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Department of Environmental Conservation

VERMONT GUIDELINES FOR LAND APPLICATION OF DAIRY PROCESSING WASTES


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BACKGROUND

A large part of Vermont's agricultural economy is based on the dairy industry, therefore it has been necessary to address the control of pollution from dairy processing waste. This concern resulted in the creation of the Vermont Whey Pollution Abatement Authority and the construction and operation of the Whey Processing Plant in Georgia, Vermont.

Dairy processing wastes, although traditionally treated as wastes in the past, have recently been considered as resources and research and development should continue towards recycling these wastes. The Guidelines have been developed for the land application of dairy processing waste to be disposed of in an environmentally sound manner at reasonable cost.

DISCUSSION

The proper application of dairy processing wastes to the land can be beneficial. Most of the solids are easily decomposed sugars which when properly applied to soil enhance soil aggregation (structure), tilth and water absorption capabilities. Increased infiltration coupled with increased stability of soil aggregation can reduce runoff and soil erosion. The nitrogen, phosphorus and potassium content in most dairy processing by-products should not be overlooked as a fertilizer amendment to the soil. However, excessive carbohydrates may result in a condition known as "clogging", which restricts water percolation and may result in anaerobic soil conditions, preventing infiltration of the dairy processing waste. This "clogging" is more likely to occur on cool, wet soils.

DISCUSSION (cont.)

Dairy processing wastes, prior to treatment, normally do not contain organisms pathogenic to human beings, or significant concentrations of toxic elements common to other solid or liquid waste materials such as sewage sludge or septic tank effluent. Thus, important soil considerations relate to nutrient movement to surface or ground waters.

Many soils have an excellent capacity to decompose organic wastes and filter out or attenuate waste constituents. Soils can act as vast sinks for a variety of nutrients such as phosphorus and potassium. In terms of nitrogen compounds, waste application should present no greater risk than fertilizer application (e.g. manures, commercial compounds) when timed for crop uptake and applied at rates according to crop nitrogen needs. Furthermore, proper land application of these wastes will enhance soil chemical and microbiological renovative processes involving various nitrogen species.

While it is recognized that proper disposal of dairy processing wastes to the land can be beneficial, improper handling can lead to severe pollution problems. Overloading of fields by land application can result in runoff to surface water which can lead to oxygen depletion and fish kills. Furthermore, the nutrient content of dairy processing wastes can accelerate eutrophication in many surface waters.

Improper disposal can also lead to pollution of groundwater and drinking water supplies. Overloading of the soil can exceed the soils renovative capability, increasing the potential for the waste constituents to migrate to the groundwater. Each daily application should be spread as uniformly as possible over the site. Overloading may also adversely affect crop yields since dairy processing waste is often high in soluble salts. Excessive sodium will migrate rapidly to groundwater and may cause soil potassium and magnesium removal. The Cation Exchange Capacity (CEC) of the soil would be a measure of the sodium absorbing power of the soil (SAR - sodium absorption ratio) and may be determined every several years to monitor the long-term application of salts. Application should be avoided on extremely salt sensitive crops such as soybeans, green beans, and red clover.

These guidelines have been adopted as a procedure and are designed to mitigate the potential for environmental pollution during the land disposal of dairy wastes. Compliance with these guidelines will be in compliance with the Indirect Discharge Rules, Section 14-C-1000(D), Non-Sewage Wastewater. In the instance of new or increased discharges the Department of Environmental Conservation may require an Indirect Discharge Permit, in addition to compliance with these guidelines for the land application of dairy processing wastes. The Department may allow exemption from full compliance with these guidelines for limited operations that do not require daily disposal. It should be emphasized that these are minimum standards and the Department may apply more stringent requirements if the Department, the consultant, or others find that the wastewater properties or site conditions warrant it.

The Department places the burden for safe and prudent land disposal of dairy waste on the manufacturer and the applicator. The Department will hold the involved parties responsible for pollution problems and any environmental harm which may result from the land application of wastes.

