



January 2011

Hydrogeology, Groundwater Quality, and Existing Wells Minidoka National Historic Site, Idaho

Introduction

Minidoka National Historic Site is an undeveloped unit of the National Park Service. It is about 15 miles east of Jerome and 15 miles north of Twin Falls. The historic site was established, “to protect, preserve, and interpret the resources associated with the former Minidoka Relocation Center where Japanese Americans were incarcerated during World War II.”

A concentrated Animal Feeding Operation (CAFO) is proposed about 1½ miles west of the monument. There are concerns about the potential impact of the CAFO to affect groundwater resources underlying the monument. Additionally, general information regarding local hydrogeology and existing wells is needed to aid with development plans for visitor facilities.

Hydrogeology

Minidoka Internment Camp National Monument (MIIN) overlies the eastern Snake River Plain Aquifer. The eastern Snake River plain was formed by the deposition of basaltic lava extruded from numerous vents across the plain. Wind and water deposited sediments overlie the basalt in most areas and are also found interbedded with basalt flows in the subsurface.

The aquifer includes a series of relatively thin basalt flows and interbedded sediments. Flows range in thickness from a few feet to tens of feet. Individual flows typically have a rubble or clinker zone at the top and bottom with a more massive interior containing fewer vesicles. Vertical fractures in the flow interiors form columnar basalt in some locations. The collective thickness of basalt flows of the eastern Snake River Plain is about a thousand feet in the vicinity of MIIN.

Prolific amounts of water can be withdrawn from the layered basalts aquifer of the eastern Snake River Plain. The repetitive sequence of successive basalt flows that make up the aquifer provide favorable hydrologic conditions for water to move quickly through the system.

Figure 1 is a portion of the water table contour map from measurements made in 1959 (Mundorf et.al., 1964). The map shows that groundwater flow in the vicinity of MIIN is from east to west with a gradient of approximately 15 feet per mile.

Figure 2 is a portion of another water table contour map for water levels measured in March 1980 (Lindholm et.al., 1982). Again we see that groundwater flow is from east to west with a gradient of about 15 feet per mile.

Figure 3 shows a more detailed water table map for the vicinity of MIIN using water level measurement data from October 2008. The 2008 map is essentially the same as maps using data from 1980 and 1959. At least at the scale of these maps, it appears that the water table is nearly unchanged over the past 50 years.

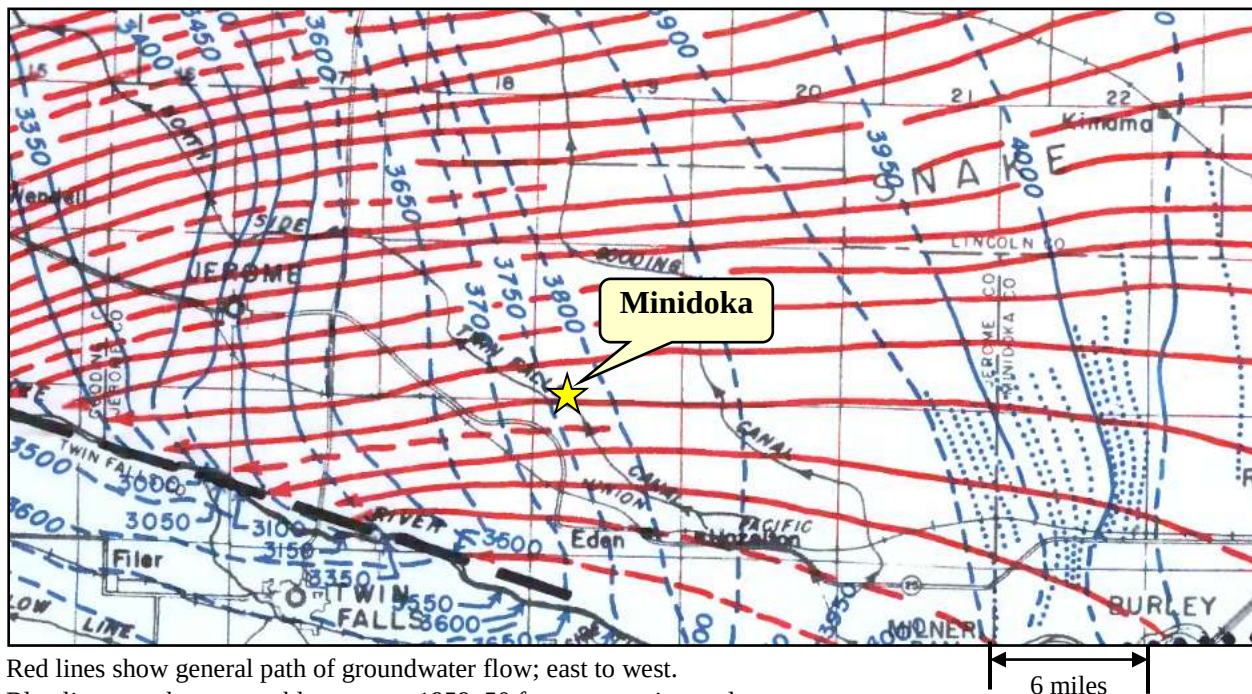


Figure 1. Water table contour map and flow net of the Snake River Plain Aquifer, Idaho

