PROPOSED UPLAND LANDFILL

HYDROGEOLOGICAL REVIEW BY GW SOLUTIONS

Victoria, October 6, 2017

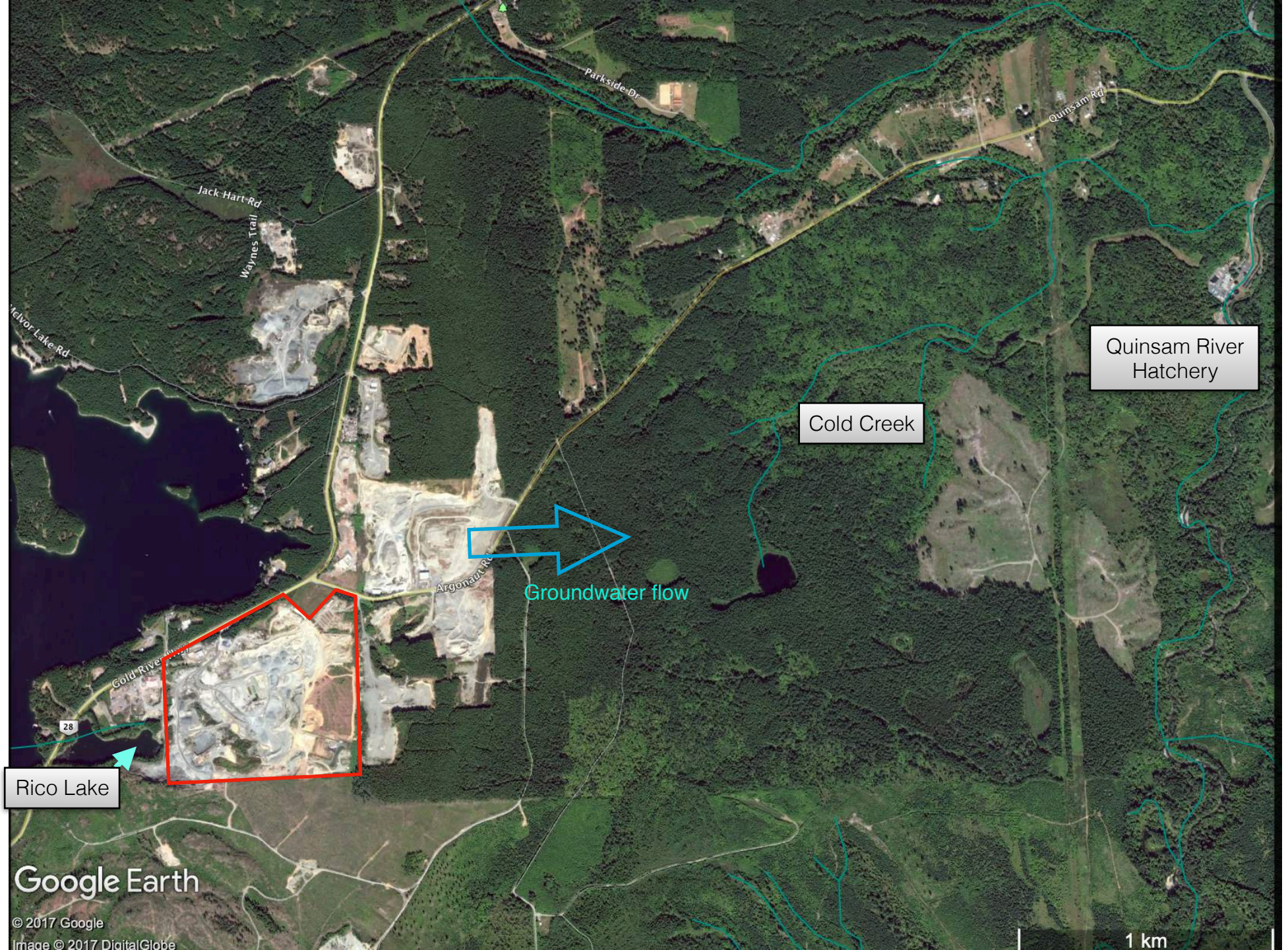
OUTLINE

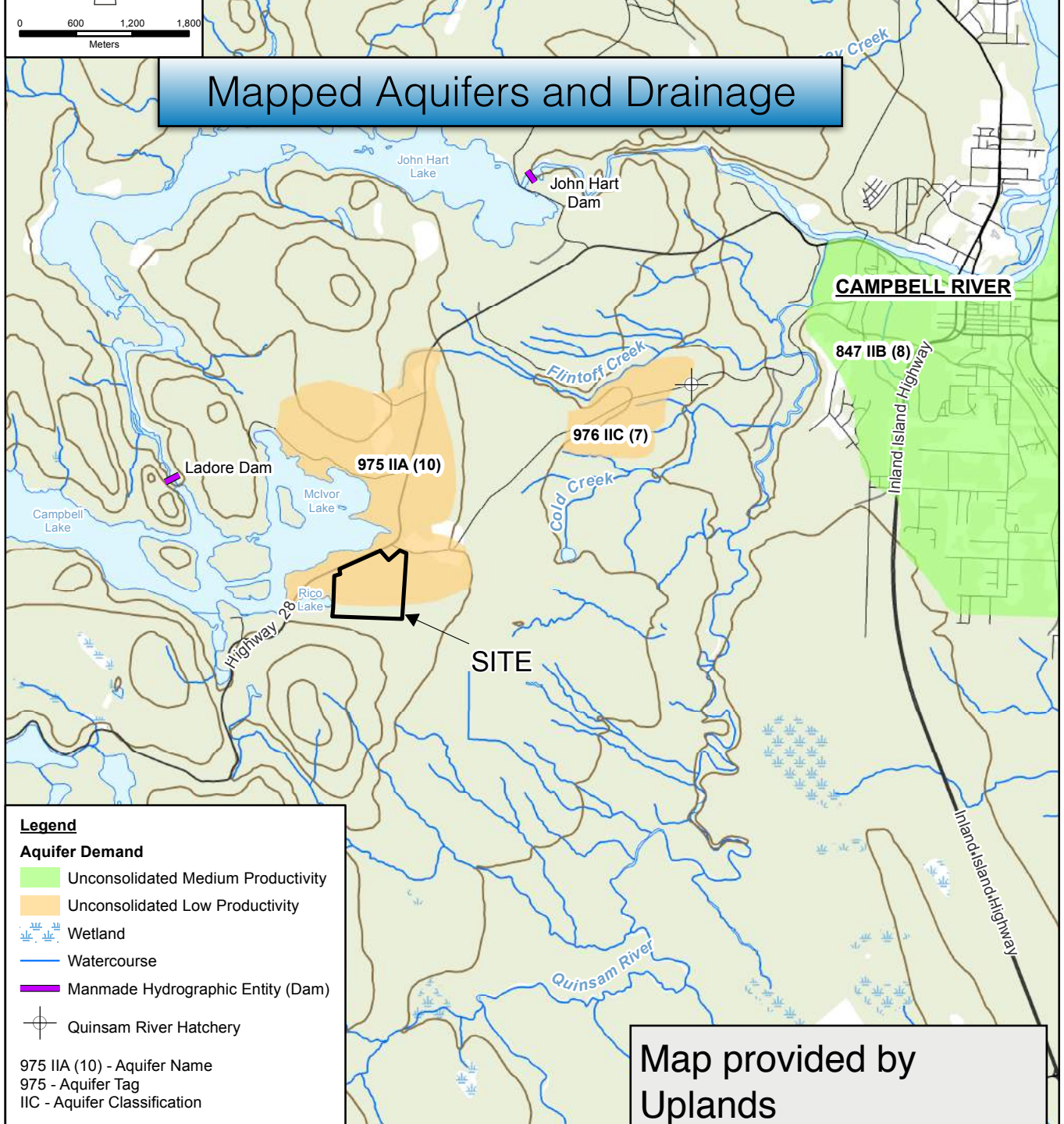
- Setting
- Sensitive Receptors - Issues
- Completed Work
- Remaining Questions

