**Final Report**

*This is end of year 1 of a 1 year proposed project.*

The Washington Grape & Wine Research Program

**Date:** 31 January 2013

**Title:** Field Validation of a Vineyard Site-Selection Tool for Washington State

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*Role: Mapping and site selection tool support.*

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**Project Summary:**

Between 2011 and 2012, multiple vineyard locations in Washington were used for ground truthing the *WSU Vineyard Site Selection Model*. American Viticultural Areas represented in the validation process were: Red Mountain, Walla Walla, Columbia Gorge/Hood River, and Lake Chelan, in addition to locations outside of AVA boundaries. These sites were GPS-mapped and the locations were assessed using the model, to determine site suitability for grape production. Prior to model ranking, manual assessments of most sites were conducted, including data collection regarding planting history, production statistics, perceived fruit quality, frequency of damaging weather events (particularly frosts and freezes), and frequency of disease outbreaks. These manual assessments were compared to the model ranks to determine where the model was performing well and where potential improvements could be made. Overall, the model was able to accurately assess in-season conditions that would either be favorable or detrimental to grape production (such as heat accumulation and frost free days). In addition, it provided excellent insight into site soil conditions and situations such as excess or insufficient drainage. However, the model (which is a mathematical calculation that combines multiple factors in a ranked form, to determine overall suitability) in its current form is not able to predict the likelihood of dormant freezing events, a critical factor in site selection in eastern Washington. As such, while the model itself does not appear to be that useful, the work of database collation and individual parameter ranking that was necessary to develop the model has proven to be a very useful extension tool for off-location evaluation. As such, the current model should not be used for site evaluation, but the remaining databases can be. In addition, this tool should be referred to as a "site evaluation" tool rather than "site selection", due to the varied vineyard management practices that can be used to manipulate locations to suit production needs.

**Abbreviated Objectives and Experiments from Proposal and Interim Report:**

As outlined in the 2011 proposal, the objectives of this work were to: (i) *begin the validation or ground-truthing process of the preliminary* WSU Vineyard Site Selection Tool, and (ii) *identify and refine parameters used in the site suitability rankings of the model.*

For point-of-reference, the *WSU Vineyard Site Selection Tool* predicts site suitability for wine grape production based on soil, climate and elevation data, combing these with other climate requirements (latitude-temperature index based on work done by Jackson and Cherry 1998; and powdery mildew risk as a function of precipitation and temperature), to rank a given area for its suitability to grow particular classes of wine grapes. Similar work has been done in Oregon (Jones et al. 2004).

As highlighted in the interim report, the model itself had some inherent challenges in determining site suitability; there was a lack of representation for cold damage risk, a critical factor in WA grape production. The model also lacked sufficient resolution in some locations, due to the low-resolution of some of the individual data layers making it impossible to evaluate vineyard locations in certain areas near the Cascades or in the Hood River area. Unfortunately, this is a function of the scale of federal and state mapping, and likely is not able to be corrected by a local effort.

In 2012, additional areas in Lake Chelan, as well as potential "clientele" contacts in northeastern and northwestern WA, were mapped, and similar model performance conclusions were drawn (i.e., great ability to assess FFD and GDD as previously discussed; inability to predict freeze events and small-scale issues with soil pH and slope due to map-layer resolution). Mapping protocols followed that which was indicated in the interim report.

**Summary of Major Research Accomplishments and Results:**

*Objective 1: Begin ground-truthing process of the* WSU Vineyard Site Selection Tool.

Locations in *Red Mountain* were selected based on past history of planting, noted "premium" grape production, and the unique attribute of heat accumulation in this small AVA. Sites in *Columbia Gorge* were selected on the opposite extreme; this location tends to be very cool in general, and has a large diversity in vineyard age. Sites in *Walla Walla* were chosen due to their frequency of die-back due to mid-winter freeze damage; this was an indirect assessment to see if there were any proxies in the model that could be used to identify potential locations of cold pockets and subsequent high-risk areas for such damaging events. Sites in *Lake Chelan* were chosen due to cold damage, frost risk, and repeated variety changeovers for many vineyard locations. Additional locations in Douglas, Stevens, Clark, Pierce, King, Kittitas, and Grant counties were also evaluated per public request, but were not followed-up with onsite evaluations as the aforementioned were.

As mentioned in the interim report, the model, based on a calculation which factored in multiple site components to give an overall score to a location, was accurately able to pick up coarse differences in regional GDD accumulation, in addition to differences in growing season as defined by FFDs; however, these two main factors were not a component to the model score. Individual composite scores (including soil pH, aspect, depth, water holding capacity,

precipitation, etc.), which are the basis of the model, were more challenging to interpret. Often, with the composite scores, it required a reassessment of the individual data layers to fully understand why a site scored low or high. In most situations, the biggest influences were slope and aspect, and soil drainage. See the interim report for additional, layer-specific descriptors. The user of the database/model has access to both the raw data layers and a coded data layer, which grouped values into low, moderate, and high suitability to grape production, based on literature; in most instances, the ranked data layers were the most useful for site evaluation.

