

GLENN McGOURTY: Good morning, I'm Glenn McGourty. I work for the University of California as the Wine Growing and Plant Science Advisor for Lake and Mendocino Counties. I've worked closely with many of the producers up here in Lake County, and it's really quite amazing to see what started as a pile of rocks and dust turn into this beautiful vineyard. And last night, we tasted wine from Snows Lake and it's quite amazing how fast things are growing up and maturing here in Lake County. It's kind of like watching my daughters grow up. They were little kids one day and the next thing there are these young women that are related to me. Like it just happened so quick, I don't know what happened. And so it is with Lake County. We see now that not only are people locally producing good wine, but people outside of the area are using the Lake County grapes to make fine wine as well.

I'm going to talk just real briefly kind of to set the stage just so we can see what we're going to talk about today. And as you all know, quality wine depends upon quality fruit. And since the earliest of times, winemakers and wine drinkers have appreciated wines from sloping vineyards. The old saying, '*Bacchus amat colle,*' the god Bacchus loves hills, is one that really reinforces that idea.

The soils in upland areas really kind of naturally restrict the amount of fruit that you're going to put in your vineyard and sometimes we're sort of in the opposite problem of not having enough fruit in some of these vineyards to really make economic sense. And we jack up the price and if Robert Parker and the other gods of wine score smile on us, we make money, even with relatively low yields. But it's a given that if you're growing wine grapes in low fertility ground with low water-holding capacity, it's going to be naturally size-controlling.

The other thing, of course, is with a tremendous luminosity that you get as you go upland. As you get on top of ridges, you're not shaded and, of course, light intensity changes, more UV, and just more luminosity overall, because you don't have the smog and the clouds and other things, especially in California, covering your area. There are some real challenges, though, to working in vineyards. This is one of the steepest ones I've ever seen. This

is in the Amalfi Coast and they couldn't even get donkeys in this one to help them. It was all done by hand. And there are a lot of issues about trying to just do the physical work that's necessary to produce grapes in steep vineyards, and it takes specialized equipment, it takes a lot of patience, and moving fruit and things like that can be really difficult sometimes.

So, I'm setting the stage for all of the speakers that we have on our panel to talk about different aspects of growing high elevation wine grapes, and what they think are the key features of vineyards in their regions.

The first person we're going to start with is Vittorino Novello. Dr. Novello is the Viticulture Professor at the University of Torino. And he also works with a Masters of Viticulture Program in other locations in Italy. From the point of view of somebody I know who knows wine grape varieties and viticulture in Italy, I consider Vittorino to be the best because he goes all over the place. A lot of the other viticulture professors are somewhat provincial. They know their region, but they don't know what's going on, and Vittorino's worked also in the University of Bari in the south, so he's my go-to person when I have questions on Italian varieties. Let's give a warm welcome to Vittorino Novello.

VITTORINO NOVELLO: Thank you very much, Glenn. I'm not sure if I'm the best viticulturist, but I'm trying to do that and to be that. And I thank, of course, the organizing committee to invite me to speak about... well, I try to give some information about the high elevation of viticulture in Europe. That is another world. Looking around this... that you call high elevation, really, our mountain viticulture is completely different. We always divided the viticulture in hilly viticulture and mountain viticulture. And this around Lake County that I'm seeing is what we call hilly viticulture. And now I give you some information about our mountain viticulture or high elevation viticulture.

The definition, very important thing, and as I explain the problem of definition. We don't have a legal definition, but this is another definition that we have for high elevation viticulture. That is, with a high slope, more than 30% of slope, the altitude about 500 meters about sea level, but not

with flat areas. So if you are in the 1,000-meter but the soil is flat, it's not high elevation viticulture, and the viticulture systems on terraces and wide shelves of ledges [?]. So one of these conditions makes high elevation viticulture in Europe.

And this definition is done by an institution, and there is a center we call Sebun [?] that is a European center, and it's a kind of association among different viticulture areas in Europe.

So in Europe, we have about 100,000 hectares of mountain viticulture that [have], more or less, 4% of the total area, and with different percentage in the different countries, of course. Let's say, 35% in Switzerland, 20% in Portugal, 90% in Germany, and 3% France, 2% in Italy. And the trend is down, the using trend. And with 100,000 hectares, we have 200,000 farms and wineries, so you see how small the vineyard in this place. And 500,000 people are working on these 100,000 hectares.

So just to give an idea about the area, these are some of the others that are associated to the Sebun [?], for the Center for Research of Mountain Viticulture. And we see some images of that. This is Ouster [?] Valley. That is in the northwest part of Italy, border with Switzerland and France. And we see on the right image, the White Mountain, we call Mountain Bianco, and there they are the highest vineyards in Europe at about... between 1,000 and 1,200 meters of elevation. And in the right part, there is a lowest valley.

In the [...unintelligible...], also, we have many valleys with very high elevation viticulture, about 1,000 meters with completely different style that you can see in these images.

The Cinque Terra is one of the most beautiful places for viticulture. You see in the left images is a very steep slope on the sea. And now it's a kind of... it's a [...unintelligible...]. It's a national park, on top is a national park that we would like to maintain this landscape for tourists also, but not all... not also for tourists but for protection against erosion and so on.

Matalina is another interesting valley close to Switzerland in the Lombardia region where they cultivate Nebbiolo. Apart from the Piemontese, it's the only place where Nebbiolo is cultivated in Italy. And in the north, close to the Austria border, we have the Trento and Bolzano province and is a particular region because they use very different [...unintelligible...].

And around Europe we have the Vanuse [?] area close to the Spanish border, Switzerland the Canton de Vorlais [?] in the French-speaking area of Switzerland, and the [...unintelligible...] Palatinato [?] in Germany with very... it's not high elevation regarding the sea level, but of course the slope is very steep.

In Austria, [...unintelligible...], in Galicia, in the north of Spain, you'll see how the harvest is done just by hand, only by hand. And we talk about the problems of this viticulture at hand. The [...unintelligible...] is very important for the port productions of everybody in the world knows this place, but it's very, very steep place.

