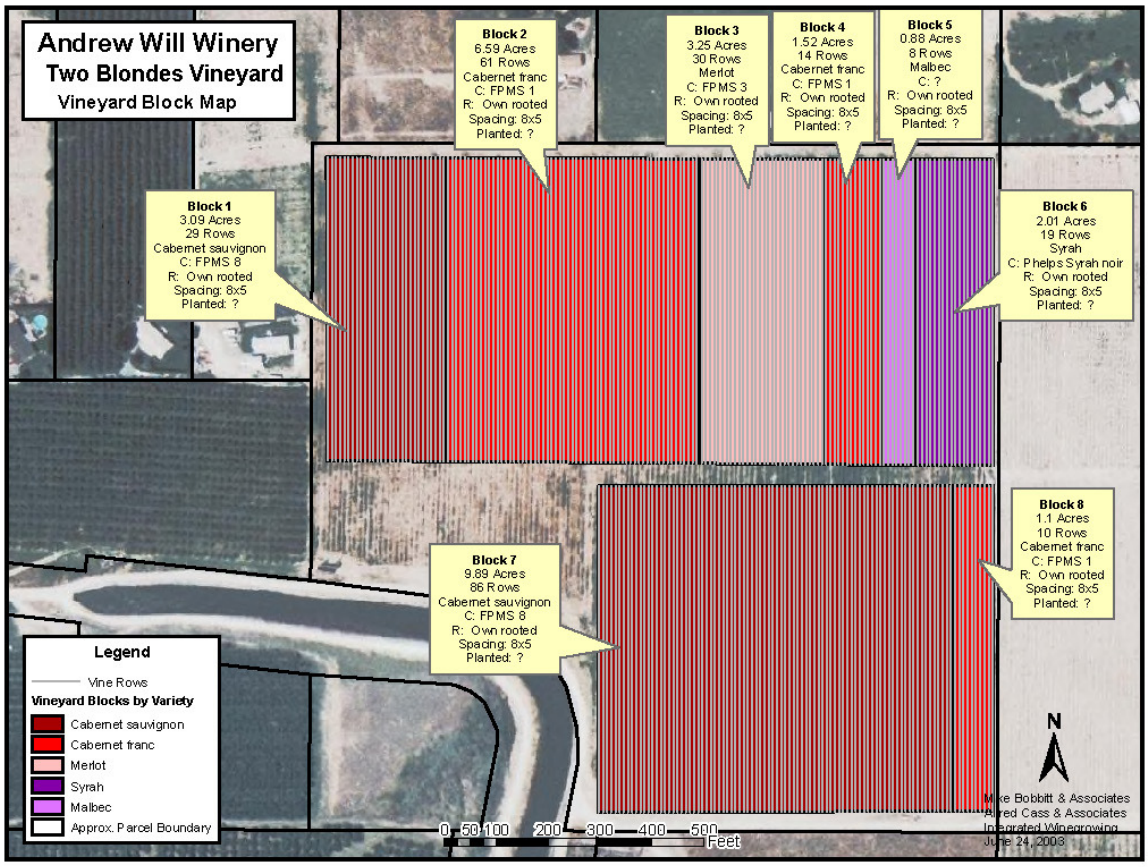
2010 Vintage Weather Summary for Two Blondes Vineyard



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Introduction

This is a weather summary for Two Blondes Vineyard based on measurements made during the 2010 growing season, with comparisons made to the 2005 through 2009 seasons. This report is not a true climate survey and does not purport to represent climatic characteristics of the vineyard sites. A climate report requires many years of data while this weather summary uses only the weather data that is available from the automated temperature data loggers that have been installed in the vineyards. As more years of data are collected, a better and better picture of the temperature climate of this location will be ascertained. In fact, some consistency in the measurements indicates that some climatic parameters may already be defining themselves.

There are two Hobo weather stations at Two Blondes Vineyard, one located at a higher elevation and the other at a lower elevation. Comparisons between the two locations will be made, when differences are apparent. The top station was used as the reference when comparing 2010 to 2005 through 2009.

Long-term averages from Oakville, CA are included for reference. Oakville was chosen as a representative climate for Bordeaux varieties in California. Oakville's climate is on the cool end of fine Cabernet Sauvignon production and on the warm end of fine Merlot production. Comparison comments to Oakville are presented in italics. Data for this season's report were made using the same time period as those measured at Two Blondes Vineyard.

I. Temperature and Heat Summation

Using the upper station as a reference, Two Blondes had 2833 degree days in 2010 compared to 3182 in 2005, 3253 in 2006, 3235 in 2007, 3065 in 2008 and 3305 in 2009 (**Figure 1a**). The lower station was about 123 degree days cooler than the upper station. 2010 was the coolest season measured thus far (since 2005), falling far short of the 2008 growing season. This follows the warmest season on record in 2009. Monthly breakdown (**Figure 2a**) showed that July was the warmest month in 2010, as it was in 2006 through 2009, but 2010 was cooler than all of the previously-measured growing seasons. The cooler temperatures in 2010 were experienced in the other months as well, with May being exceptionally cool relative to past years. Like the previous five years, the months of April and October were quite cool, indicative of the short, intense growing season at this location (and in the region).

The lower elevation station had fewer degree days than the upper station (**Figure 2b**), a smaller difference than the average of 163 degree days. Degree days were higher at the top station for each month except for April, though the differences were greatest during July through September. The differences between the two locations were primarily due to lower nighttime temperatures at the lower location.

There is a distinct difference in heat summations between Two Blondes Vineyard and Oakville. The past 6 seasons have shown consistently higher heat summations at Two Blondes than at Oakville, except for 2008. The average difference between the upper and lower station relative to Oakville is 346 and 183, respectively. While the heat summations at Two Blondes (top station), on average has been about 350 degree days F warmer than Oakville (long-term average), the season is shorter and more intense at Two Blondes. May, June and September tend to have similar heat summations to those of Oakville (though May was quite cool in 2010), but July and August are much warmer at Two Blondes compared to Oakville. Yet, the heat fades quickly into the fall, and the month of October is much cooler at Two Blondes than in Oakville. This indicates

the importance of early fruit maturation at Two Blondes vineyard, as ripening will slow down considerably during the month of October. While the bottom station had more similar heat summations to the Oakville average, though 185 degree-days warmer, the difference in the seasonal pattern is dramatic.

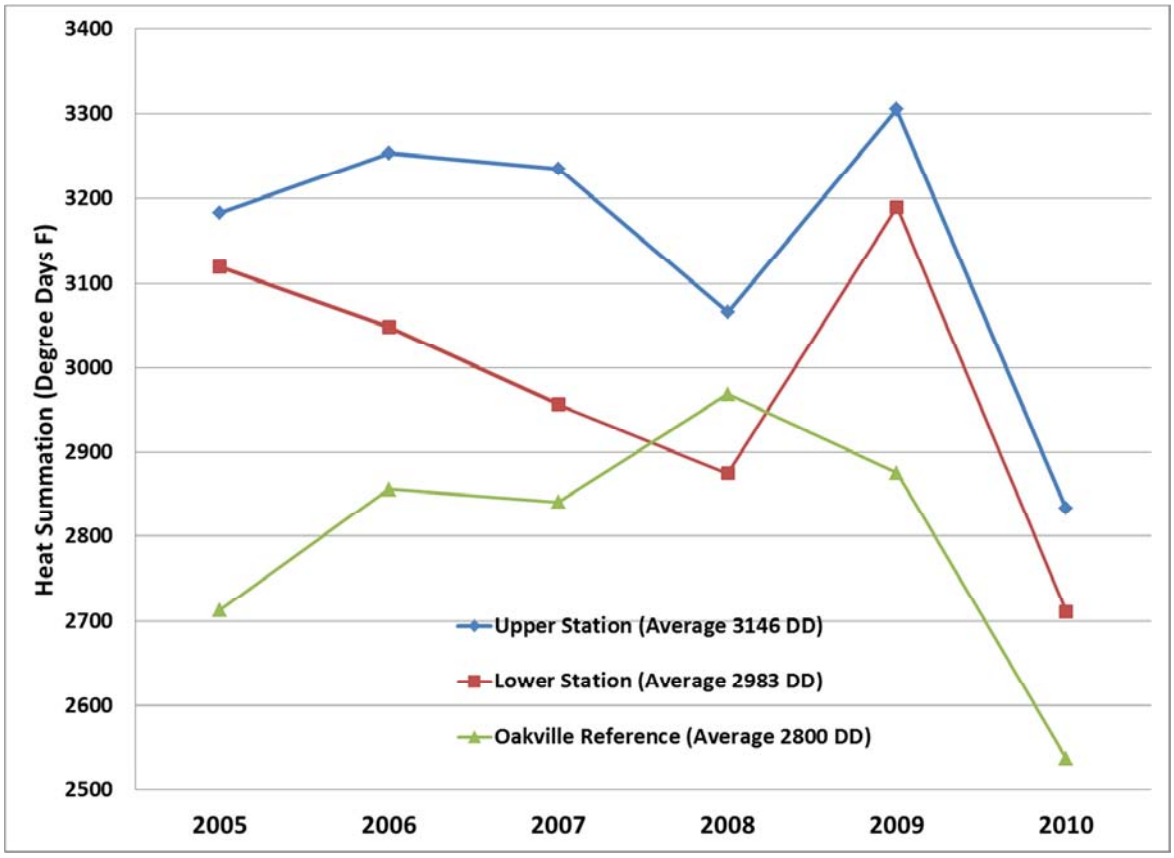

Figure 1a: Growing season heat summations for the two stations at Two Blondes Vineyard for the 2005-2010 growing seasons, along with those for Oakville, CA. 50°F was used as the baseline temperature.

