PUMP STATION CALCULATIONS AND IRRIGATION SYSTEM EVALUATION FOR TRESTLE VINEYARD

by

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2014

TITLE	:	Pump Station Calculations and Irrigation System Evaluation for Trestle Vineyard
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DATE SUBMITTED	:	June 6, 2014

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ACKNOWLEDGEMENTS

First, I would like to thank Kyle Feist for checking my work and making invaluable suggestions for improvement. I could not have perfected my calculations without his help and changes.

Second, I would like to thank Craig Macmillan for the immense amount of information and expertise on Trestle vineyard.

Finally, I would like to thank my advisor, Dr. Stuart Styles, for all his guidance and help along the way.

ABSTRACT

The goal of this project was to evaluate the current irrigation system and recommend improvements for Trestle Vineyard owned by California Polytechnic State University in San Luis Obispo, California. The distribution uniformity within the vineyard was determined and calculations were made to determine the parameters for a new pump station at Nelson Reservoir. The installation of the pump station is not included in this project.

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INTRODUCTION

Background

The United States is ranked as the fourth country in the world for wine production. California accounts for 90% of this production (Goodhue, 2008). There are 478,400 acres of vineyard in California, which is a 146,000 acre increase from 25 years ago (Wine Institute, 2013). In California there is not enough rainfall to satisfy the crops making irrigation systems a necessity. Drip Irrigation systems are standard for vineyards because they allow water to be distributed only where the vines are, while maintaining dry rows for tractors and workers. Trestle Vineyard is located northwest of the Cal Poly main campus and has a drip system installed but the distribution uniformity is low and the system needs to be repaired. The pressure is inadequate and a new pumping system needs to be installed.

Justification

In order to irrigate effectively, a constant pressure is needed to maintain the desired flow rate throughout a field. This pressure affects the flow rates in a field. In a field with major elevation changes, this is particularly important to ensure that the desired water pressure will reach all parts of the field. When the proper pressure is not available, the crop will not be properly irrigated and the yield will decrease. Even with pressure-compensating emitters, a minimum pressure is needed to maintain the flow at which the emitter is rated.

The same irrigation system is used to irrigate both the Mission Avocados and the Trestle Vineyard at California Polytechnic State University. Since Mission Avocados pays California Polytechnic State University for use of their land and water, they are given priority for the water. Trestle Vineyard is only allowed to irrigate when the orchards are not using the water. Trestle Vineyard has no leeway when it comes to their irrigation scheduling, which has contributed to the deterioration of fruit quality.

Objective

The objective of this project is to choose a pump for the pumping system that will provide enough pressure to irrigate Trestle Vineyard. This will be part of a pump station which will be installed to serve both Trestle Vineyard and Mission Avocados. Other recommendations will be made to improve the distribution uniformity, overall quality and ease of management of Trestle Vineyard at California Polytechnic State University. These suggestions will be implemented in the following years at the discretion of Craig Macmillan and the Wine and Viticulture Department.

LITERATURE REVIEW

A search was conducted on irrigation in California, specifically on vineyards. Irrigation methods in California have changed greatly in the past 20 years (Caswell, 1985). As the demand for water has increased, the importance of having high irrigation efficiencies also increased (Caswell, 1985). Until recently it was illegal in parts of Spain to install irrigation systems on vineyards and all vineyards were dry-farmed (Salon, 2004). Once the laws were changed, studies showed an increase in yields between 77% and 120%. There is no such thing as the "best" system for vineyards because there are so many variables including proper management practices (Prichard, 2000). Despite this, vineyard owners in California have moved toward favoring an elevated drip irrigation system as is evident by Figure 1 (Orang, 2008). In 1991 only 42% of California vineyards were irrigated with drip. Only a decade later, in 2001, the number had jumped to 70%. Another decade later, in 2010, that number had again increased but only to 75% (Tindula, 2010). This trend is shown in figure 1 below.

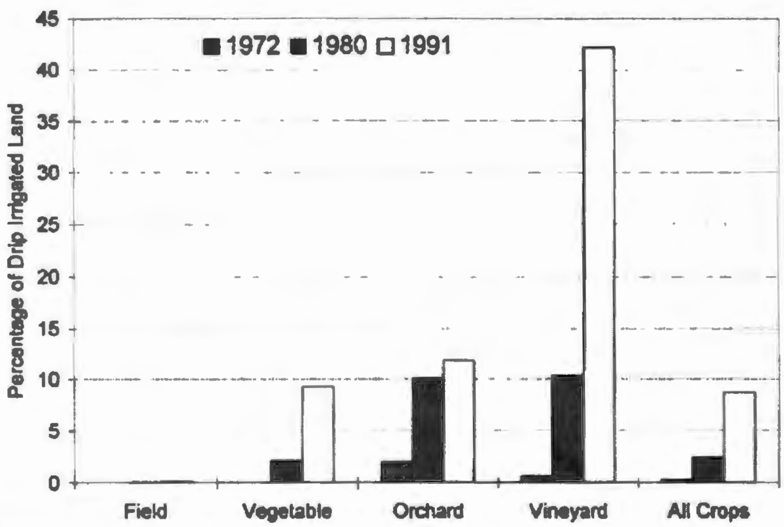

FIG. 1. Area (ha) Irrigated Using Drip Irrigation by Various Crops from 1972, 1980, and 1991 Survey Results (Field Crop Irrigation Using Drip Irrigation was Insignificant)

Figure 1: Area Irrigated Using Drip in California for Various Years (Snyder, 1996).

Drip Irrigation is preferred in vineyards because of the improved distribution uniformity, the flexible scheduling, uniform fertilizer application, higher production and it doesn't interfere with any cultural practices (Orang, 2008). Drip irrigation also allows for better management of variable soil and elevations within a field which is common in many parts of California (Prichard, 2000).

Emitters

Emitter clogging can be a problem resulting from biological or chemical contaminants or suspended matter in the water (Ahmed, 2007). Groundwater in some places has been degraded by high salinity and nitrates (Schmidt, 1987). For most water going into a drip system filtration is very important to keep the emitters from clogging.

Pressure Compensating (PC) emitters are a beneficial choice for uneven terrain where the pressure across hoses and along hoses will vary. PC emitters have a diaphragm which expands and contracts with changes in pressure in order to maintain a consistent flow rate (Boman, 2012). PC emitters work best within a specific range of pressures that can be found from the manufacturer literature such as the graph shown below in figure 2 (Netafim, 2007).

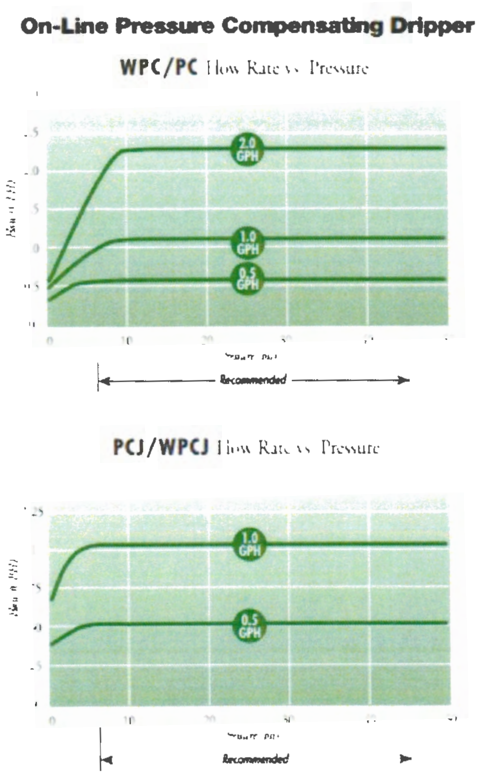

Figure 2: Performance Graphs for Netafim Woodpecker PC Emitters (Netafim, 2007).

Micro-Sprinklers

Many vineyards in the United States use micro-sprinklers for irrigation. In California vineyards it is typically installed and used for frost protection only (Boman, 2012). Frost damage occurs when the water inside any part of the plant (stem, leaves, or fruit) freezes and then bursts the cell membranes (Adhikari, 2008). Microsprinklers can provide up to 6˚F protection. The water from the microsprinklers sometimes creates a fog which will then act as a layer of insulation over the vineyard to reduce the amount of radiation loss (Boman, 2010). The continuous application of water does not always create a fog, but it does still protect against frost (Boman, 2012). The continuous application of water will freeze on the plant and the freezing process insulates the grapes which protects the fruit and the rest of the plant from freezing.

Filters

Media tanks are a very common type of filter in California agriculture. They are the most popular for dirty water (Burt & Styles, 2011). The sand particles can be sized to meet the filtration needs of the field. The tanks must also be sized based on the flow needs of the system. It is important to take into account the extra flow that will be needed for the filters to backflush. For this reason, a minimum of two media tanks are needed (three recommended) to insure that there will not be a significant impact to the irrigation system while one of the media tanks is backflushing. The backflushing process can be seen in figure 3 below.

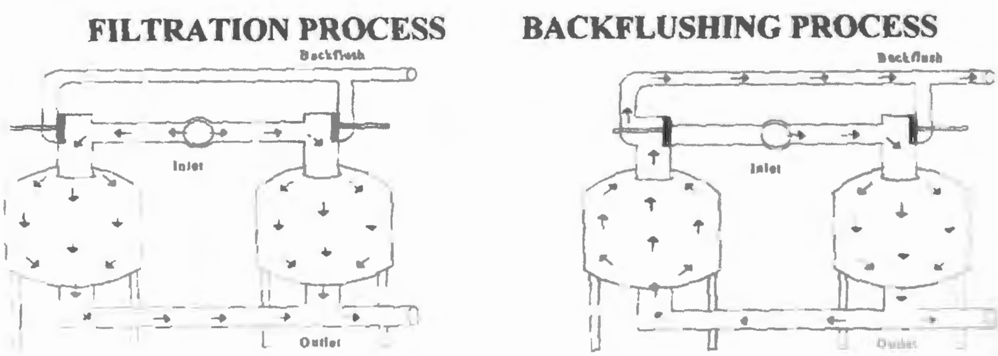

Figure 3: Filtration and Backflush of Media Tanks (Burt & Styles, 2011).

Pumps

In order to choose the best pump for an irrigation system two things must be known: Total Dynamic Head (TDH) and Flow Rate (Burt, 2013). Both these items can be calculated for a proposed system or an existing system. The required flow rate will depend on the flow needed for the largest area in the field that will be operating at any given time and the needs of the filtration system. The TDH is based on the following equation:

$$\text{TDH} = \text{Static Lift} + \text{Drawdown} + \text{Surface Discharge Pressure} + \text{Velocity Head} + \text{Friction Losses} \quad (1)$$

Once these two components are known pump curves can be used to determine which pump will have the highest efficiency at these characteristics. Pump curves like the one shown below in figure 4 can often be found online through the pump manufacturer.

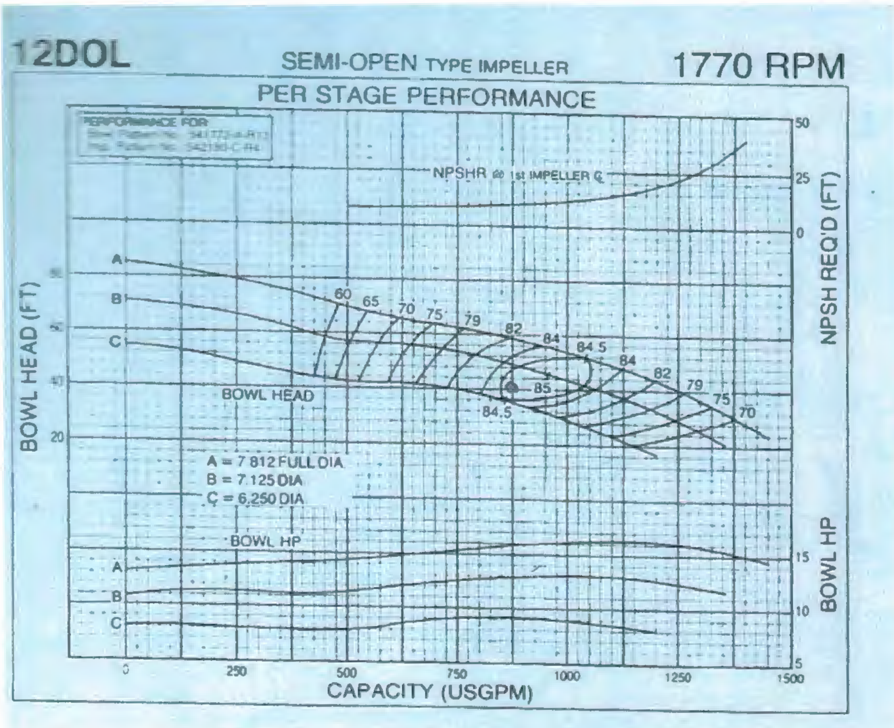

Figure 4: Typical Pump Curve (Burt, 2013).

Application

There are many different ways to check that the vines are getting enough water. At Trestle Vineyard, a leaf pressure bomb is used periodically throughout the growing season (Walsh, 2012). Plant requirements are not the only water needs that must be addressed. Deep percolation must be achieved in order to leach the salts from the root zone. With emitters, the deepest percolation happens right at each emitter and decreases as you get further from the emitter (Wallender, 2007).

It is important to consider leaching salts especially in drier climates. With excess salinity grapevines will have lower photosynthesis and lower shoot elongation (Manuck, 2012). Too much sodium and chloride can be toxic to the plants themselves. The low volume application rate of drip systems makes it essential to consider how salt build-ups will be dealt with if the problem arises.

PROCEDURES AND METHODS

Distribution Uniformity

The first thing needed was to find out everything about the irrigation system in its current state. This established a baseline to help decipher any possible improvements. To do this a distribution uniformity evaluation was performed with the help of other students in the BRAE 438 class. It was performed in two separate evaluations.

To determine the distribution uniformity (DU) the excel spreadsheet created by the Irrigation Training and Research Center at California Polytechnic State University was used.

There are many components of a DU evaluation, but they can be summarized as three main parts: Pump and Filter Station Measurements, Flow Tests, and Pressure Measurements.

Before beginning, it is important to obtain a map of the vineyard in order to develop a plan for the evaluation. A map of the irrigation system design was obtained from Cal West Rain. A soils report was also obtained from the Natural Resources Conservation Service website. This report can be found in Appendix C.

Pump and Filter Station Measurements. At the pump and filter station pressure and flow rates were measured. Observations were made of the set up to check that the chemicals were being injected in the correct place. Once measurements were completed, both the screen filter and the media filters were manually backflushed.

Pressure Measurements. The next part is to take pressure measurements. At least 60 evenly spaced measurements are needed throughout the area of the DU evaluation. A map was printed from Google Earth and the pressure measurements were written directly on the map at the location where they were obtained. This helped ensure that measurements were taken throughout the entire vineyard. The pressures can be seen in figure 5 on the next page. Figure 6 on page nine shows the blocks layout and vine spacing.

Figure 5: Pressure Map of Trestle Vineyard (Busbey, 2014).

<u>Flow Tests</u>. Flow tests were performed at three locations (A,B,C part 1 and 2 for the two separate evaluations), previously shown in figure five. Location A was closest to the pump. This location is considered the cleanest part of the field and since the vineyard uses pressure compensating emitters, five flow tests were done at this location to allow the program to compute the emitter exponent. To perform this test 16 buckets were placed under individual emitters for a total of 5 minutes each. For the first test individual flows were measured. Tests 2-5 were measured cumulatively.

Location B was chosen at an average place in the field (somewhere in the middle). Only one test is needed at location B. 16 emitters were individually measured for 5 minutes each.

Location C was chosen as the dirtiest location, or the farthest from the pump. This location had the most potential for plugging problems. For this test 28 emitters were individually measured at 5 minutes.

Figure 6: Block Map of Trestle Vineyard (Bushey, 2014).

Design Calculations

The design calculations involved several steps. For the calculations it was assumed that all current blocks would be irrigated at the same time. In addition, it was assumed that the proposed block would also be irrigated with the rest of the vines. These assumptions ensured that calculations would provide over estimates and therefore include a factor of safety. The following calculations are shown in Appendix E.

The first calculation was to determine the number of emitters and the GPM per emitter. Since all the emitters were the same (Netafim Woodpecker) and all were PC emitters, these calculations were not too difficult. It was assumed that all the emitters were working properly and applying the correct amount of water. The calculations were all made using Microsoft Excel. Table 1 on the next page shows how the calculations were formatted.

Table 1: GPM per Emitter Calculations (Bushey, 2014).

Cal Poly Vineyard Pumping Station

	Block 1	Block 2	Block 3	Block 4	Block 5	PO* - Block 6
Varietal	Tempranillo	Syrah	Chardonnay	Pinot Noir	Pinot Noir	TBD
Acreage	0.83	2.75	2.76	4.75	1.47	1.64
GPH/Emitter	0.5284	0.5284	0.5284	0.5284	0.5284	0.5284
No. of Emitters/Vine	1	1	1	1	1	1
GPH/Vine	0.5284	0.5284	0.5284	0.5284	0.5284	0.5284
No. of Vines	905	2991	3005	5801	1596	7937
No. of Emitters	905	2991	3005	5801	1596	7937
Total Block GPH	478.2	1580.4	1587.8	3065.3	843.3	4193.9
Total Block GPM	8.0	26.3	26.5	51.1	14.1	69.9
*PO = proposed object				TOTAL GPM	125.9	195.8

ET peak month (published) =	2.66 in/month	hrs/week =	27
	0.621 in/week		
	0.683 + 10% for drip		
Gross =	0.853		
		GPM/emitter =	0.009 GPM
Area =	14.2 acres		0.540 GPH
	618552 ft^2		
GPM =	200 GPM		
DU =	0.8		

The next step was to determine the critical path. This path was chosen as shown in figure 7 on the next page. This critical path was used to calculate the friction, elevation change and pressure needed at each point along the path. The result was the pressure needed directly after the filter station. The pressure needed for the filter station was added in later with separate calculations that can be seen in Appendix E. The pressure needed upstream of the filter station was calculated by adding pressure losses across the filters and valves that were part of the filter station.

Figure 7: Critical Path (Bushey, 2014).

Pump Selection

Once the calculations were complete, the pump was selected. Several factors were taken into account. Since the vineyard blocks are not of equal acreage, different flow rates and pressures will be needed at different times. Pumps operate at peak efficiency at one flow rate only. Since the flow rates for Trestle Vineyard will vary greatly, the pump would not always run at peak efficiency. This led to the decision to choose a VFD (variable frequency drive). With a VFD the pump will run at a high efficiency no matter what the flow rate at the time is.

RESULTS

The distribution uniformity of Trestle Vineyard was determined to be 0.80. The flow rate needed for the pump was 271 GPM and the TDH was 305 feet. The estimated power needed for the pump was 25 HP for the drip system. The vineyard pump that will be ordered is a 40 HP VFD. This size pump was chosen because it had enough power to run the drip system on every block at the same time or to run the frost protection (sprinkler) system on every block at the same time. The following requirements for the pump station were determined by the ITRC. This is the information that the ITRC sent to vendors to obtain the price quotations found in Appendix G. An overview of the pumping system can be found in Appendix F. The pump station will serve other Cal Poly fields as well as the vineyard. The 40 HP pump will serve Trestle Vineyard only.

