Section 6

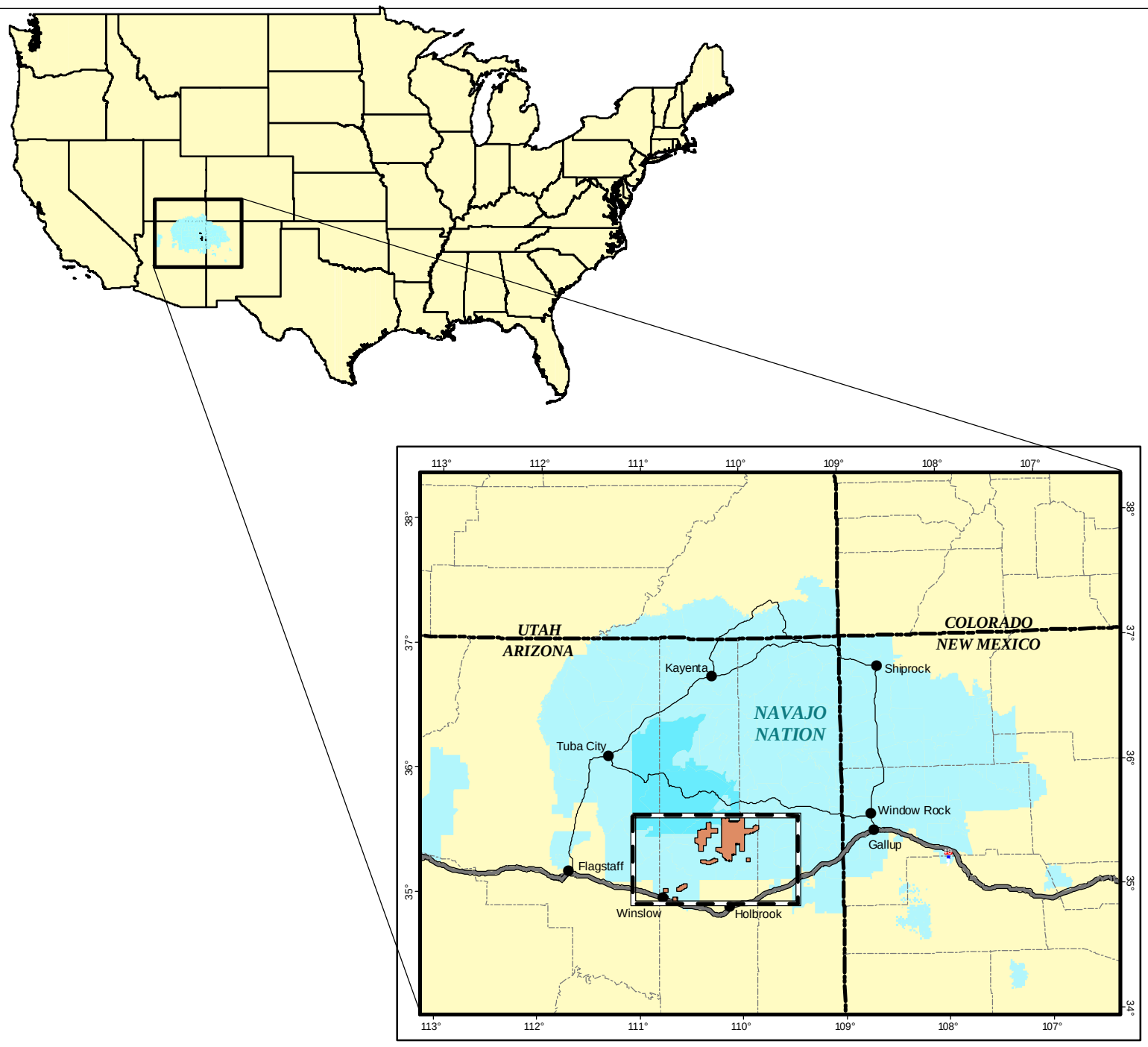
BIDAHOCHI AREA

United States Environmental Protection Agency

ABANDONED URANIUM MINES PROJECT

Bidahochi Area

OVERVIEW MAP



Coyote Spring

Tank 17M-187

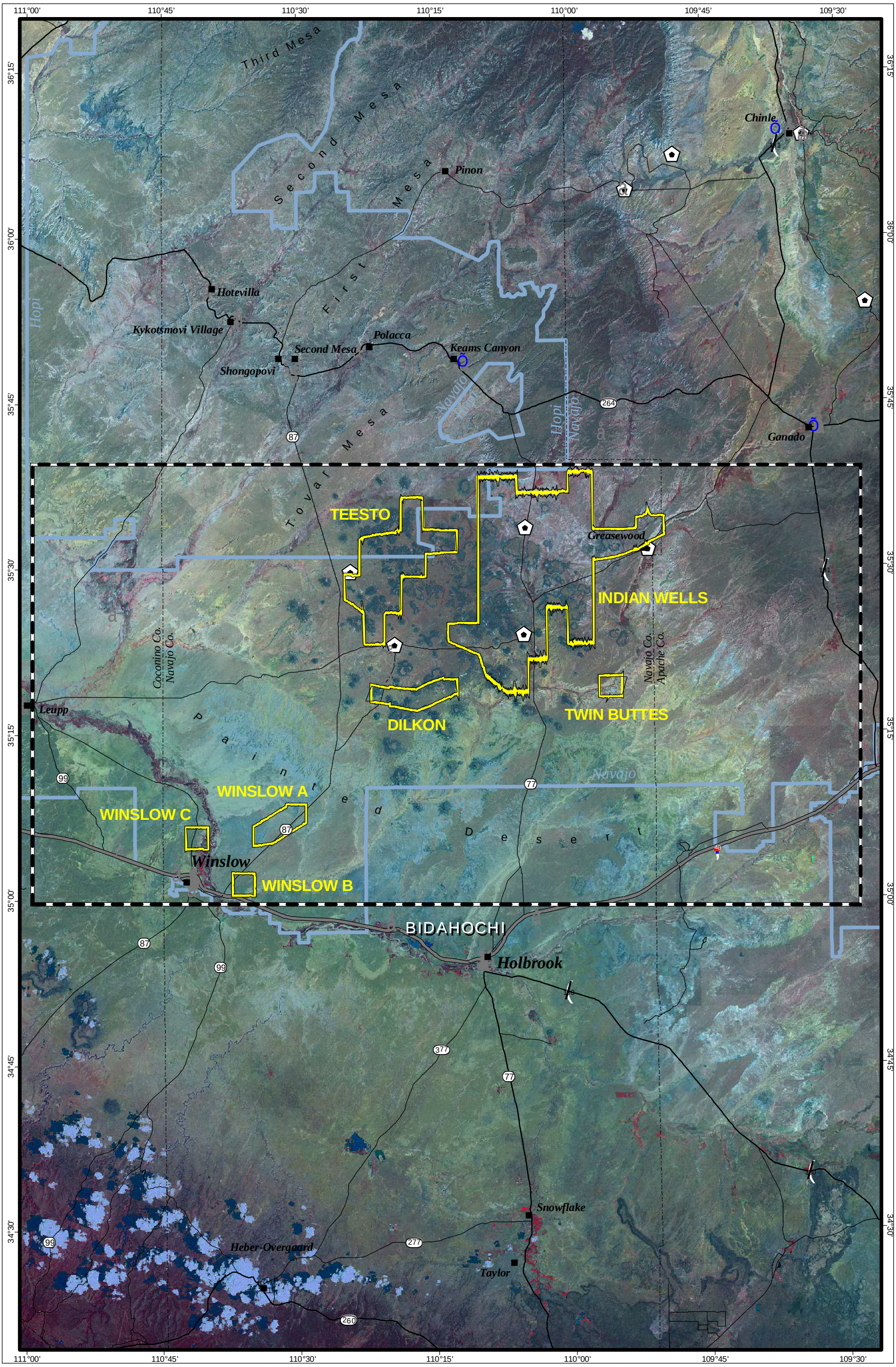
Shonetoh Spring

Middle Spring

The Bidahochi area is located in northeastern Arizona on the southern portion of the Navajo Nation. Some of the physiography of the area is shown above in photos taken by Glynn Alsup (USACE).

The overview map shown on the facing page provides the map extent boundary for the Bidahochi area maps presented in Section 6. Seven aerial radiation surveys were flown in the Bidahochi area: Teesto, Dilkon, Indian Wells, Twin Buttes, Winslow A, Winslow B, and Winslow C.

Water samples from 42 sites were collected in the Bidahochi area.



MAP FEATURES

Map Extent Boundary

Aerial Survey Boundary

4

OVERVIEW MAP

10 0 10 Miles

10 0 10 Kilometers

Scale 1:600,000

U.S. Environmental Protection Agency

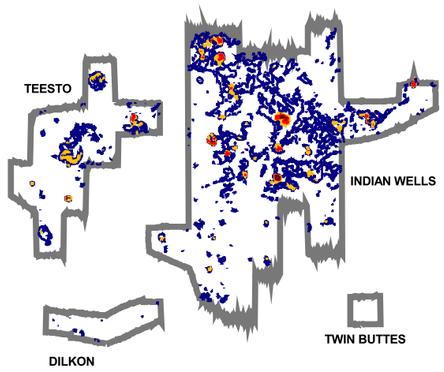
ABANDONED URANIUM MINES PROJECT

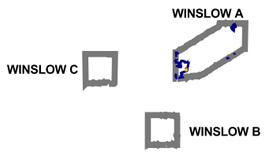
Bidahochi Area

ABANDONED URANIUM MINES PROJECT

BIDAHOCHI AREA

AERIAL RADIATION CONTOURS - GROSS COUNT





Aerial Radiation Contours

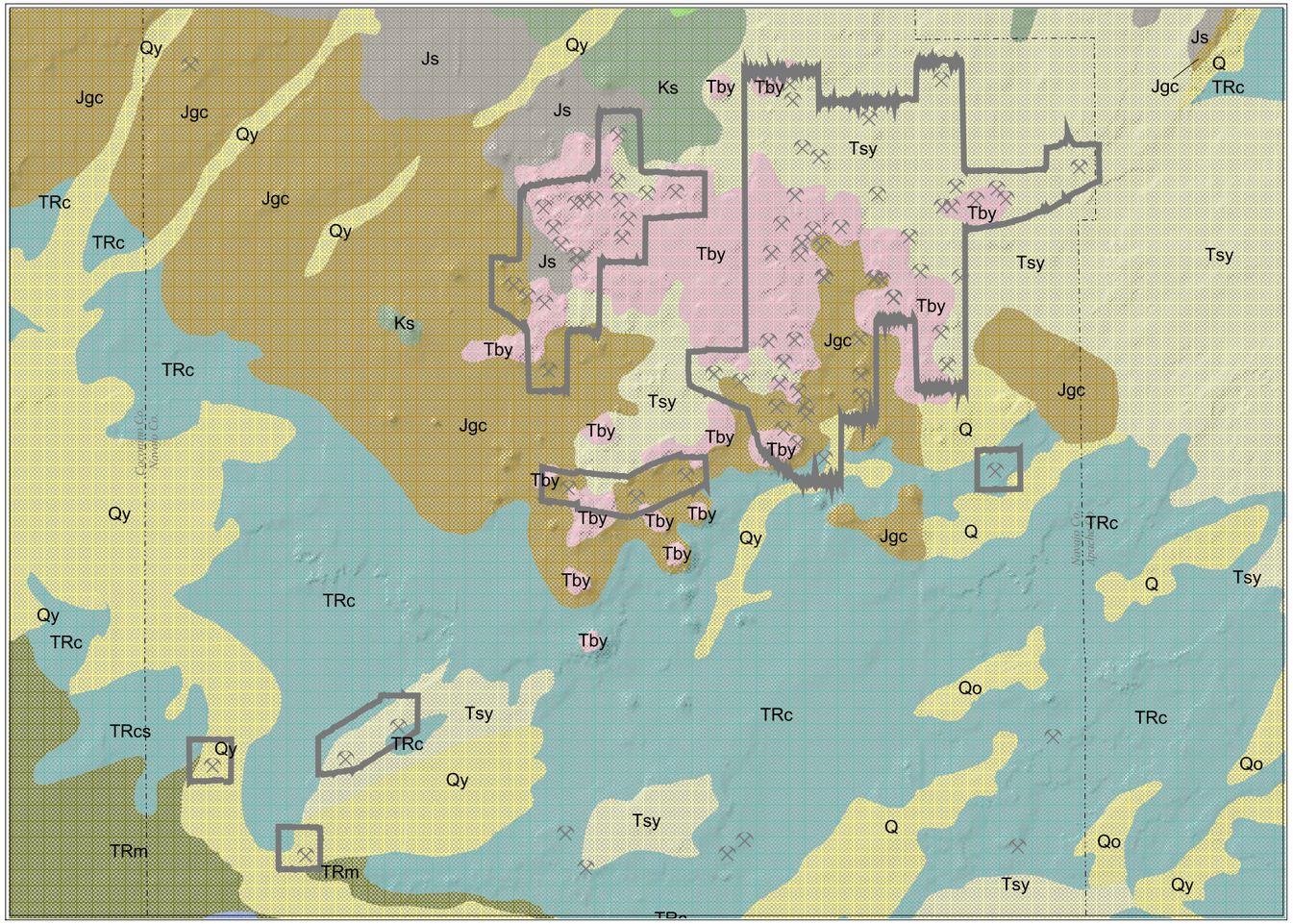
Derived terrestrial exposure rate at 1 meter above ground level. Does not include cosmic contribution (units: excess micro-R/hour)

