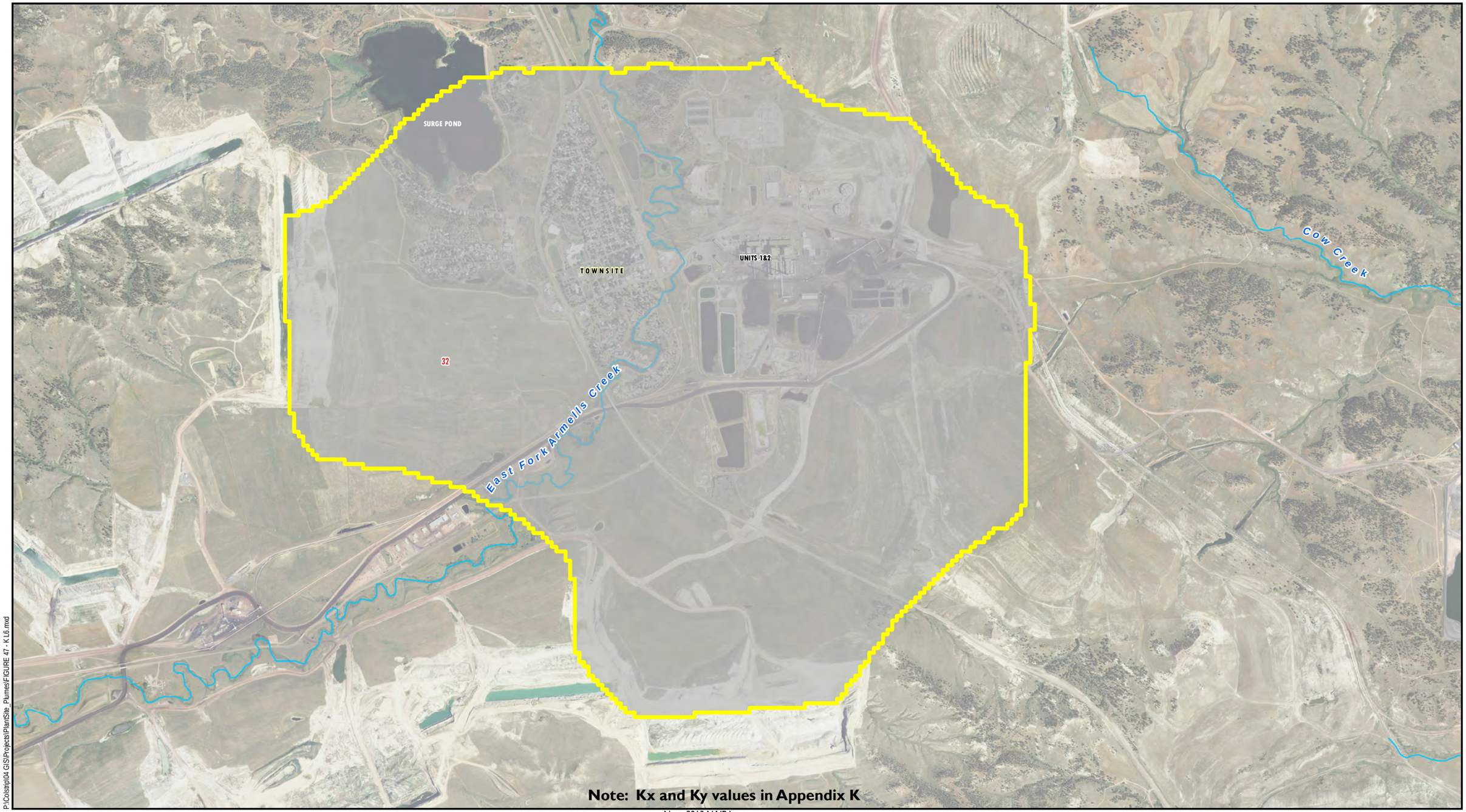


Note: 2013 NAIP Imagery

Hydraulic Conductivity Zone

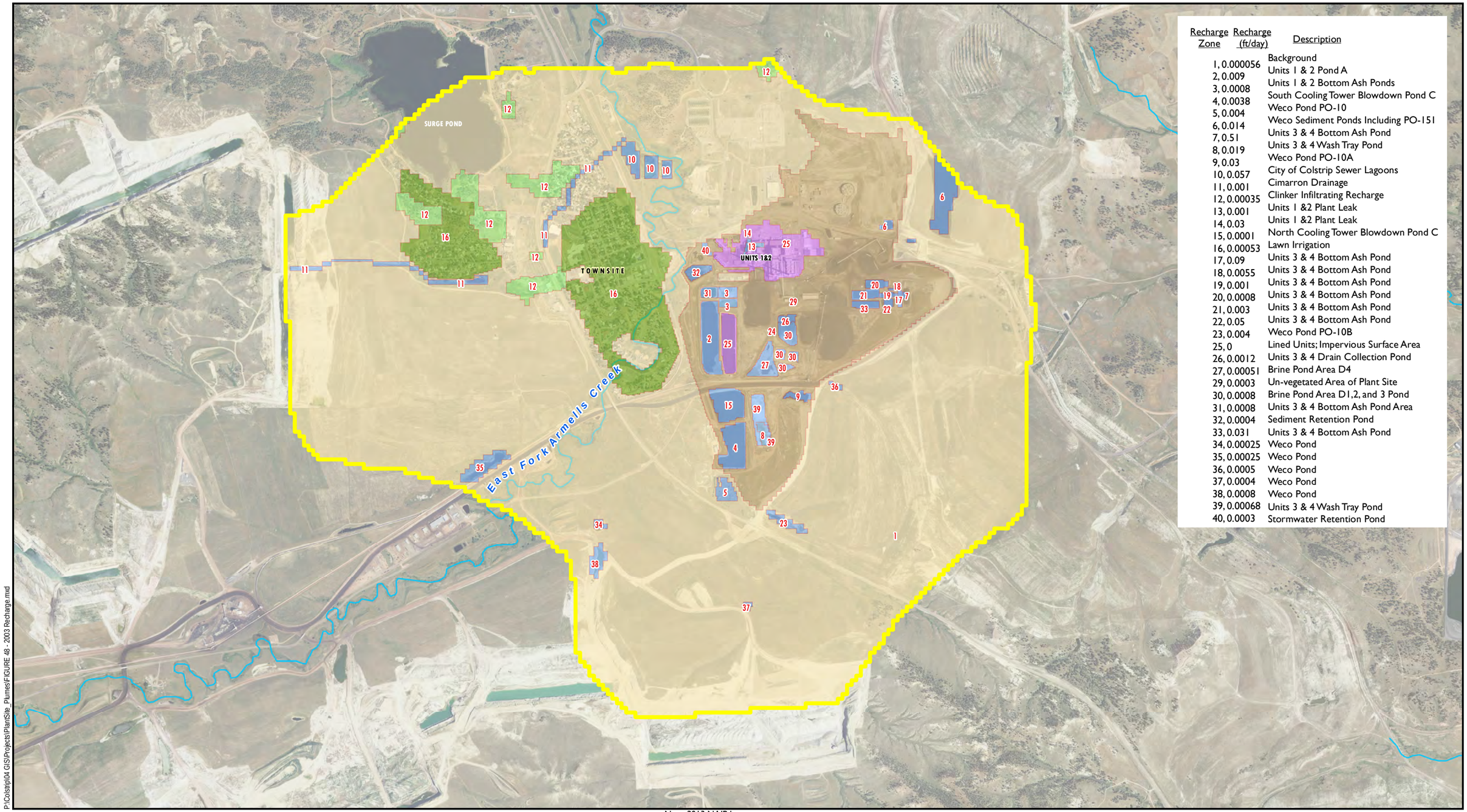
32 | Model Domain

0 Feet 2,000

NewFields

P:\Colstrip\04 GIS\Projects\PlantSite_Plumes\FIGURE 47 - K L6.mxd

Calibrated Hydraulic Conductivity Distribution - Layer 6
Plant Site Area Groundwater Model
CSES-Colstrip, Montana
FIGURE 47



Recharge Zone	Recharge (ft/day)	Description
1	0.000056	Background
2	0.009	Units 1 & 2 Pond A
3	0.0008	Units 1 & 2 Bottom Ash Ponds
4	0.0038	South Cooling Tower Blowdown Pond C
5	0.004	Weco Pond PO-10
6	0.014	Weco Sediment Ponds Including PO-151
7	0.51	Units 3 & 4 Bottom Ash Pond
8	0.019	Units 3 & 4 Wash Tray Pond
9	0.03	Weco Pond PO-10A
10	0.057	City of Colstrip Sewer Lagoons
11	0.001	Cimarron Drainage
12	0.00035	Clinker Infiltrating Recharge
13	0.001	Units 1 &2 Plant Leak
14	0.03	Units 1 &2 Plant Leak
15	0.0001	North Cooling Tower Blowdown Pond C
16	0.00053	Lawn Irrigation
17	0.09	Units 3 & 4 Bottom Ash Pond
18	0.0055	Units 3 & 4 Bottom Ash Pond
19	0.001	Units 3 & 4 Bottom Ash Pond
20	0.0008	Units 3 & 4 Bottom Ash Pond
21	0.003	Units 3 & 4 Bottom Ash Pond
22	0.05	Units 3 & 4 Bottom Ash Pond
23	0.004	Weco Pond PO-10B
25	0	Lined Units; Impervious Surface Area
26	0.0012	Units 3 & 4 Drain Collection Pond
27	0.00051	Brine Pond Area D4
29	0.0003	Un-vegetated Area of Plant Site
30	0.0008	Brine Pond Area D1,2, and 3 Pond
31	0.0008	Units 3 & 4 Bottom Ash Pond Area
32	0.0004	Sediment Retention Pond
33	0.031	Units 3 & 4 Bottom Ash Pond
34	0.00025	Weco Pond
35	0.00025	Weco Pond
36	0.0005	Weco Pond
37	0.0004	Weco Pond
38	0.0008	Weco Pond
39	0.00068	Units 3 & 4 Wash Tray Pond
40	0.0003	Stormwater Retention Pond

Note: 2013 NAIP Imagery

Recharge Zones

- Background
- Clinker Infiltrating Recharge
- Impervious
- Lawn Irrigation Infiltration
- Ponds Seepage
- Unvegetated Infiltration Recharge
- Model Domain

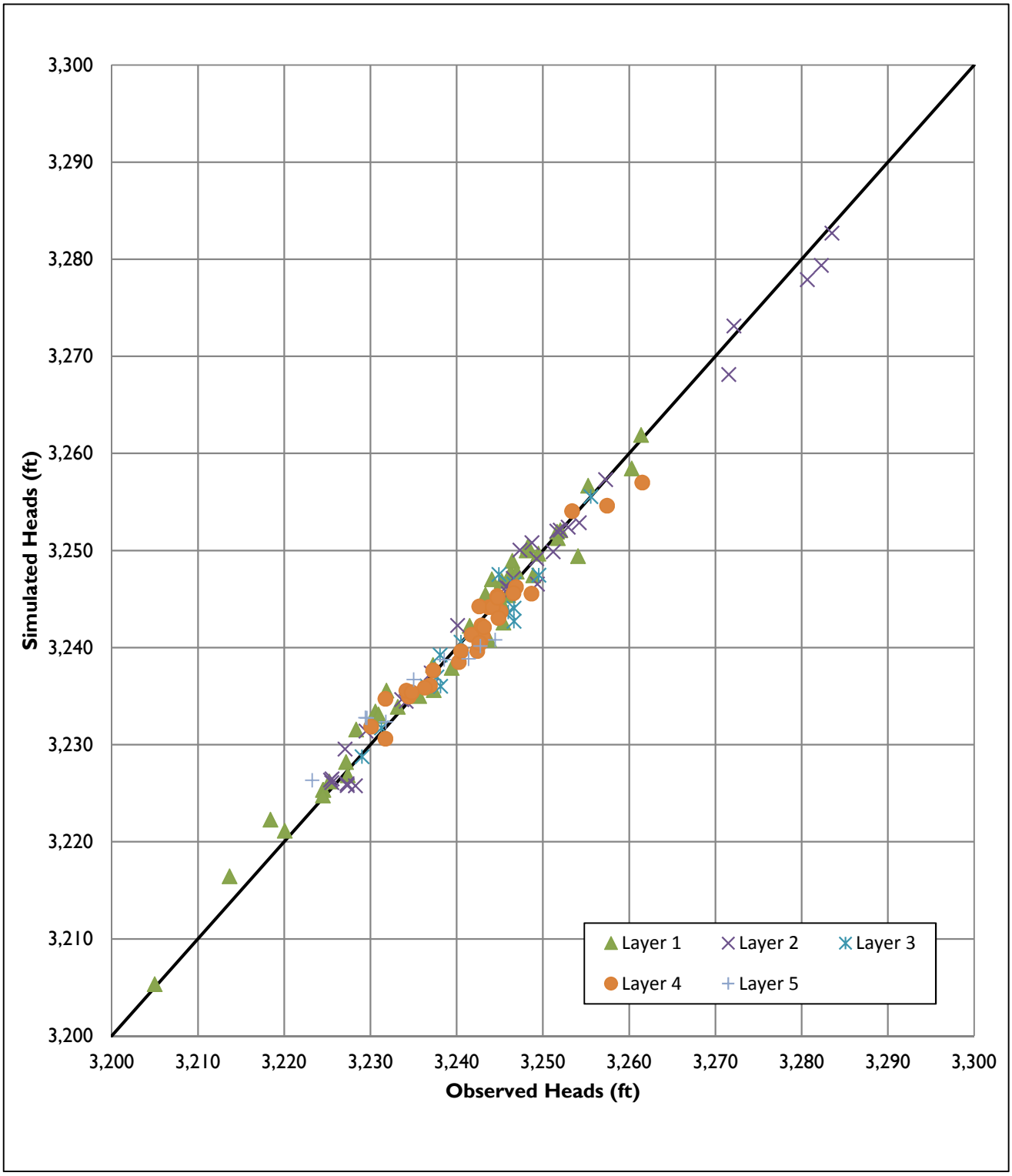
N

0 Feet 2,000

NewFields

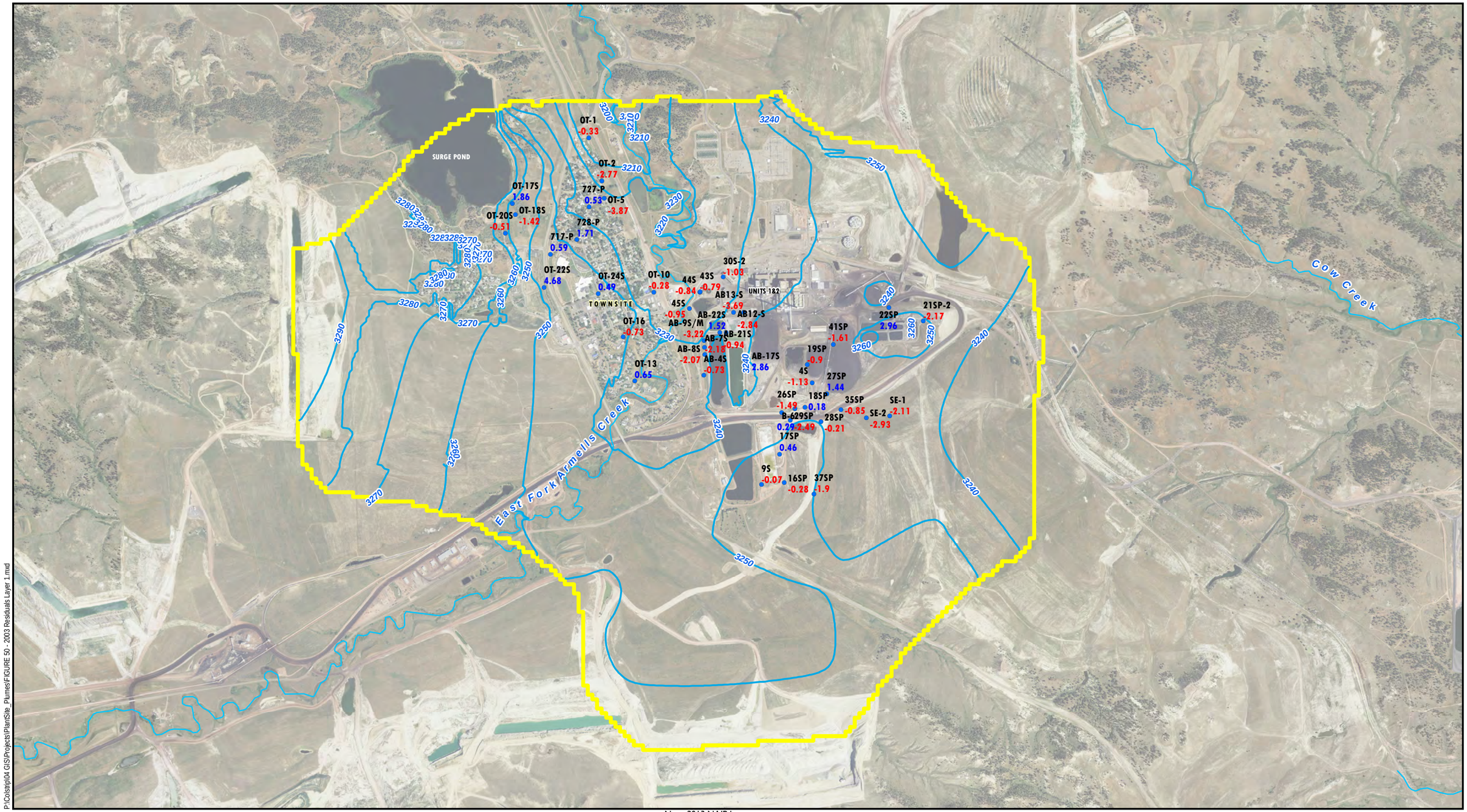
P:\Colstrip\04 GIS\Projects\PlantSite_Plumes\FIGURE 48 - 2003 Recharge.mxd

December 2003 Calibrated Recharge Distribution
Plant Site Area Groundwater Model
CSES-Colstrip, Montana
FIGURE 48



December 2003 Simulated vs.
Observed Groundwater Elevations
Plant Site Area Groundwater Model
CSES-Colstrip, Montana
FIGURE 49

NewFields



Note: 2013 NAIP Imagery

P:\Colstrip\04 GIS\Projects\PlantSite_Plumes\FIGURE 50 - 2003 Residuals Layer 1.mxd

N

0 Feet 2,000

NewFields

3.28 Positive Residual (feet under predicted)

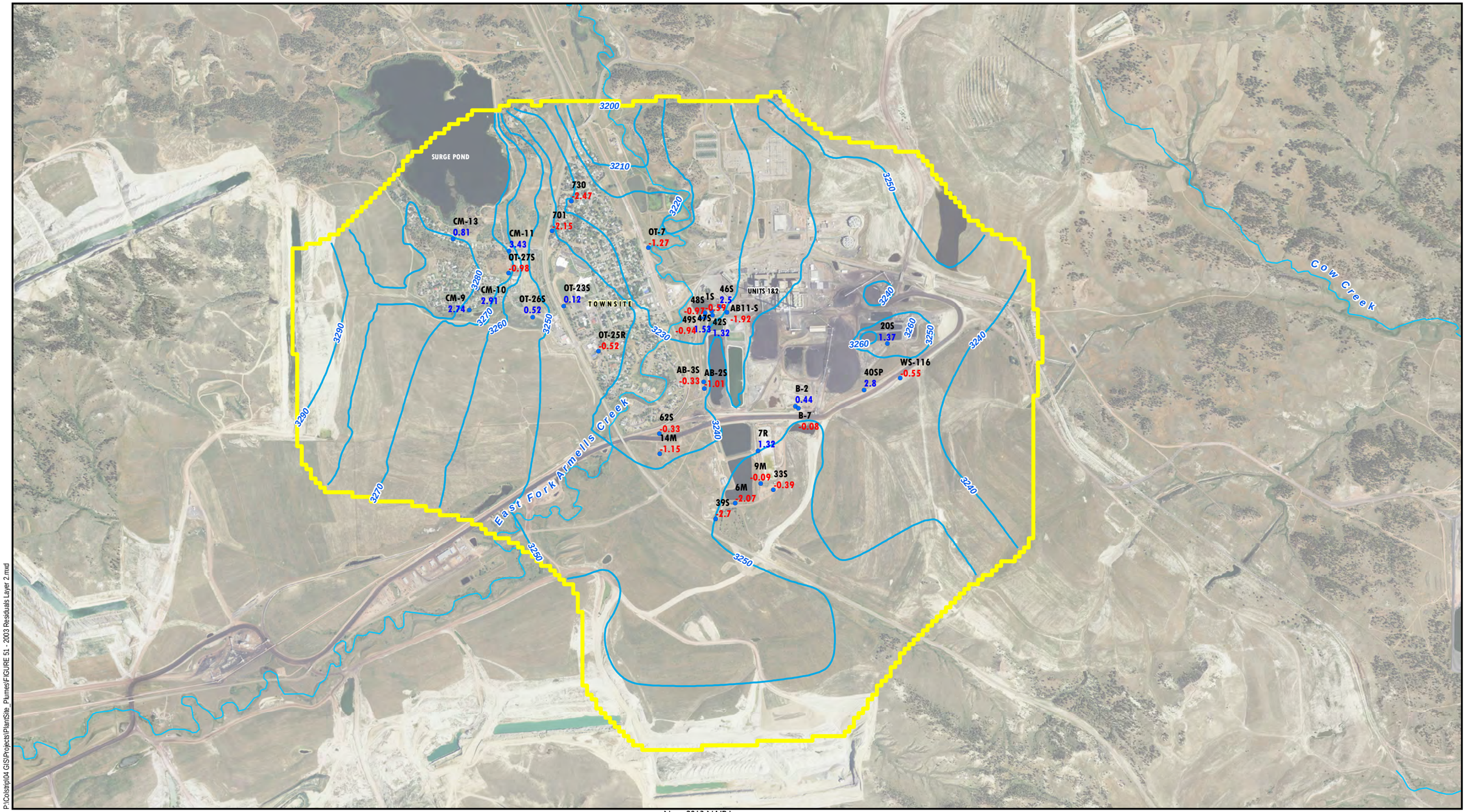
-1.89 Negative Residual (feet over predicted)