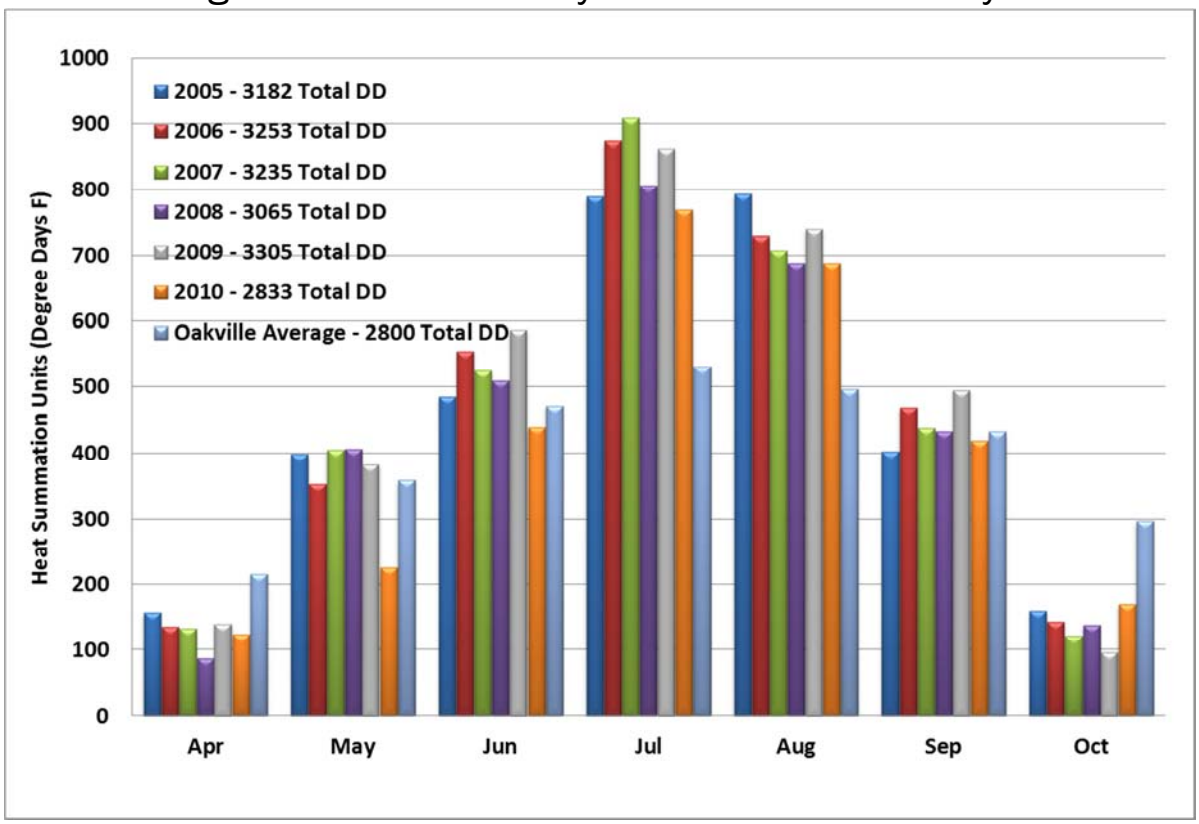

Figure 2a: Monthly heat summations for the top station at Two Blondes Vineyard for the 2005-2010 growing seasons, along with a long-term averages for Oakville, CA. 50°F was used as the baseline temperature.

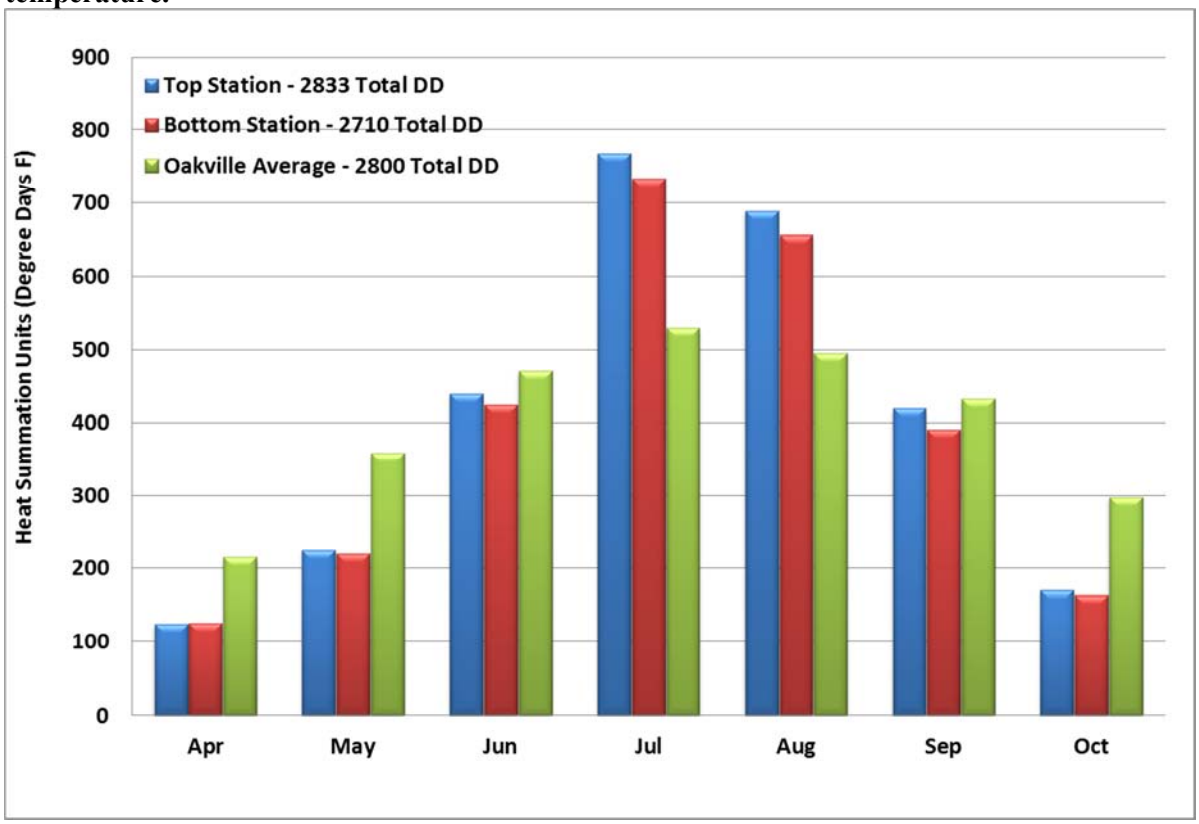

Figure 2b: 2010 monthly heat summations for two locations at Two Blondes Vineyard, along with a long-term average for Oakville, CA. 50°F was used as the baseline temperature.

During the hottest month (July), average daily maximum temperature was lower in 2010 than in any previously-measured year (**Figure 3**). Likewise for May, June and August, where temperatures in late spring were substantially lower than in previous years. This may have the effect of delaying bloom and possibly compromising fruit set. Temperatures during April, September and October were similar to previous years.

Comparing the upper and lower weather stations on the property (**Figure 4**), spring and fall daily maximum temperatures were quite similar and summer temperatures were only slightly (about 1°F) higher at the upper station relative to the lower station.

Generally, the heat extremes are not very high at this location, and the hottest summer months were very mild in 2010.

Daily high temperatures were higher at Two Blondes than the Oakville average during July and only during July. In previous years, August high temperatures were higher at Two Blondes than at Oakville, but there has been a general cooling trend in the past five years, making August 2010 temperatures similar to the long-term Oakville average. Oakville temperatures are higher during September and much higher during October and in April, pointing to a key difference in the ripening periods between the two growing regions. The milder daily maximum temperatures are conducive to high quality wine production, but present a challenge to grape ripening in the short-season at this location.

With the exception of May, temperature minima by month were most similar to those of 2005 (**Figure 5**). May featured much lower minimum temperatures than in past years, again suggesting a delayed bloom and fruit set period and potential for poor fruit set. Other months were more typical and September temperature minima were higher than in most of the prior year. Relatively warm minimum temperatures in August and September would assist the ripening process as tannins and other flavor components would be allowed to mature even during the nighttime. This may have allowed fruit to mature at a lower sugar content than in previous vintages, producing wines with greater elegance and depth without overbearing alcohol content. October temperatures showed cold nights, and coupled with cool days, the ripening processes would have slowed down into October. As has been true in the past, the bottom station had consistently colder temperatures than the top station (**Figure 6**), with temperature differences between 2 and 3°F. Colder nighttime temperatures are to be expected at lower elevations within a given location, due to settling of the colder air during the stable night conditions. Warmer uphill temperatures at night are generally beneficial to fruit ripening, and this may be important in cool years such as this one.

The night temperatures are quite cold during early spring and during fall. Night temperatures during mid-summer are quite mild, and even a bit warm (relatively speaking). The “warmer” nights during a portion of the season will aid in fruit development, since fruit metabolism is generally independent of photosynthesis, and is highly temperature dependent. However, if fruit has not matured by the end of September, further ripening will be impeded by both cool daytime and cold nighttime temperatures. If attaining fruit maturation has been or is found to be a challenge, moving the fruit zone lower to the ground may be a way to increase the temperature regime of the fruit and enhance the ripening process. That should be balanced with the consideration that temperatures are colder nearer to the ground during the winter and early spring.

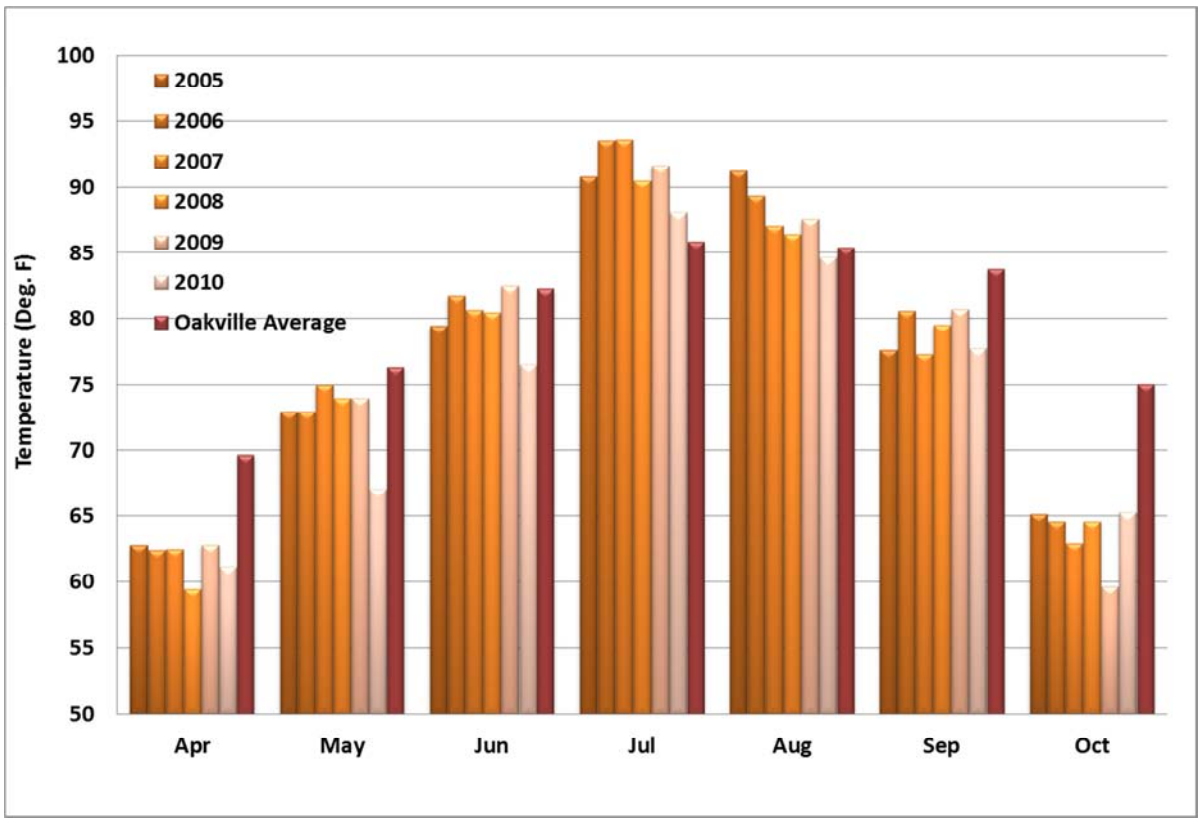

Figure 2: Monthly averages of daily maximum temperature for the top station at Two Blondes Vineyard, along with a long-term average for Oakville, CA for the 2005-2010 growing seasons.

