

**LEGEND**

- KILOMETRE POST (KP)
- ▲ PROPOSED FACILITY \*
- HORIZONTAL DIRECTIONAL DRILL AREA\*
- RIGHT OF WAY AND TEMPORARY WORKSPACE\*
- TERRAIN REGIONAL STUDY AREA
- POLYGON BOUNDARY (APPROXIMATE)
- FIELD OBSERVATION (WM/HW01 V/R/G)
- V - VISUAL PLOT TYPE
- R - RECONNAISSANCE PLOT TYPE
- G - GROUND PLOT TYPE
- BOREHOLE
- HAND AUGER
- ★ POPULATED PLACE
- CONTOUR (40 m)
- CUTLINE / TRAIL
- LOCAL ROAD
- PRIMARY HIGHWAY
- SECONDARY HIGHWAY
- WATERCOURSE
- CITY / TOWN

sgF<sup>a</sup>tp/Cv[Mks]-MuV1

texture  
surficial material  
activity qualifier  
surface expression  
delimit  
underlying material  
underlying surface expression  
geomorphological process  
geomorphological process subclass  
geomorphological process subtype

terrain stability class  
drainage  
surface erosion potential  
drainage code separator

Terrain Stability Classification (Adapted from APEGBC (2002) and Ministry of Forests (1999))	
Terrain Stability Class	Interpretation
I	No significant stability problems exist
II	Very low likelihood of landslide initiation following land clearing or road/pipeline construction
III	Low likelihood of landslide initiation following land clearing or road/pipeline construction
IV	Moderate likelihood of landslide initiation following land clearing or road/pipeline construction (may include areas of existing potentially unstable terrain)
V	High likelihood of landslide initiation following land clearing or road/pipeline construction (may include areas of existing unstable terrain)

Drainage Classification	
Drainage	Drainage Separator Code
r rapid	- no intermediate classes
w well	- all intermediate classes
m moderate	/ first drainage dominant
i imperfect	// first drainage significantly dominant
p poor	
v very poor	

Soil Erosion Potential Classification	
Soil Erosion Potential	Soil Erosion Potential
L Low	
M Moderate	
H High	
VH Very High	

Terrain Symbol Legend (Annotated List from Howes & Kenik (1997))	
Surficial Material	Texture
A Anthropogenic	c Clay
C Colluvium	g Gravel
E Eolian	m Mud
F Fluvial	s Sand
L Lacustrine	z Silt
M Moraine/Till	
N Waterbody	
O Organic	
R Bedrock	

Activity Qualifier	
Activity Qualifier	Activity Qualifier
A Active	- equal proportions
I Inactive	/ first material dominant
	// first material significantly dominant

Surface Expression	
Surface Expression	Surface Expression
a Moderate Slope (27-49%)	
b Blanket (>1m thickness)	
c Cone (>26%)	
d Depression (Lower area surrounded by higher terrain)	
f Fan (fan shaped landform with <26% gradients)	
h Hummocks (non-linear rises >26%)	
j Gentle Slope (<26%)	
k Moderately Steep Slope (50-70%)	
m Rolling (Elongate rise and hollow <26%)	
p Plain (Unidirectional surface 0-5%)	
r Ridge (Elongate Hills 26-70%)	
s Steep Slope (>70%)	
t Terrace (Step like topography)	
u Undulating (Non-linear rises <26%)	
v Veneer (<1m thickness)	
x Thin Veneer (10-25cm thickness)	

Geomorphological Process	
Geomorphological Process	Geomorphological Process
F Slow Mass Movement	c Soil creep
L Surface Seepage	d Debris flow
M Meandering Channel	r Debris fall
R Rapid Mass Movement	s Debris slide
U Unchanneled	u Slump in surficial material
V Gully Erosion (unspecified)	
W Washing	

Geomorphological Process Subtypes	
Geomorphological Process Subtypes	Geomorphological Process Subtypes
1 Gullying	b Backchannels
2 Rilling	u Progressive bank erosion