Head Target

Simulated Potentiometric Contour (feet)

Model Domain

December 2003 Simulated Layer 1
Potentiometric Surface and Residuals
Plant Site Area Groundwater Model
CSES-Colstrip, Montana
FIGURE 50



Note: 2013 NAIP Imagery

P:\Colstrip\04 GIS\Projects\PlantSite_Plumes\FIGURE 51 - 2003 Residuals Layer 2.mxd

N

0 Feet 2,000

NewFields

3.28 Positive Residual (feet under predicted)

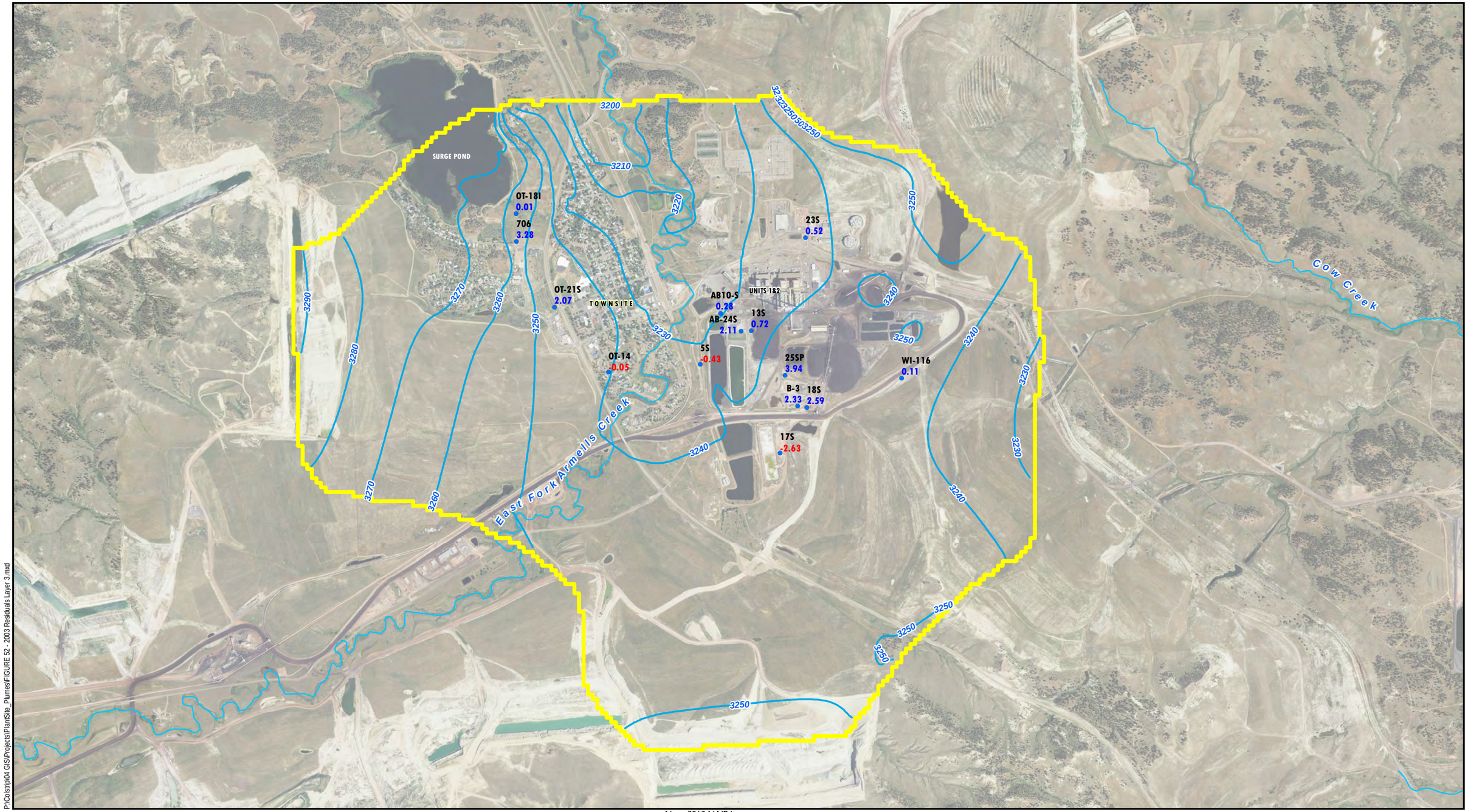
-1.89 Negative Residual (feet over predicted)

Head Target

Simulated Potentiometric Contour (feet)

Model Domain

December 2003 Simulated Layer 2
Potentiometric Surface and Residuals
Plant Site Area Groundwater Model
CSES-Colstrip, Montana
FIGURE 51



Note: 2013 NAIP Imagery

P:\Colstrip\04 GIS\Projects\PlantSite_Plumes\FIGURE 52 - 2003 Residuals Layer 3.mxd

N

0 Feet 2,000

NewFields

3.28 Positive Residual (feet under predicted)

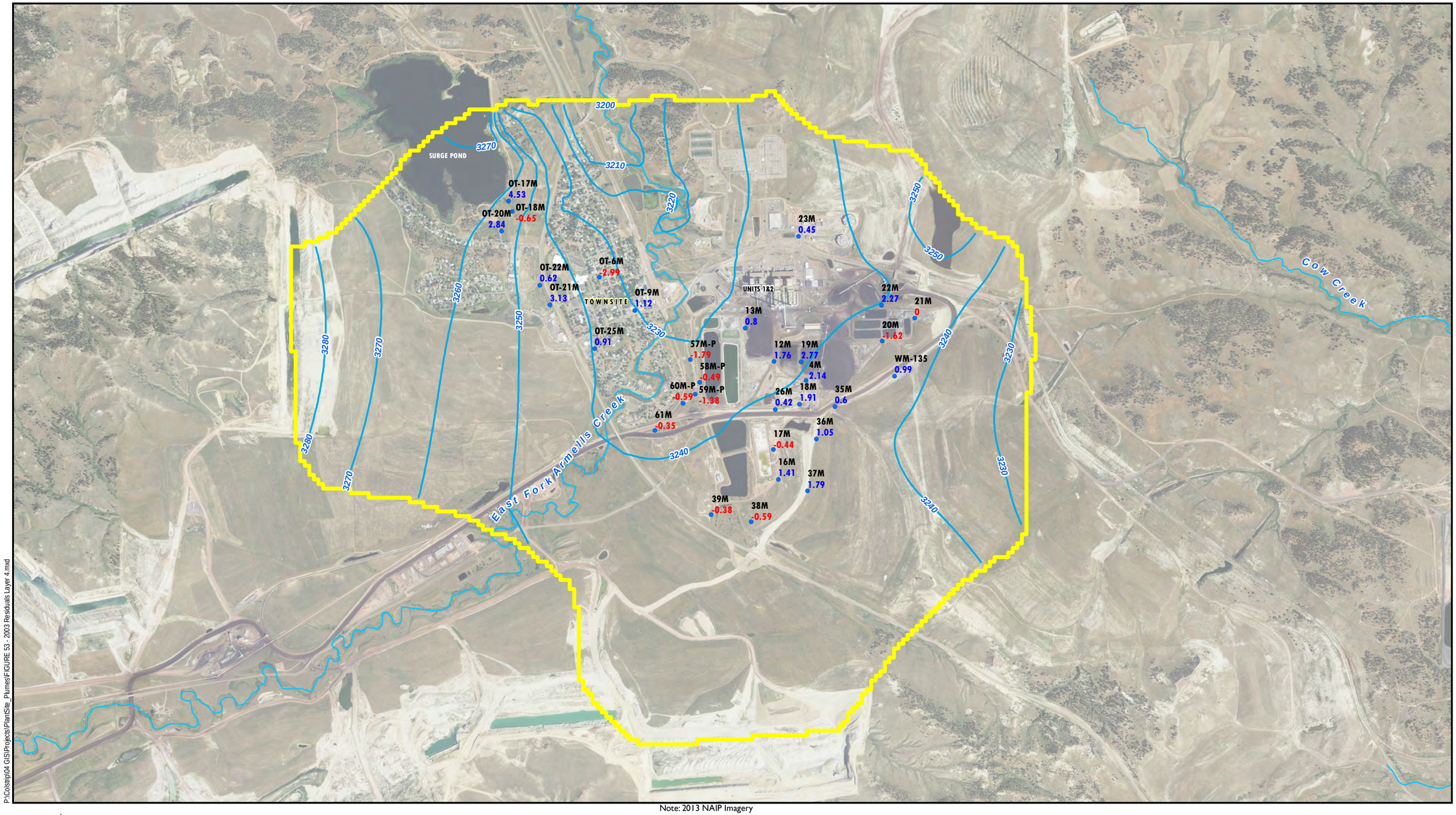
-1.89 Negative Residual (feet over predicted)

Head Target

Simulated Potentiometric Contour (feet)

Model Domain

December 2003 Simulated Layer 3
Potentiometric Surface and Residuals
Plant Site Area Groundwater Model
CSES-Colstrip, Montana
FIGURE 52



Note: 2013 NAIP Imagery

P:\Colstrip\04 GIS\Projects\PlantSite_Plumes\FIGURE 53 - 2003 Residuals Layer 4.mxd

N

0 Feet 2,000

NewFields

3.28 Positive Residual (feet under predicted)

-1.89 Negative Residual (feet over predicted)

Head Target

Simulated Potentiometric Contour (feet)

Model Domain

December 2003 Simulated Layer 4
Potentiometric Surface and Residuals
Plant Site Area Groundwater Model
CSES-Colstrip, Montana
FIGURE 53

Note: 2013 NAIP Imagery

P:\Colstrip\04 GIS\Projects\PlantSite_Plumes\FIGURE 54 - 2003 Residuals Layer 5.mxd

N

0 Feet 2,000

NewFields

3.28 Positive Residual (feet under predicted)

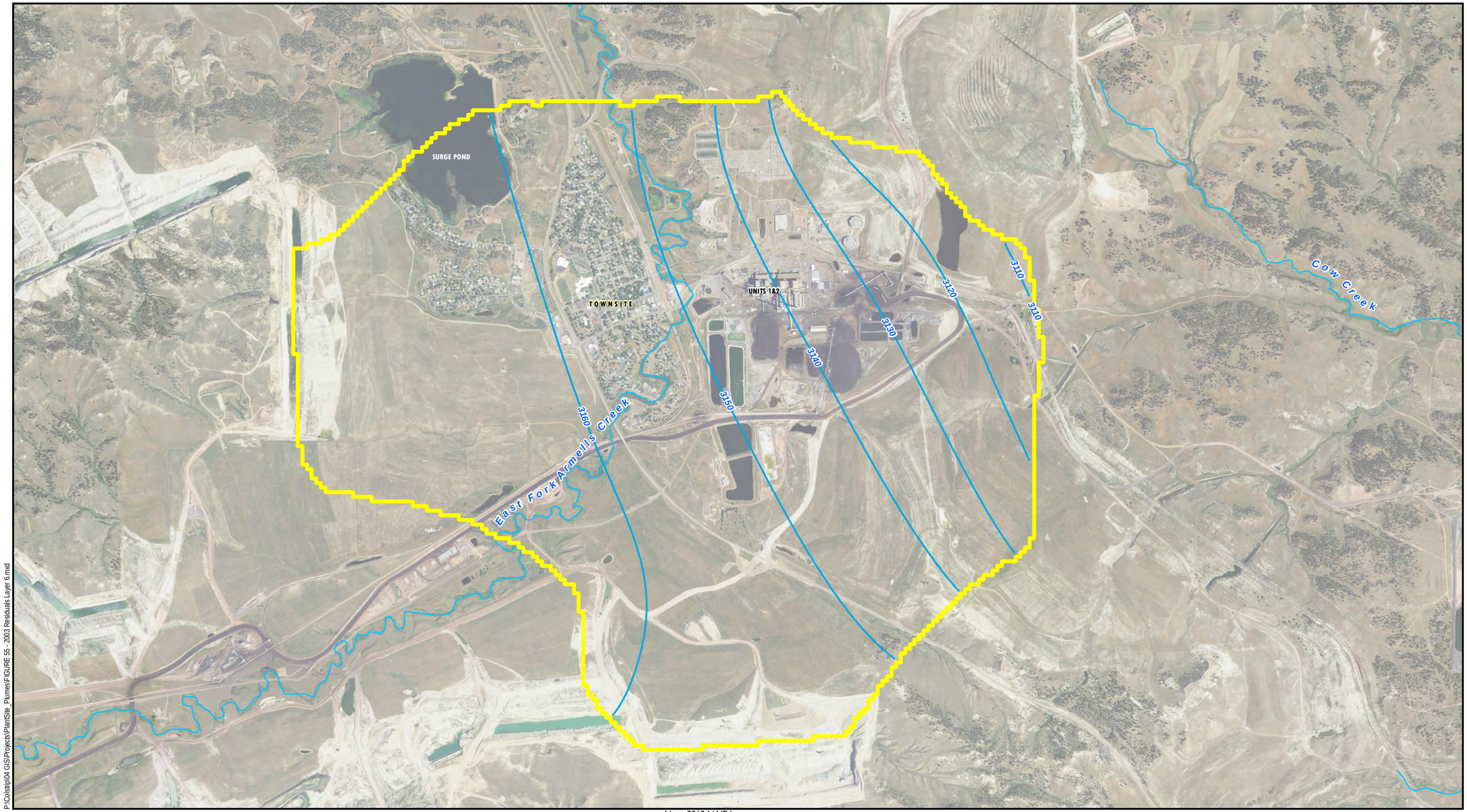
-1.89 Negative Residual (feet over predicted)

Head Target

Simulated Potentiometric Contour (feet)

Model Domain

December 2003 Simulated Layer 5
Potentiometric Surface and Residuals
Plant Site Area Groundwater Model
CSES-Colstrip, Montana
FIGURE 54



Note: 2013 NAIP Imagery

P:\Colstrip\04 GIS\Projects\PlantSite_Plumes\FIGURE 55 - 2003 Residuals Layer 6.mxd

0 Feet 2,000

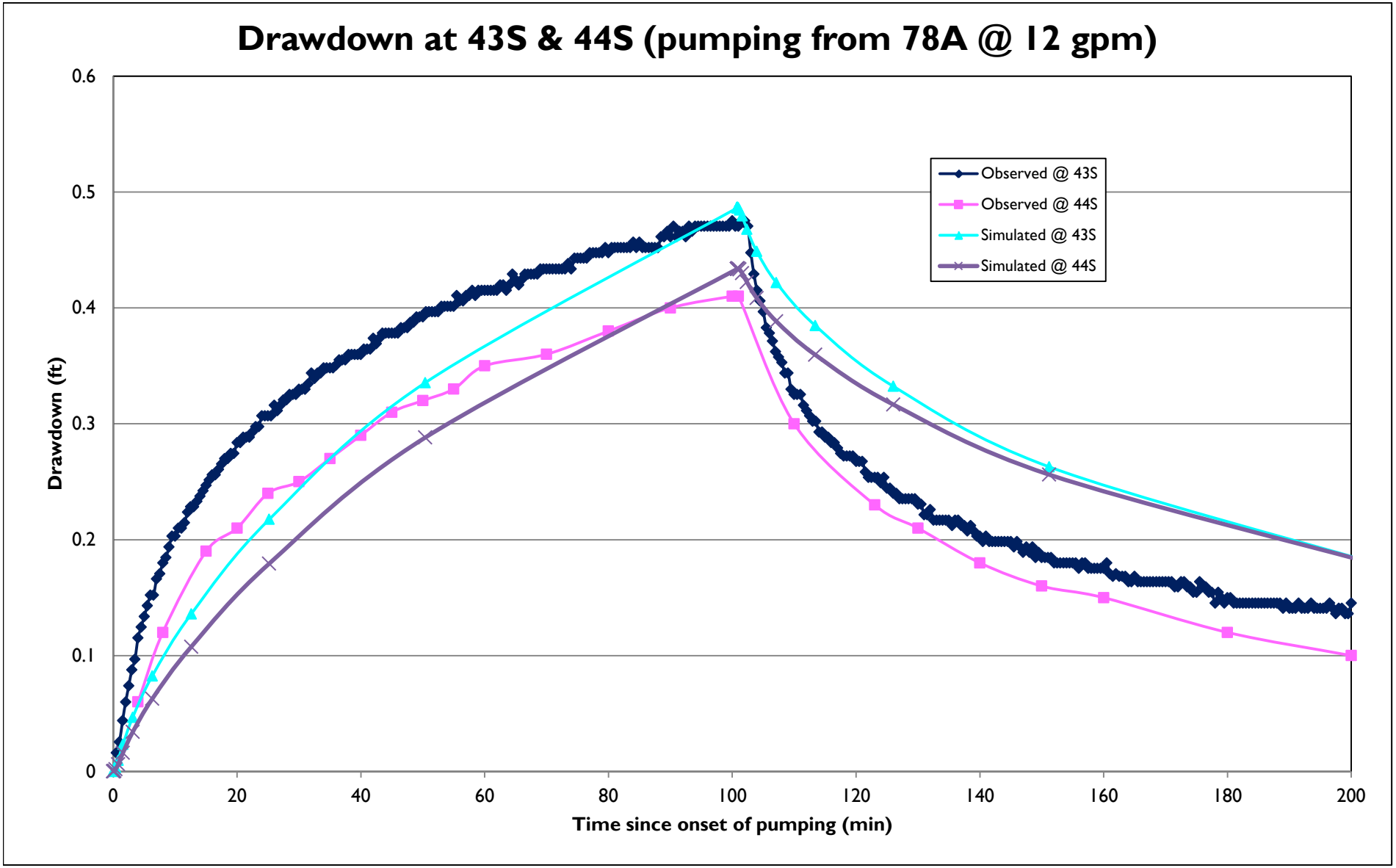
Note: There are no targets in Layer 6.