Media Filters

1. Must operate safely at a working pressure of 130 psi with the occasional surge of 50 psi past the working psi.
2. Sand media will be #15 crushed silica with a uniformity coefficient of less than 1.5. The tanks will be filled to the manufacturer's recommended level. At 250 GPM the media will filter the water at a rate equivalent to 200 mesh.
3. Backflush valves will close at a rate less than 6 seconds at a pressure of 40 psi. There will be no more than 3 psi loss during filtration at 250 GPM flow rate. There will be no more than 8 psi loss during backflush at 250 GPM flow rate.
4. The screen filter installed will be 4 times larger than the "standard" filter provided for the backflush solenoid valves.
5. The tanks will be constructed in such a way that corrosion will not be a problem. For stainless steel this will mean applying a special coating to the welds to prevent bacterial corrosion. For carbon steel this will mean installing anodes in every tank if corrosion is remotely possible.
6. Air vents will meet the following flow requirements:

Table 2: Flow Requirements for Air Vents (ITRC, 2014).

Location	Description	Minimum CFS
Inlet Manifold	Air Release	340
	Vacuum Release	170
	Continuous Air Release	17
Backflush Manifold	Air Release	130
	Vacuum Release	65

7. All air vents to manifold fittings will be no smaller than the size of the air vent provided.

8. All continuous acting air vents will include an air collection chamber, where a 6" pipe is welded as a saddle/fish-mouth and capped. A welded fitting will be provided for the continuous acting air vent at the center of the cap.
9. To keep water velocities less than 5 feet per second, the inlet and outlet manifolds will be 10" diameter, pre-fabricated steel.
10. The inlet and outlet of each tank will be connected to the manifolds with a minimum of 4" Victaulic/grooved fitting.
11. All manifold connections will be Victaulic/grooved fitting.
12. Each media tank will have a line clearly etched, painted or otherwise marked on the outside of the tank to show the proper level of the media inside the tank.
13. An automatic flow control valve shall be provided for adjustment of the backflush flow rate, followed by a clear plastic tube to see the color of the backflush water and a standard clear sight glass threaded into the backflush manifold. The clear plastic tube will be equipped with a durable (life of 20 years) sun shade that is easily moved in order to temporarily view the backflush water when adjusting the backflush flow and duration.
14. The sensing port(s) of the automatic flow control valve will be furnished with 1" screen filters that are easily inspected and cleaned.
15. The backflush manifold must be 4" diameter, at least Schedule 40 if PVC, and must be painted with a durable (minimum life of 5 years) paint if not PVC to avoid sun damage.
16. A back-up screen filter/strainer will be provided downstream of the media tanks with an appropriate mesh size to capture the smallest 10% of media particles. A preliminary estimate for the basket strainer is 80 mesh.

Filter Backflush Controller

There must be one backflush controller that is capable of controlling the backflush for all the tanks, ensuring that no more than one tank be backflushed at once. The controller will be supplied with a 110 V through wire in conduit. The controller must contain the following features:

1. Elapsed time variable. This will initially be set at a 12 hour interval.
2. Differential pressure switch. This will be set for a pressure differential of 5 psi greater than the pressure differential when clean.
3. Adjustable dwell time.
4. Easy to understand adjustments.

DISCUSSION

There were a few obstacles to overcome with this project. One difficulty was the weather during one part of the evaluation. There was high wind and the buckets for the flow tests kept getting blown over. This made is difficult to get accurate results. To compensate, only a couple buckets were timed at once and were held in place. The tests were done for two minutes instead of five which the program adjusts for automatically.

The calculations were also an obstacle. They went through many changes before being finalized. This took a lot of time to ensure the formulas were all correct. Two separate calculations were done at the beginning by Kyle Feist and Linda Bushey. Initial outcomes were compared to verify that the formulas were correct. Calculations were then merged and went through many adjustments as details were added. These calculations gave the TDH and GPM accurate within 5 feet.

Throughout the project some parameters were changed. At the beginning the pump calculations were to be added to the calculations from other fields to determine the size of one big pump that would be used. As time went on, it was determined that Trestle Vineyard would have its own pump located on the same pump station next to the Nelson Reservoir. With the realization that the blocks varied greatly in size and varietal it was decided that the pump would have varying flow demands depending on which blocks were being irrigated at the time. This led to the decision to use a variable frequency drive pump which would adjust the frequency based on the current demand in order to maximize the efficiency.

RECOMMENDATIONS

Note: These are in order from least to most amount of work to implement.

1. Rotate tubing such that emitters are facing downward
    - The emitters are on an elevated hose line. Right now, the emitters are facing upward. Due to the elevation changes throughout the field, the water is leaving the emitters and running down the hoses before dripping to the ground. This is resulting in the water not being emitted next to the vines where it is needed. If the hoses are rotated the emitters will face downward and the water would drip to the ground where it is intended.
2. Replace old emitters
    - After a while the diaphragm in the pressure compensating emitter will wear out and will not accurately distribute water. This system is 12 years old and since the ground is so hilly it is important that the emitters are distributing water in the correct amount.
3. Make the placement and number of emitters per vine consistent
    - The emitters should be moved such that there are a consistent number of emitters per vine.
    - The placement should be made consistent throughout the vineyard.
4. Remove current screen filter and media tanks
    - The current filter station will no longer be needed once the new filter and pump station is installed. The water from Nelson Reservoir will be filtered at the new pump and filter station before it is sent to Trestle Vineyard.

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APPENDIX A

HOW PROJECT MEETS REQUIREMENTS FOR THE BRAE MAJOR

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Major Design Experience

This project was required to meet certain design criteria. The following defines how these criteria were met.

Establishment of Objectives and Criteria. Objectives and criteria were established by Craig Macmillan and Dr. Styles.

Synthesis and Analysis. Calculations were done to determine the parameters needed to choose the correct pump.

Construction, Testing and Evaluation. The current irrigation system was evaluated.

Incorporation of Applicable Engineering Standards. Standards for irrigation design and pump design were used.

Capstone Design Experience

This project incorporates knowledge from the following key courses.

- SS 121 – Introductory Soil Science
- ENGL 149 – Tech Writing for Engineers
- BRAE 236 – Principles of Irrigation
- BRAE 312 – Hydraulics
- BRAE 331 – Irrigation Theory
- BRAE 414 – Irrigation Engineering
- BRAE 438 – Drip/Micro Irrigation
- BRAE 532 – Water Wells and Pumps

Design Parameters and Constraints

The design needed to meet certain constraints as follows.

Physical. The existing irrigation system is to be used. The final pump design must accommodate the existing 14 acre vineyard as well as the 1.6 acres of planned vineyard.

Economic. The price quotations for the pump station can be seen in Appendix G. The recommendations for the irrigation system will be implemented as determined by the Wine and Viticulture department at Cal Poly.

Environmental. There were no direct environmental constraints.

Sustainability. This project was established for the long term sustainability of the agricultural fields at California Polytechnic State University.

Manufacturability. All parts will be manufactured by reputable companies.

Health and Safety. Proper design ensured that the system would not be dangerous to those working around the system.

Ethical. There were no ethical constraints.

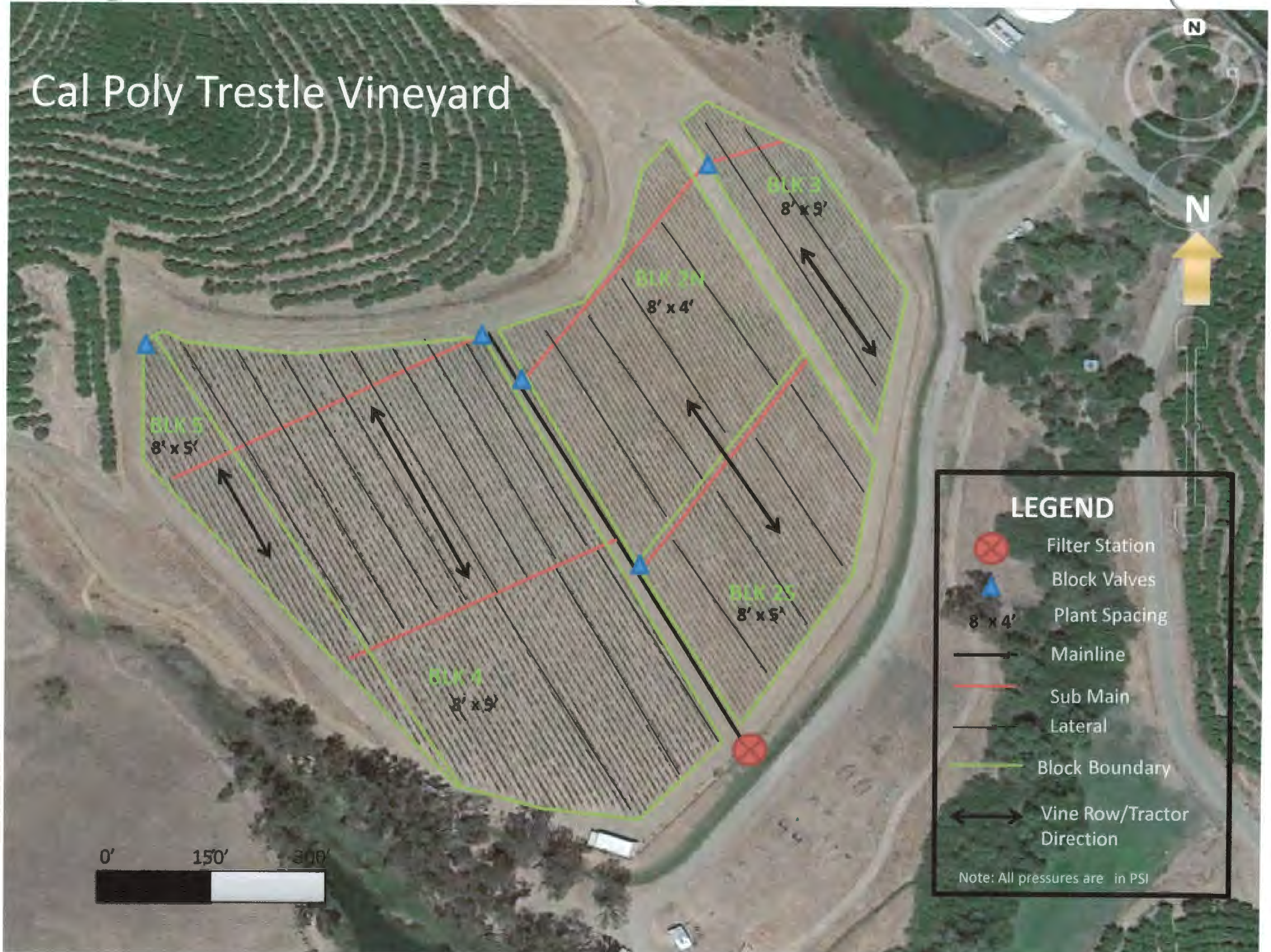
Social. There were no social constraints.

Political. There were no political constraints.

Aesthetic. There were no aesthetic constraints.

APPENDIX B

VINEYARD MAPS


Cal Poly Trestle Vineyard
N
BLK 3
8' x 5'
BLK 2N
8' x 4'
BLK 2S
8' x 5'
BLK 4
8' x 5'
BLK 5
8' x 5'
LEGEND
Filter Station
Block Valves
8' x 4'
Plant Spacing
Mainline
Sub Main
Lateral
Block Boundary
Vine Row/Tractor Direction
Note: All pressures are in PSI
0'
150'
300'


Cal Poly Trestle Vineyard
Pressure Map
N
BLK 2N
BLK 3
BLK 5
BLK 4
BLK 2S
A1
A2
B1
B2
C1
C2
LEGEND
Filter Station
Mainline
Sub Main
Lateral
Block Boundary
Note: All pressures are in PSI

Elev. = 421 ft
Elev. = 444 ft
Elev. = 408 ft
Elev. = 453 ft
Elev. = 426 ft
Elev. = 396 ft
Elev. = 447 ft
Elev. = 450 ft
Elev. = 387 ft
Elev. = 411 ft
Elev. = 416 ft
Elev. = 387 ft
Elev. = 398 ft
Elev. = 391 ft
Elev. = 389 ft
Elev. = 385 ft
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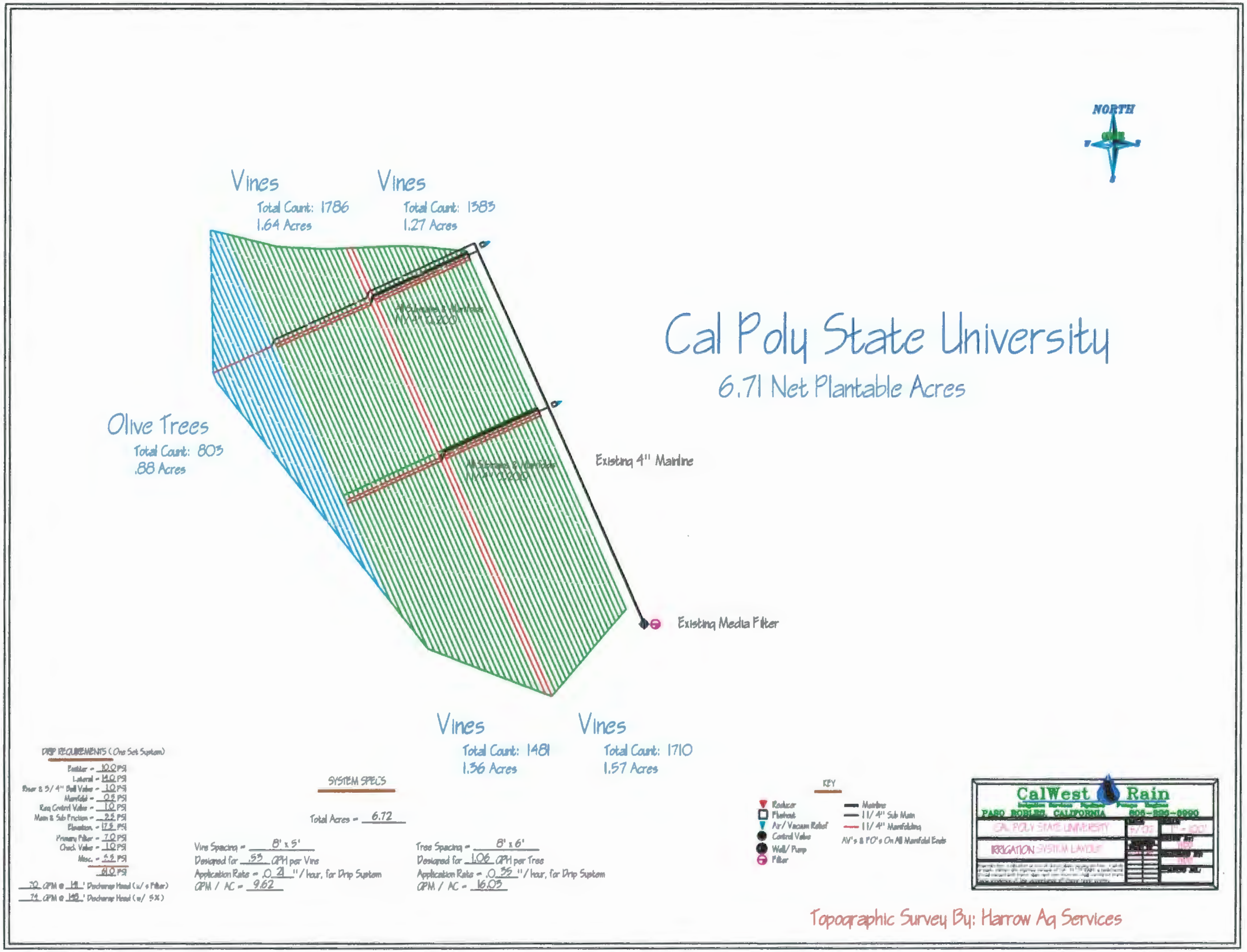
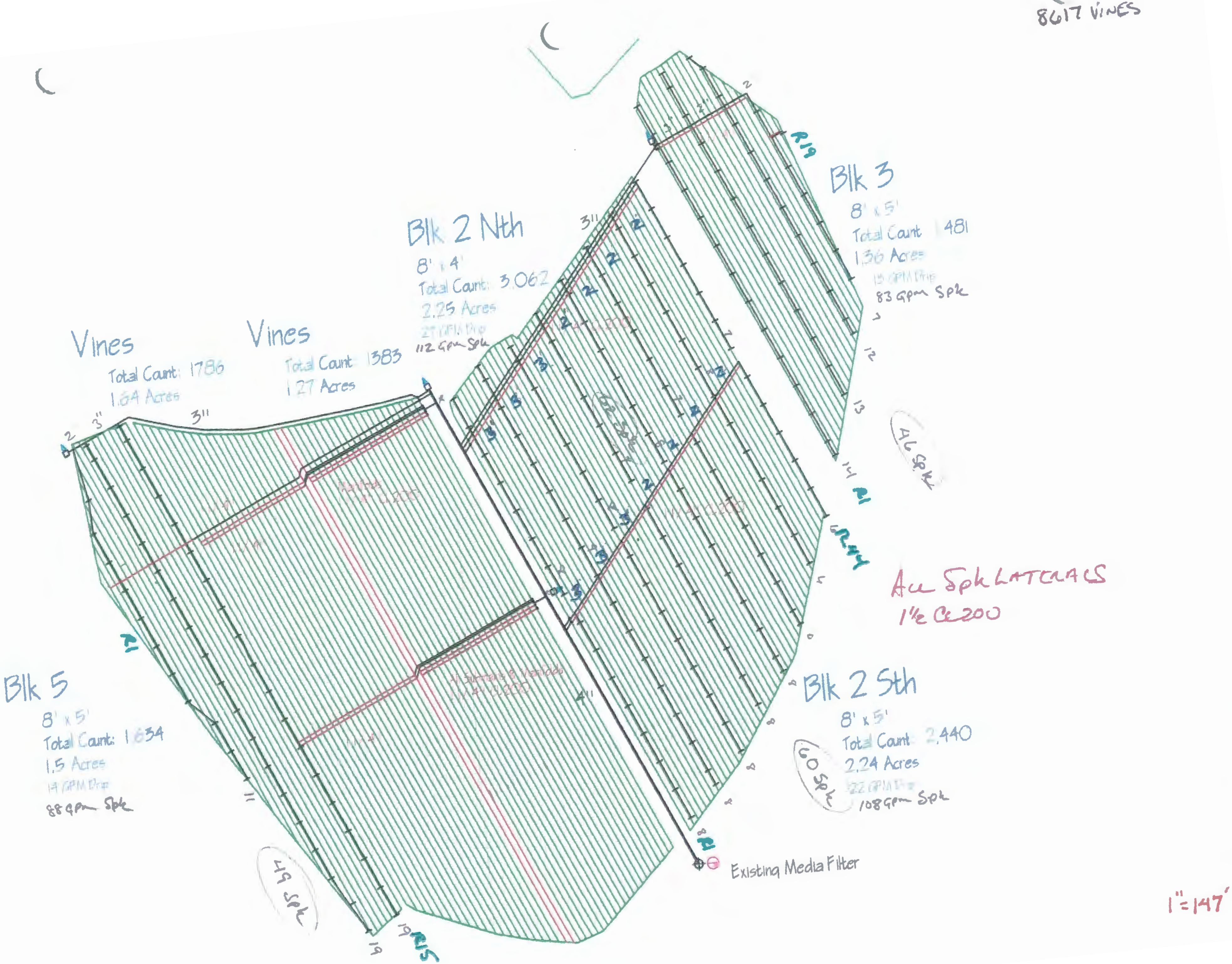
Google earth
Eye alt 2347 ft


