California Polytechnic School,
San Luis Obispo, California,
April 22, 1910.

Mr. N. Ellery, State Engineer,
Capitol Building,
Sacramento, California.

Dear Sir:

According to the request you made during your last visit here we take pleasure in submitting the following notes covering the plans we have in mind for our proposed water system; also the work that has been done on same up to date under the direction of your office. Enclosed is a map of the grounds on which we have indicated the well sites, the proposed location of pipe lines, storage tanks, etc., and also a blue print showing the plan for connecting up the wells.

The appropriation made by the last Legislature for the development of a water system at this institution was $6000.00. The purpose of this system is to develop a water site lying at the north-west corner of the school farm near the Southern Pacific right of way and Brizzolara Creek, and (1) to make the supply available for irrigating the level field north of the main buildings; (2) to apply a part of this water to the lawns and plantings adjacent to the main group of buildings.

The present pumping plant lying in Brizzolara Canyon at the north-east corner of the farm furnishes an abundant high pressure supply for domestic use about the buildings and for sprinkling lawns that may be planted around Dormitory No. 2, shown on the map. It will not be necessary at present to conduct water from the new well site across the ravine to the buildings on the south-west part of the grounds.

About $1400.00 of the $6000.00 appropriation has been expended in drilling and casing six wells, testing the same and connecting the new power house and dining hall to the present water mains, leaving a balance of $4600.00 for completing the system.

The plan we have in mind for this development is in brief:

(1) The drilling and testing of the wells at the site above mentioned.

(2) The installing of a gasoline engine driven centrifugal pumping plant of ample capacity to deliver the full yield of the wells and to store it at a suitable tank site.

(3) The laying of a 6 or 8 inch line of standard screw pipe, or riveted sheet iron pipe, across the best of the land to the north of the main buildings, tapped at various points for irrigating purposes.

(4) The construction of suitable storage, using either reinforced concrete or redwood tanks, in order to accumulate a supply of water to give a flow of sufficient volume for surface irrigation.

(5) The installing of a small gasoline engine driven centrifugal pumping plant at the main tank site with a three or four inch line of screw pipe leading to a lawn supply tank, located at the rear of the main buildings on a tower about 25 ft. high.

(6) The connecting of this tank by three and two inch lines of screw pipe to the water lines now laid throughout the grounds for watering purposes only.

WELLS.

Six 12 inch wells have been drilled and lined with No. 12 gauge perforated casing, at the north-west corner of the grounds, as shown on the accompanying map. The depth of the wells is as follows: No. 1, 40 ft.; No. 2, 40 ft.; No. 3, 40 ft.; No. 4, 44 ft.; No. 5, 48 ft.; No. 6, 45 ft. Each well is driven 2 or 3 ft. into the bed rock. The average spacing of the wells is 35 ft. on centers. The soil is a black loam running into clay, extending to a depth of about 20 ft. Below this are layers of water bearing gravel and clay extending to bed rock. The bed rock pitches from the creek toward the south, as shown by these drillings. A pit was dug around each well and a circular casing of concrete placed, as shown on the blue print of the wells. The top of the curb is 1 ft. above the ground level and the bottom of the pit 19 ft. below the top of the curb. All the pits are circular, 3 ft. 6 in. in the clear except No. 3 which is 4 ft. 6 in.

TEST OF WELLS.

During September, 1909 wells No's 1 and 2 were tested with a small gasoline engine and a 2 inch centrifugal pump. The test extended over 18 days, the pump being in well No. 2 thirteen days, and in No. 1 five days. The average run per day was 10 hours. The discharge was practically the same from each well, averaging 3,000 gallons per hour. The natural water level during the time of the test was about 17-1/2 ft. below the surface of the ground. The water level in the well being pumped quickly fell about 12 ft. and remained constant there during the day. The water level in the adjacent well fell from 10 to 12 inches after two hours steady run and remained constant there for the rest of the day, showing that neither well was seriously affected when the other was delivering 3,000 gallons per hour.

