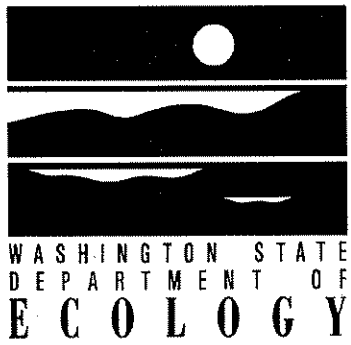

BELLINGHAM FROZEN FOODS WASTEWATER TREATMENT FACILITY CLASS II INSPECTION, OCTOBER 4, 1993

Water Body No. WA-01-1010
94-101

June 1994

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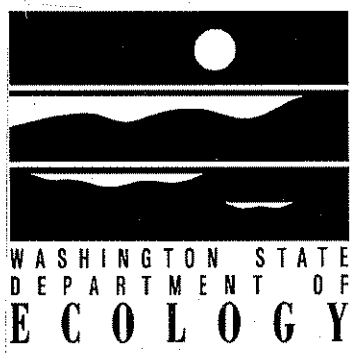

BELLINGHAM FROZEN FOODS WASTEWATER TREATMENT FACILITY CLASS II INSPECTION, OCTOBER 4, 1993

By
Paul Stasch

Environmental Investigations and Laboratory Services Program
Toxics Investigations Section
Olympia, Washington 98504-7710

June 1994

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ABSTRACT

A Class II Inspection was conducted on October 4, 1993, at the Bellingham Frozen Foods (BFF) Wastewater Treatment Facility located in Whatcom County, Washington. The facility consists of an aerated storage lagoon and spray fields for the land application of the wastewater. The facility's State Waste Discharge Permit does not specify concentration or loading limits on the wastewater discharge at this time. The inspection produced independent monitoring data. Only gross estimates of treatment efficiencies were possible. Concentrations of organophosphate and carbamate pesticides were detected. The permit does not require monitoring for these pesticides.

SUMMARY

Flow Measurements

No attempt was made to measure the Parshall flume dimensions. Pumping records are used to estimate flow to and from the lagoon.

General Chemistry

The BFF influent to the lagoon has high total solids content and a large BOD_5 concentration. The TOC concentration was also high and nutrient concentrations were low. There was little spatial variability noted between the different lagoon sample stations. The lagoon is well mixed and effluent grab samples yield representative results.

Analysis of the lagoon influent grab samples documents substantial variation in the strength of the wastewater. Composite samples would be necessary for characterization.

Variability, in influent quality and lagoon detention times, makes estimates of the levels of treatment within the lagoon unreliable. Total solids concentration was reduced by an estimated 50%. BOD_5 concentration was reduced by an estimated 60%.

Lagoon fecal coliform counts were high.

State Waste Discharge Permit Compliance

The State Waste Discharge Permit No. 7322 specifies no effluent concentration limitations only monitoring requirements. Enforcement limits for ground water protection are established in the permit. The flow was within the permit limitation.

Split Sample Analyses

Ecology and BFF split sample analytical results were comparable. Only the total suspended solids results differed substantially. The BFF contract laboratory received accreditation on May 6, 1993.

Priority Pollutant Inorganics - Metals Scans

Seven priority pollutant metals were present in the lagoon. Copper and zinc concentrations in the lagoon sample exceeded the EPA Water Quality Criteria for acute freshwater exposures.

Priority Pollutant Organics - Pesticide Scans

A total of six pesticides or metabolites were detected within the treatment/storage system. None of the compounds detected require monitoring under the conditions of the BFF's State Water Discharge Permit. The six pesticides or metabolites were either organophosphate or carbamate pesticides.

Concentrations are below acute toxicity levels for the ringneck pheasant, mallard duck and california quail and thus do not appear to be an environmental threat. Aldicarb sulfoxide and fenamiphos sulfoxide, degradation products of aldicarb and fenamiphos, were found in the lagoon at higher concentrations than the parent compounds.

The concentration of aldicarb detected in the lagoon sample was approximately 10% of the blue gill LC_{50}. The aldicarb sulfoxide concentration in the lagoon was greater than the aldicarb LC_{50} for the bluegill.

The chronic toxicity of these compounds have not been established. Degradation varies from rapid to moderate so environmental persistence is thought to be short. However, anaerobic soil conditions can inhibit the degradation.

RECOMMENDATIONS

- The accuracy of the flow estimation technique should be verified.
- If the lagoon treatment potential needs to be known, more frequent influent and effluent sampling is necessary, especially when wastewater is being applied to the sprayfields.
- Future permits should require monitoring for fecal coliform bacteria in both the lagoon influent and the lagoon proper.
- The land application of wastewater should continue to be controlled to prevent the inadvertent discharge into surface waters.
- It is recommended that the permit be modified to include monitoring for organophosphate and carbamate compounds. Monthly scans during the entire processing season for other pesticide groups may be necessary to determine a complete target compound list.
- The land application of wastewater should be scheduled to prevent the development of anaerobic soil conditions.

INTRODUCTION

A Class II Inspection was conducted at the Bellingham Frozen Foods (BFF) wastewater treatment facility on October 4, 1993. The inspection was conducted by Paul Stasch and Guy Hoyle-Dodson of the Environmental Investigations and Laboratory Services Program (EILS) of the Washington State Department of Ecology (Ecology). Mr. David Green, Operations Manager, and Mr. Dean Gilbert, the Facility Operator, represented BFF and provided assistance onsite. Kevin Fitzpatrick of the Ecology Northwest Regional Office requested the inspection. BFF has operated a frozen vegetable processing plant since 1966, processing peas, corn, beans and carrots. The processing facility is located in the City of Bellingham. In the past, wastewater was discharged to the Bellingham Sewage Treatment Plant. Beginning in 1992, process wastewater was treated/stored in an aerated lagoon/spray irrigation treatment system located approximately six miles from the processing facility in rural Whatcom County. Sanitary wastewater is still discharged to the sewage treatment plant.

Wastewater is pumped to this facility via a 16-inch diameter pipeline into a lined lagoon. The dimensions of the lagoon are 250' by 600' by 17' maximum depth (volume approximately 19 million gallons). The treatment facility occupies 366 acres on the south bank of the Nooksack River, approximately 215 acres of which are utilized for the land application of the wastewater. The facility is authorized to land apply wastewater under the provisions of State Waste Discharge Permit No. 7322. The permit was issued on February 14, 1992, and expires on February 14, 1997. A lagoon and sprayfield overview is provided on Figure 1.

The specific objectives of this inspection were to:

1. evaluate the chemical characteristics of the wastewater, including pesticide contamination;

2. estimate the level of treatment within the aerated lagoon; and

3. support future permit renewal process.

PROCEDURES

Ecology collected grab samples from the processing facility's discharge to the lagoon (lagoon influent) and from several locations within the lagoon. The lagoon influent samples were collected immediately downstream of the Parshall flume housed at the processing plant. A grab-composite of three discrete sub-samples was also collected for pesticide and metals analyses. Four separate areas of the lagoon were sampled. BELLEFF-1, BELLEFF-2, and BELLEFF-4 were collected from the shores of the lagoon; and BELLEFF-3 and BELLEFF were collected by boat from the center of the lagoon. The facility operator collected a grab sample (LAGOON) from the center of the lagoon at the same time the Ecology samples were collected to serve as a split sample. Limited access prevented the collection of an automated composite sample of the lagoon influent.