Simulated Potentiometric Contour (feet)

Model Domain

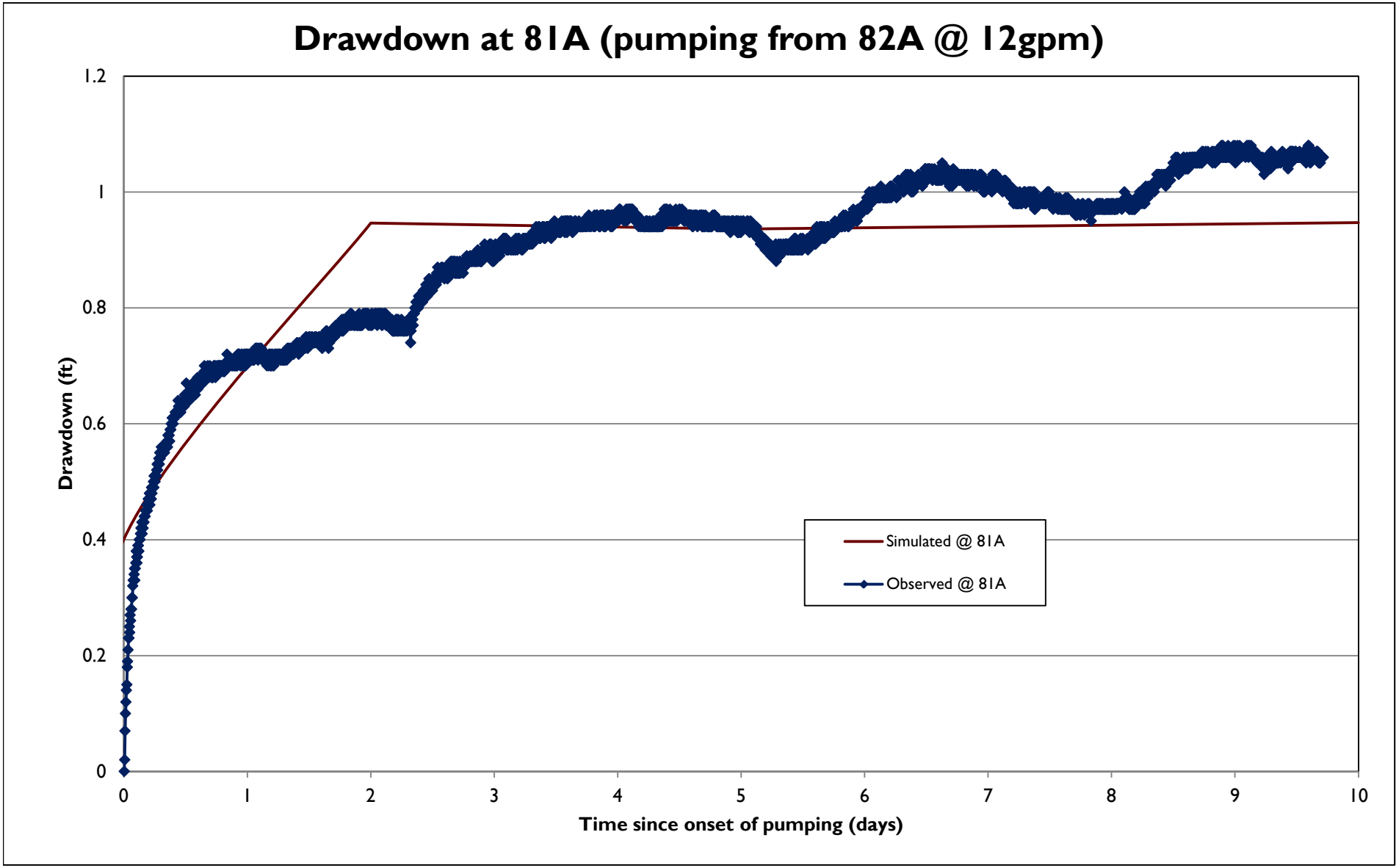
NewFields

December 2003 Simulated Layer 6
Potentiometric Surface
Plant Site Area Groundwater Model
CSES-Colstrip, Montana
FIGURE 55



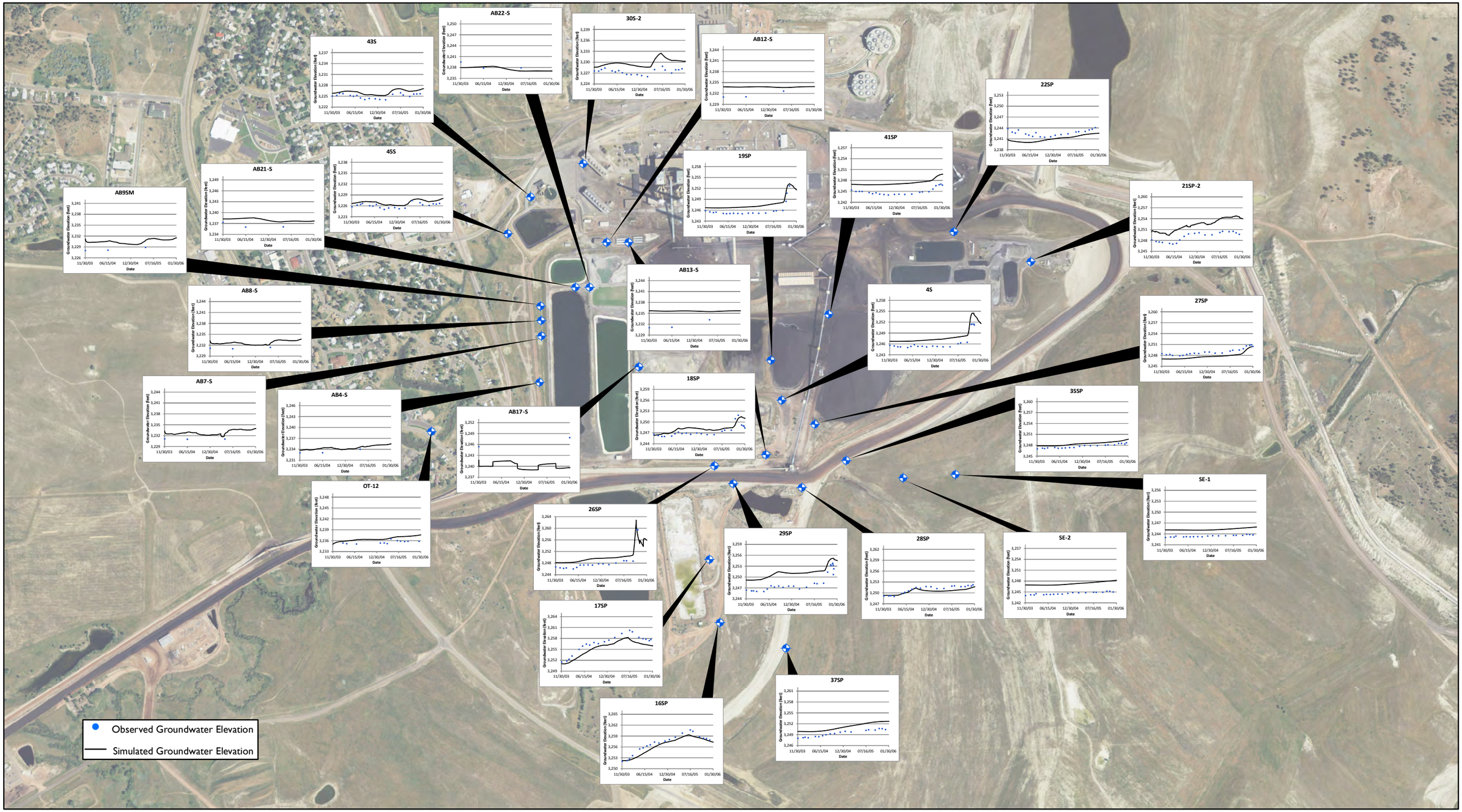
Simulated and Observed Drawdown and
Recovery during the Pumping Test in Well 78A
Plant Site Area Groundwater Model
CSES-Colstrip, Montana
FIGURE 56

NewFields



Simulated and Observed Drawdown
during the Pumping Test in Well 82A
Plant Site Area Groundwater Model
CSES-Colstrip, Montana
FIGURE 57

NewFields



Note: 2013 NAIP Imagery

Monitoring Well

0 Feet 900

NewFields

2004-2005 Transient Calibration Hydrographs-Layer 1
Plant Site Area Groundwater Model
CSES-Colstrip, Montana
FIGURE 58

Note: 2013 NAIP Imagery

0 Feet 900

Monitoring Well

NewFields

2004-2005 Transient Calibration Hydrographs-Layer 2
Plant Site Area Groundwater Model
CSES-Colstrip, Montana
FIGURE 59

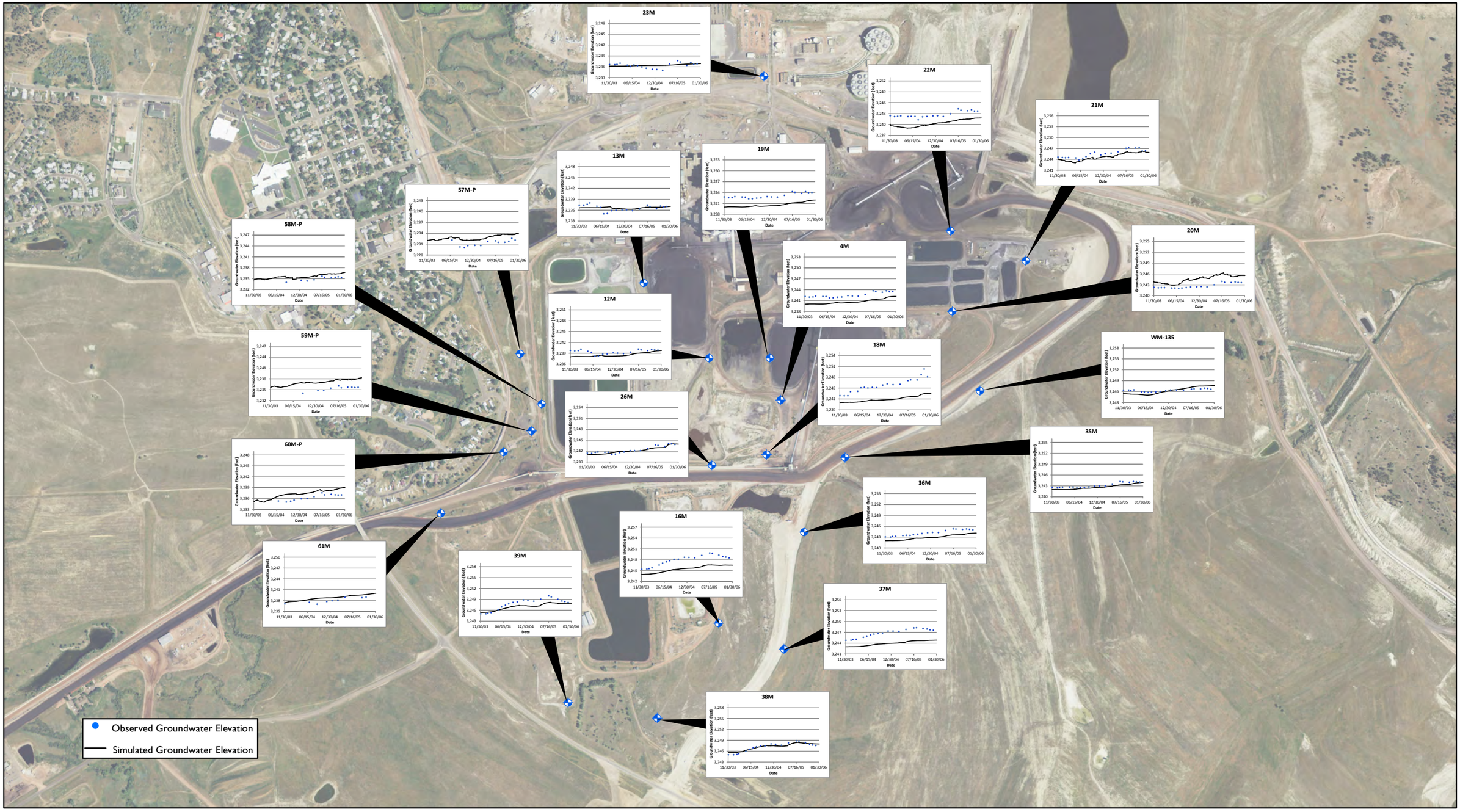
Note: 2013 NAIP Imagery

0 Feet 900

Monitoring Well

NewFields

2004-2005 Transient Calibration Hydrographs-Layer 3
Plant Site Area Groundwater Model
CSES-Colstrip, Montana
FIGURE 60



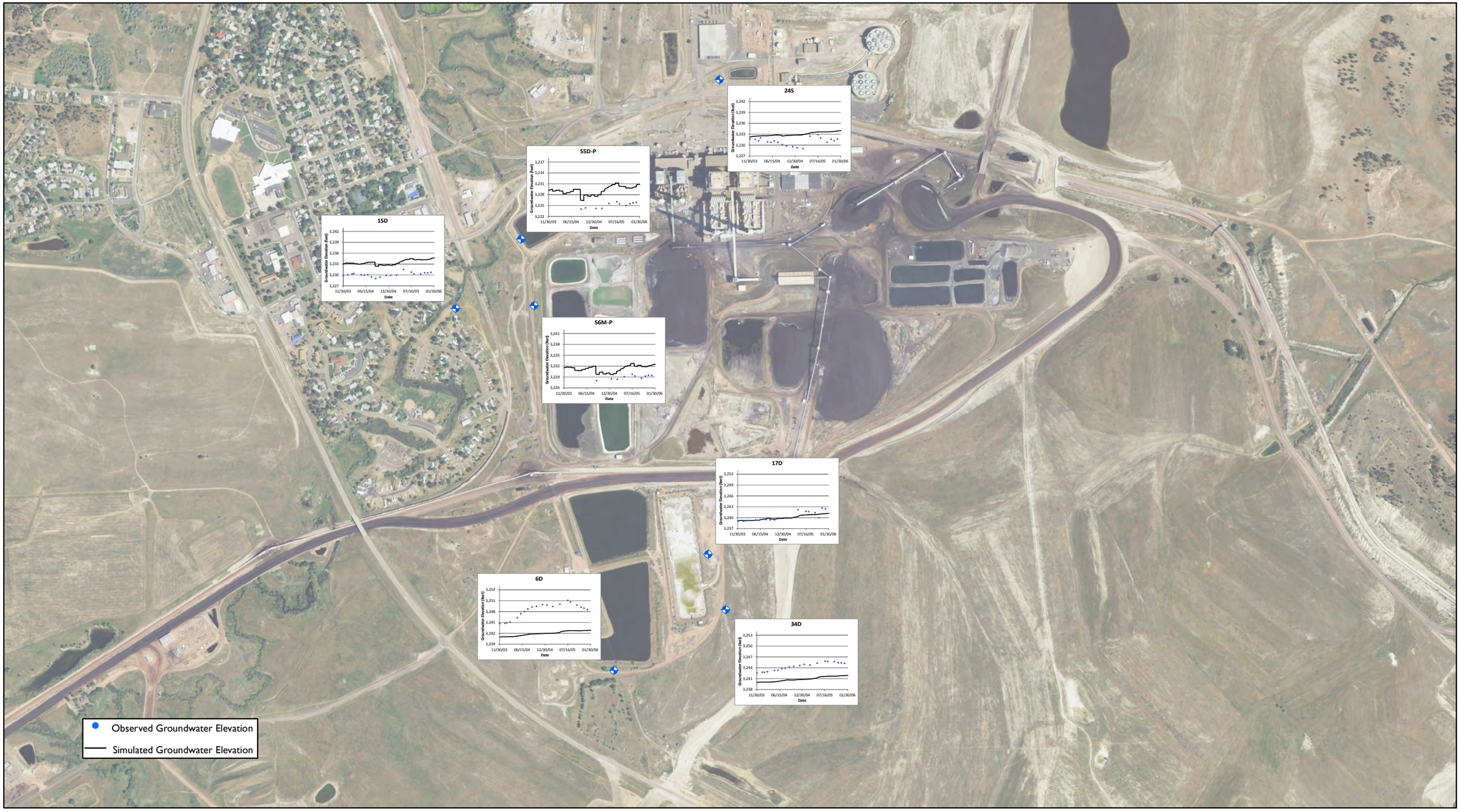
Note: 2013 NAIP Imagery

0 Feet 900

Monitoring Well

NewFields

2004-2005 Transient Calibration Hydrographs-Layer 4
Plant Site Area Groundwater Model
CSES-Colstrip, Montana
FIGURE 61



Note: 2013 NAIP Imagery

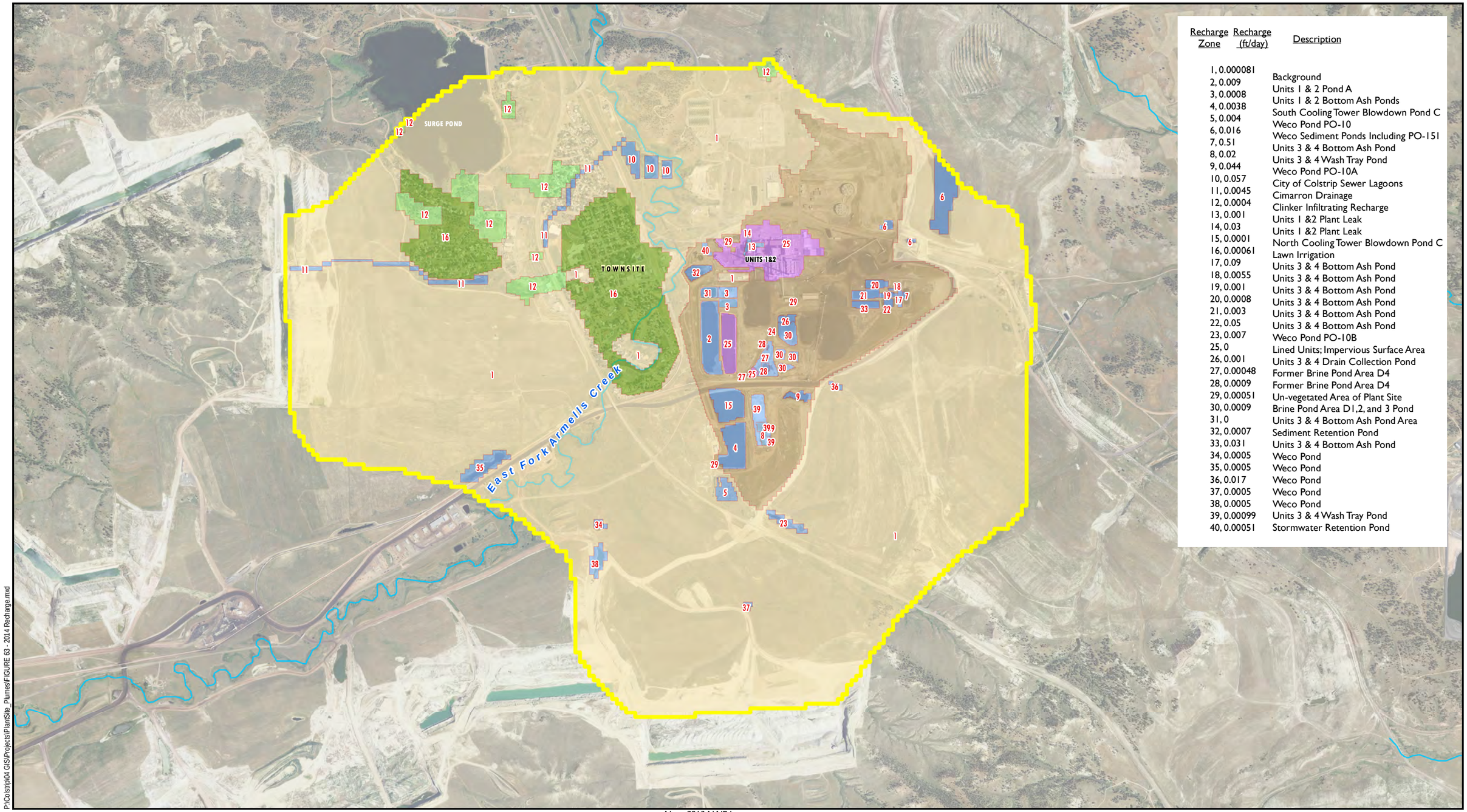
N

0 Feet 900

Monitoring Well

NewFields

2004-2005 Transient Calibration Hydrographs-Layer 5
Plant Site Area Groundwater Model
CSES-Colstrip, Montana
FIGURE 62



Recharge Zone	Recharge (ft/day)	Description
1	0.000081	Background
2	0.009	Units 1 & 2 Pond A
3	0.0008	Units 1 & 2 Bottom Ash Ponds
4	0.0038	South Cooling Tower Blowdown Pond C
5	0.004	Weco Pond PO-10
6	0.016	Weco Sediment Ponds Including PO-151
7	0.51	Units 3 & 4 Bottom Ash Pond
8	0.02	Units 3 & 4 Wash Tray Pond
9	0.044	Weco Pond PO-10A
10	0.057	City of Colstrip Sewer Lagoons
11	0.0045	Cimarron Drainage
12	0.0004	Clinker Infiltrating Recharge
13	0.001	Units 1 &2 Plant Leak
14	0.03	Units 1 &2 Plant Leak
15	0.0001	North Cooling Tower Blowdown Pond C
16	0.00061	Lawn Irrigation
17	0.09	Units 3 & 4 Bottom Ash Pond
18	0.0055	Units 3 & 4 Bottom Ash Pond
19	0.001	Units 3 & 4 Bottom Ash Pond
20	0.0008	Units 3 & 4 Bottom Ash Pond
21	0.003	Units 3 & 4 Bottom Ash Pond
22	0.05	Units 3 & 4 Bottom Ash Pond
23	0.007	Weco Pond PO-10B
25	0	Lined Units; Impervious Surface Area
26	0.001	Units 3 & 4 Drain Collection Pond
27	0.00048	Former Brine Pond Area D4
28	0.0009	Former Brine Pond Area D4
29	0.00051	Un-vegetated Area of Plant Site
30	0.0009	Brine Pond Area D1,2, and 3 Pond
31	0	Units 3 & 4 Bottom Ash Pond Area
32	0.0007	Sediment Retention Pond
33	0.031	Units 3 & 4 Bottom Ash Pond
34	0.0005	Weco Pond
35	0.0005	Weco Pond
36	0.017	Weco Pond
37	0.0005	Weco Pond
38	0.0005	Weco Pond
39	0.00099	Units 3 & 4 Wash Tray Pond
40	0.00051	Stormwater Retention Pond

