Climatic Analysis of the Lamorinda Area

by Patrick L Shabram

Prepared by Patrick L Shabram for the Lamorinda Winegrowers Association

Summary

The Lamorinda area, encompassing the communities of Lafayette, Moraga, and Orinda, is generally warmer than areas to the north, west, and south; areas more exposed to coastal influences. The Lamorinda area is also cooler than eastern Contra Costa County, but not necessarily cooler than inland locations at Concord and Pleasanton. Yet Lamorinda's viticulture is heavily influenced by terrain with microclimatic variations associated with air drainage and exposure. As such, terrain is important in distinguishing Lamorinda's climates from climates in the broader, flatter Ygnacio Valley and the Livermore Valley to the east.

Background

In the interest of assessing the unique characteristics of the Lamorinda area, the Lamorinda Winegrowers Association has asked me to review the climate characteristics of the Lamorinda area. Located in central Contra Costa County, the Lamorinda area encompasses the communities of Lafayette, Moraga, and Orinda. The viticultural area may not necessarily correlate specifically to these communities, although the name "Lamorinda" does. The purpose of this study is both to establish what climatic characteristics define Lamorinda and to help establish the general parameter of the area. This report will be compared to geologic and historical reports for the purpose of creating a petition for establishment of the Lamorinda Viticultural Area.

This study utilizes 2007 to 2011 weather data for eight weather stations from known reliable sources. Four of these weather stations are part of the California Irrigation Management Information System (CIMIS). Four additional weather stations belong to the East Bay Municipal Utility District (EBMUD) and are located at local reservoirs. Data from each station was carefully analyzed to determine reliability of both the data and the location of the station, and any data deemed unreliable was excluded from the final analysis.

Weather Stations

The weather stations analyzed include (listed generally from east to west and north to south):

- An EBMUD station located at San Pablo Reservoir north-northwest of Orinda. Exact location of this weather station is not immediately available. This weather station is listed in this report as "SanPablo."
- An EBMUD station located at Briones Reservoir north of Orinda. Exact location of this weather station is not immediately available. This weather station is listed in this report as "Briones."
- CIMIS station #147 Oakland Foothills located on the Mills College Campus south-southwest of Moraga, 37°46'51"N 122°10'44"W. This station is listed as "OakFthills."

- An EBMUD station located at Lafayette Reservoir located between Orinda and Lafayette. Exact location of this weather station is not immediately available. This weather station is listed in this report as “LafRes.”
- An EBMUD station located at Upper San Leandro Reservoir south of Moraga. Exact location of this weather station is not immediately available. This weather station is listed in this report as “USanLean.”
- CIMIS station #170 Concord at the Diablo Creek Golf Course in northern Concord northwest of Lafayette, 38°00'15"N 122°01'12"W. This weather station is listed as “Concord.”
- CIMIS station #191 Pleasanton in Alameda County, well southeast of the communities of Lafayette, Moraga, and Orinda, 37°39'50"N 121°53'06"W. The Pleasanton station is located within the Livermore Valley AVA. This weather station is listed as “Pleasantn”
- CIMIS station #47 Brentwood near Brentwood in eastern Contra Costa County, well east of the communities of Lafayette, Moraga, and Orinda, 37°55'43"N 121°39'31"W. This weather station is listed as “Brentwd”

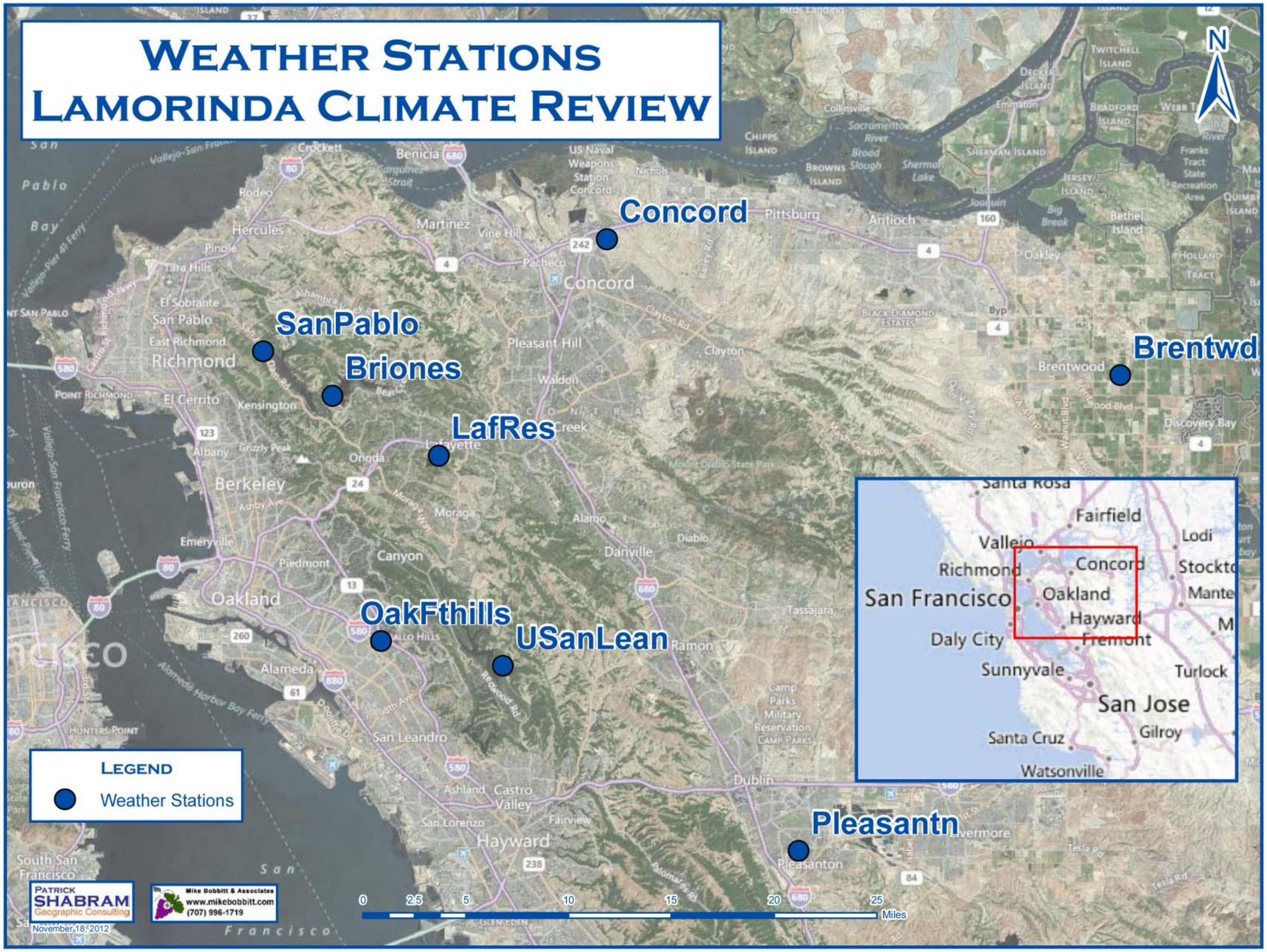
The following map identifies the relative location of these weather stations. While the Brentwood station is in east Contra Costa County and is well inland from the Lamorinda area, this station has been included to represent the largest concentration of Costra Costa viticulture. As demonstrated later in this report, Brentwood represents significantly warmer temperatures and does not play a major role in this study.