- 9
- 12
- 16
- 24

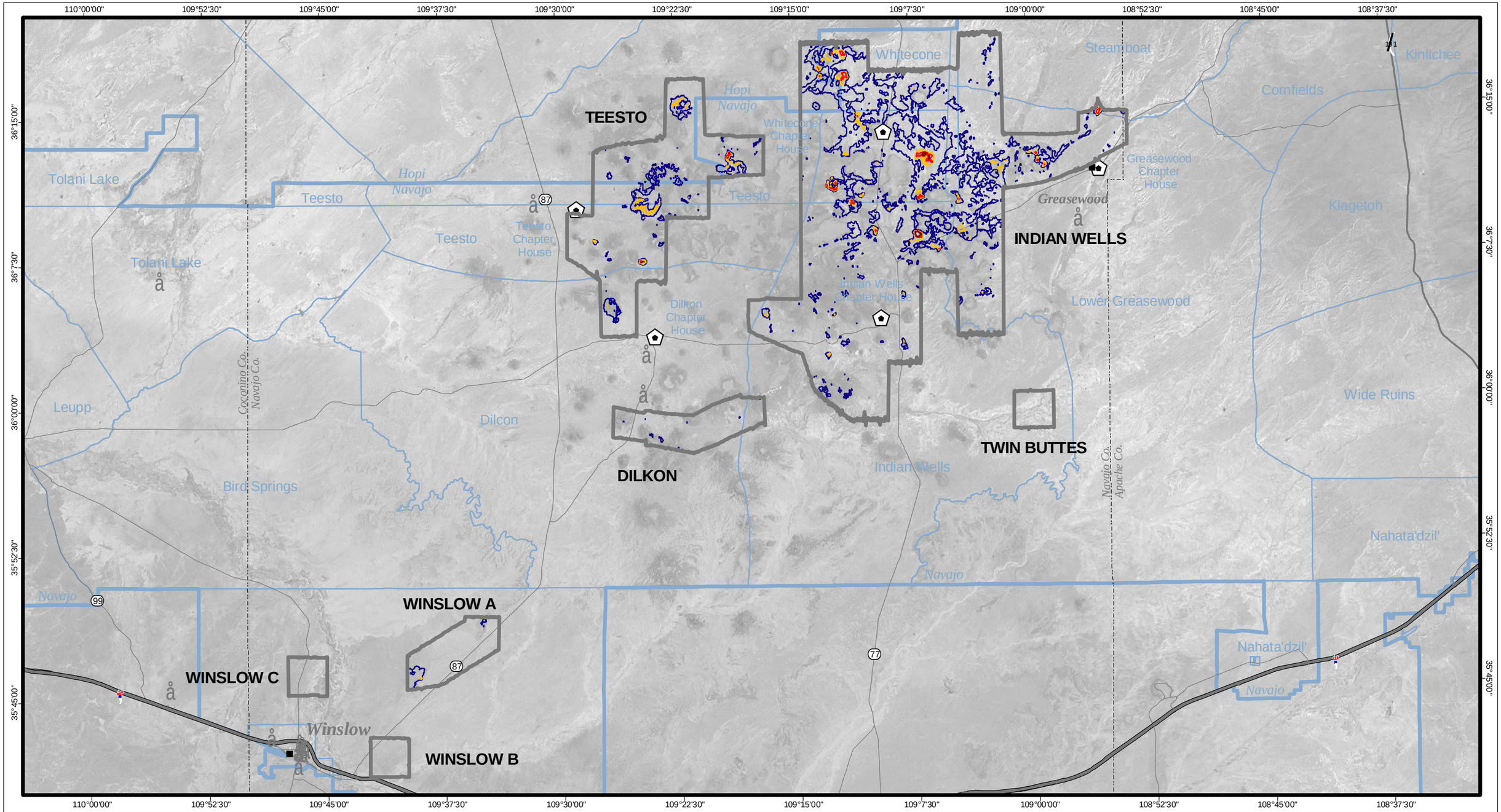
Aerial radiation contour values were compiled by Thane Hendricks, Department of Energy - Remote Sensing Laboratory. Units are in micro-Roentgens per hour. Derived from the total observed gamma spectrum. At the survey altitude of 150 feet, the footprint of the detection system is a circle approximately 300 feet in diameter. The data shown on this map are averages over this footprint at ground level.

Geological Units (Age and Unit Description)

- Q Quaternary Alluvium and Colluvium
- Qy Quaternary Alluvium and Colluvium
- Tby Early Tertiary Basaltic Rocks
- Tsy Early Tertiary Sedimentary Rocks
- Kd Cretaceous Dakota Sandstone
- Ks Cretaceous Dakota Sandstone
- Js Jurassic San Rafael Group
- Jgc Jurassic Glen Canyon Group
- TRc Triassic Chinle Formation
- TRcs Triassic Chinle Formation
- TRm Triassic Moenkopi Formation
- Qo Quaternary Alluvium and Colluvium



Sources: Aerial survey boundaries are from the Department of Energy, Remote Sensing Laboratory, Las Vegas, Nevada. Geological information from the Geologic Map of Arizona, GIS database (Richard and Kneale, 1997), Uranium mine locations shown above are approximate and were compiled from various sources by Thane Hendricks, Department of Energy, Remote Sensing Laboratory.



See facing page for legend

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AERIAL RADIATION CONTOURS
GROSS COUNT

5 0 5 Miles
5 0 5 10 Kilometers
1:350,000

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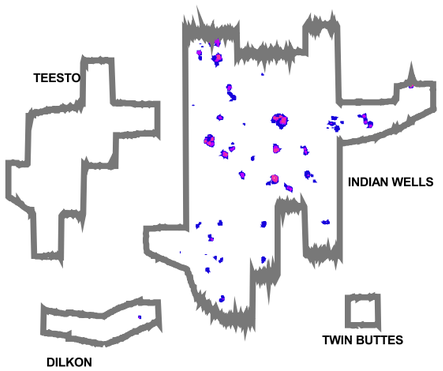
ABANDONED URANIUM MINES PROJECT

Bidahochi Area

ABANDONED URANIUM MINES PROJECT

BIDAHOCHI AREA

AERIAL RADIATION CONTOURS - BISMUTH 214



Aerial Radiation Contours	Derived contour-level Bismuth 214 photo-peak (excess counts per second)	Estimated exposure rate from excess Bismuth 214 (excess micro-R/hour)
	80	3.5
	170	7.4
	250	10.9
	800	34.9
	1200	52.4

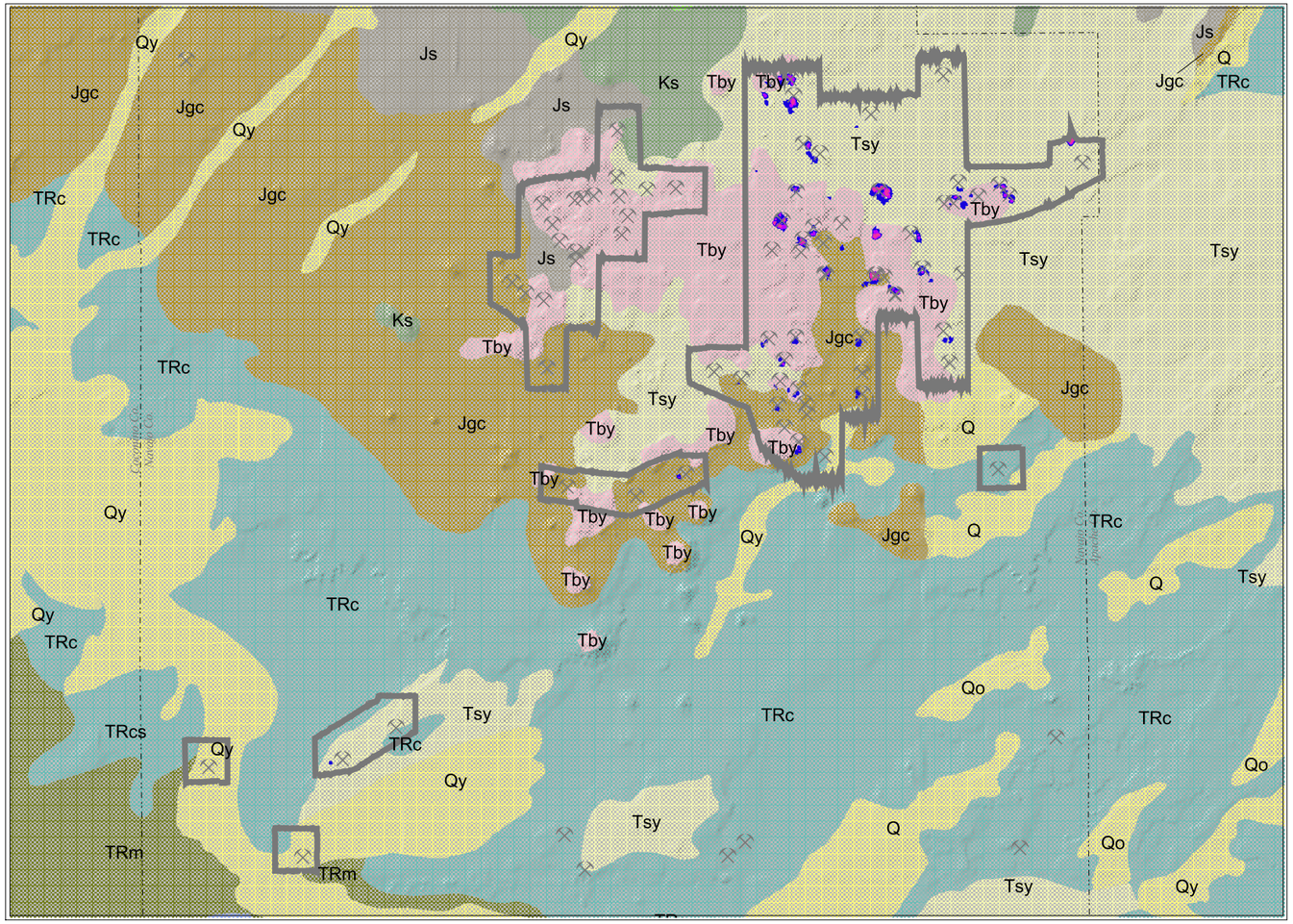
Aerial radiation contours are indicative of uranium concentrations higher than the regional levels.

Units are in micro-Roentgens per hour. The Bismuth 214 photo peak is at 1760 KeV. At the survey altitude of 150 feet above ground level, the footprint of the detection system is a circle approximately 300 feet in diameter. The data shown are averages over this footprint at ground level.

