

M E M O R A N D U M  
DEPARTMENT OF ENVIRONMENTAL QUALITY  
DIVISION OF WATER  
OFFICE OF WATER RESOURCES MANAGEMENT

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SUBJECT: OWRM Program Guidance No. 95 -002  
VPA Land Application of Water Treatment Plant Residuals

TO: Regional Directors

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DATE: January 19, 1995

COPIES: James Adams, OWRM Permits Staff, Regional Permit  
Directors

This memo is to transmit a guidance document for reviewing VPA applications and writing VPA permits for the land application of Water Treatment Plant Residuals. The guidance was developed by a regional committee and OWRM. This document should become a part of the VPA Permits Manual.

GUIDANCE DOCUMENT FOR REVIEWING VPA APPLICATIONS  
LAND APPLICATION OF WATER TREATMENT PLANT RESIDUALS

Department of Environmental Quality  
Water Division

## INTRODUCTION

The purpose of this guidance document is to assist permit writers in the review of VPA permit applications for land application of water treatment plant sludges, hereinafter called residuals (concentrated solids, typically collected from sedimentation basins or backwash from filters). The sources of these residuals include solids from coagulation processes using aluminum salts (such as aluminum sulfate, often referred to as "alum") or iron salts, and lime-soda softening by chemical precipitation. The selection of treatment technologies often depends upon the sources and characteristics of the raw water. In Virginia, a majority of the water treatment plants employ the chemical coagulation process using alum. Land application of alum sludges have been viewed by the water treatment industry as a viable option for residuals management.

This review guidance document is applicable to VPA Permit Application Form C, Industrial Waste. Guidance is provided in the same order of context as presented in the application. This document should enhance guidance beyond the application instructions and that in the VPA Permit Manual. VPA Permit Application Form C should be completed for land application of WTP residuals even if the project activity is proposed to be incorporated under the authority of a VPDES permit.

A preliminary meeting between the applicant and the DEQ Water Division staff is recommended prior to completing the application in order to communicate specific application requirements for this industrial category. The preliminary meeting should help in obtaining a complete application and should reduce the frequency of incomplete applications and need for resubmittals.

Attachment A (A.1. - A.2.) provides some information on evaluating applications and permit development for land application of WTP residuals based upon available research and guidance. Attachment B contains the PAN Table from the current VPA Procedures Manual. Attachment C contains charts depicting USGS topographic map symbols. Attachment D contains practical information on soil testing and plant analyses.

PART C-I - GENERAL INFORMATION

**1. Facility Name**

Self explanatory

**2. Sources of Waste**

This section of the application is to identify sources of waste and to describe the facility operations. The required narrative and flow diagram under this item may also serve to meet the application requirements for item No.5 (waste treatment facilities).

- a. Narrative** - The applicant should provide a concise narrative of the water treatment facility operations, including waste handling procedures. This description should give the permit writer a good understanding of the facility operations.
- b. Flow Chart** - To compliment the operation's narrative, a line drawing or flow diagram of the facility operations should be submitted. This diagram should provide as much information as possible in an "easy to read" format. Information on this flow diagram should indicate the following:
1. The process stream (raw water to finished product)
  2. The raw materials (chemicals) that are used and where they enter the process and where they exit the process
  3. The volume of wastes generated and disposal methods
  4. Residuals treatment units (i.e.: lagoons, centrifuges, sludge filter presses, etc.)
- c. Sewage Handling**
- Self explanatory
- d. Operational Parameters**
- Applies to WTP operations, not land-application operations.

### **3. Non-Hazardous Declaration**

The non-hazardous declaration must be signed in accordance with the Permit Regulation in order for the application to be administratively complete. The certification statement does not need to be supported with analytical results such as TCLP testing (TCLP test results have shown that typical WTP residuals are not hazardous waste; however, full liability and responsibility lies with the applicant). However, the applicant may submit test results with the application, if available.

If any of the waste is hazardous, the application shall be returned and the applicant advised that VPA permits are not intended to permit land application of a hazardous waste.

### **4. Waste Characterization**

The recommended minimum waste characterization requirements are provided below for residuals generated by water treatment plants to correspond with application sections 4.a to 4.d. The permit applicant should be advised of the minimum waste characterization requirements in the initial meeting to insure that the application will be technically complete on the first submittal.

The permit writer may require analyses of additional parameters based on best professional judgement. Waiver of any of the recommended minimum testing requirements should be accompanied by technical justification in the fact sheet or statement of basis prepared in the draft permit development.

For proposed facilities, residuals characteristics from similar facilities with similar water supply characteristics should be provided. Waste characterization data used from other facilities should be referenced. Residuals volumes and percent solids should be projected based upon the proposed facility design and supporting information. Proposed facilities should include the submittal of the recommended complete waste characterization information listed below as a permit special condition.

**a. Wastewater:**

For land application of water treatment plant residuals, wastewater characterization is not required. Although, for such projects, wastewater analyses may not seem appropriate, flow and waste volume information is necessary for residuals treatment, storage, and land application. Such information is to be provided in item 5.

**b. Sludge:**

Provide at least one analysis for each of the parameters listed in this section of the application. Alkalinity testing (Standard Methods 2320, 18th Edition) is required unless the residuals exhibit a high lime content (i.e. >10% CaCO<sub>3</sub>), in which case CCE testing is necessary. If required, CCE should be reported in percent. In Virginia, unless lime is used in the water treatment process, the liming effects of these residuals is minimal, since alkalinity results are normally in single digit numbers (%). Also note that nitrate nitrogen should be reported as mg/kg in lieu of percent as specified in the application.

**c. Additional Sludge Analyses:**

The following list of parameters should be marked as believed present and at least one analysis provided for each:

Sodium  
Chloride  
Sulfate (as SO<sub>4</sub>)  
Total aluminum (If used as a coagulant aid)  
Iron (If used or treated for)  
Fluoride (If used in the water supply)  
Radioactivity (If treated for)  
Manganese (if treated for)

**d. Additional Parameters**

Self explanatory.

**5. Handling, Treatment and Disposal of Wastes**

This item of the application is to provide both narrative information and a flow chart on the specific treatment, storage, and handling of wastes including disposal. The information should clearly describe and illustrate the interrelation of all treatment units and storage facilities, and handling methodologies proposed. (This information may also be addressed in item No. 2 above.) This information should be reviewed in light of the conceptual design plans and specifications proposed for the facilities. The information should describe the operation of each unit and the system as a whole.

**6. Type of Storage Facilities**

The storage volume and type of storage facilities needs to be specified. This information is compared to the volume of waste residuals generated per day to determine if sufficient storage exists for the facilities based upon the land application design.

If wastewater settling basins are also used as residuals storage facilities, then the volume of the basins should be specified as well as the volume designed for residuals storage. The permit writer should ensure that the type of residuals (liquid or solid) is compatible with the equipment, methods of residuals handling, and storage facilities proposed.

**7. Approved Treatment & Storage Facilities**

For permit reissuance or no-discharge certificate conversions, it is likely that the treatment/storage facilities have been previously approved by the Department. In the case of previously approved facilities, the applicant should provide a list of the waste treatment/storage facilities and the dates of VSWCB/DEQ approval, if available.

**8. Facilities Expansion**

If the previously approved facilities have been expanded, then items No. 9, 10, and 11 must be completed.

## 9. Conceptual Design and Groundwater Protection

The conceptual design information requirements are for the waste treatment system (i.e., backwash lagoons, residuals storage facilities, etc.) and not the potable water treatment plant processes. The information requirements herein (including groundwater protection) should be provided for proposed facilities or where expansions to existing facilities have not received prior review and approval. The review of the conceptual design should be completed during the technical review of the application. The approval memo for permit issuance should reflect the approval of the conceptual design.

Groundwater protection should be demonstrated by the evaluation of the site geology, hydrology, and topography. For most WTPs a groundwater monitoring plan is not believed necessary; however, proper liner construction should be required for storage of all waste products. A minimum two foot separation is recommended from the bottom of the treatment or storage facility (liner) and the seasonal high water table.

For **previously approved facilities** the applicant should submit documentation that the storage facilities were constructed with an adequate liner or, alternatively, submit the results of groundwater monitoring or water balances to demonstrate that the facilities are not impacting groundwater. Liner documentation may include inspection reports, an engineer's statement, field permeability data, DEQ approval memoranda, etc.

For **existing facilities which need upgrading** the region may require the conceptual design up front as a part of the application, or may include a special condition in the permit to require the upgrade, including submittal of conceptual design, in a specified schedule. In these cases the regional office may provide an upgrade schedule (generally 2-3 years). Regulation requires that there be no more than one year between schedule items.

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**NOTE:** Unreported production expansions or construction of new wastewater treatment facilities are violations of the Permit Regulation and/or the facility's existing permit. Depending on the circumstances, the permit writer may refer these cases to the Compliance Auditor for enforcement action, especially if the existing permit may expire due to delays in receiving the necessary information.

**10. Flood Potential**

Documentation should be provided to support whether the wastewater or residuals storage structures are protected from inundation or damage by a 100-year frequency storm event. Sources for flood plain information include planning/zoning offices, soil surveys or FEMA maps.

Existing constructed facilities that are not adequately protected from the 100-year flood should be permitted with a site specific special condition requiring improvements.

For proposed facilities, requirements for the 100-year flood protection should be addressed in the conceptual plan prior to permit issuance.

**11. Storm Water Runoff**

Self explanatory

**12. Land Application Statement**

Self explanatory

## **Part C-II - LAND APPLICATION & WASTE HANDLING PROCEDURE**

This part of the application form provides detailed information on the land application sites, site management, and methods of land application. Information required for each land application site includes the following: topographic and site plan maps, soil maps and legends, a description of agronomic (cropping) practices on a field-by-field basis, soil borings for frequent waste application, soil testing, land area determination requirements, and a landowner authorization form, if required, to land apply the wastes. A description of land application methods and equipment is also required.