So, one of the main characteristics of our mountain viticulture is that there's a bigger reservoir for variation for [...unintelligible...]. Each valley has many, many local autochthonous varieties that is good for the selection and is good to make different style, different wine style. And some of them are the only variety that could be grown in some places. Like, for instance, in Ouster Valley [?], the Prié we see at the end of the second line, the Prié Blanc is the only variety that could be grown below the White Mountain at 1,200 meters of elevation, because it is a very short cycle variety; this is the only one. But as you can see, apart from the normal, the traditional, the national and international variety, this valley has very good... a very wide, local [...unintelligible...] class.

In the Piedmont [?] and with the boundary [?] region of Switzerland and France we have found about 400 different varieties, and now they are in collection and we are studying this variety to see if there is something good.

We have a lot of variation on the training system, starting for the Gobelets in Switzerland, France or in Spain. Going to VSP in [...unintelligible...],

Sicily, Batalina [?] and then Germany, but the most common, the most frequent training system at high elevation is the pergola. We have the pergola in Techino [?], Switzerland and Cinque Terre in Ouster Valley [?], in Piedmont [?]. Pergola because with the pergola, we can protect shoots from the winds, from the heavy winds, and also so we can intercept more light. And especially in the Trento Province, the pergola is very typical. We call it 'trentina pergola,' and all around the world they call it 'trentina pergola.' I've seen this kind of system in South Africa; they call it 'trentina pergola.' So I think that it's very important.

As Glenn said, the climate can affect very well the quality of the grapes and I'm talking about the grapes, not the wine, because I'm a viticulturist and not an enologist, but as Glenn said the first that the quality is done in a vineyard and we agree on that. And, of course, we have very high UV radiance in the mountains, so we can have a more phenol concentration [...unintelligible...]. And so... And, also, there is less susceptibility to [...unintelligible...]. So that means less sprays, and so the wines from the mountain, we say they are more healthy wines, more healthy products for that.

There are some climate [...unintelligible...] generally, we can... I can show you some examples. In Czechoslovakia, we see the sunshine hours can change between 16:00 to about 12:00, going between 100 meters to 300 meters. And the mean temperature can change. We see this number 16- to 14-degrees Celsius. Sorry for that, but we are using the metric system, so... And this can delay the cycle, the phenological cycles. As you can see, we can have between two, three weeks of delay from bud break to bloom or... and harvest time. Another example of the climate affect is from Australia, we can have more dense canopy at some level, and we see that this kind of more dense canopy can induce, can increase the monitor veins [?], especially for Sauvignon, let's say, or other Cabernet Sauvignon and so on. And we see with highest level, in this example, we can have also highest glycerol level.

But let me show you a bigger trial that has been done in the Trento Province for many years with many varieties, different clones, different root stocks and different locations, different altitude in order to study the effect of

altitude on the quality of the grapes. You see the altitude range from 250 meters to 700 meters, and in this area, the tannic gradient is about a half degree Celsius every 100 meters of altitude. And, of course, one of the problems of the study, the altitude effect, is that going up in altitude, the soil is becoming shallow, less shallow, more rocky, so sometimes maybe the difference could be done by the different soil and the poor soil that we can have at the highest latitude.

You see, in this case, we are talking about Sauvignon Blanc and the training system is the trentina trellis. That is the local pergola with a plantation about 4,000 vines per hectare. And you may see that the production, the yield, can be reduced by the highest altitude. And they have calculated a loss of 350 grams per vine every 100 meters of elevation. And this is due to the reduction of the fertility. We have 1.6, 1.7 cluster per bud at 250 meters, and we have 1.2, 1.3 buds at 700 meters.

And, also, the cluster weight can be reduced. You see 150 grams at the lowest altitude and 100 grams at the highest altitude. And this reduction is not due only to the berry weight, but the reduction of the number of the flowers per cluster. And, also, the [...unintelligible...] concentration is reduced. You see about .7-degree brix every 100 meters of altitude. And on the [...unintelligible...], we can have an increasing acidity. You see that starting from 8.7 grams per liter at the lowest altitude to 11 grams per liter at the highest altitude and, of course, also the pH can change.

Studying the radiation effect, we can talk about Chardonnay with the same system, the same density. And we have seen that in a different side, at the same level but with different lengths of the day, we see the difference in the yield and the vigor. You see that at about a nine-hour sunshine day, we have 3.2 kilos of grapes per vine, and if you reduce one hour of solar radiation, we have 2.7 kilos per vine, so it's very important the length of the day and the solar radiation that reach the soil in this place. The vigor can be a little bit reduced by the... we can see the index, and, also, the sugar accumulation, of course, is reduced. And we can measure this reduction by .6-degree brix of reduction every one hour... well, on the contrary, it depends, one hour reduction in solar radiation or more than... more .6 brix every one hour of

solar radiation more. And the acidity, of course, is on the trend, the opposite trend, so you have a reduction of .7 grams per liter of acidity every one hour of increasing the solar radiation.

We have separated the altitude and the radiation, but also we have an interaction between altitude and radiation. And we see, according to the class of altitude, we make three classes, 300-450 meters and 450-600 meters and [?] 750 meters. And you see that an increase of one hour of solar radiation has a different effect. And the main effect of the increasing solar radiation is about around 500 meters in the second class.

And, also, another important result is that the more bigger are the vines, the more concentration of sugar we can have, and also the more acidity we can have at the highest altitude. You see increasing 10-grams per shoot of bigger, we can increase .2-degree brix and we can increase .3 grams per liter over to acidity.

Of course, there is a different behavior of the different varieties. We can see three varieties now—the Sauvignon, the Chardonnay, and Pinot Noir—and you may see the different behaviors. The Sauvignon can lose half-a-kilo every 100 meters of altitude and you'll see the Chardonnay can lose about one-degree brix every 100 meters of altitude, while the Pinot... Pinot Noir is a little bit less sensitive, it loses just .2 gram kilo per vine every 100 meters and half-degree brix every 100 meters.

And, also, for the... talking about acidity, you see the increase in the altitude, on Sauvignon, we have .6-degree of acidity more. The Chardonnay is not so much sensitive to the increase in altitude, talking about acidity, of course. And the Pinot has a good... a big sensitivity because it increased .1 gram per liter every 100 meters of altitude.