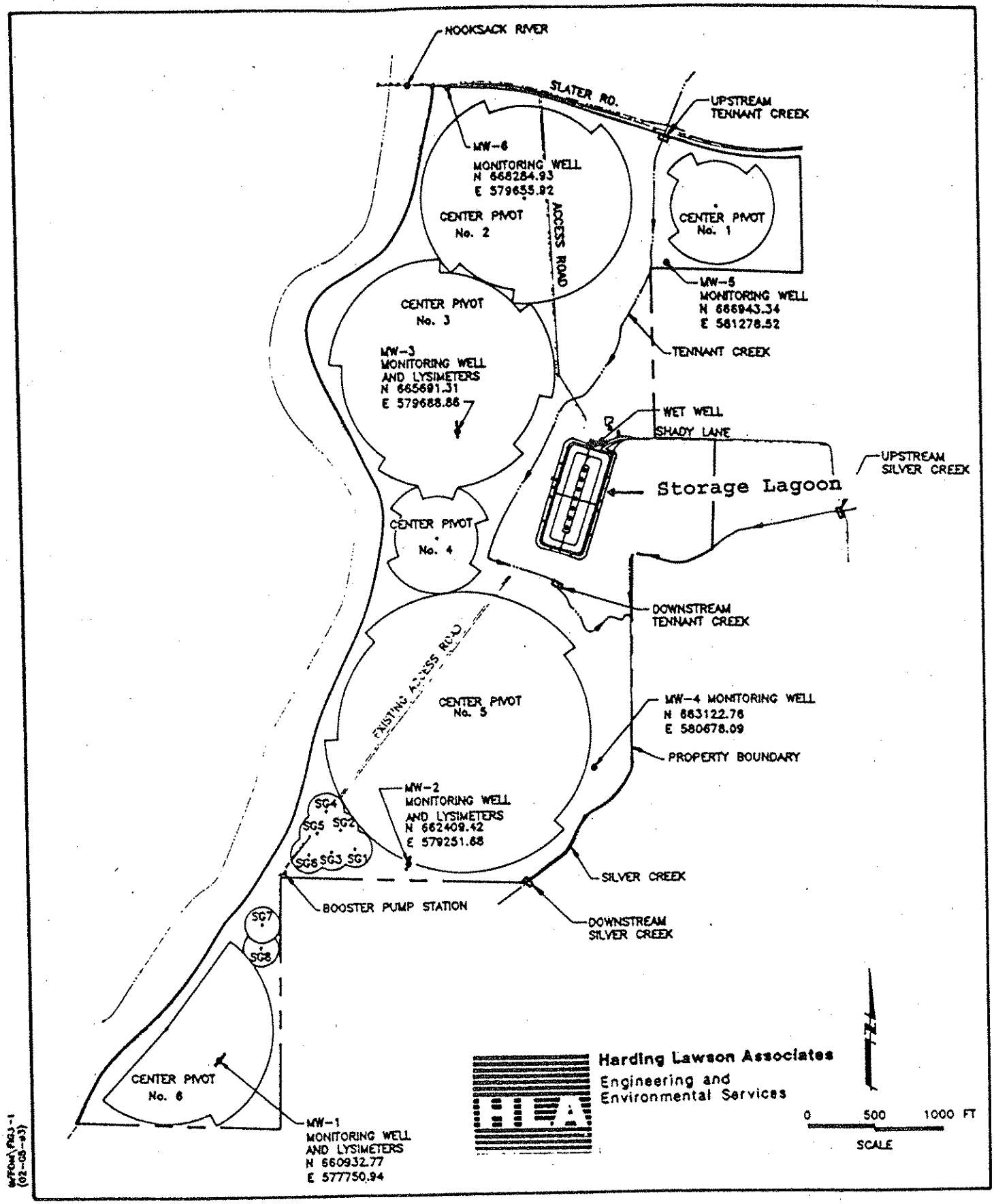

Figure 1
Lagoon and Sprayfield Overview
Bellingham Frozen Foods - October 1993

The location of the samples collected from the lagoon are identified on Figure 2 and described on Table 1. The sampling dates, type of sample and parameters analyzed for are provided in Appendix A. The laboratories conducting the analyses and the test methods used are in Appendix C.

RESULTS AND DISCUSSION

Flow Measurements

The operator reported the flow to the lagoon during the inspection of 1.32 MGD. Influent and irrigation flows are estimated from pumping records. There was no discharge from the lagoon at the time of the inspection.

BFF does not use the Parshall flume at the processing facility to measure flow. No attempt was made to confirm the Parshall flume dimensions and accuracy because the flume was choked with foam and the underground vault housing was a confined space.

General Chemistry

The lagoon influent was typical of food processing wastewater. It had a high total solids content (3763 mg/L) and a large BOD_5 (2570 mg/L) based on the mean of three grab samples collected at the time of the inspection (Table 2). The mean TOC concentration was also high (1460 mg/L) and nutrient concentrations were low. Analysis of the lagoon influent grab samples shows substantial variation in the strength of the wastewater.

The lagoon grab samples documented the wastewater available for land application had high TSS and BOD_5 concentrations. Inorganic nitrogen concentration was low while total phosphorus concen-trations were approximately 6 mg/L. Fecal coliform counts were very high. It is recommended that the permit be modified to include monitoring for fecal coliform bacteria in both the lagoon influent and the lagoon proper. The hardness of the BFF samples could not be measured at the Ecology Manchester Laboratory due to their color and other physical characteristics.

There was little spatial variability noted between the different lagoon sample stations. BFF operates the lagoon as a storage facility used to meter water to the sprayfield and not as a treatment lagoon. Aeration was specifically added to inhibit anoxic conditions for odor control. Residence time in the lagoon is estimated to range from 7 to 20 days and occasionally, wastewater is pumped directly to the spray fields (Green, personal communication).

Variable residence time and influent concentrations make estimates of the levels of treatment within the lagoon unreliable. Nevertheless, the means of the analytical results of the lagoon influent samples and the lagoon samples are compared (Table 3) to estimate rough treatment efficiencies. Total solids concentration was reduced approximately 50%. BOD_5 concentration

