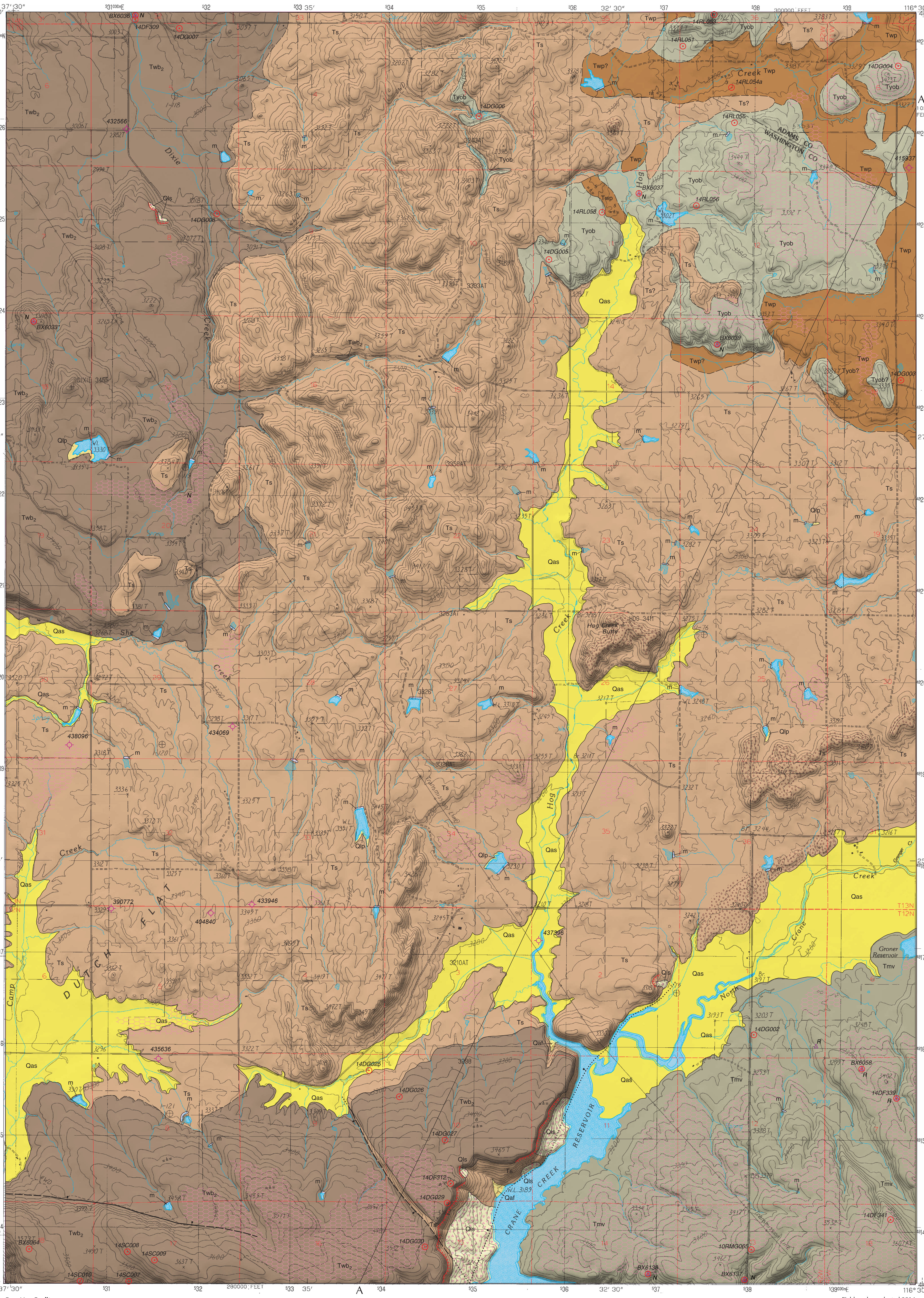
Geologic Map of the Hog Creek Butte Quadrangle, Washington and Adams Counties, Idaho

Dennis M. Feeney, Reed S. Lewis, William M. Phillips, Dean L. Garwood, and Skye W. Cooley

2016



Base Map Credit

Base digitally scanned from 24,000-scale USGS film separates, 1986.

Shaded elevation from 10 m DEM.

Topography by photogrammetric methods from aerial photographs taken 1980. Field checked 1982.