Of course, the root stock has affect on... They can be... They can change. They can have different behavior in the mountain. We see that some differences among three of the root stock used in that area. But the important thing is that the more the altitude is and the more the effect of root stocks are, we see at the highest latitude, so then 700 meters, the plant... the

41B has one-degree brix less than 3309, and .8-degree brix less than SO4. And the SO4 has 1.3 degree of acidity more than 3309 and one degree less, more than 41B. So the altitude can affect the result of the root stock also.

And, also, the clones can have a different behavior at different altitude. Here we have... I'm showing just four clones of Sauvignon Blanc and we can see the difference... the different behavior at the different altitude. We see the FR3, that is Italian clones, lose .8-degree brix every 100 meters. And, more or less, the other three are the same, .728-degree brix. But the 376 and 377, they increase, the acidity, while the previous two doesn't have this kind of effect. And at lower altitude at 250 meters, the 316 clones at about one degree brix less than the 377. And but at the highest elevation, 700 meters, the two clones are more or less the same. They have more or less the same accumulation. And you see, also, an effect on the production. You see the 377 lose 708 grams per vine every 100 meters.

And another important result we can show... I can show from the Violo [?] in the Baltalina area and you see we can have two to three days delay in the veraison [for every] 100 meters of altitude. And when we have a veraison, we end up with the final development, a good technological maturity that when the velocity of the veraison is at mid-velocity, we can have more metabolic synthesis and the more, the better phenolic maturity. And for all the altitude, talking about low wine production, of course, even the low irradiance side can have less thermal stress, and this way, they can have more phenolic maturity because of this problem.

So, just two words about the situation generally speaking. Some problems are related to the age of viticulturists in the mountains. They are always retired people or part-time workers. In Piedmont, the average age is about 70. There are few young people, and the most important problem is the small size vineyards that they spread out in many different locations, so it's quite impossible to do the mechanization and there are difficulties of [...unintelligible...] and communications among the parcels, and that's increased, of course, the production costs.

Some possible resolutions for these problems, we can try to increase the vineyard size. And when they are increasing the size, they could mechanize very well the vineyard and they reduce the cost. Of course, we have to try to stimulate the young people to work in the mountain, but this is one of the most difficult parts of the solving problem.

And another problem is, of course, to [...unintelligible...] protect the high elevation problem, because they are acid products, because as we have seen, they have more phenols and less sprays, so we can talk about organic products. And we had a law in Italy that we can use for this mountain, the label 'mountain products,' but nobody is using it now.

So, let me finish with the [major] of the vineyard where the wine that we are going to taste now is produced in Ouster Valley [?]. It's about 650 meters, and this variety is a local variety, but it's more probably a Switzerland variety, the particular vineyard. And the particular vineyard is a special varieties are characterized by the very good aroma of the [...unintelligible...]. So maybe we will taste now.

So, let's start again. Sorry, I'm kidding. Thank you very much for your patience.

PETER MOLNAR: Just a... sorry, Glenn, just a quick technical note on the left-hand side of your program, you'll find spreadsheets on all the wines, so there's basic in chemistry, as well as complex chemistry, as well as the description of the vineyard.

GLENN: And thank you, Vittorino. I just... I'm in total awe of European people and the way that they can speak. There's no way in the world I can go to a foreign country and give a technical talk in another language. It just wouldn't happen, so it's one of the things I admire about Europeans, because they seem to all speak English because that is the language of technology and, anyway, thank you very much.

Our next speaker is going to be Paul Skinner. Paul is the founder of Terra Spase and well known to most of us for producing extremely elegant maps

of vineyards using electronic data from a variety of sources. And I've certainly admired his work over the years when customers have hired him and then they call me and then say, 'What do you think?' And I look at Paul's data and go, 'You know, there's nothing I can add to this.' Paul is going to be speaking with us today about some of the different vineyards he's worked with and then he is also winemaker in his spare time, which I don't know how he manages to do that. But, anyway, let's give a warm welcome to Paul Skinner.

PAUL SKINNER: Thanks, Glenn. I want to jump right in here and talk a little bit about Lake County, since that's where we're at. So most of my talk is going to be addressing some of the characteristics of growing grapes in Lake County and some of the important things that define the terroir of the different appellations here in Lake County. This is just a general map I pulled off just so you can sort of orient yourself to where we are. The Red Hill area south of Clearlake, High valley on the other side of the lake, and the bigger boundary of the lake, I guess Clearlake appellation.

I do want to point out that the wine that we'll be tasting, if you look at the Clearlake on the map, the town of Clearlake, the Madder Lake Shiraz is produced from a vineyard in that part of the appellation. So this is what gives you the elevation map of the area just so you can sort of orient yourself to the elevation at the lake, approximately 1,326 feet. And going up to Mount Konocti at 4,300 feet, so we are in the Red Hills area of the AVA. We can, again, see Guenoc Valley and the other Benmore Valley appellations on this as well as the High Valley Appellation.

Talk a little bit about the elevation. As we sit... here we sit in Red Hills and it varies from 403 meters to 1,200 meters within this area that we're currently sitting. So we do have quite a range in elevations, even that high elevation. The High Valley Appellation on the other side of the lake ranges from about 472 to 990 meters. So, again, you have even within these appellations, quite a range in elevations.

I'm going to... I put the wine information here at the beginning because I thought we might be tasting the wine during the presentation, so at any rate

the Madder Lake Shiraz of 2004 is a wine that I selected to sort of go and... go with this talk and sort of be a benchmark of quality of Lake County wines. This is... I think this is the vineyard; I stopped and took a shot here from the road, which, Sam, I haven't really been in the vineyard, but this is the Madder Lake Vineyard on the south... or east side of Clearlake from where this fruit came and wine came. It's about an elevation of 1,500 to 2,200 feet. You can see the information there—the clones, the root stocks. All this is on the information sheets in your packet as well.

The soil, I will point out because I'm going to have some slides later of the Sambright soil. You'll want to kind of remember that name when I go through the soil profiles because it's very distinct volcanic material, and some of the wine characteristics. Again, this is in your information packet.

