United State Department of the Interior
Geological Survey
Water Resources Division

RECONNAISSANCE GEOHYDROLOGY OF PROPOSED PARK SITES IN NEZ PERCE NATIONAL HISTORICAL PARK AREA, IDAHO

ADMINISTRATIVE REPORT

Prepared in cooperation with the
U.S. National Park Service

Boise, Idaho
February 1967

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By
Ralph F. Norvitch

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Reconnaissance Geohydrology of Proposed Park Sites
in Nez Perce National Historical Park Area, Idaho

Ralph F. Norvitch

ABSTRACT

Domestic water supplies ranging from 10,000 to 50,000 gallons per day are required at Spalding Park, East Kamiah, and White Bird--park sites proposed by the U.S. National Park Service in the Nez Perce National Historical Park area in northern Idaho.

Well-production evaluations made by brief pumping tests (2½- and 6-hour durations) show that two wells presently in use at Spalding Park may provide more than 57,000 gallons per day from the alluvium and Columbia River basalt underlying the park site. One well, 180 to 200 feet deep, completed in the channel fill underlying the East Kamiah site probably will supply sufficient water for that facility.

Exploratory work may be needed to find a supply for the White Bird site. Springs along the flanks of White Bird Basin and wells drilled into the lake sediments or into the Columbia River basalt underlying the basin floor are possible sources of water. Also the municipal supply of the village of White Bird may be sufficient to furnish park needs.

The chemical quality of the ground water at the Spalding Park and East Kamiah sites will or can be made to meet drinking-water standards. The water in the lake sediments underlying White Bird Basin is of doubtful quality; however, water issuing from the springs and in the basalt is probably of good enough quality for drinking.

INTRODUCTION

Park sites proposed by the NPS (U.S. National Park Service) in the Nez Perce National Historical Park area in northern Idaho need domestic water supplies ranging from 10,000 to 50,000 gpd (gallons per day). At the request and funding of the NPS, the Water Resources Division of the Geological Survey studied the geology and hydrology of the proposed sites, evaluated the quantity and quality of present water sources, and recommended prospective water sources for future park use. This report presents the results of the studies.

Seven new park sites presently are proposed in the Nez Perce area; they are at or near Orofino, Canoe Camp, Weis Rockshelter, Cottonwood, Spalding Park, East Kamiah, and White Bird. (See fig. 1.) Only the last three sites listed are considered herein; known water supplies are available for three of the first four sites; water is not required for the Cottonwood site.

Basic water needs for those sites evaluated are 10,000-30,000 gpd, plus an irrigation requirement of 15,000-20,000 gpd for Spalding Park; 10,000 gpd for East Kamiah; and 10,000-20,000 gpd for White Bird.

The objective of the study required only a brief description of the geology of each site as it relates to the occurrence of water supplies. Field examination of the geology at each site was supplemented by published descriptions of the geology of the Clearwater Embayment (Bond, 1963), which give particular attention to the sequence, stratigraphy and structure of the basalt flows. Mundorff and Travis

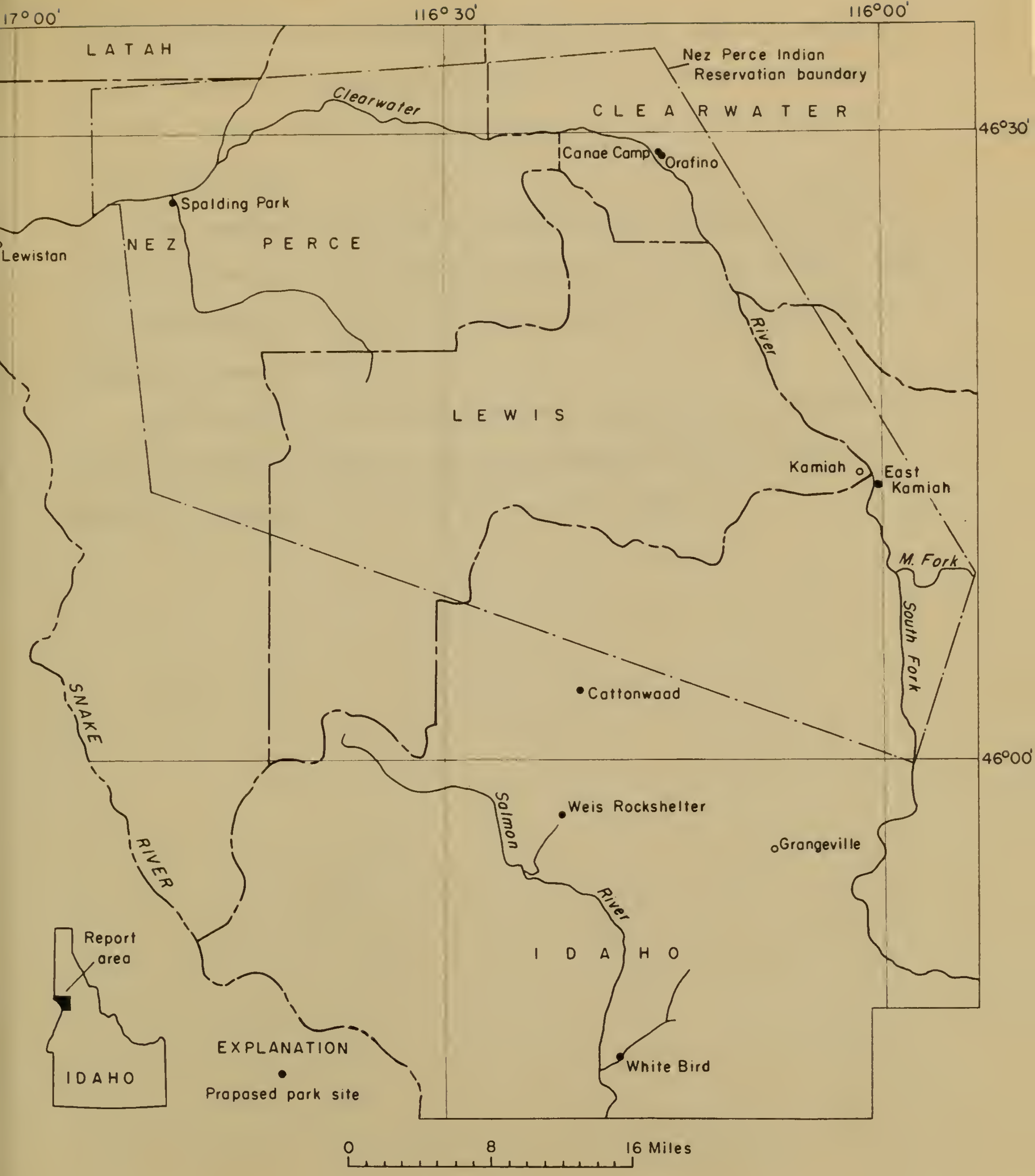


Figure 1.--Map showing location of area and proposed park sites.

(1962) evaluated water supplies for a fish-hatchery site in the valley of the Clearwater River; and discussed briefly six sites along the Clearwater River. Some of their work provided information which relates to this study.