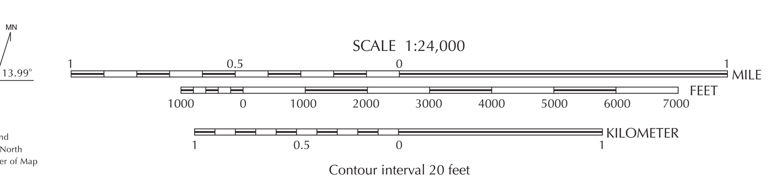
Map edited 1986.

Projection: Idaho coordinate system, west zone (Transverse Mercator). 1927 North American Datum.

10,000-foot grid ticks based on Idaho coordinate system, west zone.

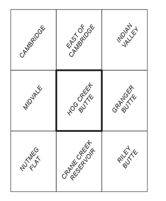
1000-meter Universal Transverse Mercator grid ticks, zone 11.

Declination from NOAA National Geophysical Data Center.



Contour interval 20 feet

QUADRANGLE LOCATION



ADJOINING QUADRANGLES

Field work conducted 2014.

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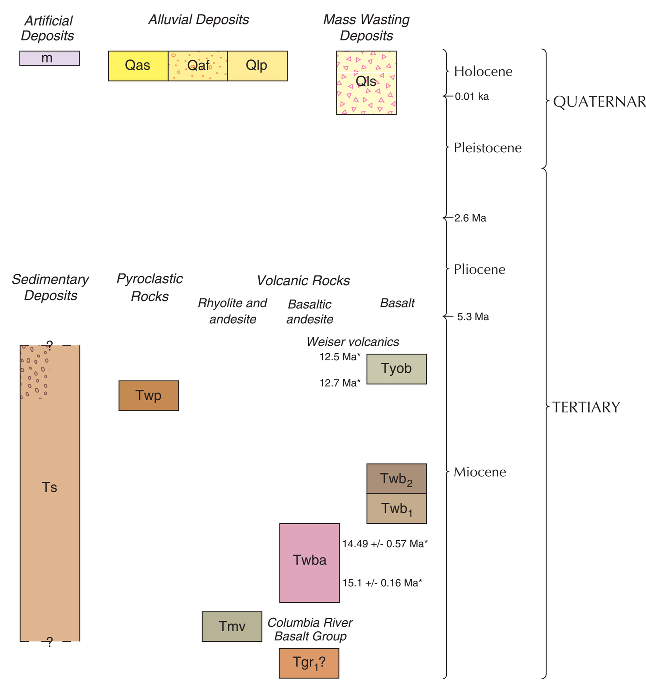
Digital cartography by Loudon R. Stanford at the Idaho Geological Survey's Digital Mapping Lab.

Technical review status: Authors only.

Map version 4-7-2016.

PDF (Acrobat Reader) map may be viewed online at www.idahogeology.org.

CORRELATION OF MAP UNITS



*Richard Gaschnig, personal comm., 2015.

INTRODUCTION

The geologic map of the Hog Creek Butte 7.5′ quadrangle depicts the rock units exposed at the surface or underlying a thin cover of soil or colluvium; alluvial and man-made surficial deposits are also depicted where they form significant mappable units. This map is a result of fieldwork conducted in the summer and autumn of 2014 by the authors. Previous work in the area includes the surficial geology map of Othberg (1982), and geology of the Payette National Forest (Lund, 2004). The field maps, field notes, fluxgate magnetometer data, XRF analytical chemistry, and posthumous Ph.D. by James Fitzgerald (1981, 1982, and 1984) were consulted and incorporated where appropriate.

The basement rocks of the Hog Creek Butte 7.5′ quadrangle are Miocene compositionally diverse flows of the Weiser volcanics. The Weiser volcanics were likely erupted along north-northwest trending linear vents that followed regional structures to the south and west and flowed over older Columbia River Basalt Group volcanics. We use stratigraphy, whole-rock XRF geochemistry, paleomagnetic data, and morphology to differentiate volcanic units. In evaluating the whole-rock geochemistry we use the total alkalis versus silica chemical classification of volcanic rocks from the International Union of Geological Sciences (LeBas and Streckeisen, 1991). Hog Creek Butte quadrangle shows the thinning of the Weiser volcanics to the east. The "mixed volcanics" unit on the southeast quarter of the map may mark the eastern extent of Weiser volcanics. The distribution of Tertiary sedimentary deposits across the central, northern, and eastern part of the quadrangle indicates the depositional environment was largely channelized by preexisting volcanics.

