HYDROLOGIC, GEOLOGIC, AND ENGINEERING STUDY

FOR THE

PURISIMA MUTUAL WATER COMPANY

SANTA CRUZ COUNTY, CALIFORNIA

January, 1975

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Purisima Mutual Water Co.
3635 Eastwood Circle
Santa Clara, CA 95050
Phone: (408) 243-3726

May 13, 1975

County of Santa Cruz
Environmental Health Department
701 Ocean Street
Santa Cruz, California 95060

Dear Sirs:

It is with great pleasure that I transmit to you the report "Hydrologic, Geologic, and Engineering Study for the Purisima Mutual Water Company, Santa Cruz County, California." This report is transmitted to fulfull the County of Santa Cruz requirements for a permit to issue water.

I hope that you will find the report satisfactory. If there are any other data needed to accomplish the issuance of the necessary permit to supply water via this mutual water company, please do not hesitate to let me know.

Very truly yours,

H. Gary Greene
President
Purisima Mutual Water Company

INTRODUCTION

INTRODUCTION

The purpose of this report is to present the facts and findings of studies and tests made for the Purisima Mutual Water Company in its development of a water supply system. It is the intent of the Purisima Mutual Water Company to establish a water supply and distribution system for the service of all landowners in the lower part of the Rider Ridge Road area (see Figure 1). For all intent and purposes this mutual water company, a non-profit organization, will distribute water for human consumption and irregation at cost to no more than 20 individual residences located on a total of 68.41 acres in the E 1/2 of the NE 1/4 of Section 16, T10S, R1W, M.D.B.&M. Santa Cruz County, California (see Plate 1, attached topographic map).

The general area to be serviced by the Purisima Mutual Water Company is located in the rugged lower western flanks of the Santa Cruz Mountains, between 650 and 950 feet elevation. It consists principally of flat-topped to gently rounded ridges and knolls and gentle to steep sloped gullies. Vegetation varies from thickly forested slopes and gullies to chaparral covered ridges and knolls. Generally, the flatter portions of land in the Rider Ridge Road area had, sometime in the past, been cleared cultivated, and planted in orchards and vineyards, all of which are now neglected and overgrown.

A water well drilled in 1972 on a flat topped ridge, approximately 920 feet above sea level, just off Rider Ridge Road, .66 miles from the intersection of Jarvis and Rider Ridge Road in the E 1/2 of the NE 1/4 of Section 16, T10S, R1W, M.D.B.&M. Santa Cruz County, California (DBA

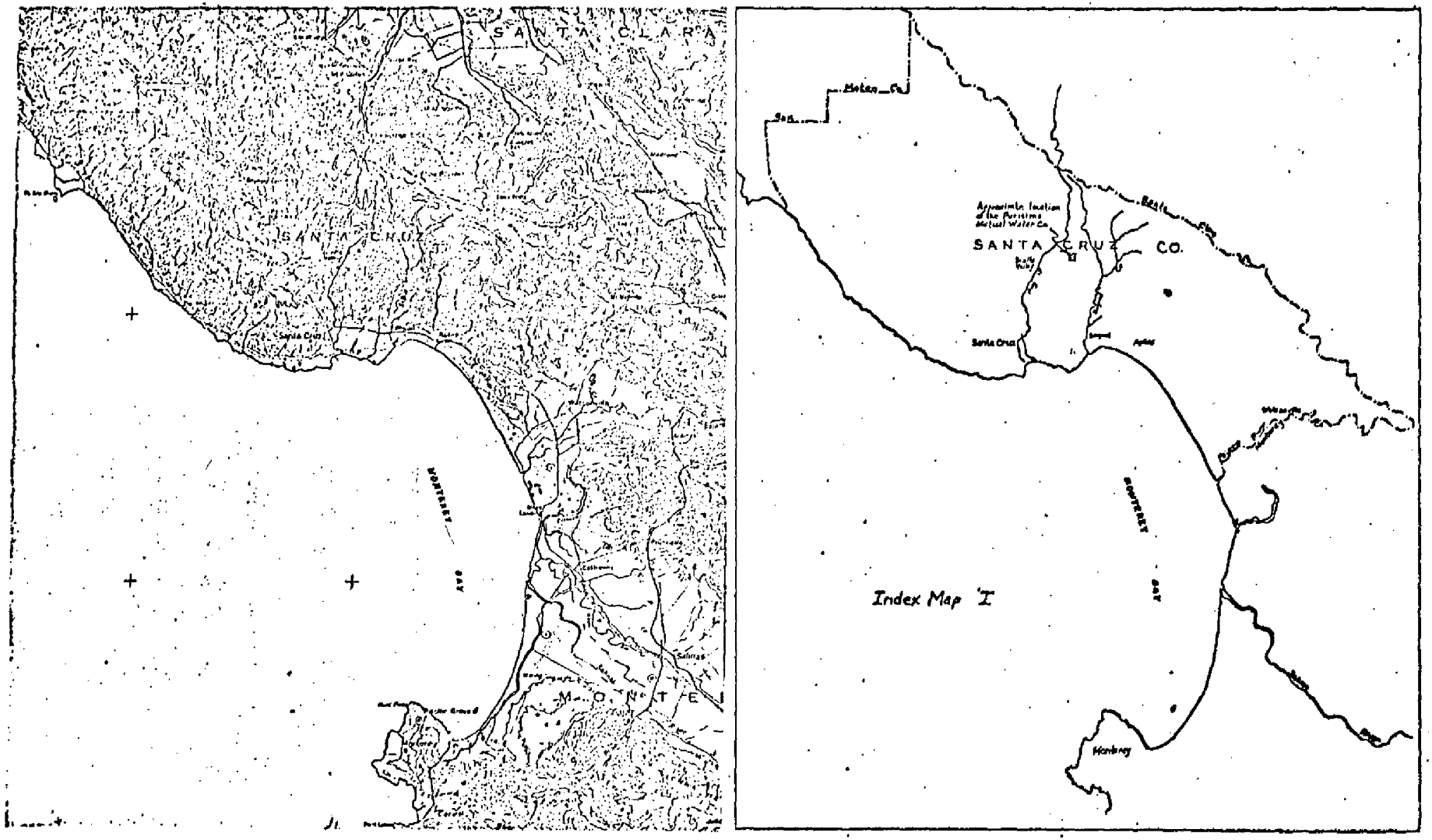

Figure 1. Index maps showing general location of the area to be serviced by the Purisima Mutual Water Company (for more detailed location see Plates 1 and 5).

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or APN 100-041-18) is to become the water supply well for the Purisima Mutual Water Company (see Plate 1 and Plate 2). The well was drilled and logged by William E. Porter of Santa Cruz, California. It has a total depth of 390 feet and is cased with 8 5/8 inch diameter #10 casing from one foot above the ground surface to 390 feet deep with perforations from 170 to 390 feet and with a 12 inch sanitary seal from one foot above ground to a depth of 50 feet. A three phase, 10 hp, 50 gpm (gallons per minute) rated submersible pump has been placed in the well at a depth of 300 feet and supplies water to the mainline distribution system through a 3 inch galvanized stand pipe.

All primary mainline pipes have been joined and layed in 36 inch deep, 1 foot wide trenches and covered with an average thickness of 30 inches of fine- to medium-grained sand. The trenches have been naturally jetted and are well compacted. Construction of the primary distribution system was undertaken after a verbal approval by the Environmental Health Department of the County of Santa Cruz, which was based on their examination of a preliminary engineering report.

This report is divided into six major sections: (1) a preliminary environmental impact statement, (2) geology, (3) hydrology, (4) water system design, (5) cost of construction, and (6) By Laws and Articles of Incorporation. The environmental impact statement, geology, and hydrology sections were prepared by H. G. Greene, a registered geologist with the State of California, registration no. 2669. Pump test data that are included in the hydrologic section were collected and reported on by

Danforth E. Apker, a registered civil engineer with the State of California, registration no. 10007. The water system design was engineered and prepared by J. Kirk Crawford, structural underground engineer for Southern California Edison Company; the waterline, tank, and well site easements were surveyed and are being recorded by Danforth E. Apker. Cost of construction were compiled by H. Gary Greene and J. Kirk Crawford. The By Laws and Articles of Incorporation were prepared by S. Stephen Nakashima, Attorney at Law, State of California.

ENVIRONMENTAL IMPACT
STATEMENT

ENVIRONMENTAL IMPACT STATEMENT

An environmental impact assessment is made here for the Purisima Mutual Water Company. This assessment follows the procedure for evaluating environmental impact as set forth in the U.S. Geological Survey Circular 645 (Leopold and others, 1971); a copy of this circular is enclosed here for general information and referencing (see Appendix D). The "Information Matrix for Environmental Assessment" supplied with Circular 645 was used and a copy of a completed matrix is also included in this report (see Plate 2).

It is proposed that a mutual water company be developed in the Rider Ridge Road area of the Santa Cruz Mountains, Santa Cruz County, California. Water is to be taken from an established well located in the E 1/2 of the NE 1/4 of Section 16, T10S, R1W, MDB&M, Santa Cruz County (DBA or APN 100-041-18) (see Plate 1). The well was drilled in 1972, is 390 feet deep, and is capable of yielding good quality water at a rate of over 57 gallons per minute (gpm). The proposed water company is to service all landowners of the lower half of Rider Ridge Road with no more than 20 services being made available. The distribution system is composed of 6 inch and 4 inch diameter, scheduled 40 equivalent PVC gravity feed and pressurized pipelines. A 30,000 gallon tank is to be constructed for the storage of water. Five fire hydrants, spaced no farther apart than 1,000 feet, have been included in the system to aid in the control of fire.

Regional Environment

The area to be serviced by the water company lies in a fairly humid region receiving between 30 and 60 inches of annual precipitation, most of which occurs in the period of December through March. Principal drainage systems in the area are the Branciforte and Soquel Creeks, located about 0.25 miles northwest and 1 mile west, of the well, respectively. Vegetation ranges from medium to heavy and consists of chaparral types, including oak, madrone, and manzanita, and dense redwood groves.

Access to the area is by means of County maintained, black-topped and oil and screened roads. From Santa Cruz the area can be reached by traveling west along Branciforte Road to Jarvis Road and then to the privately maintained Rider Ridge Road. From State Highway 17, the area can either be reached by traveling approximately 2 miles along upper Jarvis Road, a poorly maintained private road with public right-a-way, to Rider Ridge Road, or via a 4 mile route along Vine Hill (Branciforte) Road to lower Jarvis Road to Rider Ridge Road. All County and State roads are in good condition. Rider Ridge Road is in fair to poor condition; it presently is 12 feet wide with an average 6 inch rock base and an oiled surface that is in badly need of repair. However, operations are underway to widen the potentially most heavily traveled part of the road to 16 feet with an average 5 inch rock base and an oiled and screened surface.

The region is sparsely to moderately heavily settled. It supports rural living and limited agriculture, principally vineyards. The area along Rider Ridge Road has recently been rezoned from 2 1/2 acre agricultural to 5 acres agricultural, except at the lower end of Rider Ridge Road where the rezoned area is 10 acres agricultural. There are presently 4 residences located along

Rider Ridge Road. The potential amount of residences that could be established along the road is 20 with possibly 4 more, if pending or future land splits are allowed by the County.

The Purisima Mutual Water Company has established, or is planning to establish, 17 service connections. There are 14 legal parcels that will be serviced by the company and 3 pending subdivision parcels that are included in the servicing plans.

General Water Supply Plan

The general plan is to draw water from the 390 foot deep well and pump it to a 30,000 gallon storage tank located approximately 630 feet away and 40 feet above the well. Upon entering the tank the water will be sprayed across a deflector for aeration, which will cause any iron or manganese in the water to flocculate and thereby settle to the bottom of the tank as a solid precipitate. ? - I hope so! Accumulated precipitated material can then be removed from the tank without entering the distribution system (see section on Water System Design). Water in the tank will be distributed to the users by two primary mainline pipes; a gravity feed line to all parcels located more than 50 feet below the tank and a pressurized line to all parcels located less than 50 feet, or above the tank.

At this time one dwelling is being supplied water from the well. In the spring of 1975 at least 2 other dwellings will be constructed and will need water services.

Environmental Values

There are three principal environmental values which require consideration in this area as well as many subsidiary ones. A primary consideration is the effect on wildlife in the region, especially on the California bobcat.

Although, the bobcat is not an immediate endangered species, its numbers have been decreasing and if its population continues to wane it certainly will become endangered. The second major consideration is the indirect affect of increasing population which normally comes to an area where the establishment of services necessary for human occupation are established. A third primary impact is the effect on the ground water body.

The actual construction of the water system should have only superficial and short term effects on all wildlife in the area. Noise and other activity associated with the construction should disturb the wildlife in a harmless way for only the duration of construction. The working system, once constructed, will virtually be without noise and its operation will have no effect upon the wildlife. However, indirectly, the establishment of the water system will necessarily increase the human population of the area which almost certainly will have some effects upon the wildlife. For example, the less gregarious animals, such as bobcat, will move to less densely populated areas if the intrusion of humans is too great. To counteract such an overwhelming population increase the members of the mutual water company have agreed to limit the potential maximum services to 20. Probably no more than 17 services will be used in this area of 68.41 acres; this averages out to 4.03 acres per service which is 4 times that that is given to one acre minimum track area along Bonehead Road and supplied water by the Jarvis Mutual Water Company. The availability of water, on the other hand, will probably encourage most wildlife, especially birds such as quail, to stick around, particularly in the dry seasons and during droughts.

Increases in population brought about by the establishment of water services in the Rider Ridge Road area is an indirect impact. Although the construction of the water system is not immediately going to introduce large amounts of people to the region, the availability of water in the area will eventually bring in people and this impact must then be considered. Outside of the impact on wildlife as described above, the most serious long term effect is the potential dependence on, or overuse of, other services in the region--such as telephone, power, and access--by the population that would be encouraged to reside in the area because of the water availability. Fortunately, because of the far sightedness of the phone company and P.G.&E., the phone and power utilities are well established and recent new installations of high power electrical transmission lines and over 100 paired strands of phone wires assure that overtaxing of these utilities will not take place. These utilities available in the lower Rider Ridge Road area can supply well over the 20 residences that could be serviced by the mutual water company.

Unfortunately, the accessibility to the area is in danger of being overused. Although the emminent repair and widening of the privately maintained Rider Ridge Road will make travel along this road safe and comfortable, the County maintained Jarvis Road is too narrow for safe travel. Jarvis Road will probably not be able to support the increased automobile traffic that will come with development on property in this region. Its narrowness and the presence of several blind curves makes the road dangerous to travel even with todays traffic. However, the largest amount of traffic will come mainly from the one acre home sites

in the track of land around Bonehead Road. Less than 10% of the traffic will come from the 17 residences to be serviced by the Purisima Mutual Water Company in the lower Rider Ridge Road area. This accessibility problem was also considered when establishing the limit of 20 maximum hook-ups that the water company could service.

Withdrawal of water from the ground water body will certainly effect the aquifers in the region. However, the actual impact is minor. As shown in the hydrologic section of this report, if 20 shareholders of the mutual water company were to use an average of 1,000 gallons of water per day for 365 days, they would remove only 1.7% of the probable amount of water available in the ground water body. This quantity of water has little impact in light of the fact that approximately 10,000 acre-feet of water in this ground water body is discharged into Monterey Bay yearly, and, therefore, is a loss to the system (Hickey, 1968).

Among the subsidiary environmental impacts which the mutual water company might cause, a few are mentioned below and are discussed in more detail in connection with the impact matrix.

The possibility of ground water pollution from seepage of sewage into the well is minimized by the installation of a 50 foot sanitary seal. Also, since the well is producing from a deeply buried confined aquifer it is highly unlikely that any effluent perculation to the aquifer will occur. All but two potential residences will be located more than 600 feet away from the well.

Water quality in the ground water body will not be affected by the operation of the water system. The quality of water in the ground water body is good except for a high concentration of iron and manganese. These minerals will be reduced to below Public Health standards by processing the water before distribution, thereby improving water quality.

Power requirements for the operation of the pump and pressure equipment is estimated to be about 7.46 kw. No new installation of transmission lines would be required, except for a short, single phase, 110 volt line to the tank site.

The level of air pollution will be slightly increased due to the increase of automobile traffic. This is an indirect and long term impact. Availability of water in the area will eventually bring in more people who will drive automobiles. However, due to the generally strong prevailing breezes and winds in the region, air pollutants do not commonly accumulate. Nevertheless, the possibility of an increase in air pollution was considered when the 20 service limit was established by the water company.

Other indirect impacts brought about by the availability of water would be noise from an increase in automobile traffic, construction of homes, and the general living and recreation of the people. A certain amount of alteration of vegetation would take place. Some trees may be fallen and parts of the chaparral covered ridges and slopes will probably be cleared. However, with the availability of water much vegetation will be substained during droughts and probably the old, unkepmt vineyards and orchards will be revitalized. Certainly new orchards, vineyards, and small vegetable gardens will be established.

The brief summary above shows the main aspects of the planned water system for which environmental impact is being evaluated. Using material contained in this report, an information matrix analysis was completed in the manner described in the U.S. Geological Survey Circular 645 (Leopold and others, 1971). The outcome of the analysis is recapitulated in reduced form as figure 2. The explanations which follows indicate the reasoning followed in this example.

The development of the proposed water system will "withdraw fluid" from an existing well that taps an "underground water" reservoir. "Water quality" may need to be improved by "mineral processing" for "health and safety" reasons before distributing the water to domestic users. Distribution of the water will be through a series of "pipelines" that are laid in "surface excavations" and then covered. "Impoundment" or "product storage" will be by a 30,000 gallon wooden tank. A wooden storage tank is preferred over any other type of tank as it would most likely give, rather than break apart, in small to moderate magnitude "earthquakes." As the area is in a moderately high seismic zone it is preferable to construct structures that will behave well during an "earthquake." A short "transmission line" will need to be extended to the tank site for power to run pressure equipment. Upon the completion of construction of the water system "landscaping" will be done to retain the "wilderness" and "open space" qualities of the region.