OUTLINE

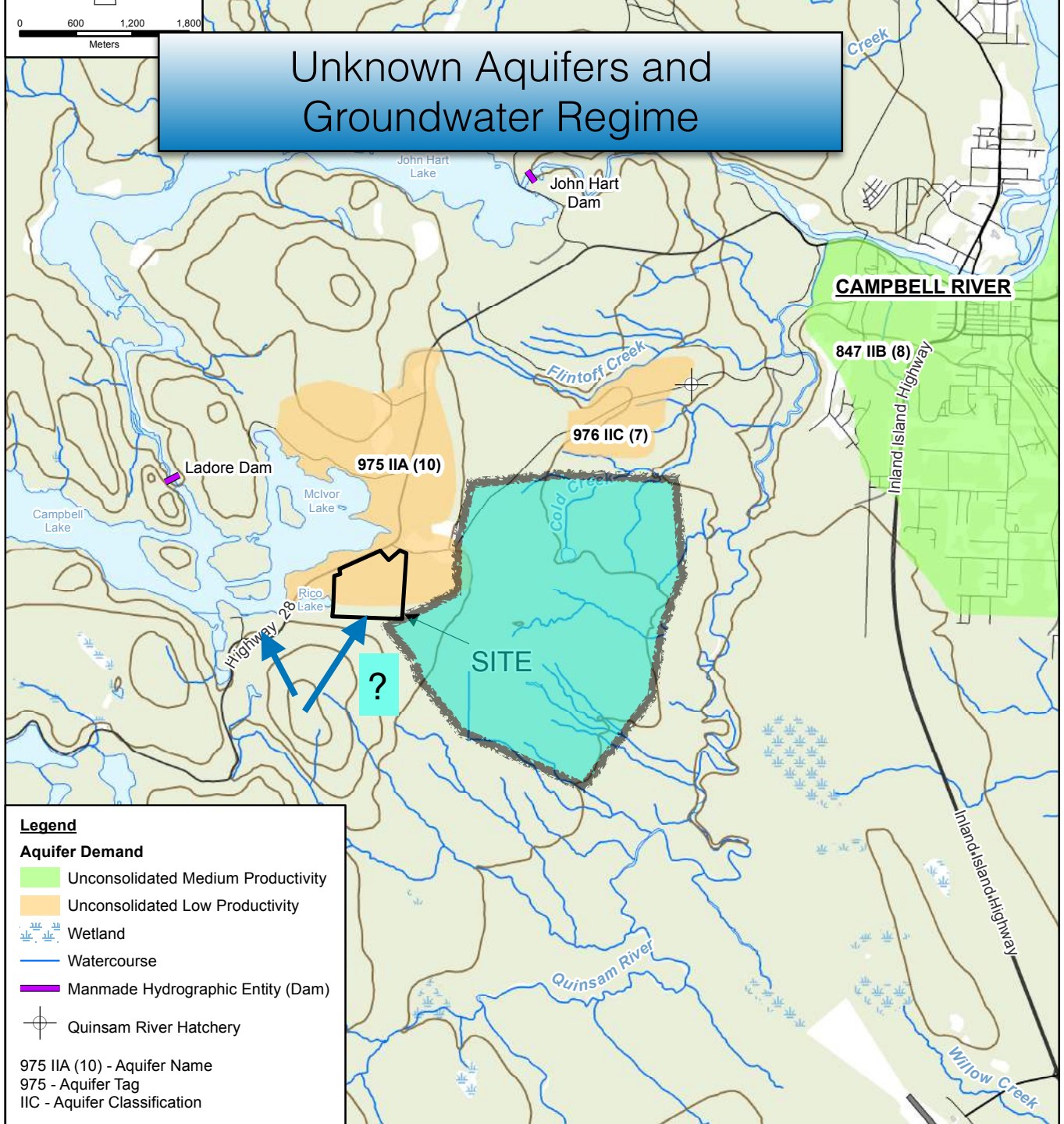
- Setting

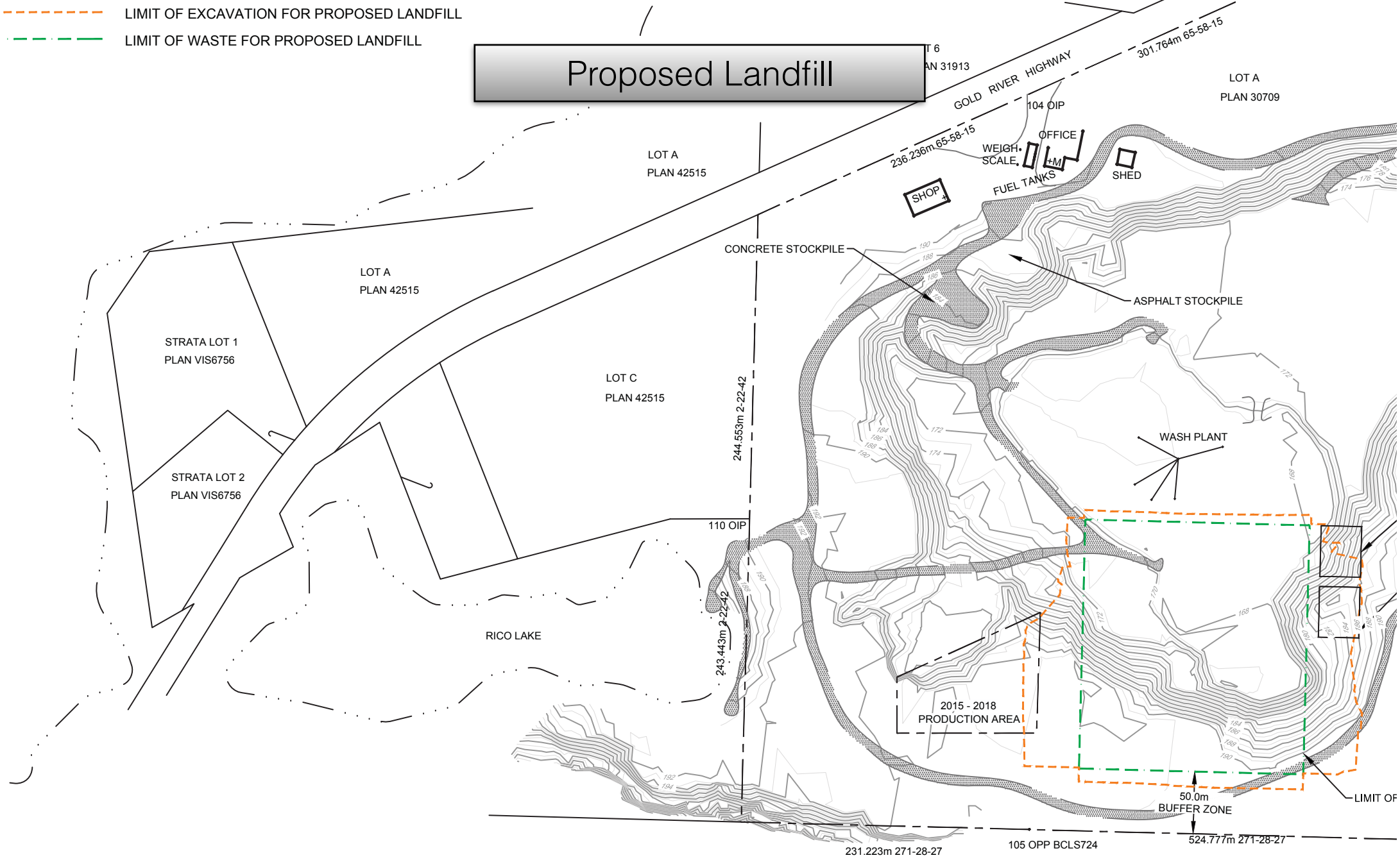

John Hart Lake
Campbell River Water Intake
Campbell River
Campbell River
Quinsam River Hatchery
Cold Creek
McIvor Lake
Rico Lake
Uplands Landfill
Quinsam River
Google Earth
Image © 2017 DigitalGlobe
© 2017 Google
Image © 2017 IMTCAN
4 km

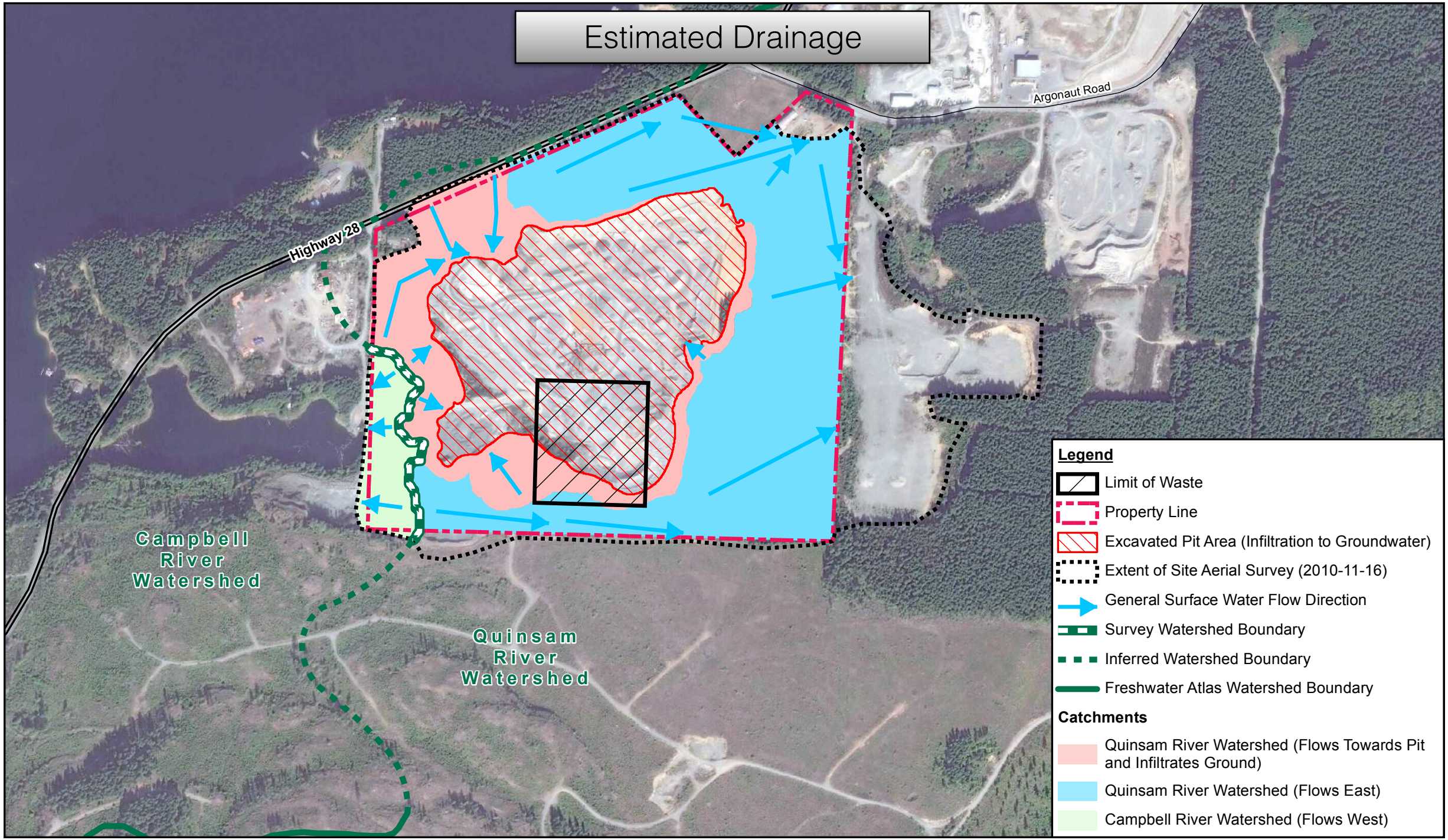

Parkside Dr
Quinsam Rd
Jack Hart Rd
Waynes Trail
Argonaut Rd
28
Quinsam River Hatchery
Cold Creek
Groundwater flow
Rico Lake
Google Earth
© 2017 Google
Image © 2017 DigitalGlobe
1 km


0 600 1,200 1,800
Meters
Mapped Aquifers and Drainage
John Hart Lake
John Hart Dam
CAMPBELL RIVER
847 IIB (8)
Flintoff Creek
976 IIC (7)
975 IIA (10)
Ladore Dam
McIvor Lake
Campbell Lake
Cold Creek
Inland Island Highway
Rico Lake
Highway 28
SITE
Quinsam River
Legend
Aquifer Demand
Unconsolidated Medium Productivity
Unconsolidated Low Productivity
Wetland
Watercourse
Manmade Hydrographic Entity (Dam)
Quinsam River Hatchery
975 IIA (10) - Aquifer Name
975 - Aquifer Tag
IIC - Aquifer Classification
Map provided by Uplands