INDEX MAP

SCALE: 1:1,000,000

NOTE

\*PROPOSED METER STATIONS OBTAINED 2014-09-25, PROPOSED TOWER LAKE SECTION RIGHT OF WAY, TEMPORARY WORKSPACE AND HORIZONTAL DIRECTIONAL DRILL AREA OBTAINED 2015-02-26, AND PROPOSED GROUNDPIECE MAINLINE LOOP RIGHT OF WAY, TEMPORARY WORKSPACE AND HORIZONTAL DIRECTIONAL DRILL AREA OBTAINED 2015-03-16 AND 2015-04-23

REFERENCE

BASE DATA OBTAINED FROM CANVEC, IHS ENERGY INC. AND GEOBASE. IMAGERY AND LIDAR OBTAINED FROM MIDWEST SURVEY (PROVIDED ON 2014/05/16). ADDITIONAL IMAGERY COPYRIGHT © 2011/09/14 ESRI AND ITS LICENSORS. SOURCE: DIGITAL GLOBE. USED UNDER LICENSE. ALL RIGHTS RESERVED.

DATUM: NAD83 PROJECTION: UTM ZONE 10

SCALE 17,500

500 0 500 METRES

PROJECT

**TransCanada**  
In business to deliver

TOWERBIRCH EXPANSION

TITLE

**TERRAIN AND TERRAIN STABILITY MAPPING**

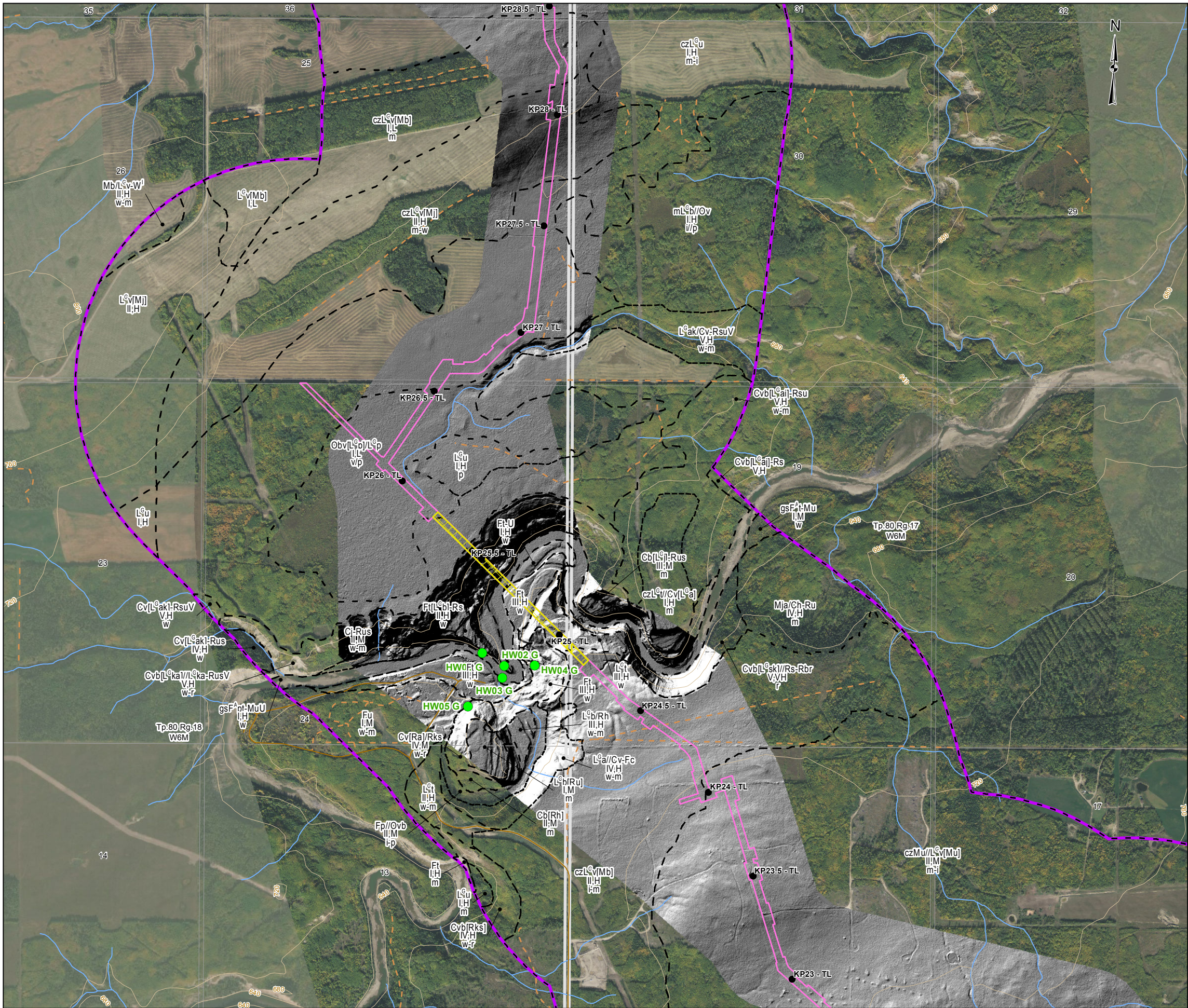
**Golder Associates**

PROJECT	1403669	FILE No.
DESIGN	WM	22 May 2015
GIS	DL	27 Aug. 2015
CHECK	MCP	27 Aug. 2015
REVIEW	MH	27 Aug. 2015

SCALE AS SHOWN	REV.
0	0

**FIGURE: D-15**





**LEGEND**

- KILOMETRE POST (KP)
- ▲ PROPOSED FACILITY \*
- HORIZONTAL DIRECTIONAL DRILL AREA\*
- RIGHT OF WAY AND TEMPORARY WORKSPACE\*
- TERRAIN REGIONAL STUDY AREA
- TERRAIN UNITS**
  - POLYGON BOUNDARY (APPROXIMATE)
  - FIELD OBSERVATION (WM/HW01 V/R/G)
  - V - VISUAL PLOT TYPE
  - R - RECONNAISSANCE PLOT TYPE
  - G - GROUND PLOT TYPE
- BOREHOLE
- HAND AUGER
- ★ POPULATED PLACE
- CONTOUR (40 m)
- CUTLINE / TRAIL
- LOCAL ROAD
- PRIMARY HIGHWAY
- SECONDARY HIGHWAY
- WATERCOURSE
- CITY / TOWN

texture  
surface material  
activity qualifier  
surface expression  
delimit  
underlying material  
underlying surface expression  