NORTH
Vines
Total Count: 1786
1.64 Acres
Vines
Total Count: 1383
1.27 Acres
Cal Poly State University
6.71 Net Plantable Acres
Olive Trees
Total Count: 803
.88 Acres
Existing 4" Mainline
Existing Media Filter
Vines
Total Count: 1481
1.36 Acres
Vines
Total Count: 1710
1.57 Acres
DRIP REQUIREMENTS (One Set System)
Emitter = 10.0 PSI
Lateral = 14.0 PSI
Riser & 3/4" Ball Valve = 1.0 PSI
Manifold = 0.5 PSI
Reg Control Valve = 1.0 PSI
Main & Sub Friction = 2.5 PSI
Elevation = 17.5 PSI
Primary Filter = 7.0 PSI
Check Valve = 1.0 PSI
Misc. = 5.5 PSI
61.0 PSI
70 GPM @ 141 ' Discharge Head (w/ o Filter)
74 GPM @ 148 ' Discharge Head (w/ 5%)
SYSTEM SPECS
Total Acres = 6.72
Vine Spacing = 8' x 5'
Designed for .53 GPH per Vine
Application Rate = .0 21 "/ hour, for Drip System
GPM / AC = 9.62
Tree Spacing = 8' x 6'
Designed for 1.06 GPH per Tree
Application Rate = .0 35 "/ hour, for Drip System
GPM / AC = 16.03
KEY
Reducer
Flushout
Air/ Vacuum Relief
Control Valve
Well/ Pump
Filter
Mainline
1 1/4" Sub Main
1 1/4" Manifolding
AV's & FO's On All Manifold Ends
CalWest Rain
PASO ROBLES, CALIFORNIA
CAL POLY STATE UNIVERSITY
IRRIGATION SYSTEM LAYOUT
Topographic Survey By: Harrow Ag Services


Cal Poly Vineyard
Draft Blocks Map
1
1.64ac
2
1.33ac
4.62ac
5.59ac
Blk 3
Blk 5
Existing Media Filter
Legend
10ft Contorus (USGS NED)
50ft Contorus (USGS NED)
Row Direction
Blocks - 13.14 ac
N
Mike Bobbitt & Associates
(805)466-2920
www.mikebobbitt.com
December 10th, 2008
400
500
Feet



8617 VINES
Blk 3
8' x 5'
Total Count 1481
1.36 Acres
83 GPM Spk
Blk 2 Nth
8' x 4'
Total Count: 3,062
2.25 Acres
112 GPM Spk
Vines
Total Count: 1786
1.64 Acres
Vines
Total Count: 1383
1.27 Acres
Blk 5
8' x 5'
Total Count: 1,634
1.5 Acres
88 GPM Spk
Blk 2 Sth
8' x 5'
Total Count 2,440
2.24 Acres
108 GPM Spk
All Spk LATERALS
1½ CL200
46 Spk
60 Spk
49 Spk
Existing Media Filter
1"=147'

APPENDIX C

DISTRIBUTION UNIFORMITY EVALUATIONS

Field Identification

Farm Name:	Trestle Vineyard
Field Name:	California Polytechnic State University
Contact:	Craig MacMillan
Evaluator:	Linda Bushey with help from BRAE 438 Classmates
System:	Single line PC drip emitters
Crop:	Wine Grapes
City:	San Luis Obispo, CA
Phone:	(805) 756-7071
Date:	Winter 2014

Drip/Micro Evaluation: Blocks 2N, 2S, 3 Results

Global System DU_{lq}..0.80
(Low Quarter Infiltrated / Average Infiltrated)

Percent of Total Non-Uniformity Due to Each Problem:

Pressure differences..12%

Difference between manifold inlet pressures	21.5	psi
Maximum pressure difference within a hose:	19	psi

Other causes of flow variation 86%
Unequal Drainage..2%

Drip/Micro Evaluation: Block 4 Results

Global System DU_{lq}..0.80
(Low Quarter Infiltrated / Average Infiltrated)

Percent of Total Non-Uniformity Due to Each Problem:

Pressure differences..32%

Difference between manifold inlet pressures	33	psi
Maximum pressure difference within a hose:	20	psi

Other causes of flow variation 66%
Unequal Drainage..1%

Problems Noted and Recommendations

The field DU is considered **low**. (Statewide DU average = 0.85)

The following is a list of noted problems and recommendations:

1. Other causes of flow variation
   - There were some leaks noted in the field due to barb leaks or hose leaks. Consider investing in no-leak or no-drain emitters for problem leaks and upon maintenance replacement if applicable.
   - Plugging is a problem. Consider flushing hoses more frequently and/or injecting chlorine or acids into the system for bacterial and bicarbonate control more often.

2. Other problems noted
   - Emitters were facing upward. Water was running down the hoses instead of being applied on the ground near the vine. Consider rotating the laterals so the emitters are facing downward.

Field Identification

Farm Name:	Trestle Vineyard
Field Name:	California Polytechnic State University
Contact:	Craig MacMillan
System:	Single line PC drip emitters
Crop:	Wine Grapes
City:	San Luis Obispo, CA
Phone:	(805) 756-7071
Date:	January 29, 2014

Drip/Micro Evaluation: Results

Global System DU_{lq}..0.80
(Low Quarter Infiltrated / Average Infiltrated)

Percent of Total Non-Uniformity Due to Each Problem:

Pressure differences...32%

Difference between manifold inlet pressures	33	psi
Maximum pressure difference within a hose:	20	psi

Other causes of flow variation 66%
Unequal Drainage...1%

Drip/Micro Evaluation: Problems Noted and Recommendations

The field DU is considered **low**. (Statewide DU average = 0.85)

The following is a list of noted problems and recommendations:

1. Other causes of flow variation
   - There were some leaks noted in the field due to barb leaks or hose leaks. Consider investing in no-leak or no-drain emitters for problem leaks and upon maintenance replacement if applicable.
   - Plugging may be a problem. Consider flushing hoses more frequently and/or injecting chlorine into the system for bacterial control more often.

2. Other problems noted
   - The pressure loss across the filter was higher than is typical. Consider increasing the frequency of back flushing or adding an automatic backflush on the primary filter.

- The program indicates a small wetted area, but the irrigation system was not running for the usual amount of time, therefore this is likely not an issue.
- Emitters were facing upward. Water was running down the hoses instead of being applied on the ground near the vine. Consider rotating the laterals so the emitters are facing downward.
- The number of emitters supplying water to a vine varied from 1 to 2 throughout the field. Consider making this more consistent.

Scheduling:

The current irrigation scheduling for the field appears to be adequate considering the age of the vines. Be sure to dig soil pits to check soil moisture to verify the correct schedule.

The Field

- The evaluated area was 5.6 acres
- This evaluated area was equipped with a 12 year old single line with pressure compensating drip emitters
- The vines were on 5' x 8' spacing
- The soil is a Los Osos Loam

The Pump System

- The pump's discharge pressure was measures as 71 psi
- Filtration was done by 1 station with 2 Sand Media Tanks and 1tubular screen. The pressure differential across the filters was 13 psi.

The PC Emitter System

- There was a single hose with 1 emitter per vine
- The calculated average flow rate per emitter was 2.5 LPH
- Hose flushing occurred annually

DRIP/MICRO EVALUATION: RESULTS

GLOBAL SYSTEM DULQ . . . . (Low Quarter Infiltrated / Average Infiltrated)	0.80

DISTRIBUTION UNIFORMITY PROBLEMS -
PERCENT OF TOTAL NON-UNIFORMITY DUE TO EACH PROBLEM:

Pressure differences		12%
Difference between hose inlet pressures across the field:	21.5 psi	
Maximum pressure difference within a hose:	19 psi	
Other causes of flow variation		86%
Unequal Spacing		0%
Unequal Drainage		2%

ESTIMATE OF EXCESS PRESSURE	0 psi
ESTIMATE OF RUNOFF (percent of applied water)	0 %

DRIP/MICRO EVALUATION: SCHEDULING DATA

AREA NUMBER:	#1	#2	#3
Available Water Holding Capacity (AWHC, inches):	4.5		
AWHC adjusted for percent wetted area (in):	0.11		
Gross Application Rate (in/hr):	0.023		
Net Application Rate (in/hr):	0.018		

MANAGEMENT INFORMATION

AREA NUMBER:	#1	#2	#3
Gross hours of irrigation required at a point to fill up 50% of the wetted soil reservoir (hours):	3.1		
Hours needed for plant to deplete 50% of the wetted soil reservoir during the peak water use period. This assumes the emitters are not operating right then at that location (hours):	15.0		

CURRENT SCHEDULING

Set duration during peak ET (hours):	6		
Irrigation frequency during peak ET (hours):	168		

DRIP/MICRO EVALUATION: PROBLEMS NOTED

Ref. #

4 The field DU is considered low

Pressure problems

Hose inlet pressure variation is a significant problem

Possible causes of hose inlet pressure variation include:

8 -Lack of pressure regulation;

consider installing hose pressure regulators

11 -Dirty hose screen washers;

consider removing and replacing with plain washers

Other causes of flow variation

14 There is a medium problem due to barb or hose leaks

Plugging may be a problem in the field

Possible causes of plugging include:

19 -Infrequent chlorine injection for bacterial control

21 -No automatic flush on filters

Other problems noted

34 Small wetted soil area

DRIP/MICRO EVALUATION: RESULTS

GLOBAL SYSTEM DULQ 0.78
(Low Quarter Infiltrated / Average Infiltrated)

DISTRIBUTION UNIFORMITY PROBLEMS -
PERCENT OF TOTAL NON-UNIFORMITY DUE TO EACH PROBLEM:

Pressure differences 38%

Difference between hose inlet pressures across the field: 33 psi
Maximum pressure difference within a hose: 20 psi

Other causes of flow variation 59%

Unequal Spacing 0%

Unequal Drainage 3%

ESTIMATE OF EXCESS PRESSURE . . . . 5 psi

ESTIMATE OF RUNOFF (percent of applied water) . . . . 0 %

DRIP/MICRO EVALUATION: SCHEDULING DATA

AREA NUMBER:	#1	#2	#3
Available Water Holding Capacity (AWHC, inches):	4.5		
AWHC adjusted for percent wetted area (in):	0.11		
Gross Application Rate (in/hr):	0.026		
Net Application Rate (in/hr):	0.021		

MANAGEMENT INFORMATION

AREA NUMBER:	#1	#2	#3
Gross hours of irrigation required at a point to fill up 50% of the wetted soil reservoir (hours):	2.7		
Hours needed for plant to deplete 50% of the wetted soil reservoir during the peak water use period. This assumes the emitters are not operating right then at that location (hours):	15.0		

CURRENT SCHEDULING

Set duration during peak ET (hours):	6		
Irrigation frequency during peak ET (hours):	168		

DRIP/MICRO EVALUATION: PROBLEMS NOTED

Ref. #

4 The field DU is considered low

Pressure problems

Hose inlet pressure variation is a significant problem

Possible causes of hose inlet pressure variation include:

8 -Lack of pressure regulation;

consider installing hose pressure regulators

Other causes of flow variation

14 There is a medium problem due to barb or hose leaks

Plugging may be a problem in the field

Possible causes of plugging include:

17 -Infrequent hose flushing

19 -Infrequent chlorine injection for bacterial control

21 -No automatic flush on filters

Other problems noted

31 High pressure losses at pump station

32 -Larger-than-typical pressure drop across the filter

34 Small wetted soil area

FIELD IDENTIFICATION

1	Farm Name:	Trestle Vineyard
2	Field Identification:	Blocks 2N, 2S and 3
3	Field Location:	Cal Poly
4	Contact Name:	Craig MacMillan
5	Address Line 1:	1 Grand Avenue
6	Address Line 2:	San Luis Obispo, CA 93401
7	Phone:	805-756-7071

JOB IDENTIFICATION

8	Evaluator:	Linda, Shiko, Ramiz
9	Date:	2/19/2014

SYSTEM DESCRIPTION

10	Age of system:	7	years
11	Is there a water penetration problem?	Yes	
12	Is there undulating (rolling; up-and-down) topography?	Yes	
13	Percentage of applied water that runs off the field:	0	%
14	Number of models/emitter designs used in the system:	1	
15	Type of water source:	Surface	

EMITTER INFORMATION

16	Manufacturer:	Netafim
17	Model:	Woodpecker
18	Nominal flow/emitter (gph or lph):	2
19	Units of nominal flow rate:	lph
20	Emitter path type:	Pressure compensating

FILTRATION

21	Automatic flush on the primary filter?	No
	Type of filter (select all that apply):	
22	Tubular screen?	Yes
23	Overflow screen?	No
24	Media filter?	Yes
25	Sand (centrifugal) separator?	No
26	Disc filter?	No
27	"Vacuum cleaned" tubular screen?	No

CHEMICAL INJECTION SYSTEM

28	Location of fertilizer injector with respect to filter:	Upstream
29	Location of pesticide injector with respect to filter:	Downstream
30	Location of acid injector with respect to filter:	Downstream
31	Location of gypsum injector with respect to filter:	No gypsum injection system
	If no chlorine or polymer injection, select "Never".	
32	Frequency of chlorine or polymer injection:	Annually
	If no acid injection, select "Never".	
33	Frequency of acid injection:	Monthly

If no injection system, skip the next question.

34	Do any of the injection systems use a throttling valve on the mainline to create a pressure differential?	No	
35	Frequency of hose/tape flushing:	Annually	

PUMP STATION MEASUREMENTS

36	Pump discharge pressure:	55	psi
37	Pressure downstream of filters and control valves:	47	psi
	Optional Pressure Values:		
38	Total filter loss:	8	psi
39	Total pump control valve loss:	3	psi
40	Loss from throttled manual valves:	0	psi

VALVING

41	Number of automatic pressure control valves near the filter and pump (0 for none):	1	
42	Is there a partially closed (i.e., "throttled") manual valve near the pump discharge to reduce pressure?	No	
43	Does the head of each manifold have an automatic pressure regulator?	Yes	
44	Does the head of each hose have an automatic pressure regulator?	No	
45	Is there a flow meter?	Yes	

FIELD PRESSURE MEASUREMENTS

Note: Water must be flowing through the hoses when the measurements are made.

Location **#1**: Submain or regulated manifold closest to the pump.

Closest hose to the inlet of the submain (or regulated manifold):

46	Downstream end of "uphill" side pressure:		psi
47	Middle of "uphill" side pressure:		psi
48	Hose inlet pressure:	28	psi
49	Middle of "downhill" side pressure:	32	psi
50	Downstream end of "downhill" side pressure:	37	psi

Most distant hose from the inlet of the submain (or regulated manifold):

51	Downstream end of "uphill" side pressure:		psi
52	Middle of "uphill" side' pressure:		psi
53	Hose inlet pressure:	20	psi
54	Middle of "downhill" side pressure:	26	psi
55	Downstream end of "downhill" side pressure:	30	psi

Location **#2**: Submain or regulated manifold most distant from the pump (or where the pressure is lowest).

Closest hose to the inlet of the submain (or regulated manifold):

56	Downstream end of "uphill" side pressure:	18	psi
57	Middle of "uphill" side pressure:	18	psi
58	Hose inlet pressure:	20	psi
59	Middle of "downhill" side pressure:	26	psi
60	Downstream end of "downhill" side pressure:	37	psi

Most distant hose from the inlet of the submain (or regulated manifold):

61	Downstream end of "uphill" side pressure:	23	psi
62	Middle of "uphill" side' pressure:	23	psi
63	Hose inlet pressure:	25	psi
64	Middle of "downhill" side pressure:	28	psi
65	Downstream end of "downhill" side pressure:	37	psi

Location **#3**: Submain or regulated manifold at an intermediate distance from the pump.

Closest hose to the inlet of the submain (or regulated manifold):

66	Downstream end of "uphill" side pressure:	6	psi
67	Middle of "uphill" side pressure:		psi
68	Hose inlet pressure:	7.5	psi
69	Middle of "downhill" side pressure:	10	psi
70	Downstream end of "downhill" side pressure:	17	psi

Most distant hose from the inlet of the submain (or regulated manifold):

71	Downstream end of "uphill" side pressure:	4.5	psi
72	Middle of "uphill" side' pressure:		psi
73	Hose inlet pressure:	6.5	psi
74	Middle of "downhill" side pressure:	10.5	psi
75	Downstream end of "downhill" side pressure:	17	psi

Location **#4**: Intermediate submain or regulated manifold close to the pump.

Closest hose to the inlet of the submain (or regulated manifold):

76	Downstream end of "uphill" side pressure:	20	psi
77	Middle of "uphill" side pressure:	20	psi
78	Hose inlet pressure:	22	psi
79	Middle of "downhill" side pressure:	28	psi
80	Downstream end of "downhill" side pressure:	36	psi

Most distant hose from the inlet of the submain (or regulated manifold):

81	Downstream end of "uphill" side pressure:		psi
82	Middle of "uphill" side' pressure:		psi
83	Hose inlet pressure:	20	psi
84	Middle of "downhill" side pressure:	26	psi
85	Downstream end of "downhill" side pressure:	33	psi

Location **#5**: Intermediate submain or regulated manifold distant from the pump.

Closest hose to the inlet of the submain (or regulated manifold):

86	Downstream end of "uphill" side pressure:		psi
87	Middle of "uphill" side pressure:		psi
88	Hose inlet pressure:	22	psi
89	Middle of "downhill" side pressure:	27	psi
90	Downstream end of "downhill" side pressure:	34	psi

Most distant hose from the inlet of the submain (or regulated manifold):

91	Downstream end of "uphill" side pressure:		psi
92	Middle of "uphill" side' pressure:		psi
93	Hose inlet pressure:	6.5	psi
94	Middle of "downhill" side pressure:	14	psi
95	Downstream end of "downhill" side pressure:	20	psi

Location **#6**: Intermediate submain or regulated manifold.

Closest hose to the inlet of the submain (or regulated manifold):

96	Downstream end of "uphill" side pressure:		psi
97	Middle of "uphill" side pressure:		psi
98	Hose inlet pressure:	24	psi
99	Middle of "downhill" side pressure:	28	psi
100	Downstream end of "downhill" side pressure:	35	psi

Most distant hose from the inlet of the submain (or regulated manifold):

101	Downstream end of "uphill" side pressure:	7	psi
102	Middle of "uphill" side' pressure:	9	psi
103	Hose inlet pressure:	9.5	psi
104	Middle of "downhill" side pressure:	16	psi
105	Downstream end of "downhill" side pressure:	21	psi

Pressure **loss** across hose entrance screens at heads of hoses:

106	Hose 1:	0	psi
107	Hose 2:	0.5	psi
108	Hose 3:	0	psi
109	Hose 4:	0	psi
110	Hose 5:	0	psi

EMITTER FLOW MEASUREMENTS

*All volume measurements are in **MILLILITERS**.*

111 Number of emitters that supply water to each plant: 1

For all emitter types, flows must be measured at 3 locations (A-C) throughout the field.

Location A - The middle of a hose (midway between the inlet and the downstream end) that is a "clean" area of the field. Typically this is hydraulically close to the pump. Flow measurements must be taken at 16 emitters, all at the same pressure.

Location B - The middle of a hose (midway between the inlet and the downstream end) that is near the middle of the field. Flow measurements must be taken at 16 emitters, all at the same pressure.