The first drilling contract was for but these two wells; the other four were put down later in the season. Before a thorough test could be made on them the wet weather raised the level of the ground water to such a height as to make a test of no value for determining low water conditions. However, in December, well No. 3 was tested for two days and as soon as it was thoroughly cleaned out it showed a flow equal to that of wells No's 1 and 2. The test was not continuous enough to furnish data as to the effect pumping this well had on the water

level in the other wells. At the close of the 18 days of the first test the water level was practically the same, showing that the supply is replenished and is not a basin in the bed rock. As the pump used was capable of lowering the water level only 30 ft. below the ground surface, and as the water bearing gravel extends from 35 to 40 ft. below the surface it is probable that a pump capable of lowering the water level to bed rock would have shown a yield considerably greater per well.

The water level in these wells varies from 12 ft. below the ground surface during the wet season to 20 ft. at the close of the dry season.

It will not be possible to make a thorough low water test on wells No's 3 to 6, inclusive, before August or September of this year, but as the layer of water bearing gravel shown by the drilling is deeper in these wells than in those tested it is reasonable to suppose that they have at least the capacity of No's 1 and 2, if not greater. We believe a flow of 18,000 gallons per hour may be secured from the six wells at a period of lowest water and a much larger supply during June and July, at which time the water is almost as valuable for irrigation as in August and September.

PUMPING PLANT.

The simplest and most inexpensive method of pumping these wells is to install a vertical centrifugal pump in well No. 3 and to connect up the other five wells to this pump by means of a suction pipe about 17 ft. below the ground with drops into each well casing. This suction pipe would be laid in a casing or tube that will allow its removal in case of air leaks forming or other defects appearing. A line of 12 inch corrugated, galvanized, sectional iron culvert would answer the purpose well. Holes have been left in the concrete casing of each pit 14 inches by 14 inches with the bottom 1 ft. above the floor of the pit, for bringing in these casings. An opening between one pair of wells should be provided, extending to this casing, which will permit any section of the horizontal piping being taken out. The casing should be large enough to allow a length of suction pipe to pass the pipe already in place. One opening would provide for the withdraw of any piece of horizontal suction pipe in the plant. Between wells No's 1 and 2 is an old well sunk sometime ago which has caved in leaving at this time a pit some 25 ft. in diameter by 12 ft. deep. An opening for removing the suction pipe could be placed in this pit very simply.

A 4 inch centrifugal pump will be of the proper capacity for the low water yield of the wells and will also handle with economy considerable of the surplus which will be available early in the season. Motor drive is out of the question for this plant as the school power plant is not in operation during the summer months when this water is most needed. The head to be pumped against will be as follows:

Water level to surface of ground at well	35 ft.
Ground to foot of storage tank	15 ft.
Average depth in tank	12 ft.
Friction head of 1100 ft. of 6 in. pipe carrying 350 gallons per minute will be	14 ft.
Total	76 ft.

A gasoline engine of 12 to 15 horse power capacity will handle the load nicely and furnish the best drive, everything considered. The probable cost of a pumping plant complete, including connecting up the wells with suction pipe, installing 4 inch centrifugal pump and belted 15 horse power gasoline engine of good grade need not exceed $2000.00.

PIPE LINE.

A pipe line of ample size should connect the pump to the storage reservoir and should cross the best of the land to be irrigated. At intervals of about 100 ft. this line should be tapped with irrigating hydrants allowing the water to be placed on the land at any point desired, either by pumping direct or by pumping into the storage tanks and later applying the water to the land by gravity. If the pipe line is 6 inch or larger a head of 15 or 20 ft. from the storage tanks to the irrigating hydrants will put the water on the land in quantities sufficient for practical surface irrigation. Either double dipped standard screw pipe or double dipped riveted sheet iron slip joint pipe may be used for this purpose as the head will be very low. The last prices we have on pipe for San Luis Obispo delivery are $70.00 per 100 ft. for 6 inch dipped standard screw pipe; $55.00 per 100 ft. for 8 inch riveted steel pipe of No. 12 gauge and $40.00 for the same pipe in No. 14 gauge. Either of the latter would have a life ranging from fifteen to twenty years. Assuming this main pipe line to be 1100 ft. long the friction head with a discharge of 350 gallons per minute, on a 6 inch line will be about 14 ft., while the same discharge through the 8 inch line will cause a friction head of 3 ft. By using the 8 inch riveted pipe in place of the 6 inch standard screw pipe a saving in head of 11 ft. and a saving in price of either $165.00 or $330.00 will be made, according to whether the No. 12 or No. 14 gauge stock is used for the riveted pipe.