SYMBOLS

Contact: dashed where approximately located.

Normal fault: ball and bar on downthrown side; dashed where approximately located; dotted where concealed.

3 Approximate strike and dip of volcanic flows.

Estimated strike and dip direction of volcanic flows.

434069 Water well showing Well ID number. Selected water wells shown with Idaho Department of Water Resources WellID number. Water well logs can be found at http://www.idwr.idaho.gov/apps/appswell/RelatedDocs.asp?WellID=xxxxxx where "xxxxxx" is the six-digit WellID.

14RL056 Geochemical sample location.

R Fluxgate magnetometer reading location (R - reverse; N - normal).

Landslide scarp and headwall.

Patterned ground: Circular to elongate silty mounds separated by gravelly zones form a pattern of contrasting soil characteristics and vegetation that are readily mappable from aerial images. The mounds average 9 to 29 m (30 to 95 ft) in diameter and 0.3 to 2 m (1 to 6 ft) in height and they are associated with a grain size contrast that varies from silt and clay in the mounds to gravel in the intermounds. The patterned ground occurs on surfaces of gravel terraces, alluvial fans, and basalt flows with varying degrees of weathering. Malde (1964) noted that patterned ground of soil mounds and stone pavements is common in southern Idaho on gravel fans, basaltic lava flows, and rocky colluvium. His description is aptly applied to the best-developed patterned ground observed in this quadrangle: "Soil mounds in flat areas are closely packed, monotonously uniform circular heaps 50-60 feet across and 3 feet high, but on slopes they are elliptical and lie in rows along paths of soil that trend downhill. Each mound is composed of a lens-shaped cap of silt about 18 inches thick, abruptly underlain by 1-2 feet of brown clay" (Malde, 1964: p. 191). It is likely that the patterned ground formed through periglacial processes during times of colder climate in the Pleistocene. These processes are investigated and modeled by Kessler and Werner (2003), who attribute the resulting landform to freeze-thaw cycles that sort stones and soil.

DESCRIPTION OF MAP UNITS

ARTIFICIAL DEPOSITS

m **Man-made land (Holocene)**—Sand, clay, and boulder fill in small stock-water dams. Thickness is generally less than 2 m (6.5 ft).

ALLUVIAL DEPOSITS

Qlp **Lake and playa deposits (Holocene)**—Fine sand, silt, and clay sorted into thin laminar beds deposited during periodic floods around small man-made reservoirs.

Qas **Alluvium of side streams (Holocene)**—Clayey sand, silt, and fragments of shale in small channels draining landscapes underlain by Tertiary sedimentary deposits (*Ts*); includes broad unchanneled areas underlain by thin re-worked eolian sediments, and floodplain deposits of Crane Creek. Thicknesses range from <1 to 2 m (<3 to 6.5 ft). Many tributary streams are ephemeral. Subject to seasonal flooding during spring snowmelt and summer thunderstorms.

Qaf **Alluvial fan deposits (Holocene)**—Crudely bedded, poorly sorted, gray to brown sand, silt, and clay derived from Tertiary sediments (*Ts*).

MASS WASTING DEPOSITS

Qls **Landslide deposits (Holocene and Pleistocene)**—Rotational slumps of Tertiary sediments (*Ts*) and basalt (*Twb₂*); thickness estimated from topographic profiles is about 43 to 37 m (140 to 120 ft); no recent failures observed on aerial images.

