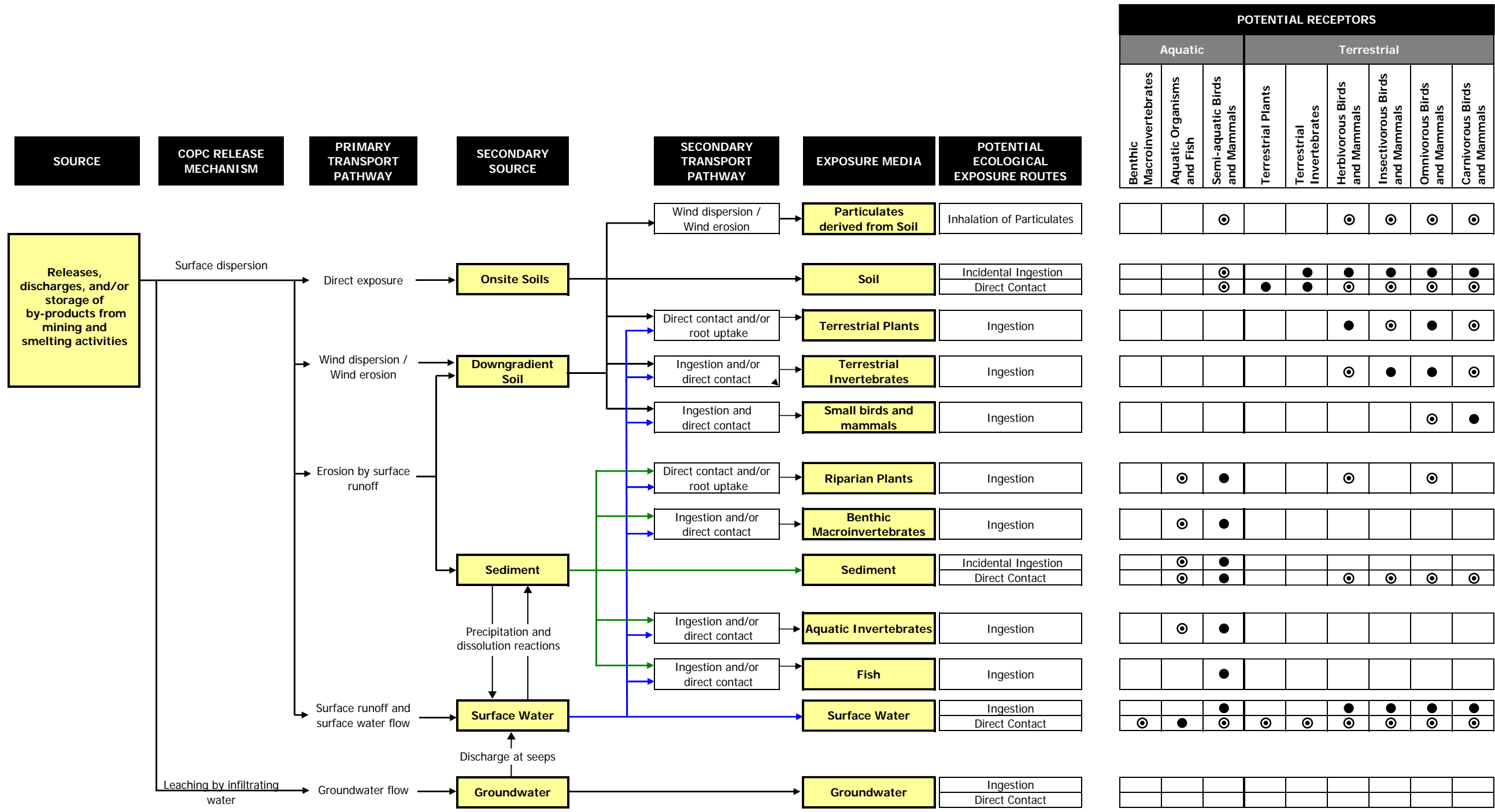


SMDP = Scientific Management Decision Point
DQO = Data Quality Objective

Adapted from Ecological Risk Assessment
Process for Superfund (EPA, 1997a)

Figure 10-1
EPA's Eight-step Ecological Risk Assessment Process for Superfund
Iron King Mine – Humboldt Smelter Superfund Site
Dewey-Humboldt, Yavapai County, Arizona