geomorphological process  
geomorphological process subclass  
geomorphological process subtype

sgF<sup>A</sup>tp/Cv[Mks]-MuV1

terrain stability class  
drainage  
surface erosion potential  
drainage code separator

Terrain Stability Classification (Adapted from APEGBC (2002) and Ministry of Forests (1999))	
Terrain Stability Class	Interpretation
I	No significant stability problems exist
II	Very low likelihood of landslide initiation following land clearing or road/pipeline construction
III	Low likelihood of landslide initiation following land clearing or road/pipeline construction
IV	Moderate likelihood of landslide initiation following land clearing or road/pipeline construction (may include areas of existing potentially unstable terrain)
V	High likelihood of landslide initiation following land clearing or road/pipeline construction (may include areas of existing unstable terrain)

Drainage Classification	
Drainage	Drainage Separator Code
r rapid	- no intermediate classes
w well	- all intermediate classes
m moderate	/ first drainage dominant
i imperfect	// first drainage significantly dominant
p poor	
v very poor	

Soil Erosion Potential Classification	
Soil Erosion Potential	
L Low	
M Moderate	
H High	
VH Very High	

Terrain Symbol Legend (Annotated List from Howes & Kenk (1997))	
Surficial Material	Texture
A Anthropogenic	c Clay
C Colluvium	g Gravel
E Eolian	m Mud
F Fluvial	s Sand
L <sup>S</sup> Glaciolacustrine	z Silt
M Moraine/Till	
N Waterbody	
O Organic	
R Bedrock	

Activity Qualifier	
Activity Qualifier	Delimiters
A Active	/ equal proportions
I Inactive	// first material dominant
	/// first material significantly dominant