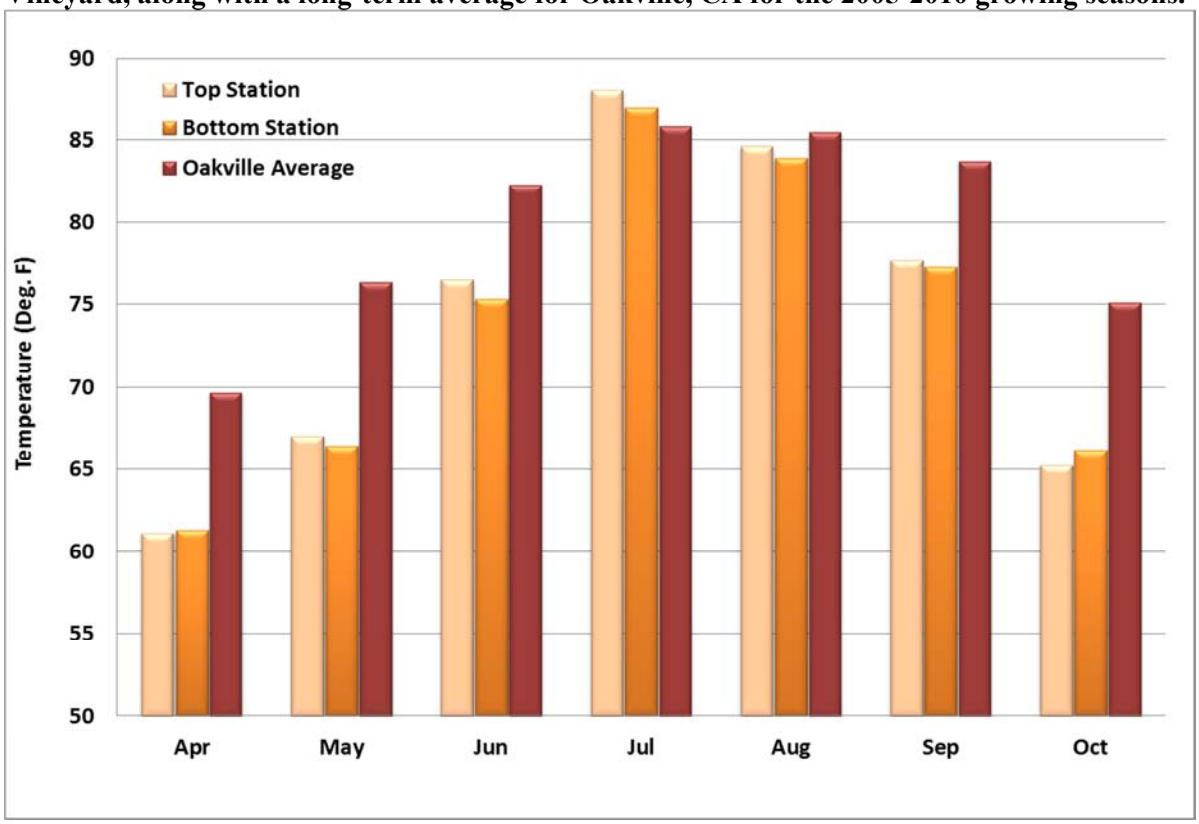

Figure 3: 2010 monthly averages of daily maximum temperatures for two locations at Two Blondes Vineyard, along with a long-term average for Oakville, CA.

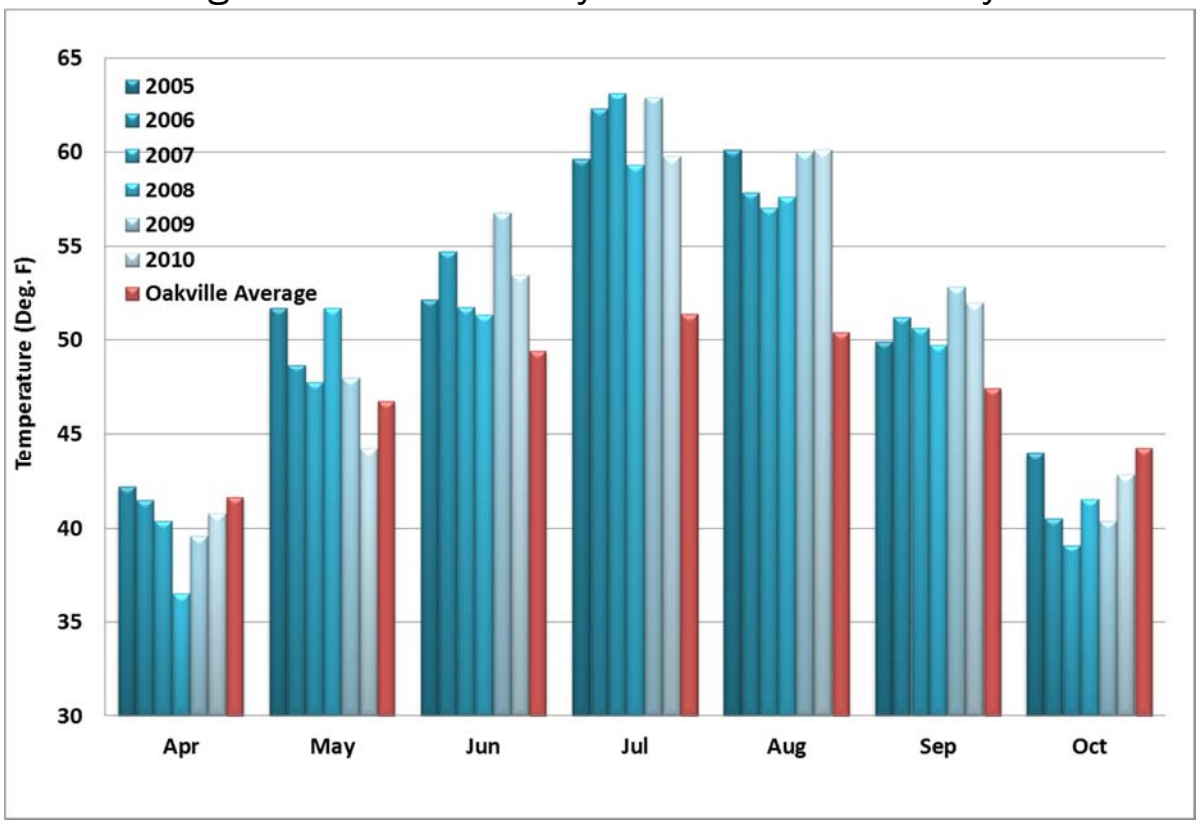

Figure 4: Monthly averages of daily minimum temperature for the top station at Two Blondes Vineyard, along with a long-term average for Oakville, CA for the 2005-2010 growing seasons.

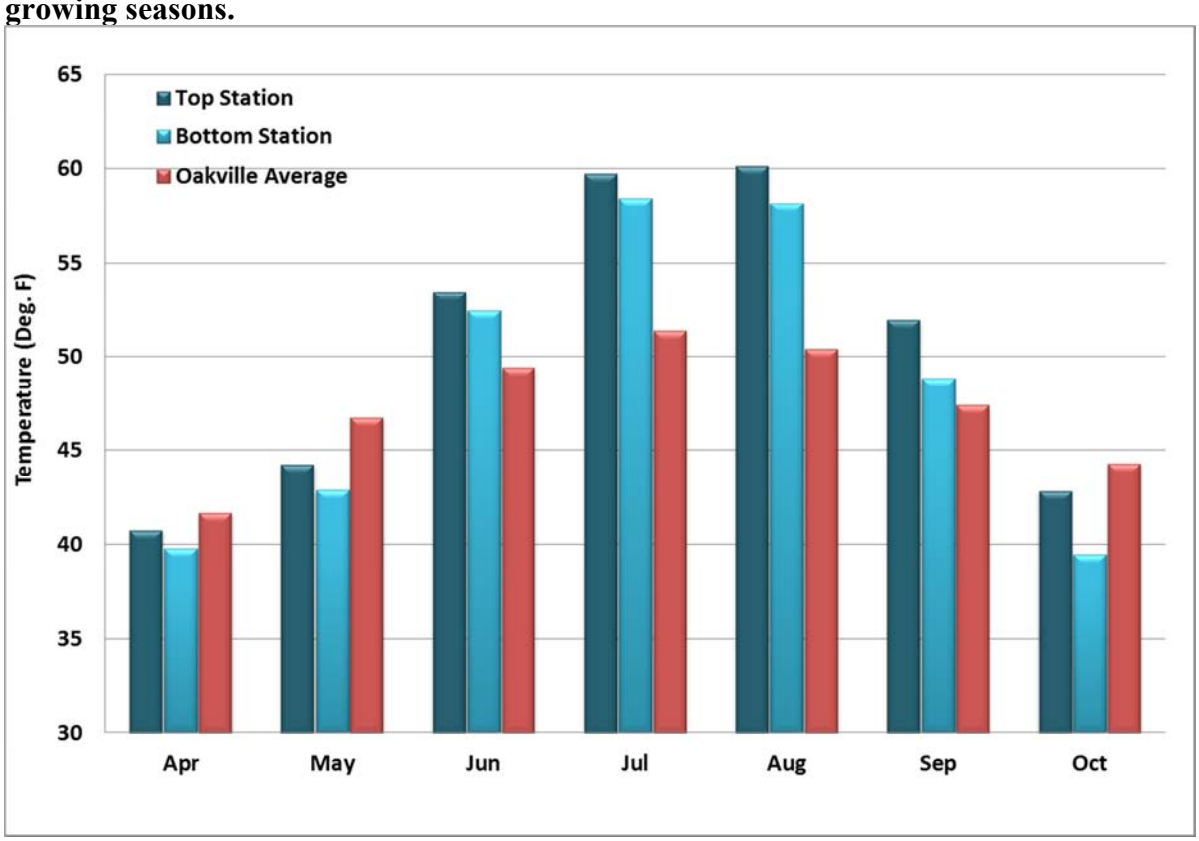

Figure 5: 2010 monthly averages of daily minimum temperatures for two locations at Two Blondes Vineyard, along with a long-term average for Oakville, CA.