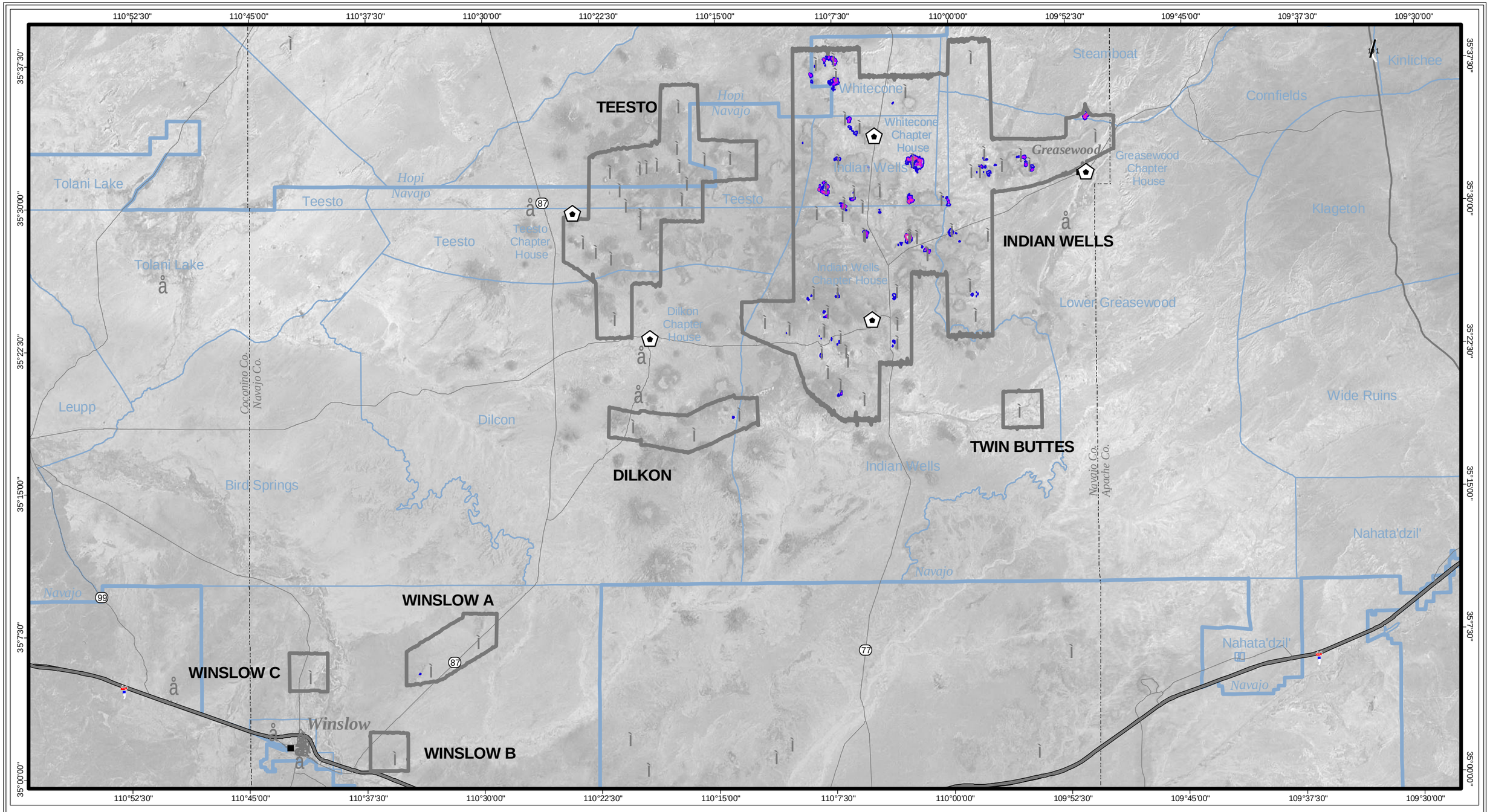
Derived and estimated values were compiled by Thane Hendricks, Department of Energy, Remote Sensing Laboratory, Las Vegas.

Geological Units (Age and Unit Description)

- Q Quaternary Alluvium and Colluvium
- Tby Early Tertiary Basaltic Rocks
- Tsy Early Tertiary Sedimentary Rocks
- Kd Cretaceous Dakota Sandstone
- Js Jurassic San Rafael Group
- Jgc Jurassic Glen Canyon Group
- TRc Triassic Chinle Formation



Sources: Aerial survey boundaries are from the Department of Energy, Remote Sensing Laboratory, Las Vegas, Nevada. Geological information from the Geologic Map of Arizona, GIS database (Richard and Kneale, 1997), Uranium mine locations shown above are approximate and were compiled from various sources by Thane Hendricks, Department of Energy, Remote Sensing Laboratory.



MAP FEATURES

Aerial Survey Boundary

4

AERIAL RADIATION CONTOURS
BISMUTH 214

5 0 5 Miles

5 0 5 10 Kilometers

1:350,000

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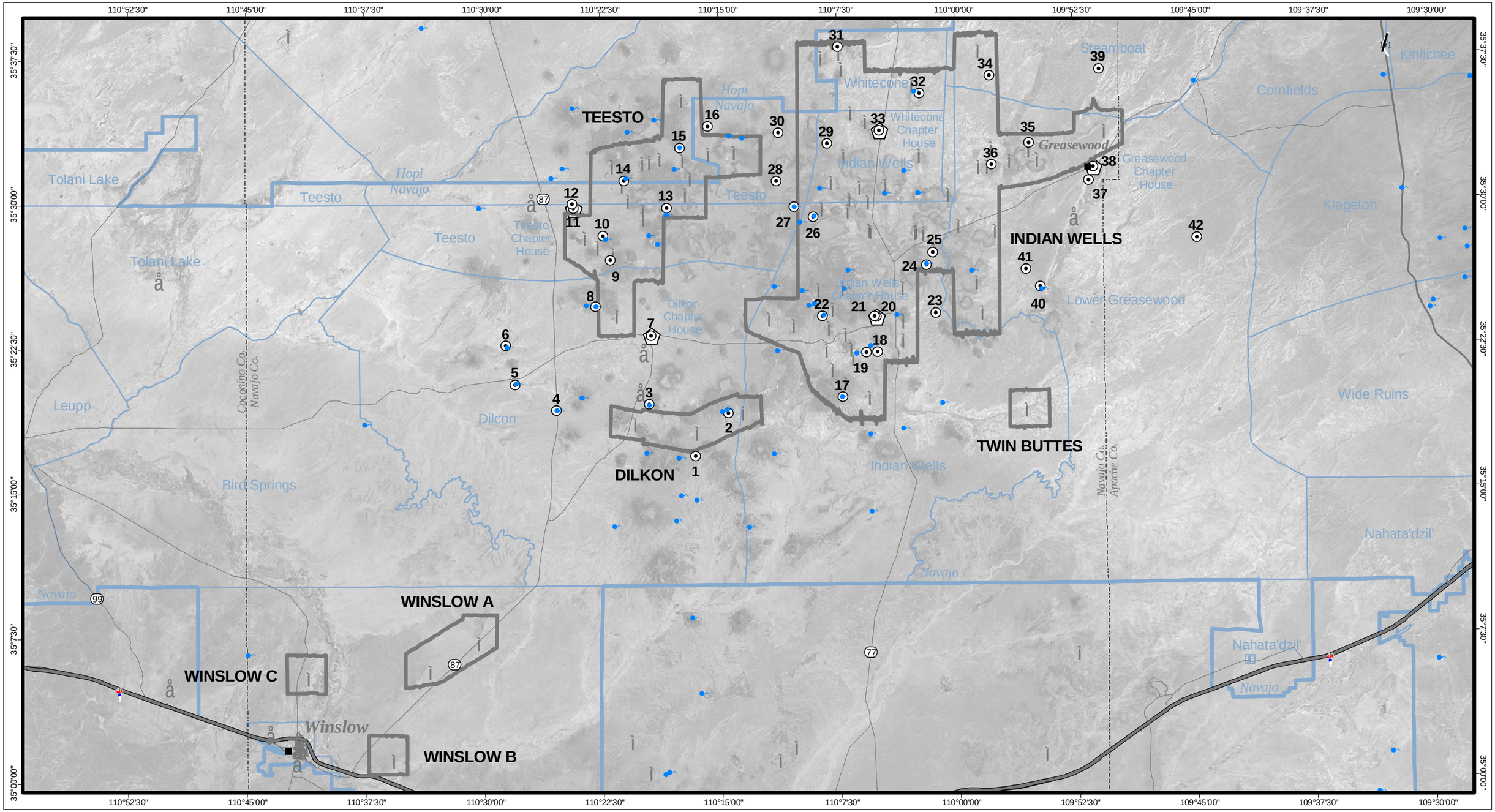
ABANDONED URANIUM MINES PROJECT

Bidahochi Area

WATER SAMPLE INFORMATION

Map ID	Sample ID	Field Type	Sample Name	Longitude (DMS) (W)	Latitude (DMS) (N)	Elevation (ft)	Sample Date	Sample Time
1	BI980708DIS005	Spring	Echo Spring No. 2	110 16 34.357	35 16 53.0861	5856	08-Jul-98	1:42 PM
2	BI980708DIS006	Spring	Cottonwood Spring	110 14 29.238	35 19 5.48400	5704	08-Jul-98	2:21 PM
3	BI980708DIS007	Spring	Castle Butte Spring	110 19 30.121	35 19 34.3332	5873	08-Jul-98	3:18 PM
4	BI980714DIS008	Spring	Chimney Butte Spring	110 25 20.890	35 19 17.4690	5525	14-Jul-98	10:26 AM
5	BI980708DIS003	Spring	Coyote Spring	110 27 58.443	35 20 37.1915	5359	08-Jul-98	11:21 AM
6	BI980708DIS001	Spring	Chandler Spring	110 28 32.068	35 22 38.4348	5441	08-Jul-98	10:01 AM
7	BI990414DIW001	Well	Dilkon Chapter House	110 19 19.947	35 23 8.93821	5811	14-Apr-99	4:20 PM
8	BI980708DIS004	Spring	Shonto Spring	110 22 50.347	35 24 39.5021	6066	08-Jul-98	12:36 PM
9	BI980713TES001	Spring	Cedar Spring	110 21 54.736	35 27 4.00320	6183	13-Jul-98	10:10 AM
10	BI980713TES003	Spring	Lone Cottonwood Spring	110 22 21.271	35 28 19.8288	5958	13-Jul-98	1:08 PM
11	BI990414TEW001	Well	Teesto Chapter House	110 24 14.200	35 29 45.0312	5711	14-Apr-99	5:10 PM
12	BI990414TEW002	Wind Mill	7H-180	110 24 18.811	35 29 57.7337	5667	14-Apr-99	5:33 PM
13	BI980713TES002	Spring	Cottonwoods Spring	110 18 18.902	35 29 45.4152	6156	13-Jul-98	10:57 AM
14	BI980713TES004	Spring	Lukai Spring	110 21 1.2761	35 31 10.8113	6161	13-Jul-98	2:25 PM
15	BI980713TES005	Spring	Shonetoh Spring	110 17 27.038	35 32 52.1141	6044	13-Jul-98	3:19 PM
16	BI980630WCW001	Wind Mill	Tank 507-1	110 15 41.487	35 33 58.3764	5885	30-Jun-98	12:05 PM
17	BI980709IWS007	Spring	Malpais Spring	110 7 14.8068	35 19 52.6302	5652	09-Jul-98	1:49 PM
18	BI980707IWS004	Spring	Dog Spring	110 5 0.70259	35 22 13.3884	5566	07-Jul-98	2:59 PM
19	BI980707IWS005	Spring	Shonto Spring	110 5 44.2020	35 22 11.3034	5620	07-Jul-98	3:46 PM
20	BI990414IWW001	Well	Indian Wells Chapter House	110 5 3.24718	35 24 2.72519	5674	14-Apr-99	3:44 PM
21	BI980709IWS006	Spring	Home			5706	09-Jul-98	11:20 PM
22	BI980707IWS003	Spring	Lokasakad Spring	110 8 28.2900	35 24 6.00058	5892	07-Jul-98	1:13 PM
23	BI980701LGS001	Spring	D-7H-116 Spring	110 1 19.3559	35 24 12.9786	5775	01-Jul-98	3:27 PM
24	BI980707IWS002	Spring	Sunshine Spring	110 1 52.1399	35 26 43.4429	6067	07-Jul-98	11:40 AM
25	BI980707IWS001	Spring	H-189 Spring	110 1 28.8785	35 27 21.7055	6112	07-Jul-98	10:12 AM
26	BI980629WCS002	Spring	Middle Spring	110 9 1.78801	35 29 14.3321	6153	29-Jun-98	1:56 PM
27	BI980629WCS003	Spring	Coyote Spring	110 10 14.114	35 29 45.3923	6295	29-Jun-98	2:33 PM
28	BI980630WCW003	Wind Mill	Tank 507-W6	110 11 21.256	35 31 6.66958	6453	30-Jun-98	4:40 PM
29	BI980629WCS001	Spring	Yazzie Spring	110 8 6.69120	35 33 2.93698	6270	29-Jun-98	10:02 AM
30	BI980630WCW002	Wind Mill	Tank 507-5	110 11 12.543	35 33 36.5645	6006	30-Jun-98	1:57 PM
31	BI980630WCS004	Spring	H-60-Spring	110 7 24.2730	35 38 2.87818	6198	30-Jun-98	3:17 PM
32	BI980701WCS005	Spring	White Cone Spring	110 2 14.0837	35 35 35.8631	6121	01-Jul-98	12:09 PM
33	BI990414WCW004	Well	White Cone Chapter House	110 4 48.2999	35 33 41.6490	6135	14-Apr-99	3:05 PM
34	BI980701LGW002	Wind Mill	Tank 17T-518	109 57 45.800	35 36 29.2086	5971	01-Jul-98	10:58 AM
35	BI980701LGW004	Wind Mill	17M-203	109 55 19.915	35 32 59.6051	5836	01-Jul-98	2:17 PM
36	BI980701LGW003	Wind Mill	Tank 17T-540	109 57 41.546	35 31 52.3344	5902	01-Jul-98	1:30 PM
37	BI980702LGS002	Spring	Sheep Dip Spring	109 51 31.832	35 31 1.70641	5797	02-Jul-98	8:42 AM
38	BI990414LGW006	Well	Lower Greasewood Chapter House	109 51 14.651	35 31 42.8555	5862	14-Apr-99	2:09 PM
39	BI980701LGW001	Wind Mill	Tank 17T-517	109 50 50.011	35 36 47.4941	6330	01-Jul-98	9:30 AM
40	BI980721LGS003	Spring	Greasewood Spring	109 54 39.886	35 25 31.0188	5720	21-Jul-98	12:33 PM
41	BI980702LGH001	Home	Home			5763	02-Jul-98	10:06 AM
42	BI980702LGW005	Wind Mill	Tank 17M-187	109 44 42.249	35 27 59.4407	6185	02-Jul-98	11:59 AM

Note: Samples collected at Map IDs 21 and 41 were from home locations. This sensitive information is not shown.