Location C - The tail end of a hose that is at the tail end of the field. Flow measurements must be taken at 28 emitters, all at the same pressure.

Location A

There are differences in how many tests of emitter flows are to be measured in Location A. Answer the following questions to determine which tests to perform at Location A.

You must answer ONE of the following questions with a "YES".
There can only be one "YES" answer.

112 Question #1: Do you know that the discharge exponent of the emitters is about 0.5 (non-pressure compensating microsprayers, non-pressure compensating microsprinklers, clean tortuous path emitters, and most tapes)? — No

Since you answered 'no' to Question #1, please go on to the next question.

113 Question #2: Is the emitter non-pressure compensating, and the discharge exponent is not known to equal 0.5 ? — No

Since you answered 'no' to Question #2, please go on to the next question.

114 Question #3: Does the emitter or microsprayer or microsprinkler have a pressure compensating (PC) feature? — Yes

Since you answered 'yes' to Question #3, for Location A do Tests 1-5

YOU MAY CONTINUE

Location A: The middle of a hose (between the inlet and the downstream end) that is a "clean" area of the field.

All 16 emitters must have the same pressure

Select a hose with a relatively high pressure, or adjust the pressure so that it is relatively high.

Location A, Test 1:

Test 1 is required for all emitter types.

115	Collection time:	5	minutes
116	Hose pressure at emitters:	32	psi
		Collected volume:	
117	#1	163	mL
118	#2	150	mL
119	#3	175	mL
120	#4	175	mL
121	#5	182	mL
122	#6	174	mL
123	#7	177	mL
124	#8	160	mL
125	#9	165	mL
126	#10	161	mL
127	#11	136	mL
128	#12	170	mL
129	#13	175	mL
130	#14	178	mL
131	#15	156	mL
132	#16	141	mL

Location A, Test 2:

*Test 2 is required for all emitter types, **except** those for which you know the exponent = 0.5.*
Use the same 16 emitters as Test 1. Lower the pressure to about the lowest measured in the field.

133	Collection time:	5	minutes
134	Hose pressure at emitters:	26	psi
135	Volume of water accumulated from all the emitters:	2310	mL
136	Number of emitters:	14	

Location A, Test 3:

PC emitters only. Low intermediate pressure. Same emitters as Test 1.

137	Collection time:	5	minutes
138	Hose pressure at emitters:	19	psi
139	Volume of water accumulated from all the emitters:	2355	mL
140	Number of emitters:	14	

Location A, Test 4:

PC emitters only. Intermediate pressure. Same emitters as Test 1.

141	Collection time:	2	minutes
142	Hose pressure at emitters:	11	psi
143	Volume of water accumulated from all the emitters:	1017	mL
144	Number of emitters:	14	

Location A, Test 5

PC emitters only. High Intermediate pressure. Same emitters as Test 1.

145	Collection time:	5	minutes
146	Hose pressure at emitters:	6	psi
147	Volume of water accumulated from all the emitters:	2425	mL
148	Number of emitters:	14	

Location B: The middle of an "average hose" in the field.

Required for all emitter types. All 16 emitters must be at the same pressure.

149	Collection time:	5	minutes
150	Hose pressure at emitters:	8	psi
		Collected volume:	
151	#1	185	mL
152	#2	177	mL
153	#3	177	mL
154	#4	177	mL
155	#5	185	mL
156	#6	170	mL
157	#7	187	mL
158	#8	175	mL
159	#9	165	mL
160	#10	170	mL
161	#11	168	mL
162	#12	175	mL

163	#13	170	mL
164	#14	220	mL
165	#15	210	mL
166	#16	158	mL
	Average emitter flow rate:	2.2	lph

Location C: At the downstream end of a hose at the most downstream end of the system.

Required for all emitter types. All 28 emitters must be at the same pressure.

167	Collection time:	5	minutes
168	Hose pressure at emitters:	28	psi
		Collected volume:	
169	#1	250	mL
170	#2	185	mL
171	#3	200	mL
172	#4	205	mL
173	#5	150	mL
174	#6	265	mL
175	#7	165	mL
176	#8	205	mL
177	#9	205	mL
178	#10	190	mL
179	#11	155	mL
180	#12	185	mL
181	#13	195	mL
182	#14	185	mL
183	#15	215	mL
184	#16	195	mL
185	#17	170	mL
186	#18	210	mL
187	#19	195	mL
188	#20	160	mL
189	#21	470	mL
190	#22	80	mL
191	#23	180	mL
192	#24	195	mL
193	#25	195	mL
194	#26	270	mL
195	#27	55	mL
196	#28	185	mL

EMITTER SPACING

*If there is only one spacing, only fill out the data for "**AREA NUMBER 1**". If there are two or three spacings, fill out the additional AREAS.*

Note that differing plant spacings, emitter spacings, emitter flow rates, irrigation duration or frequency, plant ages, plant types, canopy cover, or ET rates in different blocks within a field qualify as multiple spacings.

AREA NUMBER: 1

197	Area with this combination:	6	acres
198	Area per plant (row spacing x plant spacing):	40	ft^2
199	Number of emitters per plant (emitter/plant ratio):	1	
	The computed flow rate per emitter was found to be:	2.2	lph
200	Do you want to over-ride the computed flow per emitter?	No	
	If you answered "Yes" above, answer the following 2 questions.		
201	Over-ride flow rate (gph, lph, or mL/min):		
202	Units of over-ride flow rate:	Please Select From List	
203	Wetted soil area per emitter:	1	ft^2
204	100% Root zone available water holding capacity:	4.5	inches
205	Set duration during peak ET:	6	hours
206	Irrigation frequency at peak ET:	7	days
207	Crop ET during peak ET period:	0.09	inches/day

AREA NUMBER: 2

208	Area with this combination:		acres
209	Area per plant (row spacing x plant spacing):		ft^2
210	Number of emitters per plant (emitter/plant ratio):		
	The computed flow rate per emitter was found to be:	2.2	lph
211	Do you want to over-ride the computed flow per emitter?	No	
	If you answered "Yes" above, answer the following 2 questions.		
212	Over-ride flow rate (gph, lph, or mL/min):		
213	Units of over-ride flow rate:	Please Select From List	
214	Wetted soil area per emitter:		ft^2
215	100% Root zone available water holding capacity:		inches
216	Set duration during peak ET:		hours
217	Irrigation frequency at peak ET:		days
218	Crop ET during peak ET period:		inches/day

AREA NUMBER: 3

219	Area with this combination:		acres
220	Area per plant (row spacing x plant spacing):		ft^2
221	Number of emitters per plant (emitter/plant ratio):		
	The computed flow rate per emitter was found to be:	2.2	lph
222	Do you want to over-ride the computed flow per emitter?	Please Select From List	
	If you answered "Yes" above, answer the following 2 questions.		
223	Over-ride flow rate (gph, lph, or mL/min):		
224	Units of over-ride flow rate:	Please Select From List	
225	Wetted soil area per emitter :		ft^2
226	100% Root zone available water holding capacity:		inches
227	Set duration during peak ET:		hours
228	Irrigation frequency at peak ET:		days
229	Crop ET during peak ET period:		inches/day

CONTAMINANTS AND PLUGGING/LEAKS

230	Flushing time to get clear water from the end of the lowest, most distant hose:	7	seconds
	Rate the amount of material caught in the nylon sock when flushing the hoses:		
231	Sand:	Slight	
232	Clay:	None	
233	Bacteria/algae:	Slight	
	Rate the following causes of emitter plugging: *For this question, remove five emitters with apparent low flows. Take them apart to inspect for the cause of plugging.*		
234	Sand:	None	
235	Precipitate (bubbles with acid drop):	None	
236	Bacteria:	Slight	
237	Clay/silt:	Slight	
238	Insects:	None	
239	Plastic parts:	Slight	
240	Rate the visible signs of abnormal emitter flow due to cracked hoses, barb leaks, etc.:	Medium	

UNEQUAL DRAINAGE

241	Time some emitters run after most emitters stop:	15	minutes
242	Percentage of emitters that do this:	10	%

FIELD IDENTIFICATION

1	Farm Name:	Trestle Vineyard
2	Field Identification:	Block 4
3	Field Location:	Cal Poly
4	Contact Name:	Craig MacMillan
5	Address Line 1:	1 Grand Avenue
6	Address Line 2:	San Luis Obispo, CA
7	Phone:	805-756-7071

JOB IDENTIFICATION

8	Evaluator:	Linda B. and 438 Class
9	Date:	1/29/2014

SYSTEM DESCRIPTION

10	Age of system:	12	years
11	Is there a water penetration problem?	Yes	
12	Is there undulating (rolling; up-and-down) topography?	Yes	
13	Percentage of applied water that runs off the field:	0	%
14	Number of models/emitter designs used in the system:	1	
15	Type of water source:	Surface	

EMITTER INFORMATION

16	Manufacturer:	Netafim
17	Model:	Woodpecker
18	Nominal flow/emitter (gph or lph):	2
19	Units of nominal flow rate:	lph
20	Emitter path type:	Pressure compensating

FILTRATION

21	Automatic flush on the primary filter?	No
	Type of filter (select all that apply):	
22	Tubular screen?	Yes
23	Overflow screen?	No
24	Media filter?	Yes
25	Sand (centrifugal) separator?	No
26	Disc filter?	No
27	"Vacuum cleaned" tubular screen?	No

CHEMICAL INJECTION SYSTEM

28	Location of fertilizer injector with respect to filter:	Upstream
29	Location of pesticide injector with respect to filter:	Downstream
30	Location of acid injector with respect to filter:	Downstream
31	Location of gypsum injector with respect to filter:	No gypsum injection system
	If no chlorine or polymer injection, select "Never".	
32	Frequency of chlorine or polymer injection:	Annually
	If no acid injection, select "Never".	
33	Frequency of acid injection:	Monthly

If no injection system, skip the next question.

34	Do any of the injection systems use a throttling valve on the mainline to create a pressure differential?	No	
35	Frequency of hose/tape flushing:	Annually	

PUMP STATION MEASUREMENTS

36	Pump discharge pressure:	71	psi
37	Pressure downstream of filters and control valves:	58	psi
	Optional Pressure Values:		
38	Total filter loss:	13	psi
39	Total pump control valve loss:	3	psi
40	Loss from throttled manual valves:	0	psi

VALVING

41	Number of automatic pressure control valves near the filter and pump (0 for none):	1	
42	Is there a partially closed (i.e., "throttled") manual valve near the pump discharge to reduce pressure?	No	
43	Does the head of each manifold have an automatic pressure regulator?	Yes	
44	Does the head of each hose have an automatic pressure regulator?	No	
45	Is there a flow meter?	Yes	

FIELD PRESSURE MEASUREMENTS

Note: Water must be flowing through the hoses when the measurements are made.

Location **#1**: Submain or regulated manifold closest to the pump.

Closest hose to the inlet of the submain (or regulated manifold):

46	Downstream end of "uphill" side pressure:		psi
47	Middle of "uphill" side pressure:		psi
48	Hose inlet pressure:	35	psi
49	Middle of "downhill" side pressure:	42	psi
50	Downstream end of "downhill" side pressure:	52	psi

Most distant hose from the inlet of the submain (or regulated manifold):

51	Downstream end of "uphill" side pressure:		psi
52	Middle of "uphill" side' pressure:		psi
53	Hose inlet pressure:	42	psi
54	Middle of "downhill" side pressure:	47	psi
55	Downstream end of "downhill" side pressure:	52	psi

Location **#2**: Submain or regulated manifold most distant from the pump (or where the pressure is lowest).

Closest hose to the inlet of the submain (or regulated manifold):

56	Downstream end of "uphill" side pressure:	10	psi
57	Middle of "uphill" side pressure:	12	psi
58	Hose inlet pressure:	14	psi
59	Middle of "downhill" side pressure:	20	psi
60	Downstream end of "downhill" side pressure:	25	psi

Most distant hose from the inlet of the submain (or regulated manifold):

61	Downstream end of "uphill" side pressure:	10	psi
62	Middle of "uphill" side' pressure:	14	psi
63	Hose inlet pressure:	17.5	psi
64	Middle of "downhill" side pressure:	22	psi
65	Downstream end of "downhill" side pressure:	28	psi

Location **#3**: Submain or regulated manifold at an intermediate distance from the pump.

Closest hose to the inlet of the submain (or regulated manifold):

66	Downstream end of "uphill" side pressure:	9	psi
67	Middle of "uphill" side pressure:	11	psi
68	Hose inlet pressure:	14	psi
69	Middle of "downhill" side pressure:	19	psi
70	Downstream end of "downhill" side pressure:	22	psi

Most distant hose from the inlet of the submain (or regulated manifold):

71	Downstream end of "uphill" side pressure:	9.5	psi
72	Middle of "uphill" side' pressure:	12	psi
73	Hose inlet pressure:	14	psi
74	Middle of "downhill" side pressure:	20	psi
75	Downstream end of "downhill" side pressure:	25	psi

Location **#4**: Intermediate submain or regulated manifold close to the pump.

Closest hose to the inlet of the submain (or regulated manifold):

76	Downstream end of "uphill" side pressure:		psi
77	Middle of "uphill" side pressure:		psi
78	Hose inlet pressure:	47	psi
79	Middle of "downhill" side pressure:	49	psi
80	Downstream end of "downhill" side pressure:	50	psi

Most distant hose from the inlet of the submain (or regulated manifold):

81	Downstream end of "uphill" side pressure:		psi
82	Middle of "uphill" side' pressure:		psi
83	Hose inlet pressure:		psi
84	Middle of "downhill" side pressure:		psi
85	Downstream end of "downhill" side pressure:		psi

Location **#5**: Intermediate submain or regulated manifold distant from the pump.

Closest hose to the inlet of the submain (or regulated manifold):

86	Downstream end of "uphill" side pressure:		psi
87	Middle of "uphill" side pressure:		psi
88	Hose inlet pressure:	20	psi
89	Middle of "downhill" side pressure:	34	psi
90	Downstream end of "downhill" side pressure:	40	psi

Most distant hose from the inlet of the submain (or regulated manifold):

91	Downstream end of "uphill" side pressure:	21	psi
92	Middle of "uphill" side' pressure:	25	psi
93	Hose inlet pressure:	27	psi
94	Middle of "downhill" side pressure:	30	psi
95	Downstream end of "downhill" side pressure:	37.5	psi

Location **#6**: Intermediate submain or regulated manifold.

Closest hose to the inlet of the submain (or regulated manifold):

96	Downstream end of "uphill" side pressure:		psi
97	Middle of "uphill" side pressure:		psi
98	Hose inlet pressure:	46	psi
99	Middle of "downhill" side pressure:	47	psi
100	Downstream end of "downhill" side pressure:	51	psi

Most distant hose from the inlet of the submain (or regulated manifold):

101	Downstream end of "uphill" side pressure:	38	psi
102	Middle of "uphill" side' pressure:	34	psi
103	Hose inlet pressure:	28.5	psi
104	Middle of "downhill" side pressure:	28	psi
105	Downstream end of "downhill" side pressure:	26.5	psi

Pressure **loss** across hose entrance screens at heads of hoses:

106	Hose 1:	0	psi
107	Hose 2:	0	psi
108	Hose 3:	0	psi
109	Hose 4:	0	psi
110	Hose 5:	0	psi

EMITTER FLOW MEASUREMENTS

All volume measurements are in MILLILITERS.

111 Number of emitters that supply water to each plant: 1

For all emitter types, flows must be measured at 3 locations (A-C) throughout the field.

Location A - The middle of a hose (midway between the inlet and the downstream end) that is a "clean" area of the field. Typically this is hydraulically close to the pump. Flow measurements must be taken at 16 emitters, all at the same pressure.

Location B - The middle of a hose (midway between the inlet and the downstream end) that is near the middle of the field. Flow measurements must be taken at 16 emitters, all at the same pressure.

Location C - The tail end of a hose that is at the tail end of the field. Flow measurements must be taken at 28 emitters, all at the same pressure.

Location A

There are differences in how many tests of emitter flows are to be measured in Location A. Answer the following questions to determine which tests to perform at Location A.

**You must answer ONE of the following questions with a "YES".
There can only be one "YES" answer.**

112 **Question #1**: Do you know that the discharge exponent of the emitters is about 0.5 (non-pressure compensating microsprayers, non-pressure compensating microsprinklers, clean tortuous path emitters, and most tapes)? — No

Since you answered 'no' to Question #1, please go on to the next question.

113 **Question #2**: Is the emitter non-pressure compensating, and the discharge exponent is not known to equal 0.5 ? — No

Since you answered 'no' to Question #2, please go on to the next question.

114 **Question #3**: Does the emitter or microsprayer or microsprinkler have a pressure compensating (PC) feature? — Yes

Since you answered 'yes' to Question #3, for Location A do Tests 1-5

YOU MAY CONTINUE

Location A: The middle of a hose (between the inlet and the downstream end) that is a "clean" area of the field.

All 16 emitters must have the same pressure

Select a hose with a relatively high pressure, or adjust the pressure so that it is relatively high.

Location A, Test 1:

Test 1 is required for all emitter types.

115	Collection time:	5	minutes
116	Hose pressure at emitters:	47.5	psi
		Collected volume:	
117	#1	214	mL
118	#2	215	mL
119	#3	207	mL
120	#4	215	mL
121	#5	212	mL
122	#6	222	mL
123	#7	246	mL
124	#8	205	mL
125	#9	209	mL
126	#10	200	mL
127	#11	209	mL
128	#12	160	mL
129	#13	220	mL
130	#14	211	mL
131	#15	226	mL
132	#16	215	mL

Location A, Test 2:

*Test 2 is required for all emitter types, **except** those for which you know the exponent = 0.5.*
Use the same 16 emitters as Test 1. Lower the pressure to about the lowest measured in the field.

133	Collection time:	5	minutes
134	Hose pressure at emitters:	26	psi
135	Volume of water accumulated from all the emitters:	2310	mL
136	Number of emitters:	14	

Location A, Test 3:

PC emitters only. Low intermediate pressure. Same emitters as Test 1.

137	Collection time:	5	minutes
138	Hose pressure at emitters:	19	psi
139	Volume of water accumulated from all the emitters:	2355	mL
140	Number of emitters:	14	

Location A, Test 4:

PC emitters only. Intermediate pressure. Same emitters as Test 1.

141	Collection time:	2	minutes
142	Hose pressure at emitters:	11	psi
143	Volume of water accumulated from all the emitters:	1017	mL
144	Number of emitters:	14	

Location A, Test 5

PC emitters only. High Intermediate pressure. Same emitters as Test 1.

145	Collection time:	5	minutes
146	Hose pressure at emitters:	6	psi
147	Volume of water accumulated from all the emitters:	2425	mL
148	Number of emitters:	14	

Location B: The middle of an "average hose" in the field.

Required for all emitter types. All 16 emitters must be at the same pressure.

149	Collection time:	5	minutes
150	Hose pressure at emitters:	31	psi
		Collected volume:	
151	#1	216	mL
152	#2	208	mL
153	#3	228	mL
154	#4	204	mL
155	#5	204	mL
156	#6	202	mL
157	#7	204	mL
158	#8	182	mL
159	#9	195	mL
160	#10	200	mL
161	#11	185	mL
162	#12	185	mL

163	#13	195	mL
164	#14	250	mL
165	#15	200	mL
166	#16	270	mL
	Average emitter flow rate:	2.5	lph

<u>Location C</u>: At the downstream end of a hose at the most downstream end of the system.

