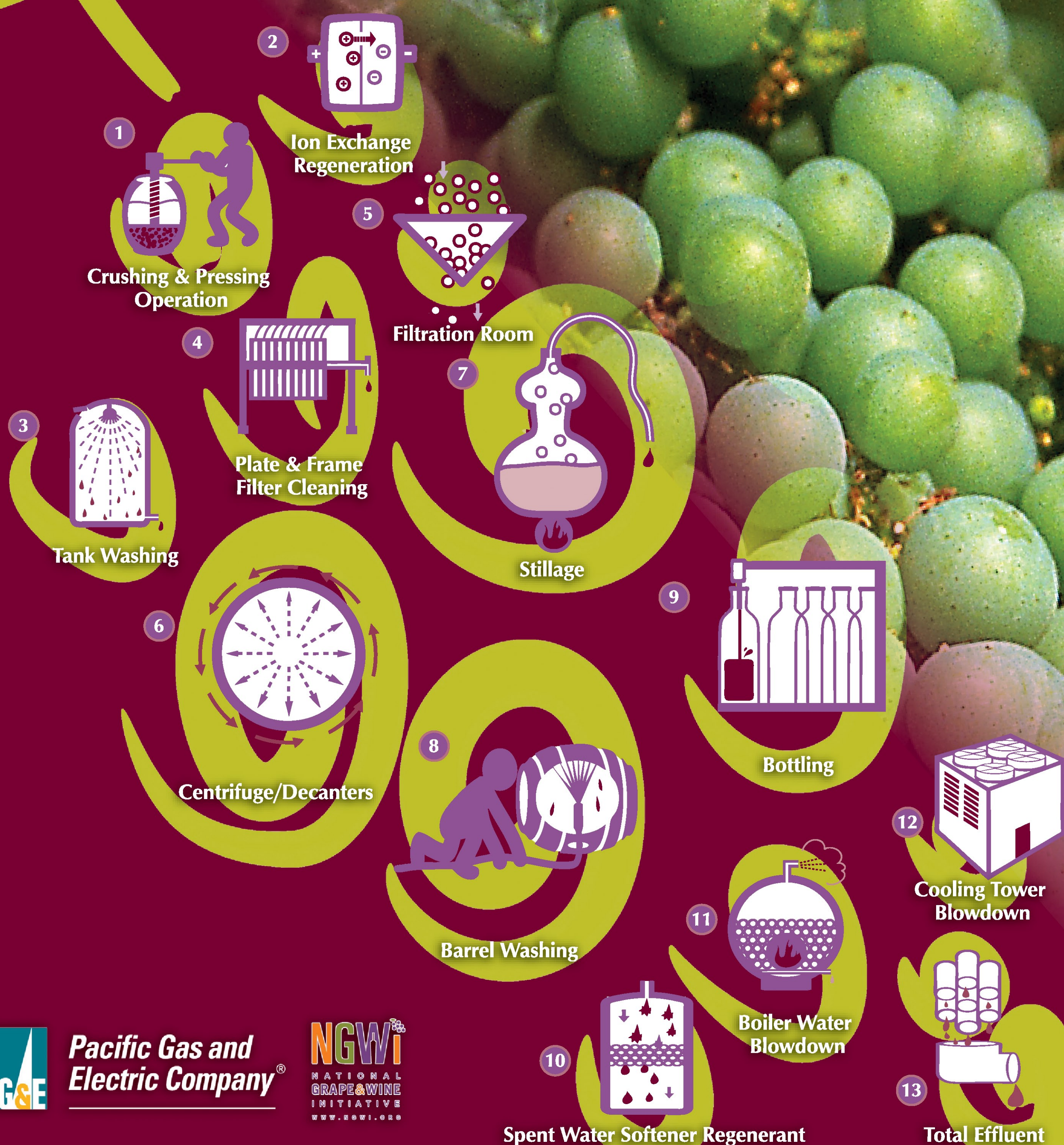
Wine Institute
The Voice for California Wine

American Vineyard Foundation

Comprehensive Guide to

Sustainable Management of Winery Water and Associated Energy

Kennedy/Jenks Consultants
Engineers & Scientists



The Code of Sustainable Winegrowing

PG&E Pacific Gas and Electric Company®

NGWi National Grape & Wine Initiative
www.ngwi.org

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Glossary of Terms

Acidity – A measure of the capacity of a water to neutralize a strong base to an endpoint of pH 8.3. Acidicity is reported as calcium carbonate in units of mg/l.

Aerobic – A process that occurs in the presence of oxygen.

Agronomic Rates – The amount of nitrogen fertilizer (customarily ammonia-N plus nitrate-N) or other constituent required for optimum crop yield. These values are different for each crop, and do not account for site specific conditions.

Alkalinity – A measure of the capacity of a water to neutralize a strong acid to an endpoint of pH 4.5. Alkalinity is reported as calcium carbonate in units of mg/l.

Anaerobic – A process that occurs in the relative absence of oxygen.

Available Water Storage Capacity – Amount of water that the soil can hold without draining. This amount is used as the maximum application volume for a spreading basin loading cycle under the proposed guidelines.

Best Practicable Treatment and Control (BPTC) – A California regulatory objective, generally defined as the level of treatment and control for process wastewater that is technically achievable using best efforts.

Biochemical Oxygen Demand, 5-Day (BOD_5) – A measure of the organic fraction in a water sample based on the amount of oxygen used by microorganisms to degrade the organic matter during a five-day test.

Chemical Oxygen Demand (COD) – A measure of the total organic fraction in a water sample based on the amount of oxygen required to oxidize the sample.

Composite Sample – A sample obtained by pooling a series of samples collected over time (e.g., mixing them in a bucket) and collecting a sample from the pool. Representative of average conditions over the timeframe of sampling.

Denitrification – Biological conversion of nitrate into nitrogen gas under anaerobic conditions, resulting in a loss of nitrogen from the ecosystem.

Disking/Tilling – Shallow mixing and aeration (e.g., 2 to 8 inches below the ground surface) of soils in a spreading basin. These techniques can be used to break the mat of particulate and biological matter that can accumulate at the soil surface of spreading basins. Disking/Tilling is a common technique to re-establish infiltration rates at the end of a cycle prior to the start of the next cycle.

Electrical Conductivity (EC) – An indicator of the concentration of dissolved salts in a water sample. When salts dissolve in water, they give off charged ions that conduct electricity. Thus the higher the concentration of ions, the higher the EC will be, depending on temperature. EC is measured in various units, including microSiemens/centimeter (µS/cm) or millimhos/centimeter (mmho/cm).

Exchangeable Sodium Percentage (ESP) – The percentage of soil cation exchange capacity occupied by sodium ions. This measure is closely related to the SAR.

Fixed Dissolved Solids – The amount of residue left by a filtered liquid sample that has been evaporated to dryness at 550 degrees C. In winery process water, it is often used as a surrogate for IDS.

Grab Sample –A sample collected manually. Representative of conditions at a single point in time.

Inorganic Dissolved Solids (IDS) – Analytically determined as the sum of the inorganic ions in the water analyzed (e.g., Ca, Mg, etc.). In winery process waters, IDS represents the inorganic fraction of the TDS, which is what remains after the organic fraction has been removed (usually by biodegradation).

Land Application Cycle – A complete wetting and drying cycle for land application to a spreading basin, consisting of: wastewater application, a resting period for soil drainage and re-aeration, and maintenance to the spreading basin prior to the next application cycle.

Leveling – The process of evening the ground surface of a spreading basin to promote even application of wastewater.

Loading Rate or Land Application Rate – The volume of wastewater or mass of a wastewater constituent applied to a given area per unit time. The application rate to a spreading basin can be expressed as mass per area of spreading basin divided by the number of days in the full application cycle (lb/acre/day). This indicates the average daily constituent load for the length of the cycle.

Nitrification – The biological conversion of ammonium to nitrite then to nitrate.

Process Wastewater – Water generated by various operations in the non-stillage and stillage winery industry, usually characterized by high BOD_5 and organic nitrogen.

Redox – Abbreviation for oxidation-reduction. Redox, in this report, refers to the oxidation-reduction potential of a subsurface environment that can affect whether certain water quality constituents are present in their reduced or oxidized forms.

Resting Period – The time after wastewater application until the beginning of the next application cycle. During this period, the applied water partially evaporates and the remainder moves downward into the soil column, allowing the upper reaches of the soil horizon to dry and reaerate.

Salinity – Refers to the total amount of dissolved inorganic salts, essentially Na^+, Mg^{2+}, Ca^{2+}, K^+, Cl^-, SO_4^{2-}, HCO_3^-, and CO_3^{2-} in aqueous samples. In soil, it refers to the soluble plus readily dissolvable salts. Although there is a large range, EC greater than 4 dS/m generally indicates that salinity will affect crop growth. The value of salinity where adverse effects occur is a function of SAR (see below).

Salt – Salt is the reaction product of an inorganic acid and an inorganic base. The term can refer to table salt (sodium chloride). For the purposes of this report, the term refers to the sum of the major inorganic ions in soil and groundwater: calcium, magnesium, potassium, sodium, chloride, sulfate, bicarbonate and carbonate.

Sodicity – Refers to conditions with an excess of sodium ions relative to calcium and magnesium ions. It is measured as the Sodium Adsorption Ratio.

Sodium Adsorption Ratio (SAR) – The SAR equals the sodium concentration expressed in moles of charge per liter divided by the square root of half the sum of calcium and magnesium expressed in moles of charge per liter. The SAR along with EC impacts the ability of water to infiltrate into soil. At a low EC, <0.2 dS/m, an SAR of 0 to 3 can impede infiltration while at a higher EC, > 5 dS/m, a SAR of less than 20 will not impede infiltration. (Ayers and Westcot, 1985)

Spreading Basin – The parcel of land used for the even, high-rate application of wastewater for treatment and discharge. Spreading basins can be various sizes, including long, thin furrows; long and slightly wider surface irrigation checks, and larger infiltration ponds.

Total Dissolved Solids (TDS) – The amount of residue left by a filtered liquid sample that has been evaporated to dryness at 180°C. In most natural waters, this approximately corresponds to IDS. In winery process waters, this analysis can be greatly affected by the organic content of the water.

Total Nitrogen (TN) – The sum of ammonia/ammonium-nitrogen (ammonia-N), organic-nitrogen (organic-N), and nitrate-nitrogen (nitrate-N). Although there are other nitrogen species (e.g., nitrite) that occur during the chemical and biological processes during land application, these three are the dominant nitrogen species. All species concentrations are normalized to mg-N/l allowing the direct comparison between species and mass balance calculations with all dominant nitrogen species.

Vadose Zone – The unsaturated portion of soil between the soil surface and saturated soil associated with the water table. Synonymous with unsaturated zone.

Volatile Dissolved Solids (VDS) – The portion of TDS that are volatilized at 550° C. This fraction of dissolved salts approximates the organic acids, sugars, other organic components, and waters of hydration from inorganic salts removed during the TDS analysis.

Executive Summary

This guide to sustainable management of winery water and associated energy has been prepared on behalf of the American Vineyard Foundation (AVF) and the California Wine Institute (Wine Institute), with support and guidance from the National Grape and Wine Initiative (NGWI). It provides a set of tools for wineries of all sizes to use in realigning existing facilities or designing new facilities to achieve goals for sustainable management of winery source water and wastewater, with the ancillary benefits of increasing energy efficiency and reducing greenhouse gas generation. This course of action is consistent with NGWI's vision for the U.S. grape and wine industry to be a world leader in sustainability. It will be particularly useful to wineries that have previously conducted a self assessment using the Code of Sustainable Winegrowing Practices Self-Assessment Workbook (Wine Institute and California Association of Winegrape Growers, 2002) or similar assessment process and are now seeking guidance on specific measures they can implement to progress toward more favorable status.

Organization and Scope of the Guide Document

Following this introductory section, the first five sections of the guide document describe a structured approach for planning and program organization, self-evaluation of existing operations, feasibility evaluation of potential improvements, and program implementation. To enable winery staff to readily carry out these steps, a series of worksheets is provided in MS Excel format. Copies of all of the worksheets are included within the sections of the document where they are referenced, and a CD containing the Excel files is enclosed. Wineries are encouraged to customize the worksheets as needed to best capture the relevant data for their unique operations. In some cases, wineries will want to substitute their own similar worksheets to accomplish the same objectives, such as a capital cost evaluation.

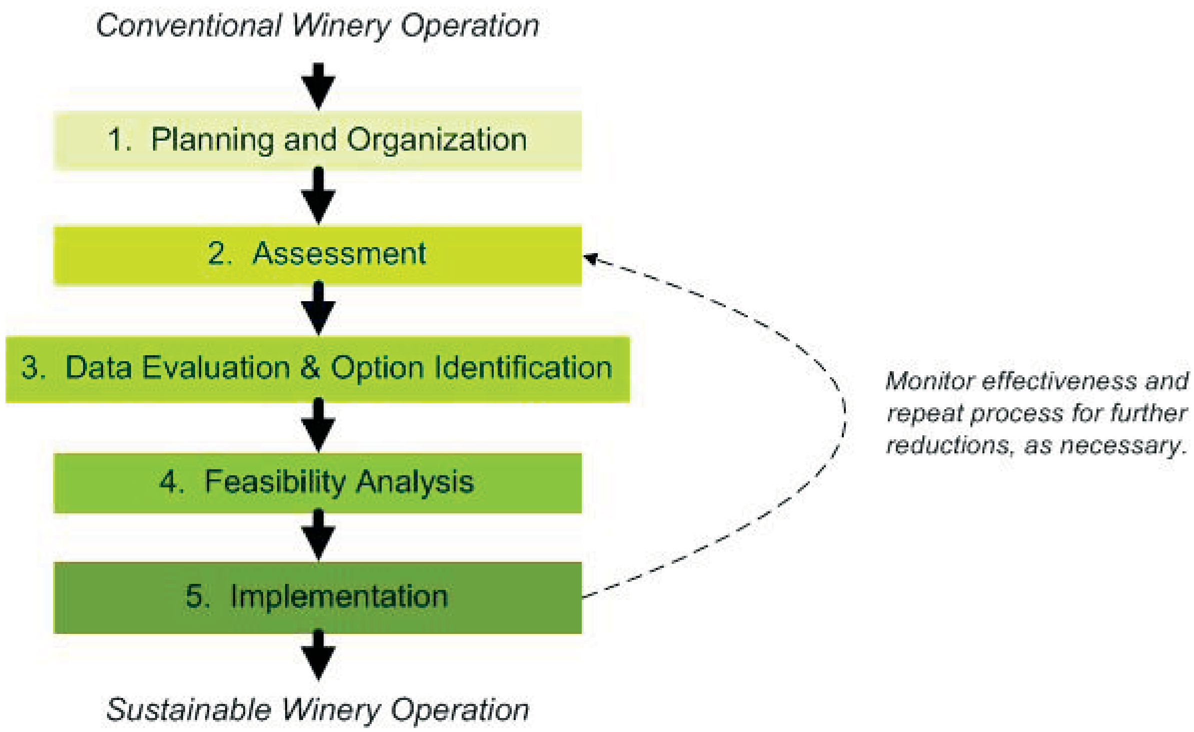
The next section of the document provides detailed implementation guidelines and recommended methods that the winery can use to complete the steps described above. The final section is a set of appendices that offer supplemental reference materials on a range of relevant topics. These materials were assembled in part from previously published sources, including guidance documents from winemaking organizations around the world and prior studies conducted by the Wine Institute and Kennedy/Jenks Consultants (Kennedy/Jenks). Both the guidelines and appendices also reflect Kennedy/Jenks' practical experience designing facility improvements to enhance sustainability.

The guide document was expressly designed to enable wineries to complete the full process from planning through implementation and monitoring on their own, without assistance. However, there may be steps along the way when the winery would be best served by consulting an experienced engineer or environmental professional for additional support. Some of these decision points are noted within the guide. Note that the scope of the implementation guidelines does not extend to the full engineering design necessary to develop more complex initiatives, such as advanced treatment systems.

Concurrent with implementing the program outlined herein, wineries should also take advantage of energy efficiency audits offered by energy companies at low or no charge in many parts of the country. Results of an audit can be an important consideration in charting the winery's holistic plan for optimizing their operations.

How to Use this Guide Document

The general approach presented in this guide for winery self-evaluation and selection and implementation of improvements and best practices has been adapted from the Environmental Protection Agency (EPA) Waste Opportunity Assessment Manual (EPA 1988). It consists of the following steps:



Although the scale and complexity of operations at each winery will be unique, this general approach will be applicable for all wineries. Smaller wineries may have fewer discrete wastewater streams to manage and lower total effluent volumes than larger wineries. Similarly, wineries that do not have distillation operations or that do not bottle onsite will not have the waste streams associated with those activities.

A detailed work flow for use of the guidance document is presented on Figure ES-1. This diagram serves as a condensed road map to all sequential steps described in this manual, including the specific worksheets associated with each of the five steps identified above and other supporting materials provided in appendices. For example, at particular points in the process it may be useful to refer to the case study included in Appendix A; those junctures are noted on the figure.

Figure ES-1: Work Flow for Use of Guide Document

Key Objectives:

- Reduce water use
- Decrease wastewater generation and strength
- Reduce associated energy consumption

Step 1. Planning and Organization

1.1 Seek management commitment

1.2 Define assessment program objectives

1.3 Organize implementation team

Use worksheets to guide data collection and record results

Refer to Case Study (Appendix A) tables for:

- Examples of streams to monitor
- Sample stream characterization data

Step 2. Winery Self-Assessment

2.1 Compile existing facility information

2.2 Collect additional information

Step 2 Tools:

Worksheets

2-1	Water use inventory
2-2	Sanitation inventory
2-3	Equipment inventory
2-4	Flow monitoring plan
2-5	Flow monitoring results
2-6	Analytical program
2-7	Analytical results

Other Useful Materials

Guideline 1:	Data collection
Appendix A:	Case Study
Appendix B:	Source Water Quality and Treatment
Appendix C:	Wastewater Sources and Characteristics

Review data to identify activities or systems that:

- Use the most water
- Generate the highest volume of wastewater
- Contribute the highest loading
- Use the most energy

Compare results to Case Study data (Appendix A) for similar streams to aid in interpretation

Screen options based on:

- Effectiveness
- Implementability
- Order-of-magnitude cost

Carry selected options forward for detailed feasibility evaluation

Step 3. Data Evaluation and Option Identification

3.1 Generate options for source reduction, recycling or treatment

3.2 Screen and select options for further study

Step 3 Tools:

Worksheets

3-1	Option brainstorming
3-2	Option description form
3-3	Evaluation by Weighted Sum
3-4	Option Screening

Other Useful Materials

Guideline 1:	Data Validation
Guideline 2:	Source Reduction, Reuse and Treatment Options
Figure 3-1:	Overview of Waste Minimization Techniques

Figure ES-1: Work Flow for Use of Guide Document (continued)

Action plan should include:

- Schedule
- Preferred suppliers
- Contingency plans for impacts on production
- Monitoring plan

Step 4. Feasibility Study

4.1 Conduct technical evaluation

4.2 Conduct economic evaluation

4.3 Identify preferred option

4.4 Develop action plan

Step 4 Tools:

Worksheets

4-1 Design criteria summary

4-2 Capital costs for improvements

4-3 Utility costs for improvements

4-4 Impact on operating costs and revenues

4-5 Impact on profitability/payback

Other Useful Materials

Guideline 3: Land Treatment

Guideline 4: Treatment System Selection

Implementation should be followed by:

- Monitoring effectiveness over time
- Monitoring compliance with procedural changes
- Contingency plans for impacts on production

If monitoring shows that the winery's goals have not been met, go back to step two.

Step 5. Implementation

5.1 Execute Implementation Plan

Step 1: Planning and Program Organization

The level of effort required for planning and program organization will be contingent on the size of the winery and the scope of management's objectives.

1.1 Seek Management Commitment

Successful implementation and long-term effectiveness of a water conservation and waste minimization program hinges on the commitment of the owner or management team of the winery. In general, wineries are very receptive to practices that promote sustainability: minimizing environmental impacts, reducing costs and fostering social well-being.

1.2 Define Assessment Program Objectives

Assessment program goals will be specific to each winery, and will depend in part on the winery's initial understanding of their own operations. Some wineries may already have sufficient operational data, so their assessment effort will be primarily a review of the data to identify potential options. Other wineries will need to perform a full chemical and physical wastewater characterization in order to maximize their potential for identifying water conservation and waste minimization opportunities. In general, the assessment should seek to answer the following questions (adapted from EPA 1988):

1. *Which processes or operations use water and have associated wastewater streams?*
2. *What input materials contribute to the wastewater stream from each process? How much of each input materials is used per stream?*
3. *How much of the raw material use requirements can be attributed to fugitive losses?*
4. *What types of housekeeping practices are used to limit the quantity of wastewater generated?*
5. *What types of process controls are used to improve process efficiency?*
6. *Are any of the wastewater streams classified as hazardous? What characteristic makes them hazardous?*

1.3 Organize Implementation Team

Determine staff that will be responsible for implementing the assessment tasks. This should include facility managers and other plant personnel who have the greatest familiarity with the operations to be assessed. For example, the team for a larger winery may include:

- Project manager – tasked with coordinating the overall water conservation and waste minimization effort and accountable for demonstrating tangible results
- Assessment task manager – responsible for collecting and evaluating data
- Winemaker or assistant winemaker – will need to provide input on current practices and the feasibility of implementing proposed changes
- Analytical laboratory representative – will need to provide input on current practices and the feasibility of implementing proposed changes
- Maintenance staff representative – will need to provide input on current practices and the feasibility of implementing proposed changes
- Financial manager – prepared to assist with evaluation of costs associated with current practices and the cost implications/feasibility of potential modifications
- Executive management representative – authorized to approve expenditures for the assessment and prepared to communicate results to the management team or owner, as applicable

At a smaller winery, the team must plan to cover the same roles identified above, though multiple roles may be assigned to the same individuals.

The assessment phase includes compiling and evaluating existing facility data on water uses, wastewater sources and other operating features; identifying and prioritizing needs for further assessment; collecting additional data, as needed; and summarizing and evaluating data. For background information on evaluating source water quality, refer to Appendix B. For information on sources and characteristics of process wastewater, refer to Appendix C.

2.1 Compile Existing Facility Data

Some or all of the data needed for the assessment may already be available. An inventory of relevant information may include:

- Facility and process design details and process flow diagrams
- Piping and instrument diagrams
- Equipment lists
- Equipment layout and workflow diagrams
- Source water volume and chemistry data
- Volume of grapes processed
- Cleaning product information (Material Safety Data Sheets [MSDS], if available) and inventory
- Chemical usage information
- Product inventory logs
- Waste stream volume and chemistry data
- Total wastewater effluent volume and chemistry data
- Facility and site environmental monitoring data, including groundwater characterization and water balance studies
- Existing wastewater treatment system design details, including land application or irrigation and any offsite discharges
- Offsite discharge cost data
- Energy use data
- Operating and maintenance cost data
- Permit requirements

Wineries can begin to compile this information using worksheets that are provided to guide inventories for water use (Worksheet 2-1), sanitation activities (Worksheet 2-2) and energy demand associated with water management (Worksheet 2-3). These worksheets were designed to allow wineries of any size to fully detail their operations.

After conducting the inventories and gathering and reviewing available facility and process information, most wineries will discover they need to collect additional water use and wastewater stream flow and chemical characterization data in order to gain a full understanding of (1) where in the winery water uses are the greatest, and (2) the relative contribution of various winery activities to wastewater, in terms of both volume and constituent concentrations.

2.2 Collect Additional Information

To fill data gaps that are identified based on the inventories and review of existing information as described above, this section provides a discussion of sampling strategies to characterize wastewater from individual winery unit operations. Although there are clearly cost/benefit considerations in collection of additional data, a more complete data set will provide a solid basis for selecting optimal water conservation and waste minimization strategies. It will also be needed to establish benchmarks for measuring the effectiveness of changes that the winery implements to improve operations.

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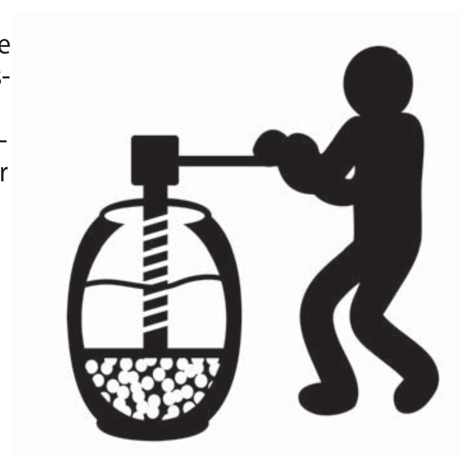
Whenever possible, flow rates and chemical concentrations of wastewater streams should be measured directly using methods described in Guideline 1; however, estimates of some parameters can be substituted if access is limited, for example if piping would require significant reconfiguration, or if there are other limiting conditions such as a conflict with production schedules. When relying on estimated values, it is important to record the methods and assumptions that were used to arrive at the estimate for future reference.

2.2.1 Crushing and Pressing Operations

During the crush season, wastewater associated with crushing and pressing operations typically makes up a large portion of the facility's total effluent. Wastewater sources include spills and rinsing and sanitizing activities for the crushing, de-stemming, and pressing equipment. Wastewater from these operations is generally allowed to discharge to the floor, where it is captured in floor drains. Floor drains may either be routed to a holding sump for later transfer to the wastewater collection system, or they may drain to the collection system directly.



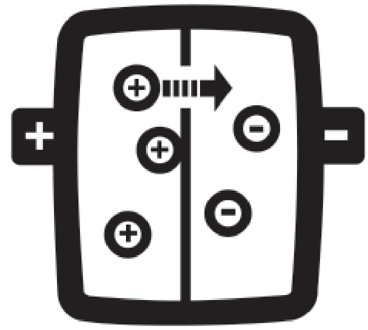
If wastewater is captured in a sump, flow can be measured by installing a transit-time ultrasonic flow meter on the discharge piping from the sump pump (refer to Guideline 1 for flow meter installation information).

If the floor drains convey wastewater directly to the wastewater collection system, flows may be measured with the use of area-velocity flowmeters. This type of flow meter can be used in either trench drains or directly in conveyance piping, depending on the drainage configuration at the facility. If wastewater flow is difficult to monitor directly, it may be preferable to monitor the inflow of source water instead. In this situation, a transit-time ultrasonic flow meter would be attached to the source water feed line(s) to assess the volume of water used over a 24-hour period.

To effectively characterize the chemistry of the wastewater from a target area, use automatic compositing sampling equipment. Configure the sampling equipment to collect discrete samples at 1-hour intervals to generate a 24-hour composite sample. Collection of at least three such composite samples is recommended to provide a basic characterization. If wastewater is captured in a sump prior to conveyance to the main collection system, a single composite sampler would be needed for stream characterization. If it flows from the floor drains directly to the collection system, it may be necessary to collect composite samples from several locations to provide adequate characterization. In short, the number of sample locations and automatic composite samplers required to characterize wastewater from the target area will depend on the specific configuration of the facility.

2.2.2 Wine/Juice Ion Exchange Regeneration

Ion exchange systems that are used for wine or juice processing will normally generate a wastewater stream when the resin bed undergoes a regeneration cycle. Regeneration is an intermittent process that typically does not occur at regular intervals. Accordingly, wastewater flows can be monitored by attaching a transit-time ultrasonic flow meter to the spent regenerant discharge line. By recording the discharge volume over a specific time interval, the average volume generated for a 24-hour period can be estimated.



In a typical wine or juice ion exchange system, spent regenerant will be routed to a holding tank for pH adjustment prior to discharge to the main wastewater collection system. Holding tanks used for this purpose are apt to contain effluent from multiple regeneration cycles. Therefore, grab samples from the tank should be sufficient to characterize the chemistry of the spent regenerant stream; composites are not needed. Contingent on the rate of regeneration, collection of one sample per day on three occasions would provide a useful data set.

2.2.3 Tank Washing

Tank washing is a regular activity in every winery, but the total volume and characteristics of wastewater generated on a daily basis will vary widely depending on the number of tanks in use, tank sizes, the nature of residuals in the tank, additives used in cleaning, and sanitation protocols. Given that direct evaluation of wastewater from sanitation of every tank is not feasible, the winery can select a set of representative tanks for investigation. These should include tanks in the sizes that are the most commonly used in the facility. To obtain a representative sample of effluent from an individual tank during a typical three-step washing process, a manual composite can be prepared as described in Table 2-1.

Floor drains receiving effluent from tank washing are typically tied to a facility's main wastewater collection system. The flow of discharges from tanks during the cleaning process may be difficult or impossible to monitor. Alternatively, the inflow of source water for tank washing activities can be monitored by attaching a transit-time ultrasonic flow meter to the source water piping. Flow data from representative tanks can be extrapolated to all tanks in the winery of the same size, or more roughly, an average of wastewater generation per tank of any size can be estimated and applied to all tanks.

Characteristics of the wastewater will vary during each step of the washing sequence, as well as within an individual step (e.g., more materials are likely to be removed at the beginning of the initial rinse step than near the end). Accordingly, composite samples should be collected manually by combining multiple sub-samples from each step, as indicated in Table 2-1. For smaller tanks, it may be sufficient to build a composite with only one sample from each step; this should include a sample from the mid-point of the final rinse. Refer to Guideline 1 for more information on collection of composite samples.

2.2.4 Plate and Frame Filter Cleaning

Plate and frame presses are typically used in conjunction with other filter equipment in a designated filter or processing building. However, larger presses are sometimes operated as stand-alone units, and this section pertains to them.

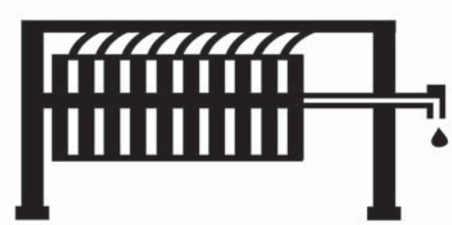
Plate and frame press operations generate wastewater during cleaning activities. Cleaning is either done manually by spraying down the filter fabric with hoses or automatically with a spray washer system. At some wineries, a clean-in-place (CIP) system is used in which a cleaning agent is added to the spray washer system during an automated cleaning cycle. Manual spray down is typically used when light cleaning is needed, while the CIP is used for deeper cleaning.

Table 2-1: Composite Sampling for Tank Washing

WASH STEP	STEP DESCRIPTION	SAMPLING PROCEDURE
Initial Flush	Overhead spray nozzles introduce water at the top of the tank and it drans out of the tank at the bottom to a floor drain.	Collect a 1-liter sample from the tank drain outlet to capture the first flows of the wash water. Collect a second 1-liter sample at the end of the flush cycle. Transfer both samples to a clean 5-gallon container.
Cleaning Sanitation	A cleaning/sanitation agent and water are added to the tank and recirculated for a prescribed length of time, in accordance with winery protocol. Spent solution is discharged.	Collect a 2-liter sample from the spent solution discharge and transfer it to the 5-gallon compositing container.
Final Rinse	Water is again added to the top of the tank through an overhead spray nozzle and allowed to drain from the tank at the bottom.	Collect a 1-liter sample of wastewater from the first flows and a second 1-liter sample from at the end of the flush cycle. Add these samples to the 5-gallon compositing container. Collect the composite sample from the pooled samples in the 5-gallon container.

At some wineries, wastewater from large plate and frame press operations is discharged directly to a floor drain, which connects to the facility's main wastewater collection system. Because the discharge can be difficult to monitor directly, inflows of source water for cleaning can instead be monitored. This can be accomplished by attaching transit-time ultrasonic flow meters to the water drops feeding the hoses used for manual cleaning and on the water line feeding the automated spray-cleaning system. Monitoring will yield the average water volume used over a 24-hour period for cleaning purposes.

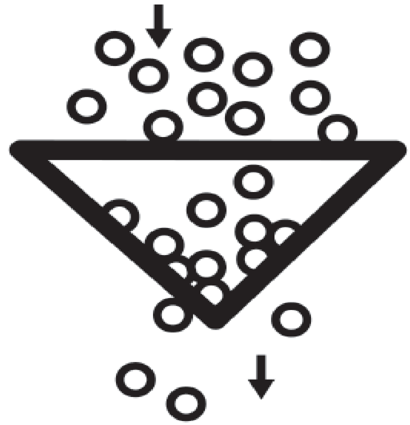
Wastewater from plate and frame operations may be discharged to a holding sump, where it accrues until it reaches a set level and is pumped to the wastewater collection system. It should be feasible to monitor this effluent by attaching a transit-time ultrasonic flow meter to the sump discharge line. This would allow measurement of wastewater generated over a 24-hour period. Composite samples can be collected using a programmable automatic compositing sampler that is configured to extract samples at one-hour intervals and generate a 24-hour composite.



For chemical characterization of effluent during a CIP cycle, collect a composite sample manually by placing a series of clean 5-gallon pails under the press unit lengthwise, at equal spacing, prior to the CIP cycle. At the end of the cycle, contents of the pails are stirred and equal volumes are transferred to a single clean 5-gallon pail for collection of composite samples.

2.2.5 Filtration Room

Sanitation activities in the filtration room can include washing pressure leaf filters, small plate and frame presses, and other separator equipment. Methods used to monitor flow and collect samples will vary depending on the configuration at each facility. For example, if wastewater is discharged to the facility floor and accrues in a trench drain before being pumped to the main wastewater collection system, an area velocity flow meter can be installed in the drain to measure the discharge volume over a 24-hour period. Composite samples can be collected using programmable automatic compositing sampling equipment configured to pull discrete sub-samples from the trench drain at one-hour intervals to make up a 24-hour composite.

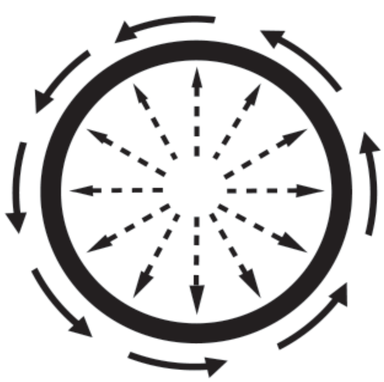


Alternatively, if wastewater is discharged to the facility floor for drainage into a holding sump prior to pumping into the facility's main wastewater collection system, a transit-time ultrasonic flow meter can be attached to the sump discharge line to measure the volume pumped over a 24-hour period. Composite samples can be collected using a programmable automatic compositing sampler configured to extract discrete sub-samples at one-hour intervals to produce a 24-hour composite.

2.2.6 Centrifuges/Decanters

There are multiple sources of wastewater associated with centrifuges and decanters, including cleaning, seal water, chase water, and watering in/out activities. Methods used to monitor flow and collect samples at each facility will vary, depending on facility configuration. At some facilities, wastewater from centrifuge/decanter activity is discharged to the facility floor and drains to a catch basin prior to conveyance to the main collection system. If wastewater flow is difficult to monitor directly, it may be preferable to monitor the inflow of source water instead. In this application, a transit-time ultrasonic flow meter is attached to the source water feed line to assess the volume of water used over a 24-hour period.

Due to the discontinuous nature of flows, characterization of the stream typically requires the collection of composite samples that are generated manually. Scheduling the sampling event will require coordination with operations personnel to determine when wastewater will be discharged. A composite can be prepared by collecting 500-mL volume sub-samples at 5-minute intervals throughout the entire discharge period. Transfer the sub-samples to a clean 5-gallon pail, mix the pail at the end of the discharge period (with a cleaned or disposable implement), and collect the composite sample for laboratory analysis.



If wastewater from centrifuge/decanter activity is discharged to the facility floor and drains to trench drains prior to final conveyance into the wastewater collection system, the number of drainage points may prevent direct measurement of wastewater flows. Alternatively, source water measurement may be substituted. If the source water piping configuration prevents direct source water flow measurement, look for manholes to the main wastewater collection system immediately upstream and downstream of the centrifuge/decanter discharge. If there are no other contributors to the line in that section, an area velocity flow meter can be installed at each location, and the difference between them will be indicative of wastewater flow from centrifuge/decanter activity.

Composite samples can be collected from the primary piping connecting the drainage from the centrifuge/decanter process area to the main wastewater collection system using a programmable automatic compositing sampler configured to take discrete volume samples at 1-hour intervals and generate a 24-hour composite.

2.2.7 Stillage

Distillation processes are typically run on a batch basis, contingent on product demand and source material availability. During any period of distillation operations, wastewater in the form of stillage is generated continuously. It should be possible to install a flow meter on the stillage discharge line directly, allowing measurement of the volume generated over 24-hour period. Because the composition of stillage is known to be relatively constant over time during stable operations, it can be characterized based on analysis of grab samples that are collected on a daily basis.

2.2.8 Barrel Washing

Barrel washing activities that generate wastewater include cleaning and sanitizing the barrel interiors, and to a much lesser extent washing the barrel exteriors. In most cases, flow monitoring and sampling efforts should focus on the cleaning/sanitizing stream. Wastewater from the barrel interior cleaning may be discharged through a hose to a catch basin prior to conveyance into the wastewater collection system. If this is a difficult stream to monitor directly, source water inflows can instead be monitored. A transit time ultrasonic flow meter can be attached to the source water feed lines to monitor influent volume over a 24-hour period. Composite samples can be collected using a programmable automatic compositing sampler or grab samples may be sufficient for characterization of smaller streams.

2.2.9 Bottling

Wastewater from bottling activities may include one or more streams draining from the floor to trench drains or sumps prior to conveyance to the main wastewater collection system. There is often also a spent cleaning solution from the bottling CIP system that is managed similarly. Flows can be monitored using an area velocity flow meter installed directly into the trench drain or sump, or if the drainage configuration is prohibitive, source water inflow to the area can instead be monitored, potentially using a transit time ultrasonic flow meters. Flow of the CIP discharge may also be done with a transit time ultrasonic flow meter on the drain line. Combining data from the various flow meters should yield a volume per 24-hour period from the bottling area as a whole.

Due to the variable nature of the bottling wastewater streams, composite samples are typically needed for effective characterization. This can be accomplished using programmable automatic compositing samplers configured to collect discrete samples at one hour intervals for a 24-hour period. If there are multiple streams from the bottling area (exclusive of the CIP stream), composites collected from each stream are sometimes further composited in a clean 5-gallon pail in proportion to the wastewater volume contributions measured for each process area. The CIP stream is typically well agitated, therefore a grab sample is considered sufficient for characterization.

2.2.10 Spent Water Softener Regenerant

As with the wine/juice ion exchange process, water softeners only generate wastewater during regeneration activity. The regenerant typically consists of a saturated salt solution that remains after mixing bulk sodium chloride with source water. Although the salt concentrations in the spent regenerant could be measured through direct sampling, as is recommended for spent regenerant from the wine/juice ion exchange process, they are more often estimated from records of bulk salt use. If daily use is not known, purchase records can be extrapolated to find average use rates. If the flow of regenerant is monitored, average loading can be estimated. Although the source water may also contribute salts to the regenerant stream, these concentrations are likely to be a negligible fraction of the total salt load.

2.2.11 Boiler Water Blowdown

Boiler blowdown cycles are a function of the demand for steam within a facility, and these needs may vary on a daily and seasonal basis. There are several options to monitor blowdown flow, averaged over a 24-hour period:

- Flow can be measured directly with a transit time ultrasonic flow meter on the blowdown discharge line -- this is generally the preferred approach, where feasible.

- If an ultrasonic flow meter cannot be used due to interferences in the discharge line, flow can be determined indirectly using facility records of the daily boiler feedwater volume and matched sets of conductivity readings for feedwater and blowdown. The blowdown volume is found from the following relationship, based on mass balance:

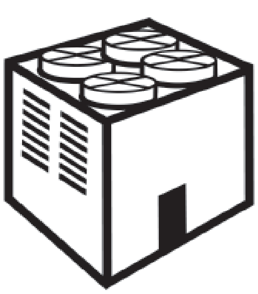
$$\frac{\text{feedwater conductivity}}{\text{blowdown conductivity}} = \frac{\text{blowdown volume}}{\text{feedwater volume}}$$

- Flow can be estimated manually at a given time with a beaker and stopwatch. This method tends to be less precise due to the intermittent nature of flows. For best results, three or more flow readings should be taken during the course of a day to generate daily average blowdown volumes.

For chemical characterization, grab samples of boiler blowdown can be collected on a daily basis during the investigation period. Composite samples are not needed due to the turbulence in the boiler, which serves to homogenize the blowdown prior to discharge.

2.2.12 Cooling Tower Blowdown/Evaporative Condenser Bleed

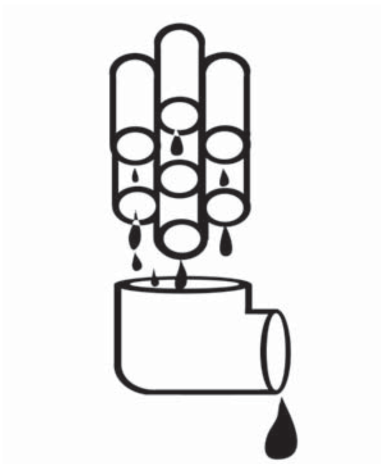
The volume of cooling tower blowdown or evaporative condenser bleed discharged over a given 24-hour period is directly proportional to the level of cooling tower activity, and this can vary depending on facility refrigeration demands, the time of year and the portion of the facility served by a particular cooling tower/evaporative condenser. Due to the variability of these streams, it may be best to select a single cooling tower or evaporative condenser that is believed to be representative of average activity levels and extrapolate to the full stream.



For flow monitoring, transit-time ultrasonic flow meters can be installed on the blowdown discharge line for a given unit. For chemistry, grab samples can be collected on a daily basis. Because the sump for each unit allows mixing, there is no need to collect composite samples.

2.2.13 Total Effluent

The aggregate of wastewater from a winery is often routed to a sump before final discharge. This is likely to be a location for compliance monitoring, if required, and is a good choice for permanent installation of a flow meter. The sump may receive flow on a continuous basis, but the flow rate and chemistry of the discharge is apt to vary throughout the day as a function of winery activities. Accordingly, wastewater flow volumes are typically monitored for a 24-hour period, and composite samples are collected for chemical analysis to reflect the average of intra-day changes in constituent loading. A programmable automatic composite sampler should be used to collect sub-samples of wastewater at 1-hour intervals over a 24-hour period. Ideally, the sub-samples are then flow-weighted to appropriately represent periods of higher flow and then combined to allow collection of a flow-proportional daily composite sample. Depending on the effluent volume and variability, collection of three daily composites during the crush season and another three during non-crush operations would provide a useful data set.



Worksheet 2-1: Water Use Inventory

Completed by: ____________
Date: ____________

Instructions: Develop a water use inventory for the winery by entering available information in unshaded cells.
Shaded cells will calculate automatically, but they are not locked from editing if you prefer to enter values directly (note that this will over-write the cell formula; copy an adjacent cell in the same column to restore auto-calculation)
Add more rows by left-clicking the mouse on a row and selecting Unhide.
Entries in red font are sample data that should be deleted.

Key Outputs: Total annual water use for each unit operation will be used in Step 3 to identify largest sources and reduction strategies.
Total winery annual water use can be compared with industry benchmarks.
Data gaps identified in the water inventory can be addressed as described in Step 2.

Operation	Source Description					Output Calculations				
Winery Operation	**Water-Using Task**	**Flow Type (select)**	**Duration of Flow (mins)[1]**	**No. of Parallel Production Lines**	**Water Use Rate (gpm)[2]**	**Water Use per Task (gals/task)[3]**	**Task Frequency (x /day)**	**Daily Water Use for Task (gals/day)[4]**	**Operating Days (days/year)**	**Water Use for Task (gals/year)[5]**
Crush						0		0		0
	bin washing	batch	0	1	30	8	200	1,500	60	90,000
						0		0		0
						0		0		0
							Crush Totals:	**1,500**		**90,000**
Press						0		0		0
	pushing must	batch	5	1	30	150	20	3,000	72	216,000
						0		0		0
						0		0		0
							Press Totals:	**3,000**		**216,000**
Fermentation						0		0		0
	hot water to start ferm	batch	1,440	5	0.5	3,600	10	36,000	10	360,000
						0		0		0
						0		0		0
							Ferment Totals:	**36,000**		**360,000**
Cellar						0		0		0
	pushing wine	batch	variable	1	30.0	750	10	7,500	250	1,875,000
						0		0		0
							Cellar Totals:	**7,500**		**1,875,000**
Tanks						0		0		0
(list size, number)	tank cleaning	batch	variable	1	variable	300	10	variable	250	750,000
						0		0		0

Operation	Source Description					Output Calculations				
Winery Operation	Water-Using Task	Flow Type (select)	Duration of Flow (mins)[1]	No. of Parallel Production Lines	Water Use Rate (gpm)[2]	Water Use per Task (gals/task)[3]	Task Frequency (x /day)	Daily Water Use for Task (gals/day)[4]	Operating Days (days/year)	Water Use for Task (gals/year)[5]
						0		0		0
							Tank Totals:	**0**		**750,000**
Barrels						0		0		0
red	humidifiers	cyclical	variable	2	8	variable		variable		150,000
white						0		0		0
						0		0		0
						0		0		0
							Barrel Totals:	**0**		**150,000**
Bins & Tankers						0		0		0
	cleaning tanker	batch	variable	1	variable	100	5	variable	200	100,000
						0		0		0
						0		0		0
							Bin Totals:	**0**		**100,000**
Fining/ Filtration						0		0		0
	lees filter sanitation	batch	variable	1	30	1,200	1	1,200	50	60,000
						0		0		0
						0		0		0
							Filtration Totals:	**1,200**		**60,000**
Wine Ion Exchange						0		0		0
						0		0		0
						0		0		0
							Wine IE Totals:	**0**		**0**
Bottling						0		0		0
	warming tank	continuous	480	1	5	2,400	1	2,400	20	48,000
						0		0		0
						0		0		0
						0		0		0
							Bottling Totals:	**2,400**		**48,000**
Laboratory						0		0		
	vacuum pump	continuous	1,440	1	5	7,200	1	7,200	265	1,908,000
						0		0		0
						0		0		0

Operation	Source Description					Output Calculations				
Winery Operation	Water-Using Task	Flow Type (select)	Duration of Flow (mins)[1]	No. of Parallel Production Lines	Water Use Rate (gpm)[2]	Water Use per Task (gals/task)[3]	Task Frequency (x /day)	Daily Water Use for Task (gals/day)[4]	Operating Days (days/year)	Water Use for Task (gals/year)[5]
							Laboratory Totals:	7,200		1,908,000
Tasting Room						0		0		0
Visitors/day:						0		0		0
Gal/person:						0		0		0
						0		0		0
							Tasting Totals:	**0**		**0**
Systems						0		0		0
Main sump						0		0		0
Cooling tower						0		0		0
Boiler						0		0		0
Water softener						0		0		0
Tank detartration						0		0		0
Pipeline detartration						0		0		0
						0		0		0
						0		0		0
							Systems Totals:	**0**		**0**
									Total Winery Water Use:	**5,557,000**

Operation	Source Description				Output Calculations					
Winery Operation	Water-Using Task	Flow Type (select)	Duration of Flow (mins)[1]	No. of Parallel Production Lines	Water Use Rate (gpm)[2]	Water Use per Task (gals/task)[3]	Task Frequency (x /day)	Daily Water Use for Task (gals/day)[4]	Operating Days (days/year)	Water Use for Task (gals/year)[5]

Notes:

1. For continuous flows, enter total minutes of operation per day, and enter "1" under Task Frequency.

2. Reference water use rates for typical equipment:

Application	Equipment	Service Pressure (psi)	Flow Rate (gpm)	Wash Cycle (mins)
Cleaning unit	Gamajet IV	20 - 500	30 - 320	3 - 30
Cleaning unit	Gamajet V (fluid-driven)	50 - 1,200	6.7 - 42	3 - 33
Cleaning unit	Gamajet VI (non-lub'd)	10 - 700	5 - 40	10
Cleaning unit	Gamajet Barrel Blaster	50 - 1500	2 - 8	2 - 5
Spray gun	Straham S-70 Nozzle	50 - 80	5 - 7	n/a
Spray gun	Straham S-70 Nozzle	100	10	n/a
Pressure wash	Hotsy BD cold	3,500 - 5,000	3.7 - 4.5	n/a
Pressure wash	Hotsy BX cold	2,000 - 3,500	2.8 - 3.7	n/a
Pressure wash	Hotsy EP cold	1,000 - 2,000	3 - 3.5	n/a
Pressure wash	Hotsy 1400 hot	3,000	3.9	n/a
Pressure wash	Hotsy 500 hot	1,000 - 1,500	2.1 - 3.0	n/a
Pressure wash	Hotsy 700 hot	1,500 - 2,000	2.8 - 3.5	n/a
Pressure wash	Hotsy 900 hot	2,000 - 2,300	3.8 - 3.9	n/a
Power wash	Hydrotek CW21004E3	2,100	4	n/a
Pressure wash	Kew 7- 66	2,750	5.5	n/a
Hot water	Aaqua Tools HotCart	n/a	13.2	n/a

3. Water use per task

= water use rate (gpm) x task duration (mins) x number of lines

4. Daily water use for task

= water use per task (gal) x task frequency (times/day)

5. Annual water use for task

= daily water use for task (gal/day) x number of operating days <u>or</u> enter estimated water use

If the winery operates year-round, can assume 180 operating days/year.

Worksheet 2-2: Sanitation Inventory

Instructions: Develop an inventory of winery sanitation tasks by entering available information in unshaded cells.
Shaded cells will calculate automatically, but they are not locked from editing if you prefer to enter values directly (note that this will over-write the cell formula; copy an adjacent cell in the same column to restore auto-calculation)
Add more rows by left-clicking the mouse on a row and selecting Unhide.
Entries in red font are sample data that should be deleted.

Key Outputs: Amount of chemical of concern discharged per year will be used in evaluating and prioritizing improvements in Step 3
Total cost per year for products will be used in evaluating the need for alternative products in Step 3
Data gaps identified in the sanitation inventory can be addressed as described in Step 2.

Operation	Source Description						Output Calculations						
Winery Operation	Equipment to be Cleaned and Sanitized	Wastewater Discharge Volume, if Known (gals/year)	Cleaning and Sanitation Process	Name of Cleaning and Sanitation Products	Names of Chemicals of Concern in Product[1]	Concentration of Each Chemical of Concern in Product (%)[1]	Sanitation Frequency (washes/day)	Operating Days (days/year)	Qty of Product Used per Wash (lbs/wash)	Qty of Product Used per Year (lbs/year)	Amount of Chemical of Concern Discharged (lbs/year)	Product Unit Cost ($ /lb)	Product Cost per Year ($ /year)
Crush										0	0		0
	crusher									0	0		0
	destemmer									0	0		0
	feed auger									0	0		0
										0	0		0
Press										0	0		0
	press									0	0		0
	wine lines									0	0		0
										0	0		0
Fermentation										0	0		0
	tank									0	0		0
	wine lines									0	0		0
										0	0		0
Tanks										0	0		0
(list size, number)	tank	600	Rinse, clean, sanitize, rinse	ChemClean 440K	Potassium Hydroxide	90	6	260	2	3,120	2,808	1.00	3,120
				Sani-Bac	Sodium Dichloro	22	12	260	2	6,240	1,373	3.00	18,720
	wine lines									0	0		0
Barrels										0	0		0
	set up sanitation									0	0		0
	barrel - interior									0	0		0
	barrel - exterior									0	0		0
	wine lines									0	0		0
	tanks									0	0		0
										0	0		0

Worksheet 2-2: Sanitation Inventory

Bins (number):		0	0		0
	pre-harvest	0	0		0
	post-harvest	0	0		0
		0	0		0
Fining/ Filtration		0	0		0
	lees filter	0	0		0
	velo filter	0	0		0
		0	0		0
Wine Ion Exchange		0	0		0
		0	0		0
		0	0		0
Bottling		0	0		0
	membrane to filler	0	0		0
	tanks	0	0		0
	lines	0	0		0
		0	0		0
Tanker Trucks		0	0		0
	wine lines	0	0		0
	tankers	0	0		0
		0	0		0
		0	0		0
					21,840

1. Refer to product MSDS for chemicals of concern and concentrations.

2. Based on the quantity of product puchased annually; should be blank if actual use data was entered.

Worksheet 2-3: Equipment Inventory to Assess Water-Related Energy Use

Instructions: Use this worksheet to tabulate energy use associated with water management

Key Outputs: Identify equipment that has the highest energy use in the winery for consideration in Step 3

Electrical Equipment:

Equipment	Nameplate Rating (HP or kW)	Load Factor	Daily Use (hrs/day)	Operating Days (days/yr)	Annual Use (hrs/yr)	Annual Energy Use (kW-hr/yr)

Natural Gas / Propane:

Equipment	Nameplate Rating (BTU/hr)	--	Daily Use (hrs/day)	Operating Days (days/yr)	Annual Use (hrs/yr)	Annual Energy Use (Therms/yr)

Fuel Oil:

Equipment	Nameplate Rating (BTU/hr)	--	Daily Use (hrs/day)	Operating Days (days/yr)	Annual Use (Gals/yr)	Annual Energy Use (Gals/yr)

Worksheet 2-4a: Flow Monitoring Plan - Current Monitoring

Completed by:
Date:

Instructions: Use this worksheet to summarize any current flow monitoring activities in the winery
Refer to Worksheet 2-4b to plan additional monitoring
Entries in red font are sample data that should be deleted.

Currently installed flow meters:

Winery Operation	Water-Using Task	Influent or Effluent Monitoring[1] (select)	Monitoring Frequency[2] (select)	Flow Meter Type[3]	Data Logger or Manual Readings[4] (select)	Monitoring Program Duration
Crush						
Press						
Fermentation						
Cellar						
Tanks						
Barrels						
Bins						
Fining/Filtration						
Wine Ion Exchange						
Bottling						
Tasting Room						
Systems						
Main sump	N/A	effluent	continuous	area velocity	data logger	Ongoing
Cooling tower	Makeup Water	influent	continuous	magmeter	manual	Ongoing
Boiler						
Water softener						
Tank detartration						
Pipeline detartration						

Worksheet 2-4a: Flow Monitoring Plan - Current Monitoring

Notes:

1. Influent/Effluent Dropdown List Options

influent
effluent

2. Monitoring Frequency Dropdown List Options

continuous
daily
weekly
random

3. Examples of flow meters that are commonly used for winery applications:

Ultrasonic - external, clamp-on meter for flow measurement with no wetted parts. Easy to install, ideal for temporary use. Types:
a) Transit time: transducers are placed on opposite sides of a pipe and an ultrasonic signal is sent between them. The signal moves faster when it travels with the flow than against it, and the flow rate can be determined from this difference.

b) Doppler: emits an ultrasonic signal which bounces off particles in the flow, causing a frequency shift that is proportional to the velocity. Less accurate than transit time, but can be more reliable for applications with dirty wastewater or water containing sand and gravel or entrained air.

Electromagnetic (magmeter) - in-pipe meter for flow measurement by electromagnetic induction. The meter sets up a magnetic field, in which flow of a conductive fluid produces a voltage proportional to the fluid's velocity. Can be used in any pipe size, either inline or as an insertion.

Area velocity - couples a submerged velocity sensor (ultrasonic or electromagnetic) with a fluid depth meter to yield flow volume. Can be installed in lines with open channel flow that are gravity-drained, such as trench drains or pipelines. Typically used with a data logger.

Manual - measure the discharge using a stop-watch and bucket.

Dropdown List Options:
utrasonic
magmeter
area velocity
manual

4. Measurement Dropdown List Options

data logger
manual

Worksheet 2-4b: Flow Monitoring Plan - Additional Monitoring

Completed by:

Date:

Instructions: Use this worksheet to plan for additional flow metering needed to complete Step 2. Refer to footnotes below and Guideline 1.1 for flow meter selection information. Entries in red font are sample data that should be deleted.

Additional flow meters needed:

Winery Operation	Water-Using Task	Influent or Effluent Monitoring[1] (select)	Monitoring Frequency[2] (select)	Flow Meter Type[3]	Supplier for Rental or Purchase	Rental Cost (e.g., per week)	Extended Cost of Rental	Cost of Purchase	Rent, Buy or Own[4] (select)
Crush									
Press									
Fermentation									
Cellar	barrel washing	effluent	random	manual	--	--	--	--	
Tanks	tank cleaning	influent	random	manual	--	--	--	--	
	wine lines	effluent	random	manual	--	--	--	--	
Barrels									
Bins									
Fining/ Filtration									
	plate and frame	influent	random	utrasonic					rent
Wine Ion Exchange									
Bottling									
	line lube	influent	daily	utrasonic					rent
Tasting Room									
Systems									
Main sump									
Cooling tower									
Boiler									
Water softener									
Tank detartration									
Pipeline detartration									

Worksheet 2-4b: Flow Monitoring Plan - Additional Monitoring

Notes:

1. Influent/Effluent Dropdown List Options

influent
effluent

2. Monitoring Frequency Dropdown List Options

continuous
daily
weekly
random

3. Examples of flow meters that are commonly used for winery applications:

Ultrasonic - external, clamp-on meter for flow measurement with no wetted parts. Easy to install, ideal for temporary use. Types:

a) Transit time: transducers are placed on opposite sides of a pipe and an ultrasonic signal is sent between them. The signal moves faster when it travels with the flow than against it, and the flow rate can be determined from this difference.

b) Doppler: emits an ultrasonic signal which bounces off particles in the flow, causing a frequency shift that is proportional to the velocity. Less accurate than transit time, but can be more reliable for applications with dirty wastewater or water containing sand and gravel or entrained air.

Electromagnetic (magmeter) - in-pipe meter for flow measurement by electromagnetic induction. The meter sets up a magnetic field, in which flow of a conductive fluid produces a voltage proportional to the fluid's velocity. Can be used in any pipe size, either inline or as an insertion.

Area velocity - couples a submerged velocity sensor (ultrasonic or electromagnetic) with a fluid depth meter to yield flow volume. Can be installed in lines with open channel flow that are gravity-drained, such as trench drains or pipelines. Typically used with a data logger.

Manual - measure the discharge using a stop-watch and bucket.

Dropdown List Options:
utrasonic
magmeter
area velocity
manual

4. Rent/Buy Dropdown List Options

rent
buy
own

Worksheet 2-5: Flow Monitoring Results

Instructions: Use this worksheet to record flow monitoring data collected throughout the winery.
Shaded cells will calculate automatically.
Record total daily flow if obtained from a data logger or flow rates measured manually.
Obtain a sufficient number of flow measurements to understand flow variability daily and seasonally
Entries in red font are sample data that should be deleted.

Key Outputs: Use average flows to define options in Step 3.
Use results to improve winery evaluation score in the *Code of Sustainable Winegrowing Practices,* Chapter 10

Flow Monitoring Data										
		Date:		Date:		Date:		Flow Summary		
Winery Operation	Monitoring Frequency[1] (select)	Total Daily Flow (gals/24-hr)	Flow Rate (gpm)	Total Daily Flow (gals/24-hr)	Flow Rate (gpm)	Total Daily Flow (gals/24-hr)	Flow Rate (gpm)	Minimum (gals/24-hr)	Average (gals/24-hr)	Maximum (gals/24-hr)
Crush								0	0	0
								0	0	0
Press	random	1,235	15	1,165	14	1,220	15	1,165	1,207	1,235
								0	0	0
Fermentation								0	0	0
								0	0	0
Cellar								0	0	0
								0	0	0
Tanks								0	0	0
								0	0	0
Barrels								0	0	0
								0	0	0
Bins								0	0	0
								0	0	0
Fining/Filtration								0	0	0
								0	0	0
Wine Ion Exchange								0	0	0
								0	0	0
Bottling								0	0	0
								0	0	0

Worksheet 2-5: Flow Monitoring Results

Tasting Room								0	0	0
								0	0	0
Systems								0	0	0
Main sump								0	0	0
Cooling tower								0	0	0
Boiler								0	0	0
Water softener								0	0	0
Tank detartration								0	0	0
Pipeline detartration								0	0	0

1. Monitoring Frequency
continuous
daily
weekly
random

Worksheet 2-6a: Analytical Monitoring Plan - Sampling Approach

Completed by:

Date:

Instructions: Use this worksheet to plan the types and numbers of samples that will be needed throughout the winery.
Refer to Guideline 1.2.2 for information on sample types
Entries in red font are sample data that should be deleted.

Sampling Approach

Winery Operation	Water-Using Task	Flow Type[1] (select)	Sample Type[2] (select)	Composite Type [3] (select)	Composite Sampling Interval (e.g., hourly)	Number of Sub-samples	Volume of Each Sub-sample (liters)
Crush							
Press							
Fermentation							
Cellar							
Tanks	cleaning	batch	composite	manual	per wash step	4	0.25
Barrels							
Bins							
Filtration							
Wine Ion Exchange							
Bottling							
Tasting Room							

Worksheet 2-6a: Analytical Monitoring Plan - Sampling Approach

Systems							
Main sump	N/A	continuous	composite	automatic	24-Hour	24	0.1
Cooling tower							
Boiler							
Water softener							
Tank detartration							
Pipeline detartration							

1. Flow Type:

batch

cyclical

continuous

2. Sample Type

grab

composite

3. Composite Type

automatic

manual

Worksheet 2-6b: Analytical Monitoring Plan - Sample Collection

Completed by:

Date:

Instructions: Use this worksheet to summarize sample analyses to be requested from the laboratory and analytical costs.
Refer to Guideline 1.2.1 for information on laboratory selection and coordination.
Entries in red font are sample data that should be deleted.

		Sample Analyses and Methods										
		General Minerals[a]	**Boron**	**Nitrate**	**Ammonia**	**TKN[b]**	**TDS[c]**	**TSS[d]**	**BOD[e]**	**VDS[f]**	**Sulfide**	**Organic Acids**
Winery Operation	**Water-Using Task**	Various[a]	EPA 200.7	EPA 300.0	EPA 350.2	SM4500	EPA 160.1	EPA 160.1	EPA 405.1	EPA 160.4	EPA 376.1	SM5560[g]
Crush												
Press												
Fermentation												
Cellar												
Tanks	cleaning	4	4	4	4	4	4	4	4	4	4	4
Barrels												
Bins												
Fining/ Filtration												
Wine Ion Exchange												
Bottling												
Tasting Room												
Systems												
Main sump												
Cooling tower												
Boiler												

Worksheet 2-6b: Analytical Monitoring Plan - Sample Collection

Water softener											
Tank detartration											
Pipeline detartration											
Total samples:	4	4	4	4	4	4	4	4	4	4	4
Cost per analysis:	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Extended cost:	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
										Analytical Program Total:	$0

Notes to Analyses and Methods:

(a) General Minerals consist of:
- Calcium (EPA 7140)
- Magnesium (EPA 7450)
- Potassium (EPA 7610)
- Sodium (EPA 7770)
- Copper (EPA 7210)
- Iron (EPA 7380)
- Manganese (EPA 7460)
- Zinc (EPA 7950)
- Total alkalinity (EPA 310.1)
- Sulfate and chloride (EPA 300.0)
- Sulfide (EPA 376.1)
- Specific conductance (EPA Method 120.1)
- pH (EPA 150.1)

(b) TKN = Total Kjeldahl Nitrogen

(c) TDS = Total Dissolved Solids

(d) TSS = Total Suspended Solids

(e) BOD = Biochemical Oxygen Demand

(f) VDS = Volatile Dissolved Solids

(g) SM5560 is a potential analytical method for Organic Acids

- All samples should be collected in pre-cleaned containers supplied by laboratory.
- Sample volume and container requirements will be specified by the laboratory.

Worksheet 2-7: Summary of Analytical Monitoring Results for Unit Operation:________________

Instructions: Use a copy of this worksheet to summarize analytical results for each winery unit operation.
Use as many of the Results columns as needed.
Shaded cells will calculate automatically, but they are not locked from editing if you prefer to enter values directly (note that this will over-write the cell formula; copy an adjacent cell in the same column to restore auto-calculation)
Entries in red font are sample data that should be deleted.

Key Outputs: Use wastewater characteristics to evaluate options in Step 3.
Use results to improve winery evalulation score in the *Code of Sustainable Winegrowing Practices,* Chapter 10

Summary of Laboratory Analytical Data

Parameter	Unit	Number of Samples	Sample #1 Result	Sample #2 Result	Sample #3 Result	Sample #4 Result	Statistics Minimum	Statistics Maximum	Statistics Average	Statistics Median
Field Measurements										
pH	none	4	5.0	6.5	5.7	6.9	5	6.9	6.0	6.1
Conductivity	mmho/cm						0	0	--	--
Temperature	°C						0	0	--	--
General Physical Analyses										
Conductivity (Laboratory)	uhmos/cm						0	0	--	--
Biochemical Oxygen Demand (BOD)	mg/L						0	0	--	--
Chemical Oxygen Demand (COD)	mg/L						0	0	--	--
Total Dissolved Solids (TDS)	mg/L						0	0	--	--
Volatile Dissolved Solids (VDS)	mg/L						0	0	--	--
Total Suspended Solids (TSS)	mg/L						0	0	--	--
Bicarbonate Alkalinity	mg/L						0	0	--	--
Total Alkalinity	mg/L						0	0	--	--
General Mineral - Cations										
Sodium	mg/L						0	0	--	--
Potassium	mg/L						0	0	--	--
Calcium	mg/L ± 6.6						0	0	--	--
Mangesium	mg/L						0	0	--	--
Iron	µg/L						0	0	--	--
Manganese	µg/L						0	0	--	--
Copper	µg/L						0	0	--	--
Zinc	ug/L						0	0	--	--
General Mineral - Anions										
Chloride	mg/L						0	0	--	--
Sulfate	mg/L						0	0	--	--
Sulfide	mg/L						0	0	--	--

Summary of Laboratory Analytical Data										
		Number	Sample #1	Sample #2	Sample #3	Sample #4	Statistics			
Parameter	Unit	of Samples	Result	Result	Result	Result	Minimum	Maximum	Average	Median
Other Minerals										
Boron	µg/L						0	0	--	--
Nitrogen										
Total Ammonia (as N)	mg/L						0	0	--	--
Nitrate	mg/L						0	0	--	--
Total Keldahl Nitrogen (TKN)	mg/L						0	0	--	--
Organic Acids										
Citric Acid	mg/L						0	0	--	--
Lactic Acid	mg/L						0	0	--	--
Malic Acid	mg/L						0	0	--	--
Succinic Acid	mg/L						0	0	--	--
Tartaric Acid	mg/L						0	0	--	--

Step 3: Data Evaluation and Option Identification

3.1 Review Data

Analytical data reports received from the laboratory should first be reviewed for completeness and quality control. An overview of data validation procedures is provided in Guideline 1.

Next, refer to the case study of winery wastewater characterization provided in Appendix A. This includes results of chemical analyses of individual waste streams at two large wineries (one stillage and one non-stillage winery) plus limited data from an additional winery (non-stillage). Although the number of wineries represented is small, the data may still be valuable for gross comparison. For example, if constituent concentrations of your barrel washing stream are well beyond the range of values reported for the barrel washing stream in the case study data tables, you could review records of your winery operations on the day the waste stream was sampled to find out if any unusual activities occurred. If operations that day were not typical, resampling may be warranted to ensure appropriate characterization. If in doubt about the reliability of your results, the most effective resolution will be to collect additional samples to support or refute the original findings. Note that some waste streams and individual constituents are intrinsically more variable than others; refer to the range and median statistics in the appendix tables for indications of this.

Note that during any sampling period, the chemistry of the sampled streams may reflect the addition of cleaning agents or other products. In the case study, potassium hydroxide is known to have been used for cleaning at the stillage winery, along with sodium hydroxide periodically to regenerate a portion of the boiler feed water. At the non-stillage winery, sodium hydroxide was used for cleaning during the first year of the study and sodium hypochlorite was used for sanitation. The winery switched to potassium hydroxide during the second year of the study.

Before proceeding, review and confirm that your data set is sufficiently representative of winery operations under the range of typical operating conditions (e.g., crush and non-crush). If data gaps remain, new questions arise, or some of the data is found to be questionable, go back and collect additional data to resolve these issues now, rather than trying to manage the uncertainties at the end of the winery evaluation process.

If data gaps remain, new questions arise, or some of the data is found to be questionable, go back and collect additional data to resolve these issues now, rather than trying to manage the uncertainties at the end of the winery evaluation process.

3.2 Generate Options for Source Reduction, Recycling or Treatment

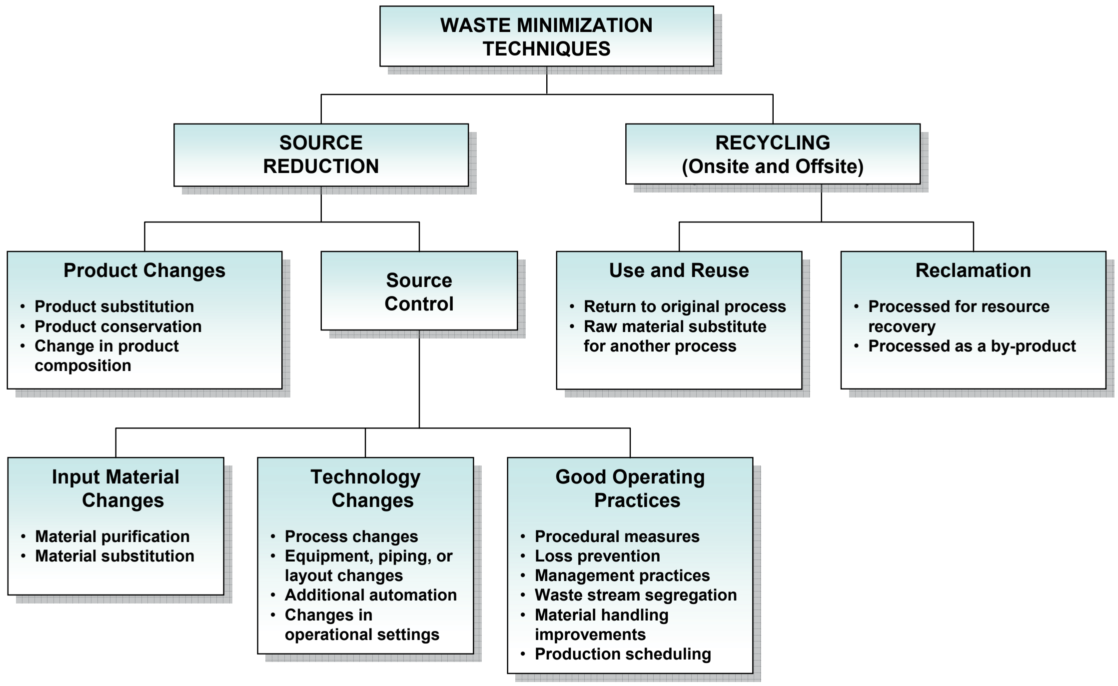
Given data on the characteristics and volumes of various winery wastewater streams, the winery can consider a wide range of options. In a broader context, the EPA defined source reduction and recycling techniques as two branches under the umbrella of waste minimization. This is shown on Figure 3-1. The EPA also defined a hierarchy to prioritize environmentally favorable options. The most favorable options are those that simply reduce the amount of source material in wastewater, whereas treatment is least favored because it requires energy input and may have other potential impacts to achieve desired results. The hierarchy is shown in Figure 3-2.

In most cases, the holistic solution for a winery will be assembled from a combination of these approaches. Before looking at options, it may be useful to categorize wastewater streams into three reuse types, based on chemical characterization results:

1. Relatively clean and can be reused without treatment

2. Can be reused after limited treatment

3. Requires full treatment and/or disposal



Note: Adapted from USEPA "Waste Minimization Opportunities Assessment Manual", EPA/625/7-88/003, July 1988

Kennedy/Jenks Consultants

WASTE MINIMIZATION TECHNIQUES

K/J 0765014*00
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Figure 3-1

After categories are assigned, the volume of wastewater in each category can be totaled to help frame the requirements for options. The best way to begin to identify options is to hold a brainstorming session involving staff members who are most familiar with processes and practices currently used in the winery. This may include winemakers, production staff and maintenance personnel who can each identify possible improvement options related to the individual processes and systems they work with.

Worksheet 3-1 is a form that can be used to capture brainstorming results.

Refer also to Guideline 2, which describes a range of potential options that have been used by wineries. If wastewater is discharged to a Publicly Owned Treatment Works (POTW), or land application for irrigation or to spreading basins is currently used or likely to be implemented in the future, the next step is to convert reported constituent concentrations into loadings. At a minimum, loadings should be calculated for salts, organics (e.g., biochemical oxygen demand) and nitrogen species. Methods for calculating loadings for land application treatment are provided in Guideline 3.

3.3 Screen and Select Options for Further Study

Results of a thorough assessment phase and brainstorming discussion should yield an array of possible options with varying degrees of feasibility. Some options will clearly be more feasible than others. In this task, the full list of options should be reviewed and screened to reduce the list to those that warrant full feasibility analysis. Worksheet 3-2 is a form that can be replicated and used to summarize available information on each option, including the rationale for proceeding with (or deferring) a feasibility analysis.

Methods to make this determination can range from an informal discussion and selection of options by staff, to a full formal weighted sum statistical evaluation (refer to Worksheet 3-3). The weighted sum method is a process for assigning a priority ranking to each option based on ratings against a set of defined criteria. This approach can be appropriate when attempting to screen a large number of options in a rigorous manner.

Figure 3-2: Hierarchy of Environmentally Favorable Options

Source: EPA, 1988

In general, screening considerations should include the following (adapted from EPA 1988):

- *What is the main benefit expected from implementing this option?*
- *Does the technology exist to develop the option?*
- *How much does it cost? How do costs compare to other options? Would it be cost-effective, considering the specific conditions at your facility and your business model?*
- *Can the option be implemented in a reasonable amount of time without disrupting production?*
- *Has this option been used successfully by other wineries?*
- *What are the water quality criteria for use of this option, such as maximum acceptable BOD or TDS?*
- *Would the option be considered a sustainable approach, as advocated by the* Code of Sustainable Winegrowing Practices Self-Assessment Workbook (Wine Institute and California Association of Winegrape Growers, 2002)?

It can be helpful to categorize the wastewater from each winery operation as low, medium, or high quality. Options can then be identified that are suitable for each water quality category. Detailed screening criteria may include:

- Ability to accommodate significant shifts in wastewater quality and quantity
- Potential to manage or minimize effect of process upsets
- Ability to consistently meet wastewater effluent quality goals
- Efficient use of space

- Minimal need for addition of nutrients or neutralizing chemicals
- Efficient energy use and/or recovery of energy
- Low volume of process residuals (e.g., sludge, air emissions)
- Ease of operation, maintenance and monitoring
- Durability of equipment and materials
- Constructability and/or implementability
- Compatibility with existing and proposed facilities
- Safety issues
- Low impact on the environment or aesthetics
- Cost effectiveness
- Regulatory agency acceptance and permitting

It should be possible to complete the initial screening process with relatively limited research beyond staff knowledge and readily available information. If more thorough research and evaluation appears to be warranted, this will be accomplished as part of the feasibility analysis.

Worksheet 3-1: Brainstorming for Improvement Options

Date: ____________________

Instructions: Use this worksheet to develop a list of potential improvements, regardless of feasibility. Rate potential impacts and costs as high, medium, low or unknown for later screening.
Entries in red font are sample data that should be deleted.

Participants: ____________________

ID #	Winery Operation	Option Description	Objective	Potential Impact	Potential Cost	Comments
1	Tanks	Reuse cleaning solution for first wash	Reduce water and product use and cost	med	low	
2						
3						
4						
5						
6						
7						
8						
9						
10						

Worksheet 3-2: Option Description Form

Date: ______________

Proposed by: ______________

Instructions: Use copies of this worksheet for preliminary evaluation of options, in conjunction with Worksheet 3-3.

	Option ID #:			**Option ID #:**			**Option ID #:**		
	Name:			**Name:**			**Name:**		
Summary of Requirements & Impacts	**Yes**	**No**	**Comments**	**Yes**	**No**	**Comments**	**Yes**	**No**	**Comments**
Equipment change									
Procedural change									
Chemical/material change									
Will reduce water use									
Will reduce process water volume									
Will reduce process water loading									
Will reduce energy use									
Will affect wine production processes									
Will result in new waste stream or by-product									
Will require significant capital investment									
Other requirement/impact									
Feasibility Analysis Warranted									
Rationale for proceeding to feasibility analysis (or aborting):									

Worksheet 3-3: Option Evaluation by Weighted Sum Method

Date:

Completed by:

Instructions:

1. Define criteria that the winery will use to select improvement options. The list below can be modified to meet your needs. Additional (hidden) rows are available.
2. Assign a relative "weight" or importance to each of the criteria. For example, assigning a 10 means that criteria is a very big factor in the decision.
   The weight will be the same for all options examined.
3. For each option, assign a rating for how well the option meets each criteria.
4. Weighted scores will calculate automatically for each option. The options with the highest scores can be considered most favorable.
5. Entries in red are sample data that should be deleted.

	Objective:	Option # 1		Option # 2		Option #3		Option #4	
	Reduce salt load from water softening	Upgrade water softening system to reduce brine		Truck brine offsite for disposal					
Criteria	**Criteria Weight (1 to 10)**	**Rating (1 to 10)**	**Weighted Score**	**Rating (1 to 10)**	**Weighted Score**	**Rating (1 to 10)**	**Weighted Score**	**Rating (1 to 10)**	**Weighted Score**
Fits within site space constraints	9	8	72	9	81		0		0
Constructable onsite	9	8	72	9	81		0		0
Proven effective for winery applications	8	8	64	8	64		0		0
Reduces water use	5	5	25	8	40		0		0
Reduces process water volume	5	5	25	8	40		0		0
Reduces process water strength	10	7	70	9	90		0		0
Reduces energy use	7	3	21	7	49		0		0
Reduces by-product generation	6	6	36	10	60		0		0
Requires a permit to operate	0	0	0	0	0		0		0
Ease of obtaining permit, if applicable	0	0	0	0	0		0		0
Ease of operation by existing staff	8	7	56	6	48		0		0
Ease of maintenance by existing staff	8	7	56	8	64		0		0
Ease of monitoring by existing staff	8	7	56	8	64		0		0
Provides a green story for winery	4	2	8	1	4		0		0
			0		0		0		0
			0		0		0		0
Total Weighted Score:			**561**		**685**		**0**		**0**

Step 4: Feasibility Analysis

This step will entail detailed evaluation of the screened options for technical and economic feasibility. Based on this evaluation, a preferred option or options will be selected for implementation.

4.1 Conduct Technical Evaluation

The level of effort required to evaluate each option will be influenced by the cost, complexity, risk, and history of use at other wineries. For example, relatively low-cost, proven changes such as a product substitution or housekeeping change may require very limited evaluation and can be implemented almost immediately with low risk. But a costly, innovative treatment system requires full evaluation, potentially including bench-scale or pilot testing to demonstrate feasibility. Depending on the winery, criteria for equipment selection may include compatibility with existing equipment and processes, fit within available floor space, ease of operation and maintenance, whether installation could be accomplished without disrupting ongoing operations, and other factors. When evaluating various options, however, the potential of any proposed change to affect the quality of the finished product will be an overriding consideration.

