



ADAPTING TO A CHANGING CLIMATE: CASE STUDY 13

NAUTILUS ESTATE

Using water wisely, to grow wine

THE BUSINESS

- A 1300 tonne winery on Rapaura Road, Marlborough.
- The company owns six vineyards (76.3 ha planted, excluding headlands and other unplanted areas) plus purchases fruit from five growers.



Michael Collins

Nautilus Estate of Marlborough manages water wisely, to consistently make quality wines that express the variable influences of nature and the nurture of vineyard management. Flavours are encouraged to develop on the vine then are further expressed through the winemaking process.

RESPONDING TO A CLIMATE CHANGE THREAT

The company acknowledges the scientific reality of climate change and vineyard management is already adapted to suit the season.

Temperature, light and water are key environmental influences on metabolic processes in the grapevine that drive fruit yield and flavour, says Nautilus viticulturist, Michael Collins.

TEMPERATURE RISE PREDICTED

The wine industry is particularly susceptible to climate change, as wine grape flavour development is predominantly temperature driven. Any change in climate will have a direct effect on grape quality.

Increasing temperature, changing rainfall patterns, a higher likelihood of out-of-season frosts, and more extreme climatic events (such as floods) are part of a probable climate change scenario for Marlborough.

Climate scientists estimate that temperatures in Marlborough and Nelson could increase by as much as 2.5 degrees over the next 70-100 years. Coastal Marlborough, where many vineyards are located, could be up to 10 percent drier.

There could also be changes in the timing and intensity of rainfall, with an increased likelihood of heavy rain in summer and early autumn, when ripening grapes are susceptible to disease. The average temperature in Blenheim has increased 0.9 degrees over the past 75 years.



Grape bins await pickers' arrival, outside the company's Marlborough winery.

"We can't directly control sun, heat or rainfall. But through vine soil/water relations and the manipulation of canopy microclimate, we can control plant growth, and influence grape and wine quality." Michael Collins.

CLIMATE CREATES MARLBOROUGH WINES

In 2009, 177,647 tonnes of sauvignon blanc were harvested in New Zealand, more than 90 percent from Marlborough where this variety accounts for close to 75 percent of vineyard area. In 2008, sauvignon made up 60 percent of New Zealand wine exports with a total value close to \$800 million.

Marlborough's grape ripening period is distinguished by a critical diurnal temperature range; warm days and cool nights. Climate change predictions of warmer temperatures mean there is a risk that the distinctive character of Marlborough sauvignon – a cool climate wine variety – could be significantly altered.

The aromatic compounds that distinguish Marlborough sauvignon are the product of enzymatic reactions. These compounds are susceptible to degradation by heat, meaning that if temperatures rise in Marlborough, the variety's grassy, asparagus to tropical character could be reduced.

Water scarcity is another potential issue, with reduced rainfall likely in Marlborough's winegrowing areas. The expansion of winegrowing into traditionally dryland areas means water supplies are already under pressure. Takes from aquifers and other sources are strictly allocated, with users providing metered returns throughout the season. Restrictions have occasionally been applied.

Inadequate watering compromises grape yields and quality not only for that season but also the next, as vines recover from stress.

More erratic rainfall and changes in frost patterns would also impact on winegrowing.

While scientists are saying climate change could mean fewer frosts in the Marlborough region, timing could become less predictable. Out-of-season frosts spell trouble, either dramatically reducing yields or limiting potential ripening.

VITICULTURIST MANIPULATES VINES

Vineyard siting has a big influence on grape production. The viticulturist's art is to manage vines according to site conditions and desired wine style.

THE NAUTILUS VINEYARDS

Location and topography	Planted size (ha)	Variety
Lanark Lane, Flat, Lower Wairau	12	sauvignon blanc
Kaituna, Flat, Northbank	18.3	sauvignon blanc (16.4 ha) pinot noir (1.9 ha)
Opawa, Flat, Renwick	25.5	sauvignon blanc (23.5 ha) pinot noir (2 ha)
Clay hills, Hill, Southern Valleys	4.8	pinot noir
Renwick, Flat	6.7	sauvignon blanc (2.2), pinot noir (1.4), pinot gris (0.9), chardonnay (1.6), gewurtztraminer (0.6)
Awatere Valley, Terraced	9	sauvignon blanc (4), pinot noir (1.9), pinot gris (2.9), chardonnay (0.2)



The Nautilus Clay Hills dam, framed by two water storage tanks, provides insurance against water restrictions being applied.