Unknown Aquifers and Groundwater Regime

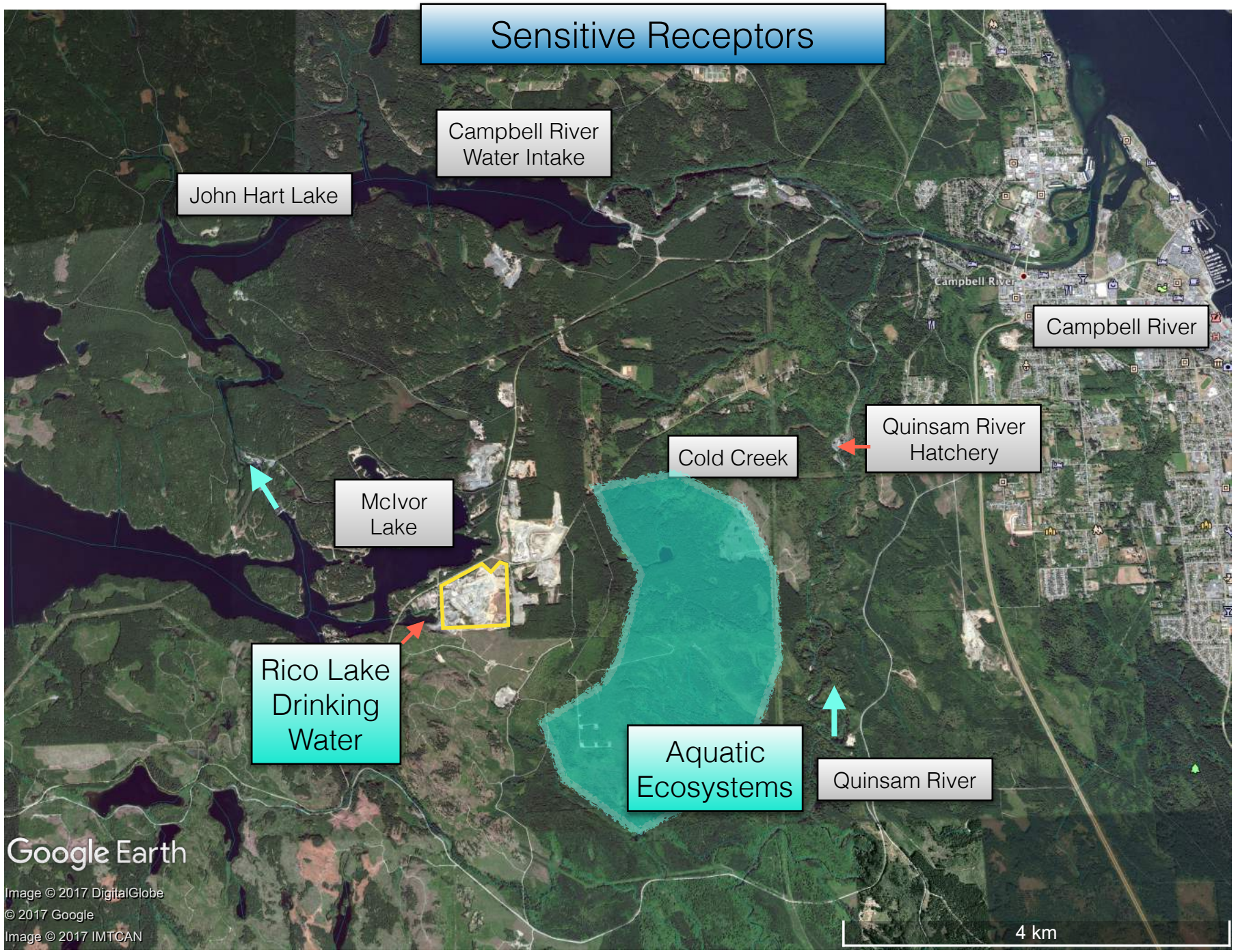



LIMIT OF EXCAVATION FOR PROPOSED LANDFILL
LIMIT OF WASTE FOR PROPOSED LANDFILL
Proposed Landfill
GOLD RIVER HIGHWAY
301.764m 65-58-15
236.236m 65-58-15
104 OIP
OFFICE
WEIGH SCALE
SHED
FUEL TANKS
SHOP
LOT A
PLAN 30709
LOT A
PLAN 42515
LOT A
PLAN 42515
STRATA LOT 1
PLAN VIS6756
STRATA LOT 2
PLAN VIS6756
LOT C
PLAN 42515
CONCRETE STOCKPILE
ASPHALT STOCKPILE
WASH PLANT
244.553m 2-22-42
110 OIP
243.443m 2-22-42
RICO LAKE
2015 - 2018
PRODUCTION AREA
50.0m
BUFFER ZONE
LIMIT OF
231.223m 271-28-27
105 OPP BCLS724
524.777m 271-28-27
NE 1/4 SEC.32 TP.2
W 1/2 OF NW 1/4 SEC. 33 TP. 2


Estimated Drainage
Argonaut Road
Highway 28
Campbell River Watershed
Quinsam River Watershed
Legend
Limit of Waste
Property Line
Excavated Pit Area (Infiltration to Groundwater)
Extent of Site Aerial Survey (2010-11-16)
General Surface Water Flow Direction
Survey Watershed Boundary
Inferred Watershed Boundary
Freshwater Atlas Watershed Boundary
Catchments
Quinsam River Watershed (Flows Towards Pit and Infiltrates Ground)
Quinsam River Watershed (Flows East)
Campbell River Watershed (Flows West)

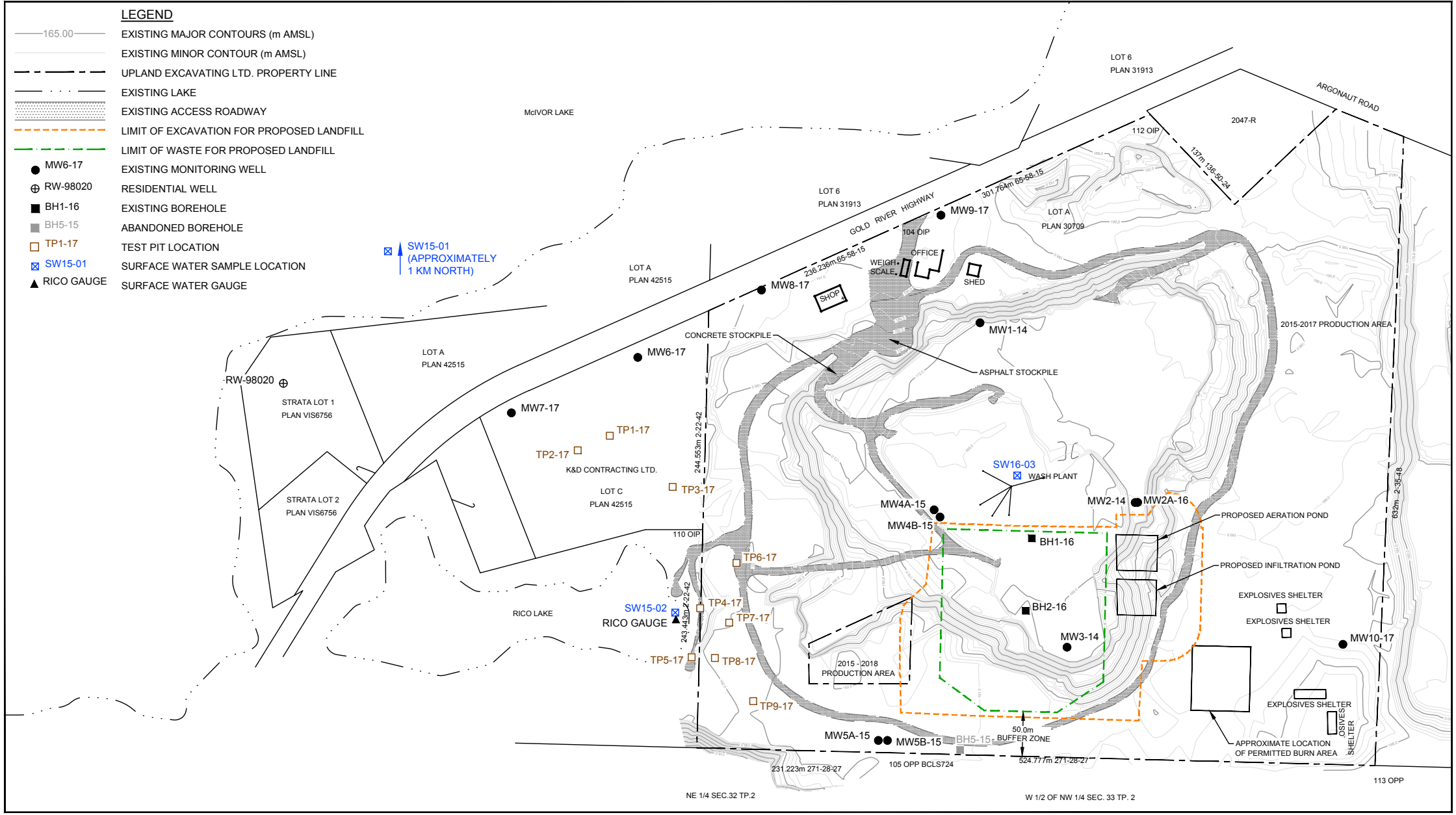
OUTLINE

- Setting
- Sensitive Receptors - Issues


Sensitive Receptors
Campbell River Water Intake
John Hart Lake
Campbell River
Campbell River
Quinsam River Hatchery
Cold Creek
McIvor Lake
Rico Lake Drinking Water
Aquatic Ecosystems
Quinsam River
Google Earth
Image © 2017 DigitalGlobe
© 2017 Google
Image © 2017 IMTCAN
4 km

OUTLINE

- Setting
- Sensitive Receptors - Issues
- Completed Work



SOURCE: TOPOGRAPHICAL SURVEY CONDUCTED BY McELHANNEY ASSOCIATES LAND SURVEYING LTD., NOVEMBER 21, 2016.

