APPLICATION FOR ALTERNATE CONCENTRATION LIMITS FOR THE SMITH RANCH-HIGHLAND MINE UNIT-B IN-SITU LEACH URANIUM MINE

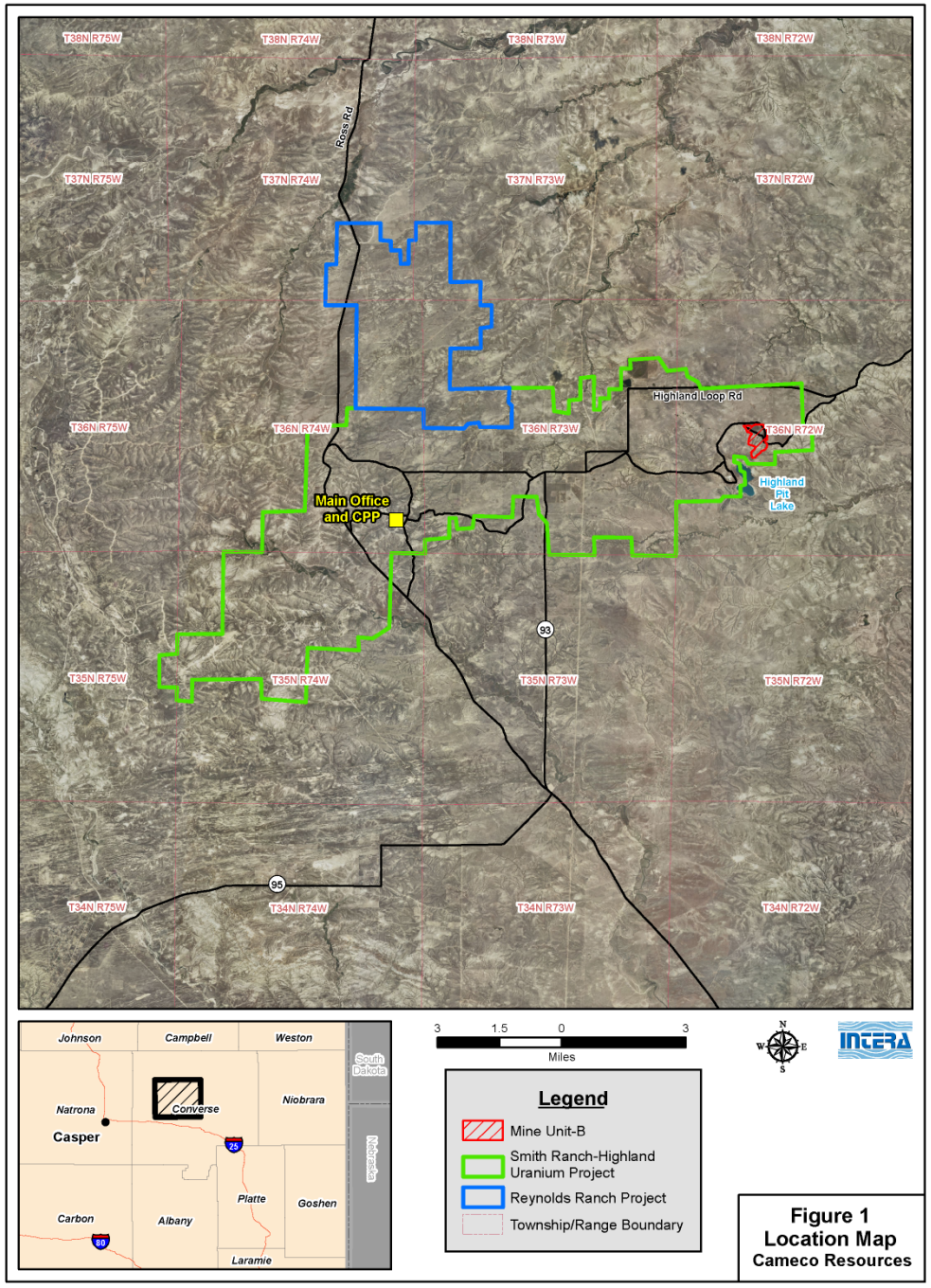
A Presentation To: The U.S. Nuclear Regulatory Commission

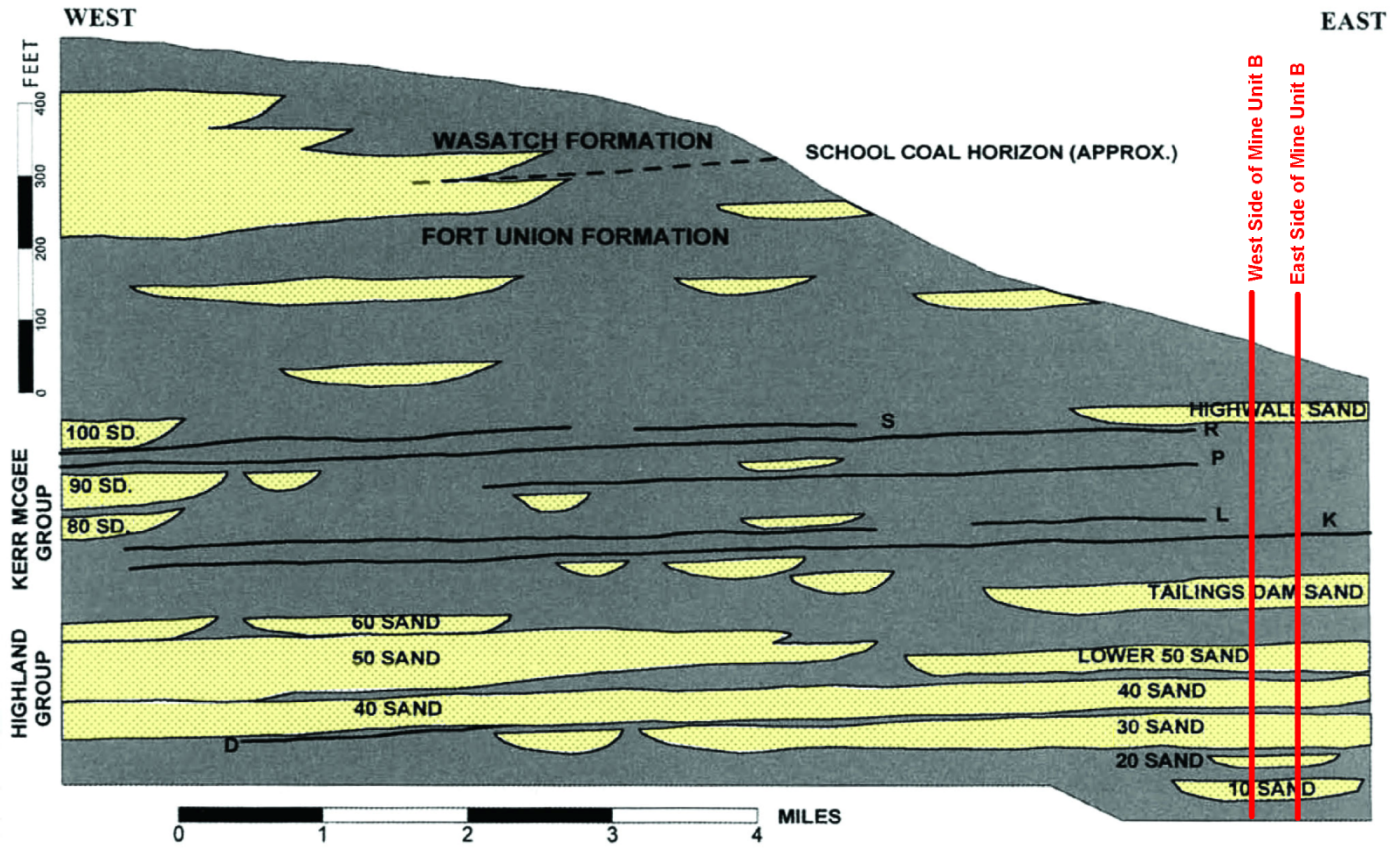
Presented By: Daniel W. Erskine, PhD

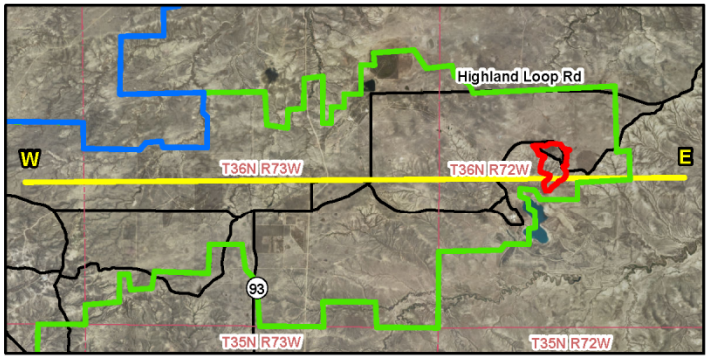
Date: September 5, 2012

Presentation Outline

- Physical Setting and Facility Background
- Geology/Hydrogeology
- Source and Contaminant Characterization
- Transport Assessment
- Pathway Assessment
- Corrective Action Assessment/ALARA Demonstration


T38N R75W
T38N R74W
T38N R73W
T38N R72W
Ross Rd
T37N R75W
T37N R74W
T37N R73W
T37N R72W
Highland Loop Rd
T36N R75W
T36N R74W
T36N R73W
T36N R72W
Highland Pit Lake
Main Office and CPP
93
T35N R75W
T35N R74W
T35N R73W
T35N R72W
95
T34N R75W
T34N R74W
T34N R73W
T34N R72W
Johnson
Campbell
Weston
South Dakota
Natrona
Converse
Niobrara
Casper
25
Nebraska
Platte
Goshen
Carbon
Albany
80
Laramie
3 1.5 0 3
Miles
N
W
E
S
Legend
Mine Unit-B
Smith Ranch-Highland Uranium Project
Reynolds Ranch Project
Township/Range Boundary
Figure 1
Location Map
Cameco Resources
File: S:\Projects\CAMEC-Cameco_Resources_ACL_ Applications_for_Areas_BA\CIGraphics\MapDocuments\Task\B2MineUnitFullReport_2012_02\FigFull01_LocationMap_Rev0.mxd 3/20/2012





Legend

- Cross Section
- Mine Unit-B
- Reynolds Ranch Project
- Smith Ranch-Highland Uranium Project
- Township/Range Boundary

3 1.5 0 3

Miles

N W E S

Source: Hunter, 1999.