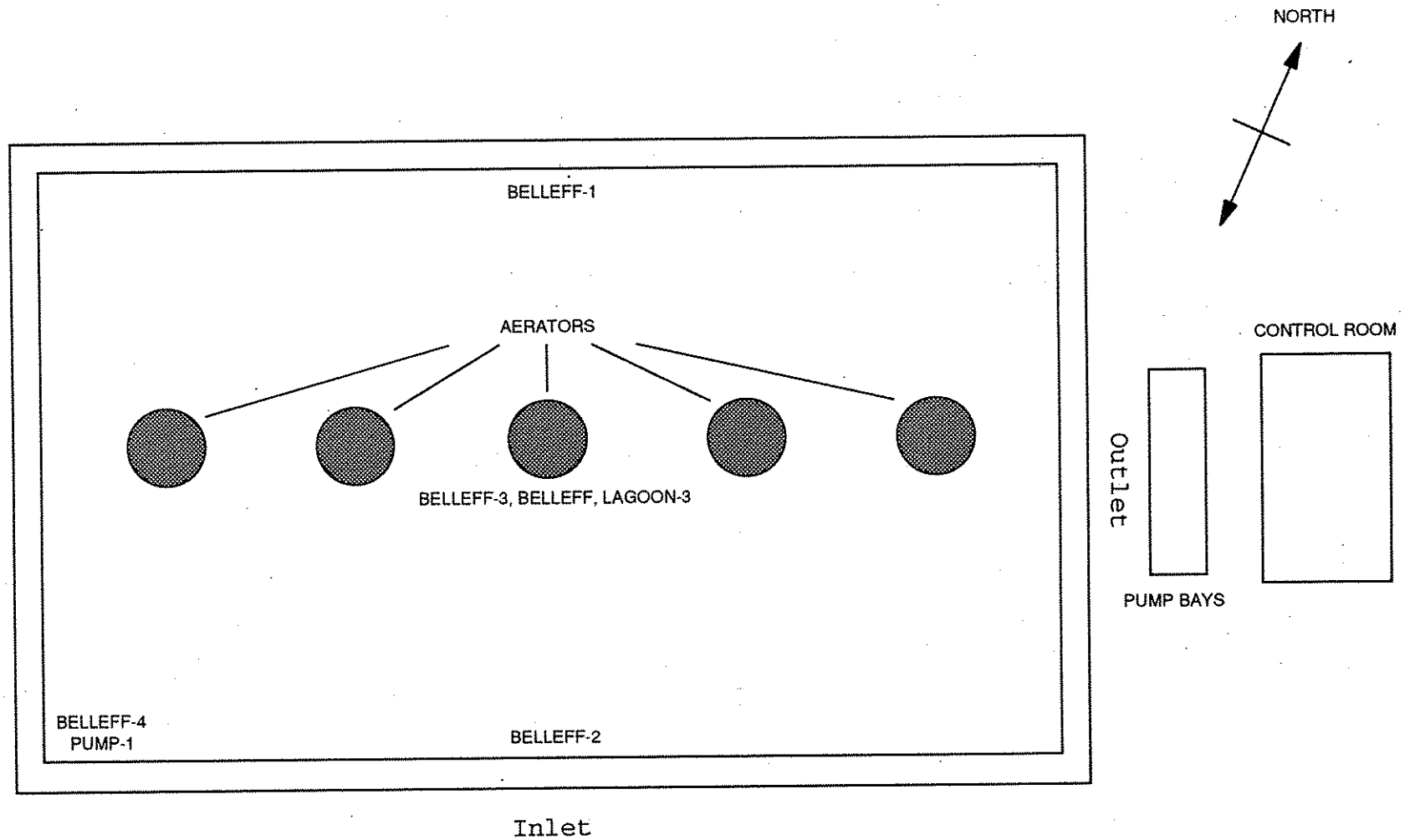

Figure 2 - Lagoon Sample Station Locations - Bellingham Frozen Foods - October 1993.

Table 1 - Sample Station Descriptions - Bellingham Frozen Foods - October 1993.

Influent Wastewater (BELLIN-1, BELLIN-3, BELLIN-4, and BELLIN) - samples of facility effluent (lagoon influent) collected immediately downstream of the parshall flume; located in the vehicle access area behind the production facility.

Lagoon Wastewater - samples collected from the aerated storage lagoon located at the land application site.

BELLEFF-1 - sample collected from the central portion of the northern shore of the lagoon.

BELLEFF-2 - sample collected from the central portion of the southern shore of the lagoon.

BELLEFF-3, BELLEFF, LAGOON-3 - samples collected by boat, adjacent to the middle aerator in the center of the lagoon.

BELLEFF-4 - sample collected from the south-western corner of the lagoon.

PUMP-1 - blind duplicate of BELLEFF-4.

Table 2 – General Chemistry Results – Bellingham Frozen Foods – October 1993.

Parameter	Location:	BELLIN–1	BELLIN–3	BELLIN–4	BELLEFF–1	BELLEFF–2	BELLEFF–3	BELLEFF–4	PUMP–1	RPD@
	Type:	grab	grab	grab	grab	grab	grab	grab	grab	
	Date:	10/4/93	10/4/93	10/4/93	10/4/93	10/4/93	10/4/93	10/4/93	10/4/93	
	Time:	0925	1330	1555	0745	0802	1105	1505	1505	
	Lab Log #:	418180	418182	418181	418184	418185	418186	418187	418189	
GENERAL CHEMISTRY										
Conductivity (umhos/cm)		483	575	786	575	573	572	578	578	0%
Hardness (mg/L, CaCO3)+										
Alkalinity (mg/L, CaCO3)		1 U	1 U	91.2*	1 U	1 U	1 U	1 U	1 U	0%
TS (mg/L)		3820	2050	5420	1920	1890	1820	1820	1880	3%
TNVS (mg/L)		428	400	573	410	393	398	398	381	4%
TSS (mg/L)		592 J	1030 J	775 J	886 J	900 J	767 J	1080 J	900 J	18%
TNVSS (mg/L)		169 J	138 J	175 J	143 J	200 J	100 J	120 J	200 J	50%
BOD5 (mg/L)		2940	1070	3700	994	1010	988	1010	994	1.6%
TOC (mg/L)		1560	725	2090	699	720	686	723	718	.7%
NH3–N (mg/L)		0.66	0.29	1.1	0.26 J	0.25	0.20	0.25	0.24	4%
NO2+NO3–N (mg/L)		0.31	0.02 J	0.68	0.03 J	0.04 J	0.04 J	0.03 J	0.03 J	0%
Total–P (mg/L)		5.1	6.5	7.9	22	5.5	6.1	5.9	6.4	8%
Oil and Grease (mg/L)		25	8	20	7	4	9	6		
F–Coliform MF (#/100 ml)					490000	360000	330000			
FIELD OBSERVATIONS										
Temperature (C)		21	21.1	21.4	13.9	13.8	14.0	15.1		
pH (SU)		6.85	6.3	6.25	5.5	5.25	5.29	4.83		

NOTE:	The permit specifies grab samples. Plant configuration and pumping cycles make composite sampling difficult.
BELLIN	Bellingham Frozen Foods lagoon influent.
BELLEFF	Bellingham Frozen Foods lagoon wastewater.
PUMP–1	Blind duplicate of BELLEFF–4.
U	The analyte was not detected at or above the reported result.
J	The analyte was positively identified identified. The associated numerical result is an estimate.
+	Manchester Laboratory was unable to analyze for hardness.
*	Result appears anomolous.
@	Relative Percent Difference (RPD) between duplicate samples BELLEFF–4 and PUMP–1. RPD = Difference/Mean.

Table 3 – Aerated Lagoon Treatment Effeciency – Bellingham Frozen Foods – October 1993.

Parameter	Location:	BELLIN	BELLEFF	% Removal
	Type:	Average#	Average#	
	Date:	10/4/93	10/4/93	
GENERAL CHEMISTRY				
TS (mg/L)		3763	1866	51
TNVS (mg/L)		467	396	15
TSS (mg/L)		799 J	906 J	–13
TNVSS (mg/L)		160 J	152 J	5
BOD5 (mg/L)		2570	999	61
TOC (mg/L)		1458	709	51
NH3–N (mg/L)		0.68 J	0.24 J	65
NO2+NO3–N (mg/L)		0.34 J	0.03 J	91
Total–P (mg/L)		6.5	6.0	8
Oil and Grease (mg/L)		17.6	6.5	63

#	Average of all grab samples.

was reduced approximately 60%. To fairly evaluate the storage lagoon as a treatment system, regular lagoon influent and effluent sampling would be necessary.

