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View of Bristol Wells

GROUND-WATER RESOURCES – RECONNAISSANCE SERIES REPORT 16

GROUND-WATER APPRAISAL OF DRY LAKE AND DELAMAR VALLEYS,
LINCOLN COUNTY, NEVADA

University of Nevada
Las Vegas
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By
THOMAS E. EAKIN
Geologist

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moves and is discharged at small springs in the mountains and which yield a few gallons per minute to wells penetrating these rocks. Under extremely favorable conditions the distribution of fracture openings in welded tuff, lava flows, or Paleozoic clastic rocks may permit the development of moderate yields of water from wells. However, these occurrences are likely to be so localized that the odds of a well encountering them are very small indeed.

The unconsolidated sand and gravel of the valley fill in Dry Lake and Delamar Valleys is capable of transmitting ground water freely. However, most of the valley fill probably is composed of deposits of fine sand and silt. Grains of this size generally have relatively low permeability and, where saturated, transmit water much more slowly than coarse sand and gravel. Deposits of silty clay and clay may transmit water so slowly to wells that they will not yield supplies adequate for stockwatering purposes. Various parts of the valley fill probably are moderately consolidated or cemented and this further reduces the capacity of these deposits to transmit useful supplies of water to wells.

GROUND-WATER APPRAISAL

Occurrence of Ground Water:

Ground-water recharge in Dry Lake and Delamar Valleys is derived principally from precipitation within the surficial drainage area of the valleys. In a general way, ground water moves from recharge areas in and bordering the mountains toward the central parts of the valleys, thence southward or southwestward to discharge through bedrock formations. This is in contrast with hydrologically closed valleys commonly found in the Basin and Range province. Carpenter (1915, p. 67) indicated that ground water in Bristol (Dry Lake) and Delamar Valleys probably finds an outlet in Pahrangat Valley. Snyder (1963, p. 400) refers to Dry Lake Valley as being a drained valley; that is, ground water moves out of the valley to discharge elsewhere.

In typical hydrologically closed valleys in the Great Basin, ground water is recharged from precipitation largely in the mountains enclosing the valley. Ground water moves from areas of recharge toward the ground-water reservoir in the valley fill underlying the central part of the valley. In or adjacent to the topographically lowest part of the valley, the water table, or upper surface of the zone of saturation, is within a few feet of land surface. Where the water table is close to land surface, ground water is discharged naturally by evaporation from the soil or from free-water surfaces and is transpired by plants (phreatophytes) which obtain most of their water from the zone of saturation or overlying capillary fringe.

Under long-term conditions in a hydrologically closed ground-water system, average annual recharge to the ground-water reservoir equals the average annual natural discharge. However, if a ground-water system in a topographically closed valley is hydrologically open, recharge from precipitation in the valley may be greater or less than the discharge within the valley. Where recharge from precipitation within the valley is greater than discharge in the valley, ground water must be discharging by underflow from the valley to an area

or areas of lower hydraulic head. Where the recharge from precipitation within the valley is less than discharge in the valley, recharge in part must be entering the valley from an area or areas beyond the topographic divide having a higher hydraulic head.

In addition to hydraulic controls, the water-bearing character of the rocks and their structure are important factors in the movement, or impedance to movement, of ground water. Where bedrock formations in the enclosing mountains are relatively impermeable, ground water normally is part of a closed hydrologic system in a topographically closed valley. Where the bedrock formations are at least locally permeable, the ground-water system may be hydrologically open. Winograd (1962, p. 110) has referred to this relationship in the vicinity of Yucca Flat in southern Nevada.

The chemical quality of the ground water is another factor that may be an aid in evaluating the nature of a ground-water system. Ordinarily, the concentration of chemical constituents shows considerable variation in different parts of a ground-water system. Generally, the concentration is least in areas of recharge and tends to be greatest in areas of natural discharge. Despite the normal variations that may be expected in the chemical constituents in ground water in a given system, the character and concentration of one or more constituents may aid in identifying whether or not a given system is closed.

In summary, closed or open ground-water systems may be identified by the relationship of recharge to discharge within the valley, by potential hydraulic gradients between the reference valley and adjacent valleys, by the water-bearing character of geologic formations, including modifications by structural deformation, and by the chemical quality of the ground water with respect to that in adjacent areas.

