AREA STRUCTURE PLAN
STAFFORD LANDING
A RESIDENTIAL SUBDIVISION
IN
Portion of NE 14-009-19-W4 &
Portion of SE 14-009-19-W4
Plan 1014991 Block 1 Lot 4
LETHBRIDGE COUNTY, AB
Bylaw 1496



Submitted by:

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1 VISION

The Stafford Landing Area Structure Plan has been developed through rigorous planning and careful consideration of the needs of a diverse group of stakeholders. The focus in developing this plan was to put forward a development proposal which would minimize the impact on area infrastructure, ensure a good fit with adjacent land uses, protect and preserve the natural environment including the Stafford Reservoir, and ultimately provide Lethbridge County with a cost-effective model for future acreage development.

Stafford Landing is a country residential development proposed to be sited adjacent to the northwest corner of Stafford Reservoir. This 29-lot subdivision will be situated so residents can benefit from low density country residential lifestyle as well as benefit from one of the best known recreational areas in Southern Alberta. The goal of this development is to create an environment where residents can enjoy the peace and quiet of country residential living, benefit from living adjacent to Stafford Reservoir but can have easy and convenient access to the municipalities of Coaldale and Lethbridge. Key to achieving this goal is sizing the lots to a 2-acre minimum to allow for the low density feeling of the area. This lower density also minimizes the environmental impact and gives a feel of integrating into the natural environment.

In addition, the planning of the development was purposely kept at low density to match the existing development to the southeast. Maintaining similar density allows for expansion of development in the area without changing the feel that country residential exudes. By directing traffic into the site from the North, existing residents will see only a minimal increase in traffic from the additional lots. Providing a fully paved internal road will likewise satisfy area residents need to minimize dust from the new development.

Lethbridge and the surrounding community have deep agricultural roots and there is a strong cultural trend to embrace rural and farm living. However, there is still a desire to access amenities located in Lethbridge and other surrounding communities. As such there is a large demand for the feel of country living but still able to access the urban areas. In addition, Stafford Reservoir offers lake based recreation. This combination of recreational activities and country residential living is a rare market opportunity.

As with any development there are numerous challenges and opportunities. The opportunity is to provide a unique living experience to the residents of the County that is rare in southern Alberta; lakeside country residential living close to the City of Lethbridge. Key challenges to this development are identified and ultimately addressed in the remainder of this document.

Overall, the development concept acknowledges and seeks to positively integrate with the existing natural and built conditions in the area while successfully offering a diverse range of housing opportunities to satisfy a broad demand for country residency. The proposal and plan has been designed to:

- Offer a new high-quality rural residential area to Lethbridge County residents;
- Be compatible and complimentary with existing adjacent county residential acreages who similarly enjoy the envious location;
- Create a desirable rural community neighborhood to live, play and raise families in a country rural lifestyle;

- Respect the natural agricultural and coulee landscape, and adjacent reservoir through good design practices and a well- managed development;
- Create a new residential housing development for the county, that will add to the residential tax base, while being developed to limit as much as possible any on-going servicing costs to the municipality; and
- Create a high-quality housing development in an area that the County has identified in its MDP, as an area that is recognized and encouraged as suitable for such proposals.

2 INTRODUCTION

This Area Structure Plan has been prepared by Hasegawa Engineering Ltd. on behalf of Stafford Developments to describe the development concept and municipal servicing strategy to be provided for the proposed Stafford Landing development. The site lies at the northeast corner of Stafford Reservoir on the eastern edge of Lethbridge County. (Figure 1) The Area Structure Plan describes the ultimate development of the subject lands, which are contained within an existing parcel which lies in the E ½ of Section 14, Range 9, Township 19, west of the 4th Meridian, Plan 1014991 Block 1 Lot 4 (Figure 2).

As the development is intended to have more than five lots, an Area Structure Plan is required under Section 6.2 of the Municipal Development Plan of Lethbridge County.

This Area Structure Plan is submitted as support for the application to adopt the Plan as a By-Law of Lethbridge County and the subsequent change to the Land Use By-Law. The Area Structure Plan will provide a basis for evaluation of future applications for subdivision of parcels and building development.

3 PLANS, DRAWINGS, AND CONCEPT

3.1 PLANS AND DRAWINGS

To illustrate the location of the property, site drainage, and the proposed subdivision layout, seven figures have been prepared. The figures are provided in *Appendix A* and are as follows:

- Figure 1 - Area Map
- Figure 2 - Rezoning Map
- Figure 3 - Tentative Lot Layout
- Figure 4 - North to South Plan and Profile
- Figure 5 - West to East Plan and Profile 1
- Figure 6 - West to East Plan and Profile 2
- Figure 7 - Entrance Detail

These plans are conceptual in nature and are to be used for planning purposes only. Upon ASP acceptance, detailed design plans will be prepared and submitted with any subdivision application.

3.2 EXISTING CONDITIONS

The proposal is designed with the existing conditions of the land in mind. The impact on adjacent landowners and residents was carefully considered in the preparation of the plan.

The lands within the boundaries of the proposed Area Structure Plan are currently used as cultivated land (irrigated and non-irrigated) or lie in a natural state. Adjacent land owners include:

- To the west lie agricultural lands under irrigation owned by a single landowner who happens to be one of the owners of this development.
- To the east lie reservoir lands owned by the St. Mary River Irrigation District, who have been consulted as part of the development of the plan.
- To the south east lies an existing cluster of acreages. The plan calls for development of the same size and standard (at a minimum) as what exists currently. Additionally, traffic flows are directed to the north of the plan area, away from the existing residents.
- Developed roads with the road allowances lie to the north and south.

An existing active sweet gas well is in the neighboring property to the west, adjacent to the northwest corner of the development. Even though this well is not within the subject property, the 100 m active well setback required by provincial government regulations has been incorporated into the design.

The boundary of the proposed Area Structure Plan is the boundary of the single parcel containing the lands to be developed.

3.3 DEVELOPMENT OBJECTIVES

Preferred Development Concept

The preferred development concept appears in Figure 3. Note that the lot layouts are tentative and may vary slightly due to design considerations. The ultimate development will create approximately 24 ha (60 acres) of net developable area. The remainder of the land is dedicated to roads, utility lots for stormwater detention ponds, and open areas.

Lot sizes will be a minimum of 0.8 ha (2 acres) in size. Some lots will be slightly larger. The result is a proposed 29 lot development.

Two phases of development are proposed with the northern 14 lots being developed first and the remaining lots in Phase 2.

The southern three lots will have access to the existing road in the southeast which serves the existing neighboring country residential area. They will benefit from the new stormwater pond yet will not be part of the larger development area. These lots will be developed in Phase 2 or after.

Bare Land Condo Development

It is proposed that the development be a bare land condo type of development with the exception of the southern three lots (lots south of Stormwater Pond 2). A bare land condo development is one where the boundaries of the condo units are the boundaries of each individual lot. Roads, utility lots and other open areas are common elements of the development. Each lot or condo unit is a taxable unit, taxable by the municipality. The rate of taxation revenue from a bare land condo lot is equivalent to that of a standard lot; however, the ongoing operating costs associated with the lot born by the municipality are lower, making this type of development advantageous for Lethbridge County.

The major advantage of having a bare land condo development in the County is that there is zero net increase to the County's infrastructure. All infrastructure and improvements on the common elements of the development will be the responsibility of the condo association. This means that the ongoing maintenance of internal roads, stormwater ponds, etc. is born by the condo association. Furthermore, if residents of the area want a higher level of service than what the municipality might be interested in providing for things like snow removal, they have the opportunity to secure those services themselves without any increase in costs to the municipality.

When subdivision occurs, a development agreement will dictate the standards to which all infrastructure must be built. This means while the infrastructure will be built to County standards, even though the infrastructure will not ultimately be the County's responsibility. The operation and maintenance of all new infrastructure within the development area will be the responsibility of the developer until the condo association is formed and assumes control.

A condo association will be formed by the lot owners under the appropriate statutes and the association will establish its own bylaws. These bylaws will dictate how the association will operate, including the operation and maintenance of any infrastructure. The creation and management of the condominium association is regulated by the province through the

Condominium Property Act which was updated and amended by the provincial legislature in December 2004.

Municipal Reserve

At this time, it is anticipated that at the time of subdivision, the municipal reserve requirements will be met by providing cash in lieu of land.

Land Use Classification

The proposed land use classification of the subdivision is Grouped Country Residential as per the Lethbridge County Land Use Bylaw.

Lethbridge County Municipal Development Plan

The Lethbridge County Municipal Development Plan contains directives for residential development. The location of the proposed development meets these directives for the following reasons:

- The site is located adjacent to an existing area of country residential development
- The site does not contain any sensitive environmental, cultural or historical features
- The site lies adjacent to Stafford Reservoir, a desirable amenity and county recreation area.
- While the lands involved have been farmed historically, they are not considered high quality. The soils are mapped as class three, but the only irrigated portions are border areas of nearby pivots. The property is an irregular shape and the property contains low areas.

3.4 HISTORY

There was a previous area structure plan completed for these parcels. This area structure plan differs in the following ways:

- Minimum size of lots is increased (2 acres)
- Density of lots is significantly decreased
- Sanitary wastewater will be handled by individual septic fields and not the County through a municipal or community system
- Access for 90% of the lots will be only from the north
- This will be a bare land condo type of development
    - The roads, ponds and any other infrastructure will be the responsibility of the condo association. There will be no infrastructure for which the County will be ultimately responsible. Therefore, there will be no increase in costs to the County for the operation and maintenance of infrastructure within the development.

3.5 POPULATION ESTIMATES

With 29 lots, and assuming a dwelling on each lot, the estimated population for the development at full build out is 73 based on an assumed population of 2.5 people per household.

3.6 PROPOSED LAND USE AREAS

The distribution of land use within the proposed ASP is shown in *Table 1* below.

Table 1: Land Use Statistics

	Hectares (Acres)	Percent of Gross Area
Net Developable Area	24.32 (60.10)	70%
Country Residential Lots	24.32 (60.10)	70%
Utility Lots - Ponds	3.21 (7.93)	10%
Roads and Right-of-ways	3.52 (8.70)	9%
Open Space	3.65 (9.02)	11%
Gross Developable Area	34.70 (85.75)	100%

4 CONSULTATION

4.1 PUBLIC CONSULTATION

An open house was held December 2, 2014, at the Readymade Community Centre, to present the development concept to the public. All neighboring landowners were invited by hand delivered letters.

Those that attended recognized there are major differences between this concept and the previous one. Several attendees said this concept would be acceptable. However, several people expressed concerns about the concept. Concerns expressed and responses included:

- Any development will adversely impact land owners
  - The subdivision was designed with adjacent acreage landowners in mind:
    - Lot sizes are similar or larger
    - Primary access to the development is from the north minimizing traffic impact on existing residents.
- Emergency access road to the south will be used as access southward despite any gating
  - The condo association will police its members by enforcing its bylaws. The bylaws will dictate that utilization of the emergency access road is not permitted. Furthermore, it is reasonable to assume that the vast majority of traffic will be heading north towards the highway to reach Lethbridge/Coaldale/Taber.
- Too many septic fields in the area
  - A study will be conducted prior to subdivision of the development that will examine the cumulative impact of the septic fields within the development. The results of this study will justify the number of lots the development is to contain. No development will be allowed to proceed unless it can meet rigorous standards clearly articulating the suitability of any wastewater systems.
- Adjacent farming areas could be affected
  - The adjacent owner of agricultural lands is also an owner of this development and therefore is aware of potential impacts and supportive of the development. Any future land owner of this parcel would be purchasing the parcel knowing what is planned for the area and would purchase the parcel with that in mind.

4.2 REGULATORY AND OTHER CONSULTATION

The following agencies were consulted when preparing this document. Their comments and concerns are addressed throughout the remaining sections of the ASP.

- Lethbridge County
- Alberta Environment and Parks (AEP)
- St. Mary River Irrigation District (SMRID)
- Palliser Regional Schools

5 SERVICING

In order to determine the viability of this development, preliminary evaluations have been performed with respect to servicing. Key service items include sewer, water, natural gas, telephone, television, and electric. Additional information on services is included in this section.

5.1 SANITARY SEWER SYSTEM

Sanitary sewage from each lot will be handled by individual private sewage treatment systems which meet or exceed the Alberta Private Sewage System Standard of Practice. All systems will be approved as meeting these required standards prior to installation.

In 2012 an Assessment of Infiltration Capacity was conducted by Tetra Tech EBA in support of the communal sewage system proposed by the previous application. (*Appendix C*) Using the information contained within the report, Tetra Tech EBA also provided an assessment in 2014 addressing the capacity of the land to support individual private sewage treatment systems. They recommended that "…individual private sewage treatment systems will likely be an acceptable servicing strategy for effluent disposal." They also indicated that further investigation will be necessary.

This detailed investigation would examine:

- Soil and groundwater characteristics of each lot
- Placement criteria for a septic field in each lot
- Cumulative effect of the multiple septic fields on each other, neighboring properties and the reservoir
- The appropriate number of septic fields to ensure no impacts would occur.

This detailed investigation would be part of any subdivision application.

SMRID has indicated that all septic fields must lie above 848.5 meters (top of dam elevation) to prevent them from flooding. Only one lot has property lower then this elevation. This lot will be raised so that it is above this elevation. Any septic field within these lots will be located as far from the reservoir as possible at an elevation above 848.5m.

Each lot owner will be responsible for ensuring their compliance with all requirements of the Alberta Private Sewage Systems Standards of Practice 2015. This will also be required by the bylaws of the condo association.

5.2 WATER SYSTEMS

It is proposed that each lot will be serviced with limited potable water but no raw water. This section covers how each of these water supply issues will be addressed. The development will have no impact on the water supply of adjacent land owners. Access to additional hydrants will improve firefighting capacity for all residents in the area.

5.2.1 Potable Water

Potable water will be provided to the development through the existing water license of the local co-op and will not impact the quality or quantity of the existing water supply to the surrounding landowners. Potable water will not be used for irrigation purposes.

Potable water services are provided by the Lethbridge South County Rural Water Association to the area. The developer has an agreement with the Association where a deposit has been placed for 34 shares within the Association. The development will be served by communal system either connected directly to the main line or from a lateral serving the areas to the south. Further discussions and agreements will be required with the Association to determine how this development will connect with the Association infrastructure. The developer will be responsible for the care and maintenance of the distribution system within the development until the condo association assumes control.

A share in the water co-op has limitations on the rate of delivery. Cisterns with pressure systems will be required for each property. In addition, this water can only be used within the household. It will not be used for irrigation.

As the development area would be served by the Association, a new water licence would not be required by Alberta Environment and Parks.

5.2.2 Non-Potable Water / Fire Protection

Non-potable water is available from the SMRID and the provision of wet ponds with dry hydrants offers fire protection to the development and the surrounding community. The care and maintenance of the dry hydrants will be the responsibility of the condominium association and not the County.

The proposed development concept has two stormwater retention ponds which are to be wet ponds with a permanent volume for fire protection. These ponds will have dry hydrants for access by fire departments.

Individual residences will be required to have firefighting water supply and fire suppression sprinklers as per the standards defined in NFPA 1142 and NFPA 13D.

An agreement will be required for the use of water from the SMRID canal to maintain volumes within the ponds. The SMRID has the capacity and legal ability to deliver water for other purposes and an agreement will dictate when and how that operation can occur.

If, in the future raw water was required for landscaping purposes, SMRID has indicated it has the ability to deliver such water under an agreement, but that agreement would have to be with the condo association not individual lot owners.

5.3 GAS

Natural gas distribution infrastructure in the area surrounding the site is operated by Atco Gas. The developer will pay for the installation of natural gas distribution infrastructure to each lot.

Atco Gas will distribute natural gas within the development and lot purchasers will be able to select a retailer for natural gas supply.

5.4 ELECTRICAL POWER

Fortis Alberta Inc. will provide services to the proposed subdivision and services to each property line.

5.5 TELEPHONE

Telus will provide services to the lots, but each individual owner must apply for the service when building.

5.6 SHAW CABLE

Shaw has existing infrastructure along Highway 3 and has indicated service could be extended to the site.

5.7 SOLID WASTE DISPOSAL

Lot purchasers will be responsible for making arrangements for solid waste disposal. The City of Lethbridge Regional Solid waste facility is located approximately 23km driving distance from the development. Alternatively, lot purchasers may contract with a private solid waste hauler.

5.8 MAIL DELIVERY

At the time of subdivision an application will be made to Canada Post for mail service to the development. The design of the subdivision will include an appropriate location per Canada Post guidelines. A community mailbox area at the entrance to the development will likely be required.

6 ROADS AND TRANSPORTATION

6.1 EXTERNAL ROADS

The main access to the development will be from the road to the north of the development. The development was designed with this route as the main access to minimize the impact on the acreages to the southeast. Most of the traffic flow is anticipated to head north from the subdivision along highway 512 to Highway 3.

The road to the north is a County road and right-of-way. The approach will be constructed to County standards. Prior to subdivision the developer will work with the County to determine what improvement, if any will be required for this road.

Alberta Transportation was consulted in the planning process and indicated that a Traffic Impact Assessment would not be required.

6.2 INTERNAL ROADS

A new road will be constructed from the north end of the property southward into the property and will end in a cul-de-sac. The southernmost lots will utilize the existing road adjacent to the southeast corner of the parcel. An emergency access will be constructed between the cul-de-sac and the southeast road to provide emergency access to the development from either the north or south roads. This access will be gated to ensure it remains an emergency access only. The cul-de-sac is longer than is typical but is suitable given the low density of the plan area and the provision of gated emergency access to the south.

The road will be constructed to meet all the requirements of the County Engineering Standards. The exception to this will likely be a smaller centreline radius. This road will be paved. Once the proposal reaches the subdivision application stage, technical details regarding road design will be presented to the County for consideration. The care and maintenance of the roads will be the responsibility of the developer until taken over by the condo association.

6.3 SCHOOL BUS ACCESS

The school district has been contacted regarding the development and its needs. The north county road is a designated school route. Further consultation will be required to determine how a large vehicle turn around could be accommodated at the entrance area of the development.

7 SITE DRAINAGE AND GRADING

The objective of the stormwater management design is to ensure that there is no impact on the surrounding landowners (SMRID, adjacent farm, nearby acreages, County) or Stafford Reservoir from changing the drainage pattern within the development.

All drainage onsite will conform to Lethbridge County and Alberta Environment and Parks requirements. The intent of stormwater management for the development is to control runoff with the use of stormwater management ponds such that runoff is contained and released from the ponds only when permission is granted. A Site Drainage Analysis was completed for the site (*Appendix D*) and is summarized below.

7.1 SITE DRAINAGE

Stormwater runoff from the subject lands presently flows towards Stafford reservoir. Figures 4-6 show the topography of the site.

Additionally, a registered irrigation drainage channel crosses the property which conveys excess water from the east. It is proposed this channel be rerouted overland via a newly constructed gravity fed drainage ditch. The excess water will flow to the north from the existing dugout along the west side of lots 5 and 6 and then turn 90 degrees and flow east along the north side of lot 6 and into culverts beneath the new road. The water then continues west along the north side of Storm pond 1 where it re-connects with the existing drainage channel and flows east into Stafford lake (refer to Figure 3). High flood flows would be passed overland and across the road into the stormwater management pond.

Two storm water management ponds will be constructed. One will be located in the area of the existing return flow channel and the second one in an existing low spot in the southeast. The ponds will receive storm water runoff from the subdivision by means of an overland drainage system constructed within the development area. The overland drainage system will consist of roadside ditches and lot line swales to collect and convey storm water runoff to the ponds. Roadside ditches will be contained in the condo association road right-of-way. Easements or drainage right-of-ways will be established for the drainage swales along property boundaries. Predevelopment overland drainage that would normally reach the development from the west will be routed through the development via underground pipelines.

7.2 DRAINAGE MODELING

The majority of the development area will drain into swales and ditches which will convey the runoff into one of the stormwater ponds. Due to topography, the back of the eastern lakeside lots will not be conveyable to the ponds. A small permeable berm will be constructed along the eastern edge of these lots forcing back of lot drainage to pond and dissipate slowly. The care and protection of this berm will be a condition of the architectural controls for these properties.

The ponds will be designed to ensure the runoff captured by the ponds will be contained and held until such time it can be released. Releases from the ponds to Stafford Reservoir will only occur when the SMRID grants permission.

To determine the required active storage volume of the pond, a hydrologic model of the site was prepared using the PC SWMM hydrologic modeling software package. The hydrologic model of the site post-development was then analyzed using a 1:100 year 24-hour design storm event.
The results of the hydrologic modeling indicate a required storage volume of 16,934 cubic meters to attenuate the runoff from the site. The stormwater management facilities were sized to retain runoff volume generated. The hydrologic model will be reviewed during the detailed design stage to confirm the required capacity of the overland drainage system and culverts. Detailed design will also determine configuration of the ponds given storage needs and landscape limitations.

7.3 STORMWATER AGREEMENTS AND APPROVALS

Stormwater runoff collected in the ponds will be released to the Stafford Reservoir. An agreement with the SMRID will be necessary in order for the release to occur. Initial discussions have begun with the SMRID regarding the stormwater infrastructure. The agreement must be in place prior to subdivision.

The stormwater management ponds will be created on common property and will be operated and maintained by the developer until taken over by the condo association.

The storm water detention ponds will require an approval under the Water Act and a registration under EPEA from AEP as municipal storm water management ponds prior to subdivision.

In addition, SMRID operates a return flow channel through the property. In order to accommodate this flow, the channel has been re-routed as shown in Figure 3. This will be a ROW dedicated to SMRID.

8 OPEN SPACES AND RESERVOIR ACCESS

The common areas will be left in a natural state as much as possible. The care and maintenance for these areas will be the responsibility of the developer until taken over by the condo association. It is not intended for these areas to be manicured parks but to remain or be restored to natural areas.

As the lands bordering the development area and the reservoir are the property of the SMRID, appropriate agreements will be necessary prior to the development of the access occurring. Initial discussions have been initiated with the SMRID and any necessary agreements would be submitted with any future subdivision applications. The care and maintenance of any access to the reservoir would be the responsibility of the condo association.

9 ARCHITECTURAL CONTROLS

Architectural controls will be used to create an environment that reflects the vision of the development and the values of the surrounding community. A high development standard also ensures revenue potential for the County. These controls will be expanded and detailed at the subdivision stage of the development process. The following criteria will apply:

Houses

- Only single family homes of a specific size and style will be permitted
- Minimum elevation buildings must be above (848.5 m)
- Mobile homes will not be permitted
- Minimum building setbacks from lot boundaries, reservoir lands and roads

Lots

- Location of septic fields will be designated
- Livestock or 'abandoned' vehicles will not be permitted
- Minimum landscaping requirements
- Property maintenance requirements
- Fencing styles and locations
- Permitted uses and restrictions

Other

- Location, size and landscaping of entrance signage.

These controls will be enforced through a deposit paid by the lot purchaser. The house plan and the landscaping plan must be approved by the developer's architectural consultant prior to any building or development permit being issued. Only once the home and landscaping are completed, and have been inspected to ensure compliance with approved plans, will the deposit will be refunded.