4.2 Conduct Economic Evaluation

Similar to the technical evaluation, the economic evaluation for a relatively minor change should be a simple assessment of cost and benefit, whereas larger investments require comprehensive analysis that accounts for both capital and operating costs, net present value, payback period and return on investment. Worksheets 4-1 and 4-2 can be used to assess capital costs and present worth of operating and maintenance costs; however, wineries may choose to substitute their own financial analysis worksheets or evaluation procedures. Water conservation and waste minimization projects should be authorized by meeting the same economic criteria used to make decisions on other winery projects. In some cases, economic feasibility can be achieved using a phased approach, staggering implementation and investment over time.

4.3 Identify Preferred Option(s)

Considering the findings from the technical and economic evaluations, it should be possible to identify preferred option(s) to meet program objectives. For future reference, the rationale for selection or deferral of each option should be recorded. This information may be useful if the implemented approach is not as successful as initially projected or further reductions are sought at a later date.

4.4 Develop Action Plan

All collected information, evaluation results and next steps should be summarized in an Action Plan. A generalized outline of the plan is below:

- Description of Existing Production Activities
- Raw Materials
- Manufacturing Processes
- Products
- Wastewater Streams
- Description of Existing Wastewater Collection and Treatment Systems
- Identification of Waste Minimization Options
- Evaluation of Options
    - Technical Feasibility

    - Economic Feasibility

    - Expected Wastewater Reduction

- Selection of Options for Implementation

- Schedule for Implementation of Selected Options

The plan is intended for use as a reference and can be expanded as more information becomes available. Overall, this approach is consistent with the self-assessment and action plan process outlined in the *Code of Sustainable Winegrowing Practices Workbook* (Wine Institute and California Association of Winegrape Growers 2002), which enables wineries to work toward becoming more sustainable by identifying and implementing practices that are environmentally sensitive, economically feasible and socially equitable.

In developing the schedule for implementation, wineries should consider the impacts of initial installation and monitoring activities on their ongoing operations. For many wineries, this will mean deferring implementation to non-crush periods. If applicable, the schedule should also reflect management decisions to stagger implementation tasks over time or divide the effort into phases to better allocate capital investments over time. The full implementation team should review the schedule and agree that it is feasible.

Worksheet 4-1: Estimate of Probable Construction and Operating Costs

Date: ______________________

Date Revised: ______________________

Prepared By: ______________________

Instructions: Enter project costs for a specific option. Shaded cells will calculate automatically.
Entries in red font are sample data that should be replaced with your own assumptions.

Option Name: ______________________________

Objective: ______________________________

(yellow)	User input data
(blue)	Spreadsheet-calculated output

Item	Qty	Units	Material Cost	Installation Cost	Subcontractor Cost	Total Cost	Assumed Factor	Basis for Factor
I. Direct Construction Costs								
A. Process Equipment								
A.1 - Pump Station						$0		
A.2 - Screening						$0		
A.3 - Aerators						$0		
A.4 -						$0		
A. Subtotal			$0	$0	$0	**$0**		
B. Building Costs								
B.1 - Lab, Control Building						$0		
B.2 -						$0		
B. Subtotal			$0	$0	$0	**$0**		
C. Site Costs								
C.1 - Site Work/Improvements						$0		
C.2 -						$0		
C. Subtotal			$0	$0	$0	**$0**		
D. Subtotal I.A through I.C			$0	$0	$0	**$0**		
E. Other Construction Costs								
E.1 - Mobilization/bonding			-	$0	-	$0	5.00%	Percent of Direct Construction Cost Subtotal (Item I.D)
E.2 - Site preparation			-	$0	-	$0	20.00%	Percent of Site Work/Improvements (Item I.C.1)
E.3 - Electrical/instrumentation						$0		
E.4 -						$0		
E. Subtotal			$0	$0	$0	**$0**		
F. Subtotal I.D and I.E			$0	$0	$0	**$0**		
G. Taxes			$0	-	-	$0	7.75%	Percent of Material Cost Column Subtotal in Item I.F
H. Subtotal I.F and I.G			$0	$0	$0	**$0**		
I. Contractor's Overhead & Profit			-	$0	-	$0	18.50%	Percent of Subtotal in Item I.H
J. Subtotal I.H and I.I			$0	$0	$0	**$0**		
K. Contingencies			$0	$0	$0	$0	20.00%	Percent of Subtotal in Item I.J
L. Subtotal I.J and I.K			$0	$0	$0	**$0**		
M. Total Direct Construction / Bid Costs			**$0**	**$0**	**$0**	**$0**		
II . Indirect Construction Costs								
A. Engineering & Administration			-	-	-	$0	15.00%	Percent of Total Direct Construction/Bid Costs (Item I.M)
B. Interest during construction			-	-	-	$0	6.00%	Percent of Total Direct Construction/Bid Costs (Item I.M)
C. Permitting			-	-	-			
D. Total Indirect Construction Cost			-	-	-	**$0**		**Total (Items II.A-C)**
III . Total Estimated Captial Costs								
A. Total Estimated Capital Costs			-	-	-	**$0**		**Total (Items I.M + II.D)**
IV. Annual Operating Costs								
A. Power			-	-	-			Based on ____ X 10^6 kWhr/yr @ $0.125/kwhr
B. Maintenance			-	-	-	$0	2.00%	Percent of Total Direct Construction/Bid Costs (Item I.M)
C. Operating Labor			-	-	-			Based on ___ hr/wk @ $25/hr, 52 weeks per year
D. Chemicals			-	-	-			Based on max chemical usage: [Mg(OH)^2 at __ lb/d @ $350/ton, NaOCl at ___ lb/day @ $0.62/gal, and sludge polymer ___ lb/ton d.s. @ $2/lb polymer
E. Annual Permit Fees, Monitoring			-	-	-			Site specific
F. Sludge Disposal			-	-	-			Based on ______ tons/yr wet sludge @ ___ % d.s. @ $5/ton, hauling only
G. Administration			-	-	-	$0		Estimated at 20% of item IV.C + 25% of item IV.E
H. Replacement Costs			-	-	-			
I. Subtotal IV.A through IV.H			-	-	-	**$0**		
J. Contingencies			-	-	-	$0	20.00%	Percent of Annual Operating Subtotal (Item IV.I)
K. Total Estimated Annual Operating Cost			-	-	-	**$0**		**Total (Items IV.I + IV.J)**

Worksheet 4-1: Estimate of Probable Construction and Operating Costs

Instructions: Enter project costs for a specific option. Shaded cells will calculate automatically.
Entries in red font are sample data that should be replaced with your own assumptions.

Date: ____________________
Date Revised: ____________________
Prepared By: ____________________

Option Name: ____________________
Objective: ____________________

User input data
Spreadsheet-calculated output

Item	Qty	Units	Material Cost	Installation Cost	Subcontractor Cost	Total Cost	Assumed Factor	Basis for Factor
V. Unit Cost Analysis								
A. Capital Cost Calculations								
A.1 - Present worth factor			-	-	-	11.4699	6.00%	Percent interest, 20-year life
A.2 - Present worth of annual operating costs			-	-	-	$0		Item IV.K multiplied by Item V.A.1, Estimated at 3% Inflation for 20 years
B. Total Estimated Capital Cost			-	-	-	$0		Equal to Item III.A
C. Present Worth			-	-	-	$0		
D. Flow Capacity								
D.1 - System flow capacity (MGD)			-	-	-			
D.2 - Annual flow (MG/yr @ flow capacity)			-	-	-			
E. Unit Costs ($)								
E.1 - Unit Cost (@ flow capacity) ($/Kgal)			-	-	-	#DIV/0!		Item V.C / Item V.D.2 / 1,000

Worksheet 4-2: Estimate of Present Worth of Operating & Maintenance Costs

Instructions: Use the tables to find and compare present value of 20- or 30-year projects at specified interest and inflation rates.
Entries in red font are sample data that should be replaced with your own assumptions/data.

Option: ______________________________ **Date:** ______________

Objective: ______________________________ **Prepared By:** ______________

Assumptions:

Interest Rate:	6%
Inflation Rate:	3%

Assuming 20-Year Operation			
	Estimated Operation & Maintenance Costs		
Year	Today's $	Future Value	Present Worth
0	$5	$5	$5
1	$5	$5	$5
2	$5	$5	$5
3	$5	$5	$5
4	$5	$6	$4
5	$0	$0	$0
6	$0	$0	$0
7	$0	$0	$0
8	$0	$0	$0
9	$0	$0	$0
10	$0	$0	$0
11	$0	$0	$0
12	$0	$0	$0
13	$0	$0	$0
14	$0	$0	$0
15	$0	$0	$0
16	$0	$0	$0
17	$0	$0	$0
18	$0	$0	$0
19	$0	$0	$0
20	$0	$0	$0
Total Estimated Present Worth =			**$24**

Assuming 30-Year Operation			
	Estimated Operation & Maintenance Costs		
Year	Today's $	Future Value	Present Worth
0	$5	$5	$5
1	$5	$5	$5
2	$5	$5	$5
3	$5	$5	$5
4	$5	$6	$4
5	$5	$6	$4
6	$5	$6	$4
7	$5	$6	$4
8	$5	$6	$4
9	$5	$7	$4
10	$5	$7	$4
11	$5	$7	$4
12	$5	$7	$4
13	$5	$7	$3
14	$5	$8	$3
15	$5	$8	$3
16	$5	$8	$3
17	$5	$8	$3
18	$5	$9	$3
19	$5	$9	$3
20	$5	$9	$3
21	$5	$9	$3
22	$5	$10	$3
23	$5	$10	$3
24	$5	$10	$3
25	$5	$10	$2
26	$5	$11	$2
27	$5	$11	$2
28	$5	$11	$2
29	$5	$12	$2
30	$5	$12	$2
Total Estimated Present Worth =			**$104**

TREATMENT TECHNOLOGY	PRIMARY PROCESS OPTION	DEFINED PROCESS OPTION	GENERAL DESCRIPTION	WINERY APPLICATION	SCREENING COMMENTS
Physical and Chemical Treatment Processes *Physical forces or chemical reactions treat wastewater*	Coarse Screening		Removal of coarse solids by interception using such technologies as bar racks, fixed and rotary screens, and rotary disks.	Frequently used for winery/stillage process water preliminary treatment. Many wineries have used fixed and rotary screens to remove organic solids such as seeds, stems, and skins prior to downstream treatment processes.	Applicable in conjunction with other process options for coarse solids removal and to protect downstream process equipment. Need to combine with removal processes for dissolved organics and inorganics.
	Accelerated Gravity Separation		Removal of setteable particles accomplished by change in gravitational or centrifugal acceleration field.	Sometimes used for winery/stillage process water preliminary treatment. Some wineries have used centrifuges to remove organic solids such as seeds, stems, and skins prior to downstream treatment processes. Centrifuges are more commonly used at wineries for removing solids from wine. EPA has denoted centrifuge as the best method for reducing stillage suspended solids (10,000 mg/l reduced to 1,000 mg/l).	Applicable in conjunction with other process options. Need to combine with removal processes for dissolved organics and inorganics.
	Comminution		In-channel grinding and cutting of solids used as an alternative to racks or coarse screening.	Not commonly used for winery/stillage process water treatment.	Not applicable for winery process water as skins and seeds are not readily removed by downstream processes and create nuisance conditions.
	Grit Removal		Use of grit chambers for the removal of grit, sand, and gravel, or other heavy solid materials having specific gravities substantially greater than organic putrescible solids. Usually preceded by screening and/or comminution.	Not commonly used for winery/stillage process water treatment.	Relatively low inorganic solids in winery process water usually makes this process unnecessary.
	Flow Equalization		Equalization of flow and mass loadings of BOD and suspended solids on subsequent treatment facilities.	Frequently used for winery/stillage process water preliminary treatment. Some wineries have used equalization tanks and storage ponds to provide uniform quality and quantity of winery process water, which is typically highly variable and high strength, prior to treatment in subsequent processes.	Applicable in conjunction with other process options to reduce both flow and strength peak loadings. Need to combine with removal processes for dissolved and particulate organics and inorganics.
	Preaeration		Replenishment of dissolved oxygen for odor suppression, grease removal, improvement of hydraulic mixing and promotion of more uniform distribution of suspended and floating solids.	Not commonly used for winery/stillage process water treatment. Sometimes used for odor control in winery process water treatment.	Applicable in conjunction with other process options. Need to combine with removal processes for dissolved and particulate organics and inorganics. Not appropriate by itself.
	Flocculation		Tank, basin, or combination flocculator-clarifier chamber used to promote the aggregation of small particles into larger particles to enhance their removal by gravity sedimentation or floatation.	Not commonly used for winery/stillage process water treatment.	Applicable in conjunction with other process options. Need to combine with removal processes for dissolved organics and inorganics.
	Mixing		Mixing of liquid suspensions, blending of miscible liquids, chemical mixing, flocculation, gas mixing, and treatment process acceleration and improved efficiency.	Sometimes used for winery/stillage process water preliminary treatment.	Applicable in conjunction with other process options for adding nutrients, adjusting pH, or flocculant chemicals. Need to combine with removal processes for dissolved and particulate organics and inorganics.
	Sedimentation		Use of sedimentation tanks or basins for the removal of setteable solids and floating material as well as thickening of sludge. Principal process used for the primary treatment of wastewater to reduce the load on downstream biological treatment units.	Frequently used for winery/stillage process water preliminary treatment.	Applicable in conjunction with other process options. Need to combine with removal processes for dissolved organics and inorganics.

LEGEND

Treatment Process Option may be screened out on the basis of technical implementability and not commonly used in winery/stillage process water treatment.

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IDENTIFICATION AND INITIAL SCREENING OF POTENTIALLY APPLICABLE TREATMENT PROCESS OPTIONS: PHYSICAL AND CHEMICAL TREATMENT

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FIGURE 4-1a

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TREATMENT TECHNOLOGY	PRIMARY PROCESS OPTION	DEFINED PROCESS OPTION	GENERAL DESCRIPTION	WINERY APPLICATION	SCREENING COMMENTS
Physical and Chemical Treatment Processes (Cont.) *Physical forces or chemical reactions treat wastewater*	Floatation		Retention tank used for the removal of light suspended floatable solids and grease through the introduction of fine gas bubbles into liquid. Used as an alternative to sedimentation or as a pretreatment unit prior to sedimentation. Floatation has also been used for waste activated sludge thickening.	Infrequently used for winery/stillage process water treatment.	Applicable in conjunction with other process options. Need to combine with removal processes for dissolved organics and inorganics.
	Fine Screening		Use of fine screens for grit removal and as a replacement for primary sedimentation tanks.	Sometimes used as an alternative to sedimentation for larger solids and algae removal from stabilization pond effluent prior to spray or drip irrigation.	Applicable in conjunction with other process options. Need to combine with removal processes for dissolved organics and inorganics.
	Evaporation		Evaporation of water contained in effluents using natural or forced techniques. Evaporation residues (sludges or dry matters) are collected for disposal.	Used for removal of water to minimize land required for treatment and disposal. Some European wineries use with spray aeration processes in sealed ponds or shallow basins as a means of disposal.	Applicable in conjunction with other process options of screening. Relatively high energy costs and drift of elevated TDS mists are possible.

LEGEND

Treatment Process Option may be screened out on the basis of technical implementability and not commonly used in winery/stillage process water treatment.

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FIGURE 4-1a

TREATMENT TECHNOLOGY	PRIMARY PROCESS OPTION	DEFINED PROCESS OPTION	GENERAL DESCRIPTION	WINERY APPLICATION	SCREENING COMMENTS
Biological Treatment - Aerobic Processes[1] *Microbiological-based processes treat wastewater*	Suspended Growth	Activated Sludge Process	Removal of carbonaceous BOD, nitrification and denitrification through the production of an activated mass of microorganisms capable of stabilizing a waste aerobically. Many variations of the activated sludge process exist.[2]	Infrequently used for winery process water treatment due to flow and loading irregularities, pH fluctuations, and high energy costs.	Applicable in conjunction with other process options. Need to pretreat for removal of particulate organics and inorganics.
		Sequencing Batch Reactor	SBR process is similar to a fill-and-draw activated sludge treatment. Main difference is that SBR processes are carried out sequentially in the same tank as opposed to simultaneously in separate tanks and thereby do not require independent secondary clarifier.	Some installations for winery/stillage process water treatment exist.	Applicable in conjunction with other process options. Need to pretreat for removal of particulate organics and inorganics.
		Membrane Biological Reactor	High-rate activated sludge process utilizing membrane to separate solids.	Some pilot-scale studies have been performed on winery process water treatment. Can have much higher solids concentrations and provides a highly polished effluent without subsequent clarification or filtration.	Applicable in conjunction with other process options especially for reuse applications. Need to pretreat for removal of particulate organics and inorganics.
	Attached Growth	Sessil Filtration	Usually consists of bed where microorganisms are attached to a substrate material and effluent is percolated at high or low rate for the removal of carbonaceous BOD and nitrification.	Can be appropriate for high-strength organic process waters similar to winery/stillage process water, particularly sessil self cleaning filters. Has been pilot tested in winery process water.	Applicable in conjunction with other process options especially for reuse applications. Need to pretreat for removal of particulate organics and inorganics.
		Rotating Biological Contactors	Series of closely spaced circular disks of polystyrene or polyvinyl chloride submerged in effluent and slowly rotated. Biological growth occurs on disks to remove carbonaceous BOD and for nitrification.	Frequently used in Germany for small winery flows.	Applicable in conjunction with other process options. Need to pretreat for removal of particulate organics and inorganics. May be subject to mechanical and odor difficulties.
		Packed-bed Reactors	Reactor filled with medium (rocks, slag, ceramic, sand, or plastic) where wastewater and air are introduced in the chamber. Used for removal of carbonaceous BOD and for nitrification.	Not used for treatment of winery/stillage process water.	Not an appropriate treatment process for high strength organic winery/stillage process water because of limited oxygenation capacity.
	Hybrid Suspended and Attached Growth Processes		Combination of activated sludge and fixed film type processes. Removal of carbonaceous BOD, nitrification, and denitrification.	Not commonly used for winery/stillage process water treatment in the past. Represents a promising, new, compact, and stable process alternative to independent suspended or attached growth processes. Frequently used in New Zealand and Australia.	Potentially applicable in conjunction with other process options. Need to pretreat for removal of particulate organics and inorganics.

NOTES:

1. All aerobic biological treatment processes require relatively uniform flow, loading, pH stabilization, and nutrient supplemented conditions by pretreatment and are relatively energy intensive for aeration requirements.

2. The activated sludge process is very flexible and can be adapted to almost any type of biological waste treatment problem. Typical examples of conventional activated sludge processes and some of the modifications that have become standardized are: Convential plug flow, Complete-mix, Tapered aeration, Step-feed aeration, Modified aeration, Contact stabilization, Extended aeration, High-rate aeration, Krauss low nutrient loading process, High-purity oxygen, Oxidation ditch, Sequencing batch reactor, Deep shaft reactor, Single-stage nitrification and denitrification, and Separate stage nitrification and denitrification.

LEGEND

Treatment Process Option may be screened out on the basis of technical implementability and not commonly used in winery/stillage process water treatment.

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IDENTIFICATION AND INITIAL SCREENING OF POTENTIALLY APPLICABLE TREATMENT PROCESS OPTIONS: BIOLOGICAL TREATMENT - AEROBIC

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FIGURE 4-1b

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TREATMENT TECHNOLOGY	PRIMARY PROCESS OPTION	DEFINED PROCESS OPTION	GENERAL DESCRIPTION	WINERY APPLICATION	SCREENING COMMENTS
Biological Treatment - Anaerobic Processes[1] *Microbiological-based processes treat wastewater*	Suspended Growth	Anaerobic Digestion	Common process used for stabilization of sludges and removal of high-strength carbonaceous BOD involving decomposition of organic/inorganic matter in absence of air to produce methane and carbon dioxide. Can consist of standard rate, high-rate, and two-stage mesophillic or thermophillic temperature processes.	Has been proven appropriate for high-strength organic wastewaters similar to winery/stillage process water.	Applicable in conjunction with other process options. Requires lower energy and nutrients and produces less sludge than aerobic biological processes.
	Suspended Growth	Upflow Anaerobic Sludge Blanket	Removal of carbonaceous BOD through the introduction of effluent at the bottom of a reactor which flows upwards through a sludge blanket of biologically formed granules. Produced gas is collected at the top of the reactor in collection domes.	Has been proven appropriate for high-strength organic wastewaters similar to winery/stillage process water. There are several operating installations of UASB treating winery/stillage process water in California and South Africa.	Applicable in conjunction with other process options. Some pretreatment of coarse solids removal is required. Operates at much higher volumetric loading rates than conventional anaerobic processes, and more economical for higher strength wastewaters.
	Attached Growth	Anaerobic Filter Process (hatched)	Removal of carbonaceous BOD, waste stabilization, and denitrification using column filled with solid media. Effluent flows upward, and bacteria grows and is retained on the media. Can be used for low-strength waste treatment at ambient temperatures.	Not appropriate for high solids and high-strength winery/stillage process water.	Not applicable due to high solids and high strength winery/stillage process water. Significant pretreatment for solids removal would be required.
	Attached Growth	Expanded/Fluidized Bed	Similar to packed-bed reactors except packing is expanded by upward movement of fluid (gas or water).	Has been proven appropriate for high-strength wastewater with some solids pretreatment.	Applicable in conjunction with other process options. Some pretreatment for solids removal is required.
	Hybrid and Two-Stage Systems		Combines two or more anaerobic process configurations to take advantage of the beneficial features of several anaerobic processes. Organic loadings are similar to anaerobic filter processes. The two-stage anaerobic process separates acid-forming (fermentation) and methane-forming phases into individual stages or thermophillic and mesophillic temperature process stages.	No known installations treating winery/stillage process water.	Potentially applicable in conjunction with other process options. Some pretreatment for solids removal is required. Not yet known to be used for winery process water treatment.
	Septic Tanks		A combination of sedimentation and anaerobic stabilization processes applicable for low flows (<2,000 gpd) and low strength wastewater.	Frequently used by very small wineries.	Requires subsurface disposal of septic tank effluent. Not applicable for larger wineries as volumetric requirements are double maximum daily flows, and leachfields frequently clog and must be rejuvenated or replaced.

NOTES:

1. Anaerobic biological stabilization treatment processes are usually more applicable than aerobic biological treatment processes for higher strength wastewater.

LEGEND

(hatched box) Treatment Process Option may be screened out on the basis of technical implementability and not commonly used in winery/stillage process water treatment.

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IDENTIFICATION AND INITIAL SCREENING OF POTENTIALLY APPLICABLE TREATMENT PROCESS OPTIONS: BIOLOGICAL TREATMENT - ANAEROBIC

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FIGURE 4-1c

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TREATMENT TECHNOLOGY	PRIMARY PROCESS OPTION	DEFINED PROCESS OPTION	GENERAL DESCRIPTION	WINERY APPLICATION	SCREENING COMMENTS
Land Application *Relies on natural environment and processes for treatment; requires careful management*	Slow-rate Irrigation	Alfalfa, Grassland Tree farms	Predominant natural treatment process. Consists of low-rate application to vegetated land (alfalfa, grassland, or tree farms) to provide wastewater treatment and meet growth needs of vegetation or crops. Treatment occurs as water percolates through soil profile and via evapotranspiration.	Frequently used for winery/stillage process water treatment, especially in the Central Valley in California. Also used in Australia.	Applicable in conjunction with other process options. May need to pretreat for removal of particulate organics and inorganics. Requires substantial land area for nutrient removal (i.e. alfalfa would require 200-300 lbs of Nitrogen/Acre; tree farm would require 50 lbs of Nitrogen/Acre)
	Rapid Infiltration Irrigation		Treatment of wastewater through intermittent, high-rate application to spreading basins or sprinkler system. Vegetation usually not provided. Treatment occurs mainly through percolation and biological stabilization through soil profile and some evaporation.	Frequently used for winery/stillage process water treatment, especially in the Central Valley in California. Also used in Australia.	Applicable in conjunction with other process options. May need to pretreat for removal of particulate organics and inorganics.
	Overland-flow		Wastewater distributed over upper portion of graded, grass slopes and allowed to overflow to collection ditches at bottom of slopes. Used at sites with low permeability soils for BOD and nutrient removal.	Not commonly used for winery/stillage process water treatment.	Not applicable for high-strength winery/stillage process water. Requires frequent mowing and large land area for large flows.
	Wetland Application/Reed Beds	Surface Subsurface	Inundated lands with water typically less than 2 feet that supports growth of emergent plants such as cattails, bulrush, reeds, and sedges. Typically constructed for and limited to polishing or secondary treatment.	Becoming popular polishing step for smaller winery process water treatment. Also used infrequently at large wineries.	Applicable in conjunction with other process options. May need to pretreat for removal of particulate organics and inorganics. Requires substantial land area for nutrient removal.
	Floating Aquatic Plants		Similar to wetlands except plants are floating species. Water levels are typically deeper than wetlands.	Not commonly used for winery/stillage process water treatment.	Not applicable. Need to pretreat for removal of particulate organics and inorganics. Plant harvesting is required, expensive, and disposal is difficult.

LEGEND

Treatment Process Option may be screened out on the basis of technical implementability and not commonly used in winery/stillage process water treatment.

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IDENTIFICATION AND INITIAL SCREENING OF POTENTIALLY APPLICABLE TREATMENT PROCESS OPTIONS: LAND APPLICATION

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FIGURE 4-1d

TREATMENT TECHNOLOGY	PRIMARY PROCESS OPTION	DEFINED PROCESS OPTION	GENERAL DESCRIPTION	WINERY APPLICATION	SCREENING COMMENTS
Stabilization Ponds *Physical and microbiological processes treat wastewater*	Aerobic	Low-rate Oxidation Pond	Treatment of soluble organic wastes and secondary effluents. Designed to maintain aerobic conditions with aeration and dissolved oxygen throughout liquid depth.	Infrequently used for winery/stillage process water treatment due to high energy requirement.	Not applicable. Very high energy requirement.
		High-rate Oxidation Pond	Nutrient removal, treatment of soluble organic waste, conversion of wastes. Designed to optimize the production of algae cell tissue and achieve high yields of harvestable protein.	Not commonly used for high strength winery/stillage process water treatment.	Not applicable.
		Maturation or Tertiary Pond	Similar to low-rate ponds but very lightly loaded. Used for polishing effluents from conventional secondary aerobic biological processes such as trickling-filter or activated-sludge.	Sometimes used for winery/stillage process water treatment.	Applicable in conjunction with other process options. Need to pretreat for removal of particulate organics and inorganics, and removal of most of the dissolved organics.
	Facultative-Aerobic-Anaerobic	Facultative Pond with Aeration	Treatment of screened untreated or primary settled wastewater. Deeper than high-rate pond; aeration and photosynthesis provide oxygen for aerobic stabilization near the surface and minimize odors. Lower depths are facultative. Bottom layer of solids undergoes anaerobic digestion.	Frequently used for winery/stillage process water treatment. Numerous installations in California.	Applicable in conjunction with other process options. Need to pretreat for removal of particulate organics and inorganics. Low nutrient and pH stabilization needed. Highly suitable for the variable flow and loading. Moderate energy requirements.
		Facultative Pond	Same as above, except without supplemental aeration. Photosynthesis and surface reaeration provide oxygen for upper layers.	Not commonly used for winery/stillage process water treatment without aeration because of odor potential and poor mixing.	Not applicable.
	Anaerobic	Pretreatment Pond	Anaerobic conditions prevail throughout, usually followed by aerobic or facultative ponds.	Frequently used for high-strength organic wastewater although not common for winery/stillage process water treatment.	Not applicable. Need to pretreat for removal of coarse solids and to provide a cover and scrubber for odor suppression.
	Anaerobic followed by Facultative and/or Aerobic	Pond System	Combination of pond types described above for the complete treatment of industrial wastewater with high bacterial removal. Aerobic-anaerobic ponds may be followed by a maturation pond. Recirculation frequently used to neutralize pH, replenish nutrients, and stabilize for intermittent flow and loading conditions.	Frequently used for high-strength organic wastewater and winery/stillage process water treatment. Numerous installations in California.	Applicable in conjunction with other process options. Need to pretreat for removal of coarse solids.

LEGEND

Treatment Process Option may be screened out on the basis of technical implementability and not commonly used in winery/stillage process water treatment.

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IDENTIFICATION AND INITIAL SCREENING OF POTENTIALLY APPLICABLE TREATMENT PROCESS OPTIONS: STABILIZATION PONDS

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FIGURE 4-1e

TREATMENT TECHNOLOGY	PRIMARY PROCESS OPTION	DEFINED PROCESS OPTION	GENERAL DESCRIPTION	WINERY APPLICATION	SCREENING COMMENTS
Nutrient Removal *Physical, chemical, or microbiological processes treat wastewater*	Nitrogen Removal	Combined Carbon Oxidation Nitrification/Denitrification in Suspended Growth or Hybrid Reactor	Similar to activated-sludge system for removal of organic carbon and denitrification.	Not commonly used for winery/stillage process water treatment but may be appropriate if nitrogen removal is necessary.	Potentially applicable in conjunction with other process options, especially in reuse applications where nitrogen removal is required.
		Attached Growth (Column)	Similar to activated-sludge system for removal of organic carbon and denitrification.	Not commonly used for winery/stillage process water treatment, but appropriate if nitrogen removal is necessary.	Potentially applicable in conjunction with other process options, especially in reuse applications where nitrogen removal is required.
		Ion Exchange	Removal of ammonia from wastewater (cation exchange). Also used for water softening, demineralization, or nitrate removal (anion exchange).	Not commonly used for winery/stillage process water treatment.	Not applicable due to high process and brine dispoal costs and addition of TDS.
		Air Stripping	Removal of ammonia nitrogen through volatilization of gaseous ammonia.	Not commonly used for winery/stillage process water treatment.	Not applicable due to elevated pH and high energy costs.
		Breakpoint Chlorination	Addition of chlorine to wastewater to oxidize ammonia nitrogen. Flow equalization and other processes are required. Potential toxicity problems may develop if chlorinated compounds discharged to environment.	Not commonly used for winery/stillage process water treatment.	Not applicable due to very high chlorine requirements and costs and addition of TDS.
	Phosphorus Removal	Chemical Precipitation	Addition of chemicals to produce insoluble particulates when combined with phosphate. Principle chemicals used are alum, sodium aluminate, ferric chloride or sulfate, and lime.	Not commonly used for winery/stillage process water treatment as phosphorus concentrations are usually low and will result in an increase of salts.	Not applicable due to high chemical costs and addition of TDS.
		Biological Removal	Anaerobic biological removal by excess phosphorus adsorbing bacteria.	Not commonly used for winery/stillage process water treatment as phosporus removal is not required.	Not applicable since winery process water does not require phosphorus removal for land treatment and disposal.

LEGEND

Treatment Process Option may be screened out on the basis of technical implementability and not commonly used in winery/stillage process water treatment.

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IDENTIFICATION AND INITIAL SCREENING OF POTENTIALLY APPLICABLE TREATMENT PROCESS OPTIONS: NUTRIENT REMOVAL

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FIGURE 4-1f

TREATMENT TECHNOLOGY	PRIMARY PROCESS OPTION	DEFINED PROCESS OPTION	GENERAL DESCRIPTION	WINERY APPLICATION	SCREENING COMMENTS
Physical and Chemical Treatment Processes used for Wastewater Polishing	Granular-Media Filtration		Sand, anthracite, gravel, or dual filters used for the removal of fine residual suspended solids remaining after biological or chemical treatment. Also used to remove chemically precipatated phosphorus.	Frequently used for winery/stillage process water polishing treatment when reuse for irrigation by spray or drip system is desired.	Applicable in conjunction with other process options for reuse applications. Need to combine with removal processes for dissolved organics and inorganics.
	Disc Filtration		Removal of fine residual suspended solids in a manner similar to granular-media filtration.	Used intermittently for winery process water with rotating cloth disks.	A new technology that offers promise as a more economical alternative than granular media filtration.
	Microfiltration		Low pressure driven membranes 2-10 microns for removal of fine particles and collodial material. Has been used for oil removal, turbidity reduction, pretreatment of RO process, and phosphorus removal.	Not commonly used in winery/stillage process water treatment unless reuse is desired or in membrane bioreactors as pretreatment to RO for TDS removal.	Applicable in conjunction with other process options for reuse applications and TDS removal. Need to combine with removal processes for particulate inorganics and organics, and dissolved organics.
	Ultrafiltration		Moderate pressure driven membranes of 0.1 to 2 microns for removal of dissolved and collodial material. Has been used for oil removal, turbidity reduction, pretreatment of RO process, and phosphorus removal.	Not used in winery/stillage process water treatment.	Not applicable.
	Disinfection		Used principally for the disinfection of sanitary wastewater or in winery disinfection processes. Achieved by chlorine, bromine, ozone, or UV radiation.	Not used or needed in winery/stillage process water treatment, unless reuse is planned and there are concerns about biofouling.	Applicable in conjunction with other process options for TDS reduction by ozonation of winery tank washwater. This is a pretreatment process that needs to be combined with other treatment processes.
	Post-aeration		Addition of dissolved oxygen by mechanical or diffused aeration of treated effluent.	Sometimes used for winery/stillage following anaerobic process water treatment to produce aerobic conditions and minimize odors.	Applicable in conjunction with other process options. Need to combine with removal processes for dissolved and particulate organics and inorganics.
	Odor Control		Various operations and processes used for the removal and elimination of odors emanating from various treatment facilities.	Typically, post-aeration is practiced for winery process water.	Applicable in conjunction with other process options. Need to combine with removal processes for dissolved and particulate organics and inorganics.
	VOC Control/Gas Stripping		Used for the treatment, destruction, or disposal of off gases containing VOCs. Can also be used for removal of carbon dioxide in anaerobic treatment processes to lower TDS.	Not commonly used in winery/stillage process water treatment.	Applicable for anaerobic treatment offgas for TDS removal and odor control.
	Adsorption/Activated Carbon		Process of removing soluble organic and some inorganic substances that are in solutions on a suitable absorbant, such as activated carbon. Usually used as a polishing process after biological treatment for collection of remaining dissolved organic matter.	Not commonly used in winery/stillage process water treatment.	Not applicable due to high solids and organic loading.

LEGEND

Treatment Process Option may be screened out on the basis of technical implementability and not commonly used in winery/stillage process water treatment.

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IDENTIFICATION AND INITIAL SCREENING OF POTENTIALLY APPLICABLE TREATMENT PROCESS OPTIONS: WASTEWATER POLISHING

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FIGURE 4-1g

TREATMENT TECHNOLOGY	PRIMARY PROCESS OPTION	DEFINED PROCESS OPTION	GENERAL DESCRIPTION	WINERY APPLICATION	SCREENING COMMENTS
Physical and Chemical Treatment Processes used for Wastewater Polishing	Dissolved Salts Removal	Chemical Precipitation	Removal of calcium magnesium, salts, metals, and phosphorus. Used as a tertiary treatment process. Typical precipitates include lime, alum, and ferrous sulfate.	Not commonly used in winery/stillage process water treatment.	Potentially applicable in conjunction with other process options for TDS removal at the source, but elevated sodium remains which is harmful to soils and plants, therefore, not applicable. Need to combine with removal processes for dissolved organics and inorganics.
		Ion Exchange	Reduction of dissolved solids in wastewater. Primarily used for water softening, demineralization, or nitrate removal.	Not commonly used in winery/stillage process water treatment. In reuse applications, treatment of portion of wastewater followed by blending with untreated wastewater is occasionally practiced.	Potentially applicable in conjunction with other process options for reuse applications but not favored because of salt addition. Need to combine with removal processes for dissolved organics and inorganics. Produces large brine volumes which are difficult and costly to dispose.
		RO Process	High-pressure driven semipermeable membrane for removal of dissolved salts and organics.	Not commonly used in winery/stillage process water treatment. Extensive pretreatment is required.	Potentially applicable in conjunction with other process options for TDS removal at the source. Need to combine with removal processes for particulate inorganics and organics, and dissolved organics. An expensive, high-energy process with brine disposal issues.
		Electrodialysis	Semipermeable ion-selective membrane and electric current for removal of dissolved solids and salts.	Not commonly used in winery/stillage process water treatment. Extensive pretreatment is required.	Potentially applicable in conjunction with other process options for TDS removal at the source. Need to combine with removal processes for particulate inorganics and organics, and dissolved organics. An expensive, high-energy process with brine disposal issues.
		Nanofiltration	Moderate-pressure driven membranes for removal of larger molecules including calcium and magnesium for water softening and TDS removal of washwater.	Can be used instead of ion exchange for water softening to lower TDS and sodium.	Potentially applicable in conjunction with other process options for TDS removal at the source. Need to combine with removal processes for particulate inorganics and organics, and dissolved organics. An expensive, high-energy process with brine disposal issues.

LEGEND

(hatched box) Treatment Process Option may be screened out on the basis of technical implementability and not commonly used in winery/stillage process water treatment.

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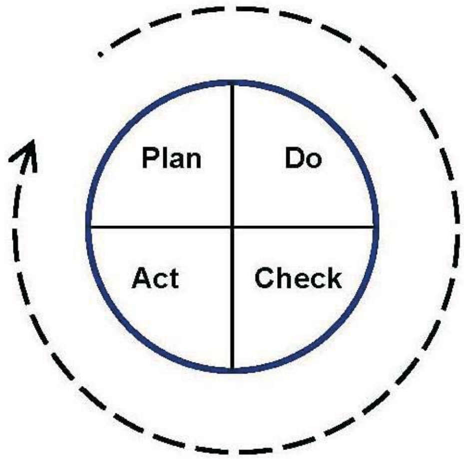
FIGURE 4-1g

Step 5: Program Implementation

Implementing the preferred option(s) may entail installing equipment and/or initiating material or procedural changes. Because the details of implementation will vary widely depending on the nature and complexity of the selected improvements as well as site- and process-specific logistical considerations, detailed guidance for these tasks is beyond the scope of this manual.

We recommend that all work be managed for quality control using a "plan-do-check-act" cycle, or Deming wheel. This is a structured approach for planning a project to meet defined specifications, executing the plan, monitoring and evaluating the results against the specifications, and acting to make adjustments or finalize the project completion.



The planning step should include developing the monitoring program that will be launched at the time of implementation. Depending on the type of project, this may include elements such as measuring outflows, collecting periodic or real-time wastewater samples, recording observations on wastewater clarity or odor, and/or other checks that are pertinent to the subject process. These data will be critical to assessing whether the installed equipment or process changes are working as intended and program goals are being met.

If monitoring indicates that the expected reductions and outcomes are not being attained, the equipment or process changes may require adjustment to achieve best results. Monitoring devices should also be checked to confirm that calibration is not a source of error. If fine-tuning measures do not improve results, it may be necessary to consider additional or alternate modifications to reach the objectives for the facility. With respect to the program workflow outlined in Figure ES-1, this would entail returning to the self-assessment phase to screen for additional feasible options, or reviewing results of the prior feasibility analysis to identify additional options that warrant implementation.

Going forward, winery management should be vigilant about re-auditing their operations annually to confirm that the installed improvements are still in-place and delivering desired results, and any procedural changes that were designated are still being implemented. This effort is critical to ensuring the long-term sustainability of the program, including attainment of financial goals for return on investment.

This section provides guidelines for monitoring wastewater flows and collecting samples for wastewater characterization. Consistent use of these methods is very important to ensure the quality and usability of the collected data.

1.1 Wastewater Flow Measurement

Obtaining accurate measurements of wastewater flows from discrete sources within the winery is a critical component of the facility assessment. Monitoring programs should be designed to assess flows over the full range of operating conditions, from crush to off-season. Careful planning may be required to capture data on flows that are intermittent or event-related.

Flow meters can be installed as either dedicated or temporary stations. For key junctures in the facility and/or points designated for ongoing compliance monitoring, dedicated instruments will be the best choice for consistency, cost effectiveness and convenience. For other locations, where data will be collected over a limited time period for purposes of the facility evaluation, temporary meters can be used. These are often rented rather than purchased, especially when a number of meters are needed to capture flows in different parts of the winery over the same time period. If access to a particular wastewater stream is not possible without significant facility modifications, it may be possible to substitute measurements of source water inflows to that process, estimating losses as appropriate. In determining whether to rent or buy or install dedicated equipment, note that it will be important to periodically repeat certain flow measurements to confirm that facility modifications or procedural changes have been effective and are sustained. In the case of small flows, simple approaches like using a bucket and stop watch are sometimes sufficient.

There are many types of flow meters available. Examples of some of the most commonly used types are described on Table 1-1 below. For further guidance on flow meter selection, an interactive tool is available at: http://seametrics.com/flowmeterfinder/flowmeterfinder.html#

Table 1-1: Flow Meter Types and Characteristics

Type	Mechanism	Measurement	Mounting	Comments
Ultrasonic - Transit time	Source and receiving transducers mounted on opposite sides of a pipe	Signal moves faster when it travels with the flow rather than against it, and the flow rate can be determined from this difference.	External, clamp-on, allowing flow measurement with no wetted parts.	▪ More accurate than Doppler for clean water applications ▪ Ideal for temporary use ▪ Low corrosion and maintenance needs
Ultrasonic - Doppler	Source and receiving transducers mounted on opposite sides of a pipe	Emits an ultrasonic signal which bounces off particles entrained in the flowing liquid, causing a frequency shift that is proportional to the velocity.	External, clamp-on, allowing flow measurement with no wetted parts.	▪ More reliable than Transit Time for dirty wastewater applications; water containing silt or sand particles; or water with entrained air bubbles ▪ Low corrosion and maintenance needs ▪ Ideal for temporary use
Electromagnetic (Magmeter)	Measure velocity based on principle of electromagnetic induction	When a conductive fluid flows through a magnetic field, a voltage is produced that is proportional to the fluid's velocity.	Internal or as insertion	▪ Can be used in a wide range of pipe sizes from small to large diameter ▪ Access may require piping modification, potentially disrupting operations
Area Velocity	Uses submerged sensor (ultrasonic or magmeter) to measure velocity, and another method to measure fluid depth to yield flow volume	Contingent on sensor	Can be installed in lines with open channel flow that are gravity-drained, such as trench drains or pipelines	▪ Typically used with a data logger to record flow at regular time intervals

1.2 Wastewater Characterization

Worksheet 2-6 is provided to guide preparation of sampling plan for a winery, including number of samples that will be needed to characterize each winery unit process, analyses that will be requested and associated costs. The sections that follow provide guidance on related topics, including laboratory selection and coordination, sample collection, laboratory data validation and calculation of constituent loadings in the wastewater.

1.2.1 Laboratory Selection and Coordination

The winery's in-house laboratory may be able to analyze samples for some wastewater parameters, often including pH, electrical conductivity, total dissolved solids and organic acids. Refer to Appendix C for a list of the typical wastewater constituents, associated analytical methods and equipment to determine which analyses can be done in-house. Note that some analyses produce hazardous waste that must be managed appropriately. Refer to the Wine Institute's guidance document on best practices for laboratory hazardous waste management (Wine Institute/Kennedy/Jenks, 2006).

In most cases, it will be necessary to work with a contract laboratory for some or all analyses. When selecting a laboratory, try to find one with a good reputation for the specific kind of samples you will be submitting, for example industrial wastewater. While laboratories may offer a range of services, if they don't have experience with a particular media, they may not be as sensitive to anomalous results.

Prior to collecting the samples, notify the laboratory of the upcoming work and discuss the following:

- Shipment of empty sample containers to the winery
- Number of samples that will be submitted and delivery dates
- Method that will be used to transport samples to the laboratory (e.g., FedEx, courier)
- Analyses that will be needed
- Sample volumes that will be needed for the requested analyses
- Quality control information that will be provided with the results
- Turnaround time for results
- Delivery format for report - hard copy and/or electronic data deliverable (EDD)
- Point-of-contact at the laboratory for communication
- Expectations for receiving the laboratory's receipt of sample delivery and chain-of-custody by fax

When the copy of the chain-of-custody is received, review it carefully to make sure the sample IDs and requested analyses are correct.

1.2.2 Sample Collection

Sampling activities should be documented for future reference on chain-of-custody forms provided by the laboratory. Wastewater samples collected for characterization purposes are typically either "grab" samples or composite samples, as defined in the following subsections.

1.2.2.1 Grab Samples

Grab samples are defined as samples collected manually from a location of interest. These samples are representative of conditions at a single point in time. The time of sample collection should be noted on the sampling log form.

1.2.2.2 Composite Samples

Composite samples are used to assess average conditions over a longer time interval without the expense of submitting many individual samples for laboratory analysis. Composites are obtained by collecting a series of sub-samples over time at a particular location, pooling the sub-samples in a clean bucket, and drawing a sample from the combined pool to be submitted to the laboratory. Thus, the composite represents an average of conditions over the timeframe that the sub-samples were collected. General procedures for collecting samples manually, with automated sampling equipment, or to obtain flow-weighted averages are as follows:

- Manual – Use a clean 500-milliliter (mL) graduated cylinder to collect equal-volume sub-samples at pre-determined time intervals. A stopwatch can be useful for timing purposes. Transfer sub-samples to a clean 5-gallon pail, and collect the composite sample from the mixture. Record details on equipment used, times and volumes of sub-samples collected and composites collected and submitted for analysis in a sampling log for future reference.

- Automatic – Program an automatic composite sampler to collect a specific number of sub-samples at defined time intervals. Sample times are typically captured by a data logger. The automated sampler will generate the composite sample itself for submittal to a laboratory. While automated samplers are an added cost, they ensure accuracy of sub-sample timing and may preclude sample contamination associated with manual composites.

- Flow-Weighted – When composites are collected from streams that are highly variable, flow-weighted samples can be prepared to provide more representative results. To collect a flow-weighted sample, the volume of each sub-sample is adjusted in proportion to the volume of flow that occurred during the subject time interval. For example, if the first sub-sample was collected between 9:00am and 10:00am when the flow totaled 10,000 gallons, and the second sub-sample was collected between 1:00pm and 2:00pm when the volume was 2,000 gallons, the flow-weighted composite would be prepared by transferring 500-mL of the first sample and 100-mL of the second sample to the pail and collecting a sample from the mixture.

For automated collection of flow-weighted composite samples, the equipment consists of a sampler directly coupled to a flow meter. After the flow meter records a specified discharge volume, a discrete sample is collected for the composite. This process is repeated until the total flow to be sampled has been recorded by the flow meter. Thus, to obtain a 24-hour composite sample, the person tasked with sampling must know (or must measure in advance) the flow volume over 24 hours, such that the equipment can be set to sample until that volume has passed. For example, if 30,000 gallons is typically discharged over a 24-hour period, the equipment may be set to collect a discrete volume after every 1,250 gallons (i.e., 30,000 gallons / 24 sub-samples = 1,250 gallons). Because the requirement for a known flow volume adds an extra step, this composite sampling method is not as widely used as the time-weighted approaches outline above.

> For wastewater characterization, duplicates and splits are not routinely collected because the wastewater itself can be highly variable.

1.2.2.3 Quality Control Samples

To verify laboratory performance in a conventional water quality study or contaminant investigation, it is a standard practice to collect duplicate samples (which are two samples from the same source labeled differently) or split samples (a single sample that is divided and submitted to two different laboratories for analysis). However, for wastewater characterization, duplicates and splits are not routinely collected because the wastewater itself can be highly variable. For example, two wastewater samples collected in rapid succession could have different chemistry, so varying analytical results cannot be attributed to a laboratory error. Instead, the best approach to confirming data quality is to follow the data validation procedures outlined below, and more importantly, to collect a sufficient number of samples to yield representative, average results.

1.2.3 Laboratory Data Validation

Analytical data reports received from the laboratory should be reviewed for completeness and quality control. At a minimum, this should entail the following steps:

- **Confirm that reported samples and analyses correlate with chain-of-custody documentation.** Be sure the laboratory provided results for all samples and specific analytes requested. Contact the laboratory immediately if any discrepancies are noted. In some cases, the laboratory may have retained a sufficient sample volume to reanalyze the sample if an error occurred.

- **Review narrative description or cover letter.** Laboratories will often include an explanation of analytical anomalies or problems associated with the reported results. If a problem is described, contact the laboratory to better understand the issue and its causes, such that any impact on the data set can be accounted for.

- **Obtain and examine quality control results.** If the laboratory did not provide data on their quality control testing, request a copy of this information. Review these results for any deficiencies, such as insufficient spike recovery. If the quality control results do not meet specified criteria, the accuracy of the entire data set may be called into question, and it may be necessary to resample the waste stream to ensure the characterization is representative.

Comprehensive data validation includes a number of additional procedures that are beyond the scope of this guidance document. In general, data obtained for wastewater characterization purposes need not be as precise as data obtained for compliance verification. But if some results appear anomalous, based on knowledge of facility operations, or if you are not familiar with data evaluation techniques, you may wish to consult an environmental professional who can assist with full validation and interpretation of results.

Guideline 2: Source Reduction and Reuse

A broad range of source reduction and reuse techniques have been documented and are potentially applicable to wineries. Most of these techniques fall within one of the general categories discussed below. The winery action plan (Step 4.4) may contain options from each of these categories, as applicable.

2.1 Product Substitution

Products used in winemaking operations or cleaning are often made from materials that constitute sources of waste (e.g., an alkaline product cleaner) in wastewater. By changing materials, significant reductions in specific waste components can often be achieved. For example, the winery may be able to reduce the amount of salt in its wastewater by replacing a salt-containing cleaner or oxidizer with one containing less salt. Also, many wineries are shifting from sodium-based cleaners to potassium-based cleaners because potassium is a nutrient that will be used or taken up by bacteria and plants in the wastewater treatment system. When reviewing effluent monitoring data to assess the potential feasibility of product substitutions, it is important to account for any products that were used during the period when the effluent monitoring was conducted.

2.2 Good Housekeeping

Housekeeping changes to storage and clean-up procedures (for example, dry sweeping rather than wet rinses) and modifications to materials handling can be inexpensive but effective in reducing waste production. Making winery personnel responsible for housekeeping activities for processes in which they are directly involved can provide additional incentive to reduce waste. Employee education is a critical component of this process.

2.3 Process Modification

Process modifications should be identified by staff members who are knowledgeable on the process. Options should be evaluated in consultation with winemakers, production personnel, maintenance personnel, manufacturers or other experts. For example, use of alkaline cleaners may be reduced with the development of Standard Operating Procedures (SOPs) that involve process modifications. Often piping, pumping or layout changes can be implemented to improve processes and minimize wastes.

2.4 Operating Procedures

Incorporating waste minimization measures into the formal written processes and SOPs for the winery, such as testing, maintenance and treatment system operating procedures can help integrate these measures in the winery routine, making the waste minimization program more effective and consistent. For instance, procedures for operating processing equipment may strictly specify that the condition of the equipment be checked or monitored weekly and repaired or replaced if necessary.

2.5 Recycling/Reuse

Recycling/reuse (R/R) techniques can reduce waste and save energy. R/R techniques can consist of simple reuse, such as using cleaning chemicals more than once prior to discharge or offsite disposal, to highly technical methods involving reverse osmosis, ion exchange, and distillation to repurify materials. Some wineries are using CIP systems that recover spent cleaning solutions for reuse.

2.6 Water Conservation

Although water conservation methods are beneficial in conserving water supplies, they do not necessarily reduce the amount of constituents generated because the lower volume of water may carry a correspondingly higher concentration of constituents. However, with more concentrated effluent, the efficiency of recovery or treatment processes may be more efficient, reducing costs. Water conservation can also improve the feasibility or economics of other options such as recycling or disposal.

Water conservation can take many forms. During cleaning operations, employees can help by using less water (e.g., dry sweeping and cleanup) or by installing flow-reducing devices, timers, and automatic shut-off valves to limit water use. More elaborate methods can be applied to conserve wastewater. For example, cleaning and rinsing processes can be modified to use less water while maintaining good results. These highly concentrated rinse waters can sometimes be treated and recovered in a more cost effective manner and can be combined with other similar streams and recovered. Rinse waters can potentially be recycled by using filtration or other recovery techniques.

2.7 Improved Water Softener Operation

Water softeners function by using salt to remove hardness from the supply water by ion exchange. The salt that is added to the water softener during regeneration increases the FDS concentration of the winery's effluent. In many wineries, making changes to water softening practices is a logical and effective way to reduce salt loading. Wineries should assess whether any of the following modifications can be implemented:

- Switch from sodium chloride to potassium chloride. Although this change will not reduce the total salt concentration in process water, potassium is a plant nutrient and is less toxic to crops than sodium.

- Reevaluate the need for water softening. At some wineries, source water quality is adequate for some or all purposes without softening. Perhaps softeners have long been used at the winery without question, even though the source of water or quality may have changed over time. Examine water chemistry data to assess whether softening is warranted.

- If the winery has multiple water softeners at different locations throughout the facility, consider consolidating them for centralized treatment using softening membranes (nanofiltration) to remove hardness. Softening membranes work by essentially separating out the hardness, similar to reverse osmosis. Permeate from the filter would be used where softened water is required, and the reject stream can be used for cleanup water. By alleviating the need for addition of salt, this substitution can lead to considerable reductions in process water salt loading. However, centralized filtration would also entail installation of a softened water distribution system, which may be cost prohibitive.

- If a centralized softening membrane system cannot be justified, the winery should consider contracting with a service that provides offsite regeneration of cation exchange softeners. This would keep the salt load out of the winery's effluent.

2.8 Improved Wastewater Treatment System Operation

Installation or improvement of a wastewater treatment system can reduce the concentrations of discharged constituents in the effluent, including chemicals that may be added as part of the treatment process. For example, when ammonia hydroxide is used as a neutralizing agent is added to a pond system to neutralize the pH, nitrogen is converted to nitrate; this conversion can pose a problem if the effluent is subsequently applied to land for disposal. Switching to an alternate form of pH neutralization, such as recirculation of alkalinity generated from biodegradation of wastewater in the pond, would be advantageous.

If a treatment system is not designed or operated properly, discharges of incompletely treated wastewater or system overflows can occur. To avert this, an evaluation of the existing treatment system should consider:

- Emergency storage capacity

- Back-up treatment units

- Multiple stage processes

- Monitoring and control features
- Formal operating and maintenance procedures

Also, the system should be evaluated to determine whether segregation of certain wastewater streams will enhance treatment or facilitate recycling of the bulk flow. As a general guideline, dilution of wastes should be avoided because a smaller volume of highly concentrated waste can be managed more efficiently. Small quantities of wastewater can often be trucked offsite for disposal or treatment, rather than developing a system specifically to recycle or treat that stream onsite. For example, if ion exchange water softening is used at the winery, offsite regeneration services will keep the regenerant brine solution out of the winery effluent.

Guideline 3: Wastewater Discharge to Land

This section provides guidelines to evaluate wastewater discharge alternatives that can be appropriate for specific winery site and operating conditions. To begin the evaluation, wastewater characterization information must be obtained or estimated, as recommended in Step 2 of the Winery Evaluation Process and Guideline 1 for Data Collection. In particular, both the total wastewater flow and the water quality must be known or estimated for the range of typical operating conditions (e.g, crush, non-crush, etc.) and associated seasonal variations. Once the characterization process is complete or at least underway, various discharge options can be evaluated as detailed below to design an appropriate system for managing the discharge, given the specific conditions and constraints at the winery and the owner's objectives.

3.1 Overview of Land Application Methods

The most common methods of wastewater discharge to land are:

1. **Discharge through a Septic Tank and Drainfield System.** This is a common solution for wineries with small wastewater flows in regions where site conditions are appropriate and regulations are not prohibitive. The discharge occurs beneath the ground surface and is typically located close to the facility.

2. **Irrigation of Wastewater on Agricultural Crops.** This is another common method, especially for wineries with adjacent agricultural or vineyard acreage. It is also referred to as slow-rate application (Crites et al., 2000).

3. **Land Application via Spreading Basins.** This technique, also known as rapid infiltration or high-rate application, makes use of permeable basins where wastewater can be discharged in larger volumes than a discharge for irrigation.

4. **Constructed Wetlands.** Discharge to a constructed wetland is most effective as a polishing treatment step before final discharge or irrigation reuse.

The general procedure for designing a system using any of these methods involves the same series of evaluation steps, as summarized in Guideline Table 3-1 and described in greater detail below.

3.1.1 Site Selection

A suitable site for wastewater land application has appropriate soil characteristics and subsurface properties that can sustain crop growth. As with agricultural land uses, medium-textured soils that are at least 5 feet deep with little slope are preferred. In practice, however, the location of an available parcel with respect to the winery is critical, and a wide variety of soil and site conditions can be adequate if proper management practices are used. Key factors that need to be evaluated when considering a prospective site include: soil properties, depth to groundwater, slope and topography, and neighboring land uses. Some of the required information is available from published soil surveys (www.websoilsurvey.nrcs.usda.gov), but for best results, a field evaluation of any prospective site is recommended.

3.1.2 Wastewater Characterization

As noted above, wastewater characterization is a critical precursor for design of any system for land application. In addition to the initial wastewater characterization, land application systems require ongoing monitoring because both wastewater quality and site characteristics change seasonally over the course of a year. Summer growing season conditions are well suited for wastewater discharge to land, while non-growing season (winter) conditions are less well suited. The primary reason for this is that biological processes that accomplish treatment of wastewater in soils and wetlands are much less active during cold weather.

3.1.3 Determining Acreage and Wastewater Storage Needs

The acreage of a land application system and wastewater storage requirements are closely related and commonly determined at the same time to find a balance that works for a given system. With more storage, less acreage is needed for irrigation, spreading basins, or wetlands treatment systems. But the exact

Table 3-1: Overview of Land Application Alternatives and Selection Criteria

Criteria	Land Application Methods			
	Septic Tank – Drainfield	Irrigation	Spreading Basins	Constructed Wetland
Site Selection	All methods require evaluation of soil properties, depth to groundwater, slope and topography, and neighboring land uses			
Wastewater Characterization	All methods require characterization of wastewater flow and chemistry (refer to Step 2 of the Guide). Wastewater quality (including pH, nitrogen, BOD_5, and salinity) is a critical component of design for irrigation, spreading basins and constructed wetlands			
Acreage Requirements	Requires only small areas because it is generally used for small flows.	Acreage depends on crop, irrigation water requirement, winter precipitation, and wastewater storage capacity available	A complex analysis is required, but acreage may be half of that required for irrigation	Size and specific components are specified after a detailed analysis. Acreage required can overlap both irrigation and spreading basins.
Wastewater Storage Requirements	The septic tank itself provides storage; often sized to hold two days of wastewater generation	Determined based on the same factors used to calculate required acreage for crops/spreading basins, plus the need for storage capacity to provide wastewater mixing.		Wetland design incorporates storage; additional storage is required for mixing.
Management Requirements	No significant day-to-day management necessary.	Skilled management of both the winery and fields/crops is necessary.	Skilled management of the winery is necessary, as well as system monitoring and analysis at least weekly.	Skilled management of the winery is necessary, along with ongoing monitoring and analysis by a trained operator.
Typical Regulatory Requirements*	Permit may be issued by a county agency for small systems, but larger systems sometimes require a state-level permit.	Refer to state-specific and Federal agency requirements. A state or Federal discharge permit is generally needed, depending on the location and proposed activity. In most cases the permit will include monitoring and reporting requirements.		

*Wineries are strongly encouraged to contact their state and local agencies to determine applicable requirements.

relationship between storage volume and land application acreage will be different for every winery due to the variability of site and winery conditions.

Some storage is always valuable for land application systems because storage capacity provides an opportunity for additional mixing of the wastewater coming from various unit processes within a winery, if that was not fully accomplished in an upstream sump or other storage. For example, the acidic wastewater stream from a certain winery process may be offset by mixing it with a higher pH wastewater stream from another process, such as clean-up and sanitation. As a result, the wastewater applied to land is more likely to have a pH close to neutral. Mixing can also be valuable to manage weekly or seasonal variability in wastewater quality associated with different aspects of winery operations. In determining storage needs, it is important to account for the fact that treatment efficiency in soil or wetlands varies seasonally, and is typically not as effective during the cool winter season as it is during dry summer growing months. This means that the winery will rely on greater winter storage capacity.

3.1.4 Managing Daily Operations and the Ongoing Program

Land application procedures range from simply sending wastewater from the facility through storage to discharge at a constant flow rate, to more elaborate procedures that synchronize application to water needs for vegetation growth in an irrigation area. In general, water delivery is simplest for septic tank-drainfield systems because these can be operated with constant flow and without frequent management. Wetlands may also be simple because, during most of the year, steady flows through the wetland are desirable. Spreading basin and irrigation systems are more complex because there are limitations on the duration, volume and quality of wastewater that can be applied in a sustainable manner.

Managing an ongoing land application program is simplest for the septic tank - drainfield method. For the other three methods, management is more complex, requiring initial planning, day to day management, and routine monitoring to provide data for decision-making. In addition, these methods often require a state-level permit for the discharge.

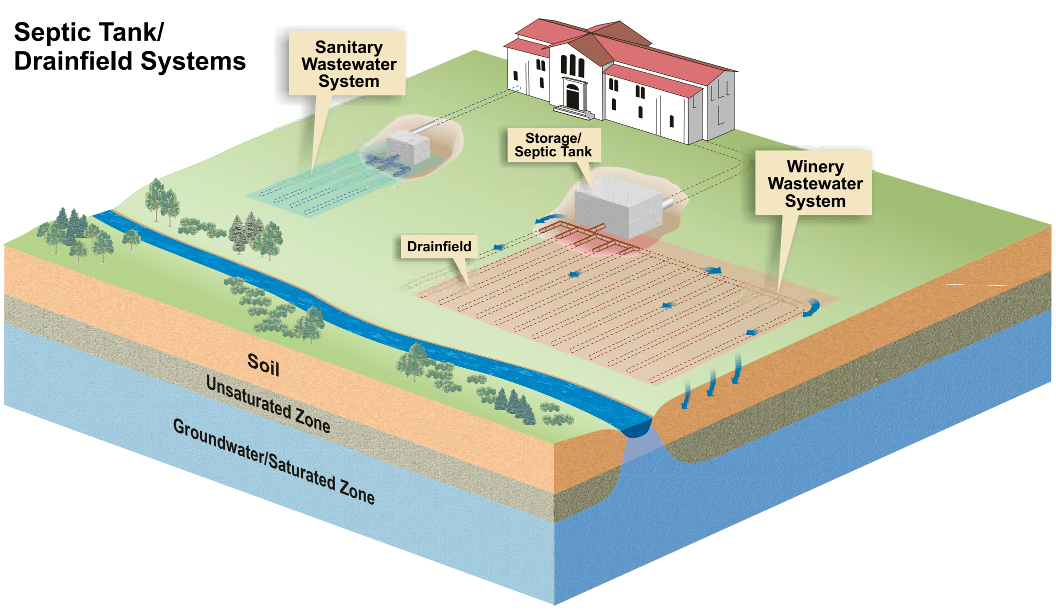
3.2 Septic Tank – Drainfield Systems

For small wineries with low production and wastewater flows, installation of a relatively simple wastewater treatment system consisting of a settling tank (a septic tank) and with a subsurface drainage discharge area (a drainfield) may meet their needs. In these systems, solids are allowed to settle in the septic tank, and the effluent is discharged to an adjacent draining field. The septic tank provides an anaerobic environment where some nitrogen transformations occur and microbes assimilate and decompose organic material. When the effluent is discharged to the soil, aerobic processes consume remaining BOD_5 and convert much of the wastewater nitrogen to nitrate-N.

Figure 3-1 shows the general layout of a septic tank – drainfield system. The figure shows two systems because domestic wastewater from the winery should be kept separate from the winery process water system. Although it isn't mandatory, a septic tank - drainfield system should be laid out to allow gravity flow from the winery through the septic tank to the discharge area, if possible.

Although extensive wastewater characterization data is not needed for initial design of the wastewater system, it is important to obtain wastewater quality measurements on an ongoing basis for analysis of system operations and potential impacts to groundwater. For small systems (less than 2,500 to 5,000 gallons per day, depending on the regulating entity), the owner is generally not required to calculate constituent loadings from the discharge. In some parts of California, however, periodic measurements of wastewater chemistry are required.

Figure 3-1: Septic Tank – Drainfield System Schematic



3.2.1 Site Selection

The suitability of a potential site for a septic system will be contingent on site and local area conditions, soil properties, groundwater elevations, and wastewater characteristics. These factors are summarized in Guideline Table 3-2 and should be addressed when evaluating any land application system.

Soil properties in particular are a primary factor in determining the suitability of a site for a septic system. The physical conditions of the soil that are relevant include soil texture, soil depth, depth to groundwater, and soil layers that may restrict water flow. It is common practice for regulatory agencies to require that soil pits be excavated at the proposed discharge location for their inspection.

Depth to groundwater should be assessed at the site if it is likely to be within 10 feet of the ground surface during any portion of the year. Drainfields are generally required to have at least 3 feet of unsaturated soil beneath the bottom of the discharge trench for proper functioning.

The infiltration capacity and permeability of site soils should be sufficiently high to allow penetration of wastewater. State regulations generally specify the amount of wastewater discharge per unit area based on soil texture. If soils with some limitations occur at an otherwise well-suited site, locate the drainfield system elsewhere.

Soil chemical constituents should be evaluated to provide general information about soil productivity of the proposed location and to document background site conditions. But in practice, this information is not used for design of the septic system.

Table 3-2: General Site and Wastewater Characterization Needs

Wastewater	
Water Quality	See Guideline 1 for additional information about sampling and analysis. Obtain monthly (or at a minimum seasonal) data for: pH, BOD_5, Total N, Ammonia-N, Nitrate-N, TDS, FDS, EC Obtain one-time characterization data for: Na, Ca, K, Mg, Cl, SO4, HCO_3, SAR, P, soluble BOD_5
Water Flow	Irrigation and spreading basin systems: determine average monthly flow and days of operation in order to define acreage and storage needs Septic tank - drainfield systems: determine average daily flow for the peak month of wastewater production
Site	
Site soils	Develop general soil description including soil depth, texture, layering, depth to groundwater, and variability. If possible, determine the depth to groundwater with an on-site boring that provides a log of soil and subsurface conditions. Measure soil properties at representative locations, including: • Chemical properties: pH, salinity, nitrogen, phosphorus, potassium, calcium, sodium, magnesium, chloride, sulfate, cation exchange capacity, soil organic matter percentage • Physical properties: texture, permeability and available water storage capacity Each distinct soil layer from the surface to 5 feet depth should be characterized.
Site layout	Consider shape and size of parcel in the system design and layout. Slope and topography should be gentle.
Local area	Consider distance from the facility, neighboring land uses, available buffers, distance to surface water, distance to nearby drinking water wells.

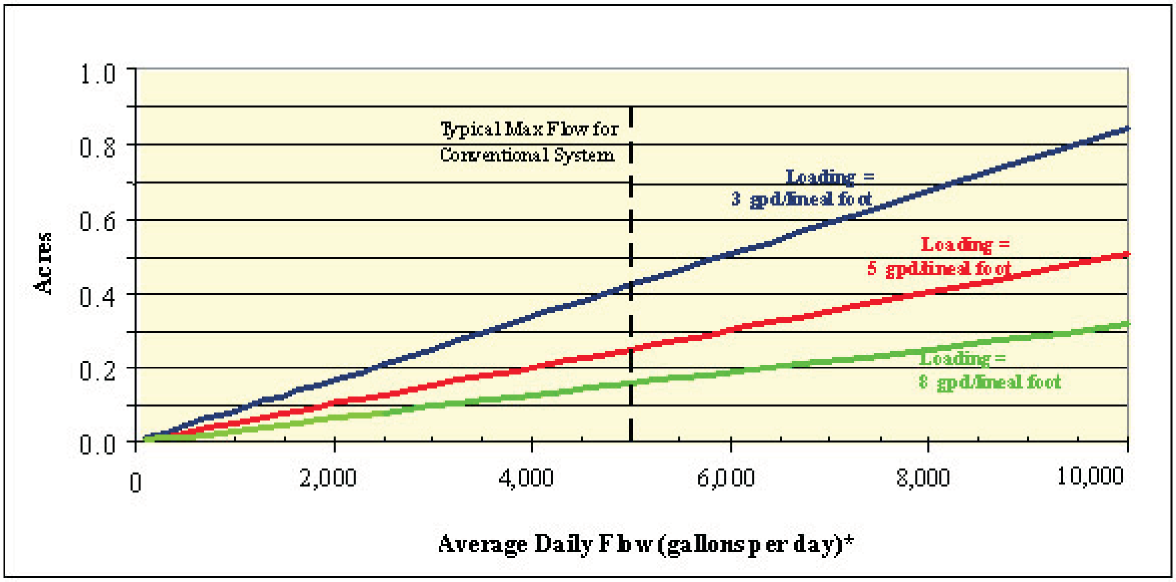
3.2.2 Determining Acreage and Wastewater Storage Needs

Guidelines for determining the drainfield acreage and wastewater storage needs for a septic system are presented in Figure 3-2.

3.2.2.1 Acreage

The most common method for estimating the drainfield size needed for a given discharge rate is to rely on standard handbook values for the acceptable discharge rate per unit area or per lineal foot of discharge trench. These are summarized on Figure 3-2 for three loading scenarios: 3, 5, and 8 gallons per day per lineal foot. The figure can be used to determine the required acreage for a given wastewater discharge rate, assuming a particular soil loading rate. For the wastewater discharge, use the average daily flow during peak flow conditions (typically crush) to ensure adequate capacity. Estimate the loading rate to be used for the system based on soil texture, depth to groundwater, and/or plans to use improved system design features.

Figure 3-2: Drainfield Acreage for Selected Loading Rates



*Average peak season flow.

The dashed vertical line on Figure 3-2 indicates a general upper limit of flow for systems that are permitted using standard design criteria. In most states, to develop a system for greater daily flows the owner will be required to apply for a permit that imposes additional design and monitoring requirements. For this reason, septic tank – drainfield systems are generally used in low wastewater flow situations. It should also be noted that most regulatory agencies require plans for septic systems to identify a second, backup drainfield area to be reserved for use in case the primary drainage area fails. In practice, this doubles the required acreage for a system.

3.2.2.2 Wastewater Storage Requirements

Storage requirements for septic tank – drainfield systems are not based on detailed engineering design considerations but do have good support based on operational experience. In some areas of California, septic tank size requirements are based on the design wastewater flow. It is common to specify a tank sufficient to hold two days of wastewater flow during the peak month of wastewater production. This allows sufficient time for solids settling as well as time for partial treatment of the wastewater through anaerobic processes. During seasons with lower flows, residence time in the tank will be longer.

3.2.3 Other System Design Considerations

Detailed engineering design information is available for septic systems for on-site sewage disposal systems (Salvato, 1995), and much of this information is useful for designing winery wastewater systems as well. Advances in system design that are pertinent to winery wastewater discharge systems include:

Improved drainfield distribution. Drain lines that rely on gravity for distribution often do not achieve uniform application rates throughout the drainfield. There are several methods to improve distribution:

- Periodically discharge wastewater in larger volumes, providing sufficient flow to reach a larger area of the drainfield. This can be done with a water level float or a dosing siphon with no power requirements.
- Install a low pressure distribution system. A system with small-diameter distribution piping and small discharge orifices can achieve very uniform distribution under low pressure.

- Divide the drainfield into smaller zones for more uniform distribution. This method allows for alternating wet and dry cycles, which further improves wastewater treatment.

Shallow discharge for irrigation. Conventional drainfields are installed at depths of 30 inches or deeper below ground surface. A number of shallow discharge designs have been developed to allow beneficial use of wastewater for irrigation water supply. This is particularly appropriate for winery wastewater, which does not have the public health issues associated with sewage (e.g., pathogens).

Solids separation to prevent clogging. Lees, bentonite and diatomaceous earth should be excluded from septic tank – drainfield systems to avoid clogging of the drainfield. Although the septic tank partially protects the drainfield, a separate system for these larger solid waste streams should be planned.

3.2.3.1 Daily Operations and Program Management

Septic tank – drainfield systems do not require extensive day-to-day management, but ongoing monitoring will improve operations. A program of wastewater flow measurement should be implemented and periodic wastewater sampling and analysis is recommended. These datasets will provide the winery manager with a record of discharges to evaluate ongoing water conservation and pollutant reduction activities at the winery, as discussed in the implementation section of the guide (Step 5). The data may also be useful if questions arise regarding potential environmental impacts.

Specifically, a monthly monitoring and inspection procedure should be established for the wastewater system. Inspection of the various system components can be conducted and recorded in a log book. This will help identify any slowly occurring changes in the system and will also allow identification of operations and maintenance needs (such as periodic septic tank pumping).

3.2.3.2 Regulatory Considerations

Typically a permit is issued by a county agency, but a state-level permit may be required for larger systems. Consult the local agencies in your area for specific requirements. In some areas, regulatory agencies do not allow use of these systems for winery wastewater applications due to the potential for system overloading and clogging. An example of regulatory agency wastewater discharge requirements that includes design criteria for septic systems is provided in Appendix G.

3.3 Irrigation of Crops and Other Vegetation

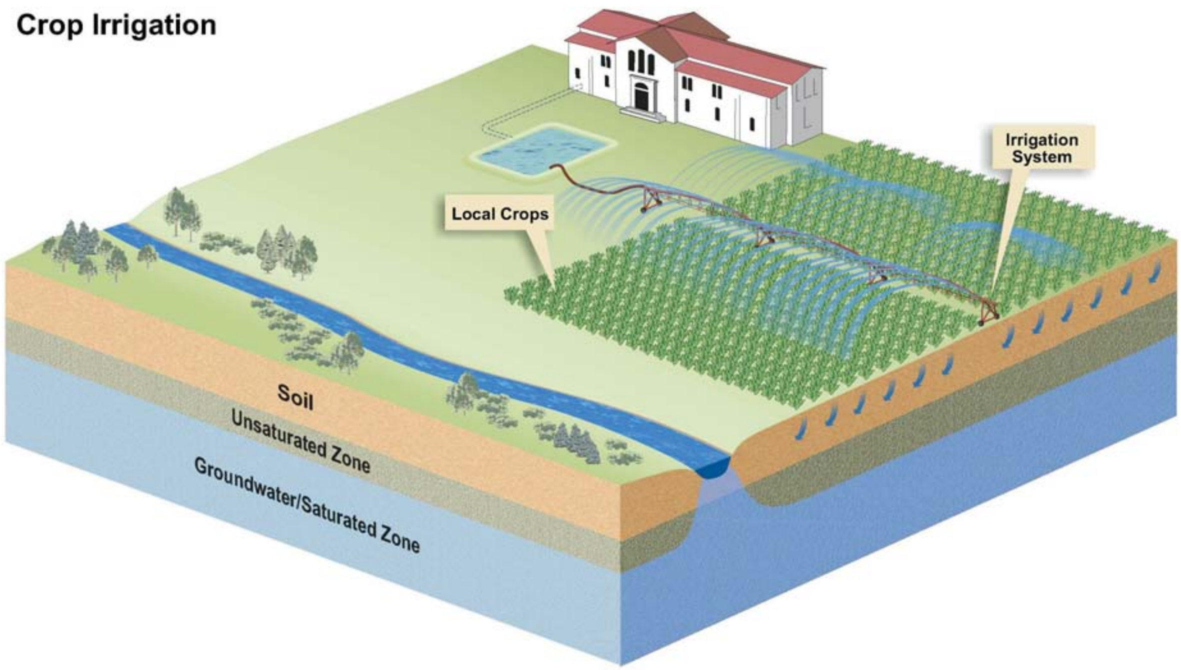
The site selection process requires deeper soil investigation than is commonly prescribed for agricultural purposes.

Some wineries and many food processors treat and discharge process wastewater by using it as an irrigation supply (refer to Guideline Figure 3-3). Irrigation involves slow-rate application to optimize crop growth and uptake of water, nutrients, and salts. Additional manuals that address wastewater irrigation programs: *Manual of Good Practice for Land Application of Food Processing/Rinse Water*, issued by California League of Food Processors (CLFP) in 2007 (CLFP, Brown & Caldwell and Kennedy/Jenks, 2007) and *Land Treatment Systems for Municipal and Industrial Wastes* (Crites et al., 2000).

Irrigation is an excellent method of wastewater reuse that puts both water and nutrients to a beneficial purpose: crop production. Because crops remove nutrients and salts from the wastewater and soil, this method can also be a positive factor in groundwater protection. Most wineries and vineyards have staff with the necessary background and management skills to effectively operate a wastewater irrigation system.

The key challenges for operating a wastewater irrigation program are matching the timing and volume of wastewater generation with crop needs for irrigation (through use of storage capacity, in some instances), and securing sufficient nearby acreage to accommodate the winery's wastewater flows. Some pre-treatment of wastewater may be required depending on the crops to be grown. Figure 3-3 shows, in schematic form, how the soil water supply must be controlled to provide sufficient water for crops, while avoiding percolation below the bottom of the root zone, and still maintaining some capacity in the soil to absorb precipitation.

Figure 3-3: Irrigation Management Schematic



3.3.1 Site Selection

The initial step in site selection for irrigation is to compile the wastewater and site characterization information identified in Table 3-2. Typically, the availability of land and the distance from the facility are key considerations. The site configuration and local area conditions are secondary, but should also be evaluated. These may pose limitations on use of a site and will likely affect the acreage available for irrigation.

For crop production, soil properties are a primary factor in determining the suitability of a site. Soil characteristics that affect water movement and crop growth, and therefore site suitability, include:

> Although the evaluation procedure is oriented toward identifying sites that are clearly suitable for reuse of wastewater for irrigation, if a site does not meet these standards, it may still be suitable, but additional evaluation or management constraints may be needed.

- **Depth to groundwater.** Groundwater should be at least 8-feet deep to provide an adequate soil depth to store irrigation and precipitation, as well as additional storage capacity below the root zone to hold any percolation above the level of groundwater. More precise management will be required if groundwater is shallower.

- **Soil profile depth.** If a soil is shallow, it can still be used for irrigation, but the site capacity will be less and more precise irrigation management will be required. In some cases, soil layers that impede root growth and water movement, such as compacted layers, can be corrected with tillage. Other layers will become limitations to the capacity of the site's crops to take up water and nutrients.

- **Infiltration capacity and permeability of site soils.** The soil should have sufficiently high infiltration capacity and permeability to allow irrigation to penetrate with little or no runoff. This can also be addressed by designing the irrigation system to match the soil conditions.

- **Soil available water capacity.** This is the amount of water that can be stored in the root zone, which is important because it is the water available for plant growth. A soil with low storage capacity requires frequent irrigation and careful management to prevent over-irrigation and percolation of water below the root zone.

Table 3-3: Characteristics of a Suitable Wastewater Irrigation Site

CRITERIA	IRRIGATION SITE CHARACTERISTICS[1]
Depth to Groundwater	Greater than 8 feet
Soil profile layering	If layers that could impede water flow or root penetration are present, determine whether these limitations can be corrected.
Infiltration and permeability	Soil profile should have a permeability of 0.2 inches/hour to a depth of 5 feet below ground surface.
Soil chemical/physical properties	• Soil pH should be between 5.5 and 8.5 in all layers • Salinity should be less than 3 dS/m • Exchangeable sodium should be less than 10% • Clay content should be less than 40%
Available water storage capacity (AWC)	AWC should be greater than 4 inches in the top 5 feet of soil
Site layout and local area conditions	Ideally, the site can be divided into fields while maintaining setbacks from property boundaries, surface water and water supply wells. Where possible, buffer strips between the site and neighboring houses or other non-agricultural uses are recommended.