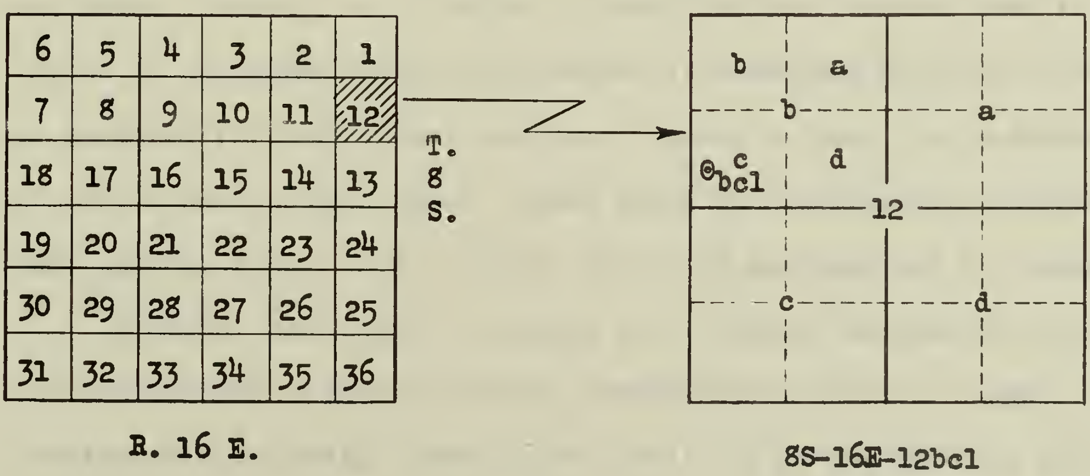
Water samples collected for this study were analyzed in the Quality of Water Laboratory of the Geological Survey in Portland, Oregon. Samples for bacteriological counts were analyzed in laboratories of the State of Idaho Department of Health.

Harold Loveless and Gerald Shoemacher, geologists for the State of Idaho Department of Highways provided information and data which greatly facilitated data collection for this report.

Idaho Well-Numbering System

(U. S. Geological Survey)

The well-numbering system used in Idaho by the Geological Survey indicate the locations of wells within the official rectangular subdivisions of the public lands, with reference to the Boise base line and meridian. The first two segments of a number designate the township and range. The third segment gives the section number, followed by two letters and a numeral, which indicate the quarter section, the 40-acre tract, and the serial number of the well within the tract. Quarter sections are lettered a, b, c, and d in counterclockwise order, from the northeast quarter of each section (see diagram). Within the quarter sections 40-acre tracts are lettered in the same manner. Well 8S-16E-12bcl is in the SW¼NW¼ sec. 12, T. 8 S., R. 16 E. and is the well first visited in that tract.



SPALDING PARK

Setting

Spalding Park (fig. 2) is in the Clearwater River valley, about 10 miles east of Lewiston, Idaho. Geologically the area of the park is an alluvial fan which was deposited at the confluence of Lapwai Creek and the Clearwater River. The surface of the fan rises about 10 to 20 feet above the water level in Clearwater River and has an overall altitude of somewhat less than 800 feet above mean sea level. With the exception of a high-level terrace deposit west of Spalding, the valley walls of the two streams, at this location, are composed of flows of Columbia River Basalt.

Occurrence of Ground Water

Ground water occurs in the alluvial fill of the Clearwater River valley and in the Columbia River basalt that underlies the alluvium beneath the park site. Good records of subsurface conditions were not available; however, W. C. DeTray, a local driller, reports that in most places in the Lapwai Valley the surface is underlain by 10 to 30 feet of cemented (?) cobbles and boulders. These, in turn, are underlain by 20 to 100 feet of hard basalt, under which is a sedimentary interbed that carries a good flow of water--10 to 100 gpm (gallons per minute).

In accord with DeTray's report, L. A. Neaman, Sanitarian for the North Idaho Public Health Service, Indian Health Station, Lapwai, Idaho, provides the following characteristic well log in the Spalding area.

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

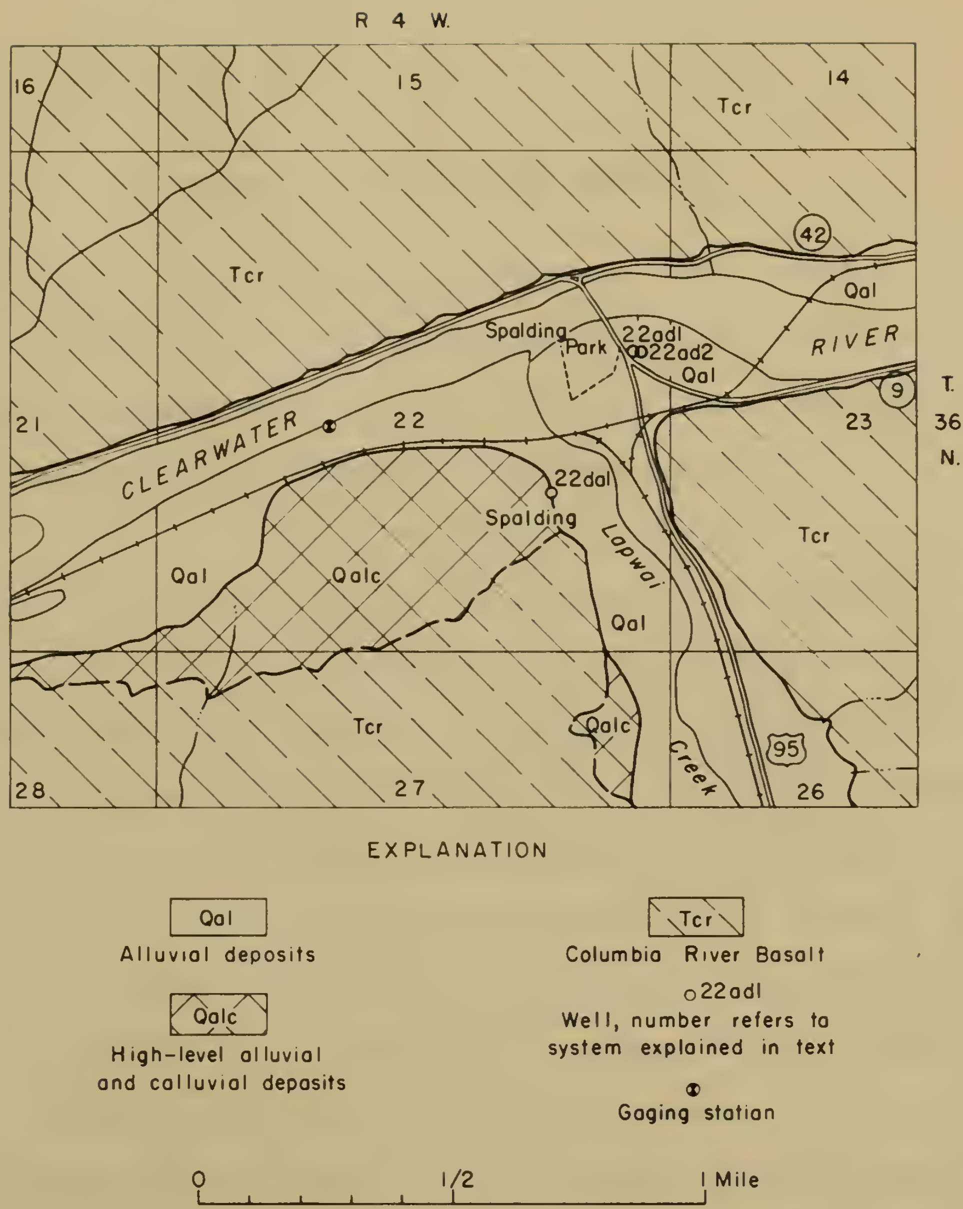


Figure 2.--Map of the Spalding Park area

Material	Depth (feet)
Soil ----------------------------	0-3
Boulders ----------------------	3-17
Sand ----------------------------	17-32
Basalt --------------------------	32-120