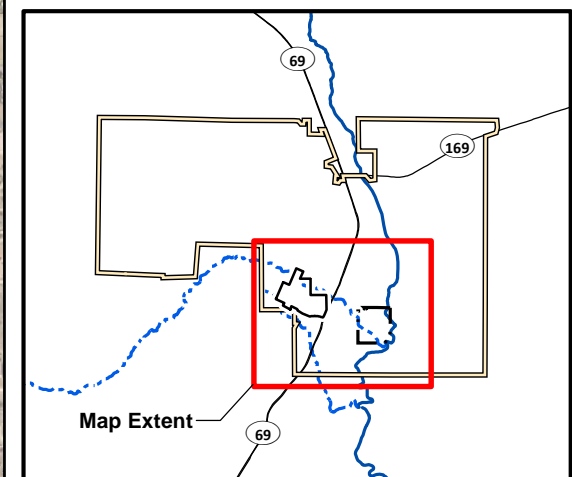
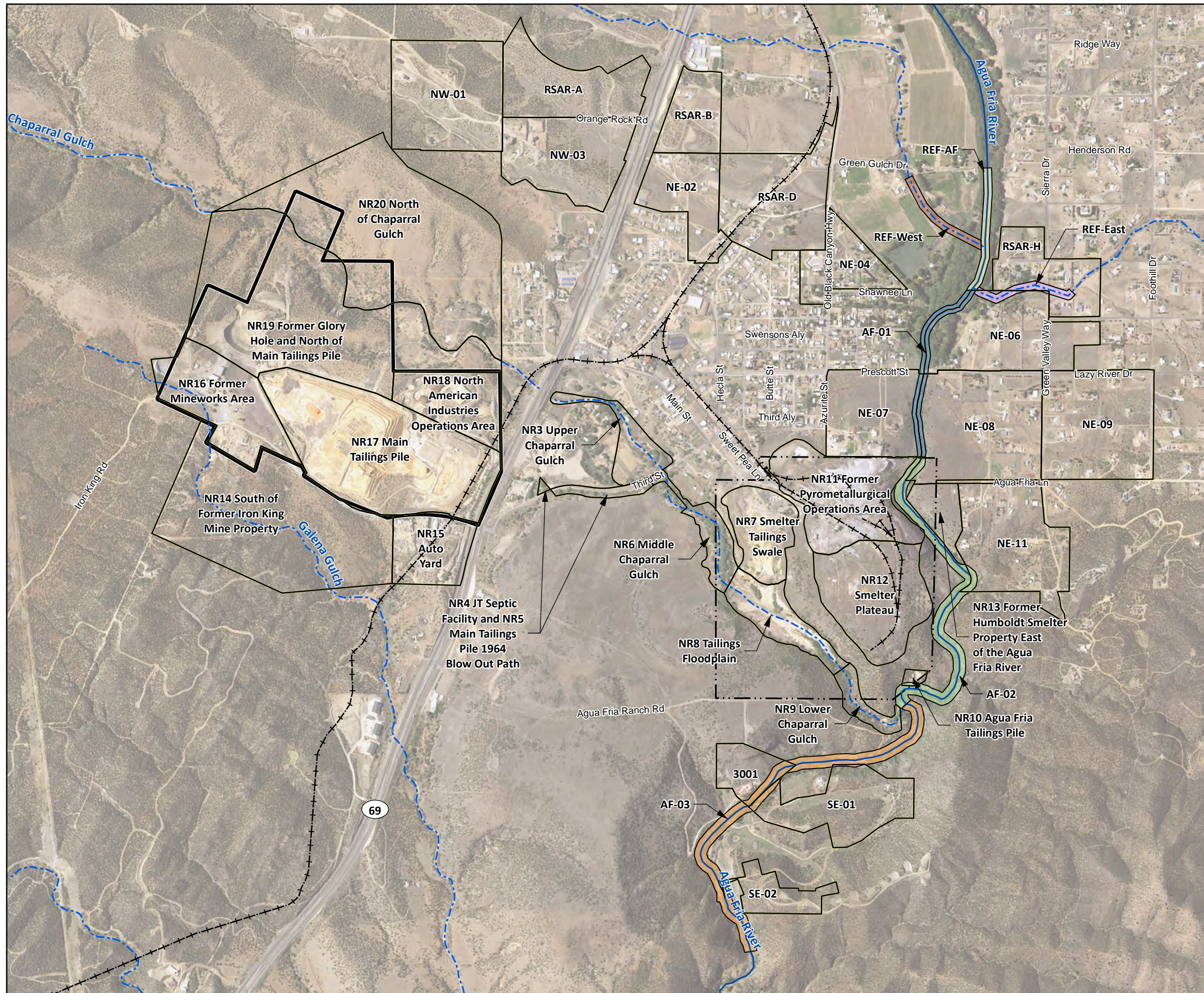


Notes:
Different line colors are only used to allow ease of reading

- Upland Receptors:**
- Primary producer: Terrestrial plants
 - Primary consumer: Soil invertebrates
 - Herbivore: Gambel's quail
 - Insectivore: Western kingbird
 - Omnivore: Song sparrow
 - Carnivore: Red-tailed hawk
 - Herbivore: Pocket gopher
 - Insectivore: Desert shrew
 - Omnivore: Raccoon
 - Carnivore: Coyote
- Aquatic/Semi-aquatic Receptors:**
- Primary producer: Aquatic plants
 - Primary consumer: Aquatic organisms (invertebrates and fish)
 - Primary consumer: Benthic macroinvertebrates
 - Omnivore: Mallard
 - Piscivore: Great blue heron
 - Omnivore: Raccoon
 - Piscivore: River otter

● Potentially complete pathway (quantitatively evaluated in this risk assessment)
 ⊙ Potentially complete minor pathway (not quantitatively evaluated in this risk assessment)
 □ Incomplete pathway

Figure 10-2
Ecological Conceptual Site Model
Iron King Mine – Humboldt Smelter Superfund Site
Dewey-Humboldt, Yavapai County, Arizona