[1] The characteristics presented in this table are to readily identify suitable sites. If a site does not meet these requirements, it may still be suitable, but may require more careful management practices to be successful.

- **Soil chemical properties.** At sites with soil chemical properties that are not optimal, fertilizer and soil amendments can sometimes be added to overcome limitations. However, under some conditions, soil chemistry may still cause a site to be unsuitable. Specifically:

  - Soil pH can be adjusted to fall within the acceptable range of 5.5 to 8.5, but it should be noted that the common effect of winery wastewater irrigation is a lowering of surface soil pH.
  - Excessive salinity and/or sodium will likely result in poor crop growth and a low site capacity for wastewater irrigation.
  - High clay percentage is an indirect limitation on crop growth, such that these soils should be avoided, if possible.

If soils with some limitations occur at an otherwise well-suited site, these areas should either be excluded from the irrigation program or separated into a field that is managed appropriately.

After compiling necessary information per Table 3-2, refer to Table 3-3 for site screening. Note that the site selection process requires deeper soil investigation than is commonly prescribed for agricultural purposes. This is necessary because irrigation sites often receive discharges during both the growing and non-growing season and have deeper penetration of water than sites irrigated only during the summer. Although the evaluation procedure is oriented toward identifying sites that are clearly suitable for reuse of wastewater for irrigation. If a site does not meet these standards, it may still be suitable, but additional evaluation or management constraints may be needed.

3.3.2 Determining Acreage and Wastewater Storage Needs

To determine acreage and storage needs, the first step is to calculate constituent loadings to the irrigated area. Guidance and examples for this calculation are presented below, followed by instructions for determining acreage and storage needs.

3.3.2.1 Calculating Constituent Loadings

After winery wastewater has been fully characterized (see Step 2, Guideline 1 and Guideline Table 3-2), the dataset can be used to calculate total loadings of wastewater constituents to the land application area. This procedure is shown by example on Worksheet G3-1. The first of the two examples is based on annual wastewater production of 70 MG, assuming average annual concentrations for BOD_5 of 2,000 mg/l; total nitrogen of 30 mg/l; and salinity of 750 mg inorganic dissolved solids (IDS). This approach is suitable for a first assessment of loading, but the same calculations should be made using monthly or seasonal data to determine the acreage requirement for the facility.

A loading is calculated by multiplying the total flow by concentration, and applying appropriate conversion factors. For example:

$$\text{Loading (lb/Ac)} = \text{Flow (Ac-in//Ac/yr)} \times \text{Concentration (mg/l)} \times 0.23$$

or

$$\text{Loading (lb/Ac)} = \text{Flow (MG/Ac/yr)} \times \text{Concentration (mg/l)} \times 8.3$$

3.3.2.2 Determining Acreage Requirements

Once individual constituent loadings are determined, they can be compared to per-acre loading limits. Loadings for irrigation rate and key constituents are established as follows:

- **Irrigation Rate.** This is based on the irrigation requirement for specific crops plus some amount of water that may be applied before or after a crop to prepare the site for the following crop. The irrigation requirement incorporates local climate (precipitation and evaporation rate) as well as specific crop requirements. In the example shown, crop irrigation requirements for grass hay are used: 48 inches per year. This allows an application of 1.3 MG per acre per year. In Table 3-4, irrigation amounts are shown for a variety of climatic regimes, primarily in California and the Pacific Northwest. The common range for hydraulic loading for winery wastewater ranges from 0.5 to 1.5 MG per acre.

- **BOD_5.** Loading rate recommendations for BOD_5 were established many years ago when the initial studies of wastewater effects on land application were conducted (EPA 1977). The rule of thumb from these studies was that 300 pounds per acre per day would result in applications that would not result in nuisance odors and other impacts. It has been observed in ongoing wastewater management programs that this value is quite conservative for land application, especially in the growing season when biological processes are active. BOD_5 concentration does impact the potential to recycle wastewater within facilities and may also affect the reliability of some irrigation systems.

- **Total Nitrogen.** The nitrogen application limit is generally termed the "agronomic rate", or the amount of nitrogen addition required to produce a standard crop yield. It is often equated to the amount of nitrogen a crop takes up before harvest which must be replaced for the next crop season. When applied to total nitrogen, this limit is generally conservative because not all the nitrogen applied is available to crops (Crites et al., 2000).

- **Salt Loading.** In arid regions, accumulation of salts has an important impact on soil quality, groundwater quality, and crop growth. In these areas, salt loading limits, expressed as fixed dissolved solids (FDS) or electrical conductance (EC), have been set based on the amount of salt taken up by a crop. Values range from 500 pounds per acre per year for biomass crops to over 2,000 pounds per acre per year for double crop or perennial crop farming practices.

The applied loads and loading limits for various constituents are used to determine the acreage requirements for a land application system. Specifically, the total number of acres needed is found by dividing the total load for each constituent by the loading limit per acre for that constituent. The highest acreage requirement among these results is the acreage that must be available each year for the system. The constituent that required the largest acreage is thus termed the limiting constituent. If the applied irrigation volume dictated by the limiting constituent is less than crop's irrigation needs, then wastewater irrigation will need to be supplemented with an additional irrigation supply to provide sufficient water for crop growth.

As a practical matter, the maximum acreage calculated for each wastewater constituent is increased by 25 percent during system planning and design so that there is extra acreage available. This acreage will be needed when additional wastewater is generated in some years. In addition, the extra acreage allows the manager of the land application area to rest some areas or temporarily remove some acreage from production in order to perform occasional maintenance or soil improvement tasks.

3.3.2.3 Determining Storage Needs

Acreage requirements should be determined in conjunction with storage plans. Temporary wastewater storage is beneficial because it allows mixing of wastewater, contributing to more consistent wastewater characteristics. A minimum storage volume for mixing can be estimated as the volume of the maximum monthly average daily flow. This can be determined by dividing the total flow for each month by the days of operation during that month, and selecting the maximum value, which usually occurs during crush.

Storage is commonly used as an opportunity to perform some pretreatment of wastewater; the most common treatment is aeration to decrease BOD_5 and total nitrogen. Minimum storage required to accomplish these objectives may be roughly the volume of total flow during one week of operation.

Larger storage volumes are valuable because they give the land application manager the flexibility to operate the system for best results, such as defering irrigation during poor weather conditions. Further, water produced by the winery during the winter can be held until the summer, when evaporative demand is higher and additional water supply is beneficial. If sufficient storage is available to avoid irrigation during months when precipitation exceeds evapotranspiration, the irrigated acreage requirements can be reduced substantially. These calculations are complex because they incorporate trade-offs in a number of variables that are specific to the site and wastewater characteristics.

3.3.3 Other System Design Considerations

Development of an irrigation system includes engineering design for water delivery mainlines, pump stations, and in-field irrigation systems. It is likely that there will be two sources of water to be delivered to the irrigation fields: wastewater and a supplemental water supply. It is becoming increasingly common to equip wastewater irrigation systems with automated controls, computerized data collection, display of real time monitoring information, and soil moisture monitoring in irrigation areas to provide detailed information for scheduling irrigation and other crop management activities.

Table 3-4: Irrigation Requirements for Selected Crops and Climates

	Average Annual Precipitation[1]		Irrigation water requirement for grass hay			Irrigation water requirement for winter wheat		
Location	Winter (inches)	Summer (inches)	in/yr	MG/Ac/yr	Irrigation Period	in/yr	MG/Ac/yr	Irrigation Period
Lodi CA	15.7	1.9	33.3	0.9	Apr - Oct	18.7	0.5	Mar - Oct
Fresno CA	9.7	1.2	34.5	0.9	Mar - Oct	20.4	0.6	Mar - Oct
Napa CA	20.4	2.6	25.6	0.7	Apr - Oct	13.4	0.4	Apr - Sep
Salinas CA	13.3	1.3	25.8	0.7	Apr - Oct	15.7	0.4	Mar - Oct
Santa Barbara CA	16.6	1.1	26.4	0.7	Apr - Oct	15.1	0.4	Mar - Oct
Temecula CA[2]	10.2	1.1	30.6	0.8	Mar - Nov	18.9	0.5	Mar - Nov
Mendocino CA[3]	33.1	5.0	15.4	0.4	May - Sep	6.9	0.2	Apr - Sep
Auburn CA	30.5	4.0	31.5	0.9	Apr - Oct	15.7	0.4	Apr - Sep
Richland WA	4.8	2.3	41.5	1.1	Mar - Oct	24.0	0.7	Feb - Oct
Aurora OR	30.5	10.7	18.4	0.5	May - Sep	6.4	0.2	Apr - Aug
Rochester NY	15.3	18.7	13.2	0.4	Apr - Oct	7.1	0.2	Apr - Oct

Notes:

[1] Winter duration: November – April; Summer duration: May - October
[2] Precipitation data from Elsinore, CA
[3] Precipitation data from Fort Bragg, CA

3.3.4 Daily Operations and Program Management

The basic operations of land application of wastewater are similar to conventional agricultural irrigation but are more complex due to the need to account for the application rate of constituents in the water. This is commonly done by determining the amount of wastewater that can be applied to each crop and field under irrigation. This planning step establishes how much wastewater can be applied; simple daily or weekly accounting of application amounts provide the information needed to determine when to switch from wastewater application to irrigation with supplemental water.

The decision about when to irrigate fields is made based on two factors: the soil moisture status of the fields (the need to irrigate for crop water use) and the available capacity of storage. When the facility's storage is nearly full, irrigation must be scheduled to avoid overfilling the storage. In practice, irrigation is scheduled on the driest fields during periods of clear weather during the winter to maintain some storage capacity.

3.3.4.1 Regulatory Considerations

Land application systems that discharge using irrigation commonly have wastewater discharge permits that are issued by a State agency. In Oregon, California, and Washington, state agencies have a responsibility to protect groundwater. In some cases, usually operations that only discharge during certain seasons, general permits for discharge may be available. It is more common for a winery to have an individual permit with conditions and requirements specifically tailored to the operations of the facility. The permittee is required to follow prescribed operating guidelines, perform routine monitoring, and report results to the agency.

3.4 Spreading Basins for Rapid Infiltration

Many wineries treat and discharge process wastewater by flood application to uncropped, bermed areas referred to as spreading basins (refer to Guideline Figure 3-4). This method involves periodic application of wastewater using a technique called rapid infiltration (Crites et al., 2000). When wastewater is applied to a spreading basin, it displaces the water in the soil profile by pushing it downward under the force of gravity. The applied wastewater is then allowed to remain in the soil to be treated by natural soil processes. The basic steps in spreading basin treatment of wastewater are shown in the first three panels of Figure 3-5, shown on the following page and as summarized below:

- Rapid infiltration begins with a wastewater application to initiate a period of wet soil conditions. Much of the applied BOD_5 is oxidized very rapidly upon application.

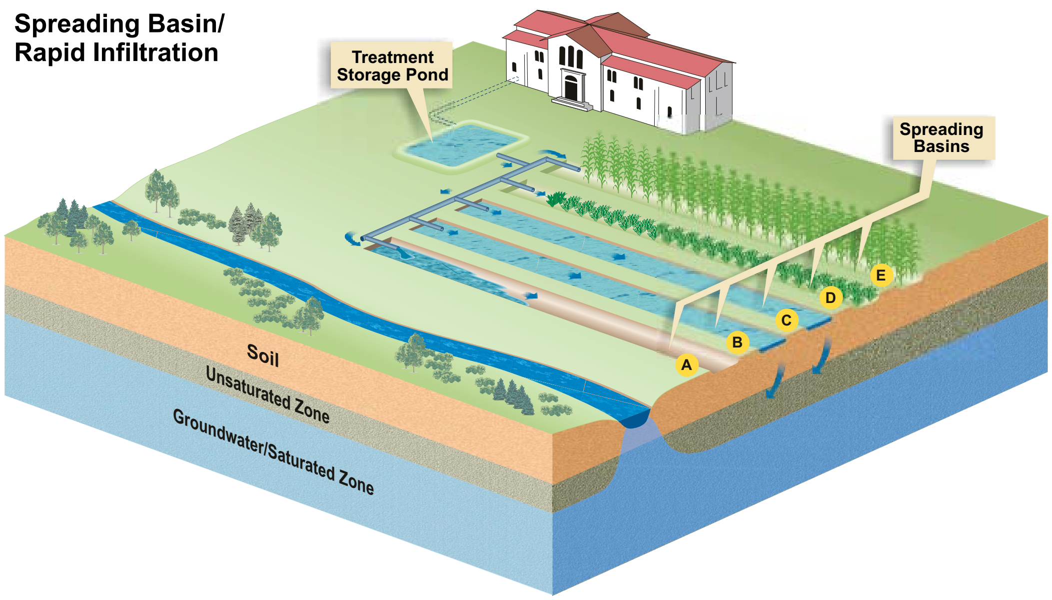
- The remaining BOD_5 establishes an anaerobic treatment zone. Refer to the Application (Cycle 1) frame in Figure 3-5. Most of the organic nitrogen applied is converted to ammonia-nitrogen.

- The next period of time, known as a resting cycle or drying cycle. Refer to the Resting frame of Figure 3-5. This allows time for air to re-enter the profile either due to evaporative water loss or soil drainage. During this time, remaining organics are oxidized and ammonia-N is converted to nitrate-N.

- The second application cycle to the spreading basin again establishes an anaerobic treatment zone. Refer to the Re-Application frame in Figure 3-5. A significant fraction of nitrate-N (up to 95% removal has been documented in recent studies (Wine Institute, 2004)) is reduced to gaseous nitrogen and lost to the atmosphere, and BOD_5 is oxidized as before.

This treatment method is effective because the wastewater applied to land first consumes oxygen, and then oxygen is re-introduced during the drying cycle. By managing the application cycles to achieve alternating anaerobic and aerobic conditions, treatment and removal occur in the upper layers of the soil. Residual solids in the wastewater are filtered out and dry on the surface of the checks during the drying cycle. After drying, the soil may be scarified or disked before the next application of wastewater. Some wineries plant cover crops in a spreading basin during spring or summer, when wastewater flows are low

Figure 3-4: Spreading Basin Schematic



and evapotranspiration is high enough to allow wastewater application to be confined to a smaller area. Crops take up residual nutrients (e.g., nitrogen) and some salts, and those constituents are removed from the spreading basin when the crops are harvested. This helps prepare the spreading basin for reuse.

Rapid infiltration requires careful monitoring and management.

The rapid infiltration method of wastewater treatment is often used by larger wineries because it can be accomplished on a smaller acreage than other methods of treatment and discharge. However, it does require extensive monitoring and management. The Wine Institute conducted a series of field trials on this method to identify best practices (Wine Institute and Kennedy/Jenks, 2004). Findings from the study have been incorporated in this section.

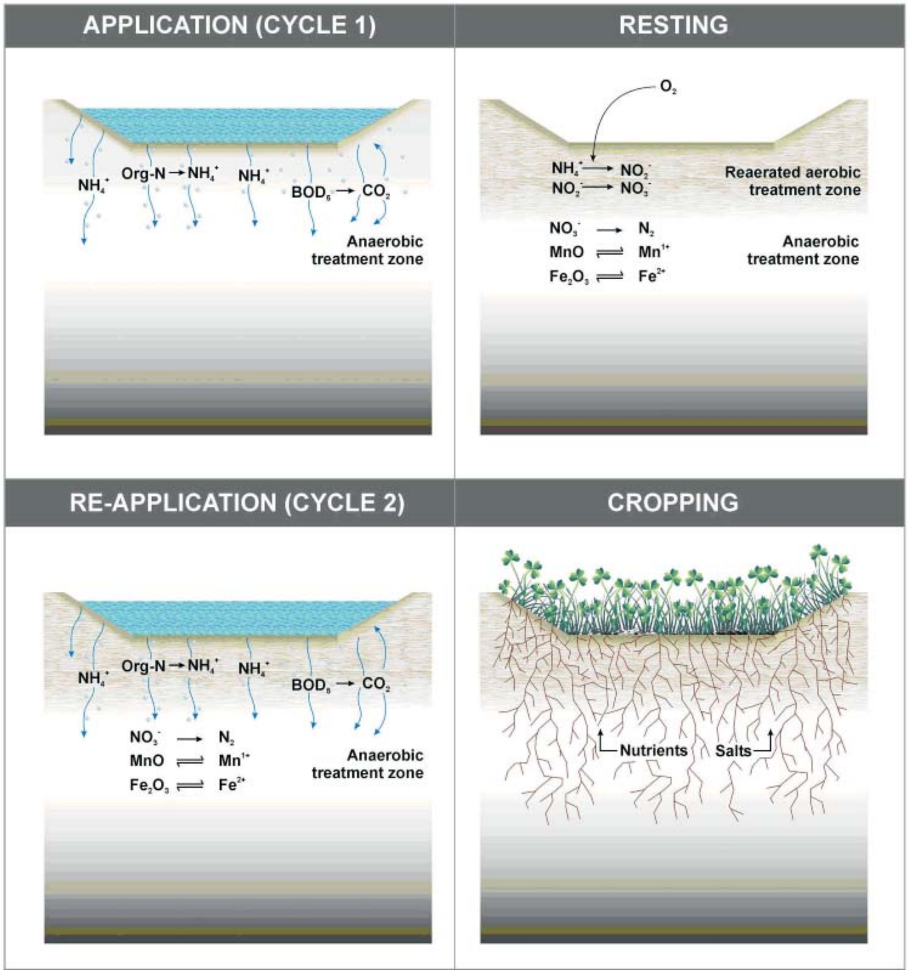
3.4.1 Site Selection

The first step in the site selection process for spreading basins is to compile the general site characterization information specified in Guideline Table 3-2. This information will provide an indication of the general suitability of a site for flood irrigation. Typically, the availability of land and the distance from the facility are key considerations. The site configuration and local area conditions are secondary, but should also be evaluated. These may pose limitations on use of a site and will likely affect the acreage that can be used to establish spreading basins.

For spreading basins, soil properties are a primary factor in determining the suitability of a site. Characterization of the soil profile should address physical, chemical and site conditions that affect water flow. Soil chemical analysis is required to address potential groundwater impacts from rapid infiltration. As noted previously, some of this information is available from published soil surveys (http://www.websoilsurvey.nrcs.usda.gov) but, for best results, a field evaluation of any prospective site is recommended.

Note that the site selection process requires deeper soil investigation than is commonly prescribed for agricultural purposes. This is necessary because spreading basin sites often receive discharges during both the growing and non-growing season and have deeper penetration of water than sites irrigated only during the summer. Although the evaluation procedure is oriented toward identifying sites that are clearly suitable for spreading basins, if a site does not meet these standards, it may still be suitable, but additional evaluation or management constraints may be needed.

Figure 3-5: Spreading Basin Treatment Process



Based on the collected data per Table 3-2, evaluation of specific site characteristics should include:

- **Depth to groundwater.** Groundwater should be at least 15 feet deep to provide an adequate unsaturated soil depth for implementing the wet and dry cycles described in detail later in this section. More precise management is required when groundwater is shallow.

- **Soil profile depth.** If a soil is shallow, it can still be used but the site capacity will be less and more precise management will be required. In some cases, soil layers that impede root growth and water movement, such as compacted layers, can be corrected with tillage. Other layers will become limitations to the capacity of the site to transmit water.

- **Infiltration capacity and permeability of site soils.** The soil should have sufficiently high infiltration capacity and permeability to allow the applied water to penetrate. Accordingly, an upper limit for clay content at 20% is provided as a site selection criterion.

- **Soil available water capacity.** This is the amount of water that can be stored in the root zone, which is important because this is where wastewater treatment will occur in a spreading basin system. A soil with low storage capacity requires frequent, small wetting cycles.

- **Soil chemical properties.** The key soil chemical properties for rapid infiltration are those which affect soil microbial activity and soil permeability. Specifically:

Table 3-5: Characteristics of a Suitable Spreading Basin Site

Criteria	Spreading Basin Site Characteristics[1]
Depth to groundwater	Greater than 15 feet
Soil profile layering	If layers that could impede water flow or root penetration are present, determine whether these limitations can be corrected
Infiltration and Permeability	Soil profile should have a permeability of 0.6 inches/hour to a depth of 5 feet below ground surface.
Soil chemical/physical properties	• Soil pH should be between 5.5 and 8.5 in all layers • Salinity should be less than 3 Ds/m • Exchangeable sodium should be less than 10% • Clay content should be less than 20%
Available water storage capacity (AWC)	AWC should be greater than 4 inches in the top 5 feet of soil
Site layout and local area conditions	Ideally, the site should be divided into long, narrow spreading basins suitable for uniform surface water application. Setbacks should be maintained from property boundaries, surface water, and water supply wells. If possible, reserve buffer strips between the site and neighboring houses.

[1] The characteristics presented in this table are intended to readily identify suitable sites. If a site does not meet these requirements, it may still be suitable, but may require more careful management practices to be successful.

- Soil pH. This can be adjusted to fall within the acceptable range of 5.5 to 8.5.
- Excessive sodium concentration would likely to result in lowered permeability; therefore the exchangeable sodium percentage for a soil should be measured.

If soils with some limitations occur at an otherwise well-suited site, these areas should be excluded from use for rapid infiltration. Refer to Guideline Table 3-5 for a full summary of site screening criteria.

3.4.2 Determining Acreage and Water Storage Needs

To determine acreage and storage needs, the first step is to calculate constituent loadings to the spreading basin. Guidance and examples for this calculation are presented below, followed by instructions for determining acreage and storage needs.

3.4.2.1 Calculating Constituent Loading to Spreading Basins

Land application using spreading basins is limited by the hydraulic capacity of the soil profile rather than wastewater concentrations because wastewater must he held in the soil for a period of time to allow treatment via the processes described above. There are, however, several operational limits based on wastewater characteristics that have been developed from past case studies of spreading basins (Wine Institute and Kennedy/Jenks, 2004):

- Wastewater should have pH values between 3 and 10
- The ratio of BOD_5 to total N concentration in wastewater should be greater than 20 to ensure that anaerobic conditions needed for denitrification will occur during rapid infiltration. If there is too much nitrogen present, spreading basin treatment may not be effective enough.
- Total BOD_5 loading per wetting cycle should not exceed 7,000 pounds per acre.

- The maximum amount of wastewater that can be applied during a wetting cycle is a function of the total BOD_5 load limitation (7,000 pounds per acre). It can be calculated as follows:

  Maximum application per cycle (in/Ac) = 7,000 (lb/Ac) / [BOD_5 concentration (mg/l) x 0.228]

3.4.2.2 Determination of Acreage

Acreage requirements for spreading basin land application can be determined using a rapid infiltration sizing calculation customized for winery wastewater. This is provided as Worksheet G3-2, which includes an example calculation. To complete the calculation, the winery will need to have the following information available:

- **Maximum monthly wastewater flow.** This is expressed in gallons per day. The maximum almost always occurs in the fall, during crush.

- **Maximum hydraulic loading rate.** Two values are needed to determine the maximum wastewater application rate per wetting cycle: (1) the BOD_5-limited application rate calculated in the previous section, and (2) the soil available water capacity for the surface 5 feet of soil, which will have been determined during initial site characterization (Tables 3-3 and 3-5). The lower of these two values is the design loading rate.

- **Soil infiltration rate.** Determined during site characterization.

- **Infiltration rate correction factor.** This is a value used to correct infiltration measurements made at a single point in a field, in order to represent infiltration rates for larger areas (EPA 1981). Past work has shown that single point measurements overestimate infiltration for larger areas. Correction factors can range from 0.04 for measurements with considerable lateral flow, to 1 for measurements made using large basins that simulate spreading basins well.
- **Length of the drying cycle.** The duration required for spreading basin soils to drain or evaporate water to establish aerated conditions must be estimated. EPA guidance provides a range of values. The duration can also be estimated by determining the time required for soil drainage to remove water from the soil profile. During the summer, drying times are shorter than during the winter because the higher summer evaporation rates can remove more water. The climate information in Table 3-4 provides some basis for estimating drying times based on rainfall amounts for the winter season. When developing a design, it is important to review the impact of various estimates of drying cycle duration on the calculated acreage requirements.

Key outputs of the calculation procedure are used to complete next steps to ultimately determine the required acreage of spreading basins. These steps include:

- Calculate the duration of the loading/wetting cycle by comparing the design loading rate to the daily infiltration rate. This determines how long it will take for the design loading rate to infiltrate.

- Once the length of a complete wetting and drying cycle is known for typical winter and summer scenarios, calculate the number of basins required to allow adequate residence time for wetting and drying. Because the drying cycle is longer for winter conditions, the number of basins required is determined by winter conditions.

- Determine the total basin acreage that is needed based on the design facility flow and the number of basins required. The acreage of each single basin can then be calculated.

3.4.2.3 Wastewater Storage Requirements

As with other land application methods, temporary wastewater storage is beneficial for mixing of wastewater with different properties that result from the variety of winery processing and clean-up activities. A minimum storage volume for mixing can be estimated as the volume of the maximum monthly average daily flow (this is calculated by dividing each monthly total flow by the number of days of operation and selecting the maximum value, which usually occurs during crush).

Use of storage as a location for pretreatment of wastewater is generally not needed for spreading basin land application. Larger storage volumes do provide with the flexibility to implement best practices, such as deferring wastewater discharge during portions of the winter when large acreage would be required to long enough resting cycles. If wastewater is stored for any length of time, however, some aeration will be required for odor control.

Winter land application acreage needs are much larger than summer needs (see reference values on Worksheet G3-2). Adding storage capacity to the land application system may be the least expensive solution, with the added benefit of greater flexibility for managing the land application program. One method to determine the effect of storage on land application acreage is to determine acreage requirement for each month of the winter, thereby identifying critical times when additional wastewater storage could significantly reduce acreage needed.

3.4.3 Other System Design Considerations

Development of the spreading basin system should include engineering designs for water delivery mainlines, pump stations, and in-field wastewater spreading. The spreading basin distribution system is often less complex than that required for irrigation systems.

3.4.4 Daily Operations and Program Management

Management of a spreading basin land application system requires more daily oversight than other methods. Daily or at least weekly planning is done to determine which checks can receive water and, based on current wastewater quality measurements, the application amount may change. Another field variable is moisture status of the spreading basins themselves. Current management practices call for some form of soil moisture measurement to determine whether the soil has dried sufficiently to create aerobic conditions needed for complete wastewater treatment.

3.4.4.1 Regulatory Considerations

Land application systems that discharge using irrigation commonly have wastewater discharge permits that are issued by a State agency. In Oregon, California, and Washington, state agencies have a responsibility to protect groundwater. Wineries using spreading basins commonly have an individual permit with conditions and requirements specifically tailored to the operations of the facility. The winery is required to follow prescribed operating guidelines, perform routine monitoring, and report results to the agency.

3.5 Constructed Wetlands

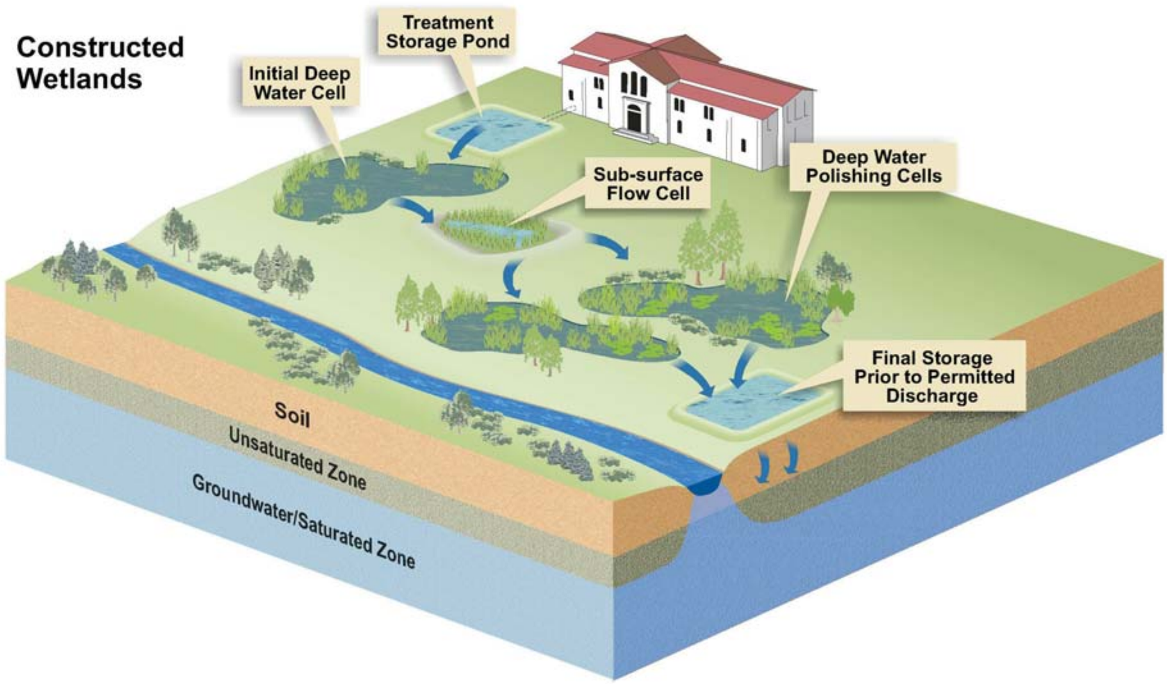
Wetlands are an alternative for wastewater discharge that combines wastewater polishing and a biological habitat with aesthetic appeal (refer to Guideline Figure 3-6). These treatment systems are generally best suited for small wastewater flows. A natural wetland system is a biologically active zone that can oxidize BOD_5, reduce nitrates, provide settling for particulates, and remove some wastewater constituents by plant uptake. Constructed wetlands can improve upon the limited performance of natural wetlands by modifying the hydraulic flow patterns and retention time, creating sequential oxic and anoxic environments for wastewater treatment, and incorporating plant species best suited for removal of wastewater constituents. The weakest part of wetlands treatment is considered to be oxidation of BOD_5 and ammonia.

Treatment wetlands have been most successful when employed as a final polishing step following other treatment steps. Treatment accomplished by wetlands is usually not sufficient to serve as a primary biological treatment of wastewaters, with the possible exception of very small systems.

Treatment accomplished by wetlands is usually not sufficient to serve as a primary biological treatment of wastewaters, with the possible exception of very small systems.

In this section, we provide an overview of design principles for wetlands treatment.

Figure 3-6: Constructed Wetlands Schematic



3.5.1 Site Selection

The suitability of a potential wetlands site will be contingent on site and local area conditions, soil properties, groundwater elevations, and wastewater characteristics. These factors are summarized in Table 3-2. Wastewater characterization or estimation is an important part of the evaluation, including data on seasonal variations. This information is used to determine the wastewater constituent that most limits discharge, usually nitrogen, organic constituents (BOD_5), total dissolved solids, or total volume of water.

Because design of constructed wetlands is highly site specific, guidance could not be provided at the same level of detail as other land application methods.

3.5.2 Acreage Requirements and Water Storage Needs

Wetland treatment systems are generally sized to provide a certain hydraulic retention time, rather than a specific loading capacity. Biological wastewater treatment methodologies that have been applied to wetlands treatment of municipal wastewater were previously summarized by Crites and Tschobangulous (1998).

Free-surface wetlands are sized to accommodate about 12 to 15 acres per MGD of inflow. For short periods of time during the crush season, the wetlands may be able to accommodate higher flows without harmful effects. Accordingly, the design for a new wetlands area should include a deeper section that could potentially provide temporary storage of larger flows. Often, this is accomplished by adding higher banks around a normally shallow wetlands cell so that it can be temporarily inundated for storage.

Detention time in the wetlands will depend on influent quality and effluent objectives, but is often on the order of a week. The wetlands design will need to incorporate sequential aerated and anoxic environments to provide treatment of BOD and nitrogen. In addition, zones with deeper water depths and some filtration through sand or gravel are recommended to provide settling of total suspended solids.

3.5.3 Other System Design Considerations

Long-term management of the wetlands should include periodic maintenance of the berms to address any degradation from animal burrowing and bulldozer work to maintain the desired plant types. In the first two years, non-suitable plants must be periodically weeded. If wetlands are constructed in a flood plain and flooding occurs, restoration may be required, such as reforming the berms and restoring the pipes between wetland cells.

Seepage of treated effluent from a newly constructed wetlands system will decline over time as the wetlands self-seal; algae and organics will sink into the mud, slowing permeability. Because the influent quality will be closely controlled to ensure tolerance of the wetlands, seepage from the system that does occur is unlikely to constitute a source of contamination to groundwater. However, regulatory agencies in some areas may require installation of a fabric or clay liner. Alternatively, if the effluent TDS concentrations are comparable to or below background groundwater concentrations, it may be possible to use the treatment wetlands as a means to recharge groundwater.

An example of a constructed free-surface wetlands system would consist of two or three parallel treatment trains, with three to five cells per train. The bottom surface would be compacted soil. The wetlands would be planted primarily with bulrush or cattails obtained from local sources. Three to five trenches about six-feet deep would be excavated to reduce short-circuiting. The polishing cells would be separated by berms that are wide enough for vehicle access. In between cells, pipes with weirs or other control structures would be constructed. Water in the wetlands would average about two-feet deep.

3.5.4 Daily Operations and Program Management

A wetlands treatment system is designed to accept continuous flow from the winery. For this reason, there are few day-to-day decisions to be made regarding water management. However, there is a need for more active field observations to assess the performance of the wetlands on a daily basis. Daily inspections should include observing the health of the vegetation, water levels in various cells of the wetlands, evidence of animal activity or damage to the system, patterns of flow through the wetlands (water must flow along a slow-moving, circuitous pathway to provide treatment), evidence of algal blooms and discharge water quality. Due to the variability of the biological ecosystem and wetlands conditions, an experienced operator is essential to the success of this treatment method.

Due to the variability of the biological ecosystem and wetlands conditions, an experienced operator is essential to the success of this treatment method.

3.5.5 Regulatory Considerations

Wetlands may be subject to regulatory requirements in the design phase, with particular emphasis on plans for the final discharge. If the wetlands are designed to discharge to surface water, a permit will be required to address surface water quality requirements; this permitting process can be arduous. If wetlands are not designed to discharge to surface water, the regulatory agency focus will be on management and monitoring for groundwater protection.

Worksheet G3-1: Limiting Constituent Analysis and Acreage Determination for Crop Uptake

Instructions: Use this worksheet to estimate irrigation acreage requirements based on the area needed for the limiting constituent.
Entries in red font are sample data that should be replaced with your own assumptions/data.

(yellow)	User input data
(lavender)	Spreadsheet-calculated output

High-Flow Example:

	Annual Flow		Average BOD_5			Average Total N			Average FDS		
	(MG)	(acre-in)	(mg/l)	(lb/yr)	(lb/acre/day)	(mg/l)	(lb/yr)	(lb/acre/yr)	(mg/l)	(lb/yr)	(lb/acre/yr)
Wastewater Characteristics	70	2,579	2,000	1,175,933	--	30	17,639	--	750	440,975	--
Loading limit per acre[2]	1.0	36	--	--	300	--	--	400	--	--	2,000
Minimum acreage by constituent[3]	72		11			44			220		
Required area for the irrigation program (acres)[4]	**275**										

Low-Flow Example:

	Annual Flow		Average BOD_5			Average Total N			Average FDS		
	(MG)	(acre-in)	(mg/l)	(lb/yr)	(lb/acre/day)	(mg/l)	(lb/yr)	(lb/acre/yr)	(mg/l)	(lb/yr)	(lb/acre/yr)
Wastewater Characteristics	7	258	2,000	117,593	--	30	1,764	--	750	44,097	--
Loading limit per acre[2]	1.0	36	--	--	300	--	--	400	--	--	2,000
Minimum acreage by constituent[3]	7		1			4			22		
Required area for the irrigation program (acres)[4]	**28**										

[1] Applied load (lb/yr) = Flow (Ac-in/yr) x Concentration (mg/l) x 0.228

[2] Limits were defined based on agronomic uptake for grass hay (refer to Section 3.3.3). Loading limits per acre are considered on a daily basis for BOD_5, but annually for other constituents.

[3] Minimum acreage = Load / (loading limit/per acre). For BOD_5, calculate minimum acreage on a daily basis by dividing the load by 365 days/yr.

[4] In these calculations, the required acreage equals 125% of the highest minimum acreage by constituent to ensure sufficient land for best management and to accommodate flow variability.

MG = million gallons

Worksheet G3-2: Spreading Basin Design

Instructions: Use this worksheet to estimate spreading basin acreage requirements.

Entries in red font are sample data that should be replaced with your own assumptions/data.

(yellow)	**User input data**
(lavender)	**Spreadsheet-calculated output**

Primary Inputs		Source Notes
Design wastewater flow, gal/day:	200,000	Max Monthly Flow, gallons per day
Soil available water capacity, in/5 feet:	5.0	From soil characterization
BOD_5-limited hydraulic load, inches:	7.0	See Section 2.4.2
Infiltration rate, in/hr:	2.0	NRCS Estimate
Infiltration rate correction factor:	0.2	Used to convert point data to basin scale
Estimated infiltration rate, in/day:	9.6	
Maximum load per cycle, inches:	5.0	
Design loading rate, in/cycle:	**5.0**	

Load-Rest Cycles	Annual	Summer[1]	Winter[1]		Reference Values[3]		
						Summer	Winter
Days in season:	365	214	151				
Load/wetting cycle[2], days:	--	1	1		Load/wet	1-3	1-3
Rest/drying cycle, days:	--	6	18		Rest/dry	4-8	5 - 20
Cycles / season:	39	31	8				

Spreading Basins	Design	Summer[1]	Winter[1]
Basins required:	**19**	7	19
Total basin area, acres:	**28.0**	10.3	28.0
Single basin size, acres:	**1.5**	1.5	1.5

[1] Summer period, April through October - 214 days; Winter period, November through March - 151 days

[2] Load/wetting cycle = estimated infiltration rate / design loading rate

[3] Adapted from US EPA design process for rapid infiltration (EPA 1981)

Guideline 4: Wastewater Treatment

This section provides guidelines for evaluating winery wastewater treatment system alternatives and selecting energy-efficient equipment that will best meet the winery's needs for subsequent discharge to land or a publicly owned treatment works (POTW). Conceptual treatment alternatives for salt, organic and nitrogen reduction are outlined in the overview section below, followed by more detailed discussion of specific treatment methods. Refer to Figures 4-1a through 4-1g for initial screening of potentially applicable treatment process options.

4.1 Overview of Treatment Process Selection

Identification of an appropriate wastewater treatment technology or multiple technologies is strongly influenced by the characteristics of the wastewater stream and the degree of treatment needed to meet site-specific discharge requirements. Wineries may need to consider using some combination of the following types of wastewater treatment processes to address discharge requirements:

- Physical and chemical processes for removal of solids (total suspended solids (TSS) and coarse solids such as lees, stems, and seeds). The technologies range from screening and sedimentation to pre-aeration, chemical precipitation, dissolved air flotation (DAF), and filtration.

- Biological processes for removal of organic matter (BOD) and nitrogen control. Treatment options include aerobic, anaerobic, and facultative (both aerobic and anaerobic) biological degradation systems.

- Membrane (reverse osmosis and nanofiltration) and thermal processes (mechanical or solar evaporation) for removal of salt.

The amount and type of treatment required will depend on the treatment objectives. Pretreatment for discharge to a publicly owned treatment works (POTW) may require only partial reduction of BOD, TSS, and perhaps total Kjeldahl nitrogen (TKN) to levels similar to those found in domestic wastewater. Higher levels of treatment may be necessary for discharges to receiving waters under NPDES permits.

On the other hand, only minimal treatment (e.g., coarse screening) may be required prior to land application treatment. However, requirements for more extensive pretreatment for discharge to land application are beginning to emerge in California for wineries regulated under Waste Discharge Requirements to address site-specific issues including organics, nitrogen, and salts. These treatment requirements are usually established by regulatory agencies with input from the discharger.

Small wineries generally produce small wastewater streams that can be assimilated by on-site disposal systems. Septic systems consisting of a settling tank and drainfield are the most common treatment and disposal option (refer to Guideline 3). In these systems, solids are allowed to settle in the septic tank, and then the effluent is discharged to an adjacent drainfield. The septic tanks must be cleaned out periodically to maintain the treatment system. Where more extensive treatment is required, pond systems, and in some cases small package treatment plants are typically used.

4.1.1 Removal of Organics

The reduction of organic compounds in wastewater is generally addressed through a combination of physical/chemical treatment for solids and biological treatment (refer to Guideline Figures 4-1a through 4-1b). Biological treatment of organics generally falls into two broad categories: aerobic and anaerobic treatment. Aerobic processes involve the use of bacteria that require oxygen and metabolize the dissolved organics into carbon dioxide and water. These types of systems can be fairly expensive and complex, and require significant amounts of energy to supply the required oxygen for the bacteria due to the high BOD concentrations in winery wastewater. These types of systems are generally effective in reducing BOD to levels below 100 mg/l. However, achievable treatment levels are highly dependent on the influent wastewater characteristics.

Anaerobic systems utilize bacteria that metabolize dissolved organics in the absence of oxygen. The resulting end products of the metabolic process are methane and carbon dioxide. These types of systems can be more robust than their aerobic counterparts and are often more expensive. They can generally treat more highly concentrated wastewaters (3,000 mg/l or higher of influent BOD), but cannot reach treatment levels as low as aerobic systems.

4.1.2 Nitrogen Reduction

The reduction of nitrogen compounds in wastewater is commonly addressed through biological treatment (refer to Figure 4-1f). Other treatment technologies exist to reduce or remove nitrogen compounds, and include ion exchange, chemical oxidation, and air stripping. However, these types of technologies are often not suited for winery wastewater applications. Ion exchange and chemical oxidation generally increase salt loading in the facility discharge. Air stripping requires operation at pH levels of 11 or higher and also results in increased salt loading.

Biological treatment for nitrogen removal is fairly complex and expensive, and generally achieved through the use of nitrifying bacteria that metabolize ammonia into nitrite and nitrate. Further operation of the biological system under anoxic conditions converts the nitrate into nitrogen gas. These type of processes are already used in the municipal wastewater treatment industry and can readily be applied to winery wastewater treatment applications.

4.1.3 Salt Reduction

Winery wastewater is not typically treated to remove salts (TDS); however, salt may limit reuse options such as irrigation. As a result, many wineries are starting to implement best practices to minimize the salt in their wastewater effluent. In California and other regions where salts may pose a threat to groundwater quality, regulatory agencies are asking for even greater salt reductions, which is driving consideration of salt removal treatment technologies.

Currently available salt reduction strategies that may be applicable to winery operations are summarized on Figure 4-1g. They are all costly, so careful evaluation of the economic feasibility of these end-of-pipe approaches is paramount. Technologies include membrane treatment, either through reverse osmosis (RO) or nanofiltration (NF). These systems are used to separate the water from its dissolved components by forcing the water through a semi-permeable membrane. The dissolved components are left to concentrate on the feed side of the membrane. The result of this process is a clean water stream, generally suitable for discharge or reuse applications, and a concentrated brine stream, which must be disposed of. Both RO and NF must be coupled with pretreatment to avoid fouling the membranes and frequent, expensive cleaning and operating measures.

Salts can be separated from winery wastewater by evaporation in shallow ponds, if sufficient land is available, or with mechanical evaporators. This process can also be used to concentrate membrane treatment reject streams. The salt brine or cake will then need to be disposed of properly, which is again difficult and expensive to accomplish.

4.1.4 Energy Efficiency Considerations

Energy efficiency should be a major consideration in the design of a winery process wastewater treatment system. An energy audit of an existing or planned treatment facility will assist a winery in determining the life cycle cost of treatment equipment and deciding where to invest resources in treatment processes. The local power utility can provide wineries with assistance conducting energy audits of their treatment facilities.

Treatment system components that have significant energy demands include aerators, pumps, motors and motor drives. Optimal selection, operation and maintenance of aerators and pumps are discussed in Appendices F and J, respectively. Key features of energy efficient treatment systems can include premium efficiency motors, variable frequency drives, and design and process improvements, as discussed below.

4.1.4.1 Premium Efficiency Motors

Properly sized premium efficiency motors (PEM) can save energy compared with standard efficiency motors and oversized motors. For assistance selecting PEM and estimating payback times, refer to a software package called MotorMaster+, which can be obtained at no cost from the U.S. Department of Energy website: http://www.eere.energy.gov/industry/bestprsctices/software.html.

4.1.4.2 Variable Frequency Drives

Variable frequency drives (VFD) are used to control the speed of pumps, mixers, surface aerators, blowers, compressors, and other rotating components used in wastewater treatment systems. Pumps and aeration equipment are the largest users of electricity in wastewater treatment systems. For pumps that operate at varying flow rates, two-speed or VDFs can be used to improve electrical efficiency. Energy savings from using such equipment will offset any higher capital cost incurred.

4.1.4.3 Design and Process Improvement

Process control systems can be used to improve the energy efficiency of many wastewater treatment processes. A primary example of design and process improvements (DPI) is the use of dissolved oxygen probes to control aerators in aerobic ponds instead of continually operating the aerators at capacity.

4.2 Physical and Chemical Processes

Many wineries employ physical and/or chemical processes for the removal of solids from process wastewater. The treatment technologies employed are usually energy efficient. Typically, they are not stand-alone processes, but are used in conjunction with other processes in a treatment train. Table 4-1 below provides a list of the most common physical-chemical processes.

Table 4-1: Energy Use in Physical and Chemical Treatement Processes

Process	Equipment	Energy Efficiency Measures
Coarse screening	Motors	Premium efficiency motors
Chemical addition	Pumps	Premium efficiency motors Dosing control
Mixing	High intensity mixers	High efficiency motors Variable speed drives
Flocculation	Low intensity mixers	Premium efficiency motors Variable speed drives
Sedimentation	Sludge collection devices	Premium efficiency motors
Dissolved air flotation	Pumps Air compressors	Premium efficiency motors Variable speed drives
Centrifugation	Motors	Premium efficiency motors Variable speed drives
Fine Screening	Motors	Premium efficiency motors
Filtration	Pumps	Premium efficiency motors Variable speed drives

4.2.1 Coarse and Fine Screening

Wineries frequently employ coarse screening to remove coarse solids by interception using technologies such as bar racks, fixed and rotary screens, and rotary disks. Many wineries have used fixed and rotary screens to remove organics such as seeds, stems, and skins prior to downstream treatment. When removal of finer suspended solids is required, fine screens have been employed to improve effluent water quality.

Motors are used to rotate moving screens. Thus, wineries should consider the use of high efficiency motors when available.

4.2.2 Clarification

Clarification processes are used to separate suspended solids from wastewaters. Sedimentation is the most common process, although DAF is also being used where space is a consideration or where solids are easier to float (e.g., anaerobic biosolids). Some wineries have used centrifuges for removing organic solids such as seeds, stems, and skins from wastewater and suspended solids from stillage. Where effluent polishing is required, granular media or fabric filters may be used to remove finer residual suspended solids. Chemicals may be added to aid separation of colloidal material. In these cases, rapid mixing to disperse chemicals and flocculation (slow mixing) to agglomerate solids is usually provided. The removed solids require disposal.

As noted in Table 4-1, many of the processes use motors and drives for rotating equipment associated with the process equipment. Examples include mixers, chemical feed pumps, sludge collector drives, and air compressors and recirculation pumps for DAF units. Wineries should consider the use of premium efficiency motors and variable frequency drives when feasible.

4.3 Biological Treatment: Facultative Pond Systems

Faculative ponds are often used by smaller wineries to accomplish biological stabilization. The ponds provide an environment for aerobic degradation of wastewater constituents near the surface, coupled with anaerobic degradation by microbes at depth. Aerobic degradation can be accelerated by installing aerators to increase available oxygen and preclude stagnation (refer to Section 4.6.3 below).

Pond systems are sized based on the expected wastewater quality and flows coming into the pond, as well as the quality of effluent needed to match potential reuses or meet discharge requirements. Design should provide for recirculation of water to buffer intermittent loading conditions, naturally supplement oxygen to reduce needs for aeration and nutrients, accomplish efficient treatment for removal of BOD and TSS, and increase alkalinity for pH control. Ponds should also be designed with contingencies for emergencies, potential overflows, 100-year precipitation events and any applicable local regulations. One of the primary drawbacks of pond systems for larger wineries is that significant land areas must be dedicated to ponds to meet treatment objectives with reasonable detention times.

Detention times for pond treatment during various times of the year can be estimated based on the daily volume of wastewater discharged into the pond, the average BOD concentration of that water, pond size, aerator characteristics and the target BOD concentration of the pond effluent. In general, greater pond surface area results in higher surface oxygen transfer, allowing lower detention time.

4.4 Biological Treatment: Anaerobic Systems

Anaerobic biotechnology, in the form of either low-flow rate or high-flow rate systems, can reduce BOD by about 90% and TSS by about 90%. Anaerobic systems also convert about a quarter of the Total Nitrogen in wastewater to Ammonia, while reducing some of the organic nitrogen. However, if alkalinity is added during in the anaerobic treatment process, TDS may be increased. Low-rate and high-rate anaerobic system options are described below. System features are summarized for comparison on Table 4-2.

Energy is required for operating pumps, mixers, and heating anaerobic reactors. Note that more energy can be generated with anaerobic processes than required to offset process energy requirements. Wineries can use premium efficiency motors, variable speed drives, high efficiency boilers, and process controls to improve energy efficiency.

4.4.1 Low-Rate Anaerobic Option

A conceptual low-rate anaerobic process for a large winery may consist of a lined, covered reactor lagoon constructed of native or imported earth fill. The reactor would have an influent and effluent distribution system and mixers; supernatant recycling and sludge systems; process instrumentation and controls; a compressed air system; biogas handling system, including an enclosed biogas flare with flame arrestor; an HDPE liner with leak monitoring and collection capabilities to protect groundwater (any leakage that accrues is pumped back into the reactor); and a flexible, insulated geomembrane cover. Typically, the low-rate anaerobic treatment process does not require nutrient supplementation to provide alkalinity and pH neutralization; however, if needed, this can be accomplished at the influent pump station. The winery must provide a control building or portion of an existing building space to be used for this purpose.

A boiler system can be used to heat the water to improve the treatment efficiency of the anaerobic reactor. But wineries should evaluate whether there are other, more efficient ways to heat the wastewater, such as using spare hot water heater capacity or waste heat from the winery. If the influent flow to the reactor is near 80° Fahrenheit (F), the water heater and heat exchanger may not be needed at all.

A low-rate system can have a number of advantages:

- Well suited for treating winery and food and beverage wastewater.
- Simple to operate. Typically controlled and monitored with a PLC/PC system that provides a graphical, user-friendly interface, allowing optimization of the anaerobic process.
- Efficient, reliable and robust. Designed to cope with peak organic and hydraulic loading conditions, given the long hydraulic and solids retention times.
- Provides consistently high performance and efficient removal of chemical oxygen demand (COD), BOD and TSS.
- Can accept high TSS concentrations and spikes without the need for extensive pretreatment, with the exception of course screening.
- Operation and maintenance costs are comparatively lower than for other anaerobic and aerobic systems.
- Can achieve high performance at less-than-optimum anaerobic operating temperatures because it is a low loaded system with a large inventory of biomass.
- The geomembrane cover and biogas handling system minimize the potential for release of objectionable odors.
- Sludge production is minimal due to the high solids retention time. Depending on reactor size, sludge wasting may not need to begin until several years after installation, continuing once or twice per year thereafter. Sludge is typically taken directly from the reactor to tanker trucks for land disposal, composting, or other disposal. With sufficient sludge storage capacity, sludge wasting need only take place when it is most desirable to do so.
- Sludge is relatively thick and very stable. It makes an excellent soil conditioner and amendment if used for land application.

- Provides an opportunity to capture and utilize biogas for hot water heaters or boilers in the winery or to heat process influent to provide improved reactor stability and performance or to generate electricity.

4.4.2 High-Rate Anaerobic Option

A conceptual high-rate anaerobic system for a large winery may consist of covered concrete reactors or tanks that treat winery wastewater biologically at a relatively high rate using a type of fluidized biofilm bed or sludge blanket. The reactors are placed on a structural foundation.

High-rate systems typically require a mechanical pre-treatment screening process. They generally come complete with an influent and effluent distribution system; supernatant recycle and sludge systems; a chemical addition system; process instrumentation and controls; compressed air system; an influent wastewater heating system; and a biogas handling system including an enclosed biogas flare with flame arrestor. A control building or portion of an existing building space is needed for system control.

The high rate anaerobic treatment process may require some nutrient supplementation and alkalinity addition for pH control. If spent alkaline cleaning compounds can be recovered from the winery, they can be reused for this purpose. Alkalinity or pH control is typically accomplished in a preconditioning tank upstream of the reactors. It may be necessary to include a heating system to bring the influent process water up to near 90° F. To maximize efficiency, wineries should assess their existing process water heating options, such as using spare boiler capacity or available waste heat.

A high-rate system has a number of advantages, including:

- Well suited for treating winery, and food and beverage wastewaters.
- Relatively simple to operate. Typically controlled and monitored with a PLC/PC system that provides a graphical, user-friendly interface, allowing optimization of the anaerobic process.
- Efficient, reliable, and can accept peak organic and hydraulic loading conditions if upstream equalization is integrated.
- Provides consistently high performance and efficient removal of COD, BOD and TSS.
- Can treat wastewater at high applied organic loading rates.
- Can accept moderate TSS concentrations and spikes without the need for extensive pretreatment, with the exception of course screening.
- The cover on the reactors seals biogas from the atmosphere, and coupled with the biogas handling system, will minimize potentially objectionable odors.
- Anaerobic solids in the effluent cab be collected and further stabilized in a downstream aerobic treatment system.
- Provides an opportunity to capture and utilize biogas for hot water heaters or boilers in the winery or to heat process influent to provide improved reactor stability and performance.
- Occupies a relatively small footprint compared with a low-rate system.
- A two-compartment or tank high-rate system provides flexibility for optimal management during crush, and offers redundancy during the non-crush season.
- High-rate reactors are modular and conducive to expansion with additional reactors if wastewater volume rises in the future.

4.4.3 Comparison of Anaerobic Options

In selecting an anaerobic system, wineries should examine the various trade-offs between high- and low-rate systems. The low-rate system offers greater treatment volume and is considered less complex than a high-rate system. A high-rate system requires only a small fraction of the site area required by the low-rate system, potentially reserving space for integration of additional reactors in the future, if necessary to treat increased flows. Estimated costs of the two systems can be comparable, but high-rate systems are usually more costly. Regardless of the selection, bench testing is recommended to optimize the anaerobic system and overall biological treatment process. Low-rate and high-rate system characteristics for anaerobic treatment of winery wastewater are compared in Table 4-2.

Table 4-2: Comparison of Low- and High-rate Anaerobic System Characteristics

Criteria	Low-Rate Process	High-Rate Process
Construction Area	Larger than high-rate	~10% of low-rate
Reactor Volume	Larger than high-rate	~3% of low-rate
Method of Containment	▪ Liner system ▪ Earth berms	▪ Concrete or tank reactors ▪ Leak containment wall
Equalization and Preconditioning Tanks	Not required	Required
Alkalinity and pH Adjustment	Unlikely to be needed	May be required
Estimated Renewable Energy Generated	Equal to high-rate	Equal to low-rate
Operation Requirements	▪ Simple to operate ▪ O&M costs lower than high-rate system	▪ Relatively simple to operate ▪ More complex than low-rate ▪ One full-time operator required (single shift)
Estimated O&M Annual Cost	~75% of high-rate	Higher than low-rate
Estimated Annual Biogas Capture Credit	Equal to high-rate	Equal to low-rate
Influent Heating System	▪ May not be required if temp is near 80° F ▪ Could be added in the future, if warranted	▪ Requires heating influent to near 90° F
Operational Flexibility	▪ Minimal, one compartment	▪ More than low-rate, dual compartments
Potential For Future Expansion	▪ May be limited by large footprint	▪ Additional reactors could be installed

4.4.4 BioGas Handling and Energy Recovery

A by-product of anaerobic digestion of wastewater is biogas containing methane. Biogas can be captured and recovered for potential reuse as a supplemental fuel source for the winery, or if necessary, used to power hot water heaters/exchangers that raise the temperature of wastewater entering the anaerobic reactor(s) to optimize the treatment process.

Excess biogas that is not used by the winery can be managed by a biogas handling system equipped with an enclosed flare with a flame arrestor. The flare will need to be permitted and operated in compliance with local air quality requirements. Of the biogas components (which will primarily include methane and carbon dioxide, and minor amounts of hydrogen sulfide and ammonia), hydrogen sulfide is the main compliance concern. Concentrations could exceed health-based concentrations and produce objectionable odors. As a result, the biogas handling system and flare will need to be managed appropriately to preclude odors.

To recover and reuse the biogas as a supplemental fuel source that is of sufficient quality for a specific end use, it may be necessary to include a gas treatment and polishing system, such as a scrubber. The actual amount and quality of biogas generated from the anaerobic process may vary depending on the type of system (high-rate or low-rate) installed. But it should be possible to develop an estimate of biogas generation and energy value (from offsetting electricity or natural gas purchases) for a specific proposed treatment option in order to assess the cost/benefit potential. Either flaring or reusing biogas is an important step to mitigate the greenhouse gas effects of the methane component, which is 23 times more powerful as a greenhouse gas than CO_2. When biogas methane is combusted, it releases carbon monoxide as a by-product, which quickly and readily combines with oxygen to create CO_2.

In some states, capture and reuse of biogas from anaerobic processes will qualify for renewable energy incentives or rebates that help to offset the cost of the treatment system. For example, in California, PG&E representatives indicated that rebates for a large project of this type could be as much as $150,000 to $300,000, and the California Public Utilities Commission offers incentives to customers who produce electricity with microturbines, gas turbines, wind turbines, photovoltaics, fuel cells and internal combustion engines; payments can range from $1 per watt to $4.50 per watt for renewables, depending on the type of system. In addition, many states, including California, offer net metering incentives that pay the customer the retail rate for generated electricity.

4.5 Biological Treatment: Aerobic Systems

Aerobic treatment systems are widely used to provide pretreatment for reuse, land application or discharge to a POTW. They are also used in sequence with an anaerobic system to oxidize or polish effluent to meet water quality goals for reuse. Aerated treatment processes include aerobic and facultative ponds; activated sludge, suspended growth aeration tanks; fixed film contactors of sessil fabrics; random or sheet packing, suspended growth contactors; hybrid fixed film, suspended growth contactors; and combinations of these options (Ryder, 2006). Multi-stage pond systems can often achieve BOD removal greater than 99 percent with little or no need for addition of chemicals for pH control, nutrients (aqua ammonia addition or salts) or supplemental bacteria. When pond systems are well designed and managed, they are much less likely to be a source of objectionable odors.

A multi-compartment pond approach provides a staged treatment process that is economical, flexible, effective, low maintenance and easy to operate. The basic reaction that occurs in aeration ponds is removal and biological stabilization of residual organic matter by aerobic bacteria that grow in the ponds and remain in suspension. The ponds can also facilitate nitrification if sufficient aeration is provided. The oxygen source for metabolizing carbonaceous material and for nitrification is generated by pond aerators.

If an upstream anaerobic process is used to pre-treat and remove organics, aerobic biotechnology can reduce the remaining BOD and TSS by more than 90 percent. The remaining Total Nitrogen can be reduced by up to approximately 50 percent via incorporation in cell biomass and settling out. Nitrogen that remains can be converted to nitrate, although less nitrogen will be incorporated into cell mass. Some alkalinity will be consumed during nitrification. Removal of organics prior to aerobic treatment also translates to a decrease in the aeration required for the ponds, which reduces both capital and operating costs. As with the anaerobic process, aerobic treatment can be accomplished utilizing different approaches such as aeration ponds, sequence batch reactors (SBRs), extended aeration, or activated sludge. Package plants are also available.

A well designed aeration system for aerobic pond treatment of winery wastewater will prevent formation of nuisance sulfurous odors that would otherwise occur in a relatively short period of time, on the order of a few hours to a day. This can be attributable to the relatively high concentration of sulfate in the water supply of many wineries, sulfites used for disinfectants, and the high concentrations of organic materials in the wastewater or sludge deposits.

Wastewater regulations in some states specify a minimum dissolved oxygen concentration in ponds. In California, for example, where air quality and odor emissions are strictly regulated, a pond operator must maintain a minimum dissolved oxygen concentration of 2 mg/l within the top two feet of a winery pond surface and a sulfide concentration of less than 1 mg/l. Typically, activated sludge processes in aeration tanks have optimal dissolved oxygen concentrations of about 2 mg/l (Tekippe 1998). It is generally considered unnecessary to maintain dissolved oxygen concentrations much above 2 mg/l to obtain efficient aerobic biological treatment.

Typically, aeration is accomplished with mechanical or diffused aeration devices that have varying oxygen transfer efficiencies and mixing abilities. Dissolved oxygen transfer efficiency is affected by temperature, elevation, salinity, aerator dispersion characteristics, flux between dissolved oxygen saturation and actual concentration. Typical actual oxygen transfer rates (AOR) are in the range of 50 to 75% of the standard oxygen transfer rate (SOR) or theoretical transfer rates.

Considering that the wastewater flows and the organic loading that result in biological oxygen demand can be highly irregular diurnally, weekly and seasonally, it can be challenging to design a cost-effective, energy efficient aeration system. This is particularly true in view of the fact that the costs of electric energy have increased by a factor of two to three times in the past ten years, and further energy cost increases are reasonably certain. To meet stringent regulations for nuisance odor control and management of wastewater applied to land disposal sites, real-time monitoring and control of dissolved oxygen is often required. A detailed discussion of aerator system design is provided in Appendix F.

4.6 Membrane Treatment Processes

Reverse osmosis (RO) and nanofiltration (NF) are two membrane processes most likely to be used to remove salt from winery wastewaters. These processes require significant pretreatment and would be added after biological treatment and effluent polishing. In addition, the RO and NF membranes are subject to fouling and frequent cleaning of the membranes is required. Relatively high operating pressures (typically 200 to 600 psig) are required to overcome the osmotic pressure and force clean water through a semi-permeable membrane, leaving the salt in a concentrated brine stream that may be 15 to 50 percent of the feed stream that will require disposal.

Pumping is the primary energy use for RO and NF systems. If these systems are used, wineries should consider the use of premium efficiency motors, variable speed drives, and energy recovery devices.

4.7 Evaporative Processes

Mechanical or solar evaporation (in shallow ponds) may be used for desalting winery wastewaters or reducing the volume of brines generated by ion exchange or membrane processes. Solar evaporation is contingent on the availability of sufficient land and favorable weather conditions. Mechanical evaporators usually have high energy costs. The pond systems themselves tend to be expensive because they must be double-lined and monitored to guard against leaks. The residual brine or cake that accrues in the ponds must be periodically removed, which can pose a disposal issue.

4.8 Solids Handling

Many of the wastewater treatment processes produce residuals that require disposal. Requirements for residuals disposal should be included in selection of site-specific treatment facilities. Some materials such as coarse odors and screenings may be disposed on site unless regulations require off-site disposal on these wastes.

4.8.1 Biosolids Handling

Anaerobic and aerobic biological processes both produce biosolids. In low-rate anaerobic systems, sludge is minimal due to the high solids retention time of the reactor. Sludge wasting will not need to begin until several years after installation. After this time, sludge wasting will occur once or twice per year directly from the reactor to tanker trucks for land disposal, composting, or other disposal method. There is sufficient sludge storage capacity such that sludge wasting need only take place when it is most desirable to do so. The waste sludge will be relatively thick and very stable, and will make an excellent soil conditioner and amendment if used for land application. If a high-rate anaerobic system is used, the anaerobic biosolids will be collected and further stabilized in the downstream aerobic treatment system.

Aerobic biosolids (including anaerobic solids from a high-rate anaerobic digester, if applicable) can accumulate at the bottom of aerobic pond treatment systems, and will need to be removed approximately every 5 to 10 years. Again, these biosolids can be utilized as a soil amendment or disposed of offsite at an additional cost. If high-rate or package aerobic systems are used, the aerobic solids and residuals will require careful management to control odors. Because the aerobic biosolids are still active and unstable, they have the potential to produce highly offensive odors in a short period of time. Solids or sludge stabilization processes such as the addition of iron salts to precipitate sulfides or lime to elevate pH are often needed to control odors prior to disposal.

4.9 Off-Site Disposal

For smaller wineries and/or those where there is no access to a city sewer or site conditions are not conducive to land application, storing and hauling wastewater to an offsite treatment facility may be a last-resort option. For example, in Northern California, the East Bay Municipal Utilities District (EBMUD) treatment facility in Oakland accepts high-strength wastewater from wineries and food processors.

Larger wineries may find that offsite disposal is an economically viable option for certain concentrated waste streams that have been segregated from the bulk flow, such water softener regenerant. The cost of hauling this waste may be significantly less than installing equipment necessary to treat it onsite.

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Appendix A: Case Study

A.1 Introduction

The Wine Institute previously conducted a two-year field study to define techniques for land application of winery process wastewater (process water) that could be used to minimize the potential impact on underlying groundwater. At the request of the State Water Resources Control Board, findings from the study were subject to peer review and are currently being reevaluated to determine the next steps. Although the study included preparation of guidelines for implementing land application in a sustainable manner for a given set of site and operating conditions, the scope did not include evaluation of waste minimization measures that could be implemented within the winery to control the concentrations of organics, nutrients and salts in process wastewater.

As a result, the Wine Institute collaborated with Kennedy/Jenks Consultants (Kennedy/Jenks) to characterize discrete winery process water streams and evaluate Best Practicable Treatment and Control (BPTC) measures for organics, nutrients and salts. Two Wine Institute member wineries, E. & J. Gallo (Gallo) and Bronco Wine Company (Bronco), volunteered their facilities for the study. Specifically, the work was conducted at Gallo's Fresno facility (which includes distillation operations) and the Bronco Winery in Ceres (no distillation). Hereafter, the Gallo Fresno facility is referred to as the stillage site and the Bronco facility as the non-stillage site.

The process water characterization conducted at both the non-stillage and stillage facilities consisted of the following steps:

- Planning and set-up
- Execution of process water characterization
- Evaluation of findings
- Waste reduction and treatment alternatives evaluation

Each of these steps is detailed below.

A.2 Planning and Set-up

Planning and set-up includes work plan development, process water stream selection, schedule considerations, equipment requirements and laboratory coordination needs.

A.2.1 Work Plan Development and Process Water Stream Selection

A process water characterization work plan was developed and initially used as a starting point to determine the appropriate process streams to evaluate at the non-stillage and stillage winery facilities. This document served as the basis for the sampling and analytical requirements for the process streams. Meetings were held with personnel at each facility to refine the list of process streams were on 3 May through 4 May 2005 at the stillage site and 24 May through 25 May 2005 at the non-stillage site. Based on these discussions, the following process water streams were identified for sampling and flow monitoring for this effort.

- Aggregate Process Water Effluent – process water from all sources aggregated in the collection sump prior to final discharge (from the stillage facility, final discharge was to the City of Fresno Publicly-Owned Treatment Works [POTW]; and to a land application area from the non-stillage facility, discharge was to a land application area)

- Wine/Juice Ion Exchange Regenerant – spent concentrated acid used to regenerate the wine or juice ion exchange resin

- Spent Water Softener Regenerant – spent concentrated sodium chloride solution used to regenerate the water softener resin

- Boiler Water Blowdown – periodic blowdown from boiler operations

- Stillage – stillage or bottoms product generated from distillation operations

- Cooling Tower Blowdown/Evaporative Condenser Bleed – aggregate blowdown from cooling towers or evaporative condenser bleed streams used for site refrigeration and chilling operations

- Tank Washing – spent wash water, cleaning agents, and rinsewater used in cleaning and sanitizing product storage and fermentation tanks

- Filtration Cleaning – includes aggregate process water generated from cleaning plate and frame, pressure leaf, filter presses, and other type of filters including milipore or nano filtration equipment

- Centrifuges/Decanters – aggregate process water generated from cleaning and rinsing centrifuges and decanters

- Barrel Washing – process water generated from barrel rinsing, cleaning, and sanitizing activities

- Bottling – process water from cleaning, sanitizing, and rinsing bottles and bottling equipment, as well as area wash water from cleanup of the bottling operations area

A.2.2 Schedule

The field effort for the project was conducted from 6 June 2005 through 30 June 2005 and from 16 August 2005 through 30 September 2005. The effort was divided into two time periods to allow portions of the work to be done during the non-crush and crush operating periods, respectively. The intended approach was to perform as much work as allowable during the non-crush period, during which facility personnel were more available to provide assistance as needed to Kennedy/Jenks field staff.

The process streams selected for sampling during the non-crush period included those whose stream characteristics were not anticipated to change between the two periods of plant operation. Some of these process streams were also sampled during the crush period due to time constraints during the non-crush period. Process streams with less activity during the non crush period were sampled only during the crush period. Process streams expected to change substantially in process water characteristics between the two periods were either sampled during the crush or both periods. Table A-1 lists the process streams and the periods during which they were sampled for the Wine Institute Study.

Table A-1: Sampling Schedule

Process Stream	Sample Period
Aggregate Process Water Effluent	Non-Crush and Crush
Wine/Juice Ion Exchange	Crush
Spent Water Softener Regenerant	Historical Data
Boiler Blowdown	Non-Crush
Stillage	Crush
Cooling Tower Blowdown/Evaporative Condenser Bleed	Non-Crush and Crush
Tank Washing	Non-Crush and Crush
Plate and Frame Press	Non-Crush and Crush
Filtration	Non-Crush and Crush
Centrifuges/Decanters	Crush
Barreling	Non-Crush
Bottling	Non-Crush and Crush

A.2.3 Equipment Requirements

The equipment needed to execute the process water characterization was determined through discussions with engineering and facility operations personnel at the two facilities, along with subsequent field evaluations of discharge locations for each of the process water streams. Equipment that was used is summarized below.

A.2.4 Flow Monitoring Equipment

Existing facility flow monitoring equipment was used whenever possible, as these instruments were generally assumed to provide the most reliable and accurate flow measurements. However, there were a number of process water discharge locations that did not have permanently installed equipment. For these locations, temporary flow monitoring equipment was used, including:

- Ultrasonic Flowmeters – Three units were rented for the study, and one owned by each facility was also made available (for a total of five). These were transit time ultrasonic flowmeters, and were used on process streams that discharged through plant piping with full pipe flow. Other meter types were considered (magnetic, turbine, gear, etc.); however, these would likely have required plant piping modifications to install. Considering the additional time for pipe modifications and possible interruption to regular process operations for the installation, these options were eliminated. The ultrasonic flowmeters used for the study included those manufactured by Polysonic, Dynasonic, and Panametrics. Vendors renting the flowmeters included Ashtead Technologies, Redwood Controls, and Goel Services.

- Area Velocity Flowmeters – Up to two units were rented depending on the requirements of the specific process stream being monitored. These were installed as needed in lines with open channel flow, such as trench drains or pipelines that gravity drained. Each unit included a data logger to record flow measurements at regular time intervals. Units were rented from Teledyne-Isco.

A.2.5 Sampling Equipment

One of three types of sampling methods was used, depending on the nature of the process water discharged in a given process water stream:

- Automatic Composite Sampler – Three were rented for the study period and were used whenever allowable. These programmable units allowed for collection of a fixed number of discrete individual samples, at defined time intervals, providing a composite sample for the entire sampling time frame. Automatic composite samplers were rented from Teledyne-Isco.

- Manually Composited Samples – Equipment for this method included a 500 mL graduated cylinder for collection of discrete samples, a stopwatch to measure time collection intervals for discrete samples, and a clean 5-gallon pail to hold discrete samples and generate a composite. Equipment requirements varied slightly for some of the process streams where manual compositing was required; those differences are noted in descriptions of the individual process streams.

- Grab Samples – No equipment was needed other than laboratory sample containers.

A.2.6 Other Equipment

Ancillary equipment used for the field study included:

- Notebook computer – Used to program the area velocity flowmeters and offload data from the data logger.

- Combination pH, conductivity, and temperature meter – Used to monitor the general parameters of a process water stream prior to collection of samples, ensuring that the sampled process stream was representative of normal operations.

A.2.7 Laboratory Coordination

Two laboratory facilities were used to perform the analyses required for the process water characterization. Twining Laboratories, located in Fresno, California, was retained to perform the organic, inorganic, nitrogen, and general physical parameter analyses. Organic acids analyses (which included lactic, malic, citric, succinic, and tartaric acids) were performed by the stillage company's in-house laboratory in Modesto, California. Refer to Table A-2 below for a summary of laboratory analytical methods used for the Wine Institute samples.

Sample pick-up was coordinated on a daily basis between Kennedy/Jenks field personnel and laboratory courier staff. Formal chain-of-custody protocol was followed for samples sent to Twining Laboratories. A separate chain-of-custody was used by the stillage facility's in-house laboratory for the organic acids analysis.

Table A-2: Laboratory Analyses

Constituent	Analytical Method
General Minerals[(a)]	Various[(a)]
Boron	EPA 200.7
Nitrate	EPA 300.0
Ammonia	EPA 350.2
Total Kjeldahl Nitrogen (TKN)	SM4500
Total Dissolved Solids (TDS)	SM2540
Total Suspended Solids (TSS)	EPA 160.1
Biochemical Oxygen Demand (BOD)	SM5210B
Volatile Dissolved Solids (VDS)	EPA 160.4
Sulfide	EPA 376.1
Organic Acids	[(b)]

(a) General Minerals consist of calcium, magnesium, potassium, sodium, copper, iron, manganese, and zinc by Method 200.7, total alkalinity, carbonate, bicarbonate and hydroxide by Method SM2320B, and sulfate and chloride by Method 300.0, conductance by EPA Method 120.1, and pH by EPA Method 150.1.

(b) As reported by the stillage site in-house laboratory manager, lactic and malic acid were measured using acid-specific enzymatic test kits and spectrophotometer analysis. Citric, succinic, and tartaric acids were analyzed using high performance liquid chromotography (HPLC) analysis.

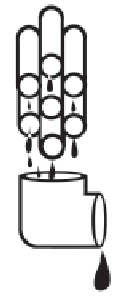
A.3 Process Water Characterization

Many of the process streams monitored in the study discharged process water either on a cyclical or periodic basis, or varied in flow rate over a 24-hour period. Similarly, the constituent concentrations for many of the process streams varied depending on the nature of the discharge (e.g., stillage, which is generally consistent, compared to tank washing, which has much higher process water constituent loading at the start of cleaning than at the end). For each process stream, the discussion below indicates how the flow was monitored, samples were collected, and methods were selected.

Following completion of the study, an additional Wine Institute member winery was identified which had independently collected similar characterization data for wastestreams in their facility. In the interest of providing representative wastestream characterization data herein for reference by industry, we have incorporated the data, as available, in our tables of average constituent concentrations from the study. Inclusion of the data is indicated by waste stream below. The additional winery is a non-stillage winery with bottling operations.

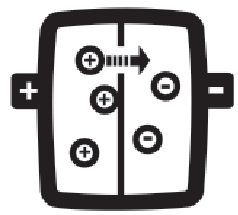
Note that the chemistry of each stream may have been influenced by the addition of various cleaning agents or other products; the detailed record of these operations at the time of sampling is not available. In general, at the stillage winery, potassium hydroxide is used for cleaning, and sometimes sodium hydroxide is used to regenerate a portion of the boiler feed water. At the non-stillage winery, during the first year of the study sodium hydroxide was used for cleaning and sodium hypochlorite was used for sanitation. During the second year of the study, the winery switched to potassium hydroxide. The additional winery was primarily using sodium hydroxide for cleaning and chlorinated trisodium phosphate for sanitation at the time of the wastestream characterization.

A.3.1 Aggregate Process Water Effluent



The aggregate of process water from each facility was routed to a sump before final discharge; this was the location for compliance monitoring. Although the sump at each facility received flow on a continuous basis, the flow rate into the sump and its constituent concentrations varied throughout the day as a function of the overall activity at each facility. To monitor flow, discharge volume data was collected from the existing compliance flow meter at each facility. These data allowed the generation of process water discharge volumes for 24-hour periods. To account for the intra-day changes in constituent loading, programmable automatic composite samplers were used at each facility. The samplers were configured to take discrete volume samples at 1-hour intervals for a 24-hour period. Each discrete sample was deposited into a larger compositing container to generate a daily composite sample. For the study, three daily composite samples were collected from each facility during the non-crush operations period, and three were similarly collected from each facility during the crush operations period. At the additional winery, three samples were collected during the non-crush and two were collected during the crush.

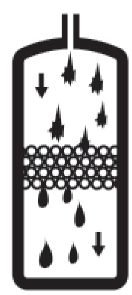
A.3.2 Wine/Juice Ion Exchange Regenerant



Generation of this process water stream only occurred from regeneration activity. Because the level of ion exchanger use varied during the study period, regenerations did not occur at regular intervals. Therefore, flow was monitored by attaching a transit-time ultrasonic flowmeter to the spent regenerant discharge line on the ion exchange system. Total process water discharge volumes were recorded at regular intervals to develop an average volume generated for a 24-hour period.

The process water generated from each regeneration cycle was discharged into an existing facility holding tank for interim storage prior to pH adjustment and final discharge. Because the tank effectively served as a large compositing container for several regeneration cycles, it was not necessary to conduct a separate compositing procedure to generate representative samples of the overall process stream. Grab samples were instead collected from the interim holding tank on a daily basis. At the additional winery, wine juice/ion exchange regenerant was not characterized.

A.3.3 Spent Water Softener Regenerant



Similar to the wine/juice ion exchange process, the water softener only generated process water during regeneration activity. The regenerant consisted of a saturated salt solution made from mixing bulk loads of sodium chloride with local well water. Rather than directly measuring the regenerant production, records of bulk salt use were instead collected to estimate the average salt (i.e., TDS) contribution from this process stream for a 24-hour period. Use of this method assumed that well water from each facility did not contribute significantly to either organic or nitrogen mass loading. Records for well water quality were reviewed to confirm that this was the case for both facilities. At the additional winery, salt use records were not available to facilitate a comparable analysis of this wastestream.

A.3.4 Boiler Water Blowdown

Process water from boiler use was generated from blowdown activity and varied depending on the steam demand at any given time for each facility. Because of the seasonal and daily fluctuations in steam demand, boiler blowdowns did not occur at regularly scheduled intervals. To monitor the blowdown volumes during the study period, one of the following methods was used, depending on site conditions:

- Direct measurement with a transit time ultrasonic flowmeter on the blowdown discharge line. This method was employed wherever possible as the first choice for flow monitoring.

- Indirect measurement using facility records of daily boiler feedwater volumes in combination with matched sets of conductivity readings for fresh boiler feedwater and blowdown. Through material balance, the TDS concentration difference between the boiler feedwater and blowdown, measured via conductivity, is inversely proportional to the volume change between the boiler feedwater and blowdown. This method was used in situations where the ultrasonic flowmeter did not provide accurate readings due to interferences in the discharge line.

- Direct volumetric measurement using a container of a known volume and a stopwatch. This method was only used in cases where the first two methods were not possible, as it is less precise and only provided a spot flow rate. For instances when this method was used, three or more flow readings were taken throughout the day to generate daily average blowdown volumes.