For the more recently mapped Lake Chelan area, the model itself continued to perform rather low, indicating lower-than-expected GDD in sites that have been able to consistently ripen white *Vitis vinifera* varieties. We had previously hoped this under-performance would be corrected with the release of new climate normals by the Western Regional Climate Center in 2012. However, year ranges used for the new release did not improve our GDD model performance due to lack of appropriate data duration for some weather stations used in the interpolation. In many of the non-AVA areas, the model did not work due to poor resolution of topography maps, typically indicating areas with excessive slopes, when in fact, they were not. In these cases, only the individual ranked data layers could be used for remote site evaluation.

*Objective 2: Identify and refine parameters used in the site suitability rankings of the model.*

An extensive review of different model parameters, and potential ways to improve their use, were presented in the project interim report. After careful consideration and additional model and database use in 2012, the PI concludes that efforts to optimize the model may not necessarily be the ideal route for the continuation of the *WSU Vineyard Site Selection Tool*. As mentioned, the "model" itself is an equation that factors in all of the different components discussed in the proposal and interim report, calculating a final "score" for a site. The PI feels providing a singular "score" gives users a false sense of production potential (as site is a part of the potential, but not the entire determinant). The PI also strongly recommends against using this model for predicting "premium" production locations, due to foreseeable legal complications and the basic nature that the concept of "premium" grapes does not come from site potential alone.

Conversely, the PI recommends using the *database* that was developed in the process of model development. This database (consisting of data layers such as FFD, GDD, soil depth, soil pH, etc) has proven to be a valuable extension tool in site *evaluation*. The database contains maps consisting of both raw values of the different model parameters, as well as maps that takes those raw values and categorizes them based on their suitability for grape production (typically scored on 0-2 or 0-3 scales; suitability determined by values reported in the literature). By individually assessing each "data layer" (whether raw data or categorized values) of a potential site, the user can provide a more comprehensive description of the positives and negatives of that location, allowing emphasis to be made on the areas that would need to be addressed if the site were to be developed for grape production. As such, the PI suggests referring to this database henceforth as the "*WSU Vineyard Site* ***Evaluation*** *Tool*", and recommends its use to be coupled with recommendations of a knowledgeable consultant or extension professional.

*General Conclusions:* The development of a GIS database containing relevant data layers for grape production has proven to be a very valuable extension tool to help with off-site evaluation of potential vineyard sites. This tool provides users (advisors) with pertinent information to direct additional information or questions on to potential growers (advisees), such as considering the need for wind machines (freeze and frost damage), soil modification pre-planting, or potential general classes of grape varieties that might be better suited for production in that area. In current form, the *WSU Vineyard Site* ***Evaluation*** *Tool* is recommend to be only used by extension and research personnel in terms of providing advice; improper or misuse of either the model or the data layers could result in legal or social implications (i.e., contract disruptions, denial of crop insurance, etc.) that may not be entirely foreseeable at present.

**Outside Presentations of Research (Associated Outreach and Extension Efforts):**
Posters regarding the use of the *WSU Vineyard Site Evaluation Tool* were presented in the 2012 Annual WAWGG and Northwest Center for Small Fruits Research Meetings. A manuscript is being revised for submission to the American Journal for Enology and Viticulture relating to this and other work done by former graduate student Ian Yau. Individual site evaluations were shared with associated vineyard managers to gain their additional perspectives on model outputs. Their reactions and responses, positive or otherwise, will be used to help define points of improvement in further model development.

**Research Success Statement:**
The *WSU Vineyard Site Evaluation Tool* (previously termed "WSU Vineyard Site Selection Tool") provides an off-site assessment of potential limiting factors in wine and juice grape production. The use of this tool allows pre-establishment questions to be answered through phone or email, reducing the need for Extension site visits, thus optimizing state available resources (and time). It also aids in helping to determine "no-grow" sites; this early-stage definition has the potential in reducing real dollar loss that is the result of investments in vineyard establishment on inappropriate sites. This study also demonstrated that several key components, including likelihood of damaging cold events and the availability of water/irrigation, will be necessary additions to the GIS database to truly make the model a singular entity for use of off-site evaluation of "plant/no-plant" zones. This tool is best used as a starting point for site evaluation, to better direct the attention of potential vineyard owners as to the challenges that might be associated with their site.

**Funds Status:**
Funds for this project were used to cover traveling expenses to the validation sites and labor costs associated with graduate student work. As of 15 January 2013, approximately $3,000 remained in the balance. Remaining funds will be used to cover additional ground truthing trips, as well as necessary hardware (external hard drives) for dataset storage, and timeslip coverage to cover costs of the former graduate student to finalize database information and papers.

**Other Sources of Funding:**
None.