LEGEND

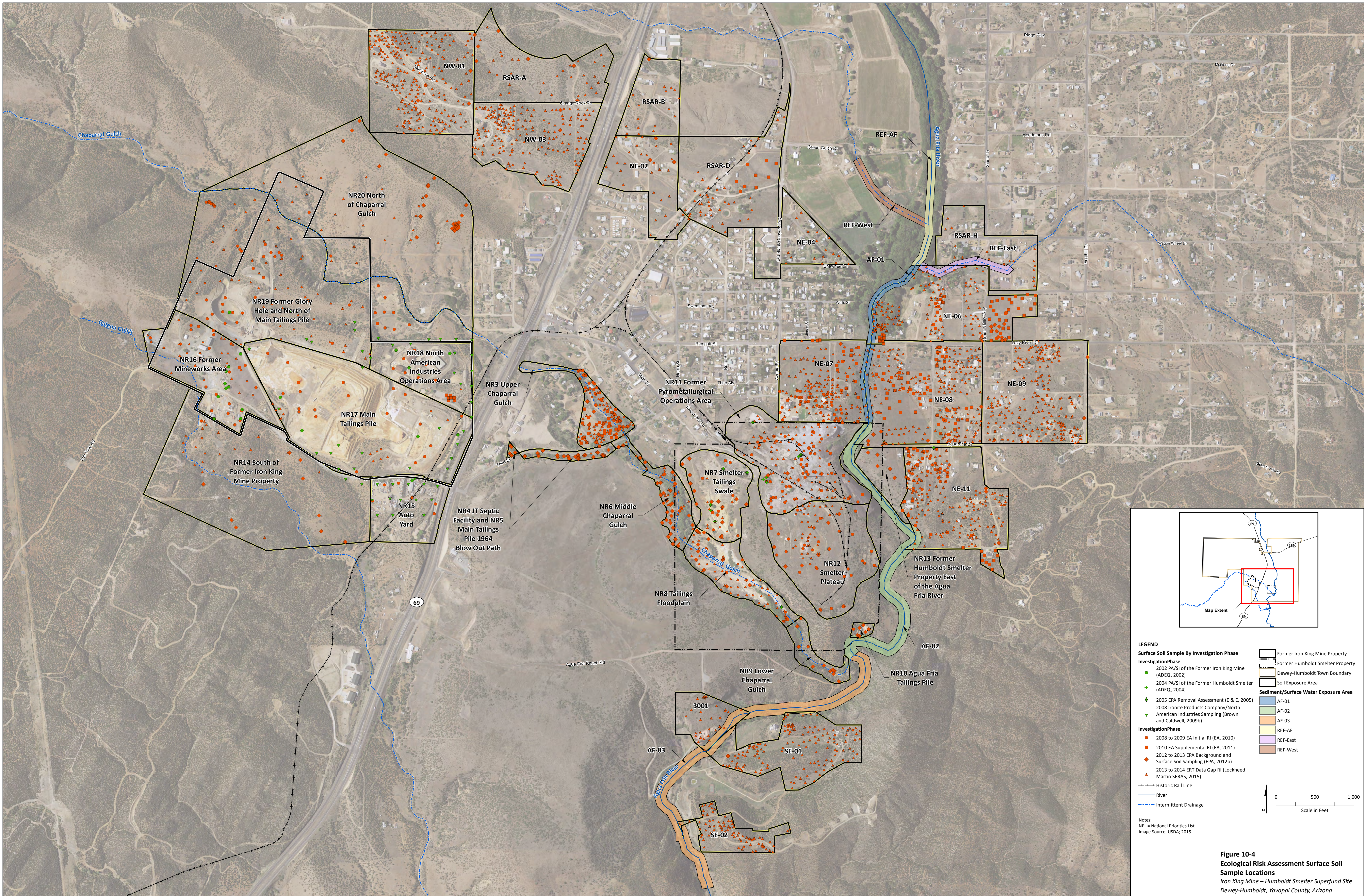
- Historic Rail Line
- River
- - - Intermittent Drainage
- ▭ Former Iron King Mine Property
- ▭ Former Humboldt Smelter Property
- ▭ Dewey-Humboldt Town Boundary
- ▭ Soil Exposure Area

Sediment/Surface Water Exposure Area

- AF-01
- AF-02
- AF-03
- REF-AF
- REF-East
- REF-West

0 1,200 2,400
Scale in Feet

Figure 10-3
Ecological Risk Assessment Exposure Areas
 Iron King Mine – Humboldt Smelter Superfund Site
 Dewey-Humboldt, Yavapai County, Arizona



LEGEND

Surface Soil Sample By Investigation Phase

InvestigationPhase

- 2002 PA/SI of the Former Iron King Mine (ADEC, 2002)
- 2004 PA/SI of the Former Humboldt Smelter (ADEC, 2004)
- ◆ 2005 EPA Removal Assessment (E & E, 2005)
- ▼ American Industries Sampling (Brown and Caldwell, 2009b)
- 2008 to 2009 EA Initial RI (EA, 2010)
- 2010 EA Supplemental RI (EA, 2011)
- ◆ 2012 to 2013 EPA Background and Surface Soil Sampling (EPA, 2012b)
- ▲ 2013 to 2014 ERT Data Gap RI (Lockheed Martin SERAS, 2015)

Sediment/Surface Water Exposure Area

- AF-01
- AF-02
- AF-03
- REF-AF
- REF-East
- REF-West

InvestigationPhase

- Historic Rail Line
- River
- Intermittent Drainage

Notes:
 NPL = National Priorities List
 Image Source: USDA, 2015.

0 500 1,000
 Scale in Feet

Figure 10-4
Ecological Risk Assessment Surface Soil Sample Locations
 Iron King Mine – Humboldt Smelter Superfund Site
 Dewey-Humboldt, Yavapai County, Arizona



LEGEND

Sediment Sample by Investigation Phase

Pre-NPL Investigation

- 2002 PA/SI of the Former Iron King Mine (ADEQ, 2002)

EPA Remedial Investigation

- 2008 to 2009 EA Initial RI (EA, 2010)
- ▲ 2014 ERT Data Gap RI (Lockheed Martin SERAS, 2015)

--- Historic Rail Line

— River

- - - Intermittent Drainage

- ▭ Former Iron King Mine Property
 - ▭ Former Humboldt Smelter Property
 - ▭ Dewey-Humboldt Town Boundary
- Sediment/Surface Water Exposure Area**
- AF-01
 - AF-02
 - AF-03
 - REF-AF
 - REF-East
 - REF-West

Notes:
NPL = National Priorities List
Image Source: USDA, 2015.