APPENDIX A

FIGURES

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DRAWING STATUS	FOR APPROVAL		
#	REVISION	DATE	BY

NOTES

CONTRACTOR TO CHECK AND VERIFY ALL DIMENSIONS BEFORE CONSTRUCTION. ANY ERRORS AND OMISSIONS SHALL BE REPORTED TO THE ENGINEER IMMEDIATELY

DRAWING SHALL NOT BE USED FOR CONSTRUCTION UNTIL APPROVED

DO NOT SCALE THE DRAWING

ALL CONSTRUCTION SHALL BE IN ACCORDANCE WITH THE LATEST CODES, MAY IT BE CONSTRUCTION, MECHANICAL, ETC

CLIENT: STAFFORD DEVELOPMENTS

PROJECT TITLE: STAFFORD LANDING

DRAWING TITLE: ASP - AREA MAP

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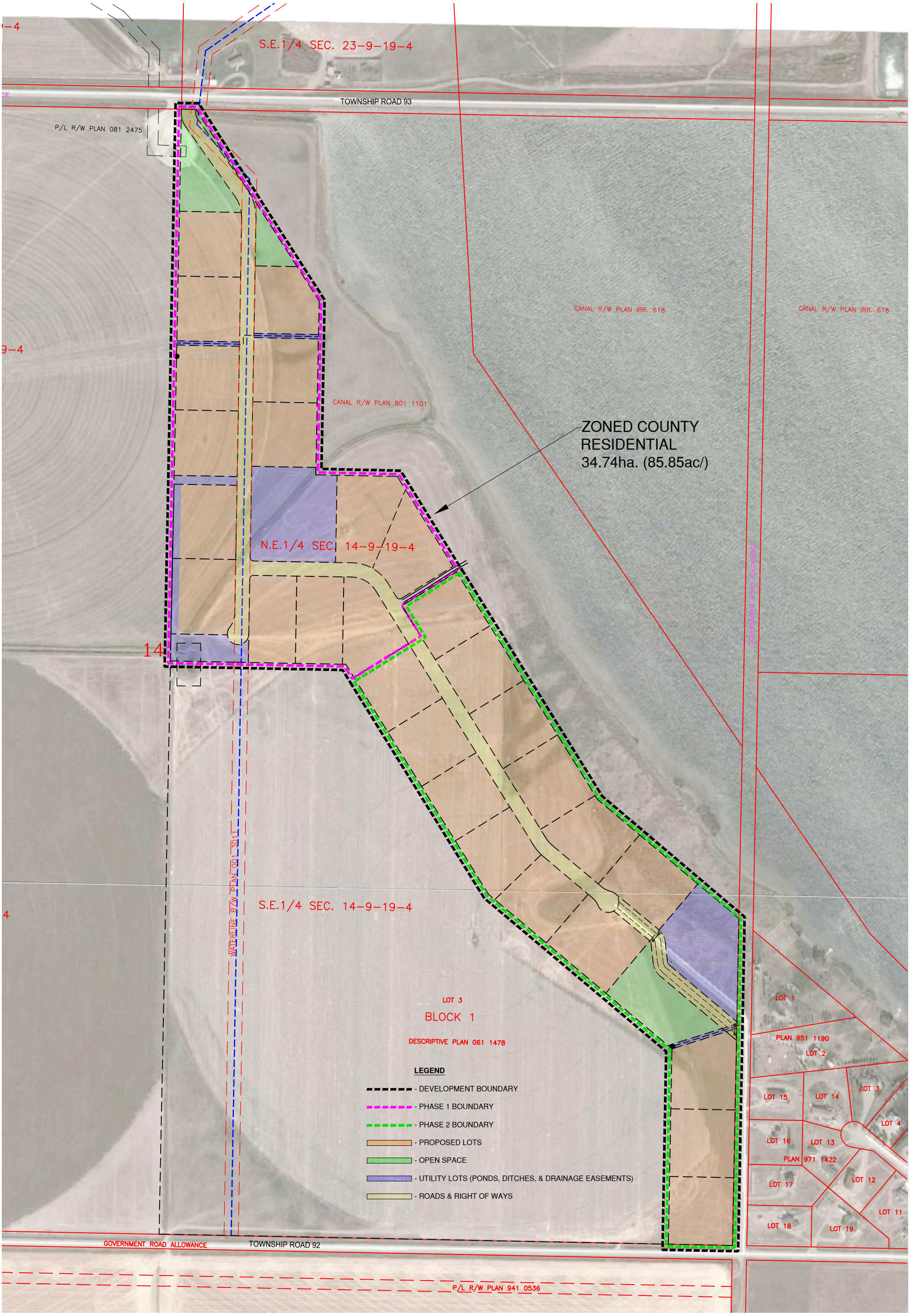
DESIGN	MAH
DRAWN	MDO
CHECKED	MAH
APPROVED	MAH
SCALE	AS SHOWN

PROJECT NUMBER	11-007
VERSION NUMBER	IFA1-1
DATE DRAWN	JAN. 12, 2017
SHEET NUMBER	FIG. 1



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DESIGN	MAH
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APPROVED	MAH
SCALE	AS SHOWN

DRAWING STATUS: FOR APPROVAL

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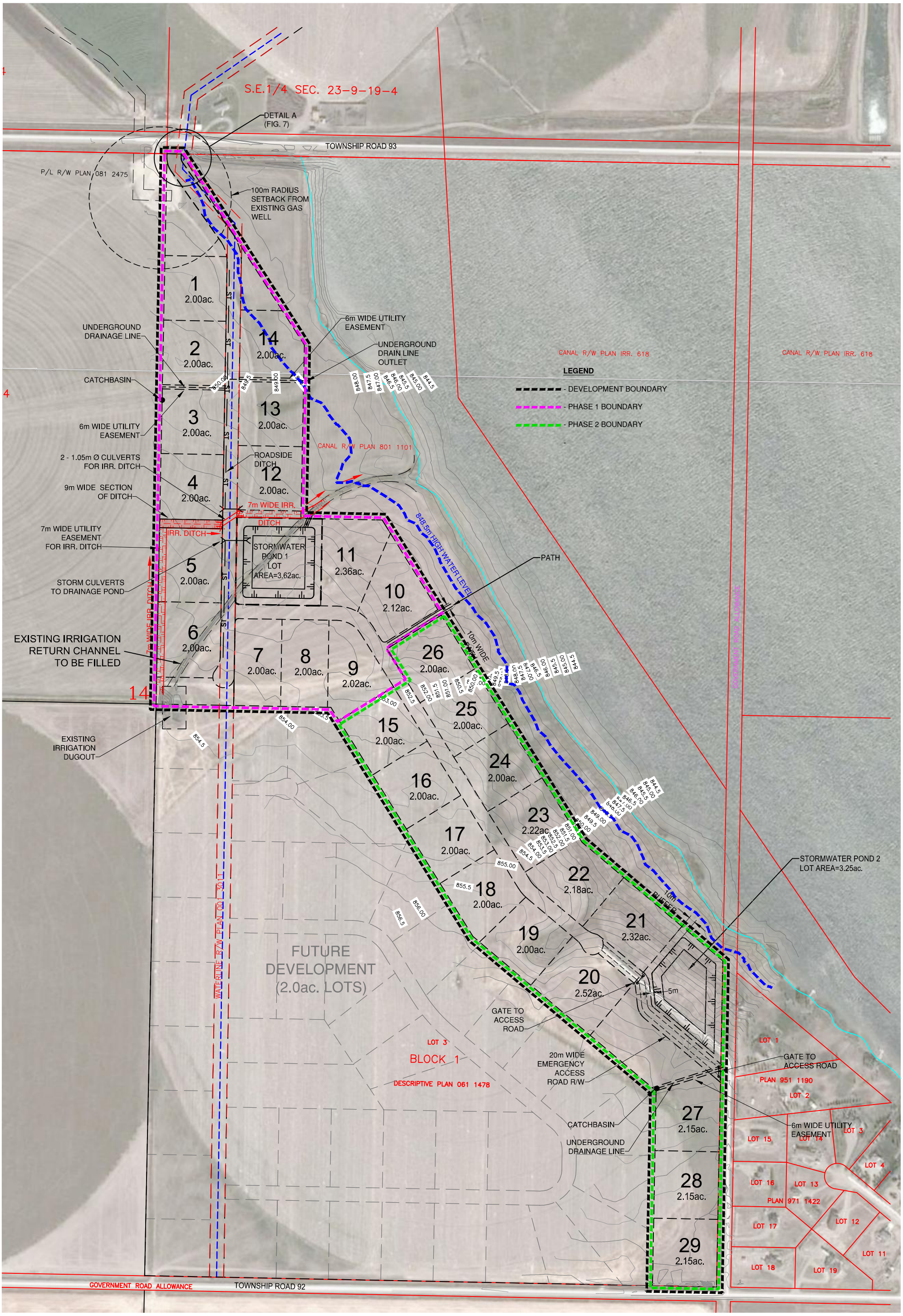
CLIENT: STAFFORD DEVELOPMENTS

PROJECT TITLE: STAFFORD LANDING

DRAWING TITLE: ASP - ZONED COUNTY RESIDENTIAL DEVELOPMENT

PROJECT NUMBER	11-007
VERSION NUMBER	IFA1-1
DATE DRAWN	JAN. 12, 2017
SHEET NUMBER	FIG. 2



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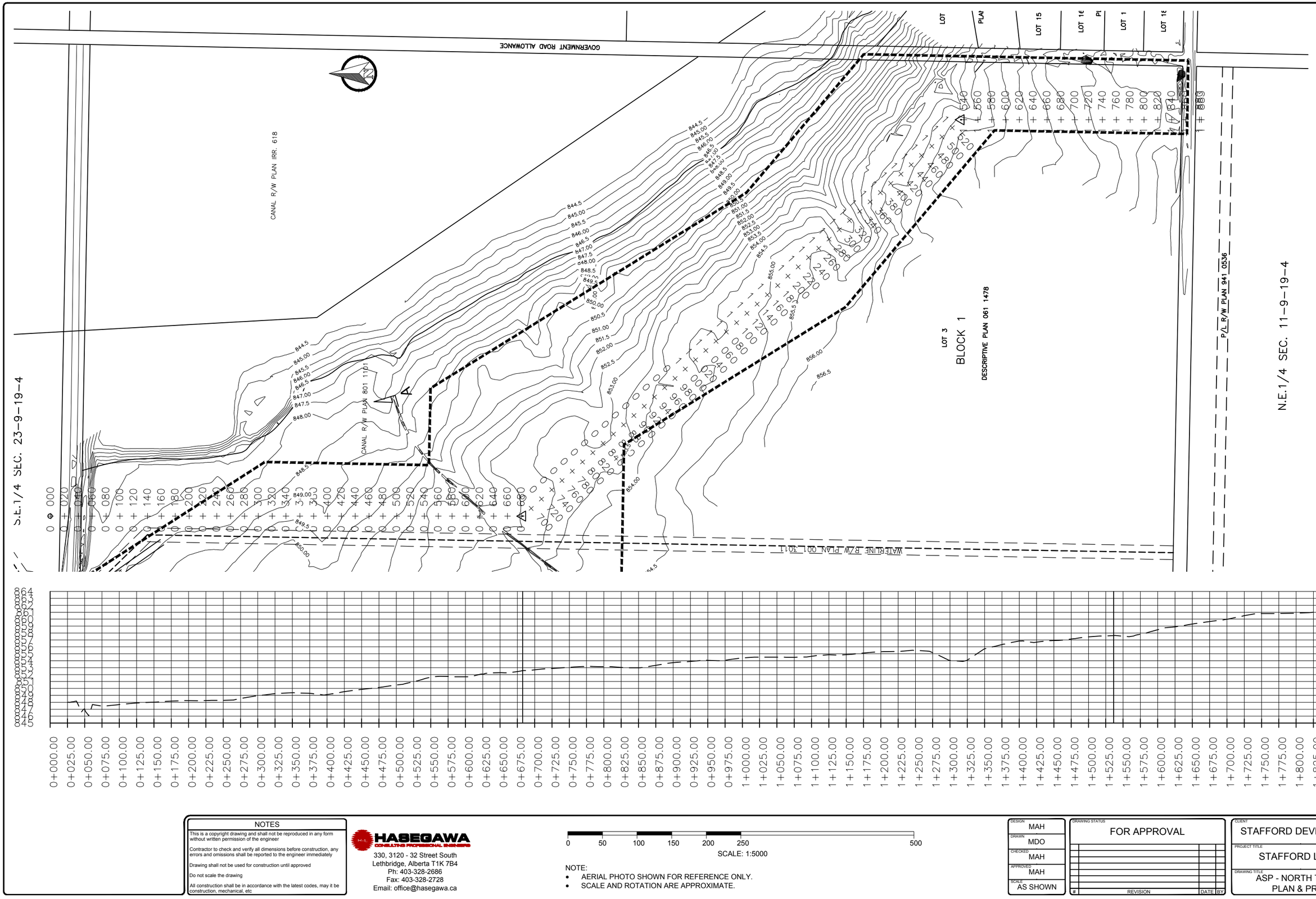
DRAWING STATUS: PRELIMINARY

#	REVISION	DATE	BY

CLIENT: STAFFORD DEVELOPMENTS
PROJECT TITLE: STAFFORD LANDING
DRAWING TITLE: TENTATIVE LOT LAYOUT

PROJECT NUMBER	11-007
VERSION NUMBER	
DATE DRAWN	JAN. 12, 2017
SHEET NUMBER	FIG.3



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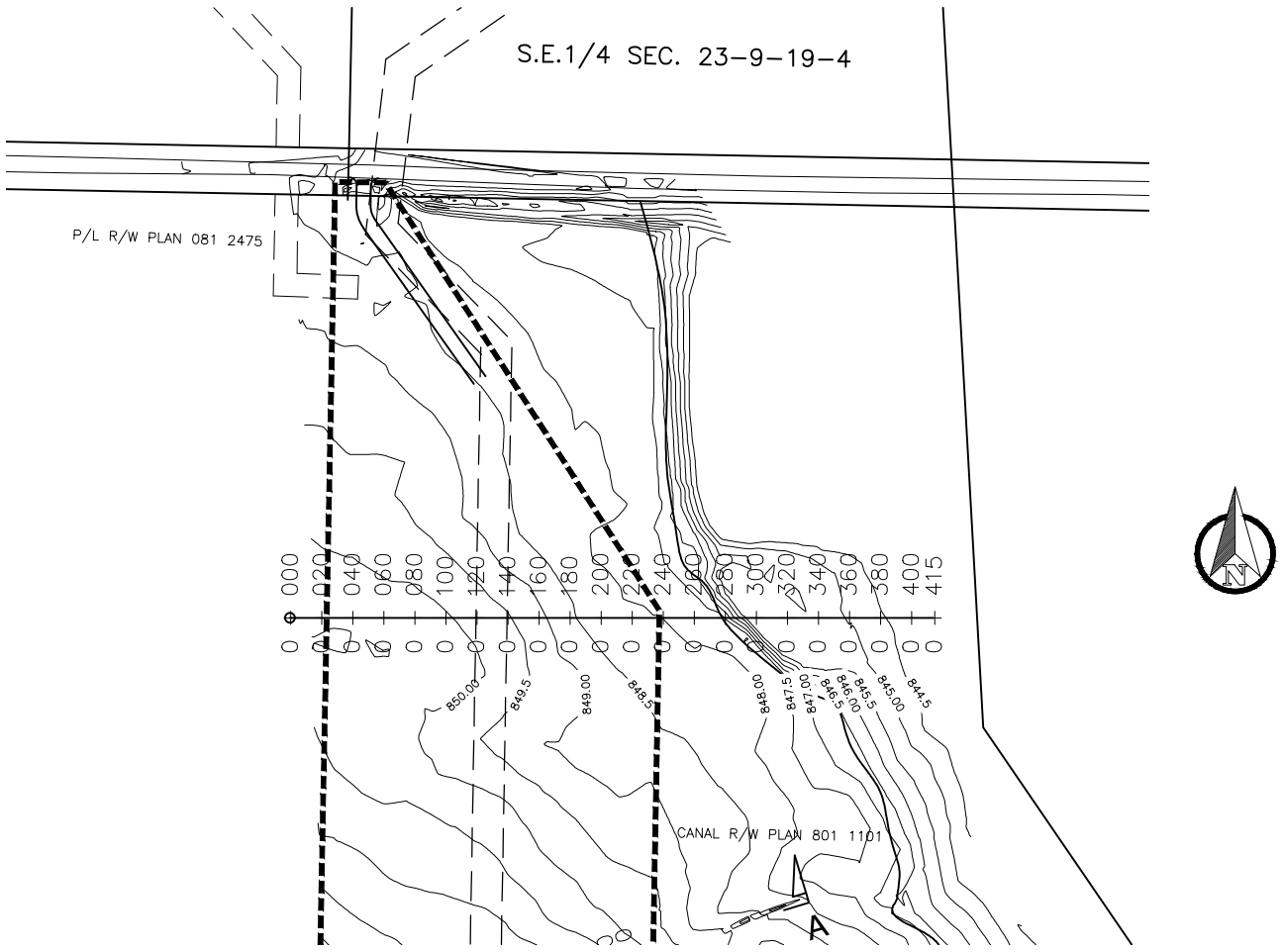
DESIGN	MAH
DRAWN	MDO
CHECKED	MAH
APPROVED	MAH
SCALE	AS SHOWN

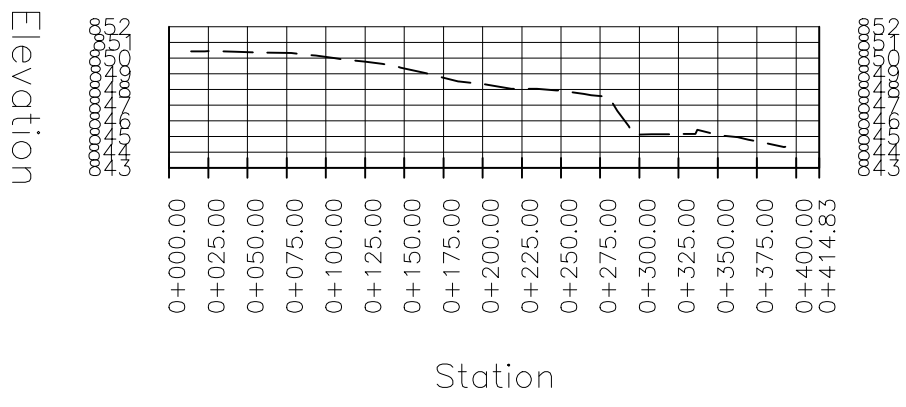
DRAWING STATUS: FOR APPROVAL

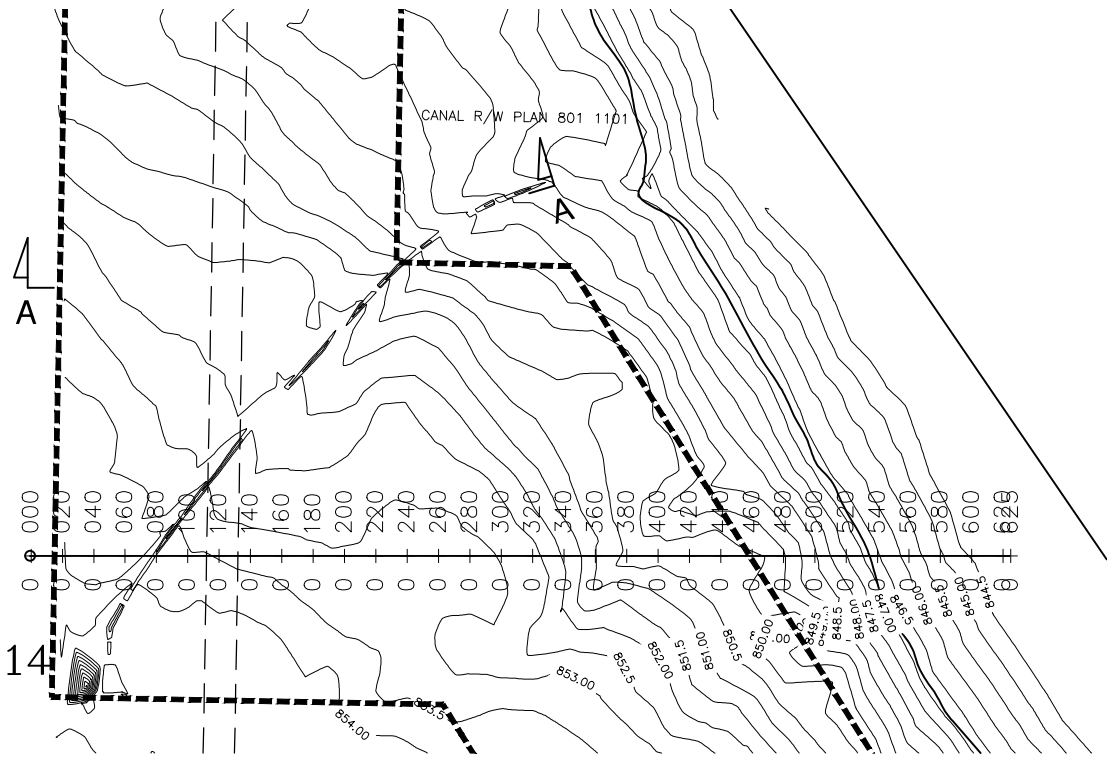
#	REVISION	DATE	BY

CLIENT	STAFFORD DEVELOPMENTS
PROJECT TITLE	STAFFORD LANDING
DRAWING TITLE	ASP - NORTH TO SOUTH PLAN & PROFILE
PROJECT NUMBER	11-007
VERSION NUMBER	IFA1-1
DATE DRAWN	JAN. 12, 2017
SHEET NUMBER	FIG. 4



WEST TO EAST 1 PROFILE
Hor Scale: 1:500
Vert Scale: 1:50





WEST TO EAST 2 PROFILE
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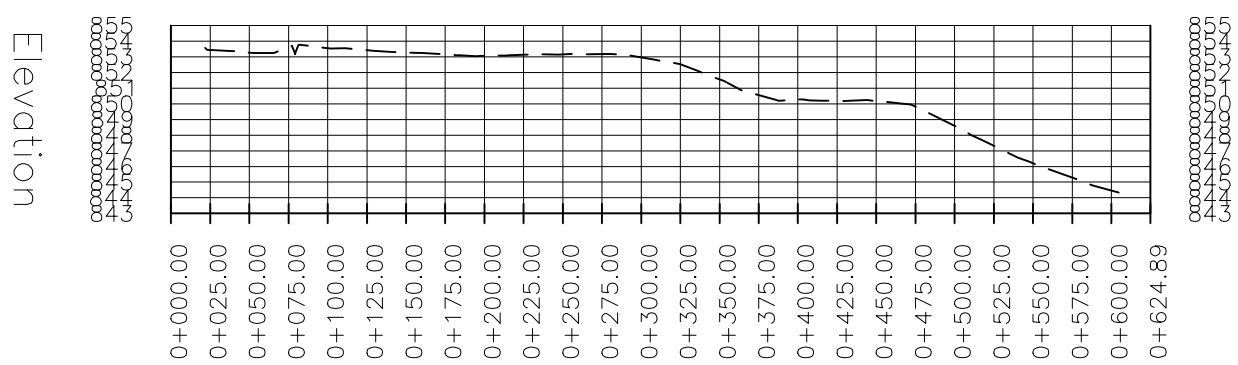
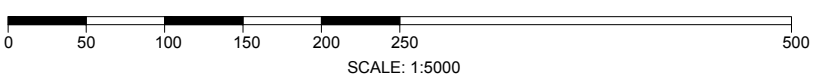


NOTE:
- AERIAL PHOTO SHOWN FOR REFERENCE ONLY.
- SCALE AND ROTATION ARE APPROXIMATE.