Use of these methods allowed for the generation of an average blowdown volume generated over a 24-hour period. Sampling consisted of grab samples collected on a daily basis. Composite samples were not needed for this process stream due to the turbulence in the boiler, which served to homogenize the blowdown prior to discharge. At the additional winery, boiler blowdown was not characterized.

A.3.5 Stillage

Distillation processes operated on a batch basis, contingent on product demand and source material availability. However, process water in the form of stillage was generated on a continuous basis during any period of operation. To monitor flow during the study period, the existing facility flowmeter on the stillage discharge line was used. These data allowed compilation of the volume generated over 24-hour period.

Sampling consisted of grab samples collected on a daily basis. Due to the steady state nature of the distillation process, the salt, organic, and nitrogen content of the process stream were expected to remain fairly constant during operations. As a result, composite samples were not necessary.

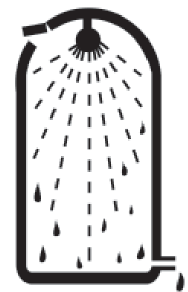
A.3.6 Cooling Tower Blowdown/Evaporative Condenser Bleed

The volume of cooling tower blowdown or evaporative condenser bleed discharged over a given 24-hour period was directly proportional to the level of cooling tower activity, and this varied depending on facility refrigeration demands. Therefore, the blowdown frequency and corresponding volume generated over a 24-hour period was influenced by the time of year and the portion of the facility served by a particular cooling tower/evaporative condenser. Considering this variability, the study focused on a single cooling tower or evaporative condenser at each facility that was considered representative of average activity levels. The selected units were identified through discussions with plant operations and engineering personnel. At the additional winery, samples from this stream were collected in a similar manner.

Flow monitoring was conducted using transit-time ultrasonic flow meters on the blowdown discharge line for each unit. Grab samples were collected on a daily basis. Because the sump for each unit acted as a large compositing container, there was no need for additional composite samples.

A.3.7 Tank Washing

Tank washings were conducted on a fairly regular basis throughout the study period. However, the volumes and character of process water generated from the cleaning process varied depending on residuals in the tank prior to cleaning, cleaning additives and to some extent the size of the tank to be cleaned. Because of these variables, the study examined results from several of the common tank sizes used most often at each facility. These included tanks with capacities ranging from 150,000 to 650,000 gallons. The additional winery characterized process water generated from tanks ranging in size from 60,000 to 216,000 gallons.



Tank washing is performed manually by facility operations personnel, and generally consisted of an initial flushing or rinsing, followed by recirculation of a cleaning agent, and a final rinsing. Process water generated from tank washing activities at each facility was discharged to the facility floor, which drains to a catch basin that connects to the overall facility process water collection system. Because of the difficulties associated with attempting to monitor the process water flow directly, the flow of source water used for tank washing activities was monitored instead. A transit time ultrasonic flowmeter was attached to the source water piping to measure water use during tank washing activities. Using the volume data from the different tank sizes evaluated, an average of process water use per tank was generated.

As noted earlier, the tank washing process consisted of a series of steps performed in sequence. Each step was presumed to remove different quantities of materials from the tank, with the start of each step containing more material than the end of the step (e.g., the process water at the start of the initial flush is presumed to be more dirty than the process water generated in the final rinsing step). Therefore, composite samples were required to adequately characterize this stream. Composites were generated manually using the following procedure:

- During the initial flush, water was continuously introduced to the top of the tank through overhead spray nozzles and allowed to drain from the tank at the bottom. One liter of process water was collected from the tank as it drained to the facility floor at the start of the initial flush. One liter was collected at the end of the initial flush. These volumes were collected in a clean 5-gallon container for compositing.

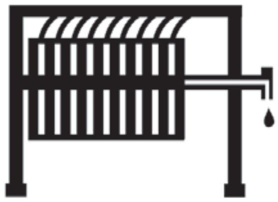
- During the cleaning/sanitation step, the cleaning/sanitation agent and water were introduced to that tank and allowed to recirculate for an amount of time prescribed by facility tank washing protocol. At the end of the cleaning/sanitation step, the spent solution and water was discharged from the tank. At this point, two liters were collected and added to the 5-gallon compositing container.

- During the rinse step, water was continuously introduced to the top of the tank through overhead spray nozzles and allowed to drain from the tank at the bottom. One liter of process water was collected from the drain location at the start of the step and one liter was collected at the end. These volumes were added to the 5-gallon compositing container.

- Following the completion of the tank washing, the contents of the 5-gallon compositing container were mixed and transferred into appropriate containers for laboratory analysis.

Manual composite samples were collected at the additional winery as well; however, details of the sampling protocol are not available.

A.3.8 Plate and Frame Filter Cleaning



Process water from large plate and frame press operations was generated solely from cleaning activities. Cleaning consisted of manual spray downs of the filter fabric with hoses, the use of automated spray washer systems, or clean-in-place (CIP) operations during which a cleaning agent was added to the spray washer system during an automated cleaning cycle. The selection of cleaning method was dependent on the level of cleaning required, with the manual spraydown being used for lighter cleanings and the CIP being used for major cleanings.

Because of differences in process configuration between the non-stillage and stillage sites, different methods were used to monitor flow and collect samples at each facility, as described below. At the additional winery, plate and frame filter cleaning effluent was not characterized.

A.3.8.1 Non-Stillage Site

Process water from large plate and frame press operations was discharged directly to the floor, where it was captured in a catch basin and conveyed into the overall process water collection system. Rather than monitor the process water flow directly, which would be difficult due to the discharge configuration, the flow of source water used for cleaning was monitored instead. Transit-time ultrasonic flowmeters were connected to the water drops feeding the hoses used for manual cleaning and the water line feeding the automated spray cleaning system. This arrangement allowed measurement of water volume used over each 24-hour period for cleaning purposes.

Samples were collected from the large plate and frame press cleaning operations were and composited manually during a CIP cycle. To generate the composite sample, six clean 5-gallon pails were placed with equal spacing lengthwise under the press unit prior to the CIP cycle. At the end of the CIP, the contents of each pail were mixed, and equal volumes were transferred into a single clean 5-gallon pail for compositing. The contents of the compositing container were then mixed and transferred into the appropriate containers for laboratory analysis.

A.3.8.2 Stillage Site

The process water from plate and frame operations discharged into a collection bin that flowed by gravity into a holding sump. The sump contents were periodically pumped into the process water collection system based on level. A transit-time ultrasonic flowmeter was attached to the sump discharge line to allow the measurement of process water generated over each 24-hour period. Composite samples were collected using a programmable automatic compositing sampler. It was configured to take discrete volume samples at one hour intervals to generate a 24-hour composite.

A.3.9 Filtration

Process water from filtration activities generally consisted of washing pressure leaf filters, although in some cases it also included small plate and frame presses and other separatory equipment. Because of differences in process configuration between the facilities, different methods were used to monitor flow and collect samples at each facility, as described below.

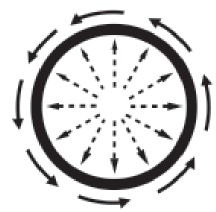
A.3.9.1 Non-Stillage Site

Process water from the filter room discharged directly to the facility floor, where it was collected in a trench drain prior to conveyance into the overall process water collection system. Flow monitoring was conducted with the use of an area velocity flowmeter installed in the trench drain. This type of flowmeter allowed for the measurement of process water volume generated over each 24-hour period for the process area. Composite samples were collected using a programmable automatic compositing sampler. It was configured to take discrete volume samples from the trench drain at one hour intervals to generate a 24-hour composite. At the additional winery, 24-hour composite samples were also collected from the filtration building drain.

A.3.9.2 Stillage Site

Process water from pressure leaf filter cleanings were discharged directly to the facility floor, where it drained to a catch basin that conveyed the process water to a holding sump. A transit-time ultrasonic flowmeter was attached to the sump discharge line to allow the measurement of process water generated over each 24-hour period. Composite samples were collected using a programmable automatic compositing sampler. It was configured to take discrete volume samples at one hour intervals to generate a 24-hour composite.

A.3.10 Centrifuges/Decanters



Process water from centrifuges and decanters had a number of sources, including but not limited to cleanings, seal water, chase water, and watering in/out activities. Because of differences in process configuration between the non-stillage and stillage sites, different methods were used to monitor flow and collect samples at each facility, as described below.

A.3.10.1 Non-Stillage Site

Process water from centrifuge/decanter activity was regularly discharged directly to the facility floor, where it drained to a catch basin prior to conveyance into the overall collection system. Because of the difficulties associated with attempting to monitor the process flow directly, the flow of source water was monitored instead. A transit time ultrasonic flowmeter was attached to the source water feed line to generate volumes used over each 24-hour period. Samples from this process stream were manually composited. To do so, Kennedy/Jenks field staff coordinated with operations personnel to determine when the equipment would be discharging process water. During this time, 500-mL volumes were collected at 5-minute intervals for the entire discharge period. These individual volumes were transferred into a clean 5-gallon pail for compositing. At the end of the discharge period, the contents of the pail were mixed and transferred into the appropriate containers for laboratory analysis. At the additional winery, manual composite samples were collected as well; however, details of the sampling protocol are not available.

A.3.10.2 Stillage Site

Process water from centrifuge/decanter activity was discharged directly to the facility floor, where it drained to a number of trench drains prior to final conveyance into the process water collection system. The number of drainage points prevented a simple method of direct process water flow measurement. Additionally, the source water piping configuration prevented a simple method of direct source water flow measurement. However, two manholes located immediately upstream and downstream of the centrifuge/ decanter equipment were identified in the facility overall process water collection system. Discussions with facility engineering personnel indicated that the process water from the centrifuge/decanter equipment would likely be the sole contributor between these points. Therefore, one area velocity flowmeter was installed at each location, with the difference assumed to be the process water generated from centrifuge/ decanter activity. Composite samples were collected via a 6-inch cleanout line in the primary piping connecting the drainage from the centrifuge/decanter process area to the main process water collection system between the two manholes. A programmable automatic compositing sampler was used. It was configured to take discrete volume samples at 1-hour intervals to generate a 24-hour composite.

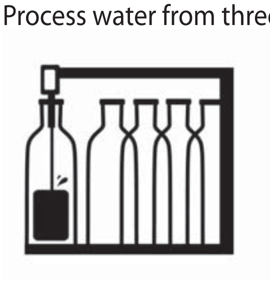
A.3.11 Barrel Washing

Process water was generated from exterior barrel washing and interior barrel cleaning/sanitization. Based on discussions with facility operations staff, the bulk of the process water generation is from latter activities. Therefore, sampling and flow monitoring focused on the process water generated during interior barrel cleaning/sanitization.

Process water from the barrel interior cleaning equipment was discharged through a hose to catch basin prior to conveyance into the process water collection system. Because of the difficulties associated with attempting to monitor the process water flow directly, the flow of source water was monitored instead. A transit time ultrasonic flowmeter was attached to the source water feed lines to generate volumes used over each 24-hour period. Composite samples were collected using a programmable automatic compositing sampler. It was configured to take discrete volume samples from the trench drain at one hour intervals to generate a 24-hour composite. At the additional winery, grab samples were collected from the barrel washing operations.

A.3.12 Bottling

Process water from three sources associated with bottling operations was discharged to three primary receiving points during this study. Process water from the first bottling area was discharged to the facility floor, where it collected in a trench drain prior to conveyance into the overall process water collection system. Process water from the second area was discharged to one of four catch basins that connected to the overall process water collection system. And process water from the third source, a spent cleaning solution from the bottling clean-in-place (CIP) system, was discharged to a separate trench drain.



Flow for the first bottling process area was monitored using an area velocity flowmeter installed directly into the trench drain. Direct flow monitoring of the process water in the second bottling process would be difficult given the configuration of the drainage in that area. Therefore, flow of the source water for this area was monitored instead. Source water flow monitoring was conducted using three transit time ultrasonic flowmeters. Flow monitoring of the spent bottling CIP discharge was done by installing a transit time ultrasonic flowmeter on the CIP system process water drain line. Based on the flows from each of these process locations, a composite process water volume per 24-hour period was generated for overall bottling area.

Table A-3: Summary of Labor and Unit Costs

Item	Value
Labor	~3-hr/sampling event/process stream
Flow Meter Rental:	
Transit Time Ultrasonic	~$400 to $500 per week
Area Velocity	~$500 per week
Offsite Laboratory Analyses	~$400 per full analytical suite per sample

Notes:

Labor – Based on an average for the field effort portion of the study. Includes installation of flow meters and sampling equipment, sample collection, sample preparation for delivery to the offsite laboratory facility, chain of custody paperwork, and disassembly of the field equipment at the conclusion of the study.

Area Velocity Flowmeter Rental – Cost includes the primary hardware for an open-channel installation (mounting plate, flowmeter, data logger, data transfer cable, and software). To program and offload data from the data logger, a separate notebook computer must be supplied. Additional hardware and labor may be required for a manhole installation. For the two manhole installations in this study, a specialist was contracted. The approximate cost for both locations was $3,800, which included flow meter installation, programming, and extraction at the completion of the flow monitoring period.

Offsite Laboratory Analyses – Cost includes the analyses indicated in Table A-2 and courier service for empty container delivery and sample pick-up from both the non-stillage and stillage facilities.

Compositing was also needed for the sampling effort to properly characterize the process stream. One programmable automatic compositing sampler was installed at the trench drain for the first bottling process area and configured to collect discrete samples at one hour intervals for a 24-hour period. An identically configured composite sampler was installed at the catch basin in the second bottling process area identified as the furthest downstream for that area. The 24-hour composite samples collected from the two locations were then further composited in a clean 5-gallon pail in proportion to the process water volume contributions measured for each process area. The final composite sample was transferred to the appropriate bottles for laboratory analysis. CIP samples were not collected at the sample time as the other bottling composite samples due to scheduling issues and were consequently analyzed separately. Grab samples of process water from the CIP system were collected. Grab samples were considered adequate in this case given the amount of agitation within the CIP system to homogenize the process water discharge. At the additional winery, 24-hour composite samples were collected from two different bottling lines.

A.3.13 Summary of Process Water Characterization Costs

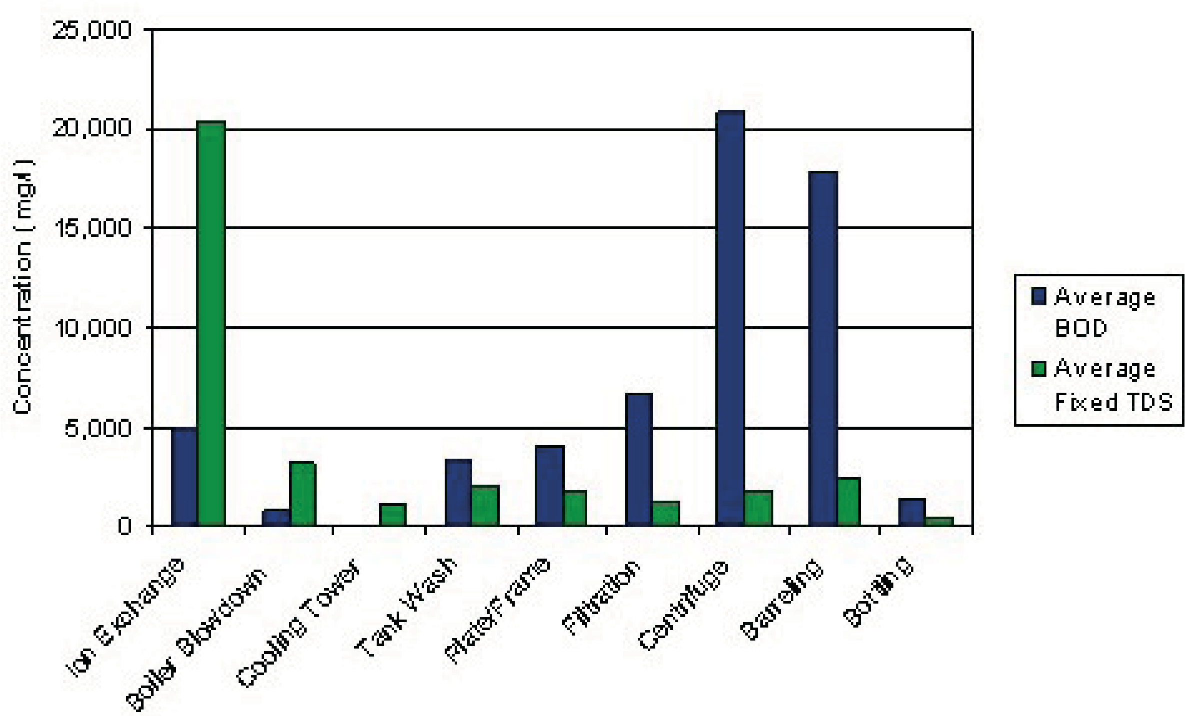
Table A-3 provides a summary of the labor necessary to conduct the field investigation and the equipment rental and analytical costs.

A.4 Evaluation of Findings

A.4.1 Data Validation and Quality Assurance/Quality Control

Data validation was performed primarily through the use of an ion balance for each data set received from the laboratory. Further quality assurance/quality control (QA/QC) was performed by grouping the data by process stream and evaluating the range of results for the analytes. Individual data points that appear

Figure A-1: Average Wastewater Concentrations of BOD and Fixed Dissolved Solids at Several Large Wineries



orders of magnitude too high or too low in each grouping may have suggested a problem with either the sample or an error in the laboratory results. The laboratory was asked to verify these anomalous findings. Findings that could not be resolved by this means were flagged as possible outliers and excluded from further analysis.

A.4.2 Summary of Results by Process Stream

The compiled results of the process water characterization, including minimum, maximum and average flow rates and reported analytical results for each process water stream are presented on Tables A-4 through A-15. Note that the characterization data on the tables is provided for illustration purposes only. Average values for each waste stream constituent were calculated based on a relatively small number of samples, thus cannot be considered representative of conditions at other facilities. The average BOD and FDS concentrations for each stream are summarized on Figure A-1.

Table A-4: Findings for Aggregate Process Water Effluent

Parameter	Unit	Number of Samples	Maximum	Minimum	Median	Average
Flow Rate	gal per 24 hr period	9	861,100	208,100	619,500	527,089
Analytical Results						
General						
pH	pH Units	14	9.3	3.8	5.7	–
Acidity	mg/l	3	180	<10	<10	67
Alkalinity	mg/l	14	710	<10	80	223
BOD	mg/l	14	9,100	190	1,850	2,767
B	mg/l	14	0.40	0.1	0.25	0.25
Cations						
Na	mg/l	14	200	31	108.5	108
K	mg/l	14	369	36	135	144
Ca	mg/l	14	130	13	21	55
Mg	mg/l	14	44	8	11	21
Fe	mg/l	14	1.67	0.50	1.04	1.03
Mn	mg/l	14	0.16	<0.025	0.12	0.10
Cu	mg/l	14	0.62	0.04	0.13	0.16
Zn	mg/l	14	1.20	0.06	0.24	0.30
Anions						
Cl	mg/l	14	180	5	91.5	85
S^{2}-	mg/l	14	7.2	<0.1	<5	3
SO_4	mg/l	14	359	56	130	149
Aggregate Inorganic						
EC	μS/cm	14	2,100	958	1,500	1,428
TDS	mg/l	14	2,270	520	1,295	1,356
Fixed TDS	mg/l	14	1,000	350	875	759
VDS	mg/l	14	1,290	100	495	598
TSS	mg/l	14	2,300	40	235	580
Nitrogen						
NH_3 as N	mg/l	14	360	0.5	4	60
NO_2 as N	mg/l	10	1.6	<0.1	<0.2	0.4
NO_3 as N	mg/l	14	5.7	<0.45	1.0	1.8
Organic N	mg/l	10	70	3	7	17
TKN	mg/l	14	430	<4	9	64
Total N	mg/l	10	430	5	8	78
Organic Acids						
Lactic Acid	mg/l	8	630	41	72.8	227
Malic Acid	mg/l	8	26	<5	<38	30
Citric Acid	mg/l	8	116	13	<50	56
Succinic Acid	mg/l	8	91	13	<45	47
Tartaric Acid	mg/l	8	1060	50	215	337

Notes:

A total of 14 analytical samples were collected (11 from the non-stillage site and 3 from the stillage site). For some samples, the laboratory did not provide analytical results for every requested constituent, thus the number of samples listed may be less than 14. Samples were collected during both crush and non-crush periods of operation.

Maximum values are generally representative of crush operations. The maximum is the highest detected value in the data set unless all data were non-detect; in that case, the highest reporting limit was listed as the maximum. For calculation of median and average values, non-detect values in the data set were counted at the reporting limit. Because pH is measured on a logarithmic scale, an average value was not calculated.

Statistics for each parameter were calculated based on a relatively small number of samples, thus they are not necessarily representative of conditions at other facilities; the table is provided for illustration purposes only. When interpreting data, it is important to consider constituent loadings (constituent concentration times the volume of the discharge), rather than concentration alone.

List of Acronyms for Tables:

gal = gallons
hr = hour
BOD = 5-day biological oxygen demand
B = boron
Na = sodium
K = potassium
Ca = calcium
Mg = magnesium
Fe = iron
Mn = manganese
Cu=copper
Zn=zinc
Cl=chloride
S^{2-} = sulfide
SO_4 = sulfate
EC = electrical conductivity
TDS = total dissolved solids
Fixed TDS = fixed dissolved solids
VDS = volatile dissolved solids
TSS = total suspended solids
NH_3 as N = ammonia as nitrogen
NO_2 as N = nitrite as nitrogen
NO_3 as N = nitrate as nitrogen
Organic N = organic nitrogen
TKN = total kjeldahl nitrogen
Total N = total nitrogen
ND = non detected value
< = analysis was below reported detection limit
Max = maximum value reported
Min = minimum value reported
"–" = no average calculated

Table A-5: Findings for Wine/Juice Ion Exchange Regenerant Process Stream

Parameter	Unit	Number of Samples	Maximum	Minimum	Median	Average
Flow Rate	gal per 24 hr period	3	86,631	69,353	76,161	77,382
Analytical Results						
General						
pH	pH Units	3	1.7	1.5	1.6	–
Acidity	mg/l	3	17,000	11,000	12,000	13,333
Alkalinity	mg/l	3	<20	<20	–	–
BOD	mg/l	3	5,900	4,100	4,900	4,967
B	mg/l	3	<0.5	<0.5	–	–
Cations						
Na	mg/l	3	280	140	160	193
K	mg/l	3	7,400	6,300	6,700	6,800
Ca	mg/l	3	280	220	240	247
Mg	mg/l	3	230	150	160	180
Fe	mg/l	3	19	6.7	18	15
Mn	mg/l	3	2.7	1.8	1.9	2.1
Cu	mg/l	3	0.7	0.2	0.21	0.4
Zn	mg/l	3	240	110	140	163
Anions						
Cl	mg/l	3	<2000	<50	–	–
S^{2-}	mg/l	3	<5	<5	–	–
SO_4	mg/l	3	29,000	25,000	25,000	26,333
Aggregate Inorganic						
EC	µS/cm	3	79,000	51,000	56,000	62,000
TDS	mg/l	3	38,000	32,000	34,000	34,667
Fixed TDS	mg/l	3	21,000	20,000	20,000	20,333
VDS	mg/l	3	18,000	12,000	13,000	14,333
TSS	mg/l	3	31	16	17	21
Nitrogen						
NH_3 as N	mg/l	3	240	110	120	157
NO_2 as N	mg/l	3	<300	<7.6	–	–
NO_3 as N	mg/l	3	<450	<11	–	–
Organic N	mg/l	3	860	560	620	680
TKN	mg/l	3	1,100	670	740	837
Total N	mg/l	3	1,100	670	740	837

Notes:

A total of 3 analytical samples were collected (all from the stillage site). For some samples, the laboratory did not provide analytical results for every requested constituent, thus the number of samples listed may be less than 3. Samples were collected during non-crush periods of operation. The maximum is the highest detected value in the data set unless all data were non-detect; in that case, the highest reporting limit was listed as the maximum. For calculation of median and average values, non-detect values in the data set were counted at the reporting limit. Because pH is measured on a logarithmic scale, an average value was not calculated. Statistics for each parameter were calculated based on a relatively small number of samples, thus they are not necessarily representative of conditions at other facilities; the table is provided for illustration purposes only.

Waste materials with pH $\leq$2 would be designated as characteristically hazardous waste by EPA due to corrosivity. As such, this waste stream may be a candidate for segregation; however, considering the volume of the stream, it will be readily neutralized when it meets the bulk flow. When interpreting data, it is important to consider constituent loadings (constituent concentration times the volume of the discharge), rather than concentration alone. Refer to Table A-4 for key to acronyms.

Table A-6: Findings for Boiler Blowdown Process Stream

Parameter	Unit	Number of Samples	Maximum	Minimum	Median	Average
Flow Rate	gal per 24 hr period	6	2,448	269	1,062	1,231
Analytical Results						
General						
pH	pH Units	6	13.0	12.0	12.0	–
Acidity	mg/l	0	–	–	–	–
Alkalinity	mg/l	6	1,300	830	1,010	1,020
BOD	mg/l	6	2,200	31	721	851
B	mg/l	6	0.36	<0.25	<0.25	0.3
Cations						
Na	mg/l	6	560	46	330	321
K	mg/l	6	2,000	240	640	948
Ca	mg/l	6	100	<2.5	5	20
Mg	mg/l	6	20	1	11	9
Fe	mg/l	6	26	0.6	5	8
Mn	mg/l	6	0.3	0	0.2	0.2
Cu	mg/l	6	9	0.1	0.4	1.8
Zn	mg/l	6	2	0.1	0.5	0.8
Anions						
Cl	mg/l	6	380	15	66	110
S^{2-}	mg/l	6	13	<5	12	9
SO_4	mg/l	6	1,400	290	410	567
Aggregate Inorganic						
EC	µS/cm	6	7,600	4,700	5,900	6,083
TDS	mg/l	6	6,800	2,000	3,950	4,200
Fixed TDS	mg/l	6	5,000	1,800	3,100	3,233
VDS	mg/l	6	1,800	200	900	967
TSS	mg/l	6	24	<4	9	11
Nitrogen						
NH_3 as N	mg/l	6	17	<4	<4	7
NO_2 as N	mg/l	2	3	<0.3	1	1
NO_3 as N	mg/l	6	22.6	<0.5	11.6	11.5
Organic N	mg/l	2	93	<14	54	54
TKN	mg/l	6	110	3	6	23
Total N	mg/l	2	110	9	60	60

Notes:

A total of 6 analytical samples were collected (3 from the non-stillage site and 3 from the stillage site). For some samples, the laboratory did not provide analytical results for every requested constituent, thus the number of samples listed may be less than 6.

Samples were collected during non-crush periods of operation. The maximum is the highest detected value in the data set unless all data were non-detect; in that case, the highest reporting limit was listed as the maximum. For calculation of median and average values, non-detect values in the data set were counted at the reporting limit. Because pH is measured on a logarithmic scale, an average value was not calculated. Statistics for each parameter were calculated based on a relatively small number of samples, thus cannot be considered representative of conditions at other facilities; this table is provided for illustration purposes only.

Waste materials with pH >12.5 would be designated as characteristically hazardous waste by EPA due to corrosivity. As such, this waste stream may be a candidate for segregation; however, considering the small volume, it will be readily neutralized when it meets the bulk flow. When interpreting data, it is important to consider constituent loadings (constituent concentration times the volume of the discharge), rather than concentration alone. Refer to Table A-4 for a key to acronyms.

Table A-7: Findings for Stillage Process Stream

Parameter	Unit	Number of Samples	Maximum	Minimum	Median	Average
Flow Rate	gal per 24 hr period	3	805,183	693,133	802,804	767,040
Analytical Results						
General						
pH	pH Units	3	4.3	3.7	4.2	–
Acidity	mg/l	3	3,900	1,300	2,800	2,667
Alkalinity	mg/l	3	<20	<20	–	–
BOD	mg/l	3	14,000	8,300	8,500	10,267
B	mg/l	3	3.0	2.6	2.9	2.8
Cations						
Na	mg/l	3	69	49	55	58
K	mg/l	3	1,500	930	980	1,137
Ca	mg/l	3	77	56	65	66
Mg	mg/l	3	64	47	47	53
Fe	mg/l	3	13	2	5	7
Mn	mg/l	3	0.9	1	0.6	0.7
Cu	mg/l	3	0.6	0.5	0.5	0.5
Zn	mg/l	3	2	0.5	0.7	1
Anions						
Cl	mg/l	3	79	40	46	55
S^{2-}	mg/l	3	32	6	7	15
SO_4	mg/l	3	1,200	410	1,100	903
Aggregate Inorganic						
EC	µS/cm	3	6,300	3,800	3,900	4,667
TDS	mg/l	3	9,726	6,256	7,146	7,709
Fixed TDS	mg/l	3	5,288	3,558	3,695	4,180
VDS	mg/l	3	4,438	2,698	3,451	3,529
TSS	mg/l	3	850	686	843	793
Nitrogen						
NH_3 as N	mg/l	3	140	10	61	70
NO_2 as N	mg/l	3	8	5	6	6
NO_3 as N	mg/l	3	3	1	3	3
Organic N	mg/l	3	460	170	250	293
TKN	mg/l	3	600	230	260	363
Total N	mg/l	3	610	240	270	373
Organic Acids						
Lactic Acid	mg/l	3	2,059	1,639	1,746	1,815
Malic Acid	mg/l	3	375	328	369	357
Citric Acid	mg/l	3	<50	<50	–	–
Succinic Acid	mg/l	3	1,248	766	853	956
Tartaric Acid	mg/l	3	2,198	330	2,183	1,570

Notes:

A total of 3 analytical samples were collected (all from the stillage site). Samples were collected during crush periods of operation. The maximum is the highest detected value in the data set unless all data were non-detect; in that case, the highest reporting limit was listed as the maximum. For calculation of median and average values, non-detect values in the data set were counted at the reporting limit. Because pH is measured on a logarithmic scale, an average value was not calculated.

Statistics for each parameter were calculated based on a relatively small number of samples, thus cannot be considered representative of conditions at other facilities; this table is provided for illustration purposes only.

When interpreting data, it is important to consider constituent loadings (constituent concentration times the volume of the discharge), rather than concentration alone. Refer to Table A-4 for key to acronyms.

Table A-8: Findings for Cooling Tower Blowdown/Evaporative Condenser Bleed Process Stream

Parameter	Unit	Number of Samples	Maximum	Minimum	Median	Average
Flow Rate	gal per 24 hr period	5	7,656	2,016	2,212	4,312
Analytical Results						
General						
pH	pH Units	7	9.1	8.7	9.1	–
Acidity	mg/l	5	<10	<10	–	–
Alkalinity	mg/l	7	550	390	460	470
BOD	mg/l	7	120	<1	21	31
B	mg/l	7	0.30	<0.05	0.19	0.17
Cations						
Na	mg/l	7	250	140	200	200
K	mg/l	7	64.0	8.4	18	27.9
Ca	mg/l	7	190.0	26.0	67	95.4
Mg	mg/l	7	73.0	15.0	49	46.0
Fe	mg/l	7	0.34	<0.05	<0.10	0.14
Mn	mg/l	7	0.03	<0.01	0.01	0.01
Cu	mg/l	7	0.05	<0.01	<0.01	0.02
Zn	mg/l	7	2.30	0.01	0.04	0.44
Anions						
Cl	mg/l	7	174	44	140	112
S^{2-}	mg/l	6	<5	<0.1	–	–
SO_4	mg/l	7	260	11	114	109
Aggregate Inorganic						
EC	µS/cm	7	2,000	1,100	1,780	1,551
TDS	mg/l	6	1,500	810	1,065	1,120
Fixed TDS	mg/l	7	1,400	680	1,080	1,011
VDS	mg/l	6	280	70	175	173
TSS	mg/l	6	100	6	18	29
Nitrogen						
NH_3 as N	mg/l	7	2.8	<0.2	<1	1.1
NO_2 as N	mg/l	7	4.0	<0.1	<0.3	1.1
NO_3 as N	mg/l	7	20	<2.3	14	13.4
Organic N	mg/l	7	60	7	27	26
TKN	mg/l	7	60	8	27	27
Total N	mg/l	7	80	11	46	41

Notes:

A total of 7 analytical samples were collected (4 from the non-stillage site and 3 from the stillage site). For some samples, the laboratory did not provide analytical results for every requested constituent, thus the number listed may be less than 7.

Samples were collected during both crush and non-crush periods of operation. Maximum values are generally representative of crush operations. The maximum is the highest detected value in the data set unless all data were non-detect; in that case, the highest reporting limit was listed as the maximum. For calculation of median and average values, non-detect values in the data set were counted at the reporting limit. Because pH is measured on a logarithmic scale, an average value was not calculated.

Statistics for each parameter were calculated based on a relatively small number of samples, thus cannot be considered representative of conditions at other facilities; the table is provided for illustration purposes only. When interpreting data, it is important to consider constituent loadings (constituent concentration times the volume of the discharge), rather than concentration alone. Refer to Table A-4 for key to acronyms.

Table A-9: Findings for Tank Washing Process Stream

Parameter	Unit	Number of Samples	Maximum	Minimum	Median	Average
Flow Rate	gal per 24 hr period	6	2,791	1,010	1,418	1,669
Analytical Results						
General						
pH	pH Units	10	13.0	4.0	7.9	–
Acidity	mg/l	1	<10	<10	–	–
Alkalinity	mg/l	10	5,000	<10	265	1,518
BOD	mg/l	10	18,000	140	525	3,303
B	mg/l	10	1.1	<0.1	0.13	0.3
Cations						
Na	mg/l	10	1,600	35	268	475
K	mg/l	10	717	3	29	168
Ca	mg/l	10	120	9	20	35
Mg	mg/l	10	36	5	10	13
Fe	mg/l	10	1.5	0.05	0.15	0.4
Mn	mg/l	10	10	0.005	0.05	1.1
Cu	mg/l	10	0.7	0.01	0.04	0.1
Zn	mg/l	10	17	0.03	0.37	2.5
Anions						
Cl	mg/l	10	126	3	26	41
S^{2-}	mg/l	9	8.4	<0.1	<5.0	3.6
SO_4	mg/l	10	959	4	65	179
Aggregate Inorganic						
EC	µS/cm	10	13,000	330	2,580	3,819
TDS	mg/l	9	7,800	260	2,100	2,580
Fixed TDS	mg/l	9	5,700	180	1,800	1,958
VDS	mg/l	9	2,100	80	280	622
TSS	mg/l	10	3,100	<10	160	489
Nitrogen						
NH_3 as N	mg/l	9	8.1	<0.20	1.5	2.7
NO_2 as N	mg/l	5	<10	<0.1	–	–
NO_3 as N	mg/l	10	13.1	0.7	2.5	4.3
Organic N	mg/l	4	137	0.6	7.5	38
TKN	mg/l	9	140	0.6	15	35
Total N	mg/l	5	141	0.9	1.9	33.4

Notes:

A total of 10 analytical samples were collected (7 from the non-stillage site and 3 from the stillage site). For some samples, the laboratory did not provide analytical results for every requested constituent, thus the number of samples listed may be less than 10. Samples were collected during both crush and non-crush periods of operation. Maximum values are generally representative of crush operations. The maximum is the highest detected value in the data set unless all data were non-detect; in that case, the highest reporting limit is listed as the maximum. For calculation of median and average values, non-detect values in the data set were counted at the reporting limit. Because pH is measured on a logarithmic scale, an average value was not calculated. Statistics for each parameter were calculated based on a relatively small number of samples, thus cannot be considered representative of conditions at other facilities; the table is provided for illustration purposes only.

Waste materials with pH ≥12.5 would be designated as characteristically hazardous waste by EPA due to corrosivity. As such, this waste stream may be a candidate for segregation, based on the maximum detected pH value; however, considering the small volume, it will be readily neutralized when it meets the bulk flow. When interpreting data, it is important to consider constituent loadings (constituent concentration times the volume of the discharge), rather than concentration alone. Refer to Table A-4 for key to acronyms.

Table A-10: Findings for Plate and Frame Filter Cleaning Process Stream

Parameter	Unit	Number of Samples	Maximum	Minimum	Median	Average
Flow Rate	gal per 24 hr period	6	26,501	7,746	7,882	11,147
Analytical Results						
General						
pH	pH Units	7	6.7	3.8	4.3	–
Acidity	mg/l	4	350	<10	350	95
Alkalinity	mg/l	7	310	<20	<20	124
BOD	mg/l	7	8,300	1,200	4,100	4,086
B	mg/l	7	1.1	<0.25	0.3	0.4
Cations						
Na	mg/l	7	120	43	90	82
K	mg/l	7	2,000	78	810	780
Ca	mg/l	7	120	<2.5	53	67
Mg	mg/l	7	38	1	23	23
Fe	mg/l	7	31	0.6	3	10
Mn	mg/l	7	0.5	0.06	0.1	0.2
Cu	mg/l	7	27	0.03	0.2	4
Zn	mg/l	7	3	0.1	0.4	0.9
Anions						
Cl	mg/l	7	55	14	47	38
S^{2-}	mg/l	7	17	4.2	5.1	6.8
SO_4	mg/l	7	1,500	160	630	721
Aggregate Inorganic						
EC	µS/cm	7	3,900	1,100	2,800	2,457
TDS	mg/l	7	6,100	929	4,100	3,252
Fixed TDS	mg/l	7	3,100	643	2,000	1,728
VDS	mg/l	7	3,000	286	2,100	1,524
TSS	mg/l	7	20,961	550	5,100	6,238
Nitrogen						
NH_3 as N	mg/l	7	18	<4	10	9
NO_2 as N	mg/l	6	3	<0.3	<0.3	3
NO_3 as N	mg/l	6	7	1	5	4
Organic N	mg/l	6	210	<14	34	58
TKN	mg/l	7	220	5	50	68
Total N	mg/l	6	220	6	46	66

Notes:

A total of 7 analytical samples were collected (3 from the non-stillage site and 4 from the stillage site). For some samples, the laboratory did not provide analytical results for every requested constituent, thus the number of samples listed may be less than 7.

Samples were collected during both crush and non-crush periods of operation. Maximum values are generally representative of crush operations. The maximum is the highest detected value in the data set unless all data were non-detect; in that case, the highest reporting limit was listed as the maximum. For calculation of median and average values, non-detect values in the data set were counted at the reporting limit. Because pH is measured on a logarithmic scale, an average value was not calculated. Statistics for each parameter were calculated based on a relatively small number of samples, thus cannot be considered representative of conditions at other facilities; the table is provided for illustration purposes only.

When interpreting data, it is important to consider constituent loadings (constituent concentration times the volume of the discharge), rather than concentration alone. Refer to Table A-4 for key to acronyms.

Table A-11: Findings for Filtration Process Stream

Parameter	Unit	Number of Samples	Maximum	Minimum	Median	Average
Flow Rate	gal per 24 hr period	8	13,277	2,776	11,709	10,629
Analytical Results						
General						
pH	pH Units	10	8.4	3.7	4.85	–
Acidity	mg/l	4	120	<10	<10	38
Alkalinity	mg/l	10	430	<10	38	114
BOD	mg/l	10	17,700	1,400	3,500	6,700
B	mg/l	10	2.3	<0.02	0.46	0.7
Cations						
Na	mg/l	10	470	4.2	59	97
K	mg/l	10	630	6.9	175	237
Ca	mg/l	10	120	3.8	51	56
Mg	mg/l	10	45	1.3	21	21
Fe	mg/l	10	10.0	0.02	1.19	3.00
Mn	mg/l	10	0.88	0.01	0.20	0.25
Cu	mg/l	10	5.04	0.002	0.150	0.676
Zn	mg/l	10	1.6	0.005	0.3	0.5
Anions						
Cl	mg/l	10	510	5.3	33.5	88.6
S^{2-}	mg/l	10	41	<0.1	<5	9.5
SO_4	mg/l	10	2,400	97.0	270	474
Aggregate Inorganic						
EC	µS/cm	10	2,900	700	1,400	1,500
TDS	mg/l	10	4,110	1,100	2,250	2,481
Fixed TDS	mg/l	10	2,000	590	990	1,177
VDS	mg/l	10	2,660	320	1,080	1,300
TSS	mg/l	10	27,900	<20	945	4,667
Nitrogen						
NH_3 as N	mg/l	10	15.0	1.7	5.2	6.3
NO_2 as N	mg/l	7	2.1	0.2	<0.3	0.6
NO_3 as N	mg/l	10	9.7	<0.5	3.3	4.2
Organic N	mg/l	7	467	32	50	115
TKN	mg/l	10	470	15	49	93
Total N	mg/l	7	472	377	61	127

Notes:

A total of 10 analytical samples were collected (7 from the non-stillage site and 3 from the stillage site). For some samples, the laboratory did not provide analytical results for every requested constituent, thus the number of samples listed may be less than 10.

Samples were collected during both crush and non-crush periods of operation. Maximum values are generally representative of crush operations. The maximum is the highest detected value in the data set unless all data were non-detect; in that case, the highest reporting limit was listed as the maximum. For calculation of median and average values, non-detect values in the data set were counted at the reporting limit. Because pH is measured on a logarithmic scale, an average value was not calculated. Statistics for each parameter were calculated based on a relatively small number of samples, thus cannot be considered representative of conditions at other facilities; the table is provided for illustration purposes only.

When interpreting data, it is important to consider constituent loadings (constituent concentration times the volume of the discharge), rather than concentration alone. Refer to Table A-4 for key to acronyms.

Table A-12: Findings for Centrifuges/Decanters Process Stream

Parameter	Unit	Number of Samples	Maximum	Minimum	Median	Average
Flow Rate	gal per 24 hr period	7	425,600	3,903	227,200	220,900
Analytical Results						
General						
pH	pH Units	9	13.0	3.7	4.3	–
Acidity	mg/l	7	610	10	320	276
Alkalinity	mg/l	9	5,900	<10	<20	676
BOD	mg/l	9	70,000	970	2,900	20,841
B	mg/l	9	2.9	<0.25	0.5	1.1
Cations						
Na	mg/l	9	84	6	57	51
K	mg/l	9	4,900	36	310	803
Ca	mg/l	9	110	14	25	49
Mg	mg/l	9	66	5	11	25
Fe	mg/l	9	4.7	<0.5	1.6	2.1
Mn	mg/l	9	2.7	<0.03	0.10	0.52
Cu	mg/l	9	3.0	0.03	0.17	0.46
Zn	mg/l	9	3.2	0.06	0.29	0.58
Anions						
Cl	mg/l	9	100	8	13	34
S^{2-}	mg/l	7	<5	<0.1	–	–
SO_4	mg/l	9	1,330	39	414	486
Aggregate Inorganic						
EC	µS/cm	9	18,000	380	1,700	3,274
TDS	mg/l	9	12,000	480	6,000	5,559
Fixed TDS	mg/l	9	5,600	180	1,300	1,823
VDS	mg/l	9	11,000	300	2,100	3,749
TSS	mg/l	9	107,000	170	1,600	13,431
Nitrogen						
NH_3 as N	mg/l	9	17.0	1.4	5.9	8.1
NO_2 as N	mg/l	9	8.4	<0.3	<0.5	1.6
NO_3 as N	mg/l	9	8.1	<0.5	4.2	3.8
Organic N	mg/l	9	150	11	64	73
TKN	mg/l	9	160	12	79	82
Total N	mg/l	9	170	12	86	86

Notes:

A total of 9 analytical samples were collected (4 from the non-stillage site and 5 from the stillage site). For some samples, the laboratory did not provide analytical results for every requested constituent, thus the number of samples listed may be less than 9. Samples were collected during crush periods of operation. The maximum is the highest detected value in the data set unless all data were non-detect; in that case, the highest reporting limit was listed as the maximum. For calculation of median and average values, non-detect values in the data set were counted at the reporting limit. Because pH is measured on a logarithmic scale, an average value was not calculated. Statistics for each parameter were calculated based on a relatively small number of samples, thus cannot be considered representative of conditions at other facilities; the table is provided for illustration purposes only.

Waste materials with pH >12.5 would be designated as characteristically hazardous waste by EPA due to corrosivity. The maximum detected pH value meets this criterion, but the median value is considerably lower. This suggests the high value may be an outlier attributable to sampling or operational error. Due to the small number of samples, however, statistical methods to potentially exclude outliers from the data set could not be applied. If present, the volume of higher pH waste would be limited, and would be readily neutralized when it meets the bulk flow. When interpreting data, it is important to consider constituent loadings (constituent concentration times the volume of the discharge), rather than concentration alone. Refer to Table A-4 for key to acronyms.

Table A-13: Findings for Barrel Washing Process Stream

Parameter	Unit	Number of Samples	Maximum	Minimum	Median	Average
Flow Rate	gal per 24 hr period	3	5,791	5,108	5,284	5,394
Analytical Results						
General						
pH	pH Units	4	3.7	3.6	3.7	–
Acidity	mg/l	0	–	–	–	–
Alkalinity	mg/l	4	<20	<10	–	–
BOD	mg/l	4	27,000	9,600	17,450	17,875
B	mg/l	4	2.4	<1.0	1.5	1.6
Cations						
Na	mg/l	4	28	1	26	20
K	mg/l	4	3,160	1,100	2,100	2,115
Ca	mg/l	4	230	67	83	116
Mg	mg/l	4	18.0	7.4	14	13.4
Fe	mg/l	4	5.0	1.4	1.6	2.4
Mn	mg/l	4	0.42	0.10	0.18	0.22
Cu	mg/l	4	1.60	0.60	1.03	1.06
Zn	mg/l	4	65	0.82	25	29
Anions						
Cl	mg/l	4	16	6	11	11
S^{2-}	mg/l	4	11	<0.1	<5	5
SO_4	mg/l	4	2,400	999	1,500	1,600
Aggregate Inorganic						
EC	µS/cm	4	3,400	2,390	2,850	2,873
TDS	mg/l	4	6,100	5,610	5,900	5,878
Fixed TDS	mg/l	4	2,530	2,400	2,450	2,458
VDS	mg/l	4	3,600	3,080	3,500	3,420
TSS	mg/l	4	29,000	4,300	7,600	12,125
Nitrogen						
NH_3 as N	mg/l	4	120	13	28	47
NO_2 as N	mg/l	1	<0.5	<0.5	–	–
NO_3 as N	mg/l	4	5.4	<0.5	4.4	3.7
Organic N	mg/l	1	207	207	207	207
TKN	mg/l	4	1,100	210	255	455
Total N	mg/l	1	220	220	220	220

Notes:

A total of 4 analytical samples were collected (all from the non-stillage site). For some samples, the laboratory did not provide analytical results for every requested constituent, thus the number of samples listed may be less than 4.

Samples were collected during non-crush periods of operation. The maximum is the highest detected value in the data set unless all data were non-detect; in that case, the highest reporting limit was listed as the maximum. For calculation of median and average values, non-detect values in the data set were counted at the reporting limit. Because pH is measured on a logarithmic scale, an average value was not calculated. Statistics for each parameter were calculated based on a relatively small number of samples, thus cannot be considered representative of conditions at other facilities; the table is provided for illustration purposes only. When interpreting data, it is important to consider constituent loadings (constituent concentration times the volume of the discharge), rather than concentration alone. Refer to Table A-4 for key to acronyms.

Table A-14: Findings for Bottling Process Stream

Parameter	Unit	Number of Samples	Maximum	Minimum	Median	Average
Flow Rate	gal per 24 hr period	4	9,630	1,608	8,703	7,161
Analytical Results						
General						
pH	pH Units	6	9.4	5.4	7.5	–
Acidity	mg/l	1	<10	<10	–	–
Alkalinity	mg/l	6	260	40	127	139
BOD	mg/l	6	3,500	440	770	1,370
B	mg/l	6	0.08	<0.25	0.175	0.17
Cations						
Na	mg/l	6	220	29	77	94
K	mg/l	6	173	37	44	82
Ca	mg/l	6	35	5.7	19	19
Mg	mg/l	6	13	1.9	8.3	8.3
Fe	mg/l	6	1.3	<0.1	<0.5	0.64
Mn	mg/l	6	0.150	0.007	0.069	0.071
Cu	mg/l	6	0.120	0.005	0.058	0.057
Zn	mg/l	6	1.20	0.02	0.27	0.40
Anions						
Cl	mg/l	6	230	14	99	112
S^{2-}	mg/l	6	<5	<0.1	–	–
SO_4	mg/l	6	58	7.2	35	34
Aggregate Inorganic						
EC	µS/cm	6	1,400	280	860	842
TDS	mg/l	6	960	86	735	674
Fixed TDS	mg/l	6	750	22	495	462
VDS	mg/l	6	320	64	215	212
TSS	mg/l	6	570	<10	47	129
Nitrogen						
NH_3 as N	mg/l	6	1.3	<4	2.7	2.5
NO_2 as N	mg/l	3	<0.3	<0.1	–	–
NO_3 as N	mg/l	6	4.1	<0.5	1.6	1.7
Organic N	mg/l	3	18	2.9	12	11
TKN	mg/l	6	19	2.9	9.6	10.2
Total N	mg/l	3	19.5	7.0	14.1	13.5

Notes:

A total of 6 analytical samples were collected (all from the non-stillage site). For some samples, the laboratory did not provide analytical results for every requested constituent, thus the number of samples listed may be less than 6.

Samples were collected during both crush and non-crush periods of operation. Maximum values are generally representative of crush operations. The maximum is the highest detected value in the data set unless all data were non-detect; in that case, the highest reporting limit was listed as the maximum. For calculation of median and average values, non-detect values in the data set were counted at the reporting limit. Because pH is measured on a logarithmic scale, an average value was not calculated. Statistics for each parameter were calculated based on a relatively small number of samples, thus cannot be considered representative of conditions at other facilities; the table is provided for illustration purposes only.

When interpreting data, it is important to consider constituent loadings (constituent concentration times the volume of the discharge), rather than concentration alone. Refer to Table A-4 for key to acronyms.

Table A-15: Estimated Salt Load Discharge from Spent Water Softener Regenerant

Parameter	Unit	Value
Start Date/Time	–	08/18/04 09:30
End Date/Time	–	11/16/04 12:30
Elapsed Time	day	90.1
Average Salt Addition per Bulk Reload	lbs	50,765
Total Water Discharge During Elapsed Time	gal	2,069,119
Total Water Discharged Between Salt Additions	gal	2,340,355
Estimated Salt Usage During Elapsed Time	lbs	44,882
Average Daily Discharge to Process Water System	gal/day	22,958
Average Daily Discharge to Process Water System	lb/day	498
Average TDS in Spent Water Softener Regenerant[1]	mg/L	2,599

Notes:

TDS reflects average for combined backwash, regeneration, and rinse steps in the overall regeneration cycle.

Samples were collected during both crush and non-crush periods of operation. Maximum values are generally representative of crush operations.

This table is provided for illustration purposes only. Refer to Table A-4 for key to acronyms.

Appendix B: Source Water Quality and Treatment

Water supply is an important utility for winery operations. Depending on location and water needs, wineries may operate their own source water systems or purchase water from a local water supplier.

B.1 General Characteristics of Water Supplies

The water quality of winery source water can vary significantly depending on the winery's location and who supplies the water. Groundwater quality will be influenced by local geology and land use practices, while surface water quality is influenced by watershed characteristics, precipitation patterns, and storage facilities (e.g., lakes, ponds) of the source.

B.1.1 Winery-Owned Water Supplies

Wineries operating wells or surface water intakes for their source waters should monitor the water quality of these sources. Groundwater sources should be monitored at least every three years for mineral quality, while surface water supplies should be monitored at least yearly or quarterly if there is significant seasonal variability in water quality. If the winery operates a public water system, then it will be subject to regulation under the Safe Drinking Water Act. These wineries should check with the primacy agency that regulates the drinking water program in its jurisdiction. This is usually the State department of public health, unless the State has not accepted primary from the USEPA. In California, the State Department of Public Health (DPH) has transferred primacy for small systems to some county health departments, so the winery may be regulated by the county rather than the DPH.

B.1.2 Purchased Water Supplies

Some wineries purchase source water from community water systems or irrigation districts. The water provided by the community water supplies will generally be potable water meeting SDWA standards, while water provided by irrigation districts, especially through canals, may not meet those requirements. The winery should get water quality data from the water supplier to evaluate the need for additional treatment for various uses within their wineries.

B.2 Water Quality Requirements in the Winery

Source waters for winery water supply should come from a reliable supply and be of suitable chemical quality and microbiologically safe. Table x provides water quality criteria for various winery uses, including vineyard irrigation, cooling water makeup, boiler feed water, and public drinking water supplies.

Water for certain individual process areas may require additional treatment. In general, potable water quality is adequate for most purposes. Exceptions may include boiler feed water and bottle washing.

B.2.1 General Requirements

Potable water quality is adequate for most winery uses. If the winery provides its own water source (e.g., a well),it may be regulated as a public water supply that may be required to comply with certain drinking water quality requirements. Drinking water requirements vary depending on whether the source is groundwater or surface water and who the primacy agency (state department of public health, county health department or U.S. Environmental Protection Agency (EPA)). Key parameters of concern are usually those with secondary maximum contaminant levels (MCLs) such as iron, manganese, total dissolved solids (TDS), chloride, and sulfate, or other parameters such as hardness and turbidity that may aesthetic quality, although some constituents that have maximum contaminant levels (MCLs) such as arsenic and nitrate may be of concern. For surface water sources, filtration and disinfection may be required.

B.2.2 Boiler Feed Water

Wineries use boilers to heat water for hot water and/or steam needs in the winery processes. Table x provides selected water quality for boiler feed water makeup. The primary concern is hardness (calcium and magnesium), iron, manganese, alkalinity, and silica, which can cause scaling problems and reduce boiler energy efficiency. Water softening is frequently used to remove hardness and iron and manganese. Boiler water chemicals are usually used to control other water quality constituents of concern.

B.2.3 Cooling Water

Wineries use water systems for cooling purposes. The water systems used are primarily either once-through cooling or cooling tower systems. Table X lists water criteria for cooling water quality. Limits on silica, hardness, and alkalinity should be closely examines. The principal water quality concerns in cooling systems are precipitative scaling, corrosion, and microbial growth control. Chemical additions are typically used to control these conditions.

B.2.4 Cleaning

Wineries use water to clean, sanitize and sterilize certain equipment, tanks, and barrels used in winery processing and storage. This water should generally be of potable quality, but sanitizers may be added depending on the cleaning operation. For bottle washing operations, calcium carbonate scaling caused by calcium hardness is the principal concern. As a result, softened water is usually used for this purpose.

B.3 Source Water Treatment Options

The need for treatment will depend on the source water quality, and the water quality criteria for the intended use. Typical treatment options that some wineries may need to consider are discussed in this section. Other water quality issues such as compliance with specific MCLs for inorganic chemicals, organic compounds, or radionuclides are beyond the scope of this document, and wineries facing such challenges should consult with their local primacy agency.

B.3.1 General Requirements

The general concerns for source water are clarity and microbial safety, especially if the water is used as part of the wineries water supply. Surface waters will require filtration, disinfection, and maintenance of a disinfection residual (usually chlorine) in the distribution system to comply with drinking water regulations. Most filtration processes generate a backwash stream that must be recycled or will require disposal. On the other hand, groundwater sources may comply with microbial standards without any treatment or simple disinfection.

B.3.2 Iron and Manganese Removal

Iron and manganese primarily are common groundwater quality concerns, and several treatment options are available for their removal from water supplies. The most common approach involves oxidation of iron and manganese with chlorine (or another oxidant such as potassium permanganate or hydrogen peroxide) followed by filtration on greensand or another appropriate media. The system will require backwashing, and the spent wash water must be recycled or will require disposal. Cation exchange can be used to remove iron and manganese, but is usually not cost effective unless the winery employs this process for hardness removal (see Guideline 3).

B.3.3 Ion Exchange Softening

Cation exchange is the most common process used at wineries to remove hardness from the source water. In this softening process, calcium and magnesium ions in the source water are exchanged for sodium ions on the ion exchange resin. When the resin bed is exhausted, it must be regenerated with a brine solution that requires disposal.

B.3.4 High-Pressure Membrane Separation

Reverse osmosis (RO) or nanofiltration (NF) processes are two-high pressure membrane processes that can be used to remove hardness and/or demineralize the source water. The type of membrane process employed will depend on the source water quality and the treatment goals. NF operates at a lower pressure than RO and primarily separates out the divalent ions such as calcium and magnesium, while RO systems will remove monovalent ions as well. These membrane processes will generate relatively large, brackish reject streams (15 to 50 percent of the feed water) that must be managed.

B.3.5 Disinfection

As previously mentioned, many source waters will require disinfection before being delivered to the winery. When water is purchased from a public water system, it will usually be disinfected and have a chlorine residual that may require dechlorination (e.g., with a reducing agent such as sodium hypochlorite) prior to use in some winery processes. Groundwater sources requiring disinfection may not need to carry a residual after disinfection and other processes besides chlorine may be considered. For example, ultraviolet (UV) light alone can be used to disinfect groundwater. If the winery provides a public water system, the primacy agency must approve the disinfection practice employed and may require an emergency disinfection plan for the source water whether disinfection is employed or not.

B.4 Potential Reuse and Energy Efficiency Opportunities

Wineries can employ water and energy audits to identify opportunities to reuse water and to reduce energy use for the source water.

B.4.1 Water Recycling/Reuse

The winery assessments discussed in other sections of this document can assist the winery in identifying opportunities for recycling/reuse (R/R) of process water streams. In particular, the assessment can identify processes where water quality lower than the source water quality may be acceptable. For example, initial washing of tanks or barrels may not require high quality water. Use of R/R techniques can save energy by eliminating the need to pump some of the source water to the winery.

B.4.2 Energy Efficiency

Pumping source water to the winery is the primary energy use for source water management. In many cases, the motors for the pumps may not be the most efficient available or the pump itself may not be operating at its most efficient condition for the supply system. Many electrical companies have programs for conducting energy audits or provide technical assistance and have educational outreach programs to help industrial users, such as wineries, become more energy efficient. Most of the capital modifications made to become more energy efficient will pay for themselves through lower energy operational costs.

Another opportunity to reduce pumping energy costs is to use less source water through water conservation and reuse. This will be particularly true if the water source is several hundred feet below ground level or the water must be pumped a long distance to the winery.

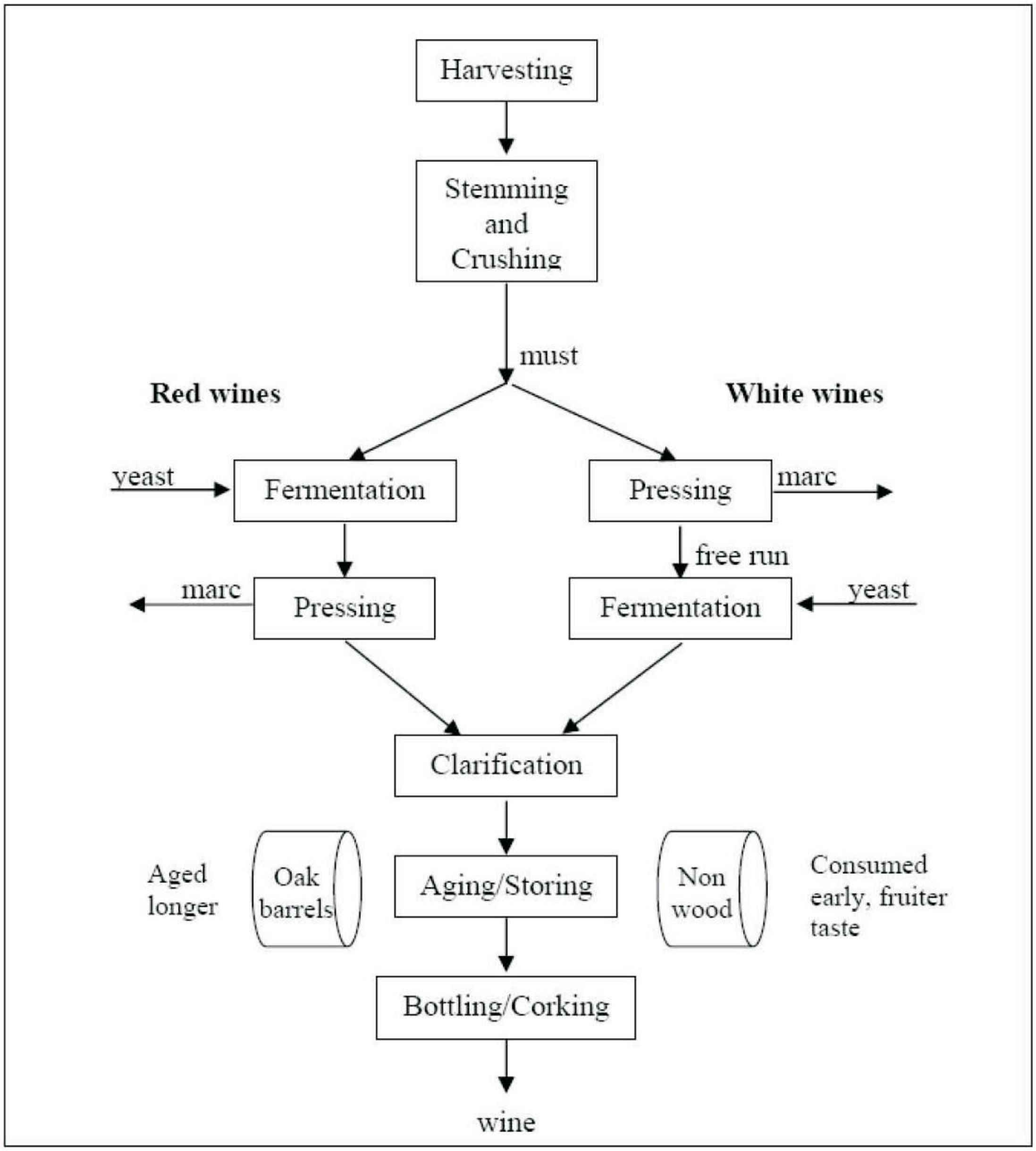
Appendix C: Wastewater Sources and Characteristics

A simplified schematic of the winemaking process for red and white wine is shown on Figure C-1 below. Winemaking and sanitation processes can use large volumes of water, resulting in a number of discrete process water streams. Depending on the size, complexity and even the age of the winery, these streams may include:

- **Wine/Juice Ion Exchange Regenerant –** spent acid or base used to regenerate the wine or juice ion-exchange resin
- **Water Softener Regenerant –** spent concentrated sodium chloride or potassium chloride solution used to regenerate the water softener resin
- **Stillage –** stillage or bottoms product generated from alcohol distillation operations, if present
- **Tank Washing –** spent wash water, cleaning agents, and rinsewater used for cleaning and sanitizing product storage and fermentation tanks
- **Filtration Cleaning –** includes aggregate process water generated from cleaning plate and frame, pressure leaf, filter presses, and other type of filters including Milipore or nanofiltration equipment
- **Centrifuges/Decanters –** includes aggregate process water generated from cleaning and rinsing centrifuges and decanters
- **Barrel Washing –** process water generated during barrel rinsing, cleaning and sanitizing activities
- **Bottling –** process water from cleaning, sanitizing and rinsing bottles and bottling equipment, as well as wash water from cleanup of the bottling operations area
- **General Cleanup –** wash water from cleaning and sanitizing within the facility, as needed
- **Boiler Water Blowdown –** periodic blowdown from boiler operations
- **Cooling Tower Blowdown/Evaporative Condenser Bleed –** includes aggregate blowdown from cooling towers or evaporative condenser bleed streams used for site refrigeration and chilling operations

An example of the relative distribution of cleaning and process wastewater generated by a large winery is shown below. Note that the distribution can be highly variable for different wineries and even at different times within a particular winery.

Figure C-1: Schematic of the Winemaking Process



Adapted from LBNL-PUB 3184: BEST Winery Guidebook: Benchmarking and Energy and Water Savings Tool for the Wine Industry, Lawrence Berkeley National Laboratory, October 2005.

Appendix C: Wastewater Sources and Characteristics

Table C-1: Example of a Winery's Wastewater Distribution

Source/Process	Volume (%)
Rinsewater	43
Caustic washing	33
Earth filtration	15
Cooling Tower	6
Ion exchange	3

Adapted from Chapman et al, 2001

Wastewater generated through these various winery operations typically contains salts, nutrients (nitrogen) and/or organics at concentrations that are often greater than naturally occurring levels in source water and in groundwater underlying wineries and vineyards. These constituents will be considered the focus or Constituents of Interest (COI) for the purpose of wastewater evaluation efforts. Table C-2 provides a list of COI for typical winery process water streams.

Table C-2: Winery Process Wastewater Consituents of Interest

Constituent	Analytical Method	Laboratory Equipment
General Minerals[(a)]	Various[(a)]	
Boron	EPA 200.7	
Nitrate	EPA 300.0	
Ammonia	EPA 350.2	
Total Kjeldahl Nitrogen (TKN)	SM4500	
Total Dissolved Solids (TDS)	SM2540	
Total Suspended Solids (TSS)	EPA 160.1	
Biochemical Oxygen Demand (BOD)	SM5210B	
Volatile Dissolved Solids (VDS)	EPA 160.4	
Sulfide	EPA 376.1	
Organic Acids	Various[(b)]	

(a) General Minerals consist of calcium, magnesium, potassium, sodium, copper, iron, manganese, and zinc by Method 200.7, total alkalinity, carbonate, bicarbonate and hydroxide by Method SM2320B, and sulfate and chloride by Method 300.0, conductance by EPA Method 120.1, and pH by EPA Method 150.1.

(b) Lactic and malic acid can be measured using acid-specific enzymatic test kits and spectrophotometer analysis. Citric, succinic, and tartaric acids can be analyzed using high performance liquid chromotography (HPLC).

Examples of characterization data for a number of water streams at representative wineries are provided in Appendix A, a case study for winery self-evaluation based on research conducted by the Wine Institute / KennedyJenks.

Table C-3: Estimated Volume of Wastewater from Tank Washing

Cleaning Step	Wastewater Volume	
Water Rinse	150 to 200 L	40 to 53 gal
Caustic Soda Washing		
- Thin tartrate deposit:		
3.5 kL (925 gal) tank	100 to 200 L *per 2 to 3 tanks*	26 to 53 gal *per 2 to 3 tanks*
36 kL (9,510 gal) tank	1,000 L *per 2 to 3 tanks*	264 gal *per 2 to 3 tanks*
- Thick tartrate deposit:		
3.5 kL (925 gal) tank	100 to 200 L	26 to 53 gal
36 kL (9,510 gal) tank	2,000 L minimum	528 gal minimum
Citric/Tartaric Acid Rinse:		
3.5 kL (925 gal) tank	100 L	26 gal
36 kL (9,510 gal) tank	1,000 L	264 gal
Tartrate Acid Recovery	100 to 200 L slurry	26 to 52 gal slurry

Adapted from: Chapman, Baker and Wills, 2001

Appendix D: Cleaning and Sanitation

This section provides an overview of typical cleaning and sanitation methods, followed by potential strategies to improve these activities to reduce wastewater generation and strength and associated energy use.

D.1 Cleaning and Sanitation Methods

Winemaking requires meticulous cleaning of winery equipment and adjacent surfaces to prevent contamination. Cleaning and sanitation are defined as follows:

Cleaning – removal of extra or foreign solids or liquids from surfaces.

Sanitation – removal of unwanted matter or microorganisms to prevent potential negative effects on wine quality.

These activities are among the primary uses of water in a winery, accounting for more than two-thirds of all wastewater (Chapman, Baker, Will, 2001). They are also significant contributors to effluent salt concentrations because most cleaning agents contain forms of salt. Methods for cleaning and sanitation vary, but may include heat treatment, chlorine or sulfur dioxide. Cleaning is often a four-step process:

Step 1: Water Rinse. An initial water rinse serves to remove solids that are not strongly adhered to winemaking equipment, reducing the use of caustic in the next step.

Step 2: Caustic Rinse. Caustic agents will dissolve residual solids and precipitates in equipment. Solid deposits may contain pigments, tannins and proteins. The higher the pH of the caustic, the faster the tartrate will be removed; however, tartrate can be effectively removed with lesser pH solutions by allowing longer contact time. Commonly used agents include:

- **Sodium Hydroxide – A 2% solution of sodium hydroxide has a pH of about 13.7.** The solution can be effectively reused until the pH falls to about 10. However, the resulting process water will be highly saline-sodic and alkaline. As a result, use of sodium hydroxide is being phased out at many wineries.

- **Sodium Metasilicate and Soda Ash (Sodium Carbonate) – These chemicals react with water to release hydroxide, but are slightly less alkaline than a 5% sodium hydroxide solution.** Sodium metasilicate in solution has a pH of 10 to12, while sodium carbonate has a pH of 9 to 10.

- **Potassium Hydroxide – Partial or full substitution of potassium hydroxide for sodium hydroxide results in a lower salinity process water.** This is pertinent for process water reuse, particularly via land application, as discussed in Guideline 2.

Step 3: Acid Rinse. After caustic cleaning, some residuals may be left behind. Because high pH is detrimental to wine quality, acidic solutions are routinely used to remove residual caustic from the insides of tanks and other equipment. Dilute solutions of citric or tartaric acid, 2 to 5%, are used for this purpose. Phosphoric acid was often used in the past, but is now avoided due to the environmental impacts associated with phosphorus in wastewater discharges.

Step 4: Final Rinse. Following the acidic rinse (or prior to use of the equipment), a final water rinse is used to remove the any last traces of cleaning products. Some wineries rely on the acid rinse residuals to preserve sanitation until the equipment is needed again, then the final water rinse is run.

D.2 Strategies to Improve Cleaning and Sanitation

Modifications to winery cleaning and sanitation practices can have a significant impact on reducing water use, salt loading, and associated energy use and carbon impacts. To determine best options for improving these practices, it is best to start with a full assessment of the winery, as detailed in Step 2 of the guide. Based on the compiled information on current practices and product uses, a range of options can be considered, as listed below. Refer also to Table D-1 for a summary of preferred cleaning and sanitizing agents.

- Determine whether the amount of chemicals being used for sanitation could be reduced.
- Use foam or gel products for cleaning from the outside whenever possible to minimize chemical use.
- Develop and promote adherence to winery protocols and standard operating procedures (SOPs) for sanitation that guard against excess dosing by defining specific chemical amounts needed. Validate SOPs by testing for excess chemical residuals.
- Replace sodium based cleaners with potassium based cleaners if wastewater is to be land applied. Although converting to a potassium-based cleaner may increase the mass loading of potassium-based salts in process water, potassium salts are more readily taken up by plants and soil microorganisms, therefore pose less risk of migration to groundwater.
- Consider product substitutions summarized in Table D-1. Replace liquid chlorine (sodium hypochlorite) sanitizing solutions with chlorine dioxide (ClO_2), ozone or peracetic acid. A solution of chlorine dioxide is a stronger oxidizer than sodium hypochlorite, so less of the chemical is needed. Ozone oxidizes and disassociates, leaving no salt contribution to the facility's process water. Peracetic acid is an organic acid that is degraded in natural biological processes.
- Evaluate the potential for caustic recycling and reclamation to reduce the overall contribution of caustic to salt loads. Caustic recycling typically entails capturing spent caustic, sometimes filtering, and reusing it for other needs at the facility.
- Assess whether any of the cleaning and sanitation steps can be completed using only hot water, without additives. However, this change should be balanced against the impact of additional water softening that may be needed if hot water use is increased. Safety precautions for hot water must also be considered.
- Evaluate whether ozone could be substituted for the final rinse in cleaning/sanitation activities.
- Evaluate whether the winery could substitute steam cleaning, with adequate safety procedures, for individual sanitation steps or throughout the winery. This could dramatically cut water use. Although running a generator for steam cleaning uses electricity, the duration of use is short enough that those costs may be offset, compared to the electricity required to pump and treat additional process water. Refer to Appendix J for a detailed discussion on use of steam cleaning.
- Assess whether water used for cleaning/sanitation could be further recycled by developing a cascading or tiered reuse system. For example, if the final rinse from one piece of equipment can be captured, it can serve as the initial rinse for the next piece.
- Use high-pressure nozzles with automatic shut-off whenever possible.
- If you have questions about the formulation of a product or possible alternatives, consult your supplier or the manufacturer.

Table D-1: Preferred Cleaning and Sanitizing Agents

Use	Conventional	Alternate	Preferred
Sanitizing	Chlorine compounds		Acid anionic compounds
Sanitizing	Sodium hypochloride		Hydrogen peroxide
Sanitizing			Peroxy-acetic acid
Sanitizing			Iodophores
Sanitizing			Quaternary ammonium compounds
Cleaning		Chlorinated alkaline products	Acid formulated products
Cleaning			Anionic / non-ionic
Cleaning			Ozone
Cleaning	Sodium hydroxide formulated		Calcium hydroxide or Potassium hydroxide

Adapted from Winetech, 2005

D.3 Sprayer Reference Data

A number of different sprayer systems are used by wineries. The following data on Gamajet systems are provided for reference in determining water use.

Gamajet IV Tank Cleaning – for large tanks

Characteristic	Gamajet IV
Height	12.2"
Weight	28 lbs. (dual nozzle)
Metal	Stainless steel or bronze
O-ring Material	Viton (standard), EPDM and Kalrez-like optional
Maximum Practical Cleaning	45' wide and 40' tall tank
Minimum Entrance Size	6.7" (dual nozzle with clutch)
Filtration	1/16" – 20 mesh
Inlet Connection	2" Female NPT and 2 ½" male camlock
Lubrication	Flow thru or food grade oil
Flow Rate	80 – 160 GPM
Pressure	40 – 150 PSI
Full Cycle Time	10 – 25 minutes

Gamajet VIII Tank Cleaning – for a variety of tank sizes

Characteristic	Gamajet VIII
Height	11″
Weight	15 lbs
Metal	Stainless steel
O-ring Material	Viton (standard), EPDM and Kalrez-like optional
Maximum Practical Cleaning	25′ wide and 20′ tall tank
Minimum Entrance Size	4.75″ (dual nozzle with clutch)
Filtration	1/16″ – 20 mesh
Inlet Connection	1-1/2″ Female NPT and 2″ male camlock
Lubrication	Food grade oil
Flow Rate	50 – 120 GPM
Pressure	50 – 300 PSI
Full Cycle Time	8 - 12 minutes

Gamajet IX Tank Cleaning – for small tanks and totes

Characteristic	Gamajet IX
Height	8.75″ tall
Weight	5 lbs
Metal	Stainless steel
O-ring Material	Viton (standard), EPDM and Kalrez-like optional
Maximum Practical Cleaning	8′ wide and 7′ tall tank
Minimum Entrance Size	2.76″ (dual nozzle with clutch)
Filtration	150 micron – 100 mesh
Inlet Connection	3/4″ Female NPT and 1 1/4″ male camlock
Lubrication	Food grade oil
Flow Rate	4 - 30 GPM
Pressure	200 - 500 PSI
Full Cycle Time	4 - 12 minutes

Gamajet Heavy Duty Barrel Blaster (HDBB) – for barrels and drums

Characteristic	Gamajet HDBB
Height	12.8″
Weight	5 lbs
Metal	Stainless steel
O-ring Material	Viton (standard), EPDM and Kalrez-like optional
Maximum Practical Cleaning Tank	Wine barrel and 50 gallon drum
Minimum Entrance Size	2.5″ (dual nozzle with clutch)
Filtration	150 micron – 100 mesh
Inlet Connection	3/8″ Female NPT
Lubrication	Food grade oil
Flow Rate	3 - 6 GPM
Pressure	600 - 800 PSI
Full Cycle Time	2.5 – 3.5 minutes

D.4 Efficient Truck Washing

Truck tank washing is typically conducted on a regular basis for trucks that transport wine or juice. Truck tank washing generally consists of three operations: detartrate, sanitize and rinse. Table D-2 outlines typical sequential steps and duration of each step. Typically no chemicals are used except for the sanitation cycle, which may use a chlorine dioxide solution or other cleaning solution such as Sterox.

When a truck arrives at the truck wash station, the driver typically opens the caps and valves at the bottom of the tanker to let any residual product drain out. The truck driver may also use a small brush to scrub the valves and a hose to possibly wash down the outside of the tanker.

Table D-2: Typical Trunk Tank Washing Cycles

Wash Cycle	Duration (minutes)	Truck Wash Operation		
		Detartrate	Sanitize	Rinse
Hot water rinse	5	X		
1st cold water rinse	5	X	X	
Drain	2	X	X	
Cold water rinse with chlorine dioxide	2	X	X	
Drain	2	X	X	
2nd cold water rinse	3	X	X	X

Truck tank wash commences by lowering one to three "stingers" into the tanker from above. Each stinger is connected to a water hose and equipped with high-pressure cleaning heads that are customized for tanker truck cleaning. The heads have nozzles with holes that let out a sharp jet of water and can pivot to reach all parts of the container. When selecting and ordering high-pressure cleaning heads for tanker truck cleaning, consider the following:

- Size of the truck
- Characteristics of the product that was in the tank to be cleaned
- Pressure washer specifications, including horsepower, gallons per minute (gpm), and pressure in pounds per square inch (psi)
- Size of the access area or duct or opening
- Pressure feeding the washers

A variety of pressure washers are used with different types of tanker truck cleaning solutions. The heads are designed to clean tanker trucks with a container diameter of up to 15 feet. Most of them are made of stainless steel. These materials can be used to convey chemicals without causing corrosion, as well as both hot and cold water. Self-spinning heads can be used for more efficient cleaning, including some that spin 360° in both vertical and horizontal planes. This allows thorough cleaning of tank interiors in a single pass. Heads are available for large, medium and small sized tanker trucks, with open or closed containers. Some can fit through access ports as small as 3 inches.

For larger tanker trucks, there are power washer heads in a variety of sizes with maximum pressures of up to 2900 psi and flow rates varying from 2.1 to 52.8 gpm. The maximum temperature these heads can withstand is 194°F. Outlets from the heads have small nozzles (maximum of four) that allow water to flow under pressure; the smaller the nozzle, the higher the pressure will be. The inlet from the hose is typically either ½- or 1-inch-diameter. Some can be used for both open and closed containers.

It may be possible to reduce wash water generation from truck tank cleaning operations by reducing wash times. However, considering the critical importance of effective cleaning, any modification of standard operating procedures should be carefully evaluated through pilot testing before the change is implemented. Pilot testing, which can be performed by knowledgeable plant staff or a consulting engineer, would consist of washing several tankers with varying regimes and collecting samples throughout the process to determine the minimum effective cycle duration necessary to effectively clean the tanker trucks.

Wash water may be suitable for reuse in certain initial wash operations, and may also meet requirements for other onsite reuses. In some cases, limited treatment such as filtration may facilitate additional reuse.

Appendix E: Odor Control for Ponds

If ponds are not effectively managed, odor control problems may arise. These are usually sulfurous type odors, although at times they may be vinegary or nitrogenous in origin (refer to Tables E-1 and E-2). Odor problems are often coincident with the crush season, when weather tends to be very warm and wineries are producing their peak volumes of process water with highest strength and organic loading. In general, winery wastewaters are moderately acidic, which exacerbates dissociation of hydrogen sulfide (H_2S) and drives emissions from the pond surface.