A review of degree day heat accumulations, utilizing the Winkler/Amerine methodology for calculating heat summations developed by researchers A.J. Winkler and M.A. Amerine[1] shows much higher degree day totals at Brentwd, Pleasantn and LafRes, and lower totals on the peripheral of the Lamorinda area.

Table 1 – Degree Day Accumulations by Year in and around the Lamorinda Viticultural Area

Year	SanPablo	Briones	OakFthills	LafRes	USanLean	Concord	Pleasantn	Brentwd
2011	2252	2405	2173	2995	2161	2778	2842	3470
2010	-	-	2103	2816	-	2664	2599	3489
2009	2528	2774	2367	3215	-	3068	3090	-
2008	2680	2834	2479	3325	2407	3209	3068	3972
2007	-	-	2187	2928	-	3024	2863	3790

[1] Developed in the mid-20th Century , this methodology uses degree day heat summations over 50° F. The model was simplified to use the sum of the average monthly high temperature above the base of 50° F multiplied by 30 days per month during the growing season extending from April 1 to October 31. Average temperature was determined by taking the average high temperature plus the average low temperature and dividing by two. Rather than use the standard 30 day total, this report uses 31 days for May, July, August, and October.


Weather Stations
Lamorinda Climate Review
Concord
SanPablo
Briones
LafRes
Brentwd
OakFthills
USanLean
Pleasantn
Legend
Weather Stations
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The area displays a high level microclimatic variation, a result of both topography and the presence of San Francisco Bay, San Pablo Bay and Suisun Bay. As such, year to year variations in climate may vary greatly based on wind patterns and their influence on marine inversion. Ideally variations in these stations would look at five year averages, but as Table 1 demonstrates, data is unavailable or incomplete for four of the stations. As such, average degree day totals were assessed using comparative totals where the data allow. These averages include:

- Five year averages for OakFthills, LafRes, Concord, and Pleasantn
- Four year averages based on 2007, 2008, 2010, and 2011 for the above stations plus Brentwood.
- Three year averages based on 2011, 2009, and 2008 for OakFthills, LafRes, Concord, and Pleasantn plus SanPablo, Briones, and USanLean.
- Two year averages based on 2011 and 2008 for all weather stations.

The following table outlines theses averages. Maps at the end of this summary also demonstrate the distribution of these averages.

Years	SanPablo	Briones	OakFthills	LafRes	USanLean	Concord	Pleasantn	Brentwd
5 year	-	-	2262	3056	-	2949	2892	-
4 year	-	-	2235	3016	-	2919	2843	3680
3 year	2487	2671	2339	3178	-	3018	3000	-
2 year	2466	2620	2326	3160	2284	2994	2955	3721

A review of these numbers and relative locations establishes several patterns. First, Brentwd's inland location makes it significantly warmer than any of the other weather stations. Hence, central Contra Costa viticulture demonstrates significant climatic differences from East County viticulture. As such, Brentwd is not considered further in this report.

Second, OakFthills and USanLean represent the coolest temperatures, which based on their relative exposure to San Francisco Bay, would be expected to have greater marine influence thereby cooler temperatures. SanPablo also represents cooler temperatures.

LafRes, located in what is typically considered the heart of the Lamorinda viticultural area, represents the warmest temperatures, with cooler temperatures to the north and west.

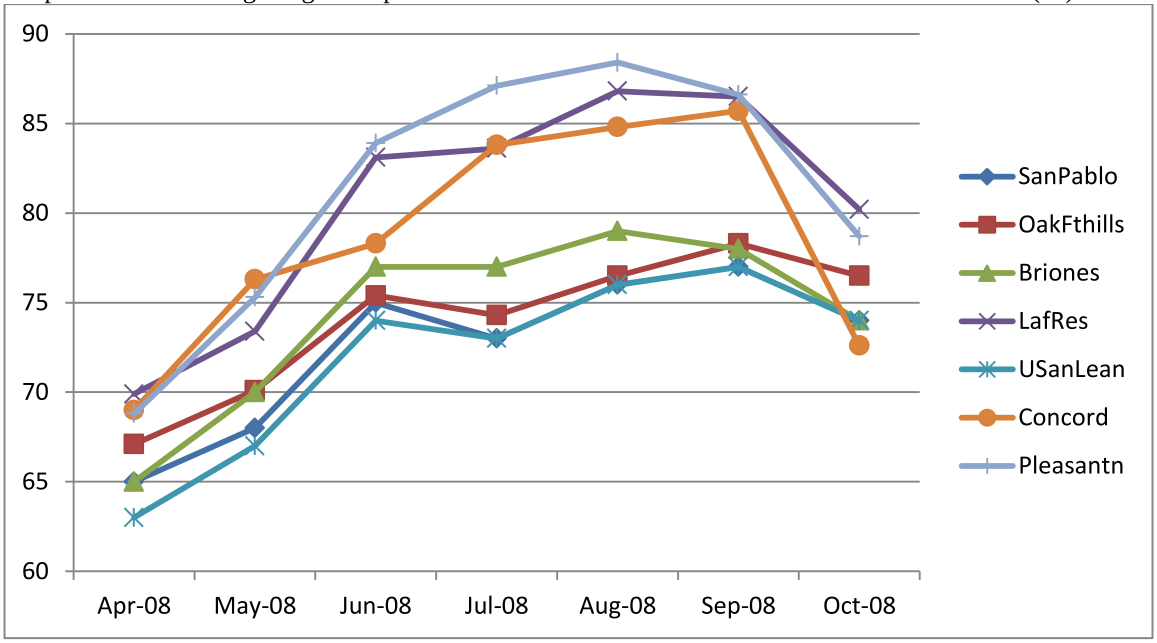
Coastal Access

A review of topographical maps of the area offers explanation to Lafayette Reservoir's warmer temperatures. Marine influences enter into the Lamorinda area from multiple valleys and wind gaps. These include the air moving from the south up from Castro Valley through the Upper San Leandro Reservoir; air moving from the west over the Moraga wind gap, air from the northwest out of San Pablo Bay through the San Pablo Creek Valley; and air from the north from Suisun Bay up Walnut Creek and Las Trampas