Figure 18
Cross Section of Uranium Bearing Strata in the Smith Ranch Highland Area
Cameco Resources

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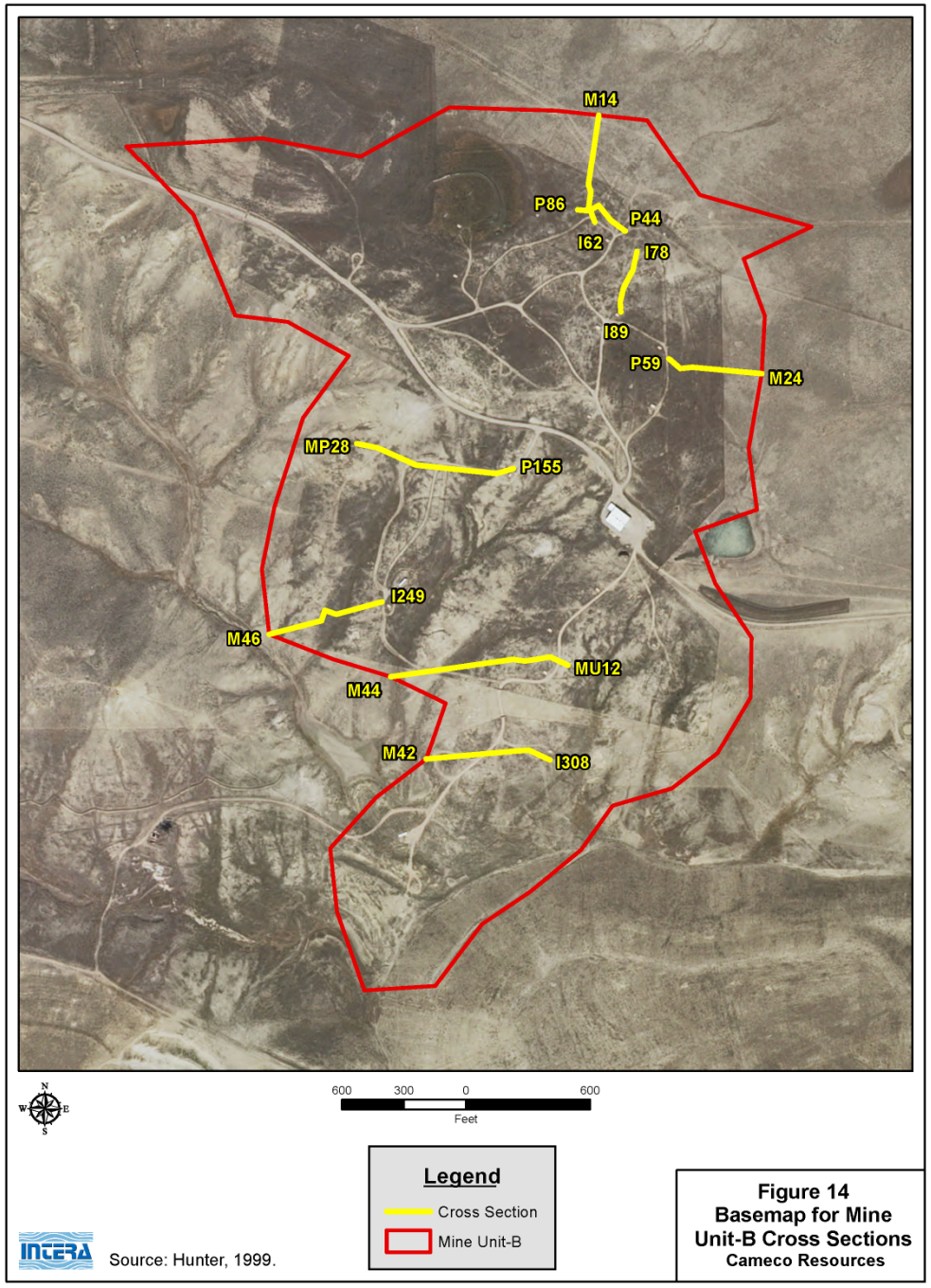
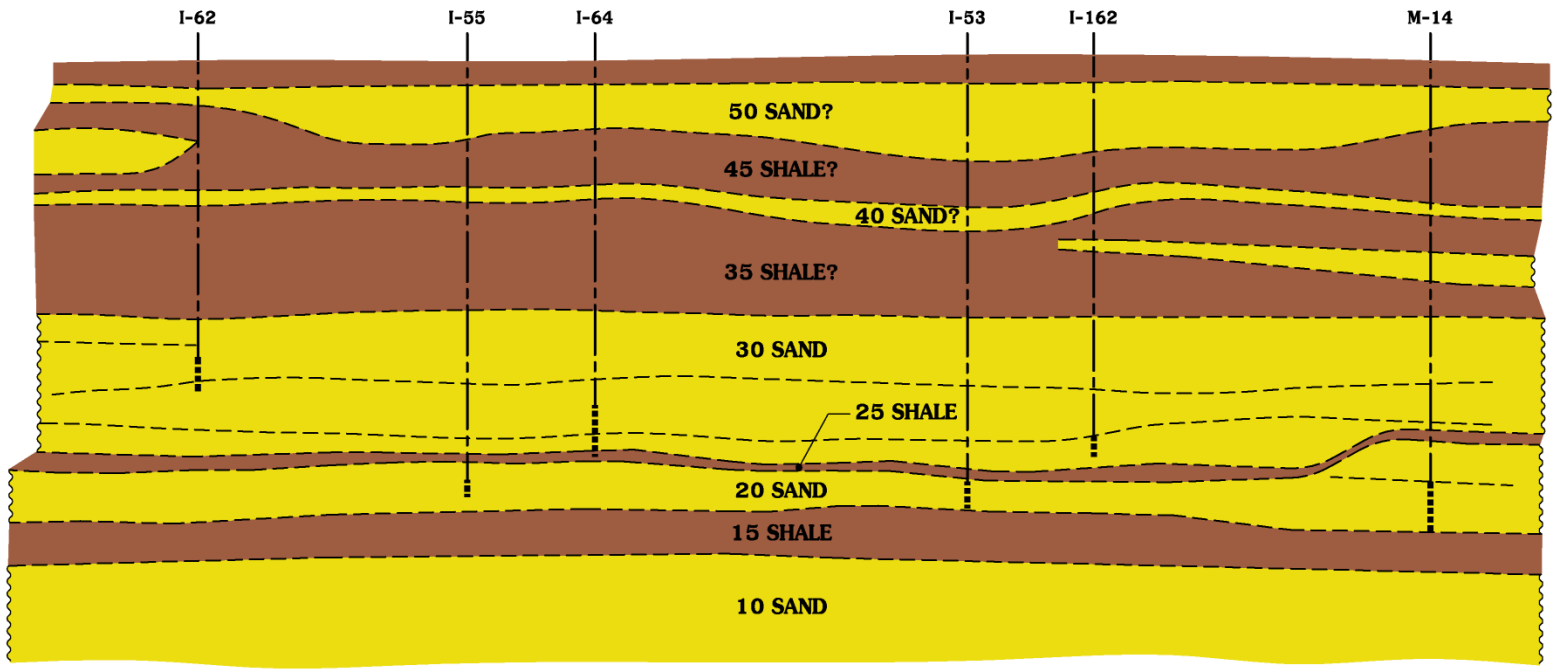

M14
P86
P44
I62
I78
I89
P59
M24
MP28
P155
I249
M46
MU12
M44
M42
I308
600
300
0
600
Feet
Legend
Cross Section
Mine Unit-B
Source: Hunter, 1999.
Figure 14
Basemap for Mine
Unit-B Cross Sections
Cameco Resources

SOUTH NORTH



B5/A3

Legend:

SAND
SHALE
WATER WELL
SCREEN SECTION OF WELL
CONTACT/EROSIONAL SURFACE
GROUPING

Note:
Additional control points from exploration boreholes (not shown) were used for creating cross sections.