SEDIMENTARY DEPOSITS

Ts **Tertiary sedimentary deposits (Pliocene and Miocene)**—Primarily flat lying to gently dipping fluvial arkosic sand with components of silty sand, to clayey silt, tuffaceous material, and ash. Arkosic sand is medium to coarse grained, subangular to subrounded grains of quartz, potassium feldspar, plagioclase feldspar, and in places trace amounts of biotite, muscovite and tuffaceous material, volcanic ash, and quartzite cobbles and gravel. Present locally are thin (< 5 cm) laminar beds of clay, silt, and organic material, sets of climbing ripples and cross-cutting beds, and quartzite cobbles and gravels. Creates knolls 31 to 84 m (100 to 275 ft) high across the central and north-central part of the map but as interbeds between flows may range from < 1 meter to 61 meters (< 3 feet to 200 feet). Unconsolidated sediments generally do not crop out in quadrangle; exposures include road cuts and small slumps or the landslides near Crane Creek Reservoir. Includes gravel deposits resistant to erosion on Hog Creek Butte in the N ½ sec. 26, T. 13 N., R. 2 W., butte 3389T in the S ½ sec. 2, T. 13 N. R. 2 W., and butte 3412T in the N ½, NE ¼ sec. 36, T. 13 N., R. 2 W. These are lag deposits < 3 m (10 ft) thick of well-rounded cobbles and pebbles composed of basalt, basaltic andesite, andesite, granite, quartzite, and gneiss (shown as a pattern within *Ts*). Also includes gravel with basaltic clasts on the slope above the North Crane Creek terrace in the S ½ sec. 36, T. 13 N., R. 2 W. that might represent a younger deposit. *Ts* consists of undifferentiated Idaho Group and Payette Formation. The unconsolidated sediments of the Payette Formation and Idaho Group have been well described (Lindgren, 1898; Kirkham, 1931; Shah, 1968; Malde and Powers, 1962; McIntryre, 1976b; Nakai, 1979; and Smiley and others, 1975). The most definitive paper is a literature review and interpretation by Kirkham (1931). Kirkham describes the Payette Formation as Miocene sediments interbedded between Columbia River basalt flows, and Idaho formation (later redefined as Idaho Group) as Pliocene, nearly flat lying sediments on top of Columbia River basalts. However, due to the poor exposure of *Ts* and a dearth of fossils, constraining the age is difficult. Our work leads us to believe that some flat-lying sediments are concurrent with the later phases of Weiser volcanics and are older than the proposed Pliocene age. We have mapped *Ts* as undifferentiated until we can resolve a more definitive stratigraphic break.

PYROCLASTIC ROCKS

Twp **Weiser pyroclastic rocks (Miocene)**—Yellow-brown to light-gray tuff. Contains abundant 0.5 to 3 cm clasts of basaltic andesite in a poorly sorted matrix. Layers are crudely sorted and the unit is characterized by little or no soil development. Clasts are subrounded and consist of finely vesiculated yellow-brown basaltic andesite that is enriched in Al_2O_3 and P_2O_5 relative to the other volcanic units in the quadrangle (sample 14DG003, Table 1). Some of the chemical variation may be due to alteration of the clasts (note loss on ignition value of 5.91 percent). Also contains subordinate non-vesicular dark-gray basaltic andesite clasts that are compositionally similar to Grande Ronde Basalt (sample 14RL054a, Table 1) as seen in neighboring maps (Garwood and Othberg, 2009, and Garwood and others, 2009a, 2009b). Mapped to the north as pyroclastic rocks of cinder cone by McIntyre (1976a). Vent for the cinder cone is about 0.8 km (0.5 mi) north of the quadrangle.

VOLCANIC ROCKS

Weiser volcanics

Tyob **Younger olivine basalt (Miocene)**—Light- to medium-gray, fine- to medium-grained trachybasalt. Contains common olivine <2 mm in diameter that is typically altered to iddingsite; rare plagioclase grains as long as 5 mm. Normal magnetic polarity, as determined in the field. Previously mapped by Fitzgerald as Cambridge member of Weiser Basalt (Fitzgerald, 1982), but renamed and reclassified in Idaho Geological Survey's work to the northeast in Indian Valley (Garwood and Othberg, 2009, and Garwood and others, 2009a, and 2009b). Comprised of 10 to 15 flows 2.4 to 4 m (8 to 13 ft) thick as seen in the canyon south of Cambridge, Idaho; however, in the Hog Creek Butte quadrangle only 2 to 4 flows are present. Total alkali versus silica values indicate samples are trachybasalt and trachyandesite (Table 1). Vent location is uncertain but may be to the north and west closer to Sturgill Peak. *Tyob* is tentatively included with the Weiser volcanics. Two samples taken from two separate flows within *Tyob* give $^{40}Ar/^{39}Ar$ ages of 12.5 Ma and 12.7 Ma (Richard Gaschnig, personal communication, 2015). As part of the Weiser volcanics it is the youngest of the mafic units, and may mark the northern extent of Weiser volcanics.