Minimum temperatures were similar between Two Blondes and Oakville Average during early spring and fall. On the other hand, Two Blondes had much warmer night temperatures during June through August. September minimum temperatures are similar, though October temperatures tend to be warmer at Oakville.

II. Ripening Period Analysis

A general period of ripening was chosen for analysis, which comprises mid-August through mid-October. This period was chosen as a standard to capture the ripening periods of multiple regions and grape varieties. The average daily minimum, maximum and mean during the ripening period are shown in **Figure 7** for 2005 through 2010. Clearly, temperature minima, maxima and averages were very similar among the six years across this time period, indicating a consistency in year-to-year weather conditions (on average) during the latter portion of the growing season. Consistency of temperatures during the ripening period is a very positive attribute of a vineyard or growing region, as ripening is highly temperature dependent and is highly tied-in to vintage quality. Daily minimum temperatures during this time period showed slightly more consistency from year-to-year than did maximum temperatures. As was found for the latter months of the growing season, temperatures at the top station had higher temperature minima during the ripening period (**Figure 8**), by about 3°F. Maximum temperatures, on the other hand, were quite similar to one another during this period of time.

One aspect of the quality of a vintage is the variability of temperatures from day-to-day, not only year-to-year. Temperature variability generally is detrimental to wine quality, especially if variability includes high heat spikes. Dips in night temperature from time-to-time can also retard flavor ripening, causing flavor maturity to occur at higher brix levels or with flavor maturation sometimes not occurring to the winemaker's satisfaction at all (especially problematic with short season regions, such as this one). The standard deviations in the daily temperature minima, maxima and averages during ripening are shown in **Figure 9**. Day-to-day temperature variability during the ripening period was much lower during 2010 than it was in the previous 5 growing seasons. This was true for maximum, minimum and average daily temperatures. This bodes well for a high-quality vintage. Temperature variability tends to be higher at Two Blondes than at the Oakville reference location, though primarily with regard to daily minimum temperatures.

The average diurnal temperatures during the ripening period are a very illustrative way of looking at the temperature characteristics during this critical period. Comparing diurnal temperatures in 2005-2010 (**Figure 10**), the night temperatures were nearly identical to one another in 2005 and 2006 and very close together in 2007 and 2008. Night temperatures in 2009 and 2010 were in the middle of the group, yet tended to be warmer as morning approached. Overall, night temperatures were most similar to those of 2009. On the other hand, the daytime temperatures were warmest in 2006, and coolest in 2007, while daytime temperatures in 2010 were most similar to those of 2009. This suggests that the 2010 climatic terroir during ripening was most similar to that of the 2009 vintage, though also similar to the 2008 vintage.

The ripening temperature differences between the upper and lower vineyard locations is evident in the average diurnal temperature curves (**Figure 11**). It is clear to see that the top station experienced warmer temperatures during the nighttime as well as the daytime, typical of that seen in previous years. The temperatures during the nighttime are critical for fruit maturation.

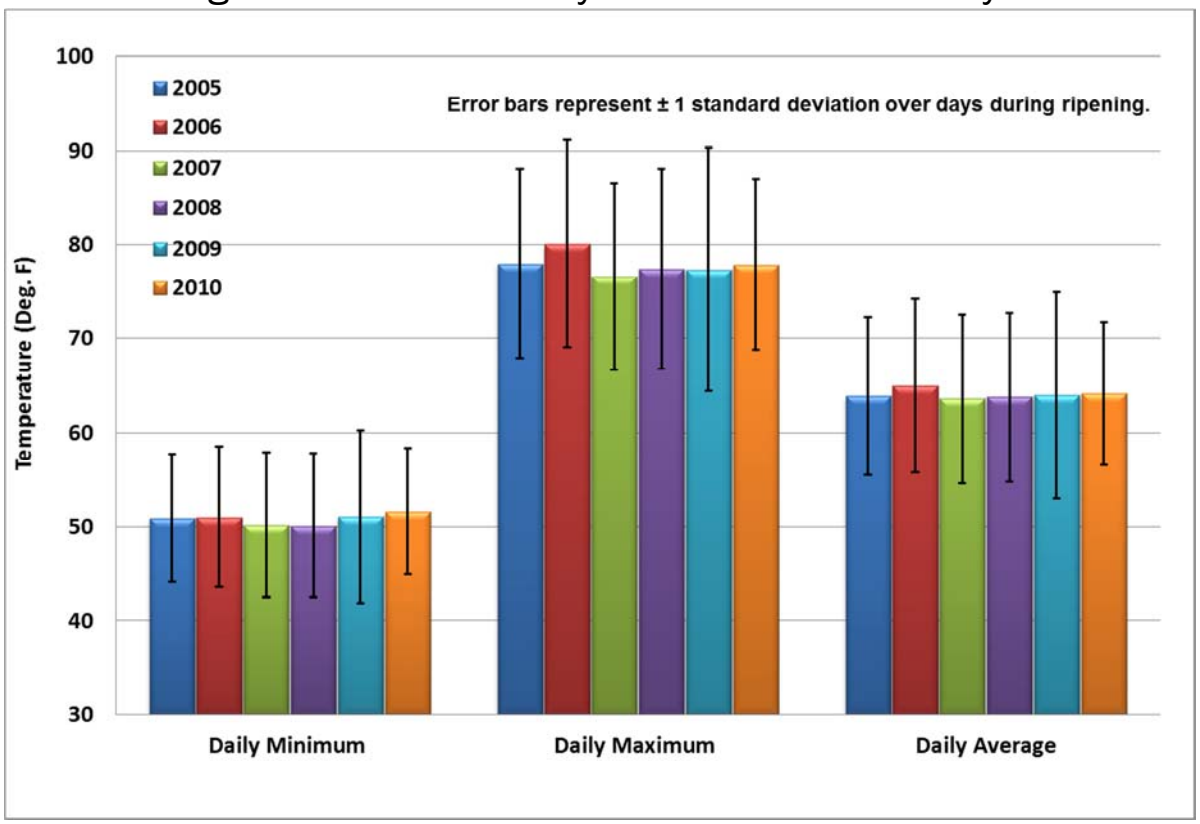

Figure 6: Average daily minimum, maximum and average temperature during the 2005-2010 ripening periods (August 15th through October 15th).

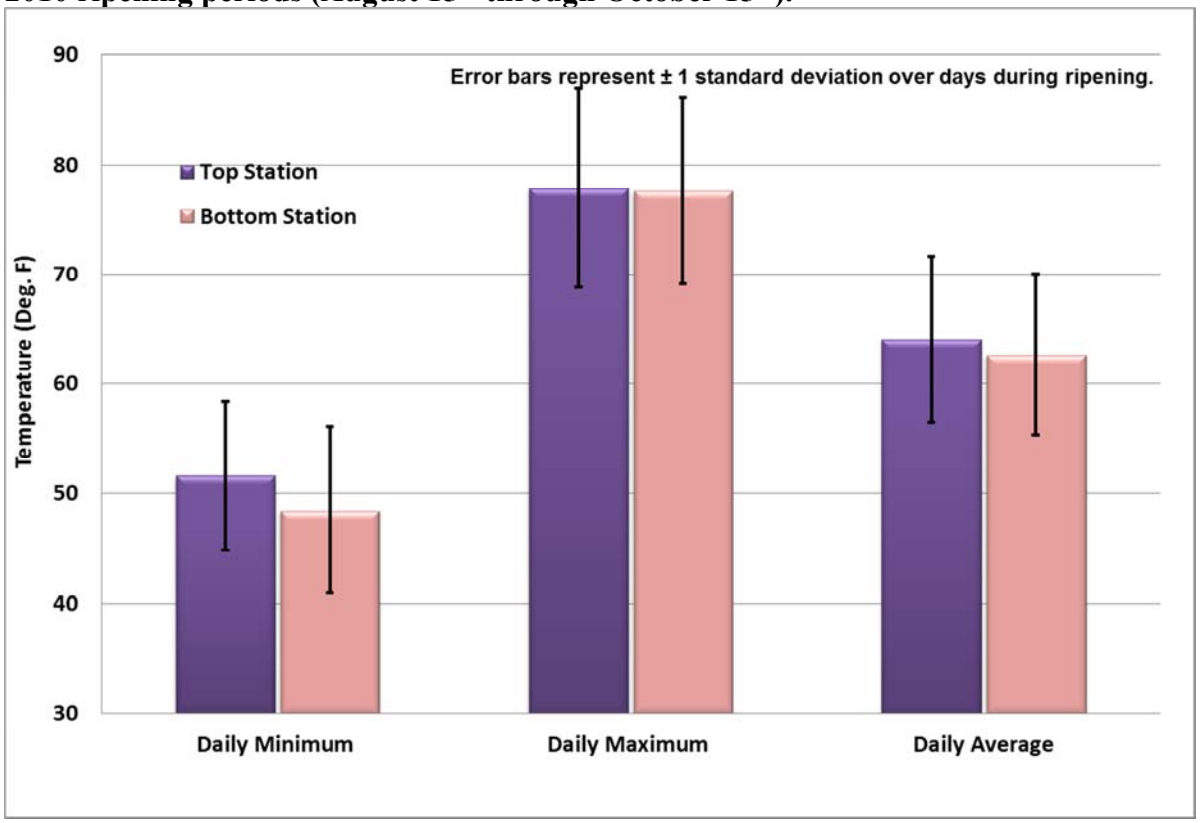

Figure 7: Average daily minimum, maximum and average temperature during the 2010 ripening period for two stations at Two Blondes Vineyard.