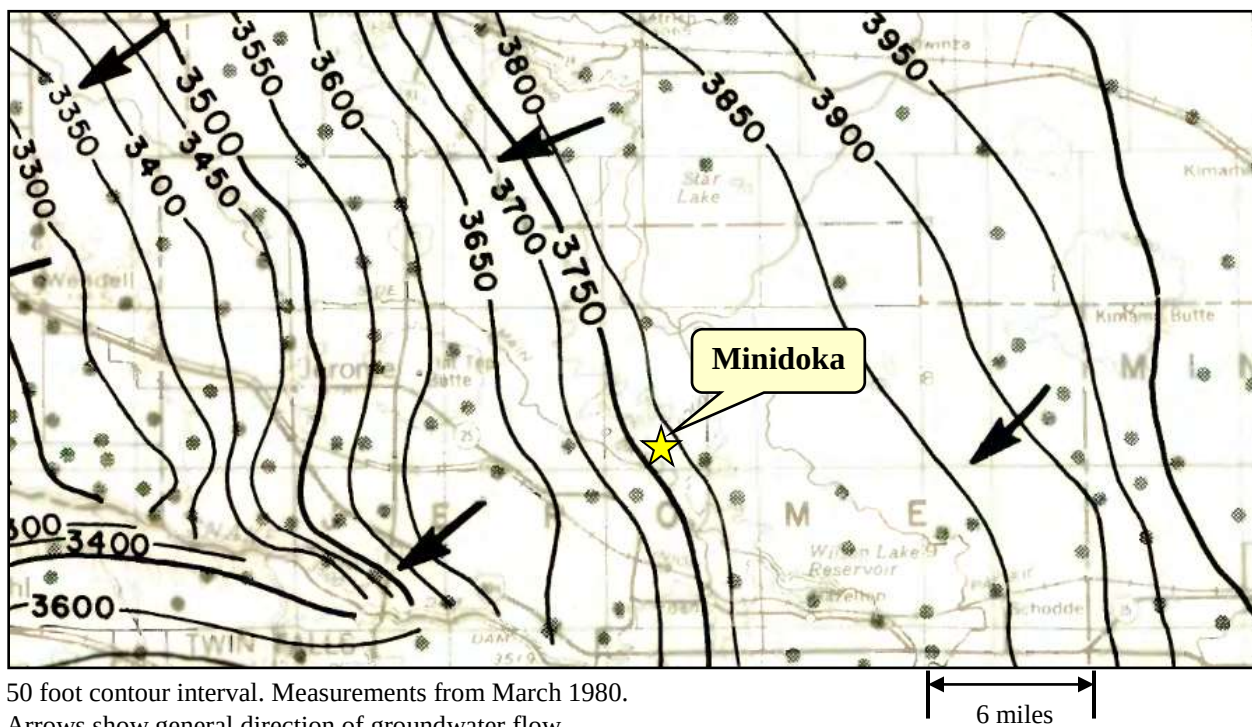
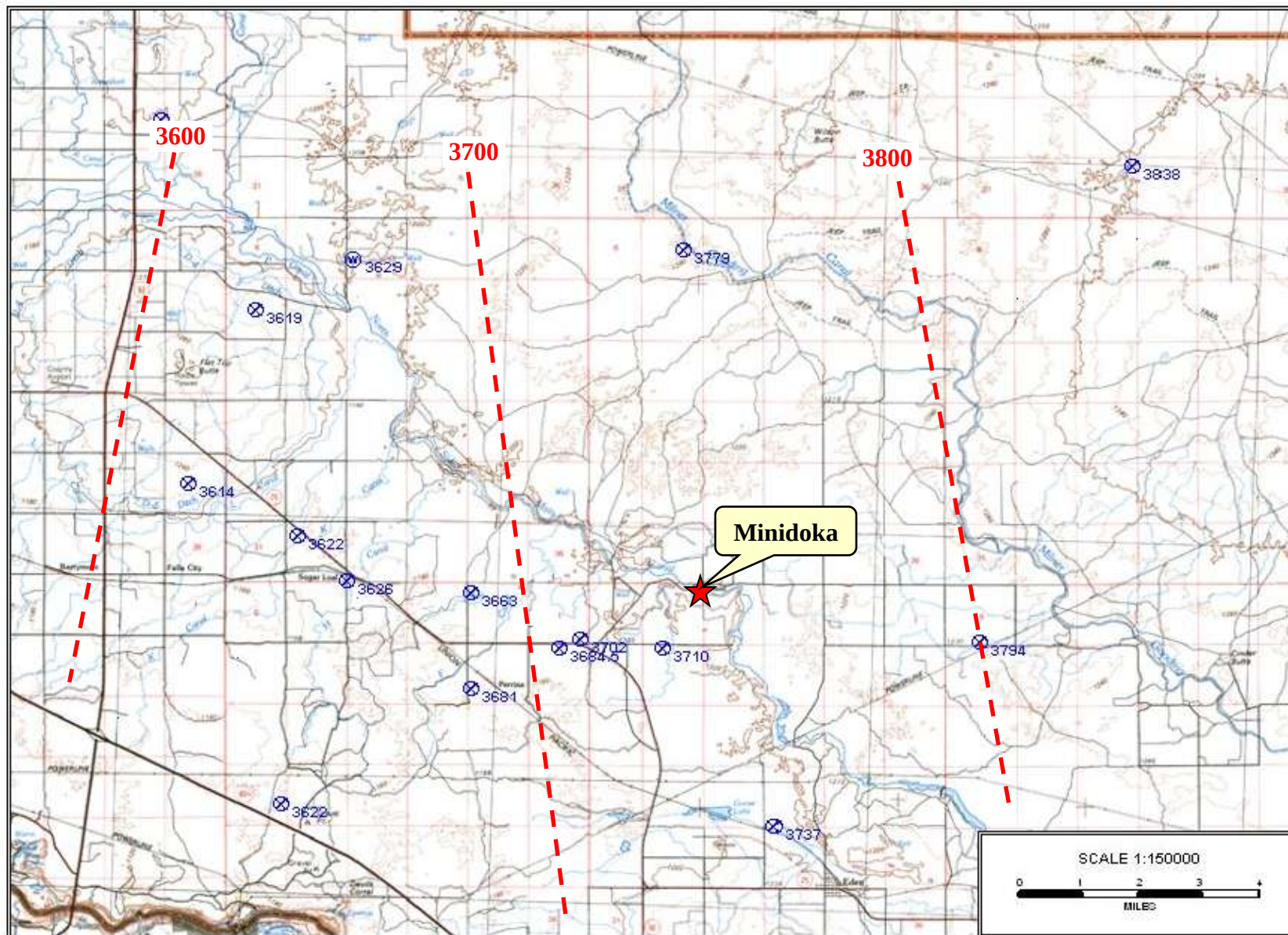


