Attachment C-1: **Case Study of a Vegetable Processor in the Tulare Lake Basin**

A discharger applies over 1.3 million gallons per day (mgd) of vegetable processing wastewater co-mingled with about 30,000 gallons per day (gpd) of disinfected secondary-treated domestic wastewater via center pivot sprinkler systems on about 350 acres of farmland. Wastewater generated from the processing of potatoes and corn has been discharged to portions of the existing application fields since the early 1980s. Applied wastewater contains about 900 mg/L biochemical oxygen demand (BOD_5); 1,200 µmhos/cm electrical conductivity (EC); and 50 mg/L total nitrogen. Maximum and average BOD_5 loading rates are 70 and 25 lbs/acre/day, respectively. Annual nitrogen loading from applied wastewater ranges from 275 to 732 lbs/acre and averages 500 lbs/acre. Soils are clays, silts, clayey-sands, and sands. Groundwater occurs at about 130 feet below ground surface. Crops grown on the application fields include Sordan grass and winter forage (wheat, barley, oats) that have annual nitrogen demands of 350 and 315 lbs/acre.

In the mid-1990s, the Regional Board updated the discharger's WDRs and required the discharger to install a lysimeter network in lieu of groundwater monitoring well network. Suction lysimeters were installed in almost half of the application fields, and in a landscaped area near the Plant to represent background conditions. The discharger's engineering consultant developed a model to predict the volume of applied water percolating below the root zone and its nitrate concentration. The model's inputs include hydraulic and nitrogen loading from applied wastewater, evapotranspiration rates, nitrogen removal via crop uptake based on pounds harvested per field and its nitrogen content, and an assumed 15 percent nitrogen removal through soil treatment processes. The model predicted that the nitrate-nitrogen concentration in lysimeter samples would not exceed 10.9 mg/L. According to discharger self-monitoring reports, lysimeter samples contained nitrate-nitrogen in concentrations ranging from 12 to 98 mg/L. The discharger's engineering consultant dismissed the lysimeter nitrate data because it did not fit model predictions. In 2003, nitrate-nitrogen concentrations in lysimeter samples continued to rise to as high as 220 mg/L. In contrast, concentrations in the background lysimeter were consistently low (below 1 mg/L). Similarly, the EC of lysimeter samples collected from application fields ranged from 1,600 to 4,300 µmhos, whereas background was 1,100 µmhos/cm).

In 2001, staff notified the discharger that its current wastewater disposal practices, monitoring data, and current nitrogen concentrations in the vadose zone place the discharge's Title 27 exemption in jeopardy. The Executive Officer directed the discharger to initiate groundwater monitoring, which the discharger did in spring 2002. Subsequent data indicate that groundwater nitrate and EC increases as it passes under the application fields. Average values for selected groundwater constituents obtained in 2003 are tabulated below:

Constituent	Unit	Upgradient	Downgradient 1	Downgradient 2
Nitrate-Nitrogen	mg/L	2.1	7.3	5.1
Total Dissolved Solids	mg/L	310	500	600
Calcium	mg/L	65	84	110
Chloride	mg/L	40	120	158
Sodium	mg/L	30	60	54

While groundwater nitrate concentrations are below the drinking water MCL, the data indicate the discharge is degrading groundwater from nitrate and salinity constituents.

Attachment C-2: **Case Study of a Winery Within the San Joaquin Valley**

This winery discharges up to 1.5 mgd of winery wastewater via flood irrigation to 300 acres of farmland, portions of which have received wastewater since the 1940s. Wastewater includes crush washdown, stillage, and spent ion exchange regenerate solution, and contains about 3,500 mg/L BOD_5, 2,800 mg/L total dissolved solids (TDS), and 100 mg/L total nitrogen. Soils are sands and silty sands. Groundwater occurs at about 120 feet below ground surface. On a rotational basis, wastewater is applied to some of the fields, while seasonal crops (barley and wheat) are grown on other fields not receiving wastewater applications. In the early 1990s, the discharger installed a groundwater monitoring well network. Background wells monitor groundwater passing under farmland.

In the mid-1990s, the Regional Board updated the discharger's WDRs to prescribe the Board's Stillage Guidelines, relying upon those conditions to mitigate further contribution of nitrogen and salt to groundwater that already exhibited nitrate and TDS in excess of MCLs. The WDRs went beyond prescribing the Stillage Guidelines by requiring waste applications not exceed 600 lbs BOD/acre/day or the environmental conditions of the site, whichever proved less. The WDRs also established numerical groundwater limitations for chemical constituents equal to the maximum drinking water MCLs and narrative limitations for taste or odor.