In Dry Lake and Delamar Valleys, the principal areas of recharge are centered in the mountains along the northwest, northeast, and east sides of Dry Lake Valley. From the areas of recharge, ground water moves toward the central part of the valley. Along at least some of the stream canyons or washes ground water is not far below land surface, such as at Bristol wells (3N/65-21d3) (See cover photograph and photograph 3) and well 1N/65-2a1 where the depth to water is about 45 feet and 10 feet, respectively. Near the centers of the valleys the depths to water generally are substantial. For example, well 5N/64-14a1 is dry at a depth of about 240 feet, an altitude of roughly 5,385 feet; the depth to water in well 3N/64-20b1 is about 318 feet, altitude of about 4,820 feet; the depth to water in well 2N/64-3b1 is about 664 feet, altitude about 4,350 feet; and the depth to water in well 1N/64-24a1 is about 398 feet, altitude on the order of 4,300 feet.

In Delamar Valley, water for the mines and town of Delamar (photograph 4) was obtained from small springs and wells in the volcanic rocks in a nearby wash according to Callaghan (1937, p. 35). Callaghan further states that this supply was inadequate and that a well was drilled 900 feet deep in the alluvium of Delamar Valley which was dry throughout. The approximate well site is shown



Photograph 3. View east of stone cabin at Bristol Wells. Well 3N/65-21d2 is a short distance to the left of the cabin. The north end of the Bristol Range forms the skyline. Bristol Wells was an early water supply point for stock and travelers, it supported a small smelter operation and at least part of the water requirements of the Bristol Silver mine about 4 miles to the southeast, beyond the right side of the picture.



Photograph 4. View southeast of Delamar. Structure to left is remains of mill. Light colored band extending to right edge of picture is part of tailings. Wind action has heavily sculptured and removed a considerable volume of the tailings. In middle distance stone walls mark the principal area of Delamar townsite. Principal mining was in hill to left of left side of picture, although numerous prospect pits mark hill in background. Most of water supply for Delamar was brought in by pipeline from Meadow Valley Wash, 10 to 12 miles to the east.

as 6S/63-12a1 on plate 1. However, the details of drilling are not known. If the well literally did not encounter water throughout the full 900 feet, the water-level altitude in this area may be below about 3,700 feet, subject of course to the accuracy of land-surface altitude and the location of the well site.

The great depth to water below the playa areas of Dry Lake and Delamar Valleys precludes evapotranspiration losses from the ground-water reservoir in these valleys, except for extremely small amounts adjacent to scattered springs in the mountains. Inasmuch as the average annual ground-water recharge to Dry Lake and Delamar Valleys is estimated to be several thousand acre-feet per year (p. 34-37), and as no equivalent ground-water discharge by evapotranspiration occurs in the valleys, virtually all the ground water is discharged from the valleys by underflow through bedrock.

That ground water is discharged outside these valleys is further confirmed by the hydraulic gradients between Dry Lake and Delamar Valleys and adjacent valleys. As noted previously the altitude of the ground-water levels in Dry Lake and Delamar Valleys decreases southward along the axial part of the valleys. Available control points do not precisely define the altitude of the ground-water levels in the valleys. However, an apparent gradient is indicated by the water-level altitudes at the several drilling sites; that is, less than about 5,385 feet in sec. 14, T. 5 N., R. 64 E., about 4,820 feet at well 3N/64-20b1, about 4,350 feet at well 2N/64-3a1, and somewhat below about 3,700 feet at well 6S/63-12a1 in Delamar Valley. Thus, the hydraulic gradient is southward at more than 35 feet per mile in the northern part of Dry Lake Valley, and southward at somewhat more than 18 feet per mile from the north-central part of Dry Lake Valley to the central part of Delamar Valley.

Valleys to the east and west of Dry Lake and Delamar Valleys superficially drain to the Colorado River. Along the White River channel in Pahranaagat Valley, Hiko Spring issues from about the alluvial-carbonate bedrock contact at an altitude of about 3,890 feet. About 5 miles south of Hiko Spring, Crystal Springs issue from limestone and alluvium at an altitude of about 3,815 feet. About 5 miles farther south in Pahranaagat Valley, Ash Springs issue from limestone at the alluvial-bedrock contact at an altitude of about 3,610 feet. About 30 miles farther south in the vicinity of Lower Pahranaagat and Maynard Lakes, at the south end of Pahranaagat Valley, ground water in the alluvium is near land surface and is at an altitude of about 3,150 feet. Additionally, the depth to water in well 4S/61-15a1, about 6 miles east of Hiko Spring, is about 678 feet or an altitude of about 3,700 feet. Land surface along the White River channel and known water-level altitudes south of Maynard Lake along the White River channel are lower still. Maynard Lake is only about 10 miles southwest of the playa in Delamar Valley. Thus, ground water from Dry Lake and Delamar Valleys could discharge to Pahranaagat Valley by underflow to the west, south, or southwest, based in terms of the potential hydraulic gradient.