Figure 2. Water table contour map of the Snake River Plain Aquifer, Idaho; March 1980



Source: USGS NWIS <http://waterdata.usgs.gov/nwis/gw> and IDWR hydro.online <http://www.idwr.idaho.gov/hydro.online/gwl/default.html>

Figure 3. Water table contour map for the vicinity of Minidoka Internment National Monument. October 2008

Existing Wells

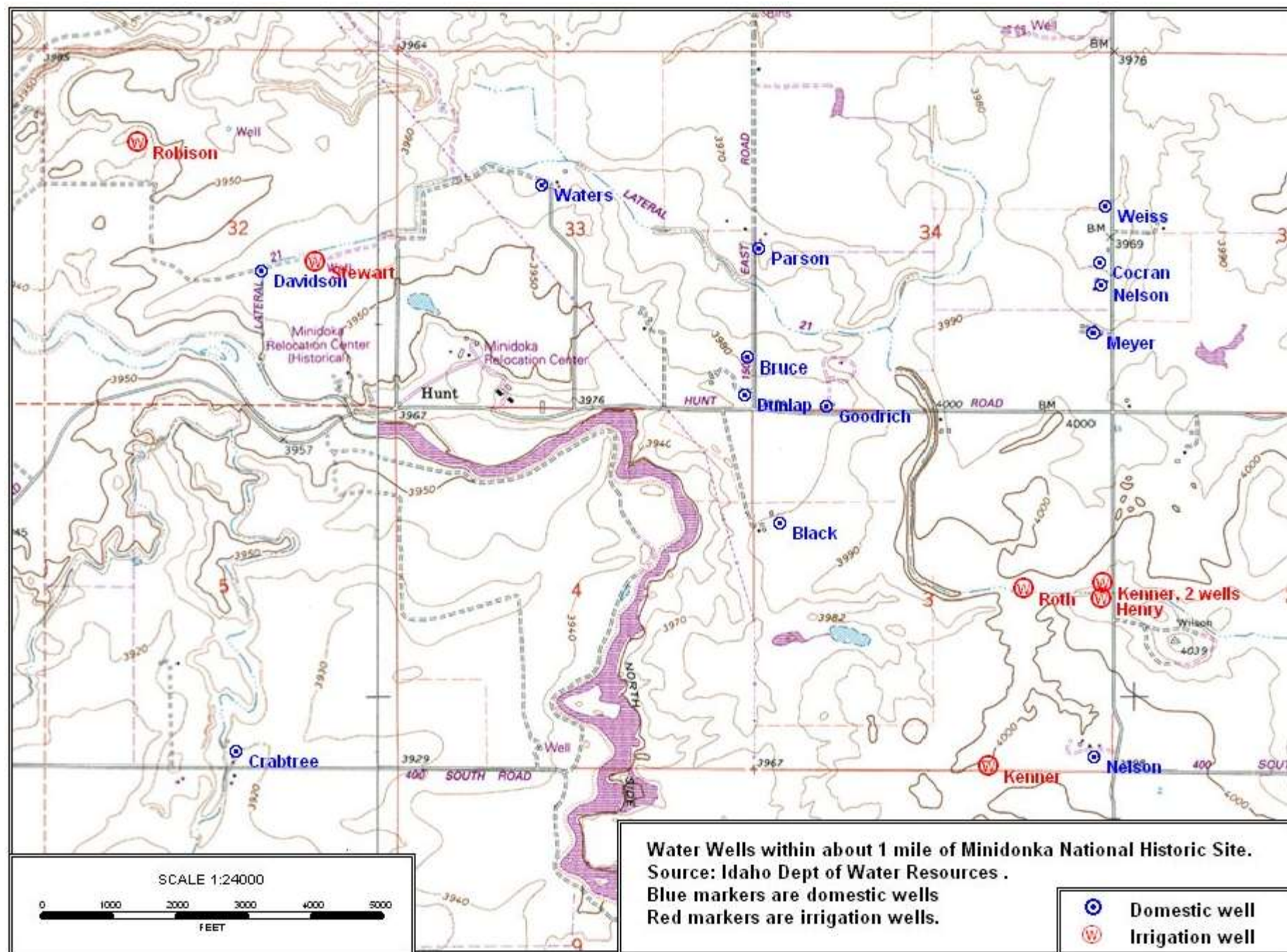
Water well completion records from Idaho Department of Water Resources were searched to identify wells within about one mile of MIIN <http://www.idwr.idaho.gov/WaterManagement>. Records were searched by public land survey system. The search included sections 32, 33, and 34 of T8S, R19E and sections 3, 4, and 5 of T9S, R19E. The search found two irrigation wells within about ½ mile northwest of MIIN and five irrigation wells about 1-1½ miles southeast of MIIN. Thirteen domestic supply wells are in the search area. This search yielded only records for wells registered with IDWR. Older wells, particularly older domestic wells, may not be included in this database, if they were constructed prior to requirements for obtaining permits for domestic wells.