Whenever we talk about terroir and what defines grape-growing, as we've heard from Greg and some of the other speakers, Randle, the weather data is really important. I'm going to run through some characteristics. Frost-free days, Randle mentioned that frost-free at 9,000 feet is one issue. That certainly can even be an issue at the elevations here. You see a range ... we just take the blue colors that are maximum on the map, 160 to 230 frost-free days within this appellation. That's quite a range in numbers, so frost protection can be in any given year very important to the growers that farm here. Here we see the high valley frost-free days, and, again, 176 to 235 days within that small appellation, so we definitely need to be thinking about the springtime temperatures. Here's some data compiled with some Napa data, some vineyards at elevation in Napa. You'll recognize Spring Mountain, Atlas Peak, Mount Veeder all being appellation at elevation compared to Red Hills.

You can see that the maximum average and minimum temperatures, what sort of distinguishes Red Hills is that it doesn't have the high maximums, but it has a high average and a high minimum temperature over, and this is 2005 data. So you can see that that high minimum temperature can hold the average temperatures up over the season. The other thing of note, I think, is looking at the maximum temperatures compared to some of the... especially the... is how long into the fall the maximum temperatures stay at the greater

amounts. You can see Atlas Peak, St. Helena, of course, is a valley floor, but those temperatures stay warmer into the months of November, December. So it's not just degree days. It's how the degree days occur over the season and what these temperatures actually look like in October and November. That's really important to some of the ripening things that we have to deal with.

Here's another year, 2006, just last year. Again, you can see the high average and minimum temperatures for Red Hills compared to some of the other appellations. And, also, how flat some of the other curves are compared to the steepness in the increasing... in the spring months versus the fall-off in the fall months. So, basically, you're talking about a shorter growing season of more intense kind of temperatures. And that's not unusual. I mean, in what we've seen for a long time in Napa and places like Spring Mountain, the vines start slower, but at the end of the season because of the high nighttime temperatures, they actually catch up and will pass the vineyards on the valley floor.

Mean July temperature, if you talk... if anybody of... the Australians, especially Richard Smart, he uses this as a metric for defining areas about where to grow what types of varieties. The mean July temperature is usually correlated with the growing degree days. And here you can see in 2005 and 2006 the range across these different appellations in the mean July temperature. So, again, Red Hills is quite a bit above some of the other appellations that we're looking at.

The other temperature that a lot of people use to define, you know, what kind of quality do you have is the ripening temperature. I just picked the September temperature because more grapes probably ripen in that month than if we went to October. So, again, comparing across these appellations, you can see in any given year some of the characteristics of the mountain versus the valley floor appellation.

And, as I said, when you look at growing degree days—this is the 2005 growing degree days—so even though you have these high maximums and high minimums, the degree days often aren't as high as you might expect.

So here you see the degree days for these same appellations and St. Helena being even with the highs and the lows still has more degree days so... compared to some of the mountain appellations. And Atlas Peak really stands out as being a high, cool appellation, and that certainly impacts the ability to ripen certain varieties.

Here's the 2006 data. This year, Red Hills actually is right there with the valley floor. So, again, any year you can see substantial differences, and that, I think, goes to Randle's point about knowing... having weather data, knowing what's going on in the season, knowing where you're at, and planning accordingly.

Topography is another... as we talk about terroir, the main factors usually are climate topography, geology and soils, as far as the environmental characteristics, so I just wanted to show a few slides of the topography for our guests that may not be familiar with some of Lake County. As far mountaintop, we have hillsides, hill slopes, very... large percentage of vineyards that occupy hillsides with all their characteristics, as Greg referred to about air drainage and things that can affect hillside and hill slope vineyards, and valley floor where we do have distinct, different types of climates and frost issues in terms of more frost days than on the slopes above.

The geology of Lake County Vineyards, it varies from, as we can see, not quite from here, but the volcanoes that dominate Lake County are very omnipresent with regard to the soils and the geology that are here. Mount Konocti being the most dominant, but here in the center of this picture is Round Mountain, which is the volcano that's present in the High Valley Appellation and has made a major impact on that area of grapes growing. The red soils we're all familiar with. This is actually what some of this material looks like as it's being mined for different purposes. But, remember, this is the same kind of material that's underlying a lot of vineyards. We go from volcanics to sedimentary-type soil formations. The Franciscan formation is present in Lake County with sandstones and shales. This is an entirely different kind of medium for growing grapes compared to the volcanics that I just showed you, so the sandstones and shales. And then

we have a metamorphic-type rock, including serpentine which I'm sure you, you know, you're familiar with and it's almost a bad word in terms of grape-growing because people just kind of go the other way when they hear serpentine because of all the difficulties that we have. But a lot of soils are influenced by serpentine minerals in this county, so we have to understand a little bit about that geology as well.

The soil series that we look at... this is just a map of the Red Hills appellation. Look on the left and look at all the different soils that occur within this appellation, so there's an extreme diversity of soils. And as Randle mentioned this morning, managing diversity in these vineyards is key. And when you have that kind of diversity across an appellation, you know that within a vineyard you're going to see a lot of variation as well, so it's important to understand what those soil differences are. Here, we see the High Valley Appellation, similar amount of diversity within that appellation. We see... this is a volcanic soil. You can see the, you know the depth of that soil, the underlying... the variation and the layer of rock and gravel down at about, you know, 60 inches. So those kinds of things can make a vineyard perform very differently, depending on where those kinds of layers are.

I'm just going to run through some of the major soils found in some of these appellations. This is a Benridge soil. You can see the textures. You can see the color. You can see the depth in these graphics. These are very common soil. This is a Hambright [?] soil that Madder Lake Vineyard is on. You can see how distinctly different it is in terms of its depth, the amount of rock that's present in the surface—18 inches. So it's a very difficult soil to perhaps grow in, but if it's done properly, as you'll, I think, attest, the wine can be quite good. The Maynan [?] soil is, again, another shallow soil. Konocti is a soil that's present here in the Red Hills, quite... to a large extent, sort of bathe in a deeper soil, clay loam texture. A lot of characteristics is, again, we've heard this morning, high elevation doesn't necessarily mean low vigor. And when you look at this type of a soil and you're growing grapes on it, you'd best not be planting them, you know, three feet apart in most cases in vigorous root stocks. The Bottlerock soil,

again, a very high, heavy-textured type soil and the subsoil that will create some vigor.