State Waste Discharge Permit Compliance

The State Waste Discharge Permit No. 7322 specifies monitoring requirements rather than effluent concentration or loading limitations. The permit limits flow and establishes enforcement limits for ground water protection. At the time of the inspection the flow was 1.32 MGD, well within the permit limitation of 2.1 and 1.8 MGD for a daily maximum and daily average, respectively. A copy of the lagoon monitoring requirements is provided in Appendix E.

Split Sample Analyses

Grab samples are specified in the permit for effluent quality monitoring. The relative uniformity of Ecology's lagoon grab samples indicated it was well mixed and that grab samples provide representative results. The variability of the influent samples suggests grab sampling would be inadequate to evaluate influent quality.

Ecology and BFF collected simultaneous grab samples from the center of the lagoon for pesticide, metals and conventional analyses. Table 5 presents Ecology and BFF analytical results. Only the total suspended solids results differed substantially. The reason for the discrepancy is unclear. The pesticide ronilin was detected by BFF's laboratory at a level below the Ecology laboratory detection limit. Appendix D presents the entire BFF data set.

The majority of BFF's analyses were conducted by Avocet Environmental Testing laboratory including TSS. Avocet was accredited on May 6, 1993. No laboratories have been accredited, by the Washington State Department of Ecology, to perform the ronilin analysis.

Priority Pollutant Inorganics - Metals Scans

Seven priority pollutant metals were present in the lagoon sample. These were arsenic, cadmium, chromium, copper, lead, nickel and zinc (Table 4). Although, a land treatment facility, with no documented surface water discharge, the copper and zinc concentrations in the lagoon sample exceeded the State of Washington Water Quality Criteria (Chapter 173-201A WAC) for acute freshwater exposures and the cadmium and lead exceeded the State of Washington Water Quality Criteria for chronic freshwater exposures when a hardness of 46 mg/L, as calculated with the BFF Ca and Mg data, is used. The cadmium concentration of the lagoon influent sample exceeded the EPA Water Quality Criterion for acute freshwater exposures. The land application of wastewater should continue to be controlled to prevent the inadvertent discharge into surface waters.

Target compounds and their respective detection limits are provided in Appendix B.

Table 4 – Pesticide and Metals Scan Results – Bellingham Frozen Foods – October 1993.

	Location:	BELLIN	BELLEFF	State/EPA Water Quality Criteria Summary	
	Type:	grab-comp	grab	Freshwater	Freshwater
	Date:	10/4	10/4		
	Time:	$	1110	acute	chronic
	Lab Log#:	418183	418188		
Metals**		ug/L	ug/L	ug/L	ug/L
Antimony		30 UN	30 UN	9000 *	1600 *
Arsenic		4.8 J	5.7 J		
Pentavalent				850 *	48 *
Trivalent				360	190
Cadmium		1.77	0.52 P	1.4 +	0.5 +
Chromium		11 P	6.6 P		
Hexvalent				16	11
Trivalent				119 +	110 +
Copper		51.4	28 P	7 +	5 +
Lead		3.4 P	2.2 P	21 +	0.8 +
Nickel		32 P	22 P	699 +	78 +
Zinc		226	146	54 +	49 +
Organophosphorus Pesticides					
Fenamiphos Sulfoxide		0.95 J	1.2 J		
Carbamate Pesticides					
Aldicarb Sulfoxide		9.9	69.5		
Aldicarb Sulfone		20.8	0.5 U		
Oxamyl (Vydate)		33.6	0.5 U		
Methomyl		0.5 U	13.2		
Aldicarb		6.35	5.45		

NOTE: SOME INDIVIDUAL COMPOUND CRITERIA OR LOELS MAY NOT AGREE WITH GROUP CRITERIA OR LOELS. REFER TO APPROPRIATE EPA DOCUMENT ON AMBIENT WATER QUALITY CRITERIA FOR FULL DISSCUSSION.

P The analyte was detected above the instrument detection limit but below the established minimum quantification limit.
U The analyte was not detected at or above the reported result.
UN The analyte was not detected at or above the estimated result.
J The analyte was positively identified. The associated numerical result is an estimate.
$ Sample was a composite of two grab samples of equal volumes.
* Insufficient data to develop criteria. Value presented is the LOEL – Lowest Observed Effect Level.
** Results are reported as total metals for Hg in the water samples. Results are reported as total recoverable metals for the remaining metals in the water samples.
+ Hardness dependent criteria (46 mg/L used).
☐ Exceeds acute or chronic criteria using wastewater hardness.

Table 5 – Split Sample Results Comparison – Bellingham Frozen Foods – October 1993.

		Location:	BELLEFF-3	LAGOON-3	BELLEFF
		Type:	grab	grab	grab
		Date:	10/4	10/4	10/4
		Time:	1105	1110	1110
		Lab Log #:	418186	5701177	418188
		Sampler:	Ecology	BFF	Ecology
PARAMETER	Analyzed by:				
TSS (mg/L)	Ecology		767 J		
	BFF			240	
BOD5 (mg/L)	Ecology		988		
	BFF			851	
NO2+NO3-N (mg/L)	Ecology		0.04 J		
	BFF				
Nitrates as N (mg/L)	Ecology				
	BFF			<0.1	
NH3-N (mg/L)	Ecology		0.2		
	BFF			0.1	
Total-P (mg/L)	Ecology		6.1		
	BFF			10.2	
Copper* (ug/L)	Ecology				28 P
	BFF			21	
Maneb (Ronilin) (ug/L)	Ecology				5 U
	BFF			0.14	
Zinc* (ug/L)	Ecology				146
	BFF			140	

* The results for BFF is total copper and zinc while the Ecology result is total recoverable copper and zinc.
P The analyte was detected above the instrument detection limit but below the minimum quantification limit.
J The analyte was positively identified. The associated numerical result is an estimate.
U The analyte was not detected at or above the reported result.

Priority Pollutant Organics - Pesticide Scans

A total of six pesticides or metabolites were detected at BFF (Table 4). Five were detected in lagoon influent and four were detected in the lagoon itself. Two were only detected in the influent and one only detected in the effluent. The highest concentration detected was aldicarb sulfoxide at 69.5 µg/L in the lagoon sample. The target analytes and their detection limits are provided in Appendix B.

All of the six pesticides or metabolites detected were either organophosphate or carbamate pesticides used as insecticides, nematocides and/or acaricides. None of the compounds detected require monitoring under the conditions of the BFF's State Water Discharge Permit. It is recommended that the permit be modified to include monitoring for organophosphate and carbamate compounds. Monthly scans during the entire processing season for other pesticide groups may be necessary to determine a complete target compound list.