Required for all emitter types. All 28 emitters must be at the same pressure.

167	Collection time:	5	minutes
168	Hose pressure at emitters:	17	psi
		Collected volume:	
169	#1	177	mL
170	#2	205	mL
171	#3	175	mL
172	#4	190	mL
173	#5	380	mL
174	#6	290	mL
175	#7	375	mL
176	#8	196	mL
177	#9	216	mL
178	#10	124	mL
179	#11	190	mL
180	#12	272	mL
181	#13	356	mL
182	#14	192	mL
183	#15	188	mL
184	#16	160	mL
185	#17	170	mL
186	#18	174	mL
187	#19	182	mL
188	#20	172	mL
189	#21	172	mL
190	#22	190	mL
191	#23	190	mL
192	#24	195	mL
193	#25	195	mL
194	#26	191	mL
195	#27	189	mL
196	#28	163	mL

EMITTER SPACING

*If there is only one spacing, only fill out the data for "**AREA NUMBER 1**". If there are two or three spacings, fill out the additional AREAS.*

Note that differing plant spacings, emitter spacings, emitter flow rates, irrigation duration or frequency, plant ages, plant types, canopy cover, or ET rates in different blocks within a field qualify as multiple spacings.

AREA NUMBER: 1

197	Area with this combination:	5.6	acres
198	Area per plant (row spacing x plant spacing):	40	ft^2
199	Number of emitters per plant (emitter/plant ratio):	1	
	The computed flow rate per emitter was found to be:	2.5	lph
200	Do you want to over-ride the computed flow per emitter?	No	
	If you answered "Yes" above, answer the following 2 questions.		
201	Over-ride flow rate (gph, lph, or mL/min):		
202	Units of over-ride flow rate:	Please Select From List	
203	Wetted soil area per emitter:	1	ft^2
204	100% Root zone available water holding capacity:	4.5	inches
205	Set duration during peak ET:	6	hours
206	Irrigation frequency at peak ET:	7	days
207	Crop ET during peak ET period:	0.09	inches/day

AREA NUMBER: 2

208	Area with this combination:		acres
209	Area per plant (row spacing x plant spacing):		ft^2
210	Number of emitters per plant (emitter/plant ratio):		
	The computed flow rate per emitter was found to be:	2.5	lph
211	Do you want to over-ride the computed flow per emitter?	Please Select From List	
	If you answered "Yes" above, answer the following 2 questions.		
212	Over-ride flow rate (gph, lph, or mL/min):		
213	Units of over-ride flow rate:	Please Select From List	
214	Wetted soil area per emitter:		ft^2
215	100% Root zone available water holding capacity:		inches
216	Set duration during peak ET:		hours
217	Irrigation frequency at peak ET:		days
218	Crop ET during peak ET period:		inches/day

AREA NUMBER: 3

219	Area with this combination:		acres
220	Area per plant (row spacing x plant spacing):		ft^2
221	Number of emitters per plant (emitter/plant ratio):		
	The computed flow rate per emitter was found to be:	2.5	lph
222	Do you want to over-ride the computed flow per emitter?	Please Select From List	
	If you answered "Yes" above, answer the following 2 questions.		
223	Over-ride flow rate (gph, lph, or mL/min):		
224	Units of over-ride flow rate:	Please Select From List	
225	Wetted soil area per emitter :		ft^2
226	100% Root zone available water holding capacity:		inches
227	Set duration during peak ET:		hours
228	Irrigation frequency at peak ET:		days
229	Crop ET during peak ET period:		inches/day

CONTAMINANTS AND PLUGGING/LEAKS

230	Flushing time to get clear water from the end of the lowest, most distant hose:	20	seconds
	Rate the amount of material caught in the nylon sock when flushing the hoses:		
231	Sand:	None	
232	Clay:	None	
233	Bacteria/algae:	Slight	
	Rate the following causes of emitter plugging: *For this question, remove five emitters with apparent low flows. Take them apart to inspect for the cause of plugging.*		
234	Sand:	None	
235	Precipitate (bubbles with acid drop):	None	
236	Bacteria:	None	
237	Clay/silt:	None	
238	Insects:	None	
239	Plastic parts:	Slight	
240	Rate the visible signs of abnormal emitter flow due to cracked hoses, barb leaks, etc.:	Medium	

UNEQUAL DRAINAGE

241	Time some emitters run after most emitters stop:	15	minutes
242	Percentage of emitters that do this:	15	%

APPENDIX D

NRCS SOILS REPORT

USDA United States Department of Agriculture

NRCS Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for San Luis Obispo County, California, Coastal Part

Trestle Vineyard

December 16, 2013

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://soils.usda.gov/sqi/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (http://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://soils.usda.gov/contact/state_offices/).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Soil Data Mart Web site or the NRCS Web Soil Survey. The Soil Data Mart is the data storage site for the official soil survey information.

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Contents

How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Soil Map


120° 41' 9" W
120° 40' 55" W
35° 19' 12" N
35° 18' 56" N
710390
710450
710510
710570
710630
710690
3911000
3910940
3910880
3910820
3910760
3910700
3910640
3910580
3910520
Map Scale: 1:2,360 if printed on A portrait (8.5" x 11") sheet.
N
0 30 60 120 180 Meters
0 100 200 400 600 Feet
Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 10N WGS84

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: San Luis Obispo County, California, Coastal Part
Survey Area Data: Version 4, Jan 2, 2008

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: May 8, 2010—May 21, 2010

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

San Luis Obispo County, California, Coastal Part (CA664)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
160	Los Osos loam, 15 to 30 percent slopes	14.3	100.0%
Totals for Area of Interest		**14.3**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

APPENDIX E

PUMP CALCULATIONS

Drip Irrigation GPM

Cal Poly Vineyard Pumping Station

	Block 1	Block 2	Block 3	Block 4	Block 5	PO* - Block 6	
Varietal	Tempranillo	Syrah	Chardonnay	Pinot Noir	Pinot Noir	TBD	
Acreage	0.83	2.75	2.76	4.75	1.47	1.64	
GPH/Emitter	0.5284	0.5284	0.5284	0.5284	0.5284	0.5284	
No. of Emitters/Vine	1	1	1	1	1	1	
GPH/Vine	0.5284	0.5284	0.5284	0.5284	0.5284	0.5284	
No. of Vines	905	2991	3005	5801	1596	7937	Total emitters
No. of Emitters	905	2991	3005	5801	1596	7937	22235
Total Block GPH	478.2	1580.4	1587.8	3065.3	843.3	4193.9	
Total Block GPM	8.0	26.3	26.5	51.1	14.1	69.9	
*PO = proposed object				TOTAL GPM	125.9	195.8	

ET peak month (published) =	2.66 in/month	hrs/week =	27
	0.621 in/week		
	0.683 + 10% for drip		
Gross =	0.853	GPM/emitter =	0.009 GPM
Area =	14.2 acres		0.540 GPH
	618552 ft^2		
GPM =	200 GPM		
DU =	0.8		

Sprinkler GPM

Cal Poly Vineyard Pumping Station

	Block 1	Block 2	Block 3	Block 4 South	Block 4	Block 5	PO* - Block 6
Varietal	Tempranillo	Syrah	Chardonnay	Pinot Noir	Pinot Noir	Pinot Noir	TBD
Acreage	0.83	1.4	2.76	2.24	2.25	1.47	1.64
GPM/Sprinkler	0.8500	0.85	0.85	0.85	0.85	0.85	0.85
No. of Sprinklers/Acre	23	23	23	23	23	23	23
No. of Sprinklers	19.09	32.2	63.48	51.52	51.75	33.81	37.72
Total Block GPM	16.2	27.4	54.0	43.8	44.0	28.7	32.1

*PO = proposed object

Total GPM needed	246.1
Total existing blocks	214.1

Critical Path Calculations

Vineyard Pump Selection (Drip only)

Assumptions:

All blocks are on
The future NE block is planted at 3'x3' spacing but with a separate main tied in at the filter station

Procedure:

Assume the critical path as shown in the map to the right

Blk3

13 GPM total drip

13 GPM / 17 rows = **0.76 GPM per row**

D/S pt	Pt (psi)	GPM out	Seg. GPM	Seg.Length	ID	Hf	ΔElev (ft)	ΔElev (psi)	ΔP (ft)	ΔP (psi)	Cummulative ΔP (psi)	
Iose Inlet Pressure	50											
Hose Riser Losses										0.5	0.5	
1	50.5	0.77	0.76	8	1.25	0.00	-1.76	-0.8	-1.8	-0.8	-1.5	
2	49.0	0.76	1.52	8	1.25	0.01	-1.76	-0.8	-1.8	-0.8	-1.5	
3	47.5	0.76	2.28	8	1.25	0.01	-1.76	-0.8	-1.7	-0.8	-1.5	
4	45.9	0.76	3.04	8	1.25	0.02	-1.76	-0.8	-1.7	-0.8	-1.5	
5	44.4	0.76	3.8	8	1.25	0.03	-1.76	-0.8	-1.7	-0.7	-1.5	
6	42.9	0.76	4.56	8	1.25	0.05	-1.76	-0.8	-1.7	-0.7	-1.5	
7	41.4	0.76	5.32	8	1.25	0.06	-1.76	-0.8	-1.7	-0.7	-1.5	
8	39.9	0.76	6.08	8	1.25	0.08	-1.76	-0.8	-1.7	-0.7	-1.5	
9	38.4	0.76	6.84	8	1.25	0.10	-1.76	-0.8	-1.7	-0.7	-1.5	
10	36.9	0.76	7.6	8	1.25	0.12	-1.76	-0.8	-1.6	-0.7	-1.5	Blk 3
11	35.5	0.76	8.36	8	1.25	0.14	-1.76	-0.8	-1.6	-0.7	-1.5	
12	34.0	0.76	9.12	8	1.25	0.17	-1.76	-0.8	-1.6	-0.7	-1.5	
13	32.6	0.76	9.88	8	1.25	0.19	-1.76	-0.8	-1.6	-0.7	-1.4	
14	31.1	0.76	10.64	8	1.25	0.22	-1.76	-0.8	-1.5	-0.7	-1.4	
15	29.7	0.76	11.4	8	1.25	0.25	-1.76	-0.8	-1.5	-0.7	-1.4	
16	28.3	0.76	12.16	8	1.25	0.28	-1.76	-0.8	-1.5	-0.6	-1.4	
17	26.9	0.76	12.92	8	1.25	0.32	-1.76	-0.8	-1.4	-0.6	-1.4	
Control Valve/Pressure Reg. Losses										2.0	28.9	
Riser Losses										1.5	30.4	
18	30.4	0	12.92	427	3	0.24	4	1.7	4.2	1.8	3.6	Submain to main
19	33.9	67	79.92	290	4	1.17	28	12.1	29.2	12.6	24.7	To Middle of Field
20	58.7	22	101.92	320	4	2.02	28	12.1	30.0	13.0	25.1	Middle of Field to Filters
21	**83.8**											Filter Station Discharge

	Pipeline Pressure (psi)	
Pressure Regulator Losses	6	psi
Magmeter losses	6	psi
Dirty Sand Media Tank Losses Dirty Screen filter losses	13	psi
Chemigation Check Valve	2	psi
Open BFV Losses	2	psi
Fertigation Injection Venturi	2	psi
Pressure at Filter Station Inlet	115	psi
	80	Water hammer presssure surge pressure- MUST BE LESS THAN 125 psi
	195	Total possible line pressure

NOTES. Max Filter pressure is 125 psi The filter station will REQUIRE a fast-acting pressure relief valve

D/S pt	Pt (psi)	GPM out	Seg. GPM	Seg Length	ID	Hf	ΔElev (ft)	ΔElev (psi)	ΔP (ft)	ΔP (psi)	Cummulative ΔP (psi)
Filter Station Inlet	115		271	700	10	0 31	9	3 9	9 3	4.0	7 9

Pump Pad	122.7	psi
Minor Losses	5	psi
Pump Discharge	127.7	psi
Pump Discharge	295.1	ft

The VFD will be set to provide a pressure lower than the anticipated potential water hammer pressure at the filters

Hf (AB) = 12.88786

P filter = 338 ft
146 psi

Total Dynamic Head (TDH) Required of the Pump

Pressure downstream of filter station	=	146.36	psi
+ media filter and screen filter loss	=	13.0	psi
+ Emergency screen loss (none exist)	=	0	psi
+ Minor losses	=	11.7	psi
- Pump inlet pressure	=	0.00	psi
TDH	=	171	psi

		K	Minor Loss (psi)
flow meter		0.8	0.310559
valves -	2	6.5	5.046584
General Losses usually accounted for in designs			6
			0
			0
riser		1	0.388199
			0
			0
		TOTAL	11.74534

Vineyard Pump Selection (Drip only)

Assumptions:

All blocks are on
The future NE block is planted at 3'x3' spacing but with a separate main tied in at the filter station

Procedure:

Assume the critical path as shown in the map to the right

Blk3

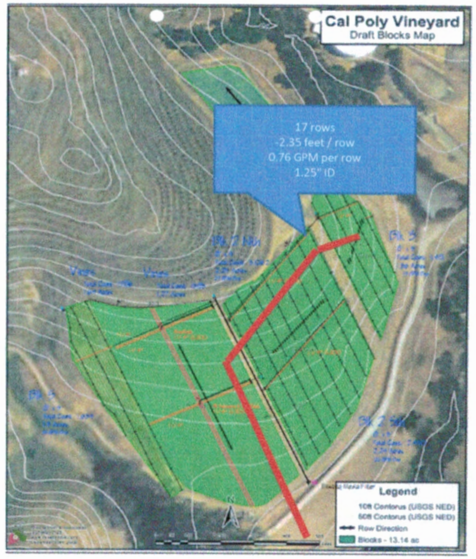
13 GPM total drip

13 GPM / 17 rows = **0.76 GPM per row**

Step 5) Manifold Design

D/S pt	Pt (psi)	GPM out	Seg. GPM	Seg.Length	ID	Hf	ΔElev (ft)	ΔElev (psi)	ΔP (ft)	ΔP (psi)	Cummulative ΔP (psi)
1	16.0	0.008	0.008	5	0.75	0.0000	0.55	0.238095238	0.6	0.238096422	0.5
2	16.5	0.008	0.016	5	0.75	0.0000	0.55	0.238095238	0.6	0.23809951	0.5
3	17.0	0.008	0.024	5	0.75	0.0000	0.55	0.238095238	0.6	0.238104291	0.5
4	17.4	0.008	0.032	5	0.75	0.0000	0.55	0.238095238	0.6	0.238110661	0.5
5	17.9	0.008	0.04	5	0.75	0.0001	0.55	0.238095238	0.6	0.238118553	0.5
6	18.4	0.008	0.048	5	0.75	0.0001	0.55	0.238095238	0.6	0.238127918	0.5
7	18.9	0.008	0.056	5	0.75	0.0001	0.55	0.238095238	0.6	0.238138715	0.5
8	19.3	0.008	0.064	5	0.75	0.0001	0.55	0.238095238	0.6	0.238150913	0.5
9	19.8	0.008	0.072	5	0.75	0.0002	0.55	0.238095238	0.6	0.238164485	0.5
10	20.3	0.008	0.08	5	0.75	0.0002	0.55	0.238095238	0.6	0.238179405	0.5
11	20.8	0.008	0.088	5	0.75	0.0002	0.55	0.238095238	0.6	0.238195653	0.5
12	21.2	0.008	0.096	5	0.75	0.0003	0.55	0.238095238	0.6	0.238213211	0.5
13	21.7	0.008	0.104	5	0.75	0.0003	0.55	0.238095238	0.6	0.238232062	0.5
14	22.2	0.008	0.112	5	0.75	0.0004	0.55	0.238095238	0.6	0.238252191	0.5
15	22.7	0.008	0.12	5	0.75	0.0004	0.55	0.238095238	0.6	0.238273583	0.5
16	23.1	0.008	0.128	5	0.75	0.0005	0.55	0.238095238	0.6	0.238296226	0.5
17	23.6	0.008	0.136	5	0.75	0.0005	0.55	0.238095238	0.6	0.238320108	0.5
18	24.1	0.008	0.144	5	0.75	0.0006	0.55	0.238095238	0.6	0.238345218	0.5
19	24.6	0.008	0.152	5	0.75	0.0006	0.55	0.238095238	0.6	0.238371545	0.5
20	25.0	0.008	0.16	5	0.75	0.0007	0.55	0.238095238	0.6	0.23839908	0.5
21	25.5	0.008	0.168	5	0.75	0.0008	0.55	0.238095238	0.6	0.238427814	0.5
22	26.0	0.008	0.176	5	0.75	0.0008	0.55	0.238095238	0.6	0.238457737	0.5
23	26.5	0.008	0.184	5	0.75	0.0009	0.55	0.238095238	0.6	0.238488843	0.5
24	27.0	0.008	0.192	5	0.75	0.0010	0.55	0.238095238	0.6	0.238521122	0.5
25	27.4	0.008	0.2	5	0.75	0.0011	0.55	0.238095238	0.6	0.238554568	0.5
26	27.9	0.008	0.208	5	0.75	0.0011	0.55	0.238095238	0.6	0.238589174	0.5
27	28.4	0.008	0.216	5	0.75	0.0012	0.55	0.238095238	0.6	0.238624933	0.5
28	28.9	0.008	0.224	5	0.75	0.0013	0.55	0.238095238	0.6	0.238661838	0.5
29	29.3	0.008	0.232	5	0.75	0.0014	0.55	0.238095238	0.6	0.238699884	0.5
30	29.8	0.008	0.24	5	0.75	0.0015	0.55	0.238095238	0.6	0.238739064	0.5
31	30.3	0.008	0.248	5	0.75	0.0016	0.55	0.238095238	0.6	0.238779373	0.5
32	30.8	0.008	0.256	5	0.75	0.0017	0.55	0.238095238	0.6	0.238820806	0.5
33	31.2	0.008	0.264	5	0.75	0.0018	0.55	0.238095238	0.6	0.238863356	0.5
34	31.7	0.008	0.272	5	0.75	0.0019	0.55	0.238095238	0.6	0.238907019	0.5
35	32.2	0.008	0.28	5	0.75	0.0020	0.55	0.238095238	0.6	0.238951791	0.5
36	32.7	0.008	0.288	5	0.75	0.0021	0.55	0.238095238	0.6	0.238997666	0.5
37	33.2	0.008	0.296	5	0.75	0.0022	0.55	0.238095238	0.6	0.239044639	0.5
38	33.6	0.008	0.304	5	0.75	0.0023	0.55	0.238095238	0.6	0.239092707	0.5
39	34.1	0.008	0.312	5	0.75	0.0024	0.55	0.238095238	0.6	0.239141865	0.5
40	34.6	0.008	0.32	5	0.75	0.0025	0.55	0.238095238	0.6	0.239192108	0.5
41	35.1	0.008	0.328	5	0.75	0.0027	0.55	0.238095238	0.6	0.239243434	0.5
42	35.5	0.008	0.336	5	0.75	0.0028	0.55	0.238095238	0.6	0.239295837	0.5
43	36.0	0.008	0.344	5	0.75	0.0029	0.55	0.238095238	0.6	0.239349314	0.5
44	36.5	0.008	0.352	5	0.75	0.0030	0.55	0.238095238	0.6	0.239403861	0.5
45	37.0	0.008	0.36	5	0.75	0.0032	0.55	0.238095238	0.6	0.239459475	0.5
46	37.5	0.008	0.368	5	0.75	0.0033	0.55	0.238095238	0.6	0.239516152	0.5
47	37.9	0.008	0.376	5	0.75	0.0034	0.55	0.238095238	0.6	0.239573888	0.5
48	38.4	0.008	0.384	5	0.75	0.0036	0.55	0.238095238	0.6	0.239632681	0.5
49	38.9	0.008	0.392	5	0.75	0.0037	0.55	0.238095238	0.6	0.239692526	0.5
50	39.4	0.008	0.4	5	0.75	0.0038	0.55	0.238095238	0.6	0.239753422	0.5