Creek into Lafayette. The weather station at Lafayette Reservoir is located in an area most removed from these separate access points. Observations of cloud cover reveal nocturnal fog patterns, but the morning fog quickly evaporates at these more isolated locations.

A review of high and low temperatures further demonstrates these characteristics. As coastal influences are moderated by temperature inversions associated with invading marine air, lower high temperatures are found at areas with the greatest inflow.

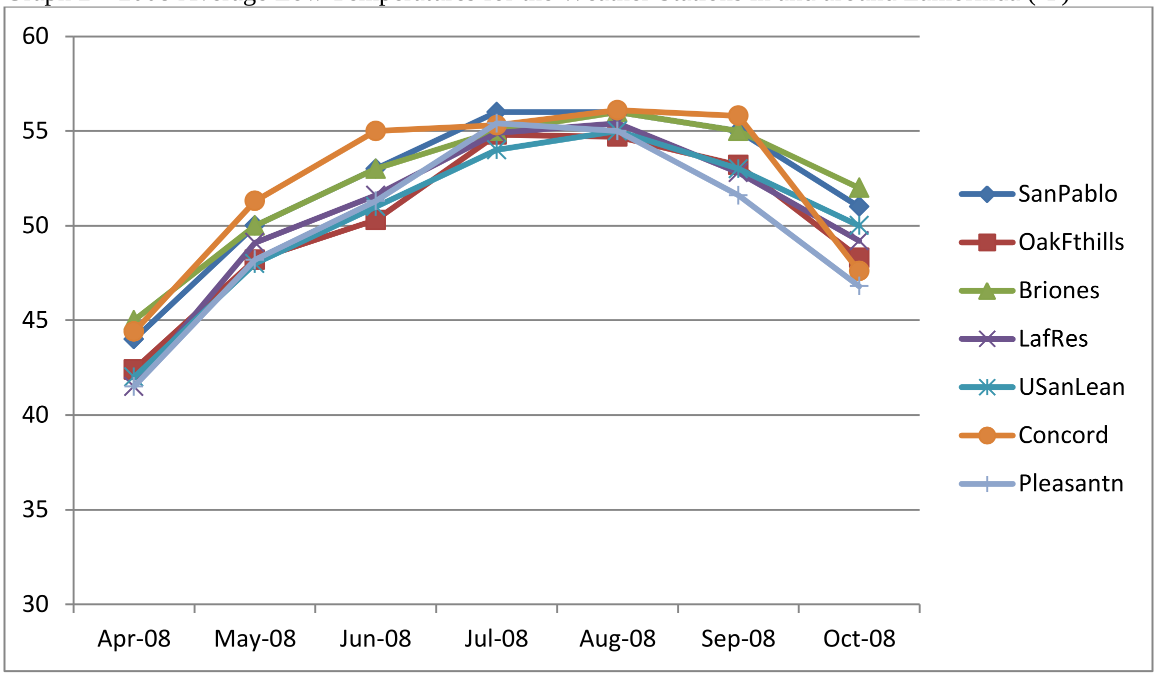
Graph 1 – 2008 Average High Temperatures for the Weather Stations in and around Lamorinda (°F)



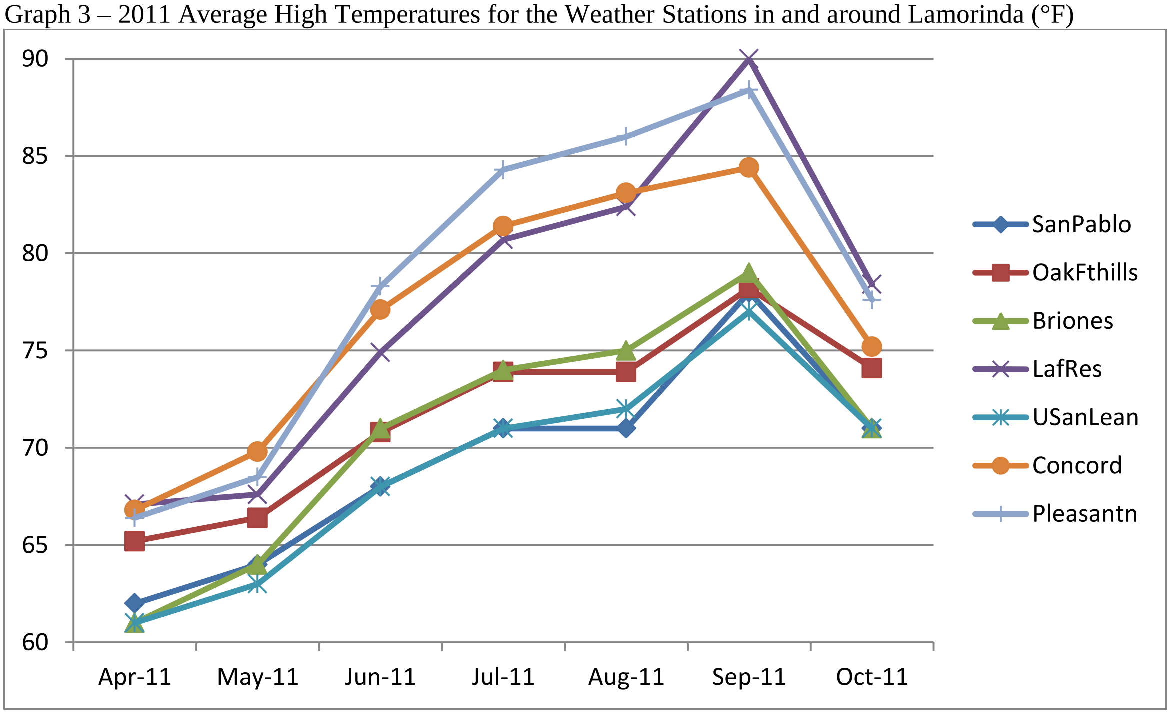
Graph 1, displaying data from 2008, demonstrates that the stations most removed from the coast are the warmer locations. Concord is the exception. Yet despite Concord's location off Suisun Bay, Concord is well inland of the Pacific Coast, the source of the greatest marine inversion layers.