0 40 80 120m

N

GHD

UPLAND EXCAVATING LTD.
PROPOSED UPLAND LANDFILL
HYDROGEOLOGIC AND HYDROLOGY CHARACTERIZATION REPORT

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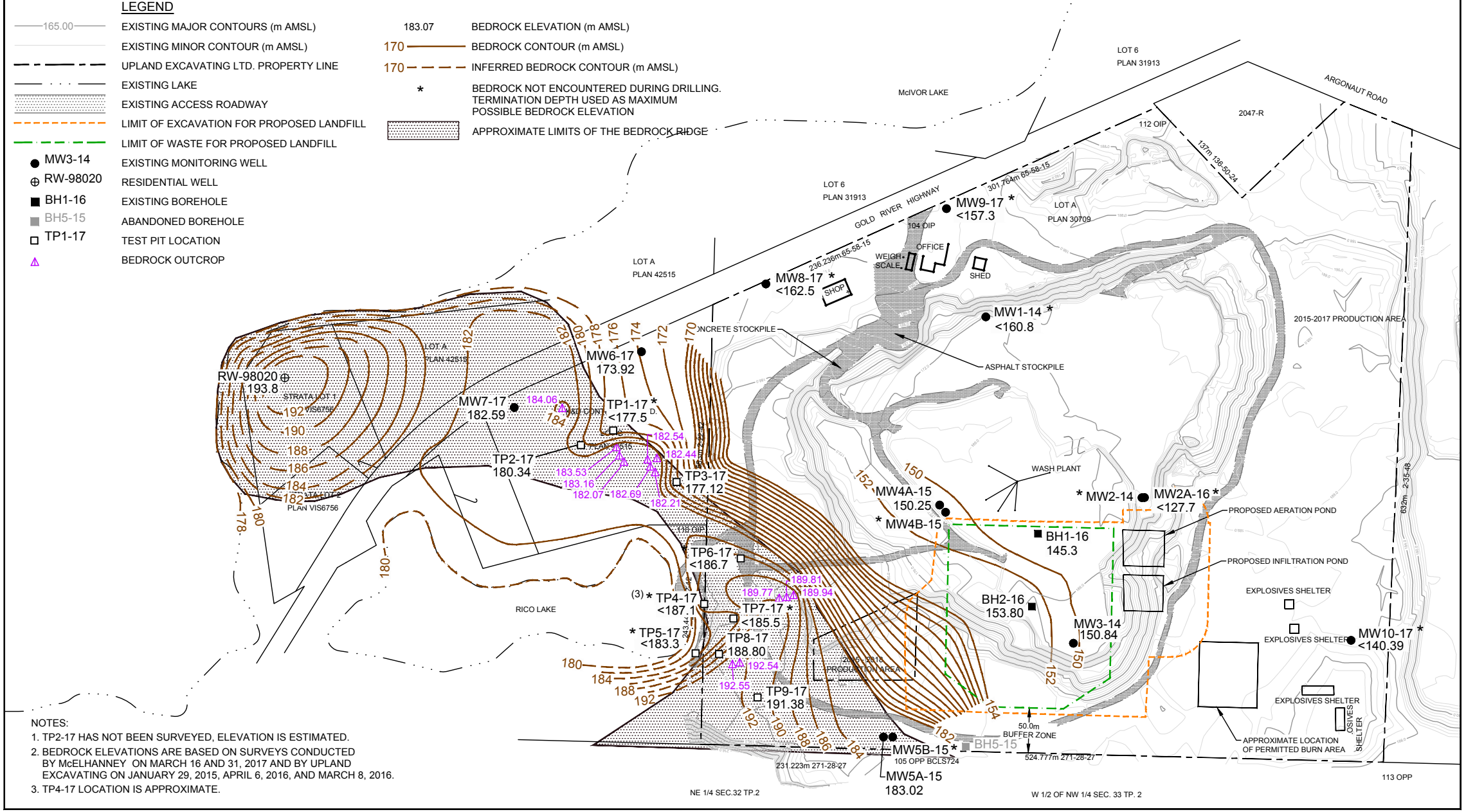
May 23, 2017

MONITORING LOCATIONS

13
FIGURE 1.4



NOTES:

1. TP2-17 HAS NOT BEEN SURVEYED, ELEVATION IS ESTIMATED.
2. BEDROCK ELEVATIONS ARE BASED ON SURVEYS CONDUCTED BY McELHANNEY ON MARCH 16 AND 31, 2017 AND BY UPLAND EXCAVATING ON JANUARY 29, 2015, APRIL 6, 2016, AND MARCH 8, 2016.
3. TP4-17 LOCATION IS APPROXIMATE.

SOURCE: TOPOGRAPHICAL SURVEY CONDUCTED BY McELHANNEY ASSOCIATES LAND SURVEYING LTD., NOVEMBER 21, 2016.

0 40 80 120m

UPLAND EXCAVATING LTD.
PROPOSED UPLAND LANDFILL
HYDROGEOLOGIC AND HYDROLOGY CHARACTERIZATION REPORT

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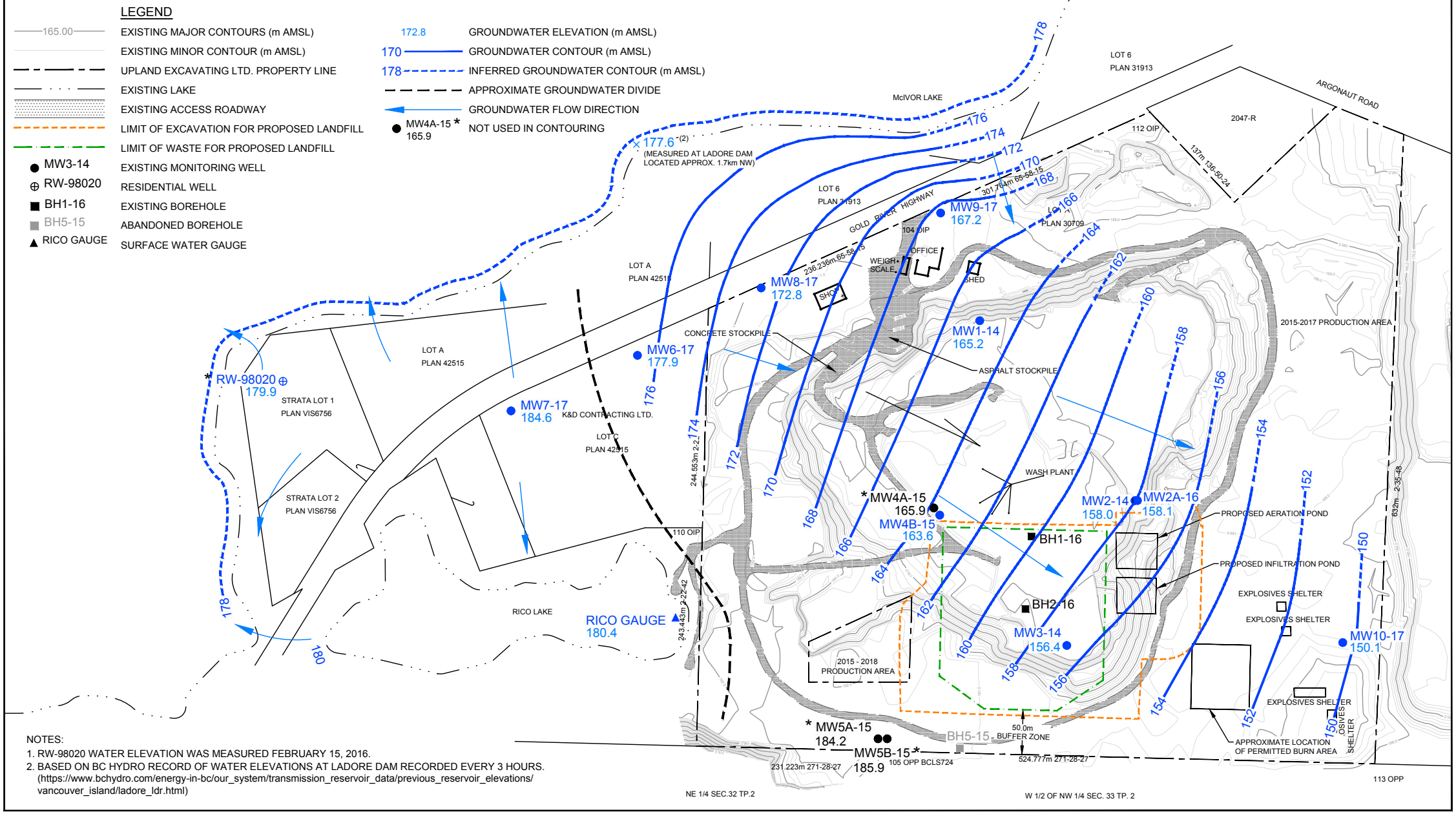
BEDROCK CONTOURS

FIGURE 2.8



NOTES:
1. RW-98020 WATER ELEVATION WAS MEASURED FEBRUARY 15, 2016.
2. BASED ON BC HYDRO RECORD OF WATER ELEVATIONS AT LADORE DAM RECORDED EVERY 3 HOURS. (https://www.bchydro.com/energy-in-bc/our_system/transmission_reservoir_data/previous_reservoir_elevations/vancouver_island/ladore_ldr.html)

SOURCE: TOPOGRAPHICAL SURVEY CONDUCTED BY McELHANNEY ASSOCIATES LAND SURVEYING LTD., NOVEMBER 21, 2016.

0 40 80 120m

UPLAND EXCAVATING LTD.
PROPOSED UPLAND LANDFILL
HYDROGEOLOGIC AND HYDROLOGY CHARACTERIZATION REPORT
GROUNDWATER ELEVATION CONTOURS
SAND & GRAVEL AQUIFER - APRIL 6, 2017