Blk 3



51	39.8	0.008	0.408	5	0.75	0.0040	0.55	0.238095238	0.6	0.239815363	0.5
52	40.3	0.008	0.416	5	0.75	0.0041	0.55	0.238095238	0.6	0.239878349	0.5
53	40.8	0.008	0.424	5	0.75	0.0043	0.55	0.238095238	0.6	0.239942375	0.5
54	41.3	0.008	0.432	5	0.75	0.0044	0.55	0.238095238	0.6	0.240007438	0.5
55	41.8	0.008	0.44	5	0.75	0.0046	0.55	0.238095238	0.6	0.240073537	0.5
56	42.2	0.008	0.448	5	0.75	0.0047	0.55	0.238095238	0.6	0.240140667	0.5
57	42.7	0.008	0.456	5	0.75	0.0049	0.55	0.238095238	0.6	0.240208826	0.5
58	43.2	0.008	0.464	5	0.75	0.0050	0.55	0.238095238	0.6	0.240278012	0.5
59	43.7	0.008	0.472	5	0.75	0.0052	0.55	0.238095238	0.6	0.240348222	0.5
60	44.1	0.008	0.48	5	0.75	0.0054	0.55	0.238095238	0.6	0.240419453	0.5
61	44.6	0.008	0.488	5	0.75	0.0055	0.55	0.238095238	0.6	0.240491703	0.5
62	45.1	0.008	0.496	5	0.75	0.0057	0.55	0.238095238	0.6	0.240564968	0.5
63	45.6	0.008	0.504	5	0.75	0.0059	0.55	0.238095238	0.6	0.240639248	0.5
64	46.1	0.008	0.512	5	0.75	0.0061	0.55	0.238095238	0.6	0.240714539	0.5
65	46.5	0.008	0.52	5	0.75	0.0062	0.55	0.238095238	0.6	0.24079084	0.5
66	47.0	0.008	0.528	5	0.75	0.0064	0.55	0.238095238	0.6	0.240868146	0.5
67	47.5	0.008	0.536	5	0.75	0.0066	0.55	0.238095238	0.6	0.240946458	0.5
68	48.0	0.008	0.544	5	0.75	0.0068	0.55	0.238095238	0.6	0.241025771	0.5
69	48.5	0.008	0.552	5	0.75	0.0070	0.55	0.238095238	0.6	0.241106085	0.5
70	48.9	0.008	0.56	5	0.75	0.0071	0.55	0.238095238	0.6	0.241187396	0.5
71	49.4	0.008	0.568	5	0.75	0.0073	0.55	0.238095238	0.6	0.241269704	0.5
72	49.9	0.008	0.576	5	0.75	0.0075	0.55	0.238095238	0.6	0.241353004	0.5
73	50.4	0.008	0.584	5	0.75	0.0077	0.55	0.238095238	0.6	0.241437297	0.5
74	50.8	0.008	0.592	5	0.75	0.0079	0.55	0.238095238	0.6	0.241522579	0.5
75	51.3	0.008	0.6	5	0.75	0.0081	0.55	0.238095238	0.6	0.241608848	0.5
76	51.8	0.008	0.608	5	0.75	0.0083	0.55	0.238095238	0.6	0.241696104	0.5
77	52.3	0.008	0.616	5	0.75	0.0085	0.55	0.238095238	0.6	0.241784343	0.5
78	52.8	0.008	0.624	5	0.75	0.0087	0.55	0.238095238	0.6	0.241873563	0.5
79	53.2	0.008	0.632	5	0.75	0.0089	0.55	0.238095238	0.6	0.241963764	0.5
80	53.7	0.008	0.64	5	0.75	0.0091	0.55	0.238095238	0.6	0.242054943	0.5
81	54.2	0.008	0.648	5	0.75	0.0094	0.55	0.238095238	0.6	0.242147098	0.5
82	54.7	0.008	0.656	5	0.75	0.0096	0.55	0.238095238	0.6	0.242240227	0.5
83	55.2	0.008	0.664	5	0.75	0.0098	0.55	0.238095238	0.6	0.242334329	0.5
84	55.6	0.008	0.672	5	0.75	0.0100	0.55	0.238095238	0.6	0.242429402	0.5
85	56.1	0.008	0.68	5	0.75	0.0102	0.55	0.238095238	0.6	0.242525445	0.5
86	56.6	0.008	0.688	5	0.75	0.0105	0.55	0.238095238	0.6	0.242622455	0.5
87	57.1	0.008	0.696	5	0.75	0.0107	0.55	0.238095238	0.6	0.24272043	0.5
88	57.6	0.008	0.704	5	0.75	0.0109	0.55	0.238095238	0.6	0.24281937	0.5
89	58.1	0.008	0.712	5	0.75	0.0111	0.55	0.238095238	0.6	0.242919273	0.5
90	58.5	0.008	0.72	5	0.75	0.0114	0.55	0.238095238	0.6	0.243020136	0.5
91	59.0	0.008	0.728	5	0.75	0.0116	0.55	0.238095238	0.6	0.243121959	0.5
92	59.5	0.008	0.736	5	0.75	0.0118	0.55	0.238095238	0.6	0.24322474	0.5

Water Hammer

Surge Pressure (psi) = 0.01345 * a * v

Where,
v = initial velocity (ft/s)
a = 4660 / ([1 + (k (SDR - 2) / E) ^ 0.5

k = fluid bulk modulus
k = 300000 psi
SDR = Pipe OD/wall thickness

E = modulus of elasticity
E = 400000 psi for PVC
30000000 psi for steel

For 4" PVC pipe (SDR 21 200 psi for < 6")
SDR = 21

a = 1193 ft/sec
v = 5 ft/sec

P = 80 psi

For 4" steel pipe
(SDR 21 200 psi for < 6")
SDR = 18.75

a = 4313 ft/sec
v = 5 ft/sec

P = 290 psi

Conclusion:

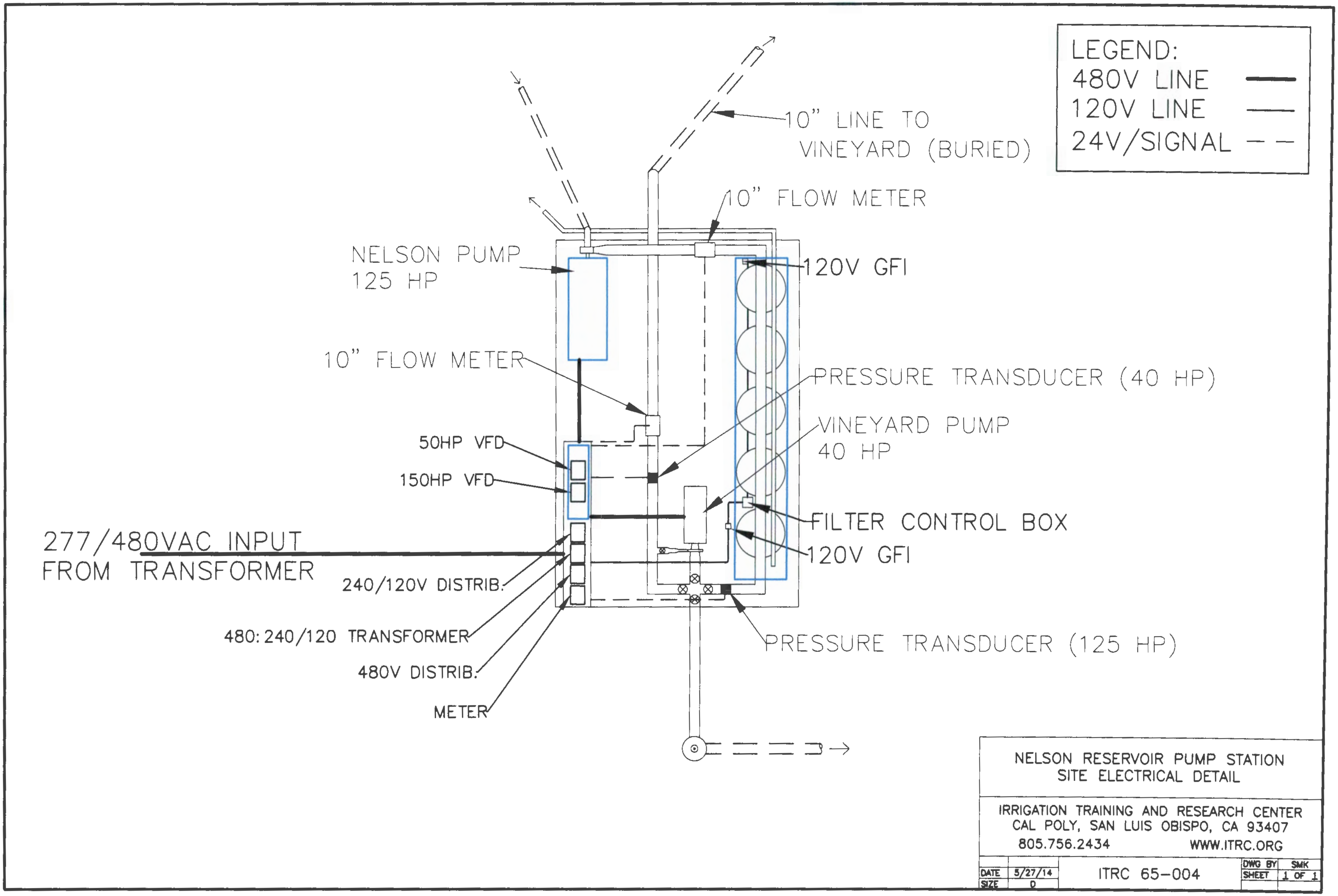
In order to have enough pressure to irrigate the whole field, and not surpass the media tank pressure rating, have a quality 2-way pressure relief valve (or spring valve) set to 115 psi

Pump Sizing

	A	B	C	D	E	F	G
1							
2		Pump Sizing					
3							
4		Pump Requirements for Drip System (All possible blocks)					
5							
6		Flow Rate		196	GPM		
7							
8		Backflush flow rate					
9							
10				75	GPM		
11							
12		**Maximum Flow**		**271**	**GPM**		
13							
14							
15		Pump Discharge P		295	ft		
16		Safety		10	ft		
17							
18		**TDH**		**305**	**ft**	132	psi
19							
20		WHP = TDH*GPM/3960					
21							
22		WHP		21	HP		
23							
24		Estimated Motor HP		24.5	HP		

APPENDIX F

AUTOCAD DRAWINGS OF NELSON RESERVOIR PROJECT


LEGEND:
480V LINE
120V LINE
24V/SIGNAL
10" LINE TO VINEYARD (BURIED)
10" FLOW METER
NELSON PUMP 125 HP
120V GFI
10" FLOW METER
PRESSURE TRANSDUCER (40 HP)
VINEYARD PUMP 40 HP
50HP VFD
150HP VFD
FILTER CONTROL BOX
120V GFI
277/480VAC INPUT FROM TRANSFORMER
240/120V DISTRIB.
480:240/120 TRANSFORMER
480V DISTRIB.
METER
PRESSURE TRANSDUCER (125 HP)
NELSON RESERVOIR PUMP STATION
SITE ELECTRICAL DETAIL
IRRIGATION TRAINING AND RESEARCH CENTER
CAL POLY, SAN LUIS OBISPO, CA 93407
805.756.2434
WWW.ITRC.ORG
DATE 5/27/14
SIZE D
ITRC 65-004
DWG BY SMK
SHEET 1 OF 1

San Luis Obispo County, California, Coastal Part

160—Los Osos loam, 15 to 30 percent slopes

Map Unit Setting

Elevation: 100 to 3,000 feet
Mean annual precipitation: 15 to 35 inches
Mean annual air temperature: 55 to 59 degrees F
Frost-free period: 275 to 350 days

Map Unit Composition

Los osos and similar soils: 85 percent
Minor components: 15 percent

Description of Los Osos

Setting

Landform: Ridges, hills
Landform position (two-dimensional): Backslope, summit
Landform position (three-dimensional): Mountaintop, crest, side slope
Down-slope shape: Convex
Across-slope shape: Linear, convex
Parent material: Residuum weathered from sandstone and shale

Properties and qualities

Slope: 15 to 30 percent
Depth to restrictive feature: 20 to 40 inches to paralithic bedrock
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Very low (0.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Low (about 5.6 inches)

Interpretive groups

Farmland classification: Not prime farmland
Land capability classification (irrigated): 6e
Land capability (nonirrigated): 6e
Hydrologic Soil Group: C
Ecological site: LOAMY CLAYPAN (R015XD049CA)

Typical profile

0 to 14 inches: Loam
14 to 32 inches: Clay
32 to 39 inches: Sandy loam
39 to 43 inches: Weathered bedrock

Minor Components

Lodo clay loam

Percent of map unit: 2 percent

Diablo clay

Percent of map unit: 2 percent

Gazos clay loam

Percent of map unit: 2 percent

Mcmullin

Percent of map unit: 2 percent

Lompico

Percent of map unit: 2 percent

Cibo clay

Percent of map unit: 2 percent

Millsap loam

Percent of map unit: 2 percent

Rock outcrop

Percent of map unit: 1 percent

References

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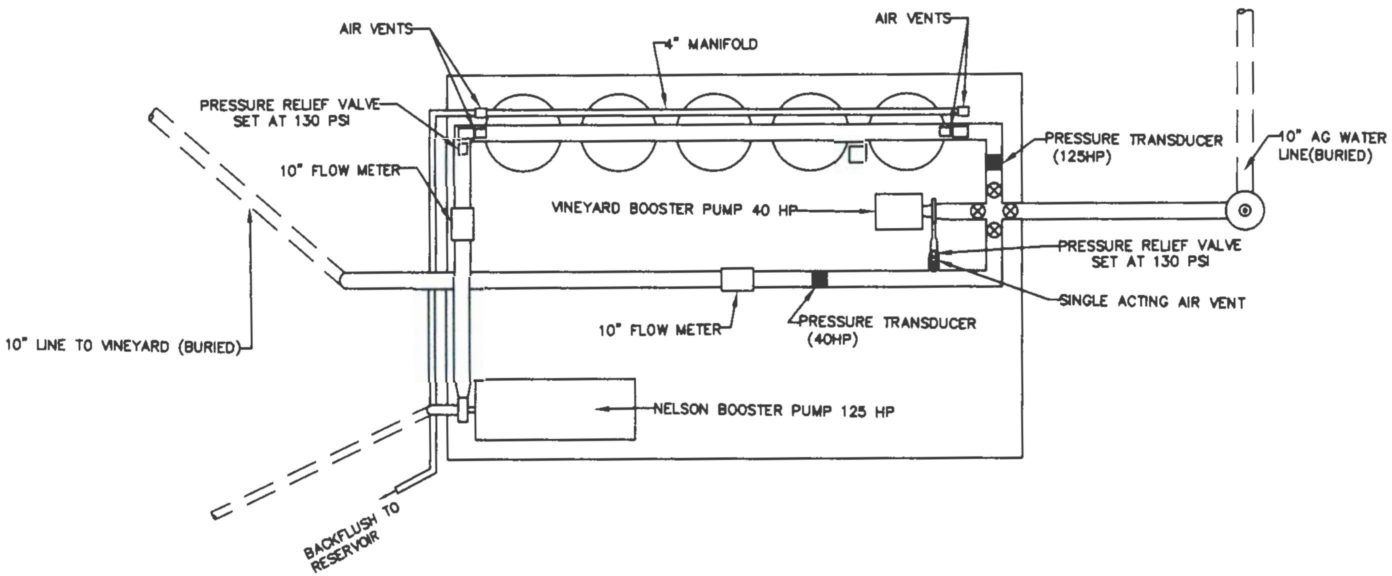
PLAN VIEW



LEGEND

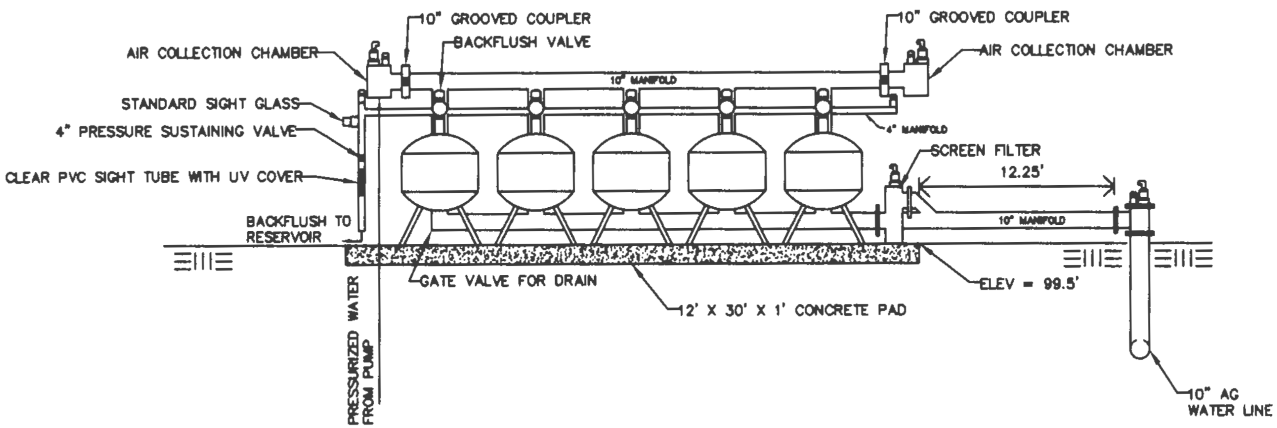
- ⊗ Gear Operated Butterfly Valve
- Single Acting Air Vent & Vacuum Relief
- Continuous Acting Air Vent

KEY SPECIFICATIONS

- Netafim ODIS or John Deere sand media tanks
- Rated for 130 psi operating pressure PLUS 50 psi surge pressure
- #16 Crushed Silica Sand Media
- Sand media will filter to 200 mesh equivalent at 250 GPM
- Emergency Screen/Strainer to filter to 80 mesh
- Continuous and single acting air vents on inlet manifold and discharge
- Single acting air vents on backflush manifold
- Flow meters to be installed with > 10d upstream of meter and > 5d downstream between flow meter and any bend in pipeline
  Where d = pipe ID (in)

0 5' 10'