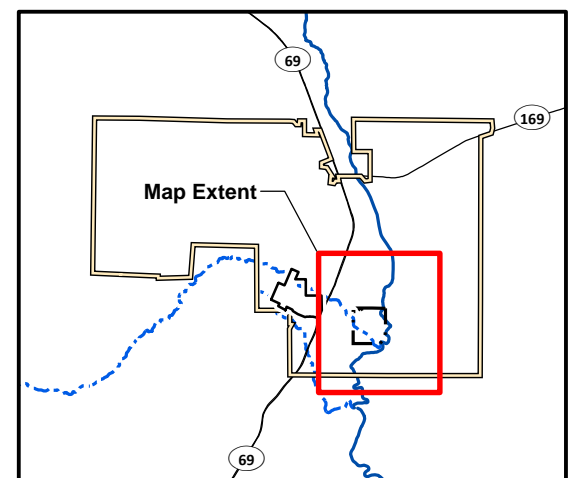
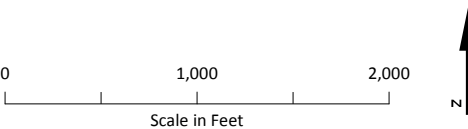
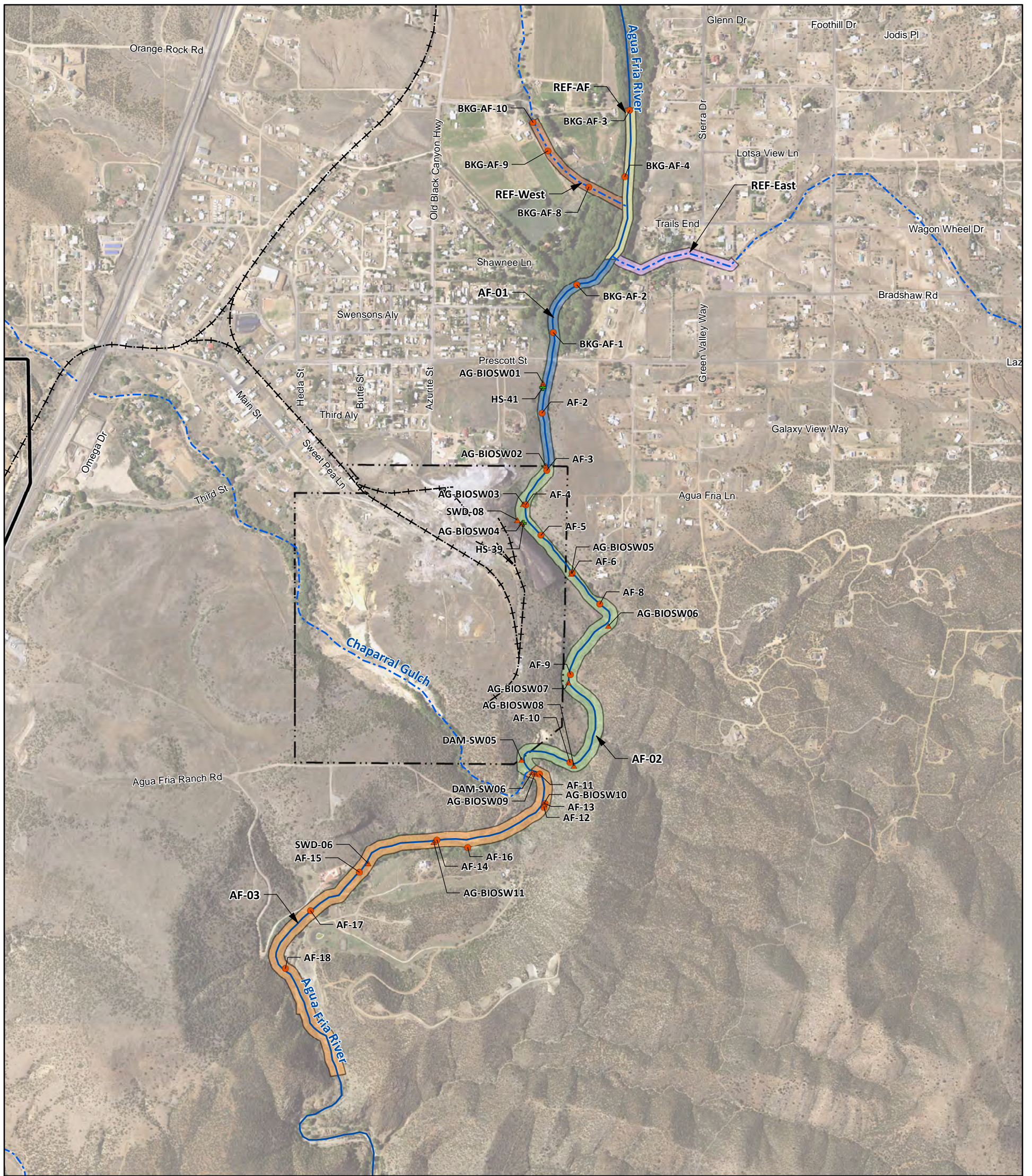


Figure 10-5
Ecological Risk Assessment Sediment
Sample Locations
Iron King Mine – Humboldt Smelter Superfund Site
Dewey-Humboldt, Yavapai County, Arizona



LEGEND

Surface Water Sample by Investigation Phase

Pre-NPL Investigation

2004 PA/SI of the Former Humboldt Smelter (ADEQ, 2004)

EPA Remedial Investigation

2008 to 2009 EA Initial RI (EA, 2010)

2014 ERT Data Gap RI (Lockheed Martin SERAS, 2015)

Historic Rail Line

River

Intermittent Drainage

Former Iron King Mine Property

Former Humboldt Smelter Property

Dewey-Humboldt Town Boundary

Sediment/Surface Water Exposure Area

AF-01

AF-02

AF-03

REF-AF

REF-East

REF-West

Notes:
NPL = National Priorities List
Image Source: USDA; 2015.