As the best of the land to be irrigated lies north of Brizzolara Creek and the slope of the land is toward the southwest the pipe line should run about as shown on the map whichever tank site is chosen.

STORAGE TANKS.

An average head of at least 15 ft. should be available for placing the water from the tanks on the land by gravity. This confines the location of storage tanks to a 290 ft. contour or higher. Two good sites are available, one between the old power house and the creamery building. The land at this point takes a sharp rise and the ground to be irrigated extends almost to the tank site. In place of bringing the supply pipe direct from the wells to this site the line may be deflected to cover a much larger amount of the land to be watered by adding 100 ft. to its length. The second tank site is west of the two cottages. This site would allow the pipe line to pass through more of the land to be watered, but would add considerably to the cost of putting this water on the lawns around the main buildings. If it is found that more water can be developed than is needed on the land below the pipe line as shown when using the tank site next the creamery, a branch line may be put in later covering any of the land desired. This can be done as efficiently from one tank site as from the other.

It is not probable that the wells will furnish sufficient flow of water in the latter part of the season to make it practical to irrigate grain crops by direct pumping. Water cannot be used economically for irrigating with checks, or by the ordinary surface flooding, with less than 40 to 50 miner's inches per ditch. This fact makes necessary some storage site in which the water can accumulate as pumped and be drawn off at whatever rate is most efficient. A 100,000 gallon reinforced concrete tank could be built for $1300.00, and would water one acre to a depth of 3-1/2 inches. The same storage could be installed in redwood tanks at something less in cost. 5-1/2 hours of pumping at 18,000 gallons per hour would be required to fill such a tank. Two or three such tanks could be used to advantage in irrigating this field.

LAWN SUPPLY.

A 15,000 gallon tank mounted on a tower back of the main buildings, giving an average elevation above the lawns of 30 ft. could be connected to either of the main storage sites with a 3 inch line and filled by a small centrifugal pump and gasoline engine. This head would be ample for watering the grounds and would allow the present pumping plant in the canyon north-east of the school to furnish water for the lawns desired around Dormitory No. 2, etc. This supply tank would be connected to the various irrigating lines about the grounds, making a system entirely independent of the high pressure system now used. Such a tank if of redwood and mounted on a substantial wood tower, should cost not over $700.00. The site for the main storage tanks north-west of the creamery is much superior to the site west of the cottages considering the laying of a supply line to this second tank and also the power required to fill it within a reasonable time. Such a tank and tower could be made a handsome feature of the grounds and can be placed with the foot at an elevation of 300 to 305 ft. without interfering with any proposed building site.

PLAN FOR PROCEDURE.

The above is the plan we have in mind for the completed plant. The funds available, however, will not cover all items. We believe the pumping plant should be put in complete, of high grade and sufficient capacity to handle the full flow of the wells. It would not be economy to connect up part of the wells at this time, as the pumping plant capable of handling them all would not work efficiently on a part of them, and a small plant put in now could not later be increased to advantage to pump all of the wells. After the pumping plant is installed the balance remaining will indicate what further can be done toward carrying out the plan. Among the items mentioned above that may be dispensed with temporarily are, (1) the lawn supply tank, with its connecting lines and pump, and (2) a part of the main water storage. By the end of June the water level will have fallen enough to allow the work of laying the suction pipes between the wells to begin.

We should like to have your permission to take up this part of the work as soon as conditions will allow. If you have no criticisms on this general plan of water development and dis-

tribution for our case, we will get together prices on the various amounts of pipe needed, on a variety of gasoline engines and go more thoroughly into the cost of various kinds of water storage. We will submit these figures to your office and follow whatever plan you may suggest as to the placing of orders, etc.

Trusting to have your decision in this matter at your earliest convenience, I am,

Very truly yours,

Prepared by H. B. Waters

HBW-C

Report of Director
to Trustees
May 14, 1910

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