### **1. & 2. Topographic Maps & Site Plans**

Depending on the complexity of the site, items No. 1 and 2 (topographic map and site plan) may be combined into one map or plan; however, elevation contours and all USGS topographic features are necessary if both items are to be combined. All maps and site plans should be clearly legible and of sufficient scale to clearly show the site features specified in the application. A sufficient scale often means that a standard edition USGS topographic map (1:24,000 scale, 1 in = 2000 ft) should be enlarged as the standard scale is often not large enough to show site details on a field by field basis. A north arrow and map scale should appear on each map as well a title block identifying the owner of the fields or land application sites. A legend showing map symbols or color codes may be necessary if the map or plan does not use USGS mapping symbols. (See Attachment C for USGS map symbols.)

The applicant's submittal should consist of topographic maps/site plans which clearly delineate: the field boundaries, assigned field numbers, property lines, and identifies any landscape features requiring buffer zones such as surface waters, springs, monitoring wells, drinking water wells, rock outcrops, sink holes, steep slopes, occupied dwellings and roadways, etc.. (Refer to Part C-II Items 1 and 2 of the application for a complete listing).

Standard buffer zones do not need to be shown on the maps or site plan; it is sufficient to indicate the landscape features that require buffer zones by a mapping symbol or use of a color code. Buffer zone requirements should be determined during the site inspection. Net acreage should be calculated and submitted along with the revised site maps if updates are needed based on the site inspection. Subsequent determinations of land area requirements should be reviewed based on the net acreage for land application.

The following buffer zones are recommended for land application of WTP residuals to protect water quality and to reduce potential nuisance conditions:

Buffer Zones (ft)

1. Drinking water wells and springs	-	100
2. Occupied dwellings	-	100
3. Surface water courses (including dry ditches)	-	50
4. Limestone outcrops	-	50
5. Sinkholes (outer rim)	-	50
6. Rock outcrops	-	50
7. All improved roadways	-	25
8. Property lines	-	25

In cases where more than one buffer distance is involved, the most restrictive distance is the limiting constraint. Other buffer zones may be delineated where believed necessary on a case-by-case basis.

### 3. Agronomic Practices

The amount of information required under this item should be dependent upon whether the site is used for infrequent (1/5 yrs) application or frequent (yearly) application of WTP residuals. For each land application site, a description of agricultural practices should be provided in the application. At a minimum, selected crops, planting and harvesting schedules, and anticipated yields based on productivity class\* should be submitted for each land application site. Additional information concerning how the application of residuals will be scheduled relative to the planting date and growth periods of the crops is also appropriate under this item. The permit writer should compare the PAN table in the VPA Manual with the expected yield\*\* for the particular crop in reviewing the application.

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\* **NOTE** The SCS capability class identified in the SCS Soil Surveys is not the same as productivity class or group assigned by VPI & SU. The productivity class or group is based on VPI&SU's Virginia Agronomic Land Use Evaluation System (VALUES). VALUES has identified soil series throughout the Commonwealth in a data base and has classified each series into a soil management group.

\*\* **NOTE** The PAN requirements for each crop are determined on a field-by-field basis by establishing the expected yield for the particular crop based upon the aggregate soils series information in item No. 5 below. PAN requirements are listed in the "Estimated Yields and Recommended PAN..." table in the VPA Permit Manual. (This PAN table is provided as Attachment B under this guidance.)

**For infrequent (1/5 yrs) land application**, the coordination and timing of land application with planting, growing, and harvesting schedules may be addressed generically for all the application sites and does not need to be addressed for each site. This generic site management information should also be included in the Operations and Maintenance (O & M) manual. Changes to cropping plans at infrequent sites should not require revisions to the O & M manual. The annual report is believed sufficient to document and track loadings, crops grown, and site management for infrequent land application sites.

**For frequent (1/yr) land application** of WTP residuals, the project should be closely scrutinized due to the typical high aluminum loadings and potential impact on the availability of phosphorus and other soil chemistry. For frequent application of WTP residuals the RO may require the establishment of the organic nitrogen mineralization rate by mineralization studies. In addition, frequent application projects should require more intensive soil and crop monitoring and site management requirements in the permit. (See Attachment A for a further discussion.) Design and monitoring of frequent land application projects using WTP residuals should involve agronomic experts from private industry, the Virginia Cooperative Extension Agents, etc.. The coordination and timing of land application with planting, growing, and harvesting schedules needs to be addressed for each site in the application and in the O & M manual. Any changes to the cropping plan at a frequent application site should be documented by a revision to the O & M manual as needed.

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**NOTE:** Although EPA has provided no guidance or regulations on land-application of water treatment plant residuals, the staff feels that such residuals can be land-applied at loading rates up to 15 dry tons/acre on an infrequent (1/5 year) basis, in an agronomic setting. The staff feels that land-application of WTP residuals should be limited to an infrequent basis, if at all possible, until EPA or other current research is provided to document an acceptable cumulative loading level based on aluminum, etc.

**4. Land Application Methods & Equipment used - Residuals Handling**

The permit writer should make sure that the type of residuals (liquid or solid) is compatible with the proposed methods of residuals handling and equipment used.

**5. Soils Maps & Soils Information**

This information is important for all land application projects. The goal of this section of the application is twofold:

- a. To develop reliable information on soil productivity classes or groups and estimates of various crop yields based upon the on-site soils information. This information helps provide the basis for land area requirement calculations.
- b. To identify sites which may be unsuitable for land application due to high water tables, depth to bedrock, etc.

If the land application site is located in a County that has been mapped by the SCS, then the applicant should submit USDA-SCS Soil Survey maps and data to fulfill the requirements of this section. SCS Soil Surveys have maps, tables, and narrative descriptions of the various soil series and phases (type and surface texture) to provide the information required under this item.

Soil maps submitted need to show the land application sites (field boundaries and field Nos.) superimposed to document the soil types present on each field. Information regarding each soil type is best presented in a table. Each major soil type (mapping unit) identified in each field should be listed along with the corresponding soil characteristics, i.e. texture classification, slope class, estimated permeability, estimated infiltration rate, depth to bedrock, depth to seasonal water table, and the estimated soil productivity classification or group. Again, note that the soil productivity class or group is not the same as the capability class from SCS identified in the Soil Surveys (see note to item 3). Because more than one soil type and, therefore, more than one soil productivity class or group may exist within a given field, the soil productivity class or group of the field (required for no. 3 above) is to be derived using the weighted average of all soil productivity groups or classes within the field.

The applicant may submit a corrected SCS map or redefine the soil characteristics for the land application site if it is determined that the soil survey did not properly map a particular field location. Preferably, this work should be conducted by a technically qualified person such as a soil scientist.

Where counties have not been mapped by SCS, the applicant will be required to conduct a soil characterization for each land application site to fulfill the application requirements. Soil maps will need to be submitted based upon the soil characterization. Again, although not required, a technically qualified person(s) such as a soil scientist should undertake this work. Assistance may also be obtained from the local USDA-SCS office or Virginia Cooperative Extension Office for both the applicant and the permit writer in evaluating proposed land application sites.

#### **6. Soil Borings For Frequent Appliers**

Site specific soil borings and information requirements are intended to verify the soil survey information provided under Item No. 5 above. Verification of soils is believed necessary for sites receiving frequent (1/year) land application of wastes. However, waiver of soil boring requirements will be left up to the Regional Office based on their confidence in the information given for item No. 5.

Infrequent land application sites do not require soil borings in counties with SCS survey mapping. Where counties have not been mapped by SCS, soil boring may be required to provide the information for item No. 5.

#### **7. Soil Analysis**

The applicant may request a soil testing waiver for any listed parameter in the application form. Approval of soil testing waivers may be handled regionally.

The following minimum soil tests are recommended for water treatment plant residuals:

- a. Infrequent (1/5 yr) land application of residuals:
  - Soil pH (std. units)
  - Cation Exchange Capacity (meq/100 g)
  - Available Phosphorus (mg/kg)
  - Exchangeable Potassium (mg/kg)
  - Total Aluminum (mg/kg) (if Al is used)
  - Exchangeable Aluminum (mg/kg) (if Al is used)

b. Frequent (1/yr) land application of residuals:

- All parameters listed on page C-II-6 of the application
- Total Aluminum (mg/kg) (if Al is used)
- Exchangeable Aluminum (mg/kg) (if Al is used)

The soil samples should be representative of the site and should be collected to depths of 0-6 inches. A representative sample typically consists of a composite of 15 to 20 randomly collected samples from tract sizes of 5-10 acres. Larger tract sizes can be justified if soils are uniform. A copy of instructions on soil sampling and testing from "A Handbook of Agronomy" from VPI & SU has been provided as Attachment D in this guidance document. The above handbook is available from VPI&SU or the county extension agent's office. (It should be noted that private labs are also available for analyses of soil samples besides VPI & SU.) The permittee's O & M manual should include soil sampling procedures.

**8. Land Area Determination**

- a. Land area requirements are to be provided along with the supporting calculations for all of the parameters listed in order to document that the design loadings will protect state waters and land resources, and are in accordance with criteria for land application.

In addition to the metals listed in no. 8.a.7. of the application, cumulative loading calculations should be provided for aluminum based on the project design.

- b. The applicant may request a waiver for this item because this information is not appropriate for land application of WTP residuals. Also, the majority of this information has already been provided in the Concept Engineering Report referred to in items 5 - 11 in Part C.I.

**9. Hydraulic Loading Rate Of The Soils**

The applicant may request a waiver for this item also. Hydraulic limits will be addressed by a permit special condition for application of liquid sludge (14,000 gal/ac/applic., 28,000 gal/ac/day, & 56,000 gal/ac/week, or by more limited rates if the soil infiltration rates are determined to be very low).