NOTES

HASEGAWA
CONSULTING PROFESSIONAL ENGINEERS
330, 3120 - 32 Street South
Lethbridge, Alberta T1K 7B4
Ph: 403-328-2686
Fax: 403-328-2728
Email: office@hasegawa.ca

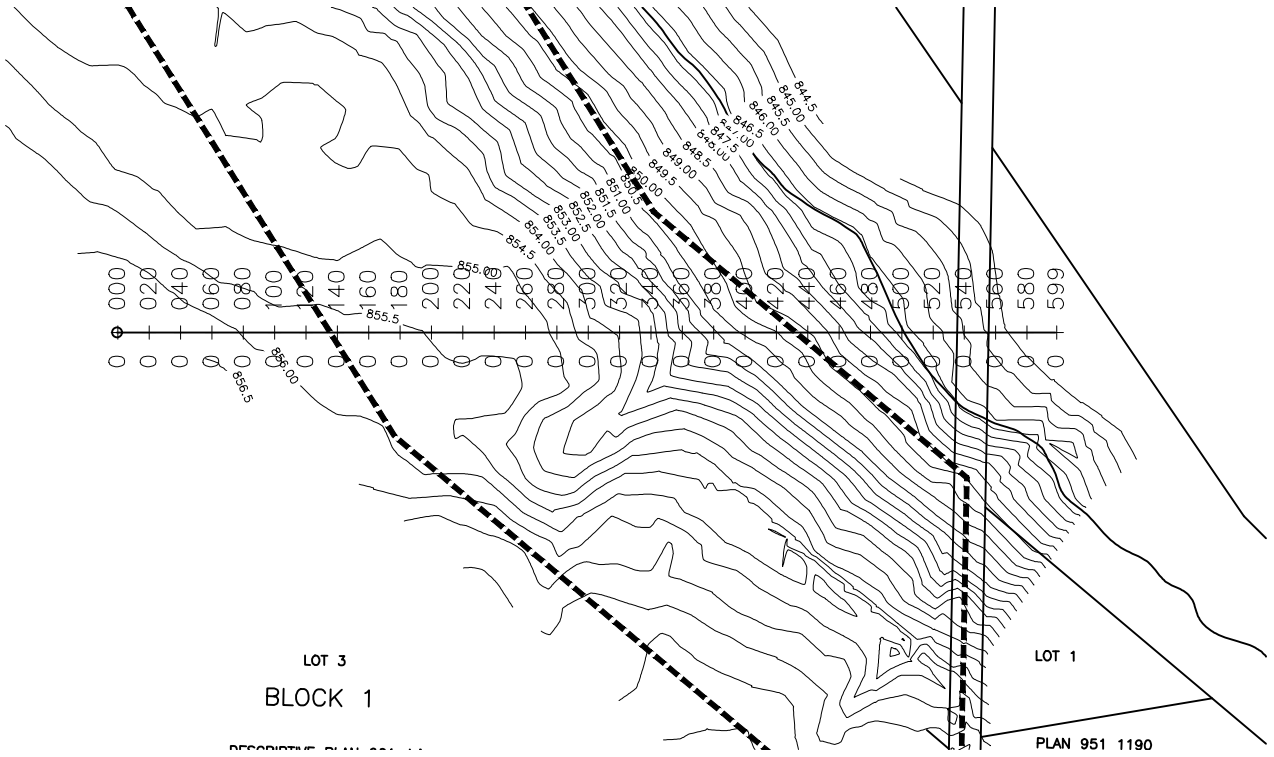
DESIGN	MAH
DRAWN	MDO
CHECKED	MAH
APPROVED	MAH
SCALE	AS SHOWN

DRAWING STATUS: FOR APPROVAL

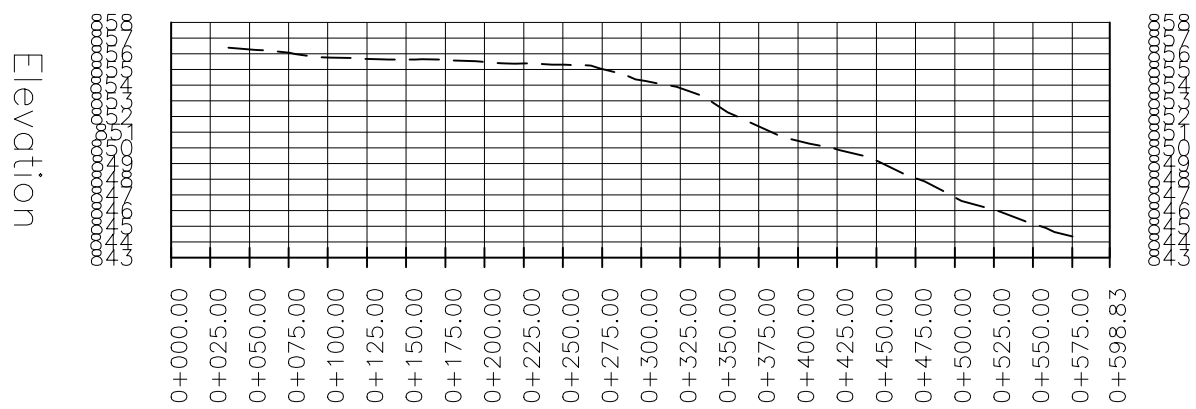
#	REVISION	DATE	BY

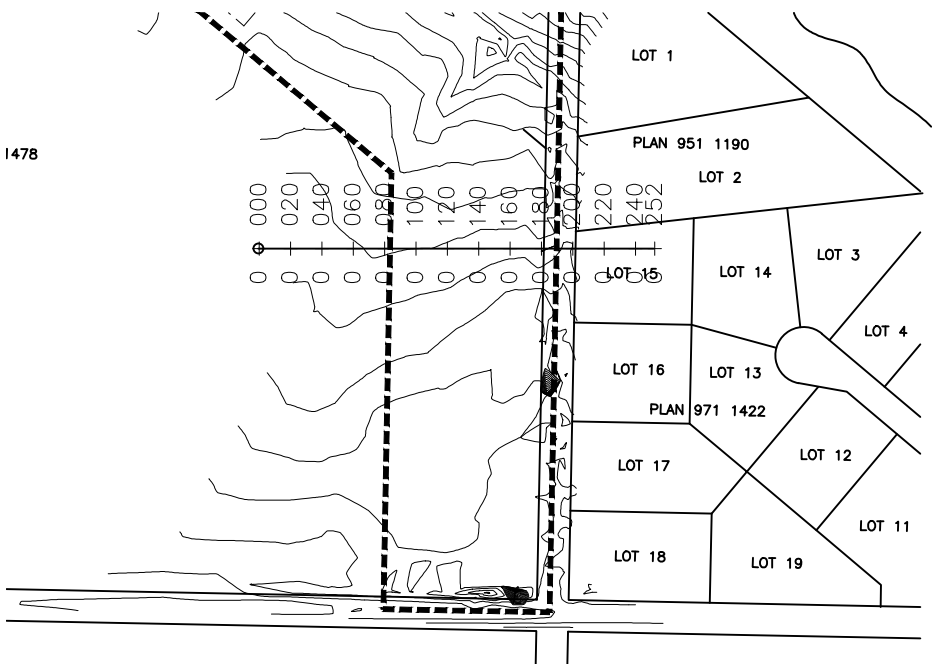
CLIENT: STAFFORD DEVELOPMENTS
PROJECT TITLE: STAFFORD LANDING
DRAWING TITLE: ASP - WEST TO EAST PLAN & PROFILE 1

PROJECT NUMBER	11-007
VERSION NUMBER	IFA1-1
DATE DRAWN	JAN. 12, 2015
SHEET NUMBER	FIG. 5

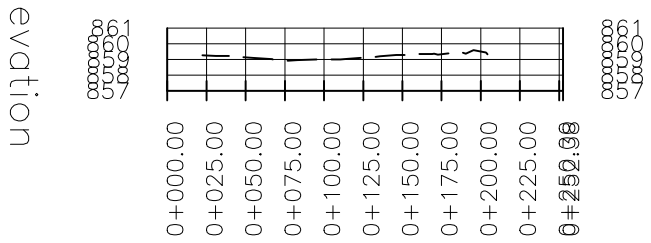


WEST TO EAST 3 PROFILE
Hor Scale: 1:500
Vert Scale: 1:50





WEST TO EAST 4 PROFILE
Hor Scale: 1:500
Vert Scale: 1:50



NOTE:
- AERIAL PHOTO SHOWN FOR REFERENCE ONLY.
- SCALE AND ROTATION ARE APPROXIMATE.

0 50 100 150 200 250 500
SCALE: 1:5000

NOTES

HASEGAWA
CONSULTING PROFESSIONAL ENGINEERS
330, 3120 - 32 Street South
Lethbridge, Alberta T1K 7B4
Ph: 403-328-2686
Fax: 403-328-2728
Email: office@hasegawa.ca

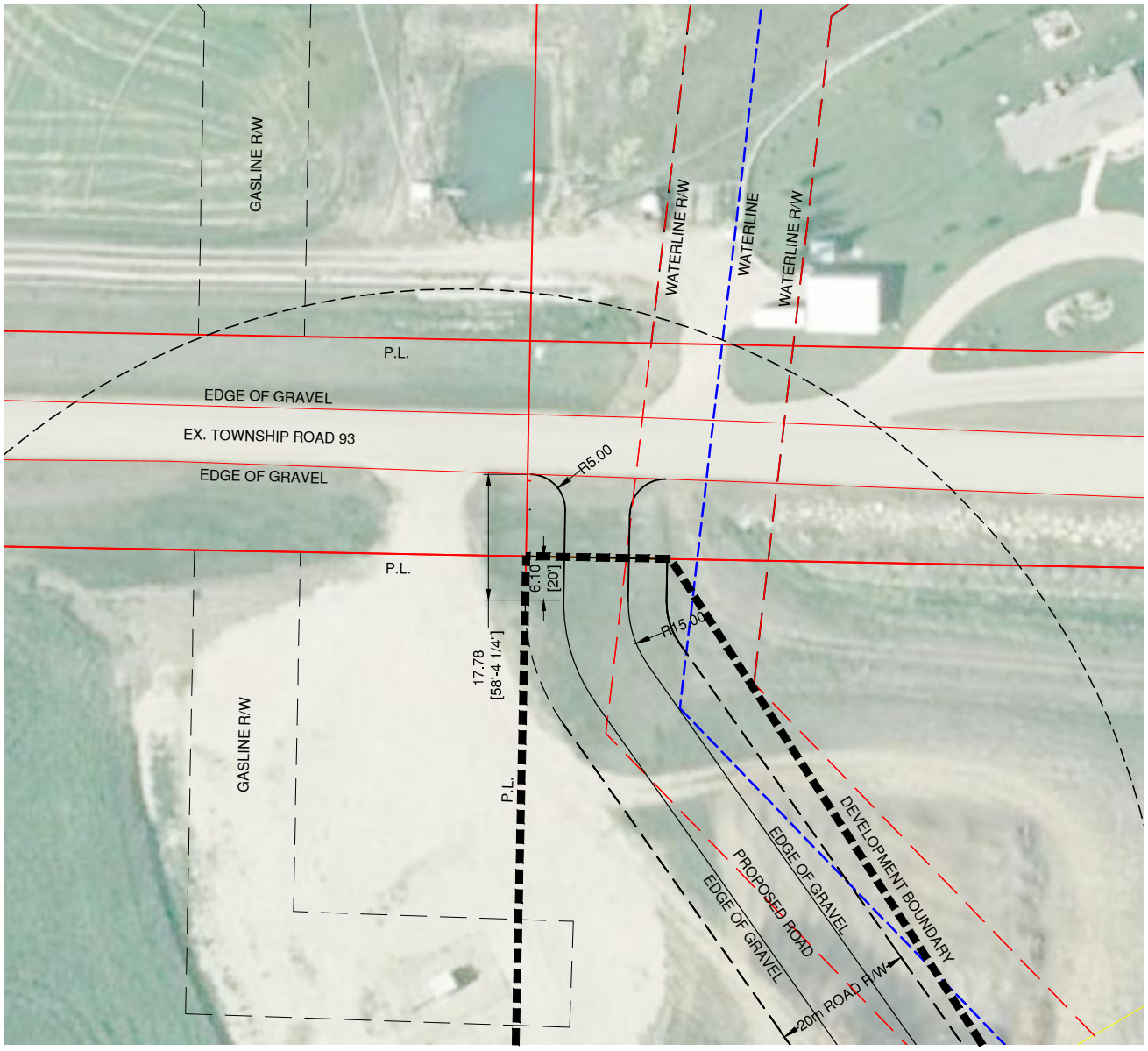
DESIGN: MAH
DRAWN: MDO
CHECKED: MAH
APPROVED: MAH
SCALE: AS SHOWN

DRAWING STATUS: FOR APPROVAL

#	REVISION	DATE	BY

CLIENT: STAFFORD DEVELOPMENTS
PROJECT TITLE: STAFFORD LANDING
DRAWING TITLE: ASP - WEST TO EAST PLAN & PROFILES 2

PROJECT NUMBER: 11-007
VERSION NUMBER: IFA1-1
DATE DRAWN: JAN. 12, 2017
SHEET NUMBER: FIG. 6



DETAIL A - PROPOSED ROAD & EXISTING TOWNSHIP ROAD 93 CONNECTION
SCALE: 1:1,000

0 10 20 30 30 50 100
SCALE: 1:1,000

N

DRAWING STATUS	FOR APPROVAL		
#	REVISION	DATE	BY

NOTES

THIS IS A COPYRIGHT DRAWING AND SHALL NOT BE REPRODUCED IN ANY FORM WITHOUT WRITTEN PERMISSION OF THE ENGINEER

CONTRACTOR TO CHECK AND VERIFY ALL DIMENSIONS BEFORE CONSTRUCTION, ANY ERRORS AND OMISSIONS SHALL BE REPORTED TO THE ENGINEER IMMEDIATELY

DRAWING SHALL NOT BE USED FOR CONSTRUCTION UNTIL APPROVED

DO NOT SCALE THE DRAWING

ALL CONSTRUCTION SHALL BE IN ACCORDANCE WITH THE LATEST CODES, MAY IT BE CONSTRUCTION, MECHANICAL, ETC

CLIENT: STAFFORD DEVELOPMENTS

PROJECT TITLE: STAFFORD LANDING

DRAWING TITLE: DETAIL A

HASEGAWA CONSULTING PROFESSIONAL ENGINEERS
330, 3120 - 32nd Street South Lethbridge Alberta T1K 7B4
PH: 403-328-2686 FX: 403-328-2728 EM: office@hasegawa.ca

DESIGN	MAH
DRAWN	MDO
CHECKED	MAH
APPROVED	MAH
SCALE	AS SHOWN
PROJECT NUMBER	11-007
VERSION NUMBER	IFA1-1
DATE DRAWN	JAN. 12, 2015
SHEET NUMBER	FIG. 7

APPENDIX B

LAND TITLES

LAND TITLE CERTIFICATE

S

LINC	SHORT LEGAL	TITLE NUMBER
0019 073 998	4;19;9;14;NE	161 039 673

LEGAL DESCRIPTION

MERIDIAN 4 RANGE 19 TOWNSHIP 9
SECTION 14
THAT PORTION OF THE NORTH EAST QUARTER
LYING TO THE WEST OF THE WESTERLY LIMIT OF THE
RESERVOIR ON PLAN IRR618
CONTAINING 39.99 HECTARES (98.71 ACRES) MORE OR LESS
EXCEPTING THEREOUT:

PLAN	NUMBER	HECTARES	(ACRES) MORE OR LESS
EXTRA CANAL R/W & ACCESS ROAD	8011101	21.536	(53.22)

EXCEPTING THEREOUT ALL MINES AND MINERALS
AND THE RIGHT TO WORK THE SAME

ESTATE: FEE SIMPLE

MUNICIPALITY: LETHBRIDGE COUNTY

REFERENCE NUMBER: 161 039 672 +1

REGISTERED OWNER(S)

REGISTRATION	DATE(DMY)	DOCUMENT TYPE	VALUE	CONSIDERATION
161 039 673	09/02/2016	TRANSFER OF LAND	$454,900	CASH & MORTGAGE

OWNERS

STAFFORD DEVELOPMENTS CORP.
OF 238 - 22 STREET NORTH
LETHBRIDGE
ALBERTA T1H 3R7

ENCUMBRANCES, LIENS & INTERESTS

REGISTRATION NUMBER	DATE (D/M/Y)	PARTICULARS
1485KX .	21/06/1971	IRRIGATION ORDER/NOTICE THIS PROPERTY IS INCLUDED IN THE ST. MARY RIVER

(CONTINUED)

REGISTRATION NUMBER	DATE (D/M/Y)	PARTICULARS
		IRRIGATION DISTRICT
761 073 673	10/06/1976	CAVEAT RE : EASEMENT CAVEATOR - THE BOARD OF DIRECTORS OF THE ST. MARY RIVER IRRIGATION DISTRICT
861 125 931	01/08/1986	IRRIGATION DISTRICT RESOLUTION PART OF AN IRRIGABLE UNIT
951 127 812	07/06/1995	UTILITY RIGHT OF WAY GRANTEE - CANADIAN WESTERN NATURAL GAS COMPANY LIMITED.
971 156 490	02/06/1997	CAVEAT RE : SURFACE LEASE CAVEATOR - DEETHREE EXPLORATION LTD. ATTN SURFACE LAND CALGARY PLACE PO BOX 20009 CALGARY ALBERTA T2P4J2 (DATA UPDATED BY: CHANGE OF NAME 051200760) (DATA UPDATED BY: TRANSFER OF CAVEAT 081438391)
971 325 916	30/10/1997	UTILITY RIGHT OF WAY GRANTEE - PENGROWTH CORPORATION. (DATA UPDATED BY: TRANSFER OF UTILITY RIGHT OF WAY 031051544) (DATA UPDATED BY: CHANGE OF ADDRESS 031256277) (DATA UPDATED BY: TRANSFER OF UTILITY RIGHT OF WAY 081061387)
011 182 931	29/06/2001	UTILITY RIGHT OF WAY GRANTEE - COUNTY OF LETHBRIDGE. AS TO PORTION OR PLAN:0013011
101 166 731	07/06/2010	DISCHARGE OF UTILITY RIGHT OF WAY 971325916 PARTIAL EXCEPT PLAN/PORTION: 0812475
161 039 674	09/02/2016	CAVEAT RE : AGREEMENT CHARGING LAND CAVEATOR - BJK HOLDINGS LTD. 238-22 STREET NORTH LETHBRIDGE ALBERTA T1H3R7 AGENT - GUY MCNAB

(CONTINUED)

TOTAL INSTRUMENTS: 009

THE REGISTRAR OF TITLES CERTIFIES THIS TO BE AN ACCURATE REPRODUCTION OF THE CERTIFICATE OF TITLE REPRESENTED HEREIN THIS 12 DAY OF APRIL, 2016 AT 09:13 A.M.

ORDER NUMBER: 30446510

CUSTOMER FILE NUMBER:

END OF CERTIFICATE

LAND TITLE CERTIFICATE

S

LINC	SHORT LEGAL	TITLE NUMBER
0034 553 413	1014119;1;4	101 352 104

LEGAL DESCRIPTION
PLAN 1014119
BLOCK 1
LOT 4
EXCEPTING THEREOUT ALL MINES AND MINERALS
AREA: 15.217 HECTARES (37.6 ACRES) MORE OR LESS

ESTATE: FEE SIMPLE
ATS REFERENCE: 4;19;9;14;SE

MUNICIPALITY: LETHBRIDGE COUNTY

REFERENCE NUMBER: 101 327 000 +1

REGISTERED OWNER(S)

REGISTRATION	DATE(DMY)	DOCUMENT TYPE	VALUE	CONSIDERATION
101 352 104	03/12/2010	TRANSFER OF LAND	$188,000	$188,000

OWNERS

STAFFORD DEVELOPMENTS CORP.
OF 238-22 ST N
LETHBRIDGE
ALBERTA T1H 3R7

ENCUMBRANCES, LIENS & INTERESTS

REGISTRATION NUMBER	DATE (D/M/Y)	PARTICULARS
1485KX .	21/06/1971	IRRIGATION ORDER/NOTICE THIS PROPERTY IS INCLUDED IN THE ST. MARY RIVER IRRIGATION DISTRICT
761 073 673	10/06/1976	CAVEAT RE : EASEMENT CAVEATOR - THE BOARD OF DIRECTORS OF THE ST. MARY RIVER IRRIGATION DISTRICT

(CONTINUED)

REGISTRATION NUMBER	DATE (D/M/Y)	PARTICULARS
861 125 931	01/08/1986	IRRIGATION DISTRICT RESOLUTION PART OF AN IRRIGABLE UNIT
951 127 812	07/06/1995	UTILITY RIGHT OF WAY GRANTEE - CANADIAN WESTERN NATURAL GAS COMPANY LIMITED.
091 083 837	30/03/2009	CAVEAT RE : UTILITY RIGHT OF WAY CAVEATOR - FORTISALBERTA INC. ATTN:LAND DEPARTMENT 320-17TH AVENUE SW CALGARY ALBERTA T2S2V1 AGENT - BOBBI MAGEE " AFFECTS PART OF THIS TITLE "
101 327 001	05/11/2010	CAVEAT RE : DEFERRED RESERVE CAVEATOR - COUNTY OF LETHBRIDGE. OLDMAN RIVER REGIONAL SERVICES COMMISSION 3105-16TH AVENUE NORTH LETHBRIDGE ALBERTA T1H5E8
101 352 105	03/12/2010	MORTGAGE MORTGAGEE - BJK HOLDINGS LTD. 238-22 ST N LETHBRIDGE ALBERTA T1H3R7 ORIGINAL PRINCIPAL AMOUNT: $2,000,000

TOTAL INSTRUMENTS: 007

THE REGISTRAR OF TITLES CERTIFIES THIS TO BE AN ACCURATE REPRODUCTION OF THE CERTIFICATE OF TITLE REPRESENTED HEREIN THIS 28 DAY OF OCTOBER, 2015 AT 03:47 P.M.

ORDER NUMBER: 29541948

CUSTOMER FILE NUMBER:

END OF CERTIFICATE

(CONTINUED)

THIS ELECTRONICALLY TRANSMITTED LAND TITLES PRODUCT IS INTENDED FOR THE SOLE USE OF THE ORIGINAL PURCHASER, AND NONE OTHER, SUBJECT TO WHAT IS SET OUT IN THE PARAGRAPH BELOW.

THE ABOVE PROVISIONS DO NOT PROHIBIT THE ORIGINAL PURCHASER FROM INCLUDING THIS UNMODIFIED PRODUCT IN ANY REPORT, OPINION, APPRAISAL OR OTHER ADVICE PREPARED BY THE ORIGINAL PURCHASER AS PART OF THE ORIGINAL PURCHASER APPLYING PROFESSIONAL, CONSULTING OR TECHNICAL EXPERTISE FOR THE BENEFIT OF CLIENT(S).

APPENDIX C

GEOTECHNICAL INFORMATION

TETRA TECH EBA

TECHNICAL MEMO

ISSUED FOR USE

To:	Mr. Bud Hogeweide, Hogeweide Management and Consulting Inc.	**Date:**	June 17, 2014
C:	Mr. Ian Franks, Hasegawa Engineering	**Memo No.:**	001
From:	Mr. Trevor Loomer	**File:**	PL12103610-01
Subject:	Assessment of Infiltration Capacity, Stafford Landing		

In 2011/2012, Tetra Tech EBA Inc.[1] (Tetra Tech EBA) completed an assessment of the potential infiltration capacity for a subdivision to be known as Stafford Landing located on the northeast ¼ Sec 14, Twp 9, Rge 19, W4M and southeast ¼ Sec 14, Twp 9, Rge 19, W4M (File No. L12101915). The assessment involved a field investigation to determine the geotechnical and groundwater conditions at the site, and an analysis of the consequences of disposal of the treated wastewater effluent from an on-site communal wastewater system on the groundwater conditions. Based on this assessment it was demonstrated that infiltration of wastewater could be used as a method of disposal.

It is Tetra Tech EBA's understanding that the developer is in the process of revising the proposed development concept. The revised development concept has increased the size of each lot and subsequently reduced the overall number of lots.

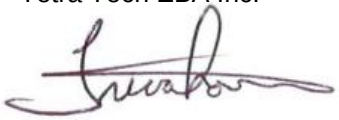
One of the other revisions identified is the effluent disposal strategy. The communal on-site wastewater system is being eliminated, and instead, it is proposed to service the site with individual private sewage treatment systems (septic fields). With the reduction of the number of lots we anticipate that the volume of effluent generated will also be significantly reduced.

Based on the previous fieldwork and analysis of the infiltration capacity of the soils, it is Tetra Tech EBA's opinion that individual private sewage treatment systems will likely be an acceptable servicing strategy for effluent disposal.

It is also Tetra Tech EBA's understanding that a subsequent field program and infiltration assessment will be required to confirm this strategy is indeed acceptable and will become a requirement of the planning process for approval.

If there are any questions please feel free to contact the undersigned.

Regards,
Tetra Tech EBA Inc.



Trevor Loomer, P.Eng.
Senior Project Director
Engineering Practice
Direct Line: 403.329.9009 x240
trevor.loomer@tetratech.com

[1] Known as EBA Engineering Consultants Ltd., operating as EBA, A Tetra Tech Company, at the time of report issuance.

Technical Appendices from
"Assessment of Infiltration Capacity, Stafford Landing"
TetraTech EBA Inc., February 2012

APPENDIX B
BOREHOLE RECORDS

PROJECT: EFFLUENT DISPOSAL AREA	CLIENT: STAFFORD DEVELOPMENTS	PROJECT NO. - BOREHOLE NO.
LOCATION: NE 1/4 14-9-19 W4M	DRILL METHOD: 150mm SOLID STEM AUGER	L12101915 - 11P001
SITE: STAFFORD LAKE	PROJECT ENGINEER: TREVOR CURTIS	

SAMPLE TYPE: DISTURBED | NO RECOVERY | SPT | A-CASING | SHELBY TUBE | CORE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	MOISTURE CONTENT	PLASTIC M.C. LIQUID (20 40 60 80)	STANDARD PENETRATION (N) (20 40 60 80) / UNCONFINED (kPa) (50 100 150 200) / POCKET PEN. (kPa) (100 200 300 400)	Depth (ft)
0	TOPSOIL - clay, silty, sandy, moist, dark brown, roots, organics						0
	CLAY (TILL) - silty, some sand, trace gravel, moist, stiff, medium plastic, brown, coal and oxide specks, white precipitates						
			B1	19			
1							
			B2	16.9			5
2			B3	18.1			
			B4				
3	... oxide staining		B5	16.6			10
			B6	16.5			
4			B7	17.1			
	End of Borehole @ 4.6m						15
5	No Seepage or Sloughing on Completion 50mm PVC Standpipe Installed to 4.6m, Bottom 1.5M Screened Borehole Measured Dry November 1, 2011						
6							20
7							
							25
8							
9							30
10							
							35
11							
11.5							38

EBA Engineering Consultants Ltd.