Evaluation of Present Water Supplies

Three wells are now in use at Spalding Park. They are wells 36N-4W-22dal (Watson Store), 36N-4W-22adl (main park well), and 36N-4W-22ad2 (Old Evans property). (See fig. 2.) These wells were examined, test pumped, and evaluated by the author as follows:

Well 36N-4W-22dal

Dug well, sounded depth--21 ft; static water level (9-20-66)--17.9 ft below land surface; cased in upper 9 feet with 21-inch diameter oil drums (steel) and in lower part with grouted stones. Equipped with a ¼ hp centrifugal pump; hydropneumatic tank of small capacity. Condition of pumping system--good. Maximum capacity of pump--about 15 gpm.

Well was test pumped at 15 gpm for about 15 minutes, at which time the pump broke suction. The water level drew down at a constant rate of about 0.14 ft per minute. The water level recovered, after the pump was shut off, at a constant rate of 0.01 ft per minute.

The volume of water (about 235 gallons) pumped during the test indicates that the diameter must be caved to more than 50 inches in the lower 3 feet of the well. In view of the difference in the rate of

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[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]

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water-level drawdown compared to the rate of water-level recovery, this well reacts somewhat as a cistern; that is, water immediately available for pumping comes from storage within the well, more so than from storage in an adjacent aquifer.

Since well 36N-4W-22dal yields only a small amount of water, it is not considered significant to the park water supply.

Well 36N-4W-22adl

Drilled well, sounded depth--106.1 ft; static water level (9-20-66)--19.4 ft below land surface; casing (steel)--about 4½-inch diameter, depth unknown. Equipped with a 1½ hp submersible pump; 575 gal capacity pressure tank; condition of pumping system--good. Maximum capacity of pump--about 30 gpm. Sounded depth may be depth to top of submersible pump.

A 6-hour step-drawdown test was made in this well. Pump discharge was controlled at rates of 15, 20, and 25 gpm for 2 hours at each rate. The following table shows the pertinent data collected and determined.

Pumping rate Q (gpm)	2-hour incremental drawdown (feet)	Total drawdown s (feet)	Specific capacity Q/s (gpm/foot)
15	20.8	20.8	0.72
20	9.1	29.9	.67
25	10.0	39.9	.63

From these data, using a formula derived by Jacob (1946), and a graphical method of solution devised by Bruin and Hudson (1961), a graph (fig. 3) of theoretical well performance was made. The graph shows that as the pumping rate increases the drawdown in the well caused by turbulent

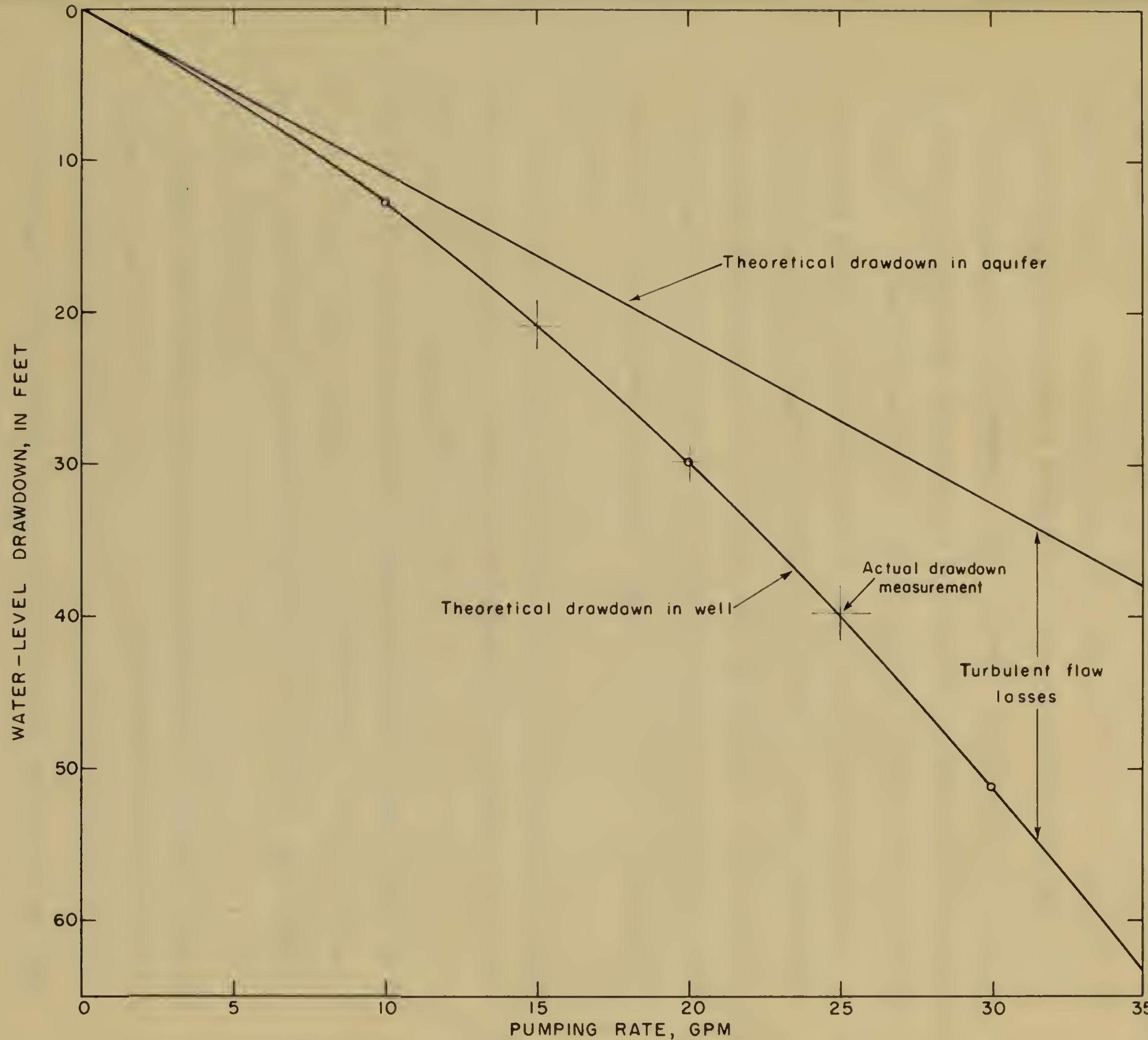

Figure 3.-- Drawdown-yield curve for well 36N-4W-22ad1, Spalding Park, based on a two-hour pumping period.

flow loss increases; and at a pumping rate of 30 gpm, the well is about 63 percent efficient (theoretical drawdown in aquifer divided by theoretical drawdown in well). Or, stated in another way, turbulent flow accounts for about 37 percent of the total drawdown at a pumping rate of 30 gpm.