**10. Site Ownership**

Self explanatory

**11. Land Owner Authorization**

Self explanatory

**ATTACHMENT A**

**LAND LIMITING CRITERION:**

- A.1. LIMITING LAND APPLICATION BASED ON NITROGEN (PAN) LOADING**
- A.2. ASSESSMENT OF CALCIUM CARBONATE EQUIVALENCE (CCE) LOADING AND ALUMINUM LOADING**

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**NOTE: THE LAND LIMITING CRITERIA SHOWN ARE NOT INCLUSIVE OF ALL LAND LIMITING CONSTITUENTS. THE PERMIT WRITER MAY WISH TO CONDUCT SIMILAR CALCULATIONS FOR OTHER PARAMETERS (i.e. - METALS) THAT MAY BE OF CONCERN.**

**ATTACHMENT A.1.**

**LIMITING LAND APPLICATION BASED UPON NITROGEN**

Often land application of wastes is limited by the nitrogen content of the waste and the nitrogen requirements of the crops. Limiting land application based upon nitrogen requirements of the crops limits the potential for formation of  $\text{NO}_3^-$  at levels that could potentially cause contamination of groundwater.

However, WTP residuals benefits as a fertilizer substitute have been considered limited due to the low nutrient value of the residuals relative to other wastes such as municipal sludge and food industry wastes. The potential benefits of WTP residuals to the soil have been considered limited. Nevertheless, land application design requires the assessment of the nutrient contribution of wastes prior to permit issuance for land application. Total loading of wastes plus other sources of nutrients are not permitted above the nutrient requirements of the crops grown.

Both the form and concentration of nitrogen and method of application affect the fertilizer value of the sludge for land application. The plant available nitrogen (PAN) content in sludge is determined from the total of organic N,  $\text{NH}_4^+\text{-N}$ , and the  $\text{NO}_2/\text{NO}_3\text{-N}$  analyses. It is assumed that both  $\text{NH}_4^+\text{-N}$  and  $\text{NO}_3^-$  are available for plant uptake during the cropping season of sludge application. This assumption is consistent with current practices of applying commercial fertilizers. WTP residuals have relatively high organic N fractions. Mineralization of the organic N provides a slow release of plant available N during the growing season and in future years.

The percent of organic N mineralized is generally related to the sludge characteristics resulting from a particular source and treatment process. In general, the greater the degree of sludge processing (treatment or stabilization) within a treatment plant, the lower the amounts of mineralization that can be expected.

Mineralization rates used for various treatment processes for municipal wastewater sludge are provided in the draft Biosolids Use Regulations. A typical mineralization rate for an anaerobically digested municipal wastewater sludge is 0.2 (20%); a typical mineralization rate for a municipal wastewater sludge compost is 0.1 (10%). The mineralization rates for typical WTP residuals have not been established to date. Therefore, the staff recommends utilizing mineralization rates in the 0.1 to 0.2 range, unless a residuals specific mineralization study is performed. Where frequent land application projects are proposed, the staff recommends the applicant establish the organic nitrogen mineralization rate of their residuals by mineralization studies so to more accurately design the nitrogen loading to meet crop requirements and to protect State waters. Such a study may be required in the permit by a special condition.

As in municipal sludges, the mineralization of the organic fraction for the first three years after application should be considered in the frequent land application design. The general rule of thumb is that the second year will provide half of the organic nitrogen provided in the first year and the third year will provide half of that provided in the second year from the time of sludge application. Nitrogen mineralization stabilizes at about three percent of the remaining organic N after the fourth and fifth year of application. Three percent mineralization rate is the often observed mineralization rate of stable organic N fractions in soil.

The amount of PAN from a sludge is also dependent on the application method used. Research of municipal sludge has shown that approximately 50 percent of the  $\text{NH}_4^+$  is lost to the atmosphere through volatilization of  $\text{NH}_3$  when liquid sludges are applied to the soil surface and allowed to dry before being incorporated.

For sludges, the PAN content should be calculated using the procedure as in the example on the following page. (Note that the mineralization factor varies with the degree of sludge stabilization.) Nutrient content of sludge is usually expressed either as percent of dry weight or as mg/kg (ppm). Most loading calculations, however, use the equivalent concentration in lbs/dry ton of sludge. To convert percent to lbs/ton, multiply by 20. To convert mg/kg to lbs/ton, multiply by 0.002.

The concentrations of organic nitrogen,  $\text{NH}_4^+$ , and  $\text{NO}_3^-$  in sludge are affected by the type of sludge, treatment received, and handling processes used. Most of the organic N in sludges is associated with the sludge solids; therefore, organic N levels are not appreciably altered by sludge dewatering or drying procedures. In contrast, the inorganic forms of N ( $\text{NH}_4^+$ , and  $\text{NO}_3^-$ ) are water soluble, and their concentrations will decrease dramatically during dewatering steps. (e.g., drying beds, centrifuges, presses, etc.) Either heat or air drying will reduce the  $\text{NH}_4^+$  because of ammonia volatilization, but not the  $\text{NO}_3^-$  level. Since the inorganic N content of sludges can be significantly influenced by sludge handling procedures, the nitrogen analysis should be conducted on the actual residuals being considered for land application.

**EXAMPLE PLANT AVAILABLE NITROGEN CALCULATIONS**

**Formula:**

$$\text{PAN (lbs/dt)} = [f_1(\text{ppm organic N}) + V_1 (\text{ppm NH}_3\text{-N}) + \text{ppm NO}_3\text{-N}] \times 0.002$$

**Terms:**

PAN = Plant Available Nitrogen

dt = Dry tons of sludge

$f_1$  = Mineralization rate of organic nitrogen

$V_1$  = Non-volatile fraction of  $\text{NH}_3\text{-N}$

= 1.0 for injection

= 0.85 for surface application with incorporation in < 24 hours

= 0.70 for surface application with incorporation in 1-7 days

= 0.50 for surface application with incorporation after 7 days

Organic N = TKN -  $\text{NH}_3\text{-N}$

**Example Calculation For A WTP Sludge**

Assume: TKN = 10,900;  $\text{NH}_3\text{-N}$  = 1,210;  $\text{NO}_3\text{-N}$  = 0

Mineralization rate = 0.1 (10%)

1. Injection

$$\text{PAN (lbs/dt)} = [0.1(9,690) + 1,210] \times 0.002 = 4.35$$

2. Surface Application with incorporation in < 24 hours

$$\text{PAN (lbs/dt)} = [0.1(9,690) + 0.85(1,210)] \times 0.002 = 3.99$$

3. Surface Application with incorporation in  $\geq$  24 hrs to 7 days

$$\text{PAN (lbs/dt)} = [0.1(9,690) + 0.70(1,210)] \times 0.002 = 3.63$$

4. Surface Application with incorporation after 7 days

$$\text{PAN (lbs/dt)} = [0.1(9,690) + 0.50(1,210)] \times 0.002 = 3.14$$

**ATTACHMENT A.2.**

**ASSESSMENT OF CALCIUM CARBONATE EQUIVALENCE (CCE) LOADING  
AND ALUMINUM LOADING**

The staff recommends WTP residuals should generally be limited to a maximum 15 dry tons/acre on an infrequent (1/5 yr) basis until EPA and/or further research is provided to document an alternative acceptable loading level based upon Aluminum, etc. EPA has not provided any guidance or regulations on land application of WTP sludges or cumulative loading for Al. Aluminum loading was not addressed in EPA's 503 regulations either.

Maintenance of a soil pH of 6.0 to 6.5 is recommended to prevent an increase in soluble aluminum levels in the soil and resulting aluminum toxicity to plants. For most soils, the availability of most plant nutrients is at a maximum between 6.0 to 7.0.

For lime treated coagulation facilities loading of WTP residuals may be limited by the Calcium Carbonate Equivalency (CCE) (liming properties) and the affect on the soil pH. When the waste characterization indicates residuals with a high lime content, the land application design needs to assess the effect of CCE loading on the pH of the soils; loadings should be established for proper soils pH management and compared to the final sludge loading design. Similar to land application of municipal sludge, the soil pH should not be elevated beyond certain maximum levels to prevent micronutrient deficiencies which can result from elevated pH levels. Micronutrient deficiency problems are more common on coastal plain soils. Lower coastal plain soils should have an upper pH limit of 6.5 while middle and upper coastal plain soils should have an upper pH limit of 6.8.

High aluminum levels in the soil can adversely affect the available phosphorus levels in the soil. Supplemental P may be required to offset the reduced availability to crops resulting from land application of WTP residuals. Soil monitoring for available P is recommended for several years after the application of WTP residuals to address this concern. (Soil monitoring for exchangeable potassium is also recommended whenever the soil is monitored for available P.)

In evaluating land application of WTP residuals, the permit writer should provide an assessment of the total aluminum levels or mass (lbs/acre) in the soils that are to receive the WTP residuals. The assessment of the Al levels in the soil should be from sampling to the proposed depth of incorporation of the residuals or to a minimum of six inches. (If injection is proposed to a 12-inch depth, then sampling should be to the 12-inch depth.)

Based upon the design of the project, one will be able to determine the total loading of aluminum to a typical soil of the application sites. The fact sheet should show the percent increase in the aluminum levels of the typical soils based upon the projected loading in the project design. An example of the calculations to make this assessment follows.

### EXAMPLE ALUMINUM LOADING CALCULATIONS FROM WTP RESIDUALS

The below calculations provide demonstration of the preapplication Al levels in soils and the percent increase in Al from the application of 15 dry tons/yr of WTP residuals. This information is beneficial to track the baseline conditions and subsequent changes to site soils from land application.

**Assume:**

WTP Residuals Al level	-	78,500 mg/kg dry wt.
Soil bulk density (clay)	-	1.31 gms/cc soil
Density of soil 6 in. x 1 acre	-	1.7857 x 10 <sup>6</sup> lbs/ac/6 in
Two Soils Al background concentration	-	6,760 mg/kg dry wt to
	-	31,800 mg/kg dry wt
WTP loading limit	-	15 dry tons/acre

**Mass of Al/acre in the top 6 inches of soil:**

$$\frac{6,760 \text{ parts Al}}{10^6 \text{ lbs}} \times 1.7857 \times 10^6 \text{ lbs/acre/6 in} = 12,071 \text{ lb/acre}$$

$$\frac{31,800 \text{ parts Al}}{10^6 \text{ lbs}} \times 1.7857 \times 10^6 \text{ lbs/acre/6 in} = 56,785 \text{ lb/acre}$$

**Mass loading of Al/acre per 15 dry ton loading:**

$$\frac{15 \text{ dry tons}}{\text{ton}} \times \frac{2,000 \text{ lbs}}{\text{ton}} \times \frac{78,500 \text{ Al}}{10^6 \text{ soil}} = 2,355 \text{ lb/acre}$$

**Percent Increase in Aluminum In Top 6 inches of Soil:**

20 % for the soil with the lowest Al levels

4% for the soil with the highest Al levels

---

**Notes:**

If one assumes the clay is the same concentration between 6 to 12 inches as above, then the percent increase in the soil aluminum would be 2 and 10 percent for the two soils respectively. Often, the clay content of a soil will be greater in the B horizon, than the A horizon of the soil profile.