I. SITE EVALUATION

1. A site evaluation work sheet (see example, page 7) shall be completed for each field.
2. A location map and sketch of the field on a recommended scale of 1:5000, shall be attached to each worksheet showing suitable areas for application and the seasonal suitability of those areas. Areas of the fields that are not suitable for waste application shall be so designated on the sketch.
3. Each field shall be evaluated for 7 criteria; (1) soil type; (2) depth to water table or bedrock; (3) slope; (4) proximity to surface waters; (5) proximity to water supplies; (6) proximity to bedrock outcrops; and (7) proximity to habitation.
4. Soil identification should be carried out in the topographically lowest portion of the field to a depth of at least 3 feet. A minimum of one test pit or hand auger boring per two (2) acres will be carried out. Soil Conservation Service maps may be submitted instead of a soils site investigation with Department approval.
5. Slopes can be approximated with hand held clinometers or other instruments.
6. Utilizing the criteria outlined in Table 1, recommendations regarding the suitability of the fields for waste application shall be provided, including:
 - a. Application rate - Maximum application shall not exceed 1 inch/acre/year to any field (27,152 gallons), and shall be limited to no more than 0.25 inches/day in the summer (6,788 gallons), and 0.13 inches/day in the fall, winter and spring (3,530 gallons). The application rate must have a dilution ratio of 10:1 between the receiving stream at low monthly median flow and the effluent. If the dilution ratio criteria results in a lower application rate, this value will be the maximum rate of application. Crop damage may result if the application rate is not applied uniformly over the acre.
 - b. Seasonal suitability - an example of appropriate seasons for application are:

Summer: June 1 - September 15
Fall: September 16 - November 15
Winter: November 16 - March 15
Spring: March 16 - May 31

These dates may be changed due to the length of the growing season.

I. SITE EVALUATION (cont.)

7. Depth to groundwater shall be a minimum of 3 feet at the time of application.
8. Depth to bedrock shall be a minimum of 3 feet at all times.
9. Application will not be permitted on lands identified as Class I or Class II Groundwater Areas as classified by the Secretary or within Public Water Source Protection Areas unless approved by the Department of Health.
10. Application will not be permitted on fields receiving sewage sludge, septage, or non-agricultural wastewaters, unless approved by the proper regulating authorities involved, each recognizing that the other use is occurring.
11. A one time summer application to hayfields that do not meet the soil/site criteria in Table 1 will be allowed under the following conditions:
 1. The application shall take place within two weeks following the cutting of the first hay crop.
 2. The maximum application rate shall not exceed 0.25 inches/acre (6,788 gallons) and will be limited to 0.125 inches/day (3,394 gallons).
 3. The slope shall not exceed 20%.
 4. The field must meet all minimum isolation distances as outlined in Table 1.
 5. Application may not take place in swales or on saturated ground.
12. A maximum of ten per cent of the volume of a manure slurry pit may consist of dairy processing waste annually. This mixture of dairy processing waste and manure shall be spread according to Accepted Agricultural Practices as defined by the Vermont Department of Agriculture, and a site evaluation will not need to be completed. A written agreement will be required between the farmer or applicator and the dairy processing waste manufacturer, stating that the farmer or applicator accepts responsibility for the disposal of the waste from the manure slurry pit in accordance with Accepted Agricultural Practices.

Table 1
 LAND APPLICATION LIMITATIONS FOR DAIRY PROCESSING WASTES (Whey, Whey Sludge, Washwaters)

SOIL/SITE CRITERIA	SEASON			
	SUMMER 6/1 - 9/15	FALL 9/16 - 11/15	WINTER ^e 11/16 - 3/15	SPRING ^e 3/16 - 5/31
Suitable ^b Soil Texture	1, 2, 3, 4, 5, 6, 7	1, 2, 3, 4, 5, 6, 7	1, 2, 3, 4, 5	1, 2, 3, 4, 5
Depth ^c to water table ^c or bedrock (feet)	3	3	3	3
Maximum slope (%)	15	10	5	5
<u>MINIMUM ISOLATION DISTANCES^d</u> (feet)				
Surface Water	50	50	100	100
Water Supply Drilled wells and upgradient shallow wells and springs	100	100	100	100
Downgradient shallow wells and springs	300	300	300	300
Bedrock outcrops	50	50	50	50
Habitation	100	100	100	100
Property lines	f	f	f	f

a These dates are for example only and may be changed due to the length of the growing season

b see Table 2, adopted from the Indirect Discharge Rules, Section 14-C-107 at time of application

c the material may not be applied nor travel closer than the prescribed isolation distances noted above

d and application of whey or whey sludge is discouraged during winter and spring and should only be exercised on an emergency basis

f isolation distances from property lines will be dependent on use.