Typically, when wastewaters are well oxygenated there is almost no sulfide or other nuisance odors. Aerators are discussed in Appendix F. If a nitrate source is present, that will enhance the growth of nitrate-reducing bacteria and suppress sulfate or sulfite reduction and production of sulfides. In addition to dissolved oxygen, other factors such as pH, temperature, turbulence and bacterial disinfectants can influence sulfurous odor emissions.

Wastewater pH is highly critical to controlling hydrogen sulfide emissions. At a pH of 5, over 95% of hydrogen sulfide is molecular or unionized H_2S and emitted as a gas. Typically, wastewater processes are operated near a neutral pH of 7, where half of the hydrogen sulfide is emitted as a gas. However, if the pH is elevated to 8.5, which is still a good condition for aerobic biological treatment, the molecules of H_2S emitted as a gas are less than five percent of the total. Thus, elevating pH quickly with an alkaline chemical is a very good way to suppress odors. Normally pH can be maintained by the bicarbonate buffering of oxidized, carbonaceous wastewater through detention or recirculation. But because unexpected shifts in wastewater pH can occur, it is desirable to maintain an inventory of pH neutralizing chemicals, such as magnesium hydroxide, caustic soda, or lime (calcium hydroxide) that can be used as needed to elevate pH and minimize emissions of H_2S.

A listing of the types of odor control chemicals available in categories of oxidants, neutralizing chemicals and absorbents are shown in Table E-3, along with designation for hazardous and non-hazardous, typical dosages needed for H_2S control, and costs (Ryder 2006). Four principal alkaline chemicals that can be used:

- Calcium hydroxide is the most economical and can be broadcast as a powder to the sumps or treatment ponds or as a 50-percent slurry through a pumped sprayer. However, it is a hazardous chemical with a pH over 12.5, and it can kill beneficial aerobic stabilizing bacteria if over-applied.

- Sodium hydroxide is generally available as a liquid at 50 percent concentration. However, it is an expensive and very hazardous chemical to use. Potassium hydroxide may be used if elevated sodium is a concern, as potassium can be environmentally more acceptable as an agronomic additive on land disposal areas; but potassium hydroxide is more expensive than sodium hydroxide.

- Magnesium hydroxide is probably the best class of an alkaline chemical for this purpose. It is typically delivered in drums or bulk at 60 percent concentration, but can also be used as a dry powder chemical. It has the advantage of being pH self regulating, as an excessive dosage cannot elevate a waste stream pH much above 8.5. It is a non-hazardous chemical, which is an advantage compared with calcium or sodium hydroxide.

Table E-1: Common Types of Odors

Compound Name	Formula	Detection Threshold ppb (v/v)	Recognition Threshold ppb (v/v)	Odor Description
Sulfer Compounds				
Hydrogen Sulfide	H_2S	0.5	5	Rotten egg
Dimethyl Sulfide	$(CH_3)_2S$	1	1	Decayed cabbage
Dipheryl Sulfide	$(C_6H_5)_2S$	0.1	2.1	Unpleasant
Sulfur Dioxide	SO_2	2,700	4,400	Pungent
Ethyl Mercaption	C_2H_5SH	0.3	1	Decayed cabbage
Nitrogen Compounds				
Ammonia	NH_3	17,000	37,000	Pungent
Methyl Ammonia	CH_3NH_2	4,700	-	Putrid
Dimethyl Ammonia		340	-	Putrid
Indole	$C_6H_4(CH)_2NH$	0.1	-	Fecal, Nauseas
Skatole	C_9H_9N	1	50	Fecal, Nauseas
Carbonaceous				
Acetaldehydrate	CH_3CHO	67	210	Pungent, Fecal

Table E-2: Hydrogen Sulfide Gas Indications

Concentration in Air (ppm/v)	Effect
<0.21	Olfactory detection threshold
0.47	Olfactory recognition threshold
0.5 – 30	Strong odor
25 (30 minutes)	OSHA limit to human health
10 – 50	Headache, nausea, eye, nose and throat irritation
50 – 300	Eye and respiratory injury
300 – 500	Life threatening (pulmonary ederma)
>700	Immediate death

Table E-3: Chemicals Used for Sulfide Reduction and Odor Control

Reactant	Kg/Kg of Sulfer[1] Theoretical	Kg/Kg of Sulfer[1] Practical	Relative Cost	Hazard Class	Notes
Oxidants					
Chlorine	8.4:1	12:1	Low	Hazardous	
Hypochlorite	8.4:1	12:1		Hazardous	
Chlorine Dioxide	16:1	20:1	High	Hazardous	
Hydrogen Peroxide	2:1	4:1		Hazardous	Limit to a daily dose to avoid impacts on oxidation activity of aerobic bacteria
Potassium Permanganate				Hazardous	
Liquid Oxygen	1.9:1	5:1	Low	Hazardous	
Ozone	5.75:1	8:1		Hazardous	
Air			Low	Non-hazardous	
Sodium Nitrate	10:1	20:1	Low	Non-hazardous	
Calcium Nitrate				Non-hazardous	
Precipitants					
Ferrous Chloride			Low	Hazardous	
Ferric Chloride	4.3:1	8:1		Hazardous	
Ferric Nitrate				Hazardous	
Ferric Sulfate				Hazardous	
Zinc Chloride				Hazardous	
Neutralizing					
Calcium Hydroxide (lime)			Med	Hazardous	Also used to suppress odors on pomace and lees piles
Magnesium Hydroxide			Low	Non-hazardous	pH self-regulating
Potassium Hydroxide			Med	Hazardous	
Sodium Hydroxide			Med	Hazardous	
Absorbents					
Granular Activated Carbon				Hazardous?	
Caustic/GAC				Hazardous?	
Organic Acids				Hazardous?	
Vegetable Seed Oils				Non-hazardous	
Biological Reactants					
Fixed Film Reactors				Non-hazardous	
Suspended Bed Reactors				Non-hazardous	

1. Actual reduction may be between theoretical and practical values.

Appendix F: Aeration System Design

This appendix provides an overview of aerator types, followed by guidance on determining the optimal configuration, estimating mixing efficiency, selecting the right materials and comparing costs. In addition, the importance of control systems to maximize energy-efficiency is discussed.

F.1 Aerator Types

Many types of aerators are available for treating and mixing winery process wastewater held in ponds, tanks and sumps. Aerators help control objectionable odors and enhance aerobic biological treatment and stabilization of wastewater by introducing large amounts of oxygen that normally would not be transferred by exchange at the water/air surface interface alone.

Criteria that are used to select appropriate aerators for a specific winery application include oxygen transfer efficiency, oxygen dispersion and mixing capability, system flexibility to accommodate variations in loading conditions, mechanical robustness and reliability, corrosion and erosion protection, accessibility for maintenance and portability.

Aerators are typically one of the three basic types:

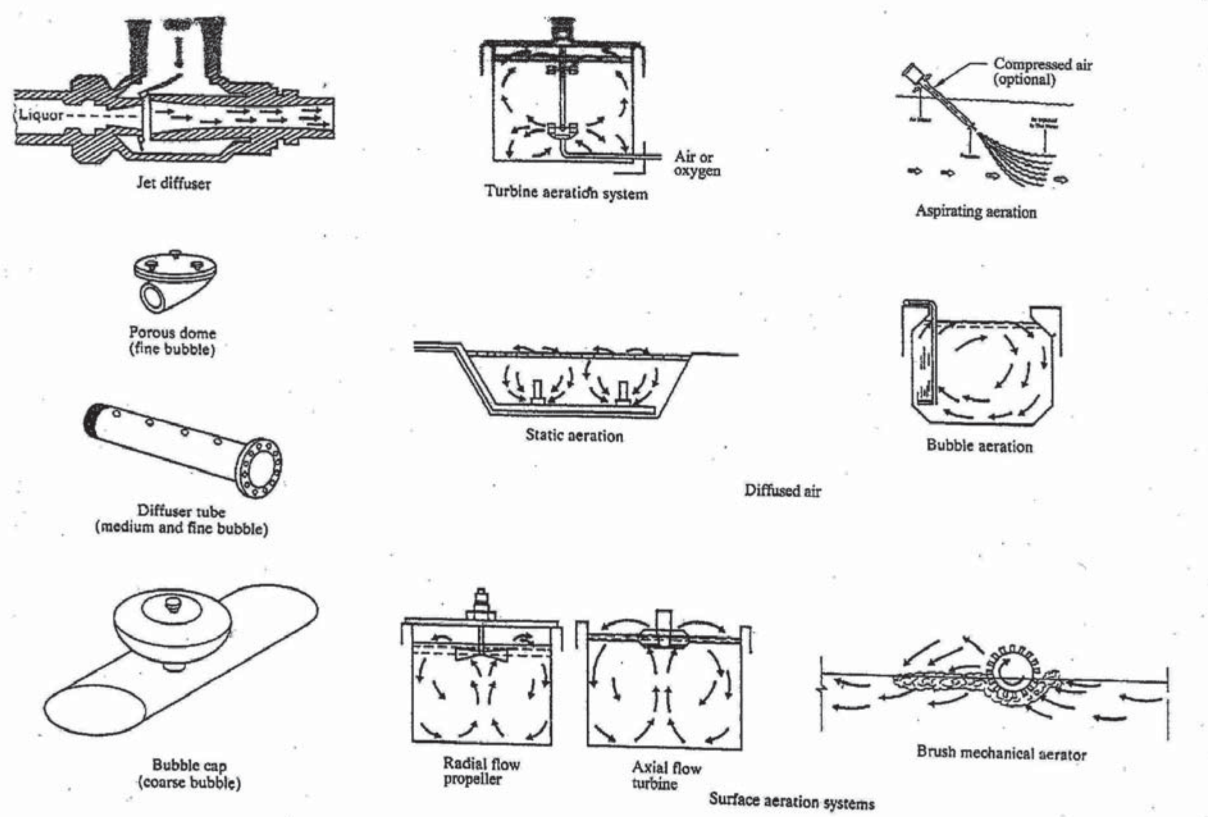
- Floating mechanical aerators
- Submerged jet or venturi aspirating pump aerators
- Submerged plastic disc, ceramic plate or tube compressed air aerators

Combinations of these basic types are also available. Aeration systems usually are designed to transfer air from the atmosphere to the wastewater, but some systems utilize commercial oxygen. Examples of aerators are depicted in Figure F-1. Each type of aerator has different mixing and oxygen dispersing characteristics and associated advantages and disadvantages.

Floating mechanical aerators have oxygen transfer efficiencies and dispersion characteristics that are usually not affected by depth. As a result, these aerators are suitable for use in pond systems that may have varying depths and water levels depending on winery operations. They are easily placed in existing facilities, and can be moved as needed to supplement aeration in other locations or to allow removal of accumulated sludge. Alternatively, submerged diffused air and jet aspirators can have the highest oxygen transfer efficiencies. Their efficiency increases as a function of depth.

Floating mechanical aerators are manufactured in sizes ranging from 0.4 kW to over 80 kW, and can be provided with variable or two-speed motors to expand the range and efficiency of oxygen delivery and pumping dispersion. Mechanical aerators include brush aerators, which typically have the highest efficiency as measured by the standard oxygen transfer rate (SOTR). Other mechanical aerators such as vertical propeller or turbine blade aerators are the next most efficient. Shallow submerged aspirating aerators are the least efficient. However, the oxygen transfer efficiency of the latter can be improved by providing a compressed air source into the aspirating chamber with a small, integral compressor that is mounted on the float of the aspirating aerator. Either brush or shallow aspirating aerators are best used to provide deeper mixing, and are suitable for installation in fully aerobic aeration ponds or tanks.

Figure F-1: Types of Aerators



F.2 Determining Aerator Sizing and Oxygen Requirements

The first step in determining the amount of aeration needed is to calculate the amount of oxygen required to treat wastewater for the particular application. This will be a function of (1) the estimated peak-season wastewater organic load and (2) the expected oxygen transfer rate. General guidelines to calculate winery wastewater organic loads and oxygen transfer rates are provided below.

F.2.1 Calculation of Organic Loads

For purposes of system design, the organic load for winery process wastewater can be calculated as the product of the average crush-season biochemical oxygen demand (BOD) concentration and the peak-day crush season wastewater discharge rate. Organic loads are typically given in pounds of BOD (lbs BOD) over a period.

F.2.1.1 Example Calculation for Organic Loading

A winery has a peak day process wastewater flow of 100,000 gallons per day (gpd) and an average BOD concentration of 5,000 milligrams per liter (mg/l) during the crush season. The estimated design-basis organic load for the winery is:

$$(100{,}000 \text{ gpd}) \; * \; (5{,}000 \text{ mg/l}) \; * \; (8.3453 / 1{,}000{,}000) \; = \; \sim 4{,}200 \text{ lbs BOD/day}$$

It is important to note that the overall organic load to a system may be higher due to a number of factors, including but not limited to solids accumulation at the bottom of a pond or tank, introduction of high strength solids or wastes, and the presence of organic acids, detergents or other constituents in the wastewater stream. If applicable, the design-basis organic load should be adjusted accordingly.

F.2.2 Calculation of Oxygen Demand and Transfer Rates

Determining the oxygen demand and the amount of oxygen that will be transferred to the wastewater can be difficult and time consuming. Oxygen demand and transfer will depend on various factors, including but not limited to wastewater makeup, constituents, salinity, water and air temperature, photosynthesis, rate and intensity of mixing, amount of water in contact with air surface and aeration bubbles, system geometry, wastewater dissolved oxygen concentration, and the respiration and decay rates of the microorganisms found in the wastewater.

A detailed evaluation of oxygen requirements for organic treatment and stabilization can be performed as a system design is refined. A factor of 1.4 can be applied to the calculated organic loading in order to estimate the approximate oxygen demand. For instance, in the example above, an estimated 5,900 pounds of oxygen per day (lbs O_2/day) would need to be delivered using surface aeration in order to aerobically treat an organic load of 4,200 lbs BOD per day.

Manufacturers of aerators typically provide the standard oxygen transfer efficiency (SOTE) for clean water, the standard oxygen transfer rate in pounds of oxygen per hour (SOTR), and the standard aerator efficiency (SAE) in pounds of oxygen per horsepower-hour. The SAE is a measure of the oxygen transfer efficiency for the aerator unit, and is equal to the SOTR divided by the power required. For winery process wastewater design, the SAE for clean water must be adjusted to more accurately predict the rate of oxygen transfer in wastewater. This is accomplished using alpha **(a)** and beta **(B)** factors.

Alpha **(a)** factors are hard to predict but typically range from 0.4 to 0.6 for fine bubble aerators, 0.8 for brush aerators, 0.55 for coarse bubble spargers, 0.6 to 0.95 for submerged static aerators, and 0.6 to 1.2 for floating surface or turbine aerators (Eckenfelder, 1998).

A beta **(B)** factor can be assigned that represents the usual loss of efficiency for aeration of winery wastewater relative to pure water, where winery water has different acidity, surface tension, salts, and aeration solids concentration. Typically, the beta factor used for winery wastewater is in the range of 0.8 to 0.9.

Accounting for the effects of both alpha and beta factors yields an actual oxygen transfer rate (AOTR) that is typically ranges from 60 to 70% of the SAE values for clean water. This uncertainty is one reason to plan for robust aerator capacity.

F.2.2.1 Example Calculation of Brush Rotor Surface Aeration Horsepower

Continuing with the example presented in Section F.1.1.1, where the winery's estimated organic loading was found to be 4,200 lbs of BOD per day during the crush season, the oxygen required to treat the organic loading can be estimated as 1.4 times the BOD loadings, or 5,900 lbs of oxygen per day. Assume that the published SAE value for a brush aerator unit that the winery is considering is 4.0 lbs of oxygen per horsepower-hour in clean water. Using an estimated AOTR that is 60% of the SAE, the estimated AOTR for the brush aerator will be 2.4 lbs of oxygen per horsepower-hour in the winery wastewater. The minimum horsepower needed to supply the required oxygen and treat the organic loading (assuming 24-hour operation of the aerator) is:

$$(5{,}900 \text{ lbs oxygen/day}) \;/\; (2.4 \text{ lbs oxygen/hp-hr}) \;/\; 24 \text{ hours} = \sim 100 \text{ horsepower}$$

If a facultative pond approach is utilized instead of a complete-mix system, the horsepower requirements and energy costs will be somewhat lower. However, if a facultative pond is not properly operated to maintain an aerobic layer above the anaerobic zone, objectionable odors will occur. Some manufacturers are researching and developing aerators that attempt to incorporate the processes of anaerobic treatment, aeration and mixing, and anoxic settling by creating separate compartments for each process. Such approaches may help reduce the amount of power required for treatment; however, further testing is needed.

Table F-1: Aerator Characteristics

Aerator Type	Equipment Characteristics	Processes Where Used	Advantages	Disadvantages	Reported Clean Water Performance[1] SOTE %	SAE kg/kW-hr[2]	SAE (lbs/hp-hr)[2]
Mechanical surface, radial flow, low speed (20-100 r/min)	Low output speed; large diameter turbine; floating, fixed-bridge, or platform mounted; used with gear reducer	Same as for porous diffuser (see below)	Tank design flexibility; high pumping capacity	Moderate cost; aerosols; some icing in cold climates; initial cost higher than axial flow aerators; gear reducer may cause maintenance problems	15 - 20	1.5-2.1	2.5-3.4
Axial flow, high speed (900-1,800 r/min	High output speed; small diameter propeller; direct motor-driven units mounted on floating structure	Aerated lagoons and re-aeration	Low initial cost; may adjust to varying water level; flexible operation	Some icing in cold climates; poor maintenance accessibility; mixing capacity may be inadequate	8 - 12	1.0-1.4	1.6-2.3
Brush rotor	Low output speed; used with gear reducer; steel or plastic bars, plastic discs	Oxidation ditch, applied either as an aerated lagoon or as an activated sludge	High initial cost; good maintenance accessibility	Subject to operational variability, which may affect efficiency; tank geometry is limited	20 - 25	1.5-3.0	2.5-4.9
Submerged turbine	Units contain a low-speed turbine and provide compressed air to diffuser rings, open pipe, or air draft; fixed-bridge application, may employ draft tube	Same as for porous diffusers, oxidation ditches	Good mixing; high capacity input per unit volume; deep tank application; operational flexibility; no icing or splash; can use oxygen for high efficiency	Require both gear reducer and blower; high total power requirements; high cost	15 - 20	1.1-2.1 (typical) 2.0-3.0 (draft tube turbine)	1.8-3.4 (typical) 3.3-4.9 (draft tube turbine)
Submerged aspirating	Same as axial flow; high speed	Aerated lagoons; temporary installations	Low cost; flexible operation	Same as axial flow; high speed	10 - 15	0.5-0.8	0.8-1.3
Pumped Venturi aeration	Pump and venturi aspirating system out of pond or tank	Aerated lagoons and odor control for equalizing tanks	Increased efficiency with supplemental blower air; moderated cost; flexible operation	Some types depth-dependent others with valves back pressure and higher lead pumps not depth-dependent	15 - 20	1.0-1.5 w/supplem. compressed air 0.5-0.8 low pump 3-5 high pressure	1.6-2.5 w/supplem. compressed air 0.8-1.3 low pump 4.9-8.2 high pressure
Other jets	Compressed air and pumped liquid mixed in nozzle and discharged; fine bubble	Same as for porous	Good mixing properties; high SOTE	Limited geometry; closing of nozzles; requires blowers and pumps; primary treatment required; low SAE	15-20	2.2-3.5	3.6-5.7
U-tube	30- to 300-foot shaft; air blown into inlet of down leg	Activated sludge with limited geometry	High efficiency because driving force is increased	Limited geometry; typically effective for strong waste	N/A	N/A	N/A
Nonporous diffusers (coarse bubble)	Fixed orifice, perforated pipe, sparger, slotted tube, valved orifice, static tube; coarse bubble typically single or dual roll, some total floor grids	Same as for porous diffusers	Do not typically clog; easy maintenance; high alpha factor	Low oxygen-transfer efficiency; high initial cost	8 - 12	1.3-1.9	2.1-3.1
Diffused air porous diffusers (fine bubble)	Ceramic, plastic, flexible membranes; dome, disk, panel tube, plate configurations; total floor grids, single or dual roll. fine bubble	High-rate conventional, extended, step, contact stabilization activated-sludge systems	High efficiency; good operational flexibility; turndown approximately 5:1	Potential for air-or water-side clogging; typically require air filtration; high initial cost; low alpha	15 - 20	1.9-6.6	3.1-10.8

Notes:

Source: Tekippe 1998.

1. Manufacturers data in clean water at standard conditions; diffused air units expressed as SOTE and SAE mechanical devices as SAE. Range of values accounts for different equipment, geometry, gas flow, power input, and other factors (SAE wire-to-water).

2. Wire-to-water SAE for diffused air calculated from adiabatic compression relationship where ambient temperature = 20°C, submergence = 4.3 m, barometric pressure = 100 ka (1 atm), and blower/motor efficiency = 70%.

Table F-2: Aerator Mixing Characteristics

Aerator Type	Oxygen Mixing[a] (kw/100m³)	Solids Suspension Mixing (kw/100m³)	Alpha Factor
Brush aerators	0.5 – 1.2	2 – 4	0.8
Floating high speed propeller	3 – 4	10 – 15	0.6-1.2
Submerged low speed turbine	2 – 3	8 – 12	0.6-1.2
Static aerators	0.5 – 1	2 – 4	1.0-1.1
Venturi aerators	0.5 – 1	2 – 4	0.8-1.2
Aspirating aerators	3 – 5	10 – 20	0.8-1.2
Coarse bubble spargers	5 – 10	5 – 10	0.7-0.8
Coarse bubble spargers, broadband	20 - 40	20 – 40	0.55-0.75
Fine bubble diffusers	4 – 8	4 – 8	0.4-0.6

Note:

(a) Source: Eckenfelder 1989

If nitrogen removal is desired, the amount of aeration and/or detention time may need to be increased. But nitrogen removal is usually not desirable for winery applications, particularly where treated water is beneficially reused for vineyard irrigation. Rather, the nitrogen concentration in winery wastewater can offset the fertilizer needs for a vineyard.

F.3 Aerator Distribution and Placement

When designing an aeration system, aerator placement is a critical factor in maximizing oxygen dispersion. By using a number of smaller capacity aerators placed at closer spacing in a pond typically provides better mixing and oxygen dispersion than fewer larger aerators. Smaller aerators also allow more flexibility in turning units on and off to accommodate seasonal and diurnal oxygen demand. In the example above, for instance, four smaller 25-horsepower brush aerator units would be preferable to two 50-horsepower units.

Table F-1 lists the attributes, advantages, and disadvantages comparative performance characteristics of different types of aerators.

F.4 Evaluating Mixing Efficiency

The mixing efficiency of various types of aerators can be evaluated in terms of the dissolved oxygen dispersion in aerated lagoons and biosolids suspension in activated sludge systems. These vary considerably among different types of aerators, but mechanical aeration typically provides much better mixing than diffused aeration due to the pumping and flow dispersion characteristics of mechanical mixing blades. Efficiencies are summarized in Table F-2 below.

F.5 Selection of Aerator Materials and Testing

Winery wastewater is acidic and usually mineralized; as a result, it is very corrosive to carbon steel, aluminum, concrete structures, galvanized steel, copper and copper alloys. Suitable materials include Type 316 stainless steel or high nickel aluminum stainless alloys, and ultraviolet deterioration pigmented epoxy fiberglass. Heavy duty gears for floating aerators, with strong self-lubricating bearings to withstand more action and moisture are required.

It is typically necessary to replace gears and bearings of floating aerators at two- to three-year intervals. As a consequence, mooring arrangements should be designed to allow aerators to be pulled to shore, removed by crane, and maintained as needed. There are considerable maintenance advantages of compressors or pumps used in submerged venturi aerators, as these units are on shore and readily accessible for maintenance.

Each aerator purchased should be supplied with an SOTR test of its size and configuration by ASCE protocol, as well as the approximate AOTR considering alpha, beta, temperature and basin configuration. Then upon installation, the AOTR aeration capacity should be tested by the aerator supplier, who may then have to adjust and/or modify the unit to meet specified expectations and warranties at AOTR, oxygen dispersion and/or biosolids suspension.

F.6 Cost-Effectiveness Comparisons

Examining the capital costs and energy costs for different types of aerators will illustrate the potential overall cost savings that can be achieved with more energy efficient aerators. An example cost evaluation is provided below for the case of 5,286 gal/day (20,000 liter/day) production winery in California. The volume of process wastewater discharged from the winery was 5 liters per liter of wine produced, or 100,000 l/d, and BOD was 5,000 mg/l.

BOD loading per day:

$$100{,}000 \quad \text{X} \quad \frac{5{,}000 \text{ mg/l}}{1{,}000{,}000 \text{ mg/kg}} \quad = \quad 500 \text{ kg/d}$$

Assume oxygen demand is 1.4 kg O2/kg BOD. Therefore, aerators must supply:

O_2 = 500 kg x 1.4 = 700 kg O_2/day

$$700 \text{ kg } O_2\text{/day} \quad \text{X} \quad \frac{1 \text{ day}}{24 \text{ hours}} \quad = \quad 29.2\ O_2\text{/hour}$$

Three types of aerators were considered, as listed with actual oxygen transfer rates and power requirements below:

- Floating High-Speed Propeller Aerator (FPA):

  AOTR = 1.2 SOTR x .8(alpha) x .8(beta) = 0.77 kg/kWh

  kW = 29.2kg/hour / 0.77 kg/kWh = 37.9, say 40 kW

- Floating Aspirating Aerator (FAA):

  AOTR = 0.8 SOTR x 1.0(alpha) x .8(beta) = 0.64 kg/kWh

  kW = 29.2kg/hour / 0.64kg/kWh = 45.6, say 45 kw

- Floating Compressed-Air Assisted Aspirating Aerator (FCAA):

  AOTR = 1.2 SOTR x 1.0(alpha) x .8(beta) = 0.96 kg/kWh

  kW = 29.2kg/hour / 0.96kg/kWh = 30.4, say 30 kW

Costs for these three types of aerators are summarized for comparison in Table F-3 below. Clearly, the savings from a more efficient aerator can be considerable, and it is worthwhile to carefully analyze all factors to obtain the most cost-effective solution.

Table F-3: Comparison of Aerator Costs

Aerator	Capital cost/ pair of aerators	Cost/year over a 20-year life	Energy costs at $0.125 per kw-hr/yr, half-time connection	Total annual cost
Floating High-Speed Propeller	$20,000	$1,000	40kW/2 x 8,760 hr/yr x $0.125/kWh = $21,900/yr	$22,900
Floating Aspirating	$25,000	$1,250	45kW/2 x 8,760 hr/yr x $0.125/kWh = $24,640/yr	$25,890
Floating Compressed-Air Assisted Aspirating	$30,000	$1,500	30kW/2 x 8,760 hr/yr x $0.125/kWh = $16,420/yr	$17,920

Notes:

yr: year; kW: kilowatt; hr: hour

F.7 Control Systems to Improve Energy Efficiency

The energy demand from aerators is often the highest for wastewater treatment and can be one of the largest in a winery. Considering the dramatic variability of aeration needs over the course of a day as well as seasonally, and the fact that there is no benefit from over-aeration (note that the rate of aerobic biological stabilization does not improve above 2 mg/l, and oxygen transfer efficiency is only half as much at 5 mg/l dissolved oxygen as it is at 2 mg/l), real-time dissolved oxygen sensing is an investment that can be readily justified for many wineries. Online monitoring systems often have the capacity to automate activation and inactivation of multiple smaller aerators or variable speed blowers, pumps and turbines. These controls may also facilitate sensor maintenance and real-time aerator calibration and control.

In the past, adjustable timers were set to start and stop aerators based on expected diurnal and seasonal demands. However, the new generation of luminescent dissolved oxygen sensors is relatively economical, very stable, and require much less calibration and maintenance time than before. Linking these sensors with a real-time control system will ensure optimal aerator performance and energy efficiency.

F.8 Other Design Considerations

Other factors that should be considered in designing an efficient and cost effective aeration system include upstream screening to reduce organic loading to the pond; algae control; recycling water to achieve pH control, alkalinity return, and balanced constituent loadings; sludge wasting; and appropriate detention times.

Incorporating an upstream anaerobic process may be beneficial to aerator treatment efficiency if flows are high enough. Anaerobic digestion will reduce the aeration requirements, while providing a potential energy source that can be used to power the aerators or applied to other facility needs. In the case of a facultative pond, anaerobic digestion occurring on the bottom of the pond and can serve to reduce the amount of aeration power required.

Appendix G: Examples of Regulatory Agency Wastewater Discharge Requirements

1. California Regional Water Quality Control Board, North Coast Region: General Waste Discharge Requirements for Discharges of Winery Waste to Land, Order No. R1-2002-0012

2. California Regional Water Quality Control Board, Central Coast Region: General Discharge Requirements Order No. R3-2008-0018 for Discharges of Winery Waste

3. Updated Memorandum of Understanding Regarding Winery Process Waste Treatment and Disposal Between California Regional Water Quality Control Board, San Francisco Bay Region, and County of Napa

4. California Regional Water Quality Control Board, Central Valley Region, Resolution No. R5-2003-0106, Approving a Waiver of Waste Discharge Requirements for Small Food Processors, Including Wineries, Within the Central Valley Region

5. Staff Report, 11 July 2003 Central Valley Regional Water Quality Control Board Meeting, Resolution Considering Approval of a Waiver of Waste Discharge Requirements for Small Food Processors, Including Wineries, Within the Central Valley Region

California Regional Water Quality Control Board
North Coast Region

ORDER NO. R1-2002-0012

GENERAL WASTE DISCHARGE REQUIREMENTS
FOR DISCHARGES OF WINERY WASTE TO LAND

All Counties

The California Regional Water Quality Control Board, North Coast Region (hereinafter Regional Water Board), finds that:

1. Section 13260(a) of the California Water Code (CWC) requires that any person discharging waste or proposing to discharge waste within any region, other than to a community sewer system, that could affect the quality of the waters of the state, file a Report of Waste Discharge (ROWD).

2. Discharges to land from winery waste treatment and disposal systems have certain common characteristics, such as similar constituents, concentrations of constituents, disposal techniques, flow ranges and they require the same or similar treatment standards. These types of discharges are more appropriately regulated under General Waste Discharge Requirements (General WDRs).

3. These General WDRs are intended to regulate discharges of winery waste that may affect waters of the state for which a waiver of WDRs or an individual set of WDRs are not appropriate. Only entities generating winery waste discharges to land (hereinafter discharger) in amounts that may affect waters of the state shall be eligible for coverage under these General WDRs.

4. Winery waste is defined as waste that is a byproduct of operations that produce wine. Winery waste includes: pomace (e.g., grape skins, stems, and seeds), lees, bottle and barrel rinse water, and equipment/floor wash water. Winery waste does not include waste produced by agricultural operations associated with the growing of wine grapes.

5. Whether an individual discharge of winery waste may affect waters of the state and be inappropriate for a waiver of WDRs varies according to factors such as the quality of the waste, soil characteristics, groundwater elevation, and others. Within the North Coast Region there is a wide variability in the volume and quality of winery waste discharges. Small volumes of wastewater discharge generally pose a minimal threat to water quality. Larger volume systems typically require a higher level of oversight, have more complicated treatment and disposal systems and, when problems occur, can directly impact water quality and

beneficial uses. Determinations of whether a winery should be covered by WDRs or is appropriate for a waiver of WDRs will be made on a case-by-case basis. In general, however, the Regional Water Board finds that winery waste discharges may affect waters of the state and are inappropriate for a waiver of WDRs if they are associated with either: (1) commercial operations; or (2) operations producing over 200 gallons of wine per year.

6. An unpermitted discharger of winery waste must submit an application for coverage under the General WDRs within 180 days of the adoption of this Order as explained in **APPLICATION PROCEDURES A.1**.

7. A discharge of winery waste covered by individual WDRs will be considered for coverage under the General WDRs when the individual WDRs come up for review/renewal, which occurs approximately every five years. Regional Water Board staff will notify the discharger of the eligibility for coverage under the General WDRs as explained in **APPLICATION PROCEDURES A.2**.

8. A discharge covered by a waiver of WDRs will be considered for coverage under the General WDRs upon expiration of the waiver. CWC Section 13269 states that all waivers of WDRs for discharges of winery waste will expire on January 1, 2003. When these waivers expire, Regional Water Board staff will notify the addresses of all affected dischargers on file to submit an application for coverage under these General WDRs.

9. The Regional Water Board has considered the range of types of winery discharges and finds that these discharges are either of category 3-C, 3-B, or 2-B as those categories are defined in the Threat to Water Quality and Complexity in the fee schedule listed in Section 2200 of Title 23, California Code of Regulations (CCR).

10. All WDRs in the North Coast Region are required to implement the *Water Quality Control Plan for the North Coast Region* (Basin Plan). Therefore, these General WDRs require dischargers to comply with all applicable Basin Plan provisions, including any prohibitions and water quality objectives, governing the discharge.

11. This Order establishes minimum standards only for discharges of winery waste. The discharger shall comply with any more stringent standards in the Basin Plan. In the event of a conflict between the provisions of this Order and the Basin Plan, the more stringent provision prevails.

12. The beneficial uses of any receiving waters in the North Coast Region may include some or all of the following:

a. municipal and domestic supply	(MUN)
b. agricultural supply	(AGR)
c. industrial service supply	(IND)
d. industrial process	(PROC)

e.	groundwater recharge	(GWR)
f.	freshwater replenishment	(FRSH)
g.	navigation	(NAV)
h.	hydropower generation	(POW)
i.	water contact recreation	(REC1)
j.	noncontact water recreation	(REC2)
k.	commercial and sport fishing	(COMM)
l.	warm freshwater habitat	(WARM)
m.	cold freshwater habitat	(COLD)
n.	preservation of areas of special biological significance	(BIOL)
o.	inland saline water habitat	(SAL)
p.	wildlife habitat	(WILD)
q.	preservation of rare and endangered species	(RARE)
r.	marine habitat	(MAR)
s.	migration of aquatic organisms	(MIGR)
t.	spawning, reproduction, and/or early development	(SPWN)
u.	shellfish harvesting	(SHELL)
v.	estuarine habitat	(EST)
w.	aquacultural	(AQUA)

13. The beneficial uses for areal ground waters include:

    a. domestic water supply
    b. agricultural water supply
    c. industrial service supply
    d. industrial process supply

14. This Order does not preempt or supersede the authority of municipalities, flood control agencies, or other local agencies to prohibit, restrict, or control discharges of waste subject to their jurisdiction.

15. This Order is intended to cover both existing and new discharges of winery waste. The adoption of WDRs for existing discharges of winery waste is exempt from the California Environmental Quality Act (CEQA) under Title 14, California Code of Regulations Section 15261 or Section 15301 as ongoing or existing projects.

16. The Regional Water Board has adopted a Negative Declaration in compliance with CEQA for new discharges of winery waste. New discharges of winery waste in compliance with this Order will not result in a significant impact on the environment.

17. This Order is consistent with the provisions of State Water Resources Control Board (State Water Board) Resolution No. 68-16, "Statement of Policy with Respect to Maintaining High Quality of Waters in California." The Order does not allow degradation of water quality.

18. The Regional Water Board has notified potential dischargers and all other known interested parties of the intent to prescribe WDRs as described in this Order.

19. The Regional Water Board, in a public meeting, heard and considered all comments pertaining to the proposed discharge.

THEREFORE, IT IS HEREBY ORDERED that dischargers of winery waste, in order to meet the provisions contained in Division 7 of the CWC and regulations adopted thereunder, shall comply with the following:

A. APPLICATION PROCEDURES

1. Within 180 days of the adoption of this Order, unpermitted dischargers of winery waste must file an application for coverage under the General WDRs as described below. Unpermitted dischargers include all dischargers of winery waste other than those covered by a waiver of WDRs or individual WDRs. Unpermitted dischargers of winery waste who fail to submit an application before the deadline will be subject to enforcement under CWC Section 13264 and other applicable law.

2. Dischargers shall seek coverage under these General WDRs by filing: (1) an application (either a standard application for WDRs (Report of Waste Discharge), a Form 200, or an equivalent document); and (2) an annual fee.[1] A completed Notice of Intent, designed to include winery wastewater information necessary for determination of applicability, will also serve as an application. Once approved by the Executive Officer, the Notice of Intent form will be attached as Attachment “A”. The Regional Water Board staff will review the application and will make a preliminary determination of whether coverage under these General WDRs, individual WDRs, or a waiver of WDRs is appropriate. Facilities that utilize a wastewater treatment system other than those covered under this Order may not be appropriate for coverage under these General WDRs and may be subject to individual WDRs. Regional Water Board Staff will notify the discharger in writing of its preliminary determination. The preliminary determination will notify the discharger of the type of CEQA compliance required to support a determination that the discharge is covered.

3. If the preliminary determination indicates that coverage under this Order is appropriate, the discharger must: (1) publish a description of the project in a newspaper of general circulation in the area of the proposed discharge and provide proof of such posting, and (2) distribute copies of the notice to nearby residences or businesses and provide proof of such distribution.

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[1] The annual fee for coverage will depend on whether the discharge corresponds to a Threat to Water Quality and Complexity of 3-C, 3-B, or 2-B as defined in the fee schedule listed in 23 CCR 2200. The annual fees for these categories of discharge are currently $200, $400, or $1,200 respectively.

4. Coverage under these Waste Discharge Requirements shall not take effect until: (1) the discharger's application is determined to be complete; (2) at least thirty (30) calendar days have passed since the notices mentioned in the preceding paragraph (Application Procedure A.3.) have been posted and distributed; (3) the Regional Water Board has complied with CEQA; and (4) the discharger has received written notification from the Executive Officer or the Regional Water Board stating that coverage under this order is appropriate. The Executive Officer shall not issue this notification upon finding that coverage of the project in question under this Order has caused or will likely cause significant public controversy. For such controversial projects, the determination of whether coverage under this Order is appropriate will be made by the Regional Water Board at a regularly scheduled board meeting.

5. A determination by the Executive Officer that a specific discharge is appropriately covered under these General WDRs creates no vested right to continued future coverage. The Regional Water Board may decide, based on good cause, to rescind coverage of a specific discharge under these General WDRs. Such a discharge may be eligible for coverage under a waiver of WDRs, another set of General WDRs, individual WDRs, and/or an National Pollutant Discharge Elimination System (NPDES) permit. If the Regional Water Board decides to regulate a discharge covered by these General WDRs a waiver of WDRs, under another set of General WDRs, under individual WDRs and/or an NPDES permit, the applicability of these General WDRs to the discharge is immediately terminated on the date the coverage under the other set of General WDRs takes effect, or on the effective date of the waiver of WDRs, individual WDRs or NPDES permit.

B. DISCHARGE PROHIBITIONS

1. The discharge of any waste not specifically regulated by this Order is prohibited.

2. Creation of a pollution, contamination, or nuisance, as defined by Section 13050 of the CWC, is prohibited.

3. The discharge of waste to land that is not under the control of the discharger is prohibited, except as authorized under Section **E. SOLIDS DISPOSAL**.

4. The discharge of untreated or partially treated winery waste from anywhere within the collection, treatment, or disposal facility is prohibited.

5. Untreated winery process wastewater shall be discharged solely to the wastewater treatment system at all times.

6. The discharge of wastewater, other than winery wastewater, into a winery wastewater surface treatment system is prohibited.

7. The discharge of waste to surface waters is prohibited.

8. The discharge of domestic waste, treated or untreated, to surface waters is prohibited.

9. The use of treated winery process wastewater shall be restricted to designated vineyards, pastures, or landscape irrigation areas under the control of the discharger.

10. Treated winery wastewater shall not be applied to the irrigation areas within two days of a forecasted rain event, during rainfall, 48 hours after a rainfall event or when soils are saturated.

11. Bypass or overflow of treated or untreated winery waste is prohibited and shall be reported to the Regional Water Board as soon as possible.

12. The direct or indirect discharge of any waste to surface waters or surface water drainage courses is prohibited.

13. The discharge of waste that is not authorized by these General WDRs or other Order or waiver by the Regional Water Board is prohibited.

14. The discharge of waste classified as “hazardous,” or “designated,” as defined in CCR, Title 23, Chapter 15, Section 2521(a) and CWC Section 13173, respectively, to any part of the wastewater disposal system is prohibited.

C. EFFLUENT LIMITATIONS

1. The discharge of treated winery process wastewater to land by spray irrigation or frost protection shall not contain constituents in excess of the following limits:

Constituent	Unit	Daily Maximum
BOD (20° C, 5-day)[2]	mg/l	80
Total Suspended Solids	mg/l	80
Settleable Solids	ml/l	1.0

2. The discharge of treated winery process wastewater to land by method of drip irrigation shall not contain constituents in excess of the following limits:

Constituent	Unit	Maximum
BOD (20° C, 5-day)	mg/l	160
Total Suspended Solids	mg/l	80
Settleable Solids	ml/l	1.0

[2] Five-day, 20° Celsius Biochemical Oxygen Demand

3. The mean daily flow of winery wastewater shall not exceed the capacity stated in the application, in gallons per day, averaged over a calendar month except as provided for in C.4.

4. The mean daily winery process wastewater flow shall not exceed the capacity of the treatment facility stated in the application, in gallons per day, as averaged over the crush period.[3]

5. The maximum daily winery process wastewater flow shall not exceed the capacity stated in the application.

6. For aerated or oxidation pond systems receiving treated winery process wastewater, the following additional requirements apply:

   a. The dissolved oxygen concentration in the treatment/holding ponds shall not be less than 1.0 mg/l at any time.

   b. A minimum freeboard, consistent with pond design but not less than two feet, shall be maintained at all times in any pond containing winery wastewater, except with prior authorization by the Regional Water Board Executive Officer.

D. GROUNDWATER LIMITATIONS

1. The storage and disposal of treated winery wastewater shall not cause or contribute to a statistically significant degradation of groundwater quality.

2. The storage and disposal of the treated winery wastewater shall not cause alterations of groundwaters that result in taste or odor-producing substances in concentrations that cause nuisance or adversely affect beneficial uses.

E. SOLIDS DISPOSAL

1. Collected screenings, sludges, and other solids removed from liquid wastes that will not and/or cannot be used agronomically shall be disposed of at a legal point of disposal, and in accordance with the State Water Board promulgated provisions of Title 27, Division 2 of the California Code of Regulations or as waived pursuant to Section 13269 of the CWC.

2. Cultivated lands that receive solid wastes from the wine making process shall be managed to prevent ponding, runoff and erosion.

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[3] The crush period is defined as the time of year during which the winery is processing the seasonal grape harvest. A typical crush period is 60 days in length and may occur from August through November.

3. During wet weather conditions when solid wastes from the wine making process cannot be incorporated into the soil or hauled off-site for disposal, the solid wastes may be temporarily stored in a designated solids storage area out of the flood plain.

4. The discharge of leachate, from wine making process solids storage areas or rainfall runoff, which has come into contact with the solids being stored, to surface water is prohibited.

5. If accumulated sludge from a wastewater pond will be used as an agronomic addition to fields, a proposal containing, at a minimum, the following information will be submitted to the Regional Water Board before commencement of the project:

   a. The physical properties of the sludge to be removed from the pond, including the volume and percent solids of the sludge.

   b. A summary of laboratory results on an analysis of a composite sample of the stockpiled sludge. The constituents of concern are: cadmium, copper, lead, nickel, zinc and total nitrogen.

   c. A statement verifying that neither hazardous waste nor domestic waste has been discharged to the ponds.

   d. A description of the proposed land application areas, including a map, acreage and the crops to be grown thereupon. Calculations showing that the sludge will be applied at agronomic rates (based on nutrient uptake of the crop).

   e. A project schedule. Projects should be winterized by October 15th, and completed by October 31st. Sludge shall be spread and incorporated into the soil in a manner to avoid erosion, runoff or any nuisances.

F. WATER RECLAMATION REQUIREMENTS

1. Reclaimed winery process waste water shall be managed in conformance with Title 22, Division 4, Chapter 3 of the California Code of Regulations.

2. The use of treated winery process wastewater that results in unreasonable use or waste of the treated wastewater is prohibited.

3. The use of treated winery process wastewater that creates a condition of pollution or nuisance is prohibited.

4. The discharger shall be responsible to ensure that all users of treated winery process wastewater comply with the terms and conditions of this Order.

5. Treated winery process wastewater shall be applied in such a manner so as not to exceed vegetative demand or field capacity.

6. The application of treated winery process waste water shall be managed to prevent ponding, runoff, and erosion.

7. All piping, valves, and outlets shall be marked to differentiate treated winery process wastewater from other sources of water.

8. There shall be no connection between a potable water supply and a treated winery process wastewater distribution system.

9. There shall be no irrigation or impoundment of winery wastewater within 100 feet of any water well.

10. Adequate measures shall be taken to prevent the breeding of insects and other vectors of health significance.

11. Warning signs shall be posted on the perimeter of every area in which winery wastewater is applied. The signs shall indicate use of non-potable water and shall be posted at least every 500 feet along the perimeter with a minimum of a sign at each corner and access road.

G. REQUIREMENTS

1. For Aerated or Oxidation Pond Systems, the following additional requirements apply:

    a. If collected screenings, sludges, and other solids removed from liquid wastes are disposed of at a landfill, such disposal shall comply with CCR, Title 23, Section 2510, et seq. (Chapter 15).

    b. The pond shall be operated and maintained to prevent inundation or washout due to floods with a 100-year return frequency.

    c. The pond shall have sufficient capacity to accommodate wastewater flow, groundwater infiltration and inflow in the collection system, and seasonal precipitation during the rainy season.

    d. All new ponds shall be sited, designed, constructed, and operated to ensure that wastes will be a minimum of five feet (5 ft.) above the highest anticipated elevation of underlying ground water.

e. All ponds shall have a foundation or base capable of providing support for the structures, and capable of withstanding hydraulic pressure gradients to prevent failure due to settlement, compression, or uplift and all effects of ground motions resulting from at least the maximum probable earthquake, as certified by a registered civil engineer or certified engineering geologist.

2. For Constructed Wetland (CW) Systems, the Following Additional Requirements Apply:

   a. Wastewater flow in the CW shall be completely subsurface.

   b. A post-system final treatment pond shall be used before irrigation.

3. For Subsurface Disposal Systems, the following additional requirements apply:

   a. The subsurface wastewater disposal system(s) shall be maintained so that at no time will wastewater surface at any location.

   b. No part of the disposal system(s) shall extend to a depth where waste may pollute groundwater.

   c. New winery wastewater systems shall reserve sufficient land area for possible future 100 percent replacement of the subsurface disposal area until such time as the discharger's facility is connected to a municipal sewerage system.

   d. The system will comply with the "Policy on the Control of Water Quality with Respect to On-Site Waste Treatment and Disposal Practices" contained in the "Water Quality Control Plan, North Coast Region".

H. GENERAL PROVISIONS

1. Adequate measures shall be taken to assure that flood or surface drainage waters do not erode or otherwise damage the discharge facilities.

2. The wastewater system shall be located where it will not substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, or substantially increase the rate or amount of surface runoff in a manner which would result in flooding or substantial erosion or siltation on- or off-site.

3. The discharger shall ensure that all site-operating personnel are familiar with the contents of this Order and shall maintain a copy of this Order at the site.

4. Prior to any modifications in the discharger's facility which would result in a material change in the quality or quantity of wastewater treated or discharged, or any material change in the location of discharge, the discharger shall report all

pertinent information in writing to the Regional Water Board and obtain confirmation from the Regional Water Board that such modifications do not disqualify the discharger from coverage under these General WDRs. Either confirmation or new WDRs shall be obtained before any modifications are implemented.

5. The discharger shall comply with General Monitoring and Reporting Program No. R1-2002-0012, and any future revisions, as specified by the Regional Water Board's Executive Officer.

6. The Regional Water Board's Executive Officer and the Director of the County Environmental Health Department or equivalent agency shall be notified immediately of any failure of the wastewater containment facilities. Such failure shall be promptly corrected in accordance with the requirements of this Order.

7. A copy of this Order shall be maintained at the discharge facility and be available at all times to operating personnel.

8. The discharger at all times shall properly operate and maintain all facilities and systems of treatment and control (and related appurtenances) which are installed or used by the discharger to achieve compliance with conditions of this Order. The discharger shall keep in a state of readiness all systems necessary to achieve compliance with the conditions of this Order. All systems, both those in service and reserve, shall be inspected and maintained on a regular basis. Records shall be kept of the tests and made available to the Regional Water Board.

9. This Order does not convey any property rights or exclusive privileges. The requirements prescribed herein do not authorize the commission of any act causing injury to persons or property, do not protect the discharger from liability under federal, state, or local laws, and do not create a vested right to continue to discharge wastewater.

10. This Order does not relieve the discharger from responsibility to obtain other necessary local, state, and federal permits to construct facilities necessary for compliance with this Order, nor does this Order prevent imposition of additional standards, requirements, or conditions by any other regulatory agency.

11. If land disturbance (excluding agricultural activity) is five (5) acres or more, the applicant will need to apply for a Construction Activities Storm Water Permit prior to commencement of construction. At such time that acreage limits are reduced under Phase II of the NPDES Storm Water Program, land disturbance of 1 acre or more will be subject to the Storm Water Permit. If storm water runoff from any industrial processing area is to be discharged to any surface water, coverage under the National Pollution Discharge Elimination System (NPDES) General Permit No. CSA000001-Discharges Of Storm Water Associated With Industrial Activities Excluding Construction Activities Permit will be required.

12. The discharger shall allow the Regional Water Board or an authorized representative, upon presentation of credentials and other documents as may be required by law, to:

    a. Enter upon the premises where a regulated facility or activity is located or conducted or where records are required to be kept under the conditions of this Order;

    b. Have access to and copy at reasonable times any records required to be kept under the conditions of this Order;

    c. Inspect, at reasonable times, any facilities, equipment, practices, or operations regulated or required under this Order; and

    d. Sample, photograph, video record, and/or monitor at reasonable times, for the purposes of assuring compliance with this Order or as otherwise authorized by the CWC, any substances or parameters at this location.

13. All regulated disposal systems shall be readily accessible for sampling and inspection.

14. The Regional Water Board will review this Order periodically and will revise requirements when necessary.

15. Severability

    Provisions of these waste discharge requirements are severable. If any provision of these requirements is found invalid, the remainder of these requirements shall not be affected.

16. Change in Discharge

    The discharger shall promptly report to the Regional Water Board any material change in the character, location, or volume of the discharge.

17. Change in Ownership

    In the event of any change in control or ownership of land or waste discharge facilities presently owned or controlled by the discharger, the discharger shall notify the succeeding owner or operator of the following items by letter, a copy of which shall be forwarded to the Regional Water Board:

    a. existence of this Order, and
    b. the status of the dischargers' annual fee account

18. Vested Rights

This Order does not convey any property rights of any sort or any exclusive privileges. The requirements prescribed herein do not authorize the commission of any act causing injury to persons or property, nor protect the discharger from his liability under federal, state, or local laws, nor create a vested right for the discharger to continue the waste discharge.

19. After notice and opportunity for a hearing, coverage of an individual discharge under this Order may be terminated or modified for cause, including but not limited to the following:

a. Violation of any term or condition contained in this Order;

b. Obtaining this Order by misrepresentation or failure to disclose all relevant facts;

c. A change in any condition that requires either a temporary or permanent reduction or elimination of the authorized discharge;

d. A change in a wastewater treatment system to a configuration that is not eligible for coverage under this Order;

e. Violation of any term or condition contained in this Order;

f. Obtaining this Order by misrepresentation or failure to disclose all relevant facts;

g. A change in any condition that requires either a temporary or permanent reduction or elimination of the authorized discharge.

h. A change in a wastewater treatment system to a configuration that is not eligible for coverage under this Order.

20. The discharger shall furnish, within a reasonable time, any information the Regional Water Board may request to determine whether cause exists for modifying, revoking and reissuing, or terminating the discharger's coverage under this Order. The Discharger shall also furnish to the Regional Water Board, upon request, copies of all records required to be kept by this Order.

21. Unless otherwise approved by the Regional Water Board's Executive Officer, all analyses shall be conducted at a laboratory certified for such analyses by the State Department of Health Services. All analyses shall be conducted in accordance with the latest edition of "Guidelines Establishing Test Procedures for Analysis of Pollutants," promulgated by the U.S. Environmental Protection Agency (U.S. EPA.

22. The discharger shall retain records of all monitoring information including all calibration and maintenance records, copies of all reports required by this Order, and records of all data used to complete the application for this Order. Records shall be maintained for a minimum of three years from the date of the sample, measurement, or report. This period may be extended during the course of any unresolved litigation regarding this discharge or when requested by the Regional Water Board's Executive Officer.

23. The discharger shall immediately remove any wastes that are discharged at the site regulated by this Order in violation of these requirements.

24. All performed maintenance and noncompliance issues shall be reported with the monitoring reports as required.

25. Adequate measures shall be taken to assure that unauthorized persons are effectively excluded from contact with the wastewater disposal facility(s).

26. The discharger shall comply with all of the conditions of this Order. Any noncompliance with this Order constitutes a violation of the Porter-Cologne Water Quality Control Act and/or Basin Plan and is grounds for an enforcement action.

27. The Regional Water Board may impose administrative civil liability, may refer a discharger to the State Attorney General to seek civil monetary penalties, may seek injunctive relief, or take other appropriate enforcement action as provided in the California Water Code or federal law for violation of State Water Board or Regional Water Board orders.

28. The discharger shall comply with all of the conditions contained in the Standard Provisions included with this Order.

29. Monitoring

    The discharger shall comply with the Contingency Planning and Notification Requirements Order No. 74-151 and the Monitoring and Reporting Program No. R1-2002-0012 and any modifications to these documents as specified by the Regional Water Board Executive Officer. Such documents are attached to this Order and incorporated herein. Chemical, bacteriological, and bioassay analyses shall be conducted at a laboratory certified for such analyses by the State Department of Health Services.

30. Inspections

The discharger shall permit authorized staff of the Regional Water Board:

a. entry upon premises in which an effluent source is located or in which any required records are kept;
b. access to copy any records required to be kept under terms and conditions of this Order;
c. inspection of monitoring equipment or records; and
d. sampling of any discharge.

31. Noncompliance

In the event the discharger is unable to comply with any of the conditions of this Order due to:

a. breakdown of waste treatment equipment;
b. accidents caused by human error or negligence; or
c. other causes such as acts of nature;

the discharger shall notify the Regional Water Board Executive Officer by telephone as soon as he or his agents have knowledge of the incident and confirm this notification in writing within two weeks of the telephone notification. The written notification shall include pertinent information explaining reasons for the noncompliance and shall indicate the steps taken to correct the problem and the dates thereof, and the steps being taken to prevent the problem from recurring.

32. Planned Changes

The discharger shall file with the Regional Water Board an application at least 120 days before making any material change or proposed change in the character, location or volume of the discharge.

33. Compliance Schedules

Reports of compliance or noncompliance with interim and final requirements contained in any compliance schedule of this order shall be submitted no later than 14 days following each schedule date. If reporting noncompliance, the report shall include a description of the reason for failure to comply, a description and schedule of tasks necessary to achieve compliance and an estimated date for achieving full compliance. A final report shall be submitted within ten working days of achieving full compliance, documenting full compliance.

34. Other Noncompliance

The discharger shall report all instances of noncompliance not reported under WATER RECLAMATION REQUIREMENTS F.31, F.32, and F.33 at the time monitoring reports are submitted. The reports shall contain the information listed in WATER RECLAMATION REQUIREMENT F.33.

35. Other Information

When the discharger becomes aware that it failed to submit any relevant facts in a permit application or submitted incorrect information in a permit application, or in any report to the Regional Water Board, the discharger shall promptly submit such facts or information.

36. False Reporting

Any person who knowingly makes any false statement, representation, or certification in any record or other document submitted or required to be maintained under this Order, including monitoring reports or reports of compliance or noncompliance shall be subject to enforcement procedures as identified in the Order and/or in these Standard Provisions.

37. Anticipated Noncompliance

The discharger shall give advance notice to the Regional Water Board of any planned changes in the permitted facility or activity that may result in noncompliance with waste discharge requirements.

I. ENFORCEMENT PROVISIONS

1. The provisions in this enforcement section shall not act as a limitation on the statutory or regulatory authority of the Regional Water Board.

2. Any violation of this Order constitutes violation of the California Water Code and regulations adopted thereunder and is basis for enforcement action, termination of the Order, revocation and reissuance of the Order, denial of an application for reissuance of the Order or a combination thereof.

3. It shall not be a defense for a discharger in an enforcement action that it would have been necessary to halt or reduce the permitted activity in order to maintain compliance with the conditions of this Order.

Certification

I, Susan Warner, Executive Officer, do hereby certify that the foregoing is a full, true, and correct copy of an Order adopted by the California Regional Water Quality Control Board, North Coast Region, on March 28, 2002.

____

Susan A. Warner
Executive Officer

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
CENTRAL COAST REGION
895 Aerovista Place, Suite 101
San Luis Obispo, California 93401

GENERAL WASTE DISCHARGE REQUIREMENTS ORDER NO. R3-2008-0018 for DISCHARGES OF WINERY WASTE

and

CATEGORICAL WAIVER OF WASTE DISCHARGE REQUIREMENTS AND WAIVER OF REQUIREMENT TO SUBMIT REPORT OF WASTE DICHARGE for CERTAIN SMALL WINERIES

The California Regional Water Quality Control Board, Central Coast Region (hereafter "Central Coast Water Board") finds:

What is Winery Waste?

1. Winery waste is defined as any byproduct of winemaking operations. Winery waste includes, but is not limited to: pomace (e.g., grape skins, stems, and seeds), lees (wine sediment), tank/barrel/bottle/floor/crush pad wash water (which may contain sterilization and/or preservation chemicals), and water softener waste brine. Typical raw winery wastewater has the following characteristics:

Parameter	Units	Crush Season Range	Non-Crush Season Range
pH	--	2.5 - 9.5	3.5 - 11
BOD_5	mg/L	500 - 12000	300 - 3500
Dissolved Oxygen	mg/L	0.5 - 8.5	1.0 - 10
Settleable Solids	mg/L	25 - 100	2 - 100
Total Suspended Solids	mg/L	40 - 800	10 - 400
Total Nitrogen	mg/L as N	1- 40	1 - 40
Nitrate	mg/L as N	0.5 - 5	--
Phosphorus	mg/L	1 - 10	1 - 40
Sulfate	mg/L	10 - 75	20 - 75
Total Dissolved Solids	mg/L	80 - 2900	80 - 2900
Sodium	mg/L	35 - 200	35 - 200
Chloride	mg/L	3 - 250	3 - 250

Basis for General Waste Discharge Requirements

2. California Water Code Section 13260 requires any entity discharging waste or proposing to discharge waste, other than to a community sewer system, which could affect the quality of the waters of the State, to file a Report of Waste Discharge with the Regional Board.

3. Whether an individual discharge of winery waste may affect the quality of waters of the State depends on the quantity of waste, the quality of waste, extent of treatment, soil characteristics, distance to surface water, depth to groundwater, and other factors. Wineries range in size from small, family-run wineries to very large, commercial winemaking operations producing several million gallons of wine per year.

4. In general, waste discharges from commercial winemaking operations that discharge to other than a community sewer system (hereafter "discharger" or "winery") may affect waters of the State and are required to submit a Report of Waste Discharge to the Regional Board.

5. A completed *Notice of Intent* (NOI) *to Comply with the Terms of the General Waste Discharge Requirements for Discharges of Winery Waste* (Attachment B) is equivalent to a Report of Waste Discharge.

6. In accordance with California Water Code Section 13263(i), wineries covered under these *General Waste Discharge Requirements for Discharges of Winery Waste* (hereafter "General WDRs"); (1) produce waste by similar operations, (2) involve similar types of waste, (3) require similar treatment standards, and (4) are more appropriately regulated under General WDRs.

General Waiver of Waste Discharge Requirements

7. California Water Code Section 13269 authorizes the Water Board to waive reports of waste discharge and waste discharge requirements [Sections 13260(a) and (b), 13263(a), and 13264(a), summarized below] for a specific discharge or specific types of discharges if the Water Board determines that the waiver is consistent with the Basin Plan and other applicable water quality control plans and is in the public interest. A waiver may not exceed five years in duration, but may be renewed by the Water Board. A waiver must be conditional and may be terminated at any time.

    a. California Water Code Sections 13260(a) and (b) require a report of waste discharge from any person or agency proposing to discharge waste or construct an injection well.

    b. California Water Code Section 13263(a) provides Regional Boards with authority to issue waste discharge requirements for any proposed or existing discharge that could affect water quality.

    c. California Water Code Section 13264(a) prohibits waste discharge without discharger submittal of a report of waste discharge and Regional Board adoption of waste discharge requirements or Regional Board issuance of a waiver.

8. Waivers may be granted for discharges to land and may not be granted for discharges to surface waters or conveyances thereto.

9. Waivers granted for discharges that do not pose a significant threat to water quality, where such waivers are not against the public interest, enable staff resources to be used effectively and avoid unnecessary expenditures of limited resources.

10. The Central Coast Water Board defines "small wineries" as those wineries crushing less than or equal to 160 tons of grapes per year, or producing less than or equal to 10,000

cases or 26,000 gallons of pressed wine per year. Small wineries disposing of wastewater to land generally do not pose a significant threat to water quality when depth to groundwater at the disposal area is greater than 50 feet, provided all other conditions of this Order are met. Small wineries reusing water for irrigation generally do not pose a significant threat to water quality when depth to groundwater at the reuse area is greater than eight feet, provided all other conditions of this Order are met. Where the discharger provides documentation of these conditions and the Executive Officer determines that the discharge will comply with the conditions of the waiver, a waiver of the requirements to provide a report of waste discharge and to obtain waste discharge requirements is in the public interest. The waiver of monitoring requirements pursuant to CWC Section 13269(a)(3) is also appropriate.

11. Issuance of a waiver does not relieve the discharger of the obligation to comply with other more stringent local, state, or federal regulations prescribed by other agencies or departments.

12. The Central Coast Water Board encourages direct regulation of small winery waste discharges by authorized and qualified local agencies where such regulation is mutually beneficial.

13. Although a discharge may qualify for waiver enrollment, the Water Board reserves the right to regulate that discharge through other programs or Water Board actions (such as enforcement orders, individual or general waste discharge requirements, general orders, etc.).

Who Must Apply? And When[1]?

14. **Winery without WDRs** – Any winery not currently covered by WDRs or a waiver of WDRs must apply for coverage under these General WDRs by March 7, 2008.

15. **Winery with Individual WDRs** – For wineries currently covered by individual WDRs, the Water Board will consider whether to regulate each winery under these General WDRs at or before the time the individual WDRs are scheduled for review or renewal. The date of review is specified within the individual WDRs. If Water Board staff determines that regulation under these General WDRs is preferable to individual WDRs, staff will require the Discharger to submit a NOI.

16. **Winery with Waiver of WDRs** – Under California Water Code Section 13269, all waivers of waste discharge requirements (WDRs) expire five years after the date of issuance. The Water Board may consider whether to regulate any winery covered by an individual waiver of WDRs or by enrollment under the Categorical Waiver of Waste Discharge Requirements for Certain Small Wineries (Small Winery Waiver) or General Waiver under this Order. If Water Board staff determines that regulation under this Order is preferable to the existing waiver or waiver enrollment, staff will require the Discharger to submit a NOI.

Is a Fee Required?

17. **Annual Fee** – An annual fee is required for coverage under General WDRs. The annual fee depends on the discharge's Threat to Water Quality and Complexity Rating. A fee schedule

[1] If you have any questions about whether or not your facility must apply for coverage under these General WDRs, you may contact Regional Board staff at (805) 549-3147.

is found in California Code of Regulations Title 23, Division 3, Chapter 9, Section 2200. Small wineries enrolled under the categorical waiver of WDRs of this Order must pay a one-time application fee corresponding to a Threat to Water Quality and Complexity Rating of 3C.

Is Monitoring Required?

18. **Monitoring and Reporting** – Monitoring and Reporting Program No. R3-2008-0018 (General MRP) is part of this Order and is included as Attachment A. The General MRP requires dischargers enrolled in General WDRs to perform regular monitoring and reporting of water supply, wine production, chemical usage, effluent, septic system(s), disposal area(s), and solid waste disposal. Groundwater and/or disposal area soils monitoring may also be required. The General MRP may be modified by the Executive Officer. Notwithstanding the waiver of monitoring requirements for small wineries subject to a waiver, the Executive Officer may require any small winery to conduct monitoring and reporting.

Basis of Requirements

19. **Basin Plan** – The *Water Quality Control Plan, Central Coast Basin* (Basin Plan) incorporates State Board plans and policies by reference and contains a strategy for protecting beneficial uses of surface and ground waters throughout the Region. This Order requires dischargers to comply with all applicable provisions of the Basin Plan.

20. **Beneficial Uses** – Existing and potential beneficial uses of groundwater within the Central Coast Region include municipal and domestic supply, agricultural supply, and industrial process and service supply.

Regulatory Considerations

21. **Storm Water** – Wineries with industrial materials, equipment, or activities that are exposed to storm water shall obtain coverage under the Statewide General Storm Water Permit for Industrial Activities. Wineries should contact Regional Board storm water program staff at (805) 549-3147 for assistance in determining whether to enroll in the Storm Water Permit. Obtaining coverage under this Order does not excuse the requirement to seek Storm Water Permit coverage.

22. **Vineyards** – Dischargers that irrigate commercial vineyards must obtain coverage under the *Conditional Waiver of Waste Discharge Requirements for Discharges from Irrigated Lands* (Agricultural Waiver). Vineyards should visit our website at http://www.waterboards.ca.gov/centralcoast/AGWaivers/Index.htm or contact Water Board Agricultural Waiver program staff at (805) 549-3147 to determine their applicability.

23. This Order does not preempt or supersede the authority of municipalities, flood control agencies, or other local agencies to prohibit, restrict, or control discharges of waste subject to their jurisdiction.

24. **California Environmental Quality Act** - The adoption of these General WDRs and Waiver is intended to protect water quality. Authorization of discharges under these General WDRs and Waiver from existing facilities that have not expanded the amount of waste they discharge is categorically exempt from the provisions of the California Environmental Quality Act

("CEQA", Public Resources Code sections 21000 et seq.) pursuant to sections 15301, exemption for existing projects, and 15308, actions by regulatory agencies for the protection of the environment.

25. **California Environmental Quality Act, New and Expanded Wineries** – New wineries and expansion of existing wineries will not be covered by this Order until the Discharger submits CEQA documents adopted or certified by a local lead agency or the Water Board determines the facility is exempt from CEQA.

26. **Anti-Degradation** – The discharge complies with State Board Resolution No. 68-16 (titled "Statement of Policy with Respect to Maintaining High Quality Waters in California" and commonly referred to as the "Antidegradation Policy").

27. **Water Code Section 13267**. The monitoring and reporting requirements in these General WDRs and in Monitoring and Reporting Program No. R3-2008-0018 are necessary to determine compliance with these waste discharge requirements and to determine the facility's impacts, if any, on receiving water. The evidence in support of requiring these reports is discussed in the above findings.

28. Violations of this Order may result in enforcement actions as authorized under the California Water Code.

29. **Public Notification** – The Water Board has notified all known potential dischargers and all other known interested parties of the intent to adopt these General WDRs and Waiver.

30. **Public Meeting** – The Water Board, in a public meeting on February 8, 2008, heard and considered all comments pertaining to the revision of these General WDRs and Waiver.

THEREFORE, IT IS HEREBY ORDERED that, pursuant to Sections 13263, 13267, and 13269 of the California Water Code, a discharger of winery waste shall comply with the following:

A. APPLICATION PROCESS

1. A discharger seeking authorization to discharge under the General Order or a waiver of WDRs shall submit a complete *Notice of Intent* (NOI) *to Comply with the Terms of the General Waste Discharge Requirements for Discharges of Winery Waste*. The NOI form is included as Attachment B of this Order. The information required with the NOI is equivalent to a Report of Waste Discharge.

2. Coverage under the General WDRs or Waiver will take effect when the discharger receives written notification of enrollment, or waiver, from the Executive Officer.

3. The Water Board reviews enrollments and may revoke any enrollment deemed inappropriate.

4. Wineries covered under the General WDRs or Waiver shall submit an updated NOI to the Executive Officer when there is any change in the information submitted within its original NOI, or any change in activities at the facility, that may affect the quality or quantity of the waste discharge.

5. This Order does not authorize discharges from facilities that have not submitted a NOI or that have not received a notice of enrollment from the Executive Officer.

6. The Executive Officer may require any discharger covered under the General WDRs or Waiver to apply for and obtain individual WDRs. If individual WDRs are issued for a discharge, then the applicability of the General WDRs or Waiver for the discharge is immediately terminated on the effective date of the alternative individual WDRs.

7. **Small Winery Waiver of WDRs** – Waste discharge requirements are hereby waived for small wineries if they satisfy the following:

    a) Submit a complete NOI and application fee to the Water Board;
    b) Provide adequate documentation that groundwater first occurs in a disposal area at least 50 feet below ground surface or 8 feet below ground surface in a reuse area;
    c) Provide adequate documentation that the facility is designed to comply with the Prohibitions, Recommendations, and Specifications of these General WDRs;
    d) Allow Water Board staff to visit your facility if deemed necessary by staff;

8. **Small Winery Application Waiver** - The requirement to submit an NOI is hereby waived for small wineries, provided the winery is under the jurisdiction of a local agency that the Water Board has certified has adequate ordinances and staff resources to appropriately regulate these facilities. Water Board certification may be in the form of a memorandum of agreement between the local agency and the Water Board.

B. PROHIBITIONS APPLICABLE TO GENERAL WDRs AND ALL WAIVER ENROLLEES

1. The discharge of any waste to surface waters is prohibited.

2. The discharge of winery wastewater to subsurface treatment and disposal systems is prohibited, unless specifically allowed in writing by the Executive Officer.

3. The on-site discharge of water softening brine is prohibited, unless specifically allowed in writing by the Executive Officer.

4. The discharge of waste other than winery wastewater (e.g., domestic wastewater) into a surface treatment and disposal system (e.g., ponds, spreading basins) is prohibited.

5. The discharge of waste classified as "hazardous," or "designated," as defined in California Code of Regulations, Title 22, Section 66261.3 et seq. and California Water Code Section 13173, respectively, to any part of the wastewater system is prohibited.

6. The discharge or reuse of waste on land that is not under the control of the discharger is prohibited unless specifically authorized by the Executive Officer.

7. Bypass or overflow of treated or untreated winery waste from transport, treatment, and disposal facilities are prohibited.

8. Creation of a condition of pollution, contamination, or nuisance, as defined by of California Water Code Section 13050, is prohibited.

9. The discharge of stillage is prohibited.

C. RECOMMENDATIONS FOR GENERAL WDRs AND ALL WAIVER ENROLLEES

Pollutant Source Control Guidelines

1. Water-conserving devices (e.g., pressure washers, trigger-handled spray nozzles, automatic barrel cleaners, stainless steel tanks, and smooth floors) should be used to minimize wastewater generation.

2. Use of cleaning chemicals should be minimized. Ozonated washwater is preferred for cleaning.

3. When using water-softening devices, canister-type water softeners or similar alternatives should be used to prevent the discharge of salt brine. Where self-regenerating water softeners are used, the number of connections to the water softener should be minimized.

4. Lees, bentonite, and diatomaceous earth should be excluded from treatment and disposal systems to the extent practicable.

Design Guidelines

5. Large solids should be separated from winery wastewater through redundant screening and removal systems (e.g., with screened floor drains, rotary drum screens, and/or settling basins) prior to further treatment and disposal.

6. Winery wastewater treatment and disposal systems should be designed to accommodate projected future growth in wine production.

7. Winery wastewater treatment and disposal systems should beneficially reuse (e.g., for vineyard irrigation, frost protection, dust abatement) winery wastewater wherever feasible.

8. Where the disposal area's soil buffering capacity may be insufficient, winery wastewater pH should be neutralized to between 6.0 and 8.5 prior to disposal/reuse. Otherwise, disposal area soils and/or groundwater monitoring may be required.

9. To prevent odor nuisance and impacts to groundwater where raw winery wastewater is discharged to land surface, organic loading rate should not exceed a 30-day average of 100 pounds of Biochemical Oxygen Demand (BOD_5) per acre per day.

10. To prevent failure of constructed wetland, settleable solids in winery process water should be removed in a pretreatment system prior to disposal in constructed wetland.

11. The use of septic systems, particularly subsurface absorption systems, for winery wastewater is discouraged. However, if septic systems are used, they shall be designed for the unique characteristics of winery wastewater. In particular, the following conditions should be addressed by the septic system design:

    a. Lees, bentonite, and diatomaceous earth may clog and destroy a soil absorption system and therefore should be excluded from the septic system.

b. Winery wastewater flow fluctuates greatly and solids (particularly lees) do not settle easily; therefore, large septic tanks and effluent filters are required to prevent solids from passing into and degrading the soil absorption system. The hydraulic detention time of septic tanks should be no less than 48 hours. Soil absorption system sizing should be based on the peak daily flow during the crush season.

c. Septic tank contents should be easily accessible to inspect solids levels, pump out solids, and clean/replace effluent filters.

d. The organic content of winery wastewater effluent from septic tanks, as measured by Biochemical Oxygen Demand (BOD_5), is generally much greater than domestic wastewater. The organic matter causes excessive slime formation that will clog a soil absorption system if the soil absorption system is not periodically rested. Dual soil absorption systems are necessary to allow alternating wastewater loading and resting.

e. Infiltration surface should be sized based on organic loading, or hydraulic loading, whichever is more conservative (see Environmental Protection Agency (EPA) manual and consider soil type).

f. Inspection risers should be installed in soil absorption systems to monitor water levels.

12. Winery wastewater treatment and disposal systems should be designed to minimize chemical addition and maintenance.

13. Collected screenings and other solids removed from liquid wastes, including pomace and lees, should be composted at the site when possible. Compost heaps should be located adjacent and upgradient to vineyards so that compost runoff goes directly to vineyard. Composting piles should be aerated or rotated enough to aid decomposition, but not to an extent to dry out piles. Good composting practices will minimize odors and pests.

D. SPECIFICATIONS

General Specifications

1. Winery wastewater shall be captured, treated, and disposed of separately from domestic wastewater. Combined subsurface disposal shall only occur if authorized in writing by the Executive Officer.

2. Winery wastewater treatment and disposal systems shall be designed for the maximum daily flow of wastewater and organic loading generated (generally at the peak of crush season), including flows resulting from precipitation.

Specifications for Flow Metering

3. Where a monitoring and reporting program specifies metered flow rate measurement, wastewater flow rates shall be measured with an accurate flow measurement method or device.

Specifications Applicable to Winery Wastewater Treatment Ponds

4. Winery wastewater treatment ponds shall be lined with either a relatively impermeable membrane, two feet of soil with a permeability of less than 10^{-6} centimeters per second, or an engineered alternative approved in writing by the Executive Officer.

5. Winery wastewater treatment ponds shall be designed to contain all wastewater flows and rainfall from any 100-year, 24-hour storm event.

6. Winery wastewater treatment ponds shall have a foundation or base capable of providing support for the structures, and capable of withstanding hydraulic pressure gradients to prevent failure due to settlement, compression, or uplift and all effects of ground motions resulting from at least the maximum probable earthquake, as certified by a registered civil engineer or certified engineering geologist.

Specifications Applicable to Constructed wetlands

7. Constructed wetlands shall be graded to prevent accumulation of storm water in wetland.

Specifications Applicable to Subsurface Soil Absorption Systems

8. Subsurface soil absorption systems shall be designed in accordance with Section VIII.D.3 of the Basin Plan.

9. The distance between any soil absorption system's trench bottom and groundwater, including perched groundwater, shall be no less than the following:

Percolation Rate (minutes / inch)	Distance (feet)
<1	50
1 – 4	20
5 – 29	8
>30	5

10. No part of the disposal system(s) shall extend to a depth where waste may pollute groundwater.

11. New winery wastewater systems with a subsurface disposal area shall reserve sufficient land area for 100-percent replacement of the disposal area.

12. The wastewater system shall not be located where it will alter the existing drainage pattern of the site, including alteration of the course of a stream or river.

Effluent Limitations

13. Winery wastewater flow shall not exceed the design capacity of the treatment and disposal system. Wastewater flows shall be limited to the flows described in the NOI.

14. Where winery wastewater is discharged to land (such as to a spreading basin or vineyard), organic loading rate shall not exceed 300 pounds of Biochemical Oxygen Demand (BOD_5) per acre per day at any time.

15. The discharger shall not discharge salt brine from water-softening devices into winery process water stream unless approved in writing by the Executive Officer. The Executive Officer may condition approval on groundwater monitoring and/or a salts management plan for facilities discharging salt brine into winery process water streams.

Groundwater Limitations

16. The discharge shall not cause a statistically significant increase of mineral constituent concentrations in underlying groundwater.

17. The discharge shall not cause concentrations of chemicals and radionuclides in groundwater to exceed limits set forth in Title 22 of the California Code of Regulations or Table 3.8 of the Basin Plan.

Operation Specifications

18. At least two feet of freeboard shall be maintained at all times in any pond or spreading basin containing winery wastewater. Staff gauges shall be installed to monitor water levels.

19. The dissolved oxygen concentration in the upper zone (one foot) of aerated or oxidation pond systems shall not be less than 1.0 mg/L at any time.

20. Where spreading basins are used for treatment and disposal, the spreading basins shall be operated in a regular rotating sequence, with a rotation frequency no less than weekly, or as agreed upon by the Executive Officer. The spreading basin bed slope shall be maintained to ensure even distribution of wastewater and prevent standing water. Wastewater contained in spreading basins shall be no deeper than four (4) inches.

21. Solids accumulation in all septic tanks shall be measured at least annually and cleaned when it appears that either the bottom of the scum layer will be within four (4) inches of the bottom of the outlet device or the sludge level will be within ten (10) inches of the outlet device before the next scheduled inspection.

22. Dual leachfield systems shall be operated in a regular rotating sequence, with a rotation frequency no less than annually.

Solids Disposal Specifications

23. Collected screenings and other solids removed from liquid wastes that will not and/or cannot be used agronomically shall be disposed of at a legal point of disposal, and in accordance with Title 27, Division 2 of the California Code of Regulations.

24. Runoff from compost areas, containing collected screenings and other solids removed from liquid wastes, shall not discharge to any surface water body.

25. In no case shall accumulated sludge from a wastewater pond be used as an agronomic addition to fields without written authorization from the Executive Officer.

26. If accumulated sludge from a wastewater pond will be used as an agronomic addition to fields, a proposal containing, at a minimum, the following information shall be submitted in writing to the Executive Officer before commencement:

    a. The physical properties of the sludge to be removed from the pond, including the volume and percent solids.

    b. A summary of laboratory analytical results for a composite sludge sample. At a minimum, the analyses shall include pH, cadmium, chromium, copper, lead, nickel, zinc, and total nitrogen. A leachability test of the sludge may be required if deemed necessary by the Executive Officer.

c. Descriptions of the proposed land application areas, including a map denoting watercourses, approximate depth to groundwater, acreage and the crops to be grown thereupon.

d. Calculations showing the sludge will be applied at reasonable agronomic rates (based on nutrient uptake of the crop).

e. A project schedule. Sludge application shall be confined to the dry season, between April 15 and October 15 each year. Sludge shall be spread and incorporated into the soil in a manner to prevent erosion, runoff or any nuisance conditions.

f. A statement verifying that no hazardous waste or domestic waste has been discharged to the ponds.

