							4000	,				_		
Before Washing Wet + Tare			5000 7500			6 3		150 75											100% 100%							
Dry+Tare	554.7		5000			2		50											100%							
Tare	254.4		1000			1/2		40											100%							
Wt. Dry	300.3	2	2500	0		1		25	.0										100%	6						
Moisture Conten	<u>t</u>		2000			/4		20											100%							
Wet + Tare			600			/8		16											100%							
Dry+Tare Tare			250 000			/2 /8		12 10											100% 100%							
MC (%)			500			/8 185		5.											100%							
WIC (70)	Passing		000	Ŭ	0.	100		0.	0										1007	0						
After Washing			200	0	0.0	937		2.					0.4				0%		100%							
Wt. Dry+Tare	275.1		125			469		1.2					0.8				0%		100%							
Tare	254.5		63			234		0.6					1.8				1%		99%							
Wt. Dry Tare No.	20.6		31 16			116 059		0.3 0.1					4.6 10.9				2% 4%		98% 96%							
Tale NO.			8			029		0.0					10.9 19.4				4% 6%		907 949							
		F	PAN		0.0	020		0.0					20.5				0,0		017	Ũ						
Classification:		Γ or CLA	Y	C)escri	ption a	and Re	ema	arks	:																
Co Cu		#N/A #N/A																								
									SIE	VE	SIZE	E (mr	n)													
1000		100	2					10	0.2		0.22	- (.,	~						0.1						0.01
			Ш	П	Т			Π	Π	Π				П	Π	TT	T			П	Π	П	Т	Γ		
90%			+++		_			- -		\square	_		 	-++	╢	++				\downarrow	11	\square	_		_	
80%																										
80%			Π	Π				Т	Π	Π					Π	П				Π	Π	Π				
70%			╋╋	╂┨	+	+ +		╫	╫	Η	+				╫	╂╂	+			╫	╢	┼┼	╈	┢	+	
Z 60%			111	Ш					Ш	Ш				\square	Щ	Ш				Ш	Ш	Ш				
₹ [*]								Ш																		
			╂╂╂	╂╂	+	┢─┼		╈	╫	┼┼	+				╈	╂╂				╫	┼┼	$\left \right $			+	
N60% HHAN 250% HHAN 240% HAN %		└──┤	$\downarrow\downarrow\downarrow\downarrow$	\parallel	_			╢	\prod	Щ	\bot			\parallel	Щ	\parallel	+	\parallel		Щ	\parallel	Щ			-	
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20%	\square		+++	+	+	\vdash	_	╢	╢	\square	+		 	\parallel	\parallel	\parallel	+			╢	╢	\square	+	<u> </u>	_	
10%			\prod						Π	Π					Π	\prod	T			\prod	Π	\prod				
0%					-	Grou											_				T	<u> </u>	_	<u> </u>	1	
						Grave	;						-		2	and							~	-		
	Cobbles	ŀ		Co	arse		F	ine			Cos	arse	N	Nedi	um			F	ine				Silt	or C	lay	



CLIENT :	Govern	ment of	Albe	erta																						
PROJECT :	SAFM																									
JOB No. :	603098	15.04																								
LOCATION :										SAN	MPL	E:				5	;									
TESTHOLE :	14-21									DEF	ΡΤΗ	:				3	3.3m									
DATE :	Februa	ry 3, 201	4							TEC	<u>CH</u> N	ICIAN	:			Ģ	SU									
TOTAL DRY W		SIEV					OPEN	ING			/EIG		PEF					CENT			S	PEC	CIFI	CAT	ION	
OF SAMP	LE	NO. (µ	um)		APPR INCH		1	mm		RE	ETAIN (g)	NED	RE	ΓΑΙΝ	IED	F	FINEF	R THA	N	L	.OW	/ER		ι	JPPEF	ર
Before Washing		15	5000	0	6	-		50.0			(3/							100								
Wet + Tare			7500		3			75.0										100								
Dry+Tare	695.3		5000		2	-		50.0										100								
	250.6		4000		1 1/:	2		10.0										100								
Wt. Dry Moisture Content	444.7		2500 2000		1 3/4			25.0 20.0										100 100								
Wet + Tare	<u>.</u>		2000 1600		3/4 5/8			20.0 16.0										100								
Dry+Tare			1250		1/2			12.5										100								
Tare			1000		3/8			10.0										100								
MC (%)			500		0.18	5		5.0				0.6			09	%		100								
After Washing	Passing		200	0	0.093	37		2.0				2.7			19	%		99	%				_			—
Wt. Dry+Tare	586.6		125		0.046			1.25				3.6			19			99								
Tare	250.6		63		0.023			.630				8.5			29			98								
Wt. Dry	336.0		31	5	0.011	16	0	.315				81.5			189	%		82								
Tare No.			16		0.005			.160				256.4			589			42								
			8 PAN		0.002	29	0	.080				332.1 336.0			759	%		25	%							
Classification:	S	M or SC			escript	ion ar	nd Ren	narks	s:	1		0.00.0				<u> </u>										
Cc Cu		#N/A #N/A																								
								SIE	EVE	SIZE	(mn	ı)														
100%		100	8				0		_		,	_	-						0.1							0.01
100%								Ш	Π					$\overline{\uparrow}$						Π						7
90%																					+		+	+		1
				+	++			Π						\dagger	┢	$\overline{\mathbf{x}}$				Ħ						
80%																Ā										-
80%																										
70%																										
70%																										
70%																		<u> </u>								
70%																										-
70% HA60% 50% 440% 30%																				×						
70% M60% 50% 30% 20%																										
70% M60% 50% 440% 30% 20% 10%																										
70% M60% 50% 30% 20%																										
70% M60% 50% 440% 30% 20% 10%	Cobbles			Cos			Fir			Coa	rse		1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1				F	ine				Sil	lt or	Clay	/	

CLIENT :	Goverr	ment of	Alb	erta	а																						
PROJECT :	SAFM																										
JOB No. :	603098	315.04																									
LOCATION :											SAN	/PL	Ξ:				1	9									
TESTHOLE :	14-21										DEF	РΤΗ	:					6.3m									
DATE :	Februa	ry 3, 20′	14								TEC	сни	CIAN	:				GU									
TOTAL DRY W		SIE				SIZE OI	F OPE	ENIN	IG			/EIG		PEI					RCEN			S	SPE	CIF	ICAT	ION	
OF SAMP	LE	NO. (μm)			PROX. CHES		m	m		RE	TAIN (g)	IED	RE	TAI	NEC)	FINE	R THA	٩N	L	_OV	VEF	ł		JPPE	R
Before Washing		1:	5000	00		6		150				(0/							100								
Wet + Tare			7500			3		75											100								
Dry+Tare	556.7		5000			2		50											100								
Tare	235.0		4000		1	1/2		40											100								
Wt. Dry	321.7		2500			1		25											100								
Moisture Content Wet + Tare	L		2000 1600			3/4 5/8		20 16											100 100								
Dry+Tare			1250			5/6 1/2		10					5.4			2	%			3%							
Tare			1000			3/8		10					7.3				%			3%							
MC (%)			500			.185		5.					8.5				%			7%							
After Washing	Passing		200	20	0.0	0937		2.	0				9.4			2	%		07	7%							
Wt. Dry+Tare	395.5		125			0469		2. 1.2					9.4 9.9				%			7%							
Tare	235.0			30		0234		0.6					11.1				%			7%							
Wt. Dry	160.5			15		0116		0.3					19.7				%			4%							
Tare No.			16	60	0.0	0059		0.1	60				41.2			13	%		87	7%							
				30	0.0	0029		0.0	80				145.5			45				5%							
Classification:	SIL	T or CLA			Desc	ription	and R	oma	arke				160.5														
Cc		#N/A			Dese	nption				•																	
Cu		#N/A										1															
1000		007	3					10	SIE		SIZE	(mn	1)	-						0.1							0.01
100%			Ш	Π	Π			╢	H	H	-				H	+	L				Ш	Π	Π				
90%				╟	++	+ +	_	╢	╢	\vdash				╫	┝╋╋	+	+	\geq	\leftarrow	+	H	+	H	+	_		-
80%			┝┼┼╴		++										┝╋┥	+			$\vdash \downarrow$				\square	_			4
70%																				\downarrow	Ш						
7000				Π		Π														X							
																		_		$\left \right $	N						
N60%																											
H40%																											
N60% HL 50% JUL 40% 30%																											
30%																											
30%																											
30%																											
30%																											
30%	Cobbles				oarse	Grave		Fine			Coa	rse			Sar				ine				S	ilt or	r Cla	у	

CLIENT : A	Iberta Government				
PROJECT: S	AFM				
JOB No. : 6	0309815.04				
LOCATION :			SAMPLE:	11	
	H14-21		DEPTH :	7.8m	
	ebruary 4, 2014		TECHNICIAN :	СК	
		LIQUID L			
Trial No.		1			
Number of Blows		24			
Container Number					
Wt. Sample (wet+tare	e)(g)	38.35			
Wt. Sample (dry+tare)		32.27			
Wt. Tare (g)		12.09			
Wt. Dry Soil (g)		20.2			
Wt. Water (g)		6.1			
Water Content (%)		30.1%	1 1		
	ERAGE VALUES		P	LASTIC LIMIT	J
Liquid Limit	30.0	Trial No.		1	
Plastic Limit	18.9	Container I	Number		
Plasticity Index	11.1		e (wet+tare)(g)	31.22	
	PLE DESCRIPTION		e (dry+tare)(g)	28.74	
		Wt. Tare (g)		15.62	
Classification:	CL-CI	Wt. Dry Soi		13.1	
		Wt. Water (2.5	
		Water Cont		18.9%	
					_
60					
00					
50					
ä 40					
IQ			СН		
5 30					
STI		СІ			
40 30 20 20					<u> </u>
_			мн		
10	CL		14111		
		MI			
	CL-ML	ML			
0			↓		
0	10 20 30	40 5 LIQUI	50 60 D LIMIT	70 80	90 100
			-		

FORM: SAFM TH14-21#11 Att.xlsx DATE: 2/5/2014



CLIENT :	Government of	Alberta								
PROJECT :	SAFM									
JOB No. :	60309815.04									
LOCATION :					SAMPLE:		C2			
BOREHOLE:	TH14-21				DEPTH :		13.0m			
DATE :	February 12, 20	14			TECHNIC	IAN :	СК			
	, , , , , , , , , , , , , , , , ,			LIQUID L						
Trial No.				1						
Number of Blows				30						
Container Numbe	r									
Wt. Sample (wet+	tare)(g)			45.60						
Wt. Sample (dry+t				37.32						
Wt. Tare (g)				12.06						
Wt. Dry Soil (g)				25.3						
Wt. Water (g)				8.3						
Water Content (%)			32.8%						
`	AVERAGE VALUE	S				PLA	STIC LIMIT	I	I	
Liquid Limit		33.5		Trial No.			1			
Plastic Limit		21.9		Container N	lumber					
Plasticity Index		11.6		Wt. Sample	(wet+tare)	(g)	32.0)4		
	MPLE DESCRIP			Wt. Sample			29.2	24		
				Wt. Tare (g)		0,	16.4	5		
Classification	:	CI		Wt. Dry Soil			12.			
				Wt. Water (g			2.8			
			-	Water Cont			21.9			
							•	•		
60										
50										
¥ 40 −										
40 +					С	н				
E 30 -										
<u></u> <u></u> <u></u> <u></u> <u></u>										
ST				CI						
20										
						мн				
10		CL								
	C	L-ML	N	۸L						
0 +0	10 2	20 30) 4	10 5 LIQUII	0 6 D LIMIT	0 70) 8	0	90	100

FORM: SAFM TH14-21#C2 Att.xlsx DATE: 2/13/2014

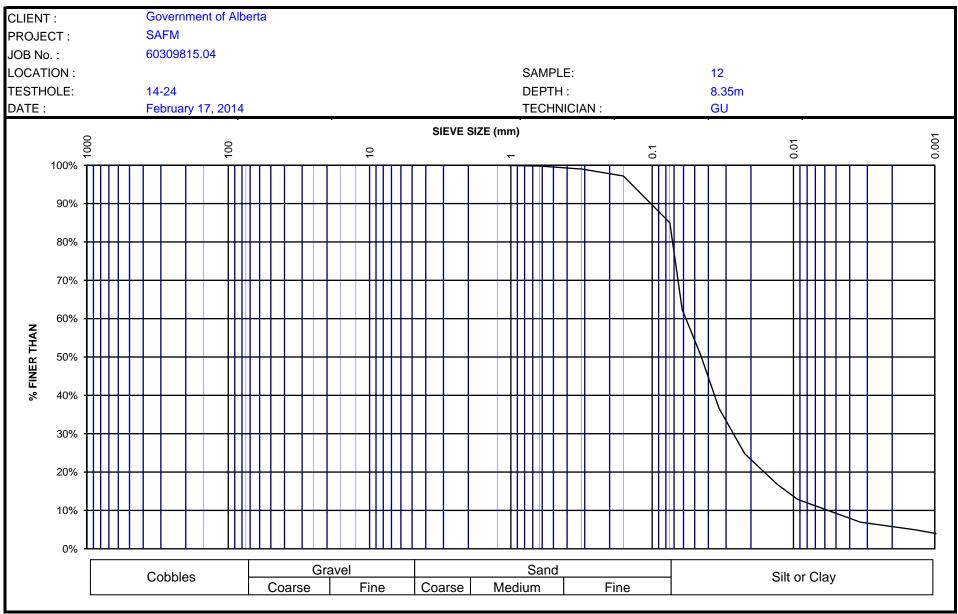


Government of Alberta				
SAFM				
60309815.04				
	SAMPLE:	1	2	
TH14-24	DEPTH :	8	3.35m	
February 18, 2014	TECHNICI	AN : 0	Ж	
	LIQUID LIMIT			
re)(g)				
e)(g)				
VERAGE VALUES		PLASTIC	LIMIT	
	Trial No.			
	Container Number			
	Wt. Sample (wet+tare)(g)		
PLE DESCRIPTION	Wt. Sample (dry+tare)(g	g)		
	Wt. Tare (g)			
NON-PLASTIC	Wt. Dry Soil (g)			
	Wt. Water (g)			
	Water Content (%)			
				<u> </u>
		_ /		
	СІ			
CL		МН		
CL-ML	ML			
10 20 30	40 50 60 LIQUID LIMIT) 70	80	90 100
	SAFM 60309815.04 TH14-24 February 18, 2014 e)(g) e)(g) VERAGE VALUES PLE DESCRIPTION NON-PLASTIC CL-ML	SAFM 60309815.04 SAMPLE: TH14-24 DEPTH : February 18, 2014 TECHNICI UIQUID LIMIT e)(g) e)(g) b)(g) VERAGE VALUES Trial No. CONSIMPLASTIC NON-PLASTIC NON-PLASTIC VERAGE VALUES CI CI CI CI CI CI CI CI CI CI	SAFM 50309815.04 TH14-24 DEPTH : 8 February 18, 2014 TECHNICIAN : C LIQUID LIMIT e)(g) a)(g) VERAGE VALUES PLASTIC VERAGE VALUES PLASTIC Trial No. Container Number Wt. Sample (wet+tare)(g) Wt. Sample (dry+tare)(g) Wt. Tare (g) Wt. Tare (g) Wt. Vater (g) Wt. Water (g) Wt. Wt. Water (g) Wt. Wt. Wt. Wt. Wt. Wt. Wt. Wt. Wt. Wt.	SAFM 50309815.04 SAMPLE: 12 TH14-24 DEPTH: 8.35m February 18, 2014 TECHNICIAN: CK LIQUID LIMIT