P:\Colstrip\04 GIS\Projects\PlantSite_Plumes\FIGURE 63 - 2014 Recharge.mxd

Note: 2013 NAIP Imagery

N

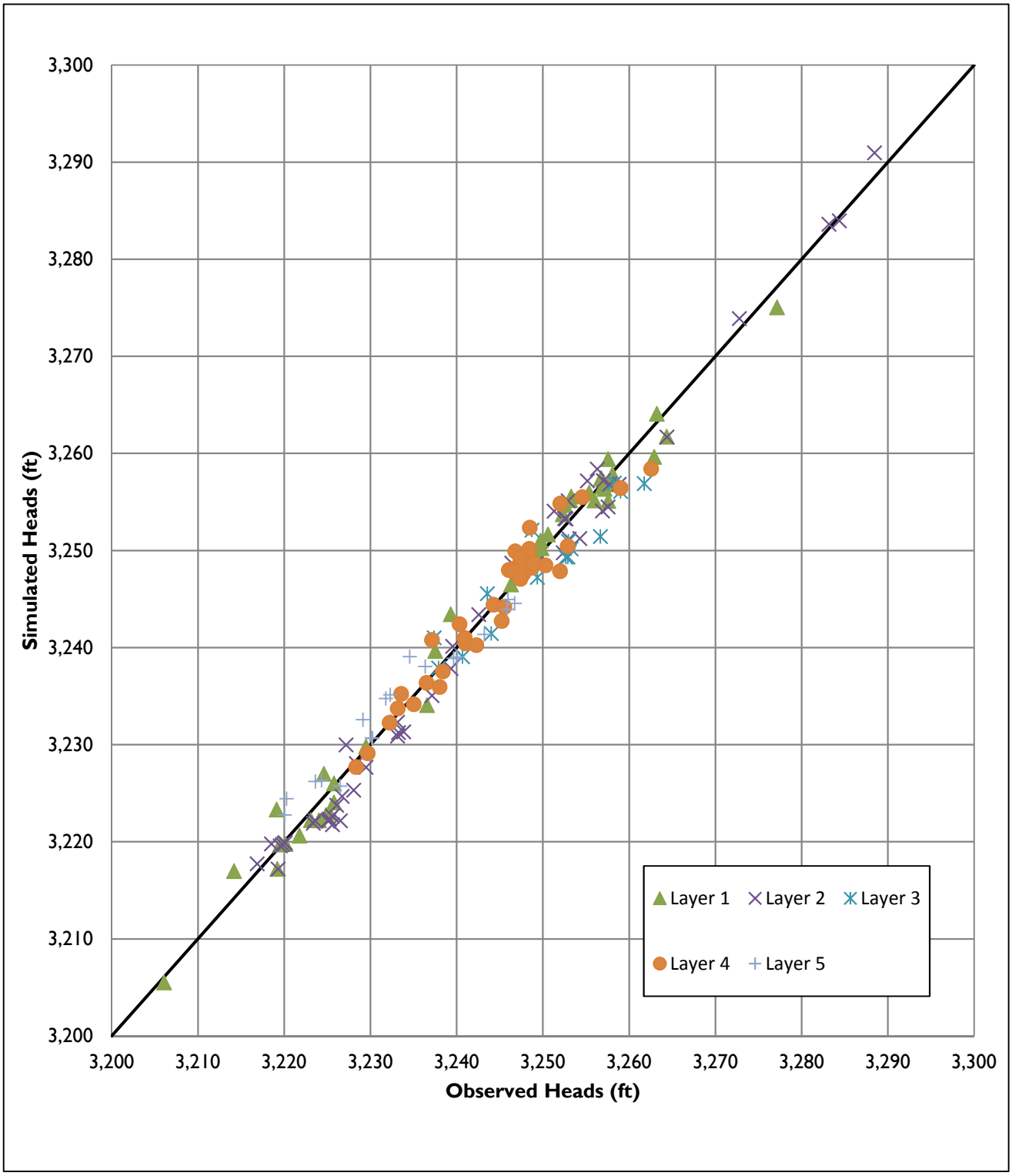
0 Feet 2,000

NewFields

Recharge Zones

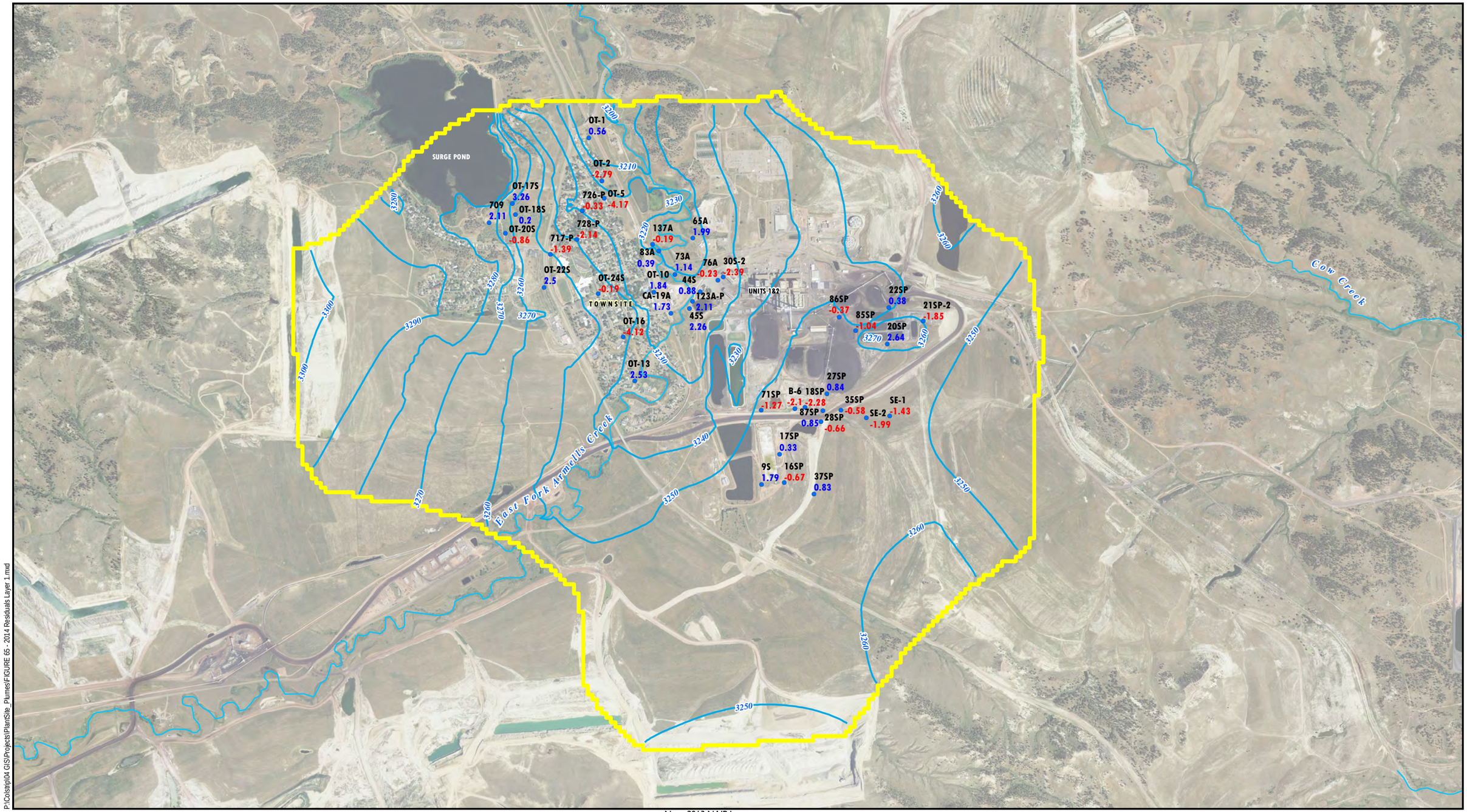
- Background
- Clinker Infiltrating Recharge
- Impervious
- Lawn Irrigation Infiltration
- Ponds Seepage
- Unvegetated Infiltration Recharge
- Model Domain

December 2014 Calibrated Recharge Distribution
Plant Site Area Groundwater Model
CSES-Colstrip, Montana
FIGURE 63



February 2014 Simulated vs.
Observed Groundwater Elevations
Plant Site Area Groundwater Model
CSES-Colstrip, Montana
FIGURE 64

NewFields



P:\Colstrip\04 GIS\Projects\PlantSite_Plumes\FIGURE 65 - 2014 Residuals Layer 1.mxd

Note: 2013 NAIP Imagery

N

0 Feet 2,000

NewFields

3.28 Positive Residual (feet under predicted)

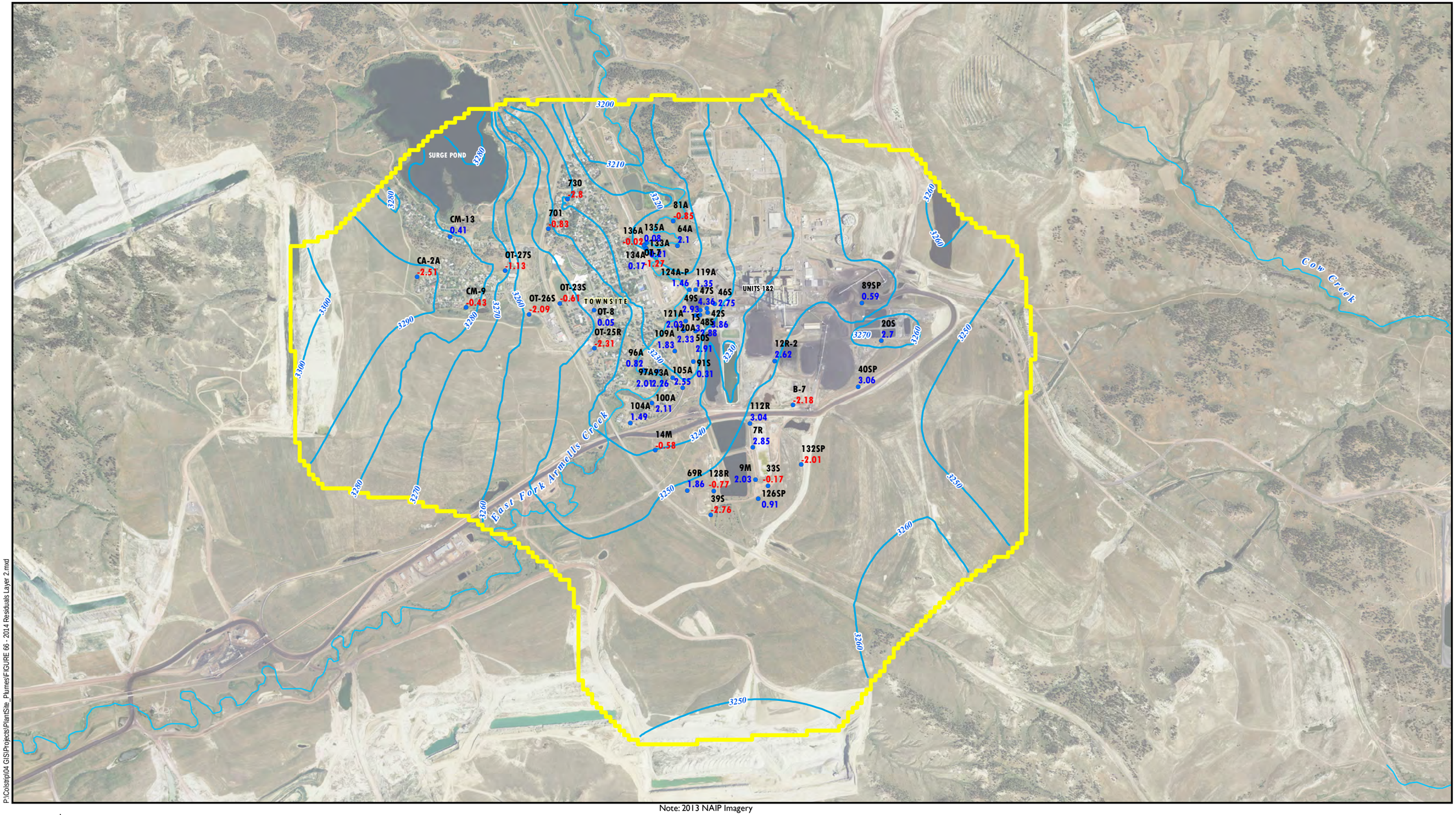
-1.89 Negative Residual (feet over predicted)

Head Target

Simulated Potentiometric Contour (feet)

Model Domain

February 2014 Simulated Layer 1
Potentiometric Surface and Residuals
Plant Site Area Groundwater Model
CSES-Colstrip, Montana
FIGURE 65



Note: 2013 NAIP Imagery

P:\Colstrip\04 GIS\Projects\PlantSite_Plumes\FIGURE 66 - 2014 Residuals Layer 2.mxd

0 Feet 2,000

NewFields

3.28 Positive Residual (feet under predicted)

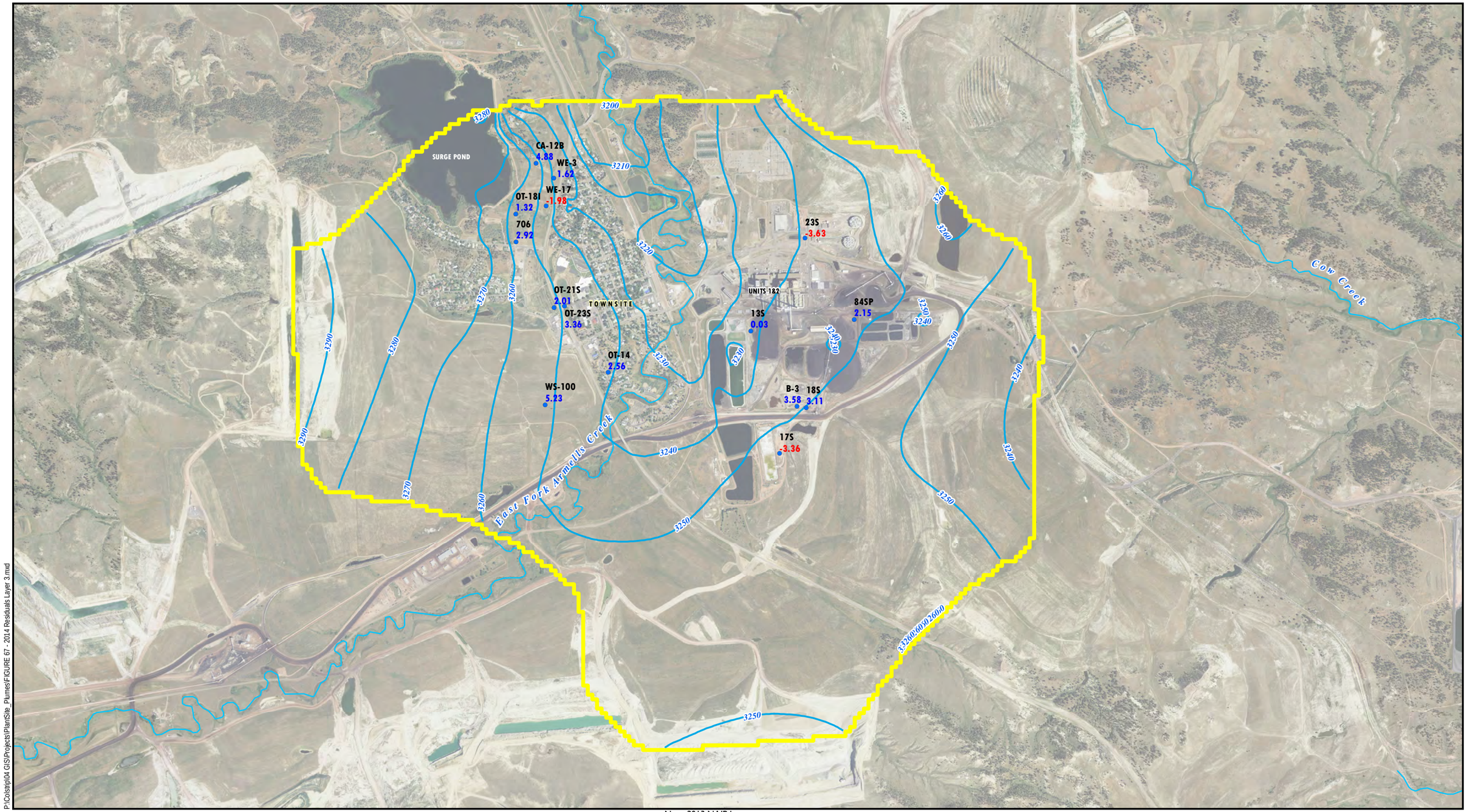
-1.89 Negative Residual (feet over predicted)

Head Target

Simulated Potentiometric Contour (feet)

Model Domain

February 2014 Simulated Layer 2
Potentiometric Surface and Residuals
Plant Site Area Groundwater Model
CSES-Colstrip, Montana
FIGURE 66



P:\Colstrip\04 GIS\Projects\PlantSite_Plumes\FIGURE 67 - 2014 Residuals Layer 3.mxd

Note: 2013 NAIP Imagery

N

0 Feet 2,000

NewFields

3.28 Positive Residual (feet under predicted)

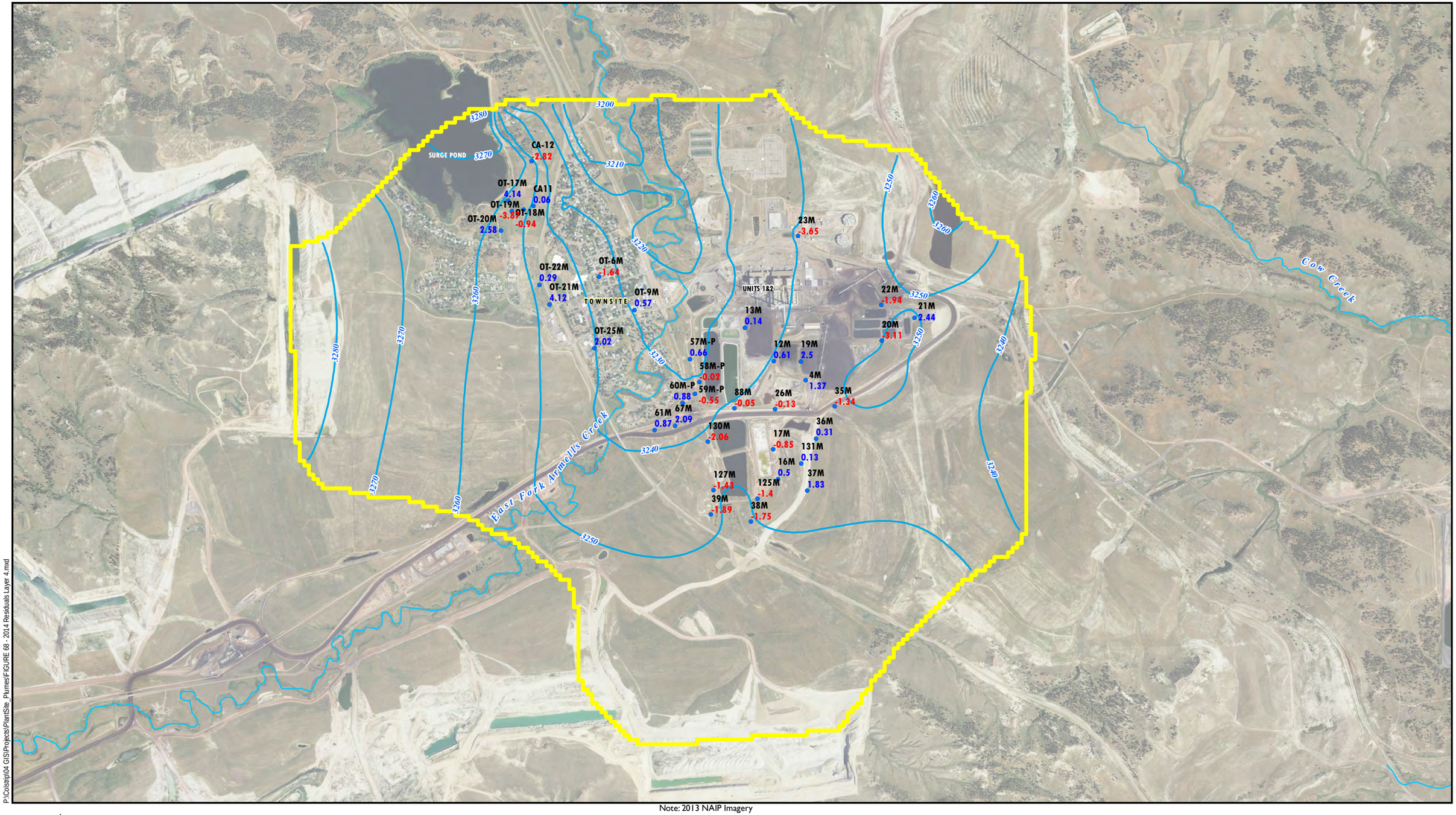
-1.89 Negative Residual (feet over predicted)

Head Target

Simulated Potentiometric Contour (feet)

Model Domain

February 2014 Simulated Layer 3
Potentiometric Surface and Residuals
Plant Site Area Groundwater Model
CSES-Colstrip, Montana
FIGURE 67



Note: 2013 NAIP Imagery

P:\Colstrip\04 GIS\Projects\PlantSite_Plumes\FIGURE 68 - 2014 Residuals Layer 4.mxd

N

0 Feet 2,000

NewFields

3.28 Positive Residual (feet under predicted)

-1.89 Negative Residual (feet over predicted)

Head Target

Simulated Potentiometric Contour (feet)

Model Domain

February 2014 Simulated Layer 4
Potentiometric Surface and Residuals
Plant Site Area Groundwater Model
CSES-Colstrip, Montana
FIGURE 68

Note: 2013 NAIP Imagery

P:\Colstrip\04 GIS\Projects\PlantSite_Plumes\FIGURE 69 - 2014 Residuals Layer 5.mxd

