INFORMATION SHEET

ORDER NO. R5-2008-xxxx
LAND O' LAKES, INC.
ORLAND CHEESE PROCESSING PLANT
GLENN COUNTY

Land O' Lakes, Inc. (hereafter Discharger) submitted a Report of Waste Discharge (RWD) dated 18 January 2008 and requested a revision to their waste discharge requirements for the Orland Cheese Processing Plant (hereafter Facility). These revised WDRs reflect changes to the process, specifically the installation of a whey ultra filter permeate evaporator to decrease the BOD and waste salt load.

The Facility was formerly owned by the Oxford Cheese and Dairy Company, who sold the facility to Land O' Lakes, Inc. in January 1995. Land O' Lakes Inc., incorporated in 1921, is a cooperative organization of producers (Co-op) and has about 40 producer members, most of whom are within 50 miles of the plant. The member dairies deliver milk to the facility by refrigerated tankers. The producer members collectively milk about 17,000 cows. The facility processes approximately 130,000 gallons of milk per day. Raw milk is received from the tankers 20 hours a day. The off-loading area is closed to deliveries for approximately four hours each day for clean-up. The plant operates 24 hours per day, seven days per week, 365 days per year and produces approximately 125,000 lbs of white cheddar cheese per day.

The Land O' Lakes facility is on County Road C, between County Roads 25 and 28, approximately six miles southwest of Orland in Sections 11, 13 and 14, T21N, R4W, MDB&M, (Latitude 39° 40' 37.95" N, Longitude -122° 16' 18.05") as shown in Attachment A, which is attached hereto and made part of the Order by reference. The Facility, including the plant area and the application area, comprises Assessor's Parcel Numbers 24-200-11 (160 acres), 24-210-24 (300 acres), 24-210-25 (20 acres), 24-210-26 (20 acres) and 24-210-27 (140 acres).

Existing Facility and Discharge

The Discharger produces approximately 125,000 lbs of cheddar cheese per day from 1.102 million pounds (127,842 gallons) of milk. A simplified narrative description of the process is as follows: Raw milk (13% solids) is delivered to the plant in refrigerated tanker trucks daily and stored in refrigerated tanks prior to coagulation in agitated vats by enzymes. The resulting slurry is pumped to drain tables where salt is added to enhance separation of the liquid whey from the cheese curd. The cheese (white cheddar) is compressed into 500 lb boxes and removed to refrigerated storage prior to sale. Whey is pasteurized and passed through a reverse osmosis (RO) membrane. The RO permeate is used as process and clean-up water within the plant and is eventually discharged to the floor drains where it flows, along with other waste streams to the first of two ponds. RO concentrate is passed through the ultra filtration membrane unit. The ultra filter concentrate, or whey protein concentrate (WPC) is sold as a product. The ultra filter permeate is pumped to the evaporator where water is removed. The resulting evaporator concentrate or lactose concentrate, is sold as a product. A schematic of the process with approximate flow rates is shown in Attachment B of this Order.

All industrial wastewater including plant waste, cooling tower blowdown and boiler blowdown is discharged to a single line, which in turn discharges to the lower pond. Flow in the line is measured immediately before the point of discharge by sensing the level in a Palmer Bowlus flume. The meter is calibrated annually.

The volume of industrial wastewater flow as measured in the Palmer Bowlus Flume in the discharge line to the lower pond ranges from approximately 0.125 to 0.200 million gallons per day (mgd). A typical analysis is as follows: BOD – 6,930 mg/L, COD – 9,120 mg/L, Total N - 268 mg/L, TDS – 3,820 mg/L, Na - 294 mg/L, Cl - 228 mg/L, NO_3 - 268 mg/L, SO_4 - 22.6 mg/L, Ca - 127 mg/L, Mg - 20 mg/L, E.C. – 3,000 and K – 144 mg/L.