MAP FEATURES

- Water Sample Site
- Spring (GNIS) used in project planning
- Mine or Mineral occurence (MRDS and MILS) used in project planning

4

WATER SAMPLE LOCATIONS

5 0 5 Miles

5 0 5 10 Kilometers

1:350,000

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ABANDONED URANIUM MINES PROJECT

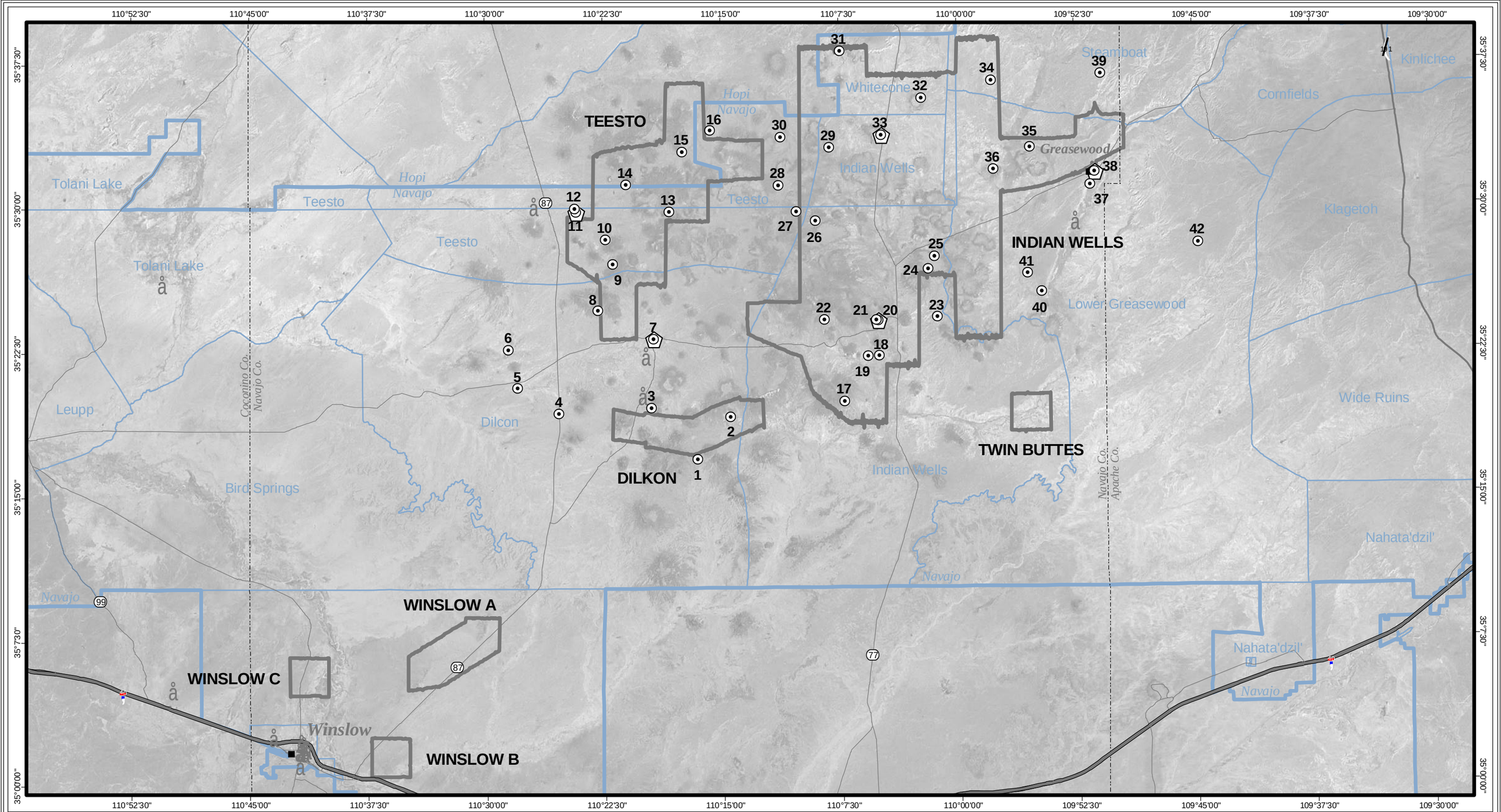
Bidahochi Area

WATER SAMPLE ANALYSIS FOR STABLE METALS

Map ID	Sample ID	Sample Name	Al	Sb[2]	As[2,4]	Ba	Be[2,4]	Cd[2,4]	Cr[2,5]	Cu[2]	Fe[2]	Pb	Mn[2]	Hg[2]	Ni[2]	Se[2]	Ag[2]	Th[2,5]	V[2]	Zn[2]	ILCRsta[1,7]	HI[3,7]
		Primary MCLs in Micrograms per Liter (µg/L)[7]	1000	6	50	1000	4	5	100	1300	300	15	50	2	None	50	100	2	None	5000		
		PRG Limits in Micrograms per Liter (µg/L)[8]	37000	15	0.045	2600	73	18	180	1400	11000	4	1700	11	730	189	180	2.6	260	11000		
1	BI980708DIS005	Echo Spring No. 2	95.3	0	8.4	26.2	0	0	0	0	0	0	0.4	0.017	0	0	0	0	39.5	18.8	1.87E-04	0.93
2	BI980708DIS006	Cottonwood Spring	96.5	0	6.7	2.3	0	0	0	4.4	0	2.9	0	0.017	0	17.5	0	0	51.7	22.1	1.49E-04	0.91
3	BI980708DIS007	Castle Butte Spring	153.0	0	63.0	2.5	0	0	0	1.7	37.1	0	0.8	0.018	0	11.5	0	0	119.0	28.6	1.40E-03	6.26
4	BI980714DIS008	Chimney Butte Spring	74.0	0	19.6	54.6	0	0	0	14.0	46.2	0	1.3	0.017	0	3.0	0	0	92.1	1,740.0	4.36E-04	2.35
5	BI980708DIS003	Coyote Spring	67.0	0	6.4	30.5	0	0	0	0	0	0	0.6	0.013	0	5.8	0	0	21.9	13.2	1.42E-04	0.71
6	BI980708DIS001	Chandler Spring	85.2	0	10.9	2.2	0	0	0	7.5	0	0	0.3	0	0	6.2	0	0	44.4	171.0	2.42E-04	1.22
7	BI990414DIW001	Dilkon Chapter House	38.7	4.9	3.2	1,020.0	0	0	0	1.2	112.0	0	19.5	0	0	0	0	0	0	44.6	7.11E-05	1.04
8	BI980708DIS004	Shonto Spring	65.4	0	2.7	3.0	0	0	0	0	0	0	0	0.011	0	0	0	0	19.8	4.2	6.00E-05	0.33
9	BI980713TES001	Cedar Spring	88.8	0	0	8.4	0	0	0	0	734.0	0	97.4	0.019	0	0	0	0	14.9	57.5	0.00E+00	0.19
10	BI980713TES003	Lone Cottonwood Spring	82.7	0	4.7	6.7	0	0	0	37.4	0	4.1	0.4	0.014	0	0	0	0	28.7	122.0	1.04E-04	0.58
11	BI990414TEW001	Teesto Chapter House	0	4.9	2.4	1,030.0	0	0	0	6.5	61.5	0	12.6	0	0	0	0	0	0	30.4	5.33E-05	0.96
12	BI990414TEW002	7H-180	0	2.0	6.1	2.3	0	0	0	11.9	246.0	0	2.4	0	0	0	0	0	24.6	90.9	1.36E-04	0.82
13	BI980713TES002	Cottonwoods Spring	115.0	0	3.6	0.8	0	0	0	0	21.1	5.6	15.9	0.015	0	3.6	0	0	31.3	22.7	8.00E-05	0.48
14	BI980713TES004	Lukai Spring	79.2	0	0	0.8	0	0	0	28.2	20.8	1.8	0	0.012	0	0	0	0	29.0	317.0	0.00E+00	0.17
15	BI980713TES005	Shonetoh Spring	81.0	0	2.8	1.1	0	0	0	4.2	0	0	0	0.012	0	3.7	0	0	27.8	91.4	6.22E-05	0.40
16	BI980630WCW001	Tank 507-1	84.3	0	4.0	1.2	0	0	0	7.4	111.0	0	3.8	0	0	0	0	0	0	20.1	8.89E-05	0.39
17	BI980709IWS007	Malpais Spring	174.0	0	0	2.0	0	0	0	1.7	83.4	0	1.8	0.008	0	0	0	6.4	9.7	14.4	0.00E+00	2.52
18	BI980707IWS004	Dog Spring	57.8	0	4.5	3.1	0	0	0	6.3	0	0	0.6	0	0	0	0	0	28.8	24.2	1.00E-04	0.53
19	BI980707IWS005	Shonto Spring	73.3	0	2.6	17.9	0	0	0	0	0	0	0.3	0	0	0	0	0	1.2	10.2	5.78E-05	0.25
20	BI990414IWW001	Indian Wells Chapter House	0	0	2.0	1,060.0	0	0	0	21.9	118.0	0	27.1	0	0	0	0	0	0	9.1	4.44E-05	0.63
21	BI980709IWS006	Home	209.0	0	21.4	2.1	0	0	0	8.1	1,330.0	0	10.8	0	0	0	0	3.2	16.5	51.6	4.76E-04	3.38
22	BI980707IWS003	Lokasakad Spring	58.1	0	6.0	15.6	0	0	0	1.8	0	0	2.2	0	0	0	0	0	0	5.4	1.33E-04	0.56
23	BI980701LGS001	D-7H-116 Spring	79.1	0	13.8	17.5	0	0	0	11.0	0	0	0.6	0	0	9.1	0	0	87.8	17.4	3.07E-04	1.66
24	BI980707IWS002	Sunshine Spring	87.0	0	19.9	0	0	0	0	0	0	0	0	0.017	0	9.9	0	0	61.1	154.0	4.42E-04	2.11
25	BI980707IWS001	H-189 Spring	84.9	0	6.3	0.6	0	0	0	0	0	0	0	0.038	0	4.5	0	0	35.2	5.7	1.40E-04	0.74
26	BI980629WCS002	Middle Spring	88.4	0	3.0	0.7	0	0	0	2.6	103.0	0	7.0	0	0	0	0	0	16.4	58.4	6.67E-05	0.36
27	BI980629WCS003	Coyote Spring	129.0	0	4.1	8.7	0	0	0	3.1	43.7	0	1.2	0	0	0	0	0	22.7	49.7	9.11E-05	0.48
28	BI980630WCW003	Tank 507-W6	76.4	0	14.3	5.7	0	0	0	15.0	459.0	0	3.4	0	0	12.8	0	0	22.3	144	3.18E-04	1.53
29	BI980629WCS001	Yazzie Spring	119.0	0	4.2	0.3	0	0	0	4.7	0	0	0	0	0	4.4	0	0	22.9	4.2	9.33E-05	0.50
30	BI980630WCW002	Tank 507-5	154.0	0	16.4	8.0	0	0	0	4.2	93.8	0	8.2	0.012	0	0	0	0	0	20.3	3.64E-04	1.52
31	BI980630WCS004	H-60-Spring	102.0	0	2.4	0.9	0	0	0	0	0	0	0	0	0	0	0	0	15.3	86.9	5.33E-05	0.29
32	BI980701WCS005	White Cone Spring	95.6	0	28.5	1.3	0	0	3.6	0	0	0	0.4	0	0	5.9	0	3.1	63.3	20.9	6.33E-04	4.08
33	BI990414WCW004	White Cone Chapter House	29.4	2.0	2.4	1,080.0	0	0	0	10.0	132.0	0	29.8	0	0	0	0	3.2	0	21.7	5.33E-05	2.04
34	BI980701LGW002	Tank 17T-518	115.0	0	77.5	32.7	0	0	0	0	201.0	0	5	0	0	0	0	0	41.4	328.0	1.72E-03	7.27
35	BI980701LGW004	17M-203	90.1	0	19.0	10.6	0	0	0	6.3	2,990.0	0	222.0	0	0	0	0	0	0	281.0	4.22E-04	2.17
36	BI980701LGW003	Tank 17T-540	104.0	0	49.7	0	0	0	0	2.3	206.0	4.7	2.5	0	0	0	0	0	1.5	26.3	1.10E-03	4.55
37	BI980702LGS002	Sheep Dip Spring	108.0	0	21.2	14.1	0	0	0	0	175.0	0	651.0	0.020	4.0	149.0	0	3.3	25.4	5.1	4.71E-04	4.50
38	BI990414LGW006	Lower Greasewood Chapter House	23.6	5.6	0	1,120.0	0	0	0	53.0	218.0	0	48.6	0	0	0	0	0	0	24.3	0.00E+00	0.89
39	BI980701LGW001	Tank 17T-517	91.5	0	237.0	15.6	0	0	0	9.8	690.0	1.4	10.0	0.015	0	17.9	0	0	203.0	519.0	5.27E-03	22.55
40	BI980721LGS003	Greasewood Spring	119.0	0	11.6	32.4	0	0	0	0	17.8	0	8.0	0	0	3.6	0	0	72.2	4.7	2.58E-04	1.37
41	BI980702LGH001	Home	84.5	0	0	1,210.0	0	0	0	845.0	235.0	0	49.9	0.013	2.2	0	0	0	0	29.9	0.00E+00	1.13
42	BI980702LGW005	Tank 17M-187	86.6	0	156.0	2.8	0	0	0	2.8	160.0	0	9.1	0.009	0	0	0	0	14.0	26.5	3.47E-03	14.26