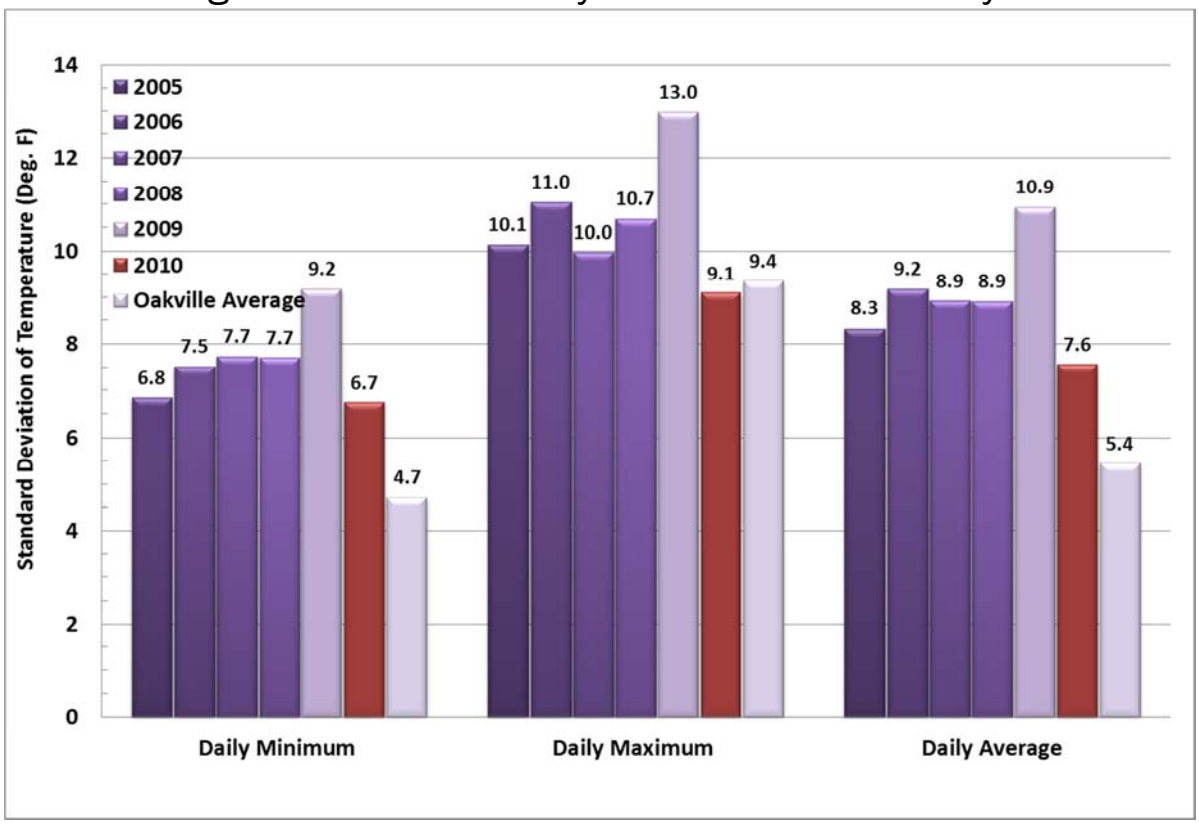

Figure 8: Standard deviations of daily minimum, maximum and average temperature during the 2005-2010 ripening periods for the top station at Two Blondes Vineyard, along with the same for the long-term average at Oakville.

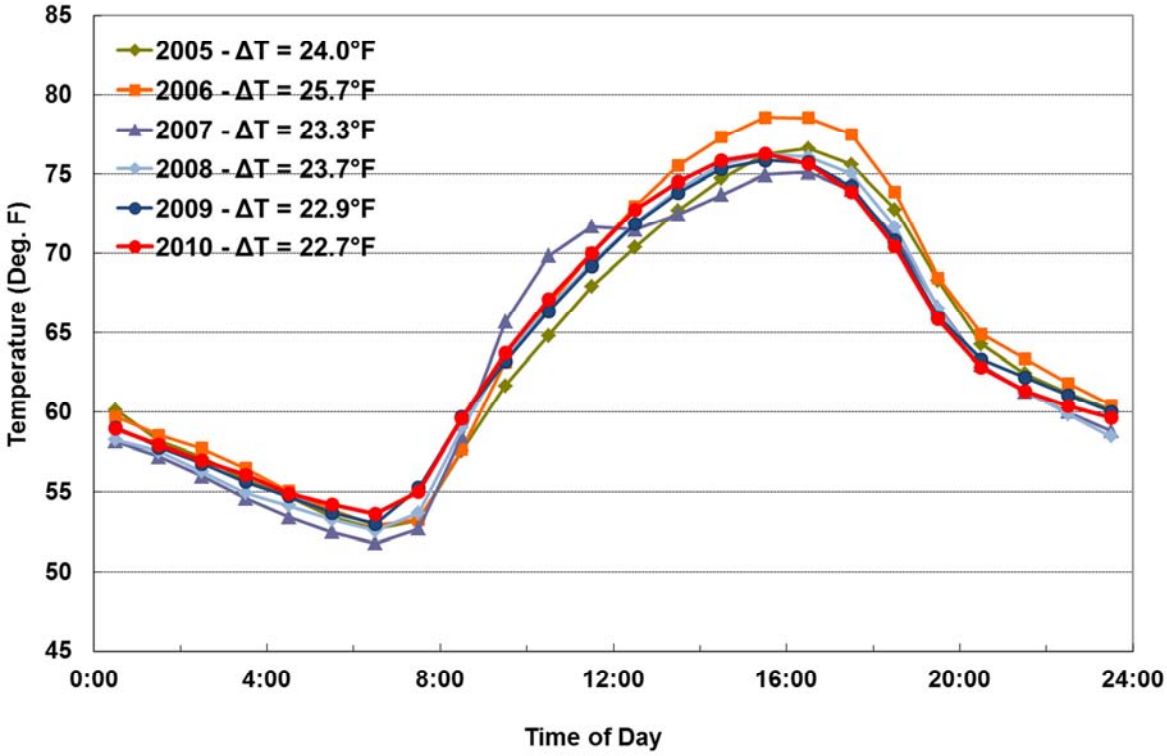

Figure 9: Average diurnal temperature cycle for two locations during the 2005-2010 ripening periods (mid-August through mid-October) for Two Blondes Vineyard.

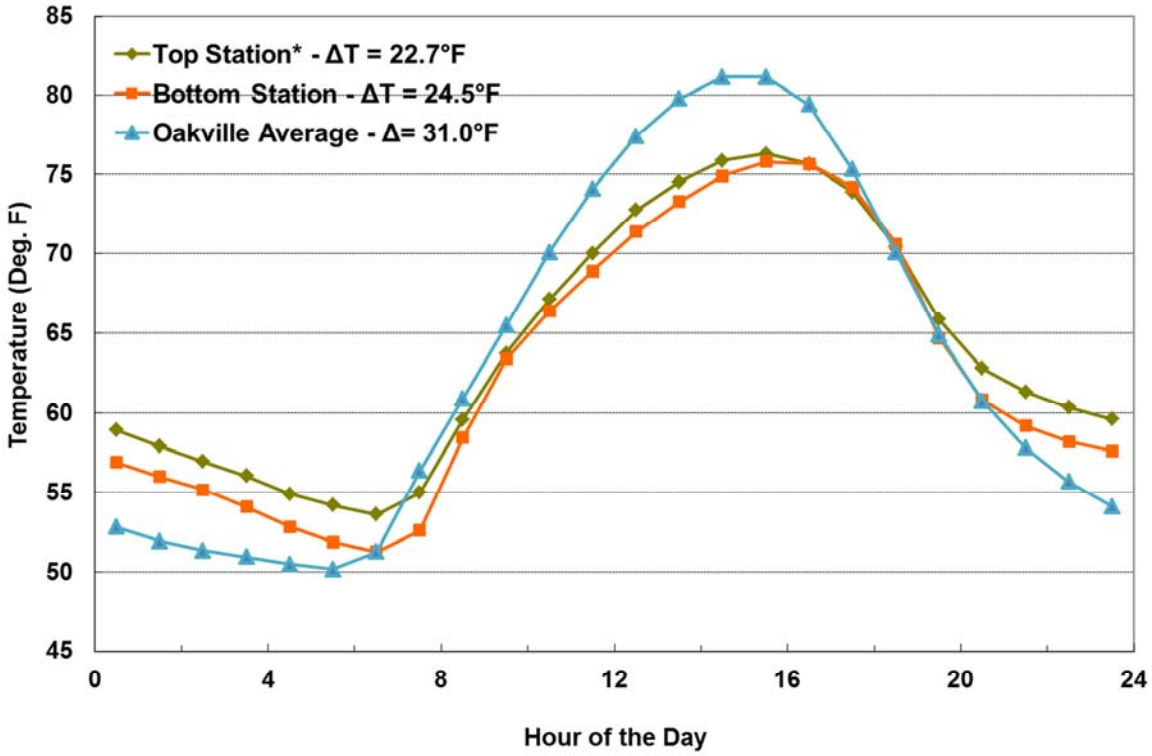

Figure 10: Average diurnal temperature cycle for two locations at Two Blondes Vineyard, along with a long-term average for Oakville, CA during the 2010 ripening period (mid-August through mid-October).

Temperatures need to stay above 50°F for berry metabolism to continue. Generally speaking, warmer night temperatures will allow fruit to reach "flavor maturity" at lower sugar content. The upper location better epitomizes the warmer night characteristic.

The primary difference between the average diurnal temperature pattern during ripening between Two Blondes and Oakville, CA is that the Oakville temperatures are about 5°F warmer during the day (during the ripening period) and 3-5°F colder at night. This pattern is not typical for the entire season, as Oakville high temperatures are not as high as Two Blondes during July and August. Night temperatures at Oakville tend to drop more quickly in the evening, but remain mostly level during the nighttime. Two Blondes temperature remains warmer in the early afternoon and declines steadily until dawn, arriving at a similar temperature minima as Oakville for the bottom station. The upper Two Blondes location remains about 2°F warmer than Oakville during its coldest (predawn) time.