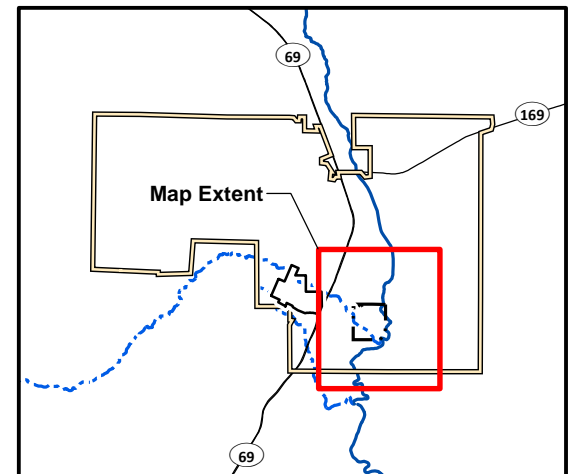
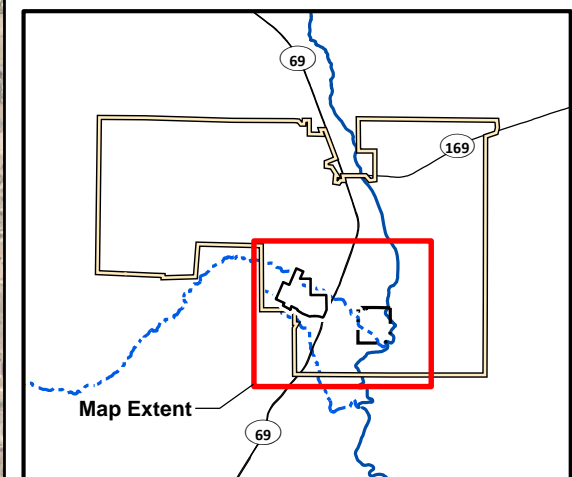
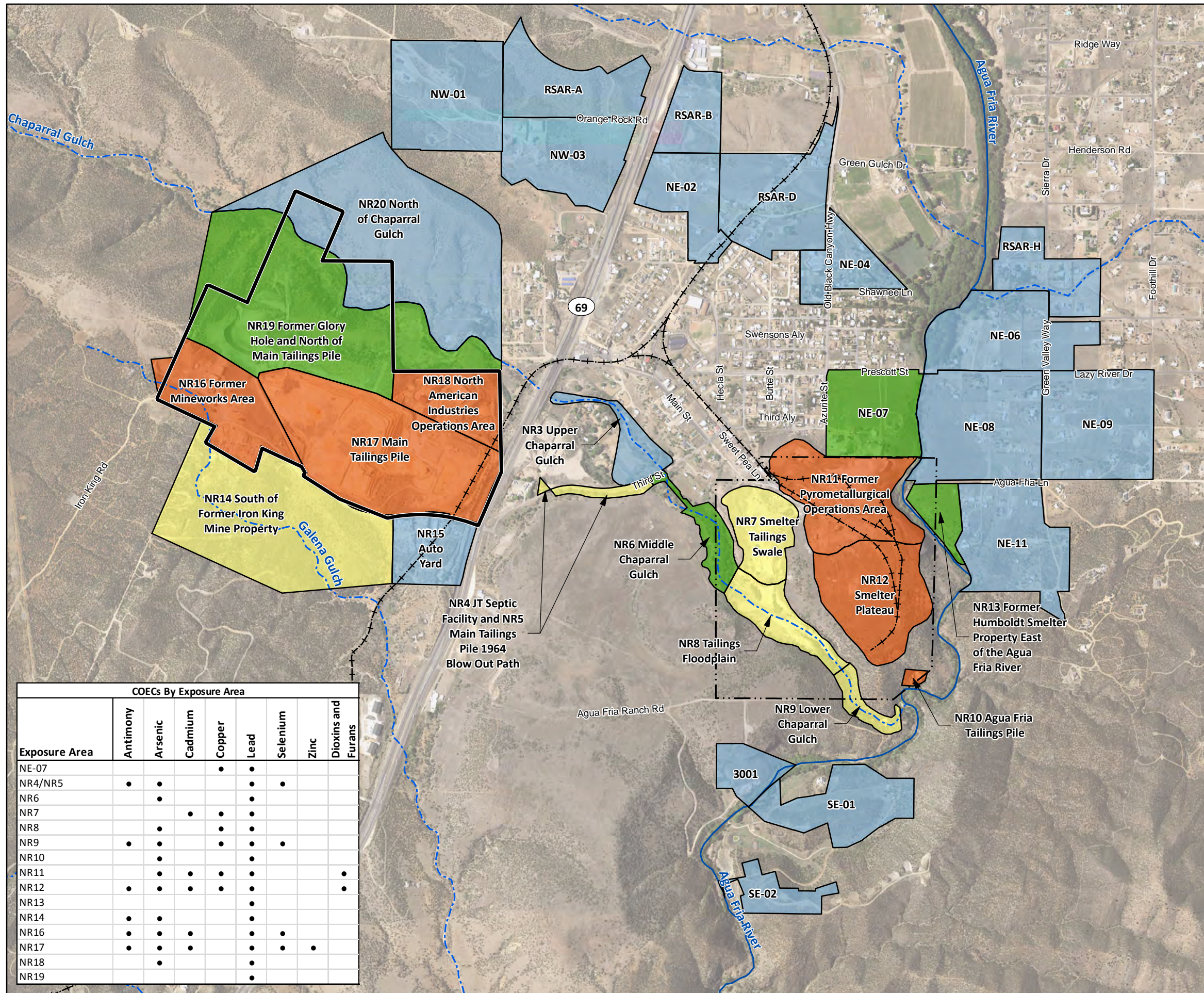


Figure 10-6
Ecological Risk Assessment Surface Water
Sample Locations
Iron King Mine – Humboldt Smelter Superfund Site
Dewey-Humboldt, Yavapai County, Arizona



LEGEND

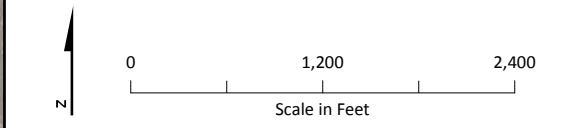
Ecological Weight of Evidence

- All LOAEL-based HQs <1
- Limited Potential for Adverse Effects^a
- Moderate Potential for Adverse Effects^b
- Higher Potential for Adverse Effects^c
- River
- Intermittent Drainage
- Former Iron King Mine Property
- Former Humboldt Smelter Property
- Dewey-Humboldt Town Boundary

^aTwo or fewer COECs or receptors with LOAEL-based HQs>1. LOAEL-based HQs 1 to 10.
^bThree or more COECs or receptors with LOAEL-based HQs>1. LOAEL-based HQs 1 to 50.
^cMultiple COECs and receptors with LOAEL-based HQs>1. LOAEL-based HQs 1 to 100+.