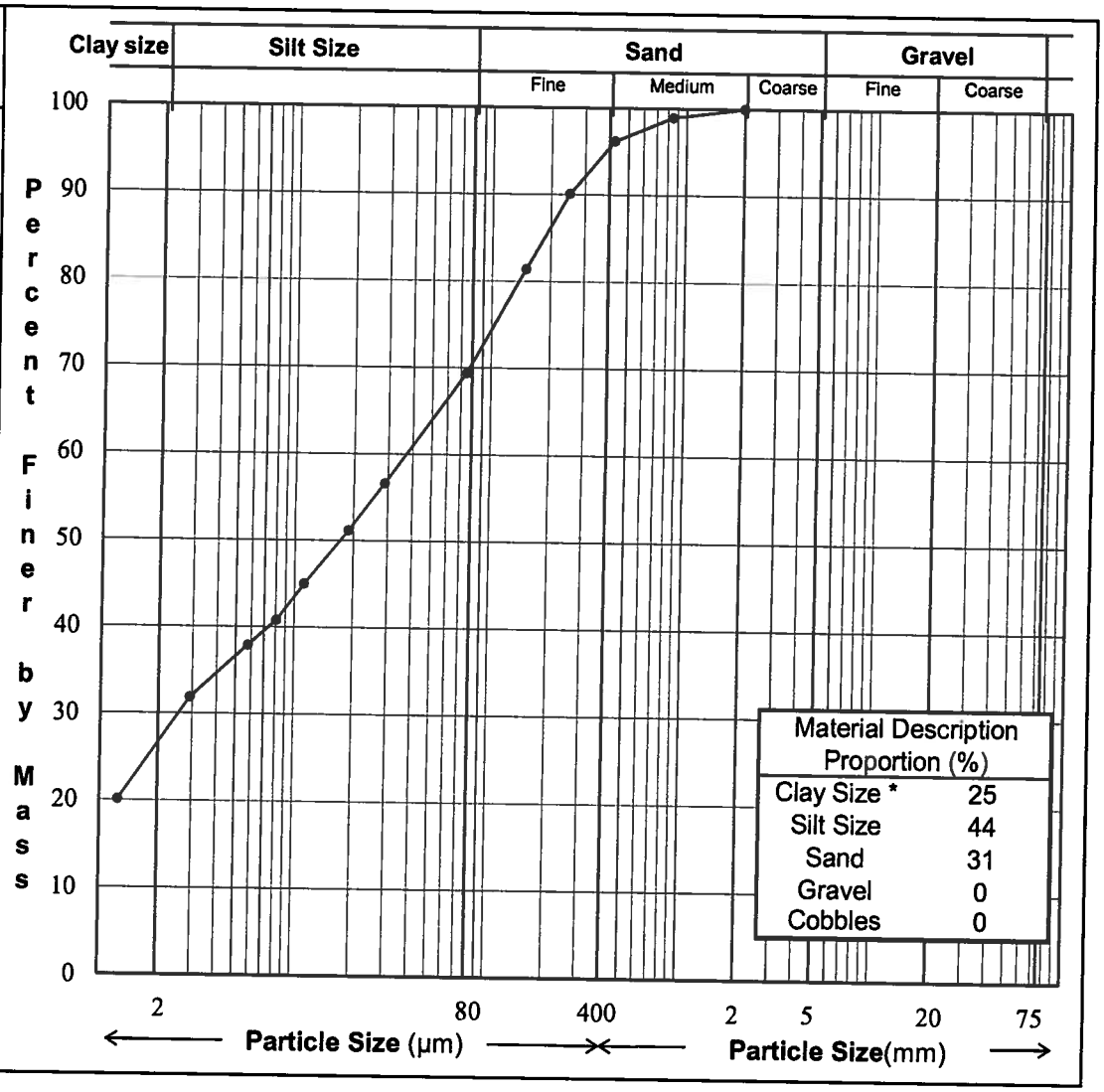
LOGGED BY: AF	COMPLETION DEPTH: 4.6m
REVIEWED BY: TC	COMPLETE: 10/26/2011
DRAWING NO: B1	Page 1 of 1

PARTICLE SIZE ANALYSIS (Hydrometer) TEST REPORT

ASTM D422

Project:	Effluent Disposal Area	Sample No.:	
Client:	Stafford Devlopments	Borehole/ TP:	11P001
Project No.:	L12101915	Depth:	1.2 m
Location:	Stafford Landing	Date Tested	November 20, 2011
Description **:	CLAY - silty, sandy		

Particle Size	Percent Passing
100 mm	
75 mm	
50 mm	
38 mm	
25 mm	
19 mm	
13 mm	
10 mm	
5 mm	
2 mm	100
850 µm	99
425 µm	96
250 µm	90
150 µm	81
75 µm	69
29 µm	57
19 µm	51
11 µm	45
8 µm	41
6 µm	38
3 µm	32
1 µm	20



Remarks: * The upper clay size of 2 µm is as per the Canadian Foundation Manual.

** The description is behaviour based & subject to EBA description protocols.

Reviewed By: _____ P.Eng.

eba
A TETRATECH COMPANY

PROJECT: EFFLUENT DISPOSAL AREA	CLIENT: STAFFORD DEVELOPMENTS	PROJECT NO. - BOREHOLE NO.
LOCATION: NE 1/4 14-9-19 W4M	DRILL METHOD: 150mm SOLID STEM AUGER	L12101915 - 11P002
SITE: STAFFORD LAKE	PROJECT ENGINEER: TREVOR CURTIS	

SAMPLE TYPE: DISTURBED | NO RECOVERY | SPT | A-CASING | SHELBY TUBE | CORE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	MOISTURE CONTENT	PLASTIC M.C. LIQUID (20 40 60 80)	STANDARD PENETRATION (N) (20 40 60 80) / UNCONFINED (kPa) (50 100 150 200) / POCKET PEN. (kPa) (100 200 300 400)	Depth (ft)
0	TOPSOIL - clay, silty, sandy, moist, dark brown, roots, organics						0
	CLAY (TILL) - silty, some sand, trace gravel, damp to moist, hard, medium plastic, light brown, coal and oxide specks, white precipitates						
			B1	16.1	●		
1			B2	11	●—|		5
	... moist, very stiff, brown						
2			B3	14.5	●		
	... stiff		B4	17	●		
3			B5	18.3	●		10
	... oxide staining						
			B6	16.8	●		
4			B7	18	●		
	End of Borehole @ 4.6m						15
5	No Seepage or Sloughing on Completion 50mm PVC Standpipe Installed to 4.6m, Bottom 1.5M Screened Borehole Measured Dry November 1, 2011						
6							20
7							
							25
8							
9							30
10							
							35
11							
11.5							38

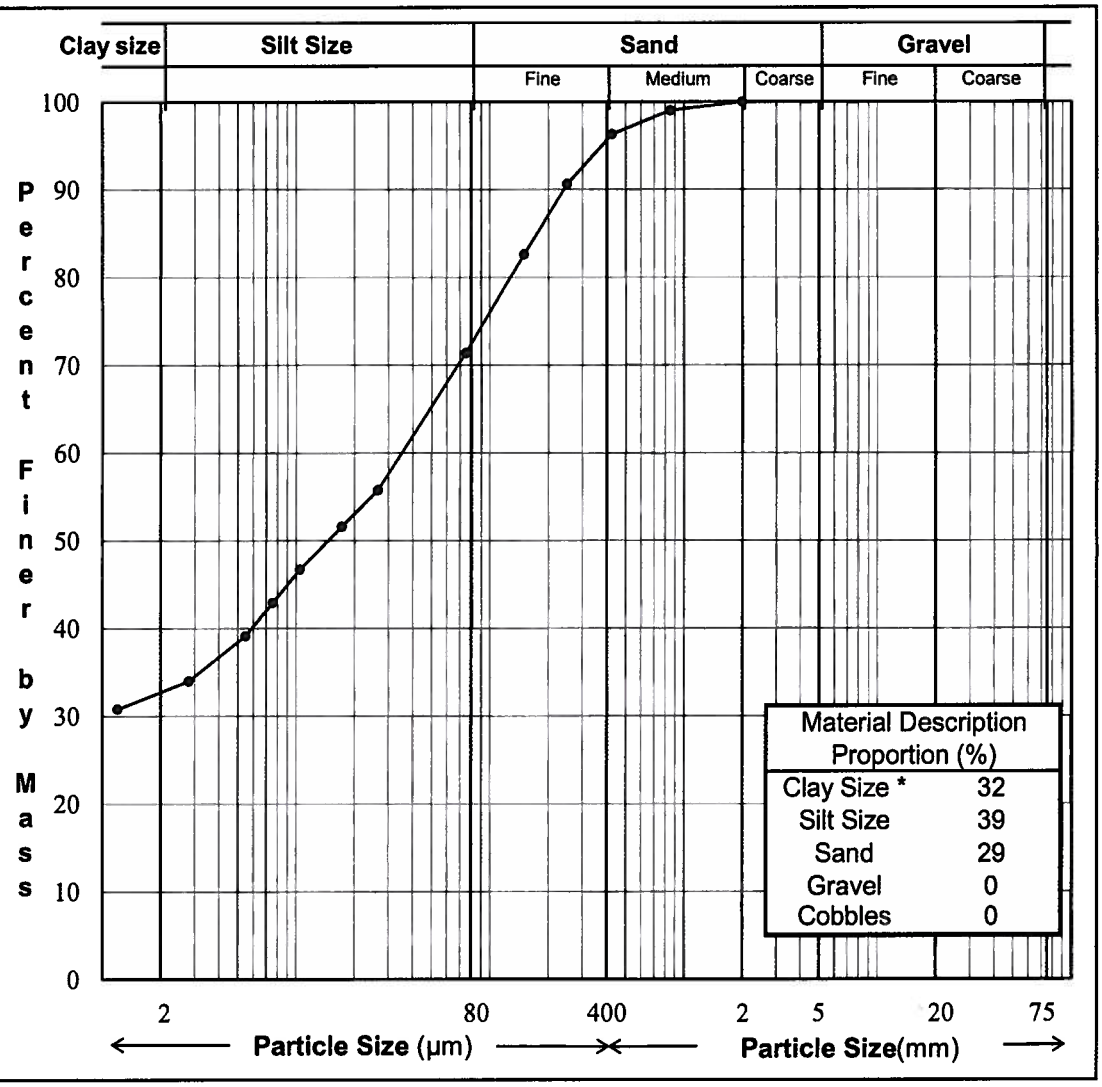
EBA Engineering Consultants Ltd.	LOGGED BY: AF	COMPLETION DEPTH: 4.6m
	REVIEWED BY: TC	COMPLETE: 10/26/2011
	DRAWING NO: B2	Page 1 of 1

PARTICLE SIZE ANALYSIS (Hydrometer) TEST REPORT

ASTM D422

Project:	Effluent Disposal Area	Sample No.:	
Client:	Stafford Devlopments	Borehole/ TP:	11P002
Project No.:	L12101915	Depth:	1.2 m
Location:	Stafford Landing	Date Tested	November 15, 2011
Description **:	CLAY - silty, sandy		

Particle Size	Percent Passing
100 mm	
75 mm	
50 mm	
38 mm	
25 mm	
19 mm	
13 mm	
10 mm	
5 mm	
2 mm	100
850 µm	99
425 µm	96
250 µm	91
150 µm	83
75 µm	71
26 µm	56
17 µm	52
10 µm	47
8 µm	43
5 µm	39
3 µm	34
1 µm	31



Remarks: * The upper clay size of 2 µm is as per the Canadian Foundation Manual.

** The description is behaviour based & subject to EBA description protocols.

Reviewed By: _____ P.Eng.

PROJECT: EFFLUENT DISPOSAL AREA	CLIENT: STAFFORD DEVELOPMENTS	PROJECT NO. - BOREHOLE NO.
LOCATION: NE 1/4 14-9-19 W4M	DRILL METHOD: 150mm SOLID STEM AUGER	L12101915 - 11P003
SITE: STAFFORD LAKE	PROJECT ENGINEER: TREVOR CURTIS	

SAMPLE TYPE: DISTURBED | NO RECOVERY | SPT | A-CASING | SHELBY TUBE | CORE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	MOISTURE CONTENT	PLASTIC M.C. LIQUID (20 40 60 80)	STANDARD PENETRATION (N) (20 40 60 80) / UNCONFINED (kPa) (50 100 150 200) / POCKET PEN. (kPa) (100 200 300 400)	Depth (ft)
0	TOPSOIL - clay, silty, sandy, moist, dark brown, roots, organics						0
	CLAY (FILL) - silty, some sand, trace gravel, moist, stiff, medium plastic, brown, coal and oxide specks, trace organics						
1			B1	21.6			
	CLAY (TILL) - silty, some sand to sandy, trace gravel, very moist, firm, medium plastic, brown, coal and oxide specks, white precipitates		B2	17.1			5
2	... moist to very moist, stiff, thin sand lenses		B3	19.2			
			B4	19.1			
3			B5	18.6			10
	... some sand, moist, very stiff, oxide staining						
4			B6	18.1			
			B7	16.9			15
	End of Borehole @ 4.6m						
5	No Seepage or Sloughing on Completion 50mm PVC Standpipe Installed to 4.6m, Bottom 1.5M Screened Borehole Measured Dry November 1, 2011						20
6							
7							25
8							
9							30
10							
							35
11							
11.5							38

EBA Engineering Consultants Ltd.

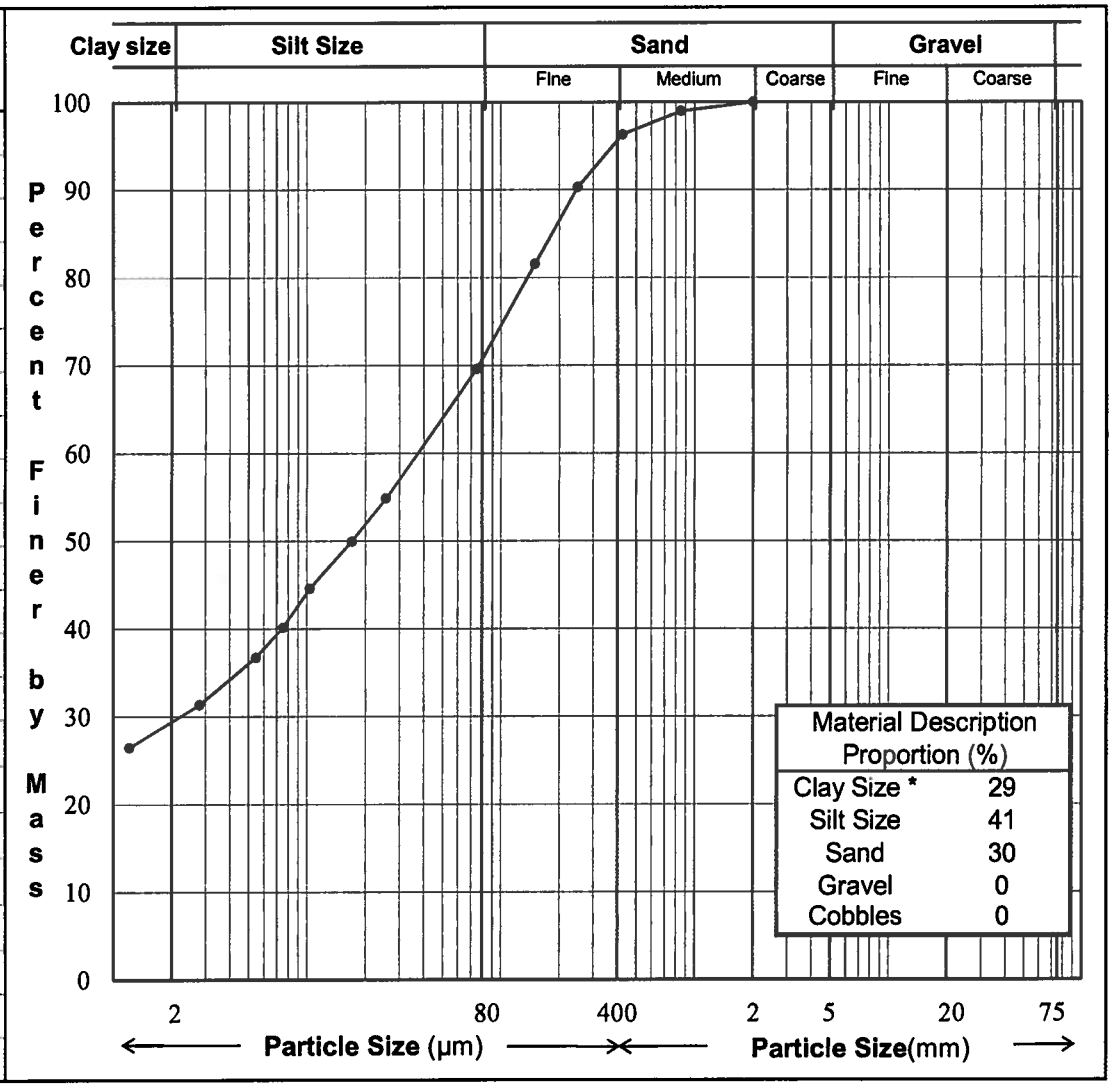
LOGGED BY: AF	COMPLETION DEPTH: 4.6m
REVIEWED BY: TC	COMPLETE: 10/26/2011
DRAWING NO: B3	Page 1 of 1

PARTICLE SIZE ANALYSIS (Hydrometer) TEST REPORT

ASTM D422

Project:	Effluent Disposal Area	Sample No.:	
Client:	Stafford Devlopments	Borehole/ TP:	11P003
Project No.:	L12101915	Depth:	1.2 m
Location:	Stafford Landing	Date Tested	November 15, 2011
Description **:	CLAY - silty, sandy		

Particle Size	Percent Passing
100 mm	
75 mm	
50 mm	
38 mm	
25 mm	
19 mm	
13 mm	
10 mm	
5 mm	
2 mm	100
850 µm	99
425 µm	96
250 µm	90
150 µm	82
75 µm	70
26 µm	55
17 µm	50
10 µm	45
8 µm	40
5 µm	37
3 µm	31
1 µm	26



Remarks: * The upper clay size of 2 µm is as per the Canadian Foundation Manual.

** The description is behaviour based & subject to EBA description protocols.

Reviewed By: _____ P.Eng.

PROJECT: EFFLUENT DISPOSAL AREA	CLIENT: STAFFORD DEVELOPMENTS	PROJECT NO. - BOREHOLE NO.
LOCATION: NE 1/4 14-9-19 W4M	DRILL METHOD: 150mm SOLID STEM AUGER	L12101915 - 11P004
SITE: STAFFORD LAKE	PROJECT ENGINEER: TREVOR CURTIS	

SAMPLE TYPE: DISTURBED | NO RECOVERY | SPT | A-CASING | SHELBY TUBE | CORE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	MOISTURE CONTENT	PLASTIC M.C. LIQUID (20 40 60 80)	STANDARD PENETRATION (N) (20 40 60 80) / UNCONFINED (kPa) (50 100 150 200) / POCKET PEN. (kPa) (100 200 300 400)	Depth (ft)
0	TOPSOIL - clay, silty, sandy, moist, dark brown, roots, organics						0
	CLAY (FILL) - silty, some sand, trace gravel, moist, stiff, medium plastic, brown, coal and oxide specks, trace organics						
			B1	18.9			
1							
	CLAY (TILL) - silty, sandy, trace gravel, very moist, firm, low plastic, brown, coal and oxide specks, white precipitates		B2	19.1			5
2	... some sand, moist, stiff, medium plastic		B3	16.4			
	... gypsum crystals						
			B4	18.2			
3							10
	... oxide staining		B5	18.4			
	... oxide staining		B6	17.9			
4							
			B7	17.3			
	End of Borehole @ 4.6m						15
5	No Seepage or Sloughing on Completion 50mm PVC Standpipe Installed to 4.6m, Bottom 1.5M Screened Borehole Measured Dry November 1, 2011						
6							20
7							
							25
8							
9							30
10							
							35
11							
11.5							38

EBA Engineering Consultants Ltd.

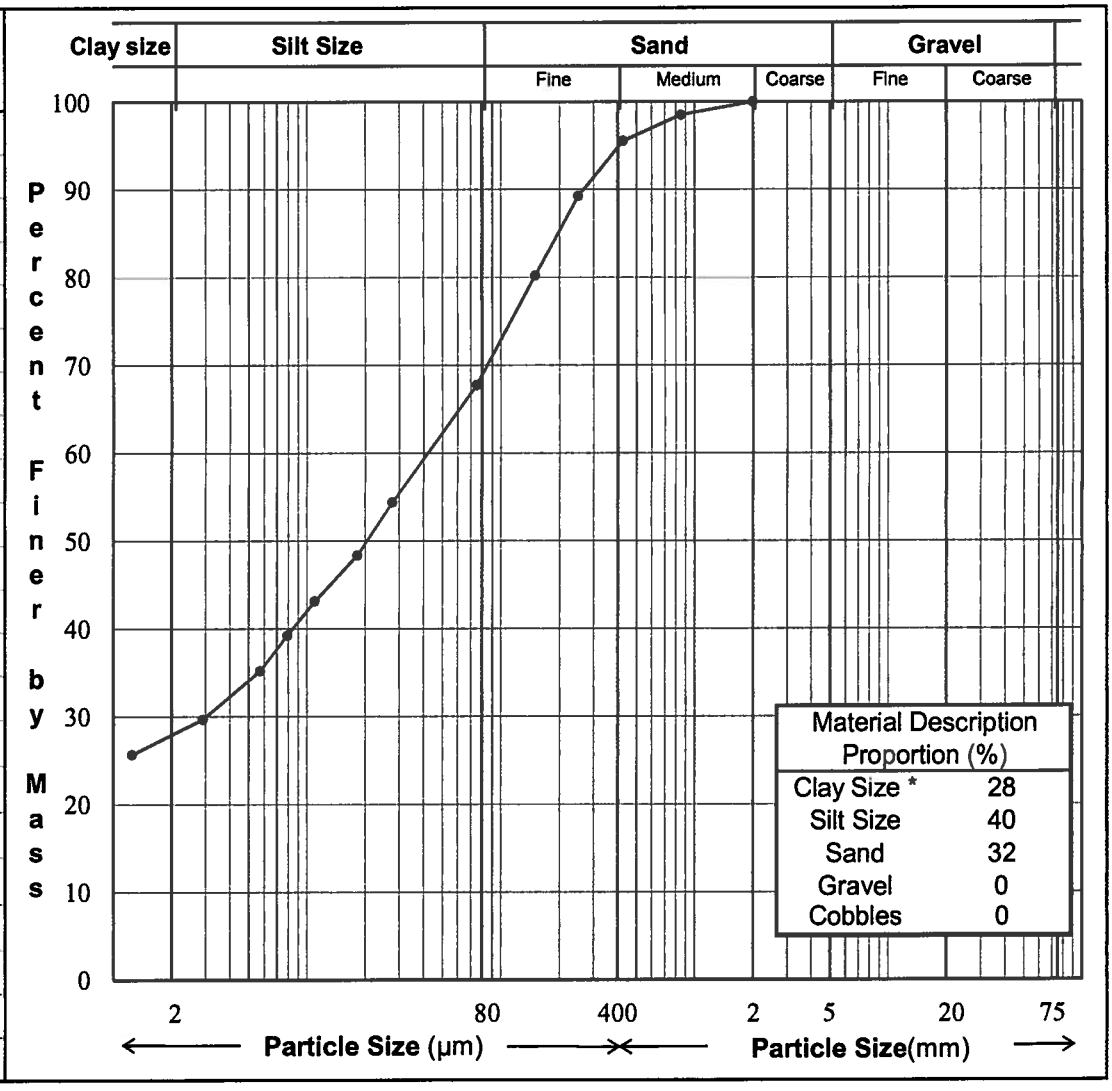
LOGGED BY: AF	COMPLETION DEPTH: 4.6m
REVIEWED BY: TC	COMPLETE: 10/26/2011
DRAWING NO: B4	Page 1 of 1

PARTICLE SIZE ANALYSIS (Hydrometer) TEST REPORT

ASTM D422

Project:	Effluent Disposal Area	Sample No.:	
Client:	Stafford Devlopments	Borehole/ TP:	11P004
Project No.:	L12101915	Depth:	1.2 m
Location:	Stafford Landing	Date Tested	November 15, 2011
Description **:	CLAY - silty, sandy		

Particle Size	Percent Passing
100 mm	
75 mm	
50 mm	
38 mm	
25 mm	
19 mm	
13 mm	
10 mm	
5 mm	
2 mm	100
850 µm	99
425 µm	96
250 µm	89
150 µm	80
75 µm	68
28 µm	54
18 µm	48
11 µm	43
8 µm	39
6 µm	35
3 µm	30
1 µm	26



Remarks: * The upper clay size of 2 µm is as per the Canadian Foundation Manual.

** The description is behaviour based & subject to EBA description protocols.

Reviewed By: _____ P.Eng.