TABLE 2: DAIRY WASTE APPLICATION GUIDELINES
SOIL TEXTURE CLASSES

<u>Soil Class</u>	<u>Typical Depositional Environment</u>	<u>Soil^a Texture (Consistence)</u>
1.	Glaciofluvial or Alluvial	Coarse Sand
2.	Glaciofluvial or Alluvial	Medium Sand or Loamy Sand
3.		
a.	Alluvial	Fine Sand or Loamy Fine Sand
b.	Glacial Till	Sandy Loam (Loose; Very Friable)
4.	Glacial Till	Sandy Loam, Fine Sandy Loam, Loam, or Silt Loam (Friable)
5.		
a.	Glacial Till	Sandy Loam, Fine Sandy Loam, Loam, or Silt Loam (Firm)
b.	Lacustrine or Alluvial	Silt
6.	Lacustrine or Marine	Sandy Clay Loam; Silty Clay Loam; or Clay Loam
7.	Marine or Lacustrine	Sandy Clay; Silty Clay; or Clay

a. Per USDA - Soil Conservation Service Soil Textural Classes
Consistence is based on moist in-place conditions.

SITE EVALUATION WORK SHEET FOR
LAND APPLICATION OF DAIRY PROCESSING WASTES
(example)

SITE NUMBER: 1A
NAME OF COMPANY: Hill Cheese Company

FIELD SIZE: 6 ACRES
ACRES SUITABLE FOR
APPLICATION: 3.5 Year round
1.5 Sum/Fall only
CROP TYPE: Hay

PROPERTY OWNER: A. Smith
TOWN: Stettin

LOCATION DESCRIPTION: North of intersection of Route 101 and Eastman Road

SITE CHARACTERISTICS

SOIL TYPE (TEXTURE)	DEPTH TO SEASONAL HIGH WATER TABLE	DEPTH TO BEDROCK	APPROXIMATE SLOPE
TH-1 0-8" light brown loamy sand, v. friable	None to depth	None to depth	5-10% in northern third
8-15" dark yellowish brown loamy sand, v. friable			< 5% elsewhere
15-36" yellowish brown loamy fine sand, friable			
No mottling present			
TH-2 - TH-6 As above.			

PROXIMITY OF FIELD TO :

STREAMS/SURFACE WATER: Unamed trib. of Fox River on northern boundary

WATER SUPPLIES: Drilled well 300 feet upgradient

PWSPA (Public Water Source Protection Area): N/A

HABITATION: 200 feet

BEDROCK OUTCROPS: None present

SEASONAL SUITABILITY AND APPLICATION RATE:

Summer-fall application in northern third except for extreme northern edge. No application in extreme northern edge. A minimum setback of 50 feet must be maintained from the stream bank. Year-round application elsewhere.

Consulting Firm

Signature

Address

Date:

SITE MAP
(example - not to scale)
STREAM

NO APPLICATION

SUMMER & FALL
APPLICATION

300

310

SLOPE

320

330

200'

300'