Along Meadow Valley Wash to the east, land-surface altitude in the wash is above 4,000 feet northward from a point about 10 miles south of Caliente. The depth to water in the wash is generally within a few tens of feet below land surface;

therefore, the water-level altitude in Meadow Valley Wash probably is equal to or higher than that in Dry Lake and Delamar Valleys at equivalent latitudes throughout most of their lengths. For most of the same distance, the mountain area probably provides sufficient recharge to maintain a hydraulic divide between the two areas. Thus, a major transfer of ground water between the two areas does not seem likely.

In further considering ground-water discharge by underflow from Dry Lake and Delamar Valleys, the Paleozoic carbonate rocks appear to be the most favorable rocks to transmit ground water. The springs in Pahrana-gat Valley demonstrate that ground water moves through solution openings and fracture systems in some quantity, at least locally. Ground-water movement through similar Paleozoic rocks in Cave Valley, northwest of Dry Lake Valley, has been described in a previous report (Eakin, 1962). Drilling at the Nevada Test Site, about 75 miles southwest of this area, has shown that the Paleozoic carbonate rocks transmit ground water more readily than do the Paleozoic clastic rocks and Tertiary tuff (Winograd, 1962, p. 110). Thus, the Paleozoic carbonate rocks probably afford the best opportunity for ground-water movement between valleys in this area.

Plate 1 shows the surficial distribution of Paleozoic carbonate rocks in Dry Lake and Delamar Valleys. They are exposed most extensively along the east and northwest sides of Dry Lake Valley. Along the west and south sides of Delamar Valley, younger volcanic rocks crop out. However, Paleozoic carbonate rocks undoubtedly underlie the volcanic rocks in this area and, further, are exposed along White River channel in Pahrana-gat Valley and southward (Tschanz and Pampeyan 1961, and Bowyer, Pampeyan, and Longwell, 1958). Accordingly, the distribution of Paleozoic carbonate rocks in this area is favorable to the movement of ground water southward or southwestward from Dry Lake and Delamar Valleys to Pahrana-gat Valley.

If the Paleozoic carbonate rocks are capable of transmitting ground water by underflow from Dry Lake and Delamar, the converse may be true; that is, ground water may move into Dry Lake and Delamar Valleys from the north through carbonate rocks from valleys upgradient from Dry Lake and Delamar Valleys. This may be evaluated roughly as follows: In the northern part of Dry Lake Valley the lowest known water-level altitude is about 4,820 feet at well 3N/64-20b1. Higher water-level altitudes occur in White River Valley to the west and northwest; in Cave Valley to the northwest, and in Lake Valley to the north and east. However, the mountains enclosing the northern part of Dry Lake Valley are areas favorable to recharge from precipitation. Because they are areas of recharge, the water levels, in these mountain blocks also must be assumed to be areas of relatively high water levels. Thus, although actual water levels are not available in these areas, it is strongly inferred that ground-water divides occur beneath the mountains and thus provide hydraulic barriers to ground-water movement from adjacent valleys into the northern part of Dry Lake Valley. Similarly, it is inferred that a hydraulic divide exists in the Bristol and Highland Peak Ranges on the east side of Dry

Lake Valley and provides a hydraulic barrier to ground-water movement between Dry Lake Valley and Meadow Valley Wash. The same condition probably occurs in the Delamar Range on the east and southeast sides of Delamar Valley, although this range probably receives less recharge from precipitation than do the ranges to the north.

The mountains bordering the west side of Dry Lake and Delamar Valleys apparently provide only meager recharge from precipitation. The amount probably is not sufficient in magnitude or time to maintain a hydraulic barrier between Dry Lake and Delamar Valleys and White River and Pahranaagat Valleys.

In summary most, if not all, of the ground-water recharged to Dry Lake and Delamar Valleys is believed to be derived from precipitation within their surficial drainage areas. Ground water moves from the areas of recharge toward the central part of the valleys, thence generally southward or southwestward. Ground water is discharged from the trough of Dry Lake and Delamar Valleys by underflow through Paleozoic carbonate rocks to areas downgradient from the trough; that is, most probably into Pahranaagat Valley, southwest of Delamar.