Considering the low pumping rates involved, the turbulent flow losses in this well might seem excessive and possibly the result of a deterioration of the well. However, considering the low specific capacity of the aquifer, 0.9 gpm per ft of drawdown (fig. 3); and noting that tha wall probably is producing from rigid bedrock openings rather than from interstitial openings in sand and gravel; it is probable that the turbulant flow losses occur in these bedrock openings adjacent to the well and not in the well itself. In that case, redevelopment would not appreciably increase the efficiency of the well.

If, at some future date, tha drawdown at the abova-specified pumping rates increases, then well redevalopment obviously is needed. It is not recommended at the present time, however.

The water level in well 36N-4W-22ad2, 126 ft east, drew down 1.02 ft at the end of 6 hours of pumping of well 36N-4W-22adl. The water level declined incrementally at a rata of about 0.2 ft for each 5 gpm pumped, for each 2-hour period.

Figure 3 shows that after 2 hours of pumping at 30 gpm, the expected drawdown in well 22adl is 51 feat, or to about 71 feet below land surface. The arithmetic plots of drawdown from tha step-drawdown test show that the water level declines very slowly after the first few hours; and that

after the first full day of continuous pumping, it probably would drop less than 10 additional feet. This would leave 25 ft of water standing in the well.

Pumping from other wells in the immediate vicinity will add slightly to the drawdown in well 22ad1. If well 22ad2 were pumped at a rate of 10 gpm continuously for 1 day, it is estimated that it would add less than 2 ft to the drawdown in well 22ad1. Adding an estimated 2 more feet of drawdown from all other wells in the area, would cause the pumping level in well 22ad1 to decline to about 85 ft below land surface, leaving 21 ft of water standing in the well.

Hydrologic boundaries might be encountered after prolonged pumping. Recharge boundaries tend to sustain pumping levels; discharge boundaries tend to hasten pumping-level declines. The most obvious recharge boundary is the Clearwater River which, when intercepted by the well's cone of influence, will sustain pumping levels in the well. The valley walls might constitute discharge boundaries, but their adverse effects on pumping levels probably would be outweighed by the recharge effects from the river.

Well 36N-4W-22ad2

Drilled well, sounded depth--38.4 ft; static water level (9-20-66)--17.4 ft below land surface; casing (steel)--about 8-inch diameter, depth unknown. Equipped with a ¾ hp jet pump; 120 gal capacity pressure tank. Condition of pumping system--fair; pressure tank needs adjustment of air-water ratio in tank. Maximum capacity of pump--about 15 gpm.

Well was test pumped at 10.9 gpm for 2½ hours. Total water-level drawdown was 6.7 ft; specific capacity of well at above pumping rate and duration of pumping is 1.6 gpm per ft of drawdown.

Water-level recovery measurements were made upon shutting off the pump. The water level recovered to the pre-test level in about 45 minutes. The pre-test level was fluctuating slightly, probably owing to uncontrolled domestic pumping in the area. This fluctuation had an adverse effect on detailed evaluation of the hydraulic characteristics of the aquifer; however, it had little effect on the practical evaluation of the well-yield characteristics. The main park well (36N-4W-22ad1), 126 ft west, drew down 0.5 feet in response to pumping of 36N-4W-22ad2 during the test.

Figure 4 shows the curve of water-level drawdown in well 22ad2 during pumping at 10.9 gpm. Extrapolation of the last 50 minutes of water-level trend, assuming no boundaries (see boundary explanation, p. 12), indicates that the pumping level after 1 day of continuous pumping would be about 27.4 ft below the measuring point or 25.1 ft below land surface. (Measuring point is 2.3 ft above land surface.) This condition would leave 13.3 ft of water in the well.

On the basis of the measured specific capacity of this well, and performance of the nearby well, this well may be expected to yield 15 gpm with no more than 12 ft of drawdown. Adding an estimated maximum of 4 ft of drawdown owing to interference from nearby pumping, the water level would be about 33 ft below land surface, leaving 5 ft of water in the well.