Basic information for the wells in the vicinity of MIIN is summarized in Table 1. Approximate locations of the wells are shown on Figure 4. In most cases, the well location should be accurate to within a 40-acre tract, provided that the location on the well completion report is correct. In many cases, the registered owner will be different from the current owner.

Table 1. Summary of information for water-supply wells near Minidoka National Historic Site.

Registered Owner	Location	Use	Depth	Depth to Water
Randy Waters	SE¼,NW¼, Sec.33, T8S, R19E	Dom	355'	221'
Don Bruce	SE¼,SE¼, Sec. 33, T8S, R19E	Dom	305'	244'
Marvin Dunlap	SE¼,NE¼, Sec. 34, T8S, R19E	Dom	355'	210'
Gary Weiss	SE¼,SE¼, Sec. 33, T8S, R19E	Dom	345'	308'
Ronald Parson	NW¼,SW¼, Sec. 34, T8S, R19E	Dom	338'	---
Russell Nelson	NE¼,SE¼, Sec. 34, T8S, R19E	Dom	230'	170'
Chris Meyer	SE¼,SE¼, Sec. 34, T8S, R19E	Dom	300'	180'
Kermit Cocran	NE¼,SE¼, Sec. 34, T8S, R19E	Dom	303'	238'
Harold Goodrich	xx¼,xx¼, Sec. 34, T8S, R19E	Dom	309'	177'
Don Black	SW¼,NW¼, Sec. 3, T9S, R19E	Dom	245'	208'
Bryant Nelson	SE¼,SE¼, Sec. 3, T9S, R19E	Dom	270'	212'
Robert Crabtree	SW¼,SE¼, Sec. 5, T9S, R19E	Dom	270'	188'
Larry Davidson	NW¼,SE¼, Sec. 32, T8S, R19E	Dom	280'	230'
Roth Investments	SE¼,NE¼, Sec. 3, T9S, R19E	Irr	330'	194'
Bob Henry	NE¼,SE¼, Sec. 3, T9S, R19E	Irr	260'	196'
Eugene Kenner	SE¼,NE¼, Sec. 3, T9S, R19E	Irr	676'	206'
Eugene Kenner	SE¼,NE¼, Sec. 3, T9S, R19E	Irr	676'	206'
Eugene Kenner	SW¼,SE¼, Sec. 3, T9S, R19E	Irr	295'	192'
Fred Stewart	NW¼,SE¼, Sec. 32, T8S, R19E	Irr	400'	229'
T.C. Robison	NW¼,NW¼, Sec. 32, T8S, R19E	Irr	295'	227'

Dom = domestic, Irr = irrigation



Records for existing wells show that the water table is generally about 200 feet below ground surface. Water-supply wells for domestic use are generally drilled to about 100 feet below the water table to provide an adequate, reliable supply. If larger volumes of groundwater are desired, such as for irrigation wells, drilling continues several hundred feet to encounter multiple zones of large permeability at the top and bottom of individual basalt flows.