0 Feet 2,000

NewFields

3.28 Positive Residual (feet under predicted)

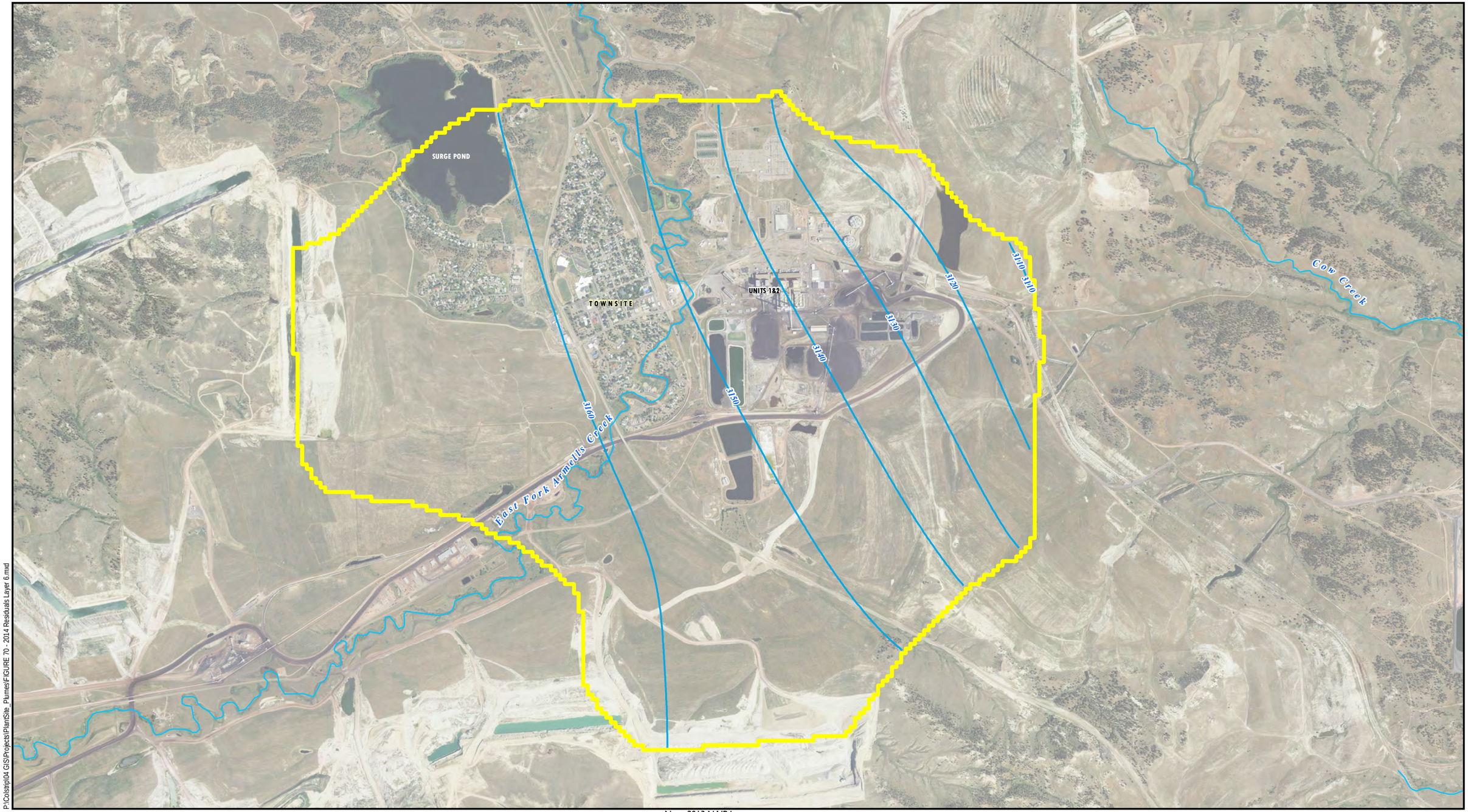
-1.89 Negative Residual (feet over predicted)

Head Target

Simulated Potentiometric Contour (feet)

Model Domain

February 2014 Simulated Layer 5
Potentiometric Surface and Residuals
Plant Site Area Groundwater Model
CSES-Colstrip, Montana
FIGURE 69



Note: 2013 NAIP Imagery

P:\Colstrip\04 GIS\Projects\PlantSite_Plumes\FIGURE 70 - 2014 Residuals Layer 6.mxd

0 Feet 2,000

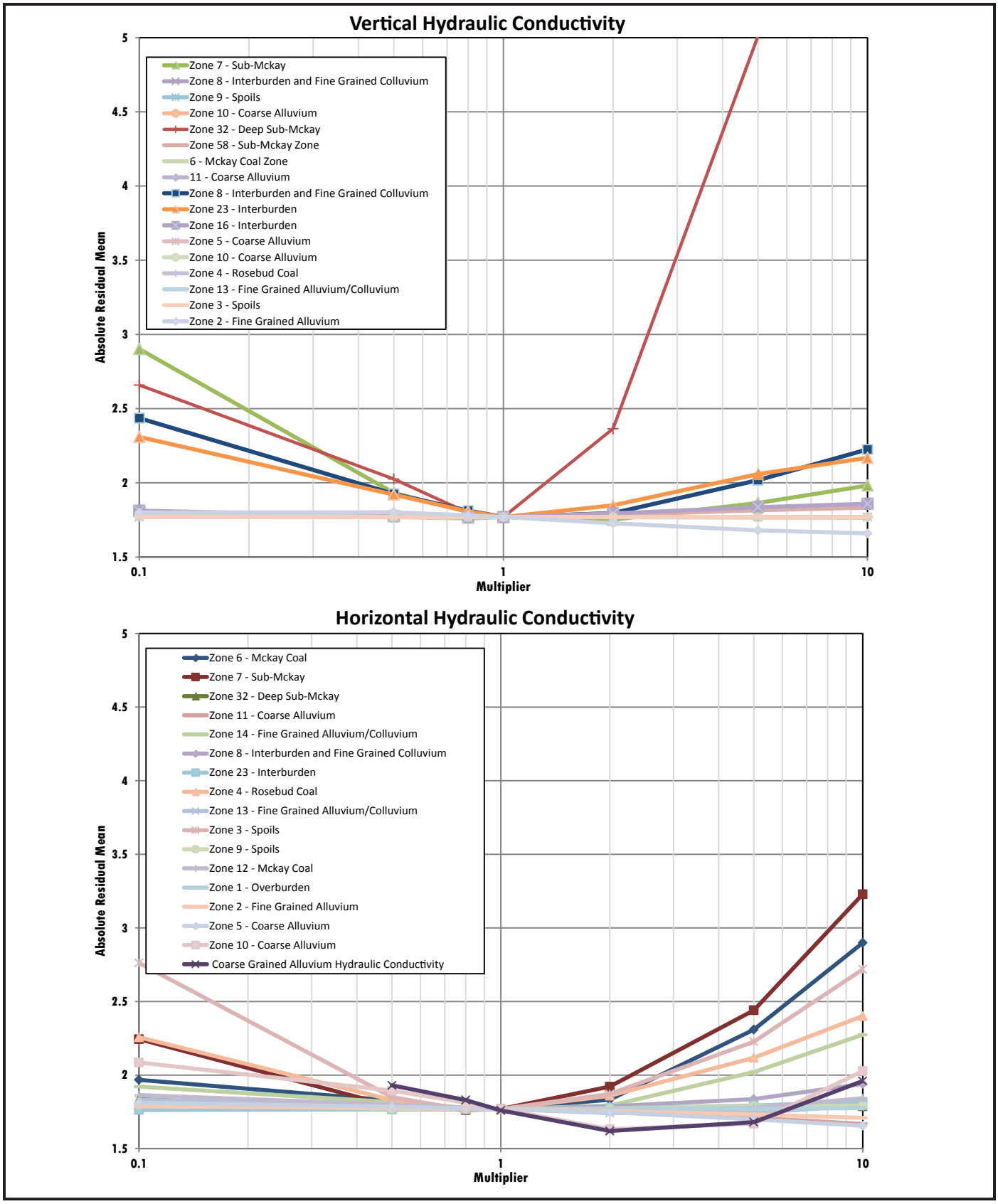
NewFields

Note: There are no targets in Layer 6.

Simulated Potentiometric Contour (feet)

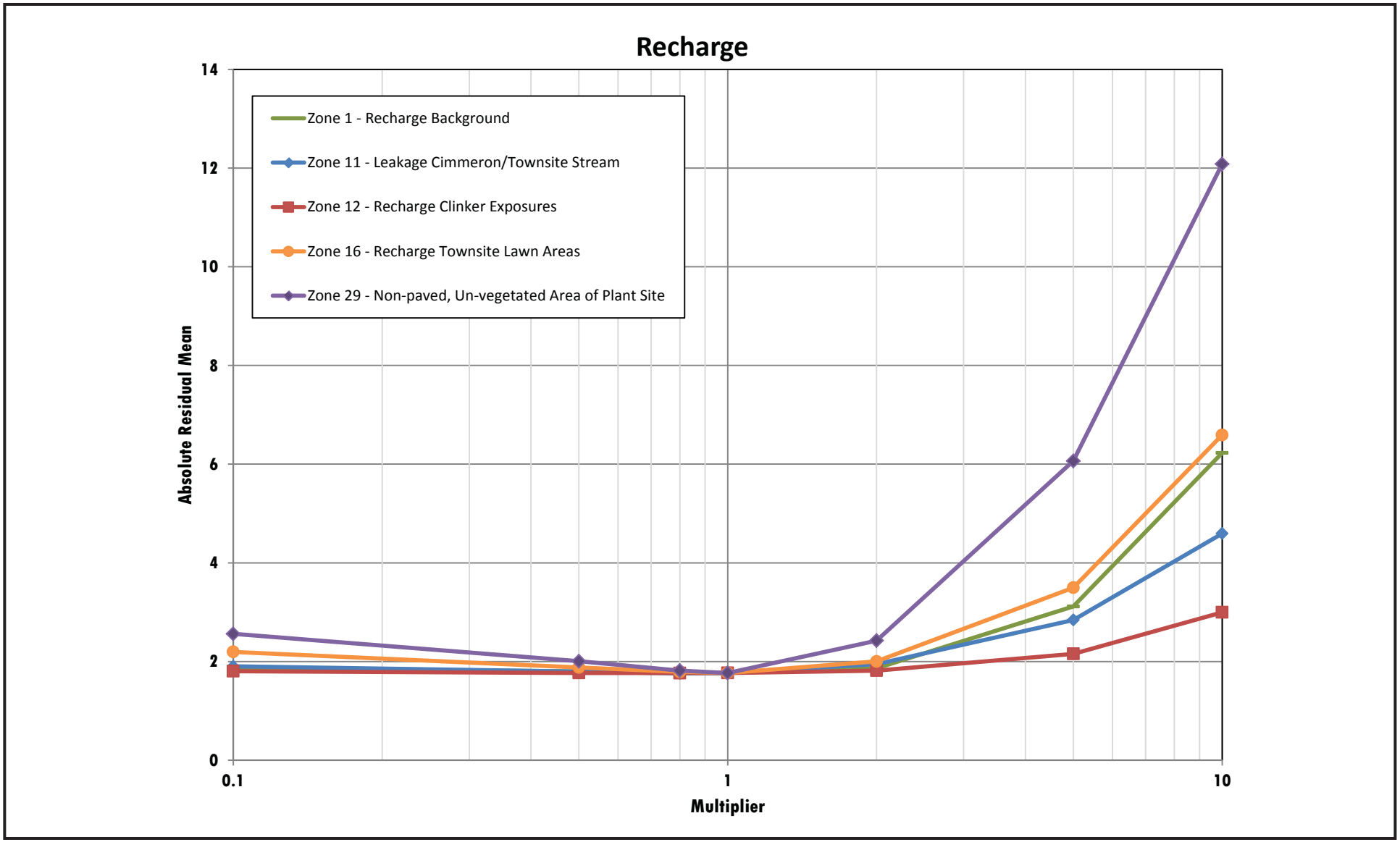
Model Domain

February 2014 Simulated Layer 6
Potentiometric Surface
Plant Site Area Groundwater Model
CSES-Colstrip, Montana
FIGURE 70



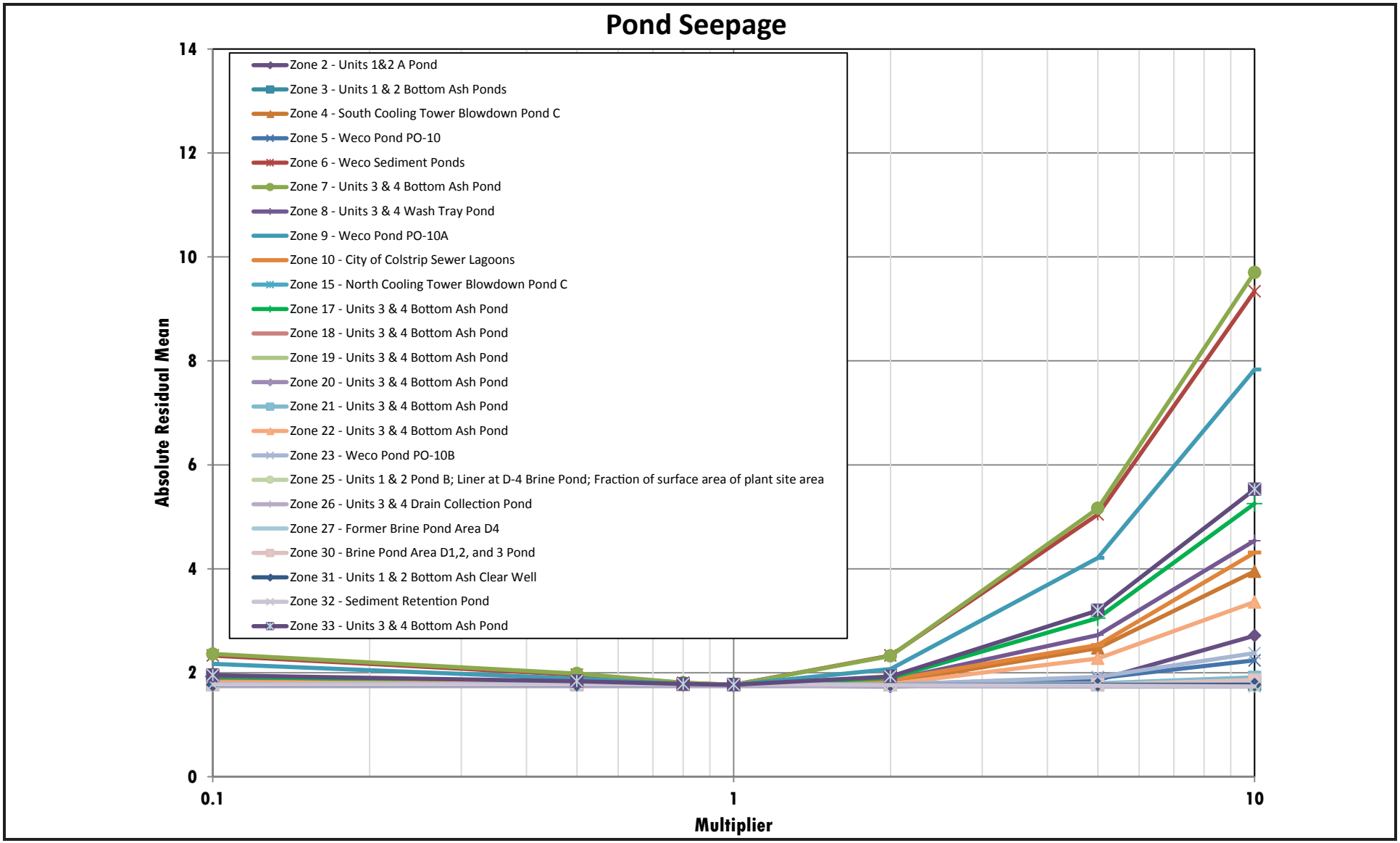
Results of Sensitivity Analysis - Hydraulic Conductivity - Select
Plant Site Area Groundwater Model
CSES-Colstrip, Montana
FIGURE 71

NewFields



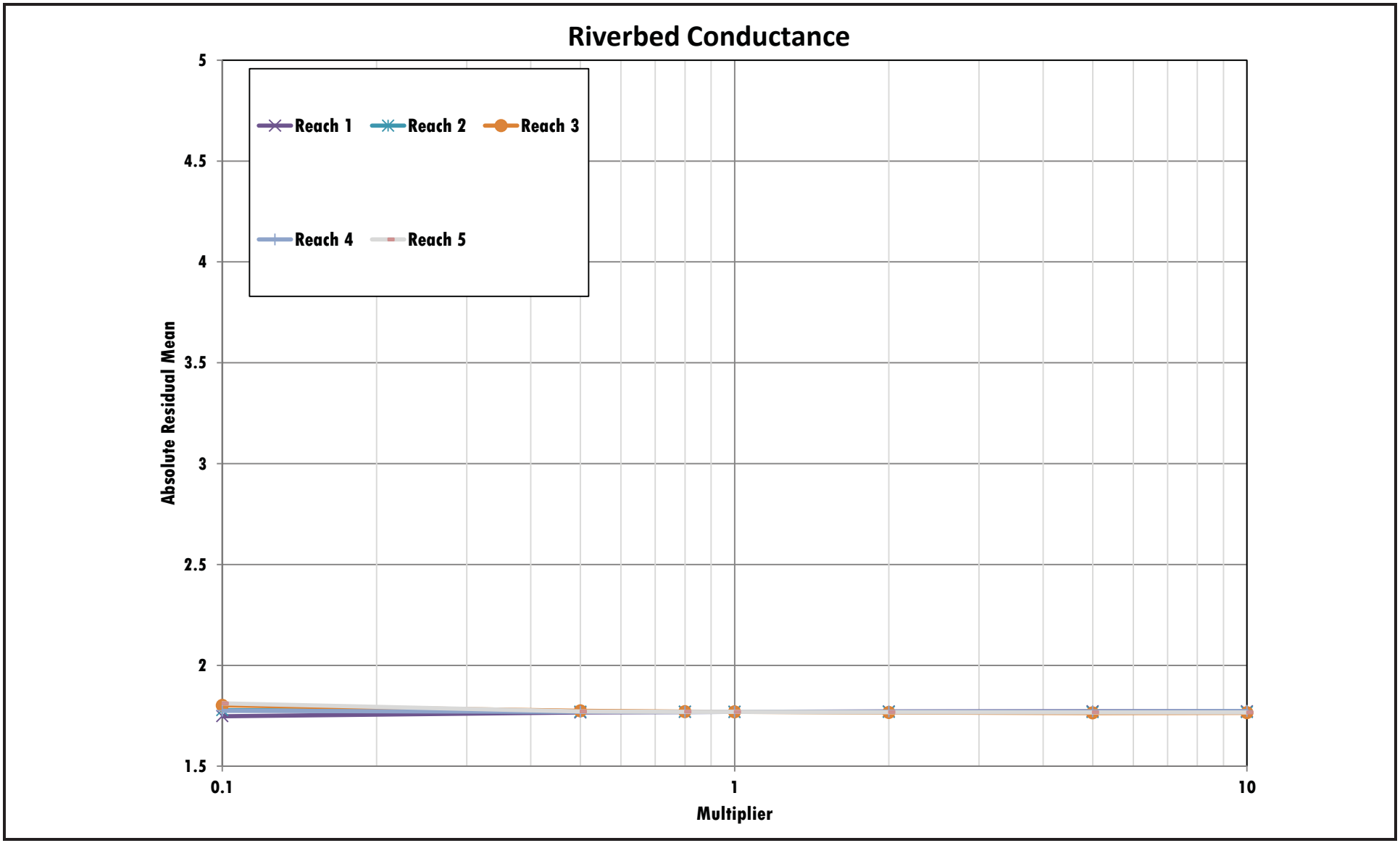
Results of Sensitivity Analysis - Recharge
Plant Site Area Groundwater Model
CSES-Colstrip, Montana
FIGURE 72

NewFields



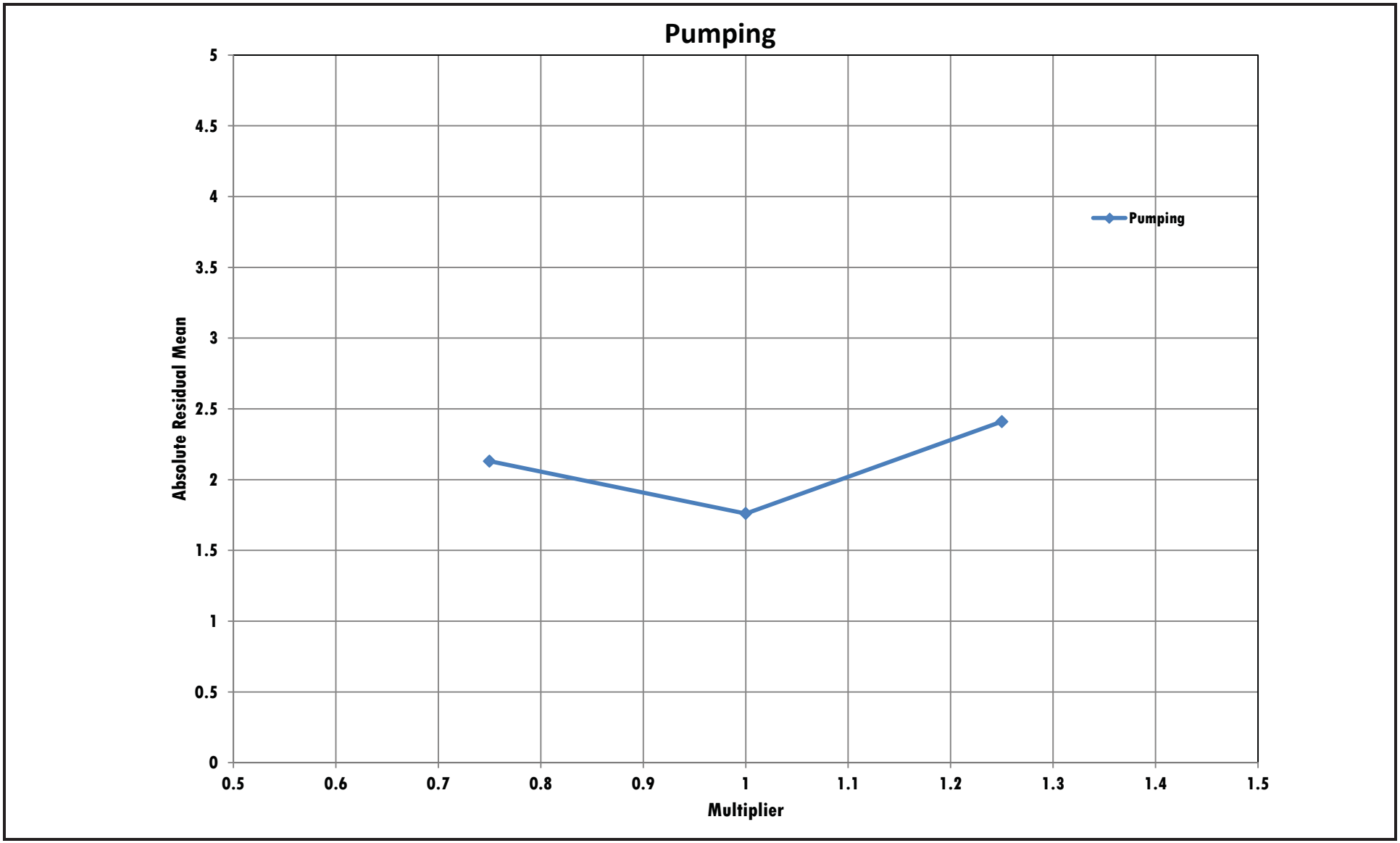
Results of Sensitivity Analysis - Pond Seepage
Plant Site Area Groundwater Model
CSES-Colstrip, Montana
FIGURE 73