Over the years, the discharger has been issued several notices of violation (NOVs) for odor nuisance, as well as for exceeding discharge flow limits and BOD waste application rates, and for failing to comply with various Stillage Guidelines specifications in the WDRs. To reduce waste application rates, the discharger constructed an aerobic biological reactor in the late 1990s and began segregating and pretreating about 100,000 gpd of tank lees, a waste stream characterized by high BOD concentrations. The discharger has recently installed center-pivot sprinkler systems to ensure wastewater is applied uniformly. Feed water to these systems is stored in double-lined surface impoundments equipped with leachate collection systems. The discharger also recently installed suction lysimeters at various depths in a disposal field and in an area not receiving wastewater for use as a background. Soil solution collected from disposal field lysimeters showed substantially higher values for nitrate, EC, and chloride compared to background. For example, nitrate-nitrogen and EC in the background lysimeter were about 5 mg/L and 800 μmhos/cm, respectively, whereas they were about 120 mg/L and 16,000 μmhos/cm in the disposal field lysimeter installed at 25 feet below ground surface. Groundwater monitoring data tabulated below shows the degradation of groundwater as it passes under the disposal fields.

Location	Nitrate-N (mg/L)	EC (μmhos/cm)	Sodium (mg/L)	Sulfate (mg/L)	Calcium (mg/L)	Magnesium (mg/L)	Bicarbonate (mg/L as $CaCO_3$)
Background 1	10	490	33	15	46	13	150
Background 2	10	490	28	31	42	12	170
Downgradient 1	20	1,500	90	200	190	47	730
Downgradient 2	25	1,900	94	200	290	75	1,000
Downgradient 3	17	2,300	19	260	330	82	1,300

The discharge has degraded groundwater with nitrate and salinity constituents. Lysimeter data suggests that the soil is saturated with waste constituents that will continue to leach to groundwater. Increased concentrations of calcium, magnesium, and bicarbonate indicate organic overloading. Increased concentrations of sodium and sulfate are due to the discharge of high saline waste streams (e.g., spent ion exchange regenerate).

Attachment C-3: **Case Study of a Vegetable Processor in the Sacramento Valley**

During the 2004, this large facility processed approximately 570 tons of tomatoes per hour throughout its 90-day season (which varies from mid-June through late September). Tomatoes are received in trucks, transported into the facility by flumes, and are then processed into tomato paste. Wastewater is generated in three major areas: the transport of tomatoes through the flumes; the evaporation system; and during equipment cleaning. The WDRs allow a discharge of 4.3 mgd of flume water into the settling pond, and a discharge of 58 mgd of evaporative water into the cooling water pond. Cleaning water is discharged directly into the irrigation supply. According to the 1995 WDRs, wastewater is to be applied to 670 acres of cropland and will be used as irrigation supply. Tailwater runoff from the fields discharges to a large tailwater return system, and is pumped for re-application to the fields. Groundwater is found at 6-10 feet below the ground surface.

During the 2004 processing season, staff received written documentation regarding eight known discharges of wastewater from the tailwater return system into an irrigation district's canals. The Department of Fish and Game is continuing to investigate whether there is a link between the known discharges and two large fish kills in downstream drains. It is staff's opinion that the discharges were caused, at least in part, because the discharger did not irrigate its entire 670 acres with the wastewater, but only irrigated 181 acres of land. In part, this was because late-season crops had been planted on most of the remaining acreage, and irrigating that land with wastewater would prevent their harvest.

The WDRs require that the Discharger maintain a dissolved oxygen (DO) concentration of 1.0 mg/L in its process water pond. This is a standard requirement for any facility that discharges oxygen-demanding substances (tomato processing waste, in this case) and is intended to prevent nuisance odor conditions. The Discharger does not have an aerator in its pond and is unable to consistently maintain the DO level; odor complaints have been received.

The Monitoring and Reporting Program (MRP) was updated in late 2003 to require more complete monitoring of the effluent, land application area, and groundwater. The discharger's 2004 monitoring reports clearly show that it was applying more nitrogen and salt to the cropland than reasonably could be expected to be consumed by the crop or assimilated by the soil. For example, the wastewater applied to one field during the period from July to September contained approximately 1,250 pounds of nitrogen per acre (lb/ac) and 24,600 lb/ac of salt. The field is planted with pasture grass, which is expected to consume no more than 300 lb/ac of nitrogen and perhaps 1,000 lb/ac of salt. The excess nitrogen and salt are likely to percolate to the water table and degrade groundwater quality.