FORM: SAFM TH14-24#12 Att.xlsx DATE: 2/19/2014



CLIENT : Government of Alberta SAFM PROJECT : JOB No. : 60309815.04 LOCATION : SAMPLE: 12 TESTHOLE: 14-24 DEPTH : 8.35m DATE : GU February 17, 2014 **TECHNICIAN**: SIZE OF OPENING WEIGHT PERCENT PERCENT FINER TOTAL DRY WEIGHT OF SAMPLE REMARKS SIEVE NO. (µm) APPROX. RETAINED (g) RETAINED THAN mm INCHES Before Washing 150,000 6 150.0 0% 100% Wet + Tare 75,000 3 75.0 0% 100% Dry+Tare 397.0 50,000 2 50.0 0% 100% 0% Tare 100.0 40,000 $1 \frac{1}{2}$ 40.0 100% Wt. Dry 297.0 25,000 1 25.0 0% 100% Moisture Content 3/4 20.0 0% 100% 20.000 Wet + Tare 0% 100% 16,000 5/8 16.0 Dry+Tare 12,500 1/2 12.5 0% 100% 0% 100% Tare 10.000 3/8 10.0 MC (%) 0.185 5.0 0% 100% 5,000 Passing After Washing 0.0937 100% 2.000 2.0 0% Wt. Dry+Tare 1,250 0.0469 1.25 0.0 0% 100.0% Tare 630 0.0234 0.63 0.6 0% 99.8% Wt. Dry 315 0.0116 0.315 3.0 1% 99.0% Tare No. 97.2% 160 0.0059 0.160 8.3 3% 15% 85.0% 75 0.00295 0.075 44.6 PAN PERCENT FINER HYDROMETER DATA READING DIAMETER (mm) TEMP. (°C) CORR. READING REMARKS TIME (min) THAN Wt Dry+Tare 397.0 36 0.5 0.061 20 32 62.4% 30 Wt Tare 0.045 20 26 50.5% 100.0 1 Wt Dry 297.0 23 2 0.034 20 19 36.6% 17 Sample Size : 50 5 0.022 20 13 24.8% 13 Wt Retained 2 mm: 0 15 0.013 20 9 16.8% % Passing 2 mm: 11 30 20 7 12.9% 100.0% 0.009 Specific Gravity : 2.70 10 60 0.007 20 6 10.9% 43-9856 20 Hydrometer No.: C 120 0.005 5 8.9% 20 Solution (g/L): 40 240 0.003 6.9% 4 8 1440 0.001 20 3 5.0% 2880 0.001 20 2 4.0%



CLIENT :	Government of	Alberta							
PROJECT :	SAFM								
JOB No. :	60309815.04								
LOCATION :					SAMPLE:		19		
BOREHOLE:	TH14-24				DEPTH :		13.7m		
DATE :	February 18, 20	14			TECHNIC	IAN :	СК		
				LIQUID L	IMIT				
Trial No.				1					
Number of Blows				21					
Container Numbe	r								
Wt. Sample (wet+	tare)(g)			42.65					
Wt. Sample (dry+t	are)(g)			34.84					
Wt. Tare (g)				12.25					
Wt. Dry Soil (g)				22.6					
Wt. Water (g)				7.8					
Water Content (%))			34.6%					
	AVERAGE VALUE	ES				PLAS			
Liquid Limit		33.9		Trial No.			1		
Plastic Limit		18.9		Container N	lumber				
Plasticity Index		14.9		Wt. Sample	(wet+tare)	(g)	29.51		
SA	MPLE DESCRIP	ΓΙΟΝ		Wt. Sample	(dry+tare)(g)	26.98		
				Wt. Tare (g)			13.60		
Classification		CI		Wt. Dry Soil	(g)		13.4		
			_	Wt. Water (g)		2.5		
				Water Cont	ent (%)		18.9%		
60 —		1		1					
50									
50									
¥ 40									
40						н			
≧ 30 —									
ASI				СІ					
		CL	• /			МН			
10		02							
	C	L-ML	Ν	/L					
0									
0	10 2	20 3	0 4	40 5 LIQUII	06 0 LIMIT	0 70	80	90	100

FORM: SAFM TH14-24#19 Att.xlsx DATE: 2/19/2014

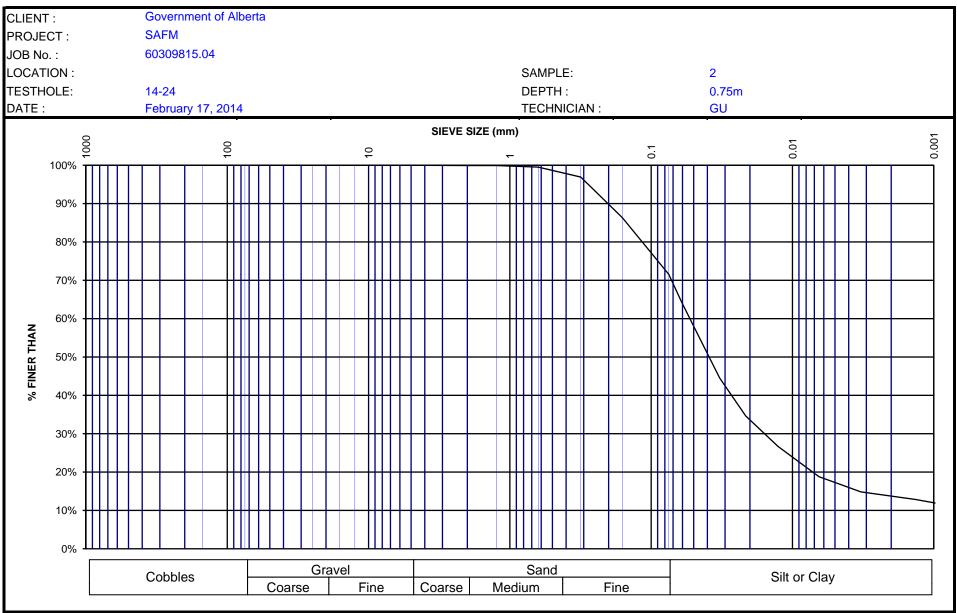


CLIENT :	Government of	Alberta								
PROJECT :	SAFM									
JOB No. :	60309815.04									
LOCATION :					SAMPLE:		2			
BOREHOLE:	TH14-24				DEPTH :		0.75m			
DATE :	February 18, 20	14			TECHNIC	IAN :	СК			
	-			LIQUID L	IMIT					
Trial No.				1						
Number of Blows				15						
Container Numbe	r									
Wt. Sample (wet+	tare)(g)			50.42						
Wt. Sample (dry+t	are)(g)			41.20						
Wt. Tare (g)				12.09						
Wt. Dry Soil (g)				29.1						
Wt. Water (g)				9.2						
Water Content (%)			31.7%						
	AVERAGE VALUE	ES				PLA	STIC LIMIT			
Liquid Limit		29.8		Trial No.			1			
Plastic Limit		26.7		Container N	lumber					
Plasticity Index		3.1		Wt. Sample	(wet+tare)	(g)	36.9	90		
SA	MPLE DESCRIP	TION		Wt. Sample			32.4	12		
				Wt. Tare (g)			15.	61		
Classification	:	ML		Wt. Dry Soil			16	8		
				Wt. Water (g			4.	5		
				Water Cont			26.7	%		
60		1				Г Г				
50										
ä 40 –										
Q					С	н				
VST				СІ						
40										
-						МН				
10 -		CL								
	C	L-ML		ИL						
			·							
0 +	10 2	20 3	0	40 5	0 6 D LIMIT	0 70) 8	0	90	100

FORM: SAFM TH14-24#2 Att.xlsx DATE: 2/19/2014



CLIENT :	Government of Al	berta						
PROJECT :	SAFM							
JOB No. :	60309815.04							
LOCATION :					SAMPLE:		2	
TESTHOLE:	14-24				DEPTH :		0.75m	
DATE :	February 17, 201	4			TECHNICIAN :		GU	
	: co.co.y, _c.		SIZE OF	OPENING				
TOTAL DRY WEIGHT	T OF SAMPLE	SIEVE NO. (µm)	APPROX. INCHES	mm	WEIGHT RETAINED (g)	PERCENT RETAINED	PERCENT FINER THAN	REMARKS
Before Washing		150,000	6	150.0		0%	100%	
Wet + Tare		75,000	3	75.0		0%	100%	
Dry+Tare	342.1	50,000	2	50.0		0%	100%	
Tare	100.0	40,000	1 1/2	40.0		0%	100%	
Wt. Dry	242.1	25,000	1	25.0		0%	100%	
Moisture Content		20,000	3/4	20.0		0%	100%	
Wet + Tare		16,000	5/8	16.0		0%	100%	
Dry+Tare		12,500	1/2	12.5		0%	100%	
Tare		10,000	3/8	10.0		0%	100%	
MC (%)		5,000	0.185	5.0		0%	100%	
	Passing							
After Washing		2,000	0.0937	2.0	0.2	0%	99.9%	
Wt. Dry+Tare		1,250	0.0469	1.25	0.2	0%	99.9%	
Tare		630	0.0234	0.63	1.2	0%	99.5%	
Wt. Dry		315	0.0116	0.315	7.5	3%	96.9%	
Tare No.		160	0.0059	0.160	33.1	14%	86.3%	
		75 PAN	0.00295	0.075	68.9	28%	71.5%	
HYDROMETER	R DATA	READING	TIME (min)	DIAMETER (mm)	TEMP. (°C)	CORR. READING	PERCENT FINER THAN	REMARKS
Wt Dry+Tare	342.1	37	0.5	0.061	20	33	64.3%	
Wt Tare	100.0	32	1	0.045	20	28	54.4%	
Wt Dry	242.1	27	2	0.033	20	23	44.5%	
Sample Size :	50	22	5	0.021	20	18	34.6%	
Wt Retained 2 mm:	0.2	18	15	0.013		14	26.7%	
% Passing 2 mm:	99.9%	16	30	0.009	20	12	22.8%	
Specific Gravity :	2.70	14	60	0.006	20	10	18.8%	
Hydrometer No.:	43-9856	13	120	0.005	20	9	16.8%	
Solution (g/L):	40	12	240	0.003	20	8	14.8%	
		11	1440	0.001	20	7	12.9%	
		11	2880	0.001	20	6	11.9%	



SIEVE ANALYSIS

CLIENT :	Govern	ment of	Alb	erta	а																									
PROJECT :	SAFM																													
JOB No. :	603098	15.04																												
LOCATION :												SA	١M	PLE	:					4	1									
TESTHOLE :	14-24											DE	ΞP٦	ΓН	:					2	2.3m									
DATE :	Februa	ry 18, 20	014									TE	ECH	INI	CIAN	1:				C	GU									
TOTAL DRY W		SIE						OPEI	NIN	IG			WE						NT			CEN			Ċ,	SPE	CIF	ICA.	TION	
OF SAMPI	_E	NO. (μm)			PRO CHE			m	m		F		'AIN (g)	IED	R	ET	AIN	IED		FINE	R TH	٩N	I	LOV	VEF	२		UPPE	R
Before Washing		1:	5000	00		6			150					(9)								100								
Wet + Tare			7500			3			75													100								
Dry+Tare	536.8		5000			2			50													100								
Tare Wt. Dry	235.0 301.8		4000 2500			1/2 1			40 25													100 100								
Moisture Content			2000			ı 3/4			20													100								
Wet + Tare			1600			5/8			16													100								
Dry+Tare			1250	00		1/2			12	.5												100	0%							
Tare			1000			3/8			10													100								
MC (%)	Passing		500	00	C	.185			5.	0					1.1				00	%		100)%							
After Washing			200	00	0	.0937	,		2.	0		T			1.2				00	%		100)%					Ī		
Wt. Dry+Tare	442.6		125			.0469			1.2						1.3				00			100								
Tare	235.0			30		.0234			0.6						1.8				19				9%							
Wt. Dry Tare No.	207.6			15 60		.0116 .0059			0.3 0.1					1	17.7 33.7				6° 44°				4% 5%							
Tale NO.				30 30		.0059			0.1						201.0				44°				3% 3%							
			PAN	١											207.5				0.	/0										
Classification: Cc		M or SC #N/A			Desc	criptic	on ar	nd Re	ema	arks	5:																			
Cu		#N/A #N/A																												
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CLIENT :	Government of a	Alberta								
PROJECT :	SAFM									
JOB No. :	60309815.04									
LOCATION :					SAMPLE:		7			
BOREHOLE:	TH14-24				DEPTH :		4.55m			
DATE :	February 18, 20	14			TECHNIC	IAN :	СК			
				LIQUID L	MIT					
Trial No.				1						
Number of Blows				28						
Container Numbe	r									
Wt. Sample (wet+t	are)(g)			46.08						
Wt. Sample (dry+ta	are)(g)			40.78						
Wt. Tare (g)				11.81						
Wt. Dry Soil (g)				29.0						
Wt. Water (g)				5.3						
Water Content (%)				18.3%						
	AVERAGE VALUE	S				PLA	STIC LIMIT			
Liquid Limit		18.5		Trial No.			1			
Plastic Limit		17.0		Container N	lumber					
Plasticity Index		1.5		Wt. Sample	(wet+tare)	(g)	39.2	.6		
SA	MPLE DESCRIPT	FION		Wt. Sample	(dry+tare)(g)	35.8	8		
				Wt. Tare (g)			16.0	5		
Classification:		ML		Wt. Dry Soil	(g)		19.	8		
				Wt. Water (g	1)		3.4			
				Water Cont	ent (%)		17.0	%		
										