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Figure 5
Mine Unit B ACL Application
Cross Section from
I-62 to M-14
Cameco Resources

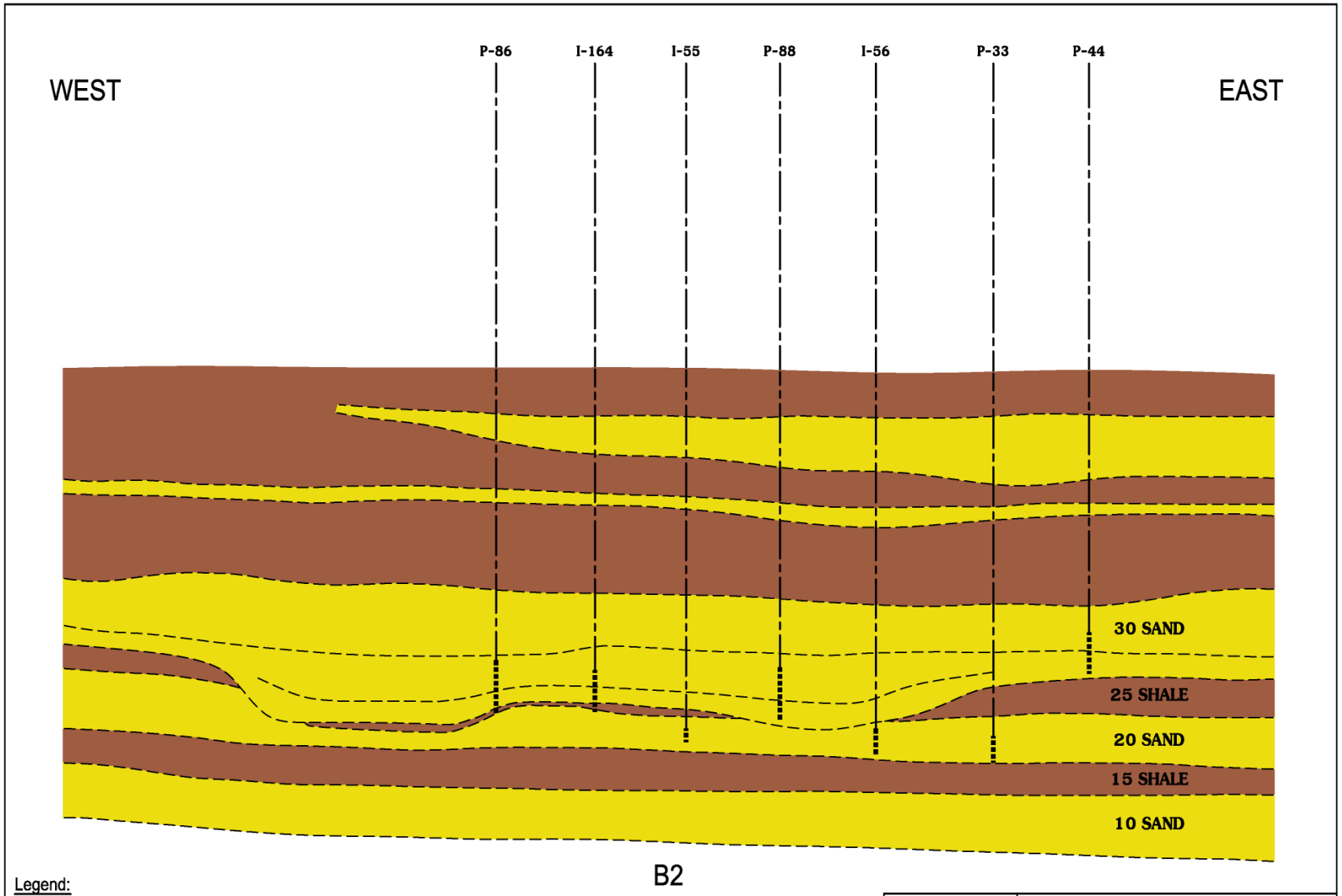
WEST
EAST
P-86
I-164
I-55
P-88
I-56
P-33
P-44
30 SAND
25 SHALE
20 SAND
15 SHALE
10 SAND
B2
Legend:
SAND
SHALE
WATER WELL
SCREEN SECTION OF WELL
CONTACT/EROSIONAL SURFACE
GROUPING
Note:
Additional control points from exploration boreholes
(not shown) were used for creating cross sections.
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Figure 6
Mine Unit B ACL Application
Cross Section from
P-86 to P-44
Cameco Resources