Surface Expression	
Surface Expression	Geomorphological Process Subclasses
a Moderate Slope (27-49%)	Mass Movement Processes
b Blanket (>1m thickness)	c Soil creep
c Cone (>26%)	d Debris flow
d Depression (Lower area surrounded by higher terrain)	r Debris fall
f Fan (fan shaped landform with <26% gradients)	s Debris slide
h Hummocks (non-linear rises >26%)	u Slump in surficial material
j Gentle Slope (6-26%)	
k Moderately Steep Slope (50-70%)	
m Rolling (Elongate rise and hollow <26%)	
p Plain (Unidirectional surface 0-5%)	
r Ridge (Elongate Hillslope 26-70%)	
s Steep Slope (>70%)	
t Terrace (Step-like topography)	
u Undulating (Non-linear rises <26%)	
v Veneer (<1m thickness)	
x Thin Veneer (10-25cm thickness)	

Geomorphological Process Subtypes	
Geomorphological Process	Geomorphological Process Subtypes
F Slow Mass Movement	Fluvial Processes
L Surface Seepage	b Backchannels
M Meandering Channel	u Progressive bank erosion
R Rapid Mass Movement	
U Undulating	
V Gully Erosion (unspecified)	
W Washing	

Gully Erosion Processes	
Gully Erosion Processes	
1 Gullying	
2 Rilling	

INDEX MAP

SCALE: 1:1,000,000

NOTE

\*PROPOSED METER STATIONS OBTAINED 2014-09-25, PROPOSED TOWER LAKE SECTION RIGHT OF WAY, TEMPORARY WORKSPACE AND HORIZONTAL DIRECTIONAL DRILL AREA OBTAINED 2015-02-26, AND PROPOSED GROUND BIRCH MAINLINE LOOP RIGHT OF WAY, TEMPORARY WORKSPACE AND HORIZONTAL DIRECTIONAL DRILL AREA OBTAINED 2015-03-16 AND 2015-04-23

REFERENCE

BASE DATA OBTAINED FROM CANVEC, IHS ENERGY INC. AND GEOBASE. IMAGERY AND LIDAR OBTAINED FROM MIDWEST SURVEY (PROVIDED ON 2014/05/16). ADDITIONAL IMAGERY COPYRIGHT © 20110914 ESRI AND ITS LICENSORS. SOURCE: DIGITAL GLOBE. USED UNDER LICENSE. ALL RIGHTS RESERVED.