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FORM: SAFM TH14-24#7 Att.xlsx DATE: 2/19/2014



SIEVE ANALYSIS

CLIENT : Governm	ent of Albert	а						
PROJECT : SAFM								
JOB No. : 60309815	5.04							
LOCATION :				SAMPLE:		3		
TESTHOLE : 14-26				DEPTH :		2m		
DATE : February	25, 2014			TECHNICIAN	1:	GU		
TOTAL DRY WEIGHT	SIEVE	SIZE OF (OPENING	WEIGHT	PERCENT	PERCENT	SPECIFI	CATION
OF SAMPLE	NO. (μm)	APPROX.	mm	RETAINED	RETAINED	FINER THAN	LOWER	UPPER
Before Washing	150000	INCHES 6	150.0	(g)		100%		
Wet + Tare	75000	3	75.0			100%		
Dry+Tare 725.8	50000	2	50.0			100%		
Tare 250.6	40000	1 1/2	40.0			100%		
Wt. Dry 475.2	25000	1	25.0	28.3	6%			
Moisture Content	20000	3/4	20.0	28.3	6%			
Wet + Tare	16000	5/8	16.0	40.7	9%			
Dry+Tare	12500	1/2	12.5	80.5	17%			
Tare	10000	3/8	10.0	91.1	19%			
MC (%)	5000	0.185	5.0	155.7	33%			
Passing								
After Washing	2000	0.0937	2.0	213.9	45%	55%		
Wt. Dry+Tare 635.9	1250	0.0469	1.25	233.1	49%			
Tare 250.6	630	0.0234	0.630	257.7	54%			
Wt. Dry 385.3	315	0.0116	0.315	306.5	64%			
Tare No.	160	0.0059	0.160	353.4	74%			
	80	0.0029	0.080	382.8	81%	19%		
Classification: SM	PAN or SC	Description ar	d Remarks:	385.3				
Cc #	N/A N/A	Description a	la Romano.					
			SIEVE	SIZE (mm)				-
	100		9		~	0.7		0.01
90%			$\sum \prod$					
80%								
70%			——————————————————————————————————————					
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30%						\mathbb{N}		
20%							$\mathbb{N} \to \mathbb{N}$	
10%		++++		+++-				
0%								
		Gravel			Sand			
Cobbles	C	Coarse	Fine	Coarse M	/ledium	Fine	Silt or	Clay

CLIENT :	Government of /	Alberta								
PROJECT :	SAFM									
JOB No. :	60309815.04									
LOCATION :					SAMPLE:		7			
BOREHOLE:	TH14-26				DEPTH :		4.6m			
DATE :	February 25, 20	14			TECHNIC	IAN :	GU			
	-			LIQUID L	IMIT					
Trial No.				1						
Number of Blows				21						
Container Number										
Wt. Sample (wet+ta	are)(g)			56.73						
Wt. Sample (dry+ta	re)(g)			49.84						
Wt. Tare (g)				16.06						
Wt. Dry Soil (g)				33.8						
Wt. Water (g)				6.9						
Water Content (%)				20.4%						
	AVERAGE VALUE	S				PLA	STIC LIMIT			
Liquid Limit		20.0	Ī	Trial No.			1			
Plastic Limit		10.5		Container N	lumber					
Plasticity Index		9.4		Wt. Sample	(wet+tare)	(g)	34.05	;		
SA	MPLE DESCRIPT	ION		Wt. Sample	(dry+tare)((g)	31.93	•		
				Wt. Tare (g)			11.81			
Classification:		CL		Wt. Dry Soil	(g)		20.1			
			_	Wt. Water (g)		2.1			
				Water Cont	ent (%)		10.5%	, D		
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FORM: SAFM TH14-26 #7 Att.xlsx DATE: 2/26/2014



DATE :

Tare

Tare

Tare

Wt. Dry

Tare No.

Wt Tare

Wt Dry

MC (%)

Wt. Dry

CLIENT : Government of Alberta SAFM PROJECT : JOB No. : 60309815.04 LOCATION : SAMPLE: 7 TESTHOLE: 14-26 DEPTH : 4.6m GU February 25, 2014 **TECHNICIAN**: SIZE OF OPENING WEIGHT PERCENT PERCENT FINER TOTAL DRY WEIGHT OF SAMPLE REMARKS SIEVE NO. (µm) APPROX. RETAINED (g) RETAINED THAN mm INCHES Before Washing 150,000 6 150.0 0% 100% Wet + Tare 75,000 3 75.0 0% 100% Dry+Tare 238.5 50,000 2 50.0 0% 100% 0% 100.0 40,000 $1 \frac{1}{2}$ 40.0 100% 138.5 25,000 1 25.0 0% 100% Moisture Content 3/4 20.0 0% 100% 20.000 Wet + Tare 0% 100% 16,000 5/8 16.0 Dry+Tare 12,500 1/2 12.5 4% 96% 5.1 8.3 6% 94.0% 10.000 3/8 10.0 0.185 5.0 16.2 12% 88.3% 5,000 Passing After Washing 0.0937 2.000 2.0 19.2 14% 86.1% Wt. Dry+Tare 1,250 0.0469 1.25 23.5 17% 83.0% 630 0.0234 0.63 29.2 21% 78.9% 315 0.0116 0.315 40.0 29% 71.1% 160 0.0059 0.160 57.6 42% 58.4% 54% 75 0.00295 0.075 74.6 46.2% PAN PERCENT FINER HYDROMETER DATA READING DIAMETER (mm) TEMP. (°C) CORR. READING REMARKS TIME (min) THAN Wt Dry+Tare 238.5 29 0.5 0.065 20 25 41.8% 25 0.047 20 21 35.0% 100.0 1 22 138.5 2 0.034 20 18 29.8% Sample Size : 50 19 5 0.022 20 15 24.7% 16 Wt Retained 2 mm: 19.2 15 0.013 20 12 19.6% % Passing 2 mm: 14 30 20 10 16.2% 86.1% 0.009 13 Specific Gravity : 2.70 60 0.007 20 9 14.5% 43-9856 12 20 Hydrometer No.: 120 0.005 8 12.8% 11 20 Solution (g/L): 40 240 0.003 7 11.1% 1440 0.001 20 5 7.7% 9

0.001

20

4

6.0%

8

2880

DATE :

% FINER THAN

Government of Alberta CLIENT : SAFM PROJECT : 60309815.04 JOB No. : LOCATION : SAMPLE: 7 TESTHOLE: DEPTH : 14-26 4.6m February 25, 2014 **TECHNICIAN** : GU SIEVE SIZE (mm) 0.001 1000 0.01 100 0.1 10 100% 90% 80% 70% 60% 50% 40% 30% 20% Π 10% 0%

Sand

Fine

Medium

Coarse

Gravel

Fine

Coarse

FORM: SAFM TH14-26#7 Hydro.xls DATE: 2/26/2014

Cobbles

AECOM

Silt or Clay

CLIENT :	Government of	Alberta								
PROJECT :	SAFM									
JOB No. :	60309815.04									
LOCATION :					SAMPLE:		5			
BOREHOLE:	TH14-27				DEPTH :		4.6m			
DATE :	February 25, 20	14			TECHNIC	IAN :	GU			
	-			LIQUID L	IMIT					
Trial No.				1						
Number of Blows				22						
Container Numbe	r									
Wt. Sample (wet+	tare)(g)			59.60						
Wt. Sample (dry+1	are)(g)			50.51						
Wt. Tare (g)				15.62						
Wt. Dry Soil (g)				34.9						
Wt. Water (g)				9.1						
Water Content (%)			26.1%						
	AVERAGE VALUE	ES				PLA	STIC LIMIT			
Liquid Limit		25.7		Trial No.			1			
Plastic Limit		17.9		Container N	lumber					
Plasticity Index		7.7		Wt. Sample	(wet+tare)	(g)	33.0	00		
S	MPLE DESCRIP	ΓΙΟΝ		Wt. Sample	(dry+tare)(g)	29.8	32		
				Wt. Tare (g)			12.1	0		
Classification	:	CL		Wt. Dry Soil	(g)		17.	7		
				Wt. Water (g	g)		3.2	2		
				Water Cont	ent (%)		17.9	%		
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FORM: SAFM TH14-27#5 Att.xlsx DATE: 2/26/2014

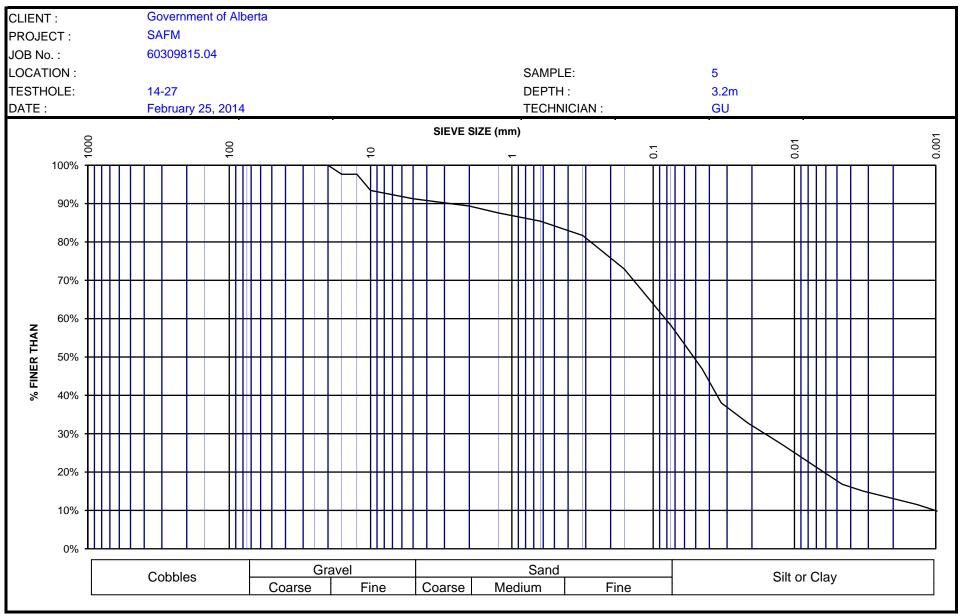


SAFM

CLIENT : PROJECT : Government of Alberta

JOB No. :	60309815.04							
LOCATION :					SAMPLE:		5	
TESTHOLE:	14-27				DEPTH :		3.2m	
DATE :	February 25, 201	4			TECHNICIAN :		GU	
DATE :	1 obraary 20, 201		SIZE OF	OPENING				
TOTAL DRY WEIG	HT OF SAMPLE	SIEVE NO. (µm)	APPROX. INCHES	mm	WEIGHT RETAINED (g)	PERCENT RETAINED	PERCENT FINER THAN	REMARKS
Before Washing		150,000	6	150.0		0%	100%	
Wet + Tare		75,000	3	75.0		0%	100%	
Dry+Tare	346.3	50,000	2	50.0		0%	100%	
Tare	100.0	40,000	1 1/2	40.0		0%	100%	
Wt. Dry	246.3	25,000	1	25.0		0%	100%	
Moisture Content		20,000	3/4	20.0		0%		
Wet + Tare		16,000	5/8	16.0	5.8	2%		
Dry+Tare		12,500	1/2	12.5	5.8	2%		
Tare		10,000	3/8	10.0	16.2	7%		
MC (%)		5,000	0.185	5.0	21.5	9%	91.3%	
	Passing							
After Washing		2,000	0.0937	2.0	26.2	11%		
Wt. Dry+Tare		1,250	0.0469	1.25	30.6	12%		
Tare		630	0.0234	0.63	35.9	15%		
Wt. Dry		315	0.0116	0.315	45.1	18%		
Tare No.		160	0.0059	0.160	66.7	27%		
		75 PAN	0.00295	0.075	102.8	42%	58.3%	
HYDROMET	ER DATA	READING	TIME (min)	DIAMETER (mm)	TEMP. (°C)	CORR. READING	PERCENT FINER THAN	REMARKS
Wt Dry+Tare	346.3	35	0.5	0.062	20	31	54.0%	
Wt Tare	100.0	31	1	0.045	20	27	46.9%	
Wt Dry	246.3	26	2	0.033	20	22	38.0%	
Sample Size :	50	23	5	0.021	20	19	32.7%	
Wt Retained 2 mm:	26.2	20	15	0.013	20	16	27.4%	
% Passing 2 mm:	89.4%	18	30	0.009	20	14	23.9%	
Specific Gravity :	2.70	16	60	0.006	20	12	20.3%	
Hydrometer No.:	43-9856	14	120	0.005	20	10	16.8%	
Solution (g/L):	40	13	240	0.003	20	9	15.0%	
		11 10	1440 2880	0.001 0.001	20 20	7 6	11.5% 9.7%	