Viticulturations in Lake County, I'd say, I'm basically going to just mention the irrigation and nutrition, because disease control is pretty much... most growers, even though there's difficulties with... sometimes certain aspect in any given year, the two that I think the environment really because of the climate and the high temperatures, irrigation is quite critical. I know Erica's done some really good work in Lake County defining some of the parameters for deficit irrigation. I would encourage you all to look at that because ... those are the kind of pieces of information that you really need to put together in defining how to manage irrigation on some of these different types of soils. If we look at the Red Hills area, again, this is a map of available water in the soil, so from a depth of zero to over 150 centimeters of soil depth. So you can see that plant-available water, which is the amount of water between field capacity and the wilting point, it varies from 5.6 centimeters up to 25 centimeters. So that's fivefold difference in available water. So you need to know what your soil capacity is in order to really define how much and when you can impose a water deficit, or if you even want to.

This is a map, or a photo of Peter's vineyard, Obsidian Ridge. These are some profiles within that vineyard. You can see the variation, again, in depth and texture. And the rock content is quite high. If we look at a map of that, the textures of the subsoil, you can see the variation. Again, clay loam, sandy clay loam, sandy loam, all mixed within one 40-acre parcel, so quite challenging. And then you throw in the amount of coarse fragments of the rocks. Again, you can see a fourfold difference in the amount of rocks in one strata of the soil. So, again, how does that hold water? How do you irrigate something like that?

And this is a map, then, that shows how much of the plant-available water is present. So defining where you take measurements, if you're doing pressure bomb readings, this kind of information can really be helpful because then you know where to take measurements and what it means. Taking one

measurement in the low stressed area doesn't really tell you how to manage the area with 14 centimeters of plant-available water.

If we look at the high valley, again, soil water supply from about 2-1/2 centimeters up to 25 centimeters—again, the extraordinary range and amount of water. If we look at some of the valley floor characteristics there, we see much deeper soils, even though they have rock. The texture is a higher percentage of loam and clay loams as we see in this map. So we can see this is about 100 acres within that high valley floor. The amount of rock is still present, so there's a lot of rock, but the plant available water is, because of the deeper soils, you still have a lot of water-holding capacity that, then, impacts irrigation amounts in your program. So separating these areas out into different irrigation zones is really the best thing that you could do, because then you have control over how much water and how much growth and vigor that you can impart to those different parts of the vineyard.

Vine nutrition, we're blessed in Lake County, or not blessed, maybe cursed, because we have excessive amounts of potassium in the serpentine soils, [or] extremely deficient amounts of potassium. So we're at either extreme with regard to potassium. And it is a major factor in fruit ripening, production, many different characteristics of shading. If you burn up a bunch of leaves due to potassium, you can certainly fry your fruit as well. Part of the negative of potassium is where you have high potassium, you have low magnesium. This top yellow leaf there at the very top of that canopy is a very pronounced leaf of showing magnesium deficiency, a white variety. Here's maybe what you see more in the red varieties, a very distinct pattern chlorosis, inner veinal chlorosis, due to magnesium. And it can definitely affect your vigor and photosynthesis because it's involved in the actual leaf chlorophyll molecule.

It's also been associated with stem necrosis, so if you have problems with bunch stem necrosis late in the season, magnesium is one of the factors that we look at. Along with magnesium is phosphorous. This is some extreme Zinfandel vines showing phosphorus deficiency. It comes on at any time of the season. It can be confused with leaf roll. It can be confused with mites at certain times, but it has a very pronounced effect on vine production and

overall ripening. This is some clusters of Chenin Blanc showing what it looks like when you have a phosphorous-deficient situation. So you can see that pretty much not only defines poor set, but just poor everything, as far as the Chenin Blanc vine.

This is some work that I did with... just to show you the impact of phosphorous on a vineyard, the numbers of clusters and the numbers of... and the yield, how dramatically it can change just by virtue of adding phosphorous to a deficient vineyard. You can see the numbers of clusters jump from 15 per vine to 45 per vine, just with a very small addition of phosphorus. And if you think that's not... if you want to see something even more dramatic, this is some yield information from a vineyard that was being farmed organically. They lost the vineyard and the new owners decided to adapt sustainable procedures. And part of that was adding some fertilizer to the vines that needed fertilizer. And you can see in one year, this is a total tonnage from one block, and this is an over 100-acre vineyard—5 tons to 40 tons of Chardonnay in one year and that it maintained itself at about 20 when that was an excessive of amount of fruit. But on the right side are grams of fertilizer added, so we're talking about grams versus tons. And if anybody doesn't recognize the sustainability of that, I think you need to sharpen your pencil. But that's an example of knowing what the problem is and fixing it, because all your costs of farming are the same, whether you're producing 5 tons or 40 tons from that vineyard.

And I want to finish just real quickly.... This goes back a ways, but my first job consulting was actually on this ranch in 1988, and these were the symptoms that... I don't know if anybody knows... remembers Mike Chewey [?]? Does anybody remember Mike? A few people do. He was the vineyard manager at Martini. He called me. I was still at Davis. He'd been trying to solve this problem through James Cooke, who was my professor there. And they had done some treatments and things were getting a little bit better but they weren't quite solved yet. Does anybody recognize what that is? Anybody grow cauliflower at all ever? No? Well, that was... Right down here as you enter the vineyard, that was some ornery Barbera. I'm not sure if it's still there, but that's a healthy vine. And this is a symptom called whiptail, and it really, as you can see, it wasn't a pretty sight when vines had

that problem. You can even see the clusters. If you look right here at the base of the first cluster, you can see the cluster starting to pop and dry out. It's an extremely negative result on vine production.