Where possible, Nautilus vineyards are oriented to maximise light exposure and encourage air circulation (to enhance ripening and reduce disease) and also to accommodate different soil classes, grape varieties and rootstocks as well as changes in aspect and slope.

IRRIGATION STRATEGIES

Nautilus vineyards each have their own irrigation strategies. Water scarcity means there is a need for careful management on some vineyards.

Irrigation water for the Clay Hills vineyard is sourced from the Marlborough District Council-managed Southern Valleys Irrigation Scheme (SVIS), a three million litre vineyard dam, and a one third shareholding in a right to draw from the Southern Valleys aquifer.

The SVIS is shut down when average daily flow of the Wairau River (from which it draws) falls below eight cubic metres per second. This has happened on three occasions over the scheme's five year history.

Water stored in the Nautilus dam is insurance against such a shutdown. "We have six weeks of irrigation there, possibly significantly more if we are careful," says Michael. "In a worst case scenario, we could partially replenish the dam by drawing on our share in the Southern Valleys aquifer."

In the 25.5 hectare Opawa vineyard, allocated water is from the Wairau aquifer. At peak demand, water from a single well is pumped for up to 143 of 168 hours available per week.

IRRIGATION ZONES

Strategies to cope with limited water supply include designing vineyards so water can be appropriately targeted to specific areas.

Soils range from fine, light alluvial gravels (Opawa vineyard) with a low water-holding capacity to sodic clays (Clay Hills). There are strong variations, not only between sites but also within vineyards.

Light soils lead to low vigour, low productivity vines and heavy soils to vigorous, sometimes overly vegetative vines.

Vineyards have been divided into irrigation zones and are independently watered based on soil type and grape variety. The 25.5 hectare Opawa vineyard and the 4.8 hectare Clay Hills vineyard, for example, are each divided into 12 irrigation zones.

The number of zones at Opawa is a compromise between allowing for site variation and ensuring the entire block can be watered in a practical cycle, says Michael.

“Water allocation is all about balance. We don’t want over-abundant water or the vine will go vegetative. Yet, we want the vine to have an active canopy so the fruit can ripen.” Michael Collins.

SOIL WATER MONITORING

Nautilus starts soil moisture monitoring in mid September. Results are used to decide how much water will be delivered, when, and for how long to each irrigation zone.

Irrigation scheduling is based on soil moisture content. Time domain reflectometry (TDR) probes take readings as frequently as every ten minutes. The number of probes used and their positioning depends on the site variability. Results are downloaded on demand, providing instant results plus recording any increases or decreases in soil moisture.

IRRIGATION SCHEDULING AND RATES

“Water is an important tool in viticulture,” says Michael. We can apply or withhold water as a mechanism to influence the vine’s growth, grape composition, yield and ultimately a wine’s flavour profile.”

Nautilus ensures the right amount of water is delivered to vines at the right time to achieve desired yields and berry quality. Targeted irrigation also conserves water, avoiding waste.

Water application rates are varied according to variety, vine growth stage, soils, the growing season (how wet or dry it is), and desired wine style. Trickle irrigation systems are used, with pressure compensating emitters delivering a uniform volume of water.

Irrigation design ensures that controllable amounts of water are accurately delivered. On light soils, emitters are placed close together to create sausage-shaped saturation under the vines while on deep soils they are further apart to maintain a consistent wetting pattern.

“We don’t want isolated pockets of watering,” says Michael.