Wastewater Recycling/Re-Use Specifications

27. Treated winery wastewater shall not be applied to land within 24 hours of a forecasted rain event, during rainfall, 24 hours after a rainfall event, or when soils are saturated.

28. Treated winery wastewater shall be applied in such a manner so as not to exceed vegetative nutrient demand.

29. Land application of treated winery wastewater shall be managed to prevent ponding, runoff, and erosion.

30. There shall be no connection between a potable water supply and a treated winery wastewater distribution system.

31. All piping, valves, and outlets shall be marked to differentiate treated winery wastewater from other sources of water.

E. PROVISIONS

1. Order No. R3-2002-0084, adopted on November 1, 2002, is hereby rescinded except for purposes of enforcement. General Order No. R3-2008-0018 supersedes the rescinded WDRs.

2. Dischargers enrolled in the General WDRs shall comply with Monitoring and Reporting Program R3-2008-0018, included as Attachment A of this Order, and any revisions prescribed thereto by the Executive Officer.

3. A copy of this Order shall be kept at the discharge facility for reference by operating personnel. Key operating and site management personnel shall be familiar with its contents.

4. In the event the discharger wishes to terminate authorization under this Order, the discharger shall submit a Notice of Termination (NOT). A Water Board staff inspection of the facility may be required prior to terminating coverage. Termination from coverage will occur on the date specified in the NOT, unless notified otherwise. All discharges shall cease before the date of termination, and any discharges on or after this date shall be considered in violation of this Order unless covered by other WDRs.

5. In the event of any change in control or ownership of land or waste discharge facilities presently owned or controlled by the discharger, the discharger shall notify the succeeding owner or operator of the existence of this Order by letter, a copy of which shall be immediately forwarded to the Executive Officer.

6. The discharger shall take all reasonable steps to prevent any discharge in violation of this Order.

7. The discharger shall at all times properly operate and maintain all facilities and systems of treatment and control (and related appurtenances) to achieve compliance with this Order. Proper operation and maintenance also includes adequate laboratory controls and appropriate quality assurance procedures. This provision requires the operation of backup or auxiliary facilities or similar systems when necessary to achieve compliance with this Order.

8. The discharger shall furnish the Water Board, within a reasonable time, any information that the Board may request to determine compliance with this Order.

9. The discharger shall allow the Water Board or its authorized representatives to:

   a. Enter upon the discharger's premises where a regulated facility or activity is located or conducted, or where records pertinent to this permit are kept;

   b. Inspect and photograph any facilities, equipment (including monitoring and control equipment), practices, or operations pertinent to this Order;

   c. Have access to and copy any records pertinent to this permit; and

   d. Sample or monitor for the purposes of assuring permit compliance.

10. All technical and monitoring reports submitted pursuant to this Order are required pursuant to Section 13267 of the California Water Code. Failure to submit reports in accordance with schedules established by this Order, attachments to this Order, or failure to submit a report of sufficient technical quality to be acceptable to the Executive Officer, may subject the discharger to enforcement action pursuant to Section 13268 of the California Water Code. The Water Board will base all enforcement actions on the date of Order adoption.

11. All reports, NOI, or other documents required by this Order, and other information requested by the Water Board shall be signed by a person described below or by a duly authorized representative of that person.

   a. For a corporation: by a responsible corporate officer such as: (a) a president, secretary, treasurer, or vice president of the corporation in charge of a principal business function; (b) any other person who performs similar policy or decision-making functions for the corporation; or (c) the manager of one or more manufacturing, production, or operating facilities if authority to sign documents has been assigned or delegated to the manager in accordance with corporate procedures.

   b. For a partnership or sole proprietorship: by a general partner or the proprietor.

12. Any person signing a document under Provision 11 makes the following certification, whether written or implied:

"I certify under penalty of law this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

13. The discharger shall give notice to the Water Board as soon as possible of any planned alterations to the permitted facility that may change the nature or concentration of pollutants in the discharge.

14. Winery process wastewater discharges for which provisions of California Water Code Sections 13260, 13263, or 13264 were waived under the previous General Winery WDRs may be issued individual waste discharge requirements, enrolled in general waste discharge requirements, regulated through other programs, enrolled in the Waiver adopted in this Order, or granted a waiver through other actions of the Water Board.

15. The Water Board's Executive Officer is authorized to enroll and terminate enrollment in the Waiver and General WDRs adopted by this Order.

16. This Order will be reviewed on or about **February 8, 2013,** or sooner at the discretion of the Water Board. A discharger enrolled under General WDRs will be automatically enrolled under the reissued General WDRs, unless a NOT is submitted to terminate coverage. The Waiver contained in this Order will expire on February 8, 2013, unless terminated or reissued by the Water Board before that date.

17. The Water Board may review this Order, including the General WDRs and the Waiver, at any time and may modify or terminate this Order in its entirety or for individual dischargers as appropriate.

I, Roger W. Briggs, Executive Officer, do hereby certify that the foregoing is a full, true, and correct copy of an Order adopted by the California Regional Water Quality Control Board, Central Coast Region, on February 8, 2008.

Roger W. Briggs,
Executive Officer

2-15-08
Date

UPDATED

MEMORANDUM OF UNDERSTANDING

Regarding

WINERY PROCESS WASTE TREATMENT AND DISPOSAL

Between

**CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
SAN FRANCICO BAY REGION**

And

COUNTY OF NAPA

STATEMENT OF INTENT

The San Francisco Bay Regional Water Quality Control Board (hereinafter Regional Board) and the County of Napa (hereinafter County) have been operating under a memorandum of understanding (agreement) which has established conditions and a procedure for waiver of waste discharge requirements issued by the Regional Board for winery process waste treatment and disposal systems in Napa County. This agreement addesses winery process wastes which are disposed of by surface means only. This arrangement has eliminated duplication of effort and reduced the time required to obtain a county building permit by waiving, reducing or eliminating much of the Regional Board's formal involvement, subject to certain conditions which assure the Board that its concerns regarding water quality effects of these discharges are being addressed at the County level. This updated MOU brings the agreement in line with current program needs.

FINDINGS

1. Winery process wastewater discharges in Napa County are presently regulated by both the Regional Board and the County.

2. Section 13269 of the California Water Code provides that a Regional Board may waive the filing of reports of waste discharge for certain specific types of discharge where such a waiver is not against the public interest. Such a waiver shall be conditional and may be terminated at any time by the Board.

3. Regulation of discharge to subsurface leach field systems has been previously conditionally waived to the County's Director of Environmental Management.

4. The Regional Board, on July 21, 1982, authorized the Executive Officer to execute a Memorandum of Understanding with the County by which the Regional Board would conditionally waive the direct regulation of the most common form of winery wastewater treatment and disposal systems provided the County agreed to regulate such systems under appropriate conditions.

5. In November 1982 both the County and the Regional Board signed an MOU which designated the County as having the primary responsibility for all aspects of approval and regulation of winery wastewater discharges.

AGREEMENT AND CONDITIONS

The Regional Board hereby waives the need for filing of reports of Waste Discharge from wineries in Napa County, and the County, through its Director of Environmental Management, hereby agrees to regulate such discharges, subject to the following conditions:

1. The waiver will apply only to winery process waste in surface treatment and disposal systems. Systems which handle combined sanitary and process waste will continue to require waste discharge requirements from the Regional Board or a written waiver from the Executive Officer.

2. The County will require that applications be filed for any new winery wastewater discharge and for any significant change in the quantity or characteristics of an existing discharge. A complete application will require a detailed engineering design including drawings, specifications and design calculations including water balances where appropriate.

3. The County will carry out the design review prior to issuance of permits in order to ascertain that the proposed design will be adequate to meet permit requirements and to protect water quality. Pond system designs will be required to conform to the "Criteria for Wastewater Storage Ponds" developed by Regional Board staff (Attachment A).

4. The County will provide notification to the Regional Board fifteen (15) days in advance of the issuance of each winery process wastewater permit. The notification will include transmittal of the application including supporting materials and plans that have been found to be acceptable to the County.

5. The County will issue a permit for each winery process wastewater discharge. The permit will include the standard Prohibitions, Specifications, and Provisions which have been included in the Regional Board's Waste Discharge Requirements for similar facilities (Attachment B).

6. County permits will contain a provision that the discharger must carry out a standard self-monitoring program, which will be developed by the County in cooperation with Regional Board staff. The records of this monitoring will be maintained on-site by the discharger and available for inspection by County or Regional Board staff.

   The County will also require dischargers to submit summary reports to it on a regular basis. These reports should be designed to provide the County sufficient information to determine compliance with permit conditions and provide the basic information needed by the County for the semi-annual reports to the Regional Board. The self-monitoring program will also require the discharger to immediately notify the County of any spill or bypass event.

   The County shall immediately notify the Regional Board in cases where wastewater enters or threatens to enter waters of the State.

7. The County permit will contain an access clause providing Regional Board staff with access to the property and wastewater facilities for inspection.

8. The County will perform routine inspections on a regular basis. Each facility will be inspected no less than once per year, during the crushing season if possible. Spot inspections will also be performed during the wet season to monitor compliance with pond freeboard requirements.

9. The Regional Board will provide technical assistance to the County as requested during the design review process.

10. The Regional Board may comment within fifteen (15) days after notification on a pending county approval.

11. The Regional Board will require a Report of Waste Discharge and will formally consider waste discharge requirements for specific discharges upon request from the County or discharger. The Board may also require a Report of Waste Discharge and/or Waste Discharge Requirements for specific discharges at the Regional Board's discretion.

12. The Regional Board will continue to enforce the Water Code in cases where there are violations or threatened violations of the Regional Board's Basin Plan provisions or prohibitions.

13. The County shall submit an annual reportto the Regional Board on February 1 covering:
    a. New permits issued
        1. Winery facility name, location and contact person
        2. Type of treatment and disposal process
        3. Permitted production and wastewater flow capacities
        4. Special permit conditions or unresolved permit issues

    b Permit modifications, reissues, or rescissions
        1. Winery facility name, location and contact person
        2. Permit action taken and associated changes to the winery wastewater treatment disposal practices

    c. Existing permits (Surface and subsurface disposal)
        1. Winery facility name, location and contact person
        2. Average daily wastewater flows
            i. During crush period
            ii During non-crush season
        3. Result of self-monitoring programs
        4. Results of facility inspections
        5. Nature and frequency of violations, and status of correction actions

14. A semi-annual summary report shall be submitted on August 1 briefly listing information in 13 .a.1., b.1, and c.5.

15. The Regional Board or the County shall have the option to terminate this agreement at any time upon thirty (30) days written notice.

16. This Agreement becomes effective November 21, 1991 and replaces the present MOU (Agreement No. 1985).

Marion Otsea, Chairperson
Regional Water Quality Control Board
San Francisco Bay Region

Mel Varrelman, Chairman
Napa County Board of Supervisors

APPROVED FEB 11 1992
BOARD OF SUPERVISORS
COUNTY OF NAPA

[illegible]NES DEL ZOMPO
[illegible]RK OF THE BOARD
BY Lori J. Bush Deputy

APPROVED AS TO FORM
Office of County Counsel
By: Margaret L. Woodbury
Date: February 20, 1992

Source: California Regional Water Quality Control Board
San Francisco Bay Region
Taken from: Don M. Eisenberg report, 1982
Date: July 1991

ATTACHMENT A

CRITERIA FOR WASTEWATER TREATMENT/STORAGE PONDS

The following guidance material applies only to ponds used for sewage, animal wastes, or food processing wastes from facilities such as wineries. This discussion is not intended to apply to facilities for the treatment, storage or disposal of hazardous, toxic, or other kinds of industrial wastes. These are covered by other regulation (e.g. Title 23, Article 3, Chapter 15, of the Water Code).

DESIGN CONSIDERATIONS

The Regional Board cannot specify the design of pond systems, but the following design methodology is used as guidance criteria to insure wet weather reliability for wastewater ponds in the region. This discussion covers two kinds of ponds; holding ponds used for the storage of wastewater until such time discharge is allowed, and disposal ponds from which no discharge is allowed.

For either kind of pond, the fundamental design tool is the water balance, in which inputs to the pond (wastewater plus rainfall) plus storage (the available volume of the pond system) must equal outputs (evaporation plus percolation plus allowable discharge to land or receiving waters).

Both rainfall and evaporation vary from year to year, but the variation in rainfall is by far the more important from a design standpoint. A useful concept in this regard is return frequency, or the interval over which, on an average, a given amount of rainfall can be expected. A good statistical basis exists in the Bay Area for defining the normal winter's rainfall, as well as those amounts falling in the wettest winter in ten years, in fifty years, etc.

The kinds of holding and disposal pond systems under discussion here are typically of sufficient size that the seasonal rainfall controls the design rather than rainfall over some shorter duration. For example a pond system designed to hold wastewater plus 40 inches of rainwater would be in no danger of overflow from a large 24 hour storm, which might contribute only six to ten inches.

Holding Ponds

Holding ponds are widely used in the Bay Area, notably by dairy ranches, wineries in the Napa and Sonoma Valleys, and the towns of St. Helena, Calistoga, and Bolinas. A typical use of holding ponds is for the storage of wastewater during the wet season with application to agricultural land during the dry season.

Holding ponds are designed on the basis of the anticipated waste flow during the period in which storage is necessary, plus the rainfall onto the ponds, minus any evaporation that occurs.Holding ponds are designed only for storage, and thus the primary consideration is volume rather than surface area. In this case rainfall is important only in the sense that, for the wet season that is the basis for design, the pond must be somewhat deeper than would be the case if normal rainfall were assumed. For example, if the once in ten year wet season were the design criteria, a pond in the Bay Area might have to be somewhere around a foot deeper than for a normal year.

This extra rain falling on the pond must also be disposed of. Where the method of disposal is by application to agricultural land, sufficient acreage must be provided. For dairy ranches and most wineries, land area is not a limiting factor.

Disposal Ponds

Disposal ponds receive wastewater and rainfall, which must be disposed of primarily by evaporation (percolation – is strongly discouraged). Because of the large are required, disposal ponds are used less than the system of holding ponds with agricultural disposal.

Disposal ponds tend to rely primarily on evaporation rather than percolation. This is due to the local conditions of soil and ground water elevation, and to the tendency of ponds to seal themselves with time. Where evaporation is the primary mode of disposal, pond design is based on evaporation minus rainfall. For example, if the total water loss is 60 inches per year and the total rainfall is 35 inches per year, then the net loss per unit area would be at a rate of 25 inches per year. This would mean that 25 acre-inches, or 680,000 gallons, of wastewater could be disposed of by each acre of pond surface area per year.

It was noted earlier that annual evaporation tends to be relatively constant year to year, but rainfall can be highly variable (the recent 'drought' period is a good example). In practice required disposal pond size is highly sensitive to the amount of rainfall assumed. This point is illustrated in Table 1 below using the previous example, in which evaporation is 60 inches and average rainfall 35 inches, and assuming the once in ten year wet winter has about 40 per cent more rain than an average year.

Table 1

Effect of Rainfall on Disposal Pond Design

	Normal Year	Ten Year Wet Year
Evaporation, inches	60	60
Rainfall, inches	35	49
Net water loss, inches	25	11

For the case given in Table 1, the requirement of design for the once in ten year wet season more than doubles the required area for any given flow. As will be discussed below, one regulatory strategy for handling this situation is to allow ponds to be designed with the assumption that some defined wet year is followed by one or more normal years. In effect this approach would allow storage carry over from one year to another (greater depth) to serve in lieu of surface area.

CRITERIA FOR WET WEATHER RELIABILITY

The selection of criteria for wet weather reliability involves a tradeoff between environmental consequences of overflows on one hand, and the added costs in the form of larger ponds and disposal areas on the other.

Consequences of Overflow

It is useful to consider the sequence of events during a winter having rainfall greater than that selected as a design criteria. If properly operated, holding or evaporation ponds would begin the wet season drawn down to the design storage volume. This volume would be used up with the unusually heavy rainfall as the winter went on, until a time would occur in which no more water could be added. In this case waste from the ponds would either spill over the ponds or be pumped onto the now saturated disposal area, from which runoff may occur to waters of the state. There is no way in which the adverse environmental impacts of such an event can be quantified. All that can be said with any certainty is that the less often overflows occur the better.

Cost of Compliance for Holding Ponds

An effort was made to estimate the costs of compliance with various criteria for holding ponds for wet winters in terms of both pond volume and disposal area. Conditions typical of the North Bay were assumed; namely 60 inches annual evaporation, 35 inches of rainfall, and wet years for various recurrence intervals are taken from a standard U.S. Geological Survey paper on the subject. An effort was made to estimate the dollar impact of compliance with various recurrence intervals, based on assumptions as to cost of land, excavation, and shaping and compaction of dikes. The actual dollar costs generated in this exercise are in 1982 dollars and are obviously of little direct value, but they serve to demonstrate the relationship that exists between costs of compliance with the baseline condition (retention for the average winter) and compliance costs for more demanding criteria. The results of this analysis are summarized in Table 2.

Table 2

Typical Effects of Wet Weather Criteria on Size and Cost of Holding Ponds[1]

Design Criterion	% Additional Pond Volume Required	% Additional Disposal Area Required	Cost
Average Wet Season	0	0	0
5 Year Wet Season	13	8	11
10 Year Wet Season	31	16	25
25 Year Wet Season	53	27	43
100 Year Wet Season	96	57	80

[1] For St. Helena, California based on 70 years of rainfall data

Note: These designs were based on no disposal during wet season (Nov thru March)

The data in Table 2 reveal no obvious break point for establishing a criteria. However, a five year criteria would be inadequate because the small additional sizes for holding ponds and disposal area is less than the uncertainty that exists as to wastewater flow and other variables. The ten year criterion would require ponds around 30 per cent larger than would be required for only average conditions. This seems an adequate measure of safety.

The once in ten year criterion has precedent in a number of other cases; it is contained in several EPA industrial effluent guidelines where rainfall is a factor, and in the State Board's guidelines for animal waste disposal.

Costs of Compliance for Disposal Ponds

An analysis similar to that illustrated by Table 2 above was carried out for disposal ponds in which evaporation was the only mode of water loss. As noted earlier in the discussion, assumptions with respect to rainfall have profound implications for pond design. One means of providing protection against frequent overflows while minimizing added costs is to assume that one or more years following the design year are of average rainfall, and allow the permittee to carry over some of the extra rainfall into the second dry weather season or beyond. In effect this approach would allow the discharger to substitute pond depth for pond area. (In theory, if ponds were of infinite depth, they would need only be designed for an average winter). The results of this analysis are summarized in Table 3.

Table 3

Typical Effects of Wet Weather Criteria on Size and Cost of Disposal Ponds[1]

Design Criterion	% Additional Pond Volume Required	% Additional Disposal Area Required	Additional Pond Cost
Average Wet Season	0	0	0
10 Year Wet Season	125	125	125
100 Year Wet Season	Not possible in most of this region		
10 Year Wet Season, followed by two avg. years	24	24	24
10 Year Wet season, followed by one avg year	42	42	42

This analysis indicates that use of the 100 year winter criterion would rule out the use of evaporation ponds, and even the ten year wet weather criterion would probably have the practical effect of eliminating their use. The allowance for carryover of the added rainfall into more than one subsequent dry season radically lowers the cost of compliance. However, the two year carryover carries too much risk based on three considerations; the Board experience with the tendency of dischargers to underestimate wastewater flows, the lack of flexibility of evaporation systems (expansion can demand land that is not readily available) and the fact that most such systems are either used for sewage rather than process wastes which are typically of less health concern or are in areas where overflows can adversely impact water quality. Based on the above the Board uses the ten year followed by one normal year criterion.

Criteria for Freeboard

Freeboard is defined as the difference between the elevation of the top of the berm and wastewater level in the pond. A pond that is properly designed and operated will generally achieve maximum design freeboard immediately prior to the onset of the wet season (early October in this area). Freeboard requirements, which specify that, at minimum, a certain amount of freeboard be maintained at all times, are intended to insure that excess holding capacity is always available to protect against high-rainfall events of shorter than seasonal duration. Examples of such events are individual storms of extremely high intensity and wet periods of several months duration.

Extra freeboard also protects against unanticipated short-term increases in wastewater flow, such as a process spill or broken water line. Furthermore, extra freeboard provides the potential to accommodate intentional but unanticipated increases in the routine wastewater flow. Finally, the requirement for excess freeboard protects the berms from wave erosion and provides additional safety in the event of a seasonal rainfall which exceeds that of the design recurrence interval.

Six inches is the minimum freeboard that could possibly be considered, as that is barely sufficient to protect from the effects of wind and waves. A one foot minimum freeboard requirement is considered adequate by many pond designers, but leaves little margin to accommodate all the elements mentioned above, which represent essentially unpredictable excess loadings. Two feet of minimum freeboard is almost certainly sufficient to deal with the effects of these unknown elements on a basically sound pond design with good operation.

Protection from Flooding

Flooding of ponds from the outside is another common type of wet weather pond failure. Ponds can be protected from flooding by requiring that they be constructed outside of flood plains or at least that the elevation of the top of the berm be higher than the maximum high water predicted on some specified recurrence interval. Most flood control districts and federal grants require protection of this type of facility from the 100-year flood. Provision for diversion and drainage of storm water runoff around the ponds is another consideration that is important in flood protection. Storm drainage provisions such as ditches and culverts must be designed on the basis of the maximum intensity expected for a rainfall event of relatively short duration. In general these designs are based on the maximum expected for a period of one to several hours, but the exact duration used is a function of the area that is drained.

POND FAILURES

Pond system failure can be due to a number of reasons including an extremely wet winter, an increase in wastewater flows above design capacity, a process upset wherein an inordinately large volume of wastewater is sent to the ponds, a flood flow greater than the pond levees can withstand, improper levee maintenance against erosion, or improper pond system management.

Pond system management is the major factor in pond systems utilizing land disposal. If the ponds are not drawn down to the proper freeboard level recommended by the water balance for the start of winter, it is likely the ponds will overflow. In addition, for those pond systems where a wet season disposal is part of the water balance (these are rare) and is allowable by permit requirements, the ponds must be continually drawn down when environmental conditions permit.

POND PERCOLATION

To protect groundwater resources, percolation of wastewater through the pond bottoms should be minimized. To keep the pond bottom and levees from leaking, construction of the pond requires the use of heavy earth-moving equipment to compact and seal existing fine-grained soil particles so that percolation of water into subsurface soils has a rate of not more than 10^{-6} cm/sec. Biological growths on the pond bottom should also form a dense slime or biofilm, which helps reduce overall permeability.

TREATMENT PARAMETERS

The treatment of winery wastewaters is typically conducted in two stages. The first stage or 'pretreatment' stage involves the physical-chemical treatment operations of solids removal, pH correction, and flow metering. The second stage is the destruction of waste organic matter by biological oxidative and reductive processes. The oxidative process may have to be supported with mechanical aerators.

Solids Removal

The primary objective in removing solids from the waste stream prior to treatment is to prevent the physical blockage or clogging of collection system piping and pumps by large objects or accumulations of smaller particles. In addition, many of the solids found in wine waste (e.g. grape skins, leaves, etc.) are biodegradable, and can represent a substantial additional organic load to the treatment system if not removed early in the process. Screening of winery effluent is the most effective method of removing these solids down to a particle size of about 1/2 millimeter.

pH Correction

Organic acids formed by yeast cells during the fermentation of grape juice reduce the pH of wine waste to the range of 3 to 5. This acid will corrode and destroy pipes, pumps and other metallic components of the waste treatment system. Furthermore, acidic conditions inhibit or completely halt many of the biological reactions employed in the waste treatment process. For these reasons, it is necessary to raise the pH of the waste to neutrality (pH 7) by metered chemical additions.

Flow Metering

Accurate records of process waste discharge volume are important, not only for efficient winery operations, but for compliance with discharge permit regulations. In addition to the instantaneous flow rates, the total cumulative flow should be recorded

Pond Loading and Aeration

The system design must be based on a design concept emphasizing simplicity, economy, effectiveness and fail-safe operation. The installation must be capable of efficiently treating the waste to the degree necessary for preventing odors and other nuisances, and, in many cases, to promote disposal of treated waste through irrigation.

Because odors occur when there is insufficient dissolved oxygen in the upper layers of the pond, enhancing pond performance and reliability concerns the selection and placement of mechanical aerators. Floating aerators provide backup to supplement the pond's natural oxygen-generating capabilities during periods of peak loading (e.g. crush season) or other unfavorable conditions. Standard engineering practice for sizing floating-loaded facilities requires that 1 to 2 pounds of aerator oxygen be available for each pound of BOD introduced to facultative ponds at the seasonal peak.

SUMMARY

The following criteria is to be used in the design of wastewater ponds and land disposal systems:

Holding Ponds	The 10-year wet seasonal rainfall should be the design basis for holding ponds. The ponds should have the capacity to store the anticipated rainfall plus wastewater for the wet season. A good water balance analysis is paramount in pond design – without it treatment and containment reliability will be questionable.Two feet of freeboard should be maintained at all times. For new or expansion of existing ponds the bottom of the pond(s) shall be lined with suitable clay soils, or compacted so that percolation of water into subsurface soils has a rate of not more than 10^{-6} cm/sec.The discharger should be required to document, by October 1 of each year, that adequate freeboard exists for the anticipated rainfall (10-year wet season) plus wastewater for the wet season. All ponds should be protected from washout or erosion resulting from a 100-year return interval flood flow.
Disposal Area	The discharger should document, by appropriate soils and engineering studies, that adequate area exists to dispose or reclaim all annual wastewater plus the 10-year wet season rainfall during the seven month dry season. If the discharger provides adequate documentation, allowance may be made to dispose of some wastewater during the wet weather months.
Evaporation Ponds	The same criteria applies as for holding ponds except that, for evaporation ponds, a normal year's rainfall shall be assumed to follow the 10-year wet season.

ATTACHMENT B

PROHIBITIONS, SPECIFICATIONS, AND PROVISIONS

FOR

WINERY PROCESS WASTEWATER DISCHARGES

The following requirements should be a part of any winery wastewater permit issued by the County. Since the permits are site specific, additions, modifications or deletions would apply on a case-by-case basis.

FINDINGS

This section should describe the production facility, treatment and disposal facilities, etc.

Winery name, owner, operator, location
Technical reports submitted
Facility description
Wastewater production flows
Discription of treatment, storage and disposal facilities
Treatment pond descriptions with projected water balances
CEQA determinations
Any other pertinent information

PROHIBITIONS

1. Wastewater discharged to the treatment system (ponds, etc.) shall not exceed the total annual design flows described in Finding ____of this permit.

2. Neither the treatment, storage, nor disposal of wastes shall create a nuisance or pollution as defined in the California Water Code.

3. There shall be no bypass or overflow of waste to waters of the State from the wastewater collection, treatment, transport, storage or disposal facilities.

4. Discharge of toxic substances into a pond treatment system which will disturb the normal biological treatment mechanisms is prohibited.

5. The discharge of waste shall not degrade the quality of any groundwater used for domestic purposes or cause an increase in any quality parameter that would make groundwater unsuitable or irrigation use.

6. No reclaimed water shall be allowed to escape from the designated use area via surface flow.

DISCHARGE SPECIFICATIONS

General

1. All wastewater streams discharging into ponds shall be measured in order to monitor the total flow rate of wastewater.

2. The permittee shall maintain in good working order and operate as efficiently as possible

any facilities or control system installed to achieve compliance with this permit.

Treatment/Storage Ponds

1. The ponds shall be adequately protected from erosion, washout, and flooding from a rainfall event having a predicted frequency of once in 100 years.
2. To prevent the threat of overflows, a minimum freeboard of 2 feet shall be maintained in the ponds at all times.
3. Water samples within 1 foot of the surface of the pond(s) shall meet the following quality limits at all times:

   In any grab sample:

Dissolved Oxygen	2.0 mg/l minimum
Dissolved Sulfide	0.1 mg/l maximum
pH	6.0 minimum 9.0 maximum

4. The treatment pond(s) shall be underlain by an impermeable layer which will allow a percolation rate of not more than 10^{-6} cm/sec (expansion or new ponds).

Reclaimed Water Use Restrictions

1. Use of reclaimed water on areas not specified in Finding on Attachment ___ of this permit is prohibited without written authorization from (Director of Environmental Management)
2. No reclaimed water shall be applied to the vineyard disposal area in anticipation of or during rainfall, 48 hours after a rainfall or when soils are saturated.
3. No reclaimed water used for irrigation shall be allowed to escape to areas outside the irrigation areas, either by surface flow or airborne spray, except for minor quantities associated with good irrigation practice.
4. Ponding shall not occur in the disposal area in amounts which could cause a mosquito problem.

PROVISIONS

1. The permittee shall comply with a Self-Monitoring Program as specified by (Director of Environmental Management)
2. In reviewing compliance with Prohibition 3 of this permit, the (Director of Environmental Management) will take special note of the difficulties encountered in achieving compliance during entire wet seasons having a rainfall recurrence interval of greater than once in ten years.
3. The permittee shall permit the (Director of Environmental Management) and/or the Regional Board, or their authorized representatives:

   a. Entry upon premises in which a regulated facility or activity is located or conducted, or where records are kept under the conditions of this permit;

   b. Access to and copy of, at reasonable times, any records that must be kept under the conditions of this permit;

c. Inspection, at reasonable times, of any facility, equipment (including monitoring and control equipment), practices, or operations regulated or required under this permit; and

d. To photograph, sample or monitor, at reasonable times, for the purpose of assuring compliance with this permit.

4. In the event of any change in control or ownership of land or waste discharge facilities presently owned or controlled by the permittee(s), the permittee(s) shall notify the succeeding owner or operator of the existence of this permit by letter, a copy of which shall be forwarded to the (Director of Environmental Management).

5. The permittee(s) shall file with the (Director of Environment Management) a written report at least 180 days before making any material change in the character, location, or volume of the waste discharge, except for emergency conditions in which case the (Director of Environmental Management) shall be notified as soon as possible by phone and in writing.

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
CENTRAL VALLEY REGION

RESOLUTION NO. R5-2003-0106

APPROVING
A WAIVER OF WASTE DISCHARGE REQUIREMENTS
FOR
SMALL FOOD PROCESSORS, INCLUDING WINERIES,
WITHIN THE CENTRAL VALLEY REGION

Whereas, the California Regional Water Quality Control Board, Central Valley Region (hereafter Regional Board), finds that:

1. California Water Code (CWC) Section 13260(a) requires that any person discharging waste or proposing to discharge waste within any region that could affect the quality of the waters of the State, other than into a community sewer system, shall file with the appropriate regional board a report of waste discharge (RWD) containing such information and data as may be required by the Regional Board.

2. The Regional Board has a statutory obligation, pursuant to CWC Section 13263, to prescribe waste discharge requirements (WDRs) for each discharge of waste, except where the Regional Board finds that a waiver of WDRs for a specific type of discharge is not against the public interest as described in CWC Section 13269.

3. CWC Section 13269 authorizes the Regional Board to waive WDRs for specific types of discharge where such a waiver is not against the public interest, is conditional, and may be terminated by the Regional Board at any time.

4. CWC Section 13269 provides, in part, that waivers of WDRs which were in existence prior to 1 January 2003 expired on that date, that waivers adopted after that date must be for specific types of discharges and must be renewed at a minimum of every five years, and that prior to renewing any waiver the Regional Board shall review the terms of the waiver at a public hearing and shall determine whether the discharge should instead be subject to general or individual WDRs.

5. On 26 March 1982, the Regional Board waived WDRs for 23 categories of discharges, including “food processing wastes spread on land” as set forth in Regional Board Resolution No. 82-036. The Regional Board acted as lead agency for this project under the California Environmental Quality Act (CEQA; Public Resources Code Section 21000 et seq.), and determined that the adoption of Resolution No. 82- 036 would not cause a significant environmental impact and therefore, in accordance with CEQA, approved a Negative Declaration dated 23 December 1981.

6. As required by CWC Section 13269, Resolution No. 82-036 expired on 1 January 2003.

7. The activities subject to this Resolution result in the generation and disposal of waste, as defined in California Water Code section 13050. Such waste has been typically discharged to

land. As described in this Resolution, due to the nature of the waste, such discharges could affect the quality of waters of the state. Discharges of waste in compliance with the conditions of this Resolution pose a lower threat to waters of the state, but still could affect the quality of the waters of the state. Waste discharged to land may migrate to groundwater or runoff to surface water and affect the quality of the waters. Groundwater monitoring from wineries and other food processing facilities subject to individual waste discharge requirements have shown that groundwater has been degraded from the discharge of process wastewater to land. Solid waste separated from wastewater and applied to land often contains residual wastewater that could affect the quality of the waters of the state. In addition, solid waste discharged to land may create odors if not properly managed, and, therefore, create a condition of nuisance. The Regional Board has received complaints about nuisance conditions at food processing facilities, including wineries. Waste discharged to tanks may leak or spill from tanks and affect the quality of waters of the state. Waste hauled from tanks may not be properly disposed of and, therefore, could affect the quality of waters of the state. Since discharges of waste in the manner described in this Resolution could affect the quality of the waters of the state, persons who discharge waste are subject to California Water Code section 13260 and 13263.

8. The Regional Board has reviewed the "food processing wastes spread on land" waiver category of Resolution No. 82-036 and has determined that the discharge of liquid and solid waste from small food processing operations, when subject to the conditions described in this Resolution, should pose a low threat of nuisance or water quality degradation.

9. As used throughout this document, the term "small food processor" includes small wineries.

10. The strength of process wastewater discharged from small food processors and wineries varies depending upon the season and the particular operation being performed. Monitoring data submitted to the Regional Board shows that the process wastewater contains the following characteristics:

Constituent	Units	Winery Concentration	Other Small Food Processors
PH	pH units	2 – 11	5 - 9
Biochemical Oxygen Demand	mg/l	300 – 12,000	1 – 2,000
Total Dissolved Solids	mg/l	80 – 6,000	400 – 2,300
Nitrogen	mg/l	1 – 50	1 - 17

11. If the food processing wastewater is applied to sufficient cropland at reasonable hydraulic and nutrient loading rates, and subject to the conditions of this Resolution, then there should be little potential for water quality degradation. The nitrogen in the wastewater, as well as some of the salts, will be utilized by the crops. In a well-aerated soil, the pH will be buffered and the biochemical oxygen demand will be reduced through microbial activity. This is enhanced by warm weather conditions, which are typical of the food processing season in the Central Valley Region. Best management practices to control irrigation tailwater will protect surface water quality.

12. Food processing residuals and wastewater, if not properly managed, can cause nuisance odors and attract vectors. However, use of best management practices, such as applying wastewater and residuals at agronomic rates, discing in residuals, and minimizing the potential for standing water, will prevent nuisance conditions.

13. Water is in short supply in some areas within the Central Valley Region, and winemakers in those areas may practice water conservation measures, producing less wastewater per gallon of wine than the industry average. Due to concentration effects, this wastewater may be of higher strength than that described in Finding No. 10. In order to determine reasonable nutrient loading rates, a Discharger may be required to submit an analysis of key wastewater constituents as part of the Report of Waste Discharge

14. Some smaller commercial wineries have determined that, for the volume of waste they generate, it is more cost effective to store their wastewater in a holding tank and then transport the wastewater to an authorized disposal facility instead of complying with the regulations for the discharge of wastewater onto land. There is little potential for water quality degradation with this method of wastewater disposal, when subject to the conditions of this Resolution.

15. This Resolution does not regulate the discharge of water - to which no chemical cleaning agents have been added - that is used for the soaking and final sanitary cleaning of pre-cleaned or new wine barrels. This clean water may be disposed of in any environmentally sound manner, including vineyard or landscape irrigation or discharge to a County-regulated septic system leachfield (in compliance with all applicable County regulations).

16. Small food processors, especially wineries, may grow over time and increase the volume of wastewater produced, and therefore an annual monitoring report is necessary to confirm that the food processor continues to meet the conditions of this waiver.

17. A waiver of the requirement to issue WDRs for waste discharges that (a) will cause no or insignificant impairment of water quality and (b) pose little risk of creating nuisance conditions is not against the public interest as it reduces the cost of activities that produce innocuous or small amounts of waste, is protective of the environment, and allows Regional Board staff to direct resources to address waste discharges that have significant potential to degrade water quality or create nuisance.

18. This Resolution is consistent with State Water Resources Control Board (State Board) Resolution No. 68-16 (Statement of Policy with Respect to Maintaining High Quality of Waters in California) in that the waiver of WDRs imposes conditions to prevent impacts to water quality, does not allow the degradation of water quality, will not unreasonably affect beneficial uses of water, and will not result in water quality less than that prescribed in plans and policies.

19. The Regional Board adopted a Negative Declaration when it adopted Resolution No. 82-036, and therefore, consistent with Title 14, California Code of Regulations (CCR) Section 15162, is not required to prepare a subsequent environmental impact report or negative declaration in renewing a specific category of discharge included in Resolution No. 82-036. In addition, the

action to adopt this Resolution is exempt from CEQA pursuant to 14 CCR Section 15308 because it is an action taken by a regulatory agency to assure the protection of the environment, and the regulatory process involves procedures for protection of the environment. Finally, the action to adopt this Resolution is also exempt from CEQA pursuant to 14 CCR Section 15301 to the extent that it applies to existing food processors that constitute "existing facilities" as that term is used in Section 15301.

20. Federal regulations for stormwater discharges have been promulgated by the U.S. Environmental Protection Agency (40 CFR Parts 122, 123, and 124) and require that specific categories of facilities which discharge stormwater obtain an NPDES permit. Wineries, and most food processors, are covered as one of the specific categories. The State Board has adopted Order No. 97-03-DWQ (General Permit No. CAS000001 or subsequent Order) specifying waste discharge requirements for discharges of stormwater associated with industrial activities, and requiring submittal of a Notice of Intent by all affected industrial dischargers. To apply for coverage under this waiver, a Discharger must either show that it is already covered (or specifically excluded) under Order No. 97-03-DWQ or (a) include a Notice of Intent to apply for coverage under Order No. 97-03-DWQ or (b) include a Notice of Non Applicability or a No Exposure Certification.

21. Section 13267(b) of the CWC provides that: "*In conducting an investigation specified in subdivision (a), the regional board may require that any person who has discharged, discharges, or is suspected of having discharged or discharging, or who proposes to discharge waste within its region, or any citizen or domiciliary, or political agency or entity of this state who has discharged, discharges, or is suspected of having discharged or discharging, or who proposes to discharge, waste outside of its region that could affect the quality of waters within its region shall furnish, under penalty of perjury, technical or monitoring program reports which the regional board requires. The burden, including costs, of these reports shall bear a reasonable relationship to the need for the report and the benefits to be obtained from the reports. In requiring those reports, the regional board shall provide the person with a written explanation with regard to the need for the reports, and shall identify the evidence that supports requiring that person to provide the reports*".

    The technical reports required by this Resolution and the attached "Monitoring and Reporting Program No. R5-2003-0106" are necessary to evaluate each Discharger's compliance with this waiver. Each individual Discharger operates the facility that discharges the waste subject to this Resolution.

22. Based on written comment and the testimony received at the public hearing, and based on the above noted facts and findings, the Regional Board finds that the Small Food Processor Waiver is not against public interest, provided that the dischargers subject to the waiver:

    (a) file with the Regional Board the required RWD and filing fee; and

    (b) comply with the conditions for this waiver of WDRs; and

(c) comply with applicable State Board and Regional Board plans and policies.

23. Based on the above-noted facts and findings, the Regional Board determines that it is not necessary at this time to adopt individual or general WDRs for the discharges described in this Resolution because these types of discharges are of low threat and Regional Board resources should focus on higher threat discharges.

24. Pursuant to CWC Section 13263(g), discharge is a privilege, not a right, and adoption of this waiver, and the receipt of a formal notification of a waiver of WDRs from the Executive Officer, does not create a vested right to continue the discharge.

25. The information contained in the Staff Report, which is attached hereto and made part of this Resolution by reference, has been considered in making decisions related to this matter.

26. The dischargers and other interested parties and persons were notified of the intent to adopt a Resolution waiving WDRs for small food processors, and were provided an opportunity to submit written comments and for a public hearing.

27. A public hearing was held on 11 July 2003 in Sacramento, California, and to consider all testimony and evidence concerning this matter.

THEREFORE BE IT RESOLVED that in accordance with CWC Section 13269, the Regional Board adopts this Resolution entitled "Waiver of Waste Discharge Requirements for Small Food Processors, Including Wineries" (hereafter informally referred to as "Small Food Processor Waiver" or "waiver") and waives the requirement to obtain WDRs for those dischargers who comply with the terms and conditions described in this document and who receive a waiver notification signed by the Executive Officer.

A. Applicability

This Waiver shall only apply to small food processors that meet the conditions listed below. Coverage under this Waiver shall only be granted to Dischargers who meet the conditions, submit a complete Report of Waste Discharge, and receive a formal waiver notification signed by the Executive Officer.

1. If wastewater and solid waste is applied to land at reasonable agronomic loading rates for nutrients and reasonable hydraulic loading rates for water:

   a. The Waiver applies to wineries that crush less than 80 tons of grapes per year or generate less than 100,000 gallons of wastewater per year.

   b. The Waiver applies to other small food processors (e.g., fruit dehydrators, walnut hullers, seed and nut processors, olive oil processors, etc.) that generate less than 100,000 gallons of wastewater per year.

2. If (a) wastewater is stored in a tank on-site prior to being hauled off-site for disposal at a permitted facility and (b) solid waste is applied to land at agronomic rates:

    a. The Waiver applies to wineries of any size.

    b. The Waiver applies to other small food processors (e.g., fruit dehydrators, walnut hullers, seed and nut processors, olive oil processors, etc.) of any size.

3. If, because of land constraints, a small food processor applies some of its wastewater and solid waste to land (as described in A.1) and removes the remainder of its wastewater (as described in A.2), then the Waiver applies to any small food processor or winery that generates less than 100,000 gallons of wastewater per year.

4. Wastewater may not be placed or stored in any impoundment (i.e., pond).

5. Process wastewater may not be discharged to any septic tank/leachfield system.

6. Wastewater and solid waste storage/disposal methods must comply with the General Conditions listed in Section C of this Waiver.

B. Report of Waste Discharge

1. Small food processors that are in existence as of the date of adoption of this Resolution, and wish to be granted coverage under it, shall submit a Report of Waste Discharge (RWD) within **90 days** of adoption of this Resolution. New small food processors which have not begun operation as of the date of adoption of this Resolution shall submit the RWD at least **120 days** before the anticipated date of discharge.

2. To be considered for coverage under this Waiver, the Discharger shall submit a RWD consisting of the following items:

    a. A completed Form 200 (*Application/Report of Waste Discharge)*. This document may be downloaded from the Internet at http://www.swrcb.ca.gov/sbforms/form200.pdf .

    b. A one-time filing fee for a threat and complexity of "3C" as described in Title 23, California Code of Regulations, Section 2200 (currently $400, although subject to change). The fee shall be submitted in a check made payable to the *State Water Resources Control Board*.

    c. If an existing winery, a copy of the most recent Alcohol and Tobacco Tax and Trade Bureau (TTB) *Report of Wine Premises Operations* (ATF F5120.17) clearly showing the tons of grapes crushed the previous year. If a new winery, the proposed tonnage of grapes to be crushed in the first year of operation.

d. If a winery that crushed over 80 tons of grapes the previous year, then an estimation of the volume of wastewater produced per calendar year, and a detailed description of the type and location of a flow meter that has been installed to measure all process wastewater flows.

e. If a small food processor or winery that proposes to dispose of wastewater as described in A.3 (above), then an estimation of the volume of wastewater produced per calendar year, and a detailed description of the type and location of a flow meter(s) that has been installed to measure all process wastewater flows. The flow meter(s) must be able to measure both the volume of wastewater discharged to land and the volume of wastewater hauled off-site.

f. If other type of food processor, a description of the type of food processed, an estimated volume of wastewater generated the past processing season, a description of the chemicals used in processing and/or equipment cleaning that may be present in the wastewater, the length of the processing season, and a description of how wastewater flows will be measured in the future.

g. A map, roughly to scale, showing the location of the facility, property boundaries, cropland, any domestic and/or irrigation wells within the property boundary, and any surface waterbodies within 1,000 feet of the property.

h. A description of whether the facility contains any ion exchange units, water softeners, boilers, or any other similar system which could generate saline wastes. If so, then describe how those waste streams will be segregated from the processing wastewater and disposed of.

i. Information showing how the Discharger has complied with State Board Order No. 97-03-DWQ (General Permit No. CAS000001 or subsequent Order) specifying waste discharge requirements for discharges of stormwater associated with industrial activities. The Discharger shall submit one of the following: information showing that coverage has already been obtained, information showing that the Discharger has been specifically excluded from the program, a Notice of Intent and filing fee for coverage under the Order, a Notice of Non Applicability, or a No Exposure Certification and filing fee. Additional information about this program may be obtained at http://www.swrcb.ca.gov/rwqcb5/available_documents/index.html#StormWaterPermits.

j. If wastewater will be collected in tanks and removed from the facility for disposal, then include a *Wastewater Disposal Operation and Maintenance Plan* describing the type and location of the tank(s), the person or entity which will transport the waste, and the name of the regulated facility which will accept the wastewater.

k. If wastewater will be applied to land, then include a *Wastewater Disposal Operation and Maintenance Plan* describing the number of acres to which wastewater will be applied, the crop(s) grown, estimated nutrient loading rates (for TDS, BOD, and total nitrogen, in lbs/ac/yr), how process wastewater flows will be measured or estimated, how the wastewater will be applied evenly over the entire acreage, how wastewater will be kept out of surface waters, how nuisance odors will be prevented, how the wastewater will be stored so that it is not applied to land during periods of precipitation or when the ground is saturated, and how the wastewater will be applied at reasonable agronomic and hydraulic loading rates.

l. If solid waste will be applied to land, then include a *Solids Disposal Operation and Maintenance Plan*. The Plan shall include information describing the waste type, annual tonnage, the location(s) where the waste will be stored, how the storage practices will protect groundwater and surface water quality, the disposal location(s), timing of application, method of spreading and/or tilling into the soil, annual application rate (in units of pounds/acre), and the best management practices that will be taken to prevent stormwater contamination by the solid wastes.

m. If solid waste will be removed from the facility, then include a *Solids Disposal Operation and Maintenance Plan* that describes how the waste will be stored, how the storage practices will protect groundwater and surface water quality, the person or entity which will transport the waste, and the name of the facility which will accept the solid waste.

n. If required by Regional Board staff, a chemical analysis of key wastewater constituents including at a minimum BOD, total nitrogen, pH, and TDS.

C. Specific Conditions

All small food processors shall comply with the following general conditions, as well as any site-specific conditions listed in the Executive Officer's formal Waiver notification.

1. The discharge shall neither degrade the quality of waters of the state nor create or threaten to create a condition of pollution, contamination, or nuisance as defined by CWC Section 13050.

2. The discharge of waste classified as "hazardous" under Title 23, California Code of Regulations (CCR), Section 2521 or as "designated" under CWC Section 13173 is prohibited.

3. The discharge of waste to surface water or surface water drainage courses is prohibited.

4. The discharge shall not contain waste from ion exchange units or water softeners, boiler blowdown wastes, or other waste having potentially high levels of total dissolved solids.

5. Wastewater shall not be discharged to impoundments (ponds) or leachfields.

6. Objectionable odors due to the storage and/or disposal of small food processing waste shall not be perceivable beyond the limits of the property owned by the Discharger.

7. The Discharger shall allow Regional Board staff reasonable access onto the affected property for the purpose of performing inspections to determine compliance with the Waiver conditions.

8. The Discharger shall take all reasonable steps to reduce the salinity of the wastewater.

9. If wastewater is applied to land:

    a. Wastewater shall not be applied to land 24 hours before a forecasted storm, during a storm, 24 hours after a storm, or when the ground is saturated.

    b. Wastewater shall be applied to crops at hydraulic rates and at agronomic rates for nitrogen and salt uptake.

10. If wastewater is stored on-site and hauled off-site for disposal:

    a. All liquid winery wastes must be contained in a holding tank in such a manner that the wastewater does not contact the ground.

    b. Winery wastewater shall be removed from the holding tank before capacity is reached, and may be removed by either a licensed septic hauler or by the Discharger.

    c. Winery wastewater shall be discharged to a permitted treatment facility or septage receiving station. The Discharger shall obtain a receipt for the transported waste from either the licensed septic hauler or the receiving facility.

11. If solid waste is applied to land:

    a. The storage and disposal of solid waste shall follow the site-specific *Solids Disposal Operation and Maintenance Plan* that is a required part of the RWD.

    b. Solid waste shall be dried (if desired) and stored in a location and manner such that any leachate is managed to prevent impacts to groundwater or surface water.

    c. Solid waste drying and/or storage areas shall be designed, constructed, operated, and maintained to prevent the washout or inundation due to floods with a 100-year return frequency.

d. Solids that are applied to land shall be managed in a manner such that no liquid in the material runs off the application area. No free liquids shall be included in livestock feed.

e. The buffering capacity of the soil profile shall not be exceeded due to the disposal of solid waste on the land.

f. Solid waste shall be applied to land at agronomic rates.

g. Grape stems may be segregated from the rest of the solid waste and applied to the vineyard property, including dirt roads, for erosion control. However, the stems must be applied in a manner and at a rate so as to prevent runoff into surface waters during storm events.

h. Any on-site composting shall comply with the composting regulations found in Title 14 CCR, Division 7, Chapter 3.1.

D. General Conditions

1. Each Discharger granted coverage under the Small Food Processor Waiver shall comply with Monitoring and Reporting Program No. R5-2003-0106, which is attached hereto and made a part of this Resolution, and with any revisions thereto as ordered by the Executive Officer.

2. The discharge of any waste not specifically regulated by this Waiver is prohibited unless the Discharger obtains WDRs, qualifies for coverage under another waiver, or obtains other permission from the Regional Board for the discharge of that waste.

3. If a Discharger receives coverage under this Waiver for one type of waste disposal method, but subsequently wishes to change disposal methods to another that is also allowed under this Waiver, then the Discharger must submit a new RWD and filing fee.

4. A copy of this Resolution and the formal waiver notification shall be kept at the facility for reference by operating personnel. Key operating and site management personnel must be familiar with the documents.

5. The RWD, monitoring reports, and any other information requested by the Regional Board shall be signed by a person described as follows, or a duly authorized representative of that person. For a corporation: by a principal executive officer of at least the level of senior vice-president. For a partnership or sole proprietorship: by a general partner or the proprietor. For a municipality or public agency: by either a principal executive officer or ranking elected or appointed official.

6. Any person signing a RWD, monitoring report, or other technical report makes the following certification, whether written or implied:

"I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

7. All technical and monitoring reports submitted pursuant to this Waiver are required pursuant to CWC Section 13267. Failure to submit reports in accordance with schedules established by this Waiver, the attachments of this Waiver, or failure to submit a report of sufficient technical quality to be acceptable to the Executive Officer, may subject the Discharger to enforcement action pursuant to CWC Section 13268.

8. In the event of any change in control or ownership of land or waste discharge facilities presently owned or controlled by the Discharger, the Discharger shall notify the succeeding owner or operator of the existence of this Waiver by letter, a copy of which shall be immediately forwarded to the Executive Officer.

9. In the event that the Discharger does not comply, or will be unable to comply, with any conditions of this Waiver, the Discharger shall notify Regional Board staff by telephone as soon as it or its agents have knowledge of such noncompliance or potential for noncompliance and shall confirm this notification in writing within two weeks. The written notification shall state the nature, time, and cause of noncompliance, shall describe the measures being taken to prevent recurrences, and shall include a timeline for corrective actions.

10. The Discharger shall permit Regional Board representatives to (a) enter premises where wastes are stored or disposed of, (b) copy any records required to be kept under the terms of this Resolution, (c) inspect monitoring equipment required by this Resolution, and (d) sample, photograph, and video tape any discharge, waste, waste management unit, or monitoring device.

11. The Discharger shall comply with all federal, state, county, and local laws and regulations pertaining to the discharge.

12. It shall not be a defense for a discharger in an enforcement action that it would have been necessary to halt or reduce its activity in order to maintain compliance with conditions of this Waiver.

13. The Discharger must comply with all conditions of this Waiver, including timely submittal of all monitoring reports. Violations may result in enforcement action under the CWC, and could include Regional Board orders, the imposition of civil liability, cessation of coverage under this Waiver, or referral to the Attorney General.

14. A Discharger may be granted coverage under this Waiver and subsequently expand its operations or change its method of discharge such that it no longer meets the conditions of his Waiver. In that case, the Discharger shall submit a RWD for individual WDRs or an applicable General WDRs at least **120 days** before it no longer meets the conditions of this Waiver.

15. Except for material determined to be confidential in accordance with California law and regulations, all reports prepared in accordance with terms of this Waiver will be available for public inspection at the Regional Board offices. Data on waste discharges, water quality, geology, and hydrogeology will not be considered confidential.

16. A discharger who discharges any waste not specifically regulated by this Waiver may not discharge such waste except in compliance with the CWC.

17. As provided by CWC Section 13350(a), any person may be civilly liable if that person, in violation of a Waiver condition or WDRs, intentionally or negligently discharges waste, or causes waste to be deposited where it is discharged, into the waters of the State and creates a condition of pollution or nuisance.

18. Pursuant to CWC Section 13269, this action waiving the issuance of WDRs for small food processors (a) is conditional, (b) may be terminated at any time, (c) does not permit an illegal activity, (d) does not preclude the need for permits which may be required by other local or governmental agencies, and (e) does not preclude the Regional Board from administering enforcement remedies (including civil liability) pursuant to the CWC.

19. The Executive Officer or Regional Board may terminate the applicability of the Small Food Processor Waiver described herein as to any individual discharger at any time when such termination is in the public interest or the activity could affect the quality or beneficial uses of the waters of the State.

20. This Small Food Processor Waiver shall become effective on 11 July 2003 and shall expire on 11 July 2008, unless terminated or renewed by the Regional Board prior to that time.

21. The Regional Board may review the Small Food Processor Waiver at any time and may modify or terminate the waiver in its entirety, as applicable for a specific type of food processing discharge, or for individual dischargers, as appropriate.

I, THOMAS R. PINKOS, Executive Officer, do hereby certify that the foregoing is a full, true, and correct copy of a Resolution adopted by the California Regional Water Quality Control Board, Central Valley Region, on 11 July 2003.

THOMAS R. PINKOS, Executive Officer

AMENDED
WSW:11-Jul-03

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
CENTRAL VALLEY REGION

MONITORING AND REPORTING PROGRAM NO.

FOR RESOLUTION NO.
A WAIVER OF WASTE DISCHARGE REQUIREMENTS
FOR
SMALL FOOD PROCESSORS, INCLUDING WINERIES,
WITHIN THE CENTRAL VALLEY REGION

This Monitoring and Reporting Program (MRP) describes requirements for monitoring the wastewater discharges from small food processors who have been granted a formal waiver of waste discharge requirements pursuant to the Small Food Processor Waiver. This MRP is issued pursuant to Section 13267 of the California Water Code. The Discharger shall not implement any changes to this MRP unless and until a revised MRP is issued by the Executive Officer.

Each Discharger granted coverage under the Small Food Processor Waiver shall submit an annual monitoring report no later than **1 February** of each year. The report shall describe activities during the previous calendar year, and shall contain the following information:

1. A statement of whether wastewater was applied to land, whether wastewater was stored on-site and hauled off-site, whether solid waste was applied to land, and whether solid waste was disposed of off-site.

2. If wastewater was applied to land, then provide:

    a. If a winery, a copy of the most recent Alcohol and Tobacco Tax and Trade Bureau (TTB) *Report of Wine Premises Operations* (ATF F5120.17) clearly showing the tons of grapes crushed.

    b. If a winery, and more than 80 tons of grapes were crushed, a data table showing the monthly process wastewater flow measurements and the total gallons of wastewater produced during the calendar year.

    c. If other type of food processor, provide the dates that processing occurred, and a data table showing the monthly process wastewater flow measurements and the total gallons of wastewater produced during the calendar year.

    d. For all types of food processors: (1) the number of acres to which wastewater was applied, (2) the approximate dates of discharge, (3) the crop(s) grown, (4) a description of how wastewater was applied evenly over the entire acreage and how it was kept out of surface waters, (5) whether nuisance odors were prevented, and (6) how the wastewater was stored so that it was not applied to land during periods of precipitation or when the ground is saturated.

3. If wastewater was stored on-site and then taken off-site for disposal, provide:

   a. Copies of receipts from the licensed septic hauler or disposal facility.

   b. The results of a monthly inspection of the condition of the storage tank(s). The inspection shall focus on the potential for leakage from the tank(s).

4. If wastewater was both applied to land and hauled off-site for disposal, then provide:

   a. The information required in Numbers 2a, 2c, 2d, 3a, and 3b (above).

   b. A data table showing the total monthly process wastewater flow measurements, broken down by the monthly flows to land and monthly flows to the storage tank(s).

5. If solid waste was applied to land, provide:

   a. An estimation of the amount of solid waste generated and where it was stored.

   b. The amount of solid waste disposed of on-site and the amount of solid waste removed for disposal off-site.

   c. The location of disposal, acreage, and cropping pattern.

6. If solid waste was taken off-site for disposal, provide copies of receipts from the licensed hauler or disposal facility.

A transmittal letter shall accompany each report. Such a letter shall include a discussion of any violations found during the reporting period, and actions taken or planned for correcting noted violations, such as operational or facility modifications. If the Discharger has previously submitted a report describing corrective actions and/or a time schedule for implementing the corrective actions, reference to the previous correspondence will be satisfactory. The transmittal letter shall contain the penalty of perjury statement by the Discharger, or the Discharger's authorized agent, as described in General Information Nos. D.5 and D.6 of the Small Food Processor Waiver.

The Discharger shall implement the above monitoring program as of the date of coverage under the Waiver.

THOMAS R. PINKOS, Executive Officer

Date

WSW: 4 August 2003

Staff Report
11 July 2003 Central Valley Regional Water Control Board Meeting

Resolution Considering Approval of a
Waiver of Waste Discharge Requirements for
Small Food Processors, Including Wineries,
Within the Central Valley Region

As directed by the Regional Board at its March 2003 meeting, staff has prepared a proposed "Waiver of Waste Discharge Requirements for Small Food Processors, Including Wineries". Those food processors who qualify for coverage under this waiver will discharge waste in a manner that constitutes a low or negligible threat to water quality.

Applicability of the Waiver
The waiver applies to small food processors and wineries who discharge wastewater and residual solid waste in one of three ways:

- If wastewater and solid waste is applied to cropland at reasonable agronomic and hydraulic loading rates, then the following facilities may be covered: (a) wineries that crush less than 80 tons of grapes per year, (b) wineries that crush over 80 tons of grapes but generate less than 100,000 gallons of wastewater per year and meter their flows; (c) other small food processors that generate less than 100,000 gallons of wastewater per year and meter their flows.

- If (a) wastewater is stored in a tank on-site prior to being hauled off-site for disposal at a permitted facility and (b) solid waste is applied to land at agronomic rates, then the waiver applies to any size winery or food processor.

- If, because of land constraints, a small food processor or winery applies some of its wastewater and solid waste to land at reasonable agronomic and hydraulic loading rates, and removes the remainder of its wastewater through tanking and hauling to a permitted facility, then the waiver applies to any small food processor or winery that generates less than 100,000 gallons of wastewater per year and meters its flows.

Major Components of the Waiver
To receive coverage, a Discharger would submit a short Report of Waste Discharge (RWD) and a one-time filing fee (currently $400, corresponding to the lowest threat and complexity rating). Upon receiving written notification of coverage by the Executive Officer, the Discharger would be required to comply with the specifications and provisions of the waiver, and to submit a simple monitoring report once per year. The waiver is designed such that a Discharger should be able to complete both the RWD and monitoring reports without needing to obtain the services of a California Registered Engineer or Geologist.

The California Water Code states that a Regional Board must review waivers at least once every five years. This waiver would be in effect for the entire five year period, after which time the Regional Board would review available information, including the annual monitoring reports, to determine whether the waiver should be renewed as is, renewed with modifications, or not renewed.

Public Input
On 25 March 2003, staff sent a letter to over 400 industry groups, individuals, and interested persons, advising them that a waiver of waste discharge requirements was under preparation and soliciting input on certain items, including the winery size to which the waiver should apply, waste disposal methods which are protective of water quality, and the submittal of a RWD, filing fee, and annual reports. Seven responses were received. Two individuals stated that wastewater from 5,000-6,000 cases of wine per year could be discharged to septic tanks without any adverse impacts. However, this analysis was made based on flow only, not the strength of the waste or depth to groundwater. Three individuals advocated the discharge of wastewater to land as a method to protect water quality, one individual asked that staff follow the direction of the Central Coast Regional Board, and one individual believes that very small wineries produce a low strength waste.

On 9 May 2003, the draft waiver was sent to the same 400+ person mailing list. Interested persons were provided with a 30 day public comment period, 20 days longer than required by the California Water Code. Staff received 14 comment letters. This staff report describes the changes that were made to the waiver in response to the comments, and the remaining issues. On 24 June 2003, the agenda package, containing the draft revised waiver, will be sent to the entire mailing list. As described in the Notice of Public Hearing, additional written comments will be considered if submitted prior to 8:30 a.m. on 7 July 2003. Any interested person may also provide comments directly to the Regional Board during the hearing to consider adoption of this waiver on 11 July 2003.

Rationale for Specific Components of the Waiver

Size Limitation for Wineries Applying Wastewater to Land
Staff has carefully considered the size limitation for wineries presented in this Order. Staff have determined that it is not appropriate to use the 1,500 case (approximately 20 tons grapes crushed) limit developed by San Joaquin County to define “boutique” wineries, as the regulations surrounding this limit apply to issues unrelated to wastewater discharge.

Staff has reviewed the Central Coast Regional Board’s General WDRs for discharges of winery waste, adopted in November 2002. This General Order specifies that a “small” winery may receive a waiver of WDRs if (a) they crush less than 80 tons of grapes or produce less than 5,000 cases of wine annually, (b) provide proof that depth to groundwater at the disposal area is greater than 100 feet (for septic tank/leachfield disposal of waste), (c) provide proof that depth to groundwater is greater than 20 feet if wastewater is incorporated into the vineyard irrigation water and applied at agronomic rates, (d) provide written certification of the intent to comply with the General WDRs, and (e) receive a written notice from the Executive Officer that WDRs have been waived.

While Central Valley staff would prefer prescribing a winery size limitation based on the actual annual volume of wastewater produced, we understand that this would require that winery owners install flow meters and periodically record the results. While that is an appropriate cost for the larger facilities covered by WDRs, it may not be necessary for the smallest facilities. Therefore, staff considered a size limitation based on either cases of wine produced or tons of grapes crushed. Neither approach is ideal, as some wineries crush their grapes and then sell bulk wine to other facilities. A limit based on cases of wine produced would not account for the excess wastewater generated during crush by the facilities that sell bulk wine, and a limit based on tons crushed does not account for the wastewater generated from handling the bulk wine. Nevertheless, staff believe that a limit based on tons crushed is fairly accurate, and a value which winemakers are already required to report to the federal Alcohol and Tobacco Tax and Trade Bureau.

Staff proposes that the waiver contain a size limitation of 80 tons of grapes crushed per year. This is consistent with the Central Coast Regional Board, and corresponds to approximately 5,000 – 6,400 cases of wine (depending on the variety and quality of grape and the winemaker's preferences) and to approximately 27,000 to 121,000 gallons of wastewater (assuming between 2 and 8 gallons of wastewater per gallon of wine produced).

Several comments have been received stating that winemakers that crush greater than 80 tons of grapes should also be allowed coverage under the waiver, as long as they produce less than 100,000 gallons of wastewater per year (the same limitation as for other small food processors, as described below). Staff understand that water is in short supply in some areas of the Sierra Foothills, and those winemakers therefore produce less wastewater than the industry average. In order to provide parity with the other small food processors, the waiver has been revised to apply to wineries that crush more than 80 tons of grapes but produce less than 100,000 gallons of wastewater. However, these wineries will be required to meter their wastewater flows, just as other small food processors must meter their flows. Staff recognize that winery process wastewater flows do not include the water - to which no chemical cleaning agents have been added - that is used for the soaking and final sanitary cleaning of pre-cleaned or new wine barrels.

Size Limitation for Other Small Food Processors Appling Wastewater to Land
This waiver is intended to apply to other small food processors in addition to wineries. These food processors typically have a limited season (for example, prune dehydrators or walnut hullers) and have a wastewater strength comparable to winery wastewater. Because of the variety of food processors which may apply for coverage under this waiver, it is not appropriate to list the volume of product processed to determine the size limitation for coverage. Instead, it is more appropriate to describe a wastewater flow limitation. In order to be consistent with the wineries, and because the wastewater strength is similar, this waiver will apply to food processors with a wastewater flow of less than 100,000 gallons per year. Individual dischargers will be required to meter their wastewater flow to determine compliance. In some cases, it may not be necessary to install flow meters; instead it may be appropriate to record run times from existing pumps (either on water supply wells or on discharge pumps).

Size Limitation for Small Food Processors that Tank/Haul their Wastewater
Some smaller commercial wineries have determined that, for the volume of waste they generate, it is more cost effective to store their wastewater in a holding tank and then transport the wastewater to an authorized disposal facility instead of complying with the regulations for the discharge of wastewater onto land. It is emphasized that the Regional Board is not requiring any small food processor to utilize this method of waste disposal; this disposal method was proposed by some of the smaller foothill wineries, and the use is a personal choice based on economics and permit compliance issues. The 9 May 2003 version of the draft waiver stated that wineries which tank/haul their wastewater, and crush less than 80 tons of grapes per year, would be eligible for coverage. Since that time, staff talked with industry representatives and realized that very few, if any, wineries

that crush over 80 tons of grapes would choose to haul off their wastewater. As stated above, crushing 80 tons of grapes produces approximately 100,000 gallons of wastewater. The average hauling/disposal rate charged by septic haulers is 25-30 cents/gallon of wastewater, leading to an annual cost of $25,000 to $30,000 to dispose of wastewater from a winery crushing 80 tons of grapes/year. If a winery has available land, it would probably be more cost effective to install an irrigation system to dispose of the wastewater at reasonable agronomic and hydraulic loading rates, than to tank/haul the wastewater.

Based on this understanding, the waiver has been revised to state that it applies to any winery or small food processor, regardless of size, that chooses to tank/haul its wastewater. In addition, staff are recommending that the Regional Board consider rescinding General Order No.R5-2003-0029, the *General Waste Discharge Requirements for the On-Site Storage and Off-Site Disposal of Wastewater Generated by Commercial Wineries Within the Central Valley Region.* The net result of this action is that any small food processor that tanks/hauls its wastewater will be covered by a waiver, the Discharger will only pay a one-time filing fee instead of an annual fee, and will only submit an annual monitoring report instead of semi-annual monitoring reports. The waiver has been revised to include all applicable Discharge Specifications from General Order No. R5-2003-0029. Therefore, the waiver will protect water quality to the same degree as the General Order.

Wastewater Disposal Methods

This waiver is only applicable to those discharges of waste which have little potential to create nuisance conditions (odors, mosquitoes, flies, etc.) and have little potential to impact water quality. There are four main constituents in winery and other food processing wastewater that may impact water quality. As shown in the table below, the strength of winery waste is variable, depending on the season and the particular operation being performed. Monitoring data submitted to the Regional Board shows that these concentration ranges are fairly constant, regardless of the size of the winery. The peak wastewater strength and volume is generally during the grape crushing season, which takes place from about August to October. Other operations such as cleaning equipment and tanks can generate high strength waste streams. It also be should be noted that many small wineries have reduced their water use, and therefore they generate higher strength wastewater (i.e., through less dilution). The wastewater strength from other food processors is also presented in the table. This data is from Reports of Waste Discharge and monitoring reports submitted by food processors currently regulated by the Board, and includes wastewater from fresh fruit packers (apple, cherry, apricot), prune dehydrators, seed producers, and a producer of soy/rice products.

Constituent	Units	Winery Concentration	Other Small Food Processors	Domestic Sewage Concentration	Groundwater Criteria
PH	pH units	2 - 11	5 - 9	6 - 8	6.5 – 8.5
BOD	mg/l	300 – 12,000	1 – 2,000	100 - 400	None
TDS (salts)	mg/l	80 – 6,000	400 – 2,300	150 – 1,000	450
Nitrogen	mg/l	1 - 50	1 - 17	20 - 50	10

The application of wastewater to cropland at reasonable hydraulic and agronomic loading rates is a long-standing practice that is typically protective of the underlying groundwater. The nitrogen in the wastewater, as well as some of the salts, will be utilized by the crops. In a well-aerated soil, the pH will be buffered and the biochemical oxygen demand will be reduced through microbial activity. This is enhanced by warm weather conditions, which are typical of the food processing season in the Central Valley Region. This waiver applies to those dischargers who dispose of wastewater in this manner. The individual discharger will need to show, through the Report of Waste Discharge, that the particular site contains sufficient land to assimilate the waste. Some example calculations follow:

A winery crushing 80 tons of grapes will generate between 27,000 and 121,000 gallons of wastewater. Using conservative values, the winery will generate 100,000 gallons of wastewater on an annual basis, containing 50 mg/l of total nitrogen, 12,000 mg/l of biochemical oxygen demand (BOD), and 6,000 mg/l of total dissolved solids (TDS). These values equate to 41 pounds of nitrogen, 10,000 lbs of BOD, and 5,000 lbs of TDS. This waste needs to be spread over sufficient cropland to take up the waste. On a hydraulic loading basis, 100,000 gallons of wastewater equates to approximately 4" of wastewater spread over an acre within a year's time. This is acceptable from a hydraulic and nitrogen loading basis, but would result in an over application of BOD and TDS. Therefore, additional acreage would be required. Individual WDRs for food processing wastewater discharges typically restrict BOD loading rates to no more than 300 lbs BOD/ac for a single day (to prevent nuisance/odor conditions) and an average of 100 lbs BOD/ac over the entire processing season (to prevent water quality degradation). Plants can uptake approximately 2,000 lbs of salt/acre/year. Some of this salt load is provided in the irrigation water and in fertilizer. In the above case, a winery producing 100,000 gallons of wastewater would need to spread the waste evenly over at least 5-6 acres of land (depending on the salt content of the irrigation water, amount of fertilization, the BOD strength of the wastewater during crush, and whether wastewater will be applied to the entire acreage).

Each individual discharger will need to describe and/or provide calculations showing the nutrient loading rates, how they plan on applying the wastewater, whether any dilution will take place through the application of irrigation water, how many acres would be necessary to prevent groundwater degradation, how they will ensure that the wastewater is evenly spread over the land, and how they will ensure that the wastewater does not run off into surface waters.

The El Dorado Winery Association states that it is developing a "wastewater management model" based on soil characteristics, geology, hydrogeology, and topography. Staff anticipate that wineries that utilize this model could apply for coverage under this waiver, if they meet the size limitations. The model, applied to the specific winery, would supply the information necessary for the Report of Waste Discharge.

Specific Prohibitions
This waiver does not allow the discharge of wastes from ion exchange units, water softeners, boilers, or any other operation with a potential to create waste containing high concentrations of total dissolved solids. Waste from small food processors contains high concentrations of total dissolved solids, and crops will only uptake a limited amount of salts. In order to protect underlying groundwater, these specific high-strength wastes must be disposed of in a separate manner.

Industries that use brining, curing, or caustic solutions in the processing are specifically exempt from coverage under this waiver. Animal slaughterhouses and/or meat processing facilities cannot be covered by this waiver.

The waiver does not allow wastewater to be placed in impoundments (any sort of pond), whether for treatment, temporary storage, or long-term storage. The placement of concentrated waste in a pond has the potential to impact water quality, and in fact, has already impacted water quality at some wineries and food processors. The use of treatment or storage ponds will be regulated under either individual WDRs or a possible future General Order for land discharge.

The waiver states that wastewater must not be applied to land 24 hours before a predicted storm, during a storm, 24 hours after the storm ceases, or when the ground is saturated. This is a standard specification in land discharge permits, and is necessary to ensure that wastewater will not co-mingle with stormwater. In order to implement this specification, it is expected that the dischargers granted coverage under this waiver will either modify their operations so that they are not producing wastewater during storm events, or will have some method (such as an above ground or underground tank) to allow the wastewater to be stored during storm events.

Report of Waste Discharge
A Report of Waste Discharge (RWD) is necessary to describe an individual food processor's operation and to show that waste is (or will be) discharged in a manner that complies with the waiver. The waiver describes the items that are to be included in the RWD. The RWD is simple enough that an individual discharger should be able to complete it directly; there should be no need to hire a consultant. It should also be noted that the Board usually requires the items of a RWD pertaining to wastewater treatment, storage, and disposal be prepared under the direction of a California Registered Engineer or Geologist. However, that is not required in this case. The RWD is to include a one-time filing fee that corresponds to the lowest threat and complexity site, as described in Title 23, California Code of Regulations, Section 2200. That filing fee is currently $400, and is necessary to cover staff's time to review the RWD, prepare the coverage letter, review the annual monitoring reports, and complete other administrative tasks.

Annual Report
An annual report is necessary for several reasons. First, the Board will need to review the waiver within five years, and will need to have data to show a history of compliance. Also, it is anticipated that many small food processors, especially wineries, will grow over time. An annual report is necessary to show that the discharger continues to meet the conditions of waiver, including the size and/or flow limitations. If a discharger exceeds the limits within this waiver, then it will be required to apply for individual WDRs or a General Order, as applicable.

Outstanding Issues

Septic Tank/Leachfield Discharges
Staff realize that a number of small wineries currently discharge their wastewater to septic tanks and leachfields. While we concur that the volume of wastewater generated by crushing 70-80 tons of grapes is comparable to the volume generated by a large household (although a winery generates much larger volumes during crush), the *strength* of the winery wastewater is substantially stronger (as shown in the above table). Staff do not believe that soil beneath a subsurface leachfield is able

to treat the high BOD, salt, and nitrogen concentrations in winery wastewater to levels that will not degrade the underlying groundwater. Despite a request for input in the 25 March 2003 letter to the winery mailing list, the industry has not provided any rationale as to how this could happen either. Without sufficient treatment in the soil beneath a leachfield, untreated waste will migrate into the groundwater and cause degradation.

Staff has reviewed available literature to see if septic tanks/leachfields are recommended as a method for the treatment and/or disposal for food processing wastewater. Neither the US EPA[1] nor the California League of Food Processors[2] recommends this type of system. A septic tank performs in essentially the same way as a sedimentation pond, and can reduce the BOD concentration significantly in wastewaters high in settable solids. However, sedimentation systems alone are ineffective in treating wastewater primarily composed of dissolved BOD, such as winery wastewater [3]. Additionally, unless such systems are specifically sized and designed to allow adequate solids settling during peak or slug flows, effluent quality will be variable [1, 2]. In any case, dissolved solids (TDS) will not be removed by a septic tank.

The Central Coast Regional Board's General Order allows a waiver for wineries using leachfields for disposal as long the discharger can "provide proof" that the depth to groundwater at the disposal area is greater than 100 feet. The Regional Board typically requires that such proof be provided in a report prepared and stamped by a California Registered Engineer or Geologist. The professional would review such items as well logs, sources of springs, depth to bedrock, the potential for perched groundwater, and the potential for fractured flow, and provide an opinion based on their professional expertise. The need to provide data stamped by a registered professional is a standard requirement for other dischargers, and would therefore be expected from wineries documenting the depth to groundwater. Many small wineries in the foothill counties are in areas with shallow soils and fractured bedrock. It seems unrealistic that many, if any, sites could provide proof that there is at least 100 feet to first groundwater beneath their leachfield. It should also be pointed out that this waiver is intended to be a simple tool for both the discharger and staff. The minimal one-time filing fee provided with the RWD does not permit staff to review in-depth analyses of groundwater conditions. That review is more appropriate in the development of site-specific WDRs.

Staff of the Central Valley Regional Board have discussed the discharge of winery wastewater with staff from the Central Coast and North Coast Regional Boards. Neither of these Regional Boards has required a winery with a septic tank/leachfield disposal system install groundwater monitoring wells to determine whether this disposal method is degrading groundwater. It appears that the Central Valley Regional Board has required the most groundwater monitoring at wineries (although

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[1] USEPA 1977. Pollution Abatement in the Fruit and Vegetable Industry, Basics of Pollution Control/Case Histories (EPA-625/3-77-0007-V.1).

[2] Brown and Caldwell, et al., 2002. Manual of Good Practice, Land application of Food Process/Rinse Water, California League of Food Processors, Sections 8.1.3 and 8.2.

[3] Storm, David R., 2001. Winery Utilities Plan, Design, and Operation, Aspen Publisher, Inc., Gaithersburg, MD, pp 201-204 and 227-235.

not a wineries with septic tank/leachfields) and has found groundwater degradation beneath a significant number of wineries, even when waste is being discharged in conformance with individual WDRs. Per the California Water Code, waivers are only appropriate when shown to be not against the public interest. It is not in the public's interest to allow groundwater degradation. Therefore, it is not appropriate to allow the discharge of winery process wastewater (or the process wastewater from any small food processor) to septic tanks/leachfields due to the strength of the wastewater, the lack of treatment in the soil beneath a leachfield, and the lack of any proof that such a discharge is protective of groundwater. It is noted that the discharge of process wastewater to septic tanks/leachfields is to systems that have never been permitted by the Regional Board, and that the Board cannot legally allow the use to continue unless the Discharger complies with State Board Resolution No. 68-16 (the "Anti-degradation Policy") and other Basin Plan requirements. No winery owners have attempted to establish that the discharge is consistent with Resolution No. 68-16, and if one did, a waiver is not an appropriate vehicle for allowing degradation under that policy. Those individuals that currently discharge to leachfields will either need to change the waste disposal system to comply with the waiver, or will need to apply for coverage under individual WDRs or for the possible future land disposal General WDRs.

Delay Consideration of this Waiver
The Wine Institute has submitted comments stating that it is conducting an on-going study on the discharge of wastewater to land and that its recent Code of Sustainable Winegrowing Practices "addresses the best management practices necessary to ensure the protection of waters of the state." The Wine Institute asks that the Board postpone consideration of the waiver "until additional science can be provided justifying the waiver based on agronomic rates".

The Wine Institute's ongoing land disposal study currently concerns the discharge of process wastewater and stillage to disposal (non-cropped) basins. Staff have reviewed the initial results from the three month study, and are concerned about the movement of a number of constituents through the vadose zone and potentially into groundwater. Staff believe that this study has no bearing on this waiver because the waiver is only concerned with two specific disposal practices: application of wastewater at reasonable agronomic and hydraulic loading rates onto cropped land, and the tanking/hauling of wastewater. Staff have also reviewed the Code of Sustainable Practices, commend the industry on its proactive stance. The "Winery Water Conservation and Quality" Chapter emphasizes water conservation practices. The chapter does not cover salinity reduction practices or disposal methods that are protective of water quality. Staff believe that the Code of Sustainable Practices has no bearing on consideration of this wavier.