There are two wastewater ponds at the facility. Initial discharge is to the lower pond that was constructed in 1983 when the original cheese plant and dairy were built. The lower pond is approximately 200 yards to the north of the plant site. The lower pond has a compacted clay liner and a volume of about 6.4 million gallons not including the contribution of the required two feet of freeboard. Enlargement of the lower pond from 3.3 million gallons to 6.4 million gallons was begun in the summer of 2005. The enlargement and clay lining was completed and the pond brought on-line in the winter of 2005/06. Prior to the enlargement of the lower pond the facility had a history of wet weather discharges due to lack of holding capacity. No discharges have occurred since the enlargement of the lower pond. Wastewater is pumped from the lower pond to the upper pond, which is the primary storage pond. Wastewater from either pond is used, in combination with pressurized water from the Orland-Artois Irrigation District, for center pivot irrigation of the five spray fields. The upper pond, constructed in 1998, is double lined with a 40-mil HDPE secondary liner and a 60-mil HDPE primary liner. Between the two liners is a HDPE geonet drainage layer. The upper pond volume is approximately 6.6 million gallons not including the contribution of the required two feet of freeboard.

At the time the upper pond was enlarged in 2005, the irrigation/transfer pump was relocated to a concrete sump adjacent to the lower pond. The pump is a five stage centrifugal, which can be used to transfer wastewater from the plant to the upper pond or to any of the five center pivot irrigation rigs.

The plant and application area are on a gently rolling fan surface underlain by alluvium of the Red Bluff Formation. Near surface soils consist primarily of very stiff to hard moderately to highly plastic clay, sandy clay and gravelly clay to depths of about 3-21 feet below grade. In addition, bands of sand and silty sand run through the formation.

Domestic wastewater is discharged to one of two septic tank leachfield systems, one serving the office and one the plant. The plant leachfield is approximately 50 feet to the southeast of the plant beneath the office parking lot. The office leachfield is approximately 50 feet to southwest of the office.

Drainage from the plant site and spray field is to Walker Creek, thence to Willows Creek, thence to the Colusa Basin Drain, which is tributary to the Sacramento River.

Source Reduction of Salts and Organic Waste (Material Balance)

Early in 2005 the Discharger installed an evaporator for removing water from the ultra filter permeate to produce lactose concentrate. This material could be sold rather than discharged to the ponds as waste, as was done previously. The evaporator has been operating since March of 2005 and all of the evaporator (lactose) concentrate is now being sold to V and V Enterprises who use it as a spray-on additive to cattle feed. In order to demonstrate that the reduction in waste constituents has actually occurred, a material balance for individual constituents has been conducted. A material balance is performed by defining a boundary, in this case an imaginary line around the Discharger's plant, and measuring the flow rate and concentration of every stream entering and leaving the bounded system. The material balance is a way to identify inconsistencies in what is reported and what actually exists, and to quantify their magnitude. In this way it is analogous to a financial audit. Analysis of waste and product streams and a material balance are presented in the following tables:

Table I. Conc. of Cations and Anions in Inlet, Waste and Product Streams

Sample	Ca	Mg	Na	K	SO4	Cl	Total Salts
Units	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Raw Milk	1250	119	427	1240	88.2	899	4,023
RO Perm.	nd	nd	27	21	2.77	53.7	105
RO Conc.	1210	242	1190	3400	254	2340	8,636
UF Perm	1100	229	1160	3300	252	2280	8,321
UF Conc.	1550	278	1240	3500	218	1930	8,716
Evap. Conc.	1500	434	3720	8120	603	7250	
Cheese	7,440[1]	300[1]	5,520[1]	936[1]	62[1]	8,330[1]	21,627
Flume[2]	127	20	294	144	22.6	228	836

[1] mg/Kg

[2] The flume carries all waste, including boiler blowdown, from the plant to the lower pond. These results are from the analysis of a 24 hour composite sample.

Table II. Conc. of COD, Total N, TDS and EC in Inlet, Waste and Product Streams

Sample	Total N	COD	TDS	EC
Units	mg/L	mg/L	mg/L	umhos/cm
Raw Milk	4200	226,000	27,600	7,460
RO Perm.	44.4	57	157	232
RO Conc.	2890	186,000	102,000	17,800
UF Perm	1190	153,000	97,300	18,000
UF Conc. (WPC)	10,300	290,000	177,000	17,700
Evap. Conc. (Lactose Conc.)	2050	362,000	196,000	41,600
Cheese	35,500 mg/Kg	1,46 x 10^6 mg/Kg	-	-
Flume[1]	268	9,120	3,820	3,000