With the availability of water, indirect, long term effects would be brought about mainly from "urbanization" of the area with an increase of both "residential" and "agricultural" activities that would require

Figure 2

Reduced Matrix

Development of Purisima Mutual Water Company

Santa Cruz Mountains
Santa Cruz County, California

Biological controls (availability of water) II.A.b	Irrigation II.A.L.	Urbanization II.B.a.	Transmission lines and pipelines II.B.h.	Impoundments - tanks II.B.m.	Surface excavations II.C.b.	Well drilling and fluid removal II.C.d	Mineral processing (water quality improvements) II.D.f.	Product storage - tanks II.D.o.	Landscaping II.E.d.	Pipeline II.G.k.	Septic tanks II.H.l.		
		7/8	4/2	4/2	1/10				2/5	1/6		Landform	I.A.1.d.
2/3	4/10	6/10		3/5		6/10	3/5	3/5		4/8	4/8	Underground water	I.A.2.c.
		3/10				2/10	+2/7				3/10	Water quality	I.A.2.d.
		7/10		4/6				4/6				Earthquakes	I.A.4.h.
+2/2	+2/2	6/7	2/4						+2/3			Trees	I.B.1.a.
+2/2	+2/2	9/9		1/3	1/1			1/3	2/3	1/1		Shrubs	I.B.1.b.
+4/5	+3/2	3/4							+2/3			Birds	I.B.2.a.
+2/2	+3/2	4/4							+2/3			Land animals	I.B.2.b.
+2/3		7/10										Endangered species	I.B.2.g.
	2/2	10/10	7/5	3/4				3/4				Wilderness and open space	I.C.1.a.
	+10/5	3/2	+10/2	+10/2		+10/5		+8/5		+10/5		Agriculture	I.C.1.e.
		2/4	+10/7	+10/8		+10/10	+3/10	+10/10	+5/2	+10/10	+3/10	Residential	I.C.1.f.
		8/6	10/8	2/8				3/3	+2/2			Scenic views	I.C.3.a.
+2/10	5/8	10/8	7/8	2/8	1/8	1/8	2/8	2/8	+3/4	1/4	7/8	Wilderness qualities	I.C.3.b.
		10/8	3/8	2/8	2/8	3/8	2/8	2/8	3/4			Open space qualities	I.C.3.c.
	3/2	2/2	2/2	2/2		3/2	2/2	2/2	1/2	3/2	2/2	Cultural patterns	I.C.4.a.
				+10/10			+10/10	+8/10		+8/10	+7/10	Health and Safety	I.C.4.b.
		10/10	10/10	10/10		10/10	10/10	10/10		10/10	10/10	Population density	I.C.4.d.
		8/6										Transportation network	I.C.5.b.
		8/6	2/3									Utility networks	I.C.5.c.
		5/5									10/10	Waste disposal	I.C.5.d.

"irrigation." With these types of activities an increase in pollution from "waste disposal", mainly from "septic tanks", will occur. New "cultural patterns" brought about from "urbanization", such as "transportation networks" and "utility networks", will change the "landform" somewhat, but not adversely so. Also, along with the increase in "residential" dwellings, human activity ("urbanization") and "irrigation", the impact on "trees", "shrubs", "birds", "land animals", and "scenic views" must be considered. The potentially "endangered species" of California bobcat could be disturbed by an increase in "population density." However, the "availability of water" will certainly aid in "biological control."

With such considerations, the number of actions considered important enough for discussion was reduced to 12. Under each of these items in the vertical column existing characteristics and conditions of the environment were inspected individually. Where the interaction was deemed sufficiently important, the impact was numerically evaluated in terms of magnitude and importance. The resulting codification appears in the completed matrix (figure 2). The types of impact are discussed below in order of the items listed on the right hand side of figure 2.

Landform (I.A.2.d.)

Landforms are disturbed very little with the "surface excavations" for the "pipelines" and therefore are assigned a magnitude 1 impact; they rate high in importance, 10 and 6, respectively, because of the esthetic quality of the mountains that could have been disturbed by trenching. Probably the most disturbance to a "landform" will be the grading for "impoundments" (tank site), which essentially entails flattening of a

gently sloping ridge top, and has been assigned a 4 magnitude. A rated 2 importance is given because the landform that will be disturbed is already relatively flat and the tank will be generally out of sight of most dwelling sites and roads. A small "transmission line" strung to the tank site from a power pole located within 100 feet of the site will have a magnitude 4 impact on landforms, but because of the existence of established "transmission lines" in the area and the short distance of the proposed span, the importance is rated 2. Power is already available at the well site and the "transmission line" has been placed underground so that its magnitude and importance is negligable.

Indirectly, "urbanization" will certainly intensify with the availability of water and will have a high magnitude impact on most all landforms. Because "urbanization" usually has the most disturbing effect it has also been assigned a high importance rating. With "urbanization" will come dwellings and "landscaping." "Landscaping" will probably have little adverse impact on the landforms, thus the magnitude 2 rating, but it is considered fairly important, especially its effect on the natural qualities of the area and if these qualities are to be preserved then it needs to be seriously considered, thus an importance rating of 5. However, major alteration of landforms by excavation for building sites is not anticipated as all potential sites are generally situated on flat or gently sloping ground.

Underground water (T.A.2.c.)

The most important impact will be the withdrawal of water from the ground water body. Therefore, the "fluid removal" will have a fairly moderate magnitude impact on the underground water. A magnitude 6 impact is given because a small percentage of water will be withdrawn to service the area. The importance of ground water is very high in any area and its rating here is in conformance with this philosophy.

Because of the importance of underground water, an expanded matrix has been constructed to show details pertinent to individual situations (see figure 3). The availability of water will certainly have a favorable impact on "biological controls" by being able to support native flora and fauna during dry periods and has been assigned a magnitude +2 because of this. An importance rating is given as 2. Availability of water in areas normally dry during summer months may encourage the establishment of new fauna or flora.

"Irrigation" that will result from the availability of water will have a favorable impact on "crops", "orchards", and "vineyards" that have either been abandoned or will be established. Because of this favorable impact they have been rated +2, +3, and +2, respectively, and have all been given an importance rating of 5 because they may contribute necessary agricultural products to the economy.

"Urbanization" of the region will need water for "domestic use", which cannot exist without water, thus the high level importance rating. A high magnitude rating is also given because water will bring about an "urbanization" impact that, if not controlled, could seriously affect the region.

Figure 3

Expanded Matrix

Purisima Mutual Water Company

Underground Water			
+2/2	Potential availability of water during dry seasons for support of native flora and fauna		Biological controls
3/2	Introduction of new fauna and flora		
+2/5	Crops		
+3/5	Orchards		Irrigation
+2/5	Vineyards		
7/10	Domestic use		
4/7	Gardens		Urbanization
3/3	Lawns		
3/5	Storage tanks		Dams and impoundments
+3/6	Iron removal	Water quality improvement	Mineral processing
+3/6	Manganese removal		
2/5	Main storage tanks		
1/2	Residential storage tanks		Product storage
1/2	Agricultural storage tanks		
3/6	Primary distribution lines		
2/5	Secondary service lines		Pipelines
2/2	Irrigation lines		

"Lawns" and "gardens" will probably be established with the "urbanization" of this area. "Impoundments", such as storage tanks, will have little impact on the area and are of relatively high importance as the quantity of water available for use depends on storage capacity.

"Mineral processing" of the ground water is important for domestic use and this processing will have a favorable effect upon the residence in the area. "Product storage" will have little impact on the area. The "Main storage tank" is considered moderately important for substaining domestic living, but subsidiary "residential" or "agricultural tanks" are not considered as important. "Pipelines", especially "primary and secondary distribution lines" are considered important for the same reasons as those given for the main storage tank. "Irrigation lines" will not be as important to the area as the other pipelines. All pipelines will have a very low magnitude impact on the area.

Water quality (I.A.2.d.)

Water quality is also very important, especially as the water is to be used principally for domestic purposes. Because of this importance another expanded matrix was constructed (see figure 4). Resulting indirectly from the availability of water, is the potential of "irrigation" of crops that would require the use of "fertilizers" and "pesticides", all of which are moderately important to the deterioration of water quality. These products, if used often, could perculate into the ground water body. However, due to the limited amount of acreage that will be used for agriculture and the confined nature of the ground water body in this area the magnitude of impact is considered to be quite small.

Figure 4

Expanded Matrix

Purisima Mutual Water Company

Water Quality		
3/6	Fertilizers	Irrigation
2/6	Pesticides	
2/4	Fertilizers	
2/4	Pesticides	
2/2	Runoff from structures and paving	Urbanization
1/2	Waste water	
3/10	Sewage	
1/2	Pipeline trenches	
1/1	Storage tank foundations	Surface excavations
3/4	Residential excavations	
2/5	Agricultural plowing	
1/10	Aquifer exposure to contaminants	Well drilling and fluid removing
3/10	Domestic sewage disposal	Septic tanks

Again, "urbanization" will have some importance in relation to water quality. The residential use of "fertilizers" and "pesticides" on lawns are considered basically as important, and will have the same magnitude impact, on the area as those for agricultural uses. "Runoff from structures and paving" and "waste water" disposal will have a minimum effect on the area due to the vary small percentage of land that will support residential dwellings. The importance of these items is also considered low because of the good permeability of the soils and the confined nature of the ground water body. "Sewage" disposal, on the other hand, is very important, but its magnitude of impact is considered small, again because of the confined nature of the aquifer from which water is being obtained.

The magnitude of impact by the "surface excavations" for "pipeline trenches", "storage tank foundations", "residential excavations", and "agricultural plowing" are quite small because the ground water body is deep and will not be disturbed by this type of activity. Also, the "well drilling and fluid removal" operation has not "exposed the aquifer to contaminants" and, thus the low magnitude rating. However, it is very important to prevent a leakage of contaminants into the aquifer and this will be prevented at all cost. The insertion of a 50 foot long sanitary seal in the well should assure that no contamination will occur through the well.

Earthquakes (I.A.4.h.)

Because the area of development is in a high seismicity zone, earthquakes must be considered. Probably, the products of "urbanization", such as houses and other structures, will be affected most by earthquakes and, thus, they are assigned a fairly high magnitude rating. Water "impoundments" or "product storage" tanks will be affected by an earthquake, but since they will be of wood and placed on bedrock the impact of an earthquake should be relatively low. "Earthquakes" are considered moderately important because the area is in an active seismic region.

Trees (I.B.1.a.) and shrubs (I.B.1.b.)

Native "trees" and "shrubs" will not be affected by the development of the water system but may be most adversely affected by "urbanization", which may require clearing areas for dwellings and garden or crop sites. "Trees" and "shrubs" are highly important to the open space qualities of this area. However, as most building sites are on flattened, nonvegetated ridges and there is plenty of open, clear ground to plant crops, it is expected that this impact will be minimal. It is given a high magnitude and importance rating here so that the "urbanization" impact on "trees" and "shrubs" will be closely monitored. "Irrigation" and "availability of water" will have definite favorable impact on the flora of the area.

Birds (i.B.2.a.) and land animals (I.B.2.b.)

The magnitude of impact on "birds" and "land animals" from the development of the water system will be quite low and probably will be favorable if "landscaping" is done correctly and if water is made available for the "birds" and "land animals" during dry periods. "Urbanization" will most likely have the most severe impact on "birds" and "land animals" which are considered moderately important for the wilderness quality of the area. "Water availability" and "irrigation" should produce favorable impacts, as water will be available for the fauna of the region.

Endangered species (I.B.2.g.)

Again, the activities of constructing the water system will not adversely affect the potentially endangered species of California bobcats that make their home in this area. However, the indirect impact of "urbanization" will probably have a moderately high magnitude impact on the bobcat. Because of the potential of endangering this species, a number 10 importance is assigned.

Wilderness and open space (I.C.1.a.)

Wilderness and open space is not directly affected by the development of the water system, but it is mentioned here because of the indirect affect, principally "urbanization." The highest magnitude impact is considered for the equally important "urbanization" effect that is bound to impact the "wilderness and open space" of the area, not because it is thought that the impact will be devastating, but because people should be aware of, and control this problem.

Agriculture (I.C.1.c.) and Residential (I.C.1.e.)

Agriculture would be most favorably affected by the availability of waters. "Fluid removal", "storage tanks", and "pipelines" that are necessary for "irrigation" are considered as the highest favorable magnitude impact for an important activity, agriculture, that may be reactivated in this area because of the availability of water.

Water availability, of course, is highly important for residences and the impact of the water distribution system in the area would also have a favorable high magnitude impact. The same type of considerations presented for agriculture can be applied here. Of course the impact of residences in this area is highly important, but because of the spacing and basically ideal settings for houses, the impact magnitude is believed to be low.

Scenic views (I.C.3.b.)

The placement of the storage tank, "impoundment", and the running of "transmission lines" to the tank will have a high to moderately low impact. Importance of these structures in relation to scenic views is fairly high. However, "landscaping" and the planting of trees around the tank will blend this structure into its surroundings and considerably reduce its impact. As usual, the indirect affect, "urbanization", and all the services that come with it, "transmission lines" etc., constitutes a high magnitude impact. In this area wilderness and open space qualities are very important and the control of "urbanization" must be done properly to prevent deterioration of these qualities. Because of the desire of the members of the mutual water company to maintain these qualities, a limit

of 20 services has been established. It is felt that 20 residences could be supported in the area without adversely impacting the wilderness and open space qualities.

Cultural patterns (I.C.3.c.)

Cultural patterns are indirectly the result of establishing a water system. In this area the cultural patterns will be of a rural nature and will have a small magnitude impact. Because of the rural nature, the importance is also considered to be quite low.

Health and safety (I.C.4.b.)

Since the water is going to be for domestic use, health and safety is of paramount concern. The "fluid removal", "impoundment" (storage), "mineral processing", and distribution ("pipelines") have all been designed with the health and safety of the users in mind and, therefore, a highly favorable magnitude impact is assigned to these equally important items.

Population density (I.C.4.d.)

Available water in the area will eventually affect the population density. As shown above "urbanization" will take place and the density of population will increase. Any increase in population will have a high magnitude impact on the area and population density is considered to also be of high importance. With this awareness of the adverse environmental impact that overpopulation can cause, the 20 maximum services limitation was established by the mutual water company.

It is believed that the area can withstand up to 20, but no more, residences in the area without adversely impacting the area. There probably will be no more than 17 residences serviced by the mutual water company. One of the reasons for putting a high magnitude and importance rating on population density is so that controls will be reevaluated periodically as population increases.

Transportation network (I.C.5.b.)

Development of the water system will have no adverse affect on the transportation network of this area. However, indirectly, "urbanization" will certainly put a load on the transportation network or roads. A high magnitude impact is assigned for the effects of "urbanization" on Rider Ridge Road, but with the widening and resurfacing of the road this impact will be reduced considerably. "Urbanization" in this area will also have an impact on Jarvis Road, but this impact will be of a very low magnitude because of the small percentage of people in the lower Rider Ridge Road area that will be using Jarvis Road, compared to the impact from the Bonehead Road area that is serviced by the Jarvis Mutual Water Company.

Utility networks (I.C.5.c.)

Utility networks in this area include electrical power and telephone "transmission lines." In the development of the water system the only "transmission line" that needs to be installed is a short line to the tank site. An underground power line is already in place for

servicing the well pump. It appears that the direct impact by the water company is of small magnitude and because of the existence of the utility lines in the area the importance is considered to be low. However, an indirect problem, "urbanization" may create a moderate magnitude impact, and because of the necessity of having utilities available for residential development the importance is also rated moderate. Probably the most preferable way to reduce the magnitude of this impact is to place all utility networks underground.

Waste disposal (I.C.5.d.)

The development of the water company will have no direct impact on waste disposal. But indirect affects, "urbanization" again, will have some impact. The magnitude and importance of this impact are considered to be moderate because of the average of 4 acres per residential site that is available for effluent disposal, the relatively high porosity and permeability of the soils in the area, and the confined nature of the ground water body. "Septic tanks" will be used by residences to dispose of sewage, and this certainly will have a high magnitude impact on an equally important process. This high magnitude impact will be reduced considerably if leech fields are placed in the highly permeable areas that locally exist near most building sites.

Conclusions

Inspection of figures 2, 3, and 4 immediately gives the essence of the matrix analysis: the proposed actions for the development of the water system which have the most direct environmental impacts are "well drilling and fluid removal", "product storage" (construction of water

storage tank), and the extension of "transmission lines." It has been shown that generally all of these have relatively low to moderate magnitude impact on the area and are considered to be of low to moderate importance.

Indirectly, however, the resulting "urbanization" that may occur with the availability of water in the area creates a more severe and long range impact. The most adversed and high magnitude impacts will come from the increase in "population density" that will establish "residential" dwellings requiring "septic tanks", landscaping", "irrigation" and "transmission lines". "Urbanization" will directly effect the flora and fauna, "wilderness and open space qualities", "scenic views", and the "transportation network" of the region. Availability of water will certainly favorably impact "agriculture" and encourage the growth of flora and continued year round habitation of the fauna.

The members of the Purisima Mutual Water Company are aware of the high magnitude impact that the increase in "population density" would cause to the area and, therefore, have limited to 20 the serves that will be allowed to hook-up to the water system. It is felt that by controlling the availability of water, population can be controlled. Also, it is believed that the lower Rider Ridge Road area can support up to 20 residences without having an adverse environmental affect in the region. However, if there are indications that this number would create an overpopulation impact, a reduction of services would be considered. As a matter of fact, the number of service hook-ups is not

expected to go over 17 or 18 and the members of this mutual water company would be willing to consider reduction of the maximum allowable hook-ups from 20 to 18; if it can be shown that unfavorable impacts would occur if the larger amount of residences were to exist.

Although the area is in a high seismic risk zone, the exposure of bedrock on all building sites reduces the impact of "earthquake" damage considerably. Also, the absence of other geological hazards in the area, such as active faults, landslides, and slumps, makes the area a geologically preferable region for controlled development.

It has been shown that impact upon the "transportation network" in the area would be reduced considerably with the anticipated reconstruction of the roads. Also, the high magnitude impact of potential fire risk in the area has been reduced with the placement of fire hydrants in critical and accessible locations. A 30,000 gallon or possibly a 50,000 gallon, water tank will be used for storage so that the hydrants will deliver more than sufficient water for combating fire. It has also been proposed that a volunteer fire department be formed in the Rider Ridge Road area. Most everyone owning land in this area is enthusiastic about this and the mutual water company has already started procuring fire fighting equipment.

such as ?

It should be pointed out explicitly that the Purisima Mutual Water Company and the landowners of the lower Rider Ridge Road area have consulted with the Santa Cruz County Planning and Environmental Health Departments and with the Branciforte Fire District, continuously, along every step of design and development of the water system. In fact all verbal recommendations made by these agencies have been implemented and verbal approvals

of the water company's and landowner's actions have been given in the County. For example, the number and spacing of fire hydrants have been placed according to the recommendation of the Brancifore Fire District. The amount of water to be delivered by these hydrants are in excess of that recommended by the fire district. In anticipation of the "urbanization" and the total number of residences (20) to be established in the area, the potentially most heavily traveled parts of the roads have been widened to an average of 16 feet, as recommended by the County Planning Department. The design of the water system meets and generally exceeds the standards detailed in the Santa Cruz County Code for water systems and recommended by the County Environmental Health Department.