1. ILCR = Incremental Lifetime Cancer Risk with Respect to Stable Metals.
2. The values of "0" represent a result of either "not detected" at the detection limit of the laboratory method or a negative count. In both cases, the result can be considered "0".
3. The evaluation of Beta is in two steps. The initial screening level is 50 pCi/L. If the measured level of Beta exceeds the 50 pCi/L, a further evaluation is merited. Beta-emitting radionuclides would be screened.
4. The values of "0" in the Pb210 column represent analytical results that measured less than the Minimum Detectable Activity (MDA).
5. Definition of final calculations and ranking is described and published in Appendix A.1 *Summary of the Characterization of Risk Leading to Exposure Reduction.*
6. When comparing these PRG's with the U.S. EPA's PRG list, the calculated PRG used for U238 is less than the EPA's PRG for U238D (D meaning that its decay daughters are included in the risk calculations).
7. MCL – Maximum Contaminant Levels are the maximum permissible level of a contaminant in water delivered to users of a public water system.
8. PRG – Preliminary Remediation Goals are tools for evaluating and cleaning up contaminated sites. They are risk-based concentrations derived from standardized equations, combining exposure information assumptions and EPA toxicity data.

Al = Aluminum Sb = Antimony As = Arsenic Ba = Barium Be = Beryllium Cd = Cadmium Cr = Chromium Cu = Copper Fe = Iron Pb = Lead Mn = Manganese Hg = Mercury Ni = Nickel Se = Selenium Ag = Silver Th = Thallium V = Vanadium Zn = Zinc HI = Hazard Index



MAP FEATURES

⊙ Water Sample Site - Stable Metals

4

WATER SAMPLE ANALYSIS FOR STABLE METALS

5 0 5 Miles

5 0 5 10 Kilometers

1:350,000

U.S. Environmental Protection Agency

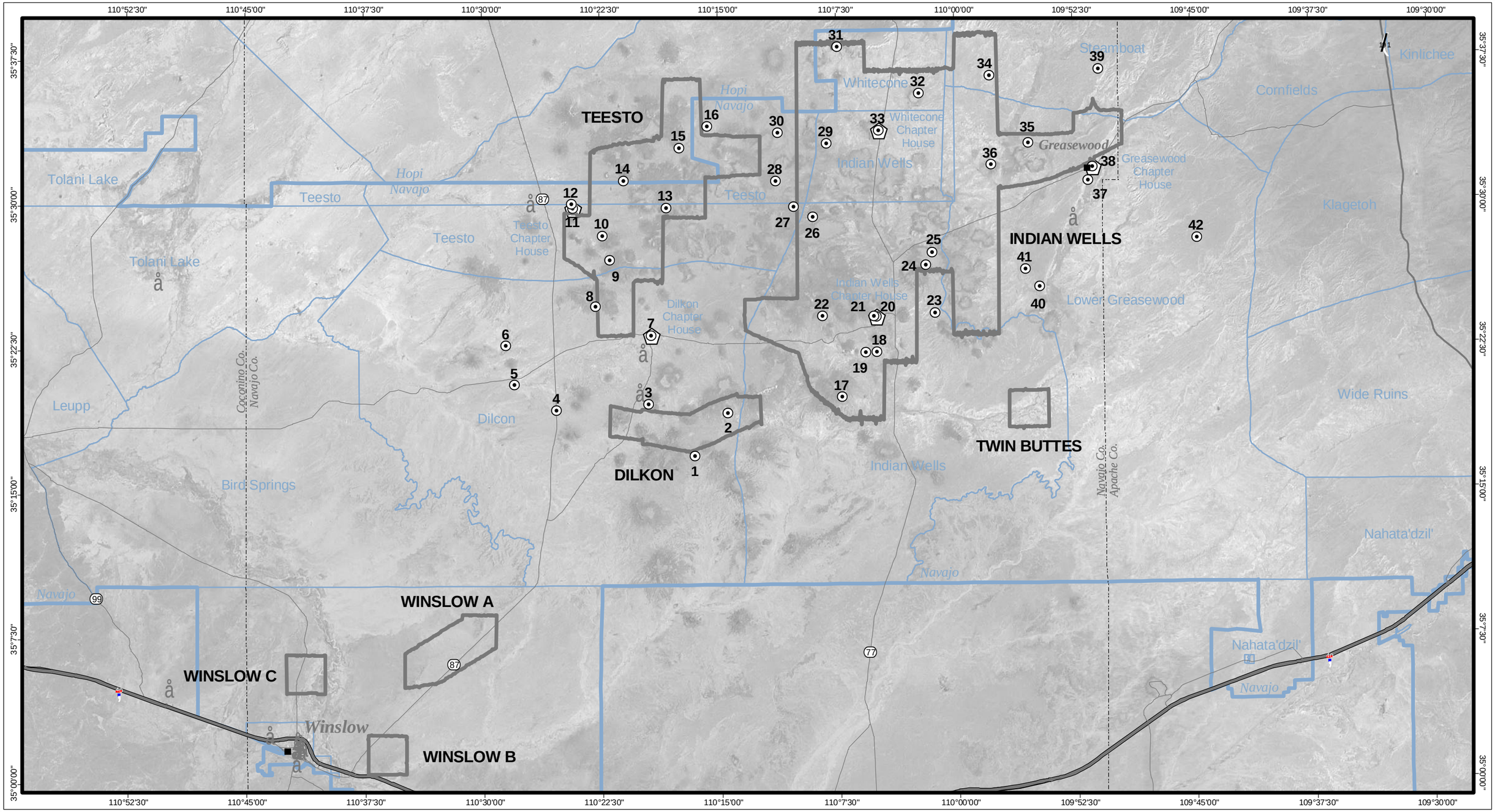
ABANDONED URANIUM MINES PROJECT

Bidahochi Area

WATER SAMPLE ANALYSIS FOR RADIOACTIVE METALS

Map ID	Sample ID	Sample Name	Alpha[2]	Beta[3]	Lead210[4]	Radium226[2]	Radium228[2]	Thorium228[2]	Thorium230[2]	Thorium232[2]	Uranium234[2]	Uranium235[2]	Uranium238[2,6]	IRCRrad[1,5]
		Primary MCLs in Pico-curies per Liter (pCi/L)[7]	15	50	None	5	5	None	None	None	20	20	20	
		PRG Limits in Pico-curies per Liter (pCi/L)[8]	None	None	0.047	0.16	0.19	0.21	1.3	1.5	1.1	1.1	0.71	
1	BI980708DIS005	Echo Spring No. 2	6.18	5.24	2.27	0.034	0.840	0.005	0.011	-0.001	4.88	0.049	2.63	6.11E-05
2	BI980708DIS006	Cottonwood Spring	3.53	5.24	1.84	0.016	0.917	0.008	0.021	0.000	2.11	0.043	1.26	8.71E-06
3	BI980708DIS007	Castle Butte Spring	9.08	9.25	1.17	0.020	0.551	-0.009	0.005	0.005	5.81	-0.009	2.87	3.72E-05
4	BI980714DIS008	Chimney Butte Spring	6.47	7.60	0.88	0.059	0.353	0.018	0.010	0.000	3.32	0.177	1.76	2.67E-05
5	BI980708DIS003	Coyote Spring	3.70	5.29	4.68	0.106	0.565	0.024	0.016	0.000	2.14	-0.004	0.77	1.06E-04
6	BI980708DIS001	Chandler Spring	2.14	1.40	0.80	-0.004	0.400	0.006	0.009	0.000	2.32	0.131	0.78	5.47E-06
7	BI990414DIW001	Dilkon Chapter House	0.03	8.00	0.90	0.072	0.215	-0.005	0.005	0.000	-0.02	-0.024	-0.03	2.08E-05
8	BI980708DIS004	Shonto Spring	3.09	6.46	0.53	0.015	0.599	-0.009	0.010	0.000	2.55	-0.004	1.82	8.14E-06
9	BI980713TES001	Cedar Spring	1.54	6.29	0.42	0.032	0.439	-0.004	0.006	0.000	0.97	0.089	0.22	3.79E-06
10	BI980713TES003	Lone Cottonwood Spring	2.16	4.97	0.28	0.073	0.559	-0.001	0.023	0.005	1.33	-0.015	0.82	5.78E-06
11	BI990414TEW001	Teesto Chapter House	0.37	5.23	0.58	0.069	0.346	0.010	0.000	0.004	-0.03	0.009	0.06	2.40E-06
12	BI990414TEW002	7H-180	3.26	5.13	0.37	0.020	0.483	0.000	0.003	0.003	1.95	0.088	1.04	5.99E-06
13	BI980713TES002	Cottonwoods Spring	4.33	9.08	2.63	0.050	0.768	-0.003	0.027	0.000	1.28	0.183	0.60	6.25E-05
14	BI980713TES004	Lukai Spring	5.58	10.80	4.01	0.018	0.699	-0.009	-0.001	0.005	3.33	0.115	1.90	9.49E-05
15	BI980713TES005	Shonetoh Spring	6.01	7.12	0.58	0.023	0.898	0.026	0.015	-0.001	3.74	0.081	2.45	1.19E-05
16	BI980630WCW001	Tank 507-1	1.52	1.83	0.51	0.030	0.592	0.012	0.011	0.000	0.14	0.000	0.05	3.56E-06
17	BI980709IWS007	Malpais Spring	1.03	8.82	0.70	-0.039	0.437	0.026	0.009	0.005	1.07	0.057	0.23	3.78E-06
18	BI980707IWS004	Dog Spring	4.49	5.63	0.52	0.022	0.942	0.011	0.005	-0.001	2.96	0.169	1.65	1.03E-05
19	BI980707IWS005	Shonto Spring	0.97	18.90	0.68	0.025	0.203	0.002	0.005	0.000	0.53	0.086	0.24	2.14E-06
20	BI990414IWW001	Indian Wells Chapter House	0.10	6.23	0.78	0.062	0.552	0.008	0.002	0.002	0.08	-0.003	0.00	2.00E-05
21	BI980709IWS006	Home	13.10	8.80	1.00	-0.005	0.917	0.014	0.021	0.003	12.00	-0.008	1.59	3.93E-05
22	BI980707IWS003	Lokasakad Spring	1.81	4.53	0.60	0.041	0.425	0.012	0.014	0.000	1.38	-0.007	0.13	4.00E-06
23	BI980701LGS001	D-7H-116 Spring	6.48	5.92	0.36	0.068	0.337	0.047	0.010	0.005	5.37	0.055	1.68	9.73E-06
24	BI980707IWS002	Sunshine Spring	12.50	7.38	0.11	0.030	0.362	0.030	0.009	0.000	5.05	0.125	2.68	1.07E-05
25	BI980707IWS001	H-189 Spring	6.11	6.59	0.69	0.038	0.504	0.006	0.006	0.000	4.34	0.049	2.59	1.06E-05
26	BI980629WCS002	Middle Spring	6.05	9.41	0.50	0.019	0.215	0.025	0.017	-0.001	4.06	0.268	3.00	9.54E-06
27	BI980629WCS003	Coyote Spring	3.94	6.59	0.38	0.032	0.249	0.004	0.020	0.002	2.01	0.249	2.19	6.68E-06
28	BI980630WCW003	Tank 507-W6	5.91	8.98	0.99	0.017	0.484	0.004	0.004	0.000	3.37	0.091	2.09	2.98E-05
29	BI980629WCS001	Yazzie Spring	12.90	10.40	-0.23	0.039	0.370	0.037	0.010	-0.001	6.02	0.393	5.74	1.63E-05
30	BI980630WCW002	Tank 507-5	1.11	1.74	0.58	0.029	0.591	-0.006	0.011	-0.001	0.13	-0.029	-0.02	3.42E-06
31	BI980630WCS004	H-60-Spring	4.76	7.14	0.29	0.028	0.409	0.000	0.000	0.002	3.01	0.159	1.42	7.21E-06
32	BI980701WCS005	White Cone Spring	5.27	6.41	0.89	0.024	0.325	0.000	0.010	-0.001	2.71	0.078	2.51	7.94E-06
33	BI990414WCW004	White Cone Chapter House	0.76	5.47	0.29	0.055	0.655	0.003	0.004	-0.001	-0.01	-0.007	0.04	3.87E-06
34	BI980701LGW002	Tank 17T-518	11.10	4.62	0.83	0.094	0.308	0.003	0.005	0.004	7.47	0.040	1.52	1.12E-05
35	BI980701LGW004	17M-203	16.60	20.70	0.21	0.423	0.834	-0.448	0.000	-0.059	10.80	-0.027	4.76	2.36E-05
36	BI980701LGW003	Tank 17T-540	2.47	4.82	1.66	0.032	0.190	0.023	0.004	-0.001	0.20	-0.011	0.08	3.69E-05
37	BI980702LGS002	Sheep Dip Spring	140.00	155.00	0.78	0.047	0.413	-0.034	0.063	0.000	102.00	2.830	85.90	2.35E-04
38	BI990414LGW006	Lower Greasewood Chapter House	0.34	5.25	0.40	0.058	0.591	0.015	0.004	0.000	0.20	0.000	0.02	3.76E-06
39	BI980701LGW001	Tank 17T-517	26.80	17.10	0.70	0.049	0.309	0.025	0.023	-0.001	24.50	0.412	8.82	3.71E-05
40	BI980721LGS003	Greasewood Spring	15.70	9.40	0.19	0.120	0.534	0.004	0.006	0.005	8.24	0.151	4.08	1.70E-05
41	BI980702LGH001	Home	0.97	5.31	0.56	0.078	0.483	0.008	0.009	-0.001	0.06	-0.004	0.00	3.13E-06
42	BI980702LGW005	Tank 17M-187	2.16	4.76	1.93	0.037	0.563	0.003	0.000	-0.001	3.15	0.050	0.65	4.81E-05