PROJECT: EFFLUENT DISPOSAL AREA	CLIENT: STAFFORD DEVELOPMENTS	PROJECT NO. - BOREHOLE NO.
LOCATION: NE 1/4 14-9-19 W4M	DRILL METHOD: 150mm SOLID STEM AUGER	L12101915 - 11MW001
SITE: STAFFORD LAKE	PROJECT ENGINEER: TREVOR CURTIS	

SAMPLE TYPE: DISTURBED | NO RECOVERY | SPT | A-CASING | SHELBY TUBE | CORE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	MOISTURE CONTENT	PLASTIC M.C. LIQUID (20 40 60 80)	STANDARD PENETRATION (N) (20 40 60 80) / UNCONFINED (kPa) (50 100 150 200) / POCKET PEN. (kPa) (100 200 300 400)	Depth (ft)
0	TOPSOIL - clay, silty, damp, dark brown, roots, organics						0
	CLAY (TILL) - silty, trace sand, trace gravel, damp to moist, very stiff, high plastic, brown, coal and oxide specks		B1	15.4			
1							
	... moist, stiff, occasional silt lenses		B2	14.8			5
	.. some sand. medium plastic						
2	11/22/11		B3	12.8			
			B4	17.4			
	... occasional coal inclusion						
3	... sand lenses		B5	18.6			10
			B6	17.6			
	... high plastic clay inclusion						
4			B7	16			15
5			B8	17.6			
			B9	17.9			
6	... dark brown mottling		B10	15.4			20
			B11	16.9			
7			B12	16.9			25
8			B13	16.2			
			B14	16.1			
9	... trace free water		B15	17.4			30
	End of Borehole @ 9.1m						
	Seepage @ 8.9m, No Sloughing 50mm PVC Standpipe INstalled to 9.1m, Bottom 3.0m Screened Indicated Water Level measured November 22, 2011						
10							35
11							
11.5							38

11/22/11

PROJECT: EFFLUENT DISPOSAL AREA	CLIENT: STAFFORD DEVELOPMENTS	PROJECT NO. - BOREHOLE NO.
LOCATION: NE 1/4 14-9-19 W4M	DRILL METHOD: 150mm SOLID STEM AUGER	L12101915 - 11MW002
SITE: STAFFORD LAKE	PROJECT ENGINEER: TREVOR CURTIS	

SAMPLE TYPE: DISTURBED | NO RECOVERY | SPT | A-CASING | SHELBY TUBE | CORE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	MOISTURE CONTENT
0	TOPSOIL - clay, silty, damp, dark brown, roots, organics			
	CLAY (TILL) - silty, trace to somesand, trace gravel, moist, very stiff, medium to hihg plastic, brown, coal and oxide specks			
			B1	12.8
1	... occasional coal inclusions			
			B2	15.5
	... some sand, medium plastic			
2			B3	16.1
	... oxide stainig		B4	17.5
3			B5	17.5
	... dark brown mottling			
	11/22/11		B6	19.2
4			B7	18.9
5			B8	17.7
			B9	17.8
6			B10	18.6
			B11	16.6
7			B12	15.7
8			B13	16.5
	... high plastic clay inclusions		B14	16.2
9	... very moist		B15	16.2
	End of Borehole @ 9.1m			
	No Seepage or Sloughing on Completion 50mm PVC Standpipe Installed to 9.1m, Bottom 3.0m Screened Indicated Water Level measured November 22, 2011			
10				
11				
11.5				

PLASTIC M.C. LIQUID (20 40 60 80)

STANDARD PENETRATION (N) (20 40 60 80)

UNCONFINED (kPa) (50 100 150 200)

POCKET PEN. (kPa) (100 200 300 400)

Depth (ft): 0, 5, 10, 15, 20, 25, 30, 35, 38

11/22/11

EBA Engineering Consultants Ltd.	LOGGED BY: AF	COMPLETION DEPTH: 9.1m
	REVIEWED BY: TC	COMPLETE: 11/18/2011
	DRAWING NO: B7	Page 1 of 1

PROJECT: EFFLUENT DISPOSAL AREA	CLIENT: STAFFORD DEVELOPMENTS	PROJECT NO. - BOREHOLE NO.
LOCATION: NE 1/4 14-9-19 W4M	DRILL METHOD: 150mm SOLID STEM AUGER	L12101915 - 11MW003
SITE: STAFFORD LAKE	PROJECT ENGINEER: TREVOR CURTIS	

SAMPLE TYPE: DISTURBED | NO RECOVERY | SPT | A-CASING | SHELBY TUBE | CORE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	MOISTURE CONTENT
0	TOPSOIL - clay, silty, damp, dark brown, roots, organics			
	CLAY (TILL) - silty, some sand, trace gravel, moist, very stiff, medium plastic, brown, coal and oxide specks, white precipitates		B1	17.4
1			B2	18
2			B3	18.9
			B4	18.8
3			B5	18.4
	... occasional coal inclusion			
4			B6	17.8
			B7	17.6
5			B8	17.8
			B9	17.3
6			B10	17.8
			B11	16.9
7			B12	16.6
8			B13	17
	... light brown mottling		B14	17.3
9			B15	18
	End of Borehole @ 9.1m			
	No Seepage or Sloughing on Completion 50mm PVC Standpipe Installed to 9.1, Bottom 3.0m Screened Indicated Water Level Measured November 22, 2011			
10				
11				
11.5				

PLASTIC M.C. LIQUID (20 40 60 80)

STANDARD PENETRATION (N) (20 40 60 80)

UNCONFINED (kPa) (50 100 150 200)

POCKET PEN. (kPa) (100 200 300 400)

11/22/11

Depth (ft): 0, 5, 10, 15, 20, 25, 30, 35, 38

EBA Engineering Consultants Ltd.	LOGGED BY: AF	COMPLETION DEPTH: 9.1m
	REVIEWED BY: TC	COMPLETE: 11/18/2011
	DRAWING NO: B8	Page 1 of 1

PROJECT: EFFLUENT DISPOSAL AREA	CLIENT: STAFFORD DEVELOPMENTS	PROJECT NO. - BOREHOLE NO.
LOCATION: NE 1/4 14-9-19 W4M	DRILL METHOD: 150mm SOLID STEM AUGER	L12101915 - 11BH005
SITE: STAFFORD LAKE	PROJECT ENGINEER: TREVOR CURTIS	

SAMPLE TYPE: DISTURBED | NO RECOVERY | SPT | A-CASING | SHELBY TUBE | CORE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	SPT (N)	MOISTURE CONTENT
0	TOPSOIL - clay, silty, sandy, moist, dark brown, roots, organics				
	CLAY - silty, sandy, very moist, firm, low plastic, light brown, white precipitates		B1		29.6
1	CLAY - silty, trace sand, very moist, firm, high plastic, light brown with dark brown mottling		B2		35
	11/01/11				
	... medium grained sand lenses with trace free water		B1	7	
2	CLAY (TILL) - silty, some sand, trace gravel, moist, stiff, medium plastic, brown, coal and oxide specks, white precipitates		B3		26.4
			B4		20
3			D2	9	
	... gypsum crystals		B5		21.3
4			B6		18
			D3	13	
5			B7		17.5
	... oxide staining		B8		17.3
6			D4	16	
			B9		16.8
7			B10		17.3
			D5	16	
8	... sand lenses		B11		17.5
	... very stiff, dark brown mottling		B12		17.2
9			D6	29	
	End of Borehole @ 9.6m				
10	No Seepage or Sloughing on Completion Slotted 25mm PVC Standpipe Installed to 9.6m Indicated Water Level Measured November 1, 2011				
11					
11.5					

PLASTIC M.C. LIQUID (20 40 60 80)

STANDARD PENETRATION (N) (20 40 60 80)

UNCONFINED (kPa) (50 100 150 200)

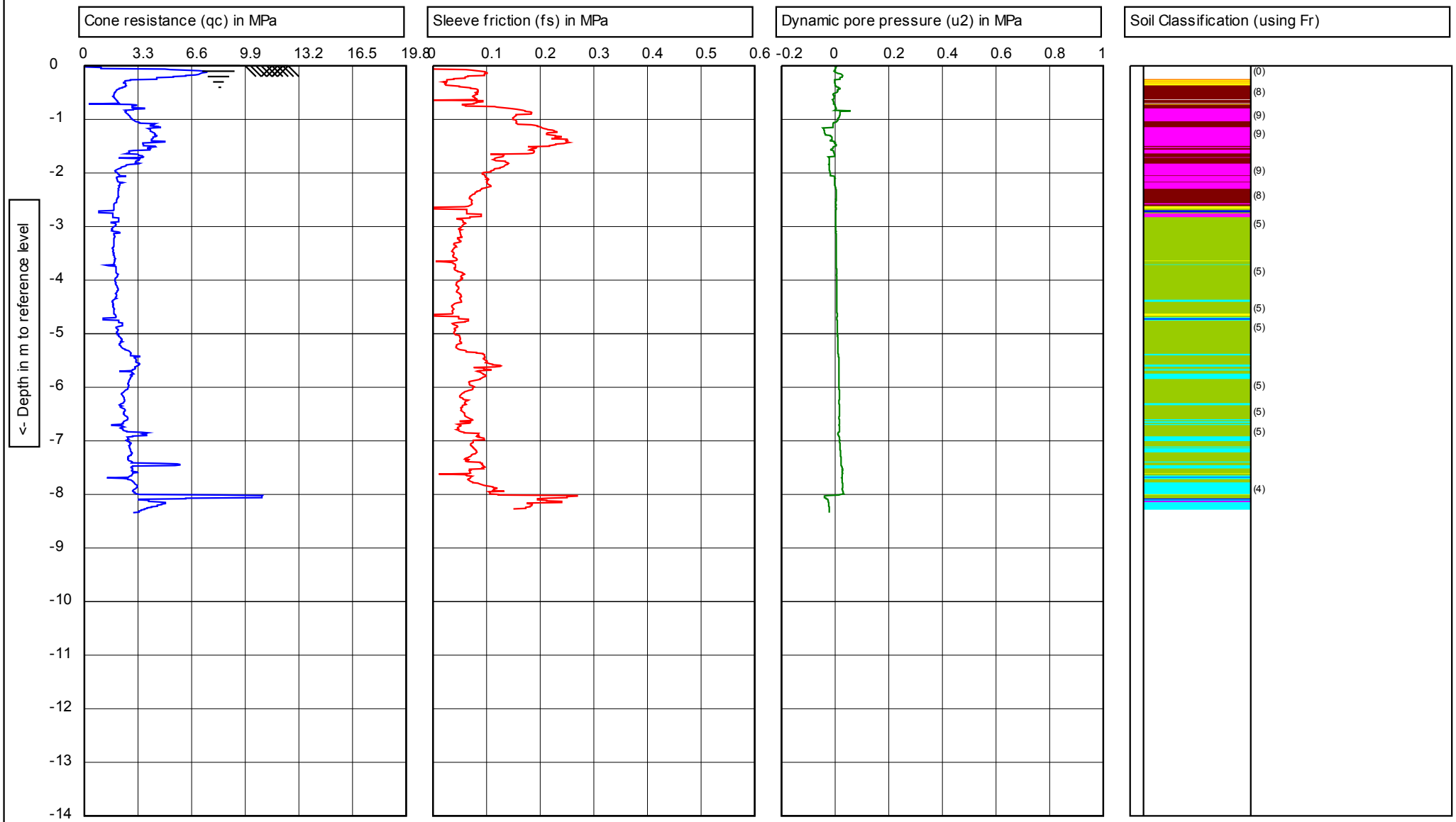
POCKET PEN. (kPa) (100 200 300 400)

Depth (ft)
0
5
10
15
20
25
30
35
38

11/01/11

EBA Engineering Consultants Ltd.

LOGGED BY: AF	COMPLETION DEPTH: 9.6m
REVIEWED BY: TC	COMPLETE: 10/26/2011
DRAWING NO: B5	Page 1 of 1

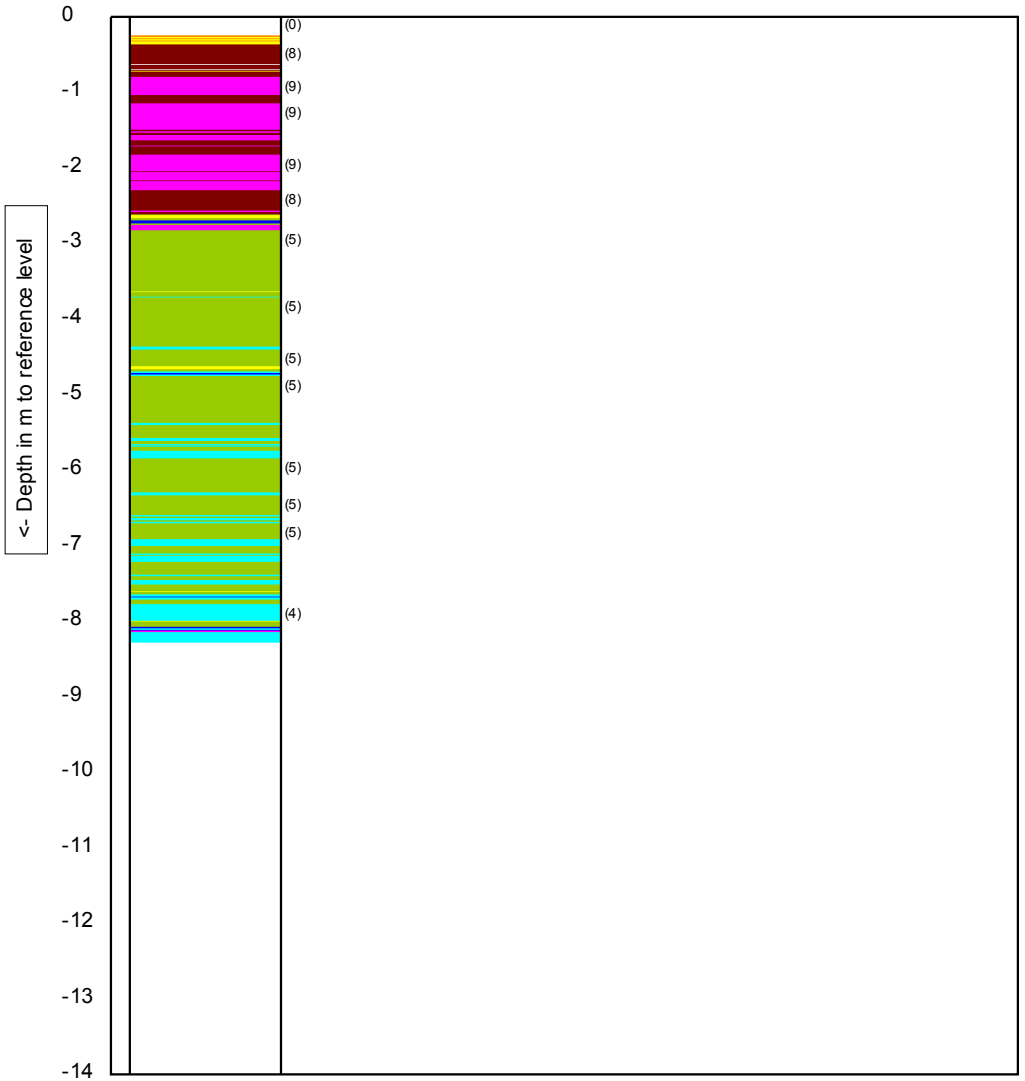


CHILAKO DRILLING

CPTask V1.24

u2 150 cm² 10 cm²	Test according NEN 5140 class 1		Predrill : **0**
	G.L. **0 NAP**	W.L.: **0**	Date: **12/15/2011**
Project: **Stafford Landing**			Cone no.: **C10CFIP.g44**
Location: **Stafford Landing**			Project no.: **L12101915**
Position:			CPT no.: **CPT 1** **1/2**

Soil Classification (using Fr)

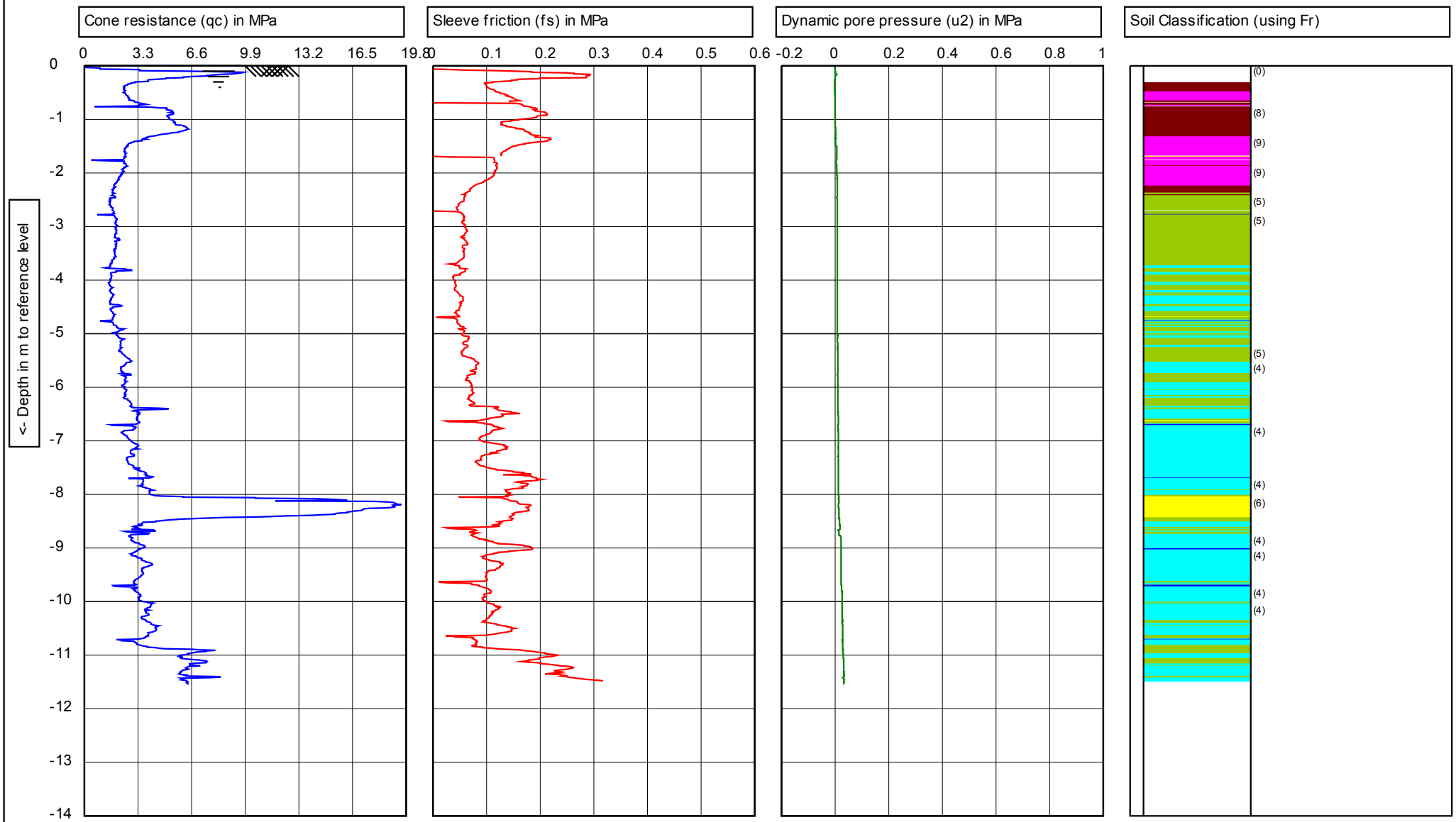


(0) Not defined
(1) Sensitive, fine grained
(2) Organic soils-peats
(3) Clays-clay to silty clay
(4) Clayey silt to silty clay
(5) Sand mixtures
(6) Sands
(7) Gravelly sand to sand
(8) Very stiff sand to clayey sand
(9) Very stiff fine grained

CHILAKO DRILLING

CPTask V1.24

┌ u2 └ 150 cm² 10 cm²	Test according NEN 5140 class 1		Predrill : 0
	G.L. 0 NAP	W.L.: 0	Date: 12/15/2011
Project: Stafford Landing			Cone no.: C10CFIP.g44
Location: Stafford Landing			Project no.: L12101915
Position:			CPT no.: CPT 1 2/2

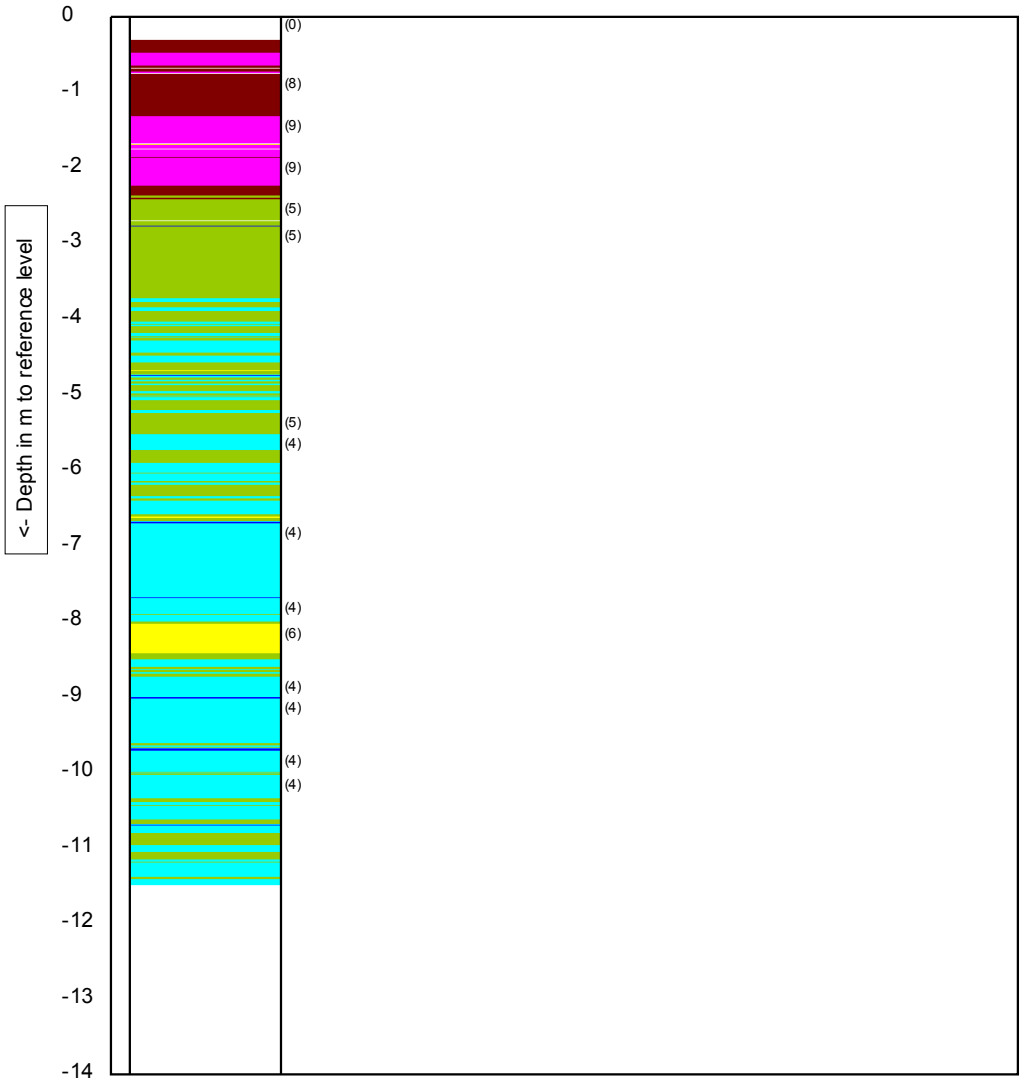


CHILAKO DRILLING

CPTask V1.24

u2 150 cm² 10 cm²	Test according NEN 5140 class 1		Predrill : **0**
	G.L. **0 NAP**	W.L.: **0**	Date: **12/15/2011**
Project: **Stafford Landing**			Cone no.: **C10CFIP.g44**
Location: **Stafford Landing**			Project no.: **L12101915**
Position:			CPT no.: **CPT 2** **1/2**

Soil Classification (using Fr)