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GEOLOGY

GEOLOGY

General Discussion

In the general Rider Ridge Road area the geology is quite simple with no complex structures or morphological features. No geological hazards exist. Only one lithologic unit, the Pliocene Purisima Formation is exposed in the area to be serviced by the Purisima Mutual Water Company. In the subsurface the Purisima appears to unconformably overlie the Cretaceous granodiorite basement complex and locally overlies the Miocene Santa Margarita or the Lompico sandstone of Clark (1966).

For this investigation all published and some unpublished literature and maps covering the geology of the region were examined. Air photographs of the specific area were looked at principally to outline areas of bedrock exposures and to identify and locate any geological hazards that may be present. These studies were followed up with field observations that were used to produce a small scale, detailed preliminary geologic map of the specific Rider Ridge Road area that is to be serviced by the Purisima Mutual Water Company.

Location

The area that will be serviced by the mutual water company is located along the lower half of Rider Ridge Road, in the E 1/2 of the NE 1/4 of Section 16, T10S, R1W, M.D.B.&M., Santa Cruz County, California (see Figure 1; Plates 1, 3, and 4). The properties to be serviced by the water system are located off Rider Ridge Road between 0.5 mile from the intersection of Jarvis and Rider Ridge Roads to the end of Rider Ridge Road, approximately 1.1 miles from the intersection.

Accessibility

The area is very accessible. It can be reached with any conventional 2-wheel drive vehicle by traveling up Jarvis Road from Branciforte Road to Rider Ridge Road. Jarvis Road is a County maintained oil and screened road in poor to fair condition. Rider Ridge Road is a privately maintained oil and screened road in poor to fair condition.

General Features

The area is composed of flat-topped ridges and gentle to steep sloped gullies. The slope and gullies are generally forested with redwood, oak, madrone, and bay trees and the ridges are generally covered with some oak trees, chaparral, and grasses. No year round flowing streams or creeks exist in the immediate area. The closest perennial creeks are located in Moores Gulch approximately 1,000 feet west, about 150 feet below, the well location and the upper reaches of Branciforte Creek located approximately 2,500 feet northwest, across a minor drainage divide, and about 300 feet below the well location.

Previous Investigations

No detailed geologic map or report of the general Rider Ridge Road area has been published and no geological mapping at the 7 1/2 minute quadrangle scale has been completed for the region. However, several regional maps have been published, one by Hickey (1968) at a 1:48,000 scale and one by Clark and Rietman (1973) at a 1:125,000 scale. The U.S. Geological Survey is presently constructing photo-geologic maps of the general region. Rogers (1966), Clark (1970), Griggs (1973) and Greene and others (1973) have also mapped the regional geology or

compiled fault and seismcity maps that cover the general Rider Ridge Road area.

The regional geology mentioned in this report is mainly from Hickey (1968) and Clark and Rietman (1973). Personal communications with J. C. Clark and K. S. Muir of the U.S. Geological Survey has given supplemental geologic information to the reported published works.

Geology

Hickey (1968) and Clark and Rietman (1973) show that the Pliocene Purisima Formation is the major lithologic unit in the Rider Ridge Road area (see Plate 5). It is a very extensive unit that covers most all of the Soquel-Aptos region including the Soquel Creek and Branciforte Creek drainage areas southwest of the Zayante fault. The Purisima Formation almost everywhere in this region lies unconformably upon the erosional surface of the Cretaceous crystalline basement complex. Locally, however, the Purisima may be separated from the basement rocks by thin beds or lenses of Miocene sandstone of the Miocene Monterey Formation, or the Miocene Lompico sandstone of Clark (1966), or a questionably mapped Santa Margarita Formation.

The basement complex is composed of igneous rocks of Cretaceous age that consist chiefly of quartzdiorite. Exposures of these rocks can be found in the channels of Branciforte, West Branch, Soquel, Hester, and Bridge Creeks and at Sugarloaf Mountain.

Locally overlying the basement complex, especially around Branciforte Creek, is an arkosic marine sandstone mapped by Clark (1966) as the Lompico sandstone; which may be the same sandstone unit mapped as the

Santa Margarita Formation by Hickey (1968). The Santa Margarita Formation is a poorly consolidated sandstone that is approximately 20 to 30 feet thick in the vicinity of Branciforte Creek (see Plate 5) and pinches out a short distance to the east. The sandstone that may represent the Lompico sandstone of Clark (1966) crops out in Blackburn Gulch where it has a maximum thickness of 300 feet (Hickey, 1968, p. 10).

The Pliocene Purisima Formation consist principally of a sequence of blue, moderately to poorly consolidated, silty to clean, very fine- to medium-grained sandstone containing siltstone interbeds. Between the Zayante fault and Monterey Bay the Purisima strata are only slightly folded and have a regional dip of 3 to 5 degrees southeast (Hickey, 1968, p. 11). From the regional geology is appears that the maximum thickness of Tertiary sedimentary rocks in the general Rider Ridge Road area is approximately 400 feet.

In the immediate area of the Purisima Mutual Water Company's distribution system bedrock consist of a single lithologic unit that everywhere lies very close to the grounds surface and crops out along the ridges (Figure 5). This unit is the lower member of the Purisima Formation, possibly the Tahana sandstone and siltstone member of Cummings, Touring and Brabb (1962), which in this area is composed of a poorly indurated, fine- to medium-grained, well sorted, bluish-grey to buff colored sandstone with some silt and clay interbeds. Locally, where the sandstone is well cemented with calcium carbonate, it stands

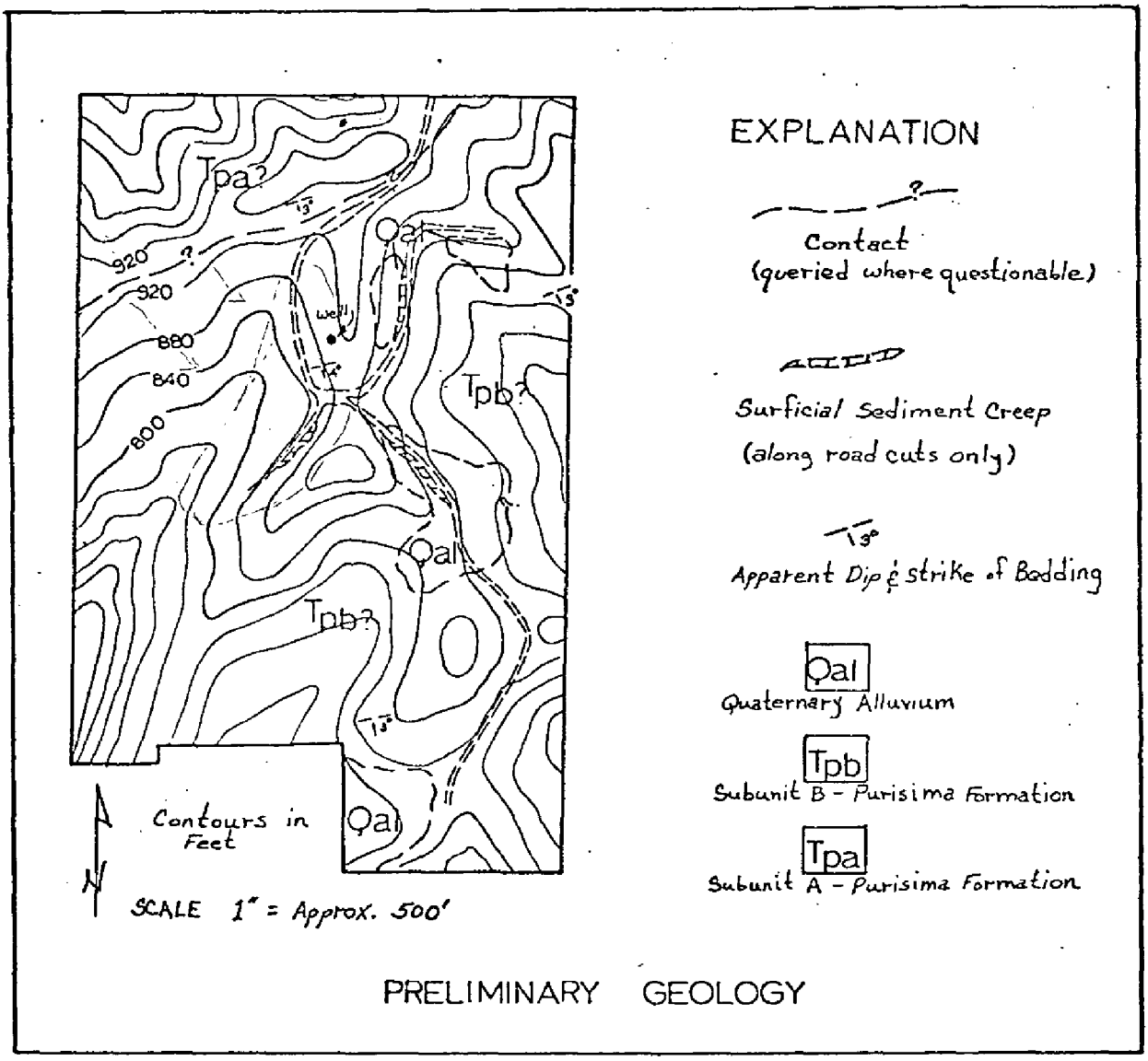

Figure 5. Preliminary detailed geologic map of the area to be serviced by the Purisima Mutual Water Company.

out as resistant ridges and slopes bare of vegetation. Other places the sandstone is fractured and breaks up into sandy soil.

Structure

Structure in the area is relatively simple. The Purisima Formation varies from 3 to 5 degrees southwesterly regional dip and are rarely gently folded. No faults have been mapped or are observed in the area. The closest potentially active fault is the Zayante fault located 1.75 miles north of the well location. The active San Andreas fault lies over 4 miles northeast of the area (see Hickey, 1968; Clark and Rietman, 1973; and Greene and others, 1973).

Geological Hazards

There is no evidence of any geological hazards in the area to be serviced by the Purisima Mutual Water Company. No slumps or landslides have been found, except for stabilized soil creep that has taken place along recent road cuts, and preliminary work done by the U.S. Geological Survey show that the area is free of such hazards. No recent earthquake epicenters fall within the area (Greene and others, 1973). All potential building sites, the water storage tank site, the well and pump site, and the pipelines are located on the flat or very gently dipping outcropping Purisima sandstone bedrock. The lack of steeply dipping beds and thick beds of clay and silt indicate the Rider Ridge Road area to be extremely stable, particularly for the Santa Cruz Mountains.

The lack of faults in the immediate vicinity indicate that the area has been free of faulting in the past and that the chances of damage to a structure or pipeline by fault displacement is minimal. However, the close proximity to the potentially active Zayante fault and to the known active San Andreas fault places the area in a potentially high seismic risk zone. This area actually lies in the IX-X apparent intensity zone established from the 1906 earthquake (Lawson, 1908). This risk is minimized by outcropping bedrock and if standard wooden framed structures--wooden water storage tanks, one or two story houses, etc.--were constructed in this area damage from a 6 to 7 magnitude earthquake located about 5 miles away from the area would probably be relatively low to moderate. Damage would certainly be low compared to damage to equivalent type structures located approximately the same distance from an epicenter, but located on alluvium or any other unconsolidated material.

Conclusions and Recommendations

The regional geologic maps that cover the Rider Ridge Road area (Hickey, 1968; Clark and Rietman, 1973), air photographs and field observations show that the bedrock is exposed or shallowly buried everywhere in the area. Bedrock in this region consist of a single lithologic unit, the Pliocene Purisima Formation, that regionally dips gently (3-5°) southeasterly and is locally flat-lying. About 400 feet of Tertiary bedrock lies directly upon the Cretaceous crystalline basement complex. No active faults, landslides, slumps, or any other geologically hazardous feature appears to exist in the area.

In my opinion this area is geologically safe for controlled development. It appears to be one of the few areas in the Santa Cruz Mountains that is free of geological hazards. Also, it appears that with the existence of a good producing water well (see next section on hydrology), good foundation material, such as the Purisima sandstone, that will support structures securely, relatively good porosity and permeability in the sandy soil for leach fields, all of which will be generally offset, both vertically and horizontally, from the deep water well and perennial streams, make the area very desirable, geologically, for low density development.

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HYDROLOGY

HYDROLOGY

General Discussion

In the Rider Ridge Road area the ground water reservoirs consist of Quaternary alluvial and valley fill deposits and sandstones of the Miocene Santa Margarita and Pliocene Purisima Formations. The Quaternary deposits and the upper part of the Purisima Formation yields most of the water pumped from the wells in this area. In this area, the Purisima Formation has a maximum thickness of about 400 feet and unconformably overlies Cretaceous granitic rocks, which are the effective base of the major water bearing units. The Purisima may also locally overlie the Santa Margarita Formation or Lompico Sandstone of Clark (1966). The granitic rocks contain ground water in fractures and in coarse-grained sandstone and basal conglomerate beds that lie directly on the erosional surface of the basement rocks; however, these rocks are not important sources of water (Muir, 1972, p. 6). There is close continuity with the hydrogeologic units of this area and those of the Soquel-Aptos and Pajaro Valley regions to the south.

Ground water in the Rider Ridge Road area is derived principally from two sources; (1) precipitation within the general area which reaches the ground water body by direct infiltration or by seepage from streams and (2) precipitation in the water shed north of the area that infiltrates and then moves southward at depth into this area. Precipitation in the general region ranges from 40 to 50 inches per year with approximately 80% of the precipitation occurring between November and March (Hickey, 1968, p. 3).

Hydrogeology

According to Hickey (1968, p. 15), ground water occurs in all the geologic formations of the Soquel-Aptos region, which includes the Rider Ridge Road area, however, available space for storage of water varies considerably. The Cretaceous basement complex of igneous rocks, principally of quartzdiorite, that underlies the entire region and is exposed in the channels of Branciforte, West Branch, Soquel, Hester, and Bridge Creeks, contains limited water within fractures and weathered zones (see Plate 5). Tertiary and Quaternary sedimentary rocks, mainly siltstones and sandstones, contain the most water, per unit volume of rock, of all the formations in the region (Hickey, 1968, p. 15).

Two Tertiary sedimentary rock formations are present in the general Rider Ridge Road area; the Miocene Santa Margarita Formation or Lompico Sandstone of Clark (1966) and the Pliocene Purisima Formation (see Plate 5). As mentioned in the geology section, the Santa Margarita Formation is a poorly consolidated sandstone, approximately 20 to 30 feet thick where it crops out in the vicinity of Branciforte Creek and pinches out a short distance to the ~~west~~ east. Sandstone of similar lithology that crops out in Blackburn Gulch has been questionably assigned to the Santa Margarita Formation and thins eastward from Blackburn Gulch where it has a maximum thickness of 300 feet. Clark (1966), however, states that this sandstone may be much older than the Santa Margarita and has mapped it as the Lompico Sandstone (Hickey, 1968, p. 10; Clark and Rietman, 1973). Nevertheless, the poorly consolidated and well sorted character of these sandstones, according to Hickey (1968, p. 11)

indicates that they should readily yield water to a well. However, Hickey (1968, p. 11) reports:

> "... in the vicinity of Branciforte Creek its (sandstone) small thickness and rapid pinchout to the east would allow only domestic-supply wells to be developed. The sandstone that crops out in Blackburn Gulch, and is mapped tentatively as Santa Margarita, could probably be developed by public-supply well but lateral extent of the unit should be determined before development is attempted."

In the Rider Ridge Road area the Purisima Formation is composed mainly of locally well induration (resistant) to highly friable and concretionary, bluish-grey, well sorted, fine-grained, marine sandstone with lenses and thinly laminated beds of siltstone and mudstone. At depth the formation is highly variable and is generally composed of blue, moderately to poorly consolidated, silty to clean sandstone with siltstone, claystone or shale, and some conglomerate interbeds (Hickey, 1968, p. 11; Muir, 1972, p. 8).