Average low temperatures are much more consistent throughout the region, with slightly lower temperatures on average found at Pleasantn. Of the weather stations, Pleasantn is the most removed from a major water source possibly explaining the slightly lower temperatures. As nocturnal marine fog invades the area, low temperatures are moderated. Due to the consistency in nocturnal low temperature, the key to regional temperatures really reside in the high temperatures, which are dictated by the influence of diurnal marine inversion layers invading the areas.

Graph 2 – 2008 Average Low Temperatures for the Weather Stations in and around Lamorinda (°F)

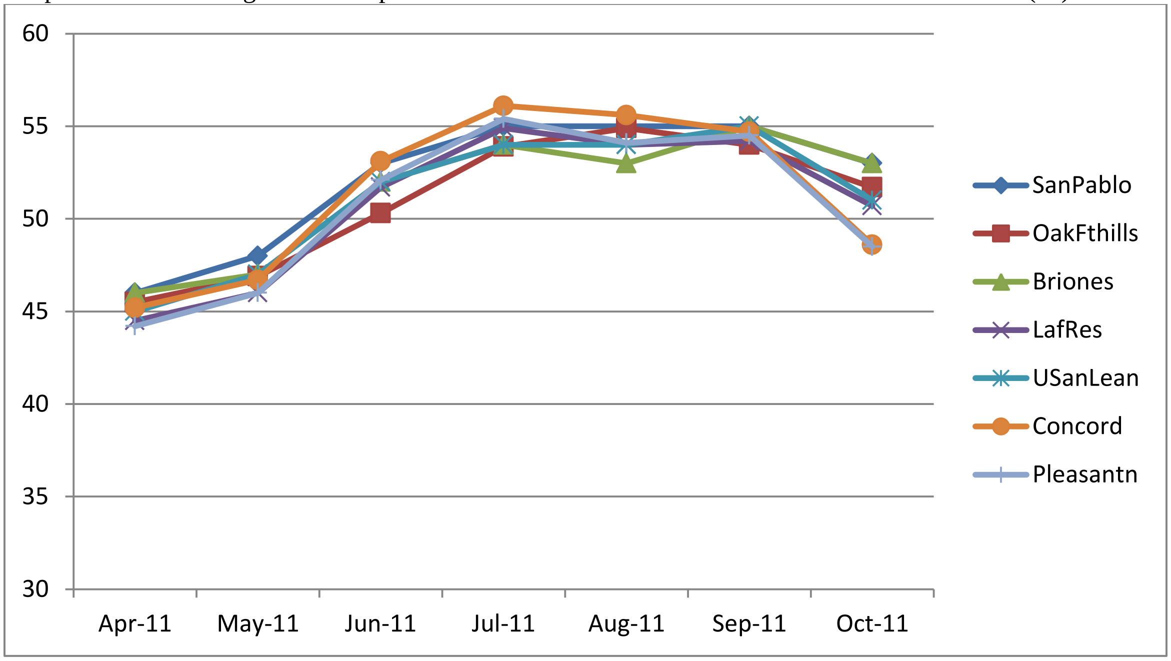


Graph 3 – 2011 Average High Temperatures for the Weather Stations in and around Lamorinda (°F)



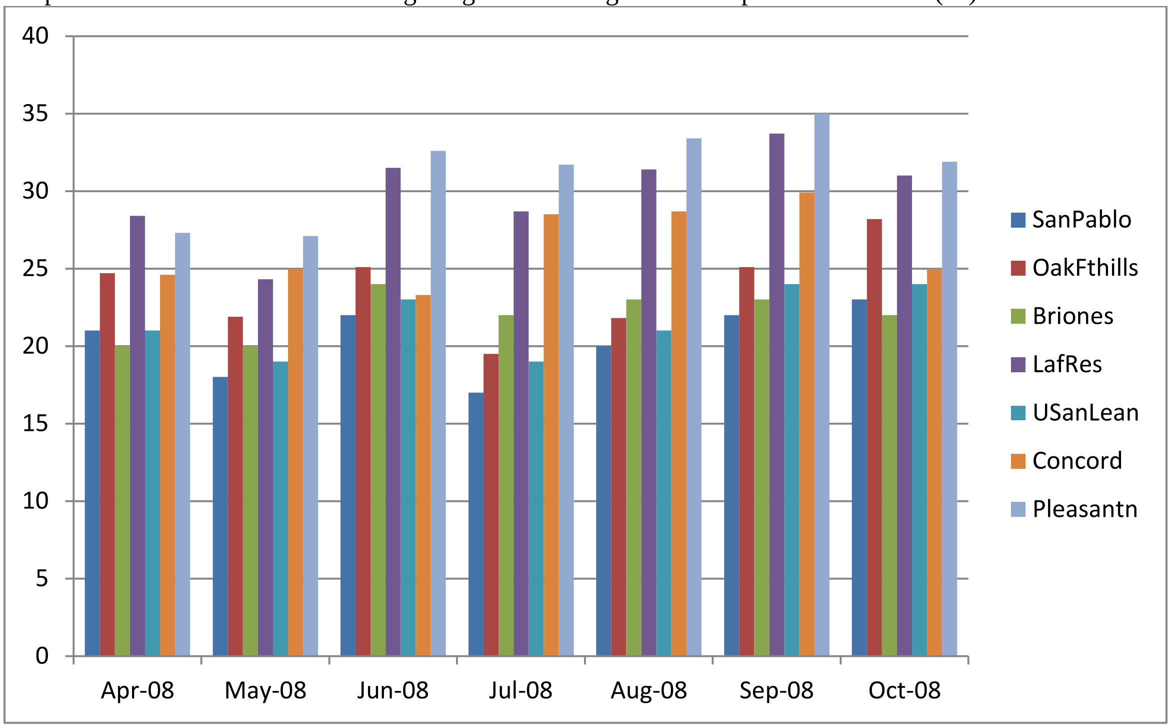
A comparative look at 2011 average high temperatures, the only other year that a complete set of growing season temperatures was available, reveals a similar pattern with the highest temperatures found at LafRes, Pleasantn, and Concord, and the lowest average high temperatures found at SanPablo and USanLean (Graph 3). Meanwhile Pleasantn shows the lowest low temperatures in the early and late season, but is consistent with the other stations throughout most of the growing season (Graph 4).