DATUM: NAD83 PROJECTION: UTM ZONE 10

500 0 500

SCALE 17,500 METRES

PROJECT

**TransCanada**  
In business to deliver

TOWERBIRCH  
EXPANSION

TITLE

**TERRAIN AND TERRAIN  
STABILITY MAPPING**

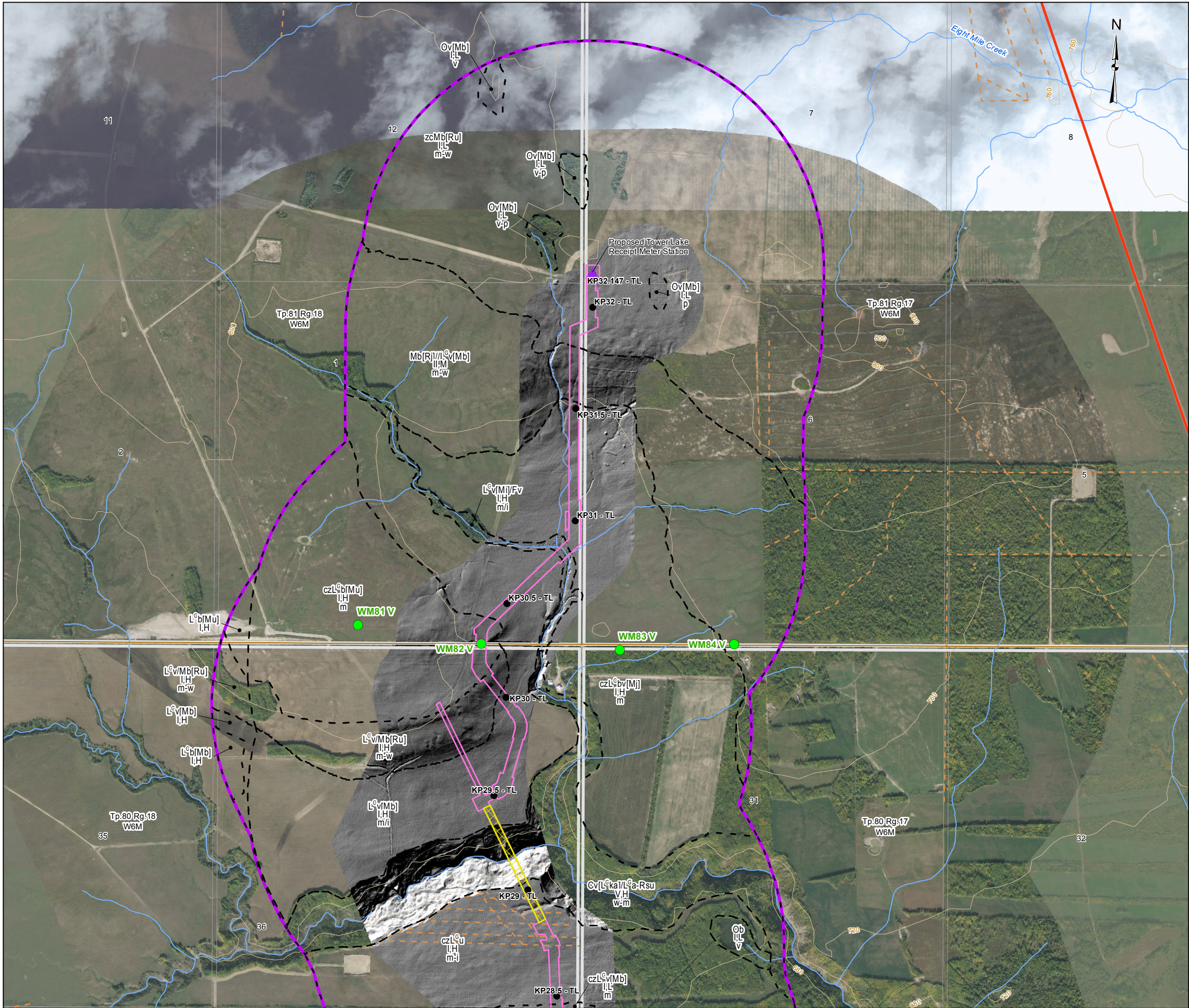
PROJECT	1403669	FILE No.
DESIGN	WM	22 May 2015
GIS	DL	27 Aug. 2015
CHECK	MCP	27 Aug. 2015
REVIEW	MH	27 Aug. 2015

SCALE AS SHOWN REV. 0

**FIGURE: D-16**

**Golder Associates**





**LEGEND**

- KILOMETRE POST (KP)
- ▲ PROPOSED FACILITY \*
- HORIZONTAL DIRECTIONAL DRILL AREA\*
- RIGHT OF WAY AND TEMPORARY WORKSPACE\*
- TERRAIN REGIONAL STUDY AREA
- TERRAIN UNITS**
  - POLYGON BOUNDARY (APPROXIMATE)
  - FIELD OBSERVATION (WM/HW01 V/R/G)
  - V - VISUAL PLOT TYPE
  - R - RECONNAISSANCE PLOT TYPE
  - G - GROUND PLOT TYPE
- BOREHOLE
- HAND AUGER
- ★ POPULATED PLACE
- CONTOUR (40 m)
- CUTLINE / TRAIL
- LOCAL ROAD
- PRIMARY HIGHWAY
- SECONDARY HIGHWAY
- WATERCOURSE
- CITY / TOWN

sgF<sup>A</sup>tp/Cv[Mks]-MuV1

terrain stability class      drainage      surface erosion potential      drainage code separator

texture  
surficial material  
activity qualifier  
surface expression  
delimit  
underlying material  
underlying surface expression  
geomorphological process  
geomorphological process subclass  
geomorphological process subtype