ΑΞϹΟΜ

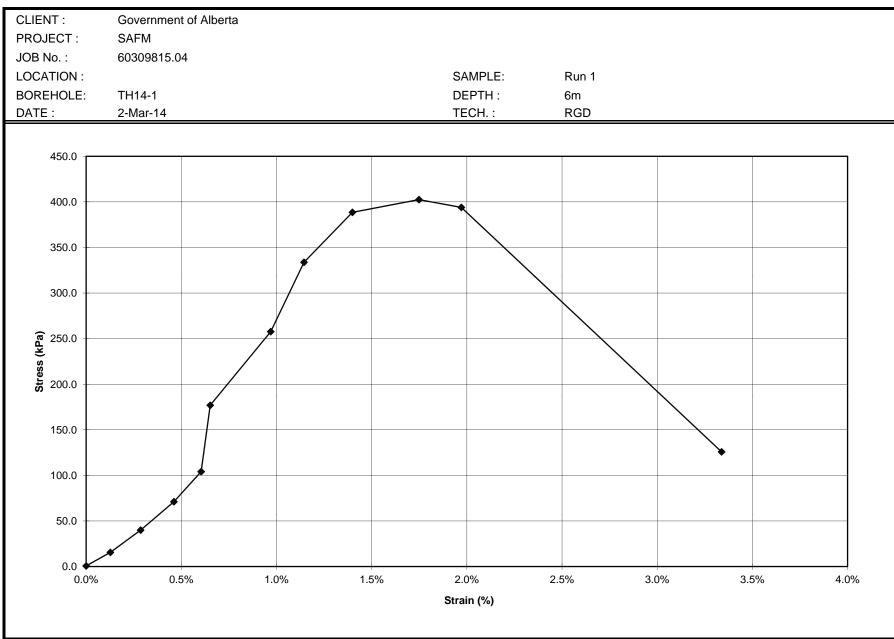


CLIENT :	Government of A	lberta								
PROJECT :	SAFM									
JOB No. :	60309815.04									
LOCATION :					SAMPLE:		C2			
BOREHOLE:	TH14-27				DEPTH :		10.5m			
DATE :	March 3, 2014				TECHNIC	IAN :	СК			
				LIQUID L	MIT					
Trial No.				1						
Number of Blows				16						
Container Number										
Wt. Sample (wet+ta	re)(g)			46.52						
Wt. Sample (dry+tar	re)(g)			38.66						
Wt. Tare (g)				11.75						
Wt. Dry Soil (g)				26.9						
Wt. Water (g)				7.9						
Water Content (%)				29.2%						
A	VERAGE VALUE	S				PLA	STIC LIMIT			
Liquid Limit		27.7		Trial No.			1			
Plastic Limit		22.1		Container N	lumber					
Plasticity Index		5.6		Wt. Sample	(wet+tare)	(g)	31.5	6		
SAN	PLE DESCRIPT	ON		Wt. Sample	(dry+tare)(g)	28.7	5		
				Wt. Tare (g)			16.09	Э		
Classification:		ML		Wt. Dry Soil	(g)		12.7			
			-	Wt. Water (1)		2.8			
				Water Cont	ent (%)		22.19	6		
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FORM: SAFM TH14-27#C2 Att.xlsx DATE: 3/4/2014



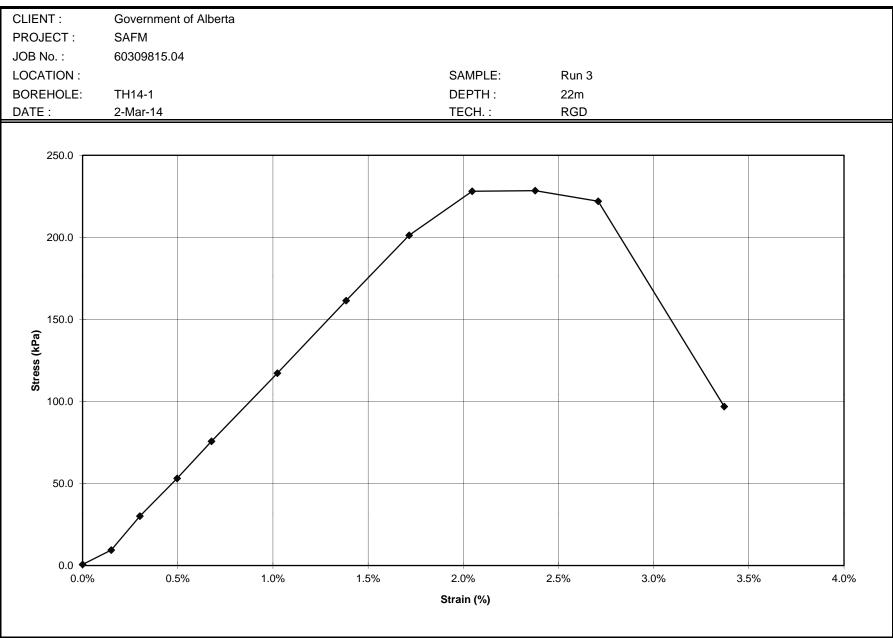
CLIENT :	Government of	of Alberta					
PROJECT :	SAFM						
JOB No. :	60309815.04						
LOCATION :					SAMPLE:	Run 1	
BOREHOLE:	TH14-1				DEPTH :	6m	
DATE :	March 2, 2014	4			TECHNICIAN :	RGD	
DENSIT	Y DETERMIN	ATION	N	ATER CONTI	ENT	SAM	PLE DESCRIPTION
Wt. Sample (g)	1581.6	Tare Numbe	r			/shale, mod strong, very
Initial Length (159.8	Wt. Sample	(wet+tare) (g)	1672.2	blocky	
Initial Diamete	-	75.0	-	(dry+tare)(g)	1529.6		
Wet Unit Weig		22.0	Wt. Tare (g)		158.3		
Dry Unit Weigh		19.9	Water Conte	ent (%)	10.4%		
	LOAD DATA			FAILURE DA	ГА	F	AILURE MODE
Ring #		3491	Load (N)		1810	bottom crushir	ng along horizontal failure
Gears Used			% Strain :		1.7%	plane	
Loading Rate		.055"/min	Corrected C	0 _∪ (kPa)	402		
— ())	Load Dial	1 1.4 %	Strain Dial	0			
Time (min)	(0.0001")	Load (N)	(0.001")	Strain (%)	Area (mm ²)	Q _∪ (kPa)	Comments
0 0.25	0 25	3 69	1000 992	0.0% 0.1%	4418 4423	0.7 15.5	
0.25	25 65	69 177	992 982	0.1%	4423	40.0	
0.75	117	316	971	0.5%	4438	71.1	
1 1.5	172 293	463 787	962 959	0.6% 0.7%	4445 4447	104.1 176.9	
2	429	1149	939	1.0%	4461	257.7	
2.5 3	558 652	1492 1741	928 912	1.1% 1.4%	4469 4481	333.8 388.5	
3.25	678	1810	890	1.7%	4496	402.5	
3 3.5	665 214	1775 575	876 790	2.0% 3.3%	4507 4570	393.9 125.8	
5.5	214	575	790	3.3%	4570	125.0	
	SAEM 14 1 1 via					L	



FORM : Unconf SAFM 14-1 1.xls DATE: 3/3/2014



CLIENT :	Government of	of Alberta					
PROJECT :	SAFM						
JOB No. :	60309815.04						
LOCATION :					SAMPLE:	Run 3	
BOREHOLE:	TH14-1				DEPTH :	22m	
DATE :	March 2, 2014	4			TECHNICIAN :	RGD	
DENSIT	Y DETERMIN	ATION	N	ATER CONT	ENT	SAM	PLE DESCRIPTION
Wt. Sample (g		1692.0	Tare Numbe	r		Olive grey clay	/shale, mod strong
Initial Length (mm)	168.8	Wt. Sample	(wet+tare) (g)	1945.2		
Initial Diamete	r (mm)	76.2	Wt. Sample	(dry+tare)(g)	1726.7		
Wet Unit Weig	ht (kN/m³)	21.6	Wt. Tare (g)		255.7		
Dry Unit Weigl	nt (kN/m³)	18.8	Water Conte	ent (%)	14.9%		
	LOAD DATA			FAILURE DA	ГА	F	AILURE MODE
Ring #		3491	Load (N)		1067	Crack starting	at top centre angling down
Gears Used			% Strain :		2.4%	to exit approx	100m from top.
Loading Rate		.055"/min	Corrected C	נ _∪ (kPa)	228		
	Load Dial		Strain Dial				
Time (min)	(0.0001")	Load (N)	(0.001")	Strain (%)	Area (mm ²)	Q _∪ (kPa)	Comments
0	0	3	1000	0.0%	4560	0.7	
0.25 0.5	15 50	43 138	990 980	0.2% 0.3%	4567 4574	9.4 30.1	
0.75	90	243	967	0.5%	4583	53.1	
1 1.5	129 201	348 540	955 932	0.7% 1.0%	4591 4608	75.7 117.2	
2	278	747	908	1.4%	4624	161.4	
2.5 3	348 396	934 1062	886 864	1.7% 2.0%	4640 4656	201.2 228.1	
3.5	398	1067	842	2.4%	4671	228.5	
4 4.5	388 170	1041 457	820 776	2.7% 3.4%	4687 4719	222.0 96.9	
4.0	170	-01	110	0.470	4713	50.5	
L	SAEM 14 1 2 vic						



FORM : Unconf SAFM 14-1 3.xls DATE: 3/3/2014



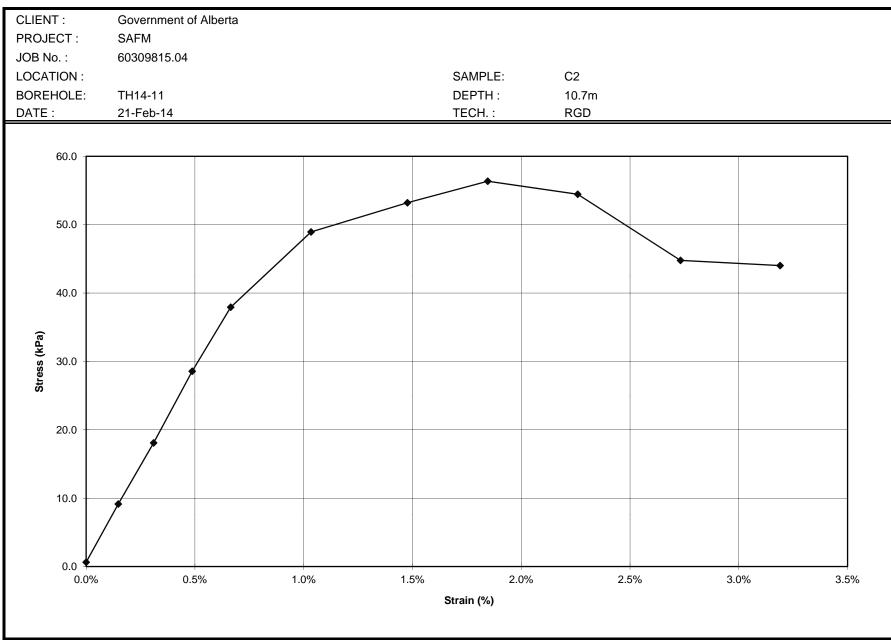
overnment o	f Alberta					
FM						
309815.04						
				SAMPLE:	Run 6	
114-1				DEPTH :	31.9m	
arch 2, 2014				TECHNICIAN :	RGD	
DETERMINA	TION	W	ATER CONTE	ENT		PLE DESCRIPTION
	1744.4	Tare Numbe	r		Siltstone, very	strong
ו)	161.3	Wt. Sample	(wet+tare) (g)	1809.3		
nm)	75.4	Wt. Sample	(dry+tare)(g)	1732.8		
(kN/m³)	23.8	Wt. Tare (g)		154.1		
	22.7					
AD DATA			FAILURE DAT		F	AILURE MODE
		-				
			iviPa)	38.3		
_oad Dial (0.0001")	Load (N)	Strain Dial (0.001")	Strain (%)	Area (mm²)	Q _U (kPa)	Comments
				4465.1		
Í		ole core was ca	pped and broł	xen in concrete b	reaker.	
	FM 309815.04 14-1 <u>irch 2, 2014</u> <u>DETERMINA</u> 0) nm) kN/m ³) AD DATA 0.0001") e to high sti	309815.04 14-1 14-1 DETERMINATION 1744.4 1) 161.3 1m) 75.4 kN/m ³) 23.8 (N/m ³) 22.7 AD DATA 100001") Load (N)	FM 309815.04 14-1 Irch 2, 2014 DETERMINATION W 1744.4 Tare Number N 1744.4 Tare Number N 1744.4 Tare Number N 1744.4 Tare Number N Sample Wt. Sample Wt. Sample Wt. Sample Wt. Sample Wt. Sample Wt. Sample N Main Strain Contect N Main Strain Dial (0.001") E to high strength of sample core was ca	FM 309815.04 14-1 Irch 2, 2014 DETERMINATION WATER CONTE 1744.4 Tare Number 1744.4 Tare Number 1744.4 Tare Number 0) 161.3 Wt. Sample (wet+tare) (g) Wt. Sample (dry+tare)(g) Wt. Sample (dry+tare)(g) Wt. Tare (g) (M/m ³) 23.8 Wt. Tare (g) (M/m ³) 23.8 Wt. Tare (g) (M/m ³) 23.8 Wt. Tare (g) (M/m ³) 22.7 Water Content (%) AD DATA FAILURE DAT Load (Kg) % Strain : Corrected (MPa)	FM 309815.04 SAMPLE: 14-1 DEPTH : 14-1 DEPTH : irch 2, 2014 TECHNICIAN : DETERMINATION WATER CONTENT 1744.4 Tare Number i) 161.3 Wt. Sample (wet+tare) (g) 1809.3 imm) 75.4 Wt. Sample (dry+tare)(g) 1732.8 kN/m³) 23.8 Wt. Tare (g) 154.1 (N/m³) 22.7 Water Content (%) 4.8% AD DATA FAILURE DATA Load (Kg) 17416 % Strain : N/A Corrected (MPa) 38.3 oad Dial Load (N) Strain Dial 0.0001") Load (N) Strain Dial Area (mm²) e to high strength of sample core was capped and broken in concrete b A465.1	FM 309815.04 14-1 DEPTH: 31.9m 14-1 DEPTH: 31.9m irch 2, 2014 TECHNICIAN: RGD ETERMINATION WATER CONTENT SAMPLE: 1744.4 Tare Number Siltstone, very i) 161.3 Wt. Sample (wet+tare) (g) 1809.3 inm) 75.4 Wt. Sample (dry+tare)(g) 1732.8 kN/m³) 23.8 Wt. Tare (g) 154.1 (N/m³) 22.7 Water Content (%) 4.8% AD DATA FAILURE DATA F Load (Kg) 17416 % Strain : N/A .oad Dial Load (N) Strain Dial Strain (%) Area (mm²) Q _U (kPa) .oad Dial Load (N) Strain Dial Strain (%) Area (mm²) Q _U (kPa) e to high strength of sample core was capped and broken in concrete breaker. E E E