The Purisima Formation in the Soquel-Aptos region is divided into three hydrologic subunits based on differing lithologic characters (Hickey, 1968, p. 11-12). These subunits are also recognizable in the Pajaro Valley region, as well as in the Rider Ridge Road area, which is located within Hickey's (1968) Soquel-Aptos region (see Figure 6). Subunit A is the basal unit composed of poorly indurated sand beds interbedded with clay and shale and is about 150 feet thick. Subunit B is the middle unit consisting of intercalated beds of poorly indurated silty to clean, fine to medium grained sandstone, siltstone, and

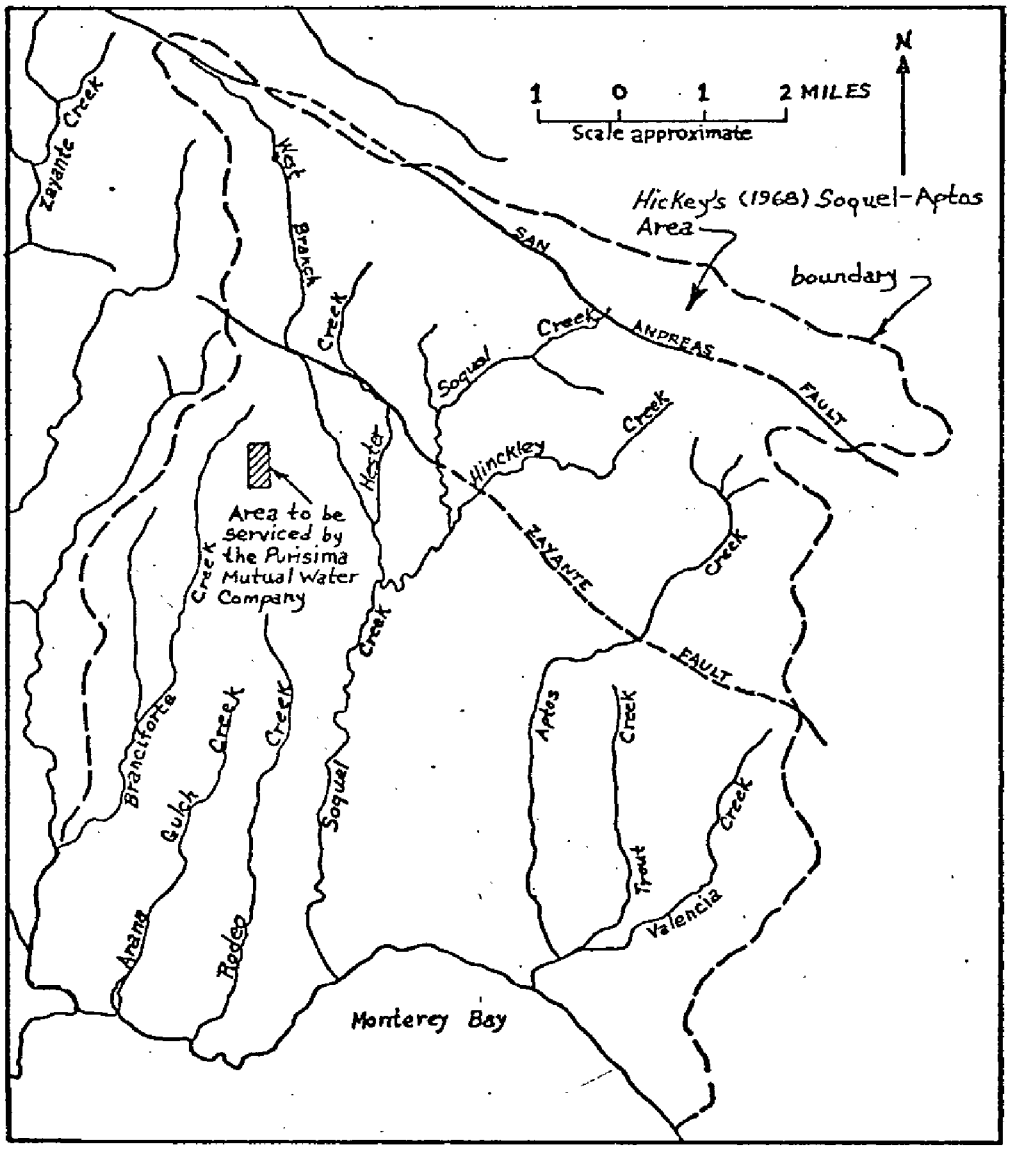


Figure 6. Map showing boundary of Hickey's (1968) Soquel-Aptos area.

claystone with some gravels and averages about 230 feet in thickness. Subunit C is the upper unit composed principally of poorly indurated, thin sand beds with interbeds of siltstone, claystone and some gravel and ranges in thickness from 0 to 1,400 feet; some of this unit has been partly removed by erosion. In the Pajaro Valley these units range in thickness from an average of about 1,500 feet for subunit A, 600 feet for subunit B, and 800 feet for subunit C. One sand bed of subunit C in the Pajaro Valley region has an average thickness of 200 to 250 feet. All of these subunits are water bearing and the yield of the various beds is related to lithology; coarse-grained beds yield water freely, fine-grained beds do not. Good yields can be obtained only from wells that penetrate the coarser-grained beds (Muir, 1972, p. 9). Hickey (1968, p. 16) explains:

> "Sandstone contains fewer openings between grains per unit volume than siltstone. However, the openings in the sandstone are larger than those in the siltstone and thus allow freer passage of water. Consequently, a well that penetrates sandstone usually yields water more readily than a well penetrating siltstone."

The hydrologic subunits of the Purisima Formation are confined. This condition is best described by Hickey (1968, p. 11) who reports the following:

> "Ground water in subunit B is confined except in areas where the subunit is exposed. The confining strata are the lowermost siltstone bed in subunit C and the uppermost siltstone bed in subunit A. Subunit B may also contain within itself several confined zones that are partly or completely separated from each other depending on lateral continuity of the siltstone."

Also, according to Hickey (1968, p. 24):

> "Most of the ground water in subunit C is confined. However, unconfined conditions may also exist at various stratigraphic positions within the subunit."

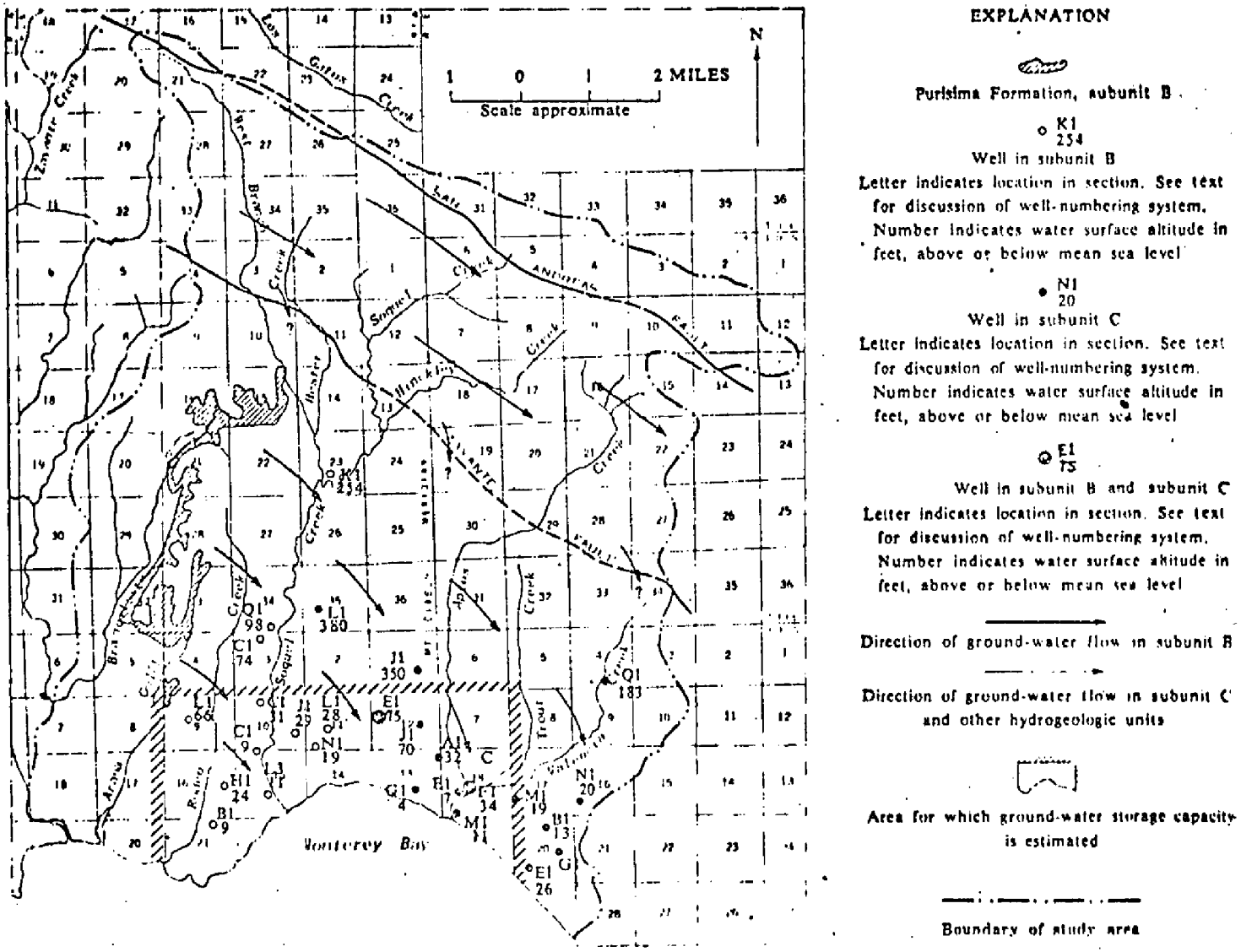
Few wells penetrate the Purisima Formation on the Pajaro Valley and Soquel-Aptos regions because younger overlying deposits yield adequate quantities of water (Hickey, 1968; Muir, 1972). However, studies by Hickey (1968) and Muir (1972) indicate that in these regions wells of sufficient penetration into subunit B may yield as much as 500 gpm of water and have specific capacities of 10 to 15 gpm per foot of drawdown. Wells that penetrate subunits A and C, which are generally finer-grained, may yield as much as 200 gpm with specific capacities of about 5 gpm per foot of drawdown (Muir, 1968, p. 9).

Ground Water Movement

All ground water in the region, southwest of the Zayante fault, appears to flow toward the southeast and south, and this water for the most part originated within the area (see Figure 7). The Zayante fault is assumed to act as an impermeable barrier and impeds ground water flow across the fault fron northeast to southwest. Also, subunit A of the Purisima Formation, where it crops out, is thought to impede ground water flow (Hickey, 1968, p. 34).

Springs

Hickey (1968, p. 16) reports that in the Soquel-Aptos region, including the Rider Ridge Road area, many small springs occur. These springs are sporadically distributed mainly throughout the region



HYPOTHETICAL GROUND-WATER MOVEMENT

Figure 7. Map showing ground water movement (After Hickey, 1968).

northeast of the Zayante fault where they occur principally above the major stream channels. All springs in the region are controlled by local geologic conditions and in general drain small, perched ground water bodies that discharge only a few gallons of water per minute (Hickey, 1968, p. 16). Along Rodeo Creek Gulch Road and near Monte Toyon small springs that have minor importance occur in subunit C of the Purisima Formation (Hickey, 1968, p. 24). The springs in this region are the source of low flow in the perennial streams, especially Branciforte, West Branch, Soquel, and Hinkley Creeks, and the small creek in Moores Gulch.

Well Evaluation and Hydrogeological Data

The Purisima Mutual Water Company's well appears to penetrate 390 feet of Purisima sandstone and shale and may bottom in a thin lense of Santa Margarita sandstone. Lithology of the ridge upon which the well is located is probably representative of the Purisima B hydrologic subunit, although it has been mapped as subunit A, with the higher elevation ridges north of the well representing subunit A (see Plate 5). Strata gently dip southerly at 4 to 5 degrees along this ridge. The well log (see Appendix A) shows that the well penetrates mostly sandstone that is concretionary in part with a few shale beds. Examination of the regional geologic map (Plate 5) shows that the well is located on subunit A and examination of the stratigraphic cross-section (Figure 8) shows the well to be located on subunit B and penetrates mostly subunit A. The high substantial yield of water

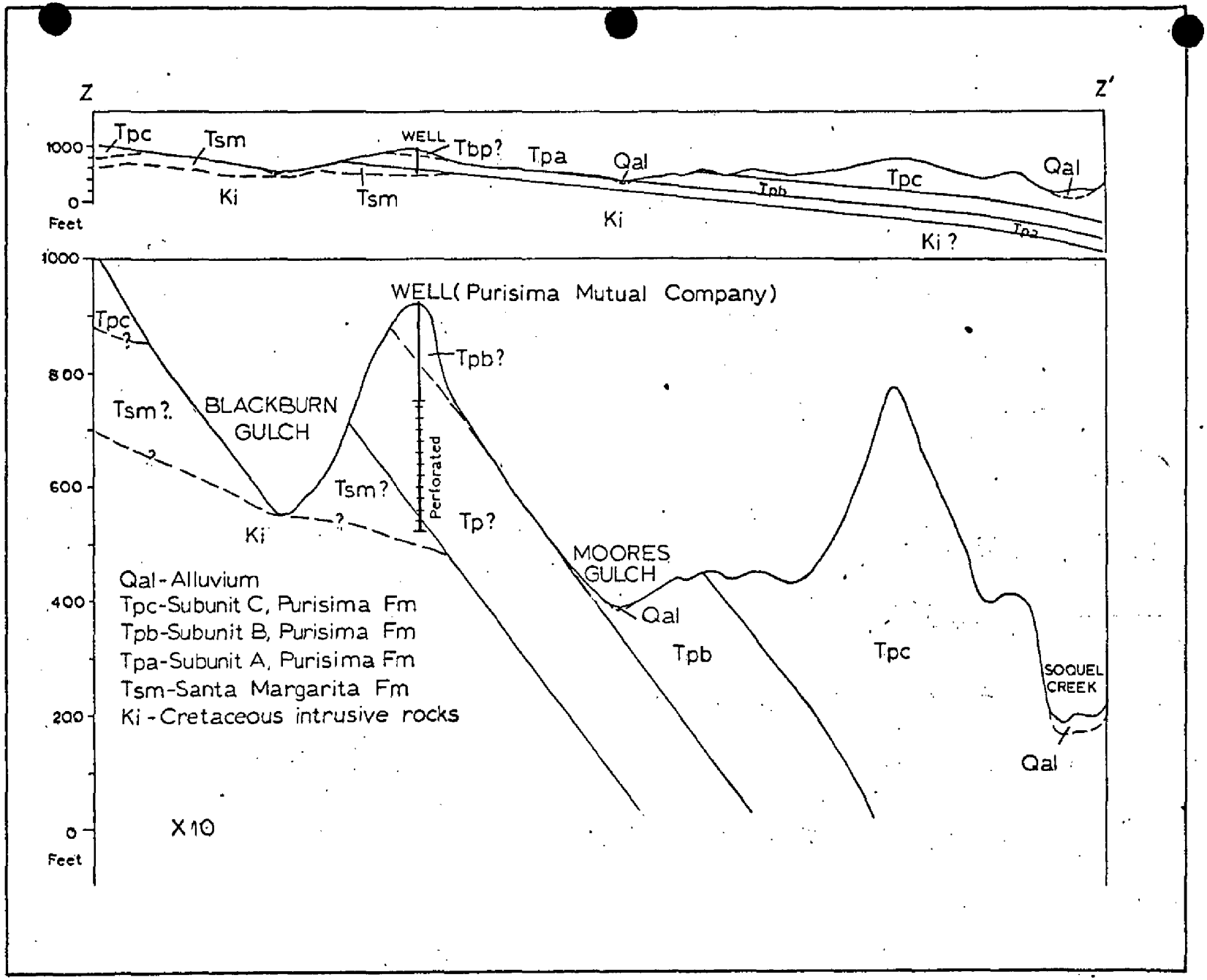


FIGURE 8 - Stratigraphic cross-section across well site of the Purisima Mutual Water Company (see Plate 5 for location)

from the well, along with the driller's lithologic log, suggests that the producing aquifers are in the lower part of subunit B or in a coarse-grained sand member at the top of subunit A. Some water may also be entering the well from the Santa Margarita Formation that may have been penetrated in the bottom of the well.

In this general locality subunit B is the best aquifer and is recharged where it crops out (K. S. Muir, personal commun., 1972). Subunit C contains several sandstone units which yield considerable water in the Soquel-Aptos region, but appears to have been completely eroded in the Rider Ridge Road area. Springs that exist below the Rider Ridge Road area most likely yield water from small perched ground water bodies or may occur in subunit B. However, it appears that springs immediately below the well do not yield water from the same horizons--or aquifers--from which the Purisima Mutual Water Company's well is pumping.

A preliminary evaluation of the water bearing units in the Rider Ridge Road area indicate that an area of no more than 4 square miles make-up the available water supply. In this area, approximately 5.3 x 106 cubic feet of water bearing sedimentary rock, based on an assumed thickness of 250 feet, may form the ground water body that can supply water for pumpage. The ground water storage capacity of this ground water body that may be available to the Purisima Mutual Water Company can be calculated by simply multiplying its volume by the estimated specific yield. Hickey (1968) and Muir (1972) have estimated the specific

yield for the Purisima Formation as approximately 10 percent, thus;

$$\text{Storage capacity} = \text{volume} \times \text{specific yield}$$

$$= 5.3 \times 10^{6} \text{ cu ft} \times .10$$

$$= .53 \times 10^{6} \text{ cu ft}$$

Therefore, the potential ground water available for pumpage may be $.53 \times 10^{6}$ cubic feet ($4.3\ 4 \times 10^{8}$ gallons) or 146 acre-feet.

However, this water supply is also influenced by pumpage down dip, south, of the general area, but this does not appear to be of any immediate threat. Hickey (1968, p. 36) reports that the approximate discharge from subunits B and C of the Purisima Formation into Monterey Bay, and a loss to the system, is on the order of 10,000 acre-feet per year; approximately 7,000 acre-feet discharged by subunit B and about 3,000 acre-feet discharged by subunit C, per year. In the year of 1966 wells in the Soquel-Aptos region removed about 30% of the total discharge from subunit B and approximately 40% from subunit C (Hickey, 1968, p. 36). Recharge necessary to balance this natural ground water discharge, assuming no change in storage, is about 4 inches of precipitation per year. This is about 13% of the estimated 30 to 32 inches of average annual precipitation that falls in the Soquel-Aptos region southwest of the Zayante fault (Hickey, 1968, p. 36).

It appears at this time that the ground water body is fully recharged during the wet seasons. So far there has been sufficient rainfall in the water shed area to completely recharge. However, in times of drought or abundant pumpage from new wells, both in the Rider Ridge Road area, and in the lowland areas of the Soquel-Aptos region, water demand may create

overdrafts. This appears not to be of threat in the immediate future, but close monitoring and up-to-date evaluation of the hydrogeology in this region needs to be done in order to avoid excessive pumping. Also, because of the lack of well holes and well hole data in the Rider Ridge Road area a complete analysis of the water bearing rocks, aquifers, and ground water bodies could not be made. Until more information is made available--much of this data will not be available until other wells are drilled--only a sketchy, preliminary analysis, such as given here, can be produced. In other words, there is not enough data to develop a complete regional hydrogeologic assessment.

Appendix A for data.

Well Tests

Pump tests made of the Purisima Mutual Water Company's well in June and October of 1973 show that the well is capable of producing water at an average rate of 57.75 gpm for at least a 72 hour duration. Pumpage tests were made with a 50 gpm rated pump and, therefore, the average rate represents a minimum yield for the well. The water level in the well stabilized within 40 minutes of the pump tests initiation with 118.5 feet of drawdown. It recovered almost fully--within 1.25 feet of the original piezometric level--within an hour and fifteen minutes of the end of the 72 hour tests. See Appendix A for pump test data, calculations and curves.

The specific capacity of the well can be determined by dividing its discharge in gallons per minute by its drawdown in feet. Thus;

$$\text{Specific capacity} = \frac{\text{discharge}}{\text{drawdown}}$$

$$= \frac{57.75 \text{ gpm}}{118.50 \text{ ft}}$$

$$= 0.49 \text{ gpm/ft drawdown}$$

Therefore, the specific capacity of the well is about 0.5 gpm per foot of drawdown, but this is a minimum value as the well was not pumping at its maximum yield due to the limited rate of the pump. A high specific capacity indicates an efficient, good yielding well. The quantity is not constant, but varies with discharge and time.

Water Quality

> "All natural water contains mineral matter dissolved from soil or rocks. The quantity of dissolved-mineral matter in natural water depends primarily on the type of rocks or soils through which the water has passed. Ground water generally has a larger concentration of dissolved solids than surface water. The value of a water supply depends, in part, upon the character and quantity of this dissolved-mineral matter and the use for which the water is intended.
>
> Most of the dissolved-mineral matter in natural water is in the form of ionized particles. Ionized particles are positively charged cations and negatively charged anions. The most common cations are calcium, magnesium, sodium, and potassium. The most common anions are bioarbonate, sulfate, chloride, and nitrate." (Muir, 1972, p. 25).