EPA has provided a recommended maximum lifetime limit of Al loading to soils of 4,113 lbs/acre without further investigation. This value is based upon the tolerances of sensitive crops, mostly fruits and vegetables, grown on soils with low capacities for retaining elements in unavailable forms. (EPA Process Design Manual - Land Treatment of Municipal Wastewater (EPA 625/1-81-013), Table 4-5 , pg. 4-9) Other than the above, EPA has not provided any guidance on limiting Al loading to soils.

**ATTACHMENT B**

**ESTIMATED YIELDS AND PLANT AVAILABLE NITROGEN (PAN) TABLE  
FROM VPA PERMIT MANUAL**

ATTACHMENT B

Estimated Yields and Recommended Plant Available Nitrogen (PAN)  
 Rates for Various Non-irrigated Crops Used in Sludge Management Systems

Productivity Class

Crop	1		2		3		4	
	Yield	PAN lbs/A	Yield	PAN lbs/A	Yield	PAN lbs/A	Yield	PAN lbs/A
Corn-Grain	160 bu/A	180	140 bu/A	160	110 bu/A	130	80 bu/A	100
Silage	24 T/A		20 T/A		15 T/A		11 T/A	
Grain sorghum	60 cwt/A	150	50 cwt/A	125	35 cwt/A	100	30 cwt/A	75
Wheat	70 bu/A	100	70 bu/A	100	70 bu/A	100	50 bu/A	75
Barley	90 bu/A	100	90 bu/A	100	90 bu/A	100	70 bu/A	80
Rye	50 bu/A	70	50 bu/A	70	50 bu/A	70	40 bu/A	50
Oats	80 bu/A	80	80 bu/A	80	80 bu/A	80	60 bu/A	60
Fescue or Orchardgrass Pasture**	*	150	*	150	*	130	*	110
Bermudagrass Pasture	*	200	*	200	*	200	--	--
Unimproved Pasture**	*	100	*	100	*	80	*	60
Fescue or Orchardgrass Hay**	4 T/A	200	4 T/A	200	3 T/A	150	2.5 T/A	125
Bermudagrass Hay**	6 T/A	350	6 T/A	350	6 T/A	350	--	--
Alfalfa***	5 T/A	300	5 T/A	300	3.5 T/A	210	2.5 T/A	150
Soybeans								
Full Season	55 bu/A	275	45 bu/A	225	35 bu/A	175	25 bu/A	125
Double Crop	40 bu/A	200	35 bu/A	175	25 bu/A	125	20 bu/A	100

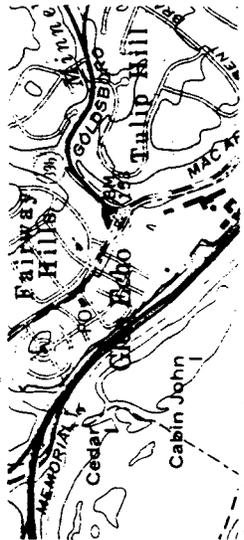
- \* No yield estimates given for pastures, PAN rates are for optimum grass production to support given number of animal units.
- \*\* If legumes, such as clover or alfalfa, are present, they may be replaced by grasses at this nitrogen application rate.
- \*\*\* At high nitrogen rates, the life of the stand may be shortened and encroachment by grasses may occur. Regardless of productivity class, alfalfa is not well suited to wet soils, even with artificial drainage.
- Indicates this crop not usually grown on soils in this productivity class.

**ATTACHMENT C**  
**TOPOGRAPHIC MAP SYMBOLS**  
**USGS**

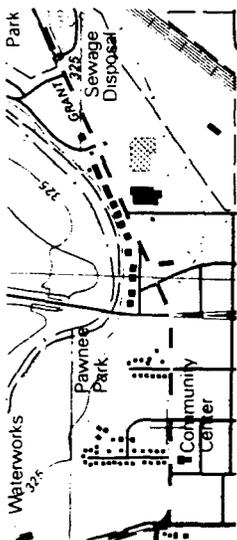


# Topographic Map Symbols

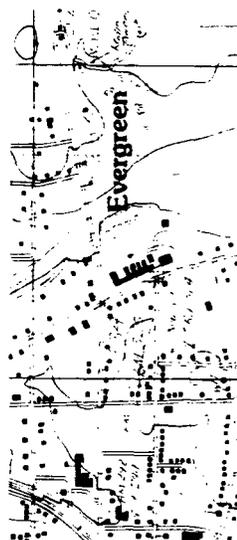
## National Large Scale Series



Standard edition maps



New or replacement standard edition maps



Provisional edition maps

Department of the Interior  
U.S. Geological Survey  
National Mapping Division

Provisional edition maps  
New or replacement standard edition maps  
Standard edition maps

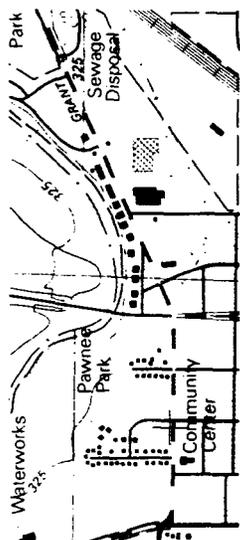
<b>CONTROL DATA AND MONUMENTS</b>	Not Shown	Not Shown	3 - 20
Aerial photograph roll and frame number	Neace	Neace	Neace
Horizontal control:			
Third order or better, permanent mark	BM 148	BM 148	Neace
With third order or better elevation	△ 64	△ 64	△ 45.1
Checked spot elevation	△	△	△ 19.5
Coincident with section corner	Cactus	Cactus	Not Shown
Unmonumented	Not Shown	Not Shown	Cactus
<b>Vertical control:</b>			
Third order or better, with tablet	BM 53	BM 53	BM X 53.4
Third order or better, recoverable mark	X 394	X 394	X 313.6
Bench mark at found section corner	BM 61	BM 61	BM 60.9
Spot elevation	x 17	x 17	x 17
<b>Boundary monument:</b>			
With tablet	BM 71	BM 71	BM 71
Without tablet	□ 562	□ 562	□ 562
With number and elevation	67 □ 988	67 □ 988	67 □ 988
U.S. mineral or location monument	▲	▲	USMA
<b>BOUNDARIES</b>			
National			
State or territorial			
County or equivalent			
Civil township or equivalent			
Incorporated-city or equivalent			
Park, reservation, or monument			
Small park			
<b>LAND SURVEY SYSTEMS</b>			
U.S. Public Land Survey System:			
Township or range line			
Location doubtful			
Section line			
Location doubtful			
Found section corner; found closing corner			
Witness corner; meander corner			
<b>Other land surveys:</b>			
Township or range line			
Section line			
Land grant or mining claim; monument			
Fence line			
<b>ROADS AND RELATED FEATURES</b>			
Primary highway			
Secondary highway			
Light duty road			
Unimproved road			
Trail			
Dual highway			
Dual highway with median strip			
Road under construction			
Underpass; overpass			
Bridge			
Drawbridge			
Tunnel			
<b>BUILDINGS AND RELATED FEATURES</b>			
Dwelling or place of employment: small; large			
School; church			
Barn, warehouse, etc.: small; large			
House omission tint			
Recetrack			
Airport			
Landing strip			
Well (other than water); windmill			
Water tank: small; large			
Other tank: small; large			
Covered reservoir			
Gaging station			
Landmark object			
Campground; picnic area			
Cemetery: small; large			

# Topographic Map Symbols

National Large Scale Series



Standard edition maps



New or replacement standard edition maps



Provisional edition maps

Provisional edition maps

New or replacement standard edition maps

Standard edition maps

**CONTROL DATA AND MONUMENTS**

Aerial photograph roll and frame number

Horizontal control:

Third order or better, permanent mark

With third order or better elevation

Checked spot elevation

Coincident with section corner

Unmonumented

Vertical control:

Third order or better, with tablet

Third order or better, recoverable mark

Bench mark at found section corner

Spot elevation

Boundary monument:

With tablet

Without tablet

With number and elevation

U.S. mineral or location monument

Not Shown

Neace

BM

148

64

Cactus

Not Shown

BM

53

394

BM

61

17

BM

71

562

67

988

3-20

Neace

BM

45.1

45.1

19.5

Not Shown

Cactus

+

BM

53.4

33.6

BM

60.9

17

BM

71

562

67

1928

USMA

Other land surveys:

Township or range line

Section line

Land grant or mining claim; monument

Fence line

**ROADS AND RELATED FEATURES**

Primary highway

Secondary highway

Light duty road

Unimproved road

Trail

Dual highway

Dual highway with median strip

Road under construction

Underpass; overpass

Bridge

Drawbridge

Tunnel

**BUILDINGS AND RELATED FEATURES**

Dwelling or place of employment: small; large

School; church

Barn, warehouse, etc.: small; large

House omission tint

Recreational

Airport

Landing strip

Well (other than water); windmill

Water tank: small; large

Other tank: small; large

Covered reservoir

Gaging station

Landmark object

Campground; picnic area

Cemetery: small; large

Provisional edition maps  
New or replacement standard edition maps  
Standard edition maps

**ROADS AND RELATED FEATURES**

Standard gauge single track; station  
Standard gauge multiple track  
Indoned  
Under construction  
Narrow gauge single track  
Narrow gauge multiple track  
Road in street  
Trough  
Trenchhouse and turntable  
Transmission line: pole; tower  
Telephone  
Pipeline  
Highway  
Powerline