CLIENT :	Government o	of Alberta					
	SAFM						
JOB No. :	60309815.04						
LOCATION :					SAMPLE:	Run 1	
BOREHOLE:	TH14-10				DEPTH :	6.5m	
DATE :	February 27, 2	2014			TECHNICIAN :	RGD	
DENSIT	Y DETERMIN	ATION	W	ATER CONTI	ENT	SAM	PLE DESCRIPTION
Wt. Sample (g)	1880.9	Tare Numbe	r		Olive grey clay	yshale
Initial Length (mm)	178.3	Wt. Sample	(wet+tare) (g)	2055.6		
Initial Diamete	r (mm)	77.4	Wt. Sample	(dry+tare)(g)	1861.8		
Wet Unit Weig	ht (kN/m³)	22.0	Wt. Tare (g)		202.4		
Dry Unit Weigh	nt (kN/m³)	19.7	Water Conte	ent (%)	11.7%		
	LOAD DATA			FAILURE DAT	ΓA	F	AILURE MODE
Ring #		3491	Load (N)		425		
Gears Used			% Strain :		2.8%		
Loading Rate		.055"/min	Corrected C	≀ _∪ (kPa)	88		
Time (min)	Load Dial (0.0001")	Load (N)	Strain Dial (0.001")	Strain (%)	Area (mm²)	Q _U (kPa)	Comments
0 0.25	0 9	3 27	1000 988	0.0% 0.2%	4705 4713	0.6 5.7	
0.5	18	51	975	0.4%	4722	10.8	
0.75	31 41	85 113	963 052	0.5% 0.7%	4730 4738	18.0 23.8	
1 1.5	41 68	113	952 926	0.7% 1.1%	4738 4755	23.8	
2	90	243 278	901 975	1.4%	4772 4790	51.0 58.1	
2.5 3	103 117	316	875 850	1.8% 2.1%	4808	65.6	
3.5	130	350	845	2.2%	4811	72.8	
4 4.5	158 141	425 380	800 765	2.8% 3.3%	4843 4868	87.8 78.0	
5	132	356	731	3.8%	4893	72.7	

CLIENT : Government of Alberta PROJECT : SAFM JOB No. : 60309815.04 LOCATION : SAMPLE: Run 1 BOREHOLE: TH14-10 DEPTH : 6.5m DATE : 27-Feb-14 TECH. : RGD 100.0 90.0 80.0 70.0 60.0 Stress (kPa) 50.0 40.0 30.0 20.0 10.0 0.0 0.0% 0.5% 1.0% 1.5% 2.0% 2.5% 3.0% 3.5% 4.0% 4.5% Strain (%)

Government of	of Alberta					
SAFM						
				SAMPLE:	C3	
TH14-10				DEPTH :	13.1m	
February 21, 2	2014			TECHNICIAN :	RGD	
Y DETERMIN	ATION	N	ATER CONTE	ENT	SAMP	LE DESCRIPTION
)	1772.3	Tare Numbe	r		Siltstone, very	strong
mm)	157.1	Wt. Sample	(wet+tare) (g)	1714.5		
er (mm)	75.5	Wt. Sample	(dry+tare)(g)	1651.4		
ıht (kN/m³)	24.7	Wt. Tare (g)		158.2		
ht (kN/m³)	23.7	Water Conte	ent (%)	4.2%		
LOAD DATA			FAILURE DAT		FA	AILURE MODE
		Load (Kg)		14267.0		
		% Strain :		N/A		
· · · · · · · · · · · · · · · · · · ·		Corrected (MPa)	31.3	ļ	
Load Dial (0.0001")	Load (N)	Strain Dial (0.001")	Strain (%)	Area (mm²)	Q _U (kPa)	Comments
				4477		
		ole core was ca	pped and brok	ken in concrete b	preaker.	
	SAFM 60309815.04 TH14-10 <u>February 21, 2</u> <u>Y DETERMIN</u>) mm) r (mm) ht (kN/m ³) <u>ht (kN/m³)</u> LOAD DATA LOAD DATA	60309815.04 TH14-10 February 21, 2014 Y DETERMINATION) 1772.3 mm) 157.1 r (mm) 75.5 ht (kN/m³) 24.7 nt (kN/m³) 23.7 LOAD DATA LOAD DATA	SAFM 60309815.04 TH14-10 February 21, 2014 Y DETERMINATION W) 1772.3 Tare Number mm) 157.1 Wt. Sample r (mm) 75.5 Wt. Sample ht (kN/m³) 24.7 Wt. Tare (g) ht (kN/m³) 23.7 Water Conter LOAD DATA Load (Kg) % Strain : Corrected (Load Dial (0.0001") Load (N) Strain Dial (0.001") Due to high strength of sample core was ca	SAFM 60309815.04 TH14-10 February 21, 2014 Y DETERMINATION WATER CONTE) 1772.3 Tare Number mm) 157.1 Wt. Sample (wet+tare) (g) r (mm) 75.5 Wt. Sample (dry+tare)(g) ht (kN/m³) 24.7 Wt. Tare (g) ht (kN/m³) 23.7 Water Content (%) LOAD DATA FAILURE DAT LOad (Kg) % Strain : Corrected (MPa) Load Dial (0.001") Load (N) Strain Dial (0.001") Strain (%) Due to high strength of sample core was capped and brok	SAFM 60309815.04 SAFM 60309815.04 SAMPLE: TH14-10 DEPTH : February 21, 2014 TECHNICIAN : Y DETERMINATION WATER CONTENT) 1772.3 Tare Number mm) 157.1 Wt. Sample (wet+tare) (g) 1714.5 r (mm) 75.5 Wt. Sample (dry+tare)(g) 1651.4 ht (kN/m³) 24.7 Wt. Tare (g) 1651.4 ht (kN/m³) 24.7 Wt. Tare (g) 158.2 nt (kN/m³) 23.7 Water Content (%) 4.2% LOAD DATA FAILURE DATA LOad (Kg) 14267.0 % Strain : N/A Corrected (MPa) 31.3 Load Dial (0.0001") Load (N) Strain Dial (0.001") Strain (%) Area (mm²) Due to high strength of sample core was capped and broken in concrete b	SAFM 60309815.04 TH14-10 SAMPLE: C3 TH14-10 DEPTH : 13.1m February 21, 2014 TECHNICIAN : RGD <u>Y DETERMINATION</u> WATER CONTENT RGD <u>Y DETERMINATION</u> 1772.3 17are Number mm) 157.1 Vt. Sample (wet+tare) (g) 1714.5 r (mm) 75.5 Vt. Sample (dry+tare)(g) 1651.4 ht (kN/m³) 24.7 Vt. Tare (g) 1651.4 ht (kN/m³) 23.7 Water Content (%) 4.2% LOAD DATA FAILURE DATA FAILURE DATA FAILURE DATA FAILURE DATA Load (Kg) 14267.0 % Strain : N/A Corrected (MPa) 31.3 Load Dial (0.001") Load (N) Strain Dial (0.001") Strain (%) Area (mm²) Q _U (kPa) Due to high strength of sample core was capped and broken in concrete breaker.

CLIENT :	Government of	of Alberta					
PROJECT :	SAFM						
JOB No. :	60309815.04						
LOCATION :					SAMPLE:	C2	
BOREHOLE:	TH14-11				DEPTH :	10.7m	
DATE :	February 21, 2	2014			TECHNICIAN :	RGD	
DENSIT	Y DETERMIN	ATION	W	ATER CONTI	ENT		PLE DESCRIPTION
Wt. Sample (g)	1758.6	Tare Numbe	r		Olive grey clay strong	yshale, mod weak to mod
Initial Length (mm)	172.0	Wt. Sample	(wet+tare) (g)	1857.4	Strong	
Initial Diamete	r (mm)	77.4	Wt. Sample	(dry+tare)(g)	1650.6		
Wet Unit Weig		21.3	Wt. Tare (g)		156.8		
Dry Unit Weigl	· · · ·	18.7	Water Conte		13.8%		
	LOAD DATA			FAILURE DA			AILURE MODE
Ring #		3491	Load (N)		270	weuge snape	d starting at bottom
Gears Used		0551/2	% Strain :) (LD-)	1.8%		
Loading Rate		.055"/min	Corrected C	≀ _∪ (кРа)	56		
Time (min)	Load Dial (0.0001")	Load (N)	Strain Dial (0.001")	Strain (%)	Area (mm²)	Q _∪ (kPa)	Comments
0 0.25	0 15	3 43	1000 990	0.0% 0.1%	4705 4712	0.6 9.1	
0.5	31	85	979	0.3%	4720	18.1	
0.75 1	49 66	135 180	967 955	0.5% 0.7%	4728 4737	28.6 37.9	
1.5	86	233	930	1.0%	4754	48.9	
2 2.5	94 100	254 270	900 875	1.5% 1.8%	4776 4794	53.2 56.4	
3 3.5	97 80	262 217	847 815	2.3% 2.7%	4814 4837	54.5 44.8	
4	79	217	784	3.2%	4860	44.0	



FORM : Unconf SAFM 14-11 2.xls DATE: 3/3/2014

overnment c	of Alberta					
AFM						
0309815.04						
				SAMPLE:	C4	
H14-11				DEPTH :	16.0m	
ebruary 21, 2	2014			TECHNICIAN :	RGD	
DETERMINA	ATION	W	ATER CONTE	ENT	SAMF	PLE DESCRIPTION
	1663.5	Tare Numbe	er		Clayshale/Silts	stone, very strong
m)	152.1	Wt. Sample	(wet+tare) (g)	1462.3		
mm)	75.6	Wt. Sample	(dry+tare)(g)	1386.3		
(kN/m³)	23.9	Wt. Tare (g)		160		
(kN/m³)	22.5			6.2%		
DAD DATA			FAILURE DAT	ГА	F	AILURE MODE
		Load (Kg)		12265.0		
		% Strain :		N/A		
		Corrected ((MPa)	26.8		
Load Dial (0.0001")	Load (N)	Strain Dial (0.001")	Strain (%)	Area (mm²)	Q _U (kPa)	Comments
				4489		
		ole core was ca	pped and brok	ken in concrete b	reaker.	
	AFM 0309815.04 H14-11 ebruary 21, 2 DETERMIN/ n) mm) (kN/m ³) (kN/m ³) (kN/m ³) DAD DATA	D309815.04 H14-11 abruary 21, 2014 DETERMINATION 1663.5 n) 152.1 mm) 75.6 (kN/m ³) 23.9 (kN/m ³) 22.5 DAD DATA Load Dial (0.0001") Load (N)	AFM 0309815.04 H14-11 abruary 21, 2014 DETERMINATION W 1663.5 Tare Number n) 152.1 Wt. Sample mm) 75.6 Wt. Sample (kN/m³) 23.9 Wt. Tare (g) (kN/m³) 22.5 Water Conter 0AD DATA Load (Kg) % Strain : Corrected (Load Dial (0.0001") Load (N) Strain Dial (0.001") (0.001") ue to high strength of sample core was car	AFM 0309815.04 H14-11 abruary 21, 2014 DETERMINATION WATER CONTR 1663.5 Tare Number 1663.5 Tare Number 1663.5 Tare Number 1663.5 Tare Number (kN/m ³) 23.9 Wt. Sample (wet+tare) (g) Wt. Sample (dry+tare)(g) (kN/m ³) 23.9 Wt. Tare (g) (kN/m ³) 23.9 Wt. Tare (g) (kN/m ³) 22.5 Water Content (%) DAD DATA FAILURE DAT Load (Kg) % Strain : Corrected (MPa) Load Dial (0.0001") Load (N) Strain Dial (0.001") Strain (%) ue to high strength of sample core was capped and brok	AFM 0309815.04 SAMPLE: 114-11 DEPTH : 2bruary 21, 2014 TECHNICIAN : DETERMINATION WATER CONTENT 1663.5 Tare Number n) 152.1 Wt. Sample (wet+tare) (g) 1462.3 mm) 75.6 Wt. Sample (dry+tare)(g) 1386.3 (kN/m³) 23.9 Wt. Tare (g) 160 (kN/m³) 22.5 Water Content (%) 6.2% DAD DATA FAILURE DATA Load (Kg) 12265.0 % Strain : N/A Corrected (MPa) 26.8 Load Dial (0.001") Load (N) Strain Dial (0.001") Strain (%) Area (mm²) ue to high strength of sample core was capped and broken in concrete b	AFM 0309815.04 SAMPLE: C4 H14-11 DEPTH : 16.0m abruary 21, 2014 TECHNICIAN : RGD DETERMINATION WATER CONTENT SAMPLE 1663.5 Tare Number Clayshale/Silts n) 152.1 Wt. Sample (wet+tare) (g) 1462.3 (kN/m³) 23.9 Wt. Tare (g) 160 (kN/m³) 23.9 Wt. Tare (g) 160 (kN/m³) 22.5 Water Content (%) 6.2% DAD DATA FAILURE DATA FAILURE DATA Load (Kg) 12265.0 % Strain : N/A Corrected (MPa) 26.8 Load Dial (0.001") Load (N) Strain Dial (0.001") Strain (%) Area (mm²) Qu (kPa) ue to high strength of sample core was capped and broken in concrete breaker. Wetaker Wetaker Wetaker