Twb₂ **Weiser basalt 2 (Miocene)**—Medium- to dark-gray with shades of purple, fine- to medium-grained basalt. Phenocrysts and microphenocrysts compose 15 percent; phenocrysts are plagioclase as long as 3 mm, iddingsite up to 2 mm, olivine, and augite; the remaining 85 percent is groundmass. Normal magnetic polarity as determined in the field (fluxgate magnetometer) and by laboratory paleomagnetic analysis (Feeney and others, 2014; Garwood and others, 2014). Formerly mapped as the Star Butte member of Weiser Basalt by Fitzgerald (1982). Consists of up to four flows ranging from about 3 to 9 m (5 to 30 ft) in thickness (Fitzgerald, 1982). Outcrops are long ridges of fractured flows or flats with blocky vesicular flow tops. Generally a capping unit with source areas uncertain. Chemical analyses from this quadrangle and adjacent quadrangles shows *Twb₂* with a SiO_2 content ranging from 46.29 to 48.94 percent, TiO_2 content ranging from 1.60 to 2.64 percent, and P_2O_5 content ranging from 0.56 to 0.95 percent (Table 1; Feeney and others, 2014; Feeney and Phillips, 2016; Garwood and others, 2014); differences in composition may reflect separate flows. Interbeds of tuffaceous material, breccia, or *Ts* are present locally between individual flows and below or above units; no attempt was made to show the interbeds unless mappable at 1:24,000 scale, as in the ashy tuffaceous bed present beneath *Twb₂* Crane Creek Reservoir (secs. 15 and 10, T. 12 N., R. 2 W.).

Twb₁ **Weiser basalt 1 (Miocene)**—Appears in cross section only. Projected from unit mapped to the southwest on Nutmeg Flat quadrangle (Garwood and others, 2014) and to the west on Midvale quadrangle (Feeney and Phillips, 2016).

Twba **Weiser basaltic andesite (Miocene)**—Appears in cross section only. Projected from unit mapped to the southwest on the Nutmeg Flat quadrangle (Garwood and others, 2014) and to the west on Midvale quadrangle (Feeney and Phillips, 2016).

Other volcanic rocks

Tmv **Mixed volcanic rocks (Miocene)**—Dark-gray and very fine-grained andesite and rusty red to brown flow-banded rhyolite. Andesite is mostly aphyric with scarce phenocrysts of plagioclase < 2 mm long. The rhyolite has phenocrysts of plagioclase as long as 3 mm in an extremely fine crystalline matrix. Most of the unit was mapped as Grande Ronde Basalt by Fitzgerald (1981 and 1982). It was later recognized as two rock types intimately associated as "mixed volcanics" by Idaho Geological Survey's work in Indian Valley (Garwood and Othberg, 2009, and Garwood and others, 2009a, 2009b). Major and trace element chemical composition of both andesite and rhyolite from this quadrangle (Table 1) are consistent with samples from Indian Valley (Garwood and Othberg, 2009; and Garwood and others, 2009a; 2009b). The vent is likely located to the east or southeast.

Columbia River Basalt Group

Tgr₁ **Grande Ronde Basalt R1 magnetostratigraphic unit (Miocene)**—Appears in cross-section only. Projected from unit mapped on the Indian Valley quadrangle to the northeast (Garwood and others, 2009b).

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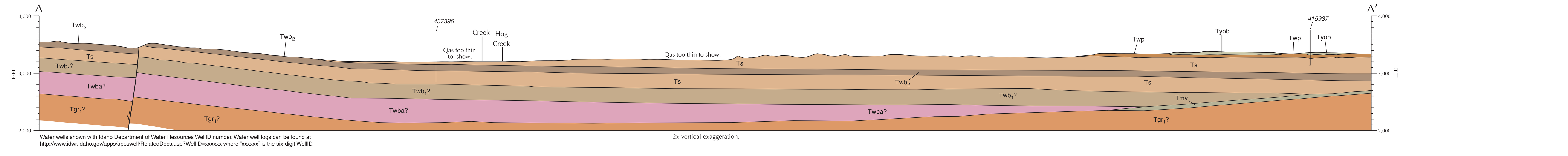
Table 1. Major oxide and trace element chemistry of samples collected in the Hog Creek Butte quadrangle.