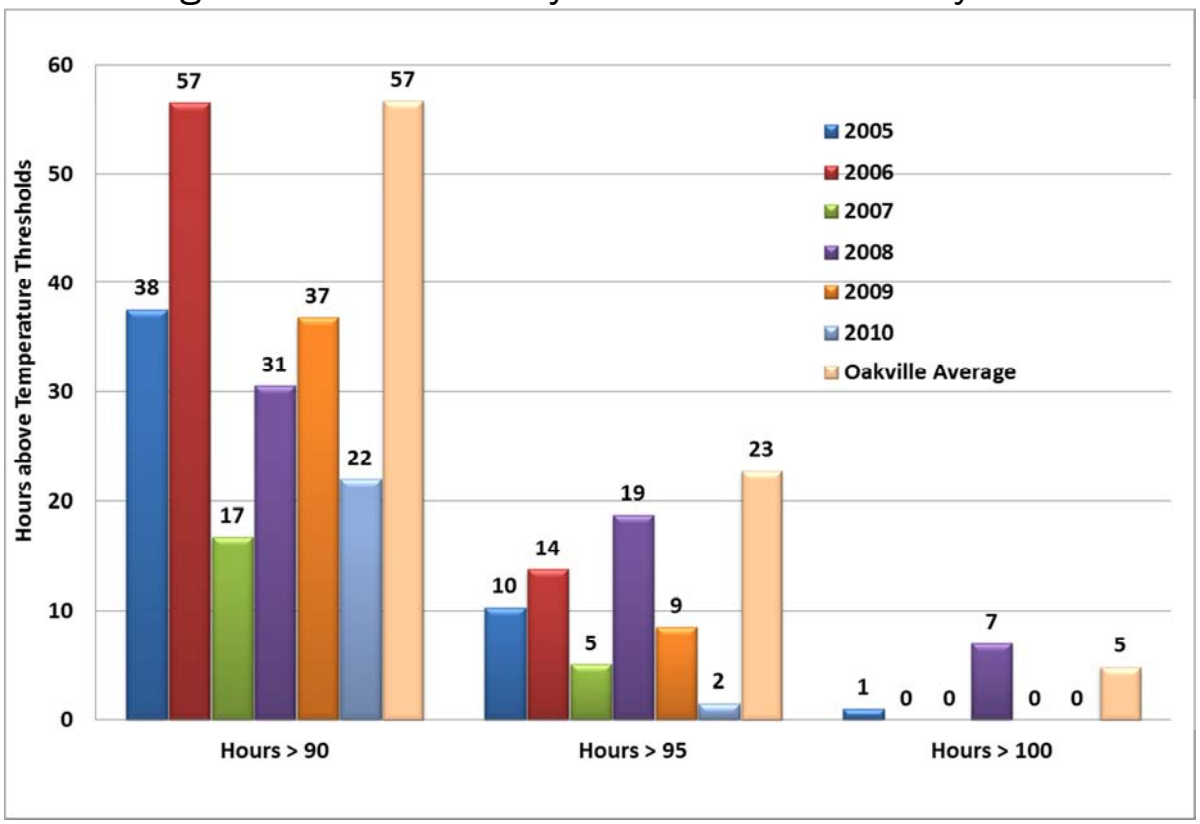

Figure 11: Hours above given critical temperatures during the ripening stage in 2005-2010 for Two Blondes Vineyard along with long term averages for Oakville, CA.

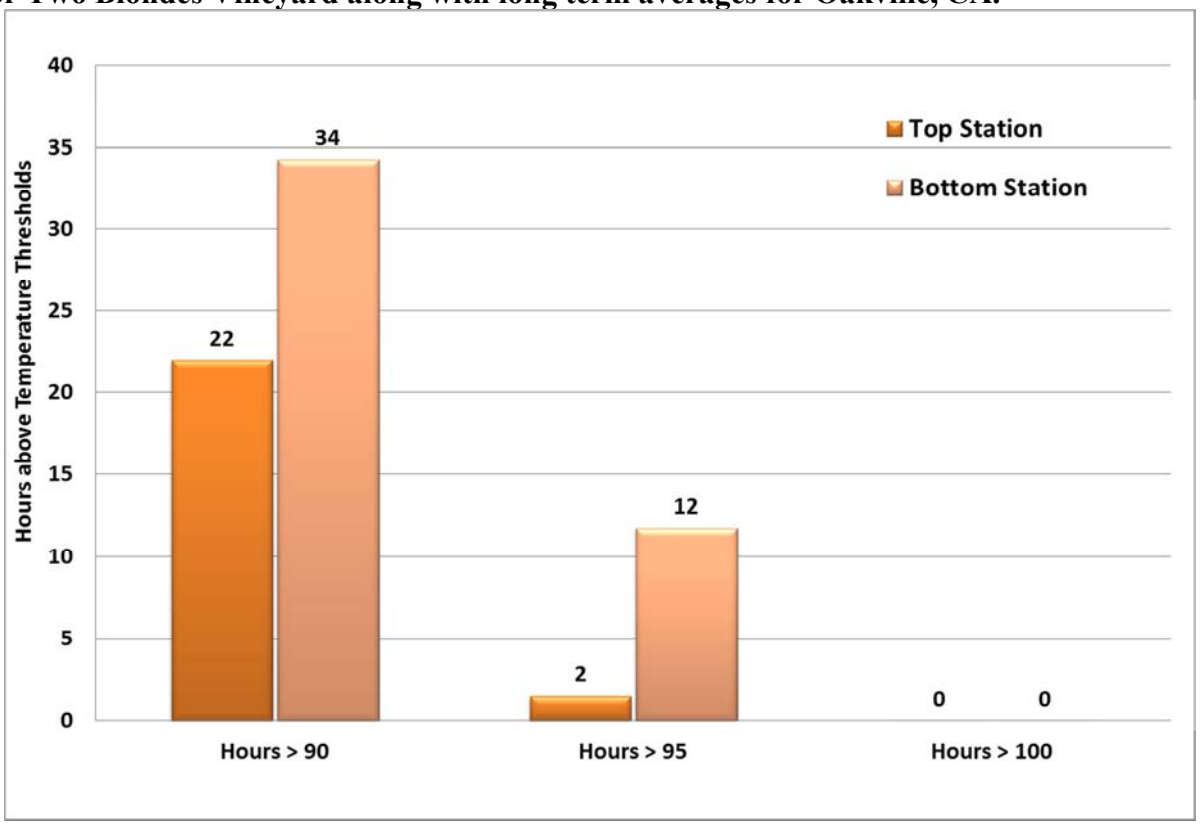

Figure 12: Hours above given critical temperatures during the ripening stage in 2010 for two locations at Two Blondes Vineyard.

Finally, it is instructive to evaluate the time during which the temperatures exceeded given threshold levels during the ripening period (**Figs. 12 and 13**). While foliage and fruit temperatures are of primary importance (not ambient temperatures), we can estimate that foliage temperature roughly tracks air temperature ± a few degrees, depending on stomatal opening or closure. Fruit temperature, on the other hand, is difficult to broadly determine. However, fruit in persistent shade will equilibrate to ambient temperature, while fruit exposed to sunlight may reach at least 15°F above ambient temperature. 90°F represents a temperature where photosynthesis in the leaves begins to decline, but fruit quality is not thought to be impacted. Actually, such temperatures are desirable, as they slow down the progress of powdery mildew fungus There were few hours above 90 degrees in 2010, similar to 2007 in this respect. The bottom station experienced about 12 hours more time at this threshold than did the top station.

At 95°F, leaf photosynthesis is essentially zero while 100°F is the temperature at which heat shock proteins are produced by the plant (a protection against heat stress). In the fruit, secondary metabolism (responsible for anthocyanin, tannin and flavor precursor formation and degradation) is highly sensitive to temperature, although the optima and maxima have not been elucidated by researchers yet. However, it is clear that, at hot temperatures (especially those of exposed fruit), anthocyanins are degraded resulting in lower extractable wine color. Fruit aromatic compounds are similarly degraded. It is generally felt that air temperatures in excess of 100°F will degrade wine quality, while temperatures between 95 and 100°F will be less detrimental to quality.

At Two Blondes Vineyard, 2010 exhibited only 2 hours above 95°F and zero hours above 100°F during the ripening period. These are lower than normal values for this location (with regard to the 95 degree threshold) and are typical at the 100 degree threshold. This points to the relatively mild climatic conditions with few high temperature events, and essentially no extreme temperatures. From the last six seasons' data sets, it does not appear as though this location receives long periods of high heat during the ripening period, which bodes well for wine quality. The scarcity of high temperature events indicates that high heat stress conditions are not a common occurrence at this vineyard during ripening, which is a strong positive characteristic. That will allow the fruit to attain high quality with a rapid degradation of undesirable vegetative character during the ripening process.

High temperature events during ripening are similar to those of Oakville, but even less common. The scarcity of high temperatures during ripening is a characteristic of high-quality growing regions. There were generally fewer hours of high temperatures (above both 95° and 100°F thresholds) at Two Blondes relative to Oakville in most years of record. That is true for both the upper and lower locations of Two Blondes Vineyard.

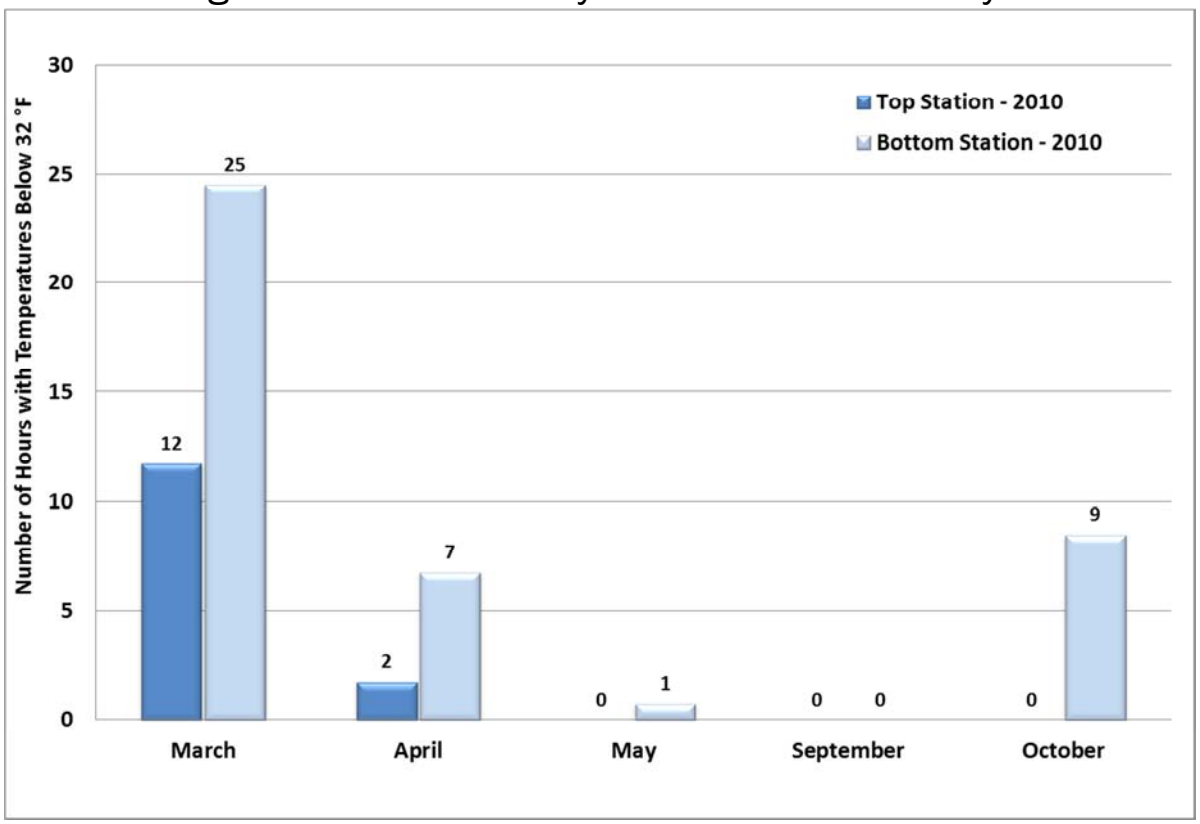

Figure 13: Total number of hours per month below 32°F during the frost-prone periods for two locations at Two Blondes Vineyard in 2010.