**TRANSMISSION LINES AND PIPELINES**

Power transmission line: pole; tower  
Telephone  
Pipeline  
Highway  
Powerline

**CONTOURS**

Graphic:  
Intermediate  
Index  
Supplementary  
Depression  
Spot; fill  
Symmetric:  
Intermediate  
Index  
Primary  
Index Primary  
Supplementary

**MINES AND CAVES**

Open or open pit mine  
Cave, sand, clay, or borrow pit  
Mine tunnel or cave entrance  
Aspect; mine shaft  
Mine dump  
Tailings

Provisional edition maps  
New or replacement standard edition maps  
Standard edition maps

**SURFACE FEATURES**

Levee  
Sand or mud area, dunes, or shifting sand  
Intricate surface area  
Gravel beach or glacial moraine  
Tailings pond

**VEGETATION**

Woods  
Scrub  
Orchard  
Vineyard  
Mangrove

**MARINE SHORELINE**

Topographic maps:  
Approximate mean high water  
Indefinite or unsurveyed  
Topographic-bathymetric maps:  
Mean high water  
Apparent (edge of vegetation)

**COASTAL FEATURES**

Foreshore flat  
Rock or coral reef  
Rock bare or awash  
Group of rocks bare or awash  
Exposed wreck  
Depth curve; sounding  
Breakwater, pier, jetty, or wharf  
Seawall

**BATHYMETRIC FEATURES**

Area exposed at mean low tide; sounding datum  
Channel  
Offshore oil or gas; well; platform  
Sunken rock

Provisional edition maps  
New or replacement standard edition maps  
Standard edition maps

**RIVERS, LAKES, AND CANALS**

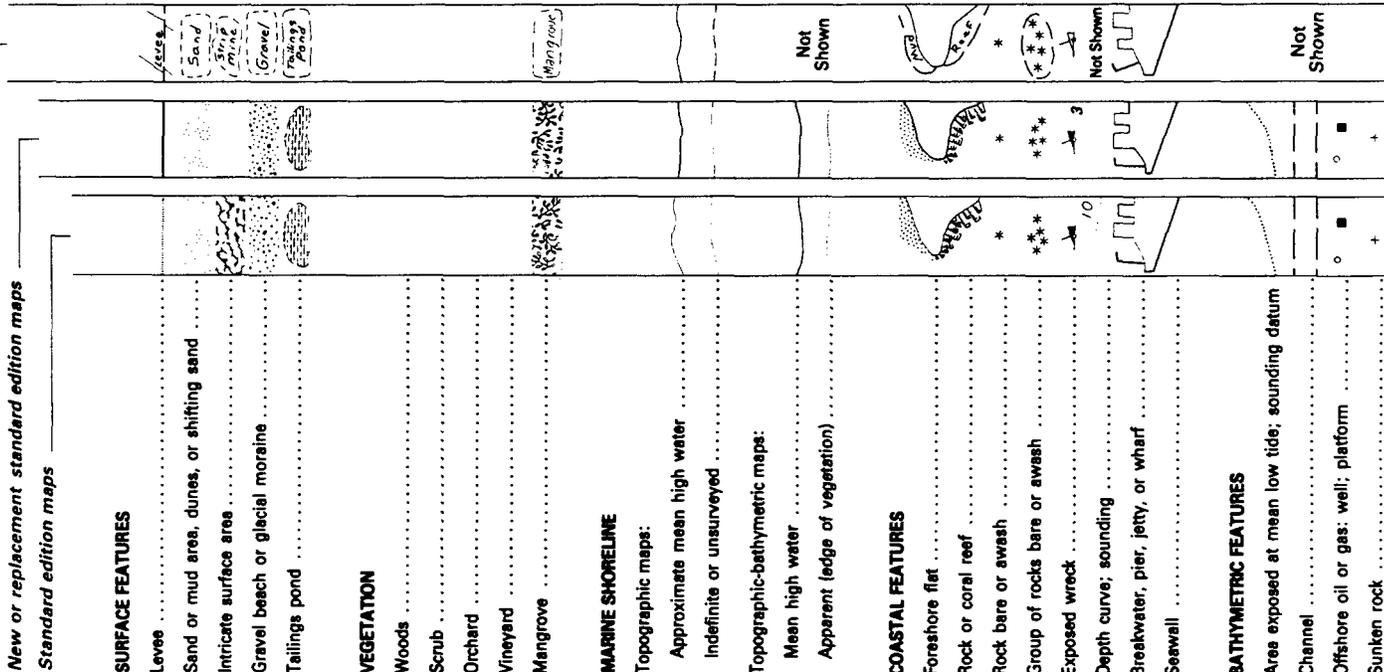
Intermittent stream  
Intermittent river  
Disappearing stream  
Perennial stream  
Perennial river  
Small falls; small rapids  
Large falls; large rapids  
Masonry dam  
Dam with lock  
Dam carrying road

**DAMS**

Intermittent lake or pond  
Dry lake  
Narrow wash  
Wide wash  
Canal, flume, or aqueduct with lock  
Elevated aqueduct, flume, or conduit  
Aqueduct tunnel  
Water well; spring or seep

**GLACIERS AND PERMANENT SNOWFIELDS**

Contours and limits  
Form lines  
SUBMERGED AREAS AND BOGS  
Marsh or swamp  
Submerged marsh or swamp  
Wooded marsh or swamp  
Submerged wooded marsh or swamp  
Rice field  
Land subject to inundation



Provisional edition maps  
New or replacement standard edition maps  
Standard edition maps

**ROADS AND RELATED FEATURES**

- Standard gauge single track, station
- Standard gauge multiple track
- Indoned
- Under construction
- Low gauge single track
- Low gauge multiple track
- Road in street
- Deposition
- Windhouse and turntable

**TRANSMISSION LINES AND PIPELINES**

- Power transmission line; pole; tower
- Telephone or telegraph line
- Overground oil or gas pipeline
- Underground oil or gas pipeline

**CONTOURS**

- Topographic:
- Intermediate
- Index
- Supplementary
- Depression
- Spot; fill
- Hydrometric:
- Intermediate
- Index
- Primary
- Index Primary
- Supplementary

**MINES AND CAVES**

- Shallow or open pit mine
- Level, sand, clay, or borrow pit
- Underground tunnel or cave entrances
- Prospect; mine shaft
- Mine dump
- Tailings

Provisional edition maps  
New or replacement standard edition maps  
Standard edition maps

**SURFACE FEATURES**

- Levee
- Sand or mud area, dunes, or shifting sand
- Intricate surface area
- Gravel beach or glacial moraine
- Tailings pond

**VEGETATION**

- Woods
- Scrub
- Orchard
- Vineyard
- Mangrove

**MARINE SHORELINE**

- Topographic maps:
- Approximate mean high water
- Indefinite or unsurveyed
- Topographic-bathymetric maps:
- Mean high water
- Apparent (edge of vegetation)

**COASTAL FEATURES**

- Foreshore flat
- Rock or coral reef
- Rock bare or awash
- Group of rocks bare or awash
- Exposed wreck
- Depth curve; sounding
- Breakwater, pier, jetty, or wharf
- Seawall

**BATHYMETRIC FEATURES**

- Area exposed at mean low tide; sounding datum
- Channel
- Offshore oil or gas; well; platform
- Sunken rock

Provisional edition maps  
New or replacement standard edition maps  
Standard edition maps

**RIVERS, LAKES, AND CANALS**

- Intermittent stream
- Intermittent river
- Disappearing stream
- Perennial stream
- Perennial river
- Small falls; small rapids
- Large falls; large rapids
- Masonry dam
- Dam with lock
- Dam carrying road

**Intermittent lake or pond**

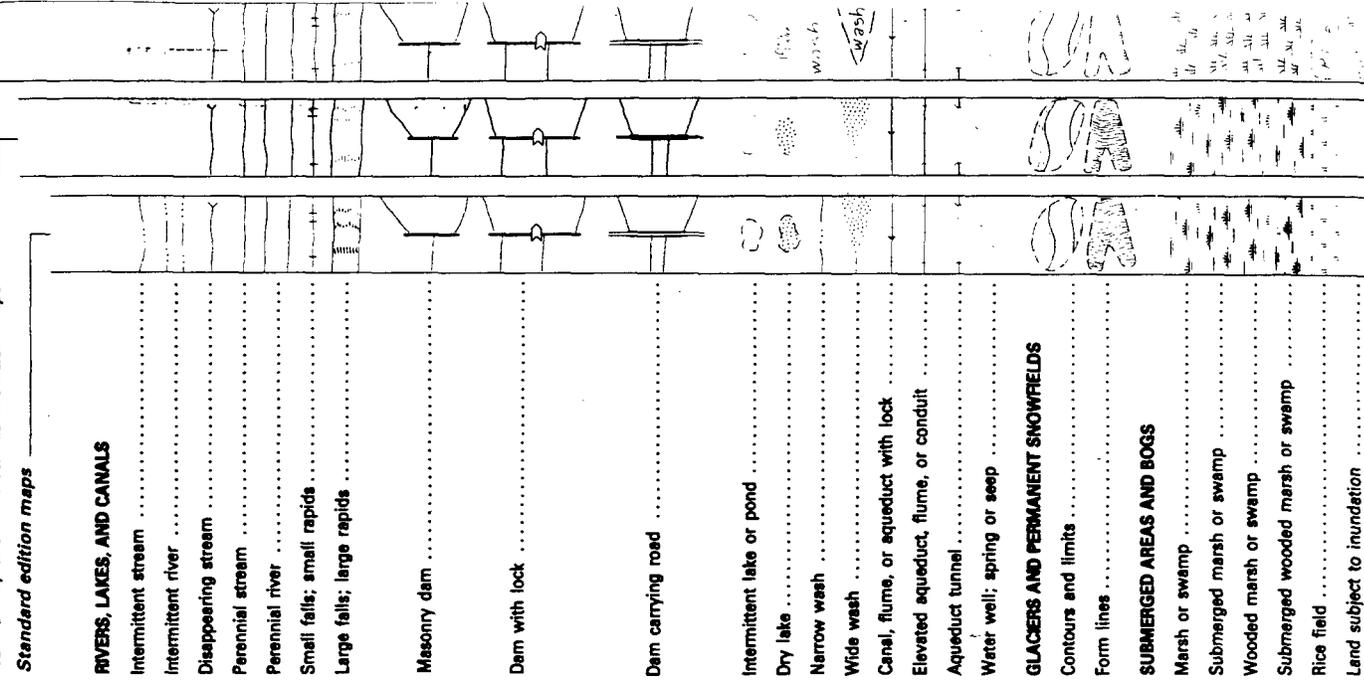
- Dry lake
- Narrow wash
- Wide wash
- Canal, flume, or aqueduct with lock
- Elevated aqueduct, flume, or conduit
- Aqueduct tunnel
- Water well; spring or seep