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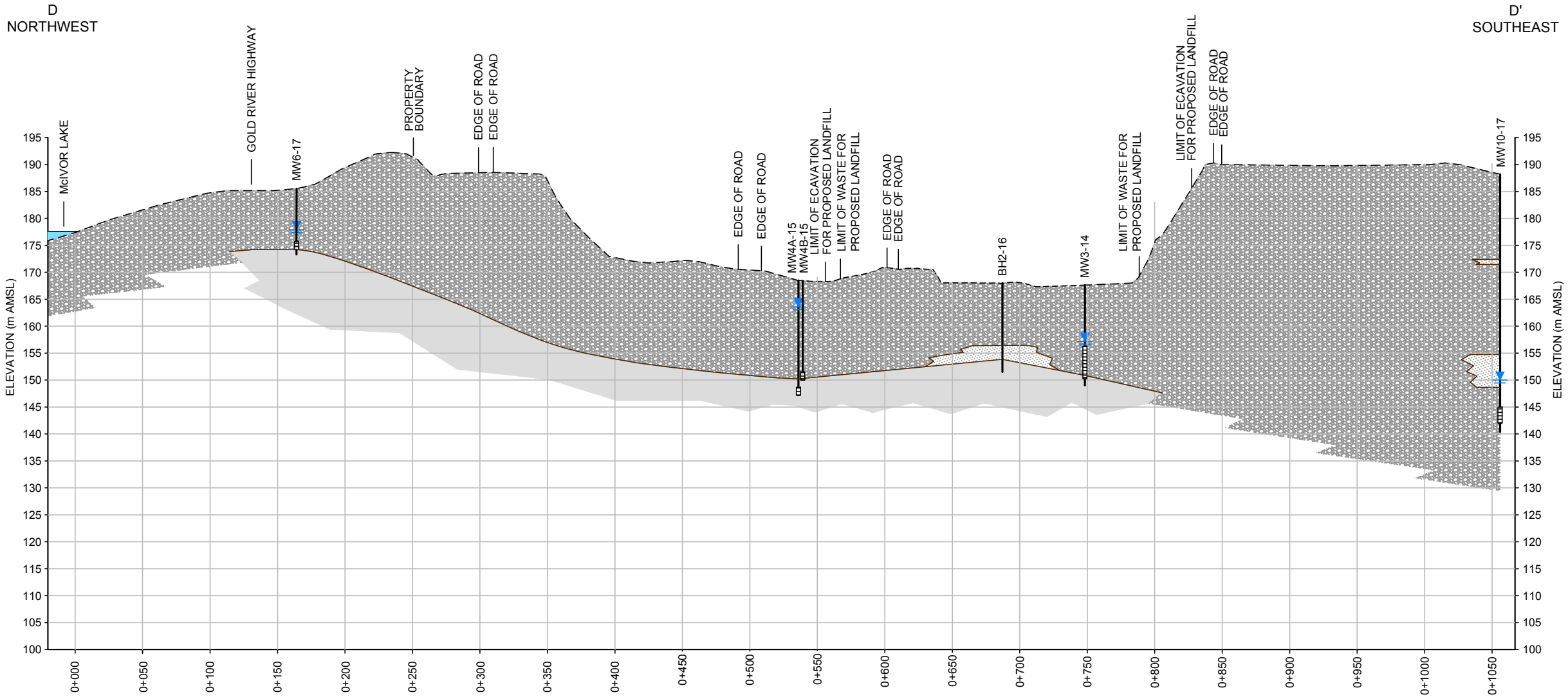
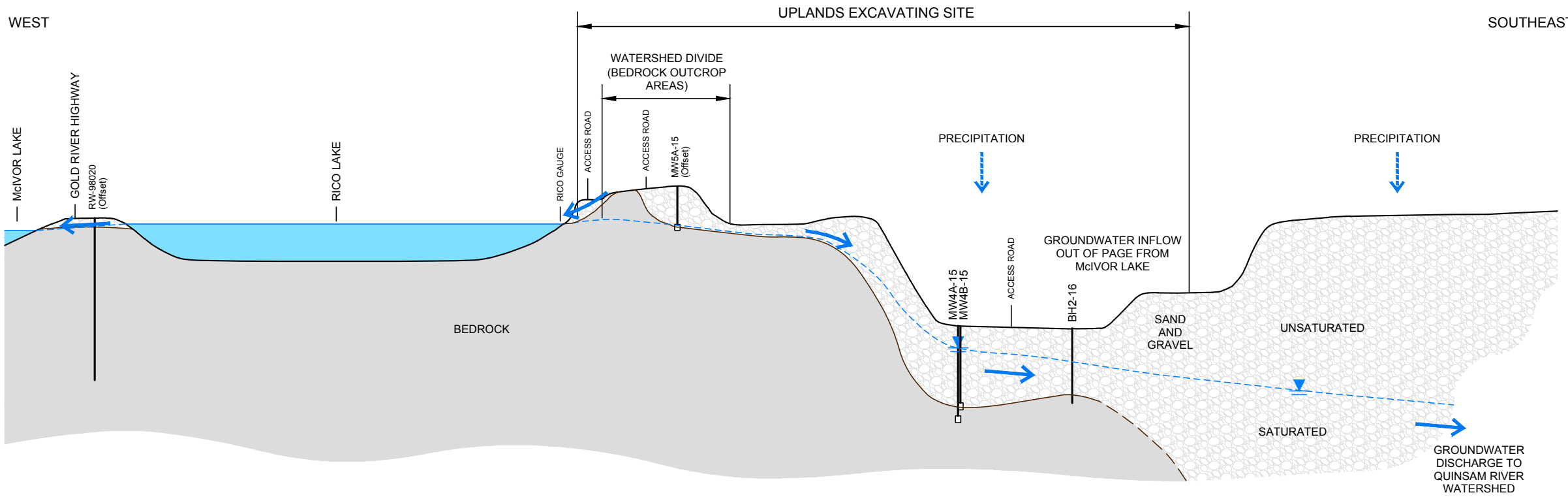
May 23, 2017

FIGURE 2.9



SECTION D-D'
HORZ 1:3000
VERT 1:750
figure 2.2



NOT TO SCALE

NOTES:
1. ONSITE TOPOGRAPHY IS BASED ON THE TOPOGRAPHICAL SURVEY CONDUCTED BY McELHANNEY ASSOCIATE LAND SURVEYING LTD., NOVEMBER 21, 2016.
2. OFFSITE TOPOGRAPHY HAS BEEN ESTIMATED USING ESRI TOPOGRAPHIC BASEMAP, ACCESSED 2017; BRITISH COLUMBIA MINISTRY OF ENVIRONMENT, WATER PROTECTION AND SUSTAINABILITY BRANCH, SEPTEMBER 11, 2014.
3. RICO LAKE IS APPROXIMATELY 12 M DEEP (LAKE BOTTOM IS AT 168 mAMSL) - MEASURED BY CAMPBELL RIVER ENVIRONMENTAL COMMITTEE.
4. ALL LOCATIONS ARE APPROXIMATE AND MEANT TO DEMONSTRATE CONCEPTUAL FLOW DIRECTION.

LEGEND

SAND AND GRAVEL
BEDROCK
SURFACE WATER
SCREEN INTERVAL
WATER LEVEL
FLOW DIRECTION

UPLAND EXCAVATING LTD.
PROPOSED UPLAND LANDFILL
HYDROGEOLOGIC AND HYDROLOGY CHARACTERIZATION REPORT

CONCEPTUAL FLOW MODEL -
SCHEMATIC CROSS-SECTION - WEST-SOUTHEAST

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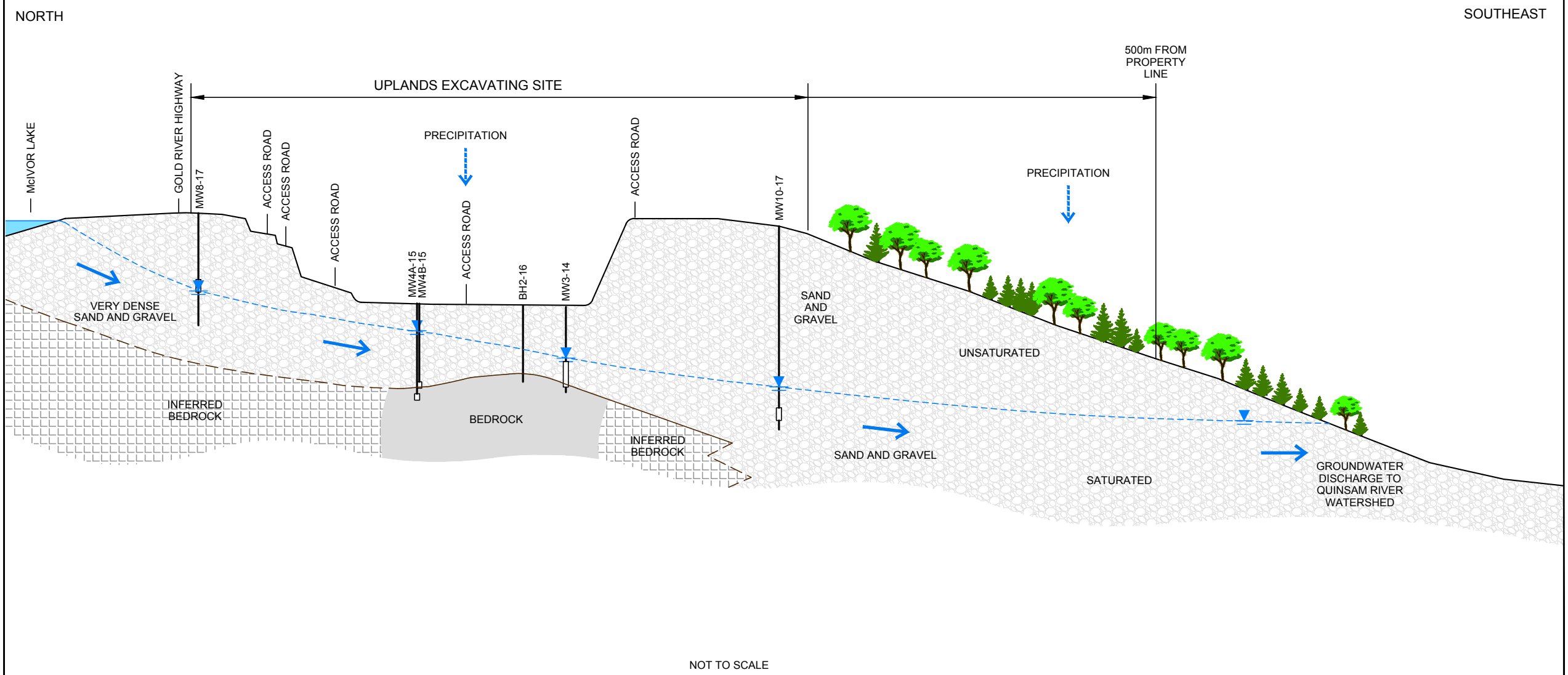
FIGURE 3.0C



NOT TO SCALE

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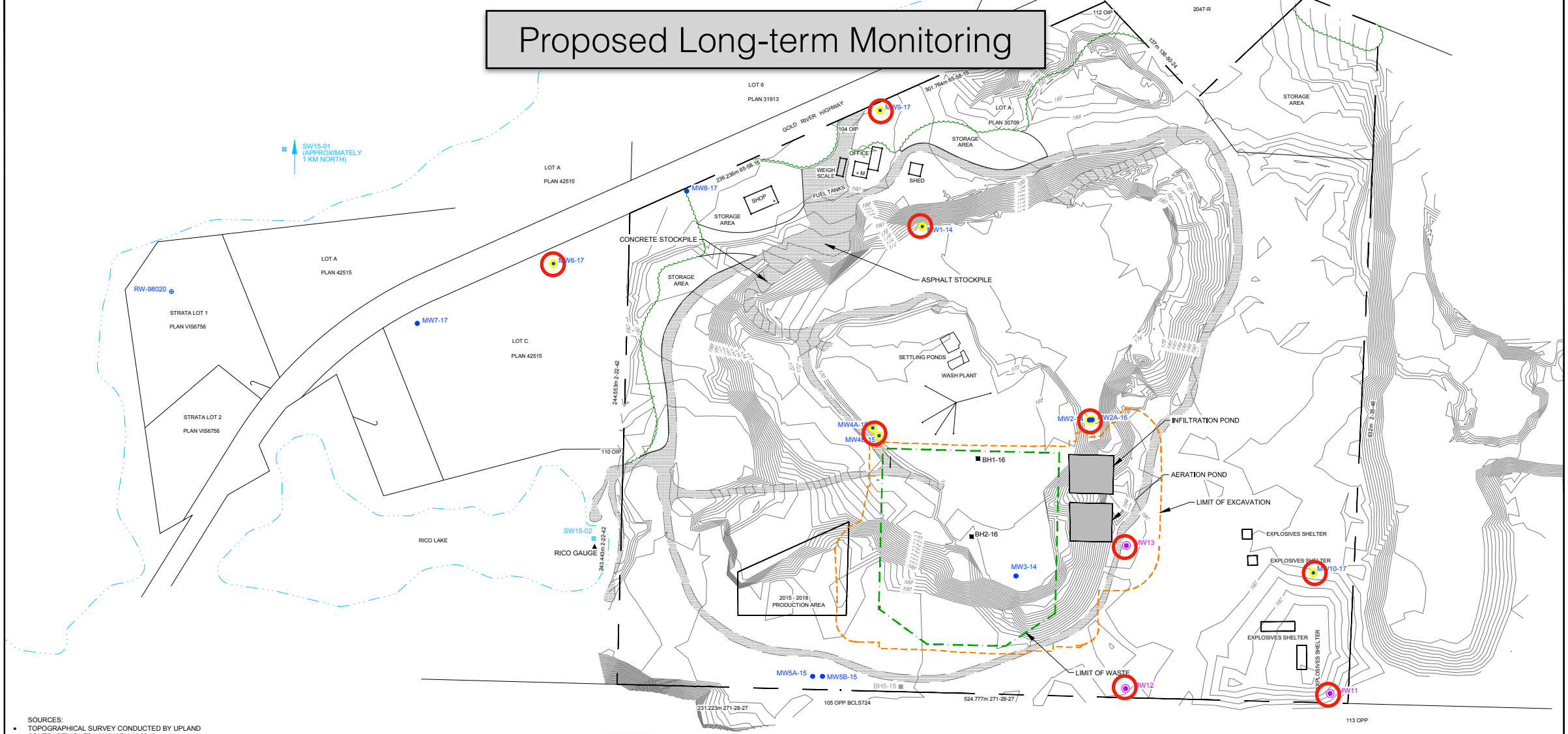
Proposed Long-term Monitoring