1. ILCR = Incremental Lifetime Cancer Risk with Respect to Radioactive Metals.
2. The values of “0” represent a result of either “not detected” at the detection limit of the laboratory method or a negative count. In both cases, the result can be considered “0”.
3. The evaluation of Beta is in two steps. The initial screen level is 50pCi/l. If the measured level of Beta exceeds the 50 pCi/L, a further evaluation is merited. The Beta-emitting radionuclides would be screened.
4. The values of “0” in the Lead210 column represent analytical results that measured less than the Method Detection Activity (MDA).
5. Definition of final calculations and ranking is described and published in Appendix A.1 *Summary of the Characterization of Risk Leading to Exposure Reduction*
6. When comparing these PRG’s with the U.S. EPA’s PRG list, the calculated PRG used for Uranium238 is less than the EPA’s PRG for Uranium238D (D meaning that its decay daughters are included in the risk calculations).
7. MCL – Maximum Contaminant Levels are the maximum permissible level of a contaminant in water delivered to users of a public water system.
8. PRG – Preliminary Remediation Goals are tools for evaluating and cleaning up contaminated sites. They are risk-based concentrations derived from standardized equations, combining exposure information assumptions and EPA toxicity data.



MAP FEATURES

⊙ Water Sample Site - Radioactive Metals

4

WATER SAMPLE ANALYSIS FOR RADIOACTIVE METALS

5 0 5 Miles
5 0 5 10 Kilometers
1:350,000

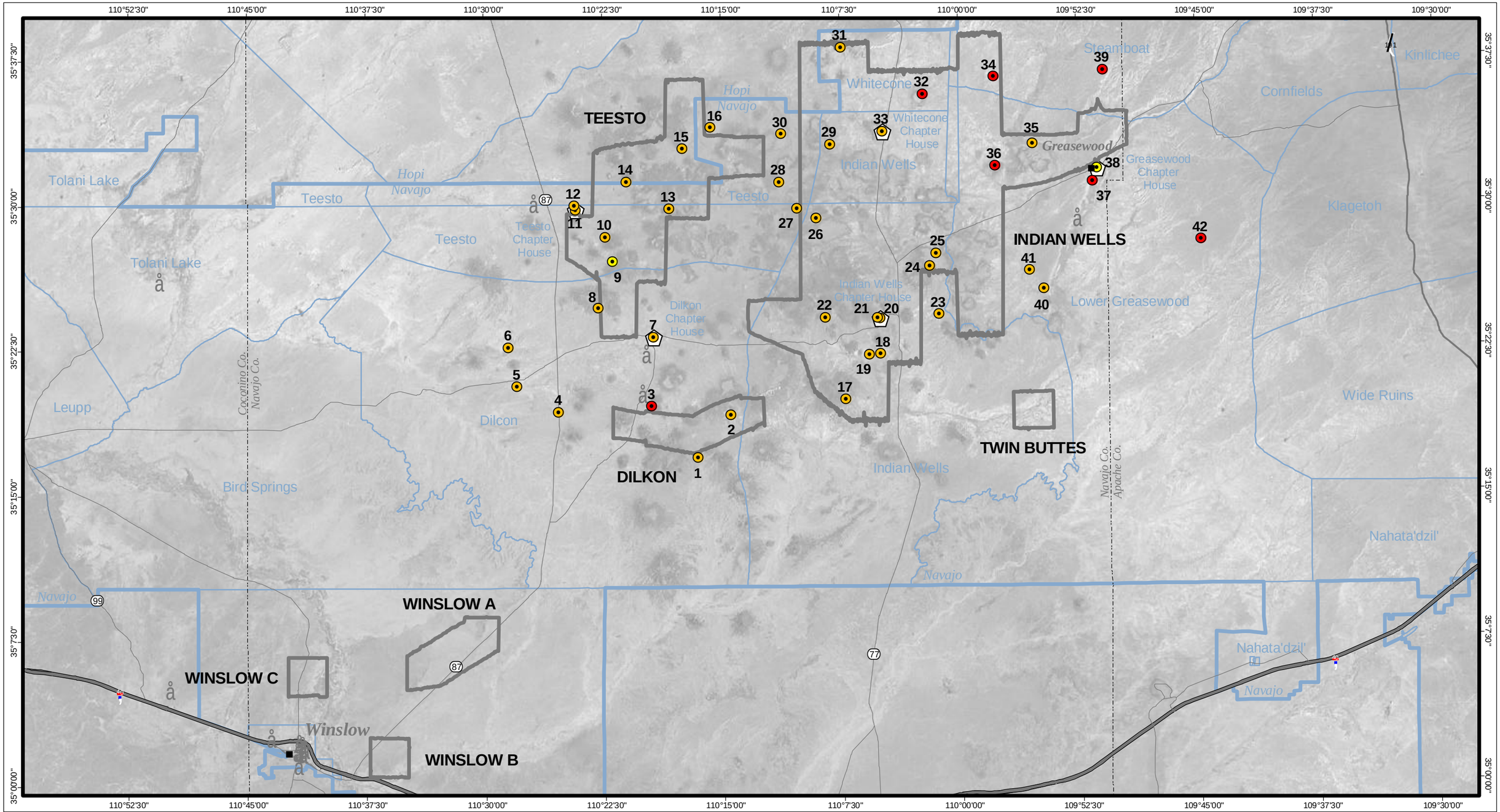
U.S. Environmental Protection Agency
ABANDONED URANIUM MINES PROJECT

Bidahochi Area

SUMMARY OF WATER QUALITY ANALYSIS WITH RESPECT TO STABLE AND RADIOACTIVE METALS

Map ID	Sample ID	Sample Name	Total Cancer Risk	HI	Arsenic[3]	Lead[3]	Total U[2]	Water Quality with Respect to Stable and Radioactive Metals[4]			Risk Category	Risk Ranking[6]
		Primary MCLs in Micrograms per Liter (µg/L)[7]			50	15	30[5]					
		PRG Limits in Micrograms per Liter (µg/L)[8]			0.045	4	None	Less Risk	Some Risk	More Risk		
1	BI980708DIS005	Echo Spring No. 2	2.48E-004	0.93	8.4	0	7.51		ILCR		SOME	27
2	BI980708DIS006	Cottonwood Spring	1.58E-004	0.91	6.7	2.9	3.37		ILCR		SOME	24
3	BI980708DIS007	Castle Butte Spring	1.44E-003	6.26	63.0	0	8.68			ILCR	MORE	38
4	BI980714DIS008	Chimney Butte Spring	4.62E-004	2.35	19.6	0	5.08		ILCR, HI		SOME	32
5	BI980708DIS003	Coyote Spring	2.49E-004	0.71	6.4	0	2.91		ILCR		SOME	21
6	BI980708DIS001	Chandler Spring	2.48E-004	1.22	10.9	0	3.1		ILCR, HI		SOME	22
7	BI990414DIW001	Dilkon Chapter House	9.19E-005	1.04	3.2	0	0		ILCR, HI		SOME	9
8	BI980708DIS004	Shonto Spring	6.81E-005	0.33	2.7	0	4.37		ILCR		SOME	12
9	BI980713TES001	Cedar Spring	3.79E-006	0.19	0	0	1.19	X			LESS	2
10	BI980713TES003	Lone Cottonwood Spring	1.10E-004	0.58	4.7	4.1	2.15		ILCR, LEAD		SOME	23
11	BI990414TEW001	Teesto Chapter House	5.57E-005	0.96	2.4	0	0		ILCR		SOME	5
12	BI990414TEW002	7H-180	1.42E-004	0.82	6.1	0	2.99		ILCR		SOME	16
13	BI980713TES002	Cottonwoods Spring	1.43E-004	0.48	3.6	5.6	2.07		ILCR, LEAD		SOME	28
14	BI980713TES004	Lukai Spring	9.49E-005	0.17	0	1.8	5.23		ILCR		SOME	19
15	BI980713TES005	Shonetoh Spring	7.42E-005	0.40	2.8	0	6.19		ILCR		SOME	15
16	BI980630WCW001	Tank 507-1	9.24E-005	0.39	4.0	0	0		ILCR		SOME	10
17	BI980709IWS007	Malpais Spring	3.78E-006	2.52	0	0	1.07		HI		SOME	4
18	BI980707IWS004	Dog Spring	1.10E-004	0.53	4.5	0	4.61		ILCR		SOME	17
19	BI980707IWS005	Shonto Spring	5.99E-005	0.25	2.6	0	0.53		ILCR		SOME	8
20	BI990414IWW001	Indian Wells Chapter House	6.44E-005	0.63	2.0	0	0		ILCR		SOME	7
21	BI980709IWS006	Home	5.15E-004	3.38	21.4	0	13.59		ILCR, HI		SOME	35
22	BI980707IWS003	Lokasakad Spring	1.37E.004	0.56	6.0	0	1.38		ILCR		SOME	13
23	BI980701LGS001	D-7H-116 Spring	3.16E-004	1.66	13.8	0	7.05		ILCR, HI		SOME	30
24	BI980707IWS002	Sunshine Spring	4.53E-004	2.11	19.9	0	7.73		ILCR, HI		SOME	33
25	BI980707IWS001	H-189 Spring	1.51E-004	0.74	6.3	0	6.93		ILCR		SOME	20
26	BI980629WCS002	Middle Spring	7.62E-005	0.36	3.0	0	7.33		ILCR		SOME	18
27	BI980629WCS003	Coyote Spring	9.78E-005	0.48	4.1	0	4.20		ILCR		SOME	14
28	BI980630WCW003	Tank 507-W6	3.48E-004	1.53	14.3	0	5.46		ILCR, HI		SOME	29
29	BI980629WCS001	Yazzie Spring	1.10E-004	0.50	4.2	0	12.15		ILCR		SOME	25
30	BI980630WCW002	Tank 507-5	3.68E-004	1.52	16.4	0	0		ILCR, HI		SOME	26
31	BI980630WCS004	H-60-Spring	6.05E-005	0.29	2.4	0	4.43		ILCR		SOME	11
32	BI980701WCS005	White Cone Spring	6.41E-004	4.08	28.5	0	5.22			ILCR	MORE	36
33	BI990414WCW004	White Cone Chapter House	5.72E-005	2.04	2.4	0	0		ILCR, HI		SOME	6
34	BI980701LGW002	Tank 17T-518	1.73E-003	7.27	77.5	0	8.99			ILCR	MORE	39
35	BI980701LGW004	17M-203	4.46E-004	2.17	19.0	0	15.56		ILCR, HI		SOME	34
36	BI980701LGW003	Tank 17T-540	1.14E-003	4.55	49.7	4.7	0			ILCR	MORE	37
37	BI980702LGS002	Sheep Dip Spring	7.06E-004	4.50	21.2	0	190.73			ILCR, TOTAL U	MORE	41
38	BI990414LGW006	Lower Greasewood Chapter House	3.76E-006	0.89	0	0	0.00	X			LESS	1
39	BI980701LGW001	Tank 17T-517	5.30E-003	22.55	237.0	1.4	33.73			ILCR, HI, TOTAL U	MORE	42
40	BI980721LGS003	Greasewood Spring	2.75E-004	1.37	11.6	0	12.32		ILCR, HI		SOME	31
41	BI980702LGH001	Home	3.13E-006	1.13	0	0	0		HI		SOME	3
42	BI980702LGW005	Tank 17M-187	3.51E-003	14.26	156.0	0	3.80			ILCR, HI	MORE	40