Table III. Material Balance

Stream	Gallons per Day	Pounds per Day	Na (lbs/day)	Cl (lbs/day)	COD (lbs/day)	Salts (lbs/day) (Na+Cl+Ca +Mg+SO_4 +K)	Total N (lbs/day)
INLET STREAMS							
Raw Milk	127,842[1]	1,102,000	456	959	241,097	4,292	4,481
Salt (NaCl)		2,610	1,035	1,575	-	-	-
Well Water	95,000	-	22.2	14.2	Neg.	65.4	Neg.
Total In	**222,546**	-	**1,513**	**2,548**	**241,097**	**4,357**	**4,481**
OUTLET STREAMS (Note – Dark shading indicates product streams. Product streams do not contribute to the waste. Light shading indicates internal streams. Internal streams do not contribute to either the product streams or the waste).							
Cheese	14,501[1]	125,000	856	1,041	219,000	2,824	3,986
Process Water [2]	95,000	-	22.2	14.2	Neg.	65	Neg.
RO Permeate	75,000	-	16.9	33.6	35.67	66	28
RO Conc.[3]	57,000	-	-	-	-	-	-
UF Permeate[3]	21,600	-	209	411	27,571	1,499	214
UF Concentrate	12,000	-	124	193	29,000	873	1,030
Evap Conc.	19,000	-	590	1,149	57,392	3,429	325.0
Evap. Cond.	29,000	-	-	-	-	-	-
Total Out (Products +Waste streams)	**244,501 (109.9%)**[4]	-	**1,609 (106.3%)**[4]	**2,431 (95.4%)**[4]	**305,428 (126.7%)**[4]	**7,257 (165.6%)**[4]	**5,369 (119.8%)**[4]
Total Out[5] (Waste Streams only)	**199,000**	-	**39.1 (6.22%)**	**47.8 (3.99%)**	**35.7 (.006%)**	**131 (3.68%)**	**28 (7.93%)**
Total Out[6] (Waste Streams + Evap. Conc.)	**218,000**	-	**629.1**	**1,197**	**57,428**	**3,560**	**353**
Total Out[7] (Flume)	**160,000**	**-**	**392.5**[7] **(38%)**	**304.1**[7] **(75%)**	**12,176**[7] **(79%)**	**1,116**[7] **(67 %)**	**357.8**[7] **(0%)**

[1] Assumes density of 8.62 lbs/gal
[2] Water is assumed to be conserved, i.e. Water In =Water Out
[3] RO Concentrate and UF Permeate are internal streams and not included in the totals.
[4] Ratio of Outlet to Inlet expressed as percentage.
[5] The waste stream also includes the boiler and cooling tower blowdown but as these are relatively small they have not been included. These figures do not take into account spills and leaks. The figures in parenthesis are

the percentage of the present quantity of waste discharged as compared to the quantity discharged when the evaporator concentrate was part of the discharge (assumes no leaks, spills or wash down).

[6] This represents the waste stream as it theoretically would have been prior to the installation of the evaporators.

[7] Calculated from analysis of discharge flume contents, assumes daily flow of 160,000 gallons. The figure in parenthesis is the percentage reduction in individual waste stream constituents before and after evaporator installation, i.e. (present waste stream + evaporator concentrate) – (total out from flume analysis))/ (present waste stream + evaporator concentrate)

If flow measurement and analysis of inflow and outflow streams are accurate and if truly representative samples have been collected, the mass of individual components in inlet and outlet streams should be in agreement, i.e. they should be equal. The ratio of outlet to inlet mass expressed as a percent has been calculated for each of the components in Table III.(See footnote [4]). The agreement between the total inlet and total outlet streams for Na, and Cl is plus or minus about 6%, which is very close. The agreement for COD is within 27% which is acceptable given the difficulties in analysis of highly concentrated streams such as cheese, WPC concentrate and lactose concentrate. The + 65% difference in total salts (Na +K+Ca+Mg+SO_4+ Cl) between outlet and inlet flows is difficult to explain, especially considering that the balance for Na and Cl is good. The + 20% difference in total N between outlet and inlet streams is probably reasonable. Flow volumes in and out of the plant based on the in-plant measurements are within 10% which is relatively close. All of the discrepancies with the exception of the minus 5% chloride difference, are on the plus side, i.e. the balance indicates that the quantity of total volumetric flow and mass of individual constituents is greater in the combined outlet streams than in the combined inlet streams