**GLACIERS AND PERMANENT SNOWFIELDS**

- Contours and limits
- Form lines

**SUBMERGED AREAS AND BOGS**

- Marsh or swamp
- Submerged marsh or swamp
- Wooded marsh or swamp
- Submerged wooded marsh or swamp
- Rice field
- Land subject to inundation



**ATTACHMENT D**

**SOIL TESTING AND PLANT ANALYSIS**

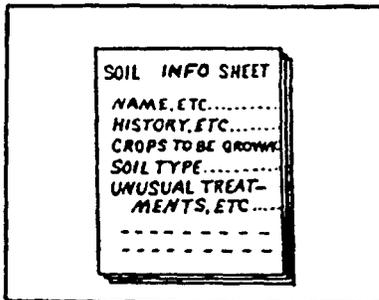
# PART VIII—SOIL TESTING AND PLANT ANALYSIS

Soil testing and plant analysis are important agronomic tools for determining crop nutrient needs. Soil testing evaluates the fertility of the soil to determine the basic amounts of fertilizer and lime to apply. Plant analysis, on the other hand, is used as a monitoring tool to determine if the fertilization and liming program, as determined by the soil test, is providing the nutrients at the necessary levels for top yields. Plant analysis is the ultimate test; i.e., is the plant obtaining, from the soil, ample nutrients for good growth and development. If not, nutrients can be added during the existing growing season to improve yields, or the fertilization program can

be modified for next year's crop. The following sections discuss how to use soil testing and plant analysis to evaluate crop nutrient needs.

## Soil Testing

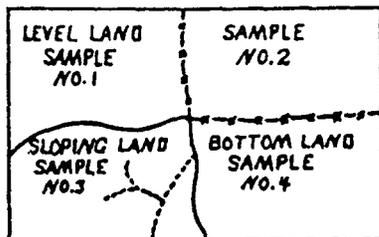
*Sampling Instructions* - Collecting the sample is one of the most important steps in the soil testing program. When one considers that a 2-lb soil sample must adequately represent 10 million or more lbs of soil in the area being sampled, the importance of doing a good job of sampling becomes apparent. Here are instructions for collecting a good representative soil sample:



## SAMPLING SOIL

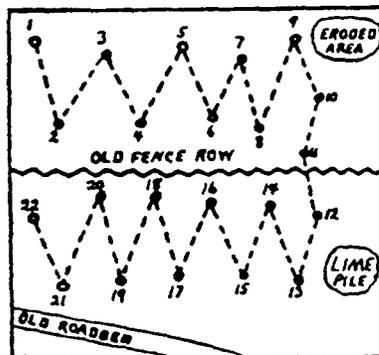
### 1. Get Soil Sample Information Sheet and Soil Boxes.

These may be obtained from Extension agents or from the Virginia Tech Agronomy Department. Follow the directions they provide.



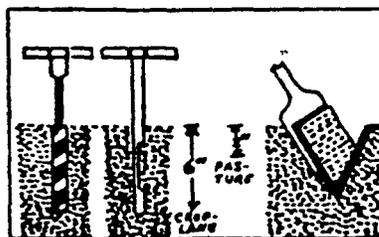
### 2. Divide Farm into Areas or Fields.

If the field is uniform, one sample will do. But most fields will have been treated differently, or the slope, drainage, or soil type will make it desirable to divide the field into small areas of 5 to 10 acres each.



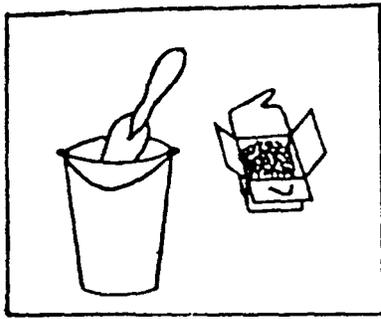
### 3. Obtain a Good Sample of Soil.

The soil test can be no better than the sample. Take the sample from 20 or more places in the field. Zig-zag across the field or area as shown in the diagram. When taking sample, avoid unusual places such as old fence rows, old roadbeds, eroded spots, where lime or manure have been piled, or in the fertilizer band of row crops.



### 4. Use Proper Sampling Tools.

Sampling may be made with a soil auger, soil tube, or spade. The desired depth for cropland is plow depth (6 to 8" or more), and for pasture land, 2 to 4". Place sample in clean container.

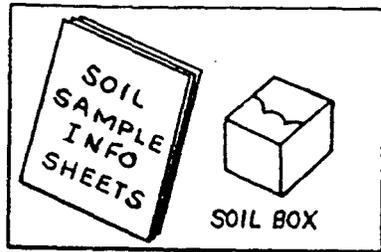


#### 5. Mix Well in Clean Plastic Pail.

From the 20 or more stops you have made, you now have  $\frac{1}{2}$  gallon or more of soil. Mix it thoroughly, then send about  $\frac{1}{2}$  pint of the mixed soil for analysis.

#### 6. Fill Out Sample Information Sheet for Each Sample.

It is essential that your name, address, and sample number be plainly written on the sheet you send with each sample. As a guide in making recommendations for each of your numbered areas, it is important that the history of treatments and any unusual treatments be stated.



#### 7. Mail to Soil Testing and Plant Analysis Laboratory.

Place the Soil Sample Information Sheet inside the top flap of the soil box and mail to the Soil Testing and Plant Analysis Laboratory, Agronomy Department, Virginia Tech, Blacksburg, VA 24061-0403. A routine test of 7 separate analyses (soil pH, Phosphorus, Potassium, Calcium, Magnesium, Zinc, and Manganese) is performed on all samples. Three special tests (Organic matter, Nitrate-Nitrogen, and Soluble Salts) are offered on a request basis.

**Using The Soil Test Report -** The Soil Test Report will contain the laboratory test results plus fertilizer and lime recommendations for the next two crops in the rotation. Additional information regarding time and method of fertilizer and lime application will also be provided in the form of a Soil Test Note which will accompany the Report. When several samples have been collected from the same field, the Soil Test Reports should be compared to determine the best rates of fertilizer and lime to use for the field. Large differences in the reports may call for fertilizer and/or lime at two or more different rates. Advice on how to best fertilize a given field can be obtained from your local Extension agent or fertilizer dealer.

### Plant Analysis

#### Sampling Instructions

1. Avoid submitting sample tissue that is contaminated with dust or soil. If tissue is dusty or dirty, remove as much of it as you can by shaking, brushing, or washing the tissue in gently-flowing water.
2. Do not sample disease, insect, or mechanically damaged plant tissue.
3. Place the plant tissue in a clean paper bag. Do not use plastic bags. If the sample is wet or succulent, let it air-dry in the open for one day before sending it to the laboratory. Identify each sample by number and crop name.

4. *Note:* When using tissue analysis in the diagnosis of crop production problems, take one sample from the *problem* area in the field and one from an area where plants appear *normal*.

5. When sampling, both the *time* (growth stage) and *plant part* collected are important. Be sure to sample at the recommended time and collect the proper plant part.

6. If you do not have specific sampling instructions for the crop you wish to have analyzed, a good rule of thumb is to sample mature leaves that are representative of the current season's growth during the mid period of the growth cycle or just prior to seed set.

7. Fill out a Plant Analysis Information Sheet (Extension Form 134), indicating where the results should be mailed, and record each sample number along with crop name. Send sample to: Soil Testing and Plant Analysis Laboratory, 145 Smyth Hall, Virginia Tech, Blacksburg, Virginia 24061-7294.

#### 8. Analyses Performed:

Samples will be analyzed for nitrogen (N), phosphorus (P), potassium (K), calcium (Ca), magnesium (Mg), manganese (Mn), zinc (Zn), copper (Cu), iron (Fe), boron (B), and aluminum (Al). In addition, a sulfur (S) test will be run on request.

**EXAMPLE VPA PERMIT FOR WATER TREATMENT PLANT LAND APPLICATION**

Permit No.: VPA0  
Effective Date:  
Expiration Date: 10 Year Permit

**AUTHORIZATION TO MANAGE POLLUTANTS UNDER THE  
VIRGINIA POLLUTION ABATEMENT PERMIT  
AND  
THE VIRGINIA STATE WATER CONTROL LAW**

In compliance with the provisions of the State Water Control Law and the Board's Permit Regulation adopted pursuant thereto, the following owner is authorized to manage pollutants in conformity with the application, plans, specifications and supporting data submitted to the Board and other conditions set forth in this permit.

Owner: Name of Permittee  
Owner Address: Address  
Facility Name: WTP Name

The authorized pollutant management shall be in accordance with this cover page, Part I - Monitoring Requirements and Special Conditions, Part II - Monitoring and Reporting Requirements, and Part III - Management Requirements, as set forth herein.