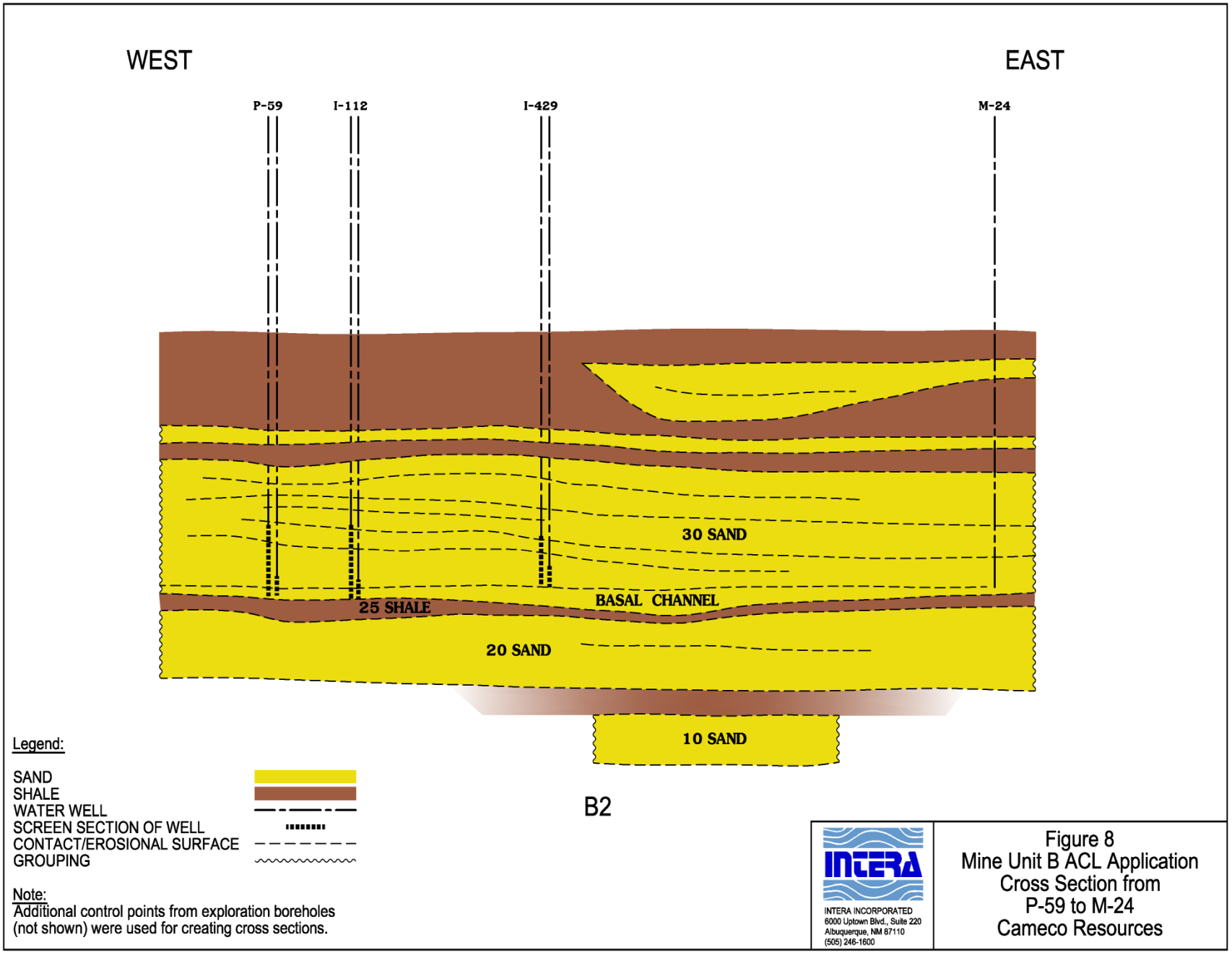

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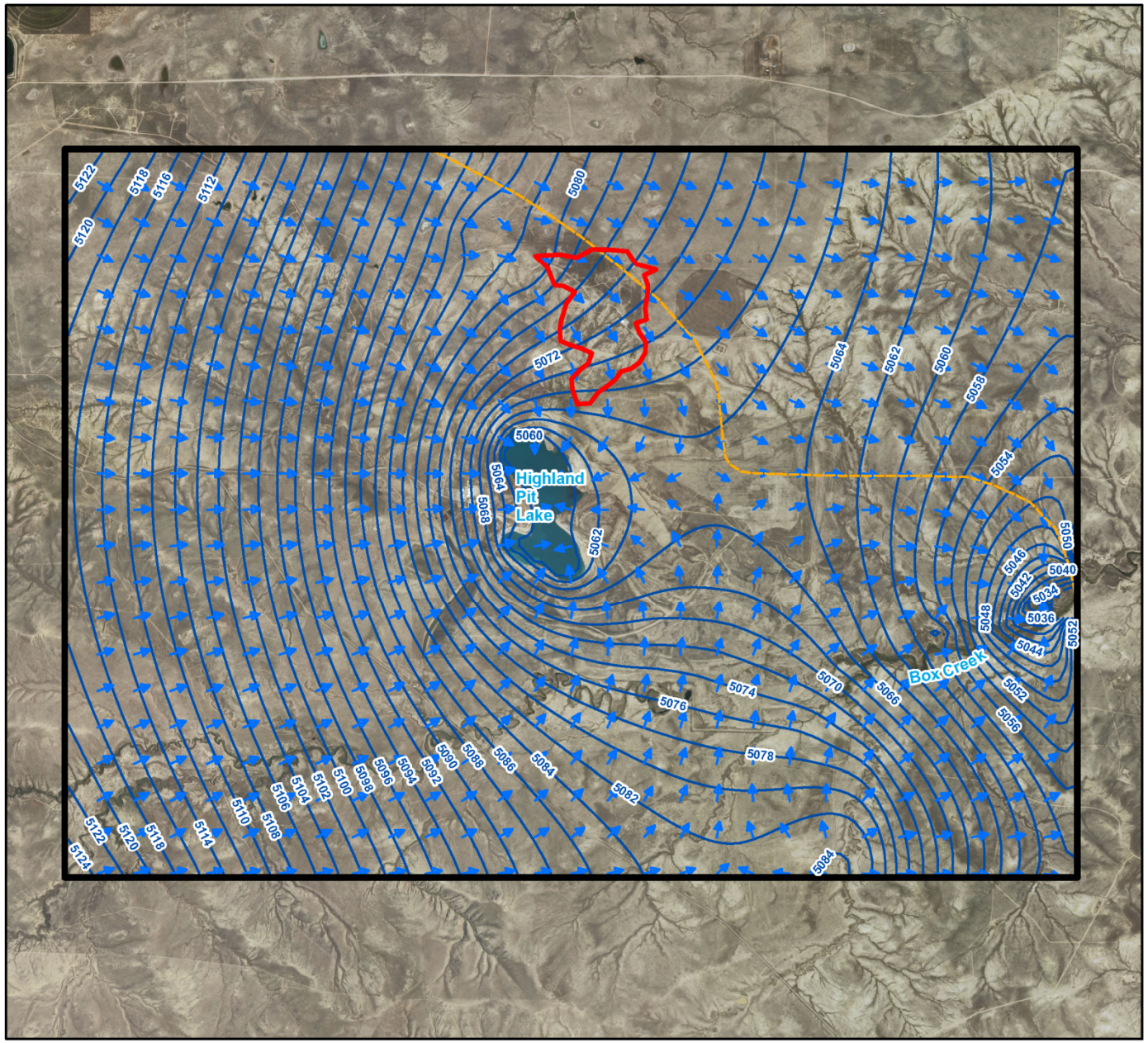
Figure 8
Mine Unit B ACL Application
Cross Section from
P-59 to M-24
Cameco Resources



N
W E
S

4,000 2,000 0 4,000
Feet

Legend

- Groundwater Elevation (ft-amsl)
- Groundwater Flow Direction
- Groundwater Flow Divide
- Mine Unit-B
- Model Domain

Figure 29
Projected 30-Sand Steady-State Water Level Elevation
Cameco Resources

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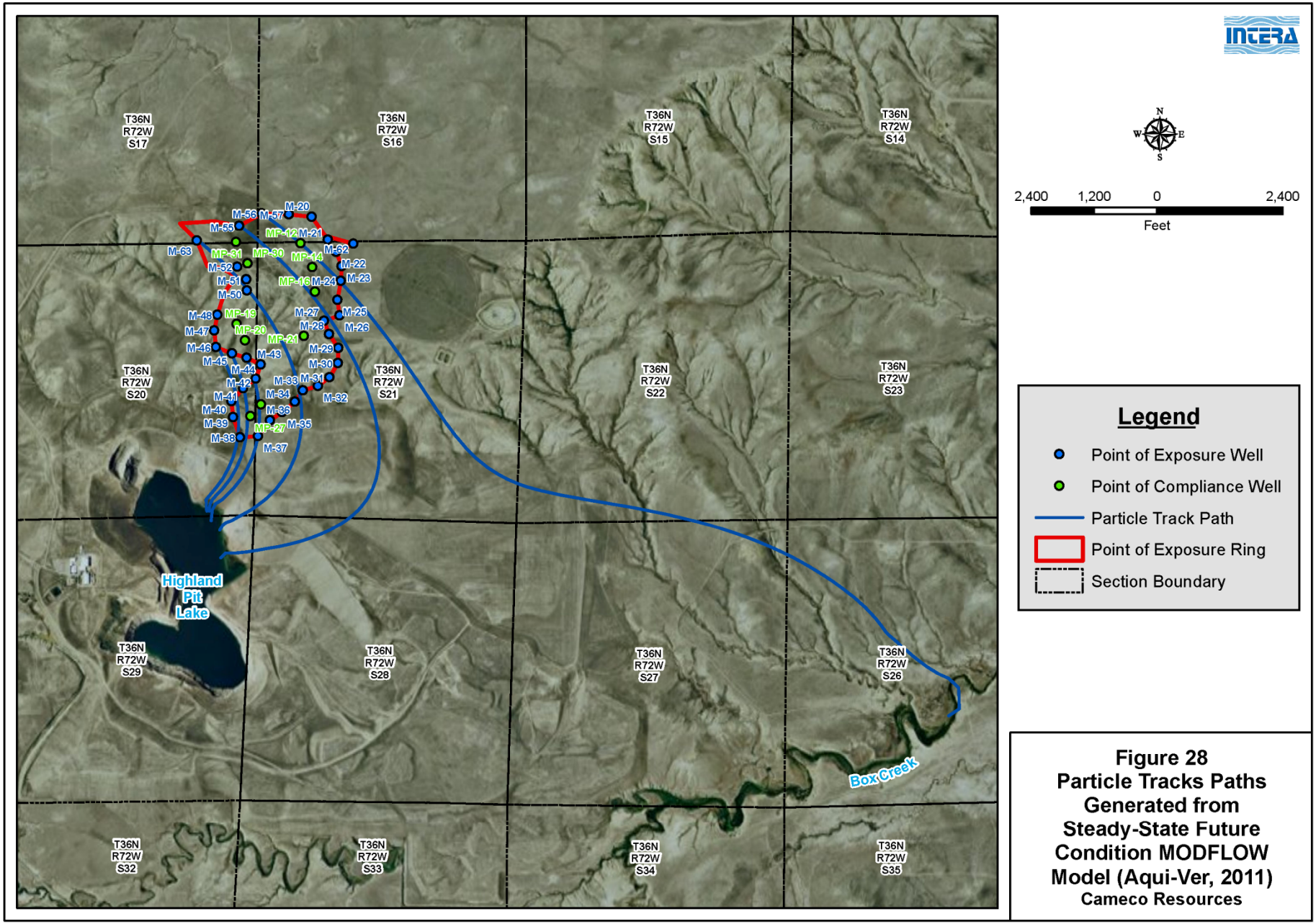


Figure 28
Particle Tracks Paths Generated from Steady-State Future Condition MODFLOW Model (Aqui-Ver, 2011)
Cameco Resources

File: S:\Projects\CAMEC-Cameco_Resources_ACL_ Applications_for_Areas_B&C\Graphics\MapDocuments\TaskB2MineUnitFullReport_2012_02\FigFull28_ParticleTracks_Rev0.mxd 3/28/2012