Hickey (1968, p. 2) reports that in the Purisima Formation;

> "The quality of water from subunit C is better than from subunit B. Water from subunit B has a slight hydrogen-sulfide odor and its calcium, iron, manganese, sulfate, and total dissolved-solids concentrations generally exceed those of subunit C."

The chemical quality of the water from the mutual company's well is good and meets Public Health drinking water standards except for high iron and manganese levels (see Appendix A, certified drinking water analysis). Levels of iron and manganese analyzed in a water sample taken at the end of the first 72 hour pump test were .99 and .17 ppm (parts per million), respectively. Public Health drinking water standards state that these should not exceed .30 and .05 ppm, respectively. A second water sample taken after the second 72 hour test has not yet been analyzed. It is anticipated that these levels will be lower than the first report, as a similar level for these minerals were reported by the nearby Jarvis Mutual Water Company and after extended pumpage it was found that these levels dropped to within tolerable standards. If iron and manganese persist, the Purisima Mutual Water Company will legally bind all water shareholders and users to install water conditioners in their domestic water supply lines that will remove the excessive minerals. However, the water company has already designed into it's water storage unit an aeriator that will create flocculation of the iron and manganese, which then can be removed as a solid precipitate and it is anticipated that this will alleviate the problem so that no other processing will have to be made. Better Sample!

OK

Conclusions

The geologic, hydrologic, and chemical analysis of the Purisima Mutual Water Company's water well indicate that the ground water from which the well is taking water can supply water to all the shareholders in sufficient quantity and quality for domestic use without unfavorable effects to both the shareholder or other users of the ground water body. Water capacity of the ground water body appears to be of sufficient quantity to supply water to the 17 potential hook-ups. A maximum of 20 hook-ups has been set by the mutual water company and the well will, under normal conditions, have no problem in supplying water to this many users. For example, if 20 shareholders of the Purisima Mutual Water Company were to use an average of 1,000 gallons of water per day for 365 days, the quantity of water taken from the ground water body in a year would equal 7.3×10^6 gallons, this is about 1.7% of the probable 4.3×10^8 gallons of water available in the ground water body. The County of Santa Cruz, on the other hand, has given operational permits to other mutual water companies that supply twice as many users with half the water yield as that proposed for the Purisima Mutual Water Company; i.e., Jarvis Mutual Water Company that supplies water mainly to the Bonehead Road area.

It appears that the major hydrologic subunits that the wells in the Rider Ridge Road area are producing from have not yet been tapped in the lower Soquel-Aptos and Pajaro Valley regions. This means that drawdown in the aquifers of the Rider Ridge Road area are locally induced and generally does not occur from pumpage outside of the immediate area.

References

Clark, J. C., 1966, Tertiary stratigraphy of the Felton-Santa Cruz area Santa Cruz Mountains, California: Stanford Univ., Stanford, Calif., Ph.D. thesis, 184 p.

Hickey, J. J., 1968, Hydrogeologic study of the Soquel-Aptos area, Santa Cruz County, California: U.S. Geol. Survey, Water Resources Division Open-File Rept., 48 p.

Muir, K. S., 1972, Geology and ground water of the Pajaro Valley area, Santa Cruz and Monterey Counties, California: U.S. Geol. Survey, Water Resources Division Open-File Rept., 33 p.

H. Gary Greene
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Registration No. 2669

WATER SYSTEM DESIGN

WATER SYSTEM DESIGN

General Discussion

The water system was designed for the Purisima Mutual Water Company by J. Kirk Crawford. Due to the variable relief of the area a radial system design, in contrast to a looping system, is implemented. However, each radial line on the gravity system is designed to carry 100% of the required capacity should future changes warrant the need.

Basically, two systems have been designed; a gravity system and a pressurized system. The gravity system is designed to supply water to Parcels 2 through 4 of the lands of Clifford Kelley, the land of Crawford (Parcel 1 of the lands of Kelley), and Parcel C, the land of Greene (see Plates 3, 4 and 6). The pressure system is designed to supply water to Parcels A and B of the lands of Cocciardi, to the land of Schott (Parcel 2 of Cocciardi), to parcels A and B of the lands of Smets, and to Parcels A, B, and C of the lands of Palermo (see Plates 3 and 6).

The distribution system consist of 845 feet of 6 inch gravity feed primary mainline that feeds the 4 inch primary distributary lines from the storage tank and feeds the storage tank from the well. Also, there is 2,513 feet of 4 inch gravity feed primary mainline and 335 feet of 4 inch pressurized primary mainline; it is anticipated that perhaps another 350 feet may be added to this pressurized line. Most all of the pipeline has been layed and buried with the approval of the Santa Cruz County Environmental Health Department. All materials used in this system are new and were manufactured specifically for domestic water systems.

During the design of the water system the Branciforte Fire Department was consulted for comments on fire fighting requirements. At their suggestion, five emergency fire hydrants capable of delivering water at 500 gpm for a duration of 30 minutes were installed at intervals of less than 1,000 feet apart (see Plates 3, 4 and 6).

Easements

The water line, well, and tank site easements are shown in the attached map to Plate 6. Description of these easements are given in Appendix B.

Engineering Report

Immediately following is the engineering report as submitted by J. Kirk Crawford. As mentioned in Crawford's letter of transmittal to the Environmental Health Department of the County of Santa Cruz, the design of the Purisima Mutual Water Company's water system meets and generally exceeds the standards detailed in the Santa Cruz County Code regarding water systems. A copy of this code is included in this report in Appendix C.

PURISIMA MUTUAL WATER COMPANY
3635 Eastwood Circle
Santa Clara, California 95050
December 6, 1974

County of Santa Cruz
Environmental Health Department
Santa Cruz, California 95060

Gentlemen:

Enclosed is the water system design for the Purisima Mutual Water Company in the Santa Cruz Mountains.

The design of this water system meets and generally exceeds the standards detailed in the Santa Cruz County Code regarding water systems.

The design is a radial system due to the mountainous terrain. While a looping system was not practical at this time, each radial line on the gravity system was designed so as to be capable of carrying 100% of the required capacity, should future changes warrant the need.

The Branciforte Fire Department office was consulted during design regarding fire fighting requirements. At their suggestion, emergency fire hydrants, capable of delivering 500 gal/min for 30 minutes, were installed at intervals less than 1,000 feet apart. The emergency design calculations as well as those for normal operating conditions are included.

All materials used are new and manufactured specifically for domestic water systems.

Under separate cover are the well test and bacteriological report.

I hope this information meets with your approval.

Sincerely,

J. Kirk Crawford

J. Kirk Crawford
Engineer
Purisima Mutual Water Company

JKC:gc
Enclosure

Water System Design for
PURISMA MUTUAL WATER COMPANY

Water System Design For

PURISIMA MUTUAL WATER COMPANY

Santa Cruz County, California

Water for the system is supplied from an individual well. Refer to the Water Well Report for specific information on the well.

Requirements for system capacity are:

Rate of flow for 2 hours

$Q = 100 + 25\sqrt{N}$ (N < 625 customers)

Ultimate of 20 customers: N = 20

Q = 212 gal./min.

Total for 2 hours ⟶ 120 min x 212 gal./min = 25,440 gal.

Actual storage = 30,000 gal.

Source requirements ⟶ 450 gal. per service/24 hours

450 gal. x 20 services = 9000 gal./24 hours

The average well yield is 55 gal./min.

9000 gal. @ 55 gal./min. = 164 min.

Pumping required to meet minimum = 2 hrs. 44 min.

Distribution facilities:

All main line pipe is 6" and 4" National Sanitation Foundation (NSF) approved polyvinyl chloride (PVC), 160 psi rated

Service pipe is 1½" NSF, PVC 160 and 200 psi rated.

All materials are new.

Calculation references: Handbook of Hydraulics - King & Brater - fifth edition

Fluid Mechanics & Hydraulics - Giles - second edition

Materials and Installation

I. All mainline water pipe to be installed with 30" minimum cover.

II. All materials are new.

6" and 4" pipe is type1120 PVC - SDR 26 (160 psi)

3" pipe is type 1120 PVC Schedule 40 - 260 psi

1½" pipe is type 1120 PVC - SDR 21 (200 psi) & SDR 26 (160 psi)

III. All pipe fittings are Schedule 40 PVC, solvent weld type except steel junctions which are threaded type.

IV. Fire hydrants are new 4" size bronze American Standard Fire Protection approved. Risers are new 4" galvanized steel pipe - encased in concrete.

V. All gate valves are cast iron with bronze finish, non-rising stems, and meet AWWA specification C-500.

VI. System to be master metered at well location adjacent to check valve.

VII. Approximately 7 connections (or shares) cannot be supplied by the gravity system and will require pressure tanks and pumps. Existing 6-100 gallon pressure tanks, with pump to be purchased, will supply immediately required demand. Future demand to be supplied by additional similar unit(s).

VIII. Purification of all lines to be accomplished by pumping chlorinated water through the system.

IX. Storage tank to be 30,000 gallon capacity redwood type, placed on a reinforced concrete pad and completely covered. Pump actuator to be float type located in tank. Primary aeration treatment to be accomplished in tank; refer to enclosed storage tank specification for details.

X. Water quality analysis (enclosed elsewhere) indicates filtration of elements Iron and Mangenese required. Elements can be reduced to acceptable levels by primary aeration treatment at storage tank. Refer to tank specification.

Pumping Calculations

Pump to Storage
0 ft. elev. to + 57 ft. elev.

Assumed average water depth in 30,000 gal. storage tank = 15 feet.

Elements in line from pump to tank

1 - gate valve (open)
1 - tee
1 - 3" pipe to 6" pipe enlargement
1 - check valve (open)
1 - meter
1 - discharge into tank
3 - 90^0 bends
600 ft. 6" pipe

Pump Q = 55 gal/min 55 gal/min thru 3" pipe = 2.2 ft/sec

55 gal/min thru 6" pipe = 0.5 ft/sec

Losses

$$\text{tee} = K\frac{v^2}{2g} \qquad k = 1.5 \qquad 1.5\ \frac{(0.5)^2}{2(32.2)} = .006 \text{ ft. head}$$

$$\text{enlargement} = \frac{(V_1 - V_2)^2}{2g} = \frac{(0.5 - 2.2)^2}{2(32.2)} = .05 \text{ ft. head}$$

check valve (open) = 3.0 ft head
meter = 1.5 ft. head

$$\text{3 bends} = K\frac{v^2}{2g} \longrightarrow .6\ \frac{(.5)^2}{2(32.2)}\ (3) = .006 \text{ ft. head} \qquad k = .6$$

$$\text{discharge} = 1.0\ \frac{v^2}{2g} = 1.0\ \frac{(.5)^2}{2(32.2)} = .004 \text{ ft. head}$$

$$\text{gate valve (open)} = K\frac{v^2}{2g} \longrightarrow .25\ \frac{(0.5)^2}{2(32.2)} = .001 \text{ ft hea} \qquad k = .25$$

6" pipe friction = .03 ft. loss/100 ft. pipe @ 600' = .18 f
head

Total head to overcome due to losses = 5 ft.

Total head pump must overcome = 57 ft. elev. +
15 ft tank + 5 ft. losses
= 77 ft. head

= 33 psi at pump exit

Calculations for Normal Operating Conditions

Storage to Intersection
+57 feet elev. to - 10 ft. elev.

Under normal conditions: 212 gal/min

Elements in line from tank to intersection

1 - gate valve (open)
1 - tank exit
2 - 90^{O} bends
810 ft. 6" pipe

Q = 212 gal/min thru 6" pipe = 2.3 ft/sec

Losses

gate valve (open) = $K \frac{v^2}{2g}$ $K = .25 \longrightarrow .25 \frac{(2.3)^2}{2(32.2)}$ = .02 ft. head

tank exit = $.5 \frac{v^2}{2g}$ = $.5 \frac{(2.3)^2}{2(32.2)}$ = .04 ft. head

2 bends = $K \frac{v^2}{2g}$ $K = .6 \longrightarrow .6 \frac{(2.3)^2}{2(32.2)}$ (2) = . 09 ft. head

6" pipe frictions = 0.3 ft. loss/100 ft. pipe @ 810 ft. = 2.5 ft head

total losses = 3 ft. head

total head available = 57 ft. + 10 ft. + 15 ft. = 82 ft. head

actual at intersection = 79 ft. head

= 34 psi.

Storage to Point "H"
+57 ft. elev. to + 9 ft. elev.

Under normal conditions: 212 gal/min

Elements in line from tank to point "H"

810 ft. 6" pipe
- 1 - tank exit
- 1 - gate valve (open)
- 2 - 90° bends
- 1 - 6" pipe to 4" pipe contraction

450 ft. 4" pipe
- 1 - tee
- bends: 10°, 35°

Q = 212 gal/min thru 6" pipe = 2.3 ft./sec
thru 4" pipe = 5.0 ft./sec

Losses

6" pipe friction = 0.3 ft. loss/100 ft. pipe @ 810' = 2.4 ft. head

tank exit = $.5 \frac{v^2}{2g}$ = .04 ft. head

gate valve (open) = $.25 \frac{v^2}{2g}$ = .02 ft. head

2 - bends = $.6 \frac{v^2}{2g}$ (2) = .10 ft. head

contraction = $.26 \frac{v^2}{2g}$ = .10 ft. head

4" pipe friction = 1.8 ft. loss/100 ft. pipe @ 450' = 8.1 ft. head

tee = $1.5 \frac{v^2}{2g}$ = .59 ft. head

bends: $K \frac{v^2}{2g} \rightarrow K_{10^o} = .2$, $K_{35^o} = .34$

10^o = .08 ft. head
35^o = .13 ft. head

total losses = 12 ft. head

total head available = 57 ft. + 15 ft. - 9 ft. = 63 ft.

actual at point "H" = 51 ft. head
= 22 psi

Storage to Point "Y"
+57 ft. elev. to - 85 ft. elev.

Under normal conditions: 212 gal/min.

Elements in line from tank to point "Y"

810 ft. 6" pipe
1 - tank exit
1 - gate valve (open)
2 - 90° bends (6")
1 - 6" pipe to 4" pipe contraction
800 ft. 4" pipe
1 - tee 6"
bends: 20°, 30°, 35°, (2)45°, 90°

Q = 212 gal/min. thru 6" pipe = 2.3 ft/sec
thru 4" pipe = 5.0 ft/sec

Losses

6" pipe friction = 0.3 ft. loss/100 ft. pipe @ 810' = 2.5 ft. hea

tank exit = $.5 \frac{v^2}{2g}$ = .04 ft. head

gate valve (open) = $.25 \frac{v^2}{2g}$ = .02 ft. head

2 bends = $.6 \frac{v^2}{2g}$ (2) = .09 ft. head

tee = $1.5 \frac{v^2}{2g}$ = .12 ft. head

contraction = $.26 \frac{v^2}{2g}$ = .1 ft. head

4" pipe friction = 1.8 ft. loss/100 ft. pipe @ 800 ft. = 14.4 ft hea

bends = $K \frac{v^2}{2g} \rightarrow K_{20°} = .24$, $K_{30°} = .3$, $K_{35°} = .34$, $K_{45°} = .4$, $K_{90°} = .6$

20° = .09 ft. head
30° = .12 ft. head
35° = .13 ft. head
(2)45° = .32 ft. head
90° = .35 ft. head

total losses = 18 ft. head
total head available = 57 ft. + 85 ft. + 15 ft. = 157 ft. head
actual at point "Y" = 139 ft. head
= 60 psi

Storage to Point "FF"
+57 ft. elev. to -133.5 ft. elev.

Under normal conditions: 212 gal/min.

Elements in line from tank to point "FF"

810 ft. 6" pipe
1 - tank exit
1 - gate valve (open)
2 - 90° bends (6")
1 - 6" pipe to 4" pipe contraction
2000 ft. 4" pipe

bends: 10°, (2) 20°, (2)30°, (2)35°, (2)45°, 75°

Q = 212 gal/min. thru 6" pipe = 2.3 ft./sec.
thru 4" pipe = 5.0 ft./sec.

Losses

6" pipe friction = 0.3 ft. loss/100 ft. pipe @ 810' = 2.5 ft. head

tank exit = $.5 \frac{v^2}{2g}$ = .04 ft. head

gate valve (open) = $.25 \frac{v^2}{2g}$ = .02 ft. head

2 bends = $.6 \frac{v^2}{2g}(2)$ = .09 ft. head

contraction = $.26 \frac{v^2}{2g} = .26 \frac{(5)^2}{2(32.2)}$ = .1 ft. head

4" pipe friction = 1.8 ft. loss/100 ft. pipe @ 2000' = 36 ft. head

bends = $K \frac{v^2}{2g} \rightarrow K_{10^{\circ}} = .2$, $K_{20^{\circ}} = .24$, $K_{30^{\circ}} = .3$, $K_{35^{\circ}} = .34$

$K_{45^{\circ}} = .4, K_{75^{\circ}} = .55$

10° = .08 ft.
(2)20° = .18 ft.
(2)30° = .24 ft.
(2)35° = .26 ft.
(2)45° = .32 ft.
75° = .21 ft.

total losses = 40 ft. head
total head available = 57 ft. + 133.5 ft. + 15 ft. = 205.5 ft. head
actual at point "FF" = 165.5 ft. head
= 72 psi

Storage to Point "KK"
+57 ft. elev. to - 61 ft. elev.

Under normal conditions: 212 gal/min.

Elements in line from tank to point "KK"

810 ft. 6" pipe
1 - tank exit
1 - gate valve (open)
2 - 90° bends
1 - 6" pipe to 4" pipe contraction
620 ft. 4" pipe
1 - tee
bends: 10°, 20°, 25°, 30°, 35°

Q = 212 gal/min. thru 6" pipe = 2.3 ft./sec.
thru 4" pipe = 5.0 ft./sec.