1. ILCR = Incremental Lifetime Cancer Risk with Respect to Stable Metals and Radioactive Metals.
2. The PRG's and MCL's for Alpha, Beta, and Uranium are in Pico-Curies per Liter (pCi/L).
3. The PRG's and MCL's for Lead and Arsenic are in Micrograms per Liter (µg/L).
4. Water Quality Levels:
   - Less Risk — Total Cancer Risk is less than or equal to 1E-05 and Hazard Index is less than or equal to 1 and Lead is less than 4 and Total Uranium is less than 30.
   - Some Risk — Total Cancer Risk is less than or equal to 6E-04 but greater than 1E-05 or Hazard Index (HI) is less than 10 but greater than 1 or Lead is less than 15 but greater than 4 and Total Uranium is less than 30.
   - More Risk — Total Cancer Risk is greater than 6E-04 or Hazard Index is greater than 10 or Lead is greater than 15 or Total Uranium is equal to or greater than 30.
5. Proposed EPA MCl is 30 pCi/L for the sum of the three Uranium isotopes.
6. The definitions of the risk categories and the ranking is described and published in Appendix A.1 *Summary of the Characterization of Risk Leading to Exposure Reduction.*
7. MCL – Maximum Contaminant Levels are the maximum permissible level of a contaminant in water delivered to users of a public water system.
8. PRG – Preliminary Remediation Goals are tools for evaluating and cleaning up contaminated sites. They are risk-based concentrations derived from standardized equations, combining exposure information assumptions and EPA toxicity data.



Less Risk
Total Cancer Risk is less than or equal to 1E-05 and Hazard Index is less than or equal to 1 and Lead is less than 4 and U is less than 30.

Some Risk
Total Cancer Risk is less than or equal to 6E-04 but greater than 1E-05 or Hazard Index is less than 10 but greater than 1 or Lead is less than 15 but greater than 4 and U is less than 30.

More Risk
Total Cancer Risk is greater than 6E-04 or Hazard Index is greater than 10 or Lead is greater than 15 or U is equal to or greater than 30.

4

SUMMARY OF WATER QUALITY ANALYSIS WITH RESPECT TO STABLE AND RADIOACTIVE METALS

5 0 5 Miles
5 0 5 10 Kilometers
1:350,000

U.S. Environmental Protection Agency
ABANDONED URANIUM MINES PROJECT

Bidahochi Area

6.16

Less Risk	Aerial Radiation Contours	Derived contour-level Bismuth 214 photo-peak (excess counts per second)	Estimated exposure rate from excess Bismuth 214 (excess micro-R/hour)
Some Risk		80	3.5
More Risk		170	7.4
		250	10.9
		800	34.9
		1200	52.4

4

SUMMARY OF WATER QUALITY ANALYSIS AND BISMUTH 214 CONTOURS

5 0 5 Miles

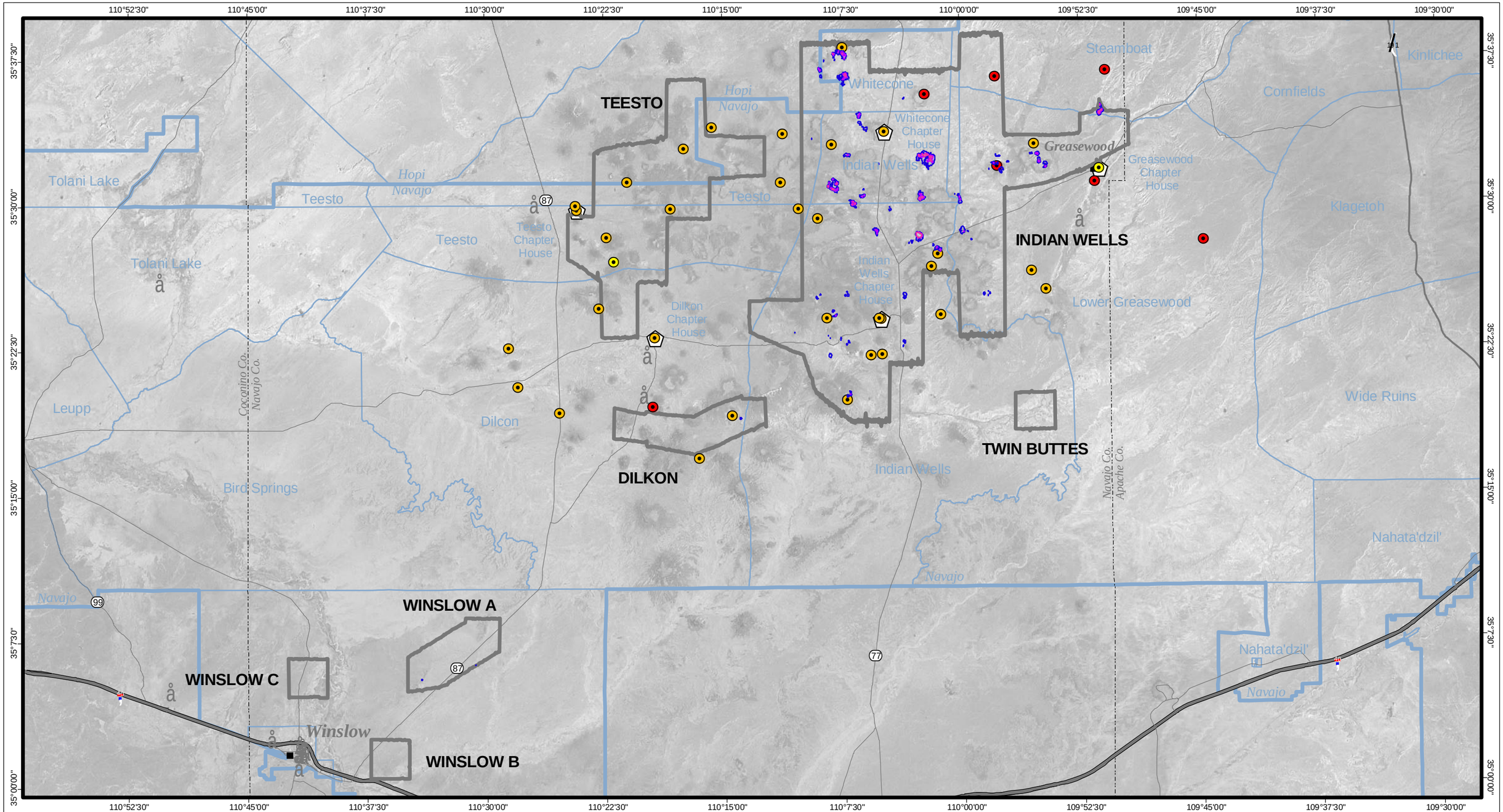
5 0 5 10 Kilometers

1:350,000

U.S. Environmental Protection Agency

ABANDONED URANIUM MINES PROJECT

Bidahochi Area



Less Risk	Aerial Radiation Contours	Derived contour-level Bismuth 214 photo-peak (excess counts per second)	Estimated exposure rate from excess Bismuth 214 (excess micro-R/hour)
		80	3.5
Some Risk		170	7.4
		250	10.9
		800	34.9
More Risk		1200	52.4

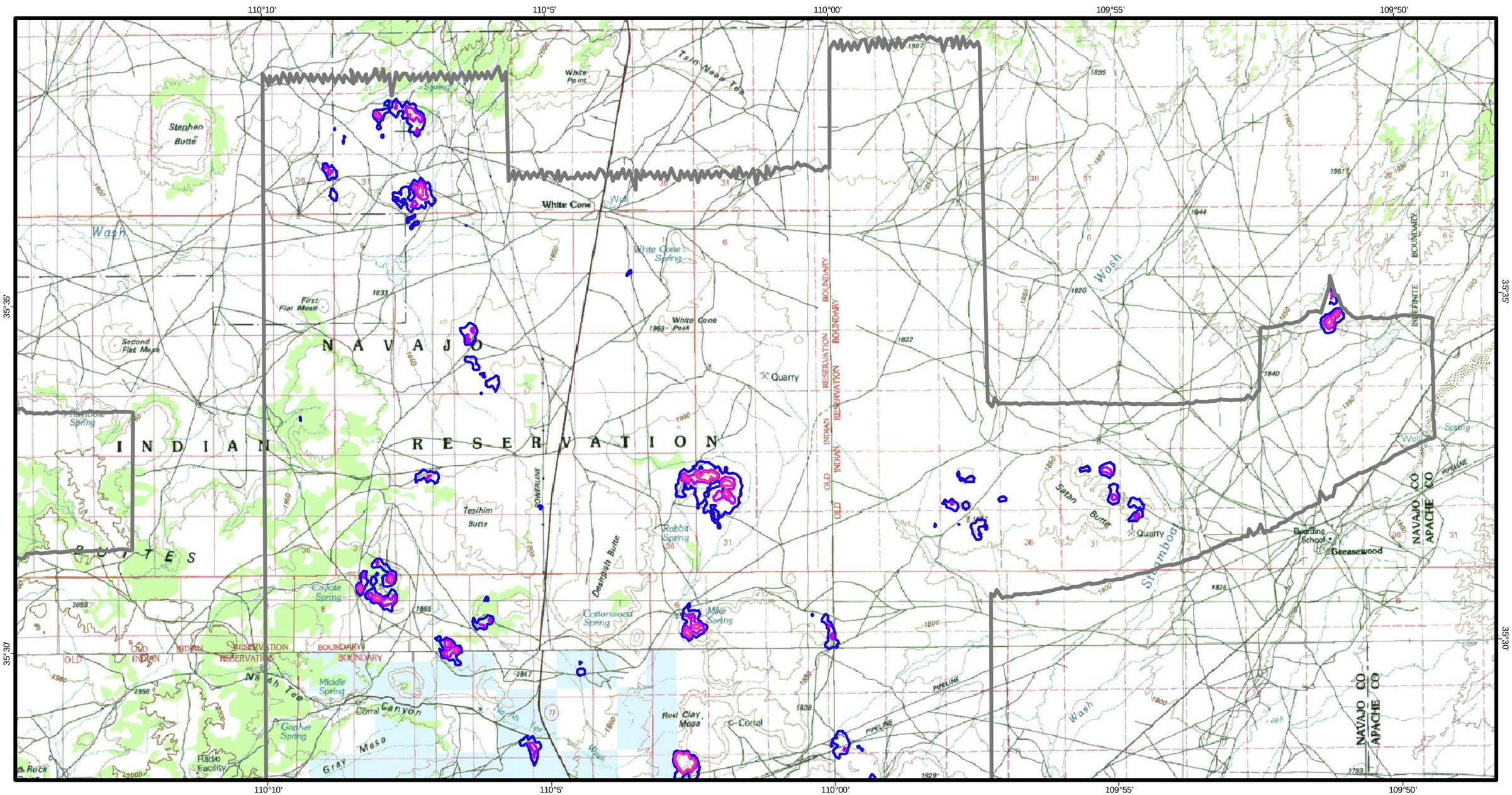
4

SUMMARY OF WATER QUALITY ANALYSIS AND BISMUTH 214 CONTOURS

5 0 5 Miles
5 0 5 10 Kilometers
1:350,000

U.S. Environmental Protection Agency
ABANDONED URANIUM MINES PROJECT

Bidahochi Area



INDIAN WELLS - NORTH

Aerial Radiation Contours	Derived contour-level Bismuth 214 photo-peak (excess counts per second)	Estimated exposure rate from excess Bismuth 214 (excess micro-R/hour)
	80	3.5
	170	7.4
	250	10.9
	800	34.9
	1200	52.4