Several comments have been received regarding the need for this waiver. The waiver is seen as an economic, expedient method for permitting new wineries. A start-up winery has many different permitting and business decisions, and many small wineries have stated that they will tank/haul their wastewater in the first few years. This allows them to direct their resources to the myriad of other issues needed to begin operation, and allows them to easily dispose of their wastewater in the short-term. As they grow, they can later explore other options for wastewater disposal. The waiver will allow staff to easily permit these new wineries, and in turn, allow the Counties to issue building permits to these new businesses.

Recommendation

Staff recommend that the Board adopt the proposed Waiver for Small Food Processors. This waiver is necessary at this time to regulate many of the small food processors within the region, and the many new wineries which are starting up within the region. A number of entities have submitted comments agreeing with the premise of the waiver, including the annual monitoring report and one-time filing fee. The waiver has been revised to include a number of recommendations by the industry. Staff recognize that the industry is investigating the water quality impacts of food processing wastes discharged to land, and respond that once new data is developed, the Board may wish to consider revising this waiver or may wish to regulate the industry in a different manner.

WSW: 20June 03

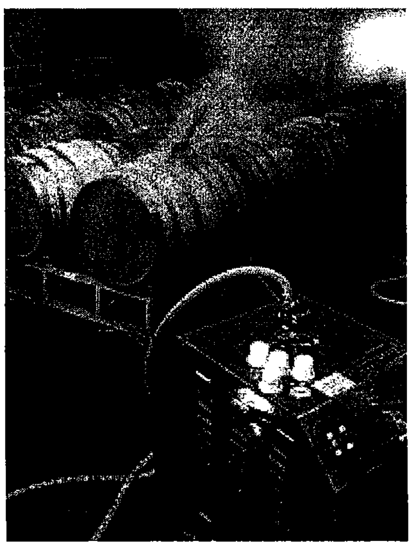
Appendix H: Steam Cleaning to Reduce Water Use

Product Review: Electric Steam Generators

Steam cleaning is quick, cost-effective and saves water in the winery.

By Bill Pregler

From Wine Business Monthly, 10/15/2007



Steaming barrels takes only three minutes. (Photos by Bill Pregler)

Using hot water to "sanitize" bottling lines, barrels and tanks is rapidly becoming too much water down the drain. It is time to consider an environmental and economic alternative that not only raises temperature to "sterilize" but uses virtually no water. Looking at the bottom line, wineries are increasingly turning to steam.

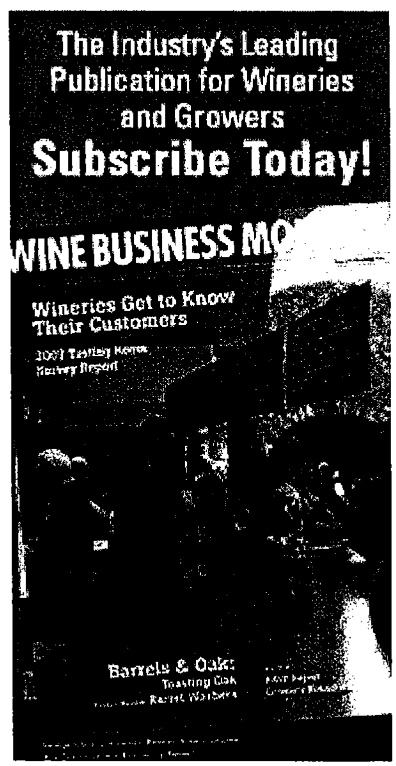
Aside from producing minimal wastewater, generating steam is quick, saves money and is considerably more effective than a typical 180-degree water "bath." Raising the "temperature bar" to 212°F elevates the "kill ratio" or LD (Lethal Dose) on molds and bacteria beyond sanitary to sterile. For years, this is why steam has been the standard for the medical and pharmaceutical industries.

A few disadvantages exist, such as the fact that steam generators are "power hungry," but that is offset by the dramatic time savings required to complete a job. In addition, it is necessary to have three-phase power and optimally be wired for 480 Voltage power. Lastly, there are valid concerns about workers using steam, and so proper procedures and training must be in place to address potential injury.

CLASSIFIEDS

Grapes & Bulk Wine	[go to]
sauvignon blanc	grape|Mar 28
merlot	grape|Mar 28
Winejobs	[go to]
harvest cellar & lab	CA|Mar 28
district sales manag	MA|Mar 28
Used Barrels	[go to]
looking for demi-m	CA|Mar 28
brett free '06 brg	CA|Mar 27
Used Equipment	[go to]
zambelli gamma 25	WA|Mar 28
krones, automatic	CA|Mar 27
Real Estate	[go to]
Land - Santa Rita H	CA|Mar 28
Other	VA|Mar 27

WINE BUSINESS MONTHLY



INDUSTRY EVENTS

Mar 26 - Mar 28

37th Annual New York Wine Industry Workshop and NY Wine and Grape Foundation Annual Seminar (Geneva, NY)

Mar 29 - Mar 30
Finger Lakes International Wine Competition (Rochester, NY)

Apr 02 - Apr 03
2008 Brewers and Vintners Scientific Symposium and Workshop (Davis, CA)

[go to industry events]

INDUSTRY LINKS

- Industry Statistics
- Reports and Consulting Firms
- Resources Online
- Trade & Research Journals
- Newsletters
- Consumer Publications
- Associations - National
- Associations - Regional
- Associations - Viticulture
- Educational Sources
- Research

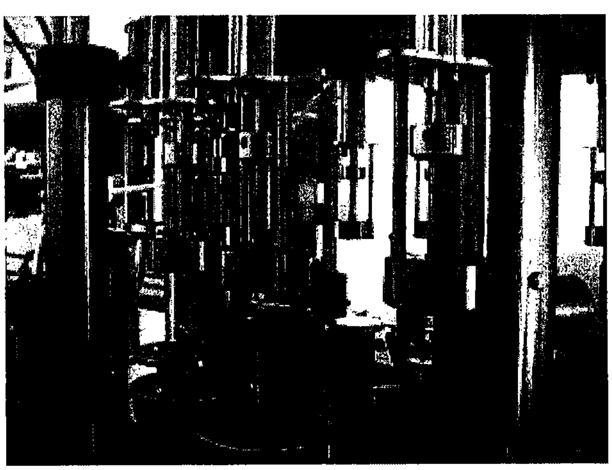
The benefits of steam, however, far outweigh the disadvantages, and in the pursuit of better winery hygiene and with an eye to the environment, *WBM* decided to look at some obvious applications for steam. When buying into the concept, several other issues must be considered: sizing equipment, choosing accessories and the need for portability. The first task, however, is to define the theory behind steam cleaning, including latent heat of vaporization.

How Steam Works

It is important to remember that you do not create energy. Energy already exists and is merely transferred. The merits of steam are based on its ability to quickly transfer high levels of temperature. It should not be viewed as anything more than an efficient vehicle that stores, then transfers, energy.

When discussing water, we usually think of two factors: latent heat of fusion, which turns solid ice into a liquid, and latent heat of vaporization, which turns that liquid into a gas. Obviously, energy has to be absorbed to move molecules apart (ice to liquid). To change liquid into a gas and overcome the strong attraction between water molecules requires substantially more energy.

There is also "wet steam," what you see when looking at a pot of boiling water. Then there is "dry-saturated" steam, meaning that 98 percent of the total water "droplets" has been fully converted into a gas. This is the form of steam that should be used in the winery and by far represents the most efficient form of transferable heat.



Transference of heat, when using only hot water, is done via absorption. The object must be subjected to a constant flow or "bath." It is a less efficient process requiring longer periods of time and considerable amounts of water. Latent heat of vaporization, or steam, transfers its entire amount of stored energy (212°F of temperature) instantly upon contact to whatever surface it touches. Anyone who has been subjected to "scalding" steam will appreciate the concept.

The time to take a surface (stainless tanks, monoblocks) to sterile levels of temperature is dramatically reduced, and the amount of water consumed is totally insignificant. Hence the practicality of steam: time savings and reduced wastewater.

A steam generator is a rather simplistic device, basically consisting of an electric element immersed in a high-pressure water vessel. All units should be outfitted according to the ASME Boiler and Pressure Vessel Codes to be assured of proper design. European (C.E.) and Canadian (C.S.A.) compliance should also be available. In all cases, this would include provisions for liquid level, low water control warnings, low and high-pressure controls, safety controls, related gauges

When sterilizing a monoblock, water comes only from condensation.

and plumbing.

Applications for steam in the winery are as varied as there are places for bacteria and mold to live. Many winemakers now use steam to (1) clean and hydrate barrels, (2) remove tartrates and sanitize tanks, (3) clean equipment and walls and (4) the most familiar, sterilize the bottling line.

APPLICATIONS

The Bottling Line

The best person to consult about bottling is the mobile bottler. They do more bottling of more varietals at more wineries per week than anyone. While early trucks used hot water, the majority of rigs now use steam.

Mobile bottlers tend not to trust a winery's water source, even if filtered. They may have issues with insufficient flow-rates from your well. Certainly they do not like excessive amounts of water on their equipment or on the floors of their trailers. In addition, because they bottle daily, constantly wetted areas can eventually occur inside the monoblock (that normally do not experience water), resulting in substantial maintenance issues. Bottling on cold days also requires more hot water than normal. Finally, you have to blow dry the equipment because labels will not adhere to wet bottles coming out of a wet monoblock.

"Steam is the cutting edge in bottling," said **Derek Palm**, owner of **Select Mobile Bottlers**. "In addition to eliminating all the water issues, we are assured a complete kill rate from the membrane filter housings, all the way to the fill spouts. The winemakers also feel more confident about the process. And a big plus, since we are getting to a higher temperature faster, means we are bottling sooner." (*WBM* suggests that you check with your filter supplier and purchase only steam-rated membranes.)

"Thermo-kill is by far the best, and the timeline is dramatically compressed," said **Kent Barthman**, winemaker at **Taft Street Winery** in Sebastopol, California. Temperature to time is the key ratio. The higher the temperature the less time required.

Barthman said they also preferred steam because the winery was located in "a very habitat-sensitive area, and steam does not impact the environment with residue and wastewater." As part of their procedure, Barthman also steams their "up-stream" plate-and-frame filter, reporting that it removes any cellulous flavors from the filter pads.

There is another advantage to using high temperature steam. Rinsing a monoblock with hot water, ozonated water or a chemical bath may not necessarily reach all the little nooks and crannies in that monoblock. Because a quality monoblock is made entirely of stainless steel, the total length from filter housings through internal plumbing, to filler bowls and fill spouts will ultimately reach 212°F. There's no need to worry about "hard to reach areas" because, if all that metal is that hot, all the hidden "bugs" will be dead. Be careful not to steam a monoblock that uses a lot of plastic in its construction.

Initially, condensation will drip from the spout because, as the steam touches metal and releases energy (heat), the water molecules return to a liquid state. Once all the metal is up to temperature, there is less energy transference and less moisture coming from the spouts. Winemakers' practices may vary, but once there is no more condensation, most agree 15 to 20 additional minutes are sufficient.

Low pressure (25 PSI or less) is introduced with the fill spouts open. A low pressure setting must always be used due to the pressure differentials surrounding the sterile membrane filters, and their integrity may be compromised. High pressure input against ambient (14.7 PSI) may cause ruptures. In addition, monoblocks can handle temperature, but their o-rings and seals cannot handle pressure. Well-made monoblocks come with Viton seals to withstand the heat.

Sizing a Generator for Your Bottling Line

In the world of bottling line sterilization, the standard formula is one Kw (kilo-watt) of power for every fill spout. Hence, to sterilize a 16-spout monoblock requires having a minimum 16 Kw rating. Fortunately, the cost differential between 10, 15 and 20 Kw systems is not significant, and the same can be said for 25 and 30 Kw systems. With a limited cost barrier, it is always best to step up to a larger piece of equipment because you should always factor in potential growth of your winery. Refer to the **American Society of Mechanical Engineers** (A.S.M.E.) linear conversion chart for Kws and BTUs.

You will see that when you double the Kws you simply double BTUs. For tartrate removal and cleaning large tanks, or floors and walls, the more BTUs the better. If you are only steaming monoblocks (depending on spout count) and barrels, you can normally get away with a 20 to 25 Kw system with low pressure settings.

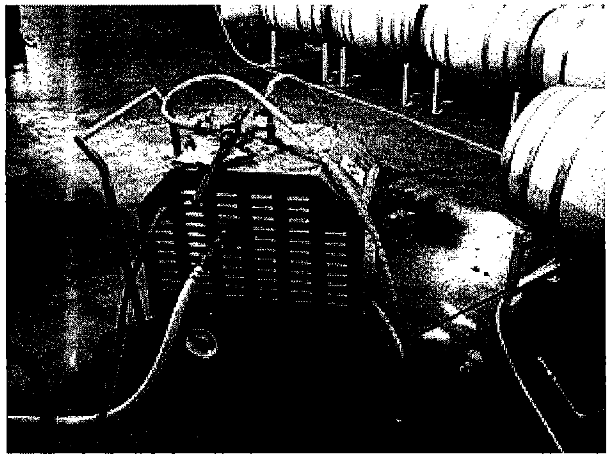
Finally, one of the biggest factors to consider when preparing for bottling is to compare a standard hot water unit using three to seven gallons of water per minute to a 20 Kw steam unit using six gallons per hour. Remember this also when accessing your barrel maintenance program and wastewater issues.

KW to BTU Conversion

Electric Rating KW	Gross BTU Output BTU/HR
10	33,500
15	50,200
20	67,000
25	83,750
30	100,400
40	133,900
50	167,500
60	201,000
75	251,250

Barrel Cleaning

Nooks and crannies are also the favorite places for bacteria to hide in barrels, but being in gaseous form, steam will effectively penetrate the cellulous structure of the wood. Also with high temperature, tartrate removal is considerably easier, taking far less time and using virtually no water.



A "Swash" steam generator with barrel wand and "thermo" gloves.

Some winemakers may question the use of steam in their expensive European oak, thinking it could possibly volatilize flavors. For others it isn't an issue. **Fritz Meier**, a winemaker at **Kendall-Jackson** and formerly at **Husch Vineyards** in Philo, California (35,000 cases), said he used steam for "peace of mind...I was trained in Germany, and everyone used steam for everything in the winery. Water and energy costs are just too expensive."

Robert Morris, operations director at the **Copain Custom Crush** facility in Santa Rosa, California (75,000 cases), also promotes steam. "We are a premium winery with many customers, and everyone has a primary goal of unfiltered wine. It is critical that we maintain absolute cellar health. Primarily, we use steam to clean and maintain our barrels, and then use Select Mobile Bottlers for bottling," he said.

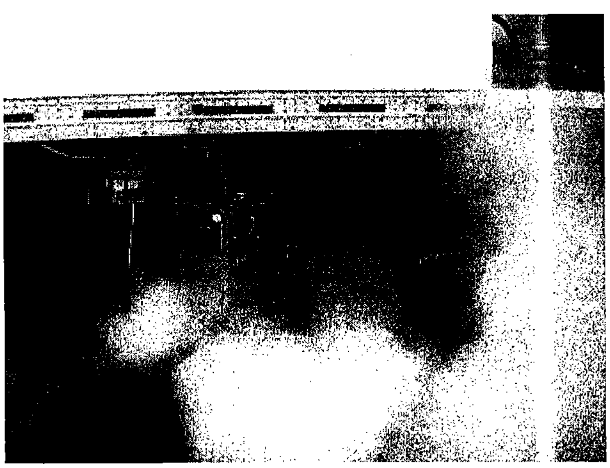
"I received my classic training in Bordeaux, France, and I continue to steam my barrels," said **Chris Phelps** at **Swanson Vineyards** in Rutherford, California. "We use low pressure of 10 to 12 PSI for about three to five minutes, then bung the barrel. As the steam cools and returns to liquid, it pulls a vacuum and can actually help extract old wine from the wood. It will also help remove bitter tannins and re-hydrates all at the same time."

All winemakers lauded the ability to hydrate barrels in storage. "Barrel maintenance is where steam really shines," said Meier.

"It can really help tighten up a barrel, especially around the head," said Phelps of Swanson. And at Copain, Morris said, "We can actually revive a barrel and continue to use it years longer than without steam."

Another plus is that steam enables the winemaker to check the integrity of the barrels. Steam will quickly penetrate and reveal any leaks that may have developed. As mentioned, after you steam and insert a bung, a vacuum develops. If the bung is hard to remove, it means absolute leak-proof integrity in the barrel. Caution is advised because the process is so effective it can actually collapse a head.

In addition, you must always use a low pressure setting because you can actually rupture a barrel with too much PSI.



Caution is advised when cleaning barrels because it is the one time when workers are directly exposed to the scalding effects of steam. Bottling line and tank cleaning is a matter of attaching the equipment and walking away. The only danger is touching the stainless before it has a chance to cool. Barrel cleaning, however, is hands-on, and cellar workers must be educated in the inherent danger of direct contact. A special wand must be inserted into each barrel. It is advised, therefore, that workers wear protective gloves rated for high temperatures.

Cleaning Tanks

Cleaning stainless tanks is one time where higher pressure and Kw (BTU) rating are an advantage, primarily due to the volume of the vessels. While you might have to buy a larger generator, the offset in savings is, again, the ease of operation and lack of water needed. Another plus is the reduction of manpower.

"The real advantage for us, when steaming tanks, is the elimination of muscle power inside the tank, scrubbing and rinsing," said **Tom Sharko**, owner of **Alba Vineyards** in Milford, New Jersey (15,000 cases). "We have a total tank farm of

As part of the cleaning procedure, a generator will have to go through a process called blow-down at the end of each use, during which high temperature and pressure must be brought back to ambient conditions.

36 1,000- and 2,000-gallon tanks. With steam we can completely sterilize a 2,000-gallon tank in 15 minutes, and no one has to go inside."

Cleaning requires that you simply connect your generator to an inlet valve above the tank floor, a racking valve for example, then open the lowest valve for drainage. Finally, crack the manway on the top of the tank to prevent excessive pressure build-up. Generally, the pressure of the generator is turned up to 80 to 100 PSI for the fastest results.

"In a short time you do not want to touch the side of the tank," said **Jim Quarella**, owner of **Bellview Winery** in Landisvelle, New Jersey (4,000 cases). Obviously, the tartrate build-up melts immediately and begins to flow out the bottom along with the condensation.

"The last thing we will do is a quick, final cold water rinse," Quarella added. "The instant blast of cold water results in a thermo-shock, removing any residual tartrates, and the tank is now sterile." The winery does not have to use caustic or other chemicals, does not have any personnel in the tanks and produces a minimum of wastewater--all without any environmental concerns.

Cleaning Equipment and Walls

Similar to tanks, steam cleaning process areas throughout the winery is also done at higher pressures, and a larger wattage generator will make sense. In addition, this and barrel cleaning are the only times you will need to attach an accessory to the generator--in this case a steam gun or "wand" with **National Sanitation Foundation** (NSA)--approved hoses rated to a minimum 100 PSI and 300°F. The steam can then be directed to all surfaces, walls and equipment, effectively reducing the "bio-burden."

"After the crush we steam everything, including racks, walls, floors, equipment, all external surfaces and especially drains. The one thing steam will not do is shine up the floor--for that we still use a pressure washer," said Morris of Copain.

The problem is that heavy organic matter, like pomace and other organics, will require water flow. As part of your ongoing hygiene, however, steam works very well and again uses virtually no water. In addition, because of the high heat and vaporization, very little condensation remains since everything evaporates into the room, leaving surfaces almost bone dry. As an interesting final thought, if you happen to be in a wintry environment (New York) and your barrel room is cold and dry (cold air does not retain humidity), a steam gun just might be the answer.

ATTRIBUTES

Sizing

It is always to a winery's advantage to purchase equipment that is versatile and can be used for different applications. Electric steam cleaning definitely fits that profile. While winemakers may initially buy a unit to sterilize a bottling line, it is not long before they use the generator to clean everything.

The most important consideration is size, so select a unit with a large enough generator to afford multiple uses. As discussed, bottling lines and barrel cleaning are both low pressure applications while tanks and equipment will require considerably more power.

"Fuel" or gas-powered steam systems are available but, in general, they are not a clean application for the winery environment. They operate with an open flame, produce fumes, obviously require a combustible fuel that requires storage and are normally relegated to a defined location in the winery requiring adequate ventilation.

For the best results with an electric steam generator, the winery should be equipped with 480 Voltage for the least amount of amperage draw. Steam generators are power hungry; but, as discussed, there's a trade off: cleaning takes less time and uses no water. The winery should also have three-phase power. Both requirements are generally standard for all new winery construction, but older facilities with single-phase power and low voltage probably will not be able to use a steamer. If you would like to jump to three-phase power, it is time to install a rotary phase converter. They are readily available from **Kay Industries** of South Bend, Indiana and not expensive--a small winery can expect to spend about $1,100 to handle all of its three-phase needs.

As mentioned above, the higher the voltage, the lower the amperage required. An example for sizing a generator is as follows: Say you want a 15 Kw steamer for a 12-spout filler. With only 208 Voltage and three-phase power, you will need a 50-amp circuit to be safe. If you have 480 Voltage, you need roughly 20 amps. The savings in amps means you can go for a larger Kw unit. Again the cost differential for upsizing is nominal. To go from 15 Kw to 30 Kw is less than $400.

Because the winery will be using the cleaner for different applications, the unit should come with the ability to change the pressure settings. The most functional will merely have a "switch" that allows you to move from one pre-set pressure to another. That way anyone can move from a bottling line to a tank project with ease. Typically, most wineries would set the generator at 20 and 80 PSI.

Accessories

Other accessories may or may not be included that will affect the unit's utility. The most obvious are hoses and cleaning wands. Not all manufacturers offer these as part of the package; and, while some are in-house add-ons, other companies require the winery find an outside vendor, such as **Grainger Industrial Supply**, to accessorize the generator. The cost in either case is not excessive, but there is one important consideration. There is a limit to the length of hose you can use. The general consensus is that you can use a hose that is $1^1/_2$ times the Kw rating. In other words, a 15 Kw generator can only use up to a 20-foot hose. Otherwise, excessive condensation will occur within the hose, and you would be pushing more water and less steam.

Portability

As we move from process centers to either crush pads, barrel or tank locations, portability is key and there is nothing better than steam on wheels. The units are not heavy as a rule, but wheels can also help avoid liability issues. If they are not included in the price, they can easily be adapted. A simple framework with an axle is sufficient, but make sure to get 8- or 10-inch wheels to negotiate cellar hoses.

Cleaning Your Generator

At the end of each use, the generator will have to go through a process called blow-down, which is part of the cleaning procedure required to maintain the health of the equipment. Following any use of a generator, high temperature and pressure must be brought back to ambient conditions, and each manufacturer will have specific instructions as to venting both. Blow-down procedures are also important because they allow for the removal of accumulated minerals solids inside the pressure vessel.

Depending on your water, residual materials must be removed on a regular basis. Filtration of water is a good option, but "hard water" may ultimately result in the build-up of calcium and magnesium carbonates inside the unit. Called "scale," this will eventually require some maintenance, but removing the heating coil and soaking it in a solution, such as **LimeAway**, normally solves the problem. In worst-case scenarios, according to Tom Shanko at Alba Vineyards, "It's only $100 for a new coil and requires the removal of four bolts." In business since 1946, **ESG** of Buchanan, Michigan does not even use a coil but two electrodes, which prevent the build-up of scale entirely.

Industrial steam units are all very simple and widely available; but as always, when applying outside technology to winemaking, it is worthwhile to research companies that cater to the industry. Steam generators can be purchased from any number of businesses that make saunas, but be advised the steam units are too small in capacity and are not capable of generating the required loads. An interesting side note is that steam saunas are always made of wood.

Two companies are leading steam technology in wineries. **Electro-Steam Generator Corporation** of Rancocas, New Jersey has been involved with winery sanitation for years and has an extensive client list. **ARS/Pressure Washer Company** of Sante Fe Springs, California are experts in the generation of steam and hot water. Marketing a custom electric steam generator called the "Swash," it is designed specifically for the wine industry and has all the necessary accessories.

Steam's Time has Arrived

Steam hygiene in your winery can be best defined by the four big Es: Economy, Efficiency, Effectiveness and Environment. Electric steam cleaning almost totally eliminates water usage. It is efficient and reduces the time it takes to achieve effective levels of cleanliness and sterilization. All of these contribute to reducing your impact on the environment.

For a long time steam has been the standard for the majority of the medical and pharmaceutical industries. Possibly, steam's time has finally arrived for wineries, especially with all of the concerns about Brett, bacteria and molds--plus the looming water and energy benchmarks that are slowly descending on our industry. It now makes sense to start calling fellow winemakers who are already using steam and learn from their experience. **wbm**

Electric Steam Generators

Companies Location Phone Web Address

ARS Sante Fe Springs, CA 800-735-9277 www.cleanwinery.com

Model Name Sizes Voltage Phase PSI Set - Switch Hoses Wheels Cost

Swash 10-30 Kw 208 to 480 3 only 10 to 80 PSI - Switch Yes Yes $6,700

Electro-Steam Rancocas, NJ 866-617-0764 www.electrosteam.com

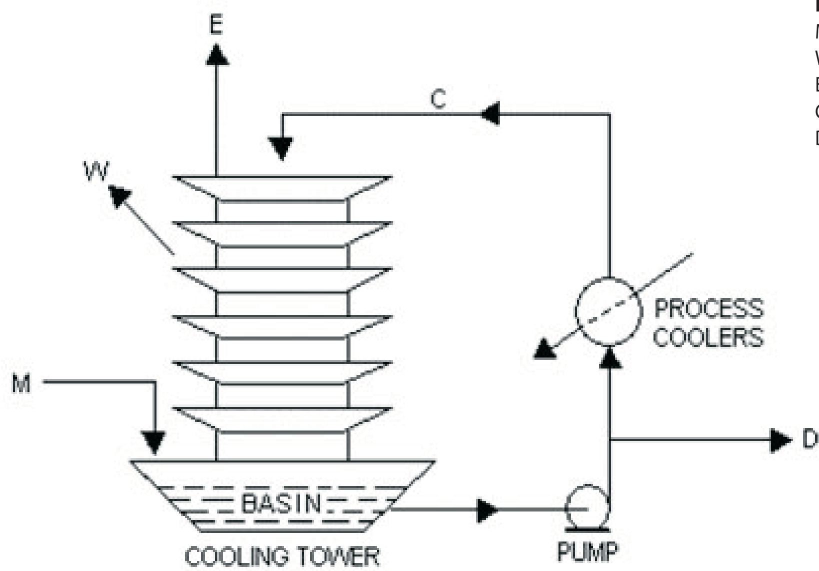
Appendix I: Water Use in Heating & Cooling Systems

This appendix provides information on energy-efficient operation and maintenance of water-using winery systems, including cooling towers, boilers and water-cooled compressors. Pumping systems are also addressed.

I.1 Cooling Tower Operation

Wineries typically use mechanical draft cooling towers to remove heat load. These rely on forced air flow to induce evaporative cooling in the recirculating water. Figure I-1 depicts a typical cooling tower schematic with cooling water recirculation.

Figure I-1: Cooling Tower Schematic



Key:
M = makeup water
W = windage
E = evaorative losses
C = recirculation water stream
D = blowdown, drawoff or bleed

In the figure, process coolers refer to any heat load that may be found in a winery. Makeup water is added to the cooling tower to offset losses due to windage, evaporative losses and blowdown. As water is recirculated in the cooling tower, water quality degrades. Evaporation leads to increasing concentrations of dissolved salts in the remaining water, and entrained dust results in an increase in suspended and settleable solids. If unchecked, cooling tower efficiency will significantly decline due to severe slime build-up and scaling on the cooling surfaces, sludge deposition in the cooling tower basin, increased corrosion on heat exchange surfaces. Cooling water spray nozzles may become blocked.

Recirculation water quality can be controlled through water treatment, such as adding biocides, pH control and sequestering agents. The optimal chemical treatment program should be determined based on a water study conducted by a water treatment chemical supplier or consulting engineer. The study will determine the maximum number of times cooling water can be recirculated, while maintaining the cooling tower efficiency.

The cooling tower manufacturer's operation and maintenance instructions should be followed whenever possible. Table J-1 provides a sample guide for cooling tower maintenance program. Larger, more complicated cooling towers with special filters or controls will require a more comprehensive maintenance program.

In areas where water supply is a concern, water-based cooling towers may be replaced with more advanced "dry cooling" equipment that uses air-cooled condensers (refer to Appendix K for more information.

Table I-1: Basic Cooling Tower Maintenance Schedule

Daily/Weekly	Periodic	Annual
▪ Test water sample for proper concentration of dissolved solids. Adjust blowdown water flow as needed. ▪ Measure the water treatment chemical residual in the circulating water. Maintain the residual recommended by your water treatment specialist. ▪ Check the strainer on the bottom of the collection basin and clean it if necessary. ▪ Operate the make-up water float switch manually to ensure proper operation. ▪ During periods of cold weather, check winterization equipment. Make sure any ice accumulation is within acceptable limits.	▪ Check the distribution spray nozzles to ensure even distribution over the fill. ▪ Check the distribution basin for corrosion, leaks, and sediment. ▪ Operate flow control valves through their range of travel and re-set for even water flow through the fill. ▪ Remove any sludge from the collection basin and check for corrosion that could develop into leaks. ▪ Check the drift eliminators, air intake louvers, and fill for scale build-up. Clean as needed. ▪ Look for damaged or out-of-place fill elements.	▪ Check the casing, basin, and piping for corrosion and decay. Without proper maintenance, cooling towers may suffer from corrosion and wood decay. Welded repairs are especially susceptible to corrosion. The protective zinc coating on galvanized steel towers is burned off during the welding process. ▪ Leaks in the cooling tower casing may allow air to bypass the fill. All cracks, holes, gaps, and door access panels should be properly sealed. ▪ Remove dust, scale, and algae from the fill, basin, and distribution spray nozzles to maintain proper water flow

Adapted from: Western Area Power Administration, 1998.

I.2 Boiler Operation

Wineries typically use low-pressure, low-power gas-fired boilers for steam heat. Boiler feed water is often softened or deionized to help prevent scale buildup. Scale buildup on the heat exchange surfaces will rapidly degrade boiler efficiency, resulting in lower steam production and higher energy costs.

For boiler maintenance, a proactive or preventative program is the best approach. This relies on tracking boiler performance and efficiency on a regular basis. By regularly recording boiler performance parameters, the operator can develop an operational baseline that is useful for anticipating or predicting when maintenance will be required to maintain optimal efficiency. For instance, fuel consumption and flue gas temperatures may be recorded on a daily or even a per-shift basis. If these records were to show, for example, that the flue gas temperature has gradually increased over the course of a month, this may indicate a build-up of scale, reducing heat transfer.

To establish a baseline for boiler operation, typical monitoring includes:

- Water level
- Low-water cut-off tested
- Blowdown water column
- Blowdown boiler
- Visual check of combustion
- Boiler operating pressure/temperature

- Feedwater pressure/temperature
- Condensate temperature
- Feedwater pump operation
- Flue gas temperature
- Gas pressure
- Oil pressure and temperature
- General boiler/burner operation

While modern boiler installations tend to be highly sophisticated with many self-monitoring and self-regulating features, it pays to maintain and follow a rigid maintenance and inspection schedule. The following boiler maintenance tips have been adapted from the Cleaver-Brooks Boiler Room Guide (1997):

- Know your equipment. Keep the boiler manufacturer's manual and data in a special file and ensure that staff consults this information whenever in doubt.
- Maintain complete records. Individual components should be listed on indexed cards or computer data base by model, serial number and date of installation.
- Establish a regular boiler inspection schedule, including an efficiency check and maintenance schedule.
- Establish and use boiler log sheets.
- Establish and keep written operating procedures updated. A detailed start-up procedure is essential in standardizing boiler room routine.
- Emphasize good housekeeping.
- Keep electrical equipment clean.
- Maintain adequate fresh air supply. Filters must be kept clean. In severe winter weather, the room may need to be heated to an acceptable ambient temperature.
- Keep accurate fuel records.
- Emphasize safety in all aspects of boiler operation.

In short, following a proactive maintenance strategy will help ensure the boiler is running efficiently, which will help to minimize boiler blow down and the associated wastewater stream. In addition to maintenance, energy efficiency can also be improved by installing heat exchangers to capture the waste heat from boilers.

I.3 Water-Cooled Compressor Operation

Wineries use compressed air for a variety of applications, including valve operation and maintenance equipment operation. Compressed air systems are categorized by operating pressure. Most wineries use low and medium pressure compressors.

- High-pressure (HP) – 3,000 to 5,000 psi
- Medium-pressure (MP) – 151 to 1,000 psi
- Low-pressure (LP) – 150 psi and below

Multi-stage compressors are often equipped with intercoolers to remove the heat generated when air is rapidly compressed. Intercooling may be accomplished with outside ambient air or water-cooled. Water-cooled compressors typically have a single-pass water line to the compressor that discharges water as waste, on the order of 5 to 20 gallons per minute. In most systems it is not interlocked with compressor operation and is left running continuously. Over the course of a year this could account for 2.6 to 10.5 million gallons of wastewater. Accordingly, discharge reduction and/or reuse options should be investigated, for example:

- If the intercooler water is not interlocked with the compressor operation, consider hiring an engineer to design a cooling water interlock system.
- If chilled water is available, the compressor cooling water can be recirculated through a plate or plate heat exchanger and booster pump. The heat load removed by the intercooler water will thus be transferred to the chilled water, and the intercooler water can be returned to the compressor. This system needs to be designed with appropriate flow and temperature interlocks to prevent loss of intercooler water to the compressor.
- The discharge stream is essentially clean water, and thus may suitable for a range of reuses, such as cooling tower or boiler makeup water, or landscape or crop irrigation.

I.4 Pump Selection and Operation

Moving water and wastewater is an energy-intensive process that generally requires pumps in the range of 10 to 50 horsepower (HP), depending on the flow rate and discharge head required. Smaller pumps are also used for tank mixers and chemical feeds. The winery can realize considerable savings on pump energy demand through careful equipment selection and/or changes to control system operation.

A number of different types of pumps are used for different applications in the winery, including centrifugal, progressive cavity, lobe, flexible impeller, diaphragm, peristaltic and reciprocating piston pumps. A pumping system consists of the pump, plus a motor and motor driver, piping, fittings, valves and controls (such as adjustable speed drives or throttles). Pump systems either have a static head (pressure) or are circulating systems (friction-only). To optimize pump performance and cost effectiveness, pumps should be selected using a systems approach that considers pumps, compressors, motors and fans. The basic goal in pump selection is to increase the volume of throughput per unit energy input. In general, capital costs are only a small fraction of the life cycle cost of a pump system; energy costs are far greater.

There are two main ways to increase pump efficiency, aside from reducing use: (1) reduce the friction in dynamic pump systems (not applicable to static or "lifting" systems) and (2) adjust the system so that it draws closer to the best efficiency point (BEP) on the pump curve (Hovstadius, 2002). Friction can be reduced through correct pipe sizing, surface coatings or polishings, and adjustable speed drives. Choosing the correct pump size and most efficient pump for the applicable system will push the system closer to the BEP on the pump curve.

If wastewater flows from some operations are intermittent, it may be possible to reduce pump demand from those areas by installing holding tanks to equalize flows over a production cycle. When designing a new winery, pumping needs can be minimized by configuring the facility to allow for gravity flow. For example, presses can be located higher than fermentation tanks.

Pumps that are sized inappropriately use excess energy. Because wastewater flows are variable and pumps must be sized to accommodate peak flows during the crush period, they are oversized for flows during the balance of the year. In order to reduce pump size, peak loads during crush must be reduced. Pumps operate most efficiently when they run at the highest speed suitable for a particular application. Exceptions to this include slurry-handling pumps, high-speed specified pumps, or pumps where a very low minimum net positive suction head is needed at the pump inlet.

Pump installers sometimes specify oversized pumps to avoid potential call-backs. If existing pumps are found to be oversized, options include replacement with a more appropriately sized pump, using variable speed pumps, retrofitting gear or belt drives, or using a slower speed motor. For varying loads, use of multiple pumps is recommended to maximize energy efficiency, particularly in a static head-dominated system. Parallel pumps also offer redundancy and increased reliability.

I.4.1 Pump Controls and Adjustable Speed Drives

Pump controls can include shutting off unneeded pumps or reducing load until needed. Remote controls allow pumping systems to be started and stopped more quickly and accurately when needed, reducing energy losses. Matching the speed of the pump to the load requirement is important for energy efficiency because energy use is approximately proportional to the cube of the flow rate. Small reductions in flow that are proportional to pump speed may yield large energy savings.

Adjustable Speed Drives (ASDs) or variable speed drives (VSDs) or on/off regulated systems always save energy compared to throttling valves. ASDs improve overall productivity, control and product quality, while reducing wear on equipment, thereby reducing future maintenance costs.

I.4.2 Pump Maintenance and Monitoring

Proper pump maintenance and ongoing monitoring can ensure pump system efficiency, increase pump life and control costs. Monitoring can allow early identification of clearances that need be adjusted, blockages, impeller damage, inadequate suction, clogged or gas-filled pumps or pipes, or worn out pumps. This should include wear monitoring, vibration analyses for main pumps, pressure and flow monitoring, current or power monitoring, and distribution system inspection for scaling or contaminant build-up. Proper maintenance includes:

- Replacing worn impellers, especially in caustic or semi-solid applications
- Inspecting and repairing bearings, and lubricating them annually or semiannually
- Inspecting and replacing packing seals, considering that allowable leakage is usually between 2 and 60 drops per minute
- Inspecting and replacing mechanical seals, considering that allowable leakage is typically 1 to 4 drops per minute
- Replacing wear ring and impeller, considering that pump efficiency degrades from 1 to 6 points for impellers less than the maximum diameter and with increased wear ring clearances
- Checking pump/motor alignment

I.4.3 Other Pump Efficiency Improvement Options

Additional options to achieve greater pumping efficiency include:

- **Using precision castings, coatings or polishing.** Use of castings, coatings or polishing reduces surface roughness, which can improve energy efficiency. It may also help maintain efficiency over time. This measure is more effective on smaller pumps.

- **Trimming impeller (or shave sheaves).** If a large differential pressure exists at the operating rate of flow (indicating excessive flow), the impeller (diameter) can be trimmed so that the pump does not develop as much head. In addition to energy savings, this can reduce maintenance costs, improve system stability, reduce cavitation, and eliminate excessive vibration and noise.

- **Replacing belt drives.** V-belt drives can be replaced with direct couplings to save energy. Regular maintenance, including replacement of existing worn-out belts will also improve efficiency.

- **Upgrading aging pumps and motors.** Pump efficiency declines over time, and newer pumps are more efficient than older models. Higher efficiency motors also increase the efficiency of a pump system.

I.5 Summary of Energy Efficiency Considerations

For energy-efficient operation of all water-using systems, including pumps, the key strategies include:

- Use of variable frequency drives to match demand

- Use of premium efficiency motors

- Installation of demand response equipment, allowing energy use to be deferred to off-peak periods

Optimizing the efficiency of other winery systems that are not linked to water and wastewater management, such as lighting, refrigeration, ventilation and insulation are also important, but they are beyond the scope of this document. Refer to CSWA's Code of Sustainable Winegrowing Practices and guidance provided by your power company to identify and implement improvements in these areas.

Appendix J: Air-Cooled Condenser Systems

GEA Energy Technology Division

GEA Power Cooling, Inc.

Contact Imprin

- Home
- Products
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GEA Group AG

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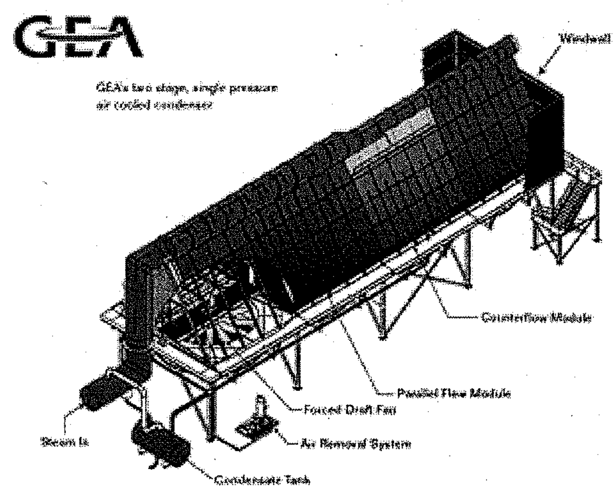
Dry Cooling - Air Cooled Condenser (ACC)

Based on more than 60 years of direct experience and research, GEA has developed and optimized fin tube systems with features particularly beneficial to the operation of vacuum steam condensers. GEA's ACC technologies combine compact surface requirements with low energy consumption to make the system as efficie as possible.

The GEA air-cooled condenser (ACC) is comprised of fin tube bundles grouped together into modules and mounted in an A-frame configuration on a steel support structure. V-frame, vertical and horizontal configurations are also available.

GEA employs a two-stage, single-pressure condensing process to achieve efficient and reliable condensation. In this process, the steam is first routed from the steam turbine to the air-cooled condenser where it enters parallel flow fin tube bundles from the top. The steam is only partly condensed in the parallel flow modules. The remainin steam is routed through lower headers to counterflow fin tube bundles. Here, the steam enters from the bottom and rises in the fin tubes to a point where condensation is completed.



Non-condensibles are drawn off above this point by ejection equipment. The condensate drains by gravity to a condensate tank and is then pumped back to the feedwater system.

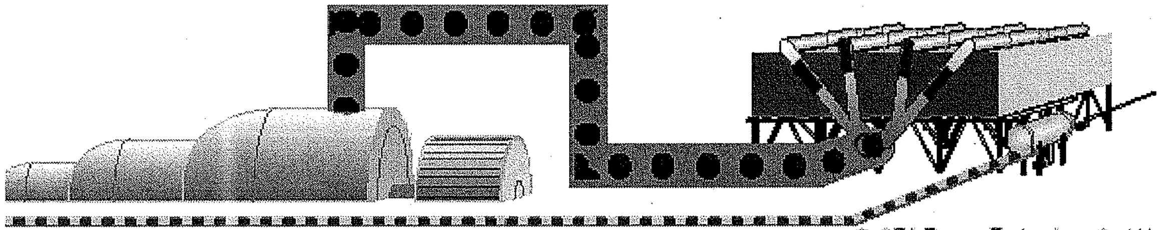
GEA offers a number of different heat exchanger surfaces. Most commonly supplied are the hot-dipped galvanized, two-row fin tube bundles (A-tube) and the aluminum-finned, single-row fin tube bundles (ALEX). Based on project parameters and customer preference, GEA will utilize the fin tube bundle design that provides the most economical and efficient solution possible.

When a high value is placed on fan power consumption or when extreme low noise emission is required, GEA's ALuminum EXchanger (ALEX) technology will be the most economical solution.

Schematics

ACC Schematic
Fin-Tube Design Evolution

For a virtual tour through our Air Cooled Condenser **please press**



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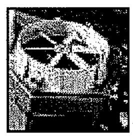
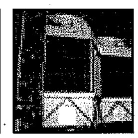
Hexacool™ Air Cooled Condenser



Overview

Hexacool™ is an air cooled condenser (ACC), well suited for use in smaller waste to energy, biomass and small size electrical power plants and industrial co-generation.

For small power and industrial applications, SPX Cooling Technologies, Inc. specifically developed its Hexacool ACC with the goal of offering a standard modular system that would be low in cost, easy to erect and robust in performance.

Features

A Revolution in Air-Cooled Condensers
For small power and industrial applications, a conventional A-Frame model may not be the most cost effective solution.

We designed a standardized, modular air-cooled condenser system that is low in cost, easy to erect, and robust in performance.

Printable version
E-mail this page

Available:
Worldwide

Related Information:

- Hexacool Brochure
- SPX Profile
- PowerGen Dry Cooling Presentation

Cooling Towers

- Balcke CP
- Counterflow Field Erected
- Crossflow Field Erected
- Marley Aquatower
- Marley AV
- Marley CTF
- Marley MCW
- Marley MS/Architectural
- Marley NC Fiberglass
- Marley NC Steel
- Marley QuadraFlow
- Marley Series 10 and 15
- Marley Sigma
- Marley SR
- Marley SRC
- Natural Draft
- Recold JT
- Round Forced Draft

Evaporative Fluid Coolers

- Marley MC Fluid Cooler
- Marley MH Fluid Cooler
- Recold JW
- Recold MW

Evaporative Condensers

- Recold JC
- Recold MC

Dry Cooling

- Air Cooled Condensers
- Air-Cooled Heat Exchangers
- Hexacool™ Air Cooled Condenser

Indirect Dry Cooling

Wet-Dry Hybrid Cooling

Air2Air™

Hybrid Cell-Type Cooling Tower

Hybrid Circular Tower

LNG Vaporization

LNG Heating Tower

Biomedia

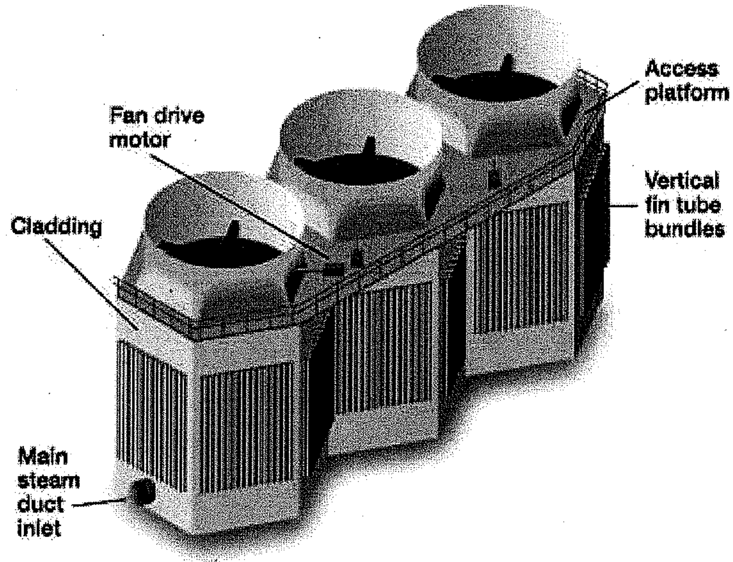
Biomedia System

MarDek

MarGrid

MarPak

MarPier



Hexacool Benefits

- **Cost effective** a cost effective solution for a high quality product.
- **Optimal Layout** simplified piping and ducting routing
- **Simplified Installation Procedure** compact simplified design with greater degree of prefabrication in workshop.
- **Lighter** load on foundations are reduced.
- **Reduced Height** low profile design - total height is lower than a A-Frame design. Easier integration in urban environment
- **Faster Installation** easy to build in the field
- **Decreased Wind Sensitivity** improved performance during windy conditions
- **Reduced Hot Air Recirculation** induced draft concept reduces risk of hot air recirculation for higher efficiency in all operating conditions.
- **Easy Access** unit designed for cleaning and maintenance
- **Low Impact Aesthetic** this innovative environmentally friendly (no plume) design is a trendsetter in the industry

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Appendix K: Sustainability Drivers

Drivers for adoption of sustainable winery practices include industry momentum, market forces and regulatory compliance, as detailed below.

K.1 Industry Momentum and Market Forces

Industry momentum to adopt sustainable practices is exemplified by the formation of the National Grape and Wine Initiative (NGWI), a nationwide coalition representing all segments of the grape industry. NGWI's vision is to enable the United States grape and wine industry to be the world leader in consumer value and sustainability and contribute to the quality of life in rural communities.

The momentum is also evident in the work of the California Sustainable Winegrowing Alliance (CSWA). CSWA developed the Code of Sustainable Winegrowing Practices to enable wineries to conduct a self-assessment of their sustainable features. Between 2002 and 2006, more than 1,165 wineries and vineyards took advantage of CSWA's programs. A number of other states, as well as Canada, Australia and other countries have adopted their own sustainability self-assessment programs.

The industry's progress toward adopting sustainable practices is a natural extension of the values for good land stewardship that have long been held by many winemakers. However, climate change and international competition have pushed the industry to act even more aggressively. Market forces, manifest as retailers dictating requirements to suppliers, are having a strong impact on the rate of change. By using this guide to develop and implement an action plan for sustainable water and wastewater management practices, wineries should be able to satisfy retailer requirements and demonstrate measurable progress. This allows retailers, in turn, to meet consumer demand for greener products.

K.2 Regulatory Compliance

Depending on the location of a winery, certain water and process water management practices identified in this document will be subject to state, local and/or federal regulations. Because the overall objective of the guidance is achieving sustainable operations, many of these practices will be fully consistent with the intent of environmental regulatory programs. Thus, in addition to other benefits, use of this document should enable a winery to more readily satisfy regulatory requirements and obtain permits, as applicable.

In most states, the lead authority for winery water and process water regulation is a state or local agency. This is the case because USEPA has delegated responsibility for implementation of the federal water policy, the Clean Water Act (CWA) (33 U.S.C., 1251 et seq.; 40 C.F.R. Part 122 et seq. and Part 400 et seq.), to individual states. The goal of the CWA is to restore and maintain the integrity of the country's surface waters. It also directs states to establish water quality standards for all "waters of the United States" and to review and update these standards at least every three years.

In addition to the CWA, most states and many localities have environmental regulatory programs that pertain to groundwater protection, well construction and abandonment, drinking water quality, sanitation, discharges to land, surface impoundment design, facility planning, environmental impacts and many other areas. An overview of the regulatory framework for water and process water management in selected states is provided below. However, for the most current, comprehensive information on applicable regulatory programs and site-specific requirements, it is incumbent upon the winery to contact the responsible regulatory agencies directly. Regulations and policies described in this section may be subject to change, pending passage of new legislation, further interpretation of existing laws or changes in regulatory agency leadership. As part of the outreach process planned for this guidance document, whereby the methodology will be introduced in winegrowing states throughout the United States. It is anticipated that information on applicable regulatory programs in each state will be collected and incorporated in subsequent editions.

K.2.1 California

Protection of water quality in California is the responsibility of both the State Water Resources Control Board (SWRCB), which develops statewide policies and regulations, and the California Regional Water Quality Control Boards (CRWQCBs), which implement these water quality policies on a regional basis. Of particular importance to wineries, California regulates discharges that could affect beneficial uses of groundwater via the Porter-Cologne Water Quality Control Act. Porter-Cologne directed the state to prepare basin plans to ensure protection of waters in each region of the state. It also gave the CRWQCBs authority to regulate discharges to land through a permit process.

The SWRCB then issued Resolution 68-16, referred to as the "Anti-Degradation Policy", which gives the CRWQCBs a further basis to regulate discharges in a manner that protects both surface water and groundwater. The Resolution calls for use of best practicable treatment or control (BPTC) measures as a means to protect water quality, but does not identify specific practices that would be effective or approved. Accordingly, this manual is an effort to define those BPTC options on behalf of the wine industry. In the paragraphs that follow, additional information is provided on the permitting process, basin plans and beneficial uses, anti-degradation policy and BPTC.

K.2.1.1 Discharge Permits

Under Porter-Cologne, wineries discharging process water to land must obtain a permit from the CRWQCB in their region. The permit is consists of a set of Waste Discharge Requirements (WDRs). Before WDRs can be issued, a discharger must submit a Report of Waste Discharge (ROWD) to the CRWQCB describing their facility site and operations. The ROWD typically specifies the winery's design capacity for winemaking, the rate of process water generation, process water chemistry, and current treatment systems and any planned improvements. Challenges to wineries and regulators associated with obtaining WDRs can include: poor background groundwater quality due to offsite or legacy activities; the absence of a "cookbook" methodology for land application that ensures groundwater protection (best management strategies must be determined on a site-specific basis, in consultation with guidelines and agency staff); and some variability in the interpretation and enforcement of applicable policies among regulatory agency staff in the different regions.

K.2.1.2 General Permits and Waivers for Small Wineries

In three of the CRWQCB's regions (North Coast, Central Coast and Central Valley), smaller wineries have the option to obtain a permit under a General WDRs program or waiver program. Eligibility is based on annual volume of wine produced and other criteria. These requirements are summarized on Table K-1. In most cases, participating in a general permit or waiver program, where applicable, will require less effort and will cost less. But wineries should review the options and requirements carefully to be certain it is the best fit for their current operations and future plans. Notably, the San Francisco Bay Region, which encompasses large winegrowing areas, does not have a general permit or waiver option. Instead, a Memorandum of Understanding (MOU) was developed with Napa County that addresses some common winery wastewater management policies. Refer to Appendix G for a copy of the MOU.

K.2.1.3 Basin Plans and Beneficial Uses

Each of the nine CRWQCBs operates in accordance with a basin plan, which is accessible from SWRCB's website (http://www.waterboards.gov/plans_policies/). Basin plans contain California's administrative policies and procedures for protecting state waters, including groundwater and surface water, for designated beneficial uses. Beneficial uses may include agricultural supply, drinking water supply, recreation involving water contact, and/or habitat of various types. The plans also define water quality objectives in terms of threshold levels of chemicals and water quality characteristics. Water quality objectives may apply region-wide or be specific to individual water bodies or portions of water bodies. Wineries that discharge process water to land may be required to meet water quality objectives that are protective of all potential beneficial uses of groundwater, rather than just the existing and probable anticipated beneficial uses of underlying groundwater body.

Table K-1: California Small Winery Waste Discharge Permit Programs by Region

Central Valley	WDRs Waiver for Small Food Processors, Including Wineries				
	For wastewater and solid waste applied to land at agronomic rates:		For wastewater stored in a tank for offsite disposal, and solid waste applied to land at agronomic rates:		Enrollment process:
	Wineries that crush <80 tons/year or generate <100,000 gal/year	Small food processors (e.g., fruit dehydrators, walnut hullers, seed/nut or olive oil processors) that generate <100,000 gal/year	Wineries of any size	Small food processors of any size	Must submit a RWD and O&M plans for WW and solids

Central Coast	General WDRs for Wineries				
	Any winery without WDRs must apply for General WDRs	Wineries w/existing Indiv WDRs will be considered for the Gen WDRs upon renewal. EO may require Indiv WDRs.	Ponds must be lined. Discharges to land must have BOD_5 <300 lb/acr/day	General MRP may include GW monitoring.	Must submit a NOI (equivalent to a RWD)
	Small Winery Waiver[1]				
	Small is defined as ≤ 160 tons crushed/yr; ≤ 10,000 cases/yr; or ≤ 26,000 gal of wine/yr	Intended for facilities that pose minimal threat to GW	Use of leachfields prohibited unless applicant demonstrates effectiveness	Depth to GW must be >50ft, or >8ft if WW is used for vineyard irrigation	Must submit a NOI (equivalent to a RWD)

North Coast	General WDRs for Discharge of Winery Waste to Land				
	Any winery without WDRs must apply for General WDRs	Wineries w/existing Indiv WDRs will be considered for the Gen WDRs upon renewal. EO may require Indiv WDRs.	Includes numeric effluent limits for spray irrig, frost protection and drip irrig. For ponds, must maintain 1mg/l DO and 2ft freeboard	General MRP may include GW monitoring, at the discretion of the EO.	Must submit a NOI and publish public notice about project
	Small Winery Waiver				
	Non-commercial wineries producing <200 gallons of wine per year, provided that discharge is to land and no adverse water quality impacts are anticipated.				

Notes:

BOD_5 - 5-day Biochemical Oxygen Demand
DO - Dissolved Oxygen
EO - Executive Officer of RWQCB
GW - Groundwater
MRP - Monitoring & Reporting Program associated with WDRs
NOI - Notice of Intent
RWD - Report of Waste Discharge
RWQCB - Regional Water Quality Control Board
WDRs - Waste Discharge Requirements issued by RWQCB
1. Per revised order, dated 7-8 February 2008

This translates to more stringent permit requirements that are intended to be protective of the "best and highest use" of groundwater, which is generally a drinking water supply or agricultural water supply suitable for the most salt-sensitive crops.

In the cases where basin plans do not dictate specific numerical objective values for particular beneficial uses or water bodies, permits have included limitations based on external references. If groundwater is considered a potential drinking water supply, discharges must meet primary and/or secondary drinking water standards established by the Department of Public Health (DPH) as maximum contaminant levels (MCLs). Primary MCLs are the highest concentrations of certain constituents that drinking water is allowed to contain. Secondary standards are limits to protect water taste, odor, and appearance.

If natural conditions make a particular beneficial use highly unlikely, it may be possible to obtain an exemption from the applicable beneficial use requirements. For example, it is unlikely that an aquifer with excessive natural salinity or a low production rate will be developed for a drinking water supply. In practice, however, an exemption is difficult to obtain because it requires an amendment to the basin plan. The burden of proof is on the entity seeking the exception. Both the CRWQCB and SWRCB must conduct public hearings, and then the Office of Administrative Law must approve it.

K.2.1.4 The Anti-Degradation Policy

The state's Anti-Degradation Policy, Resolution 68-16 (Statement of Policy with Respect to Maintaining High Quality Waters in California), applies when water quality characteristics are better than the basin plan requires for protection of beneficial uses. It establishes a goal to preserve that level of quality to the maximum extent possible. However, it is not a zero-discharge policy. If existing water quality is better than the water quality objectives, reduction of water quality can be allowed if the CRWQCB determines it will not unreasonably affect present and probable beneficial uses, will be consistent with the maximum benefit to the people of the state, and is consistent with other factors listed in the California Water Code. Specifically, Water Code Section 13241 recognizes that it may be possible for the quality of water to be changed to some degree without unreasonably affecting beneficial uses, and requires a CRWQCB to consider a range of factors including past, present and probable future uses of water; environmental characteristics of the hydrographic unit; water quality conditions reasonably achievable through coordinated control of all factors; economic considerations; and the need for housing in the region. Section 13000 mandates that activities which may affect water quality shall be regulated to attain the highest water quality which is reasonable, considering all demands being made and to be made on those waters and the total values involved.

K.2.1.5 Best Practicable Treatment and Control

A winery planning to discharge process water to land in an area where it could have an affect on high quality groundwater must demonstrate use of best management practices and BPTC for process water. Although neither the Water Code nor the Anti-Degradation Policy defines BPTC explicitly, in their rationale for decisions on several WDR applications the SWRCB has described BPTC (sometimes along with recognition of Section 13241 factors) as the level of treatment and control technically achievable using "best efforts". In these cases, the SWRCB made it clear that to demonstrate use of BPTC, dischargers need to compare proposed methods with existing proven technology, evaluate performance data, compare alternative methods of treatment and control, consider methods used by similarly situated dischargers, and evaluate the potential impact of the discharge as well as the mitigating effects of BPTC on groundwater. For wineries, the umbrella of BPTC includes two general categories:

- Source reduction - eliminating or decreasing the generation volume or strength of process water from a given winery process.
- Recycling - reusing process water that would otherwise have been discharged, including reuse facilitated by an interim treatment step to match a particular end use.

The range of general source reduction and recycling techniques defined by the EPA is summarized on Figure 3-1 of the Steps for Winery Evaluation. If source reduction and recycling are not sufficient to meet discharge objectives, treatment of process water at the source and/or at the end pipe may be warranted. Alternatively, certain process water streams may be segregated and hauled offsite for treatment or disposal, allowing the balance of process water to be more effectively managed onsite. In some cases, segregated waste streams can be evaporated, leaving a smaller volume of salts for offsite disposal. These options are discussed in more detail in other sections of this document and associated appendices.

K.2.2 Other States

<To be developed, pending participation>

Appendix L: Participating Organizations

American Vineyard Foundation: The American Vineyard Foundation (AVF) is a California corporation organized in 1978 by the American Society of Enology and Viticulture (ASEV) as a vehicle to raise funds for basic and applied research in viticulture and enology. The AVF is classified as a non-profit, tax-exempt scientific and educational organization under Section 501(c)(3) of the U.S. Internal Revenue Code.

http://www.avf.org/index.html

California Sustainable Winegrowing Alliance: The California Sustainable Winegrowing Alliance (CSWA) is a San Francisco-based 501(c)3 nonprofit organization incorporated in 2003. It was created by Wine Institute and the California Association of Winegrape Growers to promote the benefits of sustainable winegrowing practices, enlist industry commitment and assist in implementation of the Sustainable Winegrowing Program.

http://www.sustainablewinegrowing.org/index.php

National Grape and Wine Initiative: The National Grape and Wine Initiative (NGWI) is an industry-driven partnership with academic and government representatives designed to focus emphasis on research and extension as a means to strengthen the competitiveness of America's grape and grape product industries.

http://ngwi.org/

Wine Institute: Wine Institute is the public policy advocacy association of California wineries. Wine Institute brings together the resources of more than 1,000 wineries and affiliated businesses to support legislative and regulatory advocacy, international market development, media relations, scientific research, and education programs that benefit the entire California wine industry.

http://www.wineinstitute.org/

THE CODE OF SUSTAINABLE WINEGROWING PRACTICES SELF-ASSESSMENT WORKBOOK

A PROJECT OF CALIFORNIA SUSTAINABLE WINEGROWING ALLIANCE,
WINE INSTITUTE and the CALIFORNIA ASSOCIATION OF WINEGRAPE GROWERS

The ***Code of Sustainable Winegrowing Practices Self-Assessment Workbook*** is the foundation of the Sustainable Winegrowing Program (SWP) and a tool for program participants to measure their level of sustainability and to learn about ways they can improve their practices. Originally released in 2002, a second edition of the workbook was issued in late 2006. The workbook addresses ecological, economic and social equity criteria through an integrated set of 14 chapters and 227 criteria, which includes a built-in system with metrics to measure performance.

The Sustainable Winegrowing Program's (SWP) self-assessment workbook is available online to California growers and vintners, who can enter and access their assessment results using the secure, password-protected application. **Contact info@sustainablewinegrowing.org or 415-356-7545 to request an online UserID and password, or to obtain a hard copy of the workbook.**

Chapters include:

- Viticulture
- Soil Management
- Vineyard Water Management
- Pest Management
- Wine Quality
- Ecosystem Management
- Energy Efficiency
- Winery Water Conservation And Quality
- Material Handling
- Solid Waste Reduction And Management
- Environmentally Preferred Purchasing
- Human Resources
- Neighbors And Community
- Air Quality

While criteria in many of the workbook chapters are related to water and energy, the following two chapters are most closely aligned with the contents of the ***Comprehensive Guide to Sustainable Management of Winery Water and Associated Energy***.

CHAPTER 9. ENERGY EFFICIENCY

The purpose of this chapter is to provide users with 11 criteria to self-assess:

- The state of their energy efficiency planning, monitoring, goals, and results
- The total energy consumed per ton of grapes and/or gallon of wine produced
- The extent of energy efficiency per major operation
- The extent of management support and employee training efforts to improve energy efficiency
- The opportunities in your operation to identify and prioritize options to improve energy efficient practices.

List of Energy Efficiency Criteria			
9-1	Planning, Monitoring, Goals, and Results	9-6	Lighting – Offices and Labs
9-2	Refrigeration System	9-7	Lighting – Shops and Facilities
9-3	Tanks and Lines	9-8	Lighting – Outdoor and Security
9-4	Motors, Drives, and Pumps	9-9	Office Equipment
9-5	Heating Ventilation and Air Conditioning (HVAC)	9-10	Alternative Sources of Power
		9-11	Alternative Vineyard Fuels

CHAPTER 10. WINERY WATER CONSERVATION AND WATER QUALITY

The purpose of this chapter is to provide users with 11 criteria to self-assess:

- The state of their winery water conservation and water quality planning, monitoring, goals, and results
- The total water consumed per ton of grapes and/or gallon of wine produced

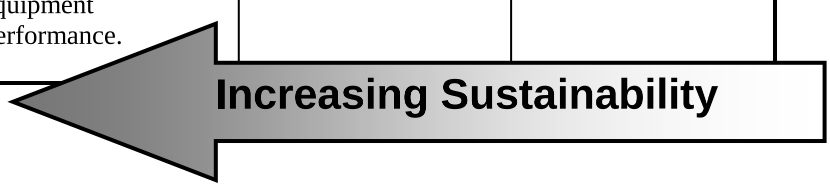
- The extent of water conservation practices per major operation
- The extent of management support and employee training efforts to improve water conservation
- The opportunities in your operation to identify and prioritize options to improve water conservation
- The opportunities in your operation to identify and prioritize options to improve discharged water quality.

List of Winery Water Conservation and Water Quality Criteria			
10-1	Water Conservation Planning, Monitoring, Goals, and Results	10-8	Crush Operations
		10-9	Presses
10-2	Water Quality Planning, Monitoring, Goals, and Results	10-10	Fermentation Tanks
		10-11	Barrel Washing
10-3	Wells	10-12	Barrel Soaking
10-4	Water to Wastewater Ponds	10-13	Bottling
10-5	Water from Wastewater Ponds	10-14	Cellars
10-6	Septic Systems	10-15	Labs
10-7	Storm Water	10-16	Landscaping

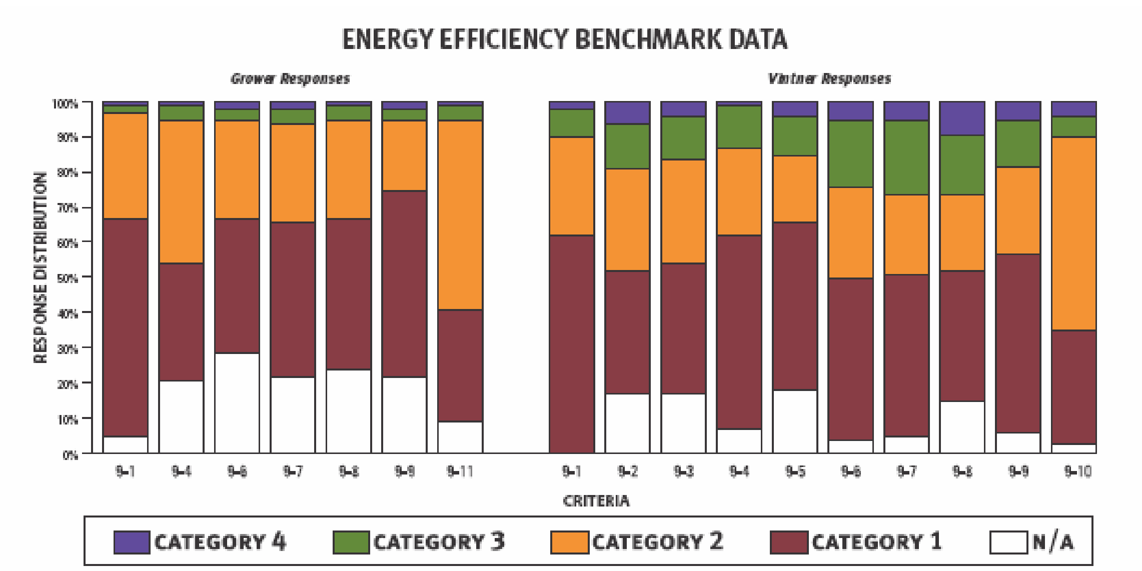
Each chapter has a set of industry specific criteria to self-assess the sustainability performance of vineyard and winery operations. Each criterion has four performance categories. The categories represent **increasing sustainability** moving from right to left (**Table 1)**.

Table 1. Example of the four-category self-assessment continuum of increasing sustainability.

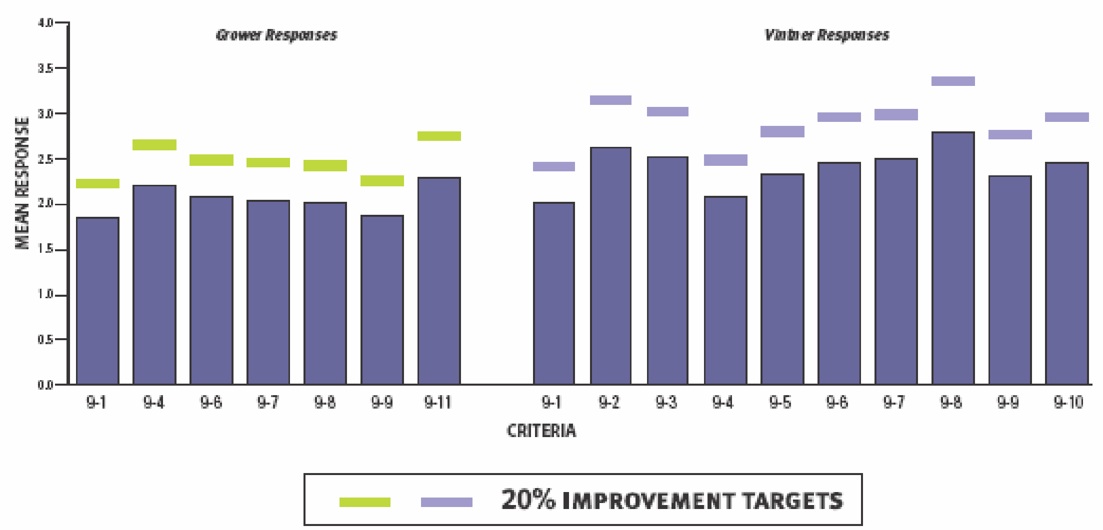
Criteria	**Category 4**	**Category 3**	**Category 2**	**Category 1**
9-4 Motors, Drives, and Pumps	An energy audit focusing on motors, drives, and pumps is part of an overall energy monitoring and conservation plan ***And*** I test selected new technologies to improve the energy efficiency of motors, drives, and pumps ***And*** New equipment purchases are made to optimize performance and results, which include, multi-speed motors, and "right sized" pumps ***And*** Energy efficient technologies and designs are used throughout our operation including sloped floors, stacked tanks, solar aerators, smaller diameter pipes*, and software for monitoring equipment performance.	An energy audit focusing on motors, drives, and pumps is part of an overall energy monitoring and conservation plan ***And*** I investigate new technology to improve the energy efficiency of motors, drives, and pumps ***And*** New equipment purchases are made to optimize performance and, which include, multi-speed motors, and "right sized" pumps ***Or*** Energy efficient technologies and designs are used throughout our operation including sloped floors, stacked tanks, solar aerators, smaller diameter pipes*, and software for monitoring equipment performance.	An energy audit focusing on motors, drives, and pumps has been performed in the last 3 years ***And*** Our operation supports efforts to improve the energy efficiency of the motors, drives, and pumps system ***And*** Existing equipment is maintained for optimal performance and results of the system energy audit are used to review capacity and performance requirements before equipment replacement.	An energy audit focusing on motors, drives, and pumps has not been performed in the last 3 years ***And*** The motors, drives, and pumps are all operated and maintained much as they have been since installation.



California Wine Community Sustainability Report 2004
Statewide Results for Chapter 9 - Energy Efficiency

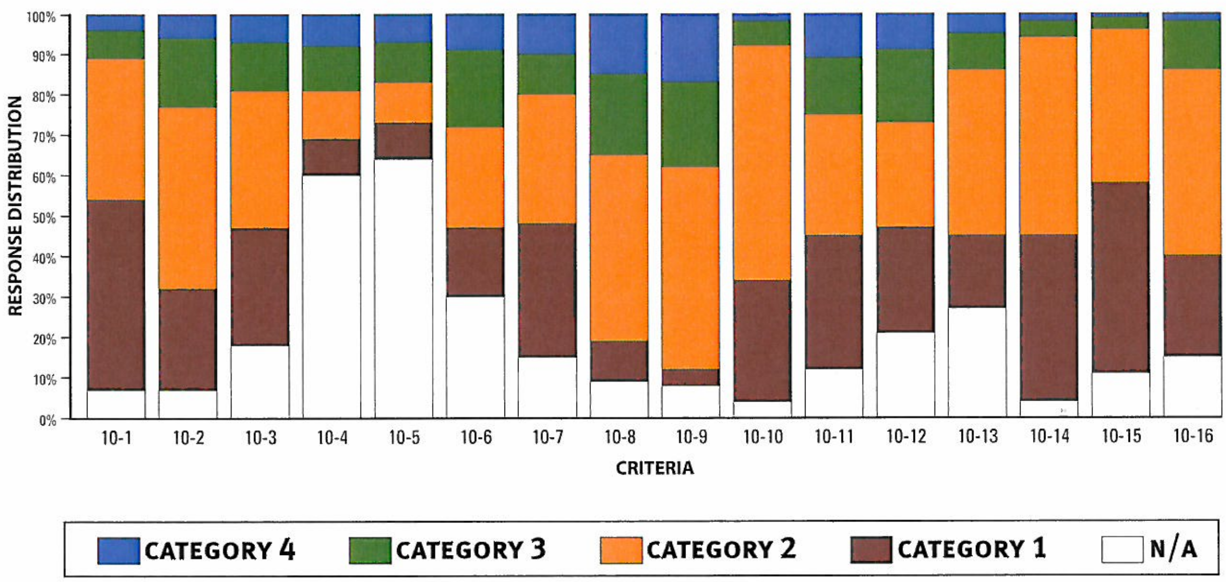


TARGETS FOR CONTINUAL IMPROVEMENT

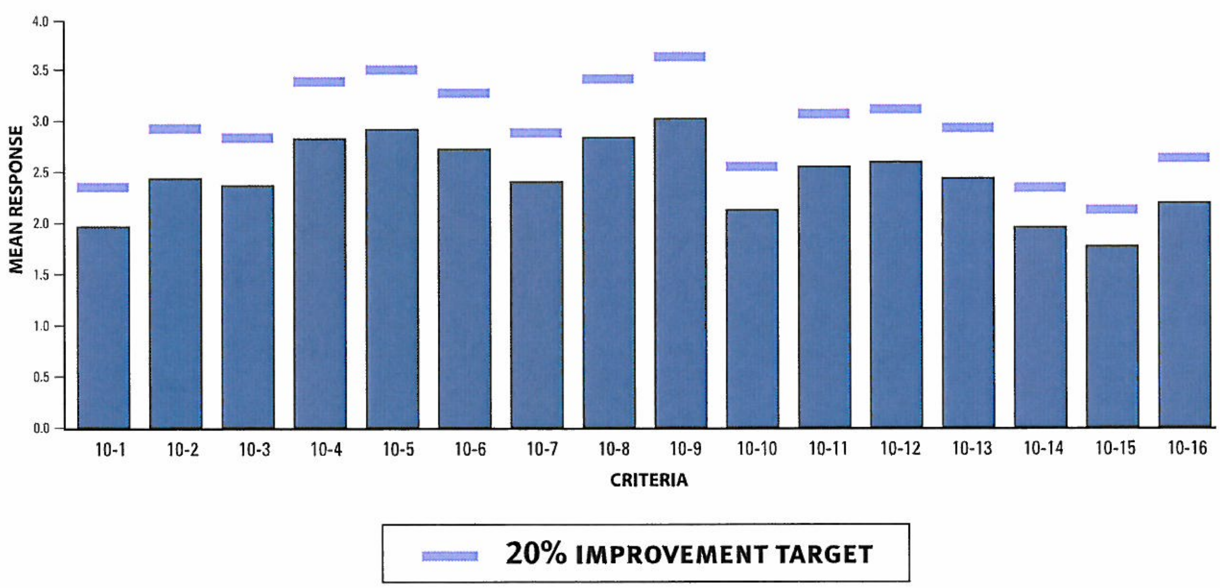


California Wine Community Sustainability Report 2004
Statewide Results for Chapter 10 –
Winery Water Conservation and Quality

WINERY WATER CONSERVATION AND WATER QUALITY BENCHMARK DATA



TARGETS FOR CONTINUAL IMPROVEMENT



Pacific Gas and Electric Company

Energy Efficiency Checklist for Wineries

Reduce your energy use by either:

Demonstrating a reduction of your annual energy use through any combination of measures or by implementing alternative technologies and behavioral changes into your business practices and operations.

EXAMPLES OF ALTERNATIVE TECHNOLOGIES

Lighting

- ✓ Replace HID fixtures with T5 or T8 Fluorescent High Bay Fixtures.
- ✓ Install T-5 or T-8 fluorescent fixtures with electronic ballasts in office, lab, and common areas.
- ✓ Install compact fluorescent fixtures in bathroom and common areas.
- ✓ Install LED exit signs.

Refrigeration

- ✓ Replace air cooled condensers with evaporative condensers.
- ✓ Oversize condensers where possible.
- ✓ Install premium efficiency motors.
- ✓ Floating head pressure control.
- ✓ Floating suction pressure control.
- ✓ Where possible attempt to utilize heat recovery from refrigeration processes.
- ✓ Replace reciprocating compressors with screw compressors.
- ✓ PLC controlled equipment using external control of the compressor cylinder loading/unloading.
- ✓ Variable speed drives on pumps and centrifugal fans.
- ✓ Variable speed drive on Glycol pumps.
- ✓ 2 speed motors on condenser fans.
- ✓ Consider R-22 or ammonia refrigerants.
- ✓ Insulate glycol lines.
- ✓ Install a thermal ice storage system.

Building & Tanks

- ✓ Insulate jacketed and cold stabilization wine tanks.
- ✓ Install strip curtains on conditioned buildings with high traffic.
- ✓ Reduce heat gain on tank farms with solar screens or building insulation.
- ✓ Insulate refrigerant lines.
- ✓ Night air cooling.

Ponds

- ✓ Install premium efficiency motors.
- ✓ 2 speed motors (varies speed based on demand)
- ✓ Dissolved oxygen sensors.
- ✓ Fine bubble diffusion.
- ✓ Time-of-Use Rate.

Boilers

- ✓ High efficiency boilers.
- ✓ Insulate hot water and steam lines.
- ✓ Heat recovery off of stacks to preheat in-take water.
- ✓ Full modulating burners (varies burner based on demand).

EXAMPLES OF BEHAVIORAL CHANGE

Lighting

- ✓ Utilize lighting controls such as timeclocks, by-pass/delay timers, photocells, and motion detectors.
- ✓ Clean lighting fixtures once a year.
- ✓ Disconnect unused ballasts and remove burned out lamps to avoid ballast damage.

Refrigeration

- ✓ Increase evaporator temperature.
- ✓ Reduce condenser temperature.
- ✓ Clean coils at recommended levels.
- ✓ Perform cooling tower water treatment at regular intervals.
- ✓ Shift electric consumption into less expensive Off-Peak times.

Building & Tanks

- ✓ Insure that tank volume is appropriate.

Ponds

- ✓ Timeclocks on aerators.
- ✓ Affective pre-screening of fluids into ponds.
- ✓ Perform recommended maintenance intervals on aerators.
- ✓ Shift electric consumption into less expensive Off-Peak times.

Boilers

- ✓ Perform annual or recommended maintenance intervals.
- ✓ Regular combustion analysis (air/fuel mixture)
- ✓ Water test/treatment at recommended intervals.
- ✓ Timeclocks on boiler.
- ✓ Automatic pump shutoff on low/no demand.
- ✓ Stack thermometer.

Case Study in Wine Production

How did Sonoma Wine Company save money, water and energy while doubling production?