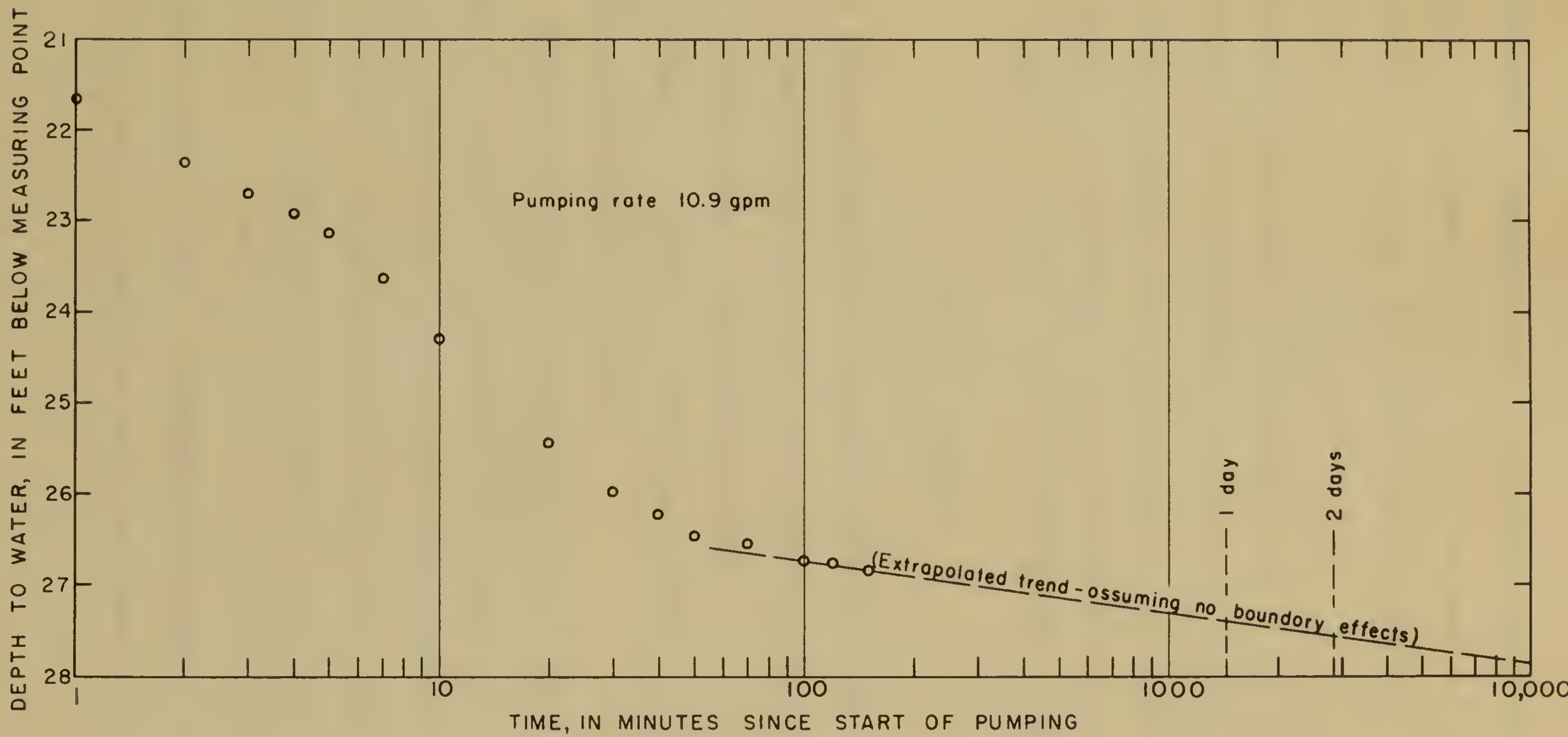

Figure 4.--Drawdown curve of water level in well 36N-4W-22ad2, Spalding Park.

In the future, when water needs may increase, additional water may be obtainable by deepening this well. A re-evaluation of the effects of combined pumping from these two near-by wells (22ad1 and 2) should be made at that time.

Wells 36N-4W-22ad1 and 2, which pump 30 and 10 gpm, respectively, can supply more than 57,000 gallons per day, if necessary. However, with sufficient water for irrigation available from Lapwai Creek and Clearwater River, it is probable that less than half of that amount will be needed, in which case well 22ad1 can provide the entire supply.

Quality of Water

Water from the three wells discussed above was examined for both chemical and bacteriological content. The chemical analyses are shown in table 1. The results of the bacteriological tests are stated on table 1 as either positive (containing intestinal bacteria) or negative (containing no intestinal bacteria).

Well 36N-4W-22da1 (Watson Store) contains water with a positive bacteriological test and an excessive nitrate content (50 ppm). Standards for drinking water set by the U.S. Public Health Service (1962) recommend a nitrate content of no greater than 45 ppm (parts per million). Feeding of this water to infants may prove injurious or even fatal. Presence of the nitrate as well as chloride and sodium concentrations high for this area, suggest that the water is contaminated by organic wastes. This well is situated down gradient from an old outhouse. Decontamination of

the ground water at this place would be difficult, therefore, the well in its present state, should be abandoned as a source for drinking-water supply.

Water in well 36N-4W-22ad2 would be considered good for drinking except that it showed a positive bacteriological test. Major contamination by organic wastes is not evidenced here, however. If the bacteria persist in repeated samplings, decontamination of the well and distribution system may be accomplished by chlorination. The water should then be tested frequently until the source of contamination is found and eliminated.

Water in well 36N-4W-22ad1 is good for drinking; however, it contains iron (1.1 ppm) in excess of that acceptable for general domestic use. This may not be significant to general park uses; but, if it proves to be troublesome it may be significantly reduced by adding an iron-removal unit at the beginning of the distribution system. The bacteriological test (9-23-66) of this water was negative.

Recommended Water Source

Wells 36N-4W-22ad1 and 2, presently in use at Spalding Park, are capable of supplying water for the proposed NPS facilities. Use of water for irrigation from Lapwai Creek and Clearwater River will alleviate any great stress that may be put on the well-water supply during peak park use. Installation of a larger storage tank at well 22ad1 would enable that well to pump for short periods on an intermittent schedule, thus eliminating the chance of excessive water-level drawdown

caused by prolonged pumping periods. Thus equipped, well 22ad1 may be the only well needed as a supply, even during peak park use.

As stated in the section on water quality, water in well 36N-4W-22da1 seems to be contaminated and should be eliminated from the park drinking-water supply.

EAST KAMIAH

Setting

The East Kamiah site (fig. 5) is in the Clearwater River valley, about 1½ miles southeast of Kamiah. Geologically, the site is an alluvial terrace that was originally on the west side of a wide bend in the Clearwater River. An overload of sediment transported in Taha Creek partially dammed the earlier channel at this place causing the river to cut a new channel about ¼ to ½ mile to the west, leaving the proposed park site on the east side of the river.

The terrace rises about 10 to 30 feet above the water surface in the river and ranges in altitude from about 1,200 to 1,220 feet.

Rocks exposed in the walls of the valley near this side are Columbia River Basalt with associated sedimentary beds of Tertiary age, and granitic rocks of Cretaceous age.

Occurrence of Ground Water

Ground water occurs principally in the valley-fill sediments of sand and gravel underlying the proposed park site. These sediments are in hydraulic connection with the Clearwater River; thereby insuring a perennial source of supply. Expected use of water at this facility is small compared to the large supply available.