The difference between the overall flow out of the plant and the overall flow into it as determined by the flume flow rather than the in plant measurements is minus 39,000 gallons per day or - 24.4% when expressed as a percentage of the flume flow. Theoretically the flow out should be the sum of the RO permeate, the evaporator condensate, process water, spills, boiler blowdown and cooling tower blowdown. The latter two streams are relatively small and can be ignored. There is no way to measure the volume of spills, however we assume that their volume is also relatively small. The combined flow of process water, evaporator condensate and RO Permeate, according to in plant measurements, is 199,000 gallons per day. The average daily flow from the Flume, however, is only 160,000 gallons. While this is a relatively large discrepancy, it is probably not unreasonable given the errors in measurement and the necessity of using average figures for many of the flows.

In theory RO Permeate, evaporator condensate and process water are the only major discharges from the plant. However, if this were strictly true, the concentration of salts and COD in the Flume would be far less than actually observed. While the contribution of spills to the discharge <u>volume</u> is probably small, spills and tank wash out appear to account for a considerable quantity of salts and especially COD, given the discrepancy between the concentration and mass of these constituents in the flume versus the concentrations that result from a combination of process water and RO Permeate. The Discharger has explained that wash down and cleaning of process equipment are done frequently and that the generation of additional salts and COD in the waste is to be expected. The evaporator in particular is a source of organic and inorganic wastes in that during operation a thick film of concentrated salts and organic material build up on the evaporator surface. These surfaces must be cleaned and rinsed every 20 hours.

The primary purpose of the mass balance is to determine if the Discharger has in fact made a significant reduction in salt and COD wastes being discharged to the ponds and ultimately to the spray field. While the material balance is not as accurate as hoped, it appears clear that the Discharger has made a significant reduction in wastes discharged from the plant as a result of the installation of evaporator. (The evaporator essentially removes ultra filter permeate from the waste stream by removing a large part of the water from this stream, and thereby creating a saleable product). The material balance indicates that the evaporator concentrate stream comprises approximately 1/3 of the sodium, half the chloride and total salts, 18% of the COD and 25% of the total N generated at the plant. Table III above indicates that the reduction in waste load over pre-evaporator conditions would be 90% or better for all inorganic constituents and virtually 100% for COD (organic constituents). The actual reduction is much less than these calculated figures, as can be seen from the flume analysis. We assume this to be a result of spills, tank wash, leaks, and to some degree, meter error.

Another demonstration of the reduction in waste load is a comparison of flume analysis prior to and after the installation of the evaporators. Table IV below presents flume and upper pond analysis for the calendar year 2004 (before installation of the evaporators) and 2007 (after installation of the evaporators).

Table IV. Flume and Upper Pond Analysis

Site/Parameter	2004		2007	
	Mean	Std. Dev.	Mean	Std. Dev.
Pond/BOD	**28,530**	**9,420**	**6,130**	**2,910**
Pond/TDS	**26,000**	**8,210**	**3,180**	**1,530**
Pond/TKN (mg/L)	**313.13**	**131.39**	**153.8**	**54.4**
Flume/BOD	**23,891**	**8,970**	**5,620**	**2,120**
Flume/TDS	**21,590**	**5,950**	**3,480**	**1,430**
Flume/TKN (mg/L)	**248.4**	**91.67**	**154.4**	**53.0**

Table IV indicates that there has been a sizeable reduction in BOD and TDS, approximately 80%, which, predictably, is also observed in the pond contents. This is more in line with the theoretical prediction based on individual waste stream analysis (see Table III). Table IV suggests that there is about a 40% reduction in total N. No reduction was seen in the calculated reductions in Table III. It should be noted that while about 40 individual analyses were used to determine each of the average values in Table IV, there was considerable variability in these individual values, which is reflected in the high standard deviations. CV (Coefficient of Variation) values were around 0.3. This variability makes accurate assessment of performance more difficult.