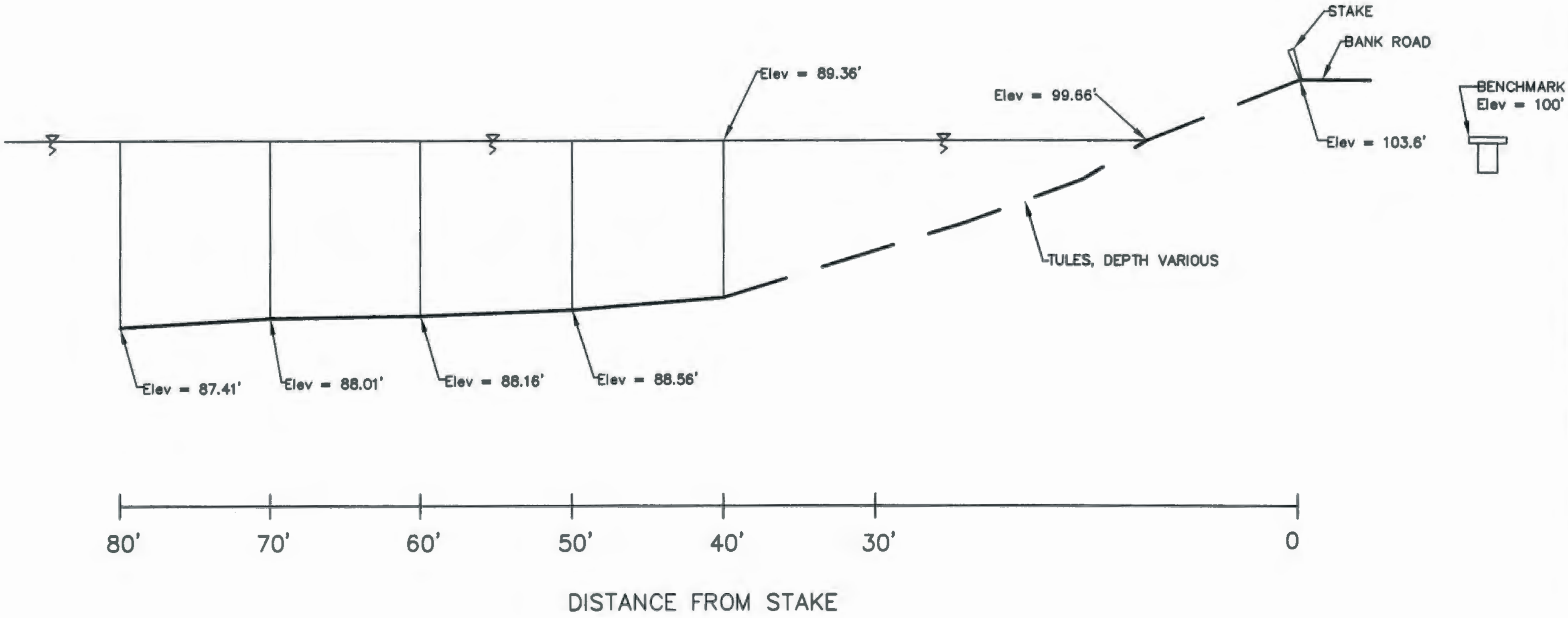
ELEVATION VIEW



NELSON RESERVOIR FILTER STATION
PIPING DETAIL

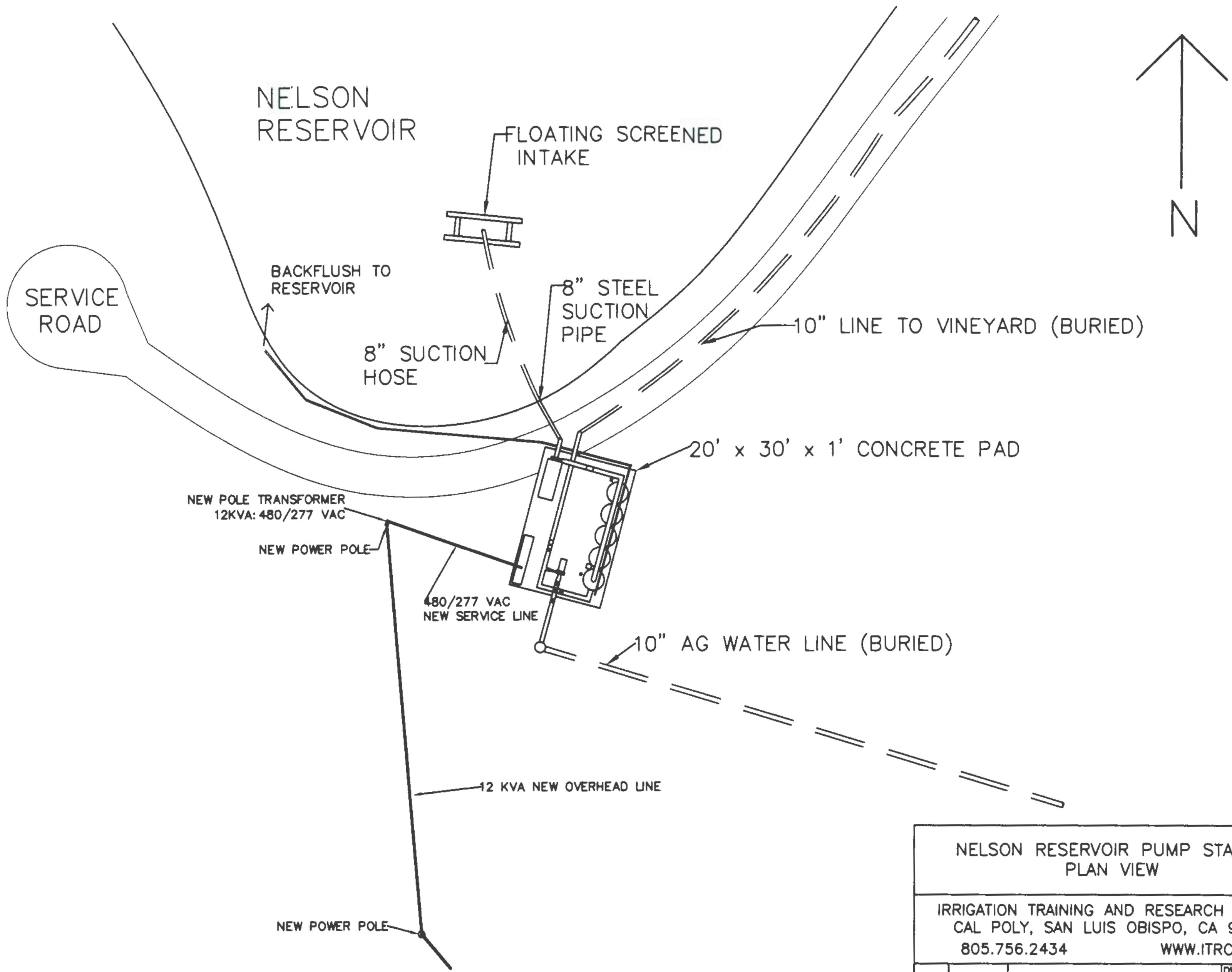
IRRIGATION TRAINING AND RESEARCH CENTER
CAL POLY, SAN LUIS OBISPO, CA 93407
805.756.2434 WWW.ITRC.ORG

DATE	5/28/14	ITRC 65-005	DWG BY	SMK
SIZE	D		SHEET	1 OF 1



* NOTE: BENCHMARK IS THE 10" AG WATER LINE FLANGE.
SURVEY BY JUSTIN McBRIDE and RYAN PEHLE MAY 2012

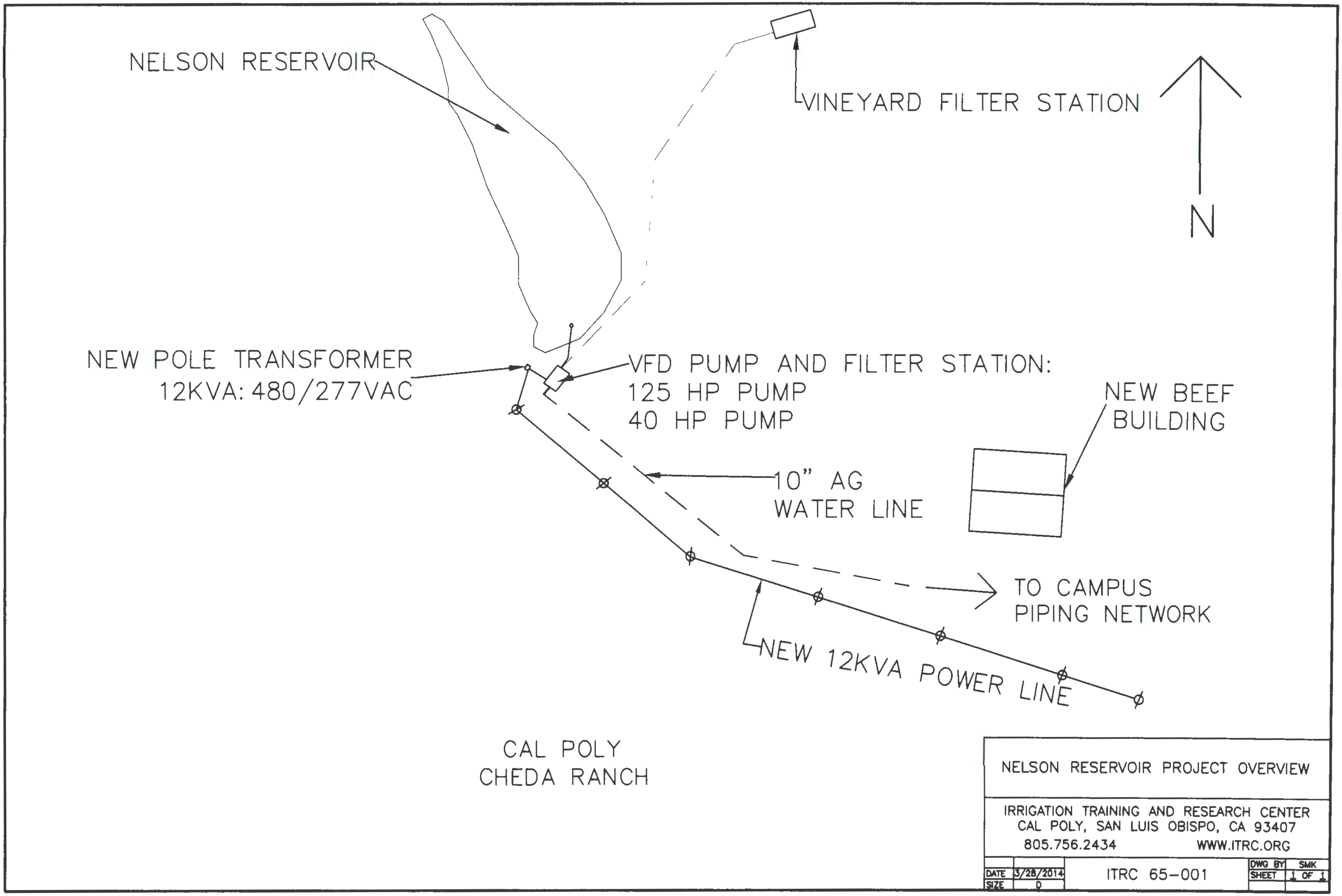
NELSON RESERVOIR WATER DEPTH SURVEY ELEVATION VIEW	
IRRIGATION TRAINING AND RESEARCH CENTER CAL POLY, SAN LUIS OBISPO, CA 93407 805.756.2434 WWW.ITRC.ORG	
DATE 3/28/14 SIZE D	ITRC 65-002	DWG BY SMK SHEET 1 OF 1



NELSON RESERVOIR PUMP STATION
PLAN VIEW

IRRIGATION TRAINING AND RESEARCH CENTER
CAL POLY, SAN LUIS OBISPO, CA 93407
805.756.2434 WWW.ITRC.ORG

DATE	3/28/14	ITRC 65-003	DWG BY	SMK
SIZE	D		SHEET	1 OF 1



NELSON RESERVOIR
VINEYARD FILTER STATION
N
NEW POLE TRANSFORMER
12KVA: 480/277VAC
VFD PUMP AND FILTER STATION:
125 HP PUMP
40 HP PUMP
NEW BEEF BUILDING
10" AG WATER LINE
TO CAMPUS PIPING NETWORK
NEW 12KVA POWER LINE
CAL POLY
CHEDA RANCH
NELSON RESERVOIR PROJECT OVERVIEW
IRRIGATION TRAINING AND RESEARCH CENTER
CAL POLY, SAN LUIS OBISPO, CA 93407
805.756.2434
WWW.ITRC.ORG
DATE 3/28/2014
SIZE D
ITRC 65-001
DWG BY SMK
SHEET 1 OF 1

APPENDIX G

PRICE QUOTATIONS FOR PUMP STATION

QUOTATION

RDO WATER
www.rdowater.com

Quote #:	**4391**
Quote Date:	03/25/14
Customer No:	ITRPOL407
Cust PO No:	JOHN DEERE - HP

Sold To:

ITRC-CAL POLY
1 GRANDE AVE BLD 8A
SAN LUIS OBISPO,CA 93407
Fax: 805-756-2433

Ship To:

ITRC-CAL POLY
1 GRANDE AVE BLD 8A
SAN LUIS OBISPO, CA 93407
Ph: Fax:

Initials

Sales Representative	Request-Delivery Date	Terms	Shipping Charge	Ship Via
Ryan Pehle	03/28/14 Initials			

Part Number	Qty	Unit	Description	Unit Price	Extended Amt
			ALL SPECIAL ORDER AND NON-STOCK PRODUCTS RETURNED ARE SUBJECT TO A 25% RESTOCKING CHARGE		
$QUOTE	1.000	EA	SPECIAL PRODUCT QUOTE	30,681.818	30,681.82
			John Deere F2000 Media Filtration		
			**** HIGH PRESSURE SYSTEM****		
			10" Inlet/Outlet manifolds		
			5 x 48" F2000 tank (High Pressure)		
			AC Unit		
			JOHN DEERE AC BACK FLUSH CONTROLLER		
			130 PSI OPERATING PRESSURE		
			180 PSI BURST RATING PRESSURE		
FPACC1065	80.000	EA	SILICA SAND #16 (100#)	10.000	800.00
FNET3215	1.000	EA	ARKAL FILTER 1.5" *SPECIFY MESH* 25A15-***	75.000	75.00
FNET3210	1.000	EA	ARKAL FILTER 1" *SPECIFY MESH* 25A47-***	50.508	50.51
STWF1525	1.000	EA	WELD TEE BUTT WELD 10" #215-10	230.000	230.00
HGVI1350	2.000	EA	VICTAULIC NIPPLE 10"IP WELD ON	65.000	130.00
STWF1475	1.000	EA	WELD ELBOW 90DEG BUTT 10" #205-10	195.000	195.00
VARIPAV114	1.000	EA	2" DYNAMIC AIR RELEASE AIR VENT #70561-001730	165.000	165.00
VARIPAV117	1.000	EA	ARI 2"COMBO AIR/VAC AIR VENT NYL #70561-001680	145.000	145.00
VARIPAV112	1.000	EA	ARI 2" GUARDIAN AIR/VAC RELIEF AIR VENT #70561-002710	30.000	30.00
HGVI1115	1.000	EA	VICTAULIC COUPLING 10"	65.000	65.00
HGVI1245	3.000	EA	VICTAULIC NIPPLE 4"X 4"PVC	7.812	23.44
PVFO401040	1.000	EA	TEE SLIP 4	8.495	8.49
PVFO438420	2.000	EA	BUSHING SXT 4X2	3.466	6.93
PVFO406040	1.000	EA	90 SLIP 4	5.722	5.72
PVFO436342	2.000	EA	MALE ADAPTER RED 3X4	4.108	8.22
PVNI1535	2.000	EA	2X3 TBE NIPPLE SCH80	0.982	1.96
PVFO429040	2.000	EA	COUPLING SLIP 4	2.625	5.25

CONTINUED ON NEXT PAGE

QUOTATION

RDO WATER
www.rdowater.com

Quote #: 4391
Quote Date: 03/25/14
Customer No: ITRPOL407
Cust PO No: JOHN DEERE - HP

Sold To:

ITRC-CAL POLY
1 GRANDE AVE BLD 8A
SAN LUIS OBISPO,CA 93407
Fax: 805-756-2433

Ship To:

ITRC-CAL POLY
1 GRANDE AVE BLD 8A
SAN LUIS OBISPO, CA 93407
Ph: 805-756-2434 Fax: 805-756-2433

Initials

Sales Representative	Request-Delivery Date	Terms	Shipping Charge	Ship Via
Ryan Pehle	03/28/14 Initials	COD	Prepaid & Charge	Pick UP

Part Number	Qty	Unit	Description	Unit Price	Extended Amt
			ALL SPECIAL ORDER AND NON-STOCK PRODUCTS RETURNED ARE SUBJECT TO A 25% RESTOCKING CHARGE		
FPEVE1270	1.000	EA	EVERFILT VIEW TUBE CLEAR PVC 4" X 12"#2105-02	65.000	65.00
PVFO402419	1.000	EA	TEE SST 4X4X1-1/2	9.352	9.35
FPACC1095	1.000	EA	ABF20 BACKWASH SIGHT GLASS 1.5"MPT	68.000	68.00
HGVI1070	1.000	EA	VICTAULIC COUPLING 4"	10.411	10.41
VDORSHY1301	1.000	EA	DOROT 2"HP BRONZE QR PR VLV #61QR2ANHPG G	585.000	585.00
PVPA1095	20.000	FT	PVC PIPE SCH40 4" BE	2.550	51.00
STWF1620	4.000	EA	WELD HALF COUPLING 2" BI	3.390	13.56
PVCE1003	1.000	EA	CEMENT (SPE) PVC-05 QT CLEAR MED BODY #PVC050C-030	14.012	14.01
PVCE1036	1.000	EA	PRIMER (SPE) PRIMER-68 QT CLEAR #PRIM68C-030	14.303	14.30
SERVICE CALL	1.000	EA	SERVICE CALL *FABRICATION OF THE AIR CHAMBERS* *(SOME MISC MATERIALS COSTS IMPLIED)*	500.000	500.00
SERVICE CALL	1.000	EA	SERVICE CALL *ASSEMBLY OF THE FILTER STATION. INCLUDES, BUT NOT LIMITED TO: SETTING AND CONNECTIONS OF THE FITLER STATION. ASSEMBLY OF THE BACK FLUSH MANIFOLD TO CUSTOMER'S DESIGNED SPECIFICATIONS. FILLING THE MEDIA TANKS WITH SAND. INSTALLATION OF THE CONTROLLER AND PLUMBING OF THE HYDRUALIC CONTORL LINES. COLOR MATCHED PAINTING OF THE BARE PIPE (STEEL AND PVC) AS SPECIFIED BY THE CUSTOMER.*	2,000.000	2,000.00

Hazard:
Operator-ID:

Acceptance ______________________

By: ______________________
By signing this quote customer represents that has read and agreed to all terms and conditions of this quote.

Subtotal:	**35,957.97**
Sales Tax:	**2,676.70**
Shipping & Handling:	**0.00**
Total:	**38,634.67**

CAL POLY
CORPORATION

Sole Source Justification

Purchasing Policy subjects the Cal Poly Corporation to competitive bidding rules. Purchase requisitions for goods and services, over $5,000, that are to be purchased from a specific vendor or limited to a specific brand where substitutes to the suggested vendor or brand are unacceptable, must be accompanied by the justification explaining the circumstances that make alternatives unacceptable. This justification must be signed by the principal investigator, department chair, or director. CPSU/CPC employees are not to make or participate in any purchasing decision that places them in a conflict of interest between their official duties and any other interest or obligation. CPSU/CPC employees who have a business relationship of financial interest (including that of a near relative) in the suggested vendor, who are conducting research for the suggested vendor, or who have received or anticipate receiving gifts, honorarium, or research grants from the suggested vendor must disclose the conflict of interest.