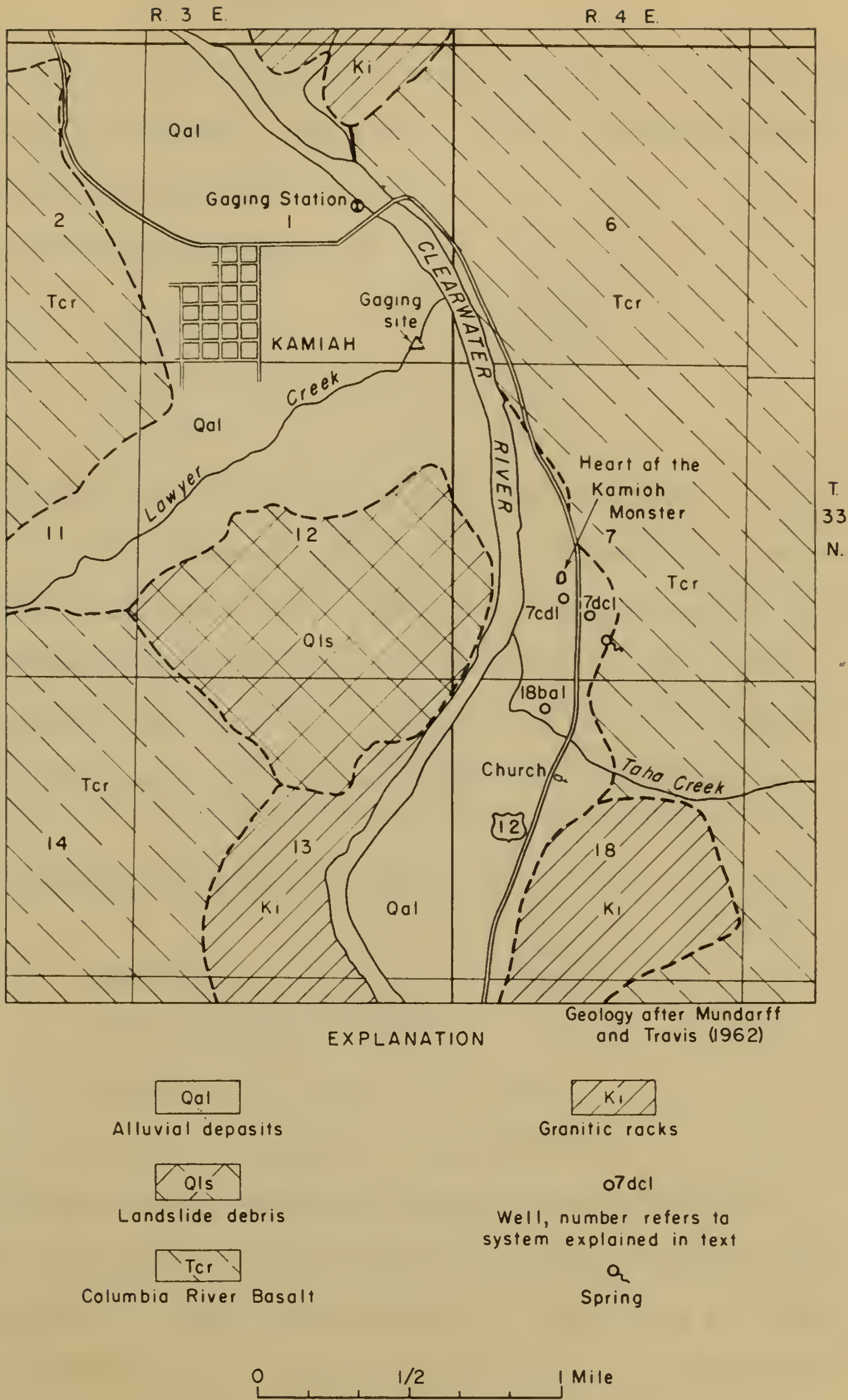

Figure 5.--Map of the East Kamiah area.

Present Wells

Wells 33N-4E-7cdl and 7dcl (fig. 5) at the north end of the proposed park, are 51 and 50 feet deep, respectively. Their logs and pertinent hydraulic data are as follows:

Well 7cdl (Ida-Lew Construction Co.).--

Material	Depth (feet)
Sand and gravel ----------	0-27
Basalt ------------------	27-51

The static water level was about 16 feet below land surface in the fall, 1965. The well was reported to have been test pumped, upon completion, at 21 gpm for 3 hours. Water-level drawdown records were not kept. The well is adequate for the domestic and industrial uses of a small gravel washing operation. The water is reported to have contained intestinal bacteria some time ago, but was not sampled for analysis during this study.

Well 7dcl (Rundell Blue Flame Gas Co.).--

Material	Depth (feet)
Sand and gravel -----------	0-25
Basalt -------------------	25-31
Sand ---------------------	31-50

The static water level was about 10 feet below land surface in February 1964. In August 1966, the water level was 40 feet below land surface and a deep-well pumping system had to be installed in the well. The well was reported to have been test pumped at 40 gpm for 48 hours; drawdown records were not kept.

Subsurface conditions are different and more favorable at the south end of the proposed park site than are those at the north end. Well 33N-4E-18bal was drilled about 196 feet deep without penetrating bedrock. The driller's well log is as follows:

Material	Depth (feet)
Broken rock and clay ------	0-70
Heaving sand --------------	70-180
Pea gravel ----------------	180-196

The static water level was 32.8 feet below land surface on September 23, 1966. The sounded well depth was 190 feet. The well is reported to be cased with 180 feet of 6-inch I.D. casing, open end (no perforations). (The reason for the discrepency among the reported log, sounded depth, and reported casing depth is unexplained, except that the data are from three different sources.) The well reportedly was bailed upon completion for 2 hours at 20 gpm; water-level drawdown records were not kept. The present pump for the well is a 1/3-hp jet; it appears to be in good condition.

Quality of Water

Water from well 33N-4E-18bal (Corbett Estate) was examined for chemical and bacteriological contents. The chemical analysis is given in table 1. Except for a slightly high iron content (0.39 ppm), the water is of good quality, containing no other constituents in excessive concentrations.

The bacteriological test (9-23-66) of the water was negative.

Recommended Water Source

Well 33N-4E-18ba1 is believed capable of supplying all the water needed for the East Kamiah facility. Presently the well belongs to the Corbett Estate which is assumed to be part of the proposed park site. After acquisition, the well could be test pumped to determine its production capacity. Also, any needed changes in pumping equipment could be determined at that time.

Should the above well be unavailable as a water source, a new well drilled 180-200 feet into the alluvial-channel fill, west of U.S. Highway 12 and near the south boundary of the proposed park site, should provide the needed water supply.

WHITE BIRD

Setting

The proposed White Bird site is about 1 to 2 miles northeast of the village of White Bird in Idaho County. Physiographically, the site is in the White Bird Basin of the Clearwater Plateau (Bond, 1963). The basin is a structural depression within the Clearwater Mountains and is geologically unique for this area, in that a large part of its floor is underlain by lake beds of Tertiary age (fig. 6). Also a large segment of the floor is in a state of solifluction and the land surface is scarred with evidence of current earth movement.

A major fault marks the contact between the lake beds and the "upper" flows of Columbia River Basalt along the west flank of the basin in the vicinity of the proposed park site. Numerous smaller faults occur in the basin floor as shown in figure 6.

Occurrence of Ground Water

Ground water occurs in the White Bird lake beds and in the porous openings within the Columbia River Basalt.

Principally, water in the lake beds seems to be in the sand deposits penetrated in drill holes 5 and 6 (fig. 6), listed in table 2. The water coming out of the clay, as reported in logs of some of the drill holes, probably occurs in silty, sandy lenses which would yield water more slowly than the sand deposits.