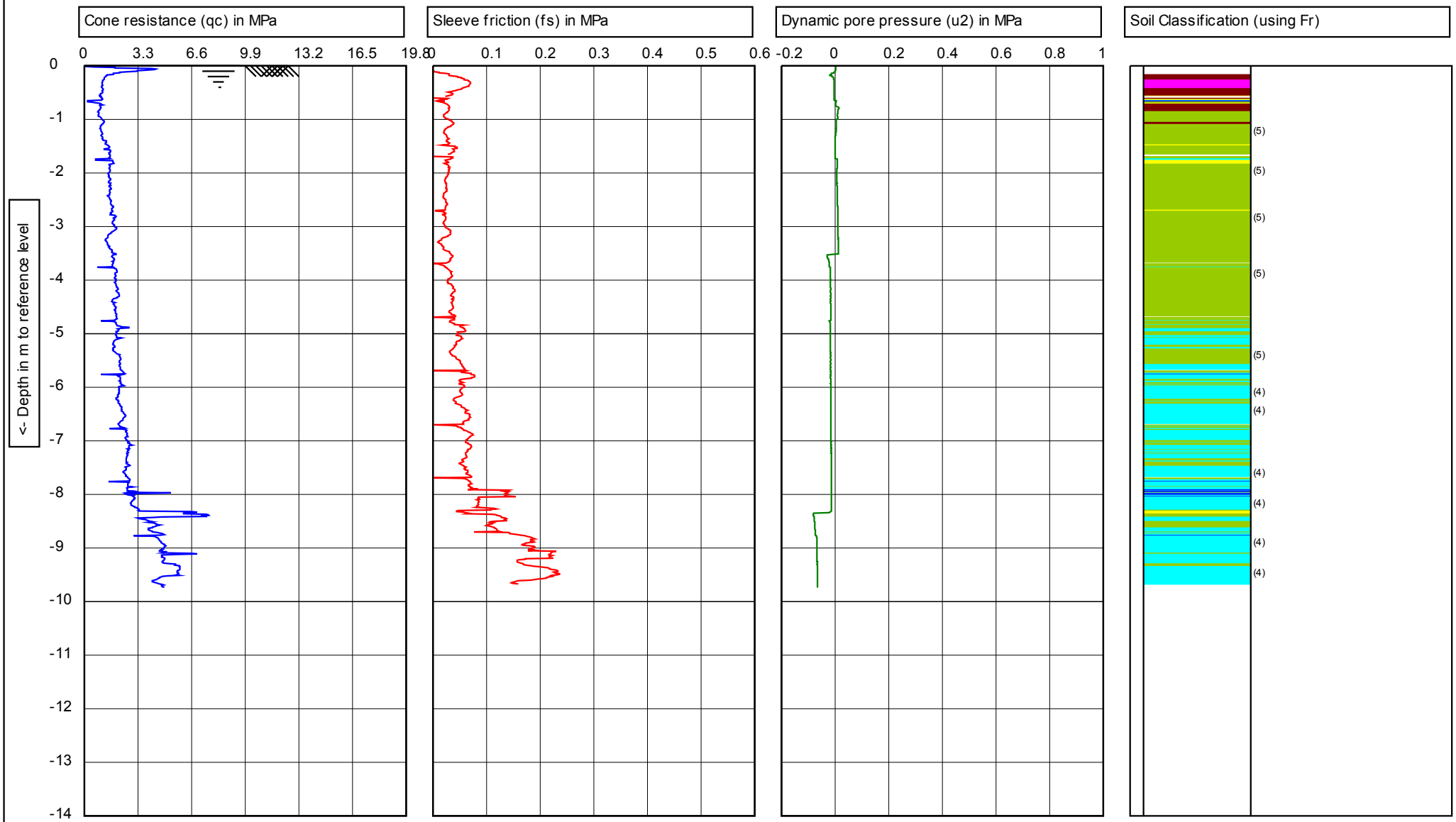


(0) Not defined
(1) Sensitive, fine grained
(2) Organic soils-peats
(3) Clays-clay to silty clay
(4) Clayey silt to silty clay
(5) Sand mixtures
(6) Sands
(7) Gravelly sand to sand
(8) Very stiff sand to clayey sand
(9) Very stiff fine grained

CHILAKO DRILLING

CPTask V1.24

r u2 / L 150 cm² / 10 cm²	Test according NEN 5140 class 1		Predrill : **0**
	G.L. **0 NAP**	W.L.: **0**	Date: **12/15/2011**
Project: **Stafford Landing**			Cone no.: **C10CFIP.g44**
Location: **Stafford Landing**			Project no.: **L12101915**
Position:			CPT no.: **CPT 2** **2/2**

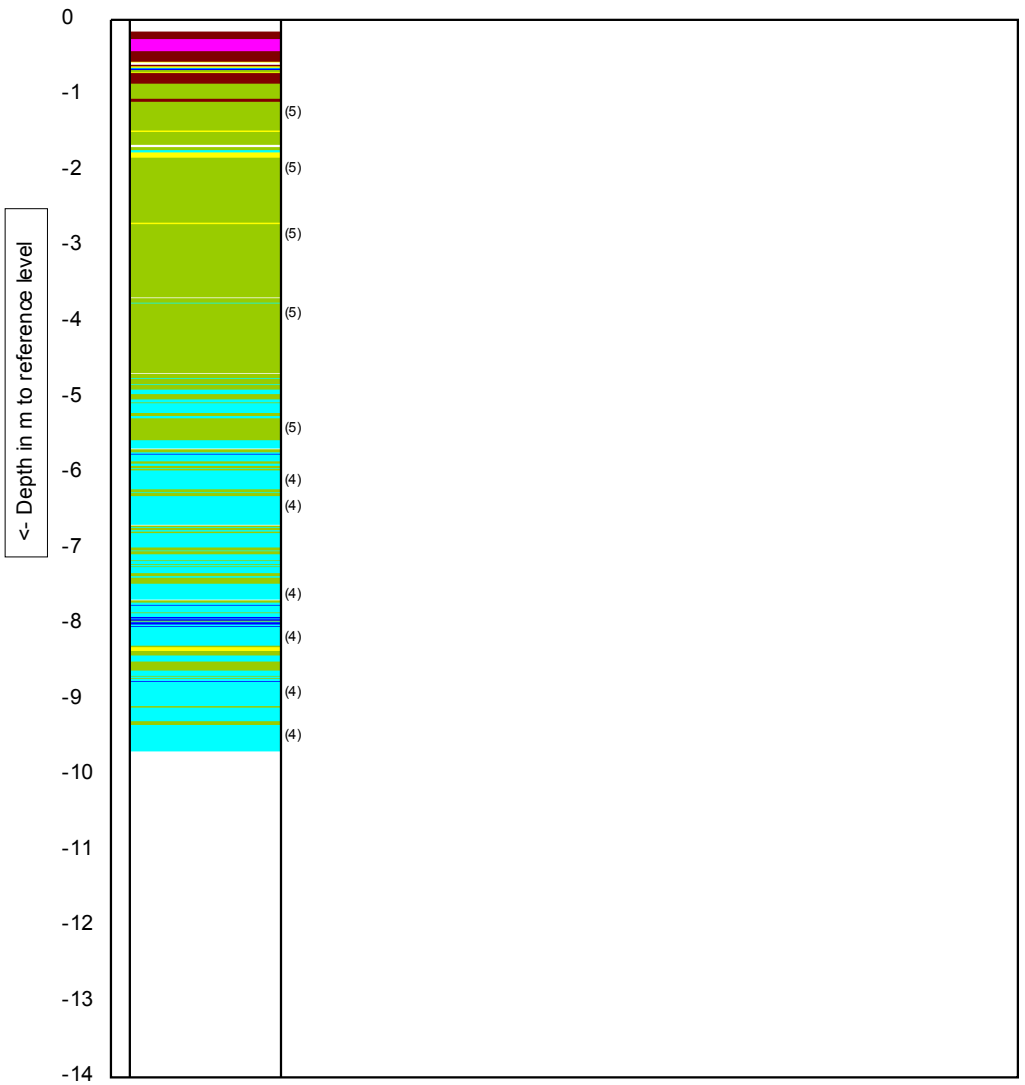


CHILAKO DRILLING

CPTask V1.24

u2 150 cm² 10 cm²	Test according NEN 5140 class 1		Predrill : **0**
	G.L. **0 NAP**	W.L.: **0**	Date: **12/15/2011**
Project: **Stafford Landing**			Cone no.: **C10CFIP.g44**
Location: **Stafford Landing**			Project no.: **L12101915**
Position:			CPT no.: **CPT3** **1/2**

Soil Classification (using Fr)



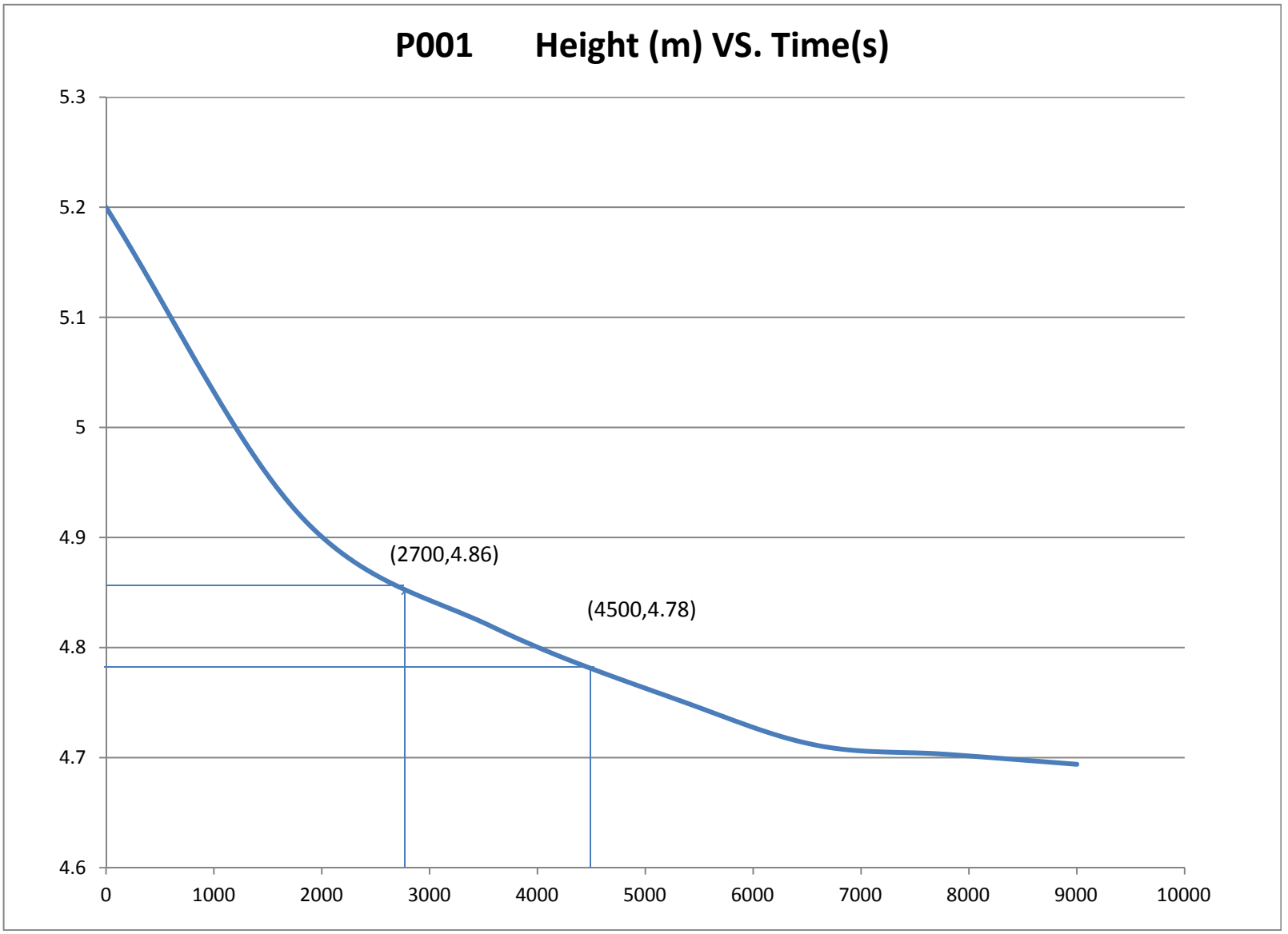
(0) Not defined
(1) Sensitive, fine grained
(2) Organic soils-peats
(3) Clays-clay to silty clay
(4) Clayey silt to silty clay
(5) Sand mixtures
(6) Sands
(7) Gravelly sand to sand
(8) Very stiff sand to clayey sand
(9) Very stiff fine grained

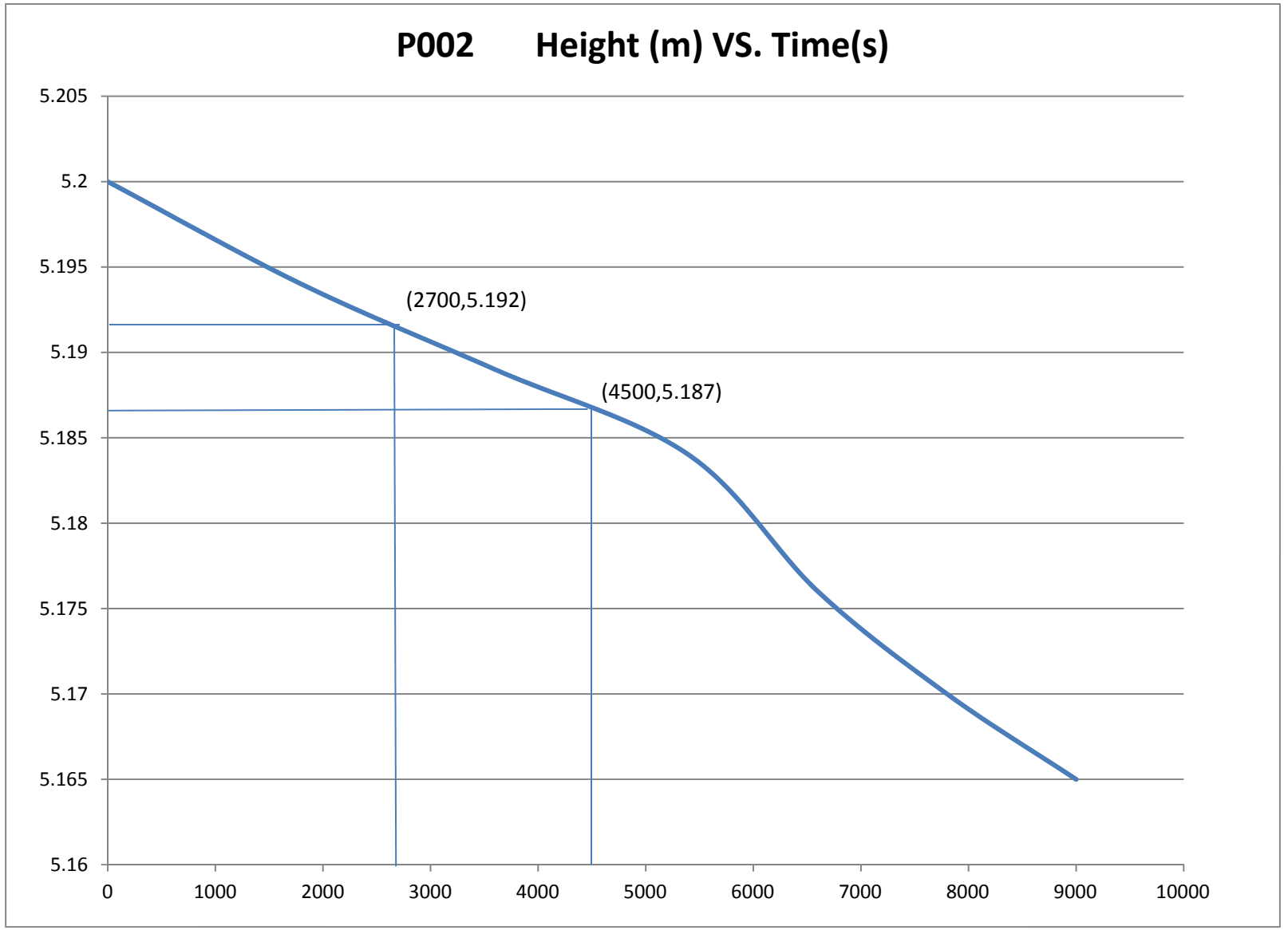
CHILAKO DRILLING

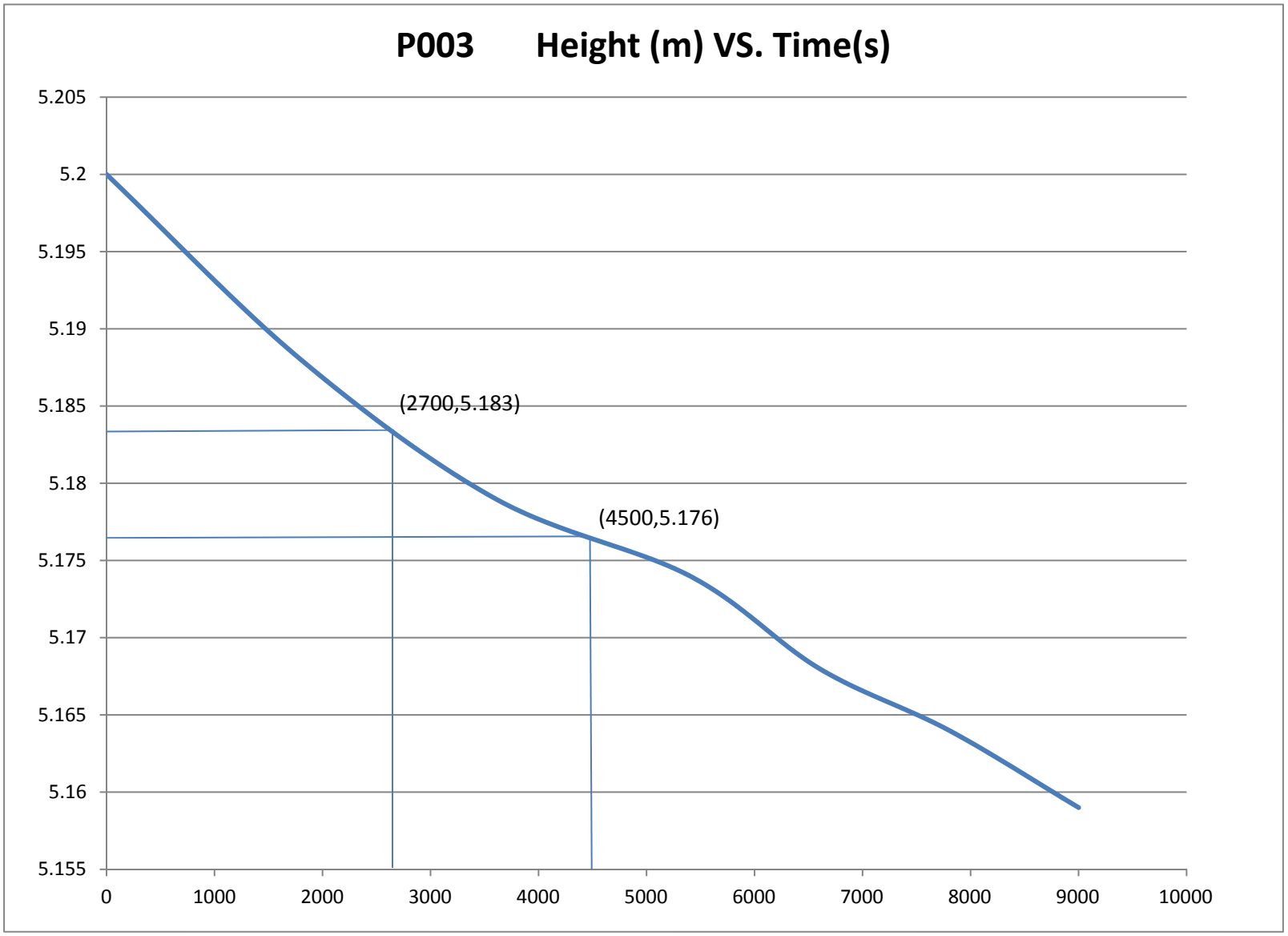
CPTask V1.24

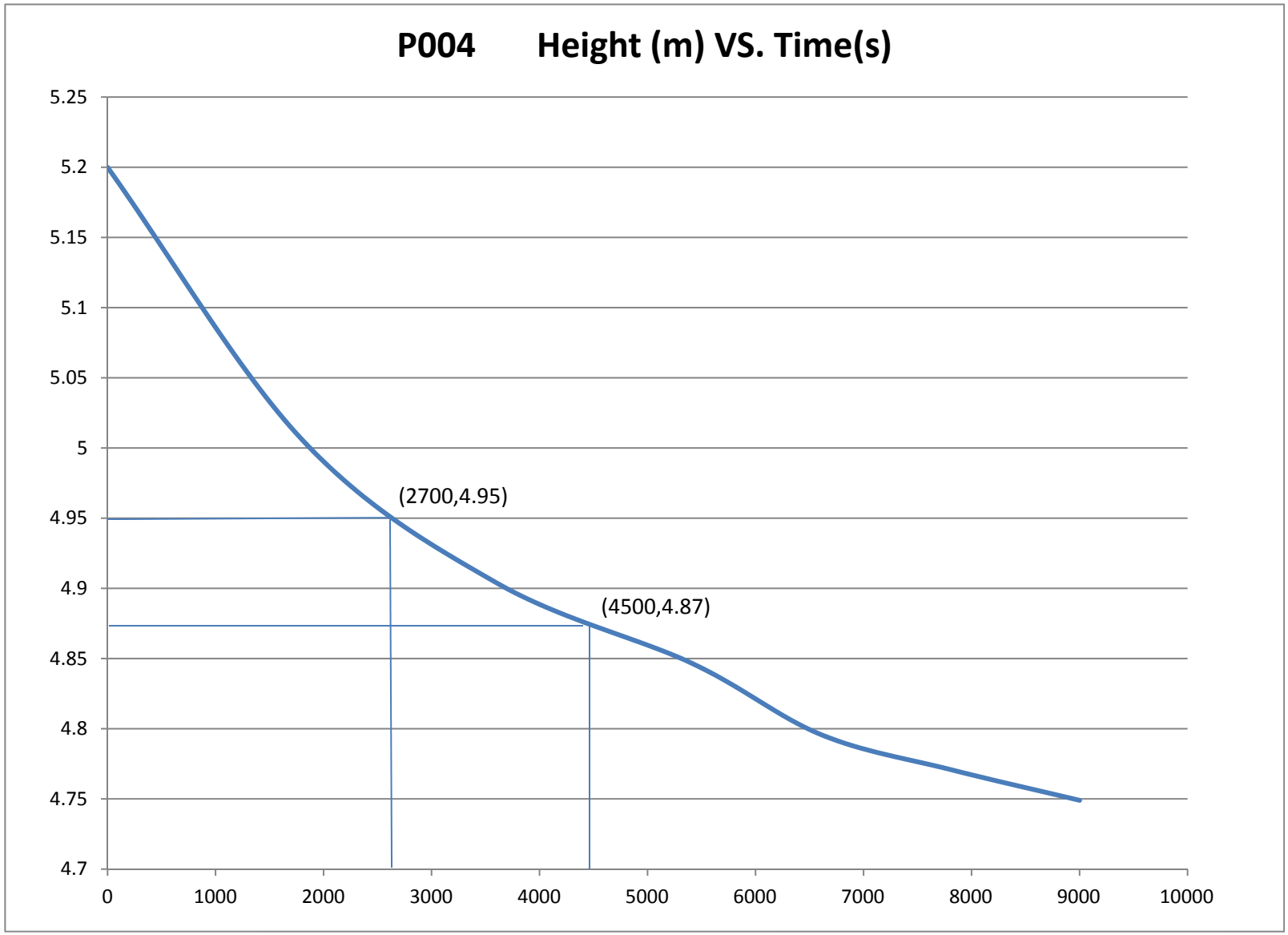
┌ u2 L 150 cm² 10 cm²	Test according NEN 5140 class 1		Predrill : **0**
	G.L. **0 NAP**	W.L.: **0**	Date: **12/15/2011**
Project: **Stafford Landing**			Cone no.: **C10CFIP.g44**
Location: **Stafford Landing**			Project no.: **L12101915**
Position:			CPT no.: **CPT3** **2/2**