SOURCES:
- TOPOGRAPHICAL SURVEY CONDUCTED BY UPLAND CONTRACTING LTD., JANUARY 29 2015
- TOPOGRAPHIC SURVEY PLAN OF UPLANDS EXCAVATING GRAVEL PIT CONDUCTED BY McELHANNEY ASSOCIATES LAND SURVEYING LTD. COMPLETED ON NOVEMBER 21ST, 2016.

0 40 80 120m

LEGEND

- EXISTING MAJOR CONTOURS
- EXISTING MINOR CONTOUR
- PROPERTY LINE
- EXISTING LAKE
- EXISTING ACCESS ROADWAY
- LIMIT OF WASTE
- LIMIT OF EXCAVATION
- TREES/VEGETATION
- MW3-14 EXISTING MONITORING WELL
- RW-98020 RESIDENTIAL WELL
- BH5-15 EXISTING BOREHOLE
- BH5-15 ABANDONED BOREHOLE
- SW15-01 SURFACE WATER SAMPLE LOCATION
- RICO GAUGE SURFACE WATER GAUGE
- MW2-14 MONITORING WELL INCLUDED IN PROPOSED ENVIRONMENTAL MONITORING PROGRAM
- MW12 APPROXIMATE LOCATION OF PROPOSED MONITORING WELL INCLUDED IN PROPOSED ENVIRONMENTAL MONITORING PROGRAM (DURING LANDFILL OPERATIONS)

GHD

UPLAND EXCAVATING LIMITED
PROPOSED UPLAND LANDFILL
2017 DESIGN, OPERATION, AND CLOSURE PLAN

ENVIRONMENTAL MONITORING PROGRAM
PROPOSED MONITORING LOCATIONS

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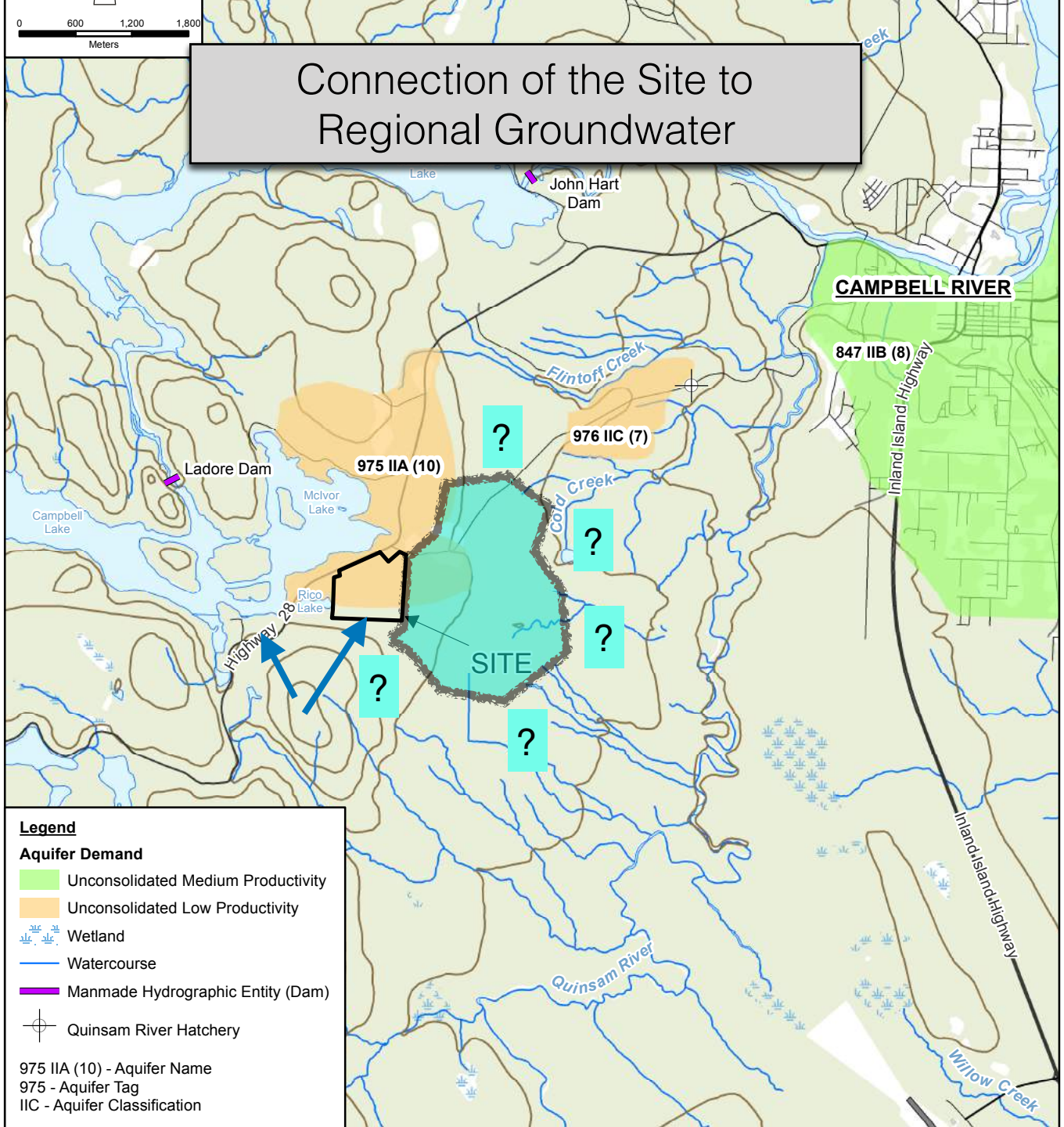
FIGURE 14.1

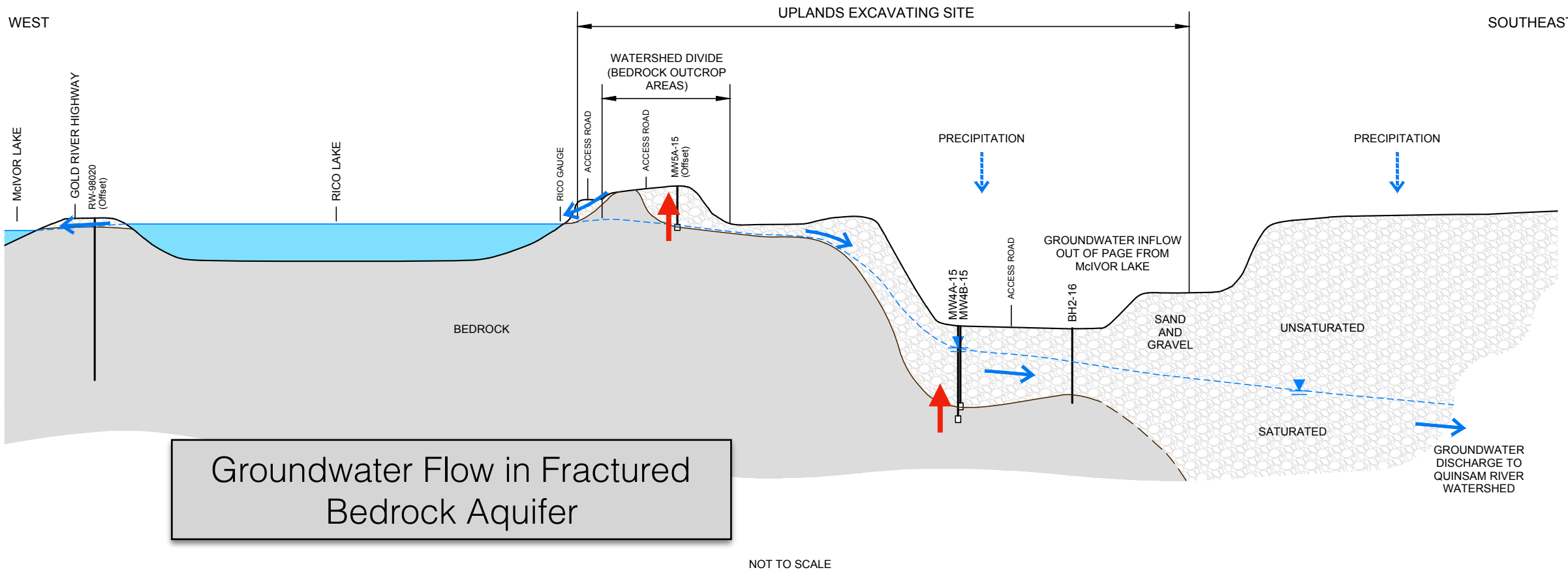
CAD File: P:\drawings\88000s\88877\88877 - REPORTS\88877-03(010)\88877-03(010)GN\88877-03(010)GN-WA005.DWG

OUTLINE

- Setting
- Sensitive Receptors - Issues
- Completed Work
- Remaining Questions

Connection of the Site to Regional Groundwater





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4. ALL LOCATIONS ARE APPROXIMATE AND MEANT TO DEMONSTRATE CONCEPTUAL FLOW DIRECTION.