Graph 4 – 2011 Average Low Temperatures for the Weather Stations in and around Lamorinda (°F)

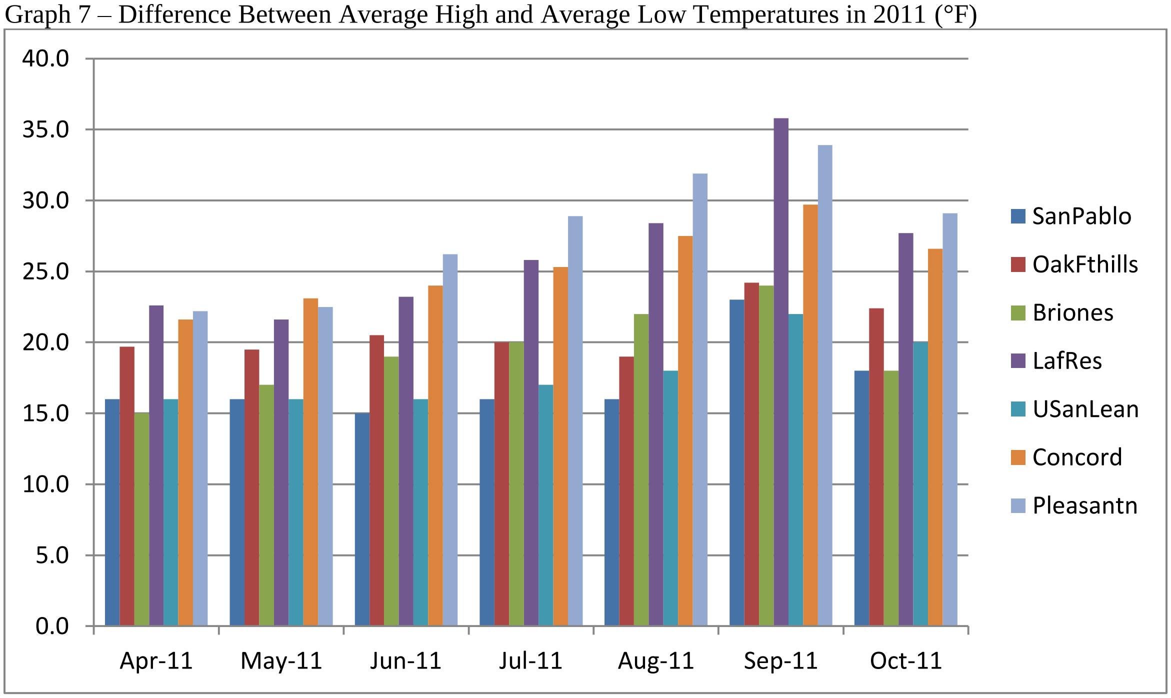


When looking at the difference between average high and average low temperatures, Pleasantn, LafRes, and Concord demonstrate the greatest swings, while SanPablo and USanLean show the lowest, as result of the moderating effects of marine air (Graphs 6 & 7).

Graph 6 – Difference Between Average High and Average Low Temperatures in 2008 (°F)



Graph 7 – Difference Between Average High and Average Low Temperatures in 2011 (°F)



The Role of Topography

While the climate of Lamorinda was analyzed using data from weather stations well positioned to represent a generalization of climatic variation, the Lamorinda area consistently displays steep to moderately steep topography throughout the area. All viticulture is hillside vineyards. With relatively little diurnal fog, viculture in the area depends as much on the microclimates dictated by exposure and air drainage as they do coastal inversion layers. Both the vegetation present and some of the successful viticulture shows lower elevations within narrow valleys offer cooler temperatures as a result of air drainage and reduced solar radiation. North facing slopes also experience slightly cooler temperatures while south facing slopes receive greater diurnal/nocturnal variation.

Captain Vineyards is representative of this variation. Hosting both warm weather grapes (e.g., Cabernet Sauvignon) and cool weather grapes (e.g., Pinot Noir) within a single vineyard, Captain Vineyards utilizes these subtle shifts in climate by placing the cool weather grapes deeper into the valley and warmer weather grapes at more exposed locations on the hillside. These variations are found throughout the Lamorinda area, but are less relevant at the more level terrain found in Concord at the mouth of the Ygnacio Valley and Pleasanton on the floor of the Livermore Valley.

Photo 1 – Captain Vineyards in Moraga has both warmer weather grapes and cooler weather grapes. In this photo, Petite Syrah vines occupy the steeper hillside while Pinot Noir is planted deeper into the valley.