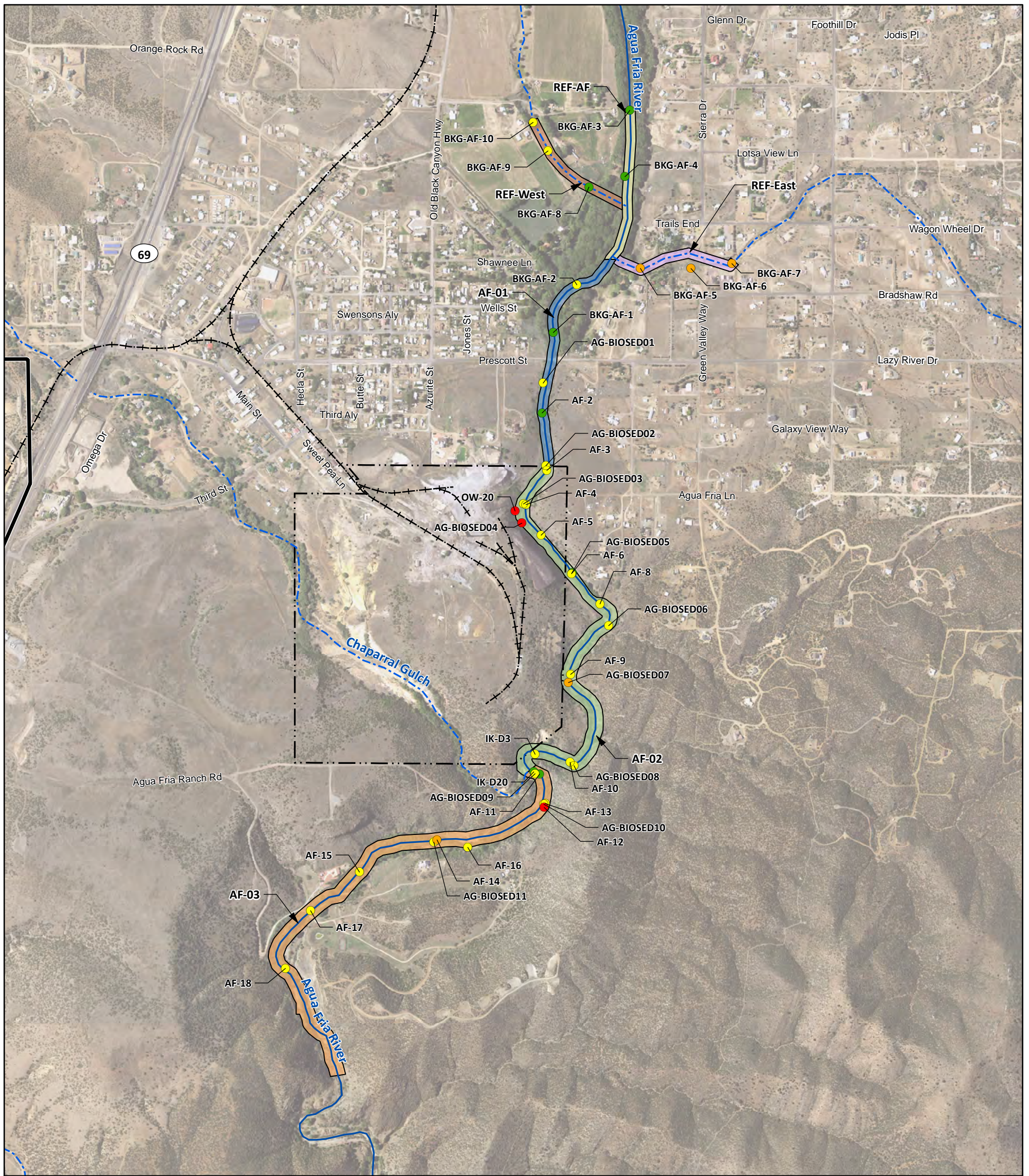
Notes:
 COEC = Chemicals of Ecological Concern
 HQ = Hazard Quotient
 LOAEL = Lowest Observed Adverse Effect Level

Exposure areas are color coded by weight of evidence for potential risks to ecological receptors in each trophic level/feeding guild. Incremental risk is used as basis for coding where background data were available, otherwise site risks are used. Estimated risks to plants or soil invertebrates were not used as the sole determinant of overall potential for unacceptable risks and are not included in color coding.
 Image Source: USDA, 2015.



Exposure Area	COECs By Exposure Area							
	Antimony	Arsenic	Cadmium	Copper	Lead	Selenium	Zinc	Dioxins and Furans
NE-07				•	•			
NR4/NR5	•	•			•	•		
NR6		•			•	•		
NR7			•	•	•			
NR8		•		•	•			
NR9	•	•		•	•	•		
NR10		•			•			
NR11		•	•	•	•			•
NR12	•	•	•	•	•			•
NR13					•			
NR14	•	•			•			
NR16	•	•	•		•	•		
NR17	•	•	•		•	•	•	
NR18		•			•			
NR19					•			

Figure 10-7
Estimated Risks for Terrestrial Receptors –
Food-chain Uptake from Soil
 Iron King Mine – Humboldt Smelter Superfund Site
 Dewey-Humboldt, Yavapai County, Arizona



LEGEND

Arsenic Concentration in Sediment (mg/kg)

- 4.2 to <9.79 (TEC)
- 9.79 to 33 (PEC)
- >33 to 66 (2x PEC)
- >66 to 206 (Highest Detection)

- River
- - - Intermittent Drainage
- ▭ Former Iron King Mine Property
- ▭ Former Humboldt Smelter Property
- ▭ Dewey-Humboldt Town Boundary

Sediment/Surface Water Exposure Area

- AF-01
- AF-02
- AF-03
- REF-AF
- REF-East
- REF-West

Notes:
 NPL = National Priorities List
 PEC = Probable Effect Concentration
 TEC = Threshold Effect Concentration
 Image Source: USDA, 2015.