A new well could be drilled at any location at MIIN to about 300-350 feet to provide an ample supply (several tens gpm) for visitor facilities.

Groundwater Rights

Paul Christensen (NPS-Water Resources Division) researched groundwater rights on property that will be owned or controlled by NPS and will be included in the historic site. He found three wells with associated groundwater rights. Interestingly, none of these wells showed up on the IDWR well log database, cited in the preceding section. No information was found regarding depth, construction, or yield for these wells. Approximate locations of the wells are shown in Figure 5.

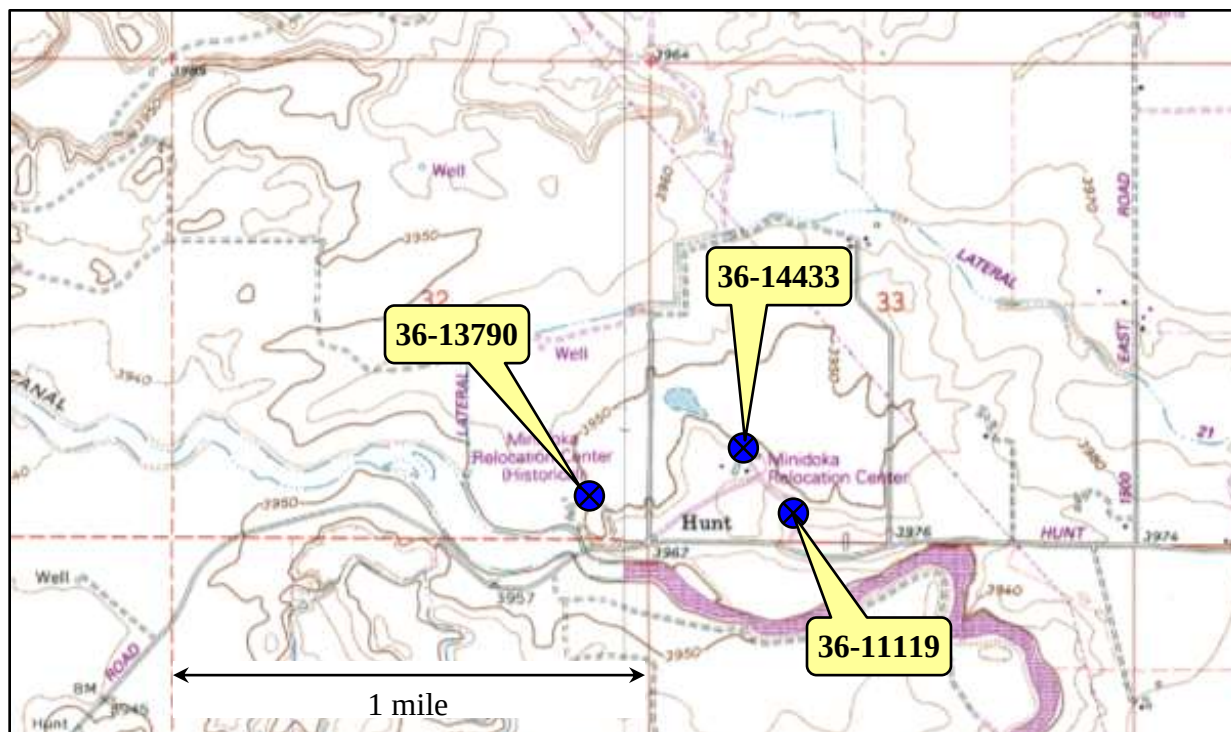


Figure 5. Approximate locations of wells associated with groundwater rights at MIIN.

The well associated with water right 36-13790 is on the former Robison farm (now owned by The Conservation Fund). The well location is in the SE $\frac{1}{4}$ of the SE $\frac{1}{4}$, Section 32, T8S, R19E. The water right is for stock and domestic use up to 13,000 gpd. It appears that this well has been sampled several times to obtain samples for water quality analyses (discussed later in this report).

The well associated with water right 36-14433 is on the former Hermann farm, now referred to as “Farm-in-a-Day. The well location is in the NE¼ of the SW¼ of the SW¼, Section 33, T8S, R19E. The water right is for stock and domestic use up to 13,000 gpd.

The well associated with water right 36-11119 was originally owned by the Bureau of Reclamation. Ownership of the land, well, and water right has been transferred to NPS. The well location is in the SW¼ of the SE¼ of the SW¼, Section 33, T8S, R19E. The water right is for domestic use up to 13,000 gpd.

Groundwater Quality

In 1990, the Idaho Department of Water Resources (IDWR), with help from other state and federal agencies, started the Statewide Ground Water Quality Monitoring Program. By the fall of 1994, the Statewide Program network included over 1,500 monitoring sites. Every year, about 400 monitoring sites are sampled. Most sites are sampled once every five years. Water quality results include: bacteria, nutrients, common ions (calcium, magnesium, etc.), trace elements (iron, arsenic, lead, etc.), pesticides, volatile organic compounds, and radioactivity.