NewFields



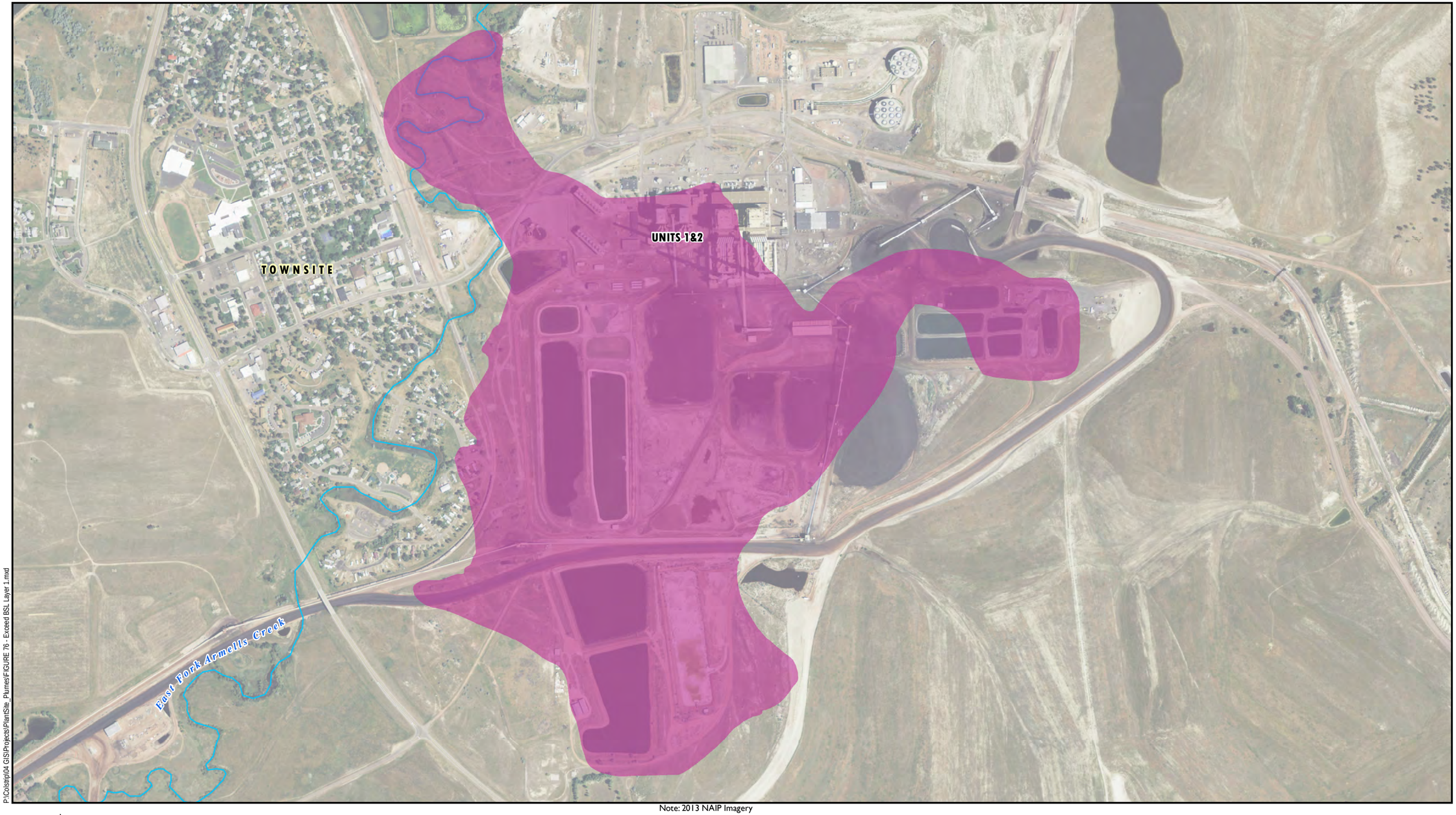
Results of Sensitivity Analysis - Riverbed Conductance
Plant Site Area Groundwater Model
CSES-Colstrip, Montana
FIGURE 74

NewFields



Results of Sensitivity Analysis - Pumping
Plant Site Area Groundwater Model
CSES-Colstrip, Montana
FIGURE 75

NewFields



P:\Colstrip\04 GIS\Projects\PlantSite_Plumes\FIGURE 76 - Exceed BSL Layer 1.mxd

Note: 2013 NAIP Imagery

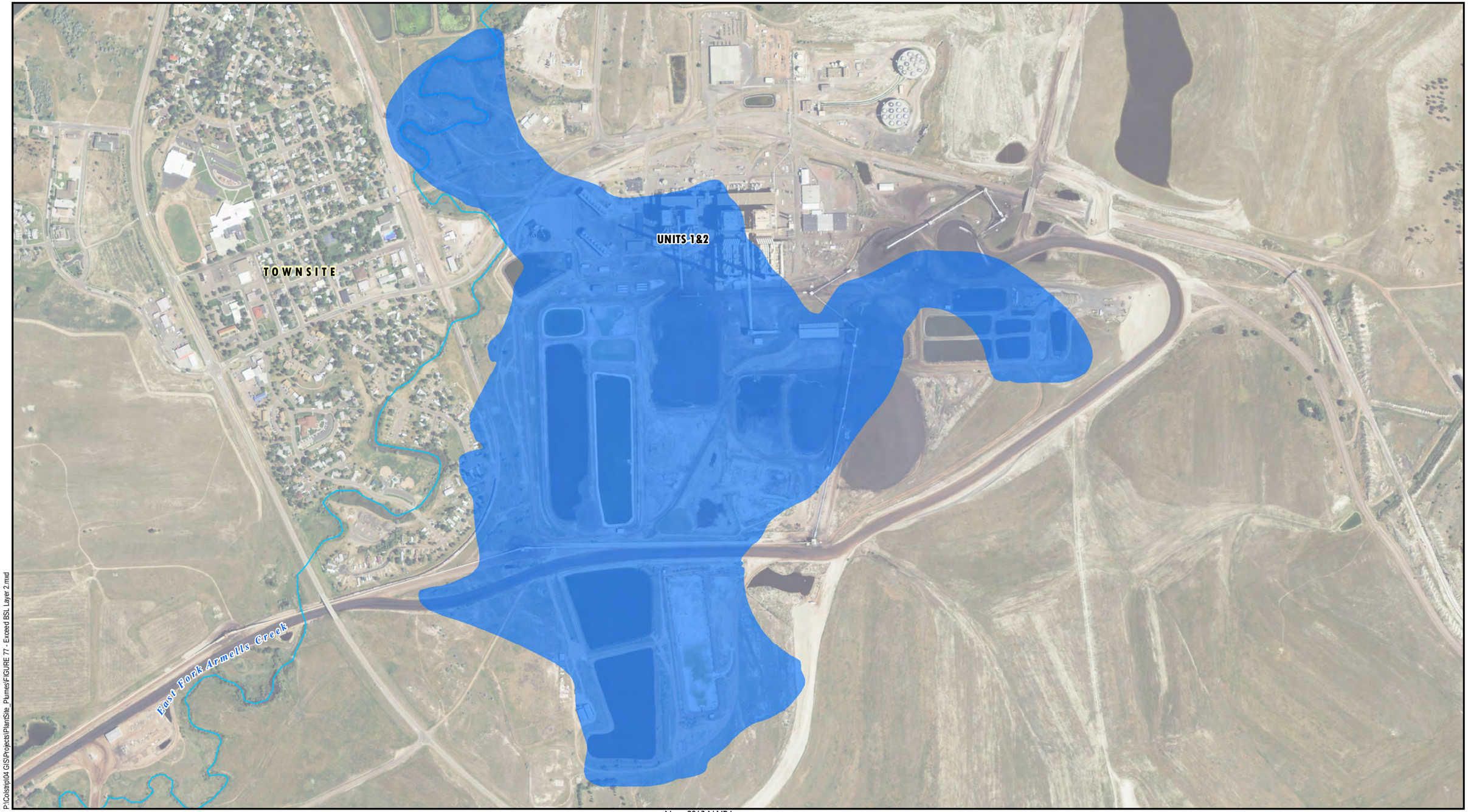
N

0 Feet 800

NewFields

Extent of Groundwater Exceeding Baseline Screening Levels (Fine-Grained Alluvium, Rosebud Coal, and Spoils)

Extent of Groundwater Exceeding Baseline Screening Levels - Layer 1
Plant Site Area Groundwater Model
CSES-Colstrip, Montana
FIGURE 76



P:\Colstrip\04 GIS\Projects\PlantSite_Plumes\FIGURE 77 - Exceed BSL Layer 2.mxd

Note: 2013 NAIP Imagery

0 Feet 800

NewFields

Extent of Groundwater Exceeding Baseline Screening Levels
(Coarse-Grained Alluvium (sand and gravel), Rosebud Coal, and Spoils)

Extent of Groundwater Exceeding Baseline Screening Levels - Layer 2
Plant Site Area Groundwater Model
CSES-Colstrip, Montana
FIGURE 77

P:\Colstrip\04 GIS\Projects\PlantSite_Plumes\FIGURE 78 - Exceed BSL Layer 3.mxd

Note: 2013 NAIP Imagery

0 Feet 800

NewFields

Extent of Groundwater Exceeding Baseline Screening Levels
(Interburden and East Fork Armells Creek Coarse-Grained Alluvium)

Extent of Groundwater Exceeding Baseline Screening Levels - Layer 3
Plant Site Area Groundwater Model
CSES-Colstrip, Montana
FIGURE 78

P:\Colstrip\04 GIS\Projects\PlantSite_Plumes\FIGURE 79 - Exceed BSL Layer 4.mxd

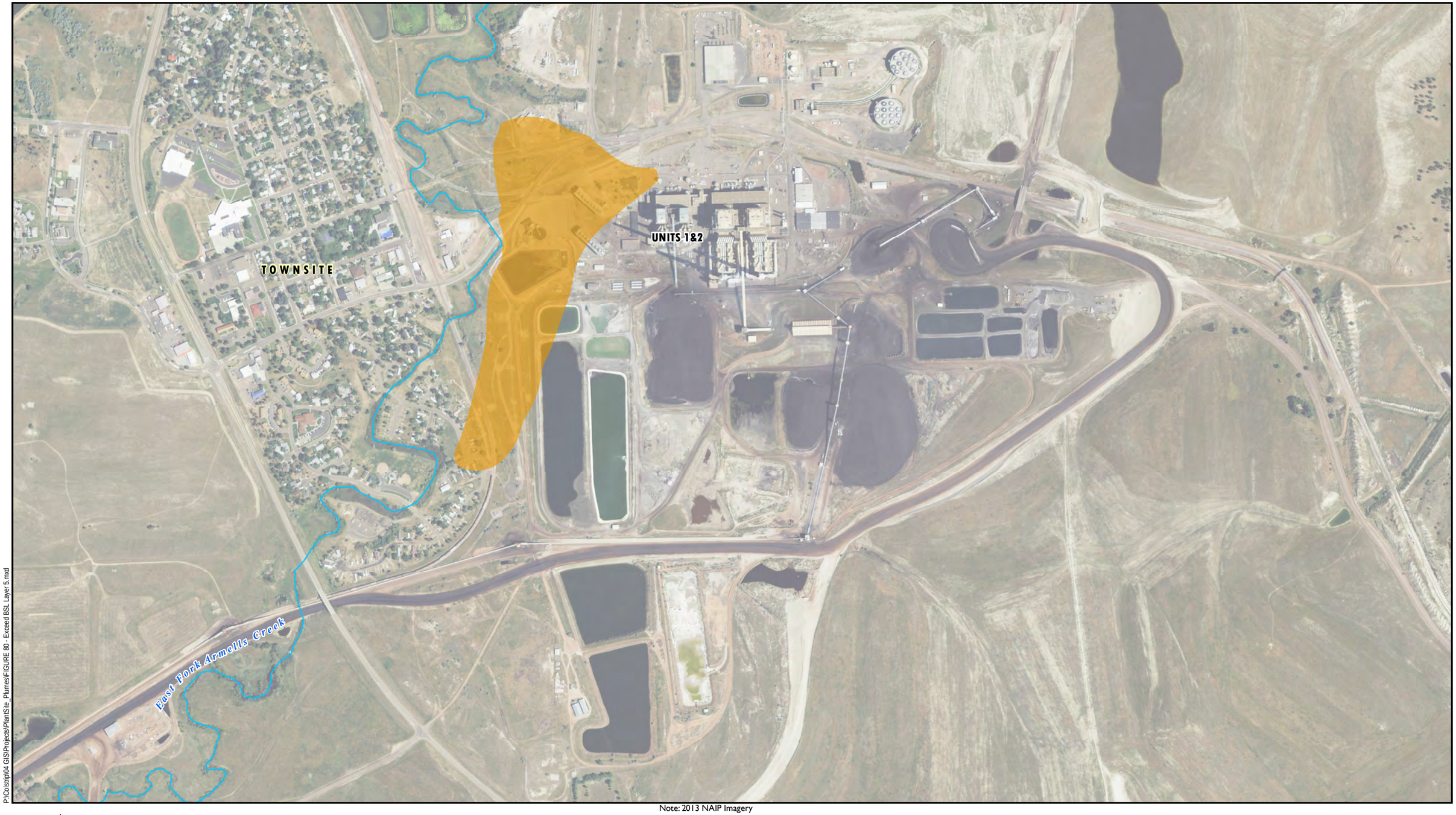
Note: 2013 NAIP Imagery

0 Feet 800

NewFields

Extent of Groundwater Exceeding Baseline Screening Levels
(McKay Coal and East Fork Armells Creek Coarse-Grained Alluvium)

Extent of Groundwater Exceeding Baseline Screening Levels - Layer 4
Plant Site Area Groundwater Model
CSES-Colstrip, Montana
FIGURE 79



P:\Colstrip\04 GIS\Projects\PlantSite_Plumes\FIGURE 80 - Exceed BSL Layer 5.mxd

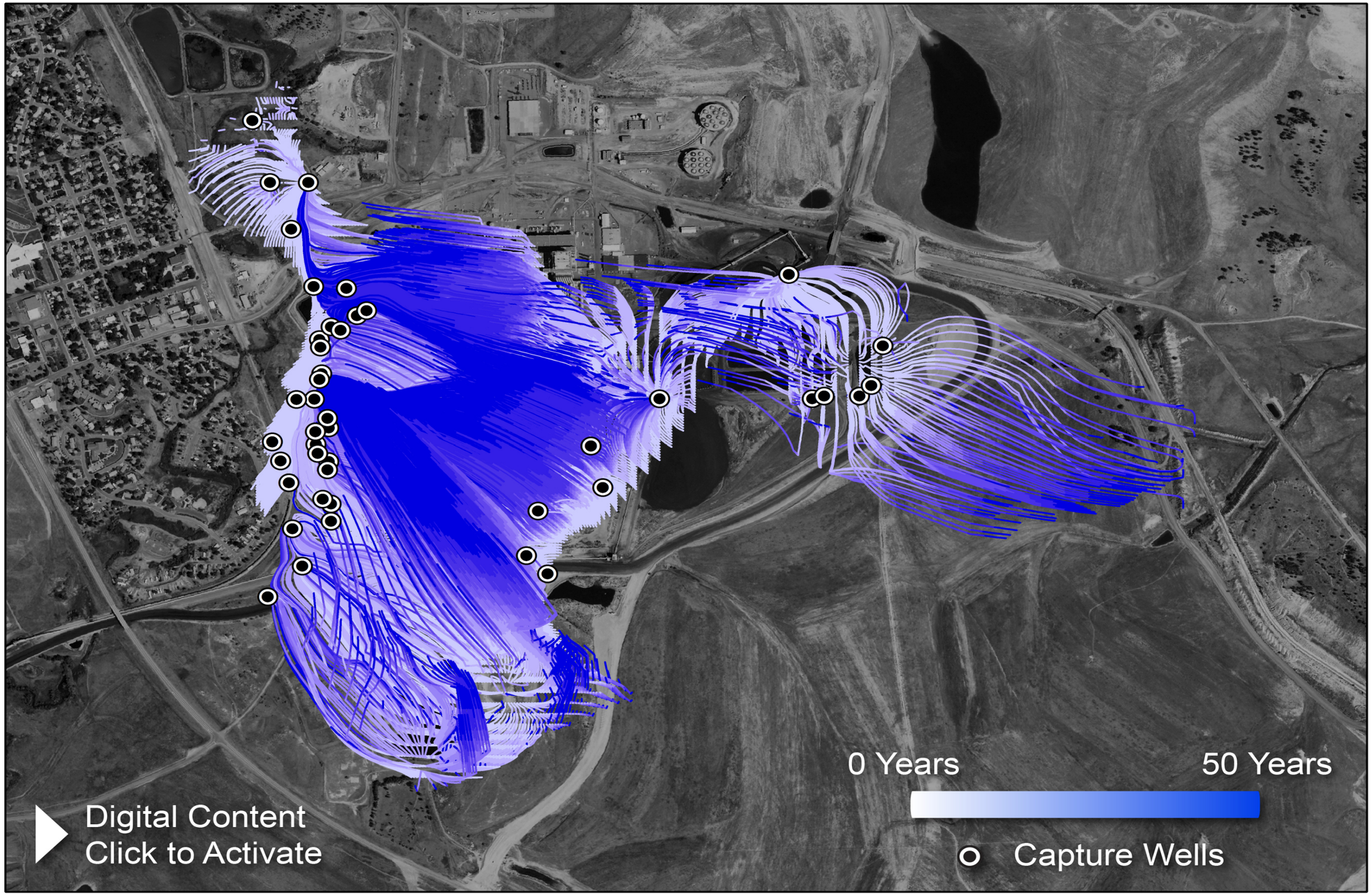
Note: 2013 NAIP Imagery

0 Feet 800

NewFields

Extent of Groundwater Exceeding Baseline Screening Levels
(Shallow Sub-McKay (approximately 75 to 135 feet thick))

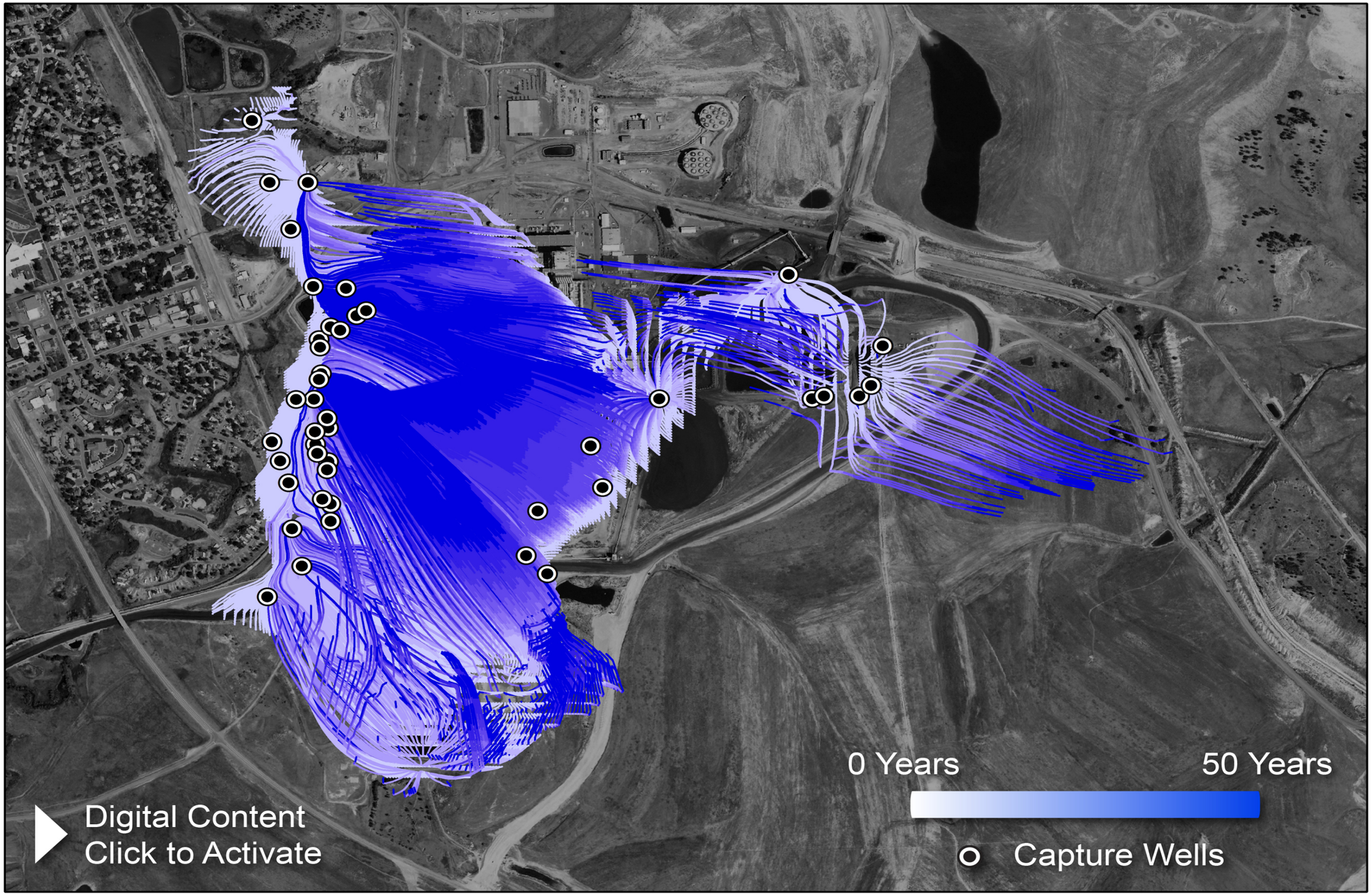
Extent of Groundwater Exceeding Baseline Screening Levels - Layer 5
Plant Site Area Groundwater Model
CSES-Colstrip, Montana
FIGURE 80