Other Climatic Patterns

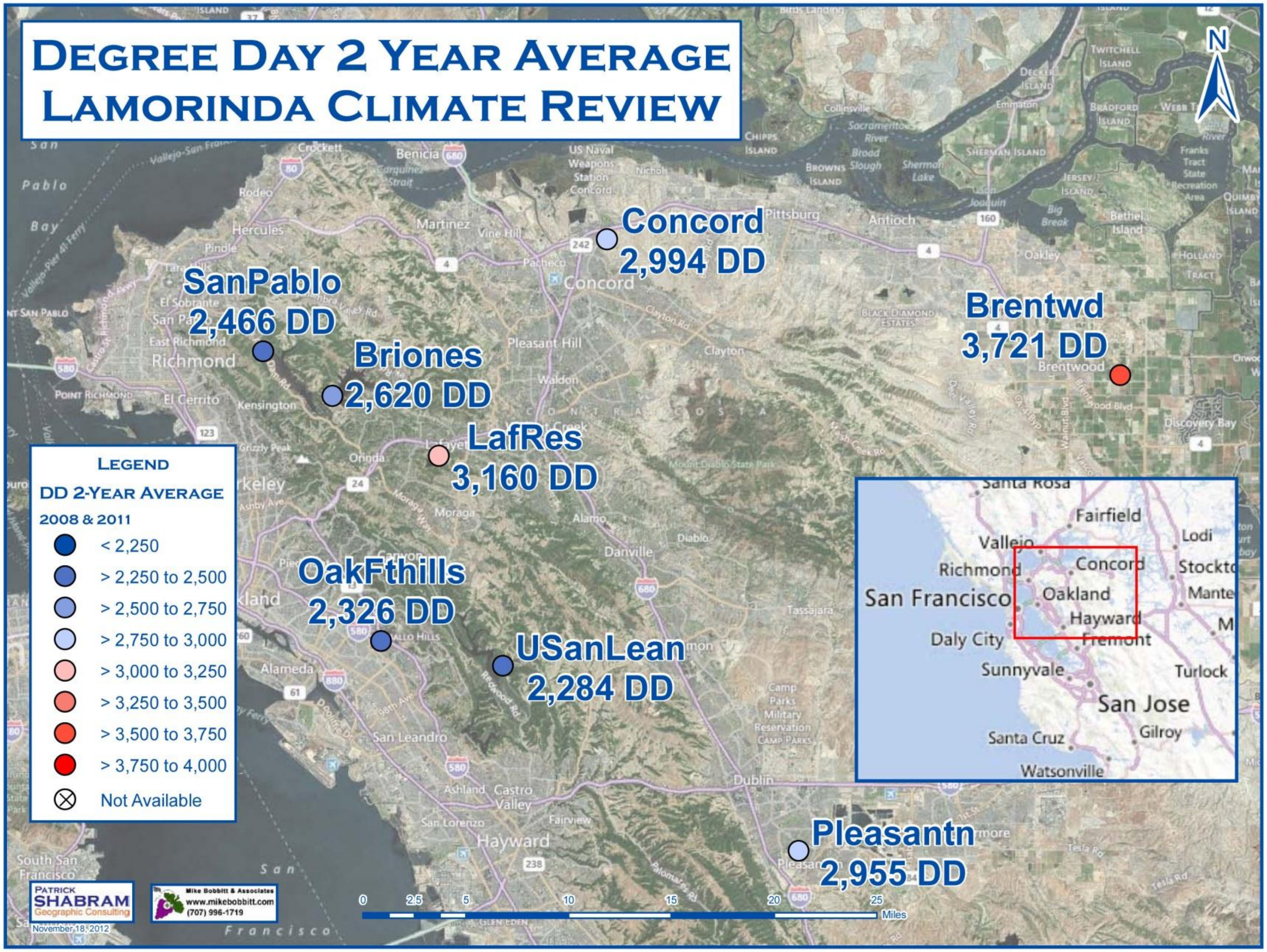
As part of this analysis, daily temperature where reviewed in an effort to locate any other local and regional patterns including daily high temperature, daily low temperatures, and diurnal/nocturnal temperature shifts. While this review was extensive, it was not completely exhaustive. No discernible patterns were observed in the time spent analyzing these data. That is not to say that other distinguishing patterns do not exist. The knowledge gained by establishing such patterns, however, may or may not be of importance to the petition to establish the Lamorinda AVA, as the distinctions established through this climatic review, the soil/geology review, and the existing topography should be sufficient to distinguish Lamorinda from surrounding areas. As such, given the number of weather stations involved and the volume of data for each station, the cost in time to establish any additional patterns is likely unwarranted unless required by the Alcohol & Tobacco Tax & Trade Bureau (TTB). Should the necessity arise, additional resources could be applied to further analysis of these data and potential other data sources.

Conclusion

Lamorinda is in a transitional climatic zone between more exposed marine environments and inland locations. While Lamorinda displays warmer temperatures than coastal areas to the west and cooler temperatures than viticultural areas well inland (e.g., cooler than Brentwood), at a local level climatic variation becomes more complicated. Degree Day accumulations and average high temperatures are good at distinguishing Lamorinda's climate from the consistently cooler locations of the Upper San Leandro Reservoir to the South, San Pablo Bay to the northwest, and the Oakland foothills to the west, but do not do a good job of delineating the area from Concord and Pleasanton to the northeast and southeast, respectively. As such, the Lamorinda climate can be distinguished from areas of greater coastal access, but not from the areas to immediate eastern vicinities that are not generally considered part of Lamorinda. Terrain, however, plays a more significant role in microclimatic variation within the Lamorinda area, and as such, reports on the topography of Lamorinda should play a role in distinguishing the climate of the Lamorinda winegrowing district.

Additional Degree Day Maps

To demonstrate the relative warm versus cool temperatures on a regional level, a series of maps were developed showing the degree day accumulations for the eight weather stations. These were broken down by years in which data was available for each station and using averages based on these availabilities. These maps follow.