The well at the former Robison farm (SE¼ of the SE¼, Section 32, T8S, R19E) is included in the Statewide Ground Water Quality Monitoring Program. It was sampled in 1994, 1998, 2003, and 2008. Data are tabulated in Table 2. Samples collected in 1994 and 1998 were analyzed for a suite of pesticides, herbicides, and VOCs (volatile organic compounds). None were detected at concentrations exceeding the detection limits of the lab analyses.

Groundwater quality data for other wells in the general vicinity of Minidoka National Historic Site are tabulated in Tables 3 and 4. Water quality from all of these wells is very similar to that of the well at MIIN (Table 2). That is to be expected since all of the wells are completed in the basalt flows of the Snake River Plain aquifer. Wells completed in similar hydrogeologic settings should have similar water chemistry.

Groundwater Levels

The Idaho Department of Water Resources (IDWR) Hydrology Section maintains a database of information on groundwater levels in Idaho.

<http://www.idwr.idaho.gov/WaterInformation/GWLevels/default.htm>

The IDWR database includes data acquired by a number of sources, including U.S. Geological Survey, IDWR contractors, IDWR staff, and the U.S. Bureau of Reclamation. I searched the IDWR database for water level data within about a five mile radius of MIIN. The search identified 33 wells with four or more water level measurements. (Many more wells have only a few water level measurements.) Figure 6 is a hydrograph of the three wells with the longest period of record of water level measurements in the vicinity of MIIN.

Water table elevations declined about 20 feet in the late 1950s to early 1960s, probably coinciding with increased pumping of groundwater for irrigation. This decline is generally attributed to the introduction of cheap electricity to rural areas. Irrigators began to switch from flood irrigation using surface water sources to sprinklers supplied from groundwater sources. Sprinkler irrigation results in less incidental recharge than flood irrigation, so the aquifer was supporting more irrigation while receiving less recharge.

There is another decline of about 20 feet in the early 2000s, probably caused by drought. Drought causes farmers and irrigation companies to incorporate conservation measures (seal leaky canals, install more efficient sprinkler systems), further reducing incidental recharge to the aquifer. As drought conditions ease, these conservation measures are not undone. They remain in place, causing a permanent decrease of incidental recharge. The aquifer continues to get less and less incidental recharge with more competition for limited water supplies and as irrigation practices become more efficient.

Despite the observed water level declines, there remains an adequate thickness of saturated aquifer underlying MIIN to provide a reliable source of groundwater for park purposes. Examination of well logs for wells within about a mile of MIIN showed that none of the wells fully penetrate the aquifer. Many of the wells are more than 300 feet deep and the Kenner irrigation wells are nearly 700 feet deep (Table 1).