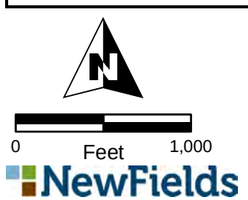


0 Feet 1,000

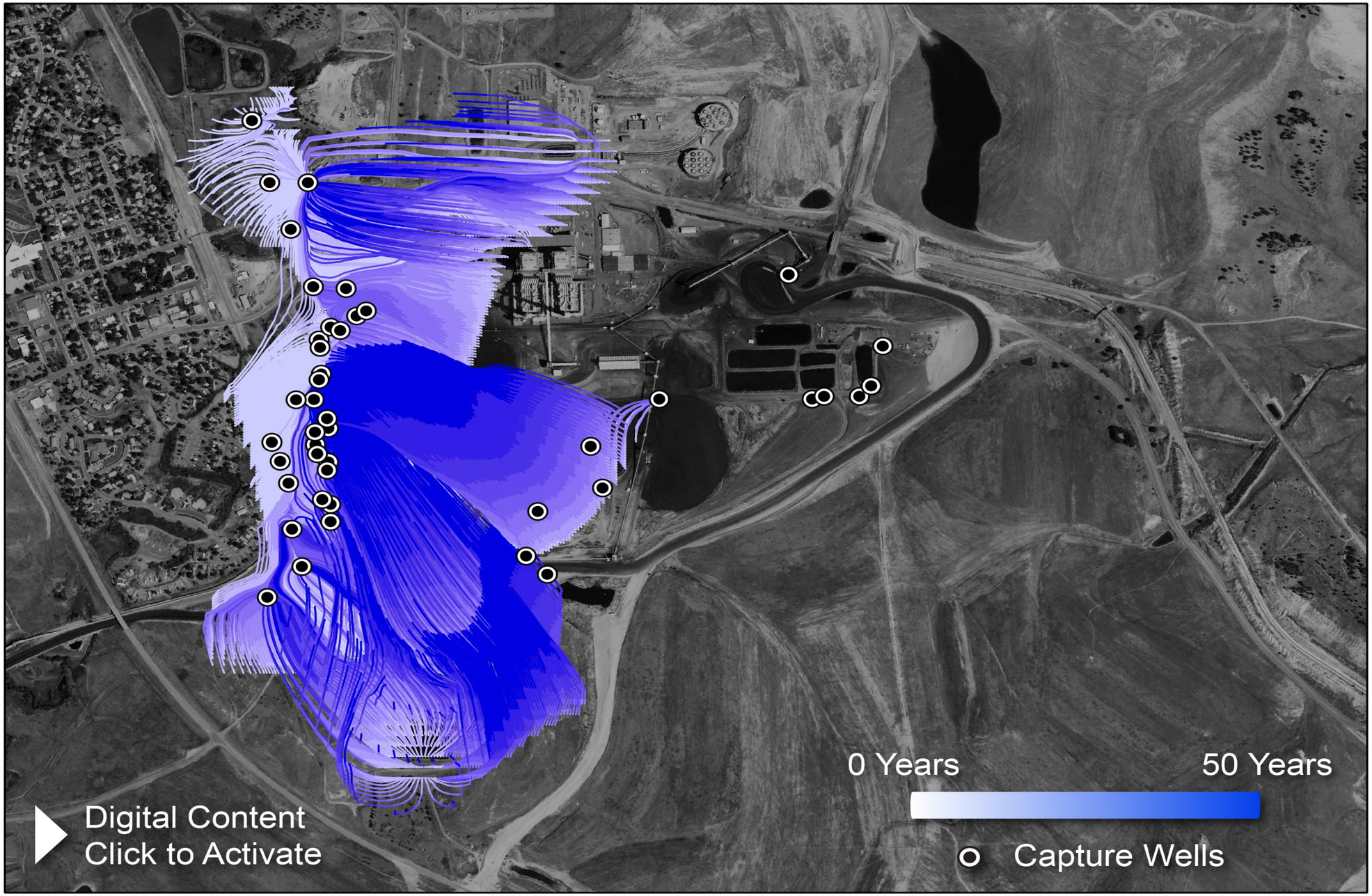
NewFields

Particle Tracking from Areas Exceeding BSLs in Layer 1
Plant Site Area Groundwater Model
CSES-Colstrip, Montana
FIGURE 81





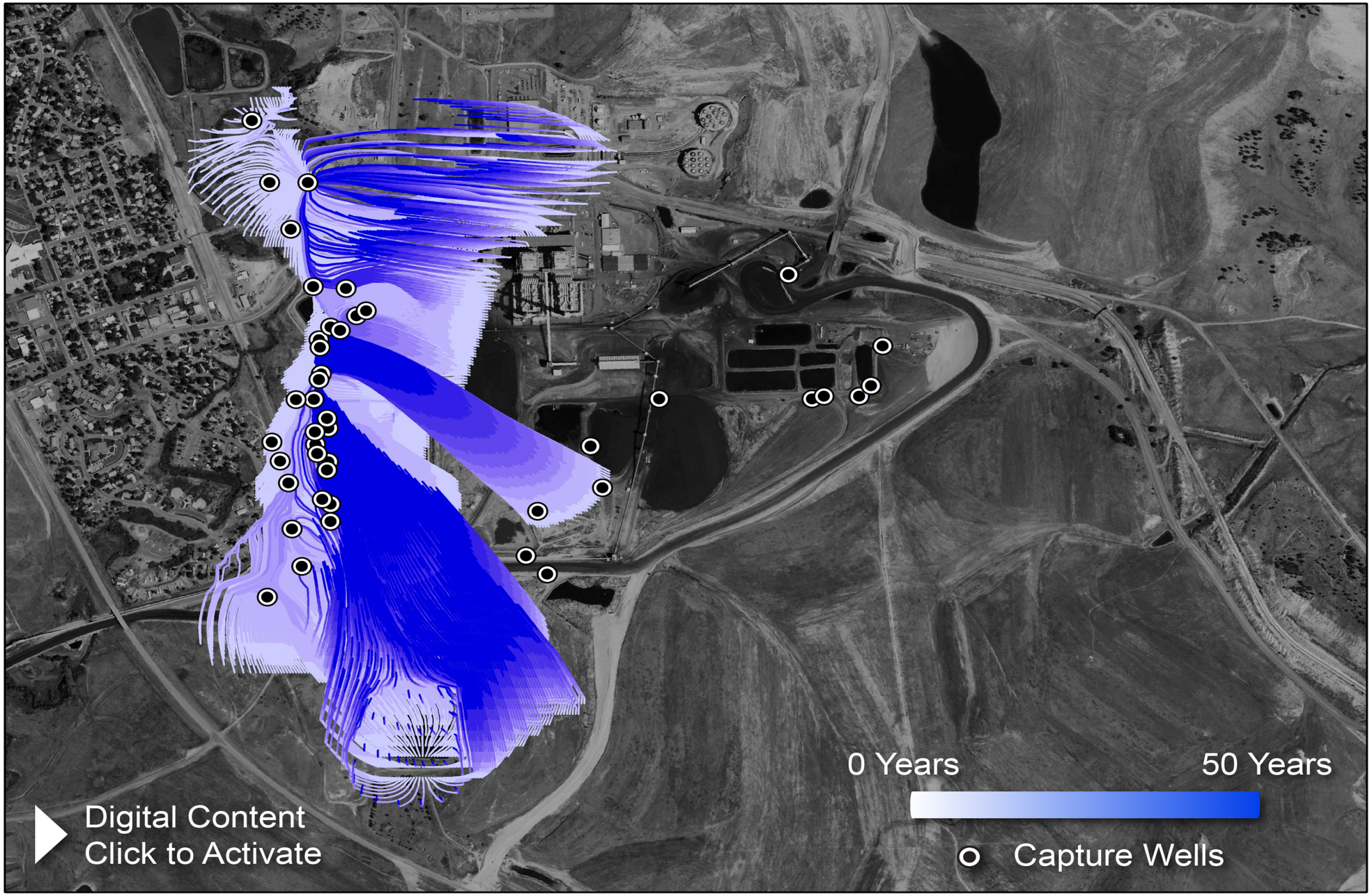
Particle Tracking from Areas Exceeding BSLs in Layer 2
Plant Site Area Groundwater Model
CSES-Colstrip, Montana
FIGURE 82



0 Feet 1,000

NewFields

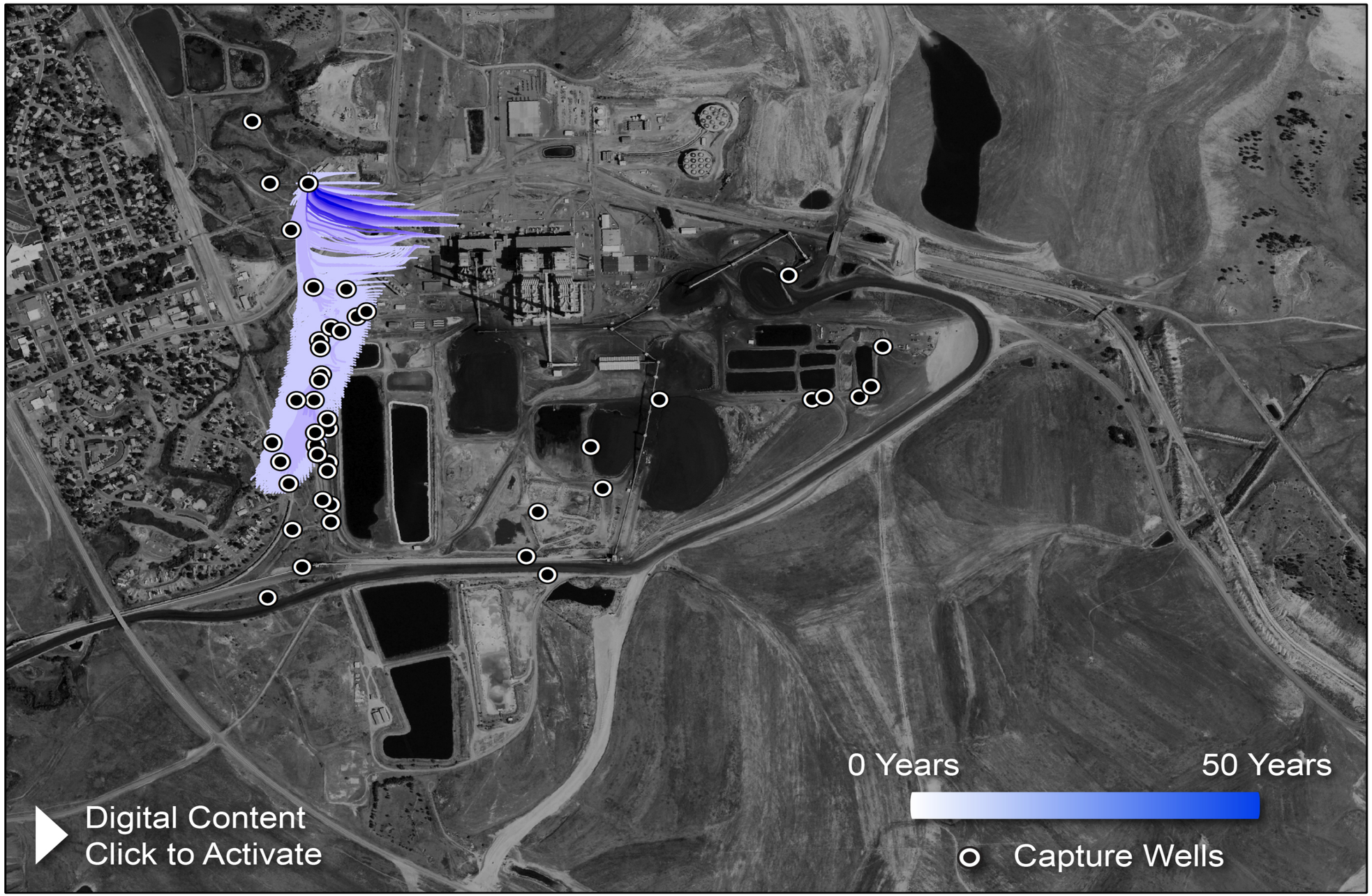
Particle Tracking from Areas Exceeding BSLs in Layer 3
Plant Site Area Groundwater Model
CSES-Colstrip, Montana
FIGURE 83



0 Feet 1,000

NewFields

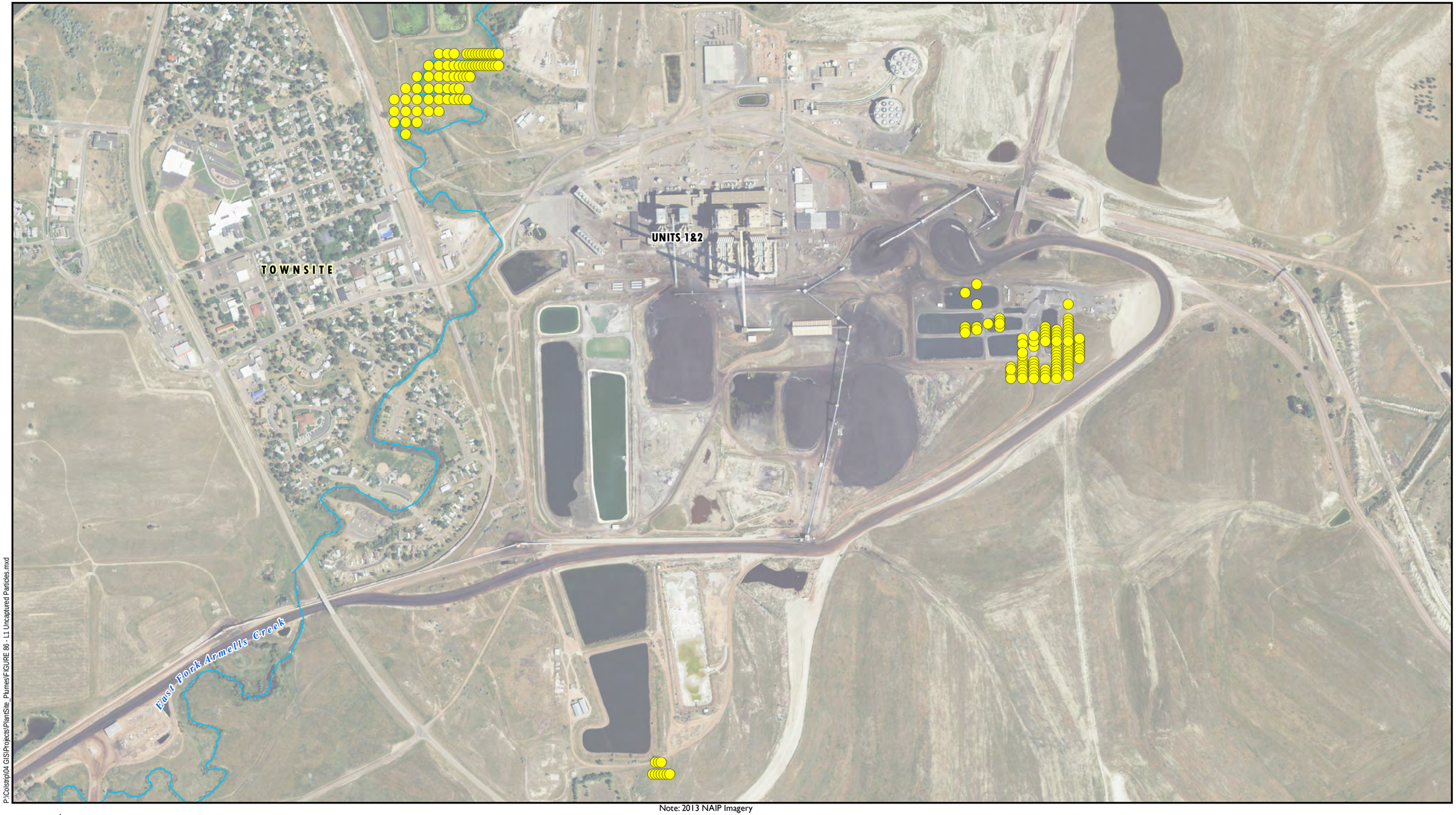
Particle Tracking from Areas Exceeding BSLs in Layer 4
Plant Site Area Groundwater Model
CSES-Colstrip, Montana
FIGURE 84



0 Feet 1,000

NewFields

Particle Tracking from Areas Exceeding BSLs in Layer 5
Plant Site Area Groundwater Model
CSES-Colstrip, Montana
FIGURE 85



P:\Colstrip\04 GIS\Projects\PlantSite_Plumes\FIGURE 86 - L1 Uncaptured Particles.mxd

Note: 2013 NAIP Imagery

N

0 Feet 800

NewFields

Layer 1 Uncaptured Particles

Layer 1 Starting Locations for Uncaptured Particles
Plant Site Area Groundwater Model
CSES-Colstrip, Montana
FIGURE 86

P:\Colstrip\04 GIS\Projects\PlantSite_Plumes\FIGURE 87 - L2 Uncaptured Particles.mxd

Note: 2013 NAIP Imagery

N

0 Feet 800

NewFields

Layer 2 Uncaptured Particles

Layer 2 Starting Locations for Uncaptured Particles
Plant Site Area Groundwater Model
CSES-Colstrip, Montana
FIGURE 87

P:\Colstrip\04 GIS\Projects\PlantSite_Plumes\FIGURE 88 - L3 Uncaptured Particles.mxd

Note: 2013 NAIP Imagery

N

0 Feet 800

NewFields

Layer 3 Uncaptured Particles

Layer 3 Starting Locations for Uncaptured Particles
Plant Site Area Groundwater Model
CSES-Colstrip, Montana
FIGURE 88

P:\Colstrip\04 GIS\Projects\PlantSite_Plumes\FIGURE 89 - L4 Uncaptured Particles.mxd