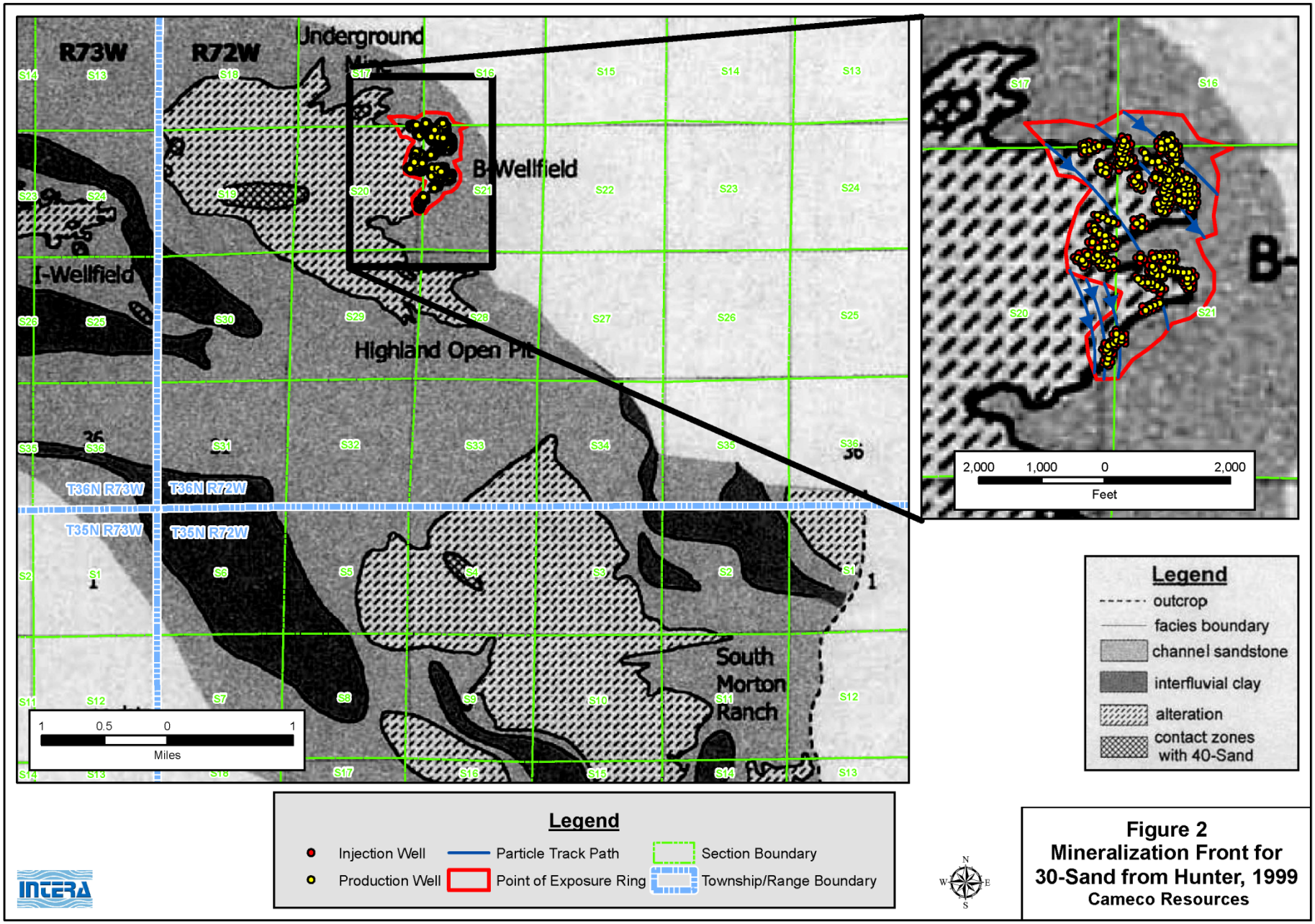
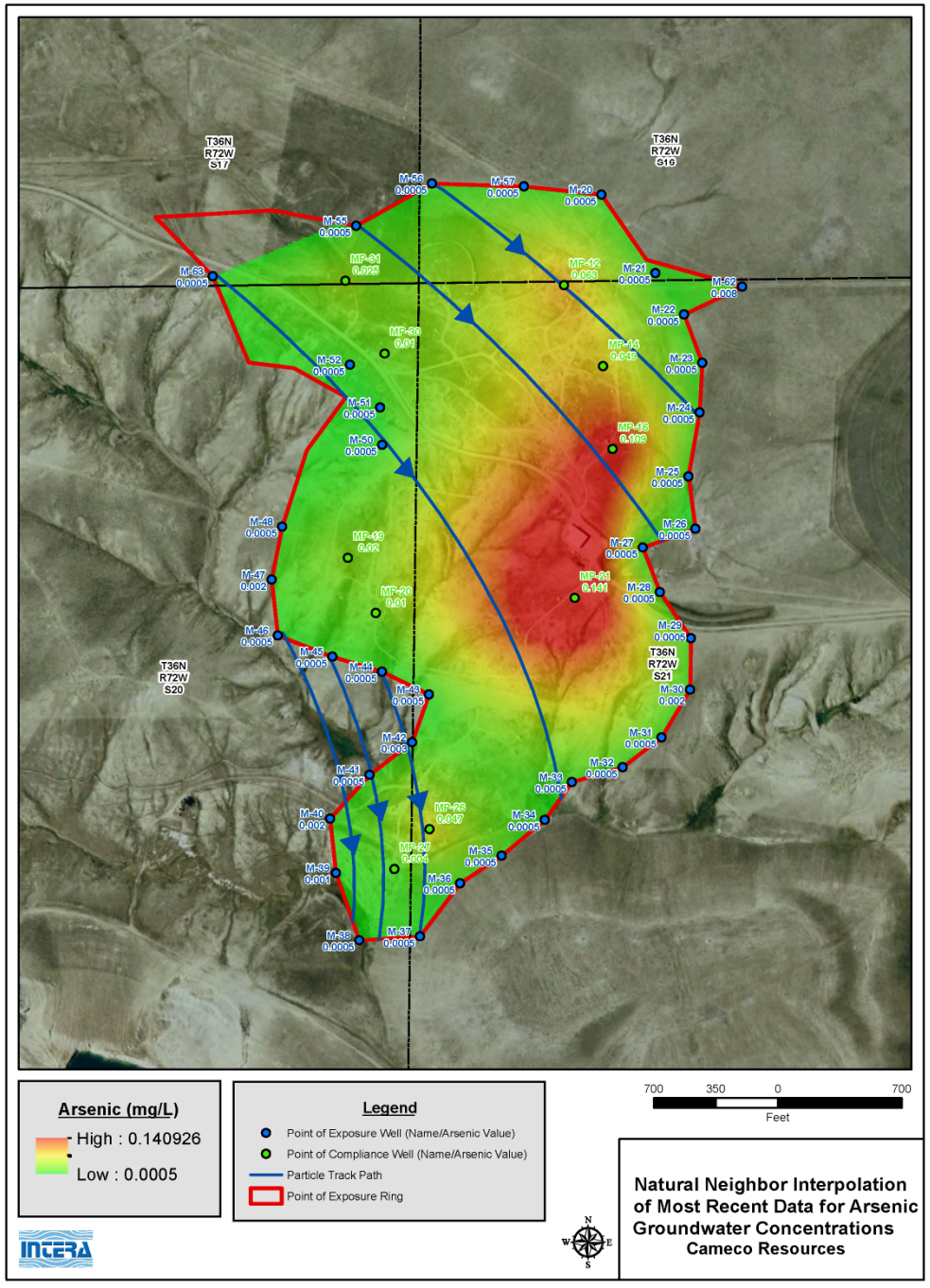


Figure 2
Mineralization Front for 30-Sand from Hunter, 1999
Cameco Resources

File: S:\Projects\CAMEC-Cameco_Resources_ACL_ Applications_for_Areas_B&C\Graphics\MapDocuments\TaskB2MineUnitReport_2012_02\Fig02_30SandMinerals_Rev0.mxd 3/2/2012



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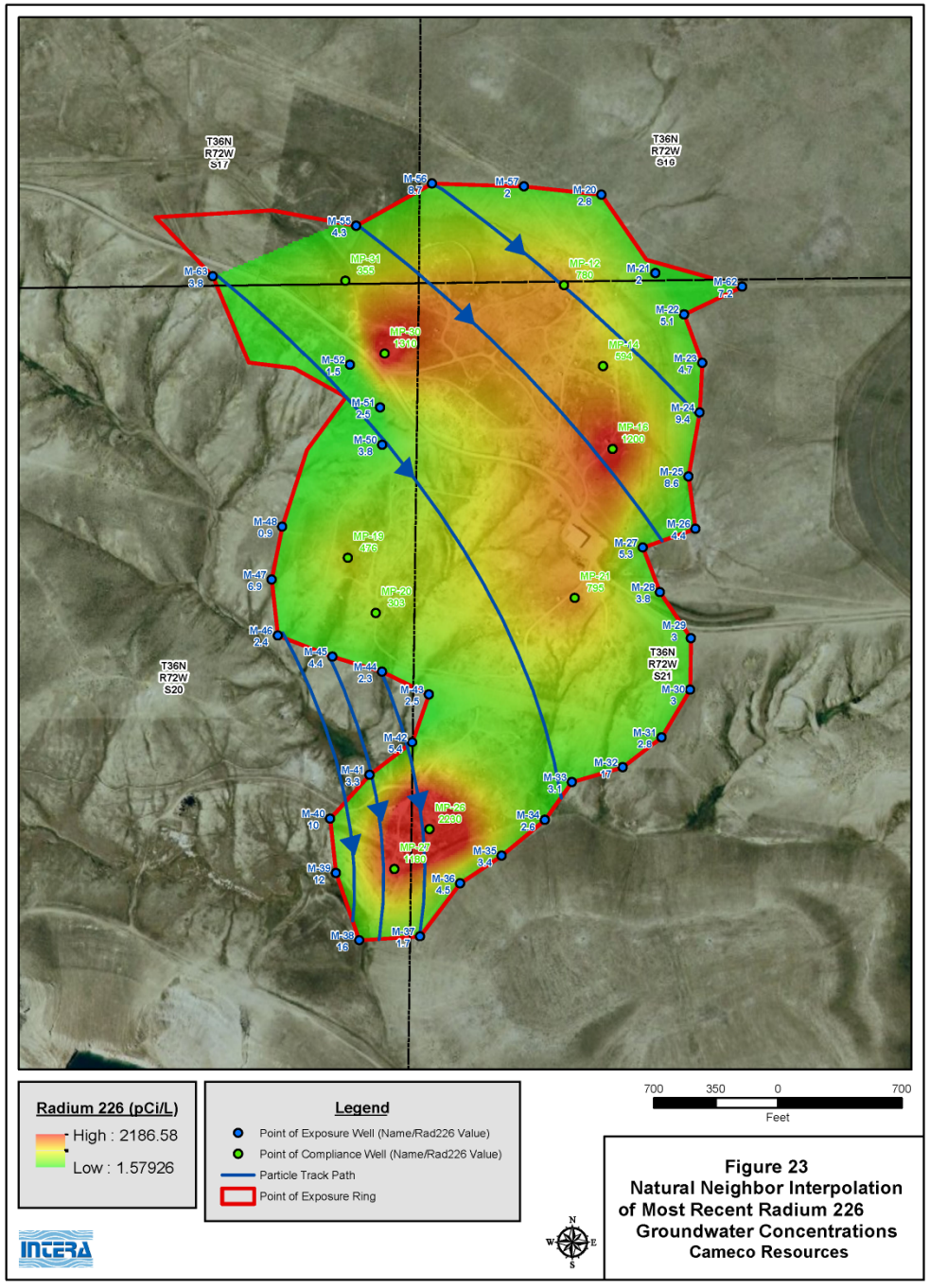