Sample number	Latitude	Longitude	Unit name	Map unit	SiO₂	TiO₂	Al₂O₃	Fe₂O₃[#]	FeO[##]	MnO	MgO	CaO	Na₂O	K₂O	P₂O₅	Total	LOI
					Major elements in weight percent												
14DF309	44.4993	-116.6073	Weiser basalt 2	Twb₂	47.01	2.70	14.58	14.68		0.22	7.95	8.71	2.60	0.84	0.79	100.08	2.41
14DF312	44.3848	-116.5639	Weiser basalt 2	Twb₂	48.67	2.17	15.79	12.46		0.21	6.01	10.01	2.95	0.72	0.79	99.78	1.73
14DF339	44.3932	-116.5028	mixed volcanics	Tmv	72.01	0.52	12.86	5.11		0.11	0.16	0.88	4.23	3.97	0.09	99.94	1.71
14DF341	44.3813	-116.5036	mixed volcanics	Tmv	72.73	0.45	12.98	4.33		0.16	0.07	0.61	4.23	4.15	0.07	99.78	1.26
14DG002	44.3994	-116.5224	mixed volcanics	Tmv	60.14	2.00	13.76	10.13		0.16	1.88	5.07	3.20	2.61	0.47	99.42	3.11
14DG003	44.4638	-116.5021	Weiser pyroclastics	Twp	55.31	1.63	18.80	7.42		0.09	1.96	8.16	3.56	1.59	1.15	99.67	5.91
14DG004	44.4947	-116.5024	Weiser younger olivine basalt	Tyob	49.72	1.91	15.89	11.32		0.16	6.15	8.49	3.79	1.36	0.62	99.41	1.24
14DG005	44.4757	-116.5504	Weiser younger olivine basalt	Tyob	48.94	2.03	16.18	13.39		0.23	5.22	7.53	3.58	1.52	0.93	99.55	2.22
14DG006	44.4898	-116.5601	Weiser younger olivine basalt	Tyob	48.86	2.03	16.23	12.71		0.23	5.95	7.71	3.31	1.64	0.93	99.60	2.14
14DG007	44.4984	-116.6012	Weiser basalt 2	Twb₂	47.88	2.50	17.76	14.84		0.13	3.48	8.75	3.14	0.98	0.94	100.40	5.27
14DG008	44.4802	-116.5961	Weiser basalt 2	Twb₂	46.29	2.61	14.41	14.43		0.22	8.34	9.14	2.59	0.89	0.78	99.70	0.78
14DG025	44.3958	-116.5743	Weiser basalt 2	Twb₂	47.91	2.13	15.17	14.23		0.22	6.90	9.37	2.48	0.52	0.74	99.67	4.54
14DG026	44.3934	-116.5710	Weiser basalt 2	Twb₂	47.57	2.09	14.73	14.59		0.24	7.58	9.05	2.44	0.62	0.76	99.67	1.10
14DG027	44.3891	-116.5647	Weiser basalt 2	Twb₂	48.87	2.07	15.90	12.52		0.21	6.13	9.61	2.83	0.74	0.77	99.65	1.44
14DG029	44.3829	-116.5644	Weiser basalt 2	Twb₂	48.64	2.02	15.82	12.84		0.20	6.44	9.44	2.82	0.74	0.76	99.72	1.13
14DG030	44.3786	-116.5675	Weiser basalt 2	Twb₂	51.59	2.35	19.14	8.46		0.16	2.12	11.11	3.36	0.78	0.85	99.92	1.72
14RL051	44.4967	-116.5320	Weiser younger olivine basalt	Tyob	48.58	2.06	16.42	12.96		0.21	5.87	7.52	3.62	1.56	0.94	99.74	1.58