Losses

6" pipe friction = 0.3 ft. loss/100 ft. pipe @ 810' = 2.4 ft. head

tank exit = $.5 \frac{v^2}{2g}$ = .04 ft. head

gate valve (open) = $.25 \frac{v^2}{2g}$ = .02 ft. head

2 bends = $.6 \frac{v^2}{2g}$ (2) = .10 ft. head

contraction = $.26 \frac{v^2}{2g}$ = .10 ft. head

4" pipe friction = 1.8 ft. loss/100 ft. pipe @ 620' = 11.2 ft. head

tee = $1.5 \frac{v^2}{2g}$ = .59 ft. head

bends: $K \frac{v^2}{2g} \longrightarrow K_{10^\circ} = .2$, $K_{20^\circ} = .24$, $K_{25^\circ} = .27$, $K_{30^\circ} = .3$, $K_{35^\circ} = .34$

10° = .08 ft. head
20° = .09 ft. head
25° = .11 ft. head
30° = .12 ft. head
35° = .13 ft. head

total losses = 15 ft. head

total head available = 57 ft. + 61 ft. + 15 ft. = 133 ft.

actual at point "KK" = 118 ft. head
= 51 psi

Storage to Point "OO"
+57 ft. elev. to + 43 ft. elev.

Under normal conditions: 212 gal/min

Elevation of storage tank insufficient to provide gravity feed. Pressure tanks and pump of sufficient size to provide for immediate demand to be installed. Pressure tank capacity to be increased when needed. Pressure at tanks to be regulated between 35 and 60 psi.

Elements in line from storage tank to point "OO"

700 ft. 4" pipe
1 - gate valve (open)
1 - tank exit
bends: 10^{o}, 25^{o}, 30^{o}, 90^{o}

Q = 212 gal/min thru 4" pipe = 5.0 ft./sec.

Losses

4" pipe friction = 1.8 ft.loss/100 ft. pipe @700' = 12.6 ft. head

tank exit = $.5 \frac{v^2}{2g}$ = 0.2 ft. head

gate valve (open) = $.25 \frac{v^2}{2g}$ = 0.1 ft.head

bends: $K \frac{v^2}{2g} \rightarrow K_{10^o} = .2,\ K_{25^o} = .27\ K_{30^o} = .3,\ K_{90^o} = .6$

10^{o} = .08 ft. head
25^{o} = .11 ft. head
30^{o} = .12 ft. head
90^{o} = .23 ft. head

total losses = 14 ft. head

total head available = 57 ft. + 15 ft. - 43 ft. = 29 ft. = 12.5 psi

Introducing pressure pump set at 35 psi minimum and 60 psi maximum into system yields:

14 ft. head loss = 6 psi

actual pressures at point "OO" = 54 psi maximum
29 psi minimum

Calculations for Emergency Operating Conditions

Storage to Intersection
+57 ft. elev. to - 10 ft. elev.

Under emergency conditons: 500 gal/min. for 30 min. = 15,000 gal. (fire) Hydrant at intersection

Elements in line from tank to hydrant

1 - gate valve (open)
1 - tank exit
1 - tee
3 - 90° bends
1 - 6" pipe to 4" pipe contraction
810 ft. 6" pipe

Q = 500 gal/min thru 6" pipe = 5.5 ft/sec

Losses

gate valve (open) = $K \frac{v^2}{2g}$ $K = .25 \longrightarrow .25 \frac{(5.5)^2}{2(32.2)}$ = .12 ft. head

tank exit = $.5 \frac{v^2}{2g} = .5 \frac{(5.5)^2}{2(32.2)}$ = .24 ft. head

tee = $K \frac{v^2}{2g}$ $K = 1.5 \longrightarrow 1.5 \frac{(5.5)^2}{2(32.2)}$ = .7 ft. head

3 bends $K \frac{v^2}{2g}$ $K = .6 \longrightarrow .6 \frac{(5.5)^2}{2(32.2)}$ (3) = .84 ft. head

contraction = $K_c \frac{v_2^2}{2g}$ $K_c = .26 \longrightarrow .26 \frac{(11.5)^2}{2(32.2)}$ = .54 ft. head

6" pipe friction = 1.5 ft. loss/100 ft. pipe @ 810' = 12.2 ft. hea

total losses = 15 ft. head

total head available = 57 ft + 10 ft. + 15 ft = 82 ft. head

actual minimum at hydrant under full emergency conditions

(500 gal/min) = 82 ft. head - 15 ft. head (losses) = 67 ft. head

= 29 psi.

Storage to Point "Y"
+57 ft. elev. to - 85 ft. elev.

Under emergency conditons: 500 gal/min.
Hydrant at point "Y"

Elements in line from tank to hydrant

810 ft. 6" pipe
1 - tank exit
1 - gate valve (open)
2 - 90° bends (6")
1 - 6" pipe to 4" pipe contraction
800 ft. 4" pipe
2 - tees (1-6", 1-4")
bends: 20°, 30°, 35°, (2) 45°, 90° (all 4")

Q = 500 gal/min thru 6" pipe = 5.5 ft./sec
thru 4" pipe = 11.5 ft./sec

Losses

6" pipe friction = 1.5 ft. loss/100 ft. pipe = 12.2 ft. head

tank exit = $.50 \frac{v^2}{2g} = .5 \frac{(5.5)^2}{2(32.2)} = .24$ ft. head

gate valve (open) = $.25 \frac{(5.5)^2}{2(32.2)} = .12$ ft. head

2 bends = $.6 \frac{(5.5)^2}{2(32.2)}$ (2) = .56 ft. head

1 tee = $1.5 \frac{(5.5)^2}{2(32.2)} = .7$ ft. head

contraction = $.26 \frac{(11.5)^2}{2(32.2)} = .54$ ft. head

4" pipe friction = 10 ft.loss/100 ft. pipe = 800 ft. = 80 ft. head

1 tee = $1.5 \frac{(11.5)^2}{2(32.2)} = 3.1$ ft. head

bends = $K \frac{v^2}{2g} \rightarrow K_{20°} = .24$, $K_{30°} = .3$, $K_{35°} = .34$, $K_{45°} = .4$, $K_{90°} = .6$

20° = .5 ft. head
30° = .62 ft. head
35° = .7 ft. head
(2)45° = 1.64 ft. head
90° = 1.25 ft. head

total losses = 102 ft. head
total head available = 57 ft. + 85 ft. + 15 ft. = 157 ft. head
actual minimum at hydrant under emergency = 55 ft. head

Storage to Point "KK"
+57 ft. elev. to -61 ft. elev.

Under emergency conditions: 500 gal/min.

Hydrant at point "KK"

Element in line from tank to point "KK"

810 ft. 6" pipe
- 1 - tank exit
- 1 - gate valve (open)
- 2 - 90° bends
- 1 - 6" pipe to 4" pipe contraction

620 ft. 4" pipe
- 1 - tee
- bends: 10°, 20°, 25°, 30°, 35°, 90°

Q = 500 gal/min thru 6" pipe = 5.5 ft./sec.
thru 4" pipe = 11.5 ft./sec.

Losses

6" pipe friction = 1.5 ft. loss/100 ft. pipe @ 810 ft. = 12.2 ft.head

tank exit = $.5 \frac{v^2}{2g}$ = .24 ft. head

gate valve (open) = $.25 \frac{v^2}{2g}$ = .12 ft. head

2 - bends = $.6 \frac{v^2}{2g(2)}$ = .56 ft. head

contraction = $.26 \frac{v^2}{2g}$ = .54 ft. head

4" pipe friction = 10 ft.loss/100 ft. pipe @ 620 ft. = 62 ft. head

tee = $1.5 \frac{v^2}{2g}$ = 3.1 ft. head

bends = $K \frac{v^2}{2g} \longrightarrow K_{10^o} = .2, K_{20^o} = .24, K_{25^o} = .27, K_{30^o} = .3$

$K_{35^o} = .34, K_{10^o} = .6$

- 10° = .41 ft. head
- 20° = .5 ft. head
- 25° = .56 ft. head
- 30° = .62 ft. head
- 35° = .7 ft. head
- 90° = 1.24 ft. head

total losses = 83 ft. head
total head available = 57 ft. +61 ft. + 15 ft. = 133 ft.head
actual minimum at hydrant under emergency = 50 ft. head

Storage Tank Information

Storage Tank Specification
refer to sketch

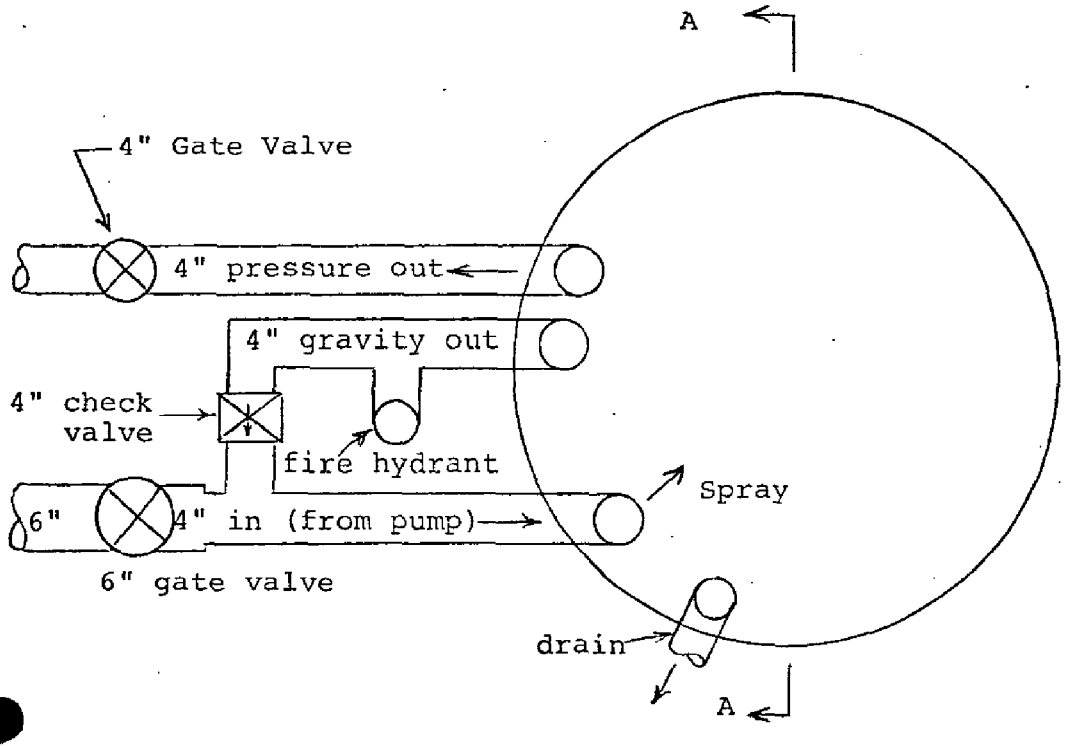
Water storage is in a completely covered, 3 inch walled, redwood tank placed on a pad of reinforced concrete. Tank capacity is 30,000 gallons.

A 110 v. float accuated control circuit signals pump turn on and off. Pump turn on initially to be set at 25,000 gallons. Pump turn off to be at 30,000 gallons. Approximately 90 minutes of pumping is required to replace these 5000 gallons.

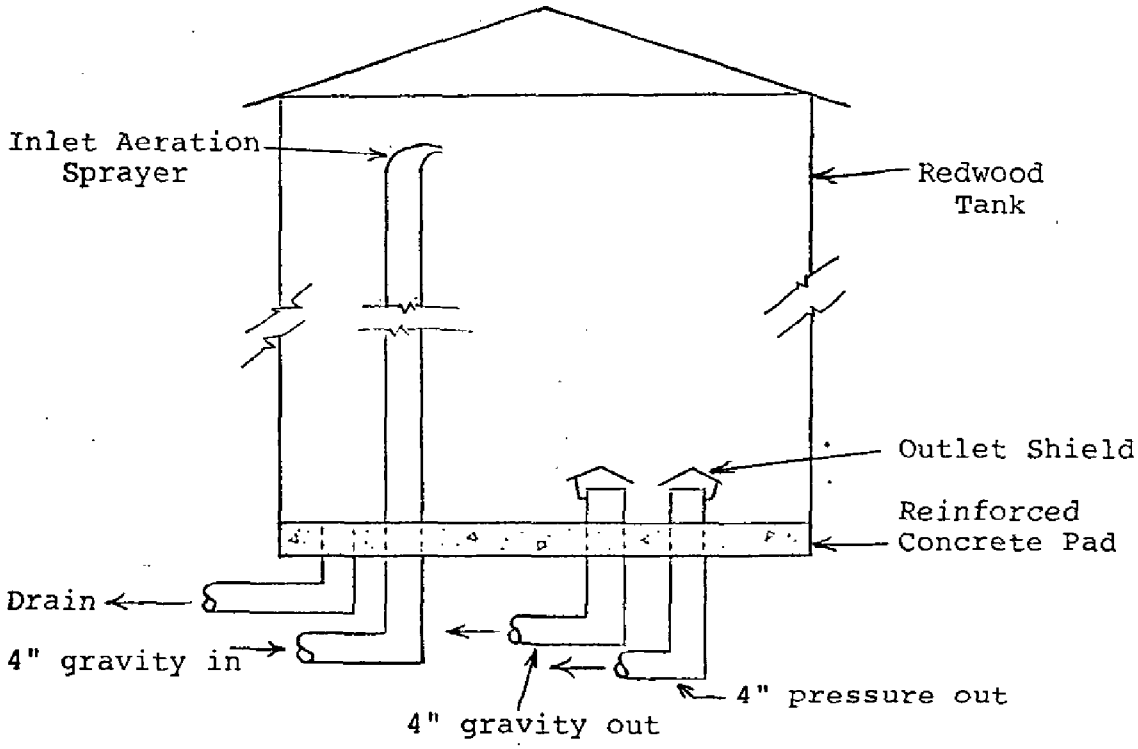
Separation of elements Iron and Mangenese to be accomplished by spray aeration within tank. Separated elements to be removed, as necessary, from tank floor with drain provided.

Pipeline intakes are elevated 12" above floor and shielded to prevent entrance of separated elements. Hydrant adjacent to tank is provided for fire use.

STORAGE TANK DETAIL



PLAN VIEW



A-A View
modified for clarity

OPERATION AND MAINTENANCE

OPERATION AND MAINTENANCE

A general guide to the operation and maintenance of the water system is given below. This will probably be expanded periodically as new equipment is added to the system or when new operational procedures and maintenance scheduling is deemed desirable. A brief summary maintenance schedule is presented at the end of this section for quick referencing by individuals responsible for inspection and maintenance of the system.

The primary items to be concerned with for the proper operation and maintenance of the system are the pump, tank, pipe, valves and fire hydrants, water meter, and water quality. These items will be attended to as follows:

Pump

The deep well pump control may be set in any of three positions; OFF, MANUAL, or AUTOMATIC. During system maintenance the control shall be set in the OFF position. Under normal system conditions and operations the control shall be set in the AUTOMATIC position. Under emergency conditions and for pump testing the control shall be set in the MANUAL position.

Semiannually the pump control system shall be inspected and its condition noted. All control settings shall be tested. Note in inspection report any deterioration of wires, housings, electrical conduits, etc.

Tank

Semiannually inspect the tank exterior for deterioration, including roof. Remove any debris from roof and air vents. Check sediment level in tank and drain sediment off if 6 inches or deeper.

Semiannually inspect the automatic float system located inside the storage tank. Electrical contacts on the float will normally require maintenance (filing) every 6 to 12 months. Note on inspection sheet the condition of electrical connections and any corrosion of float. Verify turn-on and turn-off levels in tank.

Pipe

Inspect all exposed pipe semiannually for deterioration. Drain all "dead-end" runs for 30 seconds semiannually. more frequently where corrosive "N's" or system.

Valves

Operation of all valves shall be at a slow rate to avoid water hammer effects. Main line valves shall be operated no faster than 30 seconds from full open to full closed or vice-versa. When opening a valve into a dry pipe, all valve locations on the dry pipe shall be fully opened to evacuate air from the line.

Fully operate all valves on the system, including fire hydrants, semiannually. Inspect valve flanges and bolts for leaks. Note condition of valve enclosures on report.

Meter

The water meter at the pump shall be read and the quantity of water used recorded monthly.

Water Quality

Semiannually draw a quantity of water from the system to be analyzed for chemical and biological contaminants. The results of the analyses shall be properly recorded in the operation and maintenance manual.

Any maintenance required on the water system shall be noted in the operation and maintenance manual and corrective action taken promptly. Preventive maintenance should be undertaken periodically to avoid major break-down of the system.

The operation and maintenance manual shall be kept up-to-date and accurate. All system operations, maintenance, inspections, and costs shall be recorded. This manual shall always be available for inspection by the proper County or State officials.

MAINTENANCE SCHEDULE

Approximately, on the first of every month check the following items and/or perform the following operations:

1. Read meter located at pump and record reading and amount of water delivered to the system since last reading of meter.
2. Check and record water level in storage tank.
3. Check operation of pressure equipment.
4. Make general examination of equipment at pump and tank sites and make any corrective repairs as necessary. Note any corrective or preventive maintenance performed.

Around the 15th day of January and July check the following items and/or perform the folloiwng operations:

1. Inspect and note condition of pump control system.
2. Test all control settings for pump.
3. Inspect automatic float system at tank and note any maintenance performed.

4. Verify turn-on and turn-off levels in storage tanks.

5. Examine tank for any deterioration.

6. Remove any debris from roof and air vents of tank.

7. Check sediment level in tank -- if over 6 inches deep remove.

8. Inspect all exposed pipe for deterioration.

9. Inspect all wiring, housing, and electrical conduits.

10. Fully operate, open and close, all valves, including fire hydrants, and check for leaks.

11. Inspect valve flanges, bolts, and stuffing boxes for leaks.

12. Inspect all trench easements for signs of leaks.

13. Drain all "dead-in" runs for 30 seconds.

14. Collect water sample for water quality analysis. 5N = 15 samples / 13 weeks

Every three months perform the following operation:

1. Read and record water level in well.

COST OF CONSTRUCTION

COST OF CONSTRUCTION

Expenses for the development of the Purisima Mutual Water Company are given in detail below. These costs are divided into two parts; those that have accrued to date and those anticipated in the future.