Figure 23
Natural Neighbor Interpolation of Most Recent Radium 226 Groundwater Concentrations
Cameco Resources

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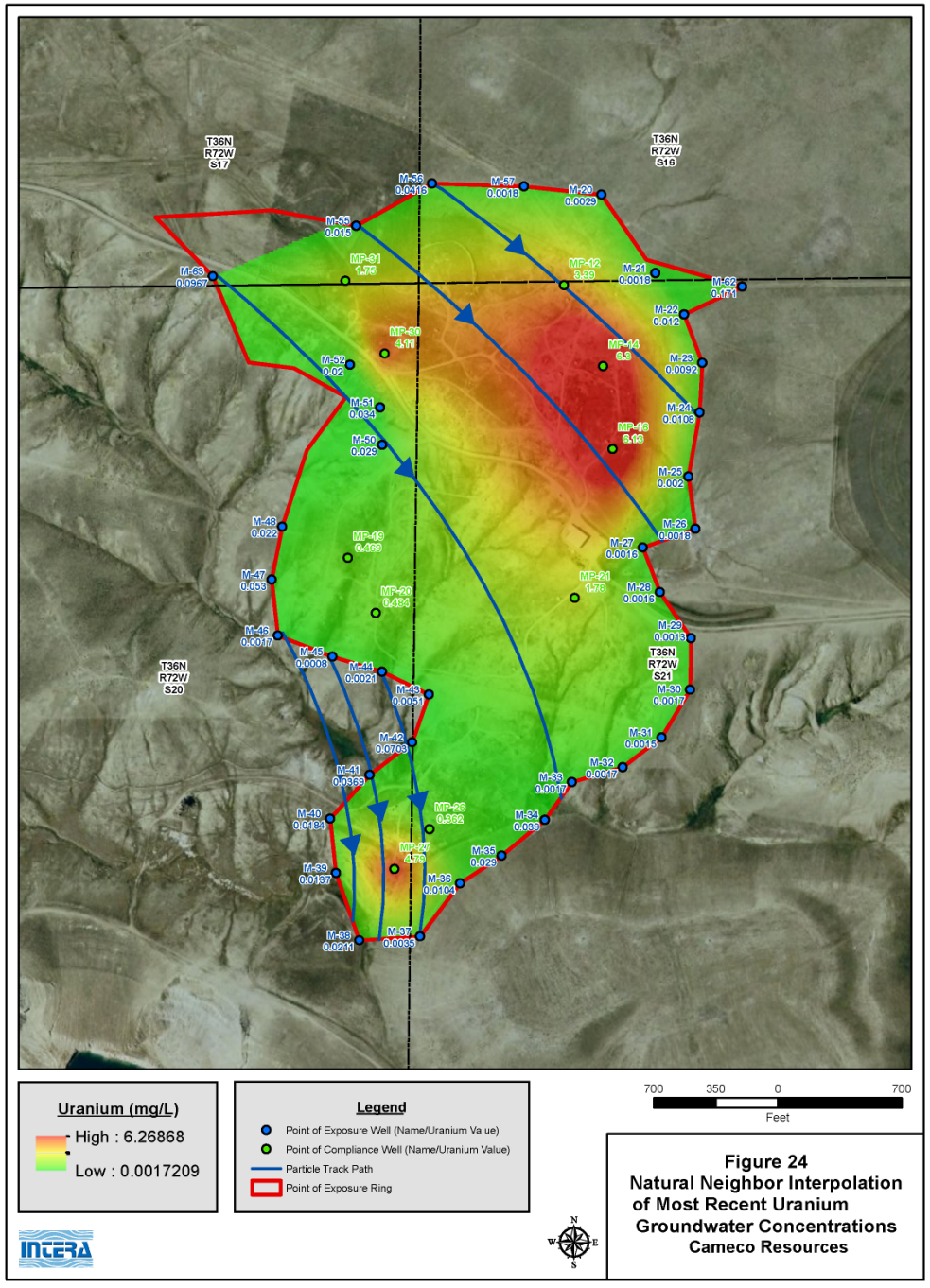
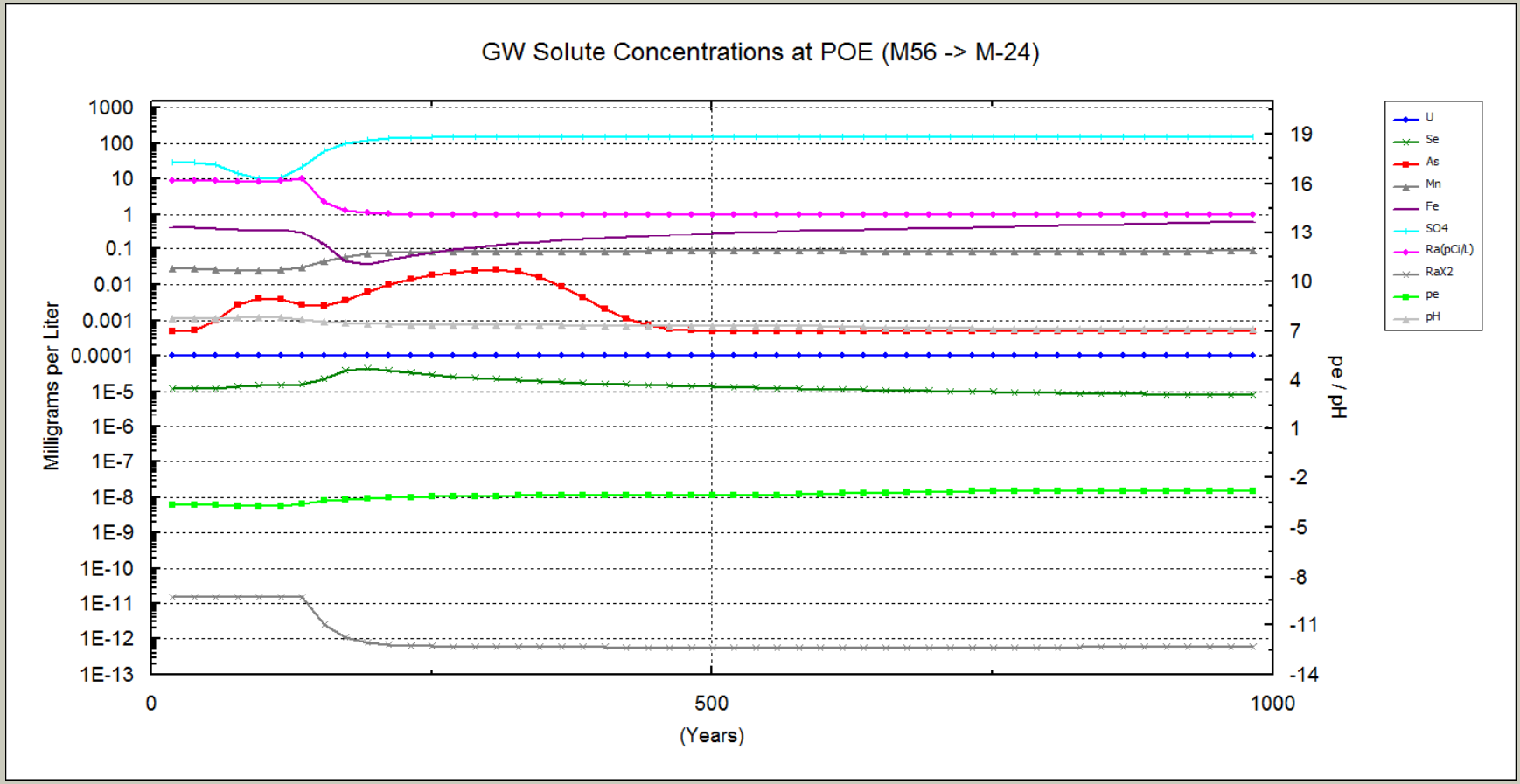