III. Frost Risk Analysis

The bottom station is most likely to be affected by frost, due to its consistently lower minimum temperatures than the top station **(Figure 14)**. There were fewer frost-prone (below 32°F) hours in April of 2010 than in 2005, 2007 and 2008 (**Figure 15**) and a similar number as 2006 and 2009. This indicates a relatively mild spring frost condition in 2010. It appears consistent that the spring frost season ends with the month of April on a consistent basis, even though one hour below the temperature threshold was recorded in May of 2010. On the other hand, the fall frost season begins with the month of October, for which 2010 was milder than the past 4 years, but slightly more severe than 2005.

More detailed looks at the daily minimum temperatures and how they may impact frost are shown in Figures **16 and 17** for spring and fall, respectively. Frost temperatures occurred primarily during late March and early April, with no occurrences below 32°F later in April. This is in contrast with the late frost conditions that occurred in April of 2008. A strong, early frost occurred in mid-October (October 17th), which was later than the fall frost in 2009. Prior years were excluded from the chart for clarity, but it appears as though the frost-free period runs between mid-April through early October. Fall frosts are less detrimental than spring frosts and tissue can tolerate lower temperatures in the fall than in the spring.

From the previous 4 years of data, fall frost did not appear to be a significant hazard. However, conditions in 2009 and 2010 showed that an early frost may occur on occasion. Because the temperatures cool so quickly in the fall, fruit will probably not continue to mature that late into October anyway. Fruit will withstand frost temperatures just below 30°F, but foliage will be damaged below approximately 29°F, and will drop off the vines as a result. No long-term damage will result from the fall frosts, but it would be beneficial to have harvested fruit by early-October at the latest to allow the vines some time for recovery after harvest and before leaf drop.

For interest, plots of daily minimum temperatures for the two locations are plotted alongside one another for 2009 in **Figures 18 and 19**. Clearly, there is less potential for frost in the upper elevations of the property. The upper side would have probably not suffered from frost damage during the spring or fall, unlike the lower side of the vineyard.

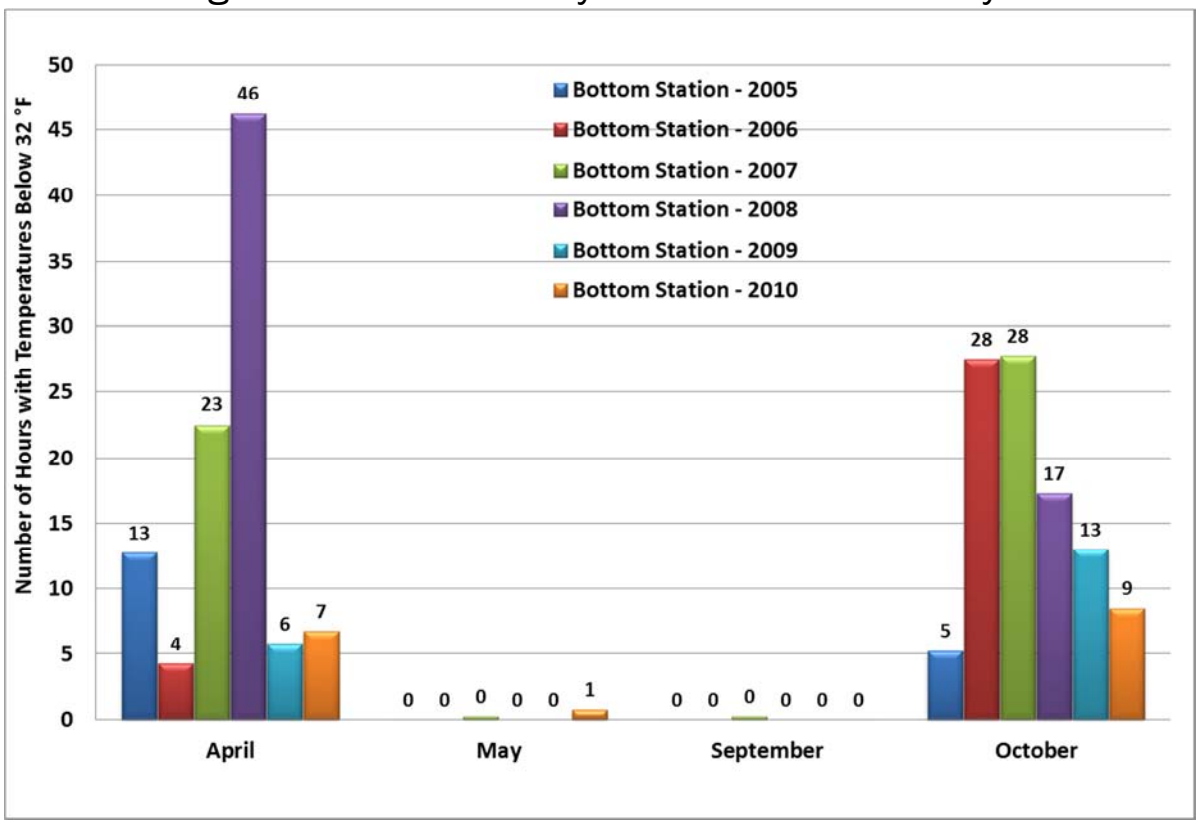

Figure 145: Total number of hours per month below 32°F for the bottom location at Two Blondes Vineyard for 2005-2010 (frost-prone months only). March 2010 data was not available.

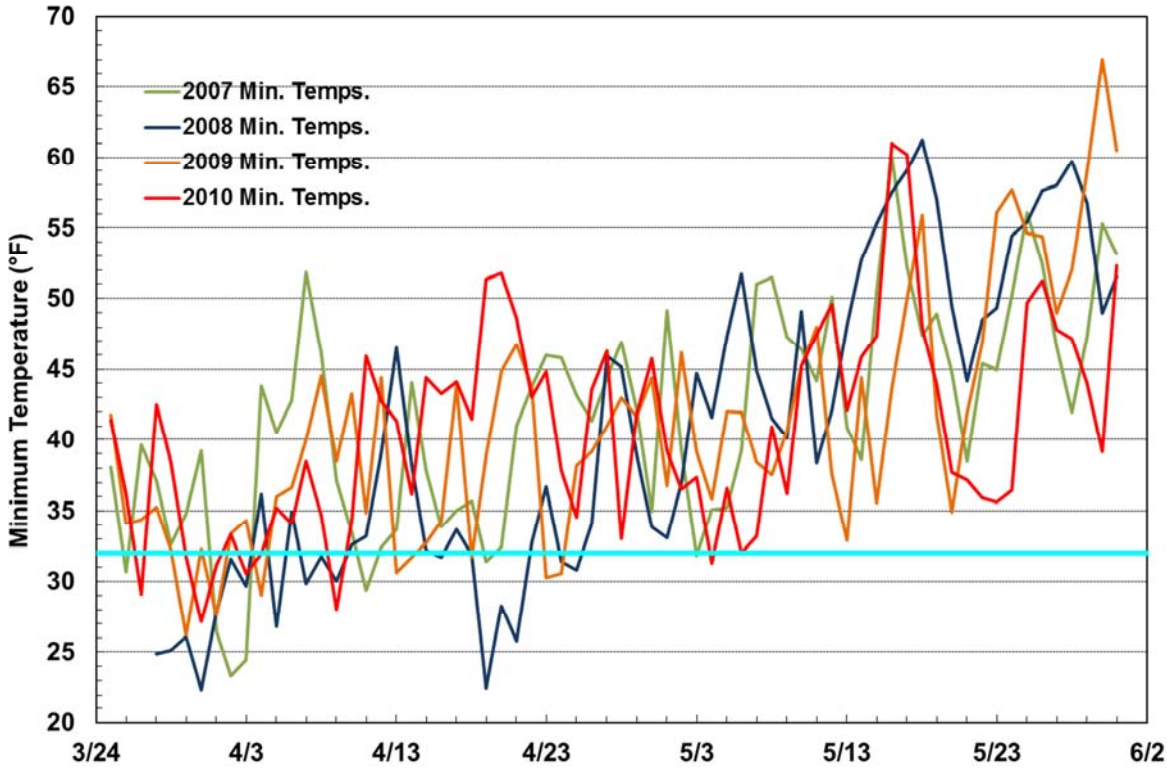

Figure 15: Daily minimum temperatures during the spring frost periods of 2007-2010 for the bottom station at Two Blondes Vineyard.

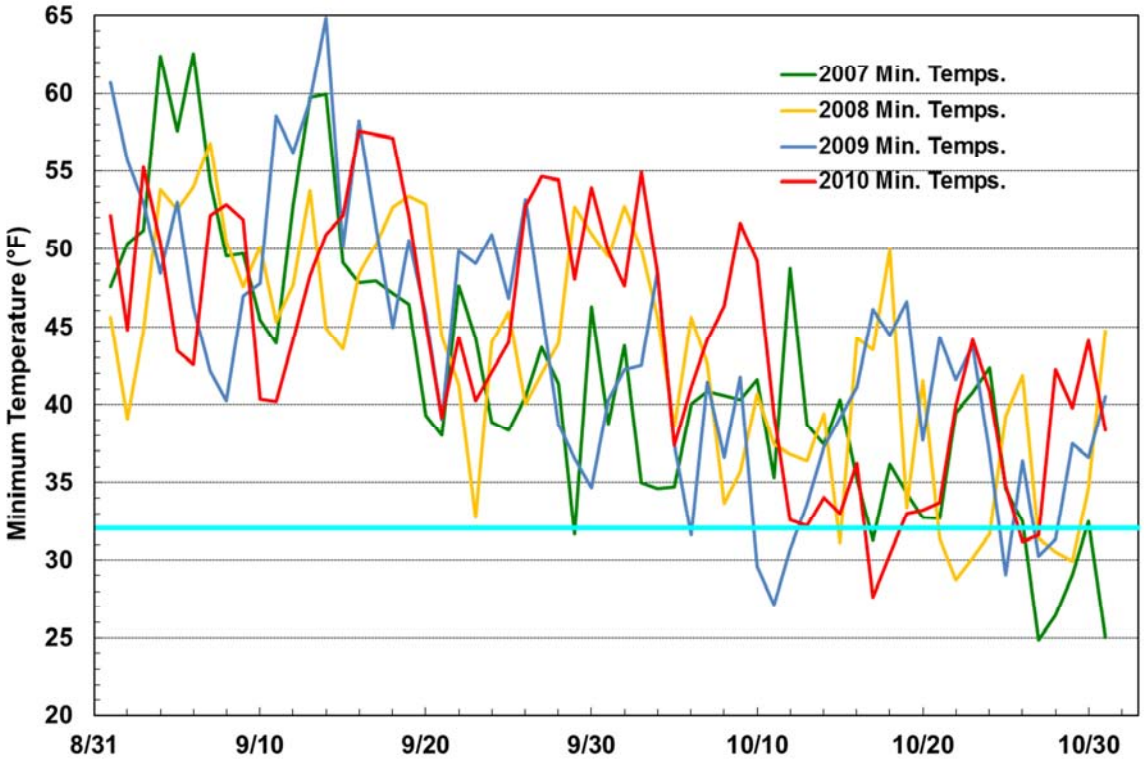

Figure 16: Daily minimum temperatures during the fall frost periods of 2007-2010 for the bottom station at Two Blondes Vineyard.