This is some more of the leaf symptoms, and this was back in 1988—very distinctly chlorotic, puckered, everything, you know, just totally abnormal look to it. And we had found some old information. This was a book... a conference done at Davis in 1968, a paper by Milt Jones, who did a lot of work in the North Coast on pastures and other... Glenn probably knows a lot about his work in the Mendocino area. But down at the bottom it actually refers to some treatments in pastures where by adding phosphorus and molybdenum ... at the same time, they were able to overcome or increase the yields in certain varieties.

And, also, Mike Chewey [?] had found some work which I think is historic, because this is Louis Martini, a study that he conducted in 1966 on foliar applications and different nutrient additions. I don't think they owned this vineyard at that time, so it must have been at Monterosso, which is also a vineyard elevation. But it's interesting that one spray that they refer to here, it's number five, as being very effective was a zinc, iron and molybdenum spray. So I know you've probably never heard of molybdenum, but this is the spray that they were using. And it turns out that—this was some of the lab data—it turns out we have very low molybdenum levels in the soil. And because they added the phosphorus at the recommendation of Dr. Cooke, they had set the stage for a response to molybdenum in the plant. And you can barely see this, but on the right-hand column there, there is a response to different foliar spray of molybdenum that actually took the symptoms away. And I don't know that that's ever really been documented, but we do have certain places where molybdenum can affect vine growth.

So, again, I'd just like to finish up a couple of shots of beautiful Lake County. Thank you.

GLENN: Thank you, Paul. I would like to just mention one thing. When you talked about coarse fragments, what you really mean, there are boulders out there the size of Volkswagens underneath the soil. And it was a real

challenge when some of these vineyards were developed. We had people coming in from other areas that said, 'Oh, well, you need to rip three directions. And you try doing that in Lake County and it looks like, you know, a nuclear bomb went off because you'll have not coarse fragments; you'll have boulders.

Our final speaker of the morning is Vince Bonotto. And Vince has been working for Diageo for seems like forever probably, huh? And he manages a lot of their properties as the vice-president in charge of viticulture. He's going to share with us some of his experiences and thoughts on high elevation viticulture.

Let's have a warm welcome for Vince.

VINCE BONOTTO: Good afternoon. It's not morning anymore, and I've... Paul told me that I would be the last one before lunch, so I'll be brief. Some of you may know me. Some of you may not. But before I became what I sometimes refer to myself as just corporate overhead, I used to be an actual vineyard manager and a winegrape grower—not a winegrower, but a winegrape grower—and spent a lot of time when we redeveloped Diamond Mountain for Sterling.

The original development of its property started in 1972 and it took about four years to complete the original development. We started replanting it in 1997, due to phylloxera. And the original vineyard was planted on... all on AHR, so when we looked at replanting it, we kind of had to look at all the soils to determine which root stock would be the best, and we looked at 110R and 1103. And our Peterson Ranch, which is also in the Diamond Mountain appellation, but it is actually off [...unintelligible...] Road, is an entirely different site, entirely different soils in Diamond Mountain so I'm not going to talk about that today. I'm just going to talk about [...unintelligible...]. This map is not very clear, and I apologize for that, but what it shows is on the left it shows what we refer to as the Cordon [?] Canyon Terraces. That's the westernmost part of the property. Then you go into the middle. We call that Ranch 12. And then on the bottom of this is actually the top of the mountain and that's what we call Ranch 11.

.... These slides are a little bit out of order, so I'm going to skip down to some of the data and then we'll go back to the pictures. Rainfall for us at Diamond Mountain is 40 to 55 inches annually, not counting this year. As you can see, the soils are residual, uplifted soils of volcanic origin, often very fine-grained, even gritty in texture. And to be more specific, if you look at them and do backhoe pits and study them, you'll find you've got forward graveling loam, kid loam, boomer forward Felton complex and the hambright complex also.

The elevation of the vineyard varies from the very bottom block at about 600 feet in elevation to about 1,600 feet at the top of the mountain. And we have slopes between 15- and 30 percent. The aspect... We couldn't run north and south. We had to go with however the hillside and the terraces that were cut into it would allow us, so we have mostly northeast and northwest-facing slopes.

The predominant varieties on the mountain now, since we replanted, we used to have Chardonnay up there, but we removed the Chardonnay, and now what we mostly have is Cabernet, which is about 50... a little over 50 acres. And then there's about 40 acres of Merlot.... The rest of the acreage is made up of about 12 acres of Cab Franc and then the remaining acreage is Petit Verdot and some Syrah.

The original survey of the vineyard after it was planted and in the 70's, I said there were 120 acres planted. After we redeveloped it and we didn't change any of the terraces, we didn't remove or add anything to it, we did a survey using GPS and we came out with about 114 planted acres. So all the years that they thought they were farming 120 acres, they were actually farming about 114.

When we replanted, we looked at... as I said, we looked at all the soils and we decided that 110R and 1103 would be the best. We tried to stay away or keep the 1103 away from anything that looks serpentine, but we did put some in some of those areas. And the 1103 seems to be struggling a little bit in that type of soil.

The terraces are anywhere from 10 to 14 feet in height, and you'll see that in a couple of the slides. And the vine spacing down the vine row between vines is five feet. Since we started in '97, now the age of the vines varies from 6 to 10 years.

Bud break is not early, not necessarily late. It kind of depends on the season. But looking at an average, it's around the 27th or between the 25th and 27th of March. Bloom is sometime around late May around the 28th.

Looking at an average on veraison, it's usually late July, almost pushing the first of August. And then harvest usually starts late September and can run all the way to late October. And that's kind of a function of the vintage and what the particular mood the winemaker's in and how long they want to try to hold the fruit out there.

As I said before, the average rainfall is somewhere between 40, 45, 50 inches. But we irrigate and we do apply water, and it varies with the site and the actual soil types between we add an additional three to five inches of water. This is... This will go back to the wine. This is strictly from winemaking, so I take no ownership to these comments, but it's says principal varieties and characteristics of Cabernet Sauvignon, Cab Franc, Merlot, Petit Verdot—'firmly structured, rich and fairly tannic when young with strong black currant mineral and seedey flavors; less supple and fleshy than valley or benchland wines with good aging potential.'