LEGEND

SAND AND GRAVEL
BEDROCK
SURFACE WATER
SCREEN INTERVAL
WATER LEVEL
FLOW DIRECTION

GHD

UPLAND EXCAVATING LTD.
PROPOSED UPLAND LANDFILL
HYDROGEOLOGIC AND HYDROLOGY CHARACTERIZATION REPORT

CONCEPTUAL FLOW MODEL -
SCHEMATIC CROSS-SECTION - WEST-SOUTHEAST

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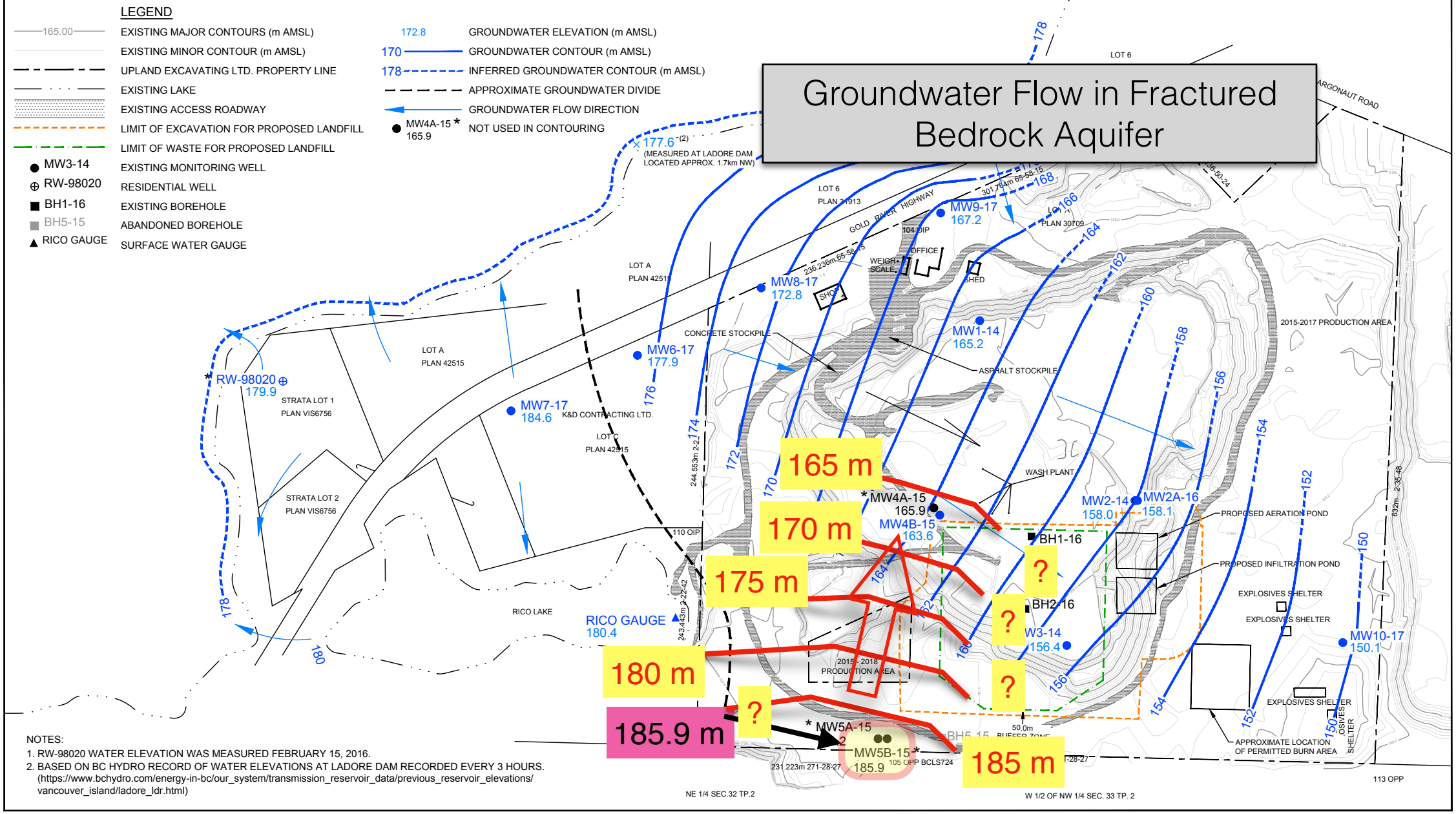
May 23, 2017

FIGURE 3.0C

Groundwater Flow in Fractured Bedrock Aquifer



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SOURCE: TOPOGRAPHICAL SURVEY CONDUCTED BY McELHANNEY ASSOCIATES LAND SURVEYING LTD., NOVEMBER 21, 2016.

0 40 80 120m

GHD

UPLAND EXCAVATING LTD.
PROPOSED UPLAND LANDFILL
HYDROGEOLOGIC AND HYDROLOGY CHARACTERIZATION REPORT
GROUNDWATER ELEVATION CONTOURS
SAND & GRAVEL AQUIFER - APRIL 6, 2017

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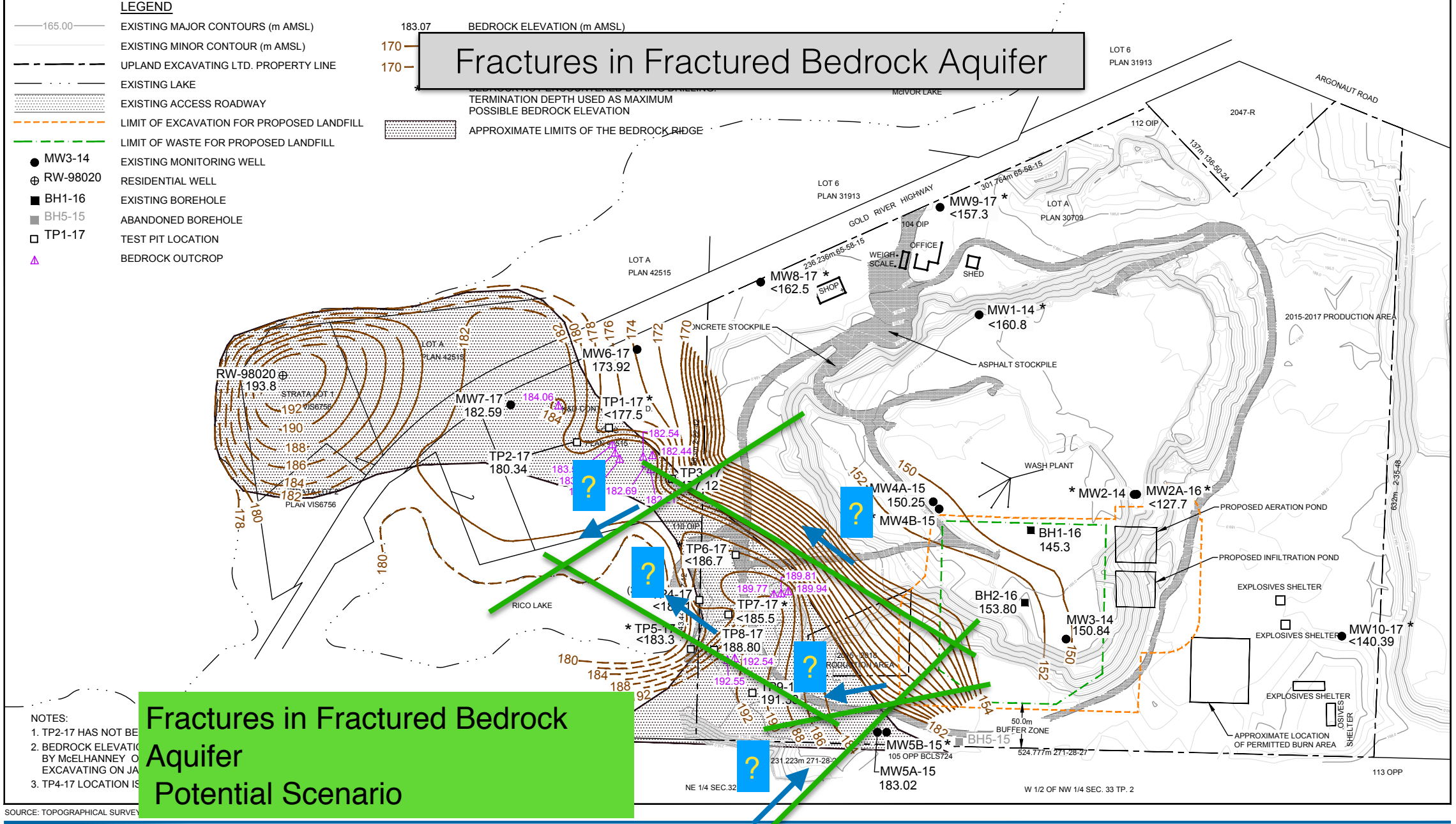
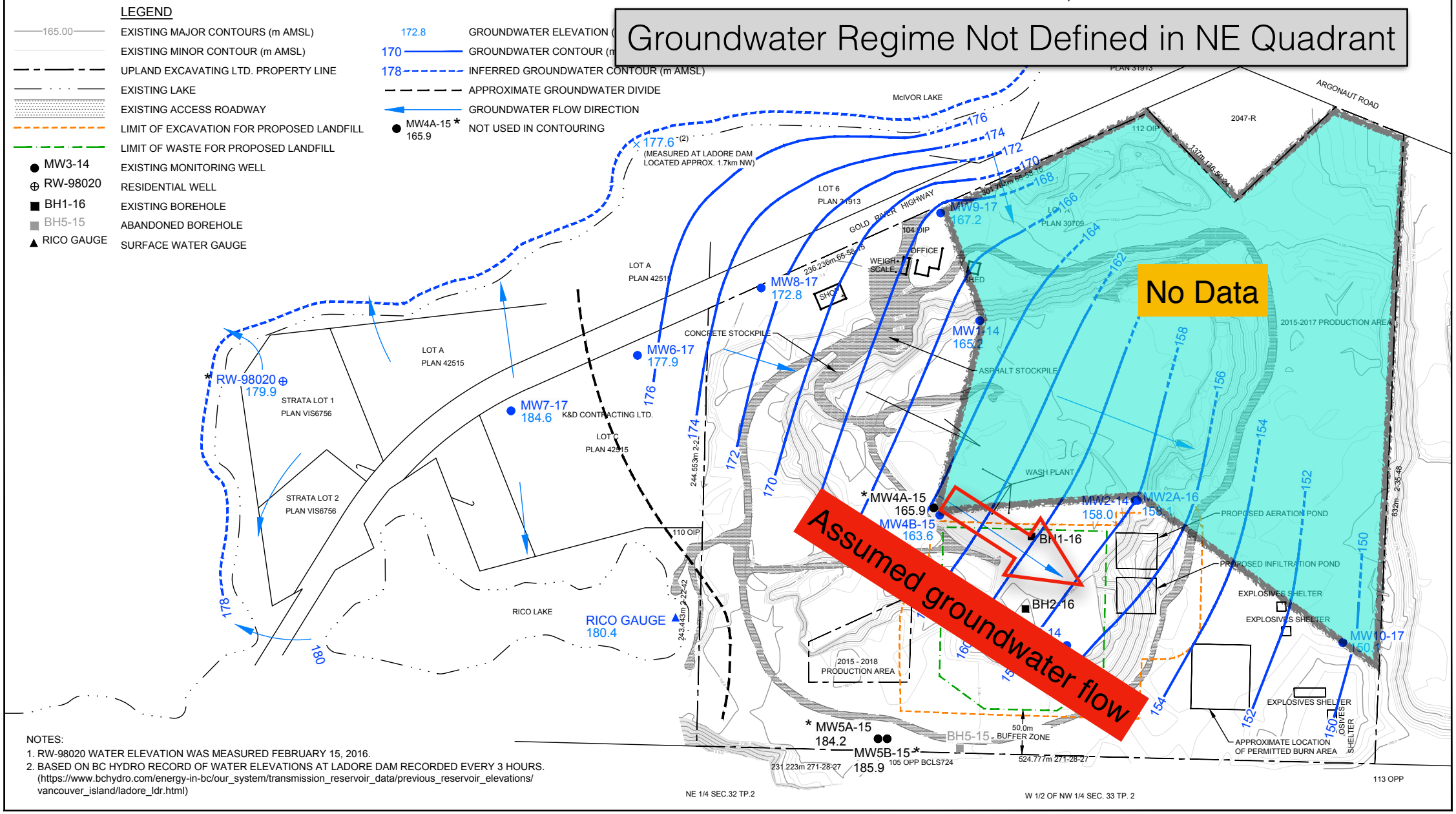
May 23, 2017