Fenamiphos (parent compound for fenamiphos sulfoxide), aldicarb, aldicarb sulfone, oxamyl and methomyl are characterized by high oral toxicity, a low potential for bioaccumulation and a relatively short environmental persistence. Fenamiphos and aldicarb have the highest acute oral toxicity of the family of compounds detected in the wastewater. Fenamiphos has LD_{50}s of 0.5 and 1.6 mg/Kg for the ringneck pheasant and mallard duck, respectively (Smith, 1993). Aldicarb has LD_{50}s of 1.0 and 2.6 mg/Kg for the mallard and california quail, respectively. Methomyl had the lowest oral toxicity with LD_{50}s of 15.0 and 15.9 mg/Kg for the pheasant and mallard, respectively (USEPA, 1984 and Smith, 1993). These three species are likely to be encountered at the land application site. One study concluded the greatest environmental hazard of aldicarb to wildlife is the possibility of ingesting unincorporated granules (Smith, 1993). The ingestion of contaminated earthworms poses a secondary hazard.

With the limited toxicological data that are available, an environmental risk assessment via the ingestion pathway can be made for the wastewater. At the aldicarb concentration (5.45 µg/L) detected in the lagoon sample, a minimum dose of 110 and 250 liters of wastewater would be necessary to cause acute mortality in half the populations of the quail and mallards exposed, respectively.

No toxicological data were found for fenamiphos sulfoxide and aldicarb sulfoxide. If fenamiphos sulfoxide and aldicarb sulfoxide are assumed to have oral toxicities equal to that of their parent compounds fenamiphos and aldicarb, estimations of environmental risk can be made.

At the fenamiphos sulfoxide concentration (1.2 µg/L) detected in the lagoon sample, a minimum dose of approximately 560 liters of wastewater would be necessary to reach the pheasant LD_{50}. For aldicarb sulfoxide which was detected at the highest concentration (69.5 µg/L) in the lagoon sample, a dose of 19 liters of wastewater would be necessary to reach the mallard LD_{50}. The calculations assume a total body mass of 225 grams for quail and 1,350 grams for both mallards and pheasants. Individuals with a smaller body mass would exhibit similar toxic responses at lower doses.

Acute aquatic toxicological data were found for two fish species, the blue gill sunfish and the rainbow trout. LC_{50}s for the rainbow trout ranged from 560 µg/L for aldicarb to 4200 µg/L for aldicarb sulfone (Miester, 1991). LC_{50}s for the blue gill ranged from 50 µg/L for aldicarb to 5300 µg/L for aldicarb sulfone (Miester, 1991). The concentration of aldicarb detected in the lagoon sample was approximately 10% of the blue gill LC_{50}. No aquatic toxicity data were found for aldicarb sulfoxide. If aldicarb sulfoxide is assumed to have an aquatic toxicity equal to that of its parent compound, the concentration in the lagoon exceeds the LC_{50} for the bluegill. Both species are likely to be encountered in the Nooksack River adjacent to the facility. The land application of wastewater should be scheduled to prevent the inadvertent discharge of effluent into surface waters.

These discussions do not attempt to estimate the doses necessary to cause acute mortality in less than half a population nor do they consider sublethal effects. Synergistic effects of multiple chemical exposures were not considered and the chronic toxicity of these compounds have not been established.

Compound degradation varies from rapid to moderate so environmental persistence, once land applied, is thought to be short. Aldicarb rapidly oxidizes in the environment to aldicarb sulfoxide and aldicarb sulfone. The half life of aldicarb is seven days in soil (Verschueren, 1983). The half life of oxamyl in soil is 6-15 days and there is no biological activity for methomyl 16 weeks after application (Smith, 1993). Aldicarb sulfone is slightly more persistent, with a half life of 2-4 weeks (USEPA, 1986). The half-life of fenamiphos in soil varies from 3-6 months, with anaerobic soil conditions inhibiting its degradation (Smith, 1993). No information on the persistence of fenamiphos sulfoxide or aldicarb sulfoxide was found. The rate of degradation in the aerobic lagoon is unknown. It appears that fenamiphos had already oxidized to fenamiphos sulfoxide, while the break down of aldicarb was advancing. The land application of wastewater should continue to be scheduled to prevent the development of anaerobic soil conditions.

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APPENDICES

Appendix A – Ecology sampling schedule and Parameters Analyzed – Bellingham Frozen Foods – October 1993.

Parameter	Location:	BELLIN–1	BELLIN–4	BELLIN–3	BELLIN	BELLEFF–1	BELLEFF–2	BELLEFF–3	BELLEFF–4	BELLEFF	PUMP–1
	Type:	grab	grab	grab	grab–comp	grab	grab	grab	grab	grab	grab
	Date:	10/4/93	10/4/93	10/4/93	10/4/93	10/4/93	10/4/93	10/4/93	10/4/93	10/4/93	10/4/93
	Lab Log #:	418180	418181	418182	418183	418184	418185	418186	418187	418188	418189
GENERAL CHEMISTRY											
Conductivity		1	1	1		1	1	1	1		1
Alkalinity		1	1	1		1	1	1	1		1
Hardness		1	1	1	1	1	1	1	1	1	1
SOLIDS 4		1	1	1		1	1	1	1		1
BOD5		1	1	1		1	1	1	1		1
TOC (water)		1	1	1		1	1	1	1		1
NH3–N		1	1	1		1	1	1	1		1
NO2+NO3–N		1	1	1		1	1	1	1		1
Total–P		1	1	1		1	1	1	1		1
Oil and Grease (water)		1	1	1		1	1	1	1		
F–Coliform MF						1	1	1			
ORGANICS											
NPest (water)					1					1	
P–OP1618 (water)					1					1	
Carbamate (water)					1					1	
P–Cl1618 (water)					1					1	
Ronilin (water)					1					1	
METALS											
PP Metals (water)					1					1	
FIELD OBSERVATIONS											
Temperature		1	1	1		1	1	1	1		
pH		1	1	1		1	1	1	1		

NOTE: The permit specifies grab samples. Plant configuration and pumping cycles make composite sampling difficult.
grab–comp Equal volumes from each of three grab samples.
BELLIN Bellingham Frozen Foods lagoon influent.
BELLEFF Bellingham Frozen Foods lagoon wastewater.
PUMP–1 Blind duplicate of BELLEFF–4.

Appendix B – Pesticide and Metals Scan Results – Bellingham Frozen Foods – October 1993.