14RL053	44.4998	-116.5277	Weiser younger olivine basalt	Tyob	48.04	2.06	16.09	13.27		0.23	6.30	7.55	3.59	1.53	0.90	99.56	1.30
14RL055	44.4891	-116.5249	Weiser younger olivine basalt	Tyob	49.91	2.08	16.91	13.14		0.24	2.71	7.66	3.94	1.73	1.19	99.51	3.11
14RL056	44.4810	-116.5302	Weiser younger olivine basalt	Tyob	48.48	2.06	16.21	12.81		0.22	6.03	7.78	3.37	1.59	0.96	99.51	1.95
14RL054a	44.4926	-116.5254	clast in Weiser pyroclastics	*in* Twp	54.89	2.18	13.79	12.02		0.25	3.87	7.50	3.17	1.66	0.37	99.70	0.80
14RL058	44.4803	-116.5432	Weiser younger olivine basalt	Tyob	48.57	2.06	16.21	13.02		0.23	6.28	7.35	3.50	1.51	0.92	99.65	2.37
14SC007	44.3752	-116.6081	Weiser basalt 2	Twb₂	48.46	1.90	15.16	13.10		0.26	6.97	9.64	2.72	0.65	0.69	99.55	1.36
14SC008	44.3781	-116.6083	Weiser basalt 2	Twb₂	48.57	2.12	16.08	12.63		0.19	6.26	9.49	2.86	0.63	0.75	99.58	1.70
14SC009	44.3773	-116.6046	Weiser basalt 2	Twb₂	47.97	2.04	14.58	14.30		0.25	7.35	9.20	2.53	0.59	0.81	99.62	2.15
14SC010	44.3752	-116.6148	Weiser basalt 2	Twb₂	47.98	2.12	14.98	13.92		0.22	7.39	9.19	2.48	0.59	0.79	99.66	2.16
BX6033	44.4696	-116.6212	Weiser basalt 2	Twb₂	45.10	2.50	14.45		12.37	0.212	8.58	8.59	2.47	0.92	0.788	95.98	
BX6036	44.4997	-116.6073	Weiser basalt 2	Twb₂	46.77	2.512	15.37		12.65	0.200	8.09	8.90	2.81	1.12	0.834	99.25	
BX6037	44.4822	-116.5381	Weiser younger olivine basalt	Tyob	48.99	2.097	16.73		10.97	0.210	5.80	8.24	3.54	1.82	1.007	99.40	
BX6039	44.4673	-116.5273	Weiser younger olivine basalt	Tyob	48.01	1.848	16.30		9.81	0.190	6.33	7.62	3.39	1.54	0.964	96.00	
BX6058	44.3961	-116.5076	mixed volcanics	Tmv	71.30	0.525	12.67		3.89	0.030	0.22	0.86	4.16	4.01	0.082	97.75	
BX6064	44.3784	-116.6218	Weiser basalt 2	Twb₂	47.50	2.129	15.13		12.21	0.200	7.83	9.68	2.61	0.56	0.806	98.64	
BX6137	44.3753	-116.5237	mixed volcanics	Tmv	59.08	2.089	13.81		10.13	0.160	1.64	4.83	3.81	2.27	0.525	98.32	
BX6138	44.3759	-116.5369	mixed volcanics	Tmv	59.39	2.063	13.67		10.53	0.150	1.94	5.05	3.80	2.31	0.513	99.41	
10RMG065	44.3783	-116.5227	mixed volcanics	Tmv	60.58	2.12	14.02		9.46	0.130	1.74	5.13	3.65	2.36	0.532	100.00	