1. Vendor proposed as a Sole Source: RDO Water - Santa Maria, CA

2. Please check all applicable categories below and proved additional information where indicated.

☐ a. The requested product is an integral repair part or accessory compatible with existing equipment

Existing equipment description: ______

Manufacturer/Model Number: ______ Age of Equipment ______

☑ b. The requested product has unique design/performance specifications or quality requirements which are essential to my research or teaching needs and are not available in comparable products.

☑ c. The requested product is essential in maintaining research continuity and/or to remain in compliance with established University/CPC standards. (Check applicable category below.)

☐ Requested product is being used in continuing research experiments

☑ I am collaborating with other parties/departments/staff/faculty who have used this product and, for compatibility of research results, I must also use it.

☐ I have standardized the requested product and the use of another brand/model would require considerable time and funding to evaluate.

☐ d. The requested product is one with which I and/or my staff have specialized training/extensive expertise, and retraining would incur substantial cost in time/money

☑ e. The requested provider of services has unique and/or exclusive capabilities that not other provider can provide. (Provide detailed explanation below)

☐ f. Other factors are involved. (Provide detailed explanation below)

______

______

3. Provide a detailed explanation for categories checked in 2a through 2f above. Attach additional sheets if necessary

The filtration package quoted from RDO Water was the only one to meet the system constraints in operating pressure, and the performance specifications set by the Irrigation Training and Research Center. See attached specifications.

4. Was an evaluation of other equipment, products, or services completed? ☐ Yes ☑ No

If yes, please attach the results of the evaluation.

Manufacturers openly publish operational pressure ratings. An in depth evaluation was not needed.

______

5. List below the names of each individual who was involved in making the recommendations to sole source this purchase

Kyle Feist, Dr. Stuart Styles and Dr. Charles Burt

6. An Individual Disclosure Statement will be requested at the discretion of management.

7. I certify that I have read the above statement, that the information entered on this form is factual and that a signed copy of the Sole Source Justification document, and all associated disclosure statements, will be kept on file in my department.

______ Signature	______ Date
______ Printed Name	______ Title
______ Corporation Management	______ Date
	______ Title

Revised: 3/19/2013

MOTION INDUSTRIES

Quotation

Motion Industries, Inc

2358 CEPHEUS COURT
BAKERSFIELD CA 93308-
PHONE : 661-324-6741
FAX : 661-324-2133

Date: 04/30/14 PAGE: 1

Note: This estimate is valid for 30 days from the date shown above. Prices quoted are for quantities shown. Stock is subject to prior sale. MTO quantities considered complete 10% under/over unless noted.

To:

CAL POLY FACILITIES
STATE RECEIVING-WAREHOUSE
BLDG 70
SAN LUIS OBISPO, CA 93407-0122

Quote Number:	CA06-306156
Customer P.O.:	
F.O.B.:	
Quote Sent By:	Ricardo Torrento
Terms:	1% 10&25thNET 30
Delivery:	STOCK UNLESS NOTED

Description	Manufacturer	Quantity	Unit	Unit Price	Amount
LINE ITEM: 001					
50/150HP DUAL VFD CONTROL PANEL		1	EA	$38,081.940	$38,081.94
SEE F24 NOTES					
MINO: 00111 Z 00000					

DELIVERY DATE: 04/09/14
SALES TAX: 2856.15

ATTN: RICARDO TORRENTO
SUBJECT: CALPOLY SLO DUAL 480VAC 50/150HP VFD CONTROL PANEL
QUOTE# CA06-20140408
WE PROPOSE TO SUPPLY THE FOLLOWING;

1) ENCLOSURE, FREE-STANDING, RAL7035, TYPE 3R/4, 72X66X20 (1)
2) WINDOW, VIEWING, LOCKABLE, 19X20" (1)
3) MCCB, ELECTRONIC TRIP UNIT, LS/I, 35KAIC, 600A (1)
   A) HANDLE, DISCONNECT, FLANGED (1)
4) AC UNIT, 480VAC/16,000-18,000 BTU (1)
5) BLOCK, DISTRIBUTION, POWER (1)
6) 150HP VFD, NORMAL DUTY, ACS550(1)
   A) KIT, FUSE, CLASST, 600V/250A (1)
   B) KIT, INTERFACE, OPERATOR, REMOTE (1)
7) 150HP 2-CONTACTOR BYPASS (1)
   A) KIT, FUSE, CLASSJ, 600V/250A (1)
   B) RELAY, OVERLOAD, 165-235A (1)
8) 50HP VFD, NORMAL DUTY, ACS550 (1)
   A) KIT, FUSE, CLASST, 600V/90A (1)
   B) KIT, INTERFACE, OPERATOR, REMOTE (1)
9) 50HP 2-CONTACTOR BYPASS (1)S (1)
   A) KIT, FUSE, CLASSJ, 600V/100A (1)
   B) RELAY, OVERLOAD, 60-80A (1)
10) TRANSFORMER, CONTROL, 2KVA (1) 1)
11) HEATER, FAN, 115V/800W (1)
   A) THERMOSTAT, 32-140 FAHRENHEIT (1)
12) MODULE, SAFETY, 120VAC, 4NO/1NC/2SS (1)

MOTION INDUSTRIES

Quotation

Motion Industries, Inc

2358 CEPHEUS COURT
BAKERSFIELD CA 93308-
PHONE : 661-324-6741
FAX : 661-324-2133

Date: 04/30/14 PAGE: 2

Note: This estimate is valid for 30 days from the date shown above. Prices quoted are for quantities shown. Stock is subject to prior sale. MTO quantities considered complete 10% under/over unless noted.

To:

CAL POLY FACILITIES
STATE RECEIVING-WAREHOUSE
BLDG 70
SAN LUIS OBISPO, CA 93407-0122

Quote Number: CA06-306156
Customer P.O.:
F.O.B.:
Quote Sent By: Ricardo Torrento
Terms: 1% 10&25thNET 30
Delivery: STOCK UNLESS NOTED

Description	Manufacturer	Quantity	Unit	Unit Price	Amount

13) 40MM E-STOP, TWIST-RELEASE, 2NC (1)
14) 22MM DPB, MOM, FL/EXT, GRN/RED, START/STOP (2)
15) 22MM SS, MAINT., 2-POS., KNOB, A-C, VFD/BYPASS (2)
16) 22MM SS, MAINT., 3-POS., KNOB, A-B-C, HAND/OFF/AUTO (2)
17) NAMEPLATE, E-STOP (1)
18) NAMEPLATES, ENGRAVED, CUSTOM (4)
19) TERMINAL BLOCKS
20) WIRE/TERMINAL BLOCK MARKERS

FOB LOS ANGELES CA
LEAD-TIME IS 5-6 WEEKS FOR CUSTOM PANELS
LEAD-TIME DOES NOT START UNTIL SUBMITTAL DRAWINGS ARE APPROVED. SUBMITTALS ARE AVAILABLE APPROXIMATELY 2-WEEKS AFTER APPROVED ORDER IS RECEIVED.

NOTE: BRANCH COST DOES NOT INCLUDE
1) STARTUP/COMMISSIONING
2) FREIGHT FROM CA50 TO CUSTOMER
3) EXPEDITE CHARGES

**CUSTOM ENCLOSURES ARE NON-REFUNDABLE/NON-RETURNABLE.

PRICES QUOTED ARE BASED ON INFORMATION SUPPLIED FOR BIDDING AND OUR INTERPRETATION OF THAT INFORMATION ALONG WITH OUR RECOMMENDATIONS AND/OR CHANGES FOR FABRICATION. PRICES ARE SUBJECT TO REVIEW AND POSSIBLE ADJUSTMENT FOR ANY CHANGES MADE THAT DEVIATE FROM OUR OUTLINE GIVEN.

PLEASE REVIEW OUR PROPOSAL AND SHOULD THERE BE ANY DISCREPANCIES OR OMISSIONS THEN THOSE CONCERNS SHOULD BE BROUGHT TO OUR ATTENTION IMMEDIATELY.
PLEASE FEEL FREE TO CONTACT ME IF YOU HAVE ANY QUESTIONS REGARDING THE ABOVE QUOTE @ 323-887-3700.

MOTION INDUSTRIES

Quotation

Motion Industries, Inc

2358 CEPHEUS COURT
BAKERSFIELD CA 93308-
PHONE : 661-324-6741
FAX : 661-324-2133

Date: 04/30/14 PAGE: 3

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To:

CAL POLY FACILITIES
STATE RECEIVING-WAREHOUSE
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Quote Number: CA06-306156
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Terms: 1% 10&25thNET 30
Delivery: STOCK UNLESS NOTED

Description	Manufacturer	Quantity	Unit	Unit Price	Amount

SUB TOTAL: $38,081.94

SALES TAX: $2,856.15
TOTAL: US$ $40,938.09

Please reference the quote number at the top of page when ordering

Want to view inventory and place orders on-line? MotionIndustries.com can meet your needs. Register On-line at www.MotionIndustries.com.

Motion Industries –
Automation Systems Center
2043 Saybrook Ave.
Los Angeles, CA 90040 USA
T (323) 887-3700
F (888) 523-0074

Quote

Motion Industries **April 8, 2014**

Attn: Ricardo Torrento

Subject: CalPoly SLO Dual 480VAC 50/150HP VFD Control Panel

Quote# CA06-20140408

We propose to supply the following;

1) **Enclosure, Free-Standing, RAL7035, Type 3R/4, 72x66x20 (1)**
2) **Window, Viewing, Pad Lockable, 19x20 " (1)***
3) **MCCB, Electronic Trip Unit, LS/I, 35kAIC, 600A (1)**
   a) **Handle, Disconnect, Flanged (1)**
4) **AC Unit, 480VAC/16,000-18,000 BTU (1)*****
5) **Block, Distribution, Power (1)**
6) **150HP VFD, Normal Duty, ACS550(1)**
   a) **Kit, Fuse, ClassT, 600V/250A (1)**
   b) **Kit, Interface, Operator, Remote (1)**
7) **150HP 2-Contactor Bypass (1)**
   a) **Kit, Fuse, ClassJ, 600V/250A (1)**
   b) **Relay, Overload, 165-235A (1)**
8) **50HP VFD, Normal Duty, ACS550 (1)**
   c) **Kit, Fuse, ClassT, 600V/90A (1)**
   d) **Kit, Interface, Operator, Remote (1)**
9) **50HP 2-Contactor Bypass (1)**
   c) **Kit, Fuse, ClassJ, 600V/100A (1)**
   d) **Relay, Overload, 60-80A (1)**
10) **Transformer, Control, 2kVA (1)**
11) **Heater, Fan, 115V/800W (1)**
   a) **Thermostat, 32-140° Fahrenheit (1)**
12) **Module, Safety, 120VAC, 4NO/1NC/2SS (1)**
13) **Signal, Sounder/Strobe, 90-135VAC, 100dB/5Joules (1)****
14) **40mm E-Stop, Twist-Release, 2NC (1)*******
15) **22mm DPB, Mom, Fl/Ext, Grn/Red, Start/Stop (2)**
16) **22mm SS, Maint., 2-Pos., Knob, A-C, VFD/Bypass (2)**
17) **22mm SS, Maint., 3-Pos., Knob, A-B-C, Hand/Off/Auto (2)**
18) **Nameplate, E-Stop (1)*******
19) **Nameplates, Engraved, Al, Custom (4)**
20) **Nameplate, Engraved, Plastic, Custom, 6 x 2 ½" (2)******
21) **Terminal Blocks**
22) **Wire/Terminal Block Markers**

Total Cost:

FOB Los Angeles CA
Lead-time is 5-6 weeks for custom panels

Quotation void after 45 days from the date shown

Lead-time does not start until submittal drawings are approved. Submittals are available approximately 2-weeks after approved order is received.

Note: Branch Cost does not include

1) **Startup/Commissioning**
2) **Freight from CA50 to customer**
3) **Expedite charges**

***Viewing Window to be pad-lockable.**
****Strobe/Siren comes in a grey housing with a Blue Lens.**
*****Per customer request, AC Unit to be mounted on right side of the enclosure.**
******Custom Engraved Nameplate to be Red with White Lettering.**
*******E-Stop Pushbutton to be mounted outside of the Viewing Window.**

Custom Enclosures are Non-Refundable/Non-Returnable.

Prices quoted are based on information supplied for bidding and our interpretation of that information along with our recommendations and/or changes for fabrication. Prices are subject to review and possible adjustment for any changes made that deviate from our outline given.

Please review our proposal and should there be any discrepancies or omissions then those concerns should be brought to our attention immediately.
Please feel free to contact me if you have any questions regarding the above quote @ 323-887-3700.

Signed,
Roy Tiefenthaler
Automation Engineer
Motion Industries – CA50

CAL POLY CORPORATION

Sole Source Justification

Purchasing Policy subjects the Cal Poly Corporation to competitive bidding rules. Purchase requisitions for goods and services, over $5,000, that are to be purchased from a specific vendor or limited to a specific brand where substitutes to the suggested vendor or brand are unacceptable, must be accompanied by the justification explaining the circumstances that make alternatives unacceptable. This justification must be signed by the principal investigator, department chair, or director. CPSU/CPC employees are not to make or participate in any purchasing decision that places them in a conflict of interest between their official duties and any other interest or obligation. CPSU/CPC employees who have a business relationship of financial interest (including that of a near relative) in the suggested vendor, who are conducting research for the suggested vendor, or who have received or anticipate receiving gifts, honorarium, or research grants from the suggested vendor must disclose the conflict of interest.

1. Vendor proposed as a Sole Source: Motion Industries - Bakersfield, CA

2. Please check all applicable categories below and proved additional information where indicated.
   - [ ] a. The requested product is an integral repair part or accessory compatible with existing equipment
     Existing equipment description: ______
     Manufacturer/Model Number: ______ Age of Equipment ______
   - [✓] b. The requested product has unique design/performance specifications or quality requirements which are essential to my research or teaching needs and are not available in comparable products.
   - [✓] c. The requested product is essential in maintaining research continuity and/or to remain in compliance with established University/CPC standards. (Check applicable category below.)
     - [ ] Requested product is being used in continuing research experiments
     - [ ] I am collaborating with other parties/departments/staff/faculty who have used this product and, for compatibility of research results, I must also use it.
     - [✓] I have standardized the requested product and the use of another brand/model would require considerable time and funding to evaluate.
   - [✓] d. The requested product is one with which I and/or my staff have specialized training/extensive expertise, and retraining would incur substantial cost in time/money
   - [ ] e. The requested provider of services has unique and/or exclusive capabilities that not other provider can provide. (Provide detailed explanation below)
   - [ ] f. Other factors are involved. (Provide detailed explanation below)

3. Provide a detailed explanation for categories checked in 2a through 2f above. Attach additional sheets if necessary
   In collaboration with Facilities Services, Cal Poly Farm Operations have standardized components for VFD-equipped pump stations.

4. Was an evaluation of other equipment, products, or services completed? [ ] Yes [✓] No
   If yes, please attach the results of the evaluation.

5. List below the names of each individual who was involved in making the recommendations to sole source this purchase
   Kyle Feist, Ben Johnson and Dr. Stuart Styles

6. An Individual Disclosure Statement will be requested at the discretion of management.

7. I certify that I have read the above statement, that the information entered on this form is factual and that a signed copy of the Sole Source Justification document, and all associated disclosure statements, will be kept on file in my department.

Signature	Date
Printed Name	Title
Corporation Management	Date
	Title

QUOTATION

MCR Technologies, Inc.
Measurement, Control & Recording

Date:	April 17, 2014	***Quote #:***	04141705JC
Company:	Cal Poly	***Reference:***	30 Series Transducer, 50 ft. cable
Attention:	Kyle Feist	***Manufacturer***	**Measurement Specialties**
Phone Number:	(805) 748-0223	***Lead Time:***	2 Weeks
FAX / E-Mail:	kfeist@calpoly.edu	***Prepared By:***	James Choi (949) 290-8348 james@mcrt.com
Quotation Valid:	30 Days		
F.O.B. Point:	Factory		
Payment Terms:	Net 30 upon credit approval		

Thank you for the opportunity to provide you with the following quotation.

Item	***Model # & Description***	***Qty.***	***Net Each***	***Extended Amount***
1	KPSI (Measurement Specialties) Part#: 30S-1424B-150.000-000.000-A-3-50-A Non-Submersible Stainless Steel Pressure Transducer Vented +/- 0.1 % FS Accuracy Pressure Connection: 1/4"-18NPT Male Fittiing Electrical Connection: 1/2"-14NPT Male Conduit Fitting 4-20 mA Output Ranged for 0-150 PSI Lightening Protection 50 ft of PVC jacketed Cable	3	685.00	$2,055.00
			NET TOTAL	*$2,055.00*
			Plus Shipping and applicable taxes	

Please issue your purchase order to:
MCR Technologies, Inc.
PO Box 1269
Lake Forest, CA 92609

e-mail your purchase order to: orders@mcrt.com or Fax to (949) 783-3101

This quotation is for the products and services listed above only. Any additional products required will be provided at additional cost.

Terms Included by reference

This quotation is offered subject to ours and the manufacturers terms and conditions. A copy of these conditions is available upon request.
MCR Technologies, Inc. is an independent manufacturers representative and distributor.

Delivery

Delivery is based on current lead times and on the longest lead time of all equipment quoted. Actual delivery may vary based on the lead times in effect when the equipment is released for production.

Materials of Construction

We offer a variety of material selections and configurations to suite process conditions. Although we have quoted the materials which were specified, or if not specified, which we believe to be satisfactory, we do not warrant that they are compatible with the chemicals, concentrations and operating conditions which will be encountered in the application. The final selection of the appropriate material is the responsibility of the customer.

PRICE QUOTATION
Agricultural Sales Group
Eric Holtan
Fax: (503) 653-0338
Direct Phone: (503) 794-0212
e-mail: eholtan@cornellpump.com

Company: ITRC at Cal Poly ***Quote#EH031814C***

Attention: Kyle Feist Date: March 18, 2014

GPM	HEAD	IMP TRIM	EFFICIENCY	HP @ DESIGN POINT
275	305ft.	9.06"	68%	32

Qty: (1) ***Build number: BML504A-A00+ JPM4109T***
Reference: Vineyard Pump

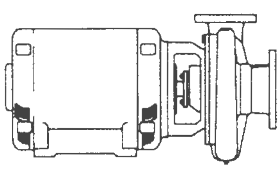
Cornell Model **2YH-40-2** Close-Coupled, end suction centrifugal pump
- **2.5"** threaded suction and **2"** threaded discharge
- Cast iron, bronze fitted construction
- **40HP** 3500 RPM **TEFC** motor; 230/460, 3PH, 60Hz
- Enclosed bronze 5-vane impeller
- Standard packing
- Grease lubricated motor bearings
- Standard Cornell 2 year warranty

Net price is: **$4,427.00** per pump FOB factory.
Add $452.00 for premium eff. motor

Estimated shipment: 2-3 weeks from date of order
- This quote is valid for 30 days. Any sale resulting from this quote is subject to Cornell Pump Company's Standard Terms & Conditions of Sale.

Thank you for the opportunity to provide you with this quotation.

Eric Holtan
Agricultural Sales Group



Horizontal Close-Coupled (CC)
Economical compact and efficient