The depth to water in the central part of the trough of Dry Lake and Delamar Valleys is deep--probably too deep for economic recovery of ground water for the usual uses in this region, except possibly for stock purposes. Depths to water in the lower parts of the valleys decrease from somewhat more than 300 feet in T. 3 N., R. 64 E., to about 400 feet in the south part of T. 1 N., R. 64 E., to possibly more than 1,000 feet beneath the playa area of Delamar Valley. Perched or semiperched ground water in the mountains and upper parts of the alluvial apron locally supply water to small springs and locally is at a sufficiently shallow depth to permit the development of small water supplies by wells, such as at Bristol wells and well 1N/65-2a1.

Estimated Average Annual Recharge:

The average annual recharge to the ground-water reservoir may be estimated as a percentage of the average annual precipitation within the valley (Eakin and others, 1951, p. 79-81). A brief description of the method follows: Zones in which the average precipitation ranges between specified limits are delineated on a map, and a percentage of the precipitation is assigned to each zone which represents the probable average recharge from the average precipitation for that zone. The degree of reliability of the estimate so obtained, of course, depends on the degree to which the values approximate the actual precipitation in the several zones, and the degree to which the assumed percentages represent the actual proportion of recharge to ground water. Neither of these factors is known precisely enough to assume a high degree of reliability of the recharge estimate for any one valley. However, the method has proved useful for reconnaissance estimates and experience suggests that in many areas the estimates probably are relatively close to the actual long-term average annual recharge.

The precipitation map of Nevada (Hardman and Mason, 1949, p. 10) has been adjusted (Hardman, oral communication, 1962) to the improved topographic base maps (scale 1:250,000) now available for the whole State. The base map for plate 1 of this report was prepared from the same series of topographic maps. The several zones of precipitation applicable to Dry Lake and Delamar Valleys are as follows: the boundary between the zones of less than 8 inches and 8 to 12 inches of precipitation was delineated at the 6,000-foot contour; between 8 to 12 inches and 12 to 15 inches, at the 7,000-foot contour; between 12 to 15 inches and 15 to 20 inches, at the 8,000-foot contour; between 15 to 20 inches and more than 20 inches at the 9,000-foot contour.

The average precipitation used for the respective zones, beginning with the zone of 8 to 12 inches of precipitation, is 10 inches (0.83 foot), 13.5 inches (1.12 feet), 17.5 inches (1.46 feet), and 21 inches (1.75 feet).

The percentages of the average precipitation assumed to represent recharge for each zone are: less than 8 inches, 0; 8 to 12 inches, 3 percent; 12 to 15 inches, 7 percent; 15 to 20 inches, 15 percent; and more than 20 inches, 25 percent.

Table 4 summarizes the computation of recharge for Dry Lake and Delamar Valleys. The recharge (column 5) for each zone is obtained by multiplying the figures in columns 2, 3, and 4. Thus, for the zone of 12 to 15 inches of precipitation in Dry Lake Valley the computed recharge is 16,000 (acres) times 1.12 (feet) times .25 (25 percent) = about 1,300 acre-feet. The estimated total average annual recharge to ground water in Dry Lake and Delamar Valleys is about 6,000 acre-feet.

Table 4.--Estimated average annual ground-water recharge from precipitation in Dry Lake and Delamar Valleys, Nev.

(1) Precipitation zone (in inches)	Dry Lake Valley					Delamar Valley				
	(2) Approximate area of zone (acres)	(3) Average annual precipitation (feet)	(4) Percent recharged	(5) Estimated recharge (acre-feet) (2x3x4)	(2) Approximate area of zone (feet)	(3) Average annual precipitation (feet)	(4) Percent recharged	(5) Estimated recharge (ac.-ft) (2x3x4)		
20+	200	1.75	25	100	0	- -	- -	- -		
15-20	3,200	1.46	15	700	0	- -	- -	- -		
12-15	16,000	1.12	7	1,300	4,000	1.12	7	300		
8-12	114,000	.83	3	2,700	35,000	.83	3	900		
8 -	442,000	- -	0	- -	208,000	- -	0	- -		
	575,400 about 900 sq. mi.	Estimated average annual recharge (rounded) 5,000			247,000 about 385 sq. mi.	Estimated average annual recharge (rounded) 1,000				