Sample number	Ni	Cr	Sc	V	Ba	Rb	Sr	Zr	Y	Nb	Ga	Cu	Zn	Pb	La	Ce	Th	Co	Nd	U
	Trace elements in parts per million																			
14DF309	108	195	27	303	442	8.2	487	136	33.4	14.9	17.4	72	111	<1	16	28	6.1	55		1.7
14DF312	114	165	29	291	465	6.7	508	155	32.1	14.9	18.5	84	119	11.0	17	35	<0.5	56		1.8
14DF339	7	9	5	35	1759	106.9	129	74	73.6	28.0	24.3	8	129	33.0	62	99	23.0	3		1.8
14DF341	6	6	4	29	1886	114.4	105	69	68.7	29.6	25.3	7	117	16.0	69	161	18.5	1		3.6
14DG002	8	8	26	166	985	63.8	342	264	57.4	18.2	22.8	7	144	9.0	34	51	13.2	25		2
14DG003	87	117	22	276	976	18.3	1077	231	28.2	23.6	21.3	79	72	4.0	29	59	0.5	21		1.5
14DG004	110	160	22	248	660	14.0	1071	141	24.1	14.3	19.1	46	98	9.0	20	41	<0.5	42		2.2
14DG005	81	70	25	232	712	17.2	706	170	29.8	37.7	18.6	55	100	3.0	23	57	4.4	47		<0.5
14DG006	67	89	23	218	750	19.7	1517	164	29.6	32.5	17.9	51	96	2.0	24	53	1.0	42		<0.5
14DG007	126	264	35	293	516	8.8	638	128	32.4	15.9	19.2	72	123	2.0	13	35	2.8	59		<0.5
14DG008	133	221	27	286	473	8.8	637	112	30.8	15.5	18.1	66	107	<1	11	34	2.6	56		<0.5
14DG025	153	234	29	262	455	4.5	486	125	29.9	11.5	18.1	106	149	<1	14	34	1.0	70		<0.5
14DG026	126	223	29	273	411	6.3	494	120	29.8	11.0	17.8	115	116	<1	15	31	5.5	57		<0.5
14DG027	101	153	29	281	441	7.0	523	154	32.0	15.5	18.4	96	111	<1	18	31	4.4	49		0.7
14DG029	104	160	29	273	402	7.8	509	149	31.6	14.0	18.2	99	118	6.0	16	31	4.5	53		0.9
14DG030	74	216	32	320	746	9.1	641	190	33.6	18.9	22.2	88	121	<1	21	26	1.2	36		1.9
14RL051	75	95	25	251	700	19.6	716	177	30.3	37.9	17.4	63	107	2.0	25	51	4.2	45		<0.5
14RL053	73	106	24	242	704	16.6	815	181	28.5	35.7	18.0	64	102	<1	24	48	<0.5	43		1.5
14RL055	76	87	27	274	878	20.2	868	199	29.4	38.5	17.4	65	112	10.0	28	52	<0.5	46		1.7
14RL056	69	79	22	224	764	20.4	1120	181	29.1	34.6	17.5	59	97	1.0	23	51	<0.5	41		1.7
14RL054a	13	21	29	402	744	32.3	345	212	38.4	14.2	21.5	52	133	6.0	18	30	4.6	46		1.8
14RL058	74	75	23	227	798	19.7	847	172	31.6	35.8	17.7	64	101	8.0	21	52	<0.5	43		<0.5
14SC007	105	155	28	270	617	5.9	523	137	31.3	13.1	17.9	86	107	2.0	18	34	3.7	49		<0.5
14SC008	104	184	30	269	469	6.7	524	152	31.2	15.0	18.3	95	110	<1	19	33	6.4	49		0.6
14SC009	131	218	29	256	513	6.7	496	132	35.6	11.7	17.9	96	115	<1	17	35	6.5	53		1.3
14SC010	138	241	28	245	410	6.0	479	123	31.4	11.6	17.3	110	122	8.0	19	34	6.6	56		<0.5
BX6033	131	234	31	297	553	11	591	115	29	18.5	18	75	114	3	21	49			31	2
BX6036	134	229	31	307	536	25	541	122	29	17.0	17	57	114	4	20	45	2		26	
BX6037	72	77	24	239	806	23	766	180	30	36.3	18	57	112	4	35	81	3		38	
BX6039	106	124	23	216	763	19	696	166	28	31.1	18	55	104	5	33	78	2		40	1
BX6058	13	20	7	20	1626	114	126	414	47	28.2	21	12	125	21	44	84	14		46	3
BX6064	146	266	31	271	631	7	510	107	30	12.8	17	59	120	4	21	48	2		28	
BX6137	13	14	27	165	950	64	332	239	45	17.2	22	8	140	14	37	72	8		40	1
BX6138	11	12	26	161	964	66	329	242	51	16.0	20	10	142	14	36	68	9		40	2
10RMG065	2		27	167	992	65	349	247	52	16.8	23	8	159	11	36	68	7		43	2

Samples with prefix 14 were analyzed by Stanley Mertzman at Franklin and Marshall College's X-Ray Laboratory.
Samples with the prefix 10 were analyzed at the WSU Geoanalytical Laboratory, only normalized major elements available
Samples with prefix BX were sampled by James Fitzgerald in 1978 and 1979, and reanalyzed at Washington State University's Geoanalytical Laboratory in 2015 for trace elements.
[#]Franklin and Marshall reports total iron as Fe_2O_3.
[##]WSU Geoanalytical Laboratory reports total iron as FeO.



Water wells shown with Idaho Department of Water Resources WellID number. Water well logs can be found at http://www.idwr.idaho.gov/apps/appswell/RelatedDocs.asp?WellID=xxxxxx where "xxxxxx" is the six-digit WellID.

2x vertical exaggeration.

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