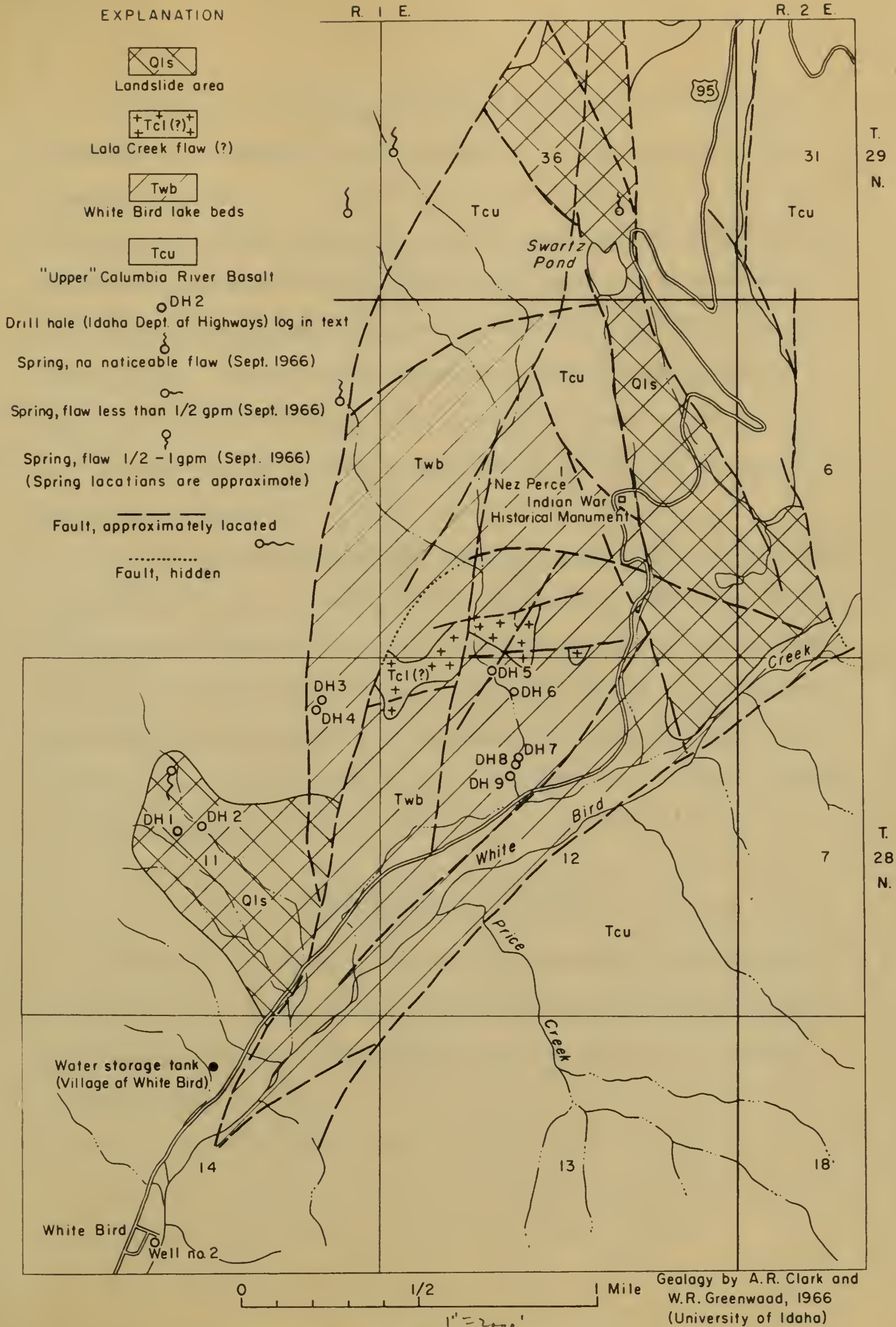

Figure 6.--Map of the White Bird area.

As indicated in the drill-hole logs, the water is under either water-table or artesian pressures, depending on local geologic conditions.

The water in the basalt issues from springs high up along the flanks of the basin where percolating ground water, unable to move downward, has been diverted laterally along strata of low permeability to the spring outlets. The outlets of these springs generally are hidden under talus which has accumulated in gullies cut into the rock slopes.

The depth to the regional water table at the White Bird location has not been determined.

The spring in the SW¼ sec.36, T.29 N., R.1 E. (fig. 6), is in an active slide area of the basin floor. In September 1966, water from this spring was standing in a swamp-like spot on the land surface but there was no visible flow. The spring probably is due to a local artesian condition rather than to an outcropping of the water table in the basin fill, as shown by Swartz Pond, just south and at a lower altitude, which was completely dry.

Possible Sources of Supply

There are four possible sources of ground-water supply for the White Bird site. Selection of any one possibility may depend largely on the location of the park facility. The four sources are briefly discussed below.

1. The sand deposit penetrated in drill holes 5 and 6 is relatively thick and is probably extensive enough to contain sufficient water for the proposed facility. The grain sizes and sorting of the sand are not known, so that estimates of well yields cannot be made. However, the descriptions on the logs indicate that adequate yields may be expected.

The quality of the water in the sands of the lake deposits is not known. The water may contain colloidal clay, may contain excessive sulfides, and may have a bad taste.

Test drilling, test pumping, and chemical sampling are required to test the water supply from the sand.

2. The springs along the west flank of the basin may be a desireable source of supply, for they could provide gravity flow of water to the proposed facility. Flow in these springs was either very small or nonexistent in September 1966, as shown in the explanation on figure 6. The spring in the SE¼NW¼ sec.11, T.28 N., R.1 E., seems to offer the best perennial source of supply.

Development of the spring sites would be necessary to determine their adequacy for park needs. This might be done by drilling laterally into the source of the spring and installing a perforated pipe outlet, or by digging into the rock face near the natural outlet to make a protected collection basin. An assured increase in flow is not certain--the work would be exploratory, at best.

3. A deep test hole at the base of the slope along the west side of the basin would probably penetrate talus and lake deposits and end in basalt. Drill holes 1, 2, 3, and 4 (table 3) penetrated porous and permeable materials but they did not reach the water table.

Wells completed in Columbia River Basalt may yield small to moderate supplies in favorable localities. The village of White Bird has 2 wells completed in basalt and they yield 15 and 33 gpm.

A test hole within the basin would be exploratory and might have to be drilled deeper than 500 feet to the regional water table.

4. The village of White Bird presently has more water than required for customer needs. Preliminary inquiries indicate that the park may be able to rely on the village for the needed supply.

The location of the village wells does not meet with standards of the Idaho Department of Health; however, the use of the supply has been approved as long as bacterial tests made of the water meet the required standards.

Of the possible sources of supply, the sands in the lake beds warrant the first exploration. If the quality of the water proves unsuitable, then the yield from the springs along the west valley wall should be tested.

Quality of Water

Water from a spring in the SE¼NW¼ sec.11, T.28 N., R.1 E., (Hagen property) was analyzed for chemical and bacteriological contents. The chemical analysis, listed in table 1, shows the water to be chemically suitable for drinking.

The bacteriological test was positive; however, this probably was caused by conditions at the water collection site, a cattle watering place. Major contamination by organic wastes is not evidenced here.

The chemical constituents in the White Bird municipal water supply also are listed in table 1. This water presently is approved for drinking and may be suitable for park use.

Need For Early Site Selection

The White Bird site is in an area of major new highway construction. The actual location of the site should be determined and this information made known to the Idaho Department of Highways as soon as possible so that any adjustments necessary for a park facility may be incorporated in the highway plans.

If one of more of the springs are to provide the water supply, they probably will be on the west side of the highway opposite the park facility; in that case provision must be made to pass pipe beneath the road bed. Water pipe will not be allowed to pass through drain culverts. Maximum cooperation may be accomplished with the highway department through early liaison

CONCLUSIONS

1. Two wells presently in use at Spalding Park can yield more than 57,000 gallons of water per day. If irrigation water is supplied from surface-water sources, well 36N-4W-22ad1 (main park well) may yield the entire supply needed. Increased storage facilities at this well would alleviate stress on the well-water system.

Well 36N-4W-22da1 (Watson Store) contains contaminated water and should be eliminated as a source for drinking water.