	Location:	BELLIN		BELLEFF		EPA Water Quality Criteria Summary			
	Type:	grab-comp		grab		Freshwater Acute		Freshwater Chronic	
	Date:	10/4		10/4					
	Lab Log#:	418183		418188					
Metals**		ug/L		ug/L					
Antimony		30	UN	30	UN	9000	*	1600	*
Arsenic		4.8	J	5.7	J				
	Pentavalent					850	*	48	*
	Trivalent					360		190	
Beryllium		1	U	1	U	130	*	5.3	*
Cadmium		1.77		0.52	P	4.5	+	1.2	+
Chromium		11	P	6.6	P				
	Hexvalent					16		11	
	Trivalent					1905	+	227	+
Copper		51.4		28	P	20	+	13	+
Lead		3.4	P	2.2	P	94	+	3.7	+
Mercury		0.05	U	0.05	U	2.4		0.012	
Nickel		32	P	22	P	1561	+	174	+
Selenium		2	U	2	U	260		35	
Silver		0.5	UN	0.5	UN	4.9	+	0.12	
Thallium		2.5	U	2.5	U	1400		40	
Zinc		226		146		129	+	117	+
Sulfur Pesticides									
Propargite		6.3	U	3.2	U				
Chlorinated Pesticides									
Alpha-BHC		1.8	U	0.91	U				
Beta-BHC		1.8	U	0.91	U				
Gamma-BHC (Lindane)		1.8	U	0.91	U				
Delta-BHC		1.8	U	0.91	U				
Heptachlor		1.8	U	0.91	U				
Aldrin		1.8	U	0.91	U				
Heptachlor Epoxide		1.8	U	0.91	U				
Trans-Chlordane (Gamma)		1.8	U	0.91	U				
Endosulfan I		1.8	U	0.91	U				
Dieldrin		1.8	U	0.91	U				
4,4'-DDE		1.8	U	0.91	U				
Endrin		1.8	U	0.91	U				
Endosulfan II		1.8	U	0.91	U				
4,4'-DDD		1.8	U	0.91	U				
Endrin Aldehyde		1.8	U	0.91	U				
Endosulfan Sulfate		1.8	U	0.91	U				
4,4'-DDT		1.8	U	0.91	U				
Endrin Ketone		1.8	U	0.91	U				
Methoxychlor		1.8	U	0.91	U				
Alpha-Chlordene		1.8	U	0.91	U				
Gamma-Chlordene		1.8	U	0.91	U				
Oxychlordane		1.8	U	0.91	U				
DDMU		1.8	U	0.91	U				
Cis-Chlordane (Alpha-Chlordane		1.8	U	0.91	U				
Cis-Nonachlor		1.8	U	0.91	U				
Kelthane		18	UJ	9.1	UJ				
Captan		14	U	6.9	U				
2,4'-DDE		1.8	U	0.91	U				
Trans-Nonachlor		1.8	U	0.91	U				
2,4'-DDD		1.8	U	0.91	U				
2,4'-DDT		1.8	U	0.91	U				

Appendix B (cont.) – Pesticide and Metals Scan Results – Bellingham Frozen Foods – October 1993.

	Location:	BELLIN		BELLEFF	
	Type:	grab-comp		grab	
	Date:	10/4		10/4	
	Lab Log#:	418183		418188	
Chlorinated Pesticides		ug/L		ug/L	
Captafol		23	U	11	U
Mirex		1.8	U	0.91	U
Toxaphene		36	U	18	U
Nitrogen Pesticides					
Dichlorbenil		3.6	U	1.8	U
Tebuthiuron		3	U	1.5	U
Propachlor (Ramrod)		6	U	3	U
Ethalfluralin (Sonalan)		4.5	U	2.3	U
Treflan (Trifluralin)		4.5	U	2.3	U
Simazine		3	U	1.5	U
Atrazine		3	U	1.5	U
Pronamide (Kerb)		9	U	4.6	U
Terbacil		15	U	7.6	U
Metribuzin		3	U	1.5	U
Alachlor		7.2	U	3.7	U
Prometryn		3	U	1.5	U
Bromacil		18	U	9.1	U
Metolachlor		9	U	4.6	U
Diphenamid		9	U	4.6	U
Pendimethalin		4.5	U	2.3	U
Napropamide		9	U	4.6	U
Oxyfluorfen		7.8	U	4	U
Norflurazon		4.5	U	2.3	U
Fluridone		24	U	12	U
Eptam		4.5	U	2.3	U
Butylate		4.5	U	2.3	U
Vernolate		4.5	U	2.3	U
Cycloate		4.5	U	2.3	U
Benefin		4.5	U	2.3	U
Prometon (Pramitol 5p)		3	U	1.5	U
Proazine		3	U	1.5	U
Chlorthalonil (Daconil)		7.2	U	3.7	U
Triallate		7.8	U	4	U
Ametryn		3	U	1.5	U
Terbutryn (Igran)		3	U	1.5	U
Hexazinone		4.5	U	2.3	U
Pebulate		7.2	U	3.7	U
Molinate		7.8	U	4	U
Chlorprpham		15	U	7.6	U
Atraton		9	U	4.6	U
Triadimefon		7.8	U	4	U
MGK264		21	U	11	U
Butachlor		11	U	5.3	U
Carboxin		33	U	17	U
Fenarimol		9	U	4.6	U
Di-allate (Avadex)		11	U	5.8	U
Profluralin		7.2	U	3.7	U
Metalaxyl		20	U	10	U
Cyanazine		4.5	U	2.3	U
Diuron		18	U	9.1	U

Appendix B (cont.) – Pesticide and Metals Scan Results – Bellingham Frozen Foods – October 1993.

Location:	BELLIN		BELLEFF	
Type:	grab-comp		grab	
Date:	10/4		10/4	
Lab Log#:	418183		418188	
Organophosphorus Pesticides	ug/L		ug/L	
Demeton-O	1.1	U	2.1	U
Sulfotepp	0.91	U	1.8	U
Demeton-S	1.1	U	2.1	U
Fonofos	0.91	U	1.8	U
Disulfoton (Di-Syston)	0.91	U	1.8	U
Methyl Chlorpyrifos	1.1	U	2.1	U
Fenitrothion	1.1	U	2.1	U
Malathion	1.2	U	2.4	U
Chlorpyrifos	1.1	U	2.1	U
Merphos (1 & 2)	2.4	U	4.8	U
Ethion	1.1	U	2.1	U
Carbophenothion	1.5	U	3	U
EPN	1.5	U	3	U
Ethyl Azinphos (Ethyl Guthion)	2.4	U	4.8	U
Ethoprop	1.2	U	2.4	U
Phorate	1.1	U	2.1	U
Dimethoate	1.2	U	2.4	U
Diazinon	1.2	U	2.4	U
Methyl Parathion	1.1	U	2.1	U
Ronnel	1.1	U	2.1	U
Fenthion	1.1	U	2.1	U
Parathion	1.2	U	2.4	U
Fensulfothion	1.5	U	3	U
Bolstar (Sulprofos)	1.1	U	2.1	U
Imidan	1.7	U	3.3	U
Azinphos (Guthion)	2.7	U	5.4	U
Coumaphos	1.8	U	3.6	U
Dichlorvos (DDVP)	1.2	U	2.4	U
Mevinphos	1.5	U	3	U
Dioxathion	2.6	U	5.1	U
Propetamphos	3	U	6	U
Methyl Paraoxon	2.7	U	5.4	U
Phosphamidan	3.7	UJ	7.2	UJ
Tetrachlorvinphos (Gardona)	3	U	6	U
Fenamiphos	2.3	U	4.5	U
Butifos (DEF)	2.1	U	4.2	U
Abate (Temephos)	14	U	27	U
Fenamiphos Sulfoxide	0.95	J	1.2	J
Pyrethrin Pesticides				
Resmethrin	6	U	3	U
Phenothrin	6	U	3	U
cis Permethrin	6	U	3	U
Fenvalerate (2 isomers)	12	U	6.1	U
Dithiocarbamate Pesticides				
Maneb	5	U	5	U
Carbamate Pesticides				
Aldicarb Sulfoxide	9.9		69.5	
Aldicarb Sulfone	20.8		0.5	U
Oxamyl (Vydate)	33.6		0.5	U

Appendix B (cont.) – Pesticide and Metals Scan Results – Bellingham Frozen Foods – October 1993.