On the basis of the information in Tables III and IV, it can be stated with reasonable confidence that the Discharger has eliminated at least half of the salt waste and perhaps ¾ of the BOD/COD (Organic) waste. There has been less reduction in total N.

Groundwater Quality and Conditions

The facility is in the Colusa Basin Hydrologic Unit, Orland Hydrologic Sub Area (520.22) of the Sacramento Valley Groundwater Basin as depicted on interagency hydrologic maps prepared by DWR.

Groundwater beneath the plant site and spray field area is encountered at approximately 100 feet bgs (below ground surface) and flows in roughly the same direction as the fall of the surface contour, i.e. from northwest to southeast. In 1994 MW-1 was installed immediately adjacent to the east side of the lower pond. In 1996 at the request of the Sacramento Office of the Regional Water Quality Control Board, the Discharger installed two additional monitoring wells, one upgradient (MW-3) and one downgradient (MW-2) of the lower pond. MW-1 is due east and approximately 6 feet from the edge of the lower pond. MW-2 is due south and approximately 40 feet from the edge of the lower pond. MW-3 is approximately 250 feet to the northwest. These wells were installed to monitor the effect of the lower pond on groundwater. A review of the results from quarterly sampling of these three wells indicates that there has been an increasing trend in the concentration of Na, Cl and TDS (but not nitrates) in MW-1. There is a suggestion of the same trend in MW-3, the upgradient well, but not in MW-2, the second downgradient well. The location of the wells and the lower pond is shown in Attachment A.

It is unclear why MW-1 was installed immediately adjacent to the lower pond, as the lower pond has only a single compacted clay liner, and could be expected to have some permeability. (MW-1 was installed in November 1994 by Oxford Cheese and Dairy, three months before being purchased by Land O' Lakes Inc.). Under these conditions it would be assumed that a well as close as MW-1 would exhibit some elevation in the concentration of soluble pond constituents. Monitoring well MW-1, therefore, will provide no useful information and in addition could act as a conduit for contamination of groundwater. For these reasons, Provision E.1.a of these requirements requires the abandonment and destruction of MW-1 as described in the California Well Standards. An additional monitoring well further downgradient of the lower pond is also required.

In August 2003, three additional monitoring wells were installed, MW-4 at the assumed upgradient property boundary, and MW-5 and MW-6 towards the southerly downgradient property line. These well locations are shown in Attachment A. The purpose of the new monitoring well installation was to determine if any downgradient effects were detectable at the property boundary. The assumed upgradient well, MW-4, which is approximately one mile and within a few degrees of true northwest from MW-3, has been dry since installation and has produced no results. Based on elevations recorded for MW-1, MW-2 and MW-3, the direction of groundwater flow in the vicinity of the lower pond has been consistently calculated to be southeast. Since we know, however, that based on its depth and casing elevation, the level of water in MW-4 can be no higher than 177.6'. and that the average levels of water in MW-1, MW-2 and MW-3 are 180.3', 181.7' and 198.1' respectively, it must be concluded that MW-4 is in fact downgradient of the lower pond area unless there is a confined aquifer beneath it. Monitoring wells MW-5 and MW-6 are due south and approximately 1,750' and 3,750' respectively from the lower pond. The average levels of water in MW-5 and MW-6 are 176.5' and 156.2' respectively, which indicates that that these wells are downgradient of the lower pond area as would be expected. The apparent piezometric surface of groundwater in the vicinity of the facility raises the possibility that groundwater intercepted by MW-1, -2, -3, -5 and -6 is a result of the application of irrigation and wastewater by the Discharger.

A review of monitoring well analyses is presented below:

Table V. Monitoring well analysis for 2000/01, 2004 and 2007

Well No./Anal.	Well Orien-tation	Na (mg/L) (ave.)	Na (mg/L) (std.dev.)	Cl (mg/L) (ave.)	Cl (mg/L) (std.dev	TDS (mg/L) (ave)	TDS (mg/L) (std.dev.)	NO_3 (mg/L) (ave.)	NO_3 (mg/L) (std.dev.)
MW1, 2000/01	6 Ft Down-Grad.	43.25	2.36	39.5	3.31	347.5	5	6.175	0.29
MW1, 2004		57	2.16	77.5	8.19	619.25	75.56	4.8425	0.43
MW1, 2007		62	5.60	96	10.86	775	94.34	5.1	0.56
MW2, 2000/01	40 Ft Down-Grad.	56.5	1.29	45.25	2.87	412.5	17.07	4.025	0.13
MW2, 2004		56.5	5.51	36.75	3.30	410	102.3	3.9	0.39
MW2, 2007		52.5	5	34.75	5.56	477.5	66.02	2.8	0.98
MW3, 2000/01	250 Ft Up-Grad.	40.5	1.29	26.75	2.22	205	12.91	10.25	0.5
MW3, 2004		47	1.83	47.5	3	271.5	16.20	12.875	0.25
MW3, 2007		46	1.83	52	2.45	325	95.39	13.25	0.5
MW6, 2004	3,800 Ft. Down-Grad.	14	0.82	8.3	1.16	225.75	5.06	4.6	0.41
MW6, 2007		13.75	1.26	11	0.82	242.5	35.94	5.675	0.30

No results are reported for MW- 4 and MW-5 as MW- 4 has contained no water since the initial drilling, and MW -5 can only be sampled about 25% of the time due to low water levels. Each average value in Table V above consists of four individual results from the quarterly monitoring reports. The pattern between wells for a given constituent is consistent, however because the number of observations is relatively small, it is in general not possible to demonstrate statistical significance. An exception is nitrate for MW-3. Initially only the results for 2004 and 2007 were included, however as it appeared there was a trend in MW-1 for increasing concentrations of Na, Cl, and TDS with time, it was decided to include the earliest available analysis (2000/01) as well. With the inclusion of the 2000/01 results the trend in MW-1 appears very strong and is probably significant at the 95% level for Na, Cl, and TDS. The trend for nitrate is absent or possibly reversed. The trend of increasing TDS also appears in MW-2 and MW-3. MW-1 is due east and approximately 6 feet from the edge of the lower pond. MW-2 is due south and approximately 40 feet from the edge of the lower pond. MW-3 is approximately 250 feet to the northwest, the calculated upgradient direction. MW-6 is approximately 3,800 ft due south of the lower pond and downgradient of field Nos. 4, 5, and 6. It appears likely that MW-1 and MW-2 are affected by leakage from the lower pond. This is not surprising considering their proximity to the pond. The case for MW-3 is less convincing, as it is in the upgradient direction and considerably further from the lower pond. It is recommended that no decision be made on the installation of a double liner (Class II Surface Impoundment) until further monitoring well analysis has been collected and compared with the existing data.

The Discharger is required in Provision 1.b. to submit a *Groundwater Quality Assessment Report,* which provides a summary and analysis of all monitoring well results for eight quarters subsequent to the installation of the new downgradient monitoring well MW-7. Staff will review the report at the time of submittal, and make a determination as to the need for a double liner with leachate collection (Class II Surface Impoundment) in the lower pond and possible further reduction in salt load to the spray field.

The facility is in the center of Section 11 and most of the wells in this section and adjoining sections are agricultural wells with depths of between 500 and 600 feet. The nearest domestic well for which information is available is located at the intersection of County Roads 28 and D, in Section 13, which is approximately 1.5 miles southeast of the facility. This well is drilled to a depth of 200’ and is screened from 60’ to 120’ and from 140’ to 180’.

Domestic water supply is from a 12” well located immediately west of the plant site and drilled to a depth of 630 feet bgs. As would be expected, the concentration of salts in the water from this well is considerably less than in the monitoring wells. An analysis of the domestic supply water and water from the Orland-Artois Irrigation District is presented below:

Analysis	LOL Domestic	Orland-Artois
Ca (mg/L)	16	21
Mg (mg/L)	15	4
Na (mg/L)	28	7
K (mg/L)	nd	2
pH (mg/L)	7.76	8.54
Cl (mg/L)	17.9	3
SO_4 (mg/L)	5.47	3.3
HCO_3 (mg/L)	144	-
NO_3 (mg/L)	nd	-
EC (umhos/cm)	287	164
TDS (mg/L)	169	102
COD (mg/L)	<7	-
Fe (mg/L)	nd	ND
Mn (mg/L)	nd	ND
Zn (mg/L)	nd	ND
Total P	n	-