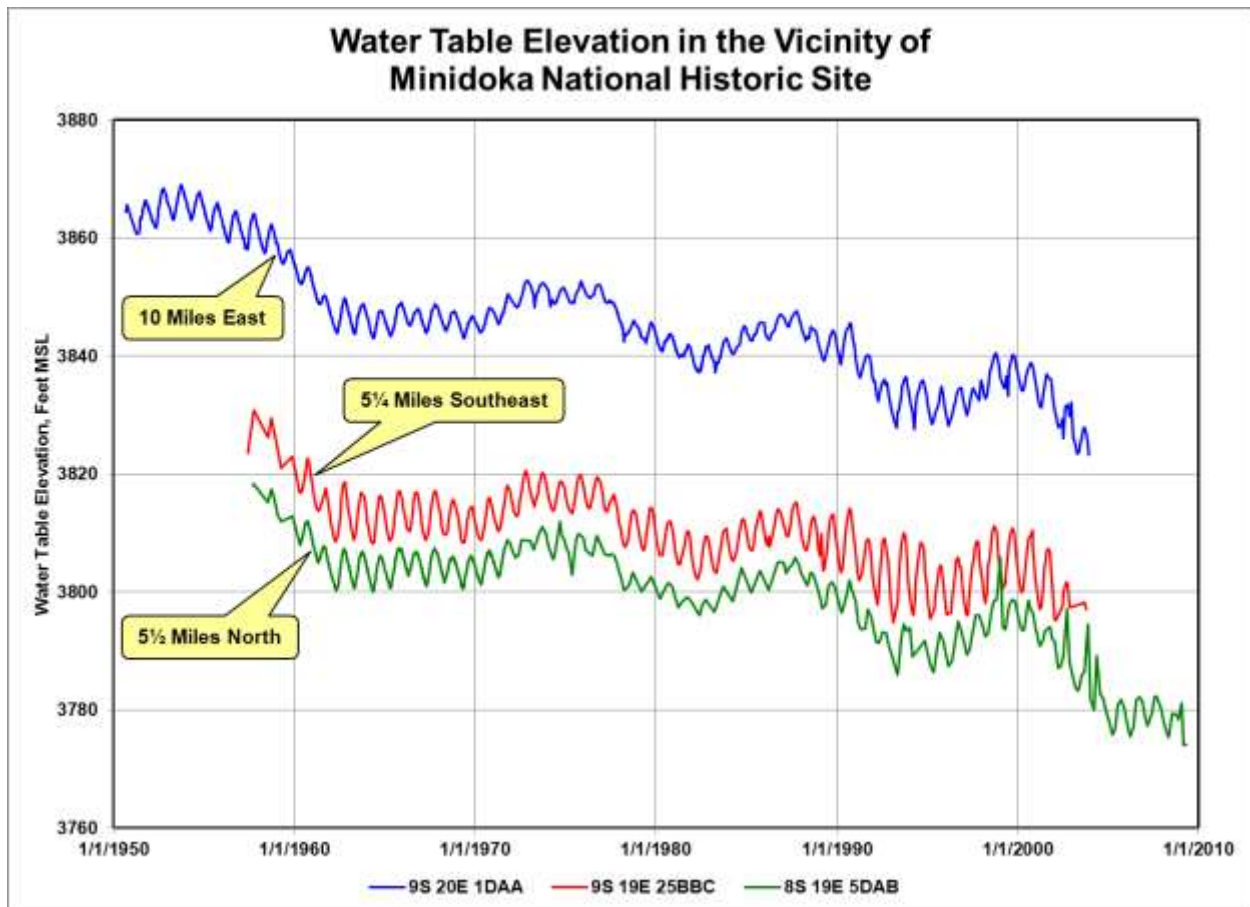


Figure 6. Water table elevation in the vicinity of Minidoka National Historic Site.

In 2009, IDWR began developing a “Comprehensive Aquifer Management Plan” in response to groundwater level declines in the Eastern Snake River Plain Aquifer and associated decreases in aquifer storage, decreased flow from springs, and changes to flow in the Snake River. The plan

establishes a conjunctive management plan for groundwater and surface water resources, including increasing recharge to the aquifer and reducing withdrawals from the aquifer. These actions should reduce future groundwater level declines, and perhaps result in rising groundwater levels in some areas. Actions taken by IDWR as part of the aquifer management plan should protect groundwater resources underlying MIIN from drastic declines in the future.

Summary

There is an abundant supply of good-quality groundwater underlying Minidoka National Historic Site. The proposed CAFO is downgradient from the park. Any contaminants that might enter surface water adjacent to the CAFO or groundwater underlying the CAFO would flow toward the west, away from the park. Neither the quantity nor quality of groundwater is threatened by the proposed CAFO 1½ miles west of the park.

Groundwater level monitoring and water chemistry monitoring conducted by IDWR is adequate to characterize hydrogeologic conditions at the park. The Comprehensive Aquifer Management Plan instituted by IDWR should provide adequate protection of groundwater and the aquifer in the vicinity of the park. Additional groundwater monitoring by NPS is not necessary at this time. In particular, note that the well at Robison farm is sampled regularly as part of IDWR's Statewide Ground Water Quality Monitoring Program.

References

- Clark, David W., Kenneth D. Skinner, and David W. Pollock, 2006, *A graphical modeling tool for evaluating nitrogen loading to and nitrate transport in ground water in the mid-Snake Region, south-central Idaho*, U.S. Geological Survey Scientific Investigations Report 2006-5137, 32 pp.
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- Whitehead, R.L., 1986, *Geohydrologic Framework of the Snake River Plain, Idaho and eastern Oregon*, U.S. Geological Survey Hydrologic Atlas HA-681, 3 sheets.
- Whitehead, R.L., 1994, *Ground Water Atlas of the United States: Idaho, Oregon, Washington*, U.S. Geological Survey Hydrologic Atlas HA-730-H.

Table 2. Groundwater quality data for Station ID 424047114150701;
T8S R19E 32DDC, Robison Farm approx. 0.1 mile from MIIN,
264 feet deep

Parameter		7/13/1994	9/29/1998	8/13/2003	7/1/2008
pH	pH	7.5	7.7	7.6	7.6
Solids	mg/L	295		309	297
Specific Conductance	uS/cm	500	440	518	499
Water Temperature	°C	17.1	16.4	17.5	17.8
Acid neutralizing capacity	mg/l	166	166	179	
Ammonia	mg/l	0.020	<0.020	<0.04	<0.02
Arsenic	ug/L	3	3	3.18	3.3
Bicarbonate	mg/L	203	200	218	194
Cadmium	ug/L	<1.0	<1.0	<0.037	<0.04
Calcium	mg/L	51	44	51.7	52.8
Carbonate	mg/L	0	0	0	0
Chloride	mg/L	24		24.9	24.4
Chromium	ug/L	<1	<1.0		
Copper	ug/L	<1	1.3		12.8
Fluoride	mg/L	0.60		0.66	0.68
Hardness	mg/L	202	180	210	210
Iron	ug/L	5	<10	<8	<8
Lead	ug/L	<1	<1.0		
Magnesium	mg/L	18	16	18.9	18.6
Manganese	ug/L	<1	<3.0	<0.4	0.5
Nitrate	mg/l	0.360	.348	0.397	0.51
Nitrite	mg/l	<0.010	<0.010	<0.008	<0.002
Phosphate, ortho	mg/l	0.060	.072	0.08	0.09
Potassium	mg/L	4.3	3.7	4.3	4.86
Selenium	ug/L	<1	<1	E0.45	0.47
Silica	mg/L	28	30	28	28.9
Sodium	mg/L	24	21	28.3	23.8
Sulfate	mg/L	43		42.7	44.6
Zinc	ug/l	27	91		

Table 3. Groundwater quality data for wells near Minidoka National Historic Site.