	Location:	BELLIN		BELLEFF	
	Type:	grab–comp		grab	
	Date:	10/4		10/4	
	Lab Log#:	418183		418188	
Carbamate Pesticides		ug/L		ug/L	
Methomyl		0.5	U	13.2	
3–Hydroxycarbofuran		0.5	U	0.5	U
Aldicarb		6.35		5.45	
Baygon (Prppoxur)		0.5	U	0.5	U
Carbofuran		0.5	U	0.5	U
Carbaryl		0.5	U	0.5	U
1–Naphthol		5	U	5	U
Methiocarb		0.5	U	0.5	U

NOTE: SOME INDIVIDUAL COMPOUND CRITERIA OR LOELS MAY NOT AGREE WITH GROUP CRITERIA OR LOELS.
REFER TO APPROPRIATE EPA DOCUMENT ON AMBIENT WATER QUALITY CRITERIA FOR FULL DISSCUSSION.

P	The analyte was detected above the instrument detection limit but below the established minimum quantification limit.
U	The analyte was not detected at or above the reported result.
UN	The analyte was not detected at or above the estimated result.
J	The analyte was positively identified. The associated numerical result is an estimate.
*	Insufficient data to develop criteria. Value presented is the LOEL – Lowest Observed Effect Level.
**	Results are reported as total metals for Hg in the water samples. Results are reported as total recoverable metals for the remaining metals in the water samples.
+	Hardness dependent criteria (100 mg/L used).

Appendix C – Ecology Analytical Methods and Laboratories Used – Bellingham Frozen Foods – October 1993.

Parameter	Method	Laboratory
Conductivity	EPA, Revised 1983: 120.1	Manchester Laboratory
Alkalinity	EPA, Revised 1983: 310.1	Manchester Laboratory
TS	EPA, Revised 1983: 160.3	Manchester Laboratory
TNVS	EPA, Revised 1983: 160.2	Manchester Laboratory
TSS	EPA, Revised 1983: 160.2	Manchester Laboratory
TNVSS	EPA, Revised 1983: 160.4	Manchester Laboratory
TVS	EPA, Revised 1983: 160.4	Manchester Laboratory
BOD5	EPA, Revised 1983: 405.1	Manchester Laboratory
TOC	EPA, Revised 1983: 415.1	Manchester Laboratory
NH3-N	EPA, Revised 1983: 350.1	Sound Analytical Services, Inc.
NO2+NO3-N	EPA, Revised 1983: 353.2	Sound Analytical Services, Inc.
Phosphorus-Total	EPA, Revised 1983: 365.3	Sound Analytical Services, Inc.
Oil and Grease	EPA, Revised 1983: 413.1	Manchester Laboratory
F-Coliform MF	ALPHA, 1989:9222D	Manchester Laboratory
Dithiocarbamates	EPA, 1986: 630	North Coast Laboratories, Inc.
Sulfur Pesticides	EPA, 1986: 1618	Manchester Laboratory
Chlorinated Pesticides	EPA, 1986: 1618	Manchester Laboratory
Nitrogen Pesticides	EPA, 1986: 1618	Manchester Laboratory
Organ-Phosphate Pesticides	EPA, 1986: 1618	Manchester Laboratory
Pyrethrin Pesticides	EPA, 1986: 1618	Manchester Laboratory
Carbamate Pesticides	EPA, 1986: 531.1	Manchester Laboratory
PP Metals	EPA, Revised 1983: 200-299	Manchester Laboratory

Method Bibliography

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EPA, Revised 1983. Methods for Chemical Analysis of Water and Wastes, EPA-600/4-79-020 (Revised March, 1983).
EPA, 1986: SW846. Test Methods for Evaluating Solid Waste Physical/Chemical Methods, SW-846, 3rd. ed. November, 1986.

APPENDIX D

Avocet Environmental Testing
500 North State Street
Bellingham, WA 98225
(206) 734-9033

RECEIVED
NOV 10 1993
B. F. F.

AVOCET
ENVIRONMENTAL TESTING

NOTE: PLANT DISCHARGE FOR 10/4/93
1.32 MILLION GALLONS

Client	Bellingham Frozen Foods		
Project	Wastewater		
Chain of Custody	C1717	Log #	5701177
Contact Name	Dean Gilbert		
Date Received	10/5/93		
Date Reported	10/19/93		
Matrix	Water		
Sample Source	Lagoon		

Test Performed	EPA Method	Sample Result	Units	Reporting Limit	Date Analyzed	Analyst
BOD	405.1	851	mg/L	1	10/11/93	AB
Total Suspended Solids	160.2	240	mg/L	1	10/12/93	JE
Nitrates as N	353.2	<0.1	mg/L	0.1	10/6/93	SVT
Ammonia	350.1	0.10	mg/L	0.02	10/13/93	SVT
TKN	351.2	36.2	mg/L	0.1	10/12/93	SVT
Total Phosphorus	365.1	10.2	mg/L	0.02	10/12/93	SVT
Soluble Phosphorus	365.1	5.1	mg/L	0.02	10/12/93	SVT
Total Copper	220.2	0.021	mg/L	0.005	10/12/93	DK
Total Zinc	289.1	0.14	mg/L	0.05	10/12/93	DK
Total Sodium	273.1	51.0	mg/L	5.0	10/11/93	DK
Total Calcium	215.1	4.7	mg/L	5.0	10/14/93	DK
Total Magnesium	242.1	8.3	mg/L	1.0	10/14/93	DK

JoAnn Ernst
Applications Chemist

Howard Cockerham
Laboratory Director

Avocet Environmental Testing
1500 North State Street
Bellingham, WA 98225
(206) 734-9033

AVOCET ENVIRONMENTAL TESTING

Client	Bellingham Frozen Foods		
Project	Wastewater		
Chain of Custody	C1717	Log #	5701177
Contact Name	Dean Gilbert		
Date Received	10/5/93		
Date Reported	11/8/93		
Matrix	Water		
Sample Source	Lagoon		

Test Performed	EPA Method	Sample Result	Units	Reporting Limit	Date Extracted
Pesticides:					
Clomazone	525	<0.1	ug/L	0.1	10/13/93
Sample analyzed by Sound Analytical Services, Inc.					
MCPA (Rhumone)	515.1	<250	ug/L	250	10/12/93
Bentazone	515.1	<0.5	ug/L	0.5	10/12/93
Permethrin (Ponce 3.2EC)	8080	<0.05	ug/L	0.05	10/12/93
Vinclozolin (Ronalin)	8080	0.14	ug/L	0.05	10/12/93
Alachlor	8080	<0.05	ug/L	0.05	10/12/93
Methomyl (Lannate)	632	<1	ug/L	1	10/12/93
EPTC (Eradicane)	632	<4	ug/L	4	10/12/93
Metribuzin	619	<0.5	ug/L	0.5	10/12/93
Metolachlor	619	<0.5	ug/L	0.5	10/12/93
Atrazine	619	<0.5	ug/L	0.5	10/12/93
Vernolate (Surpass)	619	<0.5	ug/L	0.5	10/12/93
Trifluralin	8140	<0.5	ug/L	0.5	10/12/93
Mevinphos	8140	<0.5	ug/L	0.5	10/12/93
Malathion	8140	<0.5	ug/L	0.5	10/12/93
Methyl Parathion	8140	<0.5	ug/L	0.5	10/12/93
Samples run by APPL Laboratories					

APPENDIX E
Bellingham Frozen Foods
Permit Effluent Limitations and Monitoring Requirements

S1.a. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS FOR LAND TREATMENT

Upon the issuance date of this permit and lasting through the expiration date of this permit, the Permittee is authorized to discharge vegetable process wastewater to ground water via spray irrigation at the permit location subject to the following effluent limitations and monitoring requirements:

Land application of wastewater is prohibited between the dates of November 15 and April 15 of each year.