Estimated Average Annual Discharge:

Only a very small amount of ground water is discharged from Dry Lake and Delamar Valleys by evaporation and transpiration. Areas where ground water evaporates from soil or from free-water surfaces or is transpired by vegetation are restricted to isolated areas adjacent to the few small springs. The largest of these occurs near the spring at the Meloy Ranch in the southern part of T. 5 N., R. 65 E. Discharge was estimated to be about 20 gpm in March 1963. The few wells in the valley are used largely to provide water for stock, and the total withdrawals are very small. In the past, Bristol wells have been used in part to supply water requirements for mine camps and travelers. Similarly, wells and springs in Cedar Wash were used for water supply at Delamar. However, neither of these supplies were adequate.

Because of the great depth to water, no large areas of evapotranspiration from ground water occur in the lower parts of Dry Lake and Delamar Valley. Most of the ground water apparently is discharged by underflow through bedrock from Dry Lake and Delamar Valleys, but the amount cannot be directly determined. However, to the extent that the estimate of ground-water recharge is correct, and because over a long period of time recharge equals discharge, ground-water discharge by underflow is about 6,000 acre-feet per year minus the small amount, probably less than a few hundred acre-feet discharged by wells and by evapotranspiration adjacent to spring areas.

Perennial Yield:

The perennial yield of a ground-water system is the amount of natural discharge that can be salvaged for beneficial use from the ground-water system. It is the upper limit of the amount of water that can be withdrawn economically from the system for an indefinite period of time without causing a permanent and continuing depletion of ground water in storage and without causing a deterioration of the quality of water. The average recharge from precipitation and streams, discharge by evapotranspiration, discharge to streams, and underflow from a valley are measures of the natural inflow and outflow from the ground-water system.

In an estimate of perennial yield, consideration should be given to the effects that ground-water development of wells may have on the natural circulation in the ground-water system. Development by wells may or may not induce recharge in addition to that received under natural conditions. Part of the water discharged by wells may re-enter the ground-water reservoir by downward percolation, especially if the water is used for irrigation. Ground water discharged from wells theoretically is offset eventually by a reduction of the natural discharge. In practice, however, it is difficult to offset fully the discharge from wells by a decrease in the natural discharge, except when the water table has been lowered to a level that eliminates both underflow and evapotranspiration in the area of natural discharge. The numerous pertinent factors are so complex that, in effect, specific determination of perennial yield of a valley requires a very extensive investigation, based in part on data

that can be obtained economically only after there has been substantial development of ground water for several years.

The ground-water system in Dry Lake and Delamar Valleys, as presently understood, is such that economics probably is the controlling factor in the determination of perennial yield. The great depth to water in most of the valley more or less precludes large-scale withdrawals for most uses. Hydrologically, the saturated zone, or reservoir, underlying the floor of the valleys is the most likely area in which to develop substantial water supplies. At the depth of water indicated, the ground-water reservoir probably occurs largely in Tertiary rocks or in underlying Paleozoic carbonate rocks beneath the floor of the valleys.

Whether development occurs in the Tertiary or younger rocks of the valley fill or in the Paleozoic carbonate rocks, withdrawals for a long time would have to come largely from ground water in storage. The amount of stored ground water to be removed is many times the average annual recharge and undoubtedly would require many years of pumping. Pumping from storage would result in a lowering of water levels extending outward from the area of pumping farther and farther until the area of influence eventually would divert virtually all the water from areas of recharge to the area of pumping. After this was accomplished, pumping levels would tend to stabilize, providing that the average annual net withdrawals from pumping were equal to the recharge to the pumped area. The net withdrawals at that time would be equal to perennial yield. Thus, the perennial yield would be limited to the amount of inflow that could be diverted from the areas of recharge to the area of pumping influence.

Whether the magnitude of perennial yield ultimately equals total recharge to the valley depends upon the relative location of the area of pumping with respect to the several areas of recharge to the valley, the relation of the area of pumping with respect to the principal area of ground-water discharge or underflow from the valley, and the altitude of economic pumping levels with respect to altitude of natural discharge or underflow. In Dry Lake and Delamar Valleys, the costs of pumping relatively large quantities of ground water to modify appreciably the natural ground-water regimen to salvage all the natural discharge undoubtedly would be prohibitive for all but the most exceptional water requirements. However, to the extent that such development might occur, the area in and adjacent to Tps. 1 S. and 1 N., R. 64 E., is located favorably with respect to ground-water storage, and sufficient development might result ultimately in salvaging much of the discharge from Dry Lake Valley. However, it is conceivable that to salvage a large part of the estimated 6,000 acre-feet of average annual discharge from the valley, water levels might have to be drawn down as much as 1,500 feet below land surface.