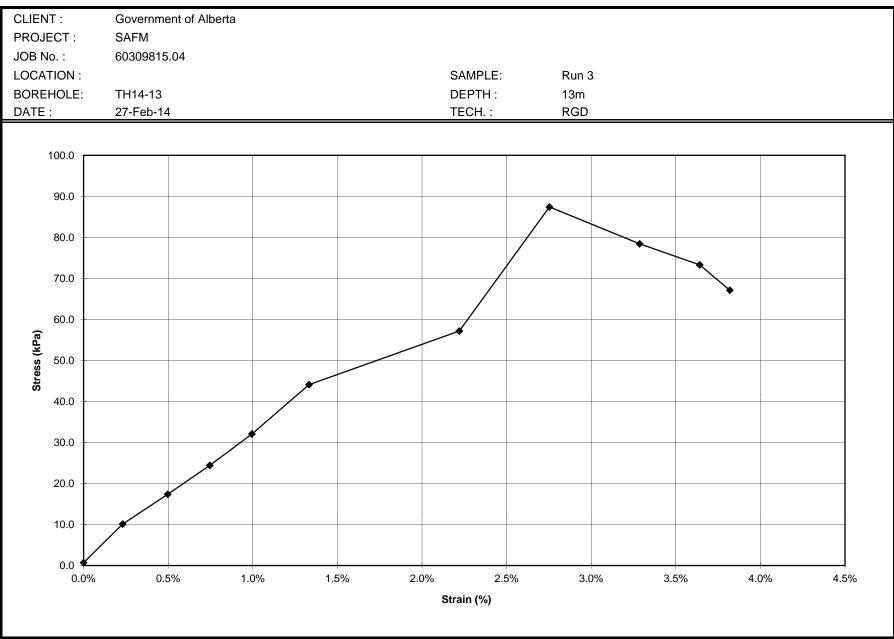
CLIENT : Go	vernment o	f Alberta					
PROJECT : SA	FM						
JOB No. : 603	309815.04						
LOCATION :					SAMPLE:	C1	
BOREHOLE: TH	14-13				DEPTH :	8.6m	
DATE : Feb	bruary 21, 2	2014			TECHNICIAN :	RGD	
DENSITY D	ETERMINA	TION	W	ATER CONTI	ENT		PLE DESCRIPTION
Wt. Sample (g)		1692.0	Tare Numbe	r		Clayshale/Silts	stone, very strong
Initial Length (mm		151.7		(wet+tare) (g)	1860.6		
Initial Diameter (m	-	75.7	Wt. Sample	(dry+tare)(g)	1786.5		
Wet Unit Weight (I		24.3	Wt. Tare (g)		233.1		
Dry Unit Weight (k		23.2	Water Conte		4.8%	_	
	AD DATA			FAILURE DA			AILURE MODE ite edge top to bottom
Ring #			Load (Kg)		12388	shear	
Gears Used			% Strain :		N/A		
Loading Rate			Corrected (MPa)	27.0		
	.oad Dial 0.0001")	Load (N)	Strain Dial (0.001")	Strain (%)	Area (mm²)	Q _∪ (kPa)	Comments
					4501		
	e to high str re failed at		e core was ca	pped and brol	ken in concrete b	reaker.	

Government of Alberta

CLIENT :

PROJECT :	SAFM						
	60309815.04						
LOCATION :					SAMPLE:	Run 3	
BOREHOLE:	TH14-13				DEPTH :	13m	
DATE :	February 27, 2	2014			TECHNICIAN :		
	Y DETERMIN		W	ATER CONTI			PLE DESCRIPTION
Wt. Sample (g		1351.9	Tare Numbe				/shale, mod weak to mod
Initial Length (143.0		(wet+tare) (g)	1457.2	strong	
Initial Diamete		73.6		(dry+tare)(g)	1294.4		
Wet Unit Weig		21.8	Wt. Tare (g)		164.5		
Dry Unit Weig		19.0	Water Conte		14.4%		
		10.0		FAILURE DA			AILURE MODE
Ring #		3491	Load (N)		382	45 ⁰ Starting at	
Gears Used		3491	% Strain :		2.8%		
Loading Rate		.055"/min	Corrected C) (kPa)	2.8% 87		
Louding Rate					01		
Time (min)	Load Dial (0.0001")	Load (N)	Strain Dial (0.001")	Strain (%)	Area (mm²)	Q _U (kPa)	Comments
0 0.25	0 15	3 43	1000 987	0.0% 0.2%	4254 4264	0.7 10.1	
0.5 0.75	27 38	74 105	972 958	0.5% 0.7%	4276 4286	17.4 24.4	
1	50	138	944	1.0%	4297	32.1	
1.5 2	70 92	190 249	925 875	1.3% 2.2%	4312 4351	44.1 57.2	
2.5	92 142	382	845	2.2%	4375	87.4	
3	128	345	815	3.3%	4399	78.4	
3.5 4	120 110	324 297	795 785	3.6% 3.8%	4415 4423	73.3 67.1	

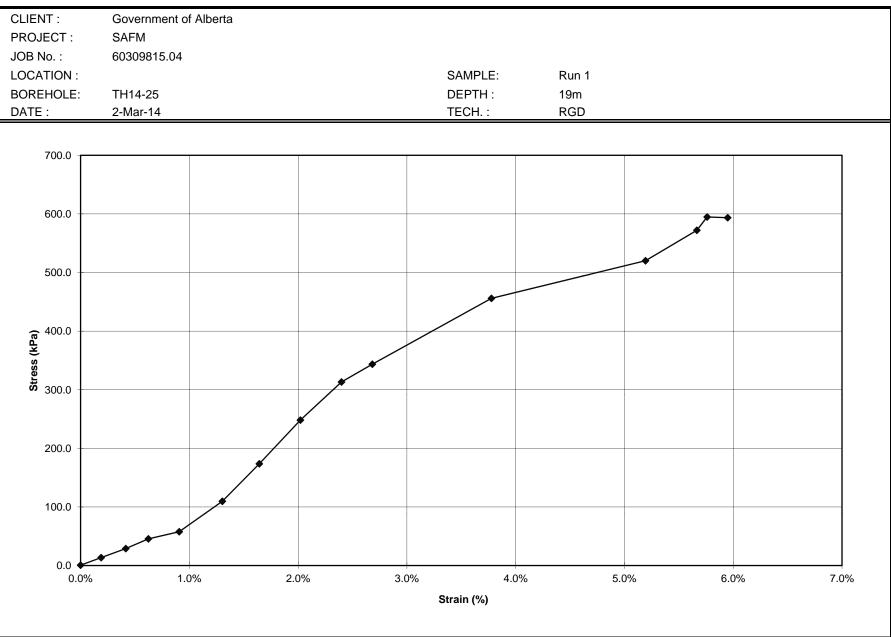




FORM : Unconf SAFM 14-13. 3.xls DATE: 3/3/2014



CLIENT :	Government of	of Alberta					
PROJECT :	SAFM						
JOB No. :	60309815.04						
LOCATION :					SAMPLE:	Run 1	
BOREHOLE:	TH14-25				DEPTH :	19m	
DATE :	March 2, 2014	1			TECHNICIAN :		
	Y DETERMIN		١٨	ATER CONT			PLE DESCRIPTION
Wt. Sample (g		1407.3	Tare Numbe				stone, olive grey, mod
Initial Length (134.5		(wet+tare) (g)	1546.6	strong to stron	
	-		-				
Initial Diamete		76.1		(dry+tare)(g)	1429.2		
Wet Unit Weig		22.6	Wt. Tare (g)	rat(0/)	207.7		
Dry Unit Weig		20.6	Water Conte		9.6%		
	LOAD DATA			FAILURE DA		F. Vertical cracki	
Ring #		3491	Load (N)		2870	V CITICAL CIACKI	''Y
Gears Used			% Strain :		5.8%		
Loading Rate	· · · · · · · · · · · · · · · · · · ·	.055"/min	Corrected C	≀ _∪ (kPa)	585	ļ	
Time (min)	Load Dial (0.0001")	Load (N)	Strain Dial (0.001")	Strain (%)	Area (mm²)	Q _U (kPa)	Comments
$\begin{array}{c} 0\\ 0.25\\ 0.5\\ 0.75\\ 1\\ 1.5\\ 2\\ 2.5\\ 3\\ 3.5\\ 4\\ 4.5\\ 5\\ 5.5\\ 5.8\\ \end{array}$	0 22 48 77 98 188 299 430 546 601 810 940 1043 1088 1088	3 62 132 209 265 505 803 1152 1460 1606 2155 2495 2758 2870 2870 2870	1000 990 978 967 952 931 913 893 873 858 800 725 700 695 685	0.0% 0.2% 0.4% 0.9% 1.3% 1.6% 2.0% 2.4% 2.7% 3.8% 5.2% 5.7% 5.8% 5.9%	4548 4557 4567 4577 4590 4608 4624 4642 4660 4674 4727 4798 4822 4826 4836	0.7 13.6 29.0 45.6 57.7 109.7 173.6 248.2 313.2 343.5 455.9 520.1 572.1 594.7 593.5	



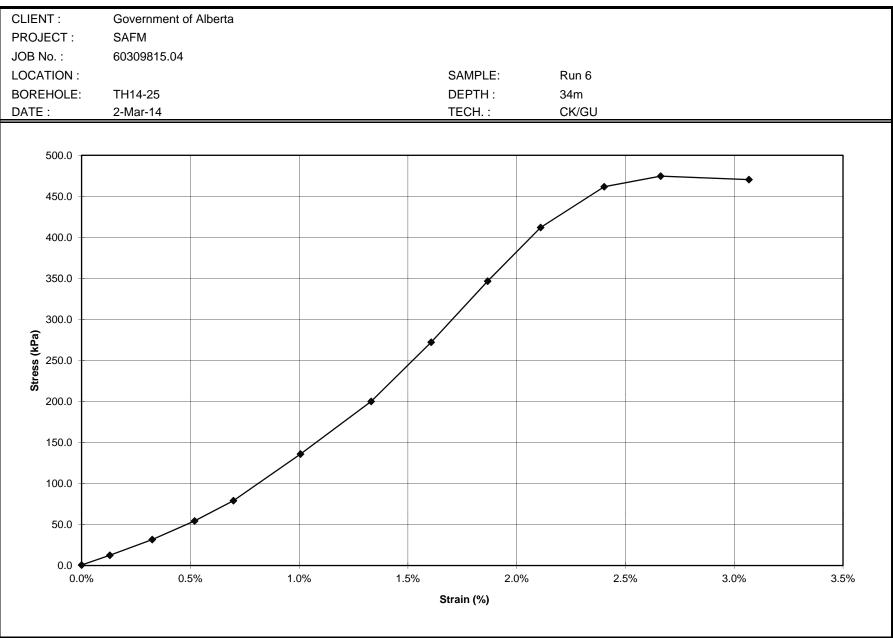
FORM : Unconf SAFM 14-25 1.xls DATE: 3/4/2014



CLIENT :	Government of	of Alberta					
PROJECT :	SAFM						
JOB No. :	60309815.04						
LOCATION :					SAMPLE:	Run 3	
BOREHOLE:	TH14-25				DEPTH :	26.8m	
	March 2, 2014	1			TECHNICIAN :		
	Y DETERMIN		١٨	ATER CONT			LE DESCRIPTION
		1734.9	Tare Numbe			Olive grey, cla	
Wt. Sample (g					1664.1		, ,
Initial Length (155.2	-	(wet+tare) (g)	1664.1		
Initial Diamete		75.9		(dry+tare)(g)	1595.3		
Wet Unit Weig		24.2	Wt. Tare (g)		223		
Dry Unit Weigl		23.1	Water Conte		5.0%		
	LOAD DATA			FAILURE DAT		F.	AILURE MODE
Ring #			Load (Kg)		6117		
Gears Used			% Strain :		N/A		
Loading Rate	[]		Corrected (MPa)	13.3		
Time (min)	Load Dial (0.0001")	Load (N)	Strain Dial (0.001")	Strain (%)	Area (mm²)	Q _∪ (kPa)	Comments
					4524.5		
	Due to high st		ple core was ca	pped and bro	ken in concrete b	reaker.	