Degree Day 2 Year Average
Lamorinda Climate Review
Concord
2,994 DD
SanPablo
2,466 DD
Briones
2,620 DD
LafRes
3,160 DD
Brentwd
3,721 DD
OakFthills
2,326 DD
USanLean
2,284 DD
Pleasantn
2,955 DD
Legend
DD 2-Year Average
2008 & 2011
< 2,250
> 2,250 to 2,500
> 2,500 to 2,750
> 2,750 to 3,000
> 3,000 to 3,250
> 3,250 to 3,500
> 3,500 to 3,750
> 3,750 to 4,000
Not Available
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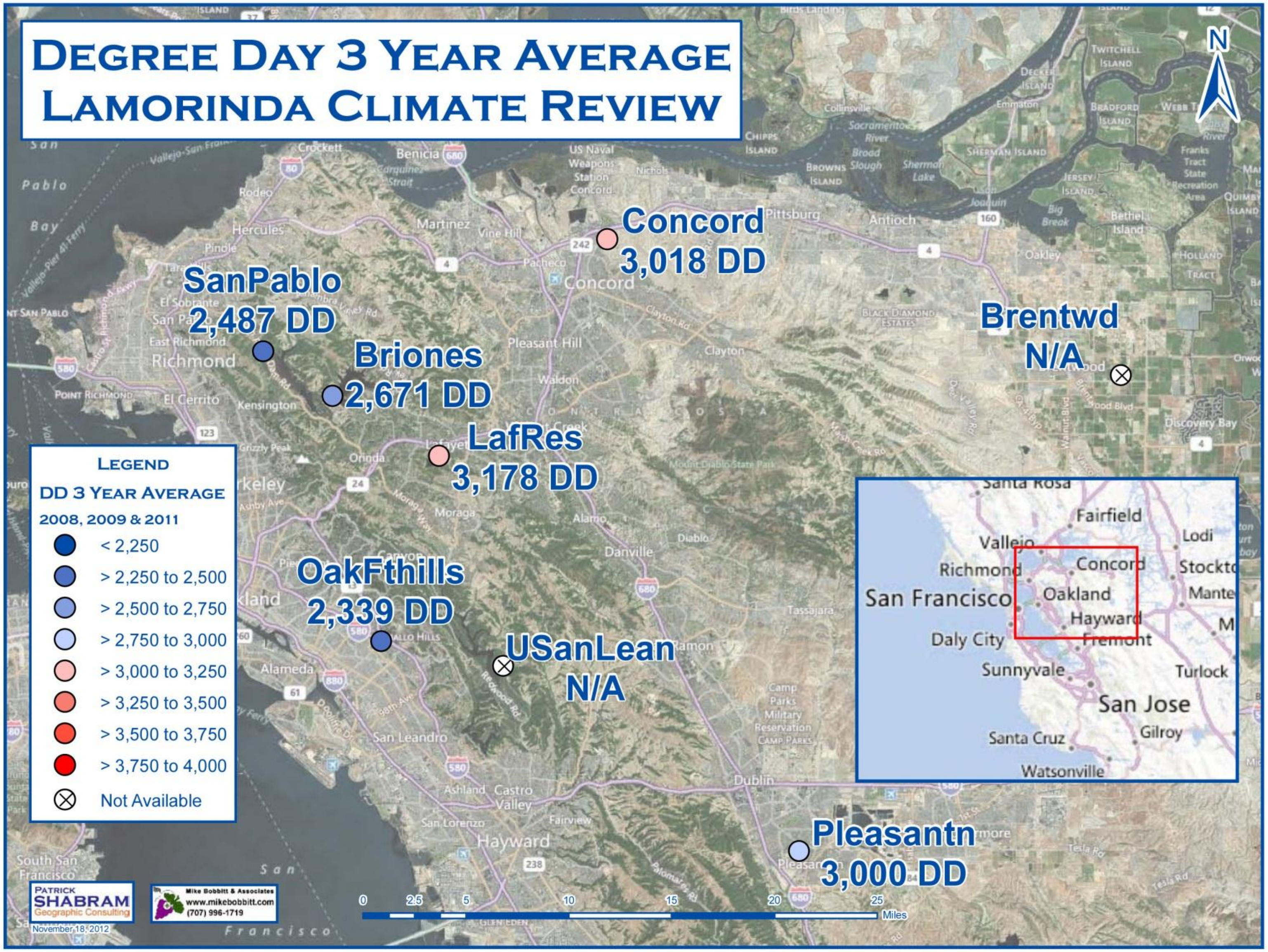