In late 2003, the Discharger was required to install additional groundwater monitoring wells. After some delays, the wells were installed and staff has now received one complete monitoring report. The data appear to indicate that the groundwater beneath the ponds and land application area is degraded with calcium, chloride, nitrate, sulfate, and TDS. A final determination of groundwater degradation will be made pending additional monitoring events for the entire well network and further study to determine background groundwater conditions.

In late 2004, staff prepared a draft Cleanup and Abatement Order (CAO) to address these and other issues of non-compliance at the facility. Upon review of the draft CAO, the Discharger asked that it be heard before the Board.

Attachment C-4: **Case Study of a Winery Within the Sacramento Valley**

This winery processes up to 2,000 tons of grapes per year to produce fermented, bottled wines for export and local sale. Wastewater flows, as averaged throughout the year, are up to 11,000 gpd; however, higher flows are allowed during the two-month crush period. Wastewater is screened at the winery prior to discharge to a series of five unlined ponds. Only passive treatment occurs in the ponds, as no aeration system is in use. From the ponds, wastewater was historically discharged to 4.5 acres of pasture. The WDRs were updated in 2003 to allow a second disposal area of containing 60 acres of pasture.

Limited data show that wastewater generated during the crush contains a TDS concentration of up to 2,700 mg/L and a BOD of up to 9,000 mg/L. Lower concentrations are reported during the non-crush period, as expected.

Groundwater is encountered at a depth of two to ten feet below ground surface and, at times, the groundwater rises to the base of the ponds. Four groundwater monitoring wells surrounding the ponds show that the groundwater beneath the pond and 4.5 acre disposal field is polluted with salt constituents. As described in the WDRs, the average TDS concentration in the downgradient well was 1,130 mg/L, as compared to the average TDS concentration of 200 mg/L in the side-gradient well and 580 mg/L in the up-gradient well. It appears that some of the wells may be within the mound created by the pond, and therefore the WDRs required installation of a new upgradient well. That work has just been completed. It is obvious that degradation and pollution have been created by past discharges.

Because of the character of the waste during storage and disposal, it must be classified as “designated waste,” and is subject to the containment requirements of Title 27. Although the Discharger proposed installation of a pond liner in 2003, the proposed design does not comply with the prescriptive standards of Title 27, nor has it been demonstrated to be an engineered alternative to the prescriptive standards. In addition, the Discharger has not demonstrated that pasture disposal area can qualify as a “Land Treatment Unit” under Title 27. While the discharge cannot continue as it has been, the Board determined that it is reasonable to allow the Discharger a period of time to remedy its deficiencies by either upgrading the ponds to comply with Title 27 or altering the character of its wastewater to qualify for an exemption from Title 27. The 2003 WDRs are intended to act as interim waste discharge requirements while the Discharger obtains and analyzes information sufficient for long-term decisions.

In response to the time schedule in the WDRs, the Discharger has recently submitted a Report of Waste Discharge (RWD) describing a proposed treatment system in which designated waste will be segregated and stored in Title 27 ponds, while the remainder of the waste will be treated and applied to land as under the WDR Program. From the winery, the wastewater will be screened and the pH chemically adjusted before it is pumped into a package treatment plant. The plant will aerate, clarify, and digest the waste, after which the effluent will flow through a reverse osmosis (RO) system. The treated wastewater will be stored in unlined, aerated ponds, prior to disposal on the existing 4.5 acres of pasture. A lined pond meeting Title 27 standards will be constructed to contain backwash water from both the RO system and the facility’s water softener. The Title 27 pond will contain an aerator and will be operated to evaporate the waste. The Discharger states that the treatment system should reduce BOD concentrations to 150 mg/L, TDS to 410 mg/L, and total nitrogen to less than 10 mg/L. While the proposal is very encouraging, staff have not yet formally reviewed or commented on the RWD.

Attachment D-1: **Case Study of a Soy Product Producer in the San Joaquin Valley**

This facility processes rice and soy into various food products. Operations are conducted year round, five to seven days a week with three shifts per day, and with cleaning operations performed as required. The facility has been in operation and discharging wastewater to land since 1985; however, until 1990 the discharge volume averaged less than 100 gallons per day. The food processing facility, and therefore the wastewater discharge volume, has grown greatly since the mid-1990s.