EFFLUENT LIMITATIONS MONITORING REQUIREMENTS

Plant Wastewater

Parameter	Daily Maximum	Daily Average	Minimum Frequency	Sample Type
Flow	7,900 m^3/d (2.1 mgd)	6,800 m^3/d (1.8 mgd)	Daily	meter reading at plant

The daily maximum is defined as the greatest allowable value for any calendar day.

The daily average is defined as the average of the measured values obtained over a calendar month.

Wastewater at aeration lagoon

Samples to be collected from irrigation wet well during irrigation season.

Parameter	Frequency	Sample Type
Flow Volume	weekly	Calculation
BOD	monthly	grab
NO_3+NO_2-N, NH_4-N, TKN	monthly	grab
Mg, Ca, Na	monthly	grab
Total Cu, Zn	monthly	grab
pH, Conductance	monthly	measurement
Pesticides : Atrazine, Lannate, Parathion Pounce, Ronilan	monthly	grab

Appendix F

Quality Assurance/Quality Control

All the samples were received by the Manchester Laboratory in good condition with chain-of-custody tracking maintained. All samples were analyzed within the USEPA Contract Laboratory Program (CLP) or method holding times for their respective analyses.

The stainless steel bucket used to collect samples for pesticide and metals analyses received careful priority pollutant cleaning appropriate for such collection. It was thoroughly washed with phosphorus free Liquinox soap, rinsed with tap water, rinsed with a 10% nitric acid solution, rinsed three times with deionized water, rinsed with methylene chloride and acetone respectively, then air dried and covered with aluminum foil.

A blind duplicate of the BELLEFF-4 grab sample (PUMP-1) was submitted to the Manchester Laboratory. A comparison of the results showed good correlation for most parameters and some differences in the solids parameters (Table 2). The relative percent differences for TNVSS and TSS were 50% and 18%, respectively.

The data generated by the analyses of these samples is considered reliable and can be used noting the qualifiers identified on the data Tables.

Appendix G - GLOSSARY

ABN	Acid base-neutral, semivolatile organics, see BNA
AED	Atomic Emission Detector
BNA	Base-neutral acids, semivolatiles, see ABN
BOD	Biological Oxygen Demand
CLP	Contract Laboratory Program
COD	Chemical Oxygen Demand
co-elutants	When two or more compounds have the same chromatographic retention time
CVAA	Cold Vapor Atomic Absorption
d-deuterium	An isotope of hydrogen
DL	Detection Limit
DOC	Dissolved Organic Carbon
DW	Dangerous Waste
ECD	Electron Capture Detector-Sensitive to halogen compounds - use: halogenated hydrocarbons
EHW	Extremely Hazardous Waste
ELD	Electrolytic Detector - Hall
EP TOX	Extraction Procedure Toxicity
Fatty Acid	Monobasic organic acids derived from hydrocarbons; include both saturated and unsaturated acids
FID	Flame Ionization Detector-Sensitive to carbon compounds, used in the determination of hydrocarbons
Flash Point	Minimum temperature that will enable combustion or explosions to take place
FTIR	Fourier Transform Infra-Red
GC	Gas Chromatography
GCMS	Gas Chromatography Mass Spectrometry, also GC/MS
HC	Hydrocarbon
HDPE	High Density Polyethylene
HH	Halogenated Hydrocarbon
HPLC	High Performance Liquid Chromatography
HSD	Halogen-Specific Detector - use: halogenated hydrocarbons
HW	Hazardous Waste
HWPAH	Hazardous Waste Polynuclear Aromatic Hydrocarbon
ICP	Inductively Coupled Plasma
ICP/MS	Inductively Coupled Plasma/Mass Spectrometry
IDL	Instrument Detection Limit
isomer	One of two or more substances which have the same elementary composition but differ in structure and hence in properties
isotope	One of two or more nuclides having the same atomic number, but differing in mass number

Isotopically labelled	The substitution of one or more isotopes for elements in a compound
kg	kilogram (1 X 10^3 grams)
L	Liter (1 X 10^3 milliliters)
LC_{50}	Lethal concentration to 50% of the test organisms
LD_{50}	Lethal dose to 50% of the test organisms
LOD	Limit of Detection
LOEC	Lowest Observable Effect Concentration
m^3	Cubic meter (1 X 10^3 liters)
MBAS	Methylene Blue Active substances
metalloids	Elements that exhibit transitional characteristics between metals and non-metals, examples include silver, selenium, antimony
MF	Membrane Filter
mg	milligram (1 X 10^{-3} grams)
mL	Milliliter (1 X 10^{-3} liters)
MPN	Most Probable Number
ng	Nanogram (1 X 10^{-9} grams)
nm	Nanometer (1 X 10^{-9} meters)
NOEC	No Observable Effect Concentration
NPDES	National Pollution Discharge Elimination System
NPOC	Non-Purgeable Organic Carbon
NTU	Nephelometric Turbidity Unit
OSHA	Occupation Safety and Health Administration
OSW	Office of Solid Waste
PCB	Polychlorinated Biphenyl
PE	Polyethylene
pg	Picogram (1 X 10^{-12} grams)
pH	Hydrogen Ion Concentration
PID	Photoionization Detector - use: aromatic hydrocarbons
PLM	Polarized Light Microscopy
POC	Purgeable Organic Carbon
Polyvalent	Capable of having more than one valance state
PP	Priority Pollutant
ppb	Parts per billion (1 X 10^{-9} ug/L or ug/kg)
ppm	Parts per million (1 X 10^{-6} ug/L or ug/kg)
ppt	Parts per thousand (1 X 10^{-3} ug/L or ug/kg)
PQL	Practical Quantitation Limit
PUF	Polyurethane Foam
SDWA	State Drinking Water Act
SOW	Statement of Work
SW	Solid Waste

TC	Target Compounds or Total Carbon
TCD	Thermal Conductivity Detector
TCL	Target Compound List
TCLP	Toxicity Characteristic Leaching Procedure
TDS	Total Dissolved Solids
TIC	Total Inorganic Carbon or for GCMS Tentatively Identified Compound
TNVS	Total Non-Volatile Solids
TNVSS	Total Non-Volatile Suspended Solids
TOC	Total Organic Carbon
TP	Total Phosphorous
TPH	Total Petroleum Hydrocarbons
TS	Total Solids
TSS	Total Suspended Solids
TVS	Total Volatile Solids
ug	Microgram (1×10^{-6} grams)
ug/m^3	Microgram per cubic meter
VOA	Volatile Organic Analysis
VOC	Volatile Organic Carbon
ZHE	Zero Headspace Extractor