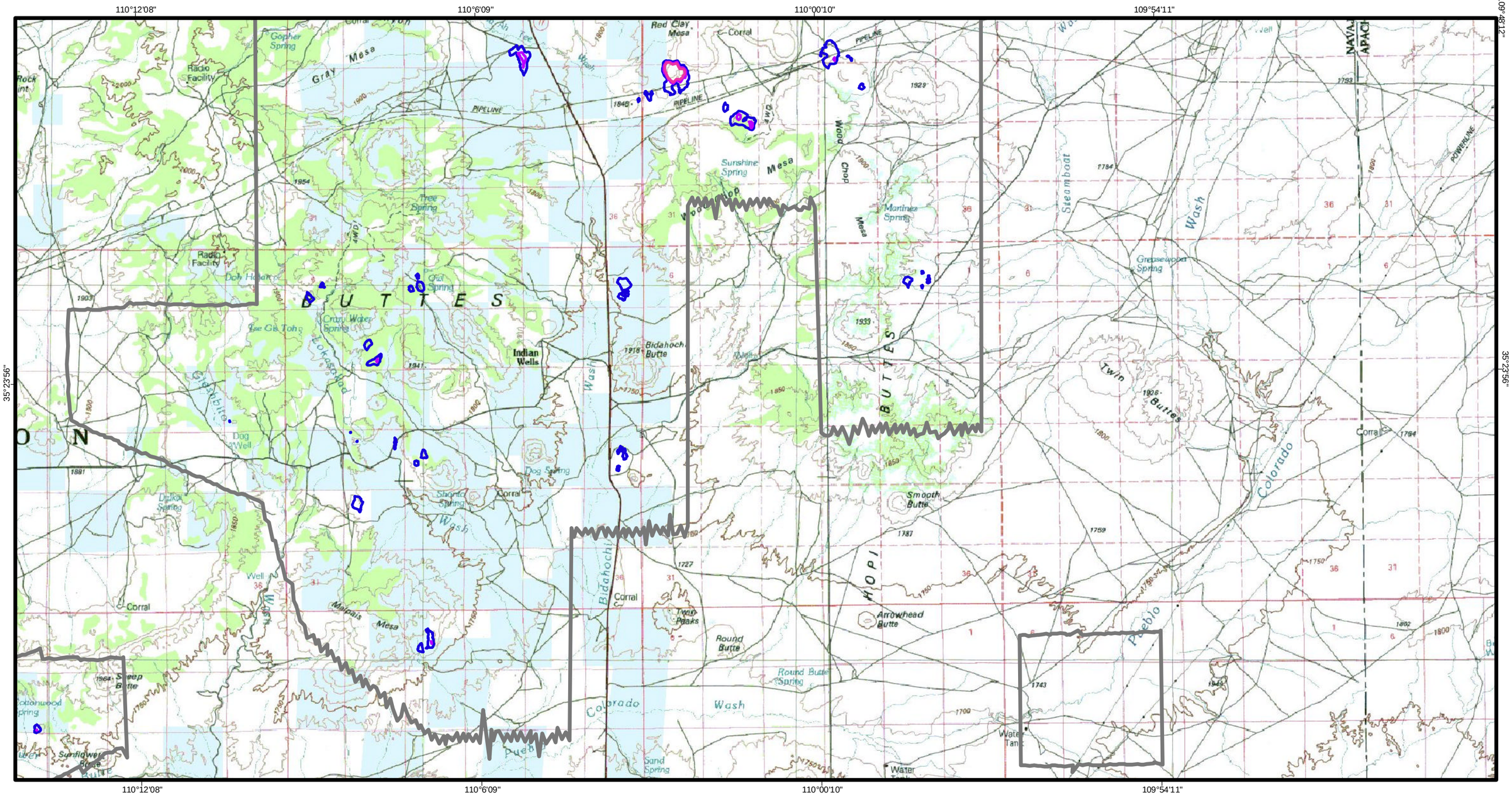
4

AERIAL RADIATION CONTOURS
BISMUTH 214
INDIAN WELLS - NORTH

1 0 1 2 Miles
1 0 1 2 3 Kilometers
1:100,000

U.S. Environmental Protection Agency
ABANDONED URANIUM MINES PROJECT

Bidahochi Area



INDIAN WELLS - SOUTH

Aerial Radiation Contours	Derived contour-level Bismuth 214 photo-peak (excess counts per second)	Estimated exposure rate from excess Bismuth 214 (excess micro-R/hour)
	80	3.5
	170	7.4
	250	10.9
	800	34.9
	1200	52.4

4

AERIAL RADIATION CONTOURS
BISMUTH 214
INDIAN WELLS - SOUTH

1 0 1 2 Miles

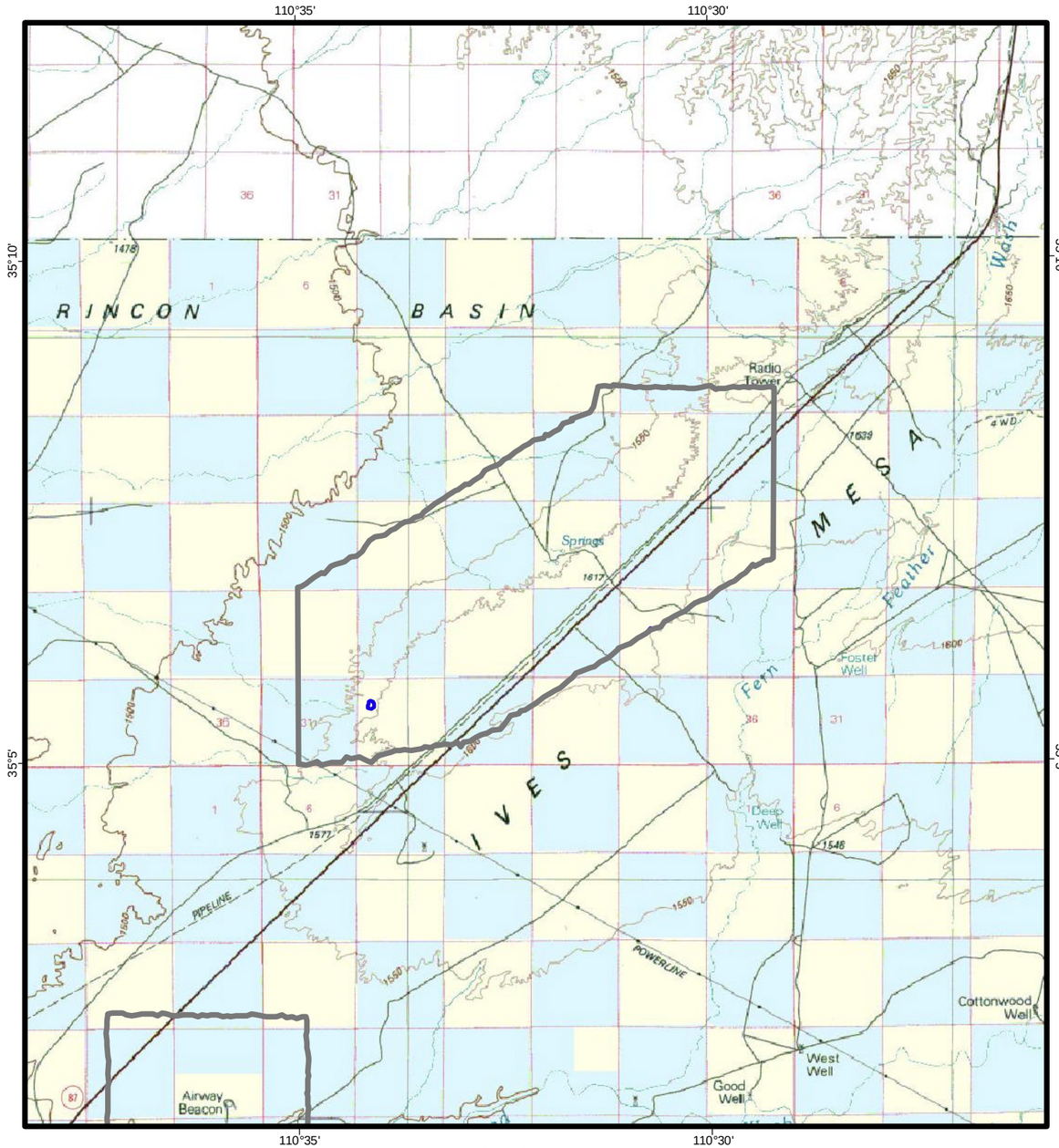
1 0 1 2 3 Kilometers

1:100,000

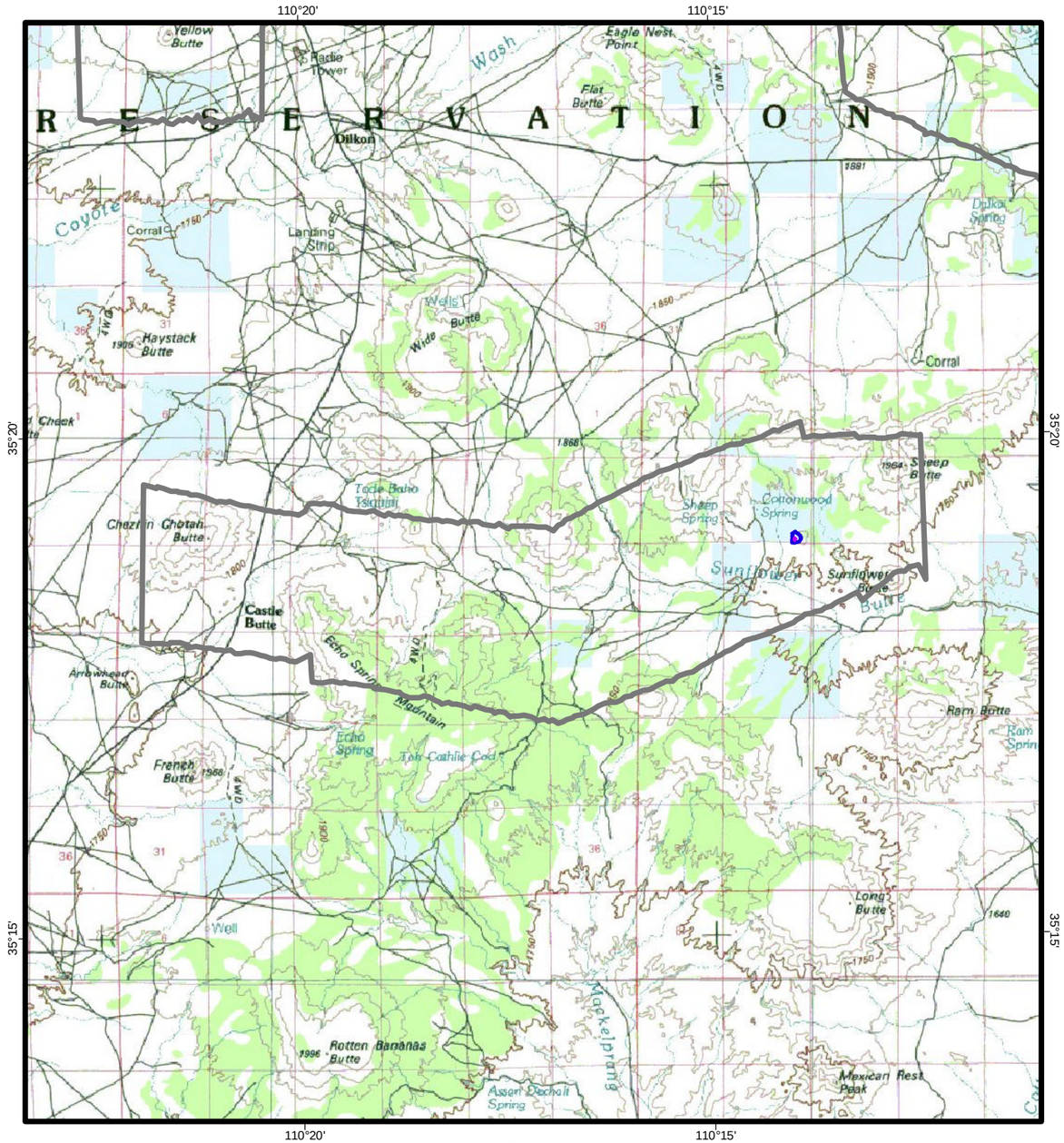
U.S. Environmental Protection Agency

ABANDONED URANIUM MINES PROJECT

Bidahochi Area



WINSLOW A



DILKON

Aerial Radiation Contours	Derived contour-level Bismuth 214 photo-peak (excess counts per second)	Estimated exposure rate from excess Bismuth 214 (excess micro-R/hour)
	80	3.5
	170	7.4
	250	10.9
	800	34.9
	1200	52.4

4

AERIAL RADIATION CONTOURS BISMUTH 214 WINSLOW A AND DILKON

1 0 1 2 Miles

1 0 1 2 3 Kilometers

1:100,000

U.S. Environmental Protection Agency

ABANDONED URANIUM MINES PROJECT

Bidahochi Area