Accrued Expenses

(1) Materials

Items	Vendor	Price
Plastic pipe and fittings	Kerona, Inc.	$382.97
Plastic fittings, glue and applicators	" "	26.60
Plastic pipe and shipping	" "	3,417.97
Plastic fittings, glue and flanges	" "	157.37
Flanges	" "	13.84
Flanges	" "	19.00
Spare plastic pipe	" "	90.66
Spare plastic fittings	" "	96.02
Gate valve and primer	N.O. Nelson Co.	40.13
Primer	" " "	16.11
PVC Cement	" " "	14.17
PVC Cement, Primer and pipe	" " "	143.89
Fire hydrants (3)	James Wallace Co.	209.48
Gate and check valves	" " "	339.26
Pipe cutting and threading	Pacific Hard. & Steel	21.20
Fire hydrants (2)	ITT Grinnell	145.95
Hydrant spanner	" "	11.03
Bleed valves and fittings	Orchard Hard. & Supply	13.64
Cement (concrete)	" " "	20.20
Pipe wrenches	" " "	16.57
Cement (concrete)	" " "	4.83
Misc. PVC fittings	" " "	13.64
Cement (concrete)	Builders Emporium	7.73
Misc. fittings	" "	6.95
PVC Cement	Gemco - San Jose	9.87
Misc. small PVC fittings	Eastside Hard. - Santa Cruz	9.86
Valve boxes	Crawford	200.00
	Sub Total	$5,247.97

(2) Equipment Rentals

Items	Vendor	Price
Backhoe-equipment & operator	Smet.	$180.00
Trencher	A. Carhart	245.77
Trencher	Rent Power-Watsonville	59.00
Bulldozer	Carter & Dahl.	105.00
Trench filling and grading	D. Regnart	720.00
Fuel		5.45
Fuel		4.26
Fuel tanks		12.37
	Sub Total	$1,331.85

(3) Shipping

Shipping of fittings	United Parcel Post	6.14
	Sub Total	6.14

(4) Labor

Operator-heavy equip.	Smets.	$250.00
Manual labor		20.00
Secretarial-typing		
Drafting-illustrations for report		
	Sub Total	

(5) Well Development

Pump purchase and installation		$3,200.00
Pressure tanks		800.00
	Sub Total	$4,000.00

(6) Professional Fees

Legal-initial water agreement	Pollock & Brinkop	$90.00
	Sub Total	90.00

TOTAL EXPENSES PAID TO DATE $10,945.96

Anticipated Expenses

(1) Materials

Misc. PVC fittings and pipes		$100.00
Steel pipe - hydrant shields		50.00
Cement (concrete)		50.00
PVC primer and cement		30.00
Check valve		25.00
Meter		100.00
Pressure equipment		1,000.00
	Sub Total	$1,355.00

(2) Equipment

Grading - bulldozer and grader		$1,000.00
	Sub Total	$1,000.00

(3) Shipping

Freight		$20.00
	Sub Total	$20.00

(4) Labor

(5) Tank Development

Tank purchase and installation		$5,000.00
Tank pad construction		1,000.00
	Sub Total	$6,000.00

(6) Professional Fees

Engineering	Crawford	
Surveying - Civil engineering	Aptker	800.00
Legal	Nakashima	
Geology - hydrology	Greene	
Filing fees		

Total Anticipated Expenses	~ $12,000.00
OVERALL TOTAL EXPENSES	~ $23,000.00

BY LAWS AND ARTICLES
OF INCORPORATION

In back pocket

APPENDIX A

Well Data

PURISIMA MUTUAL WATER COMPANY
3635 Eastwood Circle
Santa Clara, California 95050
Phone: 408 243 3726

ENVIRONMENTAL HEALTH DEPARTMENT
COUNTY OF SANTA CRUZ
SANTA CRUZ, CALIFORNIA

Dear Sirs,

Enclosed are the data resulting from a well test made from a well drilled for the PURISIMA MUTUAL WATER COMPANY in the Santa Cruz Mountains. The well is located off Rider Ridge Road in the E 1/2 of the NE 1/4 of Section 16, T10S, R1W, M.D.B.& M. Santa Cruz County, California; DBA, or APN 100-041-18.

Two different 72 hour pump tests have been made and each one has shown the well to be of high yield. The first test was made from June 23 to June 25, 1973 by myself and other officers of the mutual water company. Biological and chemical analysis were made from samples of water taken at the end of this test. The second test was made between October 11 and 14, 1973 under the supervision of Danforth E. Apker, a Registered Professional Engineer of the State of California; registration number 10007. Detailed drawdown measurements and pumpage yields were obtained during this test.

I hope that you find the enclosed information adequate and satisfying. Thanking you in advance for your consideration,

Very truely yours,

H. Gary Greene
President
Purisima Mutual Water Company

Anthony Cocciardi
22631 Mt. Eden Road
Saratoga, Calif.

WILLIAM E. PORTER
WELL DRILLING

May 18, 1972

Telephone
(408) 475-5801

Irrigation and Test Wells
MEMBER ASSOCIATED DRILLING CONTRACTORS

100 Olive Springs Road
Santa Cruz, Calif. 95060

STATEMENT

Drilling and casing including pea gravel					
	0'	to	300'	@$10.00 per ft.	$3000.00
50' Sanitary seal 12"				@$12.00 per ft.	600.00
3 Yards cement for sanitary seal					125.00
Drilling and casing	300'	to	395'	@$ 20.00 per ft.	1900.00
Well permit					20.00
				Total	$5645.00
				Paid on account	400.00
				Balance	$5245.00

ANALYTICAL CHEMISTS
and
BACTERIOLOGISTS
Approved by State of California

SOIL CONTROL LAB

1234 HIGHWAY 1
WATSONVILLE
CALIFORNIA
95076
USA

penetrates your problems!

TELEPHONES
Laboratory: 408 724-5422
KEN GALLOWAY: 688-6205
KINGSLEY PACKER: 724-7760

In any reference, please quote Certified Analysis Number appearing hereon.

Mr. Gill Schott
P.O. Box 8485
San Jose, California 95155

June 26, 1973

CERTIFIED DRINKING WATER ANALYSIS

WATER IDENTIFICATION: New well Rider ridge Rd.
SAMPLED: June 22, 1973

(parts per million when not otherwise stated)	QUANTITATIVE ANALYSIS:	PUBLIC HEALTH DRINKING WATER STANDARDS, not to exceed:	QUALITY at time sampled
Certified Analysis Number:	115967		
pH value, units:	6.4	10.6	O.K.
Conductivity, millimhos/cm:	0.30	-	-
Color, APHA color units:	0	20	O.K.
Turbidity, APHA units:	3.2	10.	O.K.
Odor, APHA system symbols:	0	III	O.K.
Carbonate Alkalinity (as $CaCO_3$)	0	120	O.K.
Bicarbonate Alkalinity " "	124	-	-
Total Alkalinity " "	124	~~35 + hardness~~	-
Total Hardness " "	125	-	-
Total Salts (electrometric):	210	500	O.K.
Chlorides (Cl):	3	250	O.K.
Sulfates (SO_4):	5	250	O.K.
Nitrates (NO_3):	1	45	O.K.
Fluorides (F):	less than 0.1	1.5	O.K.
Calcium (Ca):	17	-	-
Magnesium (Mg):	20	125	O.K.
Potassium (K):	3.6	-	-
Sodium (Na):	11	-	-
Iron, total (Fe):	0.99	0.30	Excessive
Manganese (Mn):	0.1?	0.05	Excessive

Report of Approved Water Laboratory using Standard Methods of the APHA.

The undersigned certifies that the above is a true and accurate report of the findings of this laboratory.

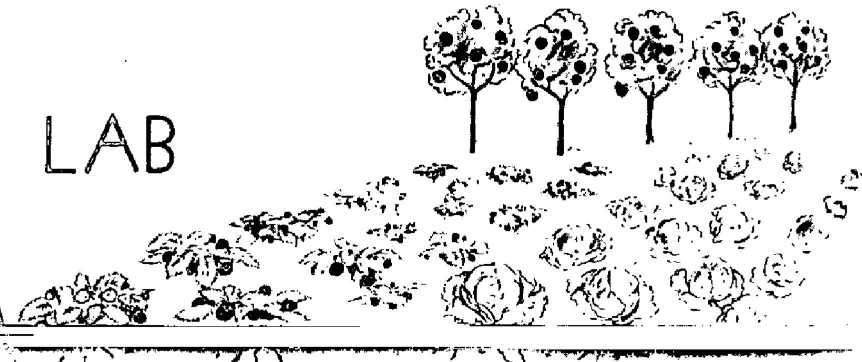
Analyst

Interpretation: This water meets Public health drinking water standards except for the high iron and manganese levels.

ANALYTICAL CHEMISTS
and
BACTERIOLOGISTS
Approved by State of California

SOIL CONTROL LAB

1234 HIGHWAY 1
WATSONVILLE
CALIFORNIA
95076
USA



penetrates your problems!

Mr. Gill Schott
P. O. Box 8485
San Jose, California 95155

TELEPHONES
Laboratory: 408 724-5422
KEN GALLOWAY: 688-6205
KINGSLEY PACKER: 724-7760

In any reference, please quote Certified Analysis Number appearing hereon.

REPORT ON

BACTERIOLOGICAL EXAMINATION OF WATER

DATE TAKEN June 22, 1973 DATE EXAMINED June 23 to 25, 1973

Certified Analysis Number	SOURCE OF SAMPLE	EXAMINATION FOR COLIFORM ORGANISMS: PORTIONS EXAMINED Size	No.	PRESUMPTIVE LACTOSE BROTH 24 Hr.	48 Hr.	CONFIRMED B. G. B. 48 Hr. or less	COLIFORM ORGANISMS M. P. NO. PER 100 ML. OF SAMPLE	QUALITY AT TIME OF SAMPLING Safe*	Unsafe
115967	New well at Rider Ridge Rd. 6/10ths of a mile	10 ml.	5	0	0		Less than 2.0	*	
		1.0 ml.	1	0	0				
		0.1 ml.	1	0	0				
		10 ml.							
		1.0 ml.							
		0.1 ml.							
		10 ml.							
		1.0 ml.							
		0.1 ml.							
		10 ml.							
		1.0 ml.							
		0.1 ml.							
		10 ml.							
		1.0 ml.							
		0.1 ml.							
		10 ml.							
		1.0 ml.							
		0.1 ml.							
		10 ml.							
		1.0 ml.							
		0.1 ml.							

All examinations are made in accordance with Standard Methods of the American Public Health Association

*Safe indicates sample free of contamination by coliform group only. Use of correct procedures in sampling & storage allow this information to be applied to source.

For standards, refer to Public Health Service Publ: 956

The undersigned certifies that the above is a true and accurate report of the findings of this Laboratory.

M Fr[illegible]
Analyst

Note: This result indicates that the sample is free from contamination by organisms of the coliform group & the water is considered safe for drinking & domestic use.

WATER WELL REPORT

(1) OWNER

NAME: PURISIMA MUTUAL WATER COMPANY

ADDRESS: #3635 EASTWOOD CIRCLE, SANTA CLARA, CALIFORNIA 95050

(2) LOCATION OF WELL

E 1/2 of the NE 1/4 of Sec. 16, T10S, R1W, M.D.B.& M. Santa Cruz Co.

Off Rider Ridge Road, 1/2 mile from Jarvis Road.

(3) PROPOSED USE

DOMESTIC: Yes, Residential IRRIGATION: _____

OTHER: _____

(4) * CASING INSTALLED: 391 feet SINGLE _____ DOUBLE

DEPTH OF COMPLETED WELL: 390 feet

DATE ORIGINALLY DRILLED: May 11, 1972

DEPTH OF CASING: FROM NO. FEET TO NO. FEET +1 to 390 feet

DIAMETER: 8 5/8 in. GAGE OF WALL: #10

SANITARY SEAL: 12 inch, from +1 foot to 50 feet.

(5) WATER LEVELS

DEPTH AT WHICH WATER WAS FIRST FOUND: Not reported

DEPTH AT WHICH WATER IS NOW STANDING: 158.50 feet

(6) WELL TEST

HAS PUMP TEST BEEN MADE: Yes DATE: October 11, 1973

IF YES, WHEN AND BY WHOM: June and October, 1973; Danforth E. Apker

YIELD: 57.75 GAL./MIN., WITH 118.50 FEET DRAWDOWN AFTER 0 HOURS

AND 38 MINUTES.

(7) GENERAL COMMENTS (Include your opinion as to adequacy of well to serve required purpose.)

I observed the 72 hour pump test of t his well and I was pleased to note that the full 60 gallons per minute was steadily being produced, day after day. I feel that this will be a very fine well and will more than handle the maximum of 15 residences that are scheduled.

* NOTE: The well drilling data was taken from the well drillers log produced by William E. Porter, 100 Olive Spring Road, Santa Cruz, California.

DATED: Oct. 25, 1973

WELL INSPECTED AND TESTED BY:

Danforth E. Apker

REGISTERED PROFESSIONAL ENGINEER
DANFORTH E. APKER
No. 10007
CIVIL
STATE OF CALIFORNIA

PURISIMA MUTUAL WATER COMPANY
Santa Cruz County, California

TABLE I
Pump Test

Date	Time	Elapsed Time	Measured Depth (in feet)	Corrected Depth (in feet)	Drawdown (in feet)
Oct. 11, 1973	1220	0 hr 0 min	155.00	158.50	0.00
	1221	1	159.00	162.50	4.00
	1224	4	174.00	177.50	19.00
	1227	7	190.00	193.50	35.00
	1231	11	200.00	203.50	45.00
	1235	15	210.00	213.50	55.00
	1240	20	223.00	226.50	68.00
	1245	25	237.00	240.50	82.00
	1250	30	252.00	255.50	97.00
	1255	35	265.00	268.50	110.00
	1258	38	273.50	277.00	118.50
	1300	40	273.50	277.00	118.50
	1310	50	273.60	277.10	118.60
	1320	60	273.60	277.10	118.60
	1330	1 hr 10 min	273.60	277.10	118.60
	1340	1 20	273.60	277.10	118.60
	1350	1 30	273.60	277.10	118.60
	1400	1 40	273.60	277.10	118.60
	1415	1 50	273.65	277.15	118.65
	1445	2 25	273.75	277.25	118.75
	1600	3 40	273.80	277.30	118.80
	1715	4 55	274.10	277.60	119.10

Date	Time	Elapsed Time	Measured Depth (in feet)	Corrected Depth (in feet)	Drawdown (in feet)
	1815	5 55	274.30	277.80	119.30
	2000	7 40	274.65	278.15	119.65
	2100	8 40	274.80	278.25	119.80
Oct. 12, 1973	0800	19 hr 40 min	274.80	278.25	119.80
	1330	25 10	274.80	278.25	119.80
	1800	29 40	274.80	278.25	119.80
Oct. 13, 1973	0800	43 hr 40 min	274.80	278.25	119.80
	1200	47 40	274.90	278.40	119.90
	1600	51 40	275.40	278.90	120.40
Oct. 14, 1973	0800	67 hr 40 min	275.60	279.10	120.60
	1245	72 25	275.65	279.15	120.65

Recovery Rate

Date	Time	Elapsed Time	Measured Depth (in feet)	Corrected Depth (in feet)	Upwell (in feet)
Oct. 14, 1973	1245	0 hr 0 min	275.65	279.15	0.00
	1250	5	250.00	253.50	25.65
	1300	15	229.75	233.40	20.10
	1325	40	185.25	188.75	44.65
	1343	58	157.50	161.00	27.75
	1400	1 hr 15 min	156.25	159.75	1.25
					119.40

Same

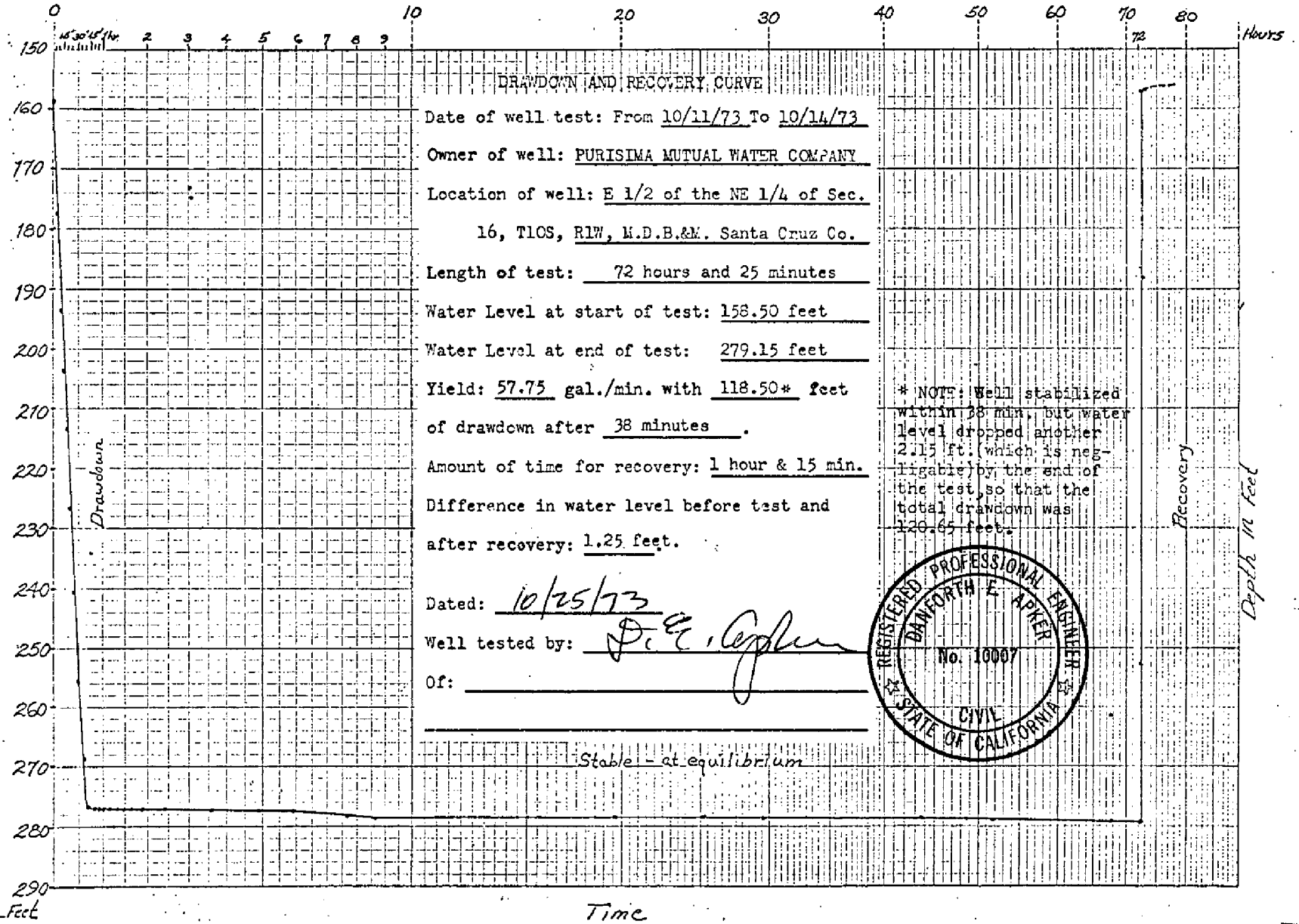
Well recovered to a depth of 119.40 feet. This is within 1.25 feet of original water level at start of pump test.