PROJECT : JOB No. : LOCATION : BOREHOLE: DATE : DENSITY Wt. Sample (g) Initial Length (r Initial Diameter Wet Unit Weigh Dry Unit Weigh	March 2, 2014 Y DETERMIN/ mm) [•] (mm) nt (kN/m³)		Tare Numbe Wt. Sample Wt. Sample Wt. Tare (g) Water Conte	(wet+tare) (g) (dry+tare)(g) nt (%)		SAMF Claystone/clay	PLE DESCRIPTION /shale - top half, siltstone- mod strong to strong
JOB No. : LOCATION : BOREHOLE: DATE : Wt. Sample (g) Initial Length (r Initial Diameter Wet Unit Weigh Dry Unit Weigh	TH14-25 <u>March 2, 2014</u> <u>Y DETERMIN/</u> mm) · (mm) nt (kN/m ³) nt (kN/m ³)	ATION 1645.2 156.5 75.7 22.9 21.2	Tare Numbe Wt. Sample Wt. Sample Wt. Tare (g) Water Conte	r (wet+tare) (g) (dry+tare)(g) nt (%)	DEPTH : TECHNICIAN : ENT 1669.8 1560.8 207.7	34m CK/GU SAMF Claystone/clay	shale - top half, siltstone-
LOCATION : BOREHOLE: DATE : Wt. Sample (g) Initial Length (r Initial Diameter Wet Unit Weigh Dry Unit Weigh	March 2, 2014 Y DETERMIN/ mm) · (mm) nt (kN/m ³) nt (kN/m ³)	ATION 1645.2 156.5 75.7 22.9 21.2	Tare Numbe Wt. Sample Wt. Sample Wt. Tare (g) Water Conte	r (wet+tare) (g) (dry+tare)(g) nt (%)	DEPTH : TECHNICIAN : ENT 1669.8 1560.8 207.7	34m CK/GU SAMF Claystone/clay	shale - top half, siltstone-
BOREHOLE: DATE : DENSIT Wt. Sample (g) Initial Length (r Initial Diameter Wet Unit Weigh Dry Unit Weigh	March 2, 2014 Y DETERMIN/ mm) · (mm) nt (kN/m ³) nt (kN/m ³)	ATION 1645.2 156.5 75.7 22.9 21.2	Tare Numbe Wt. Sample Wt. Sample Wt. Tare (g) Water Conte	r (wet+tare) (g) (dry+tare)(g) nt (%)	DEPTH : TECHNICIAN : ENT 1669.8 1560.8 207.7	34m CK/GU SAMF Claystone/clay	shale - top half, siltstone-
DATE : DENSIT Wt. Sample (g) Initial Length (r Initial Diameter Wet Unit Weigh Dry Unit Weigh	March 2, 2014 Y DETERMIN/ mm) · (mm) nt (kN/m ³) nt (kN/m ³)	ATION 1645.2 156.5 75.7 22.9 21.2	Tare Numbe Wt. Sample Wt. Sample Wt. Tare (g) Water Conte	r (wet+tare) (g) (dry+tare)(g) nt (%)	TECHNICIAN : ENT 1669.8 1560.8 207.7	CK/GU SAMF Claystone/clay	shale - top half, siltstone-
DENSIT Wt. Sample (g) Initial Length (r Initial Diameter Wet Unit Weigh Dry Unit Weigh	Y DETERMINA nm) · (mm) nt (kN/m³) nt (kN/m³)	ATION 1645.2 156.5 75.7 22.9 21.2	Tare Numbe Wt. Sample Wt. Sample Wt. Tare (g) Water Conte	r (wet+tare) (g) (dry+tare)(g) nt (%)	ENT 1669.8 1560.8 207.7	SAMF Claystone/clay	shale - top half, siltstone-
Wt. Sample (g) Initial Length (r Initial Diameter Wet Unit Weigh Dry Unit Weigh	nm) · (mm) nt (kN/m³) nt (kN/m³)	1645.2 156.5 75.7 22.9 21.2	Tare Numbe Wt. Sample Wt. Sample Wt. Tare (g) Water Conte	r (wet+tare) (g) (dry+tare)(g) nt (%)	1669.8 1560.8 207.7	Claystone/clay	shale - top half, siltstone-
Initial Length (r Initial Diameter Wet Unit Weigl Dry Unit Weigh	mm) [·] (mm) nt (kN/m³) nt (kN/m³)	156.5 75.7 22.9 21.2	Wt. Sample (Wt. Sample (Wt. Tare (g) Water Conte	(wet+tare) (g) (dry+tare)(g) nt (%)	1560.8 207.7		•
Initial Diameter Wet Unit Weigh Dry Unit Weigh	(mm) nt (kN/m³) nt (kN/m³)	75.7 22.9 21.2	Wt. Sample Wt. Tare (g) Water Conte	(dry+tare)(g) nt (%)	1560.8 207.7		
Wet Unit Weigh Dry Unit Weigh	nt (kN/m³) nt (kN/m³)	22.9 21.2	Wt. Tare (g) Water Conte	nt (%)	207.7		
Dry Unit Weigh	nt (kN/m³)	21.2	Water Conte				
L							
	<u>-OAD DATA</u>	3491				<u> </u>	
D' //		3491	Load (N)	FAILURE DAT			AILURE MODE
Ring #					2195	Vertical crackii between types	ng, horizontal crack
Gears Used			% Strain :		2.7%	Sourcon types	or matorial
Loading Rate		.055"/min	Corrected Q	≀ _∪ (kPa)	475		
Time (min)	Load Dial (0.0001")	Load (N)	Strain Dial (0.001")	Strain (%)	Area (mm²)	Q _U (kPa)	Comments
$\begin{array}{c} 0\\ 0.25\\ 0.5\\ 0.75\\ 1\\ 1.5\\ 2\\ 2.5\\ 3\\ 3.5\\ 4\\ 4.5\\ 5\end{array}$	0 20 52 91 133 230 340 465 595 710 800 825 821	3 56 143 246 358 618 912 1245 1590 1894 2129 2195 2184	1000 992 980 968 957 938 918 901 885 870 852 836 811	0.0% 0.1% 0.3% 0.5% 0.7% 1.0% 1.3% 1.6% 1.9% 2.1% 2.4% 2.7% 3.1%	4501 4507 4515 4524 4532 4546 4561 4574 4586 4598 4611 4624 4643	0.7 12.5 31.7 54.4 79.1 135.9 200.0 272.2 346.6 412.0 461.7 474.6 470.4	



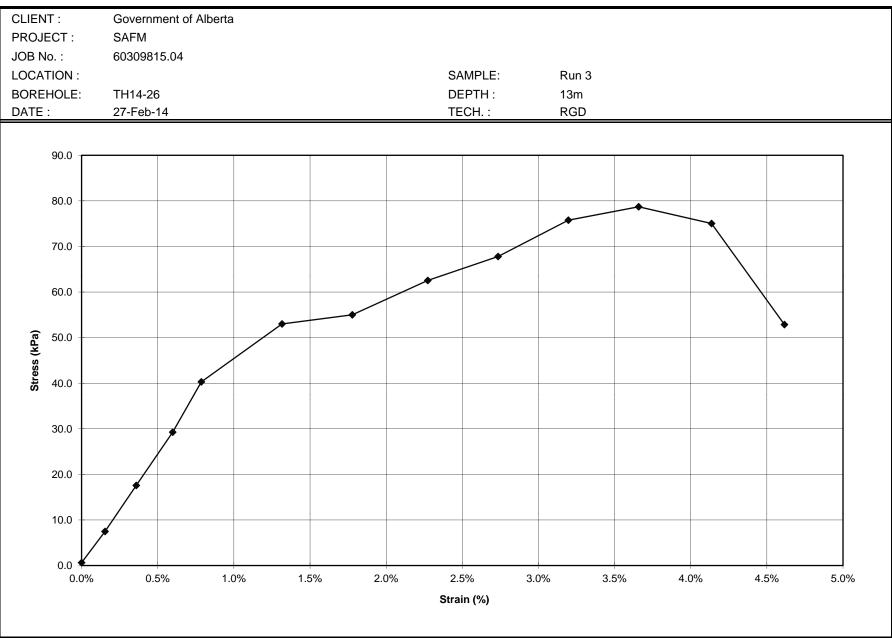
FORM : Unconf SAFM 14-25 6.xls DATE: 3/4/2014



CLIENT : Govern	ment of Alberta					
PROJECT : SAFM	Home of Alberta					
JOB No. : 603098	15 04					
LOCATION :				SAMPLE:	Run 1	
BOREHOLE: TH14-2	3			DEPTH :	8.5m	
	y 27, 2014			TECHNICIAN :		
DENSITY DETE		١٨	ATER CONTI			PLE DESCRIPTION
Wt. Sample (g)	1554.9	Tare Numbe				y shale, very weak
Initial Length (mm)	152.7		(wet+tare) (g)	1796.3	-	
Initial Diameter (mm)	76.4		(dry+tare)(g)	1589.7		
Wet Unit Weight (kN/m		Wt. Tare (g)		250.8		
Dry Unit Weight (kN/m		Water Conte		15.4%		
LOAD D			FAILURE DA		E/	AILURE MODE
Ring #		Load (Kg)		395	Vertical Cracks	
Gears Used		% Strain :		N/A		
Loading Rate		Corrected ((MPa)	0.84		
Time (min) Load		Strain Dial (0.001")	Strain (%)	Area (mm²)	Q _U (kPa)	Comments
(,	()		4584		
	nigh strength of sam led at 395 kg.	ble core was ca	pped and brol	ken in concrete b	reaker.	



CLIENT :	Government of	of Alberta					
PROJECT :	SAFM						
JOB No. :	60309815.04						
LOCATION :					SAMPLE:	Run 3	
BOREHOLE:	TH14-26				DEPTH :	13m	
DATE :	February 27, 2	2014			TECHNICIAN :	RGD	
	Y DETERMIN		W	ATER CONTI			PLE DESCRIPTION
Wt. Sample (g		1510.0	Tare Numbe				rey clayshale/Claystone,
Initial Length (148.6		(wet+tare) (g)	1476.2	mod strong	
	-	77.2	-		1325.7		
Initial Diamete				(dry+tare)(g)			
Wet Unit Weig		21.3	Wt. Tare (g)		156.7		
Dry Unit Weigl		18.9	Water Conte		12.9%		
	LOAD DATA			FAILURE DA		F. Cracking on to	
Ring #		3491	Load (N)		382		p so badiy
Gears Used			% Strain :		3.7%		
Loading Rate		.055"/min	Corrected C	ג _∪ (kPa)	78		
Time (min)	Load Dial (0.0001")	Load (N)	Strain Dial (0.001")	Strain (%)	Area (mm²)	Q _U (kPa)	Comments
$\begin{array}{c} 0\\ 0.25\\ 0.5\\ 0.75\\ 1\\ 1.5\\ 2\\ 2.5\\ 3\\ 3.5\\ 4\\ 4.5\\ 5\end{array}$	0 12 30 50 70 93 97 111 121 136 142 136 96	3 35 83 138 190 251 262 300 326 366 382 366 259	1000 991 979 965 954 923 896 867 840 813 786 758 730	0.0% 0.2% 0.4% 0.8% 1.3% 1.8% 2.3% 2.7% 3.2% 3.7% 4.1% 4.6%	4681 4688 4698 4709 4718 4743 4766 4790 4812 4835 4859 4883 4907	0.6 7.5 17.6 29.3 40.3 53.0 55.0 62.5 67.8 75.8 78.7 75.0 52.9	



FORM : Unconf SAFM 14-26. 3.xls DATE: 3/3/2014

	2						
CLIENT :	Government o	of Alberta					
PROJECT :	SAFM						
JOB No. :	60309815.04						
LOCATION :					SAMPLE:	Run 1	
BOREHOLE:	TH14-27				DEPTH :	6.2m	
DATE :	February 27, 2	2014			TECHNICIAN :	RGD	
DENSIT	Y DETERMIN	ATION	W	ATER CONTE	ENT	SAM	PLE DESCRIPTION
Wt. Sample (g)	1675.8	Tare Numbe	r			yshale/Claystone, med
Initial Length (mm)	165.5	Wt. Sample	(wet+tare) (g)	1828.8	strong	
Initial Diamete	-	77.4	Wt. Sample		1594		
Wet Unit Weig		21.1	Wt. Tare (g)	(-)	156.7		
Dry Unit Weigl		18.1	Water Conte	ent (%)	16.3%		
	LOAD DATA	1011		FAILURE DAT		F	AILURE MODE
Ring #		3491	Load (N)		1892		centre of bottom
Gears Used		5451	% Strain :		9.3%		
Loading Rate		.055"/min) (kPa)	9.3% 365		
		.000 /11111	Corrected C	u (κι α)	300		
Time (min)	Load Dial (0.0001")	Load (N)	Strain Dial (0.001")	Strain (%)	Area (mm²)	Q _U (kPa)	Comments
0 0.25	0	3 54	1000	0.0% 0.2%	4705	0.6	
0.25	19 48	54 132	989 976	0.2%	4713 4723	11.4 28.0	
0.75	85	230	960	0.6%	4734	48.6	
1 1.5	108 161	292 433	949 925	0.8% 1.2%	4742 4760	61.5 91.0	
2	212	570	900	1.5%	4778	119.2	
2.5	262	704	875	1.9%	4797	146.7	
3 3.5	307 350	824 939	854 830	2.2% 2.6%	4813 4831	171.3 194.4	
4	392	1051	804	3.0%	4851	216.7	
4.5 5	429 465	1149 1245	779 752	3.4% 3.8%	4870 4891	236.0 254.5	
5.5	491	1314	725	4.2%	4912	267.5	
6	525	1404	705	4.5%	4928	284.9	
6.5 7	550 575	1470 1537	685 650	4.8% 5.4%	4944 4972	297.4 309.0	
7.5	594	1587	628	5.7%	4990	318.0	
8 8.5	615 632	1643 1688	598 570	6.2% 6.6%	5015 5038	327.6 335.0	
9	651	1738	555	6.8%	5050	344.2	
9.5	664	1773	525	7.3%	5075	349.3	
10 10.5	680 690	1815 1842	505 487	7.6% 7.9%	5092 5107	356.5 360.6	
11	700	1868	450	8.4%	5139	363.5	
11.5	705	1881	420	8.9%	5165	364.2	
12 12.5	709 705	1892 1881	395 365	9.3% 9.7%	5187 5213	364.7 360.9	
13	700	1868	330	10.3%	5244	356.2	
						1	

CLIENT : Government of Alberta PROJECT : SAFM JOB No. : 60309815.04 LOCATION : SAMPLE: Run 1 DEPTH : 6.2m BOREHOLE: TH14-27 RGD DATE : 27-Feb-14 TECH. : 400.0 350.0 300.0 250.0 **Stress (kPa)** 50000 150.0 100.0 50.0 0.0 0.0% 2.0% 4.0% 6.0% 8.0% 10.0% 12.0% Strain (%)