The wastewater is characterized by a high organic matter and solids content. In 1999, the Discharger began operation on a pretreatment facility to reduce the organic load in its process wastewater. Treatment of process wastewater now consists of a holding/recycle tank; pH control; a dissolved air flotation (DAF) clarifier; a 45-foot diameter, 26-foot high trickling filter; an aerated skimmer; and a combination centrifuge and rotary screen to dewater the solids from the skimmer and the DAF units. Solids are contained in bins, transported off-site, and used for animal feed. The Discharger optimized the treatment system equipment in 2001, resulting in significant reductions in the BOD concentration of wastewater applied to land.

The Discharger has taken a number of steps to reduce the salinity in its discharge. A reverse osmosis (RO) system was installed for the boiler feed water, replacing a regenerative water softening equipment. RO results in a less saline discharge than the water softening equipment. In addition, the discharger uses potassium hydroxide as a caustic cleaning chemical and nitric/phosphoric acid as acidic cleaners, resulting in a discharge containing chemicals that are more likely to be taken up by the plants and less likely to percolate to groundwater. The Discharger has also recently completed a salinity reduction study and has proposed to install a system to recycle its caustic Clean-in-Place solution, resulting in further salinity reductions.

According to the 2003 WDRs, the treatment process results in the following constituent reductions: BOD is reduced from an average of 2,205 mg/L in the untreated wastewater to 151 mg/L in the treated wastewater; TDS is reduced from 2,190 mg/L to 1,093 mg/L; and total nitrogen decreases from 49 mg/L to 16 mg/L.

The current average wastewater generation rate is approximately 240,000 gpd; however, the discharger anticipates near-term growth to increase the wastewater flow rate to 430,000 gpd. Due to development in the area, the discharger is somewhat limited in its ability to expand its land application area. Therefore, the discharger currently has an agreement with the local municipality to discharge up to 60,000 gpd of wastewater into the municipal system, and has purchased a capacity of 200,000 gpd in the same municipality's almost-completed wastewater treatment plant expansion.

Treated wastewater is discharged to 33 acres of cropland and 13 acres of landscaping surrounding the facility. Enhanced treatment of the wastewater has resolved the odor complaints that staff formerly received every summer. Although the discharger has made numerous facility improvements, groundwater monitoring data imply that groundwater appears to have been impacted from the original discharge. Groundwater is found at approximately 10 to 15 feet below the ground surface, and evaluation is complicated by a relatively flat gradient, mounding, and nearby unlined irrigation canals. The Discharger is continuing to evaluate groundwater quality and install appropriate upgradient monitoring wells.

Attachment D-2: **Case Study of a Winery in the San Joaquin Valley**

A winery in the Tulare Lake Basin discharges up to 0.5 mgd of winery wastewater to 100 acres of farmland near a river. A winery has been operating at this location (and discharging winery waste to land) for about 100 years. The current winery dates to the 1950s. Wastewater is comprised of cleaning water, stillage, and non-contact cooling water. Prior to 2000, wastewater also included spent ion exchange regenerant and boiler blowdown. Soils are silty sands with high permeability. Groundwater occurs about 40 feet below ground surface. The groundwater gradient is relatively flat, and fluctuates periodically in response to seasonal changes in surface flows in the nearby river and agricultural groundwater extractions. Groundwater quality is generally excellent, with EC ranging from 200 to 600 μmhos/cm.

In the mid-1990s, the Regional Board updated the discharger's WDRs to prescribe the Board's Stillage Guidelines. The WDRs also established numerical groundwater limitations for chemical constituents equal to the maximum drinking water MCLs, a maximum EC of 900 μmhos/cm, and narrative objectives for taste or odor and for agricultural use protection. The WDRs required the discharger to implement groundwater monitoring. The discharger's current network consists of 14 groundwater monitoring wells. Evidence indicates that groundwater influenced by the discharge contains elevated concentrations of TDS (>900 mg/L), ammonia-nitrogen (>50 mg/L), total organic carbon (>10 mg/L), iron (> 10 mg/L), and manganese (>0.5 mg/L).

The discharger has been issued five notices of violation (NOVs) since 1998 for violations of WDRs that include monitoring deficiencies and exceeding groundwater limitations. To reduce waste constituent loading and improve waste application practices, the discharger started screening wastewater and changed wastewater delivery from flood to sprinkler irrigation. Crops grown on the disposal fields include Sudan grass, corn, winter wheat, and oats.