Key points

- 1** Climate change is likely to cause increased temperature and changes in rainfall and frost patterns in Marlborough’s winegrowing areas.
- 2** Wines are influenced by site and climate, especially rainfall and temperature.
- 3** Nautilus Estate manages its vineyards to grow grapes which consistently achieve quality criteria despite climatic variation.
- 4** Nautilus accepts the scientific evidence of climate change.
- 5** Changes to Marlborough’s climate, especially increased temperatures and a greater likelihood of water shortages, could alter the character of the region’s wines.
- 6** Flexibility of vineyard management systems places Nautilus in a strong position to adapt to climate change.



An extremely variable site and limited water availability means every drop counts, in Nautilus Estate’s Opawa vineyard. The site is a flat alluvial flood-plain with a series of terraces ranging from sandy silt loams to gravel beds.

FOR MORE INFORMATION

- Nautilus Estate of Marlborough www.nautilusestate.com
- New Zealand Winegrowers Statistical Annual www.nzwine.com/statistics/
- Marlborough vineyard area maps www.marlborough.govt.nz/enviromonitoing/croptype.cfm
- Sustainable Winegrowing New Zealand www.nzwine.com/swnz
- Maximising Irrigation Savings in Grapevines and the effect on Yield and Wine Quality. SFF Project 03/100. Summary of the research undertaken in the Nautilus Renwick vineyard. Available on the MAF website www.maf.govt.nz/sff

“Nautilus does a lot of intensive management of soil moisture. Soil water is monitored daily and vineyards are managed in zones according to site characteristics, grape variety and end use.” Michael Collins.

Light soils with a low water-holding capacity are irrigated at a high frequency for shorter periods. Deeper soils with high clay content are watered less frequently and for longer periods.

At Opawa, zones of lighter soils are watered daily for short intervals, sometimes twice within 24 hours. The heavier soils can be managed with longer irrigations two to four times a week.

Early in the season, vine energy is directed to leaf production. Later in the season – as the focus shifts to fruit ripening – irrigation scheduling is tapered off to discourage excessive vegetative vigour and encourage ripening.

“Water allocation is all about balance. We don’t want over-abundant water or the vine will go vegetative. Yet, we want the vine to have an active canopy so the fruit can ripen,” says Michael.

SOIL ENHANCEMENT

Winery waste is composted and used as a mulch to improve soil structure, water-holding capacity, and nutrient levels.

Winery marc (fermented pips and skins), bark and other winegrowing by-products are composted using the bokashi method, where waste is fermented (rather than decayed) in an airtight environment. The compost is applied under-vine to the driest areas at Opawa to increase soils’ moisture holding capacity and boost microbial activity. This reduces the risk of soils drying out and vines becoming stressed.

THIS IS ONE IN A SERIES OF CASE STUDIES CALLED ADAPTING TO A CHANGING CLIMATE THAT CAN BE FOUND AT WWW.MAF.GOV.TZ/CLIMATE CHANGE

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The aim at Nautilus’s Clay Hills vineyard is to produce quality rather than quantity. In a good season, the block yields about 30 tonnes of fruit which meets quality criteria including brix (sugar), pH, titratable acidity, physiological ripeness and desired flavours.

CANOPY MANAGEMENT

Trellising and pruning can be altered in response to variable vineyard conditions. In arid, stony soils Nautilus will prune vines to two canes while in heavier moderately vigorous sites, vines are pruned to a four cane Scott Henry system. Some rows may have both, starting with two canes at one end and traversing into Scott Henry as soils change.

The aim is to achieve adequate canopy growth and maximise water efficiency.

FROST PROTECTION

Nautilus has a frost risk in only two of its vineyards where protection is achieved through wind machines, frost fans and a helicopter if needed. Michael acknowledges that frosts may become less predictable, which could require extension of protection to more sites.

GRAPE VARIETY AND ROOTSTOCK SELECTION

Some rootstocks are more tolerant to low soil moisture levels than others. In light, stony soils with low water holding capacity, a drought tolerant rootstock could be selected while on soils with high water holding capacity less vigorous rootstocks may be appropriate.



Five different recent release burgundy selection pinot noir clones are planted in the Clay Hills vineyard on 3309 rootstock, good for handling heavier clay soils.