Note: 2013 NAIP Imagery

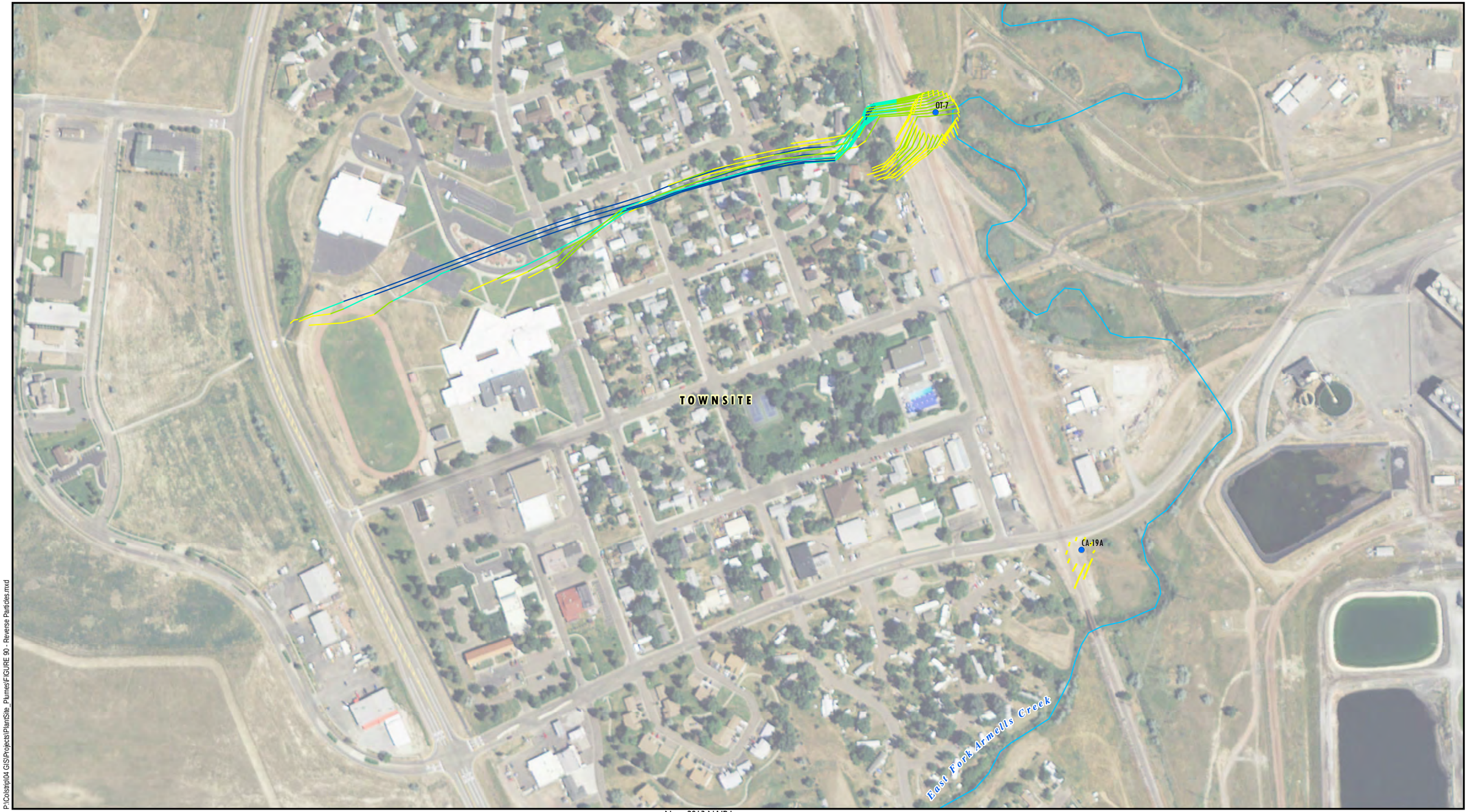
N

0 Feet 800

NewFields

Layer 4 Uncaptured Particles

Layer 4 Starting Locations for Uncaptured Particles
Plant Site Area Groundwater Model
CSES-Colstrip, Montana
FIGURE 89



P:\Colstrip\04 GIS\Projects\PlantSite_Plumes\FIGURE 90 - Reverse Particles.mxd

Note: 2013 NAIP Imagery

Monitoring Well

50 Year Particle Tracks

Layer 1

Layer 2

Layer 3

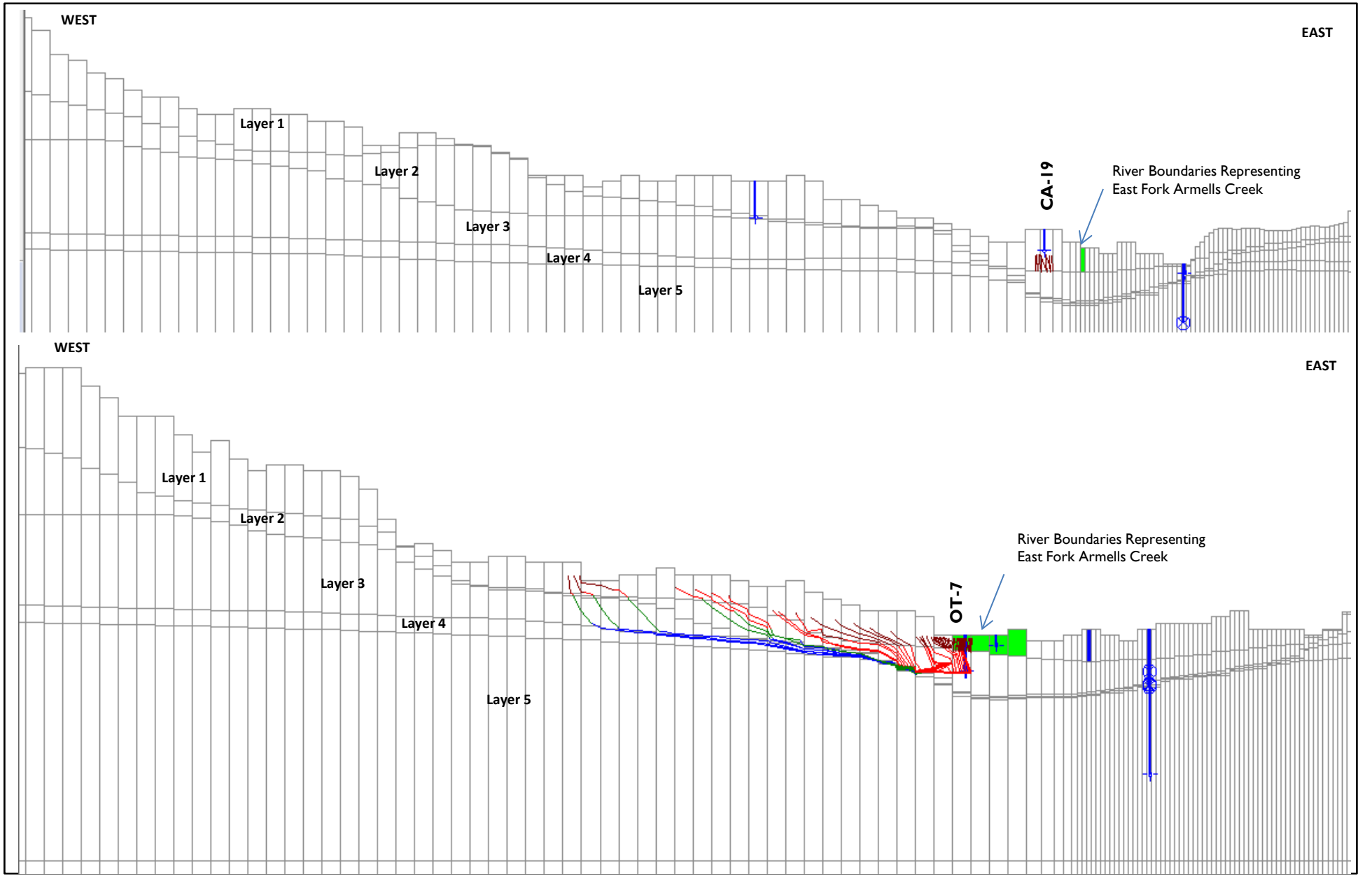
Layer 4

N

0 Feet 300

NewFields

Reverse Particle Tracking - CA-19 and OT-7
Plant Site Area Groundwater Model
CSES-Colstrip, Montana
FIGURE 90

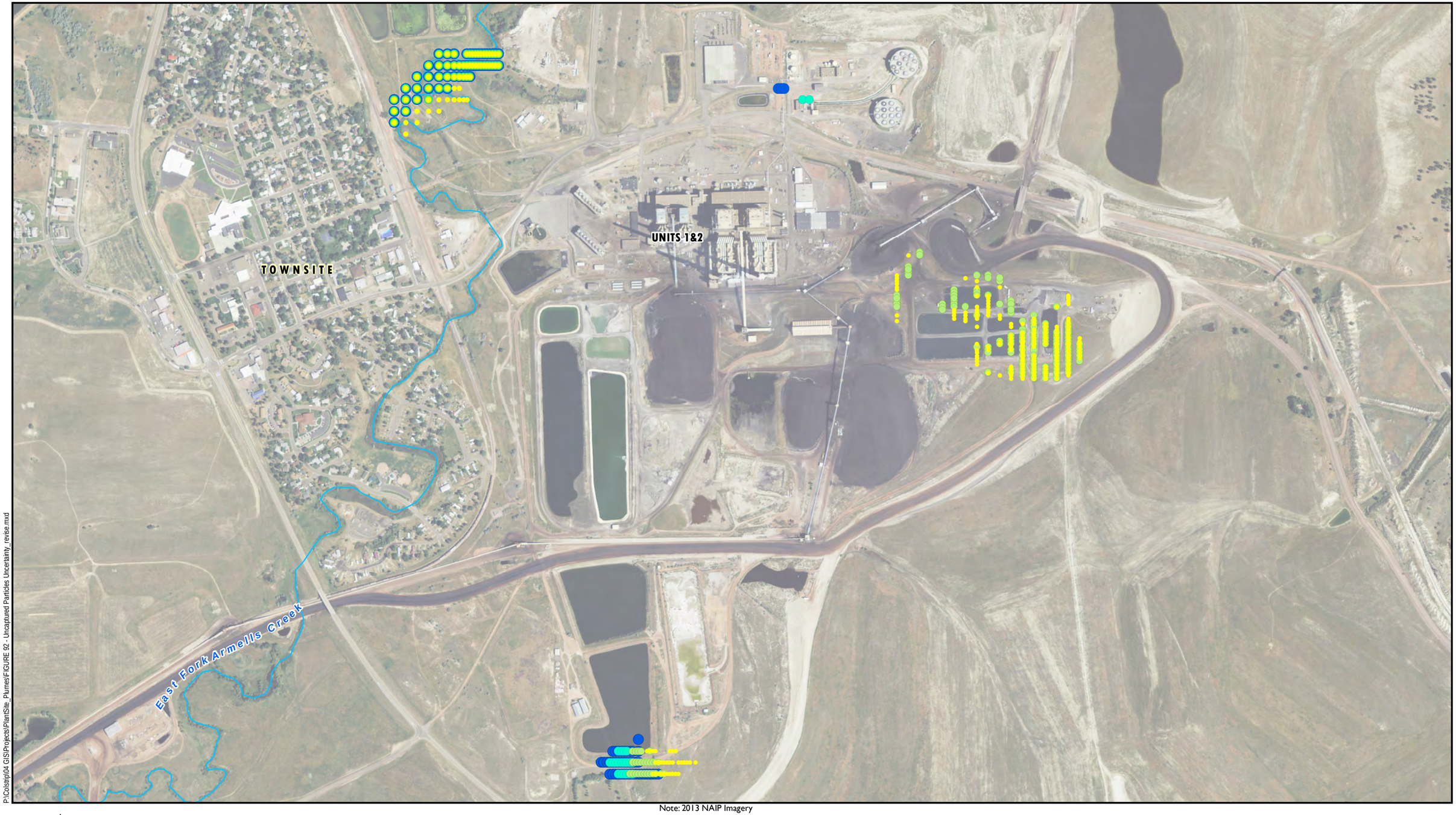


0 400 800 feet

Particle Trace – Layer 1
Particle Trace – Layer 2
Particle Trace – Layer 3
Particle Trace – Layer 4

NewFields

Reverse Particle Tracking
CA-19 and OT-7 Cross Section
Plant Site Area Groundwater Model
CSES Colstrip, Montana
FIGURE 91



P:\Colstrip\04 GIS\Projects\PlantSite_Plumes\FIGURE 92 - Uncaptured Particles Uncertainty_revise.mxd

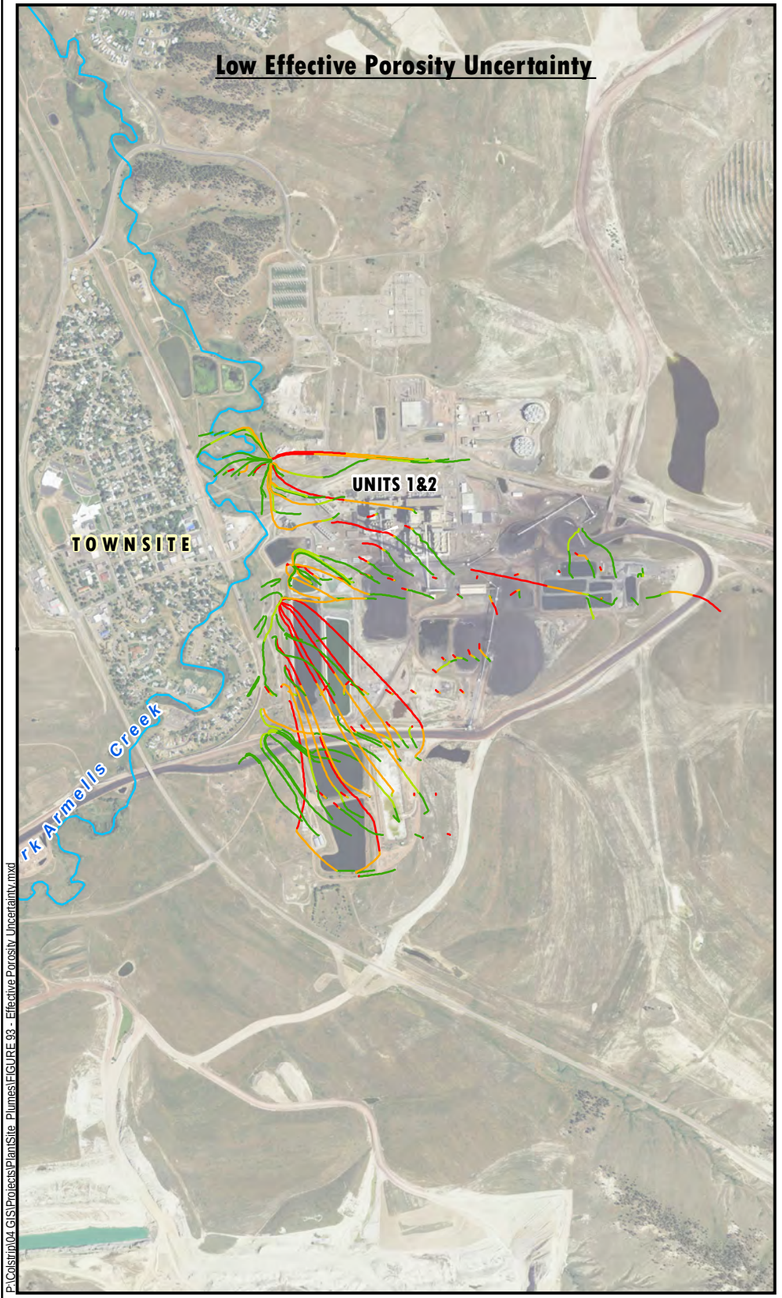
Note: 2013 NAIP Imagery

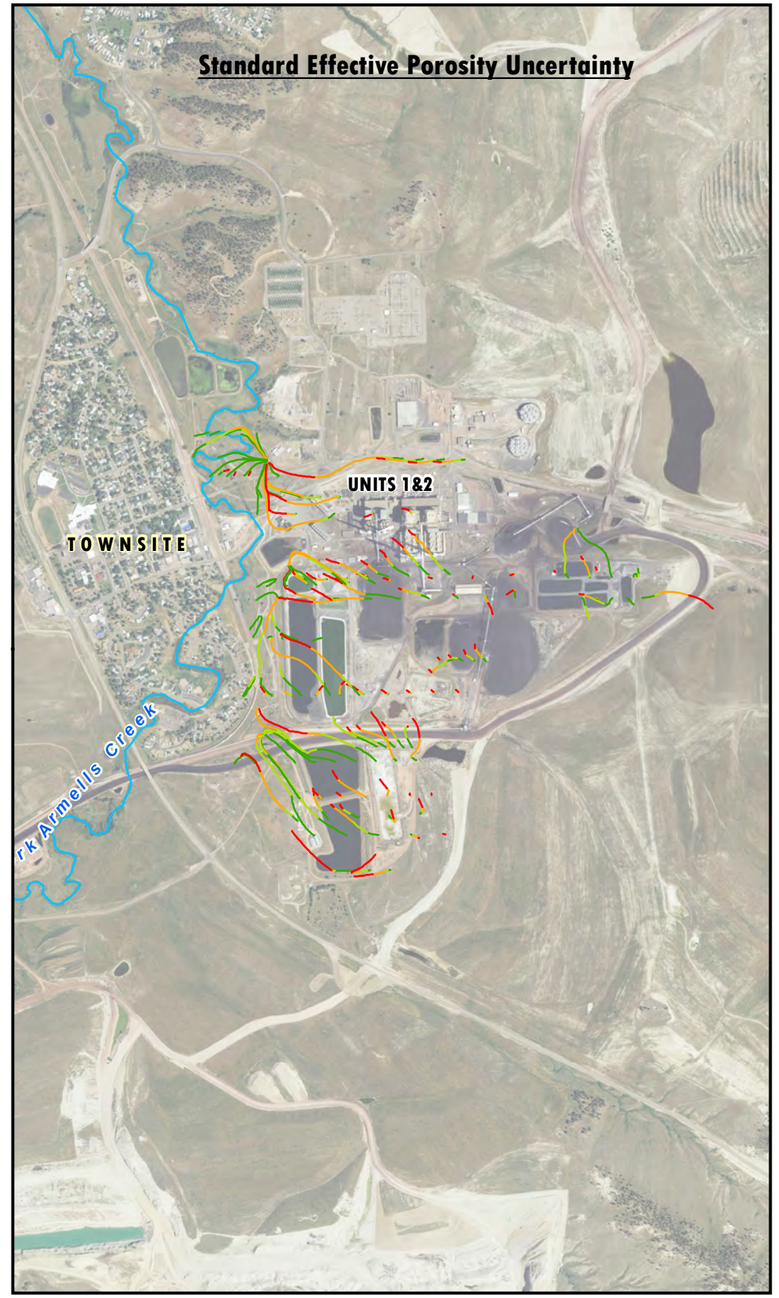
0 Feet 800

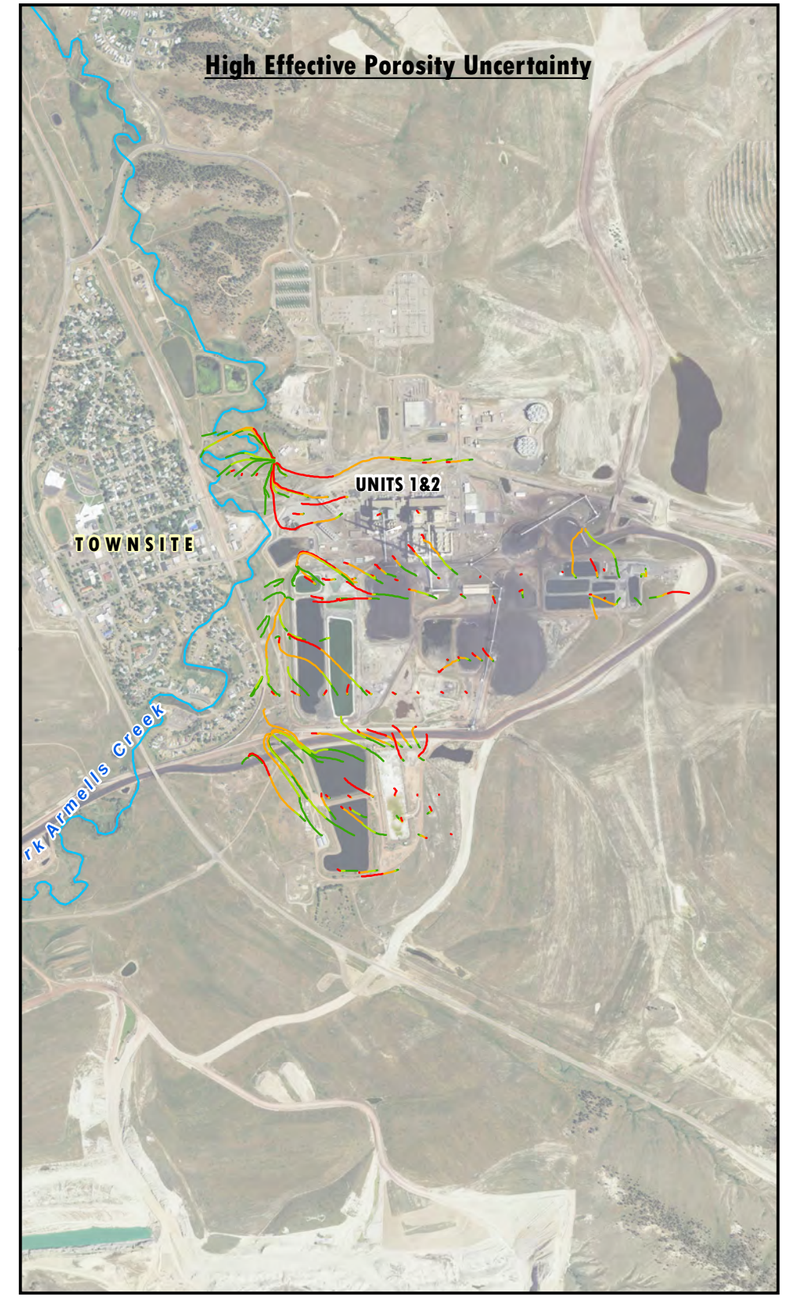
NewFields

- Layer 1 Uncaptured Particles
- Layer 2 Uncaptured Particles
- Layer 3 Uncaptured Particles
- Layer 4 Uncaptured Particles

Starting Locations for Uncaptured Particles-
Uncertainty 75% of Pumping Rates
Plant Site Area Groundwater Model
CSES-Colstrip, Montana
FIGURE 92







P:\Colstrip\04 GIS\Projects\PlantSite_Plumes\FIGURE 93 - Effective Porosity Uncertainty.mxd

Note: 2013 NAIP Imagery

TRAVEL TIME

- 0-1 Years
- 1-2 Years
- 2-5 Years
- 5-10 Years

N

0 Feet 2,000

NewFields

Uncertainty of Capture due to Effective Porosity Uncertainty
Plant Site Area Groundwater Model
CSES-Colstrip, Montana
FIGURE 93