All right, I'm going to go back up and start looking... This is at the top of the mountain looking towards Mount St. Helena. And you get a feel for the slope, the terracing and also the fact that there's fog hanging over the valley.

As far as the climate goes, we find that various areas of the vineyard, depending on air movement can be anywhere from 5- to 10- or 12-degrees cooler during the day when there's really hot weather down in the valley floor. And then we find that the opposite will happen at night when the valley floor cools off and then the mountain stays hot.

This is that same shot again showing a look towards Mount St. Helena after the fog is gone. This is across the canyon looking back at the Cordon Terraces. This was taken in the winter. I don't know if you can see it or not, but the shiny areas that are the areas where the terraces drain. They were all cut into the side of the mountain with about a 3- to 4 percent in-slope, and they all came to certain... to low spots and then either through a series of pipes or rocks to drain. We take the water down off the terraces and get it down to culverts and other pipes to bring it down into the stream below the vineyard. This is another shot of Cordon Terraces. And that white stuff up at the top is actually snow.

This will give you... I don't know if you can see it or not, but the trellising that we use up there is actually just the old California sprawl T-trellis. There's a few areas, and right below the bottom of this picture is an area we call Furnace Ridge, which has absolutely no air movement during the summer. And it's actually there. It gets hotter than... The air gets hot and stagnant. It never leaves. It just kind of collects there. And during those times, we have to be careful. We need to keep the water on because the soil gets pretty weak down in there and so because of the extreme heat, we're doing a lot of irrigating.

The other thing is with the T-trellis, we just let the... We will do... We don't do any leaf removal, and we will sometimes position the shoots and tie them to the trellis wires to hold the... and make sure we get enough shade, because the old vineyard didn't have the T-trellis. It was just a two-wire old... it was California sprawl trellis and sunburn was a big issue, or actually heat damage on the fruit was a big issue, so when we replanted it, we went back in and put the 'T' on it and trying to get enough shading for the fruit during the season to keep it from coming getting either sunburn or heat damage.

And I don't know how well this shows up, but this is a slide, it was made a number of years ago back... based on some information we took from a back hoe pit. And it shows a couple of different stages of the soil. There's about two feet of what is light gray loam of quartz, and then it goes down into the more gravelly clay loam, and then it goes down into the bedrock.

This particular type of soil is down in the middle ranch, Ranch 12, and the middle of the mountain.

This is what we dug when we looked at the cordon area. There's volcanic rock at about two feet, and then it changes, the rock gets a little bigger and there's a little more clay, and then it gets down into... way down there's volcanic ash.

And this is not a washed-out picture. This is snow and we have had... and this is at the top of the mountain. We have had snow during the winter months but also in this area, there's been an inversion before and we've had frost damage there during the spring. So while it's at 1,600 feet, we can't get... during spring, we do have to fight frost.

The challenges that we really have up there are... part of it is nutritional. As Paul was referring to, there are some serpentine soils up there, so we do a lot of potassium. We tried feeding them a little bit every irrigation when we... And we irrigate based on pressure bomb and neutron probe, and overall experience, and taking a look at the vines and see if they're growing tips and things like that. But we found that while we were feeding maybe on a weekly or every 10-day basis, the potassium, we found that actually putting on about 10-gallons per acre of a 0030 type solution actually works better. We do do a little bit of nitrogen, but that's very minimal. About a year ago, we started looking at, in a couple of places, molybdenum just to... I don't have any... I could anecdotally say something about it, but I won't. But we are looking at some of the floor fertility soils at molybdenum applications.

Because of the way the varieties are spread out on the three different areas, and because of the way the climate and the terroir goes, that's the reason why harvest goes anywhere from three to four weeks, depending on the vintage. And, actually, we have to be careful because if we get a heat spell, sometimes winemakers get in a panic and they might want to try to take it off, but we'll pour the water to it and try to hold off so we can keep the fruit on the vine. I don't think we could stretch it out to November, but late

October is... I think is where it is... gets a good maturity and get the good tannin development that we're looking for on the property.

And that's it, and if anybody has any questions, I'll be around, or I'll be glad to... And I think the wine is the third glass. It's 2004 Diamond Mountain Cabernet. And taste it and see what you think. Thank you.

GLENN: So we've got a little time before lunch. So the first thing I would like us to do is to actually taste through the wine and then each person who brought it just say something about it. I think that that would really kind of illustrative. So we'll start with Vittorino. Do you want to tell us what you think of this wine? And Vittorino is the typical Italian viticulturist. It's the way they act like, 'Well, I don't know anything about wine.' Actually, everybody on the panel does. Actually they know a lot about wine and they can tell you what they like or don't like and what they think is typical, so let's hear what he has to say.

By the way, Vittorino gets the Best-Dressed Person Award today, because I've never seen an Italian go out in public, even when they look casual, they look great. They've polished their shoes and their blue jeans are pressed, and their t-shirts are clean, and it doesn't surprise me he wore a suit.

VITTORINO: Okay, this wine is made by... the Petit Verdot variety is...

GLENN: Can you hear him okay? Can you hear Vittorino? Okay, good.

VITTORINO: Okay. And as I told you before is that the vineyard is 650 meters in Ouster Valley [?]. And it's a kind of a... the small mountain inside the valley, very close to the Ouster [?].... the Ouster [?] city. And this winery is one of the best winery. I think it's the biggest winery in the Ouster Valley [?]. This region has about 5,000 hectares of vineyards, so it's quite small as Italian standard. And most of the wine is selling locally. The people in the Ouster Valley [?], they're really good drinker people and... yeah, and also for grappa and some other things. But also it's the touristic place, so they can sell the wine for the tourists. And by the way, like some of your Petit Rouge or other red variety.

[begin Tape 2 #1]

It's grapefruit and rhubarb... for the aroma that that we've seen. And, well, that's all. It's not so much alcoholic, but this, I think, is about 12 or 13 alcohol, and the acidity is not so high because the grapes were matured, so...