Spray Field

The spray field consists of five individual application sites as shown in Attachment A. Total area of the five spray fields is approximately 380 acres. Pressurized water from the Orland-Artois Irrigation District is introduced into the facility's center pivot irrigation system and applied to the five individual spray fields as required. Annual irrigation water usage for the 2007 water year was 516.25 acre-feet or 461,000 gallons per day. Wastewater is usually applied separately from the irrigation water by pumping wastewater from either the upper or lower pond through the same center pivot system, however, it can also be mixed in line with irrigation water if required. The irrigation pump is in a sump adjacent to the lower pond. Crops grown in the spray field area include alfalfa, forage maize, oats, rye grass and winter grains.

Based on a typical BOD_5 concentration of the wastewater of 6,930 mg/L the average BOD_5 loading rate to the spray field is 24.34 pounds/acre/day, which is considerably less than the USEPA recommended maximum rate of 100/lbs/acre/day (USEPA publication No. 625/3-77-0007, *Pollution Abatement in the Fruit and Vegetable Industry)*.

The average loading rate in pounds per acre per year for individual ions over the entire spray field based on a typical analysis of flume contents is as follows: N – 343, Na – 377, Cl – 292, K – 184, Ca – 163, Mg – 25.6 and SO_4 – 28.9. This does not include the contribution from irrigation water.

The top six inches of soil in Fields 3, 4, 5, and 6 were sampled by staff in March 2003. Results indicated that pH was within the optimum range, nitrogen was low; P, K, Mn, and Fe were excessive; and sodium adsorption ratio was medium to excessive. Results are tabulated in the Information Sheet. The Discharger has recently applied lime to the spray field to improve soil permeability and general fertility. Crop yields have increased as a result.

Basin Plan, Beneficial Uses and Regulatory Considerations

The *Water Quality Control Plan for the Sacramento River and San Joaquin River Basins, Fourth Edition* (hereafter Basin Plan) designates beneficial uses, establishes water quality objectives, contains implementation plans and policies for protecting waters of the basin, and incorporates by reference plans and policies adopted by the State Water Resources Control Board. Pursuant to Section 13263(a) of the California Water Code (CWC), waste discharge requirements must implement the Basin Plan.

The designated beneficial uses of the Colusa Basin Drain are agricultural supply; water contact recreation; warm and cold (potential) freshwater habitat; migration of warm water aquatic organisms; spawning, reproduction and/or early development of warm water aquatic organisms; and wildlife habitat.

The designated beneficial uses of underlying groundwater are municipal and domestic supply, agricultural supply, industrial service supply, and industrial process supply.

The Basin Plan establishes numerical and narrative water quality objectives for surface water and groundwater that waste discharge requirements must implement. To implement narrative water quality objectives, relevant water quality criteria and guidelines are to be considered on a case-by-case basis to determine the appropriate numerical limitations.

The chemical constituent objective in the Basin Plan requires, at a minimum, compliance with California maximum contaminant levels (MCLs) for waters designated as municipal supply. More stringent criteria than MCLs are sometimes necessary to ensure that waters do not contain chemical constituents in concentrations that adversely affect beneficial uses.

The Basin Plan contains narrative water quality objectives for chemical constituents, tastes and odors, and toxicity. The toxicity objective requires that groundwater be maintained free of toxic substances in concentrations that product detrimental physiological responses in humans, plants or animals associated with beneficial uses. The chemical constituent objective requires that groundwater shall not contain chemical constituents in concentrations that adversely affect beneficial uses. The tastes and odors objective requires that groundwater shall not contain taste or odor producing substances in concentrations that cause nuisance or adversely affect beneficial uses.

Groundwater Degradation/Antidegradation Analysis

State Water Resources Control Board Resolution No. 68-16 (“Policy with Respect to Maintaining High Quality Waters of the State”) (hereafter Resolution 68-16) prohibits degradation of groundwater unless it has been shown that:

a. The degradation is consistent with the maximum benefit to the people of the State;

b. The degradation will not unreasonably affect present and anticipated future beneficial uses;

c. The degradation does not result in water quality less than that prescribed in state and regional policies, including violation of one or more water quality objectives; and

d. The discharger employs Best Practicable Treatment and Control (BPTC) to minimize degradation.