2. One well, 33N-4E-18ba1 (Corbett Estate), presently in use at the East Kamiah site, probably would supply enough water of suitable quality for park needs. Should this well be unavailable, it should be possible to obtain the needed water supply from a single well, drilled 180-200 feet into the alluvial-channel fill underlying the south end of the proposed site.

3. Possible sources of water for the White Bird site are 1) springs along the west flank of the White Bird basin; 2) a well or wells drilled into sand layers within the lake deposits underlying the basin floor; 3) a well or wells drilled deep into the basalt underlying the west side of the basin; and 4) the municipal supply for the village of White Bird.

The spring sources would require extensive development to acquire sufficient flows. The well drilling would be exploratory, at best. A well drilled to the regional water table in the basalt may have to be more than 500 feet deep.

Selection of the location of the White Bird park facility should be made early so that necessary provisions can be incorporated in plans for the new highway development in the area.

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Table 1.--Chemical Analyses of Water

(Analytical results in parts per million except as indicated)

	36N-4W-22da1	36N-4W-22ad1	36N-4W-22ad2	33N-4E-18ba1	28N-1E-11bd	White Bird municipal supply
Date (All Sept. '66)	22	21	22	23	23	25
Water Temp. (F°)	55	66	63	53	62	--
Silica (SiO_2)	45	46	47	11	52	--
Iron (Fe)	0.02	1.1	0.25	0.39	0.03	0.44
Calcuim (Ca)	90	24	24	13	27	12
Magnesium (Mg)	33	9.1	9.3	0.9	13	1.2
Sodium (Na)	51	20	20	61	12	--
Potassium (K)	6.4	4.5	4.3	1.1	3.0	--
Bicarbonate (HCO_3)	480	168	164	166	164	--
Carbonate (CO_3)	0	0	0	0	0	--
Sulfate (SO_4)	17	6.6	5.8	20	13	45
Chloride (Cl)	18	2.2	2.2	6.2	2.5	9
Fluoride (F)	0.3	0.6	0.5	1.0	0.4	1.14
Nitrate (NO_3)	50	0.1	0.0	0.6	0.3	0.25
Dissolved Solids						
Residue on evaporation at 180°C	554	206	188	195	209	220
Calculated	547	196	194	197	204	--
Hardness						
As $CaCO_3$	360	98	98	36	121	35
Noncarbonate	0	0	0	0	0	--
Specific Conductance (micrehmos at 25°C)	859	268	262	301	270	--
pH	7.0	7.4	7.4	7.8	7.1	10.4
Color	0	5	10	5	5	--
Bacteriological test	+	-	+	-	+	--
Remarks	1/	--	--	--	2/	3/

1. High nitrate content
2. Spring source
3. Alkalinity - 106, iron + manganese (0.44), total solids (220).

Table 2.--Logs of drill holes in the White Bird Area.
(Diamond-drill holes made by the Idaho Department of Highways.)

	Depth interval (feet)		
DH 1			
Top soil, silty	0	-	2
Basalt and silt (talus), compact	2	-	21
Rock, small and silt; cuttings and tests indicate less than ½-inch sizes; porous--lost drill water	21	-	63
Basalt, well fractured; no soil seams	63	-	79.5
Basalt, purple, vesicular; firm and sound; flow contact. Dry hole	79.5	-	90
DH 2			
Top soil, silty	0	-	5
Rock and soil; more rock than DH 1, material tighter; no clay found; soil washes, does not stick to bit; boulders -- 1 ft maximum size	5	-	32
Basalt boulders and silty soil, mostly boulders; lost drilling water at 32 ft	32	-	56
Basalt, sound, well fractured; sandy material in fractures. Dry hole	56	-	73
DH 3			
Soil, with minor basalt boulders	0	-	18
Rock and silt, estimated half and half	18	-	40
Silt, compact, tight	40	-	41
Basalt boulders and minor silt; porous, lost drilling water. No bedrock contact	41	-	70

Table 2.--(Cont.)

	Depth interval (feet)		
DH 4			
Silt and basalt boulders, material relatively tight; dry.	0	-	15
Basalt boulders and silt; lost drilling water; no indication of water in hole.	15	-	75
DH 5			
Silt and basalt boulders.	0	-	7
Clay, tan; dry.	7	-	9
Lake clay, brown micaceous with iron oxide stains; damp	9	-	11.3
Lake clay, blue-gray; damp; water horizon at 19.5, water rose to 13.5 ft	11.3	-	19.5
Carbonaceous material, black; impervious. . .	19.5	-	23.5
Clay, dark brown, soft; damp.	23.5	-	24
Carbonaceous stratum.	24	-	24.8
Lake clays, dark blue-green, very hard; fissured; dry. Water horizon at 34 ft, no artesian effect	24.8	-	34
Sand, quartz, very fine, compact, with minor clay; water.	34	-	37
Sand, granitic, fine, clean; water.	37	-	69

Table 2.--(Cont.)

DH 6	Depth interval (feet)		
Sand and silt	0	-	2
Clay, light gray, soft; damp; contains some mica.	2	-	7
Clay, dark gray; micaceous; moist	7	-	20
Sand, granitic, white, fine; dry.	20	-	26
Clay, light gray; very tight; dry	26	-	40
Sand, granitic, clayey. Water horizon at 55 ft, water rose to 52.2 ft	40	-	55
Sand, clean, very loose; water.	55	-	59
Clay, blue-green; tight	59	-	63
DH 7			
Clay and rock. Water horizon at 2.8 ft	0	-	2.8
Clay, silty and rock.	2.8	-	5.3
Lake Clay, light tan; tight; dry.	5.3	-	11
Clay, gray, soft.	11	-	12
Sand, fine with minor clay; water	12	-	13
Clay, tan, carbonaceous	13	-	13.3
Lake clays with soft thin-bedded layers, light blue to tan; fissured. Water horizon at 20.4 ft, water rose to 19.9 ft in 2 hours. Water horizon at 26 ft (cased out of hole, did not check)	13.3	-	34.8

Table 2.--(Cont.)

	Depth interval (feet)		
DH 8			
Clay, silty and rock	0	-	3
Sand, fine; wet at 6 ft (if allowed to stand).	3	-	6
Clay, blue-green; fissured; tight; dry	6	-	14
Clay, soft and strong water flow. Water horizon at 14 ft, artesian water rose to 6 ft; pumped hole to 10.5 ft - water rose to 7 ft in 4½ minutes; pumped hole to 12 ft - water rose to 8.2 ft in 4½ minutes; water rose to land surface over night. Abandoned hole.	14	-	?
DH 9			
Silt, light brown; dry	0	-	8
Silt, light brown with boulders; dry	8	-	16
Silt with sand lenses. Slow water seepage at 18.5 ft.	16	-	18.7
Sand, very fine; thin silt lenses. Water horizon at 48.5 ft, water rose to 26.5 ft in 2 hours and remained static	18.7	-	48.5
Lake clays, blue-green; stiff; fissured; contains small rock fragments	48.5	-	63.3
Lake clays, same as above but soft; possible intermittant aquifer	63.3	-	65
Clay, carbonaceous; tight; contain wood remains	65	-	66.2
Clay, light tan; fissured.	66.2	-	68