\_\_\_\_\_  
Director, Department of Environmental Quality

\_\_\_\_\_  
Date

A. MONITORING REQUIREMENTS

1. During the period beginning with the permit's effective date and lasting until the permit's expiration date, the permittee is authorized to manage pollutants from residuals generated at Water Treatment Plant.
2. The pollutants shall be limited and monitored by the permittee as specified below:

<u>RESIDUALS MONITORING</u>			
<u>PARAMETERS</u>	<u>LIMITATIONS</u>	<u>UNITS</u>	<u>MONITORING REQUIREMENTS</u> <u>Frequency</u> <u>Sample Type</u>
Volume (from Storage)	NL	MG or Cubic Yards	See Notes Measured
Percent Solids	NL	Percent (%)	See Notes Composite
Total Volume to each site	NL	gal/acre, dt/a, or wt/a	See Notes Measured
pH	NL	Std. Units	See Notes Composite
TKN	NL	mg/kg	See Notes Composite
Ammonia Nitrogen	NL	mg/kg	See Notes Composite
Nitrate-Nitrogen	NL	mg/kg	See Notes Composite
Calcium Carbonate	NL	mg/kg	See Notes Composite
Equivalence, CCE (See Notes)	NL	%	See Notes Composite
Total Phosphorus	NL	mg/kg	See Notes Composite
Total Potassium	NL	mg/kg	See Notes Composite
Aluminum (if used)	NL	mg/kg	See Notes Composite
Aluminum applied to each site (if used)	NL	lb/acre	See Notes Calculated
Cadmium	NL	mg/kg	See Notes Composite
Cadmium applied to each site	NL	lb/acre	See Notes Calculated
Copper (if used)	NL	mg/kg	See Notes Composite
Copper applied to each site (if used)	NL	lb/acre	See Notes Calculated
Lead	NL	mg/kg	See Notes Composite
Nickel	NL	mg/kg	See Notes Composite
Zinc	NL	mg/kg	See Notes Composite
PAN applied to each site	*	lbs/acre	See Notes Calculated

NL = No limit, this is a monitoring requirement only.

\* The total nitrogen loading rate and any other sources of PAN shall not exceed Plant Available Nitrogen (PAN) requirements of the appropriate crop specified in Attachment B, using the productivity classification noted on Attachment A.

A. MONITORING REQUIREMENTS - CONTINUED

3. Samples taken in compliance with the monitoring requirements specified above shall be taken at the following location(s):  
WTP residuals storage facility.
4. A representative composite sample shall be comprised of at least four volume average or weight average grab samples composited over a daily operating period.
5. Unless otherwise noted all concentrations shall be reported on a dry weight basis.
6. Appropriate records shall be maintained by the owner for each site regarding nitrogen input from manure, chemical fertilizers, and land applied residuals.

**NOTES TO PERMIT WRITER:**

**FREQUENCY:** Use 1/application frequency unless land-application will occur more than once per year; then use 1/6 months or 1/3 months based on the size and nature of the project.

**OCE:** Lime treated sludge (10% or more lime dry weight) should be analyzed for percent CaCO<sub>3</sub> when application review shows liming effect is of concern.

A. MONITORING REQUIREMENTS

1. During the period beginning with the permit's effective date and lasting until the permit's expiration date, the permittee is authorized to manage pollutants from residuals generated at Water Treatment Plant.
2. The pollutants shall be limited and monitored by the permittee as specified below:

<u>PARAMETERS</u>	<u>LIMITATIONS</u>	<u>SOILS MONITORING</u>	<u>MONITORING REQUIREMENTS</u>
		<u>UNITS</u>	<u>Frequency</u> <u>Sample Type</u>
Soil pH	NL	Std. Units	See Notes Composite
Cation Exchange Capacity	NL	meg/100 g	See Notes Composite
Available Phosphorus	NL	mg/kg	See Notes Composite
Exchangeable Potassium	NL	mg/kg	See Notes Composite
Aluminum (if used)	NL	mg/kg	See Notes Composite

NL = No limit, this is a monitoring requirement only.

3. Samples taken in compliance with the monitoring requirements specified above shall be taken at the following location: residuals application sites identified in Attachment A.
4. Soil composite samples shall be representative of the soil types delineated by the SCS Soil Survey (or the equivalent). Samples shall be taken at 0-6 inches soil depth for each application site. Sampling shall be performed as outlined in the approved O & M Manual.

**NOTE TO PERMIT WRITER - FREQUENCY:** Recommended frequency for infrequent sites is 1/5 years; for frequent sites, 1/year.

A. MONITORING REQUIREMENTS

1. During the period beginning with the permit's effective date and lasting until the permit's expiration date, the permittee is authorized to manage pollutants from residuals generated at Water Treatment Plant.
2. The pollutants shall be limited and monitored by the permittee as specified below:

GROUNDWATER MONITORING

<u>PARAMETERS</u>	<u>LIMITATIONS</u>	<u>UNITS</u>	<u>MONITORING REQUIREMENTS</u>
			<u>Frequency</u> <u>Sample Type</u>
Pollutants of Concern (i.e.- metals, TKN, etc.)	Probably NL	Varies	1/3 Months (recommended)      Grab

**NOTE:** OPTIONAL (Groundwater monitoring may be required for frequent land-application projects based on regional discretion) Pollutants of concern must be chosen on a case-by-case basis.

NL = No limit, this is a monitoring requirement only.  
NA = Not Applicable.

1/3 Months = In accordance with the following schedule: 1st quarter (January 1 - March 31); 2nd quarter (April 1 - June 30); 3rd quarter (July 1 - September 30); 4th quarter (October 1 - December 31).

3. Samples taken in compliance with the monitoring requirements specified above shall be taken at the following location(s):      Groundwater Monitoring Wells Nos. \_\_\_\_\_ located adjacent to the (INSERT NAME) storage facility (and Groundwater Monitoring Wells Nos. \_\_\_\_\_ located at land application sites).
4. The static water level shall be measured prior to bailing well water for sampling. At least 3 well volumes of groundwater shall be withdrawn immediately prior to sampling each monitoring well.

**B. Other Requirements or Special Conditions**

1. There shall be no discharge of pollutants to surface waters from this operation except in the case of a 25-year/24-hour or greater storm event. The operation of the facilities of the owner permitted herein shall not contravene the Water Quality Standards, as amended and adopted by the Board, or any provision of the State Water Control Law.
2. Any and all product, materials, industrial wastes, and/or other wastes resulting from the purchase, sale, mining, extraction, transport, preparation and/or storage of raw or intermediate materials, final product, by-product or wastes, shall be handled, disposed of and/or stored in such a manner so as not to permit a discharge of such product, materials, industrial wastes and/or other wastes to State waters, except as expressly authorized.
3. **(For Facilities without an approved O & M Manual)**  
The owner shall develop an O & M Manual for the treatment works/pollutant management system permitted herein. This manual shall detail practices and procedures, including applicable Best Management Practices (BMPs), which will be followed to ensure compliance with the requirements of this permit. The manual shall be submitted for staff approval within 90 days of the (**effective/modification**) date of this permit, (and approved prior to startup of operations\*). The owner shall operate the treatment works/pollutant management system in accordance with the approved O & M Manual which becomes an enforceable part of the permit.

OR

**(For Facilities with an approved O & M Manual)**  
The owner shall maintain an Operations and Maintenance (O&M) Manual for the treatment works/pollutant management system permitted herein. This manual shall reflect the practices and procedures, including applicable Best Management Practices, followed by the permittee to ensure compliance with the requirements of this permit. Any changes in those practices and procedures shall be documented and submitted for staff approval within 90 days of the effective date of the changes. Upon approval of the submitted for staff approval within 90 days of the submitted manual change, the revised manual becomes an enforceable part of the permit.

4. Residuals shall be applied only at the sites identified in Attachment A.

5. **(If applicable)** Valid landowner consent forms shall be maintained for all sites specified in this permit. The permittee shall immediately notify the Regional Office of any change in landowner agreement.
6. **(If applicable)** All trucks that transport residuals shall be water tight and shall be totally enclosed by metal covers, and/or tarps if residuals are sufficiently dewatered to prevent spillage. The tailgates shall be properly sealed to prevent spillage.
7. **(For infrequent application only)** Application of residuals shall be on an infrequent (once per five year) basis. None of the sites listed in Attachment A which previously received a complete application of residuals shall be used again until at least five years after the date of the last application. Updated soil sampling test results, in accordance with Part I.A., shall be submitted before residuals are reapplied to any field.
8. Operational limitations during periods of inclement weather
  - a. Residuals shall not be applied during times when the ground is saturated.
  - b. Surface application of residuals shall not be made to cultivated or bare ground covered with ice. However, residuals may be applied to snow covered ground if snow cover does not exceed an average depth of one inch and the snow and residuals are immediately incorporated.
  - c. Residuals may be applied to frozen ground only under the following conditions:
    - (1) Solids content of the residuals is greater than 15%;
    - (2) Slopes are not greater than 5%;
    - (3) A minimum of a 200 foot vegetative (or adequate crop residue) buffer is maintained from all surface water courses;
    - (4) Only those soils characterized by the USDA as "well drained" are utilized; and,
    - (5) Vegetation or crop residue is present and sufficient to prevent surface runoff.

9. Vegetative buffer zones (minimum 60% soil coverage) shall be maintained as follows:

Buffer Zones (ft)

1. Drinking water wells and springs	-	100
2. Occupied dwellings	-	100
3. Surface water courses (including dry ditches)	-	50
4. Limestone outcrops	-	50
5. Sinkholes (from the outer rim)	-	50
6. Rock outcrops	-	50
7. All improved roadways	-	25
8. Property lines	-	25

10. At no time shall liquid sludge be applied at a hydraulic loading rate greater than 14,000 gallons/acre in a single application procedure, 28,000 gallons/acre/day and 56,000 gallons/acre/week.
11. **(For infrequent application only)** Application site loading of residuals shall never exceed 15 dry tons/acre per five years.
12. The application of residuals together with any other source of Plant Available Nitrogen (PAN) shall not exceed the agronomic loading rate for the crops grown on each site. The residuals application rates shall be calculated for each field based upon the PAN and productivity class table provided in Attachment B.
13. An annual summary report shall be prepared and submitted to the Department by February 10th of each year. The report shall include:
- A summary of the monitoring data results including residuals, **(soil, groundwater and vegetation)** monitoring.
  - The yearly residuals balance showing such items as inputs/drawdown from storage facilities.
  - Land application site information describing the residuals applied to each field during the previous year with the annual and cumulative loadings of limiting constituents and the remaining site life for each field.
  - A summary of the agronomic practices which occurred during the preceding growing season including, but not limited to, the timing and number of crop cuttings, an estimate of total crop yield (bushels/acre or tons/acre) removed from the site, any lime and fertilizer additions made to the site (describe type and quantities) and reseeded.

e. A general statement of past system performance and the status of the permitted facilities with regard to complying with Virginia Pollution Abatement Permit requirements.