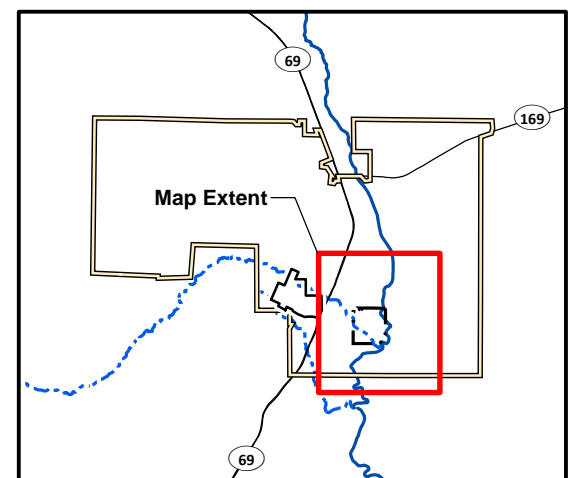
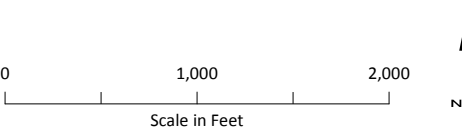
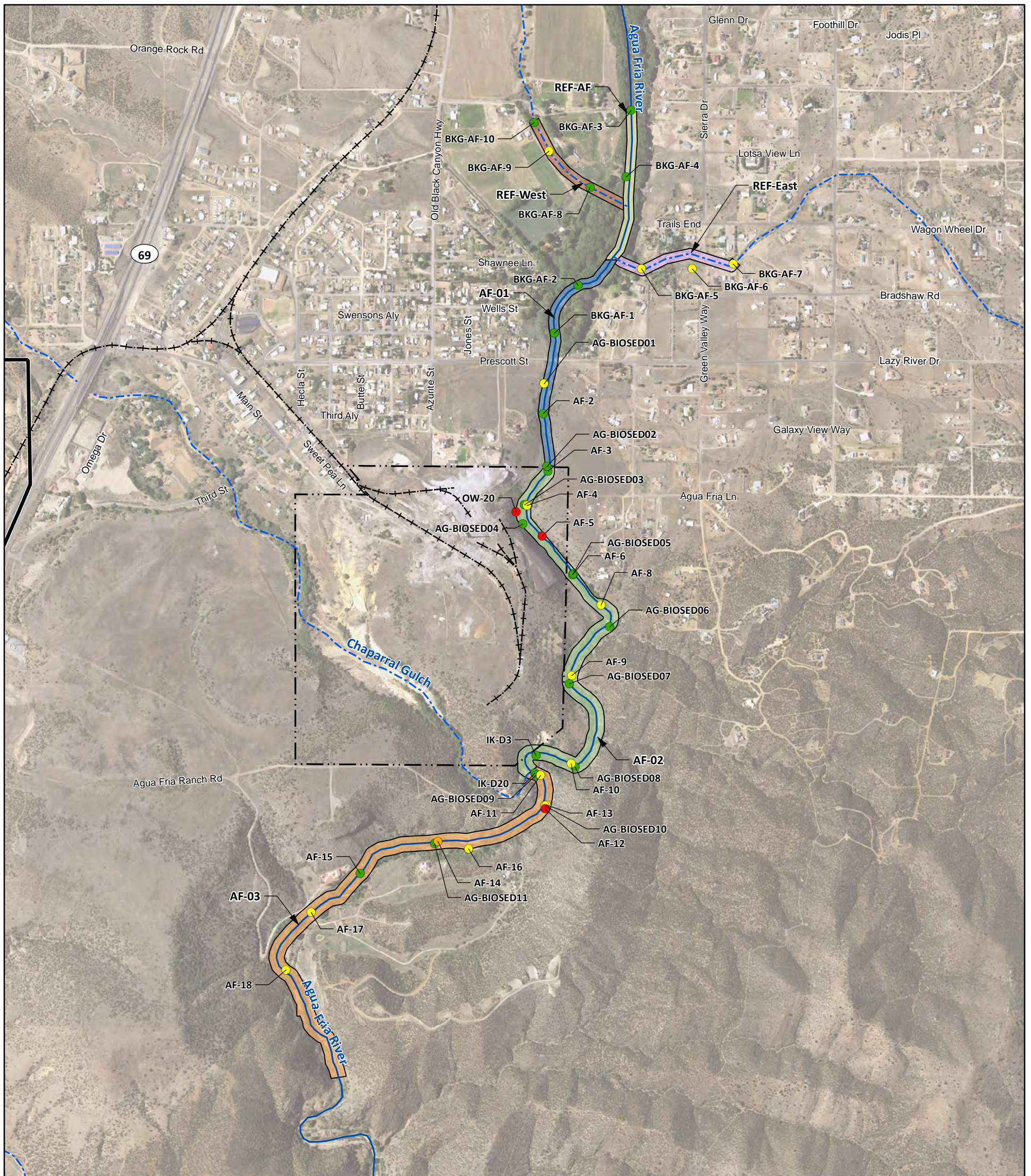


Figure 10-8
Estimated Ecological Risks from Arsenic in Sediment
 Iron King Mine – Humboldt Smelter Superfund Site
 Dewey-Humboldt, Yavapai County, Arizona



LEGEND

Copper Concentration in Sediment (mg/kg)

- 12.4 to <31.6 (TEC)
- 31.6 to 149 (PEC)
- >149 to 289 (2x PEC)
- >289 to 8,030 (Highest Detection)

- River
- - - Intermittent Drainage
- ▭ Former Iron King Mine Property
- ▭ Former Humboldt Smelter Property
- ▭ Dewey-Humboldt Town Boundary

Sediment/Surface Water Exposure Area

- AF-01
- AF-02
- AF-03
- REF-AF
- REF-East
- REF-West

Notes:
 NPL = National Priorities List
 PEC = Probable Effect Concentration
 TEC = Threshold Effect Concentration
 Image Source: USDA, 2015.