In 2000, the discharger expanded its winery to include a bottling plant. Instead of proposing to discharge wastewater flows to the land application site, thereby further contributing waste constituents and decomposition byproducts to impacted groundwater, the discharger constructed a Class II, double composite lined surface impoundment to dispose of the bottling plant's wastewater flows. The 10-acre surface impoundment, which is regulated by separate Title 27 WDRs, has a capacity of 19 million gallons and also receives the winery's spent ion exchange regenerant and boiler blowdown. Surface aerators control odors.

In the latest notice of violation (NOV), the discharger was notified that staff expected it to (1) improve its discharge to a level that is consistent with Regional Board plans and policies, (2) investigate the horizontal and vertical extent of groundwater degradation caused by its discharge, and (3) propose and implement effective groundwater remediation efforts. In response, the discharger researched and then proposed to conduct an engineered cropping pilot study to determine the effectiveness of growing poplar trees to take up chemical constituents in applied waste. Also, the discharger proposes to construct flow equalization basins to reduce wide fluctuations in discharge pH. The basins will be designed in accordance with Title 27 performance standards (i.e., double composite lined with leachate collection systems) and equipped with aerators to control odors. Further, the discharger proposes to construct shallow groundwater extraction wells to pump impacted groundwater for application on poplar trees. While the investigation of the extent of groundwater impacts is pending, the discharger had implemented best practicable treatment and control measures in constructing a Title 27 surface impoundment to contain the winery's high salinity waste streams and its bottling plant's wastewater.

Attachment D-3: **Case Study of a Poultry Processor in the San Joaquin Valley**

A major poultry processor discharges its wastewater to a municipal industrial wastewater treatment plant (IWWTP) located along a tributary of the San Joaquin River. The processor's complex includes two chicken processing plants, a rendering facility, and a delicatessen meat packing plant. It employs approximately 2,500 full-time workers, processes 500,000 chickens per day, and generates 4.4 mgd of poultry process wastewater characterized by a BOD_5 of 250 to 400 mg/L and total nitrogen of 45 to 80 mg/L. Process water undergoes extensive pretreatment in dissolved air flotation (DAF) units at the complex prior to its discharge to the IWWTP, which is comprised of a series of 12 unlined facultative lagoons covering 83 acres. Since 1993, pretreated process water has been discharged to a 120-acre farmland application area owned and operated by poultry processor.

Depth to groundwater is about 40 feet below ground surface. Groundwater underlying the facultative lagoons contains nitrate in excess of the primary drinking water MCL of 45 mg/L. In 2000, the municipality was issued an NOV for polluting groundwater with nitrate. The processor was also issued an NOV, as the processor's discharge to farmland was in excess of agronomic demand. The processor agreed to evaluate the hydraulic and nutrient loading rates to its application area, install eight groundwater monitoring wells around its farmland, and it paid for the installation of seven additional groundwater monitoring wells around the municipality's IWWTP. The resulting data show groundwater influenced by the discharge contains nitrate, manganese, and iron in excess of the drinking water MCLs, as well as sodium and chloride in concentrations that would impair the yield of sensitive crops irrigated with groundwater. Following the issuance of the NOV, the processor took a leadership role working with the municipality to resolve the issues stated in the NOVs and aggressively pursued solutions with recurring communication with Regional Board staff.

In 2002, the municipality submitted a facility plan that determined the existing treatment and disposal system is inadequate to protect groundwater from nitrogen pollution. The facility plan compared discharge scenarios involving wastewater treatment for BOD_5 reduction and effluent application at agronomic rates with and without biological nitrogen removal (BNR), and determined that implementing BNR was more cost effective than expanding farmland acreage. The processors' senior personnel traveled around the country to become educated on BNR technologies and provided the critical information needed for the municipality's facility plan addendum. The municipality's addendum evaluated nitrogen removal efficiencies of poultry processing wastewater treatment plants recently constructed in other states. Due to the processors' extensive research and input on solutions specific to poultry processing wastewater treatment, it proposed that a selected treatment technology (4-stage Bardenpho activated sludge BNR process), which is capable of reducing total nitrogen in poultry wastewater down to below 6 mg/L, reflected "best practicable treatment and control" for decomposable waste constituents. Staff concurred with this assessment. The municipality expects the new Industrial BNR WWTP to be constructed and operational by September 2007. Meanwhile, accumulated sludge is being removed from the IWWTP's treatment lagoons voluntarily by the processor and discharged to area farmland for use as a fertilizer under the terms and conditions of the Regional Board's General Waiver. The processors' active leadership and willing participation in the process, as well as its financial and technical support, are critical to the processor and the municipality eventually fully resolving this situation.