14. **(if applicable)** A Facilities Closure Plan shall be developed prior to termination of the pollutant management activities covered under this permit. The plan shall incorporate:

a. The volume, percent solids, nutrient content and other waste characterization information appropriate to the nature of the waste materials.

b. A listing of all waste products at the facility along with a description of procedures for removal, land application, or other proper disposal of the wastes.

c. Closure plans for all waste treatment, storage and handling facilities.

The Facilities Closure Plan shall be submitted to the DEQ Regional Office for review and approval prior to implementation of the plan.

16. **Other site-specific special conditions may be added by Regional personnel as deemed necessary, such as mineralization study requirement and pH requirements for middle and coastal plains and post-issuance application data requirements.**

**ATTACHMENT A**

Summary of Currently Approved Land Application Sites

Permittee's Name:

<u>Site Location</u>	<u>Operator</u>	<u>Owner</u>	<u>Field Designation*</u>	<u>Field Net Acres</u>	<u>Productivity Class</u>
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\*The exact location of all sites can be found in the VPA application.

## ATTACHMENT B

Estimated Yields and Recommended Plant Available Nitrogen (PAN)  
Rates for Various Non-irrigated Crops Used in Sludge Management Systems  
Productivity Class

Crop	1		2		3		4		
	Yield	PAN	Yield	PAN	Yield	PAN	Yield	PAN	
	lbs/A		lbs/A		lbs/A		lbs/A		
Corn-Grain	160 bu/A		180	140 bu/A	160	110 bu/A	130	80 bu/A	100
Silage	24 T/A			20 T/A		15 T/A		11 T/A	
Grain sorghum	60 cwt/A		150	50 cwt/A	125	35 cwt/A	100	30 cwt/A	75
Wheat	70 bu/A		100	70 bu/A	100	70 bu/A	100	50 bu/A	75
Barley	90 bu/A		100	90 bu/A	100	90 bu/A	100	70 bu/A	80
Rye	50 bu/A		70	50 bu/A	70	50 bu/A	70	40 bu/A	50
Oats	80 bu/A		80	80 bu/A	80	80 bu/A	80	60 bu/A	60
Fescue or Orchardgrass Pasture**	*		150	*	150	*	130	*	110
Indiangrass Pasture	*		200	*	200	*	200	—	—
Unimproved Pasture**	*		100	*	100	*	80	*	60
Fescue or Orchardgrass Hay**	4 T/A		200	4 T/A	200	3 T/A	150	2.5 T/A	125
Bermudagrass Hay**	6 T/A		350	6 T/A	350	6 T/A	350	—	—
Alfalfa***	5 T/A		300	5 T/A	300	3.5 T/A	210	2.5 T/A	150
Soybeans									
Full Season	55 bu/A		275	45 bu/A	225	35 bu/A	175	25 bu/A	125
Double Crop	40 bu/A		200	35 bu/A	175	25 bu/A	125	20 bu/A	100

\* No yield estimates given for pastures, PAN rates are for optimum grass production to support given number of animal units.

\*\* If legumes, such as clover or alfalfa, are present, they may be replaced by grasses at this nitrogen application rate.

\*\*\* At high nitrogen rates, the life of the stand may be shortened and encroachment by grasses may occur. Regardless of productivity class, alfalfa is not well suited to wet soils, even with artificial drainage.

- Indicates this crop not usually grown on soils in this productivity class.

**ATTACHEMENTS C-1 to C-3**

**THE ATTACHED REPORTING FORMS ARE EXAMPLES ONLY!**

**THE REGIONAL OFFICE PERSONNEL MAY USE ALTERNATE REPORTING FORMS IF SO DESIRED.**

**ATTACHMENT C-1**  
**DEPARTMENT OF ENVIRONMENTAL QUALITY**  
**Virginia Pollution Abatement Monitoring Report**

Facility Name:  
 Address:

VPA Permit No.: VPA0

Report Period: From \_\_\_/\_\_\_/\_\_\_ To \_\_\_/\_\_\_/\_\_\_

Monitoring Station: Residuals

Parameters	Units		Monitoring Results	Frequency of Analysis	Sample Type
Volume (from storage)	MG or Cubic Yards	Reported			
		Required	NL		Measured
Percent Solids	%	Reported			
		Required	NL		Composite
pH	S.U.	Reported			
		Required	NL		Composite
TKN	mg/kg	Reported			
		Required	NL		Composite
Ammonia Nitrogen	mg/kg	Reported			
		Required	NL		Composite
Nitrate-Nitrogen	mg/kg	Reported			
		Required	NL		Composite
Alkalinity	mg/l	Reported			
		Required	NL		Composite
Total Phosphorus	mg/kg	Reported			
		Required	NL		Composite
Total Potassium	mg/kg	Reported			
		Required	NL		Composite
Aluminum and/or Copper (if used)	mg/kg	Reported			
		Required	NL		Composite
Cadmium	mg/kg	Reported			
		Required	NL		Composite
Lead	mg/kg	Reported			
		Required	NL		Composite
Nickel	mg/kg	Reported			
		Required	NL		Composite
Zinc	mg/kg	Reported			
		Required	NL		Composite

**ATTACHMENT C-1**  
**DEPARTMENT OF ENVIRONMENTAL QUALITY**  
**Virginia Pollution Abatement Monitoring Report**

Facility Name:  
 Address:

VPA Permit No.: VPA0

Report Period: From \_\_\_\_/\_\_\_\_/\_\_\_\_ To \_\_\_\_/\_\_\_\_/\_\_\_\_

Monitoring Station: Residuals

Parameters	Units		Monitoring Results	Frequency of Analysis	Sample Type
Magnesium	mg/kg	Reported			
		Required	NL		Composite
Particle Size Anal. or USDA Text. Class.	%	Reported			
		Required	NL		Composite
Hydraulic Conductivity	inch/hour	Reported			
		Required	NL		Composite
		Required	NL		Composite

\_\_\_\_\_  
 Name of Principal Exec. Officer or Authorized Agent / Title

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system or those persons directly responsible for gathering the information, the information submitted is to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information including the possibility of fine and imprisonment for knowing violations.

\_\_\_\_\_  
 Signature of Principal Officer or Authorized Agent / Date

**ATTACHMENT C-1**  
**DEPARTMENT OF ENVIRONMENTAL QUALITY**  
**Virginia Pollution Abatement Monitoring Report**

Facility Name:

Address:

VPA Permit No.: VPA0

Report Period: From \_\_\_/\_\_\_/\_\_\_ To \_\_\_/\_\_\_/\_\_\_

Monitoring Station: Residuals

Parameters	Units		Monitoring Results	Frequency of Analysis	Sample Type
Volume applied to each site	mg/kg	Reported			
		Required	NL		Composite
Al and/or Cu applied to each site	mg/kg	Reported			
		Required	NL		Composite
Cd applied to each site	mg/kg	Reported			
		Required	NL		Composite
PAN applied to each site	lbs/acre	Reported			
		Required	NL		Calculated

\_\_\_\_\_  
 Name of Principal Exec. Officer or Authorized Agent / Title

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system or those persons directly responsible for gathering the information, the information submitted is to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information including the possibility of fine and imprisonment for knowing violations.

\_\_\_\_\_  
 Signature of Principal Officer or Authorized Agent / Date

**ATTACHMENT C-2**  
**DEPARTMENT OF ENVIRONMENTAL QUALITY**  
**Virginia Pollution Abatement Monitoring Report**

Facility Name:  
 Address:

VPA Permit No.: VPA0

Report Period: From \_\_\_/\_\_\_/\_\_\_ To \_\_\_/\_\_\_/\_\_\_

Monitoring Station: Soils (Field #\_\_\_\_)

Parameters	Units		Monitoring Results	Frequency of Analysis	Sample Type
Percent Solids	%	Reported			
		Required	NL		Composite
Soils pH	S.U.	Reported			
		Required	NL		Composite
Available Phosphorus	mg/kg	Required			
		Reported	NL		Composite
Exchangeable Potassium	mg/100 g	Reported			
		Required	NL		Composite
Copper	mg/kg	Reported			
		Required	NL		Composite
Nickel	mg/kg	Reported			
		Required	NL		Composite
Cadmium	mg/kg	Reported			
		Required	NL		Composite

\_\_\_\_\_  
 Name of Principal Exec. Officer or Authorized Agent / Title

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system or those persons directly responsible for gathering the information, the information submitted is to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information including the possibility of fine and imprisonment for knowing violations.

\_\_\_\_\_  
 Signature of Principal Officer or Authorized Agent / Date

**ATTACHMENT C-3**  
**DEPARTMENT OF ENVIRONMENTAL QUALITY**  
**Virginia Pollution Abatement Monitoring Report**

Facility Name:  
 Address:

VPA Permit No.: VPA0

Report Period: From \_\_\_\_/\_\_\_\_/\_\_\_\_ To \_\_\_\_/\_\_\_\_/\_\_\_\_

Monitoring Station: Groundwater Monitoring Well No. \_\_\_\_

Parameters	Units		Monitoring Results	Frequency of Analysis	Sample Type
		Reported			
		Required			
		Reported			
		Required			
		Reported			
		Required			
		Reported			
		Required			
		Reported			
		Required			
		Reported			
		Required			
		Reported			
		Required			

\_\_\_\_\_  
 Name of Principal Exec. Officer or Authorized Agent / Title

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system or those persons directly responsible for gathering the information, the information submitted is to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information including the possibility of fine and imprisonment for knowing violations.

\_\_\_\_\_  
 Signature of Principal Officer or Authorized Agent / Date