The analysis probably does not represent the typical chemical quality of ground water in Dry Lake Valley. However, it is somewhat suggestive of a mixed-water type found in the region. In some areas, ground water in Paleozoic carbonate rocks will contain a relatively high proportion of calcium magnesium, and bicarbonate due to solution of the carbonate rocks. As that water moves into Tertiary volcanic rocks or deposits derived from such rocks the proportion of sodium will increase partly by base exchange and partly by addition to the dissolved solids in the water until the water becomes a sodium-bicarbonate type. The relatively high chloride and nitrate in the analysis suggests local contamination, a condition that might well be expected from the local concentration of people and stock of the watering point when Bristol wells supplied water to the nearby mines and was the site of a small settlement and a smelter.

If it can be assumed that the analysis may be more or less representative of ground water in the lower part of Dry Lake Valley, with the exception of the high concentration of chloride and nitrate, the water would be suitable for domestic and stock purposes.

Development:

Small amounts of ground water from springs and wells are used to water livestock feeding on the range in Dry Lake Valley. Carpenter (1915, p. 66) reported that Bristol well (3N/65-21d1) formerly furnished the water supply for a smelter. He reported too, that several wells were dug in the vicinity and a small town sprung up around them. However, when Carpenter visited the area in 1912, only one well remained. This well had been in use to supply water to the traveling public and for miners at the Bristol mine a few miles east. The well could be pumped dry at that time during the filling of water tanks used to supply water at the mine. In October 1912 the well was 51 feet deep and water level was 43 feet below land surface. Seemingly the well has since been destroyed. There are three drilled wells in that area that are used to water stock. Reportedly, however, all three do not provide a sufficient supply to meet the needs.

Near Delamar, Carpenter (1915, p. 67) noted that water was piped from several springs, reported to be small seepages in the limestone and granite. Callaghan (1937, p. 35) also refers to the water supply of Delamar but refers to the earlier used springs and wells in a nearby wash as being developed in volcanic rocks. Carpenter also reported that well 6S/63-12a1, drilled 900 feet deep at the foot of the alluvial slope below Delamar, was dry. He further states that when the mine at Delamar was active, water supply was obtained from Meadow Valley Wash, which was pumped over the Meadow Valley Range (Delamar Range) through two 3 1/2-inch pipe lines.

Presently, ground water from wells and springs probably supplies less than 100 acre-feet per year and is used principally for watering stock in Dry Lake and Delamar Valleys. Development of ground water for irrigation probably would be prohibitive because of high pumping costs. Limited amounts of

ground water could be developed, if the need were great enough.

The very substantial depths to water in the central parts of Dry Lake and Delamar Valleys, which makes the cost of development of ground water too high for usual purposes, may make the area attractive for some types of special testing or operation required in modern day technology. In turn, ground water probably could be developed to meet limited water requirements of such activities.

DESIGNATION OF WELLS

In this report the number assigned to a well is both an identification number and a location number. It is referenced to the Mount Diablo base line and meridian established by the General Land Office.

A typical number consists of three units. The first unit designates the township; "N" after the number identifies the township as north of the Mount Diablo base line; "S" after the number identifies the township as south of the Mount Diablo base line. The second unit, a number separated by a slant line from the first, is the range east of the Mount Diablo meridian. The third unit, separated from the second by a dash, is the number of the section in the township. The section number is followed by a lower case letter, which designates the quarter section, and finally, a number designating the order in which the well was recorded in the quarter section. The letters a, b, c, and d, designate, respectively, the northeast, northwest, southwest, and southeast quarters of the section.

Thus, well number 3N/64-20b1 indicates that this well was the first well recorded in the northwest quarter of sec. 20, T. 3 N., R. 64 E.

Wells on plate 1 are identified only by the section number, quarter section letter, and serial number. The township in which the well is located can be ascertained by the township and range numbers shown on the margin of plate 1. For example, well 3N/64-20b1 is shown on plate 1 as 20b1 and is within the rectangle designated as T. 3 N., R. 64 E.