John Garn

SONOMA WINE COMPANY is a custom crush services provider in Sonoma County. Their primary facility for wine processing, wine storage and bottling is located in the town of Graton, situated in a former apple processing plant originally built in 1947. Last year, as Sonoma Wine Company considered their next round of upgrades and fully doubled their custom bottling capacity (from 1.5 to 3 million cases) per year, their facility's total energy use was far from their primary concern. Instead, President **Dennis Carroll**, general manager **Ed Silva** and director of business development **Natasha Granoff** worried about the regulatory and community risks as well as costs related to the inevitable increase in water use, wastewater output and changes in their permitted discharge levels, not to mention the potential impact and liabilities of that increase on the viable coho salmon stream adjacent to their property. But in the end, an integrated approach to energy efficiency for their planned facility expansion, which incorporated water conservation into the energy equation, not only solved their water problems but resulted in a plan that astonished the facility managers. The plan would reduce water use by 32 percent and wastewater discharge 31 percent below their existing baseline usage, and also reduce electricity use by 7 percent and natural gas by 35 percent all while producing twice as much wine Here's how they did it.

> "An integrated approach to energy efficiency for their planned facility expansion, which incorporated water conservation into the energy equation, not only solved their water problems but resulted in a plan that astonished the facility managers."

ESTABLISHING FACILITY BASELINES

When Sonoma Wine Company (SWC) bought the facility from **Pacific Wine Partners** in 2003, it suffered from antiquated equipment, un-insulated buildings and a generally inefficient layout. As business grew, providing quality services to their 20-plus client base began to place increasing stress on the existing production system and pushed capacity to the limits. In order to meet increased demand for custom wine processing services and gain market share, SWC knew they would have to invest in new equipment and expand their Graton facility. They couldn't implement their plans for growth and attract new business without equipment upgrades, new tanks and, most importantly, expanding the capacity of the wastewater pond.

The management of SWC wanted to incorporate sustainability into their plans, knew they had big improvements to make and needed to understand just how dire the current situation was. In February of 2003 they started by benchmarking their facility using the Sustainable Winegrowing Practices assessment put out by the **California Sustainable Winegrowers Alliance** (CSWA). The senior management team completed the assessment, answering questions about the 100-plus winery criteria to assess the overall sustainability of their current operations, including water use, energy use, ecosystem management, materials handling, solid waste generation, environmentally preferred purchasing and neighbors and community relations. "We realized we couldn't define where we needed to go to accomplish our goal of 100 percent production increase until we understood where we currently were," Granoff said. And according to her, completing the assessment together helped to put everyone on the same page.

The customized report they received back from CSWA compared their sustainability practices with over 100 other wineries in the state, and like many of the wineries that had completed the assessment, SWC had low scores in energy efficiency. The report prompted SWC to begin to question the intensity of all of their resource use by asking, "Just exactly how much water, energy and wastewater discharge is related to every case of wine we produce?"

Granoff, charged with researching their resource use baselines, immediately thought to enlist the services of their neighbors in Graton, the **Climate Protection Campaign** (CPC), a non-profit organization that is a national leader in helping companies and municipalities reduce their emission of greenhouse gases (GHG). **Dave Erickson**, an analyst for the CPC, used SWC's meter data and billing history from **Pacific Gas and Electric** (PG&E) company to determine a baseline energy intensity of .74 kWh per case of wine. Their energy intensity, combined with total fuel use information, allowed Erickson to calculate SWC's total baseline greenhouse gas (GHG) intensity of .44 pounds of CO_2 per case of wine.

Calculating water use was outside the scope of CPC's expertise, so Dr. **John Rosenblum** of **Rosenblum Environmental Engineering** was brought into the picture. It turned out that Rosenblum, a local water and wastewater engineer, was already intimately familiar with the site. He had analyzed it back when it was owned by **Associated Vintage Group** in 1999.

DRILLING DOWN: POTENTIAL RETROFIT SAVINGS

Meanwhile, as Granoff researched high-level resource intensity questions, SWC facilities manager **Jim Neely** drilled down into the facility specifics. He contacted his representative at PG&E to request a free comprehensive energy survey.

Three weeks later, the owners had the PG&E Energy Survey Report in hand and sat down to review the list of facility upgrade recommendations, which were organized by measure, including potential energy savings, utility cost savings and returns on investment for each measure. It also included potential rebates and incentives PG&E would offer to help pay for the improvements. The list of recommendations was long, so SWC decided to develop a phased implementation plan and worked with PG&E to reserve the incentive funds for the projects:

2004—insulate 16 tanks, high efficiency water heaters, hot water and glycol storage tanks and lighting upgrades.

2005—additional tanks and insulation, new air compressor, variable speed drives, insulate roofing, solar tubes and additional lighting upgrades.

2006—additional tanks and insulation, new air compressor and additional lighting upgrades.

By the end of 2005, SWC had completed a capital investment of half a million dollars, with PG&E incentives covering about one-third of the investment. SWC realized a 7 percent reduction in electricity and 36 percent in natural gas, despite the fact that production had actually increased 28 percent during the same period.

With business growth projections looking strong, SWC made their final decision to expand the facility to reach the 100 percent growth goal.

AN INTEGRATED APPROACH TO DESIGN

About the time SWC was deciding to double their expansion, Rosenblum shared his water use and water benchmarking findings with the winery, along with some troubling news. By Rosenblum's calculations, doubling production would require SWC to increase their permit for pond capacity from 20,000 gallons per day to 50,000 gallons per day. The enormous expense coupled with the regulatory process and potential for community resistance became a major concern.

But Rosenblum had also seen SWC's huge waste of process water throughout the facility and was convinced that an integrated approach could not only help reduce process water requirements, but could also have significant energy efficiency benefits as well. "Each gallon of water has an energy coefficient, and one of the best ways to reduce total energy use is by conserving water." Rosenblum suggested SWC enroll in PG&E's Savings By Design new construction program, which provides no-cost new construction design assistance and incentives for design elements that exceed what is the industry "Standard Practice." PG&E thereby funded Rosenblum, who was already subcontracting services to Savings By Design, to do detailed design analysis for SWC's expansion.

Rosenblum's goal was threefold: to determine where the most water and energy was used in the winery process; to make design recommendations to reduce energy and water use; and to calculate the energy difference between a "Standard Design" expansion and an efficient, integrated "Savings By Design" expansion to accomplish SWC's planned 100 percent growth in production.

Integrated design, as a practice, looks beyond individual system component opportunities and seeks efficiency solutions that can have interactive effects throughout a facility. **Patsy Dugger**, who manages programs for PG&E's Agriculture and Food Processing segment, noted, "Savings By Design will pay for all kinds of energy savings, but good, integrated design tends to reap the greatest benefits—the energy savings can really snowball."

MONEY DOWN THE DRAIN

Rosenblum knew that the linear flow of hot water through the winery, down the drain and out to the wastewater ponds was a good bet for system inefficiencies. He quickly identified opportunities in tank cleaning, barrel washing and in the process to raise the wine to ambient temperature for label adhesion during bottling. Rosenblum's baseline calculations demonstrated that these three processes accounted for over 70 percent of the total water use and 95 percent of the total hot water use. He made the following recommendations:

> "The linear flow of hot water through the winery, down the drain and out to the wastewater ponds is a good bet for system inefficiencies."

- Install new hot water return line and insulate entire loop to barrel washer, wine preheating and bottling line sterilization.
- Use the final ozone rinse to make up wash water for the barrels.
- Develop equipment and establish cascaded rinse procedures for tank cleaning.
- Modify the heat exchanger for wine preheating.
- Install new barrel washer.

The energy efficiency recommendations are projected to achieve a 23 percent reduction in cold water and a 62 percent reduction in hot water below the facility's existing current production baseline. With these main efficiency measures, as well as several other implementations, it was projected that SWC would reduce their overall water use by 30 percent. By recapturing the hot water from the barrel washing, bottle pre-heating and tank washing, the planned production expansion could be achieved with the existing two water heaters while reducing natural gas use below baseline levels. This would also eliminate the capital expenditure for two additional water heaters and save an estimated 15,300 Therms/year.

COLD HARD REFRIGERATION SAVINGS

And there were other opportunities. The largest user of energy in any winery is refrigeration. With the planned Standard Design expansion, SWC had expected to add 200 tons of refrigeration capacity to accommodate 70 additional storage tanks, 800 additional fermentation barrels and tighter climate control for 35,000 barrels in storage.

Rosenblum's Savings By Design analysis report found that improving building shells and insulating wine tanks would make a significant difference in refrigeration costs. He made the following recommendations:

- Insulate all tanks at the winery, both inside and outside.
- Insulate the main cellar building and improve ventilation to maintain inside air temperature at 70°F.
- Improve insulation and ventilation of barrel fermentation and storage buildings to maintain stable wine temperature.
- Integrate night-cooling and CO_2 controls for fermentation to avoid introducing hot afternoon air.

Insulating inside tanks appeared to be a particularly good measure given that SWC's wine cellar was an old, un-insulated sheet metal structure where the upper-level inside air temperatures often surpassed 100°F in summer months, and ice layers commonly formed on the wine tanks from the condensation. By insulating all refrigerated tanks and improving the ventilation and insulation of these buildings, Rosenblum and Petaluma architect **George Beeler** were able to determine that no more than 10 tons of additional refrigeration capacity would be needed to handle a doubling of production capacity. This was a 79 percent reduction in projected energy requirements for refrigeration from Standard Design.

WASTEWATER AS A MISNOMER

The SWC wastewater ponds are the third largest energy consumer at the winery. During the energy upgrades of 2005, SWC installed new efficient aerators along with dissolved oxygen controls. These measures were effective on the treatment side, but it was in reducing the process water through design

improvements that brought SWC the greatest energy saving benefits of all.

Rosenblum's recommendations included re-using water in a tiered system throughout the winery and building a 24,000 foot canopy over a tank farm that would divert uncontaminated rainwater from the wastewater stream to storm water drains (and also provide shade for the wine tanks). These Savings By Design water efficiency recommendations had threefold benefits: first, they reduced process water use and the associated water utility costs. Secondly, they saved pumping energy, water heating energy and water treatment energy at the wastewater pond 18 percent below SWC's baseline use. Finally, and most significantly, they reduced water output so much so that SWC does not have to build a new and larger pond to handle the increases in anticipated water use. According to Dr. Rosenblum and Granoff, avoiding much of the regulatory and permitting process is "the most significant win of all."

PROJECT SAVINGS

The cost savings and benefits from smart integrated design can include hard dollar savings (such as dollars saved on water and energy utility bills) to labor savings (such as from an avoided regulatory or permitting process) to environmental and PR savings (from avoiding potential impacts on the coho salmon stream or other community conflict). Other benefits, such as lowered temperatures in SWC's cellar, will make for improved working comfort for employees.

The hard dollar savings are impressive. While at current operating conditions, SWC is spending about $230,000 per year on gas and electricity alone, the Savings By Design proposal projects to bring them to approximately $200,000 per year with a doubling of capacity, which is approximately 43 percent of what would have been used under a Standard Design (that is, an estimated $470,000 per year).

Any CFO can tell you that good design and energy efficiency can cost more up front, which is the very barrier that PG&E and other California utilities aim to knock down by offering design assistance and incentives. For SWC, the Savings By Design approach would add $800,000 to initial costs, but with PG&E incentives of $260,000, the payback will be approximately 2.1 years.

IN SUMMARY: SMARTER BUSINESS EQUALS BETTER BUSINESS

By employing an integrated system approach with PG&E's Savings By Design program, Sonoma Wine Company will be able to double their production capacity from 1.5 million cases to 3 million cases per year while reducing electricity use by 7 percent, process water use by 32 percent, wastewater generation by 31 percent and natural gas use by 35 percent, all below their current usage baseline. What this means is that SWC will be making twice as much wine and generating twice as much business while reducing energy use by 1.5 million kWh per year and avoiding 584 tons of CO_2 emitted into the atmosphere, all while increasing the environmental protection of a coho salmon stream and addressing the environmental concerns of their neighbors. As Dennis Carroll, president of Sonoma Wine Company stated, "You can't deny this is smart business. It just makes sense!"

For their customers SWC can provide increasingly valuable information on the environmental performance of their products and become their preferred vendor as well. By being able to provide a "story of sustainable practices", SWC offers their clients a way to differentiate themselves in a competitive market while expanding the definition of "quality."

With the help of energy efficiency incentive programs like PG&E's Savings By Design program, combined with a smart integrated system approach, the California wine industry can stay globally competitive while improving the environmental quality of the state.

By the way, how intense is your wine? **wbm**

John Garn is an info-cartographer and a co-founder of ViewCraft, a management consulting firm. His experience includes private, non-profit and governmental entities such as the U.S. EPA, Wine Institute and the California Association of Winegrape Growers. In 1999 John's work on the collaboration-based Sonoma Green Business Program was recognized with a national sustainability award from the D.C.-based Joint Center for Sustainable Development.

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ENERGY AND WATER EFFICIENCY AT SONOMA WINE COMPANY, GRATON

John Rosenblum, Ph.D.
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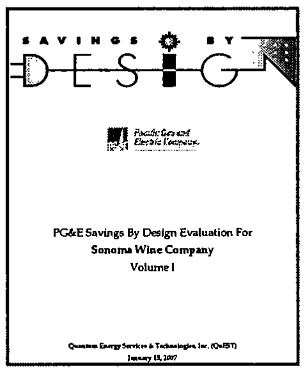
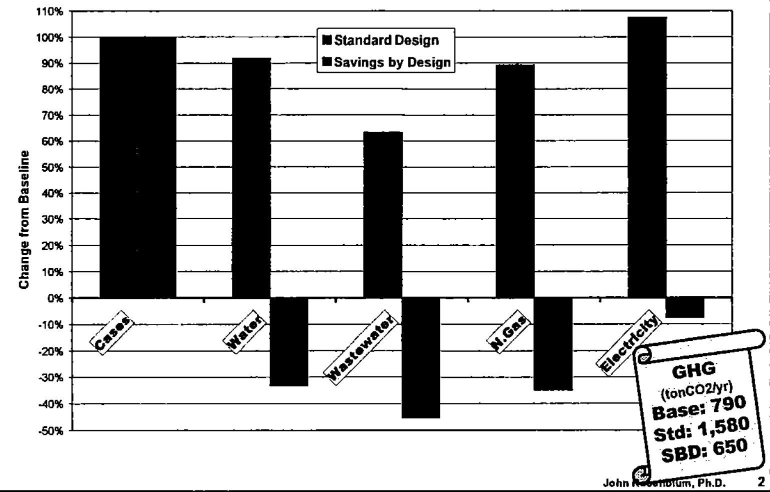
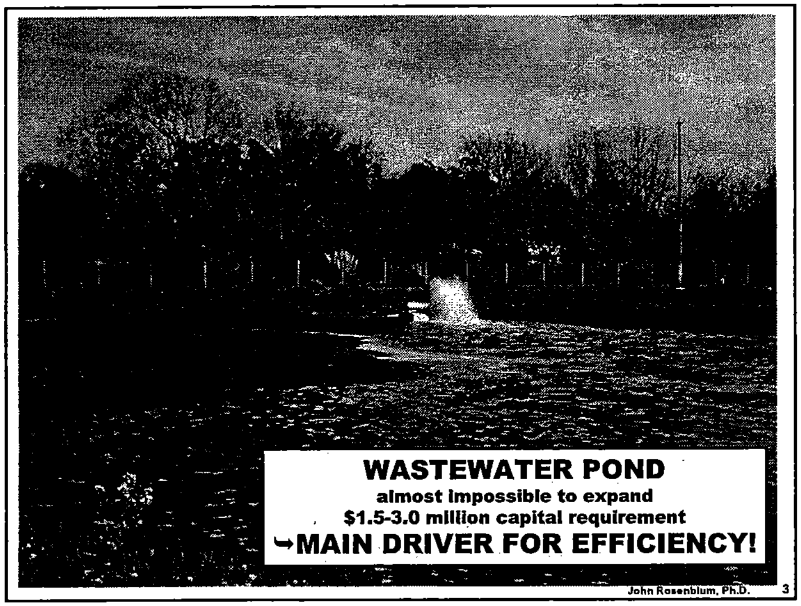
Sebastopol, CA
(707) 824-8070

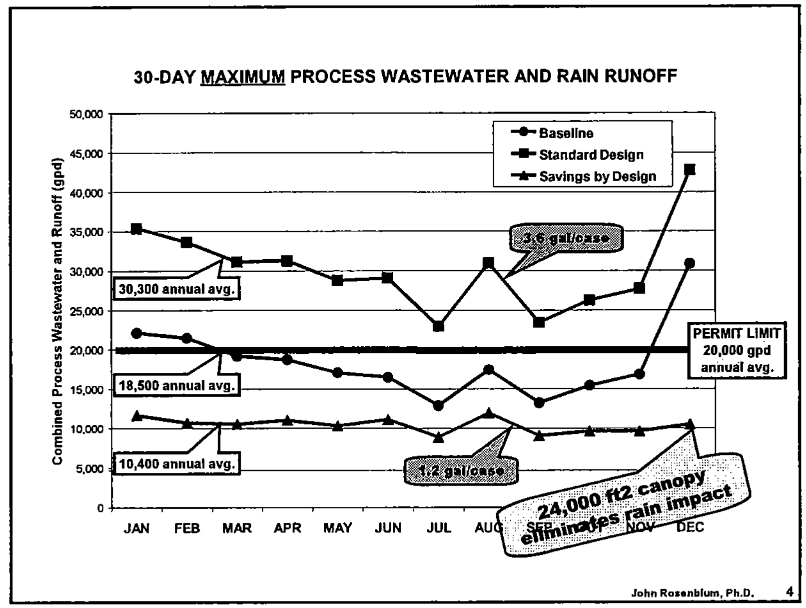


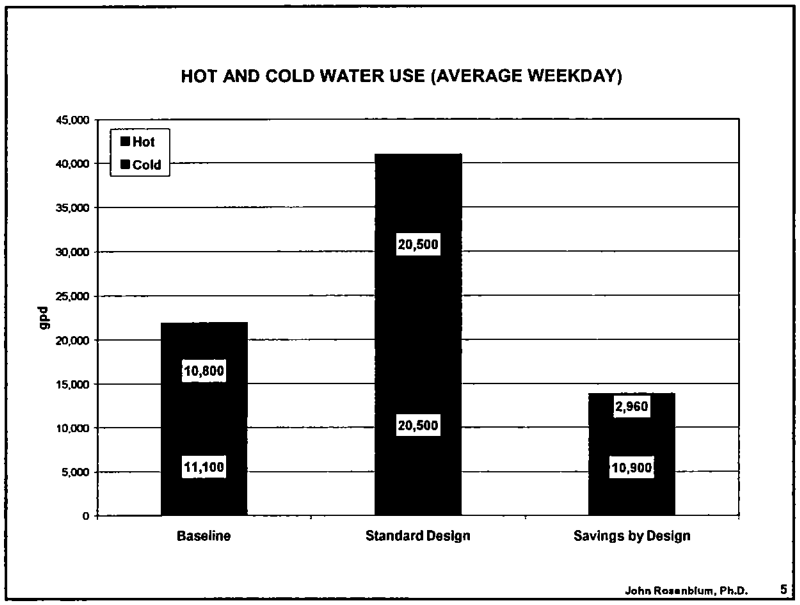
1.5 → 3.0 million cases/yr

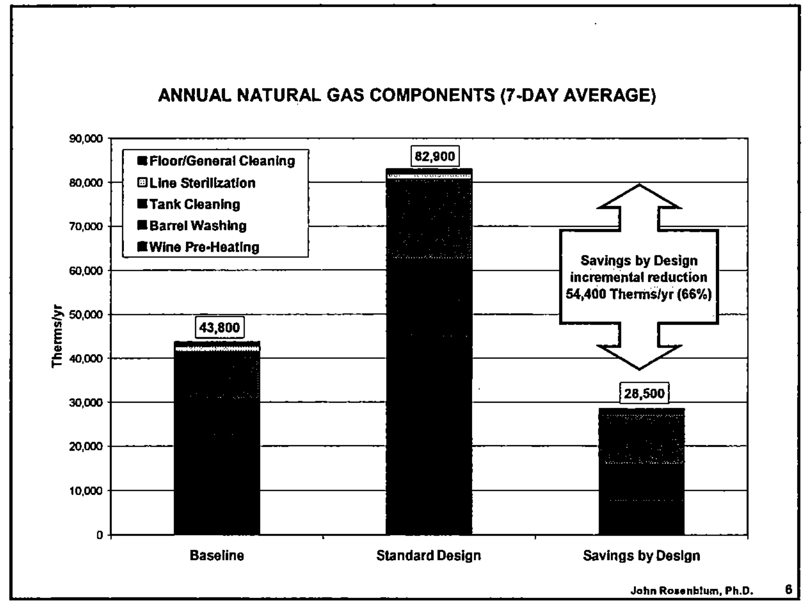
CHANGES FROM 2005 BASELINE



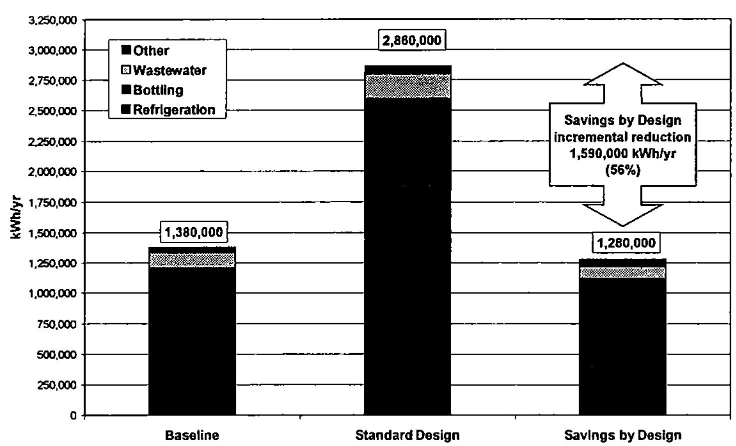

WASTEWATER POND
almost impossible to expand
$1.5-3.0 million capital requirement
→MAIN DRIVER FOR EFFICIENCY!
John Rosenblum, Ph.D.
3


30-DAY MAXIMUM PROCESS WASTEWATER AND RAIN RUNOFF
Combined Process Wastewater and Runoff (gpd)
50,000
45,000
40,000
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC
Baseline
Standard Design
Savings by Design
30,300 annual avg.
18,500 annual avg.
10,400 annual avg.
3.6 gal/case
1.2 gal/case
PERMIT LIMIT
20,000 gpd
annual avg.
24,000 ft2 canopy
eliminates rain impact
John Rosenblum, Ph.D.
4


HOT AND COLD WATER USE (AVERAGE WEEKDAY)
gpd
45,000
40,000
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
Hot
Cold
10,800
11,100
20,500
20,500
2,960
10,900
Baseline
Standard Design
Savings by Design
John Rosenblum, Ph.D.
5

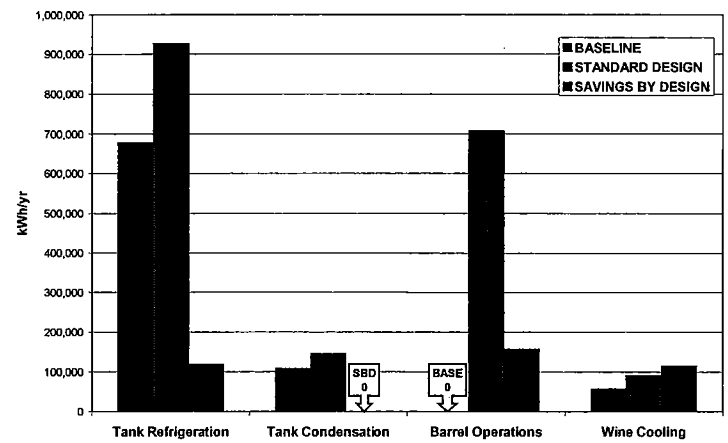

ANNUAL NATURAL GAS COMPONENTS (7-DAY AVERAGE)
Therms/yr
90,000
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
Floor/General Cleaning
Line Sterilization
Tank Cleaning
Barrel Washing
Wine Pre-Heating
43,800
82,900
28,500
Savings by Design
incremental reduction
54,400 Therms/yr (66%)
Baseline
Standard Design
Savings by Design
John Rosenblum, Ph.D.
6

ANNUAL ELECTRICITY USE COMPONENTS

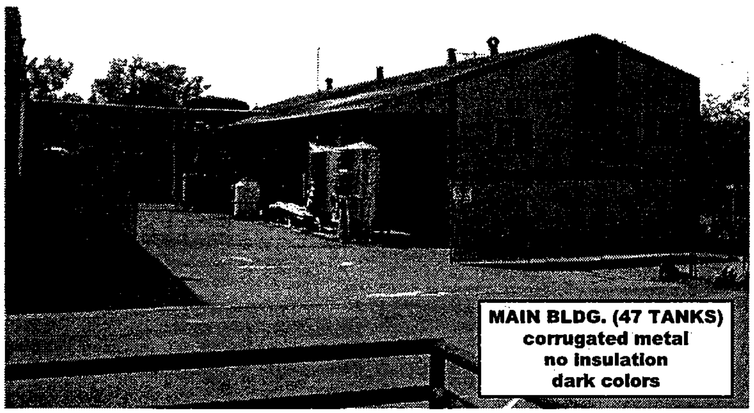


John Rosenblum, Ph.D. 7

REFRIGERATION ELECTRICITY COMPONENTS

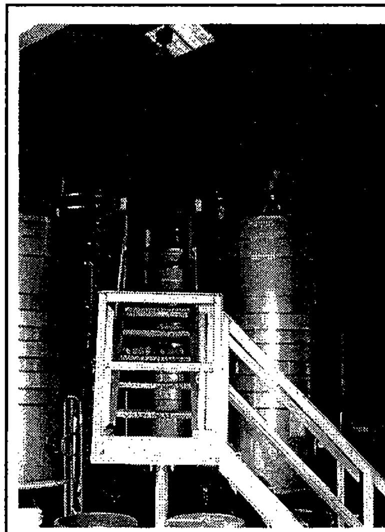


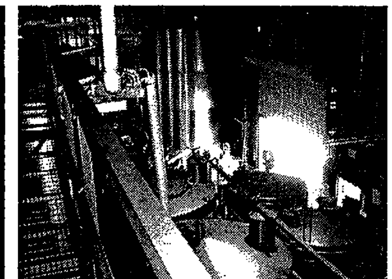
John Rosenblum, Ph.D. 8



MAIN BLDG. (47 TANKS)
corrugated metal
no insulation
dark colors

John Rosenblum, Ph.D. 9

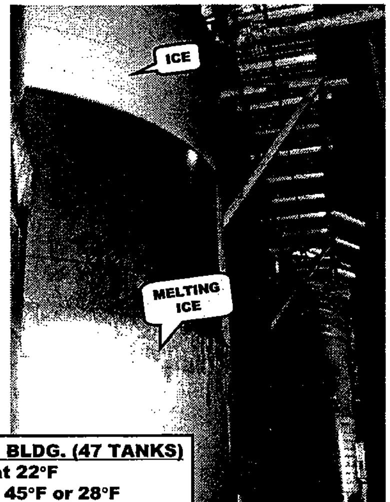




MAIN BLDG. (47 TANKS)

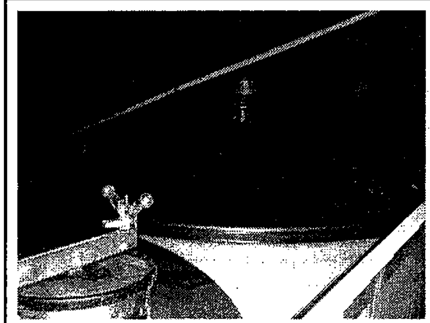
- outside: 80°F - 50%rh
- inside floor level: 60°F - 100%rh
- inside 3rd level: 100°F - 100%rh

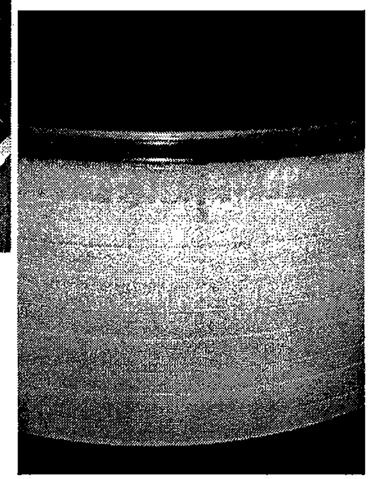
John Rosenblum, Ph.D. 10



MAIN BLDG. (47 TANKS)
- glycol at 22°F
- wine at 45°F or 28°F
- condensation on all tanks
- avg.condensation 200 gpd
- freezing when glycol flows

John Rosenblum, Ph.D. 11





MAIN BLDG. (47 TANKS)
freezing glycol bands
even at 3rd level (100°F)

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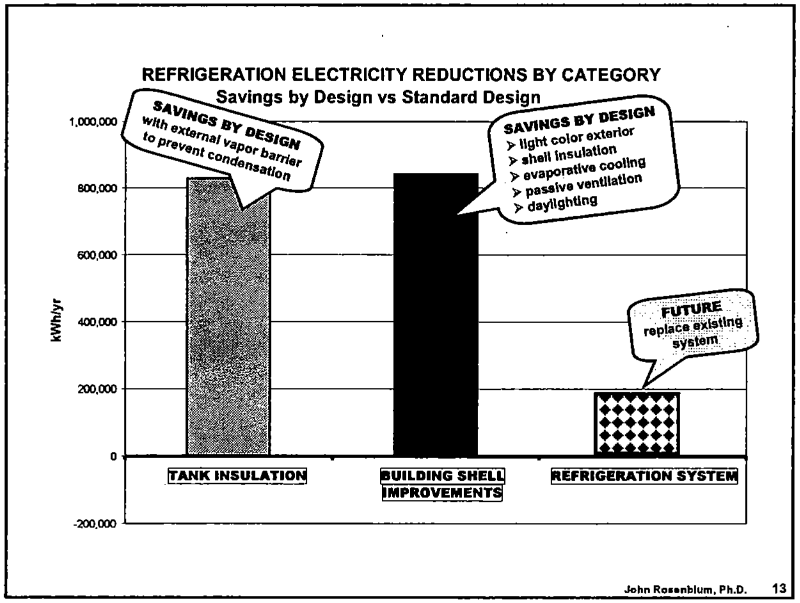
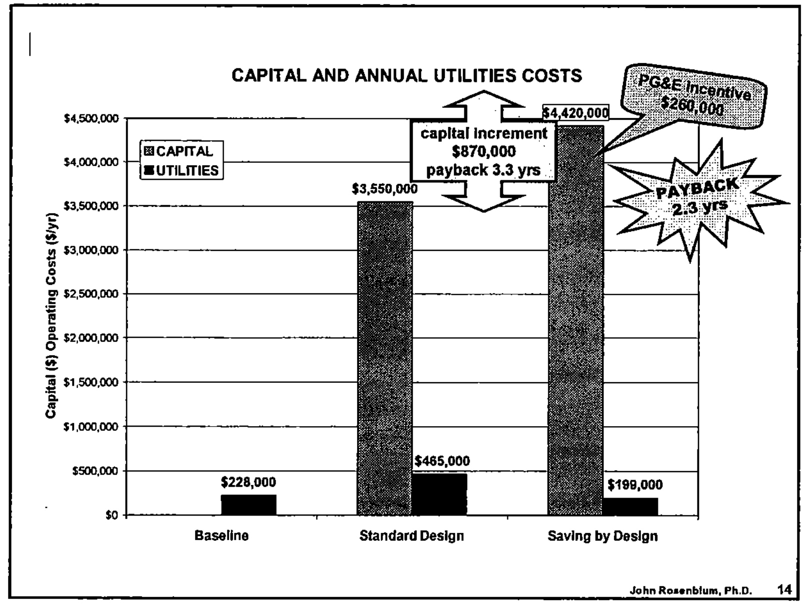

REFRIGERATION ELECTRICITY REDUCTIONS BY CATEGORY
Savings by Design vs Standard Design
kWh/yr
1,000,000
800,000
600,000
400,000
200,000
0
-200,000
SAVINGS BY DESIGN with external vapor barrier to prevent condensation
SAVINGS BY DESIGN
> light color exterior
> shell insulation
> evaporative cooling
> passive ventilation
> daylighting
FUTURE replace existing system
TANK INSULATION
BUILDING SHELL IMPROVEMENTS
REFRIGERATION SYSTEM
John Rosenblum, Ph.D. 13


CAPITAL AND ANNUAL UTILITIES COSTS
Capital ($) Operating Costs ($/yr)
$4,500,000
$4,000,000
$3,500,000
$3,000,000
$2,500,000
$2,000,000
$1,500,000
$1,000,000
$500,000
$0
CAPITAL
UTILITIES
capital increment $870,000 payback 3.3 yrs
PG&E Incentive $260,000
PAYBACK 2.3 yrs
$228,000
$3,550,000
$465,000
$4,420,000
$199,000
Baseline
Standard Design
Saving by Design
John Rosenblum, Ph.D. 14

THINGS CHANGE DURING IMPLEMENTATION

... often for the better ...
... if you keep watching ...

IMPLEMENTATION CHANGES

BARREL BUSINESS RAMP-UP
- ➔ use old washers
- ➔ additional storage locations
- ➔ tanks moved outside

✓ sump/piping
✓ bldg shell
✓ canopy

FERMENTATION RAMP-UP
- ➔ use old wine HX
- ➔ more water, w/w, and N.Gas

✓ new HX

EVAPORATOR START-UP
- ➔ 1 gpm vacuum condenser cooling water

✓ closed loop

NEW REFRIGERATION
- ➔ high efficiency ➔ less electricity
- ➔ location ➔ condenser heat recovery ➔ less N.Gas

✓ plan early!

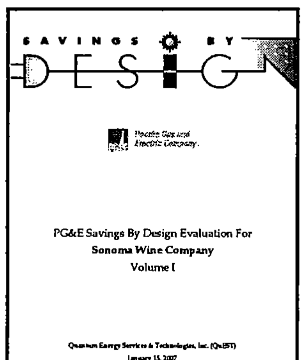
ENERGY AND WATER EFFICIENCY AT SONOMA WINE COMPANY, GRATON

John Rosenblum, Ph.D.
(707) 824-8070

Sonoma Wine Company
Dennis Carrol, President
Ed Silva, General Manager
Jim Neely, Maintenance Manager
Antonio Trevinio, Senior Winemaker
Natasha Granoff, Director of Business Development

Vendors/Consultants
George Beeler, AIM Associates
Mark Walters, Lescure Engineers
Mike Davidson, APCCO
Chip Kime, ConeTech

Pacific Gas & Electric Company
Patsy Dugger
Larry Waits
Manny D'Albora
Bob Floyd
Richard Fromberg



Best Practice Guide

Food and Beverage Growers and Processors

Case Study

Fetzer Vineyard

Location: Hopland, Mendocino County
Type: winery and vineyard
Size: 10,000 sq. ft. administrative building, 130,000 sq. ft. of barrel storage, 140,000 sq. ft. bottling warehouse, and a tank farm.
Built: 1996

Printer-friendly version
Share your thoughts

Company Website: http://www.fetzer.com

Company Information

Fetzer Vineyards is one of the largest premium wine producers in the United States and the largest grower of organic grapes along California's North Coast. 100 percent of Fetzer's 2,000-farmed acres are certified organic, eliminating pesticides, herbicides, and chemical fertilizers. Fetzer produces nearly 4 million cases of wine from 11 types of varietals, which are sold all over the world.

Fetzer operates two wineries: its main production site and administrative headquarters in Hopland, California and a second site built in the early 1990s in Paso Robles, California. Hopland has 11 million gallons of steel storage capacity, seven grape crushers, and an annual fermentation capacity of 35,000 tons. The winery is designed with separate temperature controlled areas for fermentation and bottling, as well as a 600,000-case storage center.

Photo courtesy of Fetzer Vineyard.

View Details.

Corporate Philosophy

The Fetzer family and Paul Dolan, who would become Fetzer's president, adopted sustainable business practices as early as the mid-1980s. By 1998, Fetzer had firmly established a triple bottom line: economic vitality, environmental responsibility, and social equity. More recently, Fetzer announced that by 2010 it would only purchase organic grapes (Fetzer's own acreage is already organic).

From 1999 to 2004, Fetzer's efforts have saved roughly 1 million kilowatt-hours (kWh) of electricity. Fetzer has also reduced water consumption over the same time period by 24 percent or 6.6 million gallons, and has reduced waste to landfills by 95 percent.

Building Envelope

When Fetzer moved to Hopland, California in the late-1990's, then-President Paul Dolan decided to construct the greenest administrative building possible. The resulting 10,000 sq. ft. building uses passive solar design and rammed-earth construction to minimize the need for mechanical systems while taking advantage of free daylighting and natural ventilation. Designers calculated the best solar orientation, and pre-wired the building for a photovoltaic system that would be later installed.

Fetzer has undertaken many other energy efficiency measures across its facilities. A simple insulated concrete wall, for example, was constructed to separate cold stabilizing wine from warm-fermenting wine, reducing energy bills by $5,000 per month.

Refrigeration

Refrigeration is the largest electrical load for any winery, making it Fetzer's first and primary focus for energy efficiency.

Compressor controls

Fetzer has 1200 horsepower (hp) of compressor motors available for cooling white wine, which is stored in tanks. To make these run

Aerial view of S. Martinelli & Company and the surrounding area in Santa Cruz County. Photo courtesy of S. Martinelli & Co.

View Details.

more efficiently, Fetzer installed programmable logic controls (PLC) that monitor the refrigerant for temperature and pressure. The controls use this data to cycle compressors on/off as needed, decreasing runtime of both the compressors and chilling tower pumps. Since runtimes are reduced, maintenance needs are also lower and the useful lifespan of the compressors is increased.

The PLC resulted in annual energy savings of over 225,000 kWh and cost savings of nearly $30,000. Maintenance costs were reduced, too, by about $4,000 per year. PG&E provided a $28,000 rebate for this project, helping to make payback on Fetzer's investment in just over three years.

Tartrate removal

White wines are normally cold stabilized to remove tartaric acid, requiring sustained temperatures of 26º F for two to four weeks at a time.

However, a small portion of Fetzer's white wines employ an innovative technology, known as electrodialysis, to remove tartrates. The process, known as Selective Tartrate Removal System (STARS), works by moving micro-layers of wine between two membranes that are selectively permeable; one to tartrate species, and the other to potassium and calcium. A water-based conductant flows past the other side of each membrane. A weak electrical field attracts the tartrate salts and moves them through the membranes. As the salts cross the membranes, they are carried off by a conductant solution, which is discarded. The wines are then ready for bottling.

According to Patrick Healy, environmental manager at Fetzer, "We've been renting the services of Winesecrets for the past three years to help test this for both Winesecrets and the larger wine community. Electrodialysis consumes about 20 percent of the energy of refrigeration - we're doing accurate measurements this year for the Energy Commission about actual reductions made."

During the 1990s, the French National Agronomic Research Institute, in concert with Eurodia Industrie, developed this process. Since then, Eurodia has installed over 30 units in France, Italy and Spain. In California, Winesecrets provides both stationary equipment as well as a mobile service to help wineries interested in STARS.

Heat Exchanger

White wines are cold stabilized at very cold temperatures, as low as 26º F. After the tartrates are removed, wine is then ready for bottling. However, wine temperatures are still around 30º to 40º F. Healy explains, "The temperature of the wines needs to rise in order for labels to adhere successfully to bottles. Current practices {to do this} involve too much water and too much natural gas for heating water."

After researching options, Fetzer decided to install a high-efficiency heat exchanger. Traveling in pipes between the wine production area and the pre-bottling area, wine comes in contact with the heat exchanger, which quickly warms wine to around 50° F, the optimal temperature for placing labels.

Previously, Fetzer spent almost $8,000 per year on natural gas for the boiler to provide hot water for warming wine tanks. With the heat exchange system, Fetzer pays only $2,500 for natural gas and saves 700 million Btus per year. Fetzer also saves $1,500 on reduced boiler maintenance. The new system has sped bottling lines by 20 percent, yet results in fewer label misplacements. Fewer shifts are needed to produce the same amount of wine, resulting in labor savings of $48,000. Less reworking of labels reduces waste, and saves about $11,000 annually on materials. The total savings from the project are $76,500; simple payback for this investment is slightly less than 1 year.

The heat exchanger also saves water by recirculating it over pipes several times before sending it to the wastewater system. The old system allowed water to pass along the sides of the wine tank only once, running thousands of gallons of hot water down the sides of wine tanks before sending it to wastewater runoff reservoirs. Recirculating hot water in the new system reduces the amount of water that has to be pumped, treated and disposed of and has led to savings of over 1,000,000 gallons of potable water and $11,000 in costs.

Water Efficiency

Although the industry average is up to use eight gallons of water for every gallon of wine produced, Fetzer's water-saving strategies have reduced their consumption to only 2.1 gallons for every gallon of wine.

Meters and usage tracking

Fetzer's first step was to install meters on its three water wells and in each building. Meters are read weekly, helping to show where water is used and to alert workers if spikes in usage occur. Fetzer is now able to find and repair major leaks, resulting in substantial savings. Fetzer also installed water-efficient nozzles and heads on hoses and jet-sprays.

Minimizing chemical treatments

Fetzer introduced an ultraviolet filtering system that eliminated the use of chlorine to treat on-site well water.

Natural filtration of wastewater

Wastewater ponds were converted into a natural system that employs gravel, sand filters, and a planted reed bed. Low energy aeration takes place with sprinklers instead of energy-intensive equipment. The treated water is reused to irrigate the winery's organic grapes (before fruit appears) and landscaping. Absolutely no discharge is released to the Russian River. This project was jointed developed with University of California, Davis.

Distributed Generation and Renewable Energy

Not only is Fetzer committed to energy efficiency, it also tries to make its energy supplies as green as possible. Fetzer is the only winery, for example, purchasing 100 percent renewable (green) electricity in California.

Photovoltaics

A 41-kilowatt (kW) photovoltaic (PV) system provides enough electricity to produce 1.2 million bottles of wine annually. The PV system powers 75 percent of the administration's building electric needs, and feeds any excess power back to the utility grid (net metering). PVs generate the most electricity on sunny mid-summer days, coinciding with statewide peak demand for power - allowing Fetzer to "give back" when the community needs it most.

Over the 25-year lifetime of the photovoltaic system, it will reduce an estimated 850 lbs. of nitrogen oxide and 1088 tons of carbon dioxide - the equivalent effect of planting 375 acres of trees or eliminating 4 million miles of drive time.

Additional Activity

As a leader in organic farming and sustainable best practices, Fetzer makes the time to share its lessons learned with the broader farm and food processor community.

Peer-to-Peer Education

Fetzer partnered with Lawrence Berkeley National Laboratories (LBNL) to develop the computer-based Benchmarking and Energy and water Savings Tool (BEST), which helps more than 1,000 wineries in California better understand and manage resource use. Researchers developed a model for a reference winery with state-of-the-art, commercially available energy and water saving control technologies that was based on Fetzer's actual performance data and operations.

Fetzer supports the efforts of the California Sustainable Winegrowers Alliance, a non-profit organization dedicated to identifying and disseminating sustainable best practices for wineries and winegrape growers. Fetzer also established Club Bonterra, an organization of Fetzer grape growers dedicated to sharing information about sustainable farming practices.

Fetzer employees regularly speak at industry meetings and conferences, sharing with peers tips and tools for reducing energy and water consumption. Fetzer employees also contribute to countless articles on sustainable practices.

Fetzer frequently partners with research institutions and government agencies, such as the University of California and the California Energy Commission, to demonstrate new innovations in processes or equipment.

Recycling & Composting

In 1997, Fetzer Vineyards was recognized as one of the top ten recycling companies in the state. As part of this effort, Fetzer has created a large composting program that incorporates all of the stems and seeds from the winery's crushed grapes, known as pomace. This material is composted for more than a year then spread throughout the vineyards as natural fertilizer. These efforts reduce energy use by reducing waste, therefore limiting the power required to dispose of waste both on-site and off-site in the greater community.

Fetzer uses 40 percent recycled glass in its bottling production and all case boxes are made of 100 percent post-consumer waste. Fetzer also purchases corks in bulk directly from producers in Portugal; because corks are shipped in a container direct to the winery, no excess packaging is required.

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Best Practice Guide

Food and Beverage Growers and Processors

Case Study

J Vineyards and Winery

Location: Russian River Valley, Sonoma
Type: Food and Beverage Processing Facility (winery)
Size: 45,000 sq. ft. winery and 15,000 sq. ft. barrel storage
Built: 1982

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Company Website: http://www.jwine.com

Company Information

J Vineyards & Winery was founded in 1986. J Wine farms just over 250 acres in California's Russian River Valley where Pinot Noir and Chardonnay varietals thrive, producing a sparkling wine, Pinot Noir, Pinot Gris and Chardonnay.

Located just 15 miles from the Pacific Ocean, cool coastal maritime fog helps moderate heat accumulation from spring budbreak to fall harvest. Rainfall averages 35 to 40 inches per year, November through May. These climate considerations and the refrigeration requirements present fertile ground for benefits derived from energy-efficient techniques.

J's 40,000 sq. ft. winery, 15,000 sq. ft. barrel storage, and self-contained water system provide a wide variety of potential improvements in refrigeration, lighting and cleaning.

Corporate Philosophy

J Wine is dedicated from top down to sustainable winemaking. Founder and CEO Judy Jordan, a geologist by trade and an environmentalist at heart, built and expanded the winery with green practices since the beginning. Dana DiLuvio, formerly employed by Jordan Winery, was brought on board in 1997 as Facility Manager with a responsibility to create a winery that was both cost-effective and energy efficient. "Despite all of the cache around winemaking, we are manufacturers. Green business is just good for the bottom line."

Refrigeration

According to DiLuvio, "The biggest energy expense for any winery is refrigeration. For us, approximately 70 percent of our energy bill is for cold storage." From the time the fruit arrives for fermentation, until it goes out the door, temperature control is required. During the harvest season, the heat of fermentation must be displaced. Wines need to be cold stabilized before bottling, bringing large tanks down to near freezing temperatures. The entire plant must be maintained between 55º F to 60º F all year. Post harvest, almost 700,000 gallons of product in various sized tanks must all be chilled.

By 2000, Jordan and DiLuvio realized that they needed to expand refrigerated warehouse space to keep up with production. Because such a large portion of both expenses and profits depend on J's barrel warehouse, both Jordan and DiLuvio knew to invest in the most efficient and reliable system possible. For J Wine, this meant significant changes in insulation, a downsized, more efficient refrigeration unit, and computerized controls that stage variable-speed compressors to adjust operations according to actual loads.

For optimum results, DiLuvio green-lighted over $55,000 in additional insulation beyond code requirements, layering 3 inches of foam between concrete walls. This led to an immediate reward of $20,000 in energy efficiency rebates during the construction phase. However, J Wine discovered an unexpected bonus - because of the extra insulation, the company was able to save $71,000 on purchase and installation of downsized refrigeration equipment. Between the insulation, more efficient equipment, and optimized controls, J Wine saves a significant amount of energy and money from its refrigeration.

Sub-metering and Benchmarking

J purchased its facilities from an existing winery in 1996. In order to establish baseline data about energy-intensive equipment and processes, DiLuvio started by identifying "cost centers," and then established baseline energy use for each of these. All future measures could be measured against these initial benchmarks. Small digital meters were used to take measurements since J Wine didn't have its own utility meter.

DiLuvio explained, "At one time, we shared a meter with Rodney Strong, our next-door neighbor. It is very difficult to benchmark progress and make informed decisions without sub-metering." In lieu of a meter system, DiLuvio also added small digital meters to motor control panels. "It let us more accurately assign the energy costs to the production process," said DiLuvio.

Lighting

In 2002, DiLuvio retrofitted lighting in processing areas, replacing all 70 metal halide and 35 high pressure sodium high-intensity discharge (HID) fixtures with high output T8 fluorescent lamps and electronic ballasts mounted about 20 feet from the floor. This effectively reduced each fixture from 470 watts to 220 watts. Thanks to a rebate from PG&E, energy savings paid for the investment in lighting in 18 months.

Offices and administrative spaces enjoy large glass windows that minimize the need for artificial light. When it is required, offices are equipped with T8 fluorescent indirect fixtures and fluorescent recessed fxtures. Motion sensors in the copier room shut off lights when it is unoccupied. Timers shut down outdoor lighting in the parking lot by 9 PM.

Barrel Washing and Water Sterilization

Water at J Wine is used primarily for barrel washing and, quite literally, turning water into wine. J Wine, like several wineries, is considered its own "water district," drawing its supply from a well on the property. As a result, J Wine is uniquely concerned about efficient and effective water treatment that makes the most of this important natural resource.

J Wine eliminated use of chlorine to disinfect wash water, since chlorine is capable leaching into the wood and walls of wine barrels - some of which cost over $700 each - and can alter the flavor of the wine. J Wine now relies on a system that uses ultraviolet light and ozone to sterilize water, rather than chlorine.

Besides these capital outlays, minor parts like seals and o-rings had to be replaced since ozone can some kinds of rubber.

Additional Activity

Environmental Education for Employees

There are approximately 70 employees at J Wine in a range of occupations and work environments. As a matter of company policy, recycling is encouraged across the company -- in the administrative areas, for example, office workers keep two baskets under their desks, and in production areas glass is reused, and all cardboard is bundled and recycled). Employees receive regular training at the beginning of harvest about the efficient use of resources and conservation behaviors.

Water conservation

As its own water district, J Wine tries to conserve water through process (behavior) changes that do not necessarily require technological improvements. Workers remove all solids, for example, before end-of-day cleaning and hose-downs. DiLuvio recalls that, "I've seen workers use a hose to move a single grape 9 or 10 feet as part of a clean-up. That is a enormous amount of lost water."

Community Participation

J Wine is an energy efficiency leader in the wine community and is active in peer-to-peer sharing of information about opportunities to improve energy efficiency, reduce waste, and prevent pollution. J Wine is a featured case study in Sonoma Green Business Program's "Greenovations" guide, and is a participating member of the California Sustainable Winegrowers Alliance. J Wine has also provided important feedback on Lawrence Berkley National Laboratory's new program Benchmarking for Energy and water Savings Tool (BEST).

"Staying active in the community is a reward for us, both financially and environmentally. Its important to stay connected to companies who are part of this 'green wine' effort - not only to help give us some more great ideas, but to build rapport and remind us that we're in this together," said DiLuvio.

Future Projects

DiLuvio is looking at developing onsite co-generation, installing photovoltaics, and using waste heat to power chillers and boilers in new developments scheduled for 2006 to 2008

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Best Practice Guide

Food and Beverage Growers and Processors

CASE STUDIES

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GLOSSARY

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Case Study

S. Martinelli and Company

Location: Watsonville, Santa Cruz County
Type: Food and Beverage Processing Facility (juice)
Size: 390,000 and 60,000
Built: 1968 and 1905

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Company Website: http://www.martinellis.com

Company Information

Based in California's beautiful Pajaro Valley, near the Monterey Bay, S. Martinelli & Company has been producing apple juice since 1868. Thanks to continuing plant modernization, this family owned and operated company has been able to keep pace with market expansion and keep its foothold as the best-selling brand of apple juice made in the United States from 100 percent U.S.-grown fresh apples.

Martinelli's operates two juice processing and bottling facilities in Watsonville. The orignal facility is a 60,000 sq. ft. single-story highbay plant originally built in 1885. The main facility is a 390,000 sq. ft. single-story highbay building originally built in 1968 by Green Giant Foods as a vegetable processing plant. Together, these two facilities process 100,000 gallons of apple juice each day.

Aerial view of S. Martinelli & Company and the surrounding area in Santa Cruz County. Photo courtesy of S. Martinelli & Co.

View Details.

Through a combination of capital investments and $30,000 in rebates from Pacific Gas & Electric (PG&E), S. Martinelli & Co cut its annual electricity use 13 percent in 2005, compared to 2004, including an estimated reduction of 40 kilowatts in peak demand. Retrofits to highbay lighting, installation of an EMS, and upgrades to two compressed air systems alone save more than 700,000 kilowatt-hours annually, reducing utility costs by about $86,000.

Corporate Philosophy

Vineyard 29 in Napa Valley. Photo courtesy of Vineyard 29.

View Details.

At Martinelli's, key company leaders, like fourth generation Vice President John Martinelli, make a priority of sustainable practices and environmentally sensitive production. Energy efficiency plays a large role in Martinelli's sustainable practices, as well as impacting bottom-line results - with looming energy costs of 7 to 8 percent of operating expenditures, the company continually analyzes how much electricity and natural gas it takes to produce a gallon of apple juice.

According to Greg Galvin, Martinelli's Maintenance Supervisor who spearheads energy efficiency efforts, the company has realized that, "Energy is no longer a facet to be ignored in budgeting for the cost of goods. The most viable tool the (utility) consumer has at their disposal is demand-side management." As a result the company has kept its energy cost from increasing, even though the cost of energy has gone up

As an extension of its corporate "green" philosophy, Martinelli's is currently considering a photovoltaic system on the main facility that will supply 70 percent of the power demand, and is working to achieve a Green Business Certification for its water conservation, energy efficiency, pollution control and employee education programs.

Lighting

Martinelli's made four lighting upgrades in just one year, retrofitting highbay fixtures with T8 fluorescent lamps and electronic ballasts, and installed additional skylights that help minimize the need for electric light, and installing motion sensors that automatically turn-off lights in unoccupied areas like storage rooms, copy rooms, and hallways. Work was subsidized and assisted by programs from Ecology Action and PG&E.

Not only is the new lighting significantly more energy efficient, it also has resulted in a better indoor environment. Greg Galvin explains that, "new technology lighting makes the work environment better and brighter and requires less maintenance."

Energy Management System

S. Martinelli's has already installed an energy management system (EMS) at one facility. Work is underway to install another system at the remaining facility. The EMS is used to monitor energy savings, energy use, and to assist with peak load curtailments.

Refrigeration

Refrigeration is a vital component in the Martinelli production system. Refrigeration keeps apples fresh upon delivery, after which the fruit is moved and pressed. Once pressed, the juice is held fresh in holding tanks that require additional cooling for up to 18 hours before filtration. With expertise in system energy audits, Galvin quickly went after what he determined was the "low hanging" fruit when he began his tenure in 2004. One early measure was repair of ammonia pipes used for refrigeration, which achieved immediate energy savings.

Steam Distribution System

Steam is used widely throughout both facilities, and is the primary source of process heat for pasteurization. Martinelli's insulated nearly all steam lines (none were running through refrigerated areas) so that the system's thermal energy could be better conserved. Besides saving energy from operating the steam system, this measure reduces the amount of heat inadvertently released to interior spaces.

Compressed Air System

Once delivered to the bottling line, Martinelli's juice is pasteurized, cooled, labeled and ready for sale. The entire process - including filling and bottling machines, filters and tanks, and case packaging with positioning devices, stop gates and motorized valves -- relies on a large compressed air system as well as over a hundred motors.

Indoor offices with daylighting. Photo courtesy of Fetzer Vineyard.

View Details.

Realizing the potential for energy leaks along this entire system, Martinelli's initiated a compressed air audit and consequently upgraded the compressed air systems at both facilities. Upgrades included an oil-free air compressor with flow control, a compressed air pipe loop, and EPACT motors, which deliver an automatic two to three percent increase in energy efficiency. In addition to being more energy efficient, the upgraded air systems are also cleaner and quieter. The compressed air upgrade resulted in less leaks and real time cycling according to plant pressure.

Not only did the juice company obtain a $24,000 rebate for the compressed air system upgrades and replacement motors, but Martinelli's has also reduced its use of the system by 13 percent, which will continue to reward the company with lower energy costs year after year.

Advanced Metering and Demand Response

Processing perishable items like fruit juices often doesn't lend itself to participation in demand response programs, since fresh juice can only be stored for 24 hours. Power interruptions have the potential to spoil thousands of gallons of juice. However, John Martinelli, committed to demand response as part of the company's energy policy.

Photo courtesy of Fetzer Vineyard.

View Details.

Since Martinelli's creates "press and bottle" schedules a day ahead of time, participating in PG&E's Emergency Demand Response Program (EDRP) was relatively simple. With this voluntary, day ahead bidding process, Martinelli's was able to participate in several events lasting two to three hours at a time. In these cases, workers were simply tasked to other important functions - ranging from machine maintenance to cleaning - while operations were halted or slowed to save energy. In each case, the company shaved as much as 50 kilowatts of demand.

In order to manage peak shaving and shifting of energy loads, Martinelli's brought in Applied Power Technologies (APT). APT installed whole-facility meters in one building that provides real-time energy use data on peak demand, total consumption, power quality, and outages, if any. Martinelli's staff can access this data on a computer 24-hours a day, 7-days a week via a dedicated Ethernet connection. This data acts as a "shadow" bill for electricity and natural gas, basically, a second set of cost-controls to verify utility bills. With increasing monthly utility costs, even small errors can quickly add up to big losses.

Since utilities can only provide next-day data, the advanced meters allow Galvin to ensure that the company reaches its peak demand reduction goals when participating in the EDRP.

The advanced meters help turn a fixed-cost - energy use - into a variable cost by providing comprehensive data that can track performance and improve forecasting accuracy. Martinelli's is in the process of incorporating process controls into the metering and EMS systems, to further improve data collection and system optimization.

Continuing Education

"One of my goals is to keep energy costs under control by educating and monitoring," said Galvin. During 2001-2005, Galvin gave several presentations to employees and other business representatives regarding conservation, energy management, recycling, and good manufacturing processes. At Martinelli's Galvin trained employees to look and listen for air leaks and to use brooms to clean instead of compressed air and water whenever possible, and to turn off lights when not in use. Many employees have taken the information home to their own families and had success in lowering their own utility bills.

Water Efficiency and Conservation

S. Martinelli is a participant in the Monterey County Green Business Program and is working to become certified as a green business through its water conservation efforts. To address water use efficiency and water conservation, the company installed low-flow water nozzles and water saving faucets.

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Best Practice Guide

Food and Beverage Growers and Processors

Case Study

Vineyard 29

Location: St. Helena, California
Size and Type: 17,000 sq. ft. winery and 13,000 sq. ft. climate controlled caves
Year Built: 2002
Website: Vineyard 29

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Company Information

Vineyard 29, located in Napa Valley's St. Helena, produces about 15,000 cases of premium wine each year, 6,000 for itself and 9,000 for eight other wineries. Vineyard 29's grapes are primarily grown on Vineyard 29's three acre home vineyard and the nearby 16 acre Aida Vineyard.

Aerial view of S. Martinelli & Company and the surrounding area in Santa Cruz County. Photo courtesy of S. Martinelli & Co.

View Details.

Vineyard 29 is a young vineyard, first planted in 1989. In 2000, Chuck and Anne McMinn purchased the vineyard and began plans to design and construct a state-of-the-art winery onsite. Their goal was to minimize the environmental impact of wine production while simultaneously improving the quality of wine produced. The resulting facility, completed in 2003, consists of a 17,000 sq. ft. winery built of stucco-faced concrete block with two stories and a mezzanine, and 13,000 sq. ft. of climate-controlled caves. Today, Vineyard 29 is the most technologically advanced winery in Napa Valley, yet adheres to Old World winemaking ideals.

Production at Vineyard 29 peaks for two months per year during harvest season. For the rest of the year, Vineyard 29's primary energy loads are refrigeration for barrel storage and lighting.

Design and Construction

Photo courtesy of Fetzer Vineyard.

View Details.

Vineyard 29's design team included architects from the Lail Design Group and engineers from Axiom Engineers. From the very beginning, regular meetings of the entire design team helped translate the McMinns' environmental commitment into actual plans and construction.

Energy-efficient building systems were planned from day one. Lighting, for example, is completely controlled by motion sensors. Most of the winery is unconditioned, relying instead on natural ventilation for temperature control. Double-paned thermal windows with low emissivity and shade provided by architectural elements help alleviate solar heat gain indoors. A master control system for lighting and heating, ventilating, and air conditioning (HVAC) relies on motion sensors to detect occupancy levels, but can also be programmed with a digital timer that recognizes time of day and day of week.

System performance is tracked continuously, and the McMinns are always looking for new ways to improve energy and resource efficiency. One tool to assist this overall plant optimization is the USGBC LEED certification process, which the McMinns hope will help identify additional areas of savings as well as recognize their achievements thus far.

Interior Lighting

Vineyard 29 was designed to maximize daylighting throughout the winery. Every workstation is lit by natural light, supplemented as necessary by Title-24 compliant light fixtures controlled by occupancy sensors. Ample windows, doorways, and other openings also allow each person working at the vineyard to enjoy views of the outdoors.

In the barrel storage, lighting is controlled by occupancy sensors and follows guests and staff as they move through the caves. A tan-colored stucco was selected for the interior finish, which helps reflect the artificial light and reduces by half the amount of lighting fixtures needed - fewer fixtures means less cooling loads for the refrigeration system, another energy-saving benefit.

Vineyard 29 in Napa Valley. Photo courtesy of Vineyard 29.

View Details.

Winery Climate Control

The winery at Vineyard 29 employs principles of passive solar design and natural ventilation to help minimize the use of energy-intensive heating, ventilating, and air conditioning (HVAC) equipment.

A carved cut into the hillside was structurally reinforced so that the building could be backed into the hill. The rear portion of the winery sits two-thirds below the grade; inside, 30 to 40 foot ceilings form one large volume of space in which the temperature is tempered by the thermal mass of the hill itself, rarely getting too hot in the summer or too cold in the winter. Vent shafts in the rear work with front-facing windows and doors to push hot air through the interior and out the shafts, creating a chimney effect.

Other architectural elements aid climate control within the winery. The building's front is north facing, which helps the entire building block solar radiation. Louvers and low-emissivity windows reduce solar heat gain through windows, but also let in ample natural light.

The cogeneration system provides mechanical heating or cooling as needed in extreme weather. Waste heat captured in a heat exchanger feeds a hot water loop, which supplies fan coil units during cold winter months. A forced-air fan system blows radiated air into eight different zones, each controlled by occupancy sensors and the master control system. Cooling is provided similarly by the adsorption chiller, which transforms waste heat into chilled water.

Process Cooling and Production Area Climate Control

No additional climate control is needed in production areas because wine is kept in temperature-controlled tanks and not subject to the ambient environment. Piped water from the cogeneration plant encircles the tanks and provides heating or cooling as needed for the fermentation process. The adsorption chiller provides chilled water; waste heat passed through the heat exchanger provides hot water.

At times, water colder than 37ºF is needed. In these cases, water is pre-chilled by the adsorption chiller to 37ºF, the lowest temperature possible, and then further chilled by a backup electric chiller. Otherwise, no electricity is used for process or space cooling.

Gravity-fed System Reduces Use of Pumps and Motors

Vineyard 29 developed an innovative gravity-fed system that reduces the use of pumps and motors for conveying wine between tanks and into barrels for aging. Chuck McMinn explains, "At harvest, if you use pumps, you must crush the grapes to create a slurry that can be pumped. With gravity, we can start the fermentation process with whole berries, which is a higher quality way to make wine since it forces the yeast to work through the skins, thereby extracting more colors and flavors over a longer fermentation process. Pumping agitates and aerates the wines, which is not desirable. It can also cut or abrade the seeds, which produces harsh flavors."

To help manipulate gravity flows, Vineyard 29 can lift or lower special tanks with an industrial elevator and forklift. Special trap doors, hoses, and conduits are also used to move wine between the crush pad, production, barrel storage, and bottling areas.

Caves and Climate Control

The 13,000 sq. ft. of caves at Vineyard 29 take advantage of the natural characteristics of Napa Valley's climate, soil, and rolling hills, while making the most of state-of-the-art refrigeration and energy systems. Caves require substantially less energy for climate control than conventional aboveground cold storage because of their superior thermal mass, which blocks solar heat gain in the summer and helps retain cool air

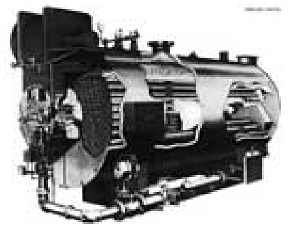

Illustration of a fire-tubed boiler. Photo courtesy of Oakridge National Laboratory.

View Details.

inside. At night, air vents open to allow cool outdoor air to enter. During the day, condensers and an adsorption chiller (powered by waste heat from the cogeneration system) keep humidity and temperatures within precise presets.

The adsorption chiller is a unique energy-saving technology. Vineyard 29 installed a 30-ton adsorption chiller developed by Nishiyodo Kuchouki Company - the first of its kind in the United States. This chiller requires only 0.20 kilowatts to operate which powers digital controls and two small pumps. The compressor - the most energy-intensive part of a conventional absorption chiller - is eliminated.

Besides energy savings, adsorption chillers have a number of advantages over absorption chillers. First, costs and risks associated with chemical inputs are reduced - a silica gel (good for thirty years) replaces lithium bromide as the absorbent/adsorbent and water is used as a refrigerant instead of freon or ammonia. Second, the design prevents corrosion or crystallization of internal parts, and so requires less maintenance. Finally, adsorption chillers operate well under a wider set of parameters - hot water inputted can be as low 122ºF, eliminating the need for a backup boiler, and the temperature of chilled water outputted can range as low as 37.4ºF.

Cooling Tower - Electrostatic Water System

An electrostatic water treatment system is used on the cooling tower, eliminating the need for and expense of herbicides, fungicides and other chemical treatments. Electrical pulses ionize the water, purifying it and reducing any buildup of scale. Because of this treatment the system requires no chemical additions and the cooling tower only needs to be back-flushed half as frequently, saving significant amounts of water and energy.

Cogeneration System Using Microturbines

As ground was breaking on winery construction, the McMinns and their design team tackled options for backup generation. At wineries as with other food processors, reliable power during harvest season is crucial to operations. For Vineyard 29, Axiom Engineers suggested a cogeneration system that supplies all of the winery's power instead of a diesel generator for emergencies only in order to attain greater energy efficiency and reliability. This option appealed to the McMinns for a number of reasons, including grid independence, economic payback, and the minimization of environmental impacts.

A dual 60-kilowatt microturbine cogeneration system was designed for and installed at Vineyard 29; two Capstone microturbines generate electricity from natural gas with about 28 percent efficiency. Waste heat from the microturbines both recovered with a heat exchanger to heat domestic and process water, and used to power an adsorption chiller that provides cooling capacity for the winery's heating, ventilating, air conditioning, and refrigerating (HVACR) system, including wine tanks and caves. A backup boiler and electric chiller provide added reliability, but are rarely needed.

When heating and cooling capacity is factored in along with electricity generation, the cogeneration system has a total system efficiency of over 80 percent (utility or "grid" power has an efficiency of about 30 percent, by comparison). Besides significantly better generation and transmission efficiencies, the cogeneration system considerably reduces greenhouse gas emissions per megawatt-hour of electricity compared with emissions associate with "grid" power.

Total energy cost savings are estimated between $24,000 and $39,000 per year. Conventional electricity and natural gas purchases would have been between $62,000 to $64,000 per year, whereas the cogeneration system costs about $25,000 to $38,000 per year (depending on the cost of natural gas). Payback on the McMinns' investment is expected in less than six years.

Although the McMinns are enthusiastic about their cogeneration system, they admit that the system's complexity and substantial capital outlay may deter others from following suit. Computer controls and software are "buggy, like software everywhere," explains McMinn. He recommends that owners expect to fine-tune the software over the course of several years in order to fully optimize the system.

Water Conservation Efforts

Vineyard 29 has a self-contained water delivery and wastewater disposal system - no water leaves the property, and all water is provided onsite by a well. Wastewater is processed onsite in a septic system, then deposited into a leach field, where it percolates through the soil for further purification, eventually and safely replenishing groundwater supplies.

Indoor offices with daylighting. Photo courtesy of Fetzer Vineyard.

View Details.

Landscaping is irrigated using an evapotranspiration system based on current weather conditions. The automated drip irrigation system is connected to a weathervane system that tracks weather conditions, and then applies preprogrammed algorithms to determine how much additional irrigation is needed.

Because the vineyard is central to Vineyard 29's operations, it is watered manually. However, moisture probes are used to measure and monitor moisture levels at 10 different sites in the vineyards at four different depths at each site from surface to up to six feet underground. Real time data loggers transmit this information from the vineyards wirelessly to a central data collection site, which then puts it on a web page accessible anywhere in the world with an Internet connection.

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COMMON ENERGY EFFICIENCY OPPORTUNITIES FOR SMALL WINERIES		
Energy Efficiency Measure	**Description of Energy Efficiency Measure**	**Typical % of Energy Savings**
Insulate Chilled Glycol Storage Tank	Insulate the chilled glycol storage tank. The reduced heat gain from this tank will result in reduced refrigeration energy costs. ***Baseline Considered:*** *The baseline is the case where the chilled glycol storage tank is not insulated.*	~1% (electrical)
Install Variable Frequency Drive on Glycol Circulation Pump(s)	Install variable frequency drives (VFD) on the glycol circulation pumps. The use of VFDs will reduce the power consumption of the supply pumps depending on the temperature of the returning glycol. ***Baseline Considered:*** *The baseline is the case that no VFDs are used to control the flow of the secondary chilled glycol pumps.*	3 – 8% (electrical)
Install Desuperheater on Exhaust of Glycol Chiller Compressor	A heat exchanger installed in the piping between the refrigeration compressors and the evaporative condenser would both heat the boiler makeup water and reduce the amount of heat (thermal load) currently being rejected by the condensers. Energy will be saved from the reduction in gas used by the boiler to heat the feedwater. There will also be reduced fan power usage of the evaporative condenser. ***Baseline Considered:*** *The baseline is the case that the exhaust of the glycol chiller is not recovered.*	10 – 20% (natural gas)
Install Floating Head Pressure on Glycol Chiller	Allowing the head pressure to "float" based on outdoor wet-bulb temperature conditions will reduce the power consumption of the refrigeration compressors. ***Baseline Considered:*** *The baseline is the case that the head pressure is pre-set and not controlled based on the ambient temperature.*	5 – 20% (electrical)
Premium Efficiency Motors	Install premium efficiency motors to replace the existing standard efficiency motors at this facility. ***Baseline Considered:*** *The baseline is the case that the motor efficiencies are based on the 1992 EPAct threshold.*	0.2 – 0.6% (electrical)
Control Cooling Tower Pumps with Sequencer	Control the condenser water pumps with an automatic sequencer to operate based on the load placed on the glycol chiller system. By controlling whether the condenser water pumps are on or off, depending upon the load temperature of the condenser water, energy savings can be attained due to the fact that not all the pumps would be operating all the time. ***Baseline Considered:*** *The baseline is the case that the condenser pumps are not controlled and operate continuously.*	~1.5% (electrical)

COMMON ENERGY EFFICIENCY OPPORTUNITIES FOR SMALL WINERIES (CONTINUED)		
Energy Efficiency Measure	**Description of Energy Efficiency Measure**	**Typical % Energy Savings**
Install Mechanical Humidifiers instead of Steam Humidifiers	It is recommended that multiple mechanical/ultrasonic humidifiers be installed in place of electrical steam humidifiers units. Mechanical/ultrasonic humidifiers rely on an adiabatic process that generates a water mist without raising its temperature and reduces humidifier energy consumption by over 90% compared to other humidifiers. ***Baseline Considered:*** The baseline is the steam humidification system.	~18% (electrical)
Install Variable Frequency Drive on Air Handler Fan(s)	Install variable frequency drives (VFD) on the air handler fans in the Barrel Cellar. The VFD controllers will reduce the power consumption of these fan motors based on ambient temperature. ***Baseline Considered:*** *The baseline is the case that the air flow of the supply fans is not controlled, or CA Title 24.*	~5% (electrical)
Install Evaporative Condensers in Place of Air-Cooled Condensers	Using evaporative condensers (controlled by ambient wet-bulb temperature) rather than the air-cooled condensers (controlled by ambient dry-bulb temperature) will allow the compressors to operate at a lower discharge pressure, which will reduce the energy consumed by the compressors. ***Baseline Considered:*** *The baseline is would be air-cooled condensers.*	~12% (electrical)
Install High Efficiency Chiller	Install high efficiency chillers with variable speed drives. Higher efficiency chillers will result in significant electrical energy savings as well as maintenance cost savings. ***Baseline Considered:*** *The baseline is would be a standard efficiency air-cooled or water-cooled chiller as specified by CA Title 24 (if applicable). If Title 24 does not apply, then the baseline efficiency would be taken from the average of several chiller manufacturers.*	~20% (electrical)

OTHER ENERGY EFFICIENCY OPPORTUNITIES FOR SMALL WINERIES	
Energy Efficiency Measure	**Description of Energy Efficiency Measure**
Insulate Wine Storage Tanks	The wine tanks can be insulated to reduce the heat gain on the chilled wine from the surrounding air. Insulating the walls of the storage tanks will reduce their heat gain, which in turn will reduce the energy consumption of the refrigeration system. ***Baseline Considered:*** *The baseline is the case where the wine storage tanks are not insulated.*
Perform Cold Stabilization with Enhancements (e.g. mixing, seeding, etc.) to Expedite Cold Stabilization	Cold stabilization with enhancements (eg. seeding with potassium bitartrate) accelerates the crystallization rate allowing for a shorter cold stabilization period. A shorter cold stabilization period results in a reduction in the facility's cooling load, which reduces the refrigeration electrical energy consumption.
Pre-Cool Blended Wine with Cold Stabilized Wine	A heat exchanger can be used to transfer heat from the warm wine to be cold stabilized to wine that has completed the cold stabilization process. The lowering temperature of the wine before cold stabilization will reduce the time and energy used to chill the wine down to 28 °F for cold stabilization. ***Baseline Considered:*** *The baseline is the case where the wine is not pre-cooled.*
Increase Refrigeration Suction Pressure When Not Cold Stabilizing	It is recommended to raise the glycol temperature and the refrigeration system suction pressure set points when not cold stabilizing wine. Raising the glycol temperature and refrigeration system suction pressure set points will result in a reduced power consumption of the refrigeration compressors.
Insulate Refrigeration Piping	Insulate the chilled pipelines. The reduced heat gain from the piping will result in reduced refrigeration energy costs. ***Baseline Considered:*** *The baseline is as specified by CA Title 24.*
Night Air Cooling for Barrel and Tank Cellars	During the evenings when the outside temperature drops below 55 °F, it is recommended that the winery turn off the air handling fans and allow outside air to cool the areas. Electrical energy savings can be realized from the supply fans not running.
Rapid Roll-Up Doors for Refrigerated Areas	Rapid roll-up doors are flexible high speed rolling industrial PVC fabric doors that can reduce the infiltration of outside air by 95%. Rapid roll-up doors will reduce the warm air infiltration into the cooled space, thereby reducing the cooling load on the refrigeration system, resulting in electrical energy savings. ***Baseline Considered:*** *The baseline is the case where there is no protective device preventing infiltration into refrigerated areas.*
Condensing Boilers	Condensing boilers are more energy efficient than non-condensing units. Condensing boilers have thermal efficiencies of over 90% compared to traditional (non-condensing) boilers which have efficiencies around 70%-80%. ***Baseline Considered:*** *The baseline is a standard efficiency hot water boiler as specified by CA Title 24 (refers to the Appliance Efficiency Regulations).*

OTHER ENERGY EFFICIENCY OPPORTUNITIES FOR SMALL WINERIES (CONTINUED)	
Energy Efficiency Measure	**Description of Energy Efficiency Measure**
Condensate Return System	Install piping to return the condensate (wherever possible) back to the boiler feed tank. Energy and water savings will be achieved by routing the hot condensate back to the boiler feed tank.
Insulate Condensate Return Piping	Insulate the condensate return pipelines. The reduced heat loss from the piping will result in reduced boiler natural gas energy costs. ***Baseline Considered:*** *The baseline is as specified by CA Title 24.*
Low Pressure Compressor with Blower Assist for Pressing	Specify presses with blower assistance and install a low-pressure air compressor for this application instead of using a high-pressure air compressor.
Purchase Transfer Pumps Equipped with Variable Frequency Drives	Purchase wine transfer pumps with variable frequency drives, which will result in electrical energy savings.
Use Ambient Air to Vaporize CO_2	Use a fan-powered ambient air temperature vaporizer instead of an electrically-heat vaporizer to vaporize the liquid CO_2. Liquid CO_2 can be vaporized with much less energy using electric fans to blow air over coils than using electric heaters.
Re-use Water from Barrel Cleaning Process	Barrels usually are rinsed twice. The water from the 2nd rinse can be re-used for the 1st rinse, resulting in water savings.
Select Refrigeration Compressors with Thermosiphon Oil Cooling Instead of Liquid Injection Oil Cooling (if screw compressors)	Screw compressors with liquid injection cooling requires a minimum refrigeration system head pressure (in most cases ~110 psig or higher) while thermosiphon oil cooling does not, which will allow for lower system head pressures. Lowering the head pressure would permit the refrigeration system to operate much more energy efficiently as the compressors will consume significantly less power.
Perform Wine Barrel Cleaning Outside of the Barrel Room	Move the wine barrels outside prior to cleaning them with warm water. Moving the barrels outside of the Barrel Room for cleaning will result in savings due to a reduction in cooling load placed upon the chilled glycol refrigeration system
Install Insulated Open Tank Fermenter Covers	The open tank fermenters can be covered by insulated covers to reduce the heat gain of the chilled wine from the outside air, resulting in a lower energy consumed by the facility's refrigeration system.
Insulate Wine Barrel Room and Fermentation Room	Install higher R-value insulation material in the Barrel Room/Fermentation Room walls and roof. ***Baseline Considered:*** *The baseline is a standard R-value of nonresidential wall or roof/ceiling requirement in the relevant climate zone as specified by CA Title 24 (refers to the Appliance Efficiency Regulations).*
Variable Frequency Drive Controlled Fan-Coils	Install variable frequency drives on the fan coil units to allow the fan speed to vary based on the cooling load in the refrigerated area. ***Baseline Considered:*** *The baseline is fan-coils with standard on/off capacity control.*
High Efficiency Pumps	Install high efficiency pumps to reduce the electrical energy usage of the pumping system. ***Baseline Considered:*** *The baseline is achievable pump efficiencies based on "Hydraulic Institute Achievable Efficiency Estimate Curves".*

Other Energy Efficiency Opportunities for Small Wineries (continued)	
Energy Efficiency Measure	**Description of Energy Efficiency Measure**
Install Automatic Defrost Control in Subfreezing Refrigerated Spaces Instead of Timer Control	Install demand-initiated defrost control instead of time-initiated defrost control. Defrosting only when necessary will reduce the electrical energy consumed by the refrigeration system.
Use a 2-Stage Refrigeration System	With a split suction system, there will be two suction headers: one at –40 °F (for the blast freezers) and the other for the refrigerated rooms. This way not all of the chiller compressors will have to operate at such a low suction pressure. The low-stage compressors serving the refrigerated rooms can operate much more energy efficiently as these compressors will consume significantly less power.
Variable Frequency Drive on Cooling Tower Fan	Control the cooling tower fan motor with a variable frequency drive (VFD) to reduce its energy consumption when the ambient wet-bulb temperature is less than maximum design load.

Note:
It should be noted that R-22 (a.k.a. HCFC-22) will be phased out soon, thus equipment should be specified to avoid using this refrigerant. According to information from the U.S. Environmental Protection Agency's website:

- No production and no importing of HCFC-142b and HCFC-22, except for use in equipment manufactured before ***1/1/2010*** (so no production or importing for NEW equipment that uses these refrigerants)
- No production and no importing of HCFC-142b and HCFC-22 as of ***1/1/2020***.