Station ID		423949114153901	424123114190901		424128114183601
PLSS Location		T9S R19E 08BAB1 1 mile SSW	T8S R18E 35BACD1 3½ miles WNW		T8S R18E 35AAC1 3 miles WNW
Well Depth		246 ft	245 ft	245 ft	325 ft
Date		8/31/1992	6/13/2001	4/24/2002	8/13/1993
pH	pH	7.79	7.7	7.9	7.8
Solids	mg/L	430	366	373	387
Specific Conductance	uS/cm	712	620	637	638
Water Temperature	°C	15.3	14.7	13.7	14.2
Acid neutralizing capacity	mg/l	192	170	172	171
Ammonia	mg/l	0.010	<0.04	<0.04	.03
Arsenic	ug/L	2	2	2.5	2
Bicarbonate	mg/L	235	204	204	208
Cadmium	ug/L	<1.0	<0.1	0.04	<1.0
Calcium	mg/L	65	59	57.4	59
Carbonate	mg/L	0	0	0	0
Chloride	mg/L	62	48	52.9	52
Chromium	ug/L	2	2.2	--	<1
Copper	ug/L	<1	<1.0	--	2.0
Fluoride	mg/L	0.40	0.67	0.57	0.5
Hardness	mg/L	257	229	230	238
Iron	ug/L	<3	<10	<10	<3
Lead	ug/L	<1	<1	--	<1
Magnesium	mg/L	23	19.8	21	22
Manganese	ug/L	<1	<3	0.9	<1
Mercury	ug/L	<0.1	<0.01	--	<0.1
Nitrate	mg/l	2.50	<1.72	<1.81	<1.7
Nitrite	mg/l	<0.010	<0.006	<0.008	<0.010
Phosphate, ortho	mg/l	0.020	0.077	0.043	0.031
Potassium	mg/L	6.6	4.96	5.05	5.10
Selenium	ug/L	<1	<2	0.8	<1
Silica	mg/L	37	31.7	32.4	35
Sodium	mg/L	40	33.1	33.5	35
Sulfate	mg/L	69	60.3	62.1	69
Zinc	ug/L	22	<20	--	5

Table 4. Groundwater quality data for a well 2½ miles E of Minidoka National Historic Site.

Station ID	424043114113801					
PLSS Location	T8S R19E 35DDC1					
Well Depth	237 ft					
Date		8/13/1993	7/13/1994	9/22/1998	7/31/2003	7/1/2008
pH	pH	7.7	7.8	7.8	7.7	7.8
Solids	mg/L	423	417	---	395	379
Specific Conductance	uS/cm	690	689	660	600	623
Water Temperature	°C	13.8	13.9	13.9	13.9	13.6
Acid neutralizing capacity	mg/l	191	174	188	172	174
Ammonia	mg/l	0.02	0.02	<0.02	<0.04	<0.02
Arsenic	ug/L	2	2	2	2.3	2.3
Bicarbonate	mg/L	233	212	229	209	210
Cadmium	ug/L	<1.0	<1.0	<1.0	<0.04	<0.04
Calcium	mg/L	63	65	58.7	64.2	57.6
Carbonate	mg/L	0	0	0	0	0
Chloride	mg/L	52	60	---	53.2	48.2
Chromium	ug/L	<1	1.5	1.5	---	---
Copper	ug/L	2.0	<1.0	1.0	---	0.69
Fluoride	mg/L	0.4	0.5	---	0.5	0.51
Hardness	mg/L	256	---	241	257	234
Iron	ug/L	8	3	<10	5	6
Lead	ug/L	<1	<1	<1	---	---
Magnesium	mg/L	24	24	23	23.6	21.8
Manganese	ug/L	2.0	<1.0	<3.0	0.9	0.2
Mercury	ug/L	<0.1	---	---	---	---
Nitrate	mg/l	<1.6	<1.5	<1.59	<1.82	<1.75
Nitrite	mg/l	<0.01	<0.01	<0.01	<0.008	<0.002
Phosphate, ortho	mg/l	0.061	<0.031	0.058	0.052	0.081
Potassium	mg/L	5.1	5.1	4.84	4.94	5.22
Selenium	ug/L	<1	<1	2	1.2	1.0
Silica	mg/L	35	35	---	34.3	34
Sodium	mg/L	40	41	39.9	38	36
Sulfate	mg/L	81	76	---	65.5	63.4
Zinc	ug/L	360	71	58	---	---