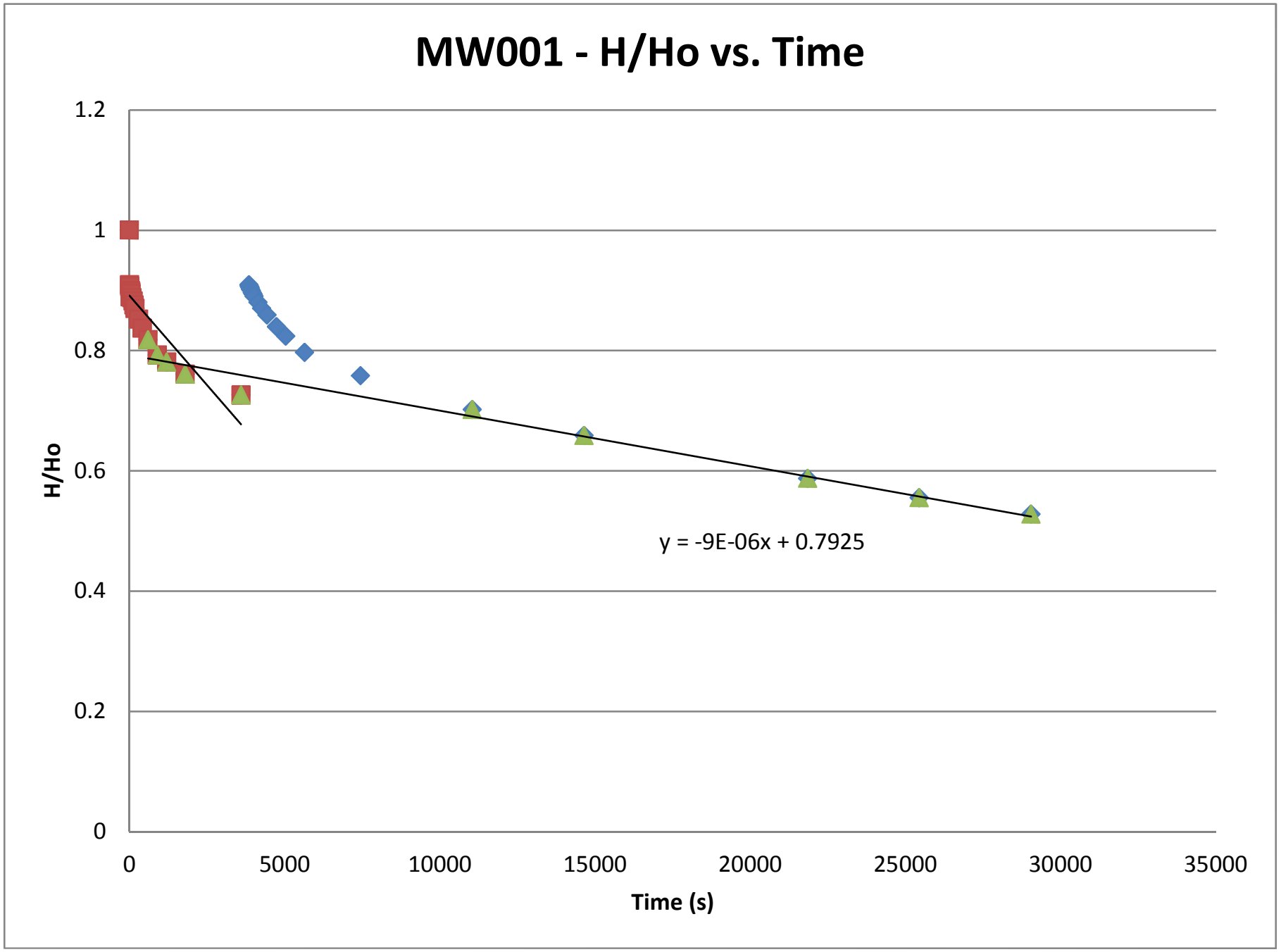
APPENDIX C
FIELD TESTING RESULTS

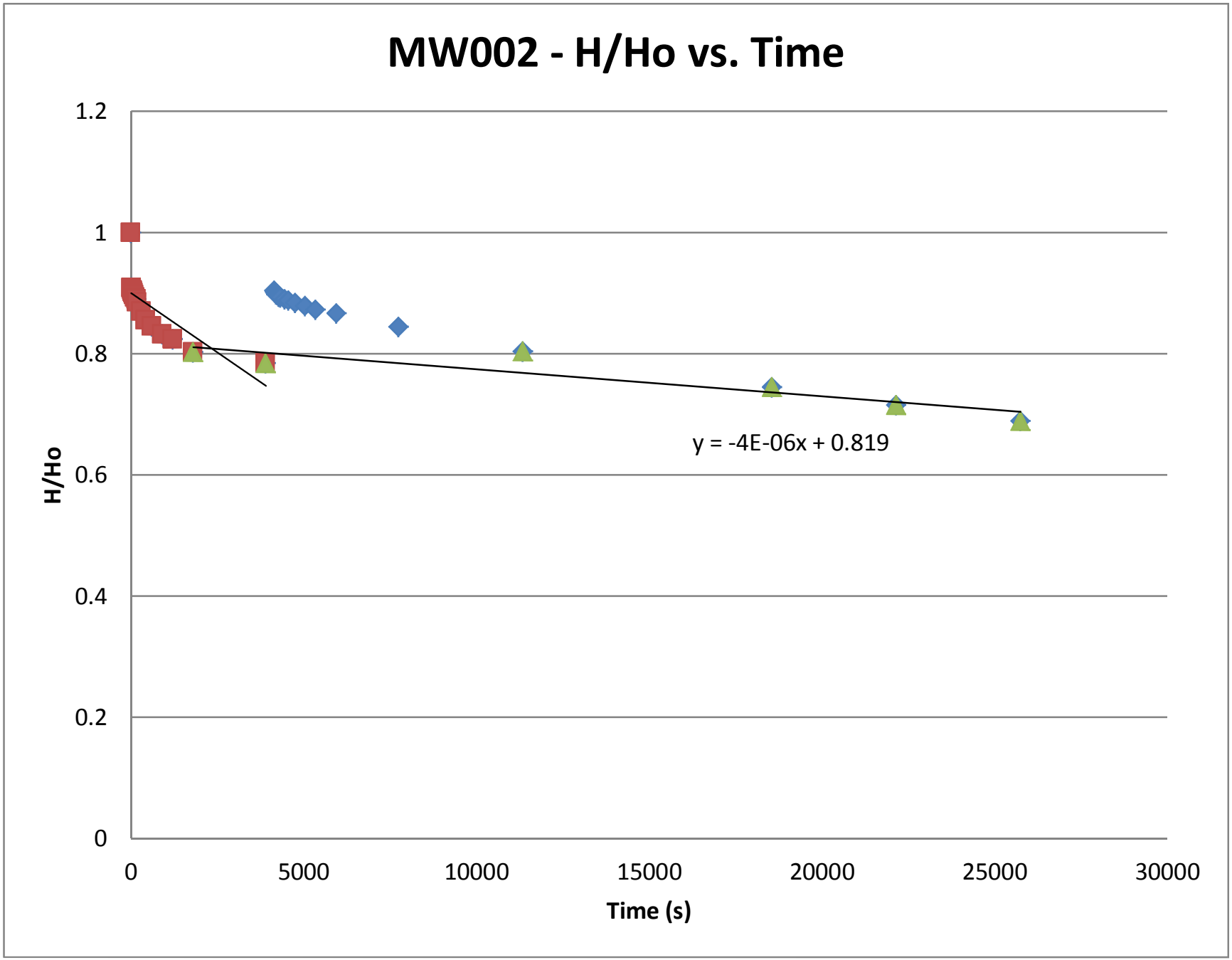

P001 Height (m) VS. Time(s)
5.3
5.2
5.1
5
4.9
4.8
4.7
4.6
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
10000
(2700,4.86)
(4500,4.78)

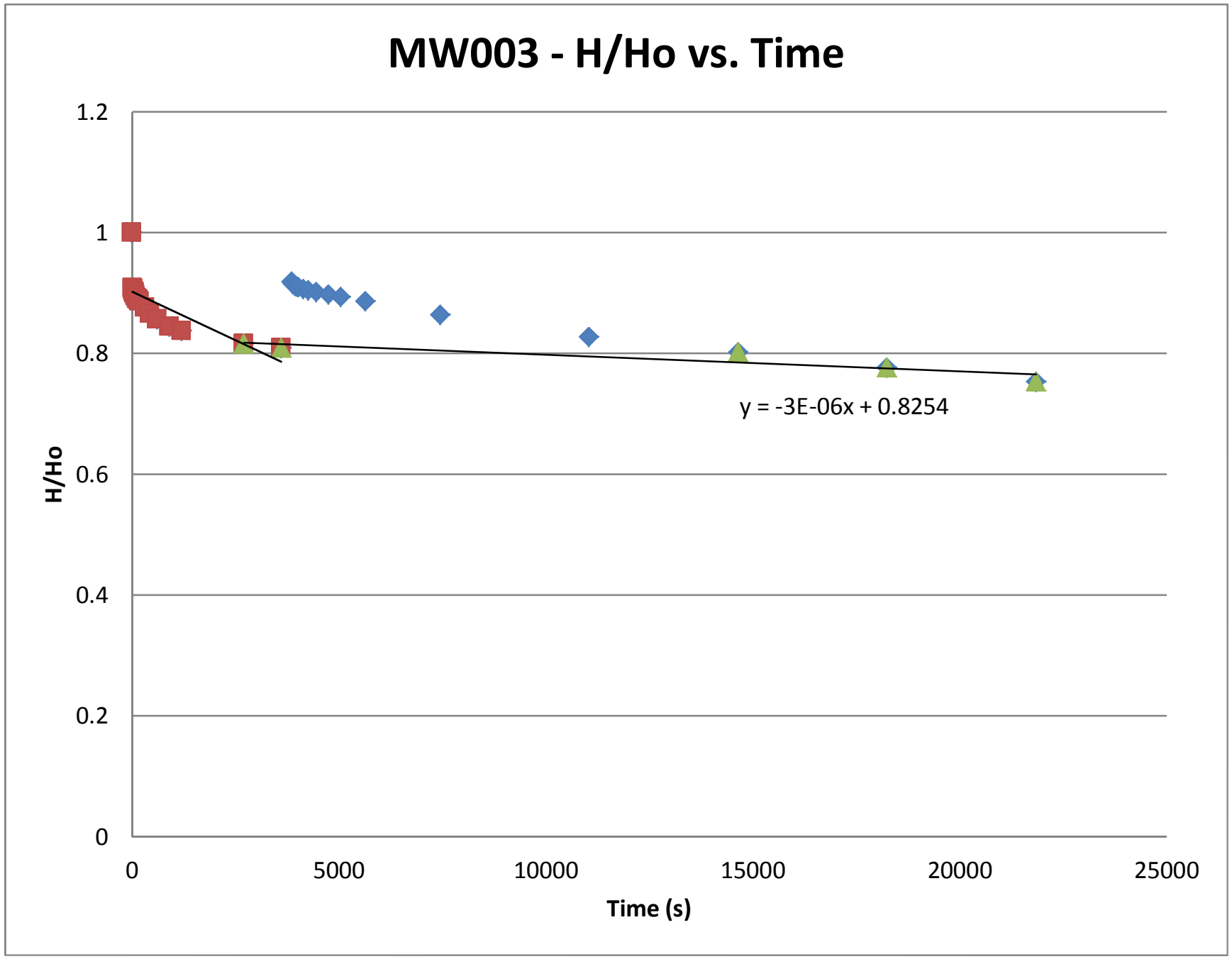

P002 Height (m) VS. Time(s)
5.205
5.2
5.195
5.19
5.185
5.18
5.175
5.17
5.165
5.16
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
10000
(2700,5.192)
(4500,5.187)


P003 Height (m) VS. Time(s)
5.205
5.2
5.195
5.19
5.185
5.18
5.175
5.17
5.165
5.16
5.155
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
10000
(2700,5.183)
(4500,5.176)


P004 Height (m) VS. Time(s)
5.25
5.2
5.15
5.1
5.05
5
4.95
4.9
4.85
4.8
4.75
4.7
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
10000
(2700,4.95)
(4500,4.87)


MW001 - H/Ho vs. Time
1.2
1
0.8
0.6
0.4
0.2
0
H/Ho
0
5000
10000
15000
20000
25000
30000
35000
Time (s)
y = -9E-06x + 0.7925


MW002 - H/Ho vs. Time
1.2
1
0.8
0.6
0.4
0.2
0
H/Ho
0
5000
10000
15000
20000
25000
30000
Time (s)
y = -4E-06x + 0.819


MW003 - H/Ho vs. Time
1.2
1
0.8
0.6
0.4
0.2
0
H/Ho
y = -3E-06x + 0.8254
0
5000
10000
15000
20000
25000
Time (s)

APPENDIX D
MOISTURE CONTENTS

MOISTURE CONTENT TEST RESULTS

Project: Stafford Landing

Project No.: L12101915

Client: Stafford Developments

Test Date: January 12, 2012

B.H. Number	Sample Number	Moisture Content
P001	0.6	19.0
	1.2	16.9
	1.8	18.1
	3.0	16.6
	3.7	16.5
	4.3	17.1
P002	0.6	16.1
	1.2	11.0
	1.8	14.5
	2.4	17.0
	3.0	18.3
	3.7	16.8
	4.3	18.0
P003	0.6	21.6
	1.2	19.1
	1.8	19.2
	2.4	19.1
	3.0	18.4
	3.7	18.1
	4.3	16.9
P004	0.6	18.9
	1.2	19.1
	1.8	16.4
	2.4	18.2
	3.0	18.4
	3.7	17.9
	4.3	17.3

Tested in accordance with ASTM standard D2216, subject to review .
issued for internal use

eba
A TETRA TECH COMPANY

MOISTURE CONTENT TEST RESULTS

Project: Stafford Landing

Project No.: L12101915

Client: Stafford Developments

Test Date: January 12, 2012

B.H. Number	Sample Number	Moisture Content
BH005	0.6	29.6
	1.2	35.0
	2.0	26.4
	2.4	20.0
	3.3	21.3
	4.3	18.0
	5.1	17.5
	5.5	17.3
	6.7	16.8
	7.3	17.3
	8.1	17.5
	8.5	17.2

Tested in accordance with ASTM standard D2216, subject to review .
issued for internal use

eba
A TETRA TECH COMPANY

APPENDIX E

POTENTIAL FOR MOUNDING ANALYSES

Calculation of Infiltration capacity
Stafford Landing waste water disposal field

based upon the Khan et al (1976) analytical solution of:

				assigned values calculated	
	H	is the heighth of the mound (m) above an impermeable base			
where	W	is the width of the infiltration basin (m)		assigned by column	
	q'	is the design infiltration rate (m/day)[1]	mean	3.11E-03	3.60E-08
	K_2	is the hydraulic conductivity of the impermeable layer (m/sec)		1.00E-08	
	K_1	is the hydraulic conductivity of the unsaturated materials above the impermeable layer (m/sec)	mean	2.00E-07	2.00E-07
	L	is the lateral distance from the centre of the basin			

maximum heigth of mound

$$H_{max} = W\left[\frac{q}{K_1}\left(\frac{q}{K_2}-1\right)\right]^{1/2}$$

	width of basin	5	7.5	10	12.5	15	20	25	40	55	70	95
mean	Hmax (m)	3	5	7	9	10	14	17	27	38	48	65
	length needed (area of 23150 m^2) m)	4630	3087	2315	1852	1543	1158	926	579	421	331	244

Length of mound from centre of infiltration basin

$$L = W\frac{q}{K_2}$$

	width of basin	5	7.5	10	12.5	15	20	25	40	55	70	95
infiltration rate mean	exent - distance from the centre of the basin (m)	18	27	36	45	54	72	90	144	198	252	342

change in mound heighth with distance from the infiltration basin

$$H = W\left[\frac{K_2}{K_1}\left(\frac{q'}{K_2}-1\right)\left(\frac{q'}{K_2}-\frac{x^2}{W^2}\right)\right]^{1/2}$$

distance from centre (x)	mound height (width of 10 m) (m)	depth (assumed impermeable base at 9 m
0		
1	6.83	2.17
2	6.80	2.20
4	6.69	2.31
6	6.49	2.51
8	6.20	2.80
10	5.81	3.19
12	5.30	3.70
14	4.62	4.38
16	3.68	5.32
18	2.16	6.84
18.5	1.52	7.48
18.8	1.05	7.95

APPENDIX D

SITE DRAINAGE ANALYSIS

HYDROLOGICAL and SITE DRAINAGE ANALYSIS

Proposed Subdivision Located Within **E ½ 14-9-19-W4**

County of Lethbridge, AB

PREPARED BY:
Hasegawa Engineering
Consulting Professional Engineers
A Division of 993997 Alberta Ltd.
1220 31st Street North
Lethbridge, AB T1H 5J8

TABLE OF CONTENTS

1.0 Introduction

On behalf of Stafford Developments, Hasegawa Engineering (HE) has completed this preliminary hydrological analysis of the subject site. The hydrological analysis includes the following major aspects:

1. Overall site layout and conditions
2. Offsite topography
3. Precipitation and runoff analysis
4. Detention Pond calculations for controlling runoff up to a 100 year storm event

The site lies in the E ½ 14-9-19-W4, in Lethbridge County. The site is situated southeast of Coaldale, AB on the northeastern edge of Stafford Reservoir.

2.0 Site Conditions

2.1 Existing

The site consists of approximately 85 acres (35 ha) of primarily agricultural land. It consists of two narrow parcels bordering the irrigation district lands along Stafford Reservoir to the east. To the north lies a county road, and to the south lies a county road. To the west are agricultural lands under irrigation. These irrigated lands are serviced by an irrigation canal running between the quarters to the west to an existing dugout partially within the development area. The dugout has a return flow channel connecting it to the reservoir.

The proposed development would divide the site into 29 country residential lots as well as two stormwater detention ponds

The site generally drains eastward toward the reservoir in an overland fashion. The contours of the land concentrate overland flow at a couple of points. In addition the irrigation channel intercepts some of the overland flow from the west. The drainage from the irrigated parcels to the west is split between the irrigation canal, the surrounding road ditches and overland towards the development area.

3.0 Surface Runoff Design Criteria

3.1 Onsite Runoff

Predevelopment

A predevelopment model was developed based on a topographic survey of the development area, and general topographic data available for the areas to the west.

Post-Development

Postdevelopment, runoff from most of the development area will be directed towards two stormwater ponds. The topography of the existing land will be used as much as possible. Some regrading will be necessary in order to direct the runoff into roadside ditches. The proposed development scheme envisions an access road through the centre of the development area with lots to either side. The lots west of the road will have back to front drainage. The lots to the east of the road will have split drainage, with the front of the lots draining towards the road and the back of the lots draining by sheet flow towards the reservoir. The roadside ditches will convey runoff to the reservoirs.

The stormwater ponds are modelled with 0.6 meters of freeboard followed by 2 meters of active storage although it will actually be deeper to accommodate fire protection water. Pond side slopes are 5h:1v in the freeboard and active storage range.

The individual lots are modelled with the following assumptions:

- Developed lots were assumed to have a house footprint of 400 m^2 and 200 m^2 of paving/sidewalk per lot. These were modeled as 100% impervious surfaces with half of the house (200 m^2) in the back 2/3 of the lot and the remainder of impervious surface in the front 1/3 of the lot.
- Subcatchment areas include the adjoining roads up to the centerline. Assumptions for the model are based on a 10 meter paved road (100% impervious) within a 20 meter road allowance that is otherwise 0% impervious for an overall average of 50% impervious.
- Pond surface is modeled as 100% impervious areas.

The post development model assumes a 100 year/24 hour storm event. The 100 year storm is a design storm that produces 109 mm of rain with a peak rate of 255 mm/hour. Results of the computer simulation are discussed in section 4 below. Key input parameters for SWMM analysis along with summaries of the computer simulations are attached in Appendix B.

3.2 Storm Water from Off-site

Runoff reaching the development area by overland flow from the west is to be conveyed by underground pipeline to the reservoir. Some off site drainage will be conveyed by the irrigation canal into the existing dugout. The dugout's outlet is to be changed to direct flow into an outlet pipe which will convey flow into the reservoir. As the irrigation canal and pipeline are part of the return flow system for the SMRID, the dugout's outlet must be sized to convey any additional flows routed through the canal by SMRID.

4.0 Surface Runoff Results

Results of initial runoff modelling show that the active storage volume in the pond is adequate to store the 100 year storm. Performance of the detention ponds is shown in Table 2 below.

Table 1 Pre Development Results

	Maximum Outflow m^3/s
Overland North	1.954
Channel	1.576
Overland South	2.542
Total Max Flow (m^3/s)	6.05

Table 2 Post Development Results – Retention Pond Storage

	Maximum Volume m^3	**Maximum Outflow m^3/s**
North Pond	8308	0
South Pond	8636	0
Overland North		1.044
Overland South		0.674
Channel		1.576
Pass Through Pipe North		1.566
Pass Through Pipe South		1.61
Total Max Flow (m^3/s)		5.402

This preliminary data shows the ponds cause an overall change in the rate at which runoff would reach the reservoir. Pond releases are controlled such that no release will occur during the event. The overall effect of having storage is that overland rates are reduced and total cumulative rates are also reduced.

Results show the ditches and swales are generally sufficient to route storm water to the retention ponds - final design will address flow and velocity within the ditches and swales.

5.0 Conclusion

Results from computer modeling using inputs appropriate for the Lethbridge area have been used to tentatively size stormwater ponds for the proposed development. The ponds produce an overall effect of reducing runoff that would reach the reservoir by retaining the runoff volume..

Detailed design of the stormwater infrastructure will be required for the application for subdivision stage of the development. Detailed design will address:

- rates and depths within ditches and swales
- details of the irrigation return flow and dugout outlet
- pond outlet controls

- system performance analysis for the 5yr/4hr storm in addition to the 100yr/24hr storm.

Applications will have to be submitted to Alberta Environment and Parks for an approval under the Water Act, and a registration under the Environmental Protection and Enhancement Act for the stormwater ponds once the design is finalized.

APPENDIX A - FIGURES

Figure 1: Predevelopment Runoff Rates

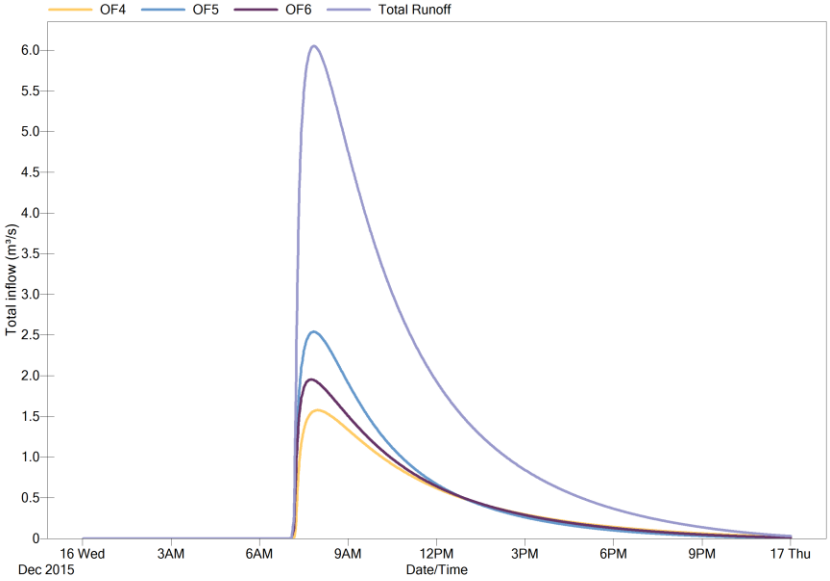
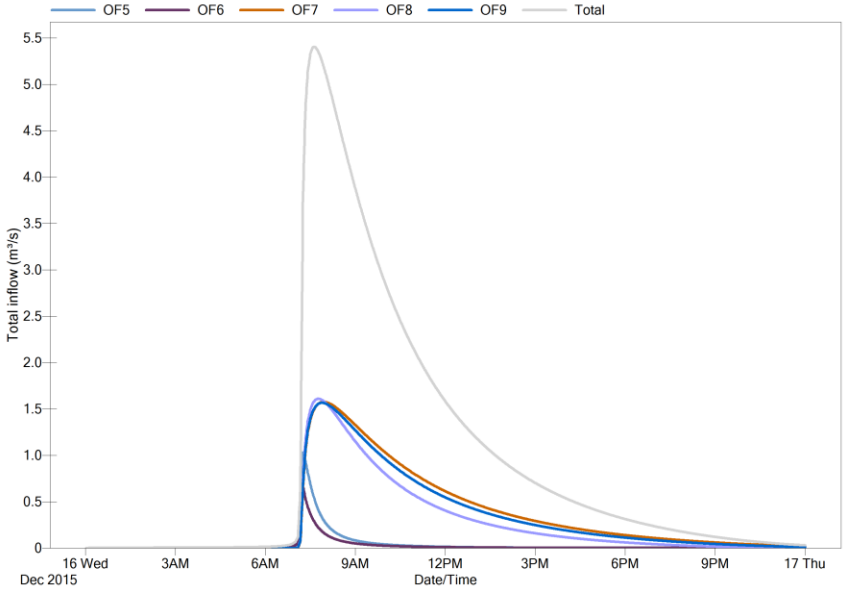


Figure 2: Postdevelopment Stormwater Runoff Rates



APPENDIX B – SWMM Outputs

EPA STORM WATER MANAGEMENT MODEL - VERSION 5.1 (Build 5.1.010)

****
Element Count
****
Number of rain gages 1
Number of subcatchments ... 8
Number of nodes 7
Number of links 2
Number of pollutants 0
Number of land uses 0

****
Raingage Summary
****

Name	Data Source	Data Type	Recording Interval
100yr/24hr	Timeseries1	INTENSITY	5 min.