ACCESS
ROAD

DAVID
RESIDENCE

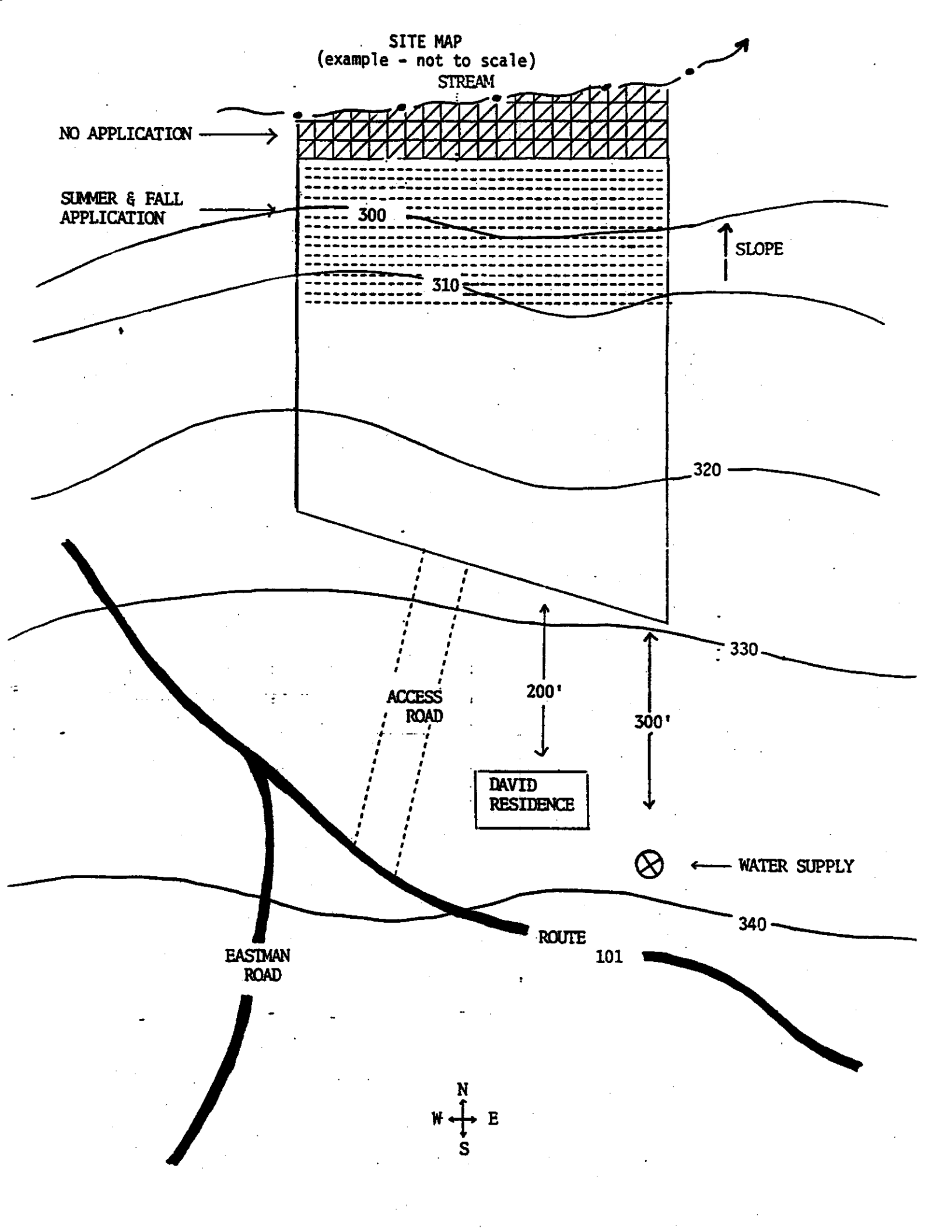
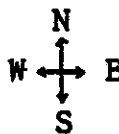
WATER SUPPLY

340

EASTMAN
ROAD

ROUTE
101

101



II. OPERATION

1. The manufacturer as well as the waste hauler/handler shall be responsible for the proper disposal of all land applied wastes.
2. The fields in the land disposal program shall be evaluated by a qualified soil scientist/agronomist and a qualified hydrogeologist. Only those fields or portions of fields determined by the consultant to be suitable for waste application and approved by the Department will be used.
3. Application rates and application season(s) designated in the consultant's report must be strictly observed. Each daily application shall be spread as uniformly as possible. Crop damage may result from overloading an area of the site.
4. To account for temporary inaccessibility or curtailment of permission to land apply on a field or parcel, adequate reserve area must be available for land application. Therefore, the consultant shall find sufficient area which meets these guidelines to accommodate, at a minimum in each season, 120% of the facilities' annual dairy processing waste flow. The reserve area should also reflect any seasonal limitations on fields, so that sufficient fields are available throughout the year.
5. The waste must always be spread as evenly as possible and never dumped or allowed to flow out of a stationary vehicle.
6. Ponding shall be prevented as a result of land application except for temporary condition following precipitation and snowmelt.
7. The vehicle used for land application shall be equipped with a distribution system such as a spreader bar or a spray nozzle, having the ability to disperse the wastewater over a width of 8 feet or greater.
8. The vehicle must be moving forward at all times during land application unless the vehicle is equipped with a high pressure spray nozzle which is used to evenly distribute the waste over the land.
9. Any overland flow or aerosol distribution of wastewater shall be confined to the boundary of the site established by the site evaluation.
10. Minimum isolation distances to surface water, water supply, bedrock outcrops, and habitation as outlined in table 1 shall be observed.
11. A detailed log of the fields utilized and volumes applied shall be maintained and spreading practices must be overseen by the manufacturer.

II. OPERATION (cont.)

12. To maximize the benefit to soil fertility and crop production when dairy wastes are land applied, nutrient application rates shall be calculated so as to allow supplementary nitrogen, phosphorus and potassium to be added and to provide a balanced fertilizer mix.
13. When dairy processing wastes are applied to cornfields, the UVM Extension Service's Nitrate Test shall be conducted annually to assess nitrogen needs. This test shall be conducted when the height of the corn is between 8 and 12 inches. Application of dairy wastes should be adjusted accordingly to correlate with the needs and requirements of the crop.
14. Consecutive annual applications at rates greater than 150 pounds of total nitrogen per year will require decreased application rates in subsequent years to allow for residual nitrogen mineralization.