Degree Day 3 Year Average
Lamorinda Climate Review
Concord
3,018 DD
SanPablo
2,487 DD
Briones
2,671 DD
LafRes
3,178 DD
Brentwd
N/A
OakFthills
2,339 DD
USanLean
N/A
Pleasantn
3,000 DD
Legend
DD 3 Year Average
2008, 2009 & 2011
< 2,250
> 2,250 to 2,500
> 2,500 to 2,750
> 2,750 to 3,000
> 3,000 to 3,250
> 3,250 to 3,500
> 3,500 to 3,750
> 3,750 to 4,000
Not Available
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(707) 996-1719
0 2.5 5 10 15 20 25 Miles
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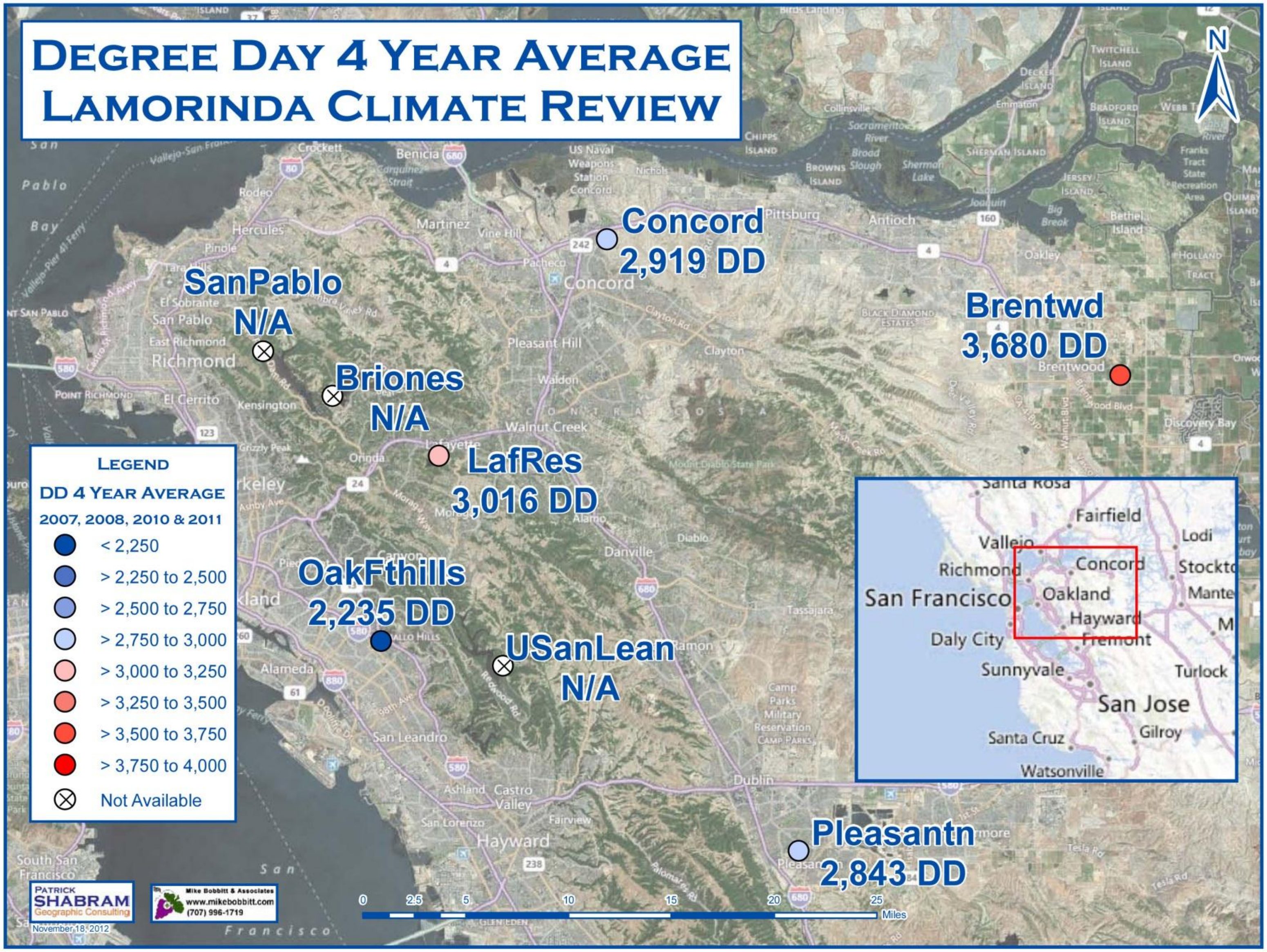
Degree Day 4 Year Average
Lamorinda Climate Review
Concord
2,919 DD
SanPablo
N/A
Brentwd
3,680 DD
Briones
N/A
LafRes
3,016 DD
OakFthills
2,235 DD
USanLean
N/A
Pleasantn
2,843 DD
Legend
DD 4 Year Average
2007, 2008, 2010 & 2011
< 2,250
> 2,250 to 2,500
> 2,500 to 2,750
> 2,750 to 3,000
> 3,000 to 3,250
> 3,250 to 3,500
> 3,500 to 3,750
> 3,750 to 4,000
Not Available
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(707) 996-1719
0 2.5 5 10 15 20 25 Miles
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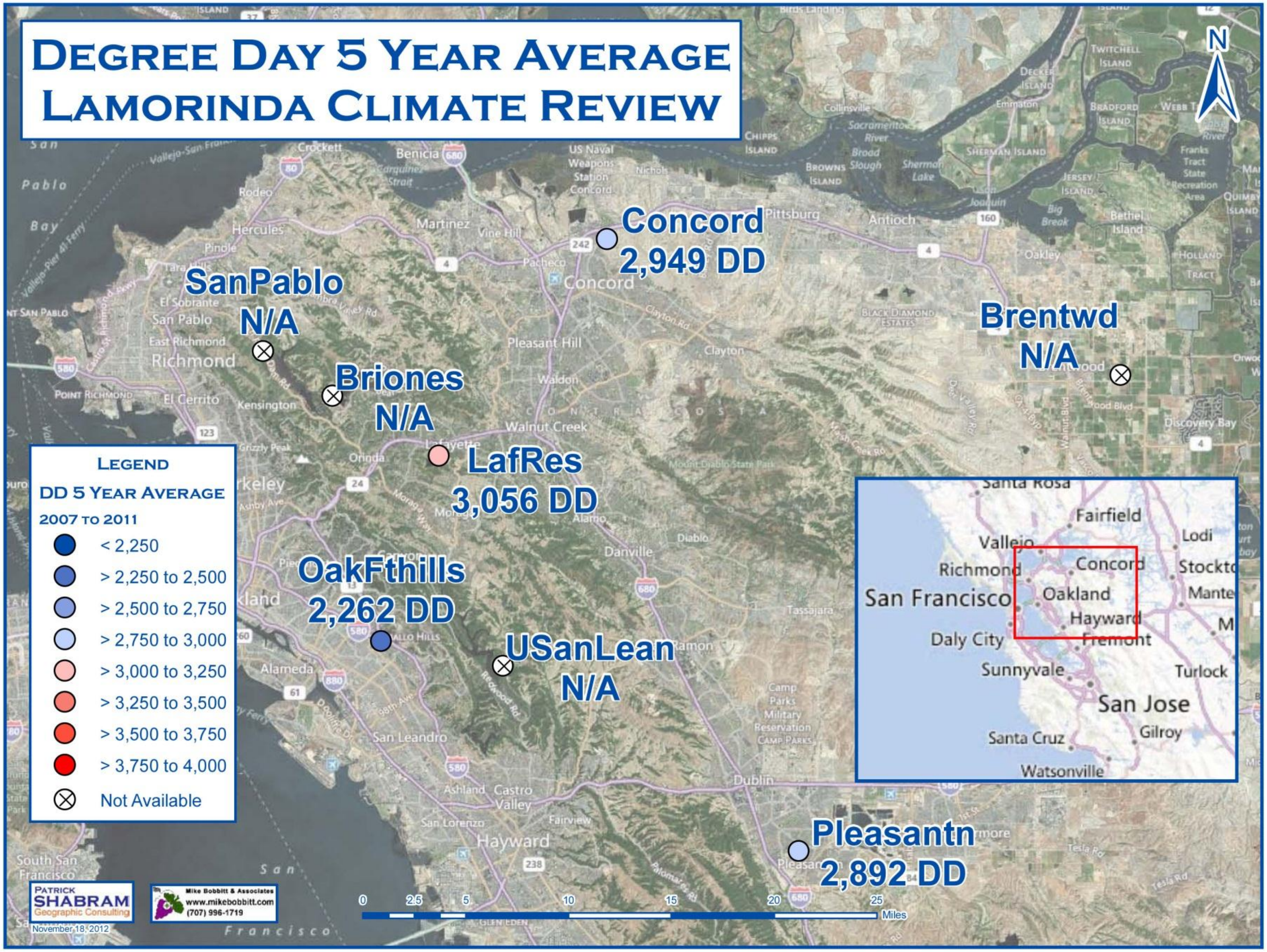

Degree Day 5 Year Average
Lamorinda Climate Review
Concord
2,949 DD
SanPablo
N/A
Briones
N/A
Brentwd
N/A
LafRes
3,056 DD
OakFthills
2,262 DD
USanLean
N/A
Pleasantn
2,892 DD
Legend
DD 5 Year Average
2007 to 2011
< 2,250
> 2,250 to 2,500
> 2,500 to 2,750
> 2,750 to 3,000
> 3,000 to 3,250
> 3,250 to 3,500
> 3,500 to 3,750
> 3,750 to 4,000
Not Available
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2.5
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