****
Subcatchment Summary
****

Name	Area	Width	%Imperv	%Slope	Rain Gage	Outlet
S1	9.73	486.50	0.00	0.5000	100yr/24hr	OF5
S1_1	39.91	798.20	0.00	0.5000	100yr/24hr	S2
S1_15	50.60	722.86	0.00	0.5000	100yr/24hr	S3
S1_19	13.40	3350.00	0.00	0.5000	100yr/24hr	OF1
S1_20	7.70	1711.11	0.00	0.5000	100yr/24hr	OF2
S1_21	56.30	709.96	0.00	0.5000	100yr/24hr	J1
S2	15.22	760.85	0.00	0.5000	100yr/24hr	OF5
S3	9.73	1139.34	0.00	0.5000	100yr/24hr	OF6

****
Node Summary
****

Name	Type	Invert Elev.	Max. Depth	Ponded Area	External Inflow
J1	JUNCTION	860.00	1.00	0.0	
J2	JUNCTION	853.00	1.00	0.0	
OF1	OUTFALL	856.00	0.00	0.0	
OF2	OUTFALL	856.00	0.00	0.0	
OF4	OUTFALL	844.00	1.00	0.0	
OF5	OUTFALL	844.00	0.00	0.0	
OF6	OUTFALL	844.00	0.00	0.0	

****
Link Summary
****

Name	From Node	To Node	Type	Length	%Slope	Roughness
C7	J1	J2	CONDUIT	390.0	1.7952	0.0250
C8	J2	OF4	CONDUIT	52.7	17.3223	0.0250

****
Cross Section Summary
****

Conduit	Shape	Full Depth	Full Area	Hyd. Rad.	Max. Width	No. of Barrels	Full Flow
C7	TRIANGULAR	1.00	2.50	0.46	5.00	1	8.03
C8	TRIANGULAR	1.00	2.50	0.46	5.00	1	24.96

****
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.
****

****
Analysis Options
****
Flow Units ..... CMS
Process Models:
  Rainfall/Runoff ..... YES
  RDII ..... NO
  Snowmelt ..... NO
  Groundwater ..... NO
  Flow Routing ..... YES
  Ponding Allowed ..... NO
  Water Quality ..... NO
Infiltration Method ..... GREEN_AMPT
Flow Routing Method ..... DYNWAVE
Starting Date DEC-16-2015 00:00:00
Ending Date DEC-17-2015 00:00:00
Antecedent Dry Days 0.0
Report Time Step 00:01:00
Wet Time Step 00:05:00
Dry Time Step 00:05:00
Routing Time Step ..... 5.00 sec
Variable Time Step ..... YES
Maximum Trials 8
Number of Threads 1
Head Tolerance ..... 0.001500 m

Runoff Quantity Continuity	Volume hectare-m	Depth mm
Total Precipitation	22.243	109.796
Evaporation Loss	0.000	0.000
Infiltration Loss	10.605	52.348
Surface Runoff	10.497	51.813
Final Storage	1.161	5.729
Continuity Error (%)	-0.087	

Flow Routing Continuity	Volume hectare-m	Volume 10^6 ltr
Dry Weather Inflow	0.000	0.000
Wet Weather Inflow	10.496	104.964
Groundwater Inflow	0.000	0.000
RDII Inflow	0.000	0.000
External Inflow	0.000	0.000
External Outflow	10.495	104.956

Flooding Loss	0.000	0.000
Evaporation Loss	0.000	0.000
Exfiltration Loss	0.000	0.000
Initial Stored Volume	0.000	0.000
Final Stored Volume	0.001	0.009
Continuity Error (%)	-0.001	

****
Time-Step Critical Elements
****
None

****
Highest Flow Instability Indexes
****
All links are stable.

****
Routing Time Step Summary
****

Minimum Time Step	:	4.50 sec
Average Time Step	:	5.00 sec
Maximum Time Step	:	5.00 sec
Percent in Steady State	:	0.00
Average Iterations per Step	:	2.00
Percent Not Converging	:	0.00

****
Subcatchment Runoff Summary
****

Subcatchment	Total Precip mm	Total Runon mm	Total Evap mm	Total Infil mm	Total Runoff mm	Total Runoff 10^6 ltr	Pea Runof CM
S1	109.80	0.00	0.00	52.01	57.56	5.60	0.7
S1_1	109.80	0.00	0.00	52.58	52.51	20.96	1.6
S1_15	109.80	0.00	0.00	52.85	49.89	25.24	1.5
S1_19	109.80	0.00	0.00	48.67	61.55	8.25	3.0
S1_20	109.80	0.00	0.00	48.80	61.38	4.73	1.6
S1_21	109.80	0.00	0.00	52.96	48.75	27.45	1.5
S2	109.80	137.73	0.00	52.89	188.91	28.75	1.8
S3	109.80	259.41	0.00	52.63	310.35	30.20	1.9

****
Node Depth Summary
****

Node	Type	Average Depth Meters	Maximum Depth Meters	Maximum HGL Meters	Time of Max Occurrence days hr:min	Reported Max Depth Meters
J1	JUNCTION	0.22	0.59	860.59	0 07:56	0.18
J2	JUNCTION	0.14	0.36	853.36	0 07:57	0.11
OF1	OUTFALL	0.00	0.00	856.00	0 00:00	0.00
OF2	OUTFALL	0.00	0.00	856.00	0 00:00	0.00
OF4	OUTFALL	0.14	0.35	844.35	0 07:57	0.11

OF5	OUTFALL	0.00	0.00	844.00	0	00:00	0.00	
OF6	OUTFALL	0.00	0.00	844.00	0	00:00	0.00	

****
Node Inflow Summary
****

Node	Type	Maximum Lateral Inflow CMS	Maximum Total Inflow CMS	Time of Max Occurrence days hr:min	Lateral Inflow Volume 10^6 ltr	Total Inflow Volume 10^6 ltr	Fl Balan Err Perce
J1	JUNCTION	1.576	1.576	0 07:55	27.4	27.4	0.0
J2	JUNCTION	0.000	1.576	0 07:57	0	27.4	0.0
OF1	OUTFALL	3.084	3.084	0 07:20	8.25	8.25	0.0
OF2	OUTFALL	1.653	1.653	0 07:20	4.73	4.73	0.0
OF4	OUTFALL	0.000	1.576	0 07:57	0	27.4	0.0
OF5	OUTFALL	2.542	2.542	0 07:50	34.3	34.3	0.0
OF6	OUTFALL	1.954	1.954	0 07:45	30.2	30.2	0.0

****
Node Surcharge Summary
****

No nodes were surcharged.

****
Node Flooding Summary
****

No nodes were flooded.

****
Outfall Loading Summary
****

Outfall Node	Flow Freq Pcnt	Avg Flow CMS	Max Flow CMS	Total Volume 10^6 ltr
OF1	31.05	0.307	3.084	8.248
OF2	31.73	0.172	1.653	4.727
OF4	70.43	0.451	1.576	27.437
OF5	70.82	0.561	2.542	34.347
OF6	70.82	0.493	1.954	30.196
System	54.97	1.986	9.344	104.955

****
Link Flow Summary
****

Link	Type	Maximum |Flow| CMS	Time of Max Occurrence days hr:min	Maximum |Veloc| m/sec	Max/ Full Flow	Max/ Full Depth

C7	CONDUIT	1.576	0	07:57	2.84	0.20	0.47
C8	CONDUIT	1.576	0	07:57	4.99	0.06	0.36

****
Flow Classification Summary
****

	Adjusted	---------- Fraction of Time in Flow Class ----------								
Conduit	/Actual Length	Dry	Up Dry	Down Dry	Sub Crit	Sup Crit	Up Crit	Down Crit	Norm Ltd	Inlet Ctrl
C7	1.00	0.29	0.00	0.00	0.00	0.71	0.00	0.00	0.00	0.00
C8	1.00	0.29	0.00	0.00	0.00	0.70	0.00	0.00	0.00	0.00

****
Conduit Surcharge Summary
****

No conduits were surcharged.

Analysis begun on: Wed Dec 23 13:11:02 2015
Analysis ended on: Wed Dec 23 13:11:02 2015
Total elapsed time: < 1 sec

EPA STORM WATER MANAGEMENT MODEL - VERSION 5.1 (Build 5.1.010)

****
Element Count
****
Number of rain gages 1
Number of subcatchments ... 18
Number of nodes 23
Number of links 14
Number of pollutants 0
Number of land uses 0

****
Raingage Summary
****

Name	Data Source	Data Type	Recording Interval
100yr/24hr	Timeseries1	INTENSITY	5 min.

****
Subcatchment Summary
****

Name	Area	Width	%Imperv	%Slope	Rain Gage	Outlet
S1_1	39.91	798.20	0.00	0.5000	100yr/24hr	J10
S1_10	2.80	280.00	25.00	0.5000	100yr/24hr	J3
S1_12	1.17	195.00	25.00	0.5000	100yr/24hr	OF5
S1_14	0.78	260.00	30.00	0.5000	100yr/24hr	J5
S1_15	50.60	722.86	0.00	0.5000	100yr/24hr	J12
S1_16	1.27	127.00	25.00	0.5000	100yr/24hr	OF6
S1_17	0.77	256.67	25.00	0.5000	100yr/24hr	J4
S1_18	1.16	193.33	25.00	0.5000	100yr/24hr	OF6
S1_19	13.40	3350.00	0.00	0.5000	100yr/24hr	OF1
S1_20	7.70	1711.11	0.00	0.5000	100yr/24hr	OF2
S1_21	56.30	709.96	0.00	0.5000	100yr/24hr	J1
S1_3	4.71	471.00	14.00	0.5000	100yr/24hr	J7
S1_4	6.45	645.00	14.00	0.5000	100yr/24hr	J6
S1_5	1.66	1660.00	90.00	0.5000	100yr/24hr	SU2
S1_6	3.72	186.00	17.00	0.5000	100yr/24hr	J9
S1_7	1.79	596.67	23.00	0.5000	100yr/24hr	J8
S1_8	1.15	1150.00	90.00	0.5000	100yr/24hr	SU1
S1_9	3.13	521.67	12.00	0.5000	100yr/24hr	OF5

****
Node Summary
****

Name	Type	Invert Elev.	Max. Depth	Ponded Area	External Inflow
J1	JUNCTION	860.00	1.00	0.0	
J10	JUNCTION	855.00	1.00	0.0	
J11	JUNCTION	854.00	1.00	0.0	
J12	JUNCTION	854.50	1.00	0.0	
J2	JUNCTION	853.00	1.00	0.0	
J3	JUNCTION	853.00	1.00	0.0	
J4	JUNCTION	853.00	1.00	0.0	
J5	JUNCTION	853.00	1.00	0.0	

J6	JUNCTION	853.00	1.00	0.0
J7	JUNCTION	854.00	1.00	0.0
J8	JUNCTION	854.00	1.00	0.0
J9	JUNCTION	854.00	1.00	0.0
OF1	OUTFALL	856.00	0.00	0.0
OF2	OUTFALL	856.00	0.00	0.0
OF3	OUTFALL	844.00	0.45	0.0
OF4	OUTFALL	844.00	0.90	0.0
OF5	OUTFALL	844.00	0.00	0.0
OF6	OUTFALL	844.00	0.00	0.0
OF7	OUTFALL	844.00	1.00	0.0
OF8	OUTFALL	844.00	1.00	0.0
OF9	OUTFALL	844.00	1.00	0.0
SU1	STORAGE	849.40	2.60	0.0
SU2	STORAGE	851.40	2.60	0.0

****
Link Summary
****

Name	From Node	To Node	Type	Length	%Slope	Roughne
C1	J10	OF8	CONDUIT	40.5	28.1838	0.0
C10	J5	SU1	CONDUIT	200.0	1.0001	0.0
C11	J3	SU1	CONDUIT	300.0	0.6667	0.0
C12	J4	SU1	CONDUIT	300.0	0.6667	0.0
C13	J12	OF9	CONDUIT	39.3	27.7254	0.0
C15	SU1	OF4	CONDUIT	300.0	1.8003	0.0
C2	J11	SU2	CONDUIT	110.0	0.9091	0.0
C3	J9	SU2	CONDUIT	100.0	1.0001	0.0
C4	SU2	OF3	CONDUIT	200.0	3.7025	0.0
C5	J8	SU2	CONDUIT	400.0	0.2500	0.0
C6	J7	SU2	CONDUIT	400.0	0.2500	0.0
C7	J1	OF7	CONDUIT	120.0	13.4535	0.0
C8	J2	SU1	CONDUIT	200.0	1.8003	0.0
C9	J6	SU1	CONDUIT	200.0	1.0001	0.0

****
Cross Section Summary
****

Conduit	Shape	Full Depth	Full Area	Hyd. Rad.	Max. Width	No. of Barrels	Full Flow
C1	CIRCULAR	1.00	0.79	0.25	1.00	1	6.62
C10	TRIANGULAR	1.00	2.50	0.46	5.00	1	6.00
C11	TRIANGULAR	1.00	2.50	0.46	5.00	1	4.90
C12	TRIANGULAR	1.00	2.50	0.46	5.00	1	4.90
C13	CIRCULAR	1.00	0.79	0.25	1.00	1	6.57
C15	CIRCULAR	0.90	0.64	0.23	0.90	1	1.26
C2	TRIANGULAR	1.00	2.50	0.46	5.00	1	5.72
C3	TRIANGULAR	1.00	2.50	0.46	5.00	1	6.00
C4	CIRCULAR	0.45	0.16	0.11	0.45	1	0.29
C5	TRIANGULAR	1.00	2.50	0.46	5.00	1	3.00
C6	TRIANGULAR	1.00	2.50	0.46	5.00	1	3.00
C7	CIRCULAR	1.00	0.79	0.25	1.00	1	4.57
C8	TRIANGULAR	1.00	2.50	0.46	5.00	1	8.05
C9	TRIANGULAR	1.00	2.50	0.46	5.00	1	6.00

****
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,

not just on results from each reporting time step.
****

****
Analysis Options
****
Flow Units ..... CMS
Process Models:
  Rainfall/Runoff ..... YES
  RDII ..... NO
  Snowmelt ..... NO
  Groundwater ..... NO
  Flow Routing ..... YES
  Ponding Allowed ..... NO
  Water Quality ..... NO
Infiltration Method ..... GREEN_AMPT
Flow Routing Method ..... DYNWAVE
Starting Date DEC-16-2015 00:00:00
Ending Date DEC-17-2015 00:00:00
Antecedent Dry Days 0.0
Report Time Step 00:01:00
Wet Time Step 00:05:00
Dry Time Step 00:05:00
Routing Time Step ..... 5.00 sec
Variable Time Step ..... YES
Maximum Trials 8
Number of Threads 1
Head Tolerance ..... 0.001500 m

Runoff Quantity Continuity	Volume hectare-m	Depth mm
Total Precipitation	21.791	109.796
Evaporation Loss	0.000	0.000
Infiltration Loss	9.925	50.010
Surface Runoff	10.877	54.803
Final Storage	1.013	5.105
Continuity Error (%)	-0.112	

Flow Routing Continuity	Volume hectare-m	Volume 10^6 ltr
Dry Weather Inflow	0.000	0.000
Wet Weather Inflow	10.875	108.748
Groundwater Inflow	0.000	0.000
RDII Inflow	0.000	0.000
External Inflow	0.000	0.000
External Outflow	9.134	91.338
Flooding Loss	0.000	0.000
Evaporation Loss	0.000	0.000
Exfiltration Loss	0.000	0.000
Initial Stored Volume	0.000	0.000
Final Stored Volume	1.732	17.317
Continuity Error (%)	0.085	

****
Highest Continuity Errors
****
Node SU1 (4.71%)

****
Time-Step Critical Elements
****
Link C13 (26.25%)

****
Highest Flow Instability Indexes
****
All links are stable.

****
Routing Time Step Summary
****

Minimum Time Step	:	0.02 sec
Average Time Step	:	4.76 sec
Maximum Time Step	:	5.00 sec
Percent in Steady State	:	0.00
Average Iterations per Step	:	2.00
Percent Not Converging	:	0.00

****
Subcatchment Runoff Summary
****

Subcatchment	Total Precip mm	Total Runon mm	Total Evap mm	Total Infil mm	Total Runoff mm	Total Runoff 10^6 ltr	P
S1_1	109.80	0.00	0.00	52.58	52.51	20.96	
S1_10	109.80	0.00	0.00	37.17	72.68	2.03	
S1_12	109.80	0.00	0.00	36.60	73.32	0.86	
S1_14	109.80	0.00	0.00	33.71	76.36	0.60	
S1_15	109.80	0.00	0.00	52.85	49.89	25.24	
S1_16	109.80	0.00	0.00	37.17	72.66	0.92	
S1_17	109.80	0.00	0.00	36.15	73.95	0.57	
S1_18	109.80	0.00	0.00	36.60	73.32	0.85	
S1_19	109.80	0.00	0.00	48.67	61.55	8.25	
S1_20	109.80	0.00	0.00	48.80	61.38	4.73	
S1_21	109.80	0.00	0.00	52.96	48.75	27.45	
S1_3	109.80	0.00	0.00	42.86	67.06	3.16	
S1_4	109.80	0.00	0.00	42.86	67.06	4.33	
S1_5	109.80	0.00	0.00	4.75	104.53	1.74	
S1_6	109.80	0.00	0.00	42.86	66.96	2.49	
S1_7	109.80	0.00	0.00	37.12	72.99	1.31	
S1_8	109.80	0.00	0.00	4.75	104.53	1.20	
S1_9	109.80	0.00	0.00	43.12	66.89	2.09	

****
Node Depth Summary
****

Node	Type	Average Depth Meters	Maximum Depth Meters	Maximum HGL Meters	Time of Max Occurrence days hr:min	Reported Max Depth Meters
J1	JUNCTION	0.14	0.41	860.41	0 07:55	0.12
J10	JUNCTION	0.10	0.34	855.34	0 07:45	0.10
J11	JUNCTION	0.00	0.00	854.00	0 00:00	0.00

J12	JUNCTION	0.11	0.34	854.84	0	07:55	0.10
J2	JUNCTION	0.00	0.00	853.00	0	00:00	0.00
J3	JUNCTION	0.11	0.46	853.46	0	07:19	0.14
J4	JUNCTION	0.06	0.33	853.33	0	07:20	0.10
J5	JUNCTION	0.06	0.32	853.32	0	07:18	0.10
J6	JUNCTION	0.12	0.53	853.53	0	07:18	0.16
J7	JUNCTION	0.16	0.65	854.65	0	07:29	0.20
J8	JUNCTION	0.12	0.56	854.56	0	07:24	0.17
J9	JUNCTION	0.10	0.41	854.41	0	07:16	0.12
OF1	OUTFALL	0.00	0.00	856.00	0	00:00	0.00
OF2	OUTFALL	0.00	0.00	856.00	0	00:00	0.00
OF3	OUTFALL	0.00	0.00	844.00	0	00:52	0.00
OF4	OUTFALL	0.00	0.00	844.00	0	01:49	0.00
OF5	OUTFALL	0.00	0.00	844.00	0	00:00	0.00
OF6	OUTFALL	0.00	0.00	844.00	0	00:00	0.00
OF7	OUTFALL	0.14	0.41	844.41	0	07:55	0.12
OF8	OUTFALL	0.10	0.34	844.34	0	07:45	0.10
OF9	OUTFALL	0.11	0.33	844.33	0	07:55	0.10
SU1	STORAGE	0.82	1.25	850.65	1	00:00	0.38
SU2	STORAGE	0.84	1.29	852.69	1	00:00	0.39

****
Node Inflow Summary
****

Node	Type	Maximum Lateral Inflow CMS	Maximum Total Inflow CMS	Time of Max Occurrence days hr:min	Lateral Inflow Volume 10^6 ltr	Total Inflow Volume 10^6 ltr	F
J1	JUNCTION	1.576	1.576	0 07:55	27.4	27.4	
J10	JUNCTION	1.610	1.610	0 07:45	21	21	
J11	JUNCTION	0.000	0.000	0 00:00	0	0	
J12	JUNCTION	1.566	1.566	0 07:55	25.2	25.2	
J2	JUNCTION	0.000	0.000	0 00:00	0	0	
J3	JUNCTION	0.706	0.706	0 07:15	2.03	2.03	
J4	JUNCTION	0.307	0.307	0 07:15	0.569	0.569	
J5	JUNCTION	0.335	0.335	0 07:15	0.595	0.595	
J6	JUNCTION	1.184	1.184	0 07:15	4.32	4.32	
J7	JUNCTION	0.864	0.864	0 07:15	3.16	3.16	
J8	JUNCTION	0.692	0.692	0 07:15	1.31	1.31	
J9	JUNCTION	0.574	0.574	0 07:15	2.49	2.49	
OF1	OUTFALL	3.084	3.084	0 07:20	8.25	8.24	
OF2	OUTFALL	1.653	1.653	0 07:20	4.73	4.72	
OF3	OUTFALL	0.000	0.000	0 00:52	0	8.32e-005	
OF4	OUTFALL	0.000	0.000	0 01:49	0	0.000814	
OF5	OUTFALL	1.044	1.044	0 07:15	2.95	2.95	
OF6	OUTFALL	0.674	0.674	0 07:15	1.77	1.77	
OF7	OUTFALL	0.000	1.576	0 07:55	0	27.4	
OF8	OUTFALL	0.000	1.610	0 07:45	0	21	
OF9	OUTFALL	0.000	1.566	0 07:55	0	25.2	
SU1	STORAGE	0.811	2.692	0 07:17	1.2	8.72	
SU2	STORAGE	1.170	2.076	0 07:16	1.73	8.68	

****
Node Surcharge Summary
****

No nodes were surcharged.

****
Node Flooding Summary
****

No nodes were flooded.

****
Storage Volume Summary
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Storage Unit	Average Volume 1000 m3	Avg Pcnt Full	Evap Pcnt Loss	Exfil Pcnt Loss	Maximum Volume 1000 m3	Max Pcnt Full	Time of Max Occurrence days hr:min
SU1	5.396	26	0	0	8.308	41	1 00:00
SU2	5.523	27	0	0	8.636	42	1 00:00

****
Outfall Loading Summary
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Outfall Node	Flow Freq Pcnt	Avg Flow CMS	Max Flow CMS	Total Volume 10^6 ltr
OF1	34.41	0.348	3.084	8.245
OF2	35.06	0.196	1.653	4.725
OF3	0.00	0.000	0.000	0.000
OF4	0.00	0.000	0.000	0.001
OF5	99.43	0.042	1.044	2.950
OF6	98.90	0.025	0.674	1.772
OF7	72.23	0.502	1.576	27.445
OF8	70.96	0.403	1.610	20.959
OF9	72.24	0.466	1.566	25.242
System	53.69	1.982	9.483	91.338

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Link Flow Summary
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Link	Type	Maximum |Flow| CMS	Time of Max Occurrence days hr:min	Maximum |Veloc| m/sec	Max/ Full Flow	Max/ Full Depth
C1	CONDUIT	1.610	0 07:45	6.89	0.24	0.34
C10	CONDUIT	0.281	0 07:18	1.15	0.05	0.31
C11	CONDUIT	0.566	0 07:20	1.22	0.12	0.43
C12	CONDUIT	0.226	0 07:21	0.97	0.05	0.30
C13	CONDUIT	1.566	0 07:55	6.80	0.24	0.33
C15	CONDUIT	0.000	0 01:49	0.03	0.00	0.50
C2	CONDUIT	0.000	0 00:00	0.00	0.00	0.00
C3	CONDUIT	0.547	0 07:16	1.35	0.09	0.40
C4	CONDUIT	0.000	0 00:52	0.01	0.00	0.50
C5	CONDUIT	0.406	0 07:25	0.78	0.14	0.46
C6	CONDUIT	0.646	0 07:29	0.89	0.22	0.54
C7	CONDUIT	1.576	0 07:55	5.27	0.34	0.41
C8	CONDUIT	0.000	0 00:00	0.00	0.00	0.50

C9	CONDUIT	1.106	0	07:18	1.59	0.18	0.53

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Flow Classification Summary
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Conduit	Adjusted /Actual Length	Fraction of Time in Flow Class: Dry	Up Dry	Down Dry	Sub Crit	Sup Crit	Up Crit	Down Crit	Norm Ltd	Inlet Ctrl
C1	1.00	0.29	0.00	0.00	0.00	0.71	0.00	0.00	0.00	0.00
C10	1.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
C11	1.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
C12	1.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
C13	1.00	0.28	0.00	0.00	0.00	0.72	0.00	0.00	0.00	0.00
C15	1.00	0.01	0.00	0.00	0.99	0.00	0.00	0.00	0.00	0.00
C2	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C3	1.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
C4	1.00	0.01	0.00	0.00	0.99	0.00	0.00	0.00	0.00	0.00
C5	1.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
C6	1.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
C7	1.00	0.28	0.00	0.00	0.00	0.72	0.00	0.00	0.00	0.00
C8	1.00	0.01	0.99	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C9	1.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00

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Conduit Surcharge Summary
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Conduit	Hours Full: Both Ends	Upstream	Dnstream	Hours Above Full Normal Flow	Hours Capacity Limited
C15	0.01	15.70	0.01	0.01	0.01
C4	0.01	16.49	0.01	0.01	0.01

Analysis begun on: Mon Apr 11 14:31:51 2016
Analysis ended on: Mon Apr 11 14:31:52 2016
Total elapsed time: 00:00:01