FIGURE 2.9


LEGEND
165.00 EXISTING MAJOR CONTOURS (m AMSL)
EXISTING MINOR CONTOUR (m AMSL)
UPLAND EXCAVATING LTD. PROPERTY LINE
EXISTING LAKE
EXISTING ACCESS ROADWAY
LIMIT OF EXCAVATION FOR PROPOSED LANDFILL
LIMIT OF WASTE FOR PROPOSED LANDFILL
MW3-14 EXISTING MONITORING WELL
RW-98020 RESIDENTIAL WELL
BH1-16 EXISTING BOREHOLE
BH5-15 ABANDONED BOREHOLE
TP1-17 TEST PIT LOCATION
BEDROCK OUTCROP
183.07 BEDROCK ELEVATION (m AMSL)
170 170 BEDROCK CONTOUR (m AMSL)
TERMINATION DEPTH USED AS MAXIMUM POSSIBLE BEDROCK ELEVATION
APPROXIMATE LIMITS OF THE BEDROCK RIDGE
Fractures in Fractured Bedrock Aquifer
LOT 6 PLAN 31913
ARGONAUT ROAD
2047-R
112 OIP
137m 136-50-24
McIVOR LAKE
GOLD RIVER HIGHWAY
301.764m 65-58-15
LOT A PLAN 30709
104 OIP
MW9-17 * <157.3
OFFICE
WEIGH SCALE
SHED
236.236m 65-58-15
LOT A PLAN 42515
MW8-17 * <162.5
SHOP
MW1-14 * <160.8
2015-2017 PRODUCTION AREA
CONCRETE STOCKPILE
ASPHALT STOCKPILE
MW6-17 173.92
RW-98020 193.8
STRATA LOT 7 PLAN VIS6756
MW7-17 182.59
184.06
TP1-17 * <177.5
TP2-17 180.34
182.54
182.44
182.69
TP3-17 .12
WASH PLANT
MW4A-15 150.25
MW4B-15
* MW2-14
MW2A-16 * <127.7
PROPOSED AERATION POND
BH1-16 145.3
PROPOSED INFILTRATION POND
118 OIP
TP6-17 <186.7
189.81
189.77
189.94
TP7-17 * <185.5
BH2-16 153.80
EXPLOSIVES SHELTER
MW3-14 150.84
MW10-17 * <140.39
RICO LAKE
TP5-17 * <183.3
TP8-17 188.80
192.54
192.55
191.30
2015-2017 PRODUCTION AREA
50.0m BUFFER ZONE
BH5-15
MW5B-15 * 105 OPP BCLS724
MW5A-15 183.02
231.223m 271-28-27
524.777m 271-28-27
APPROXIMATE LOCATION OF PERMITTED BURN AREA
113 OPP
NE 1/4 SEC.32
W 1/2 OF NW 1/4 SEC. 33 TP. 2
632m 2-35-48
NOTES:
1. TP2-17 HAS NOT BE
2. BEDROCK ELEVATIO BY McELHANNEY O EXCAVATING ON JA
3. TP4-17 LOCATION IS
Fractures in Fractured Bedrock Aquifer Potential Scenario
SOURCE: TOPOGRAPHICAL SURVEY
0 40 80 120m
N
GHD
UPLAND EXCAVATING LTD.
PROPOSED UPLAND LANDFILL
HYDROGEOLOGIC AND HYDROLOGY CHARACTERIZATION REPORT
BEDROCK CONTOURS
88877-03
May 23, 2017
24
FIGURE 2.8



SOURCE: TOPOGRAPHICAL SURVEY CONDUCTED BY McELHANNEY ASSOCIATES LAND SURVEYING LTD., NOVEMBER 21, 2016.

GHD

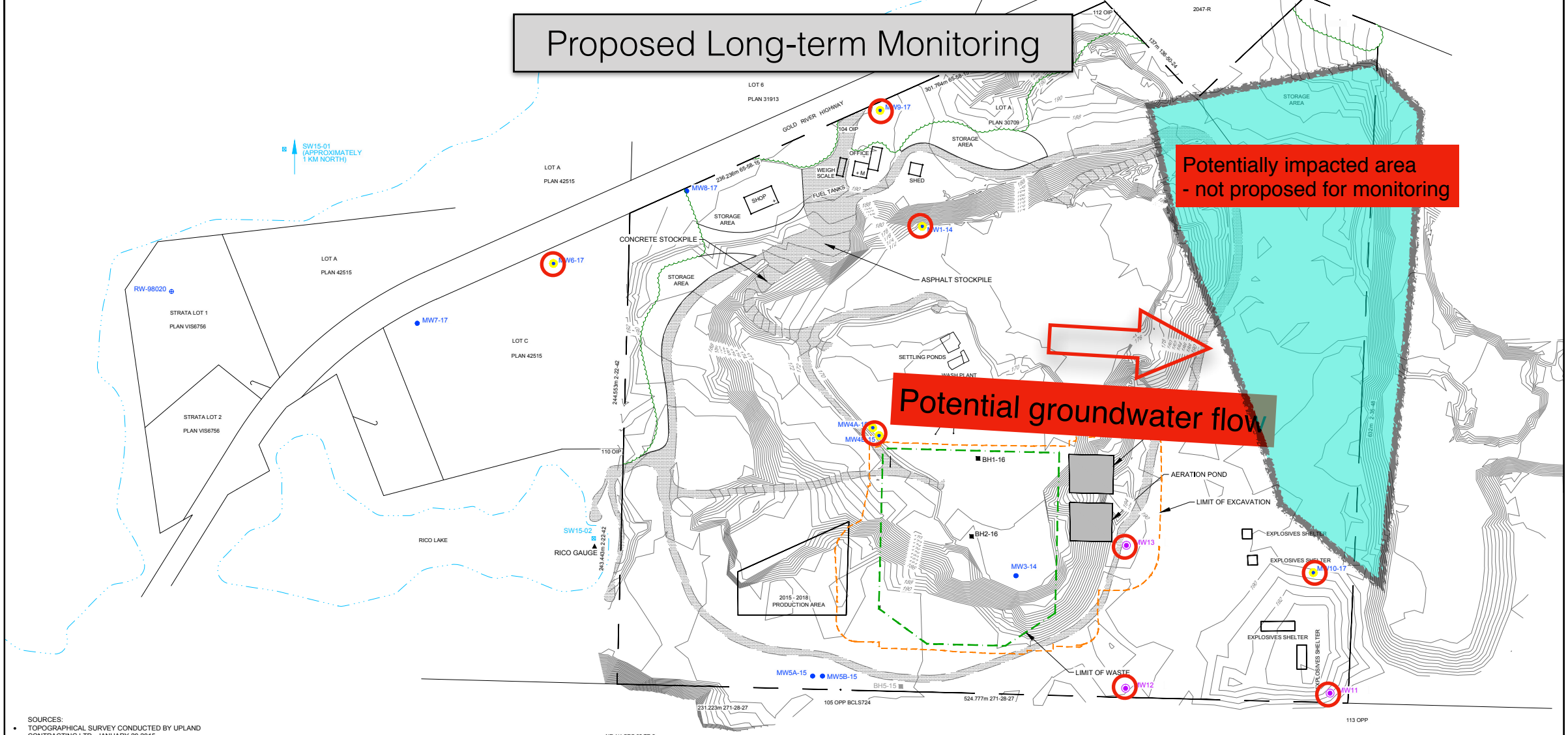
UPLAND EXCAVATING LTD.
PROPOSED UPLAND LANDFILL
HYDROGEOLOGIC AND HYDROLOGY CHARACTERIZATION REPORT

GROUNDWATER ELEVATION CONTOURS
SAND & GRAVEL AQUIFER - APRIL 6, 2017

88877-03
May 23, 2017

FIGURE 2.9

Proposed Long-term Monitoring



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0 40 80 120m

LEGEND

- EXISTING MAJOR CONTOURS
- EXISTING MINOR CONTOUR
- PROPERTY LINE
- EXISTING LAKE
- EXISTING ACCESS ROADWAY
- LIMIT OF WASTE
- LIMIT OF EXCAVATION
- TREES/VEGETATION
- MW3-14 EXISTING MONITORING WELL
- RW-98020 RESIDENTIAL WELL
- BH5-15 EXISTING BOREHOLE
- BH5-15 ABANDONED BOREHOLE
- SW15-01 SURFACE WATER SAMPLE LOCATION
- RICO GAUGE SURFACE WATER GAUGE
- MW2-14 MONITORING WELL INCLUDED IN PROPOSED ENVIRONMENTAL MONITORING PROGRAM
- MW12 APPROXIMATE LOCATION OF PROPOSED MONITORING WELL INCLUDED IN PROPOSED ENVIRONMENTAL MONITORING PROGRAM (DURING LANDFILL OPERATIONS)

GHD

UPLAND EXCAVATING LIMITED
PROPOSED UPLAND LANDFILL
2017 DESIGN, OPERATION, AND CLOSURE PLAN

ENVIRONMENTAL MONITORING PROGRAM
PROPOSED MONITORING LOCATIONS

88877-03
May 31, 2017

FIGURE 14.1

CAD File: P:\drawings\88000s\88877\88877 - REPORTS\88877-03(010)\88877-03(010)GN\88877-03(010)GN-WA005.DWG

WRAP-UP

- Completed hydrogeological study: Critical gaps remain.
- Role played by fracture bedrock aquifer: Risks of impact to Rico Lake and Campbell River water supply still exist.
- Groundwater in sand and gravel aquifer(s) discharges into sensitive aquatic ecosystems. Groundwater regime still to be defined.

THANK YOU