DATED: 10/25/73

REGISTERED PROFESSIONAL ENGINEER DANFORTH E. APKER No. 10007 CIVIL STATE OF CALIFORNIA

PUMP TESTED BY: Danforth E. Apker

PURISIMA MUTUAL WATER COMPANY
PUMP TEST



DRAWDOWN AND RECOVERY CURVE

Date of well test: From 10/11/73 To 10/14/73

Owner of well: PURISIMA MUTUAL WATER COMPANY

Location of well: E 1/2 of the NE 1/4 of Sec. 16, T10S, R1W, M.D.B.&M. Santa Cruz Co.

Length of test: 72 hours and 25 minutes

Water Level at start of test: 158.50 feet

Water Level at end of test: 279.15 feet

Yield: 57.75 gal./min. with 118.50* feet of drawdown after 38 minutes.

Amount of time for recovery: 1 hour & 15 min.

Difference in water level before test and after recovery: 1.25 feet.

Dated: 10/25/73

Well tested by: D. E. Apker

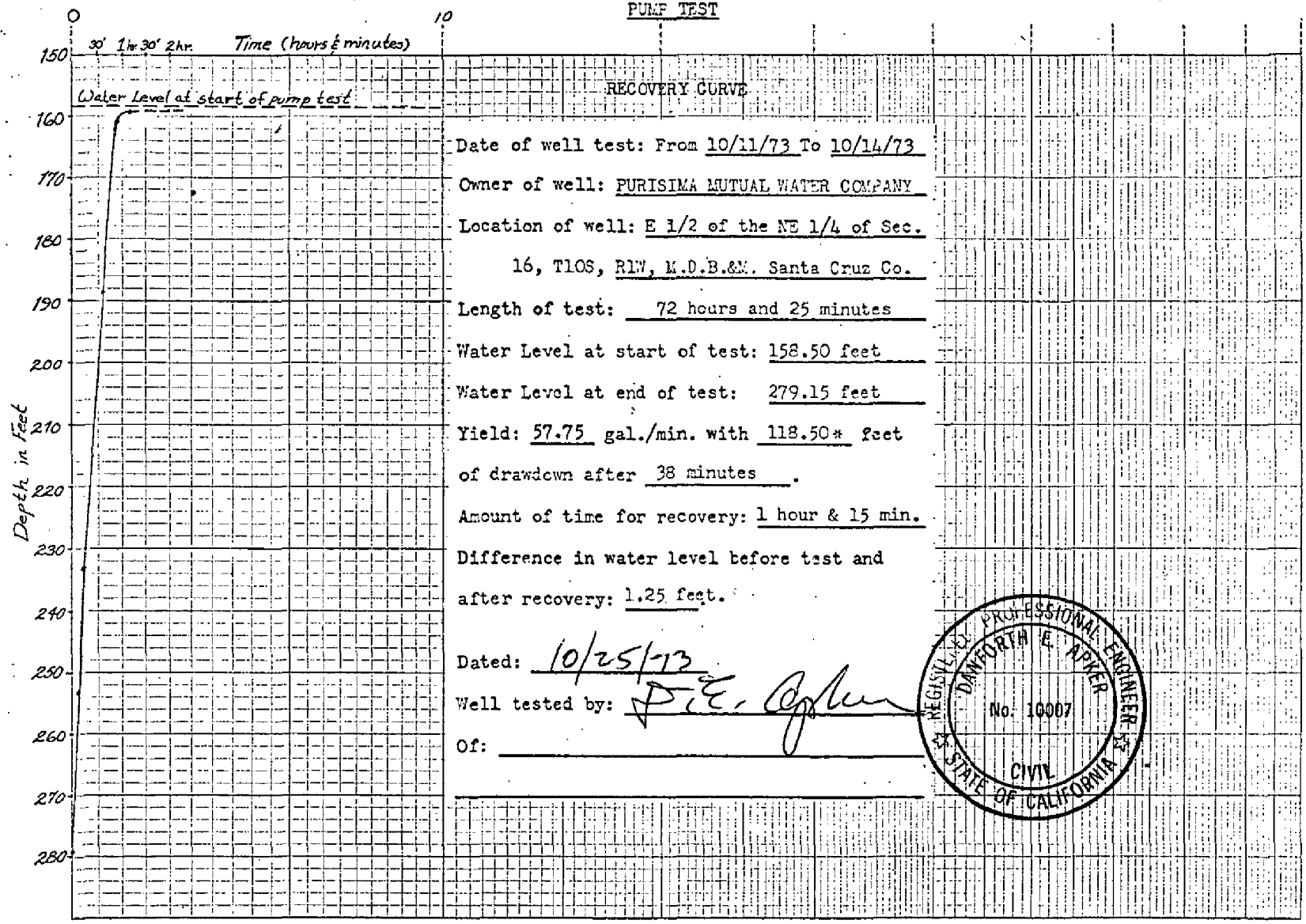
Of:

Stable - at equilibrium

* NOTE: Well stabilized within 38 min. but water level dropped another 2.15 ft. (which is negligable) by the end of the test, so that the total drawdown was 120.65 feet.

REGISTERED PROFESSIONAL ENGINEER
DANFORTH E. APKER
No. 10007
CIVIL
STATE OF CALIFORNIA

PURISIMA MUTUAL WATER COMPANY
PUMP TEST



RECOVERY CURVE

Date of well test: From 10/11/73 To 10/14/73

Owner of well: PURISIMA MUTUAL WATER COMPANY

Location of well: E 1/2 of the NE 1/4 of Sec. 16, T10S, R1W, M.D.B.&M. Santa Cruz Co.

Length of test: 72 hours and 25 minutes

Water Level at start of test: 158.50 feet

Water Level at end of test: 279.15 feet

Yield: 57.75 gal./min. with 118.50* feet of drawdown after 38 minutes.

Amount of time for recovery: 1 hour & 15 min.

Difference in water level before test and after recovery: 1.25 feet.

Dated: 10/25/73

Well tested by: D. E. Apker

Of:

REGISTERED PROFESSIONAL ENGINEER
DANFORTH E. APKER
No. 10007
CIVIL
STATE OF CALIFORNIA

PURISIMA MUTUAL WATER COMPANY
Santa Cruz County, California

TABLE II

Measured Volume of Water Pumped From
Well After 72 Hours Continuous Pumping

Measurement Number	Time (seconds)	Measured Gallons	Rate (gallons/minute)
1	6.0	5	50.0
2	6.0	5	50.0
3	6.0	5	50.0
4	5.2	5	57.6
5	5.2	5	57.6
6	4.8	5	62.5
7	5.0	5	60.0
8	5.0	5	60.0
9	5.3	5	56.6
10	5.0	5	60.0
11	5.0	5	60.0
			624.3

Average gallons per minute = 57.75

Well was pumped with a permanently installed 10 hp, 3 phase. Submersible pump that is rated at 50 gal/min.

Approximate location of well is in the E1/2 of the NE1/4 of Section 16, T10S, R1W, M.D.B.&M. Santa Cruz County, California; APMO 100-04.

DATED:
10/25/77

WELL INSPECTED AND TESTED BY:
Danforth E. Apker

REGISTERED PROFESSIONAL ENGINEER
DANFORTH E. APKER
No. 10007
CIVIL
STATE OF CALIFORNIA

HEALTH PERMIT

AND FEE RECEIPT

No. 0674

For WELL PERMIT expires, May 11, 1st. 1973

Located at Jarvis Rd, 1½ mi. from Branciforte

Name, Anthony Cocciardi

DBA, or APN 100-041-18

Add. William Porter

This permit is to be prominently displayed at place of business, and may be suspended or revoked for cause.

RICHARD H. SVIHUS, M.D.
Health Officer

By _____

Date _____

Santa Cruz County
DEPARTMENT OF PUBLIC HEALTH
ENVIRONMENTAL HEALTH DIV.
701 Ocean St., Rm. 420, Santa Cruz, CA 95060
1430 Freedom Blvd., Watsonville, CA 95076

100-041-18
Anthony Cocciardi

Jarvis Rd.

No. 0674

RECEIPT FOR FEE FOR SERVICE

SERVICE	FEE PAID	SERVICE	FEE PAID
☐ FOOD SERVICE		☐ DAIRY FARM	
☐ FOOD VENDING		☐ MILK PLANT	
☐ FOOD - ITINERANT		SEWAGE DISPOSAL	
☐ FOOD - PROCESSING		☐ INSTALLATION	
☐ KENNEL		☐ LOT INSPECTION	
☐ PET SHOP		☐ CLEANING	
☐ ORGANIZED CAMP		WATER	
☐ SWIMMING POOL		☑ WELL CONSTRUCTION Check	$20.00
☐ TRANSFER OF PERMIT		☐ WELL DESTRUCTION	
☐ PLAN CHECK		☐ PUBLIC WATER SUPPLY	
Time		TOTAL AMOUNT RECEIVED	$20.00
☐ PENALTY			
☐ OTHER			

Fee Collected By Haralee Bartlett

Date May 11, 1972

PHD 16 - 1/72 TO PAYOR 8M - 87770

SANTA CRUZ COUNTY HEALTH DEPARTMENT
Division of Environmental Health

701 Ocean Street - Room 420
Santa Cruz - 425-2341

1430 Freedom Boulevard
Watsonville - 724-0681

APPLICATION TO CONSTRUCT, REPAIR OR DESTRUCT A

WATER WELL

Fee Paid ☐

Site Location Jarvis Rd 1/2 Mile from Branciforte APN [illegible]

Directions End of Jarvis Rd right for 1/2 mile up hill

Owner Anthony Cocciardi Address 22631 Mt Eden Rd, Saratoga

Drilling Contractor William Porter License # 157162

DESIGN SPECIFICATIONS: Construction ☒ Repair ☐ Destruction ☐

Intended Use

Domestic, priv. ☐
Domestic, pub. ☒
Irrigation ☐
Industrial ☐
Other _____

Construction

Depth (ft.) 360
Diameter (in.) 8
Depth of Seal (ft.) 50

Distance from Well Site To:

Sentic Tank Systems (ft.) 100 plus
Sewer (ft.) _____

Casing

Single ☒ Double ☐
Material _____
Type of Joint Butt
Gravel Pack ☒

Type of Well

Rotary ☐
Cable ☒
Dug ☐
Other _____

Estimated Work Dates

Start May 9, 1972
Completion May 30, 1972

REMARKS:

I hereby agree to comply with all laws and regulations of the County of Santa Cruz and State of California pertaining to water well construction. I will contact the County Health Department when I commence the work. Within fifteen days after completion of work I will furnish the Santa Cruz County Health Department a report of the work performed and notify them before putting the well into use.

Signed William Porter

FOR OFFICE USE ONLY

Permit # 0674

Approved _____ (Signature)

Date _____

Inspections

Site _____ (initial) _____ (date)

Final _____ (initial) _____ (date)

PHD-133
2/72

ROOM 400
701 OCEAN STREET
PHONE 425-2286

COUNTY OF SANTA CRUZ
DEPARTMENT OF PUBLIC WORKS
Building Inspection Division

32217

Owner:	Applicant:	Location of Job:
[redacted]HONY COCCIARDI	owner	off Ryder Road Santa Cruz, California

BUILDING

Contractor _____ Lic. No. _____

Assessor's Parcel No. 100-041-16

Code Area _____

Valuation $ _____

Bldg. Fee $ _____

PLUMBING & GAS

Ref. B.P.# _____ Date _____
Contractor _____

Permit $ _____
Fixtures _____ _____
Water Heater _____ _____
Water Piping _____ _____
Gas _____ _____

Total $ _____

MECHANICAL

Permit $ _____

Total $ _____

ELECTRIC

Ref. B.P.# _____ Date 12-14-72
Contractor owner

Permit	$ 2.00
Lights	
Fixtures	
Switches	
Plugs	
Range	
Oven	
Dryer	
Water Heater	
Space Heater	
Motors	
10 HP Pump	2.50
Power Pole	2.00
Total	$ 6.50

District _____

Annexation required? _____

If "Yes", date petition filed _____

Type of service, units, etc.

Annexation	$
[redacted]nnection	
Inspection	
Other	
Total	$

DRIVEWAY OR ROAD OPENING—Road No. _____

Ref. B.P.# _____ Date _____
Contractor _____

Insurance _____

	Length	Width	Depth	
Driveway				$
Road opening.				
Other				
Total				$

Permits applied for as above are based on certain plans and specifications filed with the Department of Public Works and are subject to all county ordinances, state laws, and conditions stated on the reverse hereof, which conditions are hereby accepted.

Herbert Mary Greene
Signature of Applicant _____ Date

Total Fees Received $ 6.50

By [signature]
Cashier's validation

A 3 [illegible]

APPLICANT'S COPY

APPENDIX B

Easements

Being an easement for the installation, construction, reconstruction. maintenance, repair and operation of water mains, facilities and appertenances and work auxiliary thereto in, upon, over and across this parcel situated in the County of Santa Cruz, State of California, and more particularly described as follows:

Beginning at the most northeasterly corner of Parcel 2, as shown on that certain Parcel Map of file in Book 52 of Maps at Page 43, in the Office of the Recorder, County of Santa Cruz, State of California, thence S. 30° 43' 30" W., 48.55 feet to the Point of Beginning. Said point of beginning being on the division line between said Parcel 2 and Parcel A as shown on that certain Parcel Map as recorded and on file in Book 9 of Parcel Maps at Page 15 in the Office of the Recorder County of Santa Cruz, State of California

Thence S. 1° 08' 22" E.,238.53 feet to the southerly boundry of said Parcel A, being the end of this easement. Said easement being five (5) feet on either side of the described line as centerline.

Easement on Parcel A, Book 9 of Parcel Maps, Page 15

PARCEL 1 Easement for water lines

Being an Easement for the installation, construction, reconstruction, maintenance, repair and operation of water mains, facilities and appertenances and work auxiliary thereto in, upon, over and across parcels situated in the County of Santa Cruz, State of California, and more particularly described as follows:

Beginning at the northwesterly corner of Parcel B as shown on that certain Parcel Map on file in Book 9 of Parcel Maps at Page 15, in the Office of the Recorder, County of Santa Cruz, State of California, thence N. 84° 46' 54" E., 91.89 feet along the northerly boundry of said Parcel B to a point on the centerline of the ten (10) foot wide easement for the location of water lines as described herein, and being the TRUE POINT of BEGINNING:

Thence S. 1° 08' 22" E., 142.16 feet to a point and S. 11° 57' 30" E., 189.16 feet to a point on the southerly boundry of said Parcel B, the end of this easement. Said easement being five (5) feet on either side of the described line as centerline.

PARCEL 2 Well site

Being an Easement for the location of a well, and for the installation maintenance, repair and operation of water pumping facilities and all appertenances and work auxiliary thereto in, upon and over parcels situated in the County of Santa Cruz, State of California, and more particularly described as follows:

Beginning at the northwesterly corner of Parcel B as shown on that certain Parcel Map on file in Book 9 of Parcel Maps at Page 15, in the Office of the Recorder, County of Santa Cruz, State of California, thence N. 84° 46' 54" E., 91.89 feet, S. 1° 08' 22" E., 142.16 feet and N. 88° 51' 38" E., 5.00 feet to the Point of Beginning.

Thence N. 88° 51' 38" E., 20.00 feet, N. 1° 08' 22" W., 20.00 feet, S. 88° 51' 38" W., 20.00 feet and S. 1° 08' 22" E., 20.00 feet to the Point of Beginning.

Being an easement for the installation, construction, reconstruction, maintenance, repair and operation of water mains, facilities and appertenances and work auxiliary thereto in, upon, over and across this parcel situated in the County of Santa Cruz, State of California, and more particularly described as follows.

Beginning at the most northeasterly corner of Parcel 2, as shown on that certain Parcel Map on file in Book 52 of Maps at Page 43, in the Office of the Recorder, County of Santa Cruz, State of California, thence S. 84° 34' 08" W., 25.70 feet to the point of beginning. Said point of beginning being on the division line between said Parcel 2 and the lands of William Smets as the deed to said land is recorded and on file in Book 1949 of Official Records at Page 208 in the Office of the Recorder, County of Santa Cruz, State of California.

Thence S. 1° 08' 22" E., 39.31 feet to a point on the division line between said Parcel 2 and Parcel A as shown on that certain Map as recorded in Book 9 of Parcel Maps at Page 15 and on file in the Office of the Recorder, County of Santa Cruz, State of California. Said easement being five (5) feet on either side of the described line as centerline.

Easement on Parcel 2, Book 52 of Maps, Page 43

PARCEL 1 Easement for water lines

Being an easement for the installation, construction, reconstruction, maintenance, repair and operation of water mains, facilities and appertences and work auxiliary thereto in, upon, over and across this parcel situated in the County of Santa Cruz, State of California, and more particularly described as follows:

Beginning at the most northerly point of Parcel A as shown on that certain Parcel Map on file in Book 9 of Parcel Maps at Page 15, in the Office of the Recorder, County of Santa Cruz, State of California, thence S. 84° 34' 08" W., 142.67 feet to the TRUE POINT OF BEGINNING, said true point of beginning being on the division line between Parcel 2 as shown on the Parcel Map on file in Book 52 of Maps at Page 43 in the Office of the Recorder, County of Santa Cruz, State of California, and the lands of William Smets, as the deed to said lands is on file in Book 1949 of Official Records at Page 208, County of Santa Cruz, State of California.

Thence N. 22° 01' 22" W.,211.78 feet to a point. being the end of this easement. Said easement being five (5) feet on either side of this described line as centerline.

PARCEL 2 Water storage tank site

Being an easement for the location of a water storage tank, and for the installation, maintenance, repair and operation of a water storage tank, water pumping equipment and water piping facilities and all appertenances and work auxiliary thereto in, upon and over this parcel situated in the County of Santa Cruz, State of California, and more particularly described as follows:

Beginning at the most northerly point of Parcel A as shown on that certain Parcel Map on file in Book 9 of Parcel Maps at Page 15,in the Office of the Recorder, County of Santa Cruz, State of California, thence S. 84° 34' 08" W., 142.67 feet and N. 22° 01' 22" W., 211.78 feet to the TRUE POINT OF BEGINNING:

Thence N. 67° 58' 38" E., 20.00 feet, N. 22° 01' 22" W., 30.00 feet, S. 67° 58' 38" W., 40.00 feet, S. 22° 01' 22" E., 30.00 feet and N. 67° 58' 38" E., 20.00 feet to the Point of Beginning. The last five named bearings and distances describe a 30 foot by 40 foot site for a water storage tank and related equipment.

APPENDIX C

County Code Regarding Water Systems