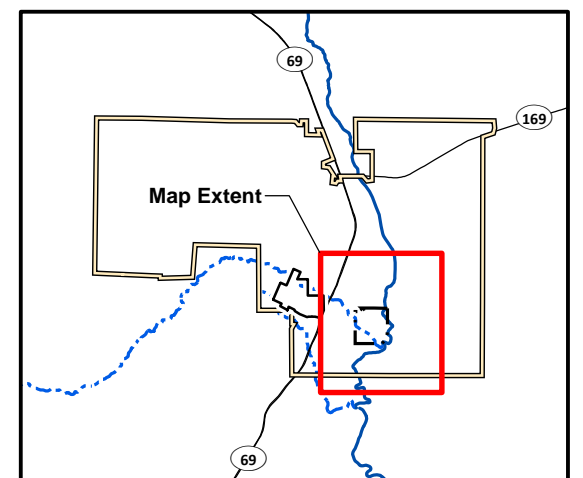
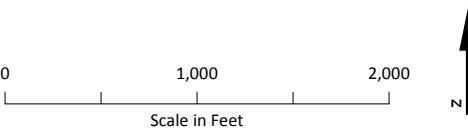
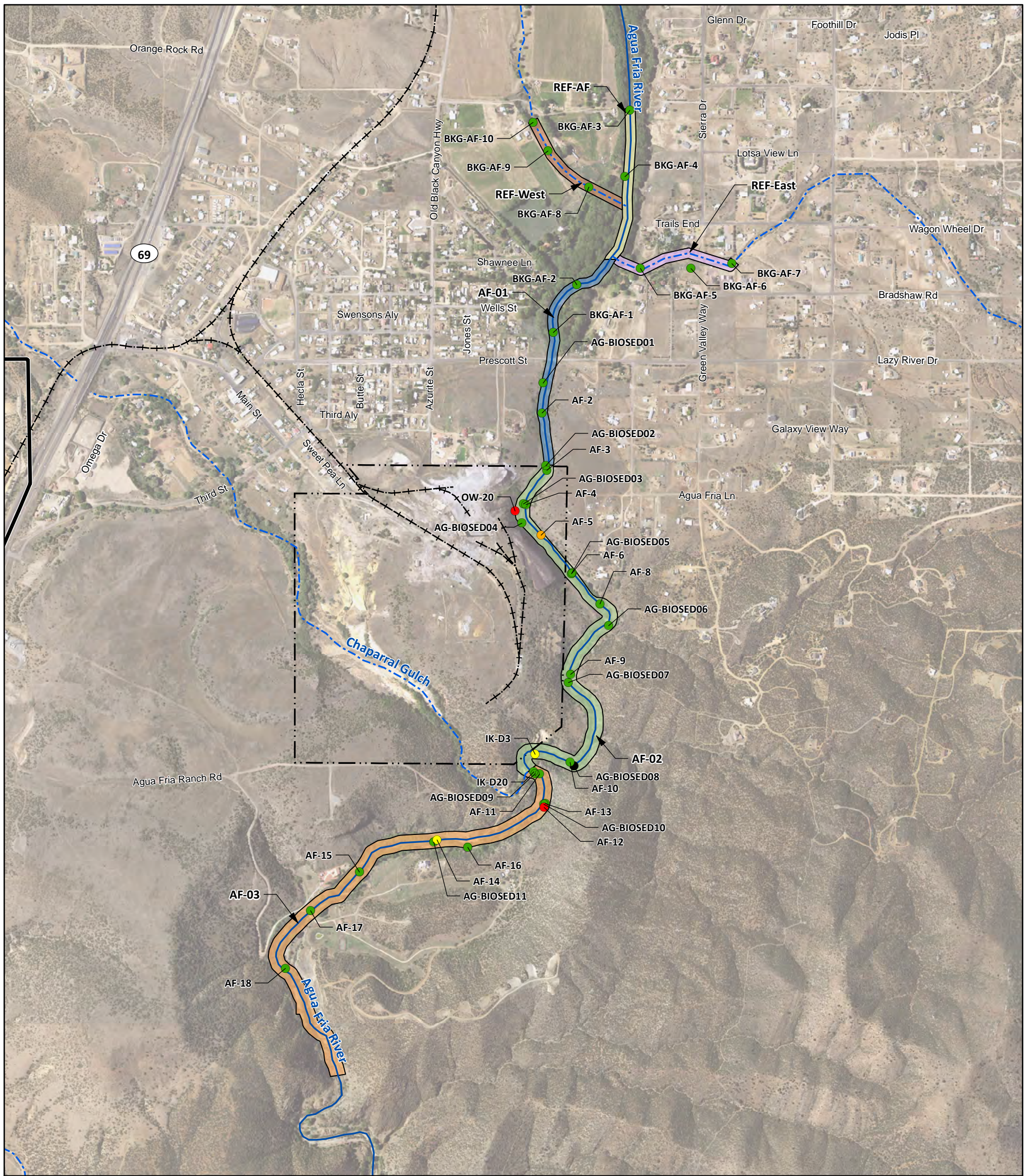


Figure 10-9
Estimated Ecological Risks from Copper in Sediment
 Iron King Mine – Humboldt Smelter Superfund Site
 Dewey-Humboldt, Yavapai County, Arizona



LEGEND

Lead Concentration in Sediment (mg/kg)

- Not Detected
- 3.1 to <35.8 (TEC)
- 35.8 to 128 (PEC)
- >128 to 256 (2x PEC)
- >256 to 709 (Highest Detection)

- River
- - - Intermittent Drainage
- ▭ Former Iron King Mine Property
- ▭ Former Humboldt Smelter Property
- ▭ Dewey-Humboldt Town Boundary

Sediment/Surface Water Exposure Area

- AF-01
- AF-02
- AF-03
- REF-AF
- REF-East
- REF-West

Notes:
 NPL = National Priorities List
 PEC = Probable Effect Concentration
 TEC = Threshold Effect Concentration
 Image Source: USDA, 2015.

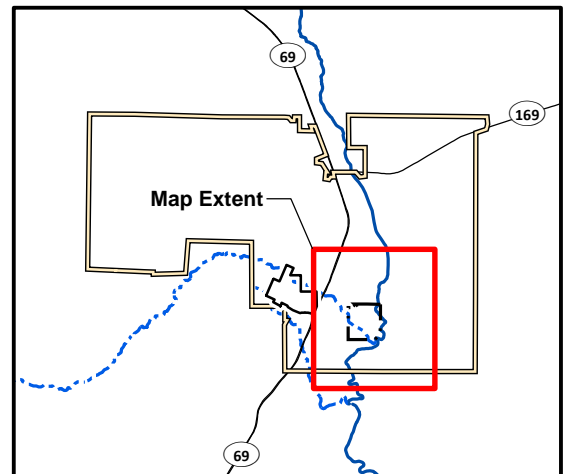
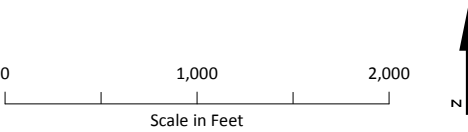


Figure 10-10
Estimated Ecological Risks from Lead in Sediment
 Iron King Mine – Humboldt Smelter Superfund Site
 Dewey-Humboldt, Yavapai County, Arizona