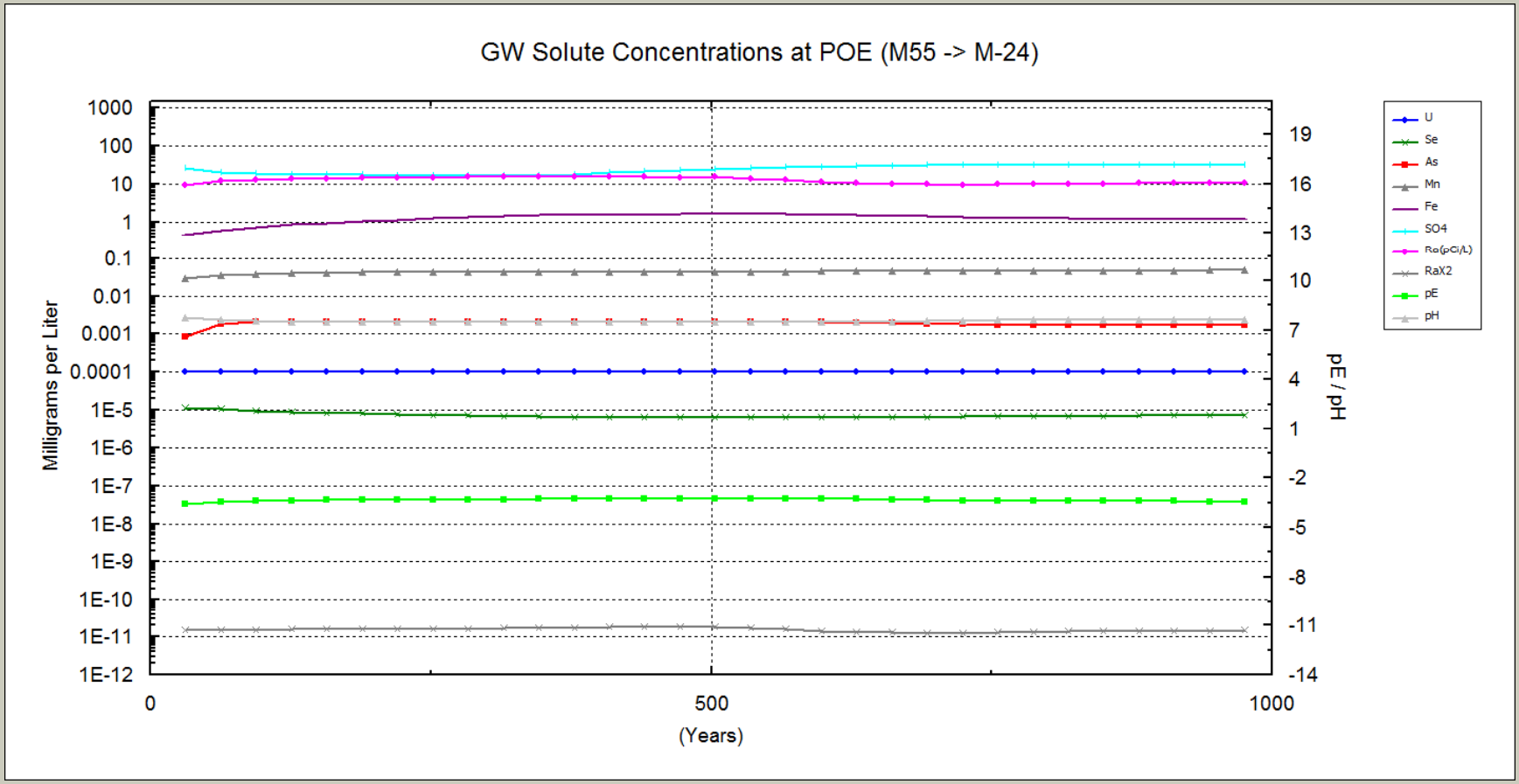
Figure 24
Natural Neighbor Interpolation of Most Recent Uranium Groundwater Concentrations
Cameco Resources

File: S:\Projects\CAMEC-Cameco_Resources_ACL_ Applications_for_Areas_B&C\Graphics\MapDocuments\Task8\2MineUnitFullReport_2012_02\FigFull24_UraniumInterpolations_Rev0.mxd 3/22/2012