III. MONITORING

These are recommended monitoring requirements which may vary depending on the characteristics of the site(s).

1. Record of the volume of whey/washwater land applied on each field on a daily basis.
2. List of each field with gallons per acre per season.
 - 1) Nitrogen loading per acre/per season for each field.
 - 2) Type of crop on each field.
3. List of cleansers, sanitizers and other products that may be present in the washwater and maximum concentrations expected in any truckload of whey/washwater. Include Material Safety Data Sheets if available.
4. Chemical analyses of dairy processing waste shall be conducted to determine concentrations of BOD₅, Total Suspended Solids, Chlorides, Total Kjeldahl Nitrogen, Ammonia-N, Nitrate+Nitrite-N, Total Phosphorus, Total Dissolved Phosphorus, Sodium and any additional constituents that may be present in concentrations which are potentially harmful to the environment or public health.
5. The Groundwater Protection Rule and Strategy, effective September 29, 1988, §12-503(3)(b)(iii), addresses the land application of dairy wastes for crop production and soil enhancement in Class III Groundwater Areas. This section includes the following:

"The application of ... dairy wastes for crop production and soil enhancement are presumed to pose acceptable levels of risk when: (a) the activity is permitted by the Secretary; (b) the adjacent groundwater quality is monitored for nitrate concentrations and other constituents as the Secretary may require in both upgradient and downgradient directions; and (c) there is no evidence of exceeding the groundwater quality enforcement standards listed at §12-702 and §12-703 beyond the property owned or controlled by the operator."

III. MONITORING (cont.)

The potential impact of land application of dairy wastes on groundwater quality must be monitored at representative fields. The consultant shall select fields that are representative of the range of soil/site conditions included in the land application program for the particular facility and crop type, and submit a proposal for the Department's review prior to initiating the monitoring program.

The monitoring program shall address the soil amendment/crop/soil/groundwater system as a whole and account for the fate of the particular constituents in dairy processing wastes that may have an adverse impact on the groundwater quality. The entire annual rate of dairy wastes shall be applied on the monitored fields. The application rate of any other soil amendments or fertilizers shall be recorded for these fields. It is recommended that four monitoring wells be installed in each field; two wells upgradient and two wells downgradient. The monitoring schedule, sample collection methods, and the constituents to be included in the chemical, physical, and biological analyses, will be determined on a case-by-case basis. Nutrient analysis and dry matter of the crop removed from monitored fields may be measured to estimate the crop uptake of nutrients.

IV. SITE EVALUATION FOR PROPOSED INCREASE IN LAND APPLICATION RATE

Any proposed increase in land application rate shall not exceed 150 pounds of total nitrogen per year, and must have a dilution ratio of 10:1 between the receiving stream at low monthly median flow and the effluent.

The following information shall be submitted to the Department:

1. Locations of all fields currently used, or proposed, for land application of whey/washwater, on USGS 7.5 minute topographic map or photo-enlargement of USGS 15 minute topographic map to a scale of 1:24,000.
2. Site suitability information for fields not yet submitted to the Department.
3. Summary of proposed change in land application with expected volumes on a month-by-month basis.
4. Technical basis for proposed changes in land application, addressing the following issues:
 - a) Potential for discharge to surface waters - including winter and spring application (snow melt, frozen soil and spring runoff).
 - b) Potential for impact on groundwater quality.
 - c) Agronomic nutrient requirements of crops.
 - 1) nutrients supplied by whey/washwater.
 - 2) nutrient potentially supplied by fertilizers and manures.
5. Consistency with intent of Vermont Guidelines For Land Application of Dairy Processing Wastes.
6. Demonstration that there is adequate area of suitable land available to dispose of projected waste flow.
7. List of fields where alternate land application is proposed.
 - a) Type of crop on each field (e.g. corn, alfalfa, pasture, etc.).
 - b) Width and description of buffer zone between areas suitable for land application, waters of the state, and water supplies.
 - c) Access limitations (e.g. road not maintained in winter, not accessible during mud season, etc.).
 - d) Acreage of suitable area in each field.
8. Proposal for monitoring potential impact of change in land application on ground water and surface water.