Terrain Stability Classification (Adapted from APEGBC (2002) and Ministry of Forests (1999))	
Terrain Stability Class	Interpretation
I	No significant stability problems exist
II	Very low likelihood of landslide initiation following land clearing or road/pipeline construction
III	Low likelihood of landslide initiation following land clearing or road/pipeline construction
IV	Moderate likelihood of landslide initiation following land clearing or road/pipeline construction (may include areas of existing potentially unstable terrain)
V	High likelihood of landslide initiation following land clearing or road/pipeline construction (may include areas of existing unstable terrain)

Drainage Classification	
Drainage	Drainage Separator Code
r rapid	- no intermediate classes
w well	- all intermediate classes
m moderate	/ first drainage dominant
i imperfect	// first drainage significantly dominant
p poor	
v very poor	

Soil Erosion Potential Classification	
L Low	M Moderate
H High	VH Very High

Terrain Symbol Legend (Annotated List from Howes & Kenik (1997))	
Surficial Material	Texture
A Anthropogenic	c Clay
C Colluvium	g Gravel
E Eolian	m Mud
F Fluvial	s Sand
L <sup>s</sup> Glaciolacustrine	z Silt
M Moraine/Till	
N Waterbody	
O Organic	
R Bedrock	

Activity Qualifier	
A Active	I Inactive

Surface Expression	
a Moderate Slope (27-49%)	b Blanket (>1m thickness)
c Cone (>26%)	d Depression (Lower area surrounded by higher terrain)
e Depression (Lower area surrounded by higher terrain)	f Fan (fan shaped landform with <26% gradients)
h Hummocks (non-linear rises >26%)	j Gentle Slope (6-26%)
k Moderately Steep Slope (50-70%)	m Rolling (Elongate rise and hollow <26%)
p Plain (Unidirectional surface 0-5%)	r Ridge (Elongate hillocks 26-70%)
s Steep Slope (>70%)	t Terrace (Step like topography)
u Undulating (Non-linear rises <26%)	v Veneer (<1m thickness)
x Thin Veneer (10-25cm thickness)	

Geomorphological Process	
F Slow Mass Movement	L Surface Seepage
M Meandering Channel	R Rapid Mass Movement
U Undulating	V Gully Erosion (unspecified)
W Washing	
Geomorphological Process Subclasses	Geomorphological Process Subtypes
Mass Movement Processes	Fluvial Processes
c Soil creep	b Backchannels
d Debris flow	u Progressive bank erosion
r Debris fall	
s Debris slide	
u Slump in surficial material	

Geomorphological Process Subtypes	
Gully Erosion Processes	Fluvial Processes
1 Gullying	
2 Rilling	

**INDEX MAP**

SCALE: 1:1,000,000

SCALE 17,500 METRES

**NOTE**

"PROPOSED METER STATIONS OBTAINED 2014-09-25, PROPOSED TOWER LAKE SECTION RIGHT OF WAY, TEMPORARY WORKSPACE AND HORIZONTAL DIRECTIONAL DRILL AREA OBTAINED 2015-02-26, AND PROPOSED GROUND BIRCH MAINLINE LOOP RIGHT OF WAY, TEMPORARY WORKSPACE AND HORIZONTAL DIRECTIONAL DRILL AREA OBTAINED 2015-03-16 AND 2015-04-23"

**REFERENCE**

BASE DATA OBTAINED FROM CANVEC, IHS ENERGY INC. AND GEOBASE. IMAGERY AND LIDAR OBTAINED FROM MIDWEST SURVEY (PROVIDED ON 2014/05/16). ADDITIONAL IMAGERY COPYRIGHT © 20110914 ESRI AND ITS LICENSORS. SOURCE: DIGITAL GLOBE. USED UNDER LICENSE. ALL RIGHTS RESERVED.

DATUM: NAD83 PROJECTION: UTM ZONE 10

**PROJECT**  
 **TransCanada**  
In business to deliver

**TOWERBIRCH EXPANSION**

**TITLE**  
**TERRAIN AND TERRAIN STABILITY MAPPING**

**Golder Associates**

PROJECT		1403669	FILE No.
DESIGN	WM	22 May 2015	SCALE AS SHOWN
GIS	DL	27 Aug. 2015	REV. 0
CHECK	MCP	27 Aug. 2015	<b>FIGURE: D-17</b>
REVIEW	MH	27 Aug. 2015	