FORM : Unconf SAFM 14-27 1.xls DATE: 3/3/2014

Government o	of Alberta					
SAFM						
60309815.04						
				SAMPLE:	C2	
TH14-27				DEPTH :	10.5m	
February 26, 2	2014			TECHNICIAN :	RGD	
Y DETERMIN	ATION	W	ATER CONTE	ENT	SAMF	LE DESCRIPTION
)	1706.4	Tare Numbe	er		Clayshale/clay	stone, very strong
mm)	154.5	Wt. Sample	(wet+tare) (g)	1797.9		
er (mm)	76.3	Wt. Sample	(dry+tare)(g)	1718.2		
ht (kN/m³)	23.7	Wt. Tare (g)		251.9		
ht (kN/m³)	22.5	Water Conte	ent (%)	5.4%		
LOAD DATA			FAILURE DAT	Ā	F	AILURE MODE
		Load (Kg)		4619		
		% Strain :		N/A		
		Corrected ((MPa)	9.9		
Load Dial (0.0001")	Load (N)	Strain Dial (0.001")	Strain (%)	Area (mm²)	Q _U (kPa)	Comments
				4572.3		
		ole core was ca	pped and brok	ken in concrete b	reaker.	
	SAFM 60309815.04 TH14-27 February 26, 2 Y DETERMIN) mm) er (mm) pht (kN/m ³) ht (kN/m ³) LOAD DATA LOAD DATA	60309815.04 TH14-27 February 26, 2014 Y DETERMINATION i) 1706.4 imm) 154.5 ir (mm) 76.3 ipht (kN/m³) 23.7 ht (kN/m³) 22.5 LOAD DATA	SAFM 60309815.04 TH14-27 February 26, 2014 TY DETERMINATION W 1) 1706.4 Tare Number mm) 154.5 Wt. Sample or (mm) 76.3 Wt. Sample or (mm) 76.3 Wt. Sample or (mm) 23.7 Wt. Tare (g) ht (kN/m³) 23.7 Wt. Tare (g) ht (kN/m³) 22.5 Water Conter LOAD DATA Load (Kg) % Strain : Corrected (g) Load Dial (0.0001") Load (N) Strain Dial (0.001") Due to high strength of sample core was car	SAFM 60309815.04 TH14-27 February 26, 2014 TOTERMINATION WATER CONTER (Marcold Marcold Ma	SAFM 60309815.04 SAMPLE: TH14-27 DEPTH : February 26, 2014 TECHNICIAN : Y DETERMINATION WATER CONTENT Y DETERMINATION WX Sample (wet+tare) (g) 1797.9 Y MT (MM) Y Sample (dry+tare)(g) 1718.2 Y (MK)/m3) 23.7 Wt. Sample (dry+tare)(g) 1718.2 Y MATER CONTENT Y MATER CONTENT 251.9 Y (KN/m3) 22.5 Water Content (%) 5.4% LOAD DATA FAILURE DATA Load (Kg) 4619 % % Strain : N/A Orrected (MPa) 9.9 Load Dial (0.001") Load (N) Strain Dial (0.001") Strain (%) Area (mm2) Due to high strength of sample core was capped and broken in concrete b Mater Concreted in the point of sample core was capped and broken in concrete b	SAFM 60309815.04 TH14-27 SAMPLE: C2 TB14-27 DEPTH: 10.5m February 26, 2014 TECHNICIAN: RGD Y DETERMINATION WATER CONTENT SAMPL Y DETERMINATION Tare Number Clayshale/clay Y DETERMINATION Y Y Sample (dry+tare) (g) 1718.2 Y Mt. KN/m³) 23.7 Wt. Sample (dry+tare) (g) 1718.2 F/ LOAD DATA FAILURE DATA F/ F/ Load (Kg) 4619 9.9 9.9 1 Load Dial (0.001") Load (M) Strain Dial (0.001") Strain (%) Area (mm²) Qu (kPa) 1



Government of	of Alberta					
SAFM						
60309815.04						
				SAMPLE:	Run 1	
TH14-07				DEPTH :	9.4m	
March 2, 2014	4			TECHNICIAN :	RGD	
Y DETERMIN	ATION	W	ATER CONTE	ENT		PLE DESCRIPTION
a)	1321.1	Tare Numbe	r		Clayshale/clay	stone, strong
(mm)	125.0	Wt. Sample	(wet+tare) (g)	1394.2		
	75.5		(dry+tare)(g)			
		-	(- · · ·			
	22.0				_	
LOAD DATA			FAILURE DAT		F/	AILURE MODE
		-				
			MPa)			
				J. <i>1</i>	 	
	Load (N)		Strain (%)	Area (mm²)	Q _U (kPa)	Comments
,		, ,		4477.0		
		ole core was ca	pped and brok	ken in concrete b	oreaker.	
	SAFM 60309815.04 TH14-07 March 2, 2014 TY DETERMIN (mm) er (mm) ght (kN/m ³) ht (kN/m ³) LOAD DATA	60309815.04 TH14-07 March 2, 2014 TY DETERMINATION g) 1321.1 (mm) 125.0 or (mm) 75.5 ght (kN/m³) 23.2 ht (kN/m³) 22.0 LOAD DATA Load Dial (0.0001") Load (N) Due to high strength of same	SAFM 60309815.04 TH14-07 March 2, 2014 TY DETERMINATION W g) 1321.1 Tare Number (mm) 125.0 Wt. Sample er (mm) 75.5 Wt. Sample er (mm) 75.5 Wt. Sample ght (kN/m³) 23.2 Wt. Tare (g) ht (kN/m³) 23.2 Wt. Tare (g) Water Conter LOAD DATA Load (Kg) % Strain : Corrected (Load Dial (0.001") Load (N) Strain Dial (0.001") Due to high strength of sample core was car	SAFM 60309815.04 TH14-07 March 2, 2014 TY DETERMINATION WATER CONTE g) 1321.1 Tare Number (mm) 125.0 Wt. Sample (wet+tare) (g) er (mm) 75.5 Wt. Sample (dry+tare)(g) er (mm) 75.5 Wt. Sample (dry+tare)(g) ght (kN/m³) 23.2 Wt. Tare (g) ht (kN/m³) 22.0 Water Content (%) LOAD DATA FAILURE DAT Load (Kg) % Strain : Corrected (MPa) Load Dial (0.001") Load (N) Strain Dial (0.001") Strain (%) Due to high strength of sample core was capped and brok	SAFM 60309815.04 SAMPLE: TH14-07 DEPTH : March 2, 2014 TECHNICIAN : TY DETERMINATION WATER CONTENT g) 1321.1 Tare Number 1394.2 (mm) 125.0 Wt. Sample (wet+tare) (g) 1394.2 er (mm) 75.5 Wt. Sample (dry+tare)(g) 1334.1 ght (kN/m³) 23.2 Wt. Tare (g) 156.7 ht (kN/m³) 22.0 Water Content (%) 5.1% LOAD DATA FAILURE DATA LOad (Kg) 2602 % Strain : N/A Corrected (MPa) 5.7 Load Dial (0.0001") Load (N) Strain Dial (0.001") Area (mm²) Due to high strength of sample core was capped and broken in concrete b March 2, 200	SAFM 60309815.04 TH14-07 SAMPLE: Run 1 March 2, 2014 DEPTH : 9.4m TY DETERMINATION WATER CONTENT SAMPLE: g) 1321.1 Tare Number Clayshale/clay gmm) 125.0 Wt. Sample (wet+tare) (g) 1394.2 er (mm) 75.5 Wt. Sample (dry+tare)(g) 1334.1 ght (kN/m³) 23.2 Wt. Tare (g) 156.7 ht (kN/m³) 22.0 Water Content (%) 5.1% LOAD DATA FAILURE DATA FAILURE DATA Load (Kg) 2602 % Strain : N/A Corrected (MPa) 5.7 Tare (mm²) Q _U (kPa) Load Dial Load (N) Strain Dial Strain (%) Area (mm²) Q _U (kPa) Due to high strength of sample core was capped and broken in concrete breaker. Due to high strength of sample core was capped and broken in concrete breaker.



001011110111	of Alberta					
SAFM						
60309815.04						
				SAMPLE:	Run 3	
					16m	
	1					
		W	ATER CONTI			LE DESCRIPTION
						rey clayshale/claystone,
				1695.3	very strong	
		-				
	20.0	-				AILURE MODE
LUAD DATA			I AILUKE DA		Г <i>і</i>	
		-				
			(1VIF a)	9.0	 	
Load Dial (0.0001")	Load (N)	Strain Dial (0.001")	Strain (%)	Area (mm²)	Q _∪ (kPa)	Comments
				4512.6		
		ole core was ca	pped and brol	ken in concrete b	reaker.	
	60309815.04 TH14-7 March 2, 2014 TY DETERMIN/ g) (mm) er (mm) ght (kN/m ³) LOAD DATA LOAD DATA	60309815.04 TH14-7 March 2, 2014 TY DETERMINATION g) 1758.9 (mm) 156.0 er (mm) 75.8 ght (kN/m³) 24.5 ght (kN/m³) 23.6 LOAD DATA e Due to high strength of same	60309815.04 TH14-7 March 2, 2014 TY DETERMINATION g) 1758.9 (mm) 156.0 wt. Sample er (mm) 75.8 ght (kN/m³) 24.5 Mater Conte LOAD DATA Load (Kg) % Strain : Corrected (0, 0001") Load (N) Strain Dial (0.001") Load (N) Due to high strength of sample core was call	60309815.04 TH14-7 March 2, 2014 TY DETERMINATION WATER CONTR g) 1758.9 Tare Number (mm) 156.0 Wt. Sample (wet+tare) (g) er (mm) 75.8 Wt. Sample (dry+tare)(g) ght (kN/m³) 24.5 Wt. Tare (g) ght (kN/m³) 23.6 Water Content (%) LOAD DATA FAILURE DAT Load (Kg) % Strain : Corrected (MPa) Load Dial Load (N) Strain Dial Strain (%) Due to high strength of sample core was capped and broke Dote to high strength of sample core was capped and broke	60309815.04 SAMPLE: TH14-7 DEPTH : March 2, 2014 TECHNICIAN : TY DETERMINATION WATER CONTENT g) 1758.9 (mm) 156.0 Wt. Sample (wet+tare) (g) 1695.3 er (mm) 75.8 ght (kN/m³) 24.5 Wt. Sample (dry+tare)(g) 1635.8 ght (kN/m³) 23.6 Water Content (%) 4.0% LOAD DATA FAILURE DATA Load Data Load (Kg) 4415 % Strain : 0.0% corrected (MPa) 9.6 Load Dial (0.0001") Load (N) Strain Dial (0.001") Area (mm²) Due to high strength of sample core was capped and broken in concrete b Area (mm²)	60309815.04 SAMPLE: Run 3 TH14-7 DEPTH : 16m March 2, 2014 TECHNICIAN : RGD TY DETERMINATION WATER CONTENT SAMPLE: g) 1758.9 Tare Number Olive to med g (mm) 156.0 Wt. Sample (wet+tare) (g) 1695.3 er (mm) 75.8 Wt. Sample (dry+tare)(g) 1635.8 ght (kN/m³) 24.5 Wt. Tare (g) 159.1 ght (kN/m³) 23.6 Water Content (%) 4.0% LOAD DATA FAILURE DATA FAILURE DATA Load (Kg) 4415 % Strain : 0.0% corrected (MPa) 9.6 0.0% 0.0% 0.0% but to high strength of sample core was capped and broken in concrete breaker. Due to high strength of sample core was capped and broken in concrete breaker.



Government of	of Alberta					
SAFM						
60309815.04						
				SAMPLE:	Run 6	
TH14-7					25m	
	4					
		۱۸ ۱۸	ATER CONTI			PLE DESCRIPTION
				1536.2		
	20.1					AILURE MODE
LUAD DATA			I AILUKE DA		Г. Г.	
			(MPa)			
				30.7		
Load Dial (0.0001")	Load (N)	Strain Dial (0.001")	Strain (%)	Area (mm²)	Q _U (kPa)	Comments
				4441.5		
		ole core was ca	pped and brol	ken in concrete b	reaker.	
	SAFM 60309815.04 TH14-7 March 2, 2014 TY DETERMIN. g) (mm) er (mm) ght (kN/m³) LOAD DATA LOAD DATA	60309815.04 TH14-7 March 2, 2014 TY DETERMINATION g) 1498.5 (mm) 137.1 er (mm) 75.2 ght (kN/m³) 24.1 ght (kN/m³) 23.1 LOAD DATA b Load Dial (0.0001") Load (N)	SAFM 60309815.04 TH14-7 March 2, 2014 TY DETERMINATION W g) 1498.5 Tare Number (mm) 137.1 Wt. Sample er (mm) 75.2 Wt. Sample ght (kN/m³) 24.1 Wt. Tare (g) ght (kN/m³) 23.1 Water Conter LOAD DATA LOAD DATA Load (Kg) % Strain : Corrected (Load Dial (0.0001") Load (N) Strain Dial (0.001") Due to high strength of sample core was ca	SAFM 60309815.04 TH14-7 March 2, 2014 TY DETERMINATION WATER CONTE g) 1498.5 (mm) 137.1 Wt. Sample (wet+tare) (g) er (mm) 75.2 Wt. Sample (dry+tare)(g) ght (kN/m³) 24.1 Wt. Tare (g) ght (kN/m³) 23.1 Water Content (%) LOAD DATA FAILURE DAT Load (Kg) % Strain : corrected (MPa) Load Dial (0.0001") Load (N) Strain Dial (0.001") Strain (%) Due to high strength of sample core was capped and brok	SAFM 60309815.04 SAMPLE: TH14-7 DEPTH : March 2, 2014 TECHNICIAN : TY DETERMINATION WATER CONTENT g) 1498.5 (mm) 137.1 Wt. Sample (wet+tare) (g) 1536.2 er (mm) 75.2 Wt. Sample (dry+tare)(g) 1478 ght (kN/m³) 24.1 Wt. Tare (g) 155.5 ght (kN/m³) 23.1 Water Content (%) 4.4% LOAD DATA FAILURE DATA Load (Kg) 14053 % Strain : N/A Corrected (MPa) 30.7 Load Dial (0.0001") Load (N) Strain Dial (0.001") Area (mm²) Due to high strength of sample core was capped and broken in concrete b At441.5	SAFM 60309815.04 SAMPLE: Run 6 TH14-7 DEPTH : 25m March 2, 2014 TECHNICIAN : RGD TY DETERMINATION WATER CONTENT SAMPLE: g) 1498.5 Tare Number Siltstone, very (mm) 137.1 Wt. Sample (wet+tare) (g) 1536.2 er (mm) 75.2 Wt. Sample (dry+tare)(g) 1478 ght (kN/m³) 24.1 Wt. Tare (g) 155.5 ght (kN/m³) 23.1 Water Content (%) 4.4% LOAD DATA FAILURE DATA F Load (Kg) 14053 % Strain : N/A Corrected (MPa) 30.7 Corrected (MPa) 30.7 Load Dial (0.001") Load (N) Strain Dial (0.001") Strain (%) Area (mm²) Q _U (kPa) Due to high strength of sample core was capped and broken in concrete breaker. Evaluation of the sample core was capped and broken in concrete breaker.

Appendix N4

Slope Stability Analysis Results