PAUL: ...but the wine, I can... I guess based on the vineyard, because I shared the... in the slides, the hambright [?] soil is a very shallow soil and I do know these vines are on 420A and 101-14, so it seems to be a very good match with the Syrah. I think given a stressed site like that, you could easily see some very harsh characteristics in the wine, but this doesn't have any of those. It... has great aromas, sort of Rhone-like aromas, violet and soft sort of perfumed sort of aroma that's very appealing. And the finish is very soft, so I think they're doing a lot of work in the vineyard to probably overcome some of the limitations, or not some of the limitations, but working with the site in order to make sure those negatives don't come through, and so it seems to be a very good match with the site and the orientation of the vineyard. And I'm sure irrigation is a real important part of that, of their viticulture. So I like the wine and I think it's a very good omen for Lake County wines that they can be of this class.

GLENN: Sam Spencer, you're in the audience. Do you want to add anything, since this is your baby?

SAM SPENCER: [...unintelligible...] Sure. It's a great [...unintelligible...] but really challenging [...unintelligible...].

GLENN: With all the great coarse fragments underneath, huh?

SAM: You know, that it's a [...unintelligible...].

GLENN: Good, thank you. Vince, can you say something flowery about this?

VINCE: Not being a winemaker, I'll do my best. No, actually I... This vintage is... marks kind of a change with some new equipment and some other things at the winery that allowed winemaking to not have to turn over tanks quite as fast and be able to take a look at our vineyard designates and some of our reserve wines and hold them. And so it was kind of a... It was a change in some things that happened in the winery, and I think that this wine is... I like it.... The tannins are there and there's a little bit of chalkiness, but I think they're fully rounded and really not that harsh.

There's kind of a dusty, smoky earthiness to the palate that I like. I think the oak isn't overstated and I think it brings through the fruit. I believe this is about 70 or so percent Cab and Merlot. I don't think there's any Cab Franc in it. And I do believe that there's just a little bit of the Petit Verdot.

GLENN: Okay, thank you. And, finally, Randle has come back to share with us one of the wines that he works with in Napa County.

RANDLE JOHNSON: Well, I was going to originally do the Cabernet from Mount Veeder, and your text sheet, they do that. But we handed out a text sheet on the Malbec. I'm just going to say two or three little, mini words here about Malbec. It's a great variety. It was subject to what the French called 'colour,' [?] which means erratic set, poor set, kind of like Merlot in some ways. So after phylloxera, Malbec kind of left the scene for many years in Bordeaux and reappeared... well, it got actually to Argentina before phylloxera, but it developed well there.

But I also want to speak just quickly to Paul's point about micronutrients. Malbec loves zinc. You have to use zinc pre-bloom and you'll get a good set, and you won't have to worry about 'colour.' I had seen Malbec growing literally on the banks of the Napa River on St. George on a quad that set such a huge crop, you have to thin it twice. So low crop in Malbec really it should not be an issue.

All right, anyway, that's enough of my soapbox on Malbec.

This wine here is from our main ranch at 7,500 feet in... my mike just went bye-bye, or maybe it's me here. There's a little blending in here of our ranch at 8,500 feet. You can see the varietal percentage is 85% Malbec, 10% Cab, 5% Tannat. Tannat came to northern Argentina from the Pyrenees in the old days and has been... kind of a fixture ever since. But I'd like you to note the texture. This is pretty round wine. It's full-bodied, and this is partially Malbec's characteristic and partially why I love it, but it's also due to the way we grow it and the way we make it in the winery. This stuff is picked between 26 and 28 brix. It's not overly alcoholic. I feel it's pretty well-balanced.

Just real quickly, you can get another kind of a visual on this ranch in the lower right-hand corner of the text sheet. This is a big chunk of our vineyard. Some of it's planted essentially five-by-seven, but that far vineyard back there against the red tile roof, that's a four-by-four. You can also see the surrounding terrain, you know very desolate, but these little oasis show up when you have water. And this is on an alluvial fan here. The winery is in the lower right. Okay.

GLENN: Okay, we're just about ready for lunch. Any questions of the panelists before we break? Sam?

SAM: [...unintelligible...].

RANDLE: Okay, you heard the question, 'Why do I like only [...unintelligible...] in certain situations? Well, this wine here is probably, oh, I don't know, 40%, 50%. We use root stocks too, and I'm by no means advocating not giving up on root stocks at all. We use these own roots in virgin areas, out in the desert. You know, at 9,500 feet, there aren't many... you know, there's been no vineyard there yet. And we're, obviously, very sensitive to the fact that bugs do come. In fact, our whole little valley has major infestation of mealy bug. It's a separate issue, but you know you have to be extremely cognizant.

Malbec roots mine the soil in what we feel is a very even-handed manner. They do not preferentially take up magnesium or potassium or phosphorus.

Their own roots seem to find their own way in picking up both macro and micro nutrients in a very balanced way. If we get balanced vines, we have to do less canopying management on own-rooted vines. And winegrape qualities are fine. It's perfect. We get good pH's, additives, sugars, phenols. I guess that's it in a nutshell. Do not ever put Malbec in SO4, ever.

AUDIENCE: What would you [...unintelligible...]?

RANDLE: I think it's worth a try. From a viticulture and wine quality standpoint, I don't see any problem. Obviously, you've got to be careful that you're not going to have phylloxera hit you.

By the way, own-roots also are very good against nematodes. We have a few nematodes, so it's not bad, but own-rooted vines can handle a certain level of nematodes.

GLENN: Well, I think that about wraps it up for this morning in terms of our session. And I think the first thing we do is give a big round of applause to our panel.

Now just a little housekeeping, I suspect we're going to be pouring more wine, which means we need to get your glasses clean before you leave, so as tough as it is, dump out the wine and rinse your glasses so you can be ready for the next go-around. Thank you.

AUDIENCE: [...unintelligible...].

GLENN: Step right up.

MALE: You each have one glass to enjoy wine at lunch. There are three wines out there. If you'd like to take a couple of the glasses in front of you, take them to the table. You're welcome to do that. We're going to clear all the glasses, clean the dump buckets, reset the whole thing while you eat. But if you want a little extra glass or two at lunch, go ahead and take one from here. Okay?