Existing groundwater data is insufficient to determine the effect of the Discharger’s installation of an ultra filter permeate evaporator, which has greatly reduced the quantity and concentration of salts and BOD discharged to the lower pond and subsequently the spray field.

The Discharger is required in Provision 1.b. of the waste discharge requirements to submit a *Groundwater Quality Assessment Report,* which provides a summary and analysis of all monitoring well results for eight quarters subsequent to the installation of the new downgradient monitoring well MW-7. This information will be reviewed by Regional Water

Board staff and a decision made as to the need for double lining of the lower pond (Class II Surface Impoundment) and possible further reduction in salt load to the spray field.

Constituents of concern that are discharged to the lower pond and eventually applied to the spray field area and have the potential to degrade groundwater include TDS, individual cations and anions, nutrients and organic materials (BOD/COD). While there has been a trend toward higher Na, Cl, and TDS in MW-1 adjacent to the east side of the lower pond, the same trend is not seen in MW-2 which is 40 feet to the south (primarily downgradient) of the lower pond. Constituents of concern noted above should not adversely affect groundwater quality due to the following:

- The total nitrogen loading rate to the spray field area is approximately 343 lbs/acre/year, which is in line with the nitrogen uptake rates of the crops being grown. It should be noted that approximately 25% of the nitrogen is lost during spray irrigation.

- The BOD the loading rate to the sprayfield is approximately 25 pounds/acre/day, which is considerably less than the USEPA recommended maximum rate of 100/lbs/acre/day.

- The Na and Cl loading rates for the sprayfield are approximately 377 and 292 lbs/acre/year respectively. Neither sodium nor chloride ions are plant nutrients and in sufficient concentrations can cause adverse soil and plant reactions. Crops being grown by the Discharger are not considered sensitive species, however, to insure that the build-up of Na and Cl does not exceed acceptable limits or inhibit crop growth, the Discharger has been required to perform appropriate soil analysis annually for each of the five individual spray field areas. In order to minimize the effects of Na on soil permeability, the Discharger has instituted a lime application program.

- The loading rates for the plant nutrients K, Ca, Mg, and SO_4 are approximately 184, 163, 25.6 and 28.9. lbs/acre/year respectively. These rates are within acceptable limits for the crops being grown by the Discharger.

- The electrical conductivity of the wastewater being applied to the spray field is approximately 3,000 µmhos/cm, which is in excess of the 700 µmhos/cm limit for a Class I Irrigation Water as defined by the U.S. Department of Agriculture. A portion of the EC in the discharge can be attributed to organic compounds that will break down in the soil profile, and will not continue to exert an osmotic pressure gradient retarding plant uptake of water. A measured volume of a 24-hour composite sample of the flume discharge was analyzed for EC, evaporated to dryness, ignited in a muffle furnace at 550 degrees C for one hour and reconstituted to the original volume with DI water. After the residue had completely dissolved, the EC was re-measured and found to be 1,600 µmhos/cm. This is a measure of the EC attributable to inorganic constituents. Wastewater applied to the sprayfield is diluted approximately 3:1 with Orland-

Artois Irrigation District water, which has an EC of approximately 164 µmhos/cm. The weighted average EC of the applied water is, therefore, approximately 523 µmhos/cm, which is within the limit for a Class I irrigation water (700 umhos/cm). Additionally it should be noted that the crops being grown by the Discharger are relatively salt tolerant and would not be greatly affected by higher EC levels.

Treatment and Control Practices

The Discharger provides treatment and control of the discharge that incorporates:

- The use of reverse osmosis to concentrate salts in the product streams and yield a permeate that can be used in the plant as a substitute for well water.

- Re-cycling of certain waste streams including salt whey skim to maximize product yield and minimize waste discharge.

- Installation of an ultra filter permeate evaporator to eliminate this highly concentrated stream from the waste discharge.

- Application of wastewater at plant uptake rates for the plant nutrients K, Ca, Mg, S, and N.

- Application of wastewater at rates well below the maximum application rate for organic loading.

- Operation of a tail water recovery system in the spray field to collect and recirculate water to improve irrigation efficiency and prevent standing water.