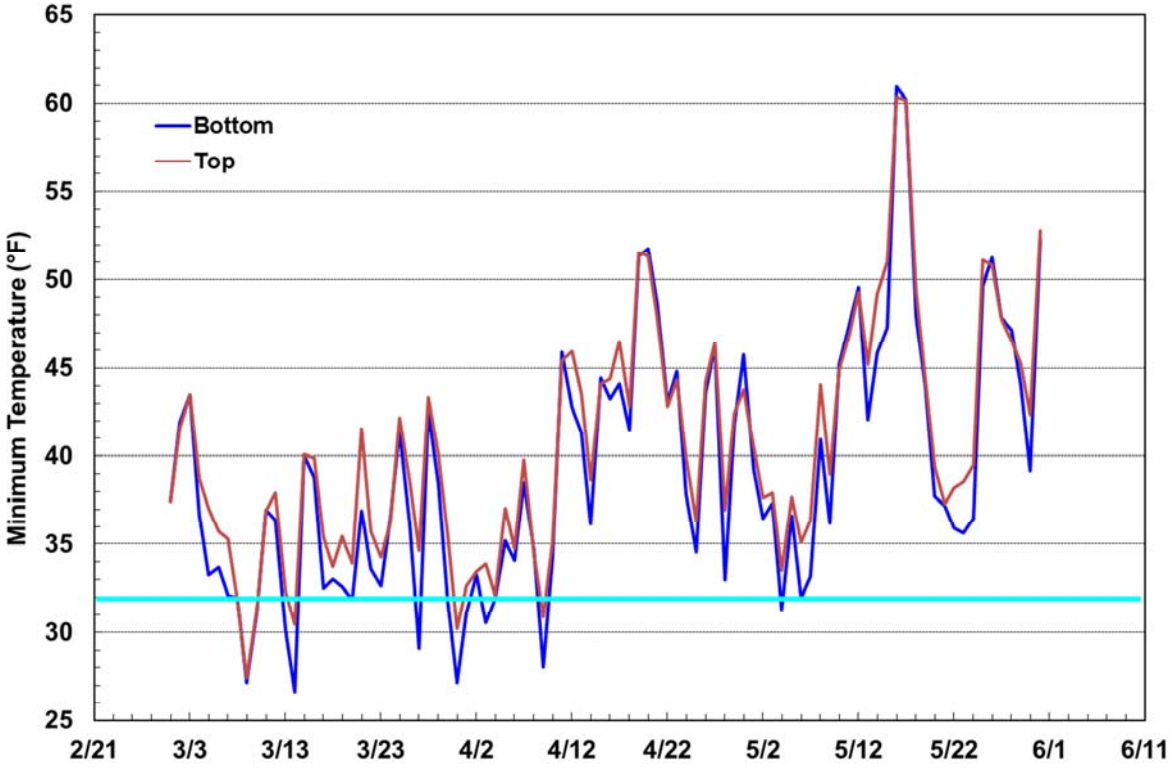

Figure 17: Daily minimum temperatures during the spring frost period of 2010 for the two stations at Two Blondes Vineyard.

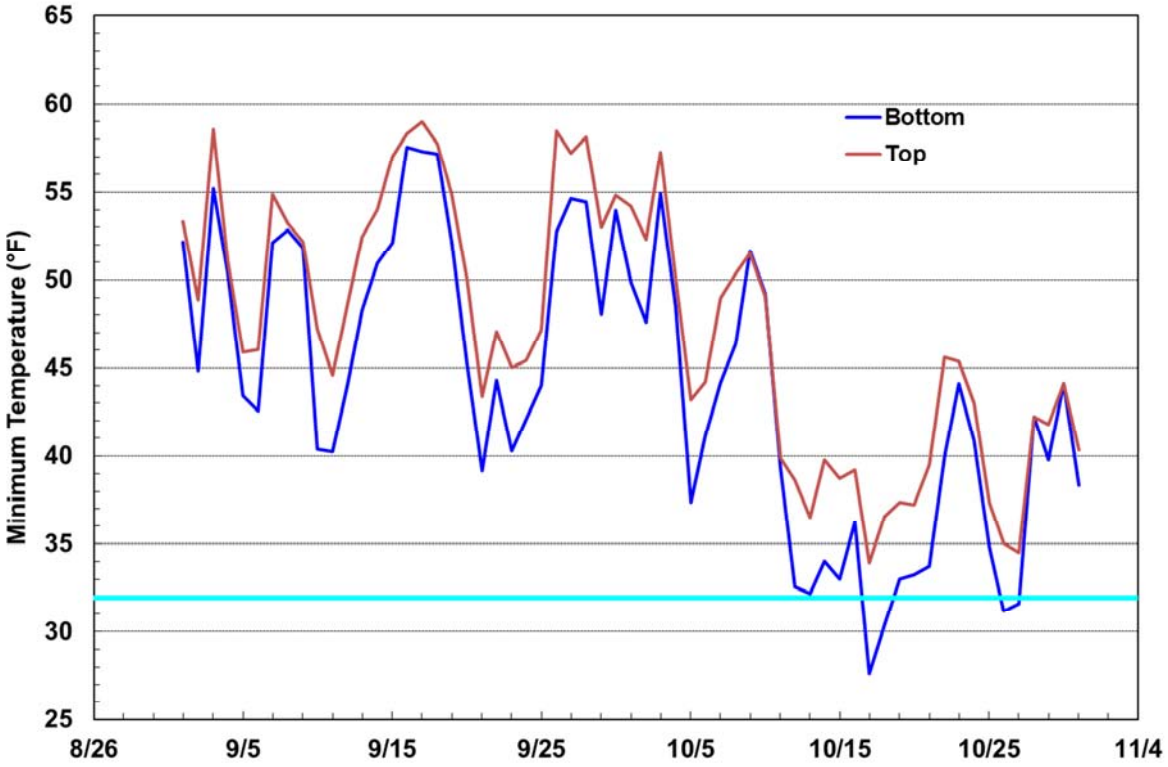

Figure 18: Daily minimum temperatures during the fall frost period of 2010 for the two stations at Two Blondes Vineyard.

IV. Conclusions

This limited, but continually-growing data set suggests that there are sufficient heat summation units available to ripen all Bordeaux varieties. On average, the site receives about 3150 degree days F, putting it in a cool Region III on the Winkler scale. The lower portions of the vineyard receive about 150 fewer degree days than the upper portions, which may make ripening of the later-season varieties more difficult, but still possible, as slightly warm night temperatures allow for "night ripening". Nevertheless, Cabernet Sauvignon may be challenging to ripen at the lower elevations of the property. The season length is short, but temperatures warm quickly in spring, allowing vine development to catch up with other growing regions, such as those at lower latitudes. However, temperatures also fall rapidly during the fall, so fruit must mature by early October, or it will have difficulty achieving flavor maturity and risk termination of the growing season by frost. Cabernet Sauvignon is the most difficult variety to ripen here, so it should be treated with some exposure of the fruit to increase fruit temperature, so as to expedite the ripening process. The lack of extreme heat here indicates that some moderate leaf removal may be performed without high risk of fruit sun-damage.

The 2010 vintage was characterized by much cooler temperatures than the previously-recorded temperatures during 2005 through 2009. 2010 was a very cool season, following on the heels of a relatively warm 2009 season. It is possible that fruit ripening was difficult and also likely that some vegetative flavors were present in the fruit at harvest. It is more likely that fruit in the upper elevations had more complete ripeness than those in the lower elevations.

General climatic assessment:

The lack of extreme temperatures during ripening is a benefit to this vineyard, as this will allow fruit to ripen without potential for sunburn or other degradation due to excessive heat. However, there may be high temperatures before fruit has reached veraison, since July temperatures tend to be warm to hot in some years. Heat during July may also be damaging to the green berries, so some heat protection should be maintained, in the form of retained leaves on the afternoon sun side of the canopy. This is particularly important for the Merlot. This lies in contrast with the statement regarding Cabernet Sauvignon. Leaf removal in that variety should be performed when the berries are at pea-size or slightly smaller, which will allow them to acclimate to the changed light regime.

The mild temperatures during ripening are accompanied by mild, but not cold, temperatures at night (at least early in the ripening period). This will allow for some "night ripening" of fruit, which allows flavors and tannins (etc.) to develop without accompanying sugar accumulation, which occurs during daylight hours. The net result is that flavor maturity may be reached before sugar (and potential alcohol) levels become excessive, creating wines that are complex, yet elegant in style.

Harvest must be concluded at or before mid-October, as temperatures cool rapidly, with the potential of first fall frosts late in the month. The relatively short season is created by cool months of April and October. This, coupled with warm months of July and August, but without high heat during the ripening period characterizes the winegrowing climate of this site. This differentiates it from other Bordeaux-variety-growing regions, such as Napa Valley. Napa Valley has a longer growing season, can tolerate long hang-times, and yet is punctuated by occasional heat events throughout the fruit development period. The latter characteristics are not attributes of Two Blondes Vineyard. The cool 2010 season was preceded by a relatively warm season, which is illustrative of the unpredictable nature of the weather in this region. That means that the bloom and/or fruit set dates should be recorded every year and that delays in the season (due to cool spring weather) should be accommodated by fruit thinning, modest leaf removal, and reduced irrigation to stimulate the ripening processes.