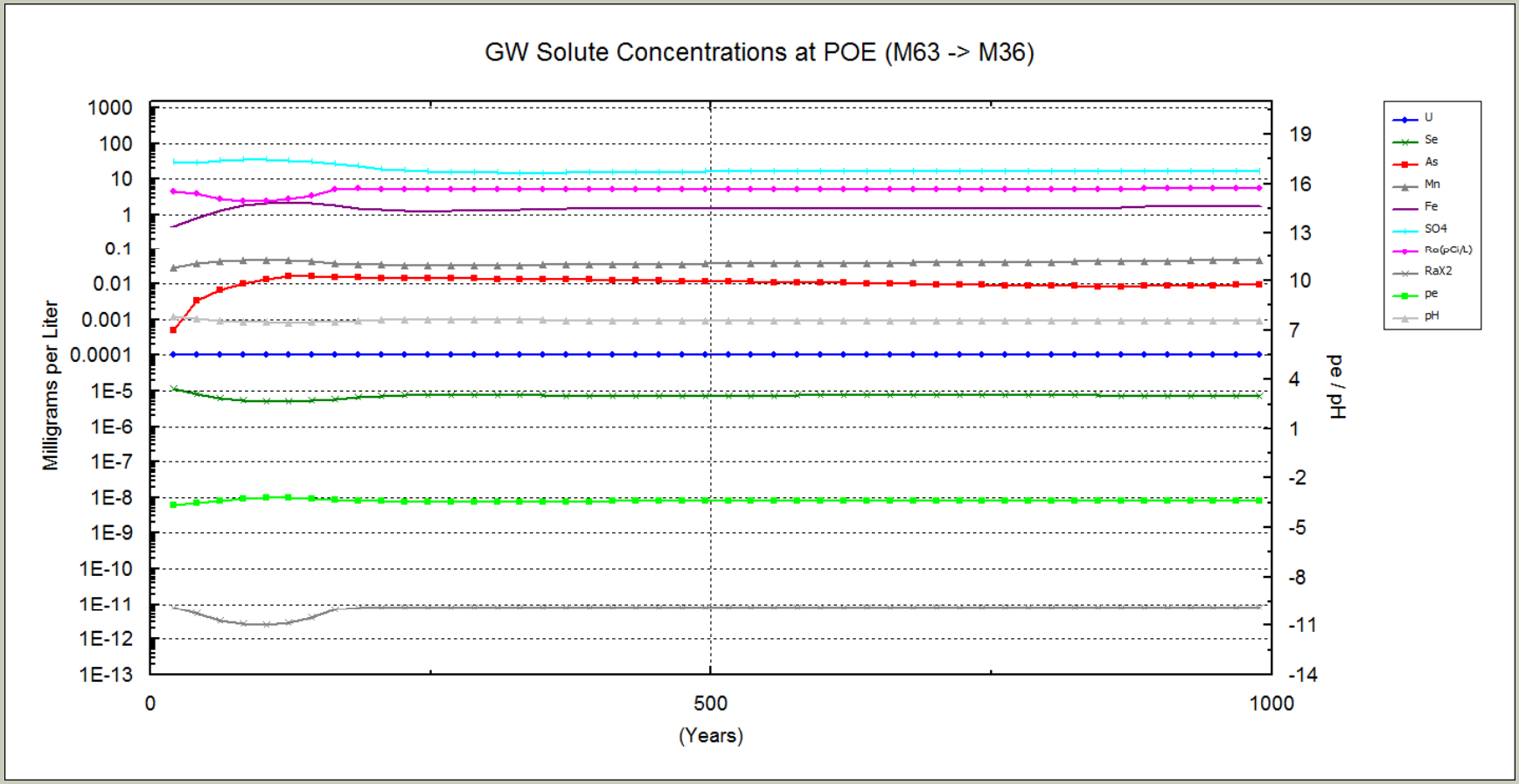
PHREEQC Output at POE Wells



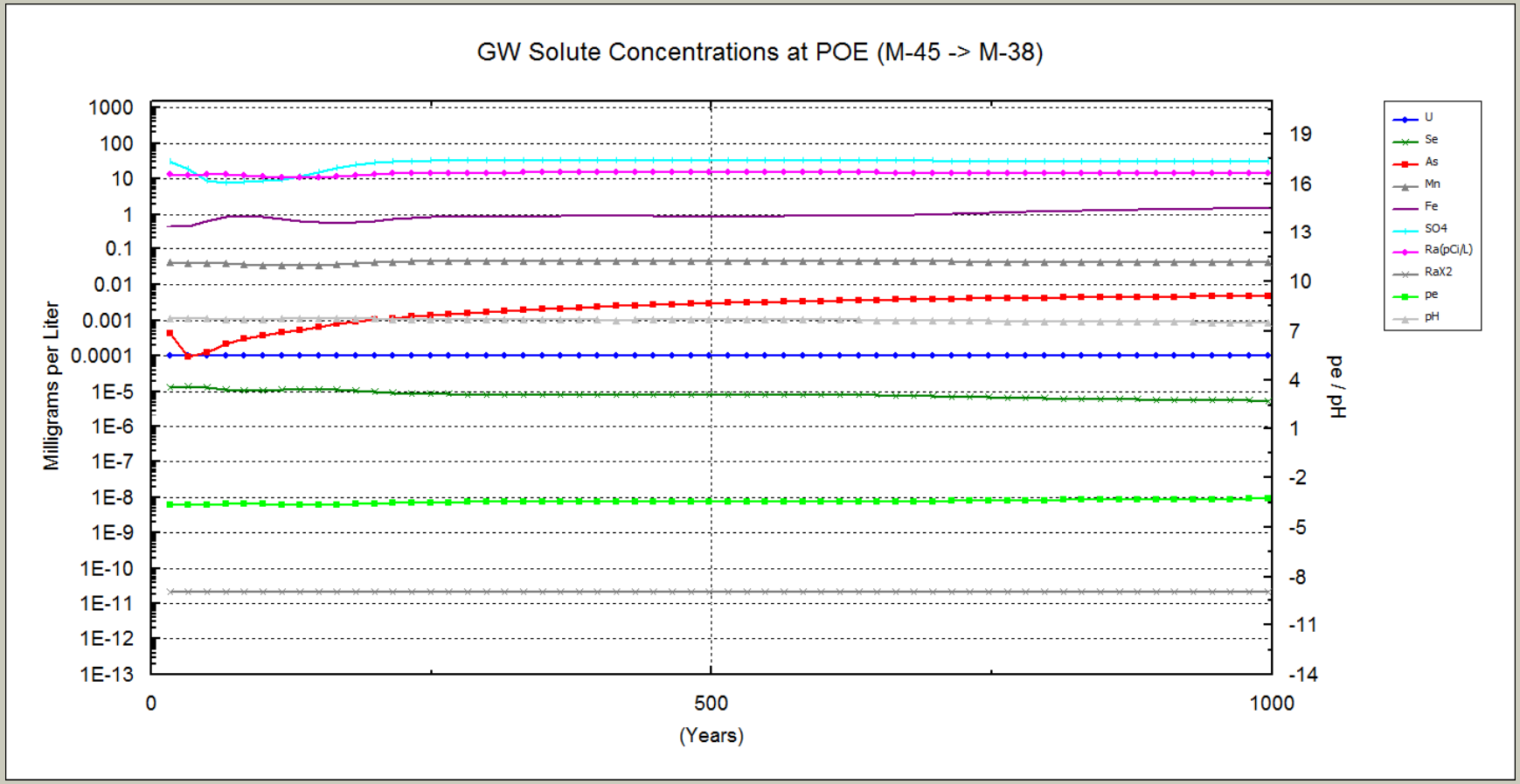
PHREEQC Output at POE Wells



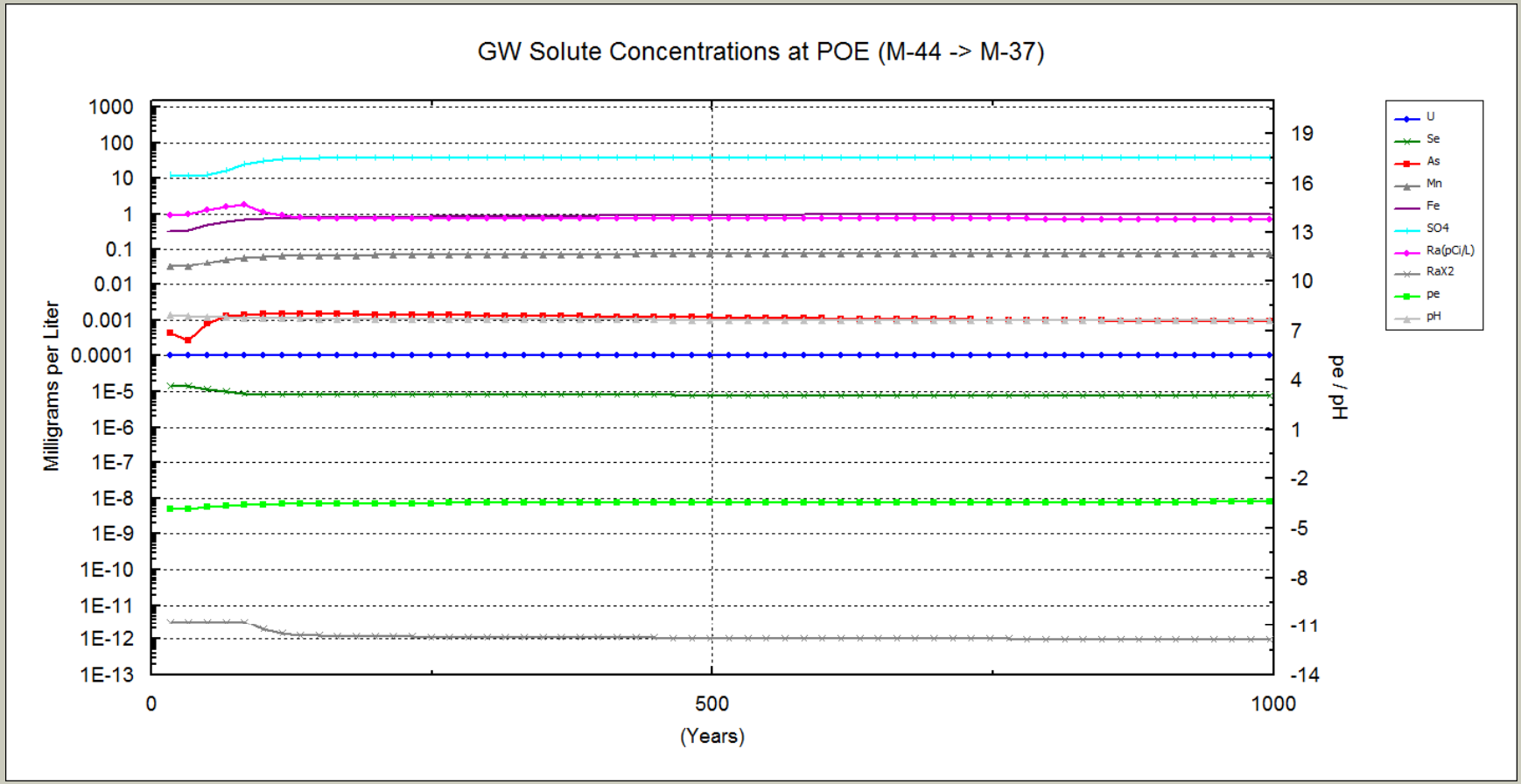
PHREEQC Output at POE Wells



PHREEQC Output at POE Wells



PHREEQC Output at POE Wells



Regulatory Standards for Constituents of Concern

Constituent	Health Risk-Based Concentration	WDEQ Domestic Water Supply	Appendix A to Part 40 CFR (MCVs)	EPA MCLs
Arsenic	0.05 mg/L	0.05 mg/L	0.05 mg/L	0.01 mg/L
Radium 226+228	44 pCi/L*	5 pCi/L	5 pCi/L	5 pCi/L
Uranium	0.24 mg/L	NA	NA	0.03 mg/L

Comparison of Health Risk-Based Concentrations to Modeled Values at the Proposed POE Wells

			Maximum Predicted POE Concentrations			Health Bases Risk Assessment Values		
Upgradient Well	**POC Well**	**POE Well**	**Uranium (mg/L)**	**Arsenic (mg/L)**	**Radium (pCi/L)**	**Uranium (mg/L)**	**Arsenic (mg/L)**	**Radium (pCi/L)**
M-56	MP-12	M-24	0.00001	0.00157	9.57	0.24	0.05	44
M-55	MP-16	M-24	0.00001	0.00211	9.89			
M-63	MP-21	M-36	0.00001	0.016	5.43			
M-45	MP-27	M-38	0.00001	0.00476	15.12			
M-44	MP-26	M-37	0.00001	0.00145	1.78			

Cost Benefit Analysis of Continuation of the CAP

Parameter	Units	Baseline (Oct/Nov 1987)*	End Mining (July 1991)*	End of Restoration (2004)*	Difference after 13 Years of Restoration	Cost (Present Value 2012 $)	50% Reduction in Concentration	Estimated Cost for 50% Reduction in Concentration
Ra-226	pCi/l	316	1478	437	1041	$4.4 Million	218.5	$10 Million
As	mg/l	<.001	0.008	0.058	-0.05		0.029	
U nat	mg/l	0.062	22.3	1.79	20.51		0.895	

ALARA

- Cost of one person rem averted $18,600
- Far exceeds the NRC's ALARA guidance of $2,000 per person-rem
- Very near to the $20,000 per person